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PREFACE

The 84th Edition of the *CRC Handbook of Chemistry and Physics* features a completely new version of the most heavily used table, Physical Constants of Organic Compounds. This is the first revision of the table since 1994. Compounds have been selected for inclusion in the new table by a careful screening of lists of organic compounds that are important in laboratory research, industrial chemistry, environmental protection, drug development, teaching, and other active areas. In this way priorities were established for choosing the most significant compounds out of the millions of organic substances that have been reported in the literature. Property data for the selected compounds have been updated, and new structure diagrams, which show much more detail than the previous structures, have been drawn for all the compounds.

This Internet version of the 84th Edition has added 17 new subsections that can be accessed as interactive tables. These include tables on Heat of Combustion, Activity Coefficients, Refrigerants, Amino Acids, Chemical Carcinogens, Laboratory Solvents, and other topics. The search screens have been modified to make them more user friendly, and there is now a subject index that permits boolean searching on the name of a physical property and the identifiers of a chemical substance (name, formula, or CAS Registry Number). An option has been added to the table displays that permits locking the left-most column, which usually contains the chemical name, when scanning a wide table. Tool-tips that explain the data in a column now appear when the cursor is held over that column heading, and it is now possible to export the results of a search directly into an Excel file.

Other new features of the 84th Edition include:

- An update and expansion of the table of Critical Constants of Fluids, with many new compounds and recently published data
- A new version of Properties of Refrigerants, which covers fluids now used in refrigeration systems and those being considered as substitutes
- A new table on Fermi Energy and Related Properties of Metals
- New tables of practical laboratory data such as Flame and Bead tests, Flame Temperatures, and Density of Ethanol-Water Mixtures
- An update of lists of Chemical Carcinogens and Interstellar Molecules.

The *Handbook of Chemistry and Physics* is dependent on the efforts of many contributors throughout the world. The list of current contributors follows this Preface. The new table of Physical Constants of Organic Compounds could not have been completed without the help of Dr. Fiona Macdonald, who oversaw the structure drawing and checked names and formulas. Thanks are also due to Janice Shackleton, Trupti Desai, Nazila Kamaly, Matt Griffiths, and Lawrence Braschi, who participated in drawing the structures.

David R. Lide
October 27, 2003

This Edition is dedicated to my grandchildren:
Mary Eleanor Lide
David Alston Lide, Jr.
Grace Eileen Lide
David Austell Whitcomb
Kate Elizabeth Whitcomb

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FUNDAMENTAL PHYSICAL CONSTANTS

Peter J. Mohr and Barry N. Taylor

These tables give the 1998 self-consistent set of values of the basic constants and conversion factors of physics and chemistry recommended by the Committee on Data for Science and Technology (CODATA) for international use. The 1998 set replaces the previous set of constants recommended by CODATA in 1986; assigned uncertainties have been reduced by a factor of 1/5 to 1/12 (and sometimes even greater) relative to the 1986 uncertainties. The recommended set is based on a least-squares adjustment involving all of the relevant experimental and theoretical data available through December 31, 1998. Full details of the input data and the adjustment procedure are given in Reference 1.

The 1998 adjustment was carried out by P. J. Mohr and B. N. Taylor of the National Institute of Standards and Technology (NIST) under the auspices of the CODATA Task Group on Fundamental Constants. The Task Group was established in 1969 with the aim of periodically providing the scientific and technological communities with a self-consistent set of internationally recommended values of the fundamental physical constants based on all applicable information available at a given point in time. The first set was published in 1973 and was followed by a revised set first published in 1986; the current 1998 set first appeared in 1999. In the future, the CODATA Task Group plans to take advantage of the high level of automation developed for the current set in order to issue a new set of recommended values at least every four years.

At the time of completion of the 1998 adjustment, the membership of the Task Group was as follows:

F. Cabiati, Istituto Elettrotecnico Nazionale "Galileo Ferraris," Italy
E. R. Cohen, Science Center, Rockwell International (retired), United States of America
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REFERENCES

1. Mohr, Peter J., and Taylor, Barry N., *J. Phys. Chem. Ref. Data* **28**, 1713, 1999; *Rev. Mod. Phys.* **72**, 351, 2000. The 1998 set of recommended values is also available at the Web site of the Fundamental Constants Data Center of the NIST Physics Laboratory: <http://physics.nist.gov/constants>.

Fundamental Physical Constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
UNIVERSAL				
speed of light in vacuum	c, c_0	299 792 458	m s^{-1}	(exact)
magnetic constant	μ_0	$4\pi \times 10^{-7}$ $= 12.566\,370\,614\dots \times 10^{-7}$	N A^{-2} N A^{-2}	(exact)
electric constant $1/\mu_0 c^2$	ϵ_0	$8.854\,187\,817\dots \times 10^{-12}$	F m^{-1}	(exact)
characteristic impedance of vacuum $\sqrt{\mu_0/\epsilon_0} = \mu_0 c$	Z_0	376.730313461...	Ω	(exact)
Newtonian constant of gravitation	G $G/\hbar c$	$6.673(10) \times 10^{-11}$ $6.707(10) \times 10^{-39}$	$\text{m}^3 \text{kg}^{-1} \text{s}^{-2}$ $(\text{GeV}/c^2)^{-2}$	1.5×10^{-3} 1.5×10^{-3}
Planck constant in eV s	h	$6.626\,068\,76(52) \times 10^{-34}$ $4.135\,667\,27(16) \times 10^{-15}$	J s eV s	7.8×10^{-8} 3.9×10^{-8}
$h/2\pi$ in eV s	\hbar	$1.054\,571\,596(82) \times 10^{-34}$ $6.582\,118\,89(26) \times 10^{-16}$	J s eV s	7.8×10^{-8} 3.9×10^{-8}
Planck mass $(\hbar c/G)^{1/2}$	m_{P}	$2.1767(16) \times 10^{-8}$	kg	7.5×10^{-4}
Planck length $\hbar/m_{\text{P}}c = (\hbar G/c^3)^{1/2}$	l_{P}	$1.6160(12) \times 10^{-35}$	m	7.5×10^{-4}
Planck time $l_{\text{P}}/c = (\hbar G/c^5)^{1/2}$	t_{P}	$5.3906(40) \times 10^{-44}$	s	7.5×10^{-4}
ELECTROMAGNETIC				
elementary charge	e e/h	$1.602\,176\,462(63) \times 10^{-19}$ $2.417\,989\,491(95) \times 10^{14}$	C A J ⁻¹	3.9×10^{-8} 3.9×10^{-8}
magnetic flux quantum $h/2e$	Φ_0	$2.067\,833\,636(81) \times 10^{-15}$	Wb	3.9×10^{-8}
conductance quantum $2e^2/h$	G_0	$7.748\,091\,696(28) \times 10^{-5}$	S	3.7×10^{-9}
inverse of conductance quantum	G_0^{-1}	12 906.403 786(47)	Ω	3.7×10^{-9}
Josephson constant ^a $2e/h$	K_{J}	$483\,597.898(19) \times 10^9$	Hz V ⁻¹	3.9×10^{-8}
von Klitzing constant ^b $h/e^2 = \mu_0 c/2\alpha$	R_{K}	25 812.807 572(95)	Ω	3.7×10^{-9}
Bohr magneton $e\hbar/2m_e$ in eV T ⁻¹	μ_{B} μ_{B}/h μ_{B}/hc μ_{B}/k	$927.400\,899(37) \times 10^{-26}$ $5.788\,381\,749(43) \times 10^{-5}$ $13.996\,246\,24(56) \times 10^9$ 46.686 4521(19) 0.671 7131(12)	J T ⁻¹ eV T ⁻¹ Hz T ⁻¹ $\text{m}^{-1} \text{T}^{-1}$ K T ⁻¹	4.0×10^{-8} 7.3×10^{-9} 4.0×10^{-8} 4.0×10^{-8} 1.7×10^{-6}
nuclear magneton $e\hbar/2m_{\text{p}}$ in eV T ⁻¹	μ_{N} μ_{N}/h μ_{N}/hc μ_{N}/k	$5.050\,783\,17(20) \times 10^{-27}$ $3.152\,451\,238(24) \times 10^{-8}$ 7.622 593 96(31) $2.542\,623\,66(10) \times 10^{-2}$ $3.658\,2638(64) \times 10^{-4}$	J T ⁻¹ eV T ⁻¹ MHz T ⁻¹ $\text{m}^{-1} \text{T}^{-1}$ K T ⁻¹	4.0×10^{-8} 7.6×10^{-9} 4.0×10^{-8} 4.0×10^{-8} 1.7×10^{-6}
ATOMIC AND NUCLEAR				
General				
fine-structure constant $e^2/4\pi\epsilon_0\hbar c$	α	$7.297\,352\,533(27) \times 10^{-3}$		3.7×10^{-9}
inverse fine-structure constant	α^{-1}	137.035 999 76(50)		3.7×10^{-9}

Fundamental Physical Constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
Rydberg constant $\alpha^2 m_e c / 2h$	R_∞	10 973 731.568 549(83)	m^{-1}	7.6×10^{-12}
	$R_\infty c$	$3.289 841 960 368(25) \times 10^{15}$	Hz	7.6×10^{-12}
	$R_\infty hc$	$2.179 871 90(17) \times 10^{-18}$	J	7.8×10^{-8}
	$R_\infty hc$ in eV	13.605 691 72(53)	eV	3.9×10^{-8}
Bohr radius $\alpha / 4\pi R_\infty = 4\pi\epsilon_0 \hbar^2 / m_e e^2$	a_0	$0.529 177 2083(19) \times 10^{-10}$	m	3.7×10^{-9}
Hartree energy $e^2 / 4\pi\epsilon_0 a_0 = 2R_\infty hc$ $= \alpha^2 m_e c^2$	E_h	$4.359 743 81(34) \times 10^{-18}$	J	7.8×10^{-8}
in eV		27.211 3834(11)	eV	3.9×10^{-8}
quantum of circulation	$h/2m_e$	$3.636 947 516(27) \times 10^{-4}$	$\text{m}^2 \text{s}^{-1}$	7.3×10^{-9}
	h/m_e	$7.273 895 032(53) \times 10^{-4}$	$\text{m}^2 \text{s}^{-1}$	7.3×10^{-9}
Electroweak				
Fermi coupling constant ^c	$G_F / (\hbar c)^3$	$1.166 39(1) \times 10^{-5}$	GeV^{-2}	8.6×10^{-6}
weak mixing angle ^d θ_W (on-shell scheme) $\sin^2 \theta_W = s_W^2 \equiv 1 - (m_W / m_Z)^2$	$\sin^2 \theta_W$	0.2224(19)		8.7×10^{-3}
Electron, e^-				
electron mass	m_e	$9.109 381 88(72) \times 10^{-31}$	kg	7.9×10^{-8}
in u, $m_e = A_r(e) \text{ u}$ (electron relative atomic mass times u)		$5.485 799 110(12) \times 10^{-4}$	u	2.1×10^{-9}
energy equivalent	$m_e c^2$	$8.187 104 14(64) \times 10^{-14}$	J	7.9×10^{-8}
in MeV		0.510 998 902(21)	MeV	4.0×10^{-8}
electron-muon mass ratio	m_e / m_μ	$4.836 332 10(15) \times 10^{-3}$		3.0×10^{-8}
electron-tau mass ratio	m_e / m_τ	$2.875 55(47) \times 10^{-4}$		1.6×10^{-4}
electron-proton mass ratio	m_e / m_p	$5.446 170 232(12) \times 10^{-4}$		2.1×10^{-9}
electron-neutron mass ratio	m_e / m_n	$5.438 673 462(12) \times 10^{-4}$		2.2×10^{-9}
electron-deuteron mass ratio	m_e / m_d	$2.724 437 1170(58) \times 10^{-4}$		2.1×10^{-9}
electron to alpha particle mass ratio	m_e / m_α	$1.370 933 5611(29) \times 10^{-4}$		2.1×10^{-9}
electron charge to mass quotient	$-e / m_e$	$-1.758 820 174(71) \times 10^{11}$	C kg^{-1}	4.0×10^{-8}
electron molar mass $N_A m_e$	$M(e), M_e$	$5.485 799 110(12) \times 10^{-7}$	kg mol^{-1}	2.1×10^{-9}
Compton wavelength $h / m_e c$	λ_C	$2.426 310 215(18) \times 10^{-12}$	m	7.3×10^{-9}
$\lambda_C / 2\pi = \alpha a_0 = \alpha^2 / 4\pi R_\infty$	$\tilde{\lambda}_C$	$386.159 2642(28) \times 10^{-15}$	m	7.3×10^{-9}
classical electron radius $\alpha^2 a_0$	r_e	$2.817 940 285(31) \times 10^{-15}$	m	1.1×10^{-8}
Thomson cross section $(8\pi/3)r_e^2$	σ_e	$0.665 245 854(15) \times 10^{-28}$	m^2	2.2×10^{-8}
electron magnetic moment	μ_e	$-928.476 362(37) \times 10^{-26}$	J T^{-1}	4.0×10^{-8}
to Bohr magneton ratio	μ_e / μ_B	$-1.001 159 652 1869(41)$		4.1×10^{-12}
to nuclear magneton ratio	μ_e / μ_N	$-1 838.281 9660(39)$		2.1×10^{-9}
electron magnetic moment anomaly $|\mu_e| / \mu_B - 1$	a_e	$1.159 652 1869(41) \times 10^{-3}$		3.5×10^{-9}
electron g-factor $-2(1 + a_e)$	g_e	$-2.002 319 304 3737(82)$		4.1×10^{-12}
electron-muon magnetic moment ratio	μ_e / μ_μ	206.766 9720(63)		3.0×10^{-8}

Fundamental Physical Constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
electron-proton magnetic moment ratio	μ_e/μ_p	$-658.210\,6875(66)$		1.0×10^{-8}
electron to shielded proton magnetic moment ratio (H ₂ O, sphere, 25 °C)	μ_e/μ'_p	$-658.227\,5954(71)$		1.1×10^{-8}
electron-neutron magnetic moment ratio	μ_e/μ_n	$960.920\,50(23)$		2.4×10^{-7}
electron-deuteron magnetic moment ratio	μ_e/μ_d	$-2\,143.923\,498(23)$		1.1×10^{-8}
electron to shielded helium ^e magnetic moment ratio (gas, sphere, 25 °C)	μ_e/μ'_h	$864.058\,255(10)$		1.2×10^{-8}
electron gyromagnetic ratio $2|\mu_e|/\hbar$	γ_e	$1.760\,859\,794(71) \times 10^{11}$	$\text{s}^{-1} \text{T}^{-1}$	4.0×10^{-8}
	$\gamma_e/2\pi$	$28\,024.9540(11)$	MHz T^{-1}	4.0×10^{-8}
	Muon, μ^-			
muon mass	m_μ	$1.883\,531\,09(16) \times 10^{-28}$	kg	8.4×10^{-8}
in u, $m_\mu = A_r(\mu) \text{ u}$ (muon relative atomic mass times u)		$0.113\,428\,9168(34)$	u	3.0×10^{-8}
energy equivalent in MeV	$m_\mu c^2$	$1.692\,833\,32(14) \times 10^{-11}$ $105.658\,3568(52)$	J MeV	8.4×10^{-8} 4.9×10^{-8}
muon-electron mass ratio	m_μ/m_e	$206.768\,2657(63)$		3.0×10^{-8}
muon-tau mass ratio	m_μ/m_τ	$5.945\,72(97) \times 10^{-2}$		1.6×10^{-4}
muon-proton mass ratio	m_μ/m_p	$0.112\,609\,5173(34)$		3.0×10^{-8}
muon-neutron mass ratio	m_μ/m_n	$0.112\,454\,5079(34)$		3.0×10^{-8}
muon molar mass $N_A m_\mu$	$M(\mu), M_\mu$	$0.113\,428\,9168(34) \times 10^{-3}$	kg mol ⁻¹	3.0×10^{-8}
muon Compton wavelength $h/m_\mu c$	$\lambda_{C,\mu}$	$11.734\,441\,97(35) \times 10^{-15}$	m	2.9×10^{-8}
$\lambda_{C,\mu}/2\pi$	$\tilde{\lambda}_{C,\mu}$	$1.867\,594\,444(55) \times 10^{-15}$	m	2.9×10^{-8}
muon magnetic moment	μ_μ	$-4.490\,448\,13(22) \times 10^{-26}$	J T ⁻¹	4.9×10^{-8}
to Bohr magneton ratio	μ_μ/μ_B	$-4.841\,970\,85(15) \times 10^{-3}$		3.0×10^{-8}
to nuclear magneton ratio	μ_μ/μ_N	$-8.890\,597\,70(27)$		3.0×10^{-8}
muon magnetic moment anomaly $|\mu_\mu|/(e\hbar/2m_\mu) - 1$	a_μ	$1.165\,916\,02(64) \times 10^{-3}$		5.5×10^{-7}
muon g -factor $-2(1 + a_\mu)$	g_μ	$-2.002\,331\,8320(13)$		6.4×10^{-10}
muon-proton magnetic moment ratio	μ_μ/μ_p	$-3.183\,345\,39(10)$		3.2×10^{-8}
	Tau, τ^-			
tau mass ^f	m_τ	$3.167\,88(52) \times 10^{-27}$	kg	1.6×10^{-4}
in u, $m_\tau = A_r(\tau) \text{ u}$ (tau relative atomic mass times u)		$1.907\,74(31)$	u	1.6×10^{-4}
energy equivalent in MeV	$m_\tau c^2$	$2.847\,15(46) \times 10^{-10}$ $1\,777.05(29)$	J MeV	1.6×10^{-4} 1.6×10^{-4}

Fundamental Physical Constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
tau-electron mass ratio	m_τ/m_e	3 477.60(57)		1.6×10^{-4}
tau-muon mass ratio	m_τ/m_μ	16.8188(27)		1.6×10^{-4}
tau-proton mass ratio	m_τ/m_p	1.893 96(31)		1.6×10^{-4}
tau-neutron mass ratio	m_τ/m_n	1.891 35(31)		1.6×10^{-4}
tau molar mass $N_A m_\tau$	$M(\tau), M_\tau$	$1.907\,74(31) \times 10^{-3}$	kg mol ⁻¹	1.6×10^{-4}
tau Compton wavelength $h/m_\tau c$	$\lambda_{C,\tau}$	$0.697\,70(11) \times 10^{-15}$	m	1.6×10^{-4}
$\lambda_{C,\tau}/2\pi$	$\tilde{\lambda}_{C,\tau}$	$0.111\,042(18) \times 10^{-15}$	m	1.6×10^{-4}
Proton, p				
proton mass	m_p	$1.672\,621\,58(13) \times 10^{-27}$	kg	7.9×10^{-8}
in u, $m_p = A_r(p)$ u (proton relative atomic mass times u)		1.007 276 466 88(13)	u	1.3×10^{-10}
energy equivalent in MeV	$m_p c^2$	$1.503\,277\,31(12) \times 10^{-10}$ 938.271 998(38)	J MeV	7.9×10^{-8} 4.0×10^{-8}
proton-electron mass ratio	m_p/m_e	1 836.152 6675(39)		2.1×10^{-9}
proton-muon mass ratio	m_p/m_μ	8.880 244 08(27)		3.0×10^{-8}
proton-tau mass ratio	m_p/m_τ	0.527 994(86)		1.6×10^{-4}
proton-neutron mass ratio	m_p/m_n	0.998 623 478 55(58)		5.8×10^{-10}
proton charge to mass quotient	e/m_p	$9.578\,834\,08(38) \times 10^7$	C kg ⁻¹	4.0×10^{-8}
proton molar mass $N_A m_p$	$M(p), M_p$	$1.007\,276\,466\,88(13) \times 10^{-3}$	kg mol ⁻¹	1.3×10^{-10}
proton Compton wavelength $h/m_p c$	$\lambda_{C,p}$	$1.321\,409\,847(10) \times 10^{-15}$	m	7.6×10^{-9}
$\lambda_{C,p}/2\pi$	$\tilde{\lambda}_{C,p}$	$0.210\,308\,9089(16) \times 10^{-15}$	m	7.6×10^{-9}
proton magnetic moment	μ_p	$1.410\,606\,633(58) \times 10^{-26}$	J T ⁻¹	4.1×10^{-8}
to Bohr magneton ratio	μ_p/μ_B	$1.521\,032\,203(15) \times 10^{-3}$		1.0×10^{-8}
to nuclear magneton ratio	μ_p/μ_N	2.792 847 337(29)		1.0×10^{-8}
proton g -factor $2\mu_p/\mu_N$	g_p	5.585 694 675(57)		1.0×10^{-8}
proton-neutron magnetic moment ratio	μ_p/μ_n	-1.459 898 05(34)		2.4×10^{-7}
shielded proton magnetic moment (H ₂ O, sphere, 25 °C)	μ'_p	$1.410\,570\,399(59) \times 10^{-26}$	J T ⁻¹	4.2×10^{-8}
to Bohr magneton ratio	μ'_p/μ_B	$1.520\,993\,132(16) \times 10^{-3}$		1.1×10^{-8}
to nuclear magneton ratio	μ'_p/μ_N	2.792 775 597(31)		1.1×10^{-8}
proton magnetic shielding correction $1 - \mu'_p/\mu_p$ (H ₂ O, sphere, 25 °C)	σ'_p	$25.687(15) \times 10^{-6}$		5.7×10^{-4}
proton gyromagnetic ratio $2\mu_p/\hbar$	γ_p	$2.675\,222\,12(11) \times 10^8$	s ⁻¹ T ⁻¹	4.1×10^{-8}
	$\gamma_p/2\pi$	42.577 4825(18)	MHz T ⁻¹	4.1×10^{-8}
shielded proton gyromagnetic ratio $2\mu'_p/\hbar$ (H ₂ O, sphere, 25 °C)	γ'_p	$2.675\,153\,41(11) \times 10^8$	s ⁻¹ T ⁻¹	4.2×10^{-8}
	$\gamma'_p/2\pi$	42.576 3888(18)	MHz T ⁻¹	4.2×10^{-8}
Neutron, n				

Fundamental Physical Constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
neutron mass	m_n	$1.674\,927\,16(13) \times 10^{-27}$	kg	7.9×10^{-8}
in u, $m_n = A_r(n)$ u (neutron relative atomic mass times u)		1.008 664 915 78(55)	u	5.4×10^{-10}
energy equivalent	$m_n c^2$	$1.505\,349\,46(12) \times 10^{-10}$	J	7.9×10^{-8}
in MeV		939.565 330(38)	MeV	4.0×10^{-8}
neutron-electron mass ratio	m_n/m_e	1 838.683 6550(40)		2.2×10^{-9}
neutron-muon mass ratio	m_n/m_μ	8.892 484 78(27)		3.0×10^{-8}
neutron-tau mass ratio	m_n/m_τ	0.528 722(86)		1.6×10^{-4}
neutron-proton mass ratio	m_n/m_p	1.001 378 418 87(58)		5.8×10^{-10}
neutron molar mass $N_A m_n$	$M(n), M_n$	$1.008\,664\,915\,78(55) \times 10^{-3}$	kg mol ⁻¹	5.4×10^{-10}
neutron Compton wavelength $h/m_n c$	$\lambda_{C,n}$	$1.319\,590\,898(10) \times 10^{-15}$	m	7.6×10^{-9}
$\lambda_{C,n}/2\pi$	$\tilde{\lambda}_{C,n}$	$0.210\,019\,4142(16) \times 10^{-15}$	m	7.6×10^{-9}
neutron magnetic moment	μ_n	$-0.966\,236\,40(23) \times 10^{-26}$	J T ⁻¹	2.4×10^{-7}
to Bohr magneton ratio	μ_n/μ_B	$-1.041\,875\,63(25) \times 10^{-3}$		2.4×10^{-7}
to nuclear magneton ratio	μ_n/μ_N	-1.913 042 72(45)		2.4×10^{-7}
neutron g -factor $2\mu_n/\mu_N$	g_n	-3.826 085 45(90)		2.4×10^{-7}
neutron-electron magnetic moment ratio	μ_n/μ_e	$1.040\,668\,82(25) \times 10^{-3}$		2.4×10^{-7}
neutron-proton magnetic moment ratio	μ_n/μ_p	-0.684 979 34(16)		2.4×10^{-7}
neutron to shielded proton magnetic moment ratio (H ₂ O, sphere, 25 °C)	μ_n/μ'_p	-0.684 996 94(16)		2.4×10^{-7}
neutron gyromagnetic ratio $2|\mu_n|/\hbar$	γ_n	$1.832\,471\,88(44) \times 10^8$	s ⁻¹ T ⁻¹	2.4×10^{-7}
	$\gamma_n/2\pi$	29.164 6958(70)	MHz T ⁻¹	2.4×10^{-7}
Deuteron, d				
deuteron mass	m_d	$3.343\,583\,09(26) \times 10^{-27}$	kg	7.9×10^{-8}
in u, $m_d = A_r(d)$ u (deuteron relative atomic mass times u)		2.013 553 212 71(35)	u	1.7×10^{-10}
energy equivalent	$m_d c^2$	$3.005\,062\,62(24) \times 10^{-10}$	J	7.9×10^{-8}
in MeV		1 875.612 762(75)	MeV	4.0×10^{-8}
deuteron-electron mass ratio	m_d/m_e	3 670.482 9550(78)		2.1×10^{-9}
deuteron-proton mass ratio	m_d/m_p	1.999 007 500 83(41)		2.0×10^{-10}
deuteron molar mass $N_A m_d$	$M(d), M_d$	$2.013\,553\,212\,71(35) \times 10^{-3}$	kg mol ⁻¹	1.7×10^{-10}
deuteron magnetic moment	μ_d	$0.433\,073\,457(18) \times 10^{-26}$	J T ⁻¹	4.2×10^{-8}
to Bohr magneton ratio	μ_d/μ_B	$0.466\,975\,4556(50) \times 10^{-3}$		1.1×10^{-8}
to nuclear magneton ratio	μ_d/μ_N	0.857 438 2284(94)		1.1×10^{-8}
deuteron-electron magnetic moment ratio	μ_d/μ_e	$-4.664\,345\,537(50) \times 10^{-4}$		1.1×10^{-8}
deuteron-proton magnetic moment ratio	μ_d/μ_p	0.307 012 2083(45)		1.5×10^{-8}

Fundamental Physical Constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
deuteron-neutron magnetic moment ratio	μ_d/μ_n	-0.448 206 52(11)		2.4×10^{-7}
Helion, h				
helion mass ^e in u, $m_h = A_r(\text{h})$ u (helion relative atomic mass times u)	m_h	$5.006\,411\,74(39) \times 10^{-27}$	kg	7.9×10^{-8}
energy equivalent in MeV	$m_h c^2$	3.014 932 234 69(86) $4.499\,538\,48(35) \times 10^{-10}$ 2 808.391 32(11)	u J MeV	2.8×10^{-10} 7.9×10^{-8} 4.0×10^{-8}
helion-electron mass ratio	m_h/m_e	5 495.885 238(12)		2.1×10^{-9}
helion-proton mass ratio	m_h/m_p	2.993 152 658 50(93)		3.1×10^{-10}
helion molar mass $N_A m_h$	$M(\text{h}), M_h$	$3.014\,932\,234\,69(86) \times 10^{-3}$	kg mol ⁻¹	2.8×10^{-10}
shielded helion magnetic moment (gas, sphere, 25 °C)	μ'_h	$-1.074\,552\,967(45) \times 10^{-26}$	J T ⁻¹	4.2×10^{-8}
to Bohr magneton ratio	μ'_h/μ_B	$-1.158\,671\,474(14) \times 10^{-3}$		1.2×10^{-8}
to nuclear magneton ratio	μ'_h/μ_N	-2.127 497 718(25)		1.2×10^{-8}
shielded helion to proton magnetic moment ratio (gas, sphere, 25 °C)	μ'_h/μ_p	-0.761 766 563(12)		1.5×10^{-8}
shielded helion to shielded proton magnetic moment ratio (gas/H ₂ O, spheres, 25 °C)	μ'_h/μ'_p	-0.761 786 1313(33)		4.3×10^{-9}
shielded helion gyromagnetic ratio $2|\mu'_h|/\hbar$ (gas, sphere, 25 °C)	γ'_h	$2.037\,894\,764(85) \times 10^8$	s ⁻¹ T ⁻¹	4.2×10^{-8}
	$\gamma'_h/2\pi$	32.434 1025(14)	MHz T ⁻¹	4.2×10^{-8}
Alpha particle, α				
alpha particle mass in u, $m_\alpha = A_r(\alpha)$ u (alpha particle relative atomic mass times u)	m_α	$6.644\,655\,98(52) \times 10^{-27}$	kg	7.9×10^{-8}
energy equivalent in MeV	$m_\alpha c^2$	4.001 506 1747(10) $5.971\,918\,97(47) \times 10^{-10}$ 3 727.379 04(15)	u J MeV	2.5×10^{-10} 7.9×10^{-8} 4.0×10^{-8}
alpha particle to electron mass ratio	m_α/m_e	7 294.299 508(16)		2.1×10^{-9}
alpha particle to proton mass ratio	m_α/m_p	3.972 599 6846(11)		2.8×10^{-10}
alpha particle molar mass $N_A m_\alpha$	$M(\alpha), M_\alpha$	$4.001\,506\,1747(10) \times 10^{-3}$	kg mol ⁻¹	2.5×10^{-10}
PHYSICO-CHEMICAL				
Avogadro constant	N_A, L	$6.022\,141\,99(47) \times 10^{23}$	mol ⁻¹	7.9×10^{-8}
atomic mass constant $m_u = \frac{1}{12}m(^{12}\text{C}) = 1$ u $= 10^{-3}$ kg mol ⁻¹ / N_A	m_u	$1.660\,538\,73(13) \times 10^{-27}$	kg	7.9×10^{-8}
energy equivalent in MeV	$m_u c^2$	$1.492\,417\,78(12) \times 10^{-10}$ 931.494 013(37)	J MeV	7.9×10^{-8} 4.0×10^{-8}
Faraday constant ^g $N_A e$	F	96 485.3415(39)	C mol ⁻¹	4.0×10^{-8}

Fundamental Physical Constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r	
molar Planck constant	$N_A h$	$3.990\,312\,689(30) \times 10^{-10}$	J s mol^{-1}	7.6×10^{-9}	
	$N_A h c$	$0.119\,626\,564\,92(91)$	J m mol^{-1}	7.6×10^{-9}	
molar gas constant	R	$8.314\,472(15)$	$\text{J mol}^{-1} \text{K}^{-1}$	1.7×10^{-6}	
Boltzmann constant R/N_A in eV K^{-1}	k	$1.380\,6503(24) \times 10^{-23}$	J K^{-1}	1.7×10^{-6}	
		$8.617\,342(15) \times 10^{-5}$	eV K^{-1}	1.7×10^{-6}	
	k/h	$2.083\,6644(36) \times 10^{10}$	Hz K^{-1}	1.7×10^{-6}	
	k/hc	$69.503\,56(12)$	$\text{m}^{-1} \text{K}^{-1}$	1.7×10^{-6}	
molar volume of ideal gas RT/p $T = 273.15 \text{ K}$, $p = 101.325 \text{ kPa}$	V_m	$22.413\,996(39) \times 10^{-3}$	$\text{m}^3 \text{mol}^{-1}$	1.7×10^{-6}	
	Loschmidt constant N_A/V_m	n_0	$2.686\,7775(47) \times 10^{25}$	m^{-3}	1.7×10^{-6}
	$T = 273.15 \text{ K}$, $p = 100 \text{ kPa}$	V_m	$22.710\,981(40) \times 10^{-3}$	$\text{m}^3 \text{mol}^{-1}$	1.7×10^{-6}
Sackur-Tetrode constant (absolute entropy constant) ^h $\frac{5}{2} + \ln[(2\pi m_u k T_1 / h^2)^{3/2} k T_1 / p_0]$ $T_1 = 1 \text{ K}$, $p_0 = 100 \text{ kPa}$ $T_1 = 1 \text{ K}$, $p_0 = 101.325 \text{ kPa}$	S_0/R	$-1.151\,7048(44)$		3.8×10^{-6}	
		$-1.164\,8678(44)$		3.7×10^{-6}	
Stefan-Boltzmann constant $(\pi^2/60)k^4/\hbar^3 c^2$	σ	$5.670\,400(40) \times 10^{-8}$	$\text{W m}^{-2} \text{K}^{-4}$	7.0×10^{-6}	
	first radiation constant $2\pi\hbar c^2$	c_1	$3.741\,771\,07(29) \times 10^{-16}$	W m^2	7.8×10^{-8}
	first radiation constant for spectral radiance $2hc^2$	c_{1L}	$1.191\,042\,722(93) \times 10^{-16}$	$\text{W m}^2 \text{sr}^{-1}$	7.8×10^{-8}
	second radiation constant hc/k	c_2	$1.438\,7752(25) \times 10^{-2}$	m K	1.7×10^{-6}
	Wien displacement law constant $b = \lambda_{\max} T = c_2/4.965\,114\,231\dots$	b	$2.897\,7686(51) \times 10^{-3}$	m K	1.7×10^{-6}

^a See the “Adopted values” table for the conventional value adopted internationally for realizing representations of the volt using the Josephson effect.

^b See the “Adopted values” table for the conventional value adopted internationally for realizing representations of the ohm using the quantum Hall effect.

^c Value recommended by the Particle Data Group, Caso et al., Eur. Phys. J. C **3**(1-4), 1-794 (1998).

^d Based on the ratio of the masses of the W and Z bosons m_W/m_Z recommended by the Particle Data Group (Caso et al., 1998). The value for $\sin^2\theta_W$ they recommend, which is based on a particular variant of the modified minimal subtraction ($\overline{\text{MS}}$) scheme, is $\sin^2\hat{\theta}_W(M_Z) = 0.231\,24(24)$.

^e The helion, symbol h, is the nucleus of the ^3He atom.

^f This and all other values involving m_τ are based on the value of $m_\tau c^2$ in MeV recommended by the Particle Data Group, Caso et al., Eur. Phys. J. C **3**(1-4), 1-794 (1998), but with a standard uncertainty of 0.29 MeV rather than the quoted uncertainty of -0.26 MeV , $+0.29 \text{ MeV}$.

^g The numerical value of F to be used in coulometric chemical measurements is $96\,485.3432(76)$ [7.9×10^{-8}] when the relevant current is measured in terms of representations of the volt and ohm based on the Josephson and quantum Hall effects and the internationally adopted conventional values of the Josephson and von Klitzing constants K_{J-90} and R_{K-90} given in the “Adopted values” table.

^h The entropy of an ideal monoatomic gas of relative atomic mass A_r is given by $S = S_0 + \frac{3}{2}R \ln A_r - R \ln(p/p_0) + \frac{5}{2}R \ln(T/K)$.

Fundamental Physical Constants — Adopted values

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
molar mass of ^{12}C	$M(^{12}\text{C})$	12×10^{-3}	kg mol^{-1}	(exact)
molar mass constant ^a $M(^{12}\text{C})/12$	M_{u}	1×10^{-3}	kg mol^{-1}	(exact)
conventional value of Josephson constant ^b	$K_{\text{J}-90}$	483 597.9	GHz V^{-1}	(exact)
conventional value of von Klitzing constant ^c	$R_{\text{K}-90}$	25 812.807	Ω	(exact)
standard atmosphere		101 325	Pa	(exact)
standard acceleration of gravity	g_{n}	9.806 65	m s^{-2}	(exact)

^a The relative atomic mass $A_r(\text{X})$ of particle X with mass $m(\text{X})$ is defined by $A_r(\text{X}) = m(\text{X})/m_{\text{u}}$, where $m_{\text{u}} = m(^{12}\text{C})/12 = M_{\text{u}}/N_{\text{A}} = 1 \text{ u}$ is the atomic mass constant, N_{A} is the Avogadro constant, and u is the atomic mass unit. Thus the mass of particle X in u is $m(\text{X}) = A_r(\text{X}) \text{ u}$ and the molar mass of X is $M(\text{X}) = A_r(\text{X})M_{\text{u}}$.

^b This is the value adopted internationally for realizing representations of the volt using the Josephson effect.

^c This is the value adopted internationally for realizing representations of the ohm using the quantum Hall effect.

Energy Equivalents

	J	kg	m^{-1}	Hz
1 J	(1 J) = 1 J	$(1 \text{ J})/c^2 =$ $1.112\,650\,056 \times 10^{-17} \text{ kg}$	$(1 \text{ J})/hc =$ $5.034\,117\,62(39) \times 10^{24} \text{ m}^{-1}$	$(1 \text{ J})/h =$ $1.509\,190\,50(12) \times 10^{33} \text{ Hz}$
1 kg	$(1 \text{ kg})c^2 =$ $8.987\,551\,787 \times 10^{16} \text{ J}$	$(1 \text{ kg}) =$ 1 kg	$(1 \text{ kg})c/h =$ $4.524\,439\,29(35) \times 10^{41} \text{ m}^{-1}$	$(1 \text{ kg})c^2/h =$ $1.356\,392\,77(11) \times 10^{50} \text{ Hz}$
1 m^{-1}	$(1 \text{ m}^{-1})hc =$ $1.986\,445\,44(16) \times 10^{-25} \text{ J}$	$(1 \text{ m}^{-1})h/c =$ $2.210\,218\,63(17) \times 10^{-42} \text{ kg}$	$(1 \text{ m}^{-1}) =$ 1 m^{-1}	$(1 \text{ m}^{-1})c =$ 299 792 458 Hz
1 Hz	$(1 \text{ Hz})h =$ $6.626\,068\,76(52) \times 10^{-34} \text{ J}$	$(1 \text{ Hz})h/c^2 =$ $7.372\,495\,78(58) \times 10^{-51} \text{ kg}$	$(1 \text{ Hz})/c =$ $3.335\,640\,952 \times 10^{-9} \text{ m}^{-1}$	$(1 \text{ Hz}) =$ 1 Hz
1 K	$(1 \text{ K})k =$ $1.380\,6503(24) \times 10^{-23} \text{ J}$	$(1 \text{ K})k/c^2 =$ $1.536\,1807(27) \times 10^{-40} \text{ kg}$	$(1 \text{ K})k/hc =$ $69.503\,56(12) \text{ m}^{-1}$	$(1 \text{ K})k/h =$ $2.083\,6644(36) \times 10^{10} \text{ Hz}$
1 eV	$(1 \text{ eV}) =$ $1.602\,176\,462(63) \times 10^{-19} \text{ J}$	$(1 \text{ eV})/c^2 =$ $1.782\,661\,731(70) \times 10^{-36} \text{ kg}$	$(1 \text{ eV})/hc =$ $8.065\,544\,77(32) \times 10^5 \text{ m}^{-1}$	$(1 \text{ eV})/h =$ $2.417\,989\,491(95) \times 10^{14} \text{ Hz}$
1 u	$(1 \text{ u})c^2 =$ $1.492\,417\,78(12) \times 10^{-10} \text{ J}$	$(1 \text{ u}) =$ $1.660\,538\,73(13) \times 10^{-27} \text{ kg}$	$(1 \text{ u})c/h =$ $7.513\,006\,658(57) \times 10^{14} \text{ m}^{-1}$	$(1 \text{ u})c^2/h =$ $2.252\,342\,733(17) \times 10^{23} \text{ Hz}$
1 E_h	$(1 E_h) =$ $4.359\,743\,81(34) \times 10^{-18} \text{ J}$	$(1 E_h)/c^2 =$ $4.850\,869\,19(38) \times 10^{-35} \text{ kg}$	$(1 E_h)/hc =$ $2.194\,746\,313\,710(17) \times 10^7 \text{ m}^{-1}$	$(1 E_h)/h =$ $6.579\,683\,920\,735(50) \times 10^{15} \text{ Hz}$

Derived from the relations $E = mc^2 = hc/\lambda = h\nu = kT$, and based on the 1998 CODATA adjustment of the values of the constants;

1 eV = (e/C) J, 1 u = $m_u = \frac{1}{12}m(^{12}\text{C}) = 10^{-3} \text{ kg mol}^{-1}/N_A$, and $E_h = 2R_\infty hc = \alpha^2 m_e c^2$ is the Hartree energy (hartree).

Energy Equivalents

	K	eV	u	E_h
1 J	(1 J)/ k = $7.242\,964(13) \times 10^{22}$ K	(1 J) = $6.241\,509\,74(24) \times 10^{18}$ eV	(1 J)/ c^2 = $6.700\,536\,62(53) \times 10^9$ u	(1 J) = $2.293\,712\,76(18) \times 10^{17}$ E_h
1 kg	(1 kg) c^2/k = $6.509\,651(11) \times 10^{39}$ K	(1 kg) c^2 = $5.609\,589\,21(22) \times 10^{35}$ eV	(1 kg) = $6.022\,141\,99(47) \times 10^{26}$ u	(1 kg) c^2 = $2.061\,486\,22(16) \times 10^{34}$ E_h
1 m ⁻¹	(1 m ⁻¹) hc/k = $1.438\,7752(25) \times 10^{-2}$ K	(1 m ⁻¹) hc = $1.239\,841\,857(49) \times 10^{-6}$ eV	(1 m ⁻¹) h/c = $1.331\,025\,042(10) \times 10^{-15}$ u	(1 m ⁻¹) hc = $4.556\,335\,252\,750(35) \times 10^{-8}$ E_h
1 Hz	(1 Hz) h/k = $4.799\,2374(84) \times 10^{-11}$ K	(1 Hz) h = $4.135\,667\,27(16) \times 10^{-15}$ eV	(1 Hz) h/c^2 = $4.439\,821\,637(34) \times 10^{-24}$ u	(1 Hz) h = $1.519\,829\,846\,003(12) \times 10^{-16}$ E_h
1 K	(1 K) = 1 K	(1 K) k = $8.617\,342(15) \times 10^{-5}$ eV	(1 K) k/c^2 = $9.251\,098(16) \times 10^{-14}$ u	(1 K) k = $3.166\,8153(55) \times 10^{-6}$ E_h
1 eV	(1 eV)/ k = $1.160\,4506(20) \times 10^4$ K	(1 eV) = 1 eV	(1 eV)/ c^2 = $1.073\,544\,206(43) \times 10^{-9}$ u	(1 eV) = $3.674\,932\,60(14) \times 10^{-2}$ E_h
1 u	(1 u) c^2/k = $1.080\,9528(19) \times 10^{13}$ K	(1 u) c^2 = $931.494\,013(37) \times 10^6$ eV	(1 u) = 1 u	(1 u) c^2 = $3.423\,177\,709(26) \times 10^7$ E_h
1 E_h	(1 E_h)/ k = $3.157\,7465(55) \times 10^5$ K	(1 E_h) = $27.211\,3834(11)$ eV	(1 E_h)/ c^2 = $2.921\,262\,304(22) \times 10^{-8}$ u	(1 E_h) = 1 E_h

Derived from the relations $E = mc^2 = hc/\lambda = h\nu = kT$, and based on the 1998 CODATA adjustment of the values of the constants;
 1 eV = (e/C) J, 1 u = $m_u = \frac{1}{12}m(^{12}\text{C}) = 10^{-3}$ kg mol⁻¹/ N_A , and $E_h = 2R_\infty hc = \alpha^2 m_e c^2$ is the Hartree energy (hartree).

STANDARD ATOMIC WEIGHTS (2001)

This table of atomic weights includes the changes made in 1999 and 2001 by the IUPAC Commission on Atomic Weights and Isotopic Abundances. The Standard Atomic Weights apply to the elements as they exist naturally on Earth, and the uncertainties take into account the isotopic variation found in most laboratory samples. Further comments on the variability are given in the footnotes.

The number in parentheses following the atomic weight value gives the uncertainty in the last digit. An atomic weight entry in brackets indicates that the element that has no stable isotopes; the value given is the atomic mass in u (or the mass number, if the mass is not accurately known) for the isotope of longest half-life. Thorium, protactinium, and uranium have no stable isotopes, but the terrestrial isotopic composition is sufficiently uniform to permit a standard atomic weight to be specified.

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2. Coplen, T. D., *Pure Appl. Chem.* 73, 667, 2001.
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4. Loss, R. D., Report of the IUPAC Commission on Atomic Weights and Isotopic Abundances, *Chemistry International*, 23, 179, 2001.

Name	Symbol	Atomic No.	Atomic Weight	Footnotes
Actinium	Ac	89	[227.0277]	a
Aluminum	Al	13	26.981538(2)	
Americium	Am	95	[243.0614]	a
Antimony	Sb	51	121.760(1)	g
Argon	Ar	18	39.948(1)	g r
Arsenic	As	33	74.92160(2)	
Astatine	At	85	[209.9871]	a
Barium	Ba	56	137.327(7)	
Berkelium	Bk	97	[247.0703]	a
Beryllium	Be	4	9.012182(3)	
Bismuth	Bi	83	208.98038(2)	
Bohrium	Bh	107	[264.12]	a
Boron	B	5	10.811(7)	g m r
Bromine	Br	35	79.904(1)	
Cadmium	Cd	48	112.411(8)	g
Calcium	Ca	20	40.078(4)	g
Californium	Cf	98	[251.0796]	a
Carbon	C	6	12.0107(8)	g r
Cerium	Ce	58	140.116(1)	g
Cesium	Cs	55	132.90545(2)	
Chlorine	Cl	17	35.453(2)	g m r
Chromium	Cr	24	51.9961(6)	
Cobalt	Co	27	58.933200(9)	
Copper	Cu	29	63.546(3)	r
Curium	Cm	96	[247.0704]	a
Dubnium	Db	105	[262.1141]	a
Dysprosium	Dy	66	162.500(1)	g
Einsteinium	Es	99	[252.0830]	a
Erbium	Er	68	167.259(3)	g
Europium	Eu	63	151.964(1)	g
Fermium	Fm	100	[257.0951]	a
Fluorine	F	9	18.9984032(5)	
Francium	Fr	87	[223.0197]	a
Gadolinium	Gd	64	157.25(3)	g
Gallium	Ga	31	69.723(1)	
Germanium	Ge	32	72.64(1)	
Gold	Au	79	196.96655(2)	
Hafnium	Hf	72	178.49(2)	

STANDARD ATOMIC WEIGHTS (2001) (continued)

Name	Symbol	Atomic No.	Atomic Weight	Footnotes
Hassium	Hs	108	[277]	a
Helium	He	2	4.002602(2)	g r
Holmium	Ho	67	164.93032(2)	
Hydrogen	H	1	1.00794(7)	g m r
Indium	In	49	114.818(3)	
Iodine	I	53	126.90447(3)	
Iridium	Ir	77	192.217(3)	
Iron	Fe	26	55.845(2)	
Krypton	Kr	36	83.798(2)	g m
Lanthanum	La	57	138.9055(2)	g
Lawrencium	Lr	103	[262.1097]	a
Lead	Pb	82	207.2(1)	g r
Lithium	Li	3	6.941(2)	b g m r
Lutetium	Lu	71	174.967(1)	g
Magnesium	Mg	12	24.3050(6)	
Manganese	Mn	25	54.938049(9)	
Meitnerium	Mt	109	[268.1388]	a
Mendelevium	Md	101	[258.0984]	a
Mercury	Hg	80	200.59(2)	
Molybdenum	Mo	42	95.94(2)	g
Neodymium	Nd	60	144.24(3)	g
Neon	Ne	10	20.1797(6)	g m
Neptunium	Np	93	[237.0482]	a
Nickel	Ni	28	58.6934(2)	
Niobium	Nb	41	92.90638(2)	
Nitrogen	N	7	14.0067(2)	g r
Nobelium	No	102	[259.1010]	a
Osmium	Os	76	190.23(3)	g
Oxygen	O	8	15.9994(3)	g r
Palladium	Pd	46	106.42(1)	g
Phosphorus	P	15	30.973761(2)	
Platinum	Pt	78	195.078(2)	
Plutonium	Pu	94	[244.0642]	a
Polonium	Po	84	[208.9824]	a
Potassium	K	19	39.0983(1)	g
Praseodymium	Pr	59	140.90765(2)	
Promethium	Pm	61	[144.9127]	a
Protactinium	Pa	91	231.03588(2)	
Radium	Ra	88	[226.0254]	a
Radon	Rn	86	[222.0176]	a
Rhenium	Re	75	186.207(1)	
Rhodium	Rh	45	102.90550(2)	
Rubidium	Rb	37	85.4678(3)	g
Ruthenium	Ru	44	101.07(2)	g
Rutherfordium	Rf	104	[261.1088]	a
Samarium	Sm	62	150.36(3)	g
Scandium	Sc	21	44.955910(8)	
Seaborgium	Sg	106	[266.1219]	a
Selenium	Se	34	78.96(3)	r
Silicon	Si	14	28.0855(3)	r
Silver	Ag	47	107.8682(2)	g
Sodium	Na	11	22.989770(2)	
Strontium	Sr	38	87.62(1)	g r
Sulfur	S	16	32.065(5)	g r
Tantalum	Ta	73	180.9479(1)	
Technetium	Tc	43	[97.9072]	a
Tellurium	Te	52	127.60(3)	g
Terbium	Tb	65	158.92534(2)	

STANDARD ATOMIC WEIGHTS (2001) (continued)

Name	Symbol	Atomic No.	Atomic Weight	Footnotes
Thallium	Tl	81	204.3833(2)	
Thorium	Th	90	232.0381(1)	g
Thulium	Tm	69	168.93421(2)	
Tin	Sn	50	118.710(7)	g
Titanium	Ti	22	47.867(1)	
Tungsten	W	74	183.84(1)	
Ununbium	Uub	112	[285]	a
Ununhexium	Uuh	116	[289]	a
Ununnilium	Uun	110	[281]	a
Ununquadium	Uuq	114	[289]	a
Unununium	Uuu	111	[272.1535]	a
Uranium	U	92	238.02891(3)	g m
Vanadium	V	23	50.9415(1)	
Xenon	Xe	54	131.293(6)	g m
Ytterbium	Yb	70	173.04(3)	g
Yttrium	Y	39	88.90585(2)	
Zinc	Zn	30	65.409(4)	
Zirconium	Zr	40	91.224(2)	g

- ^a No stable isotope exists. The atomic mass in u (or the mass number, if the mass is not accurately known) is given in brackets for the isotope of longest half-life.
- ^b Commercially available Li materials have atomic weights that range between 6.939 and 6.996; if a more accurate value is required, it must be determined for the specific material.
- ^g Geological specimens are known in which the element has an isotopic composition outside the limits for the normal material. The difference between the atomic weight of the element in such specimens and that given in the table may exceed the stated uncertainty.
- ^m Modified isotopic compositions may be found in commercially available material because it has been subject to an undisclosed or inadvertent isotopic fractionation. Substantial deviations in atomic weight of the element from that given in the table can occur.
- ^r Range in isotopic composition of normal terrestrial material prevents a more precise atomic weight being given; the tabulated value should be applicable to any normal material.

ATOMIC MASSES AND ABUNDANCES

This table lists the mass (in atomic mass units, symbol u) and the natural abundance (in percent) of the stable nuclides and a few important radioactive nuclides. A complete table of all nuclides may be found in Section 11 ("Table of the Isotopes").

The atomic masses are based on the 1995 evaluation of Audi and Wapstra (Reference 2). The number in parentheses following the mass value is the uncertainty in the last digit(s) given.

Natural abundance values are also followed by uncertainties in the last digit(s) of the stated values. This uncertainty includes both the estimated measurement uncertainty and the reported range of variation in different terrestrial sources of the element (see Reference 3 and 4 for more details). The absence of an entry in the Abundance column indicates a radioactive nuclide not present in nature or an element whose isotopic composition varies so widely that a meaningful natural abundance cannot be defined.

An electronic version of these data is available on the Web site of the NIST Physics Laboratory (Reference 5).

REFERENCES

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3. Rosman, K. J. R., and Taylor, P. D. P., *J. Phys. Chem. Ref. Data*, 27, 1275, 1998.
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5. Coursey, J. S., and Dragoset, R. A., *Atomic Weights and Isotopic Compositions* (version 2.1). Available: <http://physics.nist.gov/Compositions/> National Institute of Standards and Technology, Gaithersburg, MD.

Z	Isotope	Mass in u	Abundance in %	Z	Isotope	Mass in u	Abundance in %
1	¹ H	1.0078250321(4)	99.9850(70)		⁴⁰ Ar	39.962383123(3)	99.6003(30)
	² D	2.0141017780(4)	0.0115(70)	19	³⁹ K	38.9637069(3)	93.2581(44)
	³ T	3.0160492675(11)			⁴⁰ K	39.96399867(29)	0.0117(1)
2	³ He	3.0160293097(9)	0.000137(3)		⁴¹ K	40.96182597(28)	6.7302(44)
	⁴ He	4.0026032497(10)	99.999863(3)	20	⁴⁰ Ca	39.9625912(3)	96.941(156)
3	⁶ Li	6.0151223(5)	7.59(4)		⁴² Ca	41.9586183(4)	0.647(23)
	⁷ Li	7.0160040(5)	92.41(4)		⁴³ Ca	42.9587668(5)	0.135(10)
4	⁹ Be	9.0121821(4)	100		⁴⁴ Ca	43.9554811(9)	2.086(110)
5	¹⁰ B	10.0129370(4)	19.9(7)		⁴⁶ Ca	45.9536928(25)	0.004(3)
	¹¹ B	11.0093055(5)	80.1(7)		⁴⁸ Ca	47.952534(4)	0.187(21)
6	¹² C	12.0000000(0)	98.93(8)	21	⁴⁵ Sc	44.9559102(12)	100
	¹³ C	13.0033548378(10)	1.07(8)	22	⁴⁶ Ti	45.9526295(12)	8.25(3)
7	¹⁴ N	14.0030740052(9)	99.632(7)		⁴⁷ Ti	46.9517638(10)	7.44(2)
	¹⁵ N	15.0001088984(9)	0.368(7)		⁴⁸ Ti	47.9479471(10)	73.72(3)
8	¹⁶ O	15.9949146221(15)	99.757(16)		⁴⁹ Ti	48.9478708(10)	5.41(2)
	¹⁷ O	16.99913150(22)	0.038(1)		⁵⁰ Ti	49.9447921(11)	5.18(2)
	¹⁸ O	17.9991604(9)	0.205(14)	23	⁵⁰ V	49.9471628(14)	0.250(4)
9	¹⁹ F	18.99840320(7)	100		⁵¹ V	50.9439637(14)	99.750(4)
10	²⁰ Ne	19.9924401759(20)	90.48(3)	24	⁵⁰ Cr	49.9460496(14)	4.345(13)
	²¹ Ne	20.99384674(4)	0.27(1)		⁵² Cr	51.9405119(15)	83.789(18)
	²² Ne	21.99138551(23)	9.25(3)		⁵³ Cr	52.9406538(15)	9.501(17)
11	²³ Na	22.98976967(23)	100		⁵⁴ Cr	53.9388849(15)	2.365(7)
12	²⁴ Mg	23.98504190(20)	78.99(4)	25	⁵⁵ Mn	54.9380496(14)	100
	²⁵ Mg	24.98583702(20)	10.00(1)	26	⁵⁴ Fe	53.9396148(14)	5.845(35)
	²⁶ Mg	25.98259304(21)	11.01(3)		⁵⁶ Fe	55.9349421(15)	91.754(36)
13	²⁷ Al	26.98153844(14)	100		⁵⁷ Fe	56.9353987(15)	2.119(10)
14	²⁸ Si	27.9769265327(20)	92.2297(7)		⁵⁸ Fe	57.9332805(15)	0.282(4)
	²⁹ Si	28.97649472(3)	4.6832(5)	27	⁵⁹ Co	58.9332002(15)	100
	³⁰ Si	29.97377022(5)	3.0872(5)	28	⁵⁸ Ni	57.9353479(15)	68.0769(89)
15	³¹ P	30.97376151(20)	100		⁶⁰ Ni	59.9307906(15)	26.2231(77)
16	³² S	31.97207069(12)	94.93(31)		⁶¹ Ni	60.9310604(15)	1.1399(6)
	³³ S	32.97145850(12)	0.76(2)		⁶² Ni	61.9283488(15)	3.6345(17)
	³⁴ S	33.96786683(11)	4.29(28)		⁶⁴ Ni	63.9279696(16)	0.9256(9)
	³⁶ S	35.96708088(25)	0.02(1)	29	⁶³ Cu	62.9296011(15)	69.17(3)
17	³⁵ Cl	34.96885271(4)	75.78(4)		⁶⁵ Cu	64.9277937(19)	30.83(3)
	³⁷ Cl	36.96590260(5)	24.22(4)	30	⁶⁴ Zn	63.9291466(18)	48.63(60)
18	³⁶ Ar	35.96754628(27)	0.3365(30)		⁶⁶ Zn	65.9260368(16)	27.90(27)
	³⁸ Ar	37.9627322(5)	0.0632(5)		⁶⁷ Zn	66.9271309(17)	4.10(13)

ATOMIC MASSES AND ABUNDANCES (continued)

Z	Isotope	Mass in u	Abundance in %	Z	Isotope	Mass in u	Abundance in %
	⁶⁸ Zn	67.9248476(17)	18.75(51)		¹⁰⁶ Pd	105.903483(5)	27.33(3)
	⁷⁰ Zn	69.925325(4)	0.62(3)		¹⁰⁸ Pd	107.903894(4)	26.46(9)
31	⁶⁹ Ga	68.925581(3)	60.108(9)		¹¹⁰ Pd	109.905152(12)	11.72(9)
	⁷¹ Ga	70.9247050(19)	39.892(9)	47	¹⁰⁷ Ag	106.905093(6)	51.839(8)
32	⁷⁰ Ge	69.9242504(19)	20.84(87)		¹⁰⁹ Ag	108.904756(3)	48.161(8)
	⁷² Ge	71.9220762(16)	27.54(34)	48	¹⁰⁶ Cd	105.906458(6)	1.25(6)
	⁷³ Ge	72.9234594(16)	7.73(5)		¹⁰⁸ Cd	107.904183(6)	0.89(3)
	⁷⁴ Ge	73.9211782(16)	36.28(73)		¹¹⁰ Cd	109.903006(3)	12.49(18)
	⁷⁶ Ge	75.9214027(16)	7.61(38)		¹¹¹ Cd	110.904182(3)	12.80(12)
33	⁷⁵ As	74.9215964(18)	100		¹¹² Cd	111.9027572(30)	24.13(21)
34	⁷⁴ Se	73.9224766(16)	0.89(4)		¹¹³ Cd	112.9044009(30)	12.22(12)
	⁷⁶ Se	75.9192141(16)	9.37(29)		¹¹⁴ Cd	113.9033581(30)	28.73(42)
	⁷⁷ Se	76.9199146(16)	7.63(16)		¹¹⁶ Cd	115.904755(3)	7.49(18)
	⁷⁸ Se	77.9173095(16)	23.77(28)	49	¹¹³ In	112.904061(4)	4.29(5)
	⁸⁰ Se	79.9165218(20)	49.61(41)		¹¹⁵ In	114.903878(5)	95.71(5)
	⁸² Se	81.9167000(22)	8.73(22)	50	¹¹² Sn	111.904821(5)	0.97(1)
35	⁷⁹ Br	78.9183376(20)	50.69(7)		¹¹⁴ Sn	113.902782(3)	0.66(1)
	⁸¹ Br	80.916291(3)	49.31(7)		¹¹⁵ Sn	114.903346(3)	0.34(1)
36	⁷⁸ Kr	77.920386(7)	0.35(1)		¹¹⁶ Sn	115.901744(3)	14.54(9)
	⁸⁰ Kr	79.916378(4)	2.28(6)		¹¹⁷ Sn	116.902954(3)	7.68(7)
	⁸² Kr	81.9134846(28)	11.58(14)		¹¹⁸ Sn	117.901606(3)	24.22(9)
	⁸³ Kr	82.914136(3)	11.49(6)		¹¹⁹ Sn	118.903309(3)	8.59(4)
	⁸⁴ Kr	83.911507(3)	57.00(4)		¹²⁰ Sn	119.9021966(27)	32.58(9)
	⁸⁶ Kr	85.9106103(12)	17.30(22)		¹²² Sn	121.9034401(29)	4.63(3)
37	⁸⁵ Rb	84.9117893(25)	72.17(2)		¹²⁴ Sn	123.9052746(15)	5.79(5)
	⁸⁷ Rb	86.9091835(27)	27.83(2)	51	¹²¹ Sb	120.9038180(24)	57.21(5)
38	⁸⁴ Sr	83.913425(4)	0.56(1)		¹²³ Sb	122.9042157(22)	42.79(5)
	⁸⁶ Sr	85.9092624(24)	9.86(1)	52	¹²⁰ Te	119.904020(11)	0.09(1)
	⁸⁷ Sr	86.9088793(24)	7.00(1)		¹²² Te	121.9030471(20)	2.55(12)
	⁸⁸ Sr	87.9056143(24)	82.58(1)		¹²³ Te	122.9042730(19)	0.89(3)
39	⁸⁹ Y	88.9058479(25)	100		¹²⁴ Te	123.9028195(16)	4.74(14)
40	⁹⁰ Zr	89.9047037(23)	51.45(40)		¹²⁵ Te	124.9044247(20)	7.07(15)
	⁹¹ Zr	90.9056450(23)	11.22(5)		¹²⁶ Te	125.9033055(20)	18.84(25)
	⁹² Zr	91.9050401(23)	17.15(8)		¹²⁸ Te	127.9044614(19)	31.74(8)
	⁹⁴ Zr	93.9063158(25)	17.38(28)		¹³⁰ Te	129.9062228(21)	34.08(62)
	⁹⁶ Zr	95.908276(3)	2.80(9)	53	¹²⁷ I	126.904468(4)	100
41	⁹³ Nb	92.9063775(24)	100	54	¹²⁴ Xe	123.9058958(21)	0.09(1)
42	⁹² Mo	91.906810(4)	14.84(35)		¹²⁶ Xe	125.904269(7)	0.09(1)
	⁹⁴ Mo	93.9050876(20)	9.25(12)		¹²⁸ Xe	127.9035304(15)	1.92(3)
	⁹⁵ Mo	94.9058415(20)	15.92(13)		¹²⁹ Xe	128.9047795(9)	26.44(24)
	⁹⁶ Mo	95.9046789(20)	16.68(2)		¹³⁰ Xe	129.9035079(10)	4.08(2)
	⁹⁷ Mo	96.9060210(20)	9.55(8)		¹³¹ Xe	130.9050819(10)	21.18(3)
	⁹⁸ Mo	97.9054078(20)	24.13(31)		¹³² Xe	131.9041545(12)	26.89(6)
	¹⁰⁰ Mo	99.907477(6)	9.63(23)		¹³⁴ Xe	133.9053945(9)	10.44(10)
43	⁹⁷ Tc	96.906365(5)			¹³⁶ Xe	135.907220(8)	8.87(16)
	⁹⁸ Tc	97.907216(4)		55	¹³³ Cs	132.905447(3)	100
	⁹⁹ Tc	98.9062546(21)		56	¹³⁰ Ba	129.906310(7)	0.106(1)
44	⁹⁶ Ru	95.907598(8)	5.54(14)		¹³² Ba	131.905056(3)	0.101(1)
	⁹⁸ Ru	97.905287(7)	1.87(3)		¹³⁴ Ba	133.904503(3)	2.417(18)
	⁹⁹ Ru	98.9059393(21)	12.76(14)		¹³⁵ Ba	134.905683(3)	6.592(12)
	¹⁰⁰ Ru	99.9042197(22)	12.60(7)		¹³⁶ Ba	135.904570(3)	7.854(24)
	¹⁰¹ Ru	100.9055822(22)	17.06(2)		¹³⁷ Ba	136.905821(3)	11.232(24)
	¹⁰² Ru	101.9043495(22)	31.55(14)		¹³⁸ Ba	137.905241(3)	71.698(42)
	¹⁰⁴ Ru	103.905430(4)	18.62(27)	57	¹³⁸ La	137.907107(4)	0.090(1)
45	¹⁰³ Rh	102.905504(3)	100		¹³⁹ La	138.906348(3)	99.910(1)
46	¹⁰² Pd	101.905608(3)	1.02(1)	58	¹³⁶ Ce	135.907140(50)	0.185(2)
	¹⁰⁴ Pd	103.904035(5)	11.14(8)		¹³⁸ Ce	137.905986(11)	0.251(2)
	¹⁰⁵ Pd	104.905084(5)	22.33(8)		¹⁴⁰ Ce	139.905434(3)	88.450(51)

ATOMIC MASSES AND ABUNDANCES (continued)

Z	Isotope	Mass in u	Abundance in %	Z	Isotope	Mass in u	Abundance in %
	¹⁴² Ce	141.909240(4)	11.114(51)	73	¹⁸⁰ Ta	179.947466(3)	0.012(2)
59	¹⁴¹ Pr	140.907648(3)	100		¹⁸¹ Ta	180.947996(3)	99.988(2)
60	¹⁴² Nd	141.907719(3)	27.2(5)	74	¹⁸⁰ W	179.946706(5)	0.12(1)
	¹⁴³ Nd	142.909810(3)	12.2(2)		¹⁸² W	181.948206(3)	26.50(16)
	¹⁴⁴ Nd	143.910083(3)	23.8(3)		¹⁸³ W	182.9502245(29)	14.31(4)
	¹⁴⁵ Nd	144.912569(3)	8.3(1)		¹⁸⁴ W	183.9509326(29)	30.64(2)
	¹⁴⁶ Nd	145.913112(3)	17.2(3)		¹⁸⁶ W	185.954362(3)	28.43(19)
	¹⁴⁸ Nd	147.916889(3)	5.7(1)	75	¹⁸⁵ Re	184.9529557(30)	37.40(2)
	¹⁵⁰ Nd	149.920887(4)	5.6(2)		¹⁸⁷ Re	186.9557508(30)	62.60(2)
61	¹⁴⁵ Pm	144.912744(4)		76	¹⁸⁴ Os	183.952491(3)	0.02(1)
	¹⁴⁷ Pm	146.915134(3)			¹⁸⁶ Os	185.953838(3)	1.59(3)
62	¹⁴⁴ Sm	143.911995(4)	3.07(7)		¹⁸⁷ Os	186.9557479(30)	1.96(2)
	¹⁴⁷ Sm	146.914893(3)	14.99(18)		¹⁸⁸ Os	187.9558360(30)	13.24(8)
	¹⁴⁸ Sm	147.914818(3)	11.24(10)		¹⁸⁹ Os	188.9581449(30)	16.15(5)
	¹⁴⁹ Sm	148.917180(3)	13.82(7)		¹⁹⁰ Os	189.958445(3)	26.26(2)
	¹⁵⁰ Sm	149.917271(3)	7.38(1)		¹⁹² Os	191.961479(4)	40.78(19)
	¹⁵² Sm	151.919728(3)	26.75(16)	77	¹⁹¹ Ir	190.960591(3)	37.3(2)
	¹⁵⁴ Sm	153.922205(3)	22.75(29)		¹⁹³ Ir	192.962924(3)	62.7(2)
63	¹⁵¹ Eu	150.919846(3)	47.81(3)	78	¹⁹⁰ Pt	189.959930(7)	0.014(1)
	¹⁵³ Eu	152.921226(3)	52.19(3)		¹⁹² Pt	191.961035(4)	0.782(7)
64	¹⁵² Gd	151.919788(3)	0.20(1)		¹⁹⁴ Pt	193.962664(3)	32.967(99)
	¹⁵⁴ Gd	153.920862(3)	2.18(3)		¹⁹⁵ Pt	194.964774(3)	33.832(10)
	¹⁵⁵ Gd	154.922619(3)	14.80(12)		¹⁹⁶ Pt	195.964935(3)	25.242(41)
	¹⁵⁶ Gd	155.922120(3)	20.47(9)		¹⁹⁸ Pt	197.967876(4)	7.163(55)
	¹⁵⁷ Gd	156.923957(3)	15.65(2)	79	¹⁹⁷ Au	196.966552(3)	100
	¹⁵⁸ Gd	157.924101(3)	24.84(7)	80	¹⁹⁶ Hg	195.965815(4)	0.15(1)
	¹⁶⁰ Gd	159.927051(3)	21.86(19)		¹⁹⁸ Hg	197.966752(3)	9.97(20)
65	¹⁵⁹ Tb	158.925343(3)	100		¹⁹⁹ Hg	198.968262(3)	16.87(22)
66	¹⁵⁶ Dy	155.924278(7)	0.06(1)		²⁰⁰ Hg	199.968309(3)	23.10(19)
	¹⁵⁸ Dy	157.924405(4)	0.10(1)		²⁰¹ Hg	200.970285(3)	13.18(9)
	¹⁶⁰ Dy	159.925194(3)	2.34(8)		²⁰² Hg	201.970626(3)	29.86(26)
	¹⁶¹ Dy	160.926930(3)	18.91(24)		²⁰⁴ Hg	203.973476(3)	6.87(15)
	¹⁶² Dy	161.926795(3)	25.51(26)	81	²⁰³ Tl	202.972329(3)	29.524(14)
	¹⁶³ Dy	162.928728(3)	24.90(16)		²⁰⁵ Tl	204.974412(3)	70.476(14)
	¹⁶⁴ Dy	163.929171(3)	28.18(37)	82	²⁰⁴ Pb	203.973029(3)	1.4(1)
67	¹⁶³ Ho	164.930319(3)	100		²⁰⁶ Pb	205.974449(3)	24.1(1)
68	¹⁶² Er	161.928775(4)	0.14(1)		²⁰⁷ Pb	206.975881(3)	22.1(1)
	¹⁶⁴ Er	163.929197(4)	1.61(3)		²⁰⁸ Pb	207.976636(3)	52.4(1)
	¹⁶⁶ Er	165.930290(3)	33.61(35)	83	²⁰⁹ Bi	208.980383(3)	100
	¹⁶⁷ Er	166.932045(3)	22.93(17)	84	²⁰⁹ Po	208.982416(3)	
	¹⁶⁸ Er	167.932368(3)	26.78(26)		²¹⁰ Po	209.982857(3)	
	¹⁷⁰ Er	169.935460(3)	14.93(27)	85	²¹⁰ At	209.987131(9)	
69	¹⁶⁹ Tm	168.934211(3)	100		²¹¹ At	210.987481(4)	
70	¹⁶⁸ Yb	167.933894(5)	0.13(1)	86	²¹¹ Rn	210.990585(8)	
	¹⁷⁰ Yb	169.934759(3)	3.04(15)		²²⁰ Rn	220.0113841(29)	
	¹⁷¹ Yb	170.936322(3)	14.28(57)		²²² Rn	222.0175705(27)	
	¹⁷² Yb	171.9363777(30)	21.83(67)	87	²²³ Fr	223.0197307(29)	
	¹⁷³ Yb	172.9382068(30)	16.13(27)	88	²²³ Ra	223.018497(3)	
	¹⁷⁴ Yb	173.9388581(30)	31.83(92)		²²⁴ Ra	224.0202020(29)	
	¹⁷⁶ Yb	175.942568(3)	12.76(41)		²²⁶ Ra	226.0254026(27)	
71	¹⁷⁵ Lu	174.9407679(28)	97.41(2)		²²⁸ Ra	228.0310641(27)	
	¹⁷⁶ Lu	175.9426824(28)	2.59(2)	89	²²⁷ Ac	227.0277470(29)	
72	¹⁷⁴ Hf	173.940040(3)	0.16(1)	90	²³⁰ Th	230.0331266(22)	
	¹⁷⁶ Hf	175.9414018(29)	5.26(7)		²³² Th	232.0380504(22)	100
	¹⁷⁷ Hf	176.9432200(27)	18.60(9)	91	²³¹ Pa	231.0358789(28)	100
	¹⁷⁸ Hf	177.9436977(27)	27.28(7)	92	²³³ U	233.039628(3)	
	¹⁷⁹ Hf	178.9458151(27)	13.62(2)		²³⁴ U	234.0409456(21)	0.0055(2)
	¹⁸⁰ Hf	179.9465488(27)	35.08(16)		²³⁵ U	235.0439231(21)	0.7200(51)

ATOMIC MASSES AND ABUNDANCES (continued)

Z	Isotope	Mass in u	Abundance in %	Z	Isotope	Mass in u	Abundance in %
	²³⁶ U	236.0455619(21)			²⁴⁹ Bk	249.074980(3)	
	²³⁸ U	238.0507826(21)	99.2745(106)	98	²⁴⁹ Cf	249.074847(3)	
93	²³⁷ Np	237.0481673(21)			²⁵⁰ Cf	250.0764000(24)	
	²³⁹ Np	239.0529314(23)			²⁵¹ Cf	251.079580(5)	
94	²³⁸ Pu	238.0495534(21)			²⁵² Cf	252.081620(5)	
	²³⁹ Pu	239.0521565(21)		99	²⁵² Es	252.082970(50)	
	²⁴⁰ Pu	240.0538075(21)		100	²⁵⁷ Fm	257.095099(7)	
	²⁴¹ Pu	241.0568453(21)		101	²⁵⁶ Md	256.094050(60)	
	²⁴² Pu	242.0587368(21)			²⁵⁸ Md	258.098425(5)	
	²⁴⁴ Pu	244.064198(5)		102	²⁵⁹ No	259.101020(110)*	
95	²⁴¹ Am	241.0568229(21)		103	²⁶² Lr	262.109690(320)*	
	²⁴³ Am	243.0613727(23)		104	²⁶¹ Rf	261.108750(110)*	
96	²⁴³ Cm	243.0613822(24)		105	²⁶² Db	262.114150(200)*	
	²⁴⁴ Cm	244.0627463(21)		106	²⁶³ Sg	263.118310(130)*	
	²⁴⁵ Cm	245.0654856(29)		107	²⁶⁴ Bh	264.124730(300)*	
	²⁴⁶ Cm	246.0672176(24)		108	²⁶⁵ Hs	265.130000(320)*	
	²⁴⁷ Cm	247.070347(5)		109	²⁶⁸ Mt	268.138820(340)*	
	²⁴⁸ Cm	248.072342(5)		110	²⁶⁹ Uun	269.145140(310)*	
97	²⁴⁷ Bk	247.070299(6)		111	²⁷² Uuu	272.153480(360)*	

*Mass values derived not purely from experimental data, but at least partly from systematic trends.

ELECTRON CONFIGURATION OF NEUTRAL ATOMS IN THE GROUND STATE

Atomic no.	<i>n</i> = Element	K 1	L 2		M 3			N 4				O 5				P 6			Q 7		
		s	s	p	s	p	d	s	p	d	f	s	p	d	f	s	p	d	s	p	
1	H	1																			
2	He	2																			
3	Li	2	1																		
4	Be	2	2																		
5	B	2	2	1																	
6	C	2	2	2																	
7	N	2	2	3																	
8	O	2	2	4																	
9	F	2	2	5																	
10	Ne	2	2	6																	
11	Na	2	2	6	1																
12	Mg	2	2	6	2																
13	Al	2	2	6	2	1															
14	Si	2	2	6	2	2															
15	P	2	2	6	2	3															
16	S	2	2	6	2	4															
17	Cl	2	2	6	2	5															
18	Ar	2	2	6	2	6															
19	K	2	2	6	2	6		1													
20	Ca	2	2	6	2	6		2													
21	Sc	2	2	6	2	6	1	2													
22	Ti	2	2	6	2	6	2	2													
23	V	2	2	6	2	6	3	2													
24	Cr	2	2	6	2	6	5	1													
25	Mn	2	2	6	2	6	5	2													
26	Fe	2	2	6	2	6	6	2													
27	Co	2	2	6	2	6	7	2													
28	Ni	2	2	6	2	6	8	2													
29	Cu	2	2	6	2	6	10	1													
30	Zn	2	2	6	2	6	10	2													
31	Ga	2	2	6	2	6	10	2	1												
32	Ge	2	2	6	2	6	10	2	2												
33	As	2	2	6	2	6	10	2	3												
34	Se	2	2	6	2	6	10	2	4												
35	Br	2	2	6	2	6	10	2	5												
36	Kr	2	2	6	2	6	10	2	6												
37	Rb	2	2	6	2	6	10	2	6		1										
38	Sr	2	2	6	2	6	10	2	6		2										
39	Y	2	2	6	2	6	10	2	6	1	2										
40	Zr	2	2	6	2	6	10	2	6	2	2										
41	Nb	2	2	6	2	6	10	2	6	4	1										
42	Mo	2	2	6	2	6	10	2	6	5	1										
43	Tc	2	2	6	2	6	10	2	6	5	2										
44	Ru	2	2	6	2	6	10	2	6	7	1										
45	Rh	2	2	6	2	6	10	2	6	8	1										
46	Pd	2	2	6	2	6	10	2	6	10											
47	Ag	2	2	6	2	6	10	2	6	10	1										
48	Cd	2	2	6	2	6	10	2	6	10	2										
49	In	2	2	6	2	6	10	2	6	10	2	1									
50	Sn	2	2	6	2	6	10	2	6	10	2	2									
51	Sb	2	2	6	2	6	10	2	6	10	2	3									
52	Te	2	2	6	2	6	10	2	6	10	2	4									
53	I	2	2	6	2	6	10	2	6	10	2	5									
54	Xe	2	2	6	2	6	10	2	6	10	2	6									
55	Cs	2	2	6	2	6	10	2	6	10	2	6				1					
56	Ba	2	2	6	2	6	10	2	6	10	2	6				2					

INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

B. W. Mangum

A new temperature scale, the International Temperature Scale of 1990 (ITS-90), was officially adopted by the Comité International des Poids et Mesures (CIPM), meeting 26—28 September 1989 at the Bureau International des Poids et Mesures (BIPM). The ITS-90 was recommended to the CIPM for its adoption following the completion of the final details of the new scale by the Comité Consultatif de Thermométrie (CCT), meeting 12—14 September 1989 at the BIPM in its 17th Session. The ITS-90 became the official international temperature scale on 1 January 1990. The ITS-90 supersedes the present scales, the International Practical Temperature Scale of 1968 (IPTS-68) and the 1976 Provisional 0.5 to 30 K Temperature Scale (EPT-76).

The ITS-90 extends upward from 0.65 K, and temperatures on this scale are in much better agreement with thermodynamic values that are those on the IPTS-68 and the EPT-76. The new scale has subranges and alternative definitions in certain ranges that greatly facilitate its use. Furthermore, its continuity, precision, and reproducibility throughout its ranges are much improved over that of the present scales. The replacement of the thermocouple with the platinum resistance thermometer at temperatures below 961.78°C resulted in the biggest improvement in reproducibility.

The ITS-90 is divided into four primary ranges:

1. Between 0.65 and 3.2 K, the ITS-90 is defined by the vapor pressure-temperature relation of ^3He , and between 1.25 and 2.1768 K (the λ point) and between 2.1768 and 5.0 K by the vapor pressure-temperature relations of ^4He . T_{90} is defined by the vapor pressure equations of the form:

$$T_{90}/\text{K} = A_0 + \sum_{i=1}^9 A_i \left[(\ln(p/\text{Pa}) - B)/C \right]^i$$

The values of the coefficients A_i , and of the constants A_0 , B , and C of the equations are given below.

2. Between 3.0 and 24.5561 K, the ITS-90 is defined in terms of a ^3He or ^4He constant volume gas thermometer (CVGT). The thermometer is calibrated at three temperatures — at the triple point of neon (24.5561 K), at the triple point of equilibrium hydrogen (13.8033 K), and at a temperature between 3.0 and 5.0 K, the value of which is determined by using either ^3He or ^4He vapor pressure thermometry.
3. Between 13.8033 K (−259.3467°C) and 1234.93 K (961.78°C), the ITS-90 is defined in terms of the specified fixed points given below, by resistance ratios of platinum resistance thermometers obtained by calibration at specified sets of the fixed points, and by reference functions and deviation functions of resistance ratios which relate to T_{90} between the fixed points.
4. Above 1234.93 K, the ITS-90 is defined in terms of Planck's radiation law, using the freezing-point temperature of either silver, gold, or copper as the reference temperature.

Full details of the calibration procedures and reference functions for various subranges are given in:

The International Temperature Scale of 1990, *Metrologia*, 27, 3, 1990; errata in *Metrologia*, 27, 107, 1990.

Defining Fixed Points of the ITS-90

Material ^a	Equilibrium state ^b	Temperature	
		T_{90} (K)	t_{90} (°C)
He	VP	3 to 5	−270.15 to −268.15
e-H ₂	TP	13.8033	−259.3467
e-H ₂ (or He)	VP (or CVGT)	≈17	≈−256.15
e-H ₂ (or He)	VP (or CVGT)	≈20.3	≈−252.85
Ne ^c	TP	24.5561	−248.5939
O ₂	TP	54.3584	−218.7916
Ar	TP	83.8058	−189.3442
Hg ^c	TP	234.3156	−38.8344
H ₂ O	TP	273.16	0.01
Ga ^c	MP	302.9146	29.7646
In ^c	FP	429.7485	156.5985
Sn	FP	505.078	231.928
Zn	FP	692.677	419.527
Al ^c	FP	933.473	660.323
Ag	FP	1234.93	961.78
Au	FP	1337.33	1064.18
Cu ^c	FP	1357.77	1084.62

INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90) (continued)

Defining Fixed Points of the ITS-90 (continued)

- ^a e-H₂ indicates equilibrium hydrogen, that is, hydrogen with the equilibrium distribution of its ortho and para states. Normal hydrogen at room temperature contains 25% para hydrogen and 75% ortho hydrogen.
- ^b VP indicates vapor pressure point; CVGT indicates constant volume gas thermometer point; TP indicates triple point (equilibrium temperature at which the solid, liquid, and vapor phases coexist); FP indicates freezing point, and MP indicates melting point (the equilibrium temperatures at which the solid and liquid phases coexist under a pressure of 101 325 Pa, one standard atmosphere). The isotopic composition is that naturally occurring.
- ^c Previously, these were secondary fixed points.

Values of Coefficients in the Vapor Pressure Equations for Helium

Coef.or constant	³ He 0.65—3.2 K	⁴ He 1.25—2.1768 K	⁴ He 2.1768—5.0 K
A ₀	1.053 447	1.392 408	3.146 631
A ₁	0.980 106	0.527 153	1.357 655
A ₂	0.676 380	0.166 756	0.413 923
A ₃	0.372 692	0.050 988	0.091 159
A ₄	0.151 656	0.026 514	0.016 349
A ₅	-0.002 263	0.001 975	0.001 826
A ₆	0.006 596	-0.017 976	-0.004 325
A ₇	0.088 966	0.005 409	-0.004 973
A ₈	-0.004 770	0.013 259	0
A ₉	-0.054 943	0	0
B	7.3	5.6	10.3
C	4.3	2.9	1.9

CONVERSION OF TEMPERATURES FROM THE 1948 AND 1968 SCALES TO ITS-90

This table gives temperature corrections from older scales to the current International Temperature Scale of 1990 (see the preceding table for details on ITS-90). The first part of the table may be used for converting Celsius temperatures in the range -180 to 4000°C from IPTS-68 or IPTS-48 to ITS-90. Within the accuracy of the corrections, the temperature in the first column may be identified with either t_{68} , t_{48} , or t_{90} . The second part of the table is designed for use at lower temperatures to convert values expressed in kelvins from EPT-76 or IPTS-68 to ITS-90.

The references give analytical equations for expressing these relations. Note that Reference 1 supersedes Reference 2 with respect to corrections in the 630 to 1064°C range.

REFERENCES

1. Burns, G. W. et al., in *Temperature: Its Measurement and Control in Science and Industry*, Vol. 6, Schooley, J. F., Ed., American Institute of Physics, New York, 1993.
2. Goldberg, R. N. and Weir, R. D., *Pure and Appl. Chem.*, 1545, 1992.

$t/^\circ\text{C}$	$t_{90}-t_{68}$	$t_{90}-t_{48}$	$t/^\circ\text{C}$	$t_{90}-t_{68}$	$t_{90}-t_{48}$	$t/^\circ\text{C}$	$t_{90}-t_{68}$	$t_{90}-t_{48}$
-180	0.008	0.020	270	-0.039	0.028	720	0.00	0.45
-170	0.010	0.017	280	-0.039	0.030	730	0.02	0.49
-160	0.012	0.007	290	-0.039	0.032	740	0.03	0.53
-150	0.013	0.000	300	-0.039	0.034	750	0.03	0.56
-140	0.014	0.001	310	-0.039	0.035	760	0.04	0.60
-130	0.014	0.008	320	-0.039	0.036	770	0.05	0.63
-120	0.014	0.017	330	-0.040	0.036	780	0.05	0.66
-110	0.013	0.026	340	-0.040	0.037	790	0.05	0.69
-100	0.013	0.035	350	-0.041	0.036	800	0.05	0.72
-90	0.012	0.041	360	-0.042	0.035	810	0.05	0.75
-80	0.012	0.045	370	-0.043	0.034	820	0.04	0.76
-70	0.011	0.045	380	-0.045	0.032	830	0.04	0.79
-60	0.010	0.042	390	-0.046	0.030	840	0.03	0.81
-50	0.009	0.038	400	-0.048	0.028	850	0.02	0.83
-40	0.008	0.032	410	-0.051	0.024	860	0.01	0.85
-30	0.006	0.024	420	-0.053	0.022	870	0.00	0.87
-20	0.004	0.016	430	-0.056	0.019	880	-0.02	0.87
-10	0.002	0.008	440	-0.059	0.015	890	-0.03	0.89
0	0.000	0.000	450	-0.062	0.012	900	-0.05	0.90
10	-0.002	-0.006	460	-0.065	0.009	910	-0.06	0.92
20	-0.005	-0.012	470	-0.068	0.007	920	-0.08	0.93
30	-0.007	-0.016	480	-0.072	0.004	930	-0.10	0.94
40	-0.010	-0.020	490	-0.075	0.002	940	-0.11	0.96
50	-0.013	-0.023	500	-0.079	0.000	950	-0.13	0.97
60	-0.016	-0.026	510	-0.083	-0.001	960	-0.15	0.97
70	-0.018	-0.026	520	-0.087	-0.002	970	-0.16	0.99
80	-0.021	-0.027	530	-0.090	-0.001	980	-0.18	1.00
90	-0.024	-0.027	540	-0.094	0.000	990	-0.19	1.02
100	-0.026	-0.026	550	-0.098	0.002	1000	-0.20	1.04
110	-0.028	-0.024	560	-0.101	0.007	1010	-0.22	1.05
120	-0.030	-0.023	570	-0.105	0.011	1020	-0.23	1.07
130	-0.032	-0.020	580	-0.108	0.018	1030	-0.23	1.10
140	-0.034	-0.018	590	-0.112	0.025	1040	-0.24	1.12
150	-0.036	-0.016	600	-0.115	0.035	1050	-0.25	1.14
160	-0.037	-0.012	610	-0.118	0.047	1060	-0.25	1.17
170	-0.038	-0.009	620	-0.122	0.060	1070	-0.25	1.19
180	-0.039	-0.005	630	-0.125	0.075	1080	-0.26	1.20
190	-0.039	-0.001	640	-0.11	0.12	1090	-0.26	1.20
200	-0.040	0.003	650	-0.10	0.15	1100	-0.26	1.2
210	-0.040	0.007	660	-0.09	0.19	1200	-0.30	1.4
220	-0.040	0.011	670	-0.07	0.24	1300	-0.35	1.5
230	-0.040	0.014	680	-0.05	0.29	1400	-0.39	1.6
240	-0.040	0.018	690	-0.04	0.32	1500	-0.44	1.8
250	-0.040	0.021	700	-0.02	0.37	1600	-0.49	1.9
260	-0.040	0.024	710	-0.01	0.41	1700	-0.54	2.1

CONVERSION OF TEMPERATURES FROM THE 1948 AND 1968 SCALES TO ITS-90 (continued)

$t/^{\circ}\text{C}$	$t_{90}-t_{68}$	$t_{90}-t_{48}$	T/K	$T_{90}-T_{76}$	$T_{90}-T_{68}$	T/K	$T_{90}-T_{76}$	$T_{90}-T_{68}$
1800	-0.60	2.2	28		-0.005	77		0.008
1900	-0.66	2.3	29		-0.006	78		0.008
2000	-0.72	2.5	30		-0.006	79		0.008
2100	-0.79	2.7	31		-0.007	80		0.008
2200	-0.85	2.9	32		-0.008	81		0.008
2300	-0.93	3.1	33		-0.008	82		0.008
2400	-1.00	3.2	34		-0.008	83		0.008
2500	-1.07	3.4	35		-0.007	84		0.008
2600	-1.15	3.7	36		-0.007	85		0.008
2700	-1.24	3.8	37		-0.007	86		0.008
2800	-1.32	4.0	38		-0.006	87		0.008
2900	-1.41	4.2	39		-0.006	88		0.008
3000	-1.50	4.4	40		-0.006	89		0.008
3100	-1.59	4.6	41		-0.006	90		0.008
3200	-1.69	4.8	42		-0.006	91		0.008
3300	-1.78	5.1	43		-0.006	92		0.008
3400	-1.89	5.3	44		-0.006	93		0.008
3500	-1.99	5.5	45		-0.007	94		0.008
3600	-2.10	5.8	46		-0.007	95		0.008
3700	-2.21	6.0	47		-0.007	96		0.008
3800	-2.32	6.3	48		-0.006	97		0.009
3900	-2.43	6.6	49		-0.006	98		0.009
4000	-2.55	6.8	50		-0.006	99		0.009
			51		-0.005	100		0.009
			52		-0.005	110		0.011
			53		-0.004	120		0.013
T/K	$T_{90}-T_{76}$	$T_{90}-T_{68}$	54		-0.003	130		0.014
5	-0.0001		55		-0.002	140		0.014
6	-0.0002		56		-0.001	150		0.014
7	-0.0003		57		0.000	160		0.014
8	-0.0004		58		0.001	170		0.013
9	-0.0005		59		0.002	180		0.012
10	-0.0006		60		0.003	190		0.012
11	-0.0007		61		0.003	200		0.011
12	-0.0008		62		0.004	210		0.010
13	-0.0010		63		0.004	220		0.009
14	-0.0011	-0.006	64		0.005	230		0.008
15	-0.0013	-0.003	65		0.005	240		0.007
16	-0.0014	-0.004	66		0.006	250		0.005
17	-0.0016	-0.006	67		0.006	260		0.003
18	-0.0018	-0.008	68		0.007	270		0.001
19	-0.0020	-0.009	69		0.007	273.16		0.000
20	-0.0022	-0.009	70		0.007	300		-0.006
21	-0.0025	-0.008	71		0.007	400		-0.031
22	-0.0027	-0.007	72		0.007	500		-0.040
23	-0.0030	-0.007	73		0.007	600		-0.040
24	-0.0032	-0.006	74		0.007	700		-0.055
25	-0.0035	-0.005	75		0.008	800		-0.089
26	-0.0038	-0.004	76		0.008	900		-0.124
27	-0.0041	-0.004						

1 SI base units

Table 1 gives the seven base quantities, assumed to be mutually independent, on which the SI is founded; and the names and symbols of their respective units, called ‘‘SI base units.’’ Definitions of the SI base units are given in Appendix A. The kelvin and its symbol K are also used to express the value of a temperature interval or a temperature difference.

Table 1. SI base units

Base quantity	SI base unit	
	Name	Symbol
length	meter	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

2 SI derived units

Derived units are expressed algebraically in terms of base units or other derived units (including the radian and steradian which are the two supplementary units – see Sec. 3). The symbols for derived units are obtained by means of the mathematical operations of multiplication and division. For example, the derived unit for the derived quantity molar mass (mass divided by amount of substance) is the kilogram per mole, symbol kg/mol. Additional examples of derived units expressed in terms of SI base units are given in Table 2.

Table 2. Examples of SI derived units expressed in terms of SI base units

Derived quantity	SI derived unit	
	Name	Symbol
area	square meter	m ²
volume	cubic meter	m ³
speed, velocity	meter per second	m/s
acceleration	meter per second squared	m/s ²
wave number	reciprocal meter	m ⁻¹
mass density (density)	kilogram per cubic meter	kg/m ³
specific volume	cubic meter per kilogram	m ³ /kg
current density	ampere per square meter	A/m ²
magnetic field strength	ampere per meter	A/m
amount-of-substance concentration (concentration)	mole per cubic meter	mol/m ³
luminance	candela per square meter	cd/m ²

2.1 SI derived units with special names and symbols

Certain SI derived units have special names and symbols; these are given in Tables 3a and 3b. As discussed in Sec. 3, the radian and steradian, which are the two supplementary units, are included in Table 3a.

INTERNATIONAL SYSTEM OF UNITS (SI) (continued)

Table 3a. SI derived units with special names and symbols, including the radian and steradian

Derived quantity	SI derived unit			
	Special name	Special symbol	Expression in terms of other SI units	Expression in terms of SI base units
plane angle	radian	rad		$\text{m} \cdot \text{m}^{-1} = 1$
solid angle	steradian	sr		$\text{m}^2 \cdot \text{m}^{-2} = 1$
frequency	hertz	Hz		s^{-1}
force	newton	N		$\text{m} \cdot \text{kg} \cdot \text{s}^{-2}$
pressure, stress	pascal	Pa	N/m^2	$\text{m}^{-1} \cdot \text{kg} \cdot \text{s}^{-2}$
energy, work, quantity of heat	joule	J	$\text{N} \cdot \text{m}$	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2}$
power, radiant flux	watt	W	J/s	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-3}$
electric charge, quantity of electricity	coulomb	C		$\text{s} \cdot \text{A}$
electric potential, potential difference, electromotive force	volt	V	W/A	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-3} \cdot \text{A}^{-1}$
capacitance	farad	F	C/V	$\text{m}^{-2} \cdot \text{kg}^{-1} \cdot \text{s}^4 \cdot \text{A}^2$
electric resistance	ohm	Ω	V/A	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-3} \cdot \text{A}^{-2}$
electric conductance	siemens	S	A/V	$\text{m}^{-2} \cdot \text{kg}^{-1} \cdot \text{s}^3 \cdot \text{A}^2$
magnetic flux	weber	Wb	$\text{V} \cdot \text{s}$	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{A}^{-1}$
magnetic flux density	tesla	T	Wb/m^2	$\text{kg} \cdot \text{s}^{-2} \cdot \text{A}^{-1}$
inductance	henry	H	Wb/A	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{A}^{-2}$
Celsius temperature ^(a)	degree Celsius	°C		K
luminous flux	lumen	lm	$\text{cd} \cdot \text{sr}$	$\text{cd} \cdot \text{sr}^{(b)}$
illuminance	lux	lx	lm/m^2	$\text{m}^{-2} \cdot \text{cd} \cdot \text{sr}^{(b)}$

^(a) See Sec. 2.1.1.1.

^(b) The steradian (sr) is not an SI base unit. However, in photometry the steradian (sr) is maintained in expressions for units (see Sec. 3).

Table 3b. SI derived units with special names and symbols admitted for reasons of safeguarding human health^(a)

Derived quantity	SI derived unit			
	Special name	Special symbol	Expression in terms of other SI units	Expression in terms of SI base units
activity (of a radionuclide)	becquerel	Bq		s^{-1}
absorbed dose, specific energy (imparted), kerma	gray	Gy	J/kg	$\text{m}^2 \cdot \text{s}^{-2}$
dose equivalent, ambient dose equivalent, directional dose equivalent, personal dose equivalent, equivalent dose	sievert	Sv	J/kg	$\text{m}^2 \cdot \text{s}^{-2}$

^(a) The derived quantities to be expressed in the gray and the sievert have been revised in accordance with the recommendations of the International Commission on Radiation Units and Measurements (ICRU).

2.1.1 Degree Celsius In addition to the quantity thermodynamic temperature (symbol T), expressed in the unit kelvin, use is also made of the quantity Celsius temperature (symbol t) defined by the equation

$$t = T - T_0 ,$$

where $T_0 = 273.15 \text{ K}$ by definition. To express Celsius temperature, the unit degree Celsius, symbol °C, which is equal in magnitude to the unit kelvin, is used; in this case, "degree Celsius" is a special name used in place of "kelvin." An interval or difference of Celsius temperature can, however, be expressed in the unit kelvin as well as in the unit degree Celsius. (Note that the thermodynamic temperature T_0 is exactly 0.01 K below the thermodynamic temperature of the triple point of water.)

2.2 Use of SI derived units with special names and symbols

Examples of SI derived units that can be expressed with the aid of SI derived units having special names and symbols (including the radian and steradian) are given in Table 4.

Table 4. Examples of SI derived units expressed with the aid of SI derived units having special names and symbols

Derived quantity	SI derived unit		
	Name	Symbol	Expression in terms of SI base units
angular velocity	radian per second	rad/s	$\text{m} \cdot \text{m}^{-1} \cdot \text{s}^{-1} = \text{s}^{-1}$
angular acceleration	radian per second squared	rad/s ²	$\text{m} \cdot \text{m}^{-1} \cdot \text{s}^{-2} = \text{s}^{-2}$
dynamic viscosity	pascal second	Pa · s	$\text{m}^{-1} \cdot \text{kg} \cdot \text{s}^{-1}$
moment of force	newton meter	N · m	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2}$
surface tension	newton per meter	N/m	$\text{kg} \cdot \text{s}^{-2}$
heat flux density, irradiance	watt per square meter	W/m ²	$\text{kg} \cdot \text{s}^{-3}$
radiant intensity	watt per steradian	W/sr	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-3} \cdot \text{sr}^{-1}$ ^(a)
radiance	watt per square meter steradian	W/(m ² · sr)	$\text{kg} \cdot \text{s}^{-3} \cdot \text{sr}^{-1}$ ^(a)
heat capacity, entropy	joule per kelvin	J/K	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{K}^{-1}$
specific heat capacity, specific entropy	joule per kilogram kelvin	J/(kg · K)	$\text{m}^2 \cdot \text{s}^{-2} \cdot \text{K}^{-1}$
specific energy	joule per kilogram	J/kg	$\text{m}^2 \cdot \text{s}^{-2}$
thermal conductivity	watt per meter kelvin	W/(m · K)	$\text{m} \cdot \text{kg} \cdot \text{s}^{-3} \cdot \text{K}^{-1}$
energy density	joule per cubic meter	J/m ³	$\text{m}^{-1} \cdot \text{kg} \cdot \text{s}^{-2}$
electric field strength	volt per meter	V/m	$\text{m} \cdot \text{kg} \cdot \text{s}^{-3} \cdot \text{A}^{-1}$
electric charge density	coulomb per cubic meter	C/m ³	$\text{m}^{-3} \cdot \text{s} \cdot \text{A}$
electric flux density	coulomb per square meter	C/m ²	$\text{m}^{-2} \cdot \text{s} \cdot \text{A}$
permittivity	farad per meter	F/m	$\text{m}^{-3} \cdot \text{kg}^{-1} \cdot \text{s}^4 \cdot \text{A}^2$
permeability	henry per meter	H/m	$\text{m} \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{A}^{-2}$
molar energy	joule per mole	J/mol	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{mol}^{-1}$
molar entropy, molar heat capacity	joule per mole kelvin	J/(mol · K)	$\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$
exposure (x and γ rays)	coulomb per kilogram	C/kg	$\text{kg}^{-1} \cdot \text{s} \cdot \text{A}$
absorbed dose rate	gray per second	Gy/s	$\text{m}^2 \cdot \text{s}^{-3}$

^(a) The steradian (sr) is not an SI base unit. However, in radiometry the steradian (sr) is maintained in expressions for units (see Sec. 3).

The advantages of using the special names and symbols of SI derived units are apparent in Table 4. Consider, for example, the quantity molar entropy: the unit J/(mol · K) is obviously more easily understood than its SI base-unit equivalent, $\text{m}^2 \cdot \text{kg} \cdot \text{s}^{-2} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$. Nevertheless, it should always be recognized that the special names and symbols exist for convenience; either the form in which special names or symbols are used for certain combinations of units or the form in which they are not used is correct. For example, because of the descriptive value implicit in the compound-unit form, communication is sometimes facilitated if magnetic flux (see Table 3a) is expressed in terms of the volt second (V · s) instead of the weber (Wb).

Tables 3a, 3b, and 4 also show that the values of several different quantities are expressed in the same SI unit. For example, the joule per kelvin (J/K) is the SI unit for heat capacity as well as for entropy. Thus the name of the unit is not sufficient to define the quantity measured.

A derived unit can often be expressed in several different ways through the use of base units and derived units with special names. In practice, with certain quantities, preference is given to using certain units with special names, or combinations of units, to facilitate the distinction between quantities whose values have identical expressions in terms of SI base units. For example, the SI unit of frequency is specified as the hertz (Hz) rather than the reciprocal second (s^{-1}), and the SI unit of moment of force is specified as the newton meter (N · m) rather than the joule (J).

Similarly, in the field of ionizing radiation, the SI unit of activity is designated as the becquerel (Bq) rather than the reciprocal second (s^{-1}), and the SI units of absorbed dose and dose equivalent are designated as the gray (Gy) and the sievert (Sv), respectively, rather than the joule per kilogram (J/kg).

3 SI supplementary units

As previously stated, there are two units in this class: the radian, symbol rad, the SI unit of the quantity plane angle; and the steradian, symbol sr, the SI unit of the quantity solid angle. Definitions of these units are given in Appendix A.

The SI supplementary units are now interpreted as so-called dimensionless derived units for which the CGPM allows the freedom of using or not using them in expressions for SI derived units.³ Thus the radian and steradian are not given in a separate table but have been included in Table 3a together with other derived units with special names and symbols (see Sec. 2.1). This interpretation of the supplementary units implies that plane angle and solid angle are considered derived quantities of dimension one (so-called dimensionless quantities), each of which has the unit one, symbol 1, as its coherent SI unit. However, in practice, when one expresses the values of derived quantities involving plane angle or solid angle, it often aids understanding if the special names (or symbols) "radian" (rad) or "steradian" (sr) are used in place of the number 1. For example, although values of the derived quantity angular velocity (plane angle divided by time) may be expressed in the unit s^{-1} , such values are usually expressed in the unit rad/s.

Because the radian and steradian are now viewed as so-called dimensionless derived units, the Consultative Committee for Units (CCU, *Comité Consultatif des Unités*) of the CIPM as result of a 1993 request it received from ISO/TC12, recommended to the CIPM that it request the CGPM to abolish the class of supplementary units as a separate class in the SI. The CIPM accepted the CCU recommendation, and if the abolishment is approved by the CGPM as is likely (the question will be on the agenda of the 20th CGPM, October 1995), the SI will consist of only two classes of units: base units and derived units, with the radian and steradian subsumed into the class of derived units of the SI. (The option of using or not using them in expressions for SI derived units, as is convenient, would remain unchanged.)

4 Decimal multiples and submultiples of SI units: SI prefixes

Table 5 gives the SI prefixes that are used to form decimal multiples and submultiples of SI units. They allow very large or very small numerical values to be avoided. A prefix attaches directly to the name of a unit, and a prefix symbol attaches directly to the symbol for a unit. For example, one kilometer, symbol 1 km, is equal to one thousand meters, symbol 1000 m or 10^3 m. When prefixes are attached to SI units, the units so formed are called "multiples and submultiples of SI units" in order to distinguish them from the coherent system of SI units.

Note: Alternative definitions of the SI prefixes and their symbols are not permitted. For example, it is unacceptable to use kilo (k) to represent $2^{10} = 1024$, mega (M) to represent $2^{20} = 1\,048\,576$, or giga (G) to represent $2^{30} = 1\,073\,741\,824$.

³ This interpretation was given in 1980 by the CIPM. It was deemed necessary because Resolution 12 of the 11th CGPM, which established the SI in 1960, did not specify the nature of the supplementary units. The interpretation is based on two principal considerations: that plane angle is generally expressed as the ratio of two lengths and solid angle as the ratio of an area and the square of a length, and are thus quantities of dimension one (so-called dimensionless quantities); and that treating the radian and steradian as SI base units – a possibility not disallowed by Resolution 12 – could compromise the internal coherence of the SI based on only seven base units. (See ISO 31-0 for a discussion of the concept of dimension.)

Table 5. SI prefixes

Factor	Prefix	Symbol	Factor	Prefix	Symbol
$10^{24} = (10^3)^8$	yotta	Y	10^{-1}	deci	d
$10^{21} = (10^3)^7$	zetta	Z	10^{-2}	centi	c
$10^{18} = (10^3)^6$	exa	E	$10^{-3} = (10^3)^{-1}$	milli	m
$10^{15} = (10^3)^5$	peta	P	$10^{-6} = (10^3)^{-2}$	micro	μ
$10^{12} = (10^3)^4$	tera	T	$10^{-9} = (10^3)^{-3}$	nano	n
$10^9 = (10^3)^3$	giga	G	$10^{-12} = (10^3)^{-4}$	pico	p
$10^6 = (10^3)^2$	mega	M	$10^{-15} = (10^3)^{-5}$	femto	f
$10^3 = (10^3)^1$	kilo	k	$10^{-18} = (10^3)^{-6}$	atto	a
10^2	hecto	h	$10^{-21} = (10^3)^{-7}$	zepto	z
10^1	deka	da	$10^{-24} = (10^3)^{-8}$	yocto	y

5 Units Outside the SI

Units that are outside the SI may be divided into three categories:

- those units that are accepted for use with the SI;
- those units that are temporarily accepted for use with the SI; and
- those units that are not accepted for use with the SI and thus must strictly be avoided.

5.1 Units accepted for use with the SI

The following sections discuss in detail the units that are acceptable for use with the SI.

5.1.1 Hour, degree, liter, and the like

Certain units that are not part of the SI are essential and used so widely that they are accepted by the CIPM for use with the SI. These units are given in Table 6. The combination of units of this table with SI units to form derived units should be restricted to special cases in order not to lose the advantages of the coherence of SI units.

Additionally, it is recognized that it may be necessary on occasion to use time-related units other than those given in Table 6; in particular, circumstances may require that intervals of time be expressed in weeks, months, or years. In such cases, if a standardized symbol for the unit is not available, the name of the unit should be written out in full.

Table 6. Units accepted for use with the SI

Name	Symbol	Value in SI units
minute	min	1 min = 60 s
hour	h	1 h = 60 min = 3600 s
day	d	1 d = 24 h = 86 400 s
degree	$^{\circ}$	$1^{\circ} = (\pi/180)$ rad
minute	'	$1' = (1/60)^{\circ} = (\pi/10\,800)$ rad
second	"	$1'' = (1/60)' = (\pi/648\,000)$ rad
liter	l, L ^(b)	1 L = 1 dm ³ = 10 ⁻³ m ³
metric ton ^(c)	t	1 t = 10 ³ kg

^(b) The alternative symbol for the liter, L, was adopted by the CGPM in order to avoid the risk of confusion between the letter l and the number 1. Thus, although both l and L are internationally accepted symbols for the liter, to avoid this risk the symbol to be used in the United States is L. The script letter ℓ is not an approved symbol for the liter.

^(c) This is the name to be used for this unit in the United States; it is also used in some other English-speaking countries. However, "tonne" is used in many countries.

5.1.2 Neper, bel, shannon, and the like

There are a few highly specialized units not listed in Table 6 that are given by the International Organization for Standardization (ISO) or the International Electrotechnical Commission (IEC) and which are also acceptable for use with the SI. They include the neper (Np), bel (B), octave, phon, and sone, and units used in information technology, including the baud (Bd), bit (bit), erlang (E), hartley (Hart), and shannon (Sh)⁴. It is the position of NIST that the only such additional units that may be used with the SI are those given in either the International Standards on quantities and units of ISO or of IEC.

5.1.3 Electronvolt and unified atomic mass unit

The CIPM also finds it necessary to accept for use with the SI the two units given in Table 7. These units are used in specialized fields; their values in SI units must be obtained from experiment and, therefore, are not known exactly.

Note: In some fields the unified atomic mass unit is called the dalton, symbol Da; however, this name and symbol are not accepted by the CGPM, CIPM, ISO, or IEC for use with the SI. Similarly, AMU is not an acceptable unit symbol for the unified atomic mass unit. The only allowed name is "unified atomic mass unit" and the only allowed symbol is u.

Table 7. Units accepted for use with the SI whose values in SI units are obtained experimentally

Name	Symbol	Definition
electronvolt	eV	^(a)
unified atomic mass unit	u	^(b)

^(a) The electronvolt is the kinetic energy acquired by an electron in passing through a potential difference of 1 V in vacuum; $1 \text{ eV} = 1.602\,177\,33 \times 10^{-19} \text{ J}$ with a combined standard uncertainty of $0.000\,000\,49 \times 10^{-19} \text{ J}$.

^(b) The unified atomic mass unit is equal to 1/12 of the mass of an atom of the nuclide ¹²C; $1 \text{ u} = 1.660\,540\,2 \times 10^{-27} \text{ kg}$ with a combined standard uncertainty of $0.000\,001\,0 \times 10^{-27} \text{ kg}$.

5.1.4 Natural and atomic units

In some cases, particularly in basic science, the values of quantities are expressed in terms of fundamental constants of nature or so-called natural units. The use of these units with the SI is permissible when it is necessary for the most effective communication of information. In such cases, the specific natural units that are used must be identified. This requirement applies even to the system of units customarily called "atomic units" used in theoretical atomic physics and chemistry, inasmuch as there are several different systems that have the appellation "atomic units." Examples of physical quantities used as natural units are given in Table 8.

NIST also takes the position that while theoretical results intended primarily for other theorists may be left in natural units, if they are also intended for experimentalists, they must also be given in acceptable units.

⁴ The symbol in parentheses following the name of the unit is its internationally accepted unit symbol, but the octave, phon, and sone have no such unit symbols. For additional information on the neper and bel, see Sec. 0.5 of ISO 31-2. The question of the byte (B) is under international consideration.

Table 8. Examples of physical quantities sometimes used as natural units

Kind of quantity	Physical quantity used as a unit	Symbol
action	Planck constant divided by 2π	\hbar
electric charge	elementary charge	e
energy	Hartree energy	E_h
length	Bohr radius	a_0
length	Compton wavelength (electron)	λ_C
magnetic flux	magnetic flux quantum	Φ_0
magnetic moment	Bohr magneton	μ_B
magnetic moment	nuclear magneton	μ_N
mass	electron rest mass	m_e
mass	proton rest mass	m_p
speed	speed of electromagnetic waves in vacuum	c

5.2 Units temporarily accepted for use with the SI

Because of existing practice in certain fields or countries, in 1978 the CIPM considered that it was permissible for the units given in Table 9 to continue to be used with the SI until the CIPM considers that their use is no longer necessary. However, these units must not be introduced where they are not presently used. Further, NIST strongly discourages the continued use of these units except for the nautical mile, knot, are, and hectare; and except for the curie, roentgen, rad, and rem until the year 2000 (the cessation date suggested by the Committee for Interagency Radiation Research and Policy Coordination or CIRRPC, a United States Government interagency group).⁵

Table 9. Units temporarily accepted for use with the SI^(a)

Name	Symbol	Value in SI units
nautical mile		1 nautical mile = 1852 m
knot		1 nautical mile per hour = (1852/3600) m/s
ångström	Å	1 Å = 0.1 nm = 10^{-10} m
are ^(b)	a	1 a = 1 dam ² = 10^2 m ²
hectare ^(b)	ha	1 ha = 1 hm ² = 10^4 m ²
barn	b	1 b = 100 fm ² = 10^{-28} m ²
bar	bar	1 bar = 0.1 MPa = 100 kPa = 1000 hPa = 10^5 Pa
gal	Gal	1 Gal = 1 cm/s ² = 10^{-2} m/s ²
curie	Ci	1 Ci = 3.7×10^{10} Bq
roentgen	R	1 R = 2.58×10^{-4} C/kg
rad	rad ^(c)	1 rad = 1 cGy = 10^{-2} Gy
rem	rem	1 rem = 1 cSv = 10^{-2} Sv

^(a) See Sec. 5.2 regarding the continued use of these units.

^(b) This unit and its symbol are used to express agrarian areas.

^(c) When there is risk of confusion with the symbol for the radian, rd may be used as the symbol for rad.

⁵ In 1993 the CCU (see Sec. 3) was requested by ISO/TC 12 to consider asking the CIPM to deprecate the use of the units of Table 9 except for the nautical mile and knot, and possibly the are and hectare. The CCU discussed this request at its February 1995 meeting.

Appendix A. Definitions of the SI Base Units and the Radian and Steradian

A.1 Introduction

The following definitions of the SI base units are taken from NIST SP 330; the definitions of the SI supplementary units, the radian and steradian, which are now interpreted as SI derived units (see Sec. 3), are those generally accepted and are the same as those given in ANSI/IEEE Std 268-1992.

SI derived units are uniquely defined only in terms of SI base units; for example, $1 \text{ V} = 1 \text{ m}^2 \cdot \text{kg} \cdot \text{s}^{-3} \cdot \text{A}^{-1}$.

A.2 Meter (17th CGPM, 1983)

The meter is the length of the path travelled by light in vacuum during a time interval of $1/299\,792\,458$ of a second.

A.3 Kilogram (3d CGPM, 1901)

The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.

A.4 Second (13th CGPM, 1967)

The second is the duration of $9\,192\,631\,770$ periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom.

A.5 Ampere (9th CGPM, 1948)

The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per meter of length.

A.6 Kelvin (13th CGPM, 1967)

The kelvin, unit of thermodynamic temperature, is the fraction $1/273.16$ of the thermodynamic temperature of the triple point of water.

A.7 Mole (14th CGPM, 1971)

1. *The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12.*

2. *When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.*

In the definition of the mole, it is understood that unbound atoms of carbon 12, at rest and in their ground state, are referred to.

Note that this definition specifies at the same time the nature of the quantity whose unit is the mole.

A.8 Candela (16th CGPM, 1979)

The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of $(1/683)$ watt per steradian.

A.9 Radian

The radian is the plane angle between two radii of a circle that cut off on the circumference an arc equal in length to the radius.

A.10 Steradian

The steradian is the solid angle that, having its vertex in the center of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere.

CONVERSION FACTORS

The following table gives conversion factors from various units of measure to SI units. It is reproduced from NIST Special Publication 811, *Guide for the Use of the International System of Units (SI)*. The table gives the factor by which a quantity expressed in a non-SI unit should be multiplied in order to calculate its value in the SI. The SI values are expressed in terms of the base, supplementary, and derived units of SI in order to provide a coherent presentation of the conversion factors and facilitate computations (see the table "International System of Units" in this Section). If desired, powers of ten can be avoided by using SI Prefixes and shifting the decimal point if necessary.

Conversion from a non-SI unit to a different non-SI unit may be carried out by using this table in two stages, e.g.,

$$1 \text{ cal}_{\text{th}} = 4.184 \text{ J}$$
$$1 \text{ Btu}_{\text{T}} = 1.055056 \text{ E}+03 \text{ J}$$

Thus,

$$1 \text{ Btu}_{\text{T}} = (1.055056 \text{ E}+03 \div 4.184) \text{ cal}_{\text{th}} = 252.164 \text{ cal}_{\text{th}}$$

Conversion factors are presented for ready adaptation to computer readout and electronic data transmission. The factors are written as a number equal to or greater than one and less than ten with six or fewer decimal places. This number is followed by the letter E (for exponent), a plus or a minus sign, and two digits which indicate the power of 10 by which the number must be multiplied to obtain the correct value. For example:

$$3.523 \ 907 \ \text{E}-02 \text{ is } 3.523 \ 907 \times 10^{-2}$$

or

$$0.035 \ 239 \ 07$$

Similarly:

$$3.386 \ 389 \ \text{E}+03 \text{ is } 3.386 \ 389 \times 10^3$$

or

$$3 \ 386.389$$

A factor in boldface is exact; i.e., all subsequent digits are zero. All other conversion factors have been rounded to the figures given in accordance with accepted practice. Where less than six digits after the decimal point are shown, more precision is not warranted.

It is often desirable to round a number obtained from a conversion of units in order to retain information on the precision of the value. The following rounding rules may be followed:

(1) If the digits to be discarded begin with a digit less than 5, the digit preceding the first discarded digit is not changed.

Example: 6.974 951 5 rounded to 3 digits is 6.97

(2) If the digits to be discarded begin with a digit greater than 5, the digit preceding the first discarded digit is increased by one.

Example: 6.974 951 5 rounded to 4 digits is 6.975

(3) If the digits to be discarded begin with a 5 and at least one of the following digits is greater than 0, the digit preceding the 5 is increased by 1.

Example: 6.974 851 rounded to 5 digits is 6.974 9

(4) If the digits to be discarded begin with a 5 and all of the following digits are 0, the digit preceding the 5 is unchanged if it is even and increased by one if it is odd. (Note that this means that the final digit is always even.)

Examples: 6.974 951 5 rounded to 7 digits is 6.974 952

6.974 950 5 rounded to 7 digits is 6.974 950

REFERENCE

Taylor, B. N., *Guide for the Use of the International System of Units (SI)*, NIST Special Publication 811, 1995 Edition, Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, 1995.

Factors in **boldface** are exact

To convert from	to	Multiply by	
abampere	ampere (A)	1.0	E+01
abcoumb	coulomb (C)	1.0	E+01
abfarad	farad (F)	1.0	E+09
abhenry	henry (H)	1.0	E-09
abmho	siemens (S)	1.0	E+09
abohm	ohm (Ω)	1.0	E-09
abvolt	volt (V)	1.0	E-08
acceleration of free fall, standard (g_n)	meter per second squared (m/s^2)	9.806 65	E+00
acre (based on U.S. survey foot) ⁹	square meter (m^2)	4.046 873	E+03
acre foot (based on U.S. survey foot) ⁹	cubic meter (m^3)	1.233 489	E+03
ampere hour (A · h)	coulomb (C)	3.6	E+03
ångström (Å)	meter (m)	1.0	E-10
ångström (Å)	nanometer (nm)	1.0	E-01
are (a)	square meter (m^2)	1.0	E+02
astronomical unit (AU)	meter (m)	1.495 979	E+11
atmosphere, standard (atm)	pascal (Pa)	1.013 25	E+05
atmosphere, standard (atm)	kilopascal (kPa)	1.013 25	E+02
atmosphere, technical (at) ¹⁰	pascal (Pa)	9.806 65	E+04
atmosphere, technical (at) ¹⁰	kilopascal (kPa)	9.806 65	E+01
bar (bar)	pascal (Pa)	1.0	E+05
bar (bar)	kilopascal (kPa)	1.0	E+02
barn (b)	square meter (m^2)	1.0	E-28
barrel [for petroleum, 42 gallons (U.S.)](bbl)	cubic meter (m^3)	1.589 873	E-01
barrel [for petroleum, 42 gallons (U.S.)](bbl)	liter (L)	1.589 873	E+02
biot (Bi)	ampere (A)	1.0	E+01
British thermal unit _{IT} (Btu _{IT}) ¹¹	joule (J)	1.055 056	E+03
British thermal unit _{th} (Btu _{th}) ¹¹	joule (J)	1.054 350	E+03
British thermal unit (mean) (Btu)	joule (J)	1.055 87	E+03
British thermal unit (39 °F) (Btu)	joule (J)	1.059 67	E+03
British thermal unit (59 °F) (Btu)	joule (J)	1.054 80	E+03
British thermal unit (60 °F) (Btu)	joule (J)	1.054 68	E+03
British thermal unit _{IT} foot per hour square foot degree Fahrenheit [Btu _{IT} · ft/(h · ft ² · °F)]	watt per meter kelvin [W/(m · K)]	1.730 735	E+00
British thermal unit _{th} foot per hour square foot degree Fahrenheit [Btu _{th} · ft/(h · ft ² · °F)]	watt per meter kelvin [W/(m · K)]	1.729 577	E+00
British thermal unit _{IT} inch per hour square foot degree Fahrenheit [Btu _{IT} · in/(h · ft ² · °F)]	watt per meter kelvin [W/(m · K)]	1.442 279	E-01
British thermal unit _{th} inch per hour square foot degree Fahrenheit [Btu _{th} · in/(h · ft ² · °F)]	watt per meter kelvin [W/(m · K)]	1.441 314	E-01
British thermal unit _{IT} inch per second square foot degree Fahrenheit [Btu _{IT} · in/(s · ft ² · °F)]	watt per meter kelvin [W/(m · K)]	5.192 204	E+02

⁹ The U.S. survey foot equals (1200/3937) m. 1 international foot = 0.999998 survey foot.

¹⁰ One technical atmosphere equals one kilogram-force per square centimeter (1 at = 1 kgf/cm²).

¹¹ The Fifth International Conference on the Properties of Steam (London, July 1956) defined the International Table calorie as 4.1868 J. Therefore the exact conversion factor for the International Table Btu is 1.055 055 852 62 kJ. Note that the notation for International Table used in this listing is subscript "IT". Similarly, the notation for thermochemical is subscript "th." Further, the thermochemical Btu, Btu_{th}, is based on the thermochemical calorie, cal_{th}, where cal_{th} = 4.184 J exactly.

To convert from	to	Multiply by
British thermal unit _{th} inch per second square foot degree Fahrenheit [Btu _{th} · in/(s · ft ² · °F)]	watt per meter kelvin [W/(m · K)]	5.188 732 E+02
British thermal unit _{IT} per cubic foot (Btu _{IT} /ft ³)	joule per cubic meter (J/m ³)	3.725 895 E+04
British thermal unit _{th} per cubic foot (Btu _{th} /ft ³)	joule per cubic meter (J/m ³)	3.723 403 E+04
British thermal unit _{IT} per degree Fahrenheit (Btu _{IT} /°F)	joule per kelvin (J/k)	1.899 101 E+03
British thermal unit _{th} per degree Fahrenheit (Btu _{th} /°F)	joule per kelvin (J/k)	1.897 830 E+03
British thermal unit _{IT} per degree Rankine (Btu _{IT} /°R)	joule per kelvin (J/k)	1.899 101 E+03
British thermal unit _{th} per degree Rankine (Btu _{th} /°R)	joule per kelvin (J/k)	1.897 830 E+03
British thermal unit _{IT} per hour (Btu _{IT} /h)	watt (W)	2.930 711 E-01
British thermal unit _{th} per hour (Btu _{th} /h)	watt (W)	2.928 751 E-01
British thermal unit _{IT} per hour square foot degree Fahrenheit [Btu _{IT} /(h · ft ² · °F)]	watt per square meter kelvin [W/(m ² · K)]	5.678 263 E+00
British thermal unit _{th} per hour square foot degree Fahrenheit [Btu _{th} /(h · ft ² · °F)]	watt per square meter kelvin [W/(m ² · K)]	5.674 466 E+00
British thermal unit _{th} per minute (Btu _{th} /min)	watt (W)	1.757 250 E+01
British thermal unit _{IT} per pound (Btu _{IT} /lb)	joule per kilogram (J/kg)	2.326 E+03
British thermal unit _{th} per pound (Btu _{th} /lb)	joule per kilogram (J/kg)	2.324 444 E+03
British thermal unit _{IT} per pound degree Fahrenheit [Btu _{IT} /(lb · °F)]	joule per kilogram kelvin [J/(kg · K)]	4.1868 E+03
British thermal unit _{th} per pound degree Fahrenheit [Btu _{th} /(lb · °F)]	joule per kilogram kelvin [J/(kg · K)]	4.184 E+03
British thermal unit _{IT} per pound degree Rankine [Btu _{IT} /(lb · °R)]	joule per kilogram kelvin [J/(kg · K)]	4.1868 E+03
British thermal unit _{th} per pound degree Rankine [Btu _{th} /(lb · °R)]	joule per kilogram kelvin [J/(kg · K)]	4.184 E+03
British thermal unit _{IT} per second (Btu _{IT} /s)	watt (W)	1.055 056 E+03
British thermal unit _{th} per second (Btu _{th} /s)	watt (W)	1.054 350 E+03
British thermal unit _{IT} per second square foot degree Fahrenheit [Btu _{IT} /(s · ft ² · °F)]	watt per square meter kelvin [W/(m ² · K)]	2.044 175 E+04
British thermal unit _{th} per second square foot degree Fahrenheit [Btu _{th} /(s · ft ² · °F)]	watt per square meter kelvin [W/(m ² · K)]	2.042 808 E+04
British thermal unit _{IT} per square foot (Btu _{IT} /ft ²)	joule per square meter (J/m ²)	1.135 653 E+04
British thermal unit _{th} per square foot (Btu _{th} /ft ²)	joule per square meter (J/m ²)	1.134 893 E+04
British thermal unit _{IT} per square foot hour [(Btu _{IT} /(ft ² · h))]	watt per square meter (W/m ²)	3.154 591 E+00
British thermal unit _{th} per square foot hour [Btu _{th} /(ft ² · h)]	watt per square meter (W/m ²)	3.152 481 E+00
British thermal unit _{th} per square foot minute [Btu _{th} /(ft ² · min)]	watt per square meter (W/m ²)	1.891 489 E+02
British thermal unit _{IT} per square foot second [(Btu _{IT} /(ft ² · s))]	watt per square meter (W/m ²)	1.135 653 E+04
British thermal unit _{th} per square foot second [Btu _{th} /(ft ² · s)]	watt per square meter (W/m ²)	1.134 893 E+04
British thermal unit _{th} per square inch second [Btu _{th} /(in ² · s)]	watt per square meter (W/m ²)	1.634 246 E+06

To convert from	to	Multiply by	
bushel (U.S.) (bu)	cubic meter (m ³)	3.523 907	E-02
bushel (U.S.) (bu)	liter (L)	3.523 907	E+01
calorie _{IT} (cal _{IT}) ¹¹	joule (J)	4.1868	E+00
calorie _{th} (cal _{th}) ¹¹	joule (J)	4.184	E+00
calorie (cal) (mean)	joule (J)	4.190 02	E+00
calorie (15 °C) (cal ₁₅)	joule (J)	4.185 80	E+00
calorie (20 °C) (cal ₂₀)	joule (J)	4.181 90	E+00
calorie _{IT} , kilogram (nutrition) ¹²	joule (J)	4.1868	E+03
calorie _{th} , kilogram (nutrition) ¹²	joule (J)	4.184	E+03
calorie (mean), kilogram (nutrition) ¹²	joule (J)	4.190 02	E+03
calorie _{th} per centimeter second degree Celsius [cal _{th} /(cm · s · °C)]	watt per meter kelvin [W/(m · K)]	4.184	E+02
calorie _{IT} per gram (cal _{IT} /g)	joule per kilogram (J/kg)	4.1868	E+03
calorie _{th} per gram (cal _{th} /g)	joule per kilogram (J/kg)	4.184	E+03
calorie _{IT} per gram degree Celsius [cal _{IT} /(g · °C)]	joule per kilogram kelvin [J/(kg · K)]	4.1868	E+03
calorie _{th} per gram degree Celsius [cal _{th} /(g · °C)]	joule per kilogram kelvin [J/(kg · K)]	4.184	E+03
calorie _{IT} per gram kelvin [cal _{IT} /(g · K)]	joule per kilogram kelvin [J/(kg · K)]	4.1868	E+03
calorie _{th} per gram kelvin [cal _{th} /(g · K)]	joule per kilogram kelvin [J/(kg · K)]	4.184	E+03
calorie _{th} per minute (cal _{th} /min)	watt (W)	6.973 333	E-02
calorie _{th} per second (cal _{th} /s)	watt (W)	4.184	E+00
calorie _{th} per square centimeter (cal _{th} /cm ²)	joule per square meter (J/m ²)	4.184	E+04
calorie _{th} per square centimeter minute [cal _{th} /(cm ² · min)]	watt per square meter (W/m ²)	6.973 333	E+02
calorie _{th} per square centimeter second [cal _{th} /(cm ² · s)]	watt per square meter (W/m ²)	4.184	E+04
candela per square inch (cd/in ²)	candela per square meter (cd/m ²)	1.550 003	E+03
carat, metric	kilogram (kg)	2.0	E-04
carat, metric	gram (g)	2.0	E-01
centimeter of mercury (0 °C) ¹³	pascal (Pa)	1.333 22	E+03
centimeter of mercury (0 °C) ¹³	kilopascal (kPa)	1.333 22	E+00
centimeter of mercury, conventional (cmHg) ¹³	pascal (Pa)	1.333 224	E+03
centimeter of mercury, conventional (cmHg) ¹³	kilopascal (kPa)	1.333 224	E+00
centimeter of water (4 °C) ¹³	pascal (Pa)	9.806 38	E+01
centimeter of water, conventional (cmH ₂ O) ¹³	pascal (Pa)	9.806 65	E+01
centipoise (cP)	pascal second (Pa · s)	1.0	E-03
centistokes (cSt)	meter squared per second (m ² /s)	1.0	E-06
chain (based on U.S. survey foot) (ch) ⁹	meter (m)	2.011 684	E+01
circular mil	square meter (m ²)	5.067 075	E-10
circular mil	square millimeter (mm ²)	5.067 075	E-04
clo	square meter kelvin per watt (m ² · K/W)	1.55	E-01
cord (128 ft ³)	cubic meter (m ³)	3.624 556	E+00
cubic foot (ft ³)	cubic meter (m ³)	2.831 685	E-02
cubic foot per minute (ft ³ /min)	cubic meter per second (m ³ /s)	4.719 474	E-04
cubic foot per minute (ft ³ /min)	liter per second (L/s)	4.719 474	E-01
cubic foot per second (ft ³ /s)	cubic meter per second (m ³ /s)	2.831 685	E-02

¹² The kilogram calorie or "large calorie" is an obsolete term used for the kilocalorie, which is the calorie used to express the energy content of foods. However, in practice, the prefix "kilo" is usually omitted.

¹³ Conversion factors for mercury manometer pressure units are calculated using the standard value for the acceleration of gravity and the density of mercury at the stated temperature. Additional digits are not justified because the definitions of the units do not take into account the compressibility of mercury or the change in density caused by the revised practical temperature scale, ITS-90. Similar comments also apply to water manometer pressure units. Conversion factors for conventional mercury and water manometer pressure units are based on ISO 31-3.

To convert from	to	Multiply by
cubic inch (in ³) ¹⁴	cubic meter (m ³)	1.638 706 E-05
cubic inch per minute (in ³ /min)	cubic meter per second (m ³ /s)	2.731 177 E-07
cubic mile (mi ³)	cubic meter (m ³)	4.168 182 E+09
cubic yard (yd ³)	cubic meter (m ³)	7.645 549 E-01
cubic yard per minute (yd ³ /min)	cubic meter per second (m ³ /s)	1.274 258 E-02
cup (U.S.)	cubic meter (m ³)	2.365 882 E-04
cup (U.S.)	liter (L)	2.365 882 E-01
cup (U.S.)	milliliter (mL)	2.365 882 E+02
curie (Ci)	becquerel (Bq)	3.7 E+10
darcy ¹⁵	meter squared (m ²)	9.869 233 E-13
day (d)	second (s)	8.64 E+04
day (sidereal)	second (s)	8.616 409 E+04
debye (D)	coulomb meter (C · m)	3.335 641 E-30
degree (angle) (°)	radian (rad)	1.745 329 E-02
degree Celsius (temperature) (°C)	kelvin (K)	$T/K = t/°C + 273.15$
degree Celsius (temperature interval) (°C)	kelvin (K)	1.0 E+00
degree centigrade (temperature) ¹⁶	degree Celsius (°C)	$t/°C \approx t/\text{deg. cent.}$
degree centigrade (temperature interval) ¹⁶	degree Celsius (°C)	1.0 E+00
degree Fahrenheit (temperature) (°F)	degree Celsius (°C)	$t/°C = (t/°F - 32)/1.8$
degree Fahrenheit (temperature) (°F)	kelvin (K)	$T/K = (t/°F + 459.67)/1.8$
degree Fahrenheit (temperature interval) (°F)	degree Celsius (°C)	5.555 556 E-01
degree Fahrenheit (temperature interval) (°F)	kelvin (K)	5.555 556 E-01
degree Fahrenheit hour per British thermal unit _{IT} (°F · h/Btu _{IT})	kelvin per watt (K/W)	1.895 634 E+00
degree Fahrenheit hour per British thermal unit _{th} (°F · h/Btu _{th})	kelvin per watt (K/W)	1.896 903 E+00
degree Fahrenheit hour square foot per British thermal unit _{IT} (°F · h · ft ² /Btu _{IT})	square meter kelvin per watt (m ² · K/W)	1.761 102 E-01
degree Fahrenheit hour square foot per British thermal unit _{th} (°F · h · ft ² /Btu _{th})	square meter kelvin per watt (m ² · K/W)	1.762 280 E-01
degree Fahrenheit hour square foot per British thermal unit _{IT} inch [°F · h · ft ² /(Btu _{IT} · in)]	meter kelvin per watt (m · K/W)	6.933 472 E+00
degree Fahrenheit hour square foot per British thermal unit _{th} inch [°F · h · ft ² /(Btu _{th} · in)]	meter kelvin per watt (m · K/W)	6.938 112 E+00
degree Fahrenheit second per British thermal unit _{IT} (°F · s/Btu _{IT})	kelvin per watt (K/W)	5.265 651 E-04
degree Fahrenheit second per British thermal unit _{th} (°F · s/Btu _{th})	kelvin per watt (K/W)	5.269 175 E-04
degree Rankine (°R)	kelvin (K)	$T/K = (T/°R)/1.8$
degree Rankine (temperature interval) (°R)	kelvin (K)	5.555 556 E-01
denier	kilogram per meter (kg/m)	1.111 111 E-07
denier	gram per meter (g/m)	1.111 111 E-04
dyne (dyn)	newton (N)	1.0 E-05
dyne centimeter (dyn · cm)	newton meter (N · m)	1.0 E-07
dyne per square centimeter (dyn/cm ²)	pascal (Pa)	1.0 E-01
electronvolt (eV)	joule (J)	1.602 177 E-19
EMU of capacitance (abfarad)	farad (F)	1.0 E+09
EMU of current (abampere)	ampere (A)	1.0 E+01
EMU of electric potential (abvolt)	volt (V)	1.0 E-08
EMU of inductance (abhenry)	henry (H)	1.0 E-09

¹⁴ The exact conversion factor is 1.638 706 4 E-05.

¹⁵ The darcy is a unit for expressing the permeability of porous solids, not area.

¹⁶ The centigrade temperature scale is obsolete; the degree centigrade is only approximately equal to the degree Celsius.

To convert from	to		Multiply by
EMU of resistance (abohm)	ohm (Ω)	1.0	E-09
erg (erg)	joule (J)	1.0	E-07
erg per second (erg/s)	watt (W)	1.0	E-07
erg per square centimeter second [$\text{erg}/(\text{cm}^2 \cdot \text{s})$]	watt per square meter (W/m^2)	1.0	E-03
ESU of capacitance (statfarad)	farad (F)	1.112 650	E-12
ESU of current (statampere)	ampere (A)	3.335 641	E-10
ESU of electric potential (statvolt)	volt (V)	2.997 925	E+02
ESU of inductance (stathenry)	henry (H)	8.987 552	E+11
ESU of resistance (statohm)	ohm (Ω)	8.987 552	E+11
faraday (based on carbon 12)	coulomb (C)	9.648 531	E+04
fathom (based on U.S. survey foot) ⁹	meter (m)	1.828 804	E+00
fermi	meter (m)	1.0	E-15
fermi	femtometer (fm)	1.0	E+00
fluid ounce (U.S.) (fl oz)	cubic meter (m^3)	2.957 353	E-05
fluid ounce (U.S.) (fl oz)	milliliter (mL)	2.957 353	E+01
foot (ft)	meter (m)	3.048	E-01
foot (U.S. survey) (ft) ⁹	meter (m)	3.048 006	E-01
footcandle	lux (lx)	1.076 391	E+01
footlambert	candela per square meter (cd/m^2)	3.426 259	E+00
foot of mercury, conventional (ftHg) ¹³	pascal (Pa)	4.063 666	E+04
foot of mercury, conventional (ftHg) ¹³	kilopascal (kPa)	4.063 666	E+01
foot of water (39.2 °F) ¹³	pascal (Pa)	2.988 98	E+03
foot of water (39.2 °F) ¹³	kilopascal (kPa)	2.988 98	E+00
foot of water, conventional (ftH ₂ O) ¹³	pascal (Pa)	2.989 067	E+03
foot of water, conventional (ftH ₂ O) ¹³	kilopascal (kPa)	2.989 067	E+00
foot per hour (ft/h)	meter per second (m/s)	8.466 667	E-05
foot per minute (ft/min)	meter per second (m/s)	5.08	E-03
foot per second (ft/s)	meter per second (m/s)	3.048	E-01
foot per second squared (ft/s ²)	meter per second squared (m/s ²)	3.048	E-01
foot poundal	joule (J)	4.214 011	E-02
foot pound-force (ft · lbf)	joule (J)	1.355 818	E+00
foot pound-force per hour (ft · lbf/h)	watt (W)	3.766 161	E-04
foot pound-force per minute (ft · lbf/min)	watt (W)	2.259 697	E-02
foot pound-force per second (ft · lbf/s)	watt (W)	1.355 818	E+00
foot to the fourth power (ft ⁴) ¹⁷	meter to the fourth power (m ⁴)	8.630 975	E-03
franklin (Fr)	coulomb (C)	3.335 641	E-10
gal (Gal)	meter per second squared (m/s ²)	1.0	E-02
gallon [Canadian and U.K. (Imperial)] (gal)	cubic meter (m^3)	4.546 09	E-03
gallon [Canadian and U.K. (Imperial)] (gal)	liter (L)	4.546 09	E+00
gallon (U.S.) (gal)	cubic meter (m^3)	3.785 412	E-03
gallon (U.S.) (gal)	liter (L)	3.785 412	E+00
gallon (U.S.) per day (gal/d)	cubic meter per second (m^3/s)	4.381 264	E-08
gallon (U.S.) per day (gal/d)	liter per second (L/s)	4.381 264	E-05
gallon (U.S.) per horsepower hour [gal/(hp · h)]	cubic meter per joule (m^3/J)	1.410 089	E-09
gallon (U.S.) per horsepower hour [gal/(hp · h)]	liter per joule (L/J)	1.410 089	E-06
gallon (U.S.) per minute (gpm)(gal/min)	cubic meter per second (m^3/s)	6.309 020	E-05
gallon (U.S.) per minute (gpm)(gal/min)	liter per second (L/s)	6.309 020	E-02

¹⁷ This is a unit for the quantity second moment of area, which is sometimes called the "moment of section" or "area moment of inertia" of a plane section about a specified axis.

To convert from	to	Multiply by	
gamma (γ)	tesla (T)	1.0	E-09
gauss (Gs, G)	tesla (T)	1.0	E-04
gilbert (Gi)	ampere (A)	7.957 747	E-01
gill [Canadian and U.K. (Imperial)] (gi)	cubic meter (m^3)	1.420 653	E-04
gill [Canadian and U.K. (Imperial)] (gi)	liter (L)	1.420 653	E-01
gill (U.S.) (gi)	cubic meter (m^3)	1.182 941	E-04
gill (U.S.) (gi)	liter (L)	1.182 941	E-01
gon (also called grade) (gon)	radian (rad)	1.570 796	E-02
gon (also called grade) (gon)	degree (angle) ($^\circ$)	9.0	E-01
grain (gr)	kilogram (kg)	6.479 891	E-05
grain (gr)	milligram (mg)	6.479 891	E+01
grain per gallon (U.S.) (gr/gal)	kilogram per cubic meter (kg/m^3)	1.711 806	E-02
grain per gallon (U.S.) (gr/gal)	milligram per liter (mg/L)	1.711 806	E+01
gram-force per square centimeter (gf/cm^2)	pascal (Pa)	9.806 65	E+01
gram per cubic centimeter (g/cm^3)	kilogram per cubic meter (kg/m^3)	1.0	E+03
hectare (ha)	square meter (m^2)	1.0	E+04
horsepower (550 ft · lbf/s) (hp)	watt (W)	7.456 999	E+02
horsepower (boiler)	watt (W)	9.809 50	E+03
horsepower (electric)	watt (W)	7.46	E+02
horsepower (metric)	watt (W)	7.354 988	E+02
horsepower (U.K.)	watt (W)	7.4570	E+02
horsepower (water)	watt (W)	7.460 43	E+02
hour (h)	second (s)	3.6	E+03
hour (sidereal)	second (s)	3.590 170	E+03
hundredweight (long, 112 lb)	kilogram (kg)	5.080 235	E+01
hundredweight (short, 100 lb)	kilogram (kg)	4.535 924	E+01
inch (in)	meter (m)	2.54	E-02
inch (in)	centimeter (cm)	2.54	E+00
inch of mercury (32 $^\circ$ F) ¹³	pascal (Pa)	3.386 38	E+03
inch of mercury (32 $^\circ$ F) ¹³	kilopascal (kPa)	3.386 38	E+00
inch of mercury (60 $^\circ$ F) ¹³	pascal (Pa)	3.376 85	E+03
inch of mercury (60 $^\circ$ F) ¹³	kilopascal (kPa)	3.376 85	E+00
inch of mercury, conventional (inHg) ¹³	pascal (Pa)	3.386 389	E+03
inch of mercury, conventional (inHg) ¹³	kilopascal (kPa)	3.386 389	E+00
inch of water (39.2 $^\circ$ F) ¹³	pascal (Pa)	2.490 82	E+02
inch of water (60 $^\circ$ F) ¹³	pascal (Pa)	2.4884	E+02
inch of water, conventional (inH ₂ O) ¹³	pascal (Pa)	2.490 889	E+02
inch per second (in/s)	meter per second (m/s)	2.54	E-02
inch per second squared (in/s ²)	meter per second squared (m/s ²)	2.54	E-02
inch to the fourth power (in ⁴) ¹⁷	meter to the fourth power (m ⁴)	4.162 314	E-07
kayser (K)	reciprocal meter (m^{-1})	1.0	E+02
kelvin (K)	degree Celsius ($^\circ$ C)	$t/^\circ\text{C} = T/\text{K} -$	273.15
kilocalorie _{IT} (kcal _{IT})	joule (J)	4.1868	E+03
kilocalorie _{th} (kcal _{th})	joule (J)	4.184	E+03
kilocalorie (mean) (kcal)	joule (J)	4.190 02	E+03
kilocalorie _{th} per minute (kcal _{th} /min)	watt (W)	6.973 333	E+01
kilocalorie _{th} per second (kcal _{th} /s)	watt (W)	4.184	E+03
kilogram-force (kgf)	newton (N)	9.806 65	E+00
kilogram-force meter (kgf · m)	newton meter (N · m)	9.806 65	E+00

To convert from	to	Multiply by	
kilogram-force per square centimeter (kgf/cm ²).....	pascal (Pa).....	9.806 65	E+04
kilogram-force per square centimeter (kgf/cm ²).....	kilopascal (kPa).....	9.806 65	E+01
kilogram-force per square meter (kgf/m ²).....	pascal (Pa).....	9.806 65	E+00
kilogram-force per square millimeter (kgf/mm ²).....	pascal (Pa).....	9.806 65	E+06
kilogram-force per square millimeter (kgf/mm ²).....	megapascal (MPa).....	9.806 65	E+00
kilogram-force second squared per meter (kgf · s ² /m).....	kilogram (kg).....	9.806 65	E+00
<i>kilometer per hour</i> (km/h).....	meter per second (m/s).....	2.777 778	E−01
kilopond (kilogram-force) (kp).....	newton (N).....	9.806 65	E+00
<i>kilowatt hour</i> (kW · h).....	joule (J).....	3.6	E+06
<i>kilowatt hour</i> (kW · h).....	megajoule (MJ).....	3.6	E+00
kip (1 kip=1000 lbf).....	newton (N).....	4.448 222	E+03
kip (1 kip=1000 lbf).....	kilonewton (kN).....	4.448 222	E+00
kip per square inch (ksi) (kip/in ²).....	pascal (Pa).....	6.894 757	E+06
kip per square inch (ksi) (kip/in ²).....	kilopascal (kPa).....	6.894 757	E+03
<i>knot</i> (nautical mile per hour).....	meter per second (m/s).....	5.144 444	E−01
lambert ¹⁸	candela per square meter (cd/m ²).....	3.183 099	E+03
langley (cal _{th} /cm ²).....	joule per square meter (J/m ²).....	4.184	E+04
light year (l.y.) ¹⁹	meter (m).....	9.460 73	E+15
<i>liter</i> (L) ²⁰	cubic meter (m ³).....	1.0	E−03
lumen per square foot (lm/ft ²).....	lux (lx).....	1.076 391	E+01
maxwell (Mx).....	weber (Wb).....	1.0	E−08
mho.....	siemens (S).....	1.0	E+00
microinch.....	meter (m).....	2.54	E−08
microinch.....	micrometer (μm).....	2.54	E−02
micron (μ).....	meter (m).....	1.0	E−06
micron (μ).....	micrometer (μm).....	1.0	E+00
mil (0.001 in).....	meter (m).....	2.54	E−05
mil (0.001 in).....	millimeter (mm).....	2.54	E−02
mil (angle).....	radian (rad).....	9.817 477	E−04
mil (angle).....	degree (°).....	5.625	E−02
mile (mi).....	meter (m).....	1.609 344	E+03
mile (mi).....	kilometer (km).....	1.609 344	E+00
mile (based on U.S. survey foot) (mi) ⁹	meter (m).....	1.609 347	E+03
mile (based on U.S. survey foot) (mi) ⁹	kilometer (km).....	1.609 347	E+00
<i>mile, nautical</i> ²¹	meter (m).....	1.852	E+03
mile per gallon (U.S.) (mpg) (mi/gal).....	meter per cubic meter (m/m ³).....	4.251 437	E+05
mile per gallon (U.S.) (mpg) (mi/gal).....	kilometer per liter (km/L).....	4.251 437	E−01
mile per gallon (U.S.) (mpg) (mi/gal) ²²	liter per 100 kilometer (L/100 km).....	divide 235.215 by number of miles per gallon	
mile per hour (mi/h).....	meter per second (m/s).....	4.4704	E−01
mile per hour (mi/h).....	kilometer per hour (km/h).....	1.609 344	E+00

¹⁸ The exact conversion factor is 10⁴/π.

¹⁹ This conversion factor is based on 1 d = 86 400 s; and 1 Julian century = 36 525 d. (See *The Astronomical Almanac for the Year 1995*, page K6, U.S. Government Printing Office, Washington, DC, 1994).

²⁰ In 1964 the General Conference on Weights and Measures reestablished the name “liter” as a special name for the cubic decimeter. Between 1901 and 1964 the liter was slightly larger (1.000 028 dm³); when one uses high-accuracy volume data of that time, this fact must be kept in mind.

²¹ The value of this unit, 1 nautical mile = 1852 m, was adopted by the First International Extraordinary Hydrographic Conference, Monaco, 1929, under the name “International nautical mile.”

²² For converting fuel economy, as used in the U.S., to fuel consumption.

To convert from	to	Multiply by	
mile per minute (mi/min)	meter per second (m/s)	2.682 24	E+01
mile per second (mi/s)	meter per second (m/s)	1.609 344	E+03
millibar (mbar)	pascal (Pa)	1.0	E+02
millibar (mbar)	kilopascal (kPa)	1.0	E-01
millimeter of mercury, conventional (mmHg) ¹³	pascal (Pa)	1.333 224	E+02
millimeter of water, conventional (mmH ₂ O) ¹³	pascal (Pa)	9.806 65	E+00
minute (angle) (')	radian (rad)	2.908 882	E-04
minute (min)	second (s)	6.0	E+01
minute (sidereal)	second (s)	5.983 617	E+01
oersted (Oe)	ampere per meter (A/m)	7.957 747	E+01
ohm centimeter ($\Omega \cdot \text{cm}$)	ohm meter ($\Omega \cdot \text{m}$)	1.0	E-02
ohm circular-mil per foot	ohm meter ($\Omega \cdot \text{m}$)	1.662 426	E-09
ohm circular-mil per foot	ohm square millimeter per meter ($\Omega \cdot \text{mm}^2/\text{m}$)	1.662 426	E-03
ounce (avoirdupois) (oz)	kilogram (kg)	2.834 952	E-02
ounce (avoirdupois) (oz)	gram (g)	2.834 952	E+01
ounce (troy or apothecary) (oz)	kilogram (kg)	3.110 348	E-02
ounce (troy or apothecary) (oz)	gram (g)	3.110 348	E+01
ounce [Canadian and U.K. fluid (Imperial)] (fl oz)	cubic meter (m ³)	2.841 306	E-05
ounce [Canadian and U.K. fluid (Imperial)] (fl oz)	milliliter (mL)	2.841 306	E+01
ounce (U.S. fluid) (fl oz)	cubic meter (m ³)	2.957 353	E-05
ounce (U.S. fluid) (fl oz)	milliliter (mL)	2.957 353	E+01
ounce (avoirdupois)-force (ozf)	newton (N)	2.780 139	E-01
ounce (avoirdupois)-force inch (ozf · in)	newton meter (N · m)	7.061 552	E-03
ounce (avoirdupois)-force inch (ozf · in)	millinewton meter (mN · m)	7.061 552	E+00
ounce (avoirdupois) per cubic inch (oz/in ³)	kilogram per cubic meter (kg/m ³)	1.729 994	E+03
ounce (avoirdupois) per gallon [Canadian and U.K. (Imperial)] (oz/gal)	kilogram per cubic meter (kg/m ³)	6.236 023	E+00
ounce (avoirdupois) per gallon [Canadian and U.K. (Imperial)] (oz/gal)	gram per liter (g/L)	6.236 023	E+00
ounce (avoirdupois) per gallon (U.S.) (oz/gal)	kilogram per cubic meter (kg/m ³)	7.489 152	E+00
ounce (avoirdupois) per gallon (U.S.) (oz/gal)	gram per liter (g/L)	7.489 152	E+00
ounce (avoirdupois) per square foot (oz/ft ²)	kilogram per square meter (kg/m ²)	3.051 517	E-01
ounce (avoirdupois) per square inch (oz/in ²)	kilogram per square meter (kg/m ²)	4.394 185	E+01
ounce (avoirdupois) per square yard (oz/yd ²)	kilogram per square meter (kg/m ²)	3.390 575	E-02
parsec (pc)	meter (m)	3.085 678	E+16
peck (U.S.) (pk)	cubic meter (m ³)	8.809 768	E-03
peck (U.S.) (pk)	liter (L)	8.809 768	E+00
pennyweight (dwt)	kilogram (kg)	1.555 174	E-03
pennyweight (dwt)	gram (g)	1.555 174	E+00
perm (0 °C)	kilogram per pascal second square meter [kg/(Pa · s · m ²)]	5.721 35	E-11
perm (23 °C)	kilogram per pascal second square meter [kg/(Pa · s · m ²)]	5.745 25	E-11
perm inch (0 °C)	kilogram per pascal second meter [kg/(Pa · s · m)]	1.453 22	E-12
perm inch (23 °C)	kilogram per pascal second meter [kg/(Pa · s · m)]	1.459 29	E-12

To convert from	to		Multiply by
phot (ph)	lux (lx)	1.0	E+04
pica (computer) (1/6 in)	meter (m)	4.233 333	E-03
pica (computer) (1/6 in)	millimeter (mm)	4.233 333	E+00
pica (printer's)	meter (m)	4.217 518	E-03
pica (printer's)	millimeter (mm)	4.217 518	E+00
pint (U.S. dry) (dry pt)	cubic meter (m ³)	5.506 105	E-04
pint (U.S. dry) (dry pt)	liter (L)	5.506 105	E-01
pint (U.S. liquid) (liq pt)	cubic meter (m ³)	4.731 765	E-04
pint (U.S. liquid) (liq pt)	liter (L)	4.731 765	E-01
point (computer) (1/72 in)	meter (m)	3.527 778	E-04
point (computer) (1/72 in)	millimeter (mm)	3.527 778	E-01
point (printer's)	meter (m)	3.514 598	E-04
point (printer's)	millimeter (mm)	3.514 598	E-01
poise (P)	pascal second (Pa · s)	1.0	E-01
pound (avoirdupois) (lb) ²³	kilogram (kg)	4.535 924	E-01
pound (troy or apothecary) (lb)	kilogram (kg)	3.732 417	E-01
poundal	newton (N)	1.382 550	E-01
poundal per square foot	pascal (Pa)	1.488 164	E+00
poundal second per square foot	pascal second (Pa · s)	1.488 164	E+00
pound foot squared (lb · ft ²)	kilogram meter squared (kg · m ²)	4.214 011	E-02
pound-force (lbf) ²⁴	newton (N)	4.448 222	E+00
pound-force foot (lbf · ft)	newton meter (N · m)	1.355 818	E+00
pound-force foot per inch (lbf · ft/in)	newton meter per meter (N · m/m)	5.337 866	E+01
pound-force inch (lbf · in)	newton meter (N · m)	1.129 848	E-01
pound-force inch per inch (lbf · in/in)	newton meter per meter (N · m/m)	4.448 222	E+00
pound-force per foot (lbf/ft)	newton per meter (N/m)	1.459 390	E+01
pound-force per inch (lbf/in)	newton per meter (N/m)	1.751 268	E+02
pound-force per pound (lbf/lb) (thrust to mass ratio)	newton per kilogram (N/kg)	9.806 65	E+00
pound-force per square foot (lbf/ft ²)	pascal (Pa)	4.788 026	E+01
pound-force per square inch (psi) (lbf/in ²)	pascal (Pa)	6.894 757	E+03
pound-force per square inch (psi) (lbf/in ²)	kilopascal (kPa)	6.894 757	E+00
pound-force second per square foot (lbf · s/ft ²)	pascal second (Pa · s)	4.788 026	E+01
pound-force second per square inch (lbf · s/in ²)	pascal second (Pa · s)	6.894 757	E+03
pound inch squared (lb · in ²)	kilogram meter squared (kg · m ²)	2.926 397	E-04
pound per cubic foot (lb/ft ³)	kilogram per cubic meter (kg/m ³)	1.601 846	E+01
pound per cubic inch (lb/in ³)	kilogram per cubic meter (kg/m ³)	2.767 990	E+04
pound per cubic yard (lb/yd ³)	kilogram per cubic meter (kg/m ³)	5.932 764	E-01
pound per foot (lb/ft)	kilogram per meter (kg/m)	1.488 164	E+00
pound per foot hour [lb/(ft · h)]	pascal second (Pa · s)	4.133 789	E-04
pound per foot second [lb/(ft · s)]	pascal second (Pa · s)	1.488 164	E+00
pound per gallon [Canadian and U.K. (Imperial)] (lb/gal)	kilogram per cubic meter (kg/m ³)	9.977 637	E+01
pound per gallon [Canadian and U.K. (Imperial)] (lb/gal)	kilogram per liter (kg/L)	9.977 637	E-02
pound per gallon (U.S.) (lb/gal)	kilogram per cubic meter (kg/m ³)	1.198 264	E+02
pound per gallon (U.S.) (lb/gal)	kilogram per liter (kg/L)	1.198 264	E-01
pound per horsepower hour [lb/(hp · h)]	kilogram per joule (kg/J)	1.689 659	E-07
pound per hour (lb/h)	kilogram per second (kg/s)	1.259 979	E-04

²³ The exact conversion factor is 4.535 923 7 E-01. All units that contain the pound refer to the avoirdupois pound.

²⁴ If the local value of the acceleration of free fall is taken as $g_n=9.806 65 \text{ m/s}^2$ (the standard value), the exact conversion factor is 4.448 221 615 260 5 E+00.

To convert from	to	Multiply by	
pound per inch (lb/in).....	kilogram per meter (kg/m)	1.785 797	E+01
pound per minute (lb/min).....	kilogram per second (kg/s)	7.559 873	E-03
pound per second (lb/s).....	kilogram per second (kg/s)	4.535 924	E-01
pound per square foot (lb/ft ²)	kilogram per square meter (kg/m ²)	4.882 428	E+00
pound per square inch (<i>not</i> pound-force) (lb/in ²)	kilogram per square meter (kg/m ²)	7.030 696	E+02
pound per yard (lb/yd)	kilogram per meter (kg/m)	4.960 546	E-01
psi (pound-force per square inch) (lbf/in ²).....	pascal (Pa).....	6.894 757	E+03
psi (pound-force per square inch) (lbf/in ²).....	kilopascal (kPa).....	6.894 757	E+00
quad (10 ¹⁵ Btu _{IT}) ¹¹	joule (J).....	1.055 056	E+18
quart (U.S. dry) (dry qt)	cubic meter (m ³).....	1.101 221	E-03
quart (U.S. dry) (dry qt)	liter (L)	1.101 221	E+00
quart (U.S. liquid) (liq qt).....	cubic meter (m ³).....	9.463 529	E-04
quart (U.S. liquid) (liq qt).....	liter (L)	9.463 529	E-01
<i>rad</i> (absorbed dose) (rad)	gray (Gy)	1.0	E-02
<i>rem</i> (rem).....	sievert (Sv)	1.0	E-02
revolution (r).....	radian (rad).....	6.283 185	E+00
revolution per minute (rpm) (r/min).....	radian per second (rad/s)	1.047 198	E-01
rhe	reciprocal pascal second [(Pa · s) ⁻¹].....	1.0	E+01
rod (based on U.S. survey foot) (rd) ⁹	meter (m).....	5.029 210	E+00
<i>roentgen</i> (R)	coulomb per kilogram (C/kg).....	2.58	E-04
rpm (revolution per minute) (r/min).....	radian per second (rad/s)	1.047 198	E-01
<i>second</i> (angle) (")	radian (rad).....	4.848 137	E-06
second (sidereal).....	second (s).....	9.972 696	E-01
shake.....	second (s).....	1.0	E-08
shake.....	nanosecond (ns)	1.0	E+01
slug (slug).....	kilogram (kg).....	1.459 390	E+01
slug per cubic foot (slug/ft ³).....	kilogram per cubic meter (kg/m ³)	5.153 788	E+02
slug per foot second [slug/(ft · s)]	pascal second (Pa · s).....	4.788 026	E+01
square foot (ft ²)	square meter (m ²).....	9.290 304	E-02
square foot per hour (ft ² /h)	square meter per second (m ² /s).....	2.580 64	E-05
square foot per second (ft ² /s)	square meter per second (m ² /s).....	9.290 304	E-02
square inch (in ²)	square meter (m ²).....	6.4516	E-04
square inch (in ²)	square centimeter (cm ²).....	6.4516	E+00
square mile (mi ²).....	square meter (m ²).....	2.589 988	E+06
square mile (mi ²).....	square kilometer (km ²).....	2.589 988	E+00
square mile (based on U.S. survey foot) (mi ²) ⁹	square meter (m ²).....	2.589 988	E+06
square mile (based on U.S. survey foot) (mi ²) ⁹	square kilometer (km ²).....	2.589 988	E+00
square yard (yd ²).....	square meter (m ²).....	8.361 274	E-01
statampere	ampere (A)	3.335 641	E-10
statcoulomb	coulomb (C)	3.335 641	E-10
statfarad.....	farad (F)	1.112 650	E-12
stathenry	henry (H)	8.987 552	E+11
statmho	siemens (S)	1.112 650	E-12
statohm.....	ohm (Ω)	8.987 552	E+11
statvolt	volt (V)	2.997 925	E+02
stere (st).....	cubic meter (m ³).....	1.0	E+00
stilb (sb).....	candela per square meter (cd/m ²).....	1.0	E+04
stokes (St).....	meter squared per second (m ² /s).....	1.0	E-04

To convert from	to	Multiply by	
tablespoon.....	cubic meter (m ³).....	1.478 676	E−05
tablespoon.....	milliliter (mL).....	1.478 676	E+01
teaspoon.....	cubic meter (m ³).....	4.928 922	E−06
teaspoon.....	milliliter (mL).....	4.928 922	E+00
tex.....	kilogram per meter (kg/m).....	1.0	E−06
therm (EC) ²⁵	joule (J).....	1.055 06	E+08
therm (U.S.) ²⁵	joule (J).....	1.054 804	E+08
ton, assay (AT).....	kilogram (kg).....	2.916 667	E−02
ton, assay (AT).....	gram (g).....	2.916 667	E+01
ton-force (2000 lbf).....	newton (N).....	8.896 443	E+03
ton-force (2000 lbf).....	kilonewton (kN).....	8.896 443	E+00
ton, long (2240 lb).....	kilogram (kg).....	1.016 047	E+03
ton, long, per cubic yard.....	kilogram per cubic meter (kg/m ³).....	1.328 939	E+03
<i>ton, metric</i> (t).....	kilogram (kg).....	1.0	E+03
tonne (called “metric ton” in U.S.) (t).....	kilogram (kg).....	1.0	E+03
ton of refrigeration (12 000 Btu _{IT} /h).....	watt (W).....	3.516 853	E+03
ton of TNT (energy equivalent) ²⁶	joule (J).....	4.184	E+09
ton, register.....	cubic meter (m ³).....	2.831 685	E+00
ton, short (2000 lb).....	kilogram (kg).....	9.071 847	E+02
ton, short, per cubic yard.....	kilogram per cubic meter (kg/m ³).....	1.186 553	E+03
ton, short, per hour.....	kilogram per second (kg/s).....	2.519 958	E−01
torr (Torr).....	pascal (Pa).....	1.333 224	E+02
unit pole.....	weber (Wb).....	1.256 637	E−07
<i>watt hour</i> (W · h).....	joule (J).....	3.6	E+03
<i>watt per square centimeter</i> (W/cm ²).....	watt per square meter (W/m ²).....	1.0	E+04
<i>watt per square inch</i> (W/in ²).....	watt per square meter (W/m ²).....	1.550 003	E+03
<i>watt second</i> (W · s).....	joule (J).....	1.0	E+00
yard (yd).....	meter (m).....	9.144	E−01
year (365 days).....	second (s).....	3.1536	E+07
year (sidereal).....	second (s).....	3.155 815	E+07
year (tropical).....	second (s).....	3.155 693	E+07

²⁵ The therm (EC) is legally defined in the Council Directive of 20 December 1979, Council of the European Communities (now the European Union, EU). The therm (U.S.) is legally defined in the Federal Register of July 27, 1968. Although the therm (EC), which is based on the International Table Btu, is frequently used by engineers in the United States, the therm (U.S.) is the legal unit used by the U.S. natural gas industry.

²⁶ Defined (not measured) value.

CONVERSION OF TEMPERATURES

From	To	
Celsius	Fahrenheit	$t_F/^{\circ}\text{F} = (9/5) t/^{\circ}\text{C} + 32$
	Kelvin	$T/\text{K} = t/^{\circ}\text{C} + 273.15$
	Rankine	$T/^{\circ}\text{R} = (9/5) (t/^{\circ}\text{C} + 273.15)$
Fahrenheit	Celsius	$t/^{\circ}\text{C} = (5/9) [(t_F/^{\circ}\text{F}) - 32]$
	Kelvin	$T/\text{K} = (5/9) [(t_F/^{\circ}\text{F}) - 32] + 273.15$
	Rankine	$T/^{\circ}\text{R} = t_F/^{\circ}\text{F} + 459.67$
Kelvin	Celsius	$t/^{\circ}\text{C} = T/\text{K} - 273.15$
	Rankine	$T/^{\circ}\text{R} = (9/5) T/\text{K}$
Rankine	Fahrenheit	$t_F/^{\circ}\text{F} = T/^{\circ}\text{R} - 459.67$
	Kelvin	$T/\text{K} = (5/9) T/^{\circ}\text{R}$

Definition of symbols:

T = thermodynamic (absolute) temperature

t = Celsius temperature (the symbol q is also used for Celsius temperature)

t_F = Fahrenheit temperature

DESIGNATION OF LARGE NUMBERS

	U.S.A.	Other Countries
10^6	million	million
10^9	billion	milliard
10^{12}	trillion	billion
10^{15}	quadrillion	billiard
10^{18}	quintillion	trillion
10^{100}	googol	
10^{googol}	googolplex	

CONVERSION FACTORS FOR ENERGY UNITS

If greater accuracy is required, use the *Energy Equivalents* section of the *Fundamental Physical Constants* table.

	Wavenumber $\bar{\nu}$ cm ⁻¹	Frequency ν MHz	Energy E aJ	Energy E eV	Energy E E_h	Molar energy E_m kJ/mol	Molar energy E_m kcal/mol	Temperature T K
$\bar{\nu}$: 1 cm ⁻¹	≐ 1	2.997925×10^4	1.986447×10^{-5}	1.239842×10^{-4}	4.556335×10^{-6}	11.96266×10^{-3}	2.85914×10^{-3}	1.438769
ν : 1 MHz	≐ 3.33564×10^{-5}	1	6.626076×10^{-10}	4.135669×10^{-9}	1.519830×10^{-10}	3.990313×10^{-7}	9.53708×10^{-8}	4.79922×10^{-5}
1 aJ	≐ 50341.1	1.509189×10^9	1	6.241506	0.2293710	602.2137	143.9325	7.24292×10^4
E : 1 eV	≐ 8065.54	2.417988×10^8	0.1602177	1	3.674931×10^{-2}	96.4853	23.0605	1.16045×10^4
E_h	≐ 219474.63	6.579684×10^9	4.359748	27.2114	1	2625.500	627.510	3.15773×10^5
E_m : 1 kJ/mol	≐ 83.5935	2.506069×10^6	1.660540×10^{-3}	1.036427×10^{-2}	3.808798×10^{-4}	1	0.239006	120.272
1 kcal/mol	≐ 349.755	1.048539×10^7	6.947700×10^{-3}	4.336411×10^{-2}	1.593601×10^{-3}	4.184	1	503.217
T : 1 K	≐ 0.695039	2.08367×10^4	1.380658×10^{-5}	8.61738×10^{-5}	3.16683×10^{-6}	8.31451×10^{-3}	1.98722×10^{-3}	1

Examples of the use of this table: 1 aJ ≐ 50341 cm⁻¹
1 eV ≐ 96.4853 kJ mol⁻¹

The symbol ≐ should be read as meaning “corresponds to” or “is equivalent to”.
 $E = h\nu = hc\bar{\nu} = kT$; $E_m = N_A E$; E_h is the Hartree energy

CONVERSION FACTORS FOR PRESSURE UNITS

	Pa	kPa	MPa	bar	atmos	Torr	μmHg	psi
Pa	1	0.001	0.000001	0.00001	9.8692×10^{-6}	0.0075006	7.5006	0.0001450377
kPa	1000	1	0.001	0.01	0.0098692	7.5006	7500.6	0.1450377
MPa	1000000	1000	1	10	9.8692	7500.6	7500600	145.0377
bar	100000	100	0.1	1	0.98692	750.06	750060	14.50377
atmos	101325	101.325	0.101325	1.01325	1	760	760000	14.69594
Torr	133.322	0.133322	0.000133322	0.00133322	0.00131579	1	1000	0.01933672
μmHg	0.133322	0.000133322	1.33322×10^{-7}	1.33322×10^{-6}	1.31579×10^{-6}	0.001	1	1.933672×10^{-5}
psi	6894.757	6.894757	0.006894757	0.06894757	0.068046	51.7151	51715.1	1

To convert a pressure value from a unit in the left hand column to a new unit, multiply the value by the factor appearing in the column for the new unit. For example:

$$1 \text{ kPa} = 9.8692 \times 10^{-3} \text{ atmos}$$

$$1 \text{ Torr} = 1.33322 \times 10^{-4} \text{ MPa}$$

Notes: μmHg is often referred to as “micron”

Torr is essentially identical to mmHg

psi is an abbreviation for the unit pound–force per square inch

psia (as a term for a physical quantity) implies the true (absolute) pressure

psig implies the true pressure minus the local atmospheric pressure

CONVERSION FACTORS FOR THERMAL CONDUCTIVITY UNITS

MULTIPLY

↓ by appropriate

factor to
OBTAIN→

	Btu _{IT} h ⁻¹ ft ⁻¹ °F ⁻¹	Btu _{IT} in. h ⁻¹ ft ⁻² °F ⁻¹	Btu _{th} h ⁻¹ ft ⁻¹ °F ⁻¹	Btu _{th} in. h ⁻¹ ft ⁻² °F ⁻¹	cal _{IT} s ⁻¹ cm ⁻¹ °C ⁻¹	cal _{th} s ⁻¹ cm ⁻¹ °C ⁻¹	kcal _{th} h ⁻¹ m ⁻¹ °C ⁻¹	J s ⁻¹ cm ⁻¹ K ⁻¹	W cm ⁻¹ K ⁻¹	W m ⁻¹ K ⁻¹	mW cm ⁻¹ K ⁻¹
Btu _{IT} h ⁻¹ ft ⁻¹ °F ⁻¹	1	12	1.00067	12.0080	4.13379 × 10 ⁻³	4.13656 × 10 ⁻³	1.48916	1.73073 × 10 ⁻²	1.73073 × 10 ⁻²	1.73073	17.3073
Btu _{IT} in. h ⁻¹ ft ⁻² °F ⁻¹	8.33333 × 10 ⁻²	1	8.33891 × 10 ⁻²	1.00067	3.44482 × 10 ⁻⁴	3.44713 × 10 ⁻⁴	0.124097	1.44228 × 10 ⁻³	1.44228 × 10 ⁻³	0.144228	1.44228
Btu _{th} h ⁻¹ ft ⁻¹ °F ⁻¹	0.999331	11.9920	1	12	4.13102 × 10 ⁻³	4.13379 × 10 ⁻³	1.48816	1.72958 × 10 ⁻²	1.72958 × 10 ⁻²	1.72958	17.2958
Btu _{th} in. h ⁻¹ ft ⁻² °F ⁻¹	8.32776 × 10 ⁻²	0.999331	8.33333 × 10 ⁻²	1	3.44252 × 10 ⁻⁴	3.44482 × 10 ⁻⁴	0.124014	1.44131 × 10 ⁻³	1.44131 × 10 ⁻³	0.144131	1.44131
cal _{IT} s ⁻¹ cm ⁻¹ °C ⁻¹	2.41909 × 10 ²	2.90291 × 10 ³	2.42071 × 10 ²	2.90485 × 10 ³	1	1.00067	3.60241 × 10 ²	4.1868	4.1868	4.1868 × 10 ²	4.1868 × 10 ³
cal _{th} s ⁻¹ cm ⁻¹ °C ⁻¹	2.41747 × 10 ²	2.90096 × 10 ³	2.41909 × 10 ²	2.90291 × 10 ³	0.999331	1	3.6 × 10 ²	4.184	4.184	4.184 × 10 ²	4.184 × 10 ³
kcal _{th} h ⁻¹ m ⁻¹ °C ⁻¹	0.671520	8.05824	0.671969	8.06363	2.77592 × 10 ⁻³	2.77778 × 10 ⁻³	1	1.16222 × 10 ⁻²	1.16222 × 10 ⁻²	1.16222	11.6222
J s ⁻¹ cm ⁻¹ K ⁻¹	57.7789	6.93347 × 10 ²	57.8176	6.93811 × 10 ²	0.238846	0.239006	86.0421	1	1	1 × 10 ²	1 × 10 ³
W cm ⁻¹ K ⁻¹	57.7789	6.93347 × 10 ²	57.8176	6.93811 × 10 ²	0.238846	0.239006	86.0421	1	1	1 × 10 ²	1 × 10 ³
W m ⁻¹ K ⁻¹	0.577789	6.93347	0.578176	6.93811	2.38846 × 10 ⁻³	2.39006 × 10 ⁻³	0.860421	1 × 10 ⁻²	1 × 10 ⁻²	1	10
mW cm ⁻¹ K ⁻¹	5.77789 × 10 ⁻²	0.693347	5.78176 × 10 ⁻²	0.693811	2.38846 × 10 ⁻⁴	2.39006 × 10 ⁻⁴	8.60421 × 10 ⁻²	1 × 10 ⁻³	1 × 10 ⁻³	0.1	1

CONVERSION FACTORS FOR ELECTRICAL RESISTIVITY UNITS

To convert from
 ↓ multiply by
 appropriate
 factor to

Obtain →	abΩ cm	μΩ cm	Ω cm	StatΩ cm	Ω m	Ω cir. mil ft ⁻¹	Ω in.	Ω ft
abohm centimeter	1	1×10^{-3}	10^{-9}	1.113×10^{-21}	10^{-11}	6.015×10^{-3}	3.937×10^{-10}	3.281×10^{-11}
microhm centimeter	10^3	1	10^{-6}	1.113×10^{-18}	10^{-8}	6.015	3.937×10^{-7}	3.281×10^{-6}
ohm centimeter	10^8	10^6	1	1.113×10^{-12}	1×10^{-2}	6.015×10^6	3.937×10^{-1}	3.281×10^{-2}
statohm centimeter (esu)	8.987×10^{20}	8.987×10^{17}	8.987×10^{11}	1	8.987×10^9	5.406×10^{18}	3.538×10^{11}	2.949×10^{10}
ohm meter	10^{11}	10^8	10^2	1.113×10^{-10}	1	6.015×10^8	3.937×10^1	3.281
ohm circular mil per foot	1.662×10^2	1.662×10^{-1}	1.662×10^{-7}	1.850×10^{-19}	1.662×10^{-9}	1	6.54×10^{-6}	5.45×10^{-9}
ohm inch	2.54×10^9	2.54×10^6	2.54	2.827×10^{-12}	2.54×10^{-2}	1.528×10^7	1	8.3×10^{-2}
ohm foot	3.048×10^{10}	3.048×10^7	3.048×10^{-1}	3.3924×10^{-11}	3.048×10^{-1}	1.833×10^8	12	1

CONVERSION FACTORS FOR CHEMICAL KINETICS

Equivalent second order rate constants

A \ B	$\text{cm}^3 \text{ mol}^{-1} \text{ s}^{-1}$	$\text{dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$	$\text{m}^3 \text{ mol}^{-1} \text{ s}^{-1}$	$\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	$(\text{mm Hg})^{-1} \text{ s}^{-1}$	$\text{atm}^{-1} \text{ s}^{-1}$	$\text{ppm}^{-1} \text{ min}^{-1}$	$\text{m}^2 \text{ kN}^{-1} \text{ s}^{-1}$
1 $\text{cm}^3 \text{ mol}^{-1} \text{ s}^{-1} =$	1	10^{-3}	10^{-6}	1.66×10^{-24}	$1.604 \times 10^{-5} T^{-1}$	$1.219 \times 10^{-2} T^{-1}$	2.453×10^{-9}	$1.203 \times 10^{-4} T^{-1}$
1 $\text{dm}^3 \text{ mol}^{-1} \text{ s}^{-1} =$	10^3	1	10^{-3}	1.66×10^{-21}	$1.604 \times 10^{-2} T^{-1}$	$12.19 T^{-1}$	2.453×10^{-6}	$1.203 \times 10^{-1} T^{-1}$
1 $\text{m}^3 \text{ mol}^{-1} \text{ s}^{-1} =$	10^6	10^3	1	1.66×10^{-18}	$16.04 T^{-1}$	$1.219 \times 10^4 T^{-1}$	2.453×10^{-3}	$120.3 T^{-1}$
1 $\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1} =$	6.023×10^{23}	6.023×10^{20}	6.023×10^{17}	1	$9.658 \times 10^{18} T^{-1}$	$7.34 \times 10^{21} T^{-1}$	1.478×10^{15}	$7.244 \times 10^{19} T^{-1}$
1 $(\text{mm Hg})^{-1} \text{ s}^{-1} =$	$6.236 \times 10^4 T$	$62.36 T$	$6.236 \times 10^{-2} T$	$1.035 \times 10^{-19} T$	1	760	4.56×10^{-2}	7.500
1 $\text{atm}^{-1} \text{ s}^{-1}$	$82.06 T$	$8.206 \times 10^{-2} T$	$8.206 \times 10^{-5} T$	$1.362 \times 10^{-22} T$	1.316×10^{-3}	1	6×10^{-5}	9.869×10^{-3}
1 $\text{ppm}^{-1} \text{ min}^{-1} =$ at 298 K, 1 atm total pressure	4.077×10^8	4.077×10^5	407.7	6.76×10^{-16}	21.93	1.667×10^4	1	164.5
1 $\text{m}^2 \text{ kN}^{-1} \text{ s}^{-1} =$	$8314 T$	$8.314 T$	$8.314 \times 10^{-3} T$	$1.38 \times 10^{-20} T$	0.1333	101.325	6.079×10^{-3}	1

To convert a rate constant from one set of units A to a new set B find the conversion factor for the row A under column B and multiply the old value by it, e.g. to convert $\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ to $\text{m}^3 \text{ mol}^{-1} \text{ s}^{-1}$ multiply by 6.023×10^{17} .

Table adapted from High Temperature Reaction Rate Data No. 5, The University, Leeds (1970).

Equivalent third order rate constants

A \ B	$\text{cm}^6 \text{ mol}^{-2} \text{ s}^{-1}$	$\text{dm}^6 \text{ mol}^{-2} \text{ s}^{-1}$	$\text{m}^6 \text{ mol}^{-2} \text{ s}^{-1}$	$\text{cm}^6 \text{ molecule}^{-2} \text{ s}^{-1}$	$(\text{mm Hg})^{-2} \text{ s}^{-1}$	$\text{atm}^{-2} \text{ s}^{-1}$	$\text{ppm}^{-2} \text{ min}^{-1}$	$\text{m}^4 \text{ kN}^{-2} \text{ s}^{-1}$
1 $\text{cm}^6 \text{ mol}^{-2} \text{ s}^{-1} =$	1	10^{-6}	10^{-12}	2.76×10^{-48}	$2.57 \times 10^{-10} T^{-2}$	$1.48 \times 10^{-4} T^{-2}$	1.003×10^{-10}	$1.447 \times 10^{-8} T^{-2}$
1 $\text{dm}^6 \text{ mol}^{-2} \text{ s}^{-1} =$	10^6	1	10^{-6}	2.76×10^{-42}	$2.57 \times 10^{-4} T^{-2}$	$148 T^{-2}$	1.003×10^{-13}	$1.447 \times 10^{-2} T^{-2}$
1 $\text{m}^6 \text{ mol}^{-2} \text{ s}^{-1} =$	10^{12}	10^6	1	2.76×10^{-36}	$257 T^{-2}$	$1.48 \times 10^8 T^{-2}$	1.003×10^{-7}	$1.447 \times 10^4 T^{-2}$
1 $\text{cm}^6 \text{ molecule}^{-2} \text{ s}^{-1} =$	3.628×10^{47}	3.628×10^{41}	3.628×10^{35}	1	$9.328 \times 10^{37} T^{-2}$	$5.388 \times 10^{43} T^{-2}$	3.64×10^{28}	$5.248 \times 10^{39} T^{-2}$
1 $(\text{mm Hg})^{-2} \text{ s}^{-1} =$	$3.89 \times 10^9 T^2$	$3.89 \times 10^3 T^2$	$3.89 \times 10^{-3} T^2$	$1.07 \times 10^{-38} T^2$	1	5.776×10^5	3.46×10^{-5}	56.25
1 $\text{atm}^{-2} \text{ s}^{-1} =$	$6.733 \times 10^3 T^2$	$6.733 \times 10^{-3} T^2$	$6.733 \times 10^{-9} T^2$	$1.86 \times 10^{-44} T^2$	1.73×10^{-6}	1	6×10^{-11}	9.74×10^{-5}
1 $\text{ppm}^{-2} \text{ min}^{-1} =$ at 298 K, 1 atm total pressure	9.97×10^{18}	9.97×10^{12}	9.97×10^6	2.75×10^{-29}	2.89×10^4	1.667×10^{10}	1	1.623×10^8
1 $\text{m}^4 \text{ kN}^{-2} \text{ s}^{-1} =$	$6.91 \times 10^7 T^2$	$6.91 T^2$	$69.1 \times 10^{-3} T^2$	$1.904 \times 10^{-40} T^2$	0.0178	1.027×10^4	6.16×10^{-7}	1

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CONVERSION FACTORS FOR IONIZING RADIATION

CONVERSION BETWEEN SI AND OTHER UNITS

Quantity	Symbol for quantity	Expression in SI units	Expression in symbols for SI units	Special name for SI units	Symbols using special names	Conventional units	Symbol for conventional unit	Value of conventional unit in SI units
Activity	A	1 per second	s^{-1}	becquerel	Bq	curie	Ci	3.7×10^{10} Bq
Absorbed dose	D	joule per kilogram	$J\ kg^{-1}$	gray	Gy	rad	rad	0.01 Gy
Absorbed dose rate	\dot{D}	joule per kilogram second	$J\ kg^{-1}\ s^{-1}$		$Gy\ s^{-1}$	rad	rad s^{-1}	0.01 Gy s^{-1}
Average energy per ion pair	W	joule	J			electronvolt	eV	1.602×10^{-19} J
Dose equivalent	H	joule per kilogram	$J\ kg^{-1}$	sievert	Sv	rem	rem	0.01 Sv
Dose equivalent rate	\dot{H}	joule per kilogram second	$J\ kg^{-1}\ s^{-1}$		$Sv\ s^{-1}$	rem per second	rem s^{-1}	0.01 Sv s^{-1}
Electric current	I	ampere	A			ampere	A	1.0 A
Electric potential difference	U, V	watt per ampere	$W\ A^{-1}$	volt	V	volt	V	1.0 A
Exposure	X	coulomb per kilogram	$C\ kg^{-1}$			roentgen	R	2.58×10^{-4} C kg^{-1}
Exposure rate	\dot{X}	coulomb per kilogram second	$C\ kg^{-1}\ s^{-1}$			roentgen	R s^{-1}	2.58×10^{-4} C $kg^{-1}\ s^{-1}$
Fluence	ϕ	1 per meter squared	m^{-2}			1 per centimeter squared	cm^{-2}	$1.0 \times 10^4\ m^{-2}$
Fluence rate	Φ	1 per meter squared second	$m^{-2}\ s^{-1}$			1 per centimeter squared second	$cm^{-2}\ s^{-1}$	$1.0 \times 10^4\ m^{-2}\ s^{-1}$
Kerma	K	joule per kilogram	$J\ kg^{-1}$	gray	Gy	rad	rad	0.01 Gy
Kerma rate	\dot{K}	joule per kilogram second	$J\ kg^{-1}\ s^{-1}$		$Gy\ s^{-1}$	rad per second	rad s^{-1}	0.01 Gy s^{-1}
Lineal energy	y	joule per meter	$J\ m^{-1}$			kiloelectron volt per micrometer	keV μm^{-1}	1.602×10^{-10} J m^{-1}
Linear energy transfer	L	joule per meter	$J\ m^{-1}$			kiloelectron volt per micrometer	keV μm^{-1}	1.602×10^{-10} J m^{-1}
Mass attenuation coefficient	μ/ρ	meter squared per kilogram	$m^2\ kg^{-1}$			centimeter squared per gram	$cm^2\ g^{-1}$	0.1 $m^2\ kg^{-1}$
Mass energy transfer coefficient	μ_{tr}/ρ	meter squared per kilogram	$m^2\ kg^{-1}$			centimeter squared per gram	$cm^2\ g^{-1}$	0.1 $m^2\ kg^{-1}$
Mass energy absorption coefficient	μ_{en}/ρ	meter squared per kilogram	$m^2\ kg^{-1}$			centimeter squared per gram	$cm^2\ g^{-1}$	0.1 $m^2\ kg^{-1}$
Mass stopping power	S/ρ	joule meter squared per kilogram	$J\ m^2\ kg^{-1}$			MeV centimeter squared per gram	MeV $cm^2\ g^{-1}$	1.602×10^{-14} J $m^2\ kg^{-1}$
Power	P	joule per second	$J\ s^{-1}$	watt	W	watt	W	1.0 W
Pressure	p	newton per meter squared	$N\ m^{-2}$	pascal	Pa	torr	torr	(101325/760)Pa
Radiation chemical yield	G	mole per joule	$mol\ J^{-1}$			molecules per 100 electron volts	molecules $(100\ eV)^{-1}$	1.04×10^{-7} mol J^{-1}
Specific energy	z	joule per kilogram	$J\ kg^{-1}$	gray	Gy	rad	rad	0.01 Gy

CONVERSION FACTORS FOR IONIZING RADIATION (continued)

CONVERSION OF RADIOACTIVITY UNITS FROM MBq TO mCi AND μ Ci

MBq	mCi	MBq	mCi	MBq	μ Ci	MBq	μ Ci
7000	189.	500	13.5	30	810	1	27
6000	162.	400	10.8	20	540	0.9	24
5000	135.	300	8.1	10	270	0.8	21.6
4000	108.	200	5.4	9	240	0.7	18.9
3000	81.	100	2.7	8	220	0.6	16.2
2000	54.	90	2.4	7	189	0.5	13.5
1000	27.	80	2.16	6	162	0.4	10.8
900	24.	70	1.89	5	135	0.3	8.1
800	21.6	60	1.62	4	108	0.2	5.4
700	18.9	50	1.35	3	81	0.1	2.7
600	16.2	40	1.08	2	54		

CONVERSION OF RADIOACTIVITY UNITS FROM mCi AND μ Ci TO MBq

mCi	MBq	mCi	MBq	μ Ci	MBq	μ Ci	MBq
200	7400	10	370	1000	37.0	80	2.96
150	5550	9	333	900	33.3	70	2.59
100	3700	8	296	800	29.6	60	2.22
90	3330	7	259	700	25.9	50	1.85
80	2960	6	222	600	22.2	40	1.48
70	2590	5	185	500	18.5	30	1.11
60	2220	4	148	400	14.8	20	0.74
50	1850	3	111	300	11.1	10	0.37
40	1480	2	74.0	200	7.4	5	0.185
30	1110	1	37.0	100	3.7	2	0.074
20	740			90	3.33	1	0.037

CONVERSION OF RADIOACTIVITY UNITS

<p>100 TBq (10^{14} Bq) = 2.7 kCi (2.7×10^3 Ci)</p> <p>10 TBq (10^{13} Bq) = 270 Ci (2.7×10^2 Ci)</p> <p>1 TBq (10^{12} Bq) = 27 Ci (2.7×10^1 Ci)</p> <p>100 GBq (10^{11} Bq) = 2.7 Ci (2.7×10^0 Ci)</p> <p>10 GBq (10^{10} Bq) = 270 mCi (2.7×10^{-1} Ci)</p> <p>1 GBq (10^9 Bq) = 27 mCi (2.7×10^{-2} Ci)</p> <p>100 MBq (10^8 Bq) = 2.7 mCi (2.7×10^{-3} Ci)</p> <p>10 MBq (10^7 Bq) = 270 μCi (2.7×10^{-4} Ci)</p> <p>1 MBq (10^6 Bq) = 27 μCi (2.7×10^{-5} Ci)</p>	<p>100 kBq (10^5 Bq) = 2.7 μCi (2.7×10^{-6} Ci)</p> <p>10 kBq (10^4 Bq) = 270 nCi (2.7×10^{-7} Ci)</p> <p>1 kBq (10^3 Bq) = 27 nCi (2.7×10^{-8} Ci)</p> <p>100 Bq (10^2 Bq) = 2.7 nCi (2.7×10^{-9} Ci)</p> <p>10 Bq (10^1 Bq) = 270 pCi (2.7×10^{-10} Ci)</p> <p>1 Bq (10^0 Bq) = 27 pCi (2.7×10^{-11} Ci)</p> <p>100 mBq (10^{-1} Bq) = 2.7 pCi (2.7×10^{-12} Ci)</p> <p>10 mBq (10^{-2} Bq) = 270 fCi (2.7×10^{-13} Ci)</p> <p>1 mBq (10^{-3} Bq) = 27 fCi (2.7×10^{-14} Ci)</p>
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CONVERSION OF ABSORBED DOSE UNITS

SI Units	Conventional
100 Gy (10^2 Gy)	= 10,000 rad (10^4 rad)
10 Gy (10^1 Gy)	= 1,000 rad (10^3 rad)
1 Gy (10^0 Gy)	= 100 rad (10^2 rad)
100 mGy (10^{-1} Gy)	= 10 rad (10^1 rad)
10 mGy (10^{-2} Gy)	= 1 rad (10^0 rad)
1 mGy (10^{-3} Gy)	= 100 mrad (10^{-1} rad)
100 μ Gy (10^{-4} Gy)	= 10 mrad (10^{-2} rad)
10 μ Gy (10^{-5} Gy)	= 1 mrad (10^{-3} rad)
1 μ Gy (10^{-6} Gy)	= 100 μ rad (10^{-4} rad)
100 nGy (10^{-7} Gy)	= 10 μ rad (10^{-5} rad)
10 nGy (10^{-8} Gy)	= 1 μ rad (10^{-6} rad)
1 nGy (10^{-9} Gy)	= 100 nrad (10^{-7} rad)

CONVERSION OF DOSE EQUIVALENT UNITS

100 Sv (10^2 Sv)	= 10,000 rem (10^4 rem)
10 Sv (10^1 Sv)	= 1,000 rem (10^3 rem)
1 Sv (10^0 Sv)	= 100 rem (10^2 rem)
100 mSv (10^{-1} Sv)	= 10 rem (10^1 rem)
10 mSv (10^{-2} Sv)	= 1 rem (10^0 rem)
1 mSv (10^{-3} Sv)	= 100 mrem (10^{-1} rem)
100 μ Sv (10^{-4} Sv)	= 10 mrem (10^{-2} rem)
10 μ Sv (10^{-5} Sv)	= 1 mrem (10^{-3} rem)
1 μ Sv (10^{-6} Sv)	= 100 μ rem (10^{-4} rem)
100 nSv (10^{-7} Sv)	= 10 μ rem (10^{-5} rem)
10 nSv (10^{-8} Sv)	= 1 μ rem (10^{-6} rem)
1 nSv (10^{-9} Sv)	= 100 nrem (10^{-7} rem)

VALUES OF THE GAS CONSTANT IN DIFFERENT UNIT SYSTEMS

In SI units the value of the gas constant, R , is:

$$\begin{aligned} R &= 8.314510 \text{ Pa m}^3 \text{ K}^{-1} \text{ mol}^{-1} \\ &= 8314.510 \text{ Pa L K}^{-1} \text{ mol}^{-1} \\ &= 0.08314510 \text{ bar L K}^{-1} \text{ mol}^{-1} \end{aligned}$$

This table gives the appropriate value of R for use in the ideal gas equation, $PV = nRT$, when the variables are expressed in other units. The following conversion factors for pressure units were used in generating the table:

$$\begin{aligned} 1 \text{ atm} &= 101325 \text{ Pa} \\ 1 \text{ psi} &= 6894.757 \text{ Pa} \\ 1 \text{ torr (mmHg)} &= 133.322 \text{ Pa [at } 0^\circ\text{C]} \\ 1 \text{ in Hg} &= 3386.38 \text{ Pa [at } 0^\circ\text{C]} \\ 1 \text{ in H}_2\text{O} &= 249.082 \text{ Pa [at } 4^\circ\text{C]} \\ 1 \text{ ft H}_2\text{O} &= 2988.98 \text{ Pa [at } 4^\circ\text{C]} \end{aligned}$$

The advice of Prabir K. Chandra is appreciated.

Units of V, T, n			Units of P						
V	T	n	kPa	atm	psi	mmHg	in Hg	in H ₂ O	ft H ₂ O
ft ³	K	mol	0.2936241	0.00289785	0.0425866	2.20237	0.0867074	1.17882	0.0982355
		lb-mol	133.1857	1.31444	19.3169	998.978	39.3298	534.706	44.5589
	°R	mol	0.1631245	0.00160991	0.0236592	1.22354	0.0481708	0.654903	0.0545753
		lb-mol	73.99204	0.730245	10.7316	554.987	21.8499	297.059	24.7549
cm ³	K	mol	8314.510	82.0578	1205.92	62364.1	2455.28	33380.6	2781.72
		lb-mol	3771398	37220.8	546995	28287900	1113700	15141200	1261770
	°R	mol	4619.172	45.5877	669.954	34646.7	1364.04	18544.8	1545.40
		lb-mol	2095221	20678.2	303886	15715500	618720	8411770	700982
L	K	mol	8.314510	0.0820578	1.20592	62.3641	2.45528	33.3806	2.78172
		lb-mol	3771.398	37.2208	546.995	28287.9	1113.70	15141.2	1261.77
	°R	mol	4.619172	0.0455877	0.669954	34.6467	1.36404	18.5448	1.54540
		lb-mol	2095.221	20.6782	303.886	15715.5	618.720	8411.77	700.982
m ³	K	mol	0.008314510	0.0000820578	0.00120592	0.0623641	0.00245528	0.0333806	0.00278172
		lb-mol	3.771398	0.0372208	0.546995	28.2879	1.11370	15.1412	1.26177
	°R	mol	0.004619172	0.0000455877	0.000669954	0.0346467	0.00136404	0.0185448	0.00154540
		lb-mol	2.095221	0.0206782	0.303886	15.7155	0.618720	8.41177	0.700982

PERIODIC TABLE OF THE ELEMENTS

1 Group IA		2 IIA		New Notation Previous IUPAC Form CAS Version										13 IIIB IIIA	14 IVB IVA	15 VB VA	16 VIB VIA	17 VIIB VIIA	18 VIIIA	Shell								
1 H 1.00794 1																				2 He 4.002602 2	K							
3 Li 6.941 2-1	4 Be 9.012182 2-2																				5 B 10.811 2-3	6 C 12.0107 2-4	7 N 14.0067 2-5	8 O 15.9994 2-6	9 F 18.9984032 2-7	10 Ne 20.1797 2-8	K-L	
11 Na 22.989770 2-8-1	12 Mg 24.3050 2-8-2	3 IIIA IIIB	4 IVA IVB	5 VA VB	6 VIA VIB	7 VIIA VIIB	8 VIII VIII	9 VIII VIII	10 VIII VIII	11 IB IB	12 IIB IIB	13 Al 26.981538 2-8-3	14 Si 28.0855 2-8-4	15 P 30.973761 2-8-5	16 S 32.065 2-8-6	17 Cl 35.453 2-8-7	18 Ar 39.948 2-8-8									K-L-M		
19 K 39.0983 -8-8-1	20 Ca 40.078 -8-8-2	21 Sc 44.955910 -8-9-2	22 Ti 47.867 -8-10-2	23 V 50.9415 -8-11-2	24 Cr 51.9961 -8-13-1	25 Mn 54.938049 -8-13-2	26 Fe 55.845 -8-14-2	27 Co 58.933200 -8-15-2	28 Ni 58.6934 -8-16-2	29 Cu 63.546 -8-18-1	30 Zn 65.409 -8-18-2	31 Ga 69.723 -8-18-3	32 Ge 72.64 -8-18-4	33 As 74.92160 -8-18-5	34 Se 78.96 -8-18-6	35 Br 79.904 -8-18-7	36 Kr 83.798 -8-18-8										-L-M-N	
37 Rb 85.4678 -18-8-1	38 Sr 87.62 -18-8-2	39 Y 88.90585 -18-9-2	40 Zr 91.224 -18-10-2	41 Nb 92.90638 -18-12-1	42 Mo 95.94 -18-13-1	43 Tc (98) -18-13-2	44 Ru 101.07 -18-15-1	45 Rh 102.90550 -18-16-1	46 Pd 106.42 -18-18-0	47 Ag 107.8682 -18-18-1	48 Cd 112.411 -18-18-2	49 In 114.818 -18-18-3	50 Sn 118.710 -18-18-4	51 Sb 121.760 -18-18-5	52 Te 127.60 -18-18-6	53 I 126.90447 -18-18-7	54 Xe 131.293 -18-18-8										-M-N-O	
55 Cs 132.90545 -18-8-1	56 Ba 137.327 -18-8-2	57* La 138.9055 -18-9-2	72 Hf 178.49 -32-10-2	73 Ta 180.9479 -32-11-2	74 W 183.84 -32-12-2	75 Re 186.207 -32-13-2	76 Os 190.23 -32-14-2	77 Ir 192.217 -32-15-2	78 Pt 195.078 -32-17-1	79 Au 196.96655 -32-18-1	80 Hg 200.59 -32-18-2	81 Tl 204.3833 -32-18-3	82 Pb 207.2 -32-18-4	83 Bi 208.98038 -32-18-5	84 Po (209) -32-18-6	85 At (210) -32-18-7	86 Rn (222) -32-18-8										-N-O-P	
87 Fr (223) -18-8-1	88 Ra (226) -18-8-2	89** Ac (227) -18-9-2	104 Rf (261) -32-10-2	105 Db (262) -32-11-2	106 Sg (266) -32-12-2	107 Bh (264) -32-13-2	108 Hs (277) -32-14-2	109 Mt (268) -32-15-2	110 Uun (281) -32-16-2	111 Uuu (272)	112 Uub (285)		114 Uuq (289)		116 Uuh (289)													-O-P-Q
* Lanthanides		58 Ce 140.116 -19-9-2	59 Pr 140.90765 -21-8-2	60 Nd 144.24 -22-8-2	61 Pm (145) -23-8-2	62 Sm 150.36 -24-8-2	63 Eu 151.964 -25-8-2	64 Gd 157.25 -25-9-2	65 Tb 158.92534 -27-8-2	66 Dy 162.500 -28-8-2	67 Ho 164.93032 -29-8-2	68 Er 167.259 -30-8-2	69 Tm 168.93421 -31-8-2	70 Yb 173.04 -32-8-2	71 Lu 174.967 -32-9-2													-N-O-P
** Actinides		90 Th 232.0381 -18-10-2	91 Pa 231.03588 -20-9-2	92 U 238.02891 -21-9-2	93 Np (237) -22-9-2	94 Pu (244) -24-8-2	95 Am (243) -25-8-2	96 Cm (247) -25-9-2	97 Bk (247) -27-8-2	98 Cf (251) -28-8-2	99 Es (252) -29-8-2	100 Fm (257) -30-8-2	101 Md (258) -31-8-2	102 No (259) -32-8-2	103 Lr (262) -32-8-3													-O-P-Q

Key to Chart

Atomic Number → 50
 Symbol → Sn
 1995 Atomic Weight → 118.710
 -18-18-4

Oxidation States → +2, +4
 Electron Configuration →

The new IUPAC format numbers the groups from 1 to 18. The previous IUPAC numbering system and the system used by Chemical Abstracts Service (CAS) are also shown. For radioactive elements that do not occur in nature, the mass number of the most stable isotope is given in parentheses.

References

1. G. J. Leigh, Editor, *Nomenclature of Inorganic Chemistry*, Blackwell Scientific Publications, Oxford, 1990.
2. *Chemical and Engineering News*, 63(5), 27, 1985.
3. Atomic Weights of the Elements, 1999, *Pure & Appl. Chem.*, 73, 667, 2001.

UNITS FOR MAGNETIC PROPERTIES

Quantity	Symbol	Gaussian & cgs emu ^a	Conversion factor, C ^b	SI & rationalized mks ^c
Magnetic flux density, magnetic induction	B	gauss (G) ^d	10^{-4}	tesla (T), Wb/m ²
Magnetic flux	Φ	maxwell (Mx), G·cm ²	10^{-8}	weber (Wb), volt second (V·s)
Magnetic potential difference, magnetomotive force	U, F	gilbert (Gb)	$10/4\pi$	ampere (A)
Magnetic field strength, magnetizing force	H	oersted (Oe), ^e Gb/cm	$10^3/4\pi$	A/m ^f
(Volume) magnetization ^g	M	emu/cm ³ ^h	10^3	A/m
(Volume) magnetization	$4\pi M$	G	$10^3/4\pi$	A/m
Magnetic polarization, intensity of magnetization	J, I	emu/cm ³	$4\pi \times 10^{-4}$	T, Wb/m ² ⁱ
(Mass) magnetization	σ, M	emu/g	1 $4\pi \times 10^{-7}$	A·m ² /kg Wb·m/kg
Magnetic moment	m	emu, erg/G	10^{-3}	A·m ² , joule per tesla (J/T)
Magnetic dipole moment	j	emu, erg/G	$4\pi \times 10^{-10}$	Wb·m ⁱ
(Volume) susceptibility	χ, κ	dimensionless, emu/cm ³	4π $(4\pi)^2 \times 10^{-7}$	dimensionless henry per meter (H/m), Wb/(A·m)
(Mass) susceptibility	χ_ρ, κ_ρ	cm ³ /g, emu/g	$4\pi \times 10^{-3}$ $(4\pi)^2 \times 10^{-10}$	m ³ /kg H·m ² /kg
(Molar) susceptibility	$\chi_{\text{mol}}, \kappa_{\text{mol}}$	cm ³ /mol, emu/mol	$4\pi \times 10^{-6}$ $(4\pi)^2 \times 10^{-13}$	m ³ /mol H·m ² /mol
Permeability	μ	dimensionless	$4\pi \times 10^{-7}$	H/m, Wb/(A·m)
Relative permeability ^j	μ_r	not defined		dimensionless
(Volume) energy density, energy product ^k	W	erg/cm ³	10^{-1}	J/m ³
Demagnetization factor	D, N	dimensionless	$1/4\pi$	dimensionless

- a. Gaussian units and cgs emu are the same for magnetic properties. The defining relation is $B = H + 4\pi M$.
- b. Multiply a number in Gaussian units by C to convert it to SI (e.g., $1 \text{ G} \times 10^{-4} \text{ T/G} = 10^{-4} \text{ T}$).
- c. SI (*Système International d'Unités*) has been adopted by the National Bureau of Standards. Where two conversion factors are given, the upper one is recognized under, or consistent with, SI and is based on the definition $B = \mu_0(H + M)$, where $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$. The lower one is not recognized under SI and is based on the definition $B = \mu_0 H + J$, where the symbol I is often used in place of J .
- d. $1 \text{ gauss} = 10^5 \text{ gamma } (\gamma)$.
- e. Both oersted and gauss are expressed as $\text{cm}^{-1/2} \cdot \text{g}^{1/2} \cdot \text{s}^{-1}$ in terms of base units.
- f. A/m was often expressed as "ampere-turn per meter" when used for magnetic field strength.
- g. Magnetic moment per unit volume.
- h. The designation "emu" is not a unit.
- i. Recognized under SI, even though based on the definition $B = \mu_0 H + J$. See footnote c.
- j. $\mu_r = \mu/\mu_0 = 1 + \chi$, all in SI. μ_r is equal to Gaussian μ .
- k. $B \cdot H$ and $\mu_0 M \cdot H$ have SI units J/m³; $M \cdot H$ and $B \cdot H/4\pi$ have Gaussian units erg/cm³.

R. B. Goldfarb and F. R. Fickett, U.S. Department of Commerce, National Bureau of Standards, Boulder, Colorado 80303, March 1985
NBS Special Publication 696 For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES

The International Organization for Standardization (ISO), International Union of Pure and Applied Chemistry (IUPAC), and the International Union of Pure and Applied Physics (IUPAP) have jointly developed a set of recommended symbols for physical and chemical quantities. Consistent use of these recommended symbols helps assure unambiguous scientific communication. The list below is reprinted from Reference 1 with permission from IUPAC. Full details may be found in the following references:

1. Ian Mills, Ed., *Quantities, Units, and Symbols in Physical Chemistry*, Blackwell Scientific Publications, Oxford, 1988.
2. E. R. Cohen and P. Giacomo, *Symbols, Units, Nomenclature, and Fundamental Constants in Physics*, Document IUPAP-25, 1987; also published in *Physica*, 146A, 1–68, 1987.
3. *ISO Standards Handbook 2: Units of Measurement*, International Organization of Standardization, Geneva, 1982.

GENERAL RULES

The value of a physical quantity is expressed as the product of a numerical value and a unit, e.g.:

$$T = 300 \text{ K}$$

$$V = 26.2 \text{ cm}^3$$

$$C_p = 45.3 \text{ J mol}^{-1} \text{ K}^{-1}$$

The symbol for a physical quantity is always given in italic (sloping) type, while symbols for units are given in roman type. Column headings in tables and axis labels on graphs may conveniently be written as the physical quantity symbol divided by the unit symbol, e.g.:

$$T/\text{K}$$

$$V/\text{cm}^3$$

$$C_p/\text{J mol}^{-1} \text{ K}^{-1}$$

The values in the table or graph axis are then pure numbers.

Subscripts to symbols for physical quantities should be italic if the subscript refers to another physical quantity or to a number, e.g.:

$$C_p \text{ — heat capacity at constant pressure}$$

$$B_n \text{ — } n\text{th virial coefficient}$$

Subscripts which have other meanings should be in roman type:

$$m_p \text{ — mass of the proton}$$

$$E_k \text{ — kinetic energy}$$

The following tables give the recommended symbols for the major classes of physical and chemical quantities. The expression in the Definition column is given as an aid in identifying the quantity but is not necessarily the complete or unique definition. The SI Unit gives one (not necessarily unique) expression for the coherent SI unit for the quantity. Other equivalent unit expressions, including those which involve SI prefixes, may be used.

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
SPACE AND TIME			
cartesian space coordinates	x, y, z		m
spherical polar coordinates	r, θ, ϕ		m, 1, 1
generalized coordinate	q, q_i		(varies)
position vector	\mathbf{r}	$\mathbf{r} = xi + yj + zk$	m
length	l		m
special symbols:			
height	h		
breadth	b		
thickness	d, δ		
distance	d		

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
radius	r		
diameter	d		
path length	s		
length of arc	s		
area	A, A_s, S		m^2
volume	$V, (v)$		m^3
plane angle	$\alpha, \beta, \gamma, \theta, \phi \dots$	$\alpha = s/r$	rad, 1
solid angle	ω, Ω	$\omega = A/r^2$	sr, 1
time	t		s
period	T	$T = t/N$	s
frequency	ν, f	$\nu = 1/T$	Hz
circular frequency, angular frequency	ω	$\omega = 2\pi\nu$	$\text{rad s}^{-1}, \text{s}^{-1}$
characteristic time interval, relaxation time, time constant	τ, T	$\tau = |dt/d\ln x|$	s
angular velocity	ω	$\omega = d\phi/dt$	$\text{rad s}^{-1}, \text{s}^{-1}$
velocity	v, u, w, c, \dot{r}	$v = dr/dt$	m s^{-1}
speed	v, u, w, c	$v = |v|$	\text{m s^{-1}
acceleration	$a, (g)$	$a = dv/dt$	m s^{-2}

CLASSICAL MECHANICS

mass	m		kg
reduced mass	μ	$\mu = m_1 m_2 / (m_1 + m_2)$	kg
density, mass density	ρ	$\rho = m/V$	kg m^{-3}
relative density	d	$d = \rho/\rho^\circ$	1
surface density	ρ_A, ρ_S	$\rho_A = m/A$	kg m^{-2}
specific volume	v	$v = V/m = 1/\rho$	$\text{m}^3 \text{kg}^{-1}$
momentum	p	$p = mv$	kg m s^{-1}
angular momentum, action	L	$L = r \times p$	J s
moment of inertia	I, J	$I = \sum m_i r_i^2$	kg m^2
force	F	$F = dp/dt = ma$	N
torque, moment of a force	$T, (M)$	$T = r \times F$	N m
energy	E		J
potential energy	E_p, V, Φ	$E_p = -\int F \cdot ds$	J
kinetic energy	E_k, T, K	$E_k = \frac{1}{2}mv^2$	J
work	W, w	$W = \int F \cdot ds$	J
Hamilton function	H	$H(q, p)$ $= T(q, p) + V(q)$	J
Lagrange function	L	$L(q, \dot{q})$ $= T(q, \dot{q}) - V(q)$	J

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
pressure	p, P	$p = F/A$	Pa, N m^{-2}
surface tension	γ, σ	$\gamma = dW/dA$	N m^{-1} , J m^{-2}
weight	$G, (W, P)$	$G = mg$	N
gravitational constant	G	$F = Gm_1 m_2/r^2$	$\text{N m}^2 \text{kg}^{-2}$
normal stress	σ	$\sigma = F/A$	Pa
shear stress	τ	$\tau = F/A$	Pa
linear strain,	ε, e	$\varepsilon = \Delta l/l$	1
relative elongation			
modulus of elasticity,	E	$E = \sigma/\varepsilon$	Pa
Young's modulus			
shear strain	γ	$\gamma = \Delta x/d$	1
shear modulus	G	$G = \tau/\gamma$	Pa
volume strain,	θ	$\theta = \Delta V/V_0$	1
bulk strain			
bulk modulus,	K	$K = -V_0(dp/dV)$	Pa
compression modulus			
viscosity,	η, μ	$\tau_{x,z} = \eta(dv_x/dz)$	Pa s
dynamic viscosity			
fluidity	ϕ	$\phi = 1/\eta$	$\text{m kg}^{-1} \text{s}$
kinematic viscosity	ν	$\nu = \eta/\rho$	$\text{m}^2 \text{s}^{-1}$
friction coefficient	$\mu, (f)$	$F_{\text{frict}} = \mu F_{\text{norm}}$	1
power	P	$P = dW/dt$	W
sound energy flux	P, P_a	$P = dE/dt$	W
acoustic factors,			
reflection factor	ρ	$\rho = P_r/P_0$	1
acoustic absorption	$\alpha_a, (\alpha)$	$\alpha_a = 1 - \rho$	1
factor			
transmission factor	τ	$\tau = P_{tr}/P_0$	1
dissipation factor	δ	$\delta = \alpha_a - \tau$	1
ELECTRICITY AND MAGNETISM			
quantity of electricity,	Q		C
electric charge			
charge density	ρ	$\rho = Q/V$	C m^{-3}
surface charge density	σ	$\sigma = Q/A$	C m^{-2}
electric potential	V, ϕ	$V = dW/dQ$	V, J C^{-1}
electric potential	$U, \Delta V, \Delta\phi$	$U = V_2 - V_1$	V
difference			
electromotive force	E	$E = \int (F/Q) \cdot ds$	V
electric field strength	E	$E = F/Q = -\text{grad } V$	V m^{-1}
electric flux	Ψ	$\Psi = \int D \cdot dA$	C
electric displacement	D	$D = \varepsilon E$	C m^{-2}
capacitance	C	$C = Q/U$	F, C V^{-1}
permittivity	ε	$D = \varepsilon E$	F m^{-1}

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit
permittivity of vacuum	ϵ_0	$\epsilon_0 = \mu_0^{-1} c_0^{-2}$	F m^{-1}
relative permittivity	ϵ_r	$\epsilon_r = \epsilon/\epsilon_0$	1
dielectric polarization (dipole moment per volume)	P	$P = D - \epsilon_0 E$	C m^{-2}
electric susceptibility	χ_e	$\chi_e = \epsilon_r - 1$	1
electric dipole moment	p, μ	$p = Qr$	C m
electric current	I	$I = dQ/dt$	A
electric current density	j, J	$I = \int j \cdot dA$	A m^{-2}
magnetic flux density, magnetic induction	B	$F = Qv \times B$	T
magnetic flux	Φ	$\Phi = \int B \cdot dA$	Wb
magnetic field strength	H	$B = \mu H$	A m^{-1}
permeability	μ	$B = \mu H$	$\text{N A}^{-2}, \text{H m}^{-1}$
permeability of vacuum	μ_0		H m^{-1}
relative permeability	μ_r	$\mu_r = \mu/\mu_0$	1
magnetization (magnetic dipole moment per volume)	M	$M = B/\mu_0 - H$	A m^{-1}
magnetic susceptibility	$\chi, \kappa, (\chi_m)$	$\chi = \mu_r - 1$	1
molar magnetic susceptibility	χ_m	$\chi_m = V_m \chi$	$\text{m}^3 \text{mol}^{-1}$
magnetic dipole moment	m, μ	$E_p = -m \cdot B$	$\text{A m}^2, \text{J T}^{-1}$
electrical resistance	R	$R = U/I$	Ω
conductance	G	$G = 1/R$	S
loss angle	δ	$\delta = (\pi/2) + \phi_I - \phi_U$	1, rad
reactance	X	$X = (U/I) \sin \delta$	Ω
impedance (complex impedance)	Z	$Z = R + iX$	Ω
admittance (complex admittance)	Y	$Y = 1/Z$	S
susceptance	B	$Y = G + iB$	S
resistivity	ρ	$\rho = E/j$	Ωm
conductivity	κ, γ, σ	$\kappa = 1/\rho$	S m^{-1}
self-inductance	L	$E = -L(dI/dt)$	H
mutual inductance	M, L_{12}	$E_1 = L_{12}(dI_2/dt)$	H
magnetic vector potential	A	$B = \nabla \times A$	Wb m^{-1}
Poynting vector	S	$S = E \times H$	W m^{-2}
QUANTUM MECHANICS			
momentum operator	\hat{p}	$\hat{p} = -i\hbar\nabla$	$\text{m}^{-1} \text{J s}$
kinetic energy operator	\hat{T}	$\hat{T} = -(\hbar^2/2m)\nabla^2$	J

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit
hamiltonian operator	\hat{H}	$\hat{H} = \hat{T} + V$	J
wavefunction, state function	Ψ, ψ, ϕ	$\hat{H}\psi = E\psi$	(m ^{-3/2})
probability density	P	$P = \psi^*\psi$	(m ⁻³)
charge density of electrons	ρ	$\rho = -eP$	(C m ⁻³)
probability current density	S	$S = -i\hbar(\psi^*\nabla\psi - \psi\nabla\psi^*)/2m_e$	(m ⁻² s ⁻¹)
electric current density of electrons	j	$j = -eS$	(A m ⁻²)
matrix element of operator \hat{A}	$A_{ij}, \langle i|\hat{A}|j\rangle$	$A_{ij} = \int \psi_i^* \hat{A} \psi_j d\tau$	(varies)
expectation value of operator \hat{A}	$\langle A \rangle, \bar{A}$	$\langle A \rangle = \int \psi^* \hat{A} \psi d\tau$	(varies)
hermitian conjugate of \hat{A}	\hat{A}^\dagger	$(\hat{A}^\dagger)_{ij} = (A_{ji})^*$	(varies)
commutator of \hat{A} and \hat{B}	$[\hat{A}, \hat{B}], [\hat{A}, \hat{B}]_-$	$[\hat{A}, \hat{B}] = \hat{A}\hat{B} - \hat{B}\hat{A}$	(varies)
anticommutator of \hat{A} and \hat{B}	$[\hat{A}, \hat{B}]_+$	$[\hat{A}, \hat{B}]_+ = \hat{A}\hat{B} + \hat{B}\hat{A}$	(varies)
spin wavefunction	$\alpha; \beta$		1
coulomb integral	H_{AA}	$H_{AA} = \int \psi_A^* \hat{H} \psi_A d\tau$	J
resonance integral	H_{AB}	$H_{AB} = \int \psi_A^* \hat{H} \psi_B d\tau$	J
overlap integral	S_{AB}	$S_{AB} = \int \psi_A^* \psi_B d\tau$	1
ATOMS AND MOLECULES			
nucleon number, mass number	A		1
proton number, atomic number	Z		1
neutron number	N	$N = A - Z$	1
electron rest mass	m_e		kg
mass of atom, atomic mass	m_a, m		kg
atomic mass constant	m_u	$m_u = m_a(^{12}\text{C})/12$	kg
mass excess	Δ	$\Delta = m_a - Am_u$	kg
elementary charge, proton charge	e		C
Planck constant	h		J s
Planck constant/ 2π	\hbar	$\hbar = h/2\pi$	J s
Bohr radius	a_0	$a_0 = 4\pi\epsilon_0\hbar^2/m_e e^2$	m
Hartree energy	E_h	$E_h = \hbar^2/m_e a_0^2$	J
Rydberg constant	R_∞	$R_\infty = E_h/2hc$	m ⁻¹
fine structure constant	α	$\alpha = e^2/4\pi\epsilon_0\hbar c$	1
ionization energy	E_i		J

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit
electron affinity	E_{ea}		J
dissociation energy	E_d, D		J
from the ground state	D_0		J
from the potential minimum	D_e		J
principal quantum number (H atom)	n	$E = -hcR/n^2$	1
angular momentum quantum numbers	see under Spectroscopy		
magnetic dipole moment of a molecule	m, μ	$E_p = -m \cdot B$	$J T^{-1}$
magnetizability of a molecule	ξ	$m = \xi B$	$J T^{-2}$
Bohr magneton	μ_B	$\mu_B = e\hbar/2m_e$	$J T^{-1}$
nuclear magneton	μ_N	$\mu_N = (m_e/m_p)\mu_B$	$J T^{-1}$
magnetogyric ratio (gyromagnetic ratio)	γ	$\gamma = \mu/L$	$C kg^{-1}$
g factor	g		1
Larmor circular frequency	ω_L	$\omega_L = (e/2m)B$	s^{-1}
Larmor frequency	ν_L	$\nu_L = \omega_L/2\pi$	Hz
longitudinal relaxation time	T_1		s
transverse relaxation time	T_2		s
electric dipole moment of a molecule	p, μ	$E_p = -p \cdot E$	C m
quadrupole moment of a molecule	$Q; \Theta$	$E_p = \frac{1}{2}Q; V'' = \frac{1}{3}\Theta; V''$	$C m^2$
quadrupole moment of a nucleus	eQ	$eQ = 2\langle\Theta_{zz}\rangle$	$C m^2$
electric field gradient tensor	q	$q_{\alpha\beta} = -\partial^2 V/\partial\alpha\partial\beta$	$V m^{-2}$
quadrupole interaction energy tensor	χ	$\chi_{\alpha\beta} = eQq_{\alpha\beta}$	J
electric polarizability of a molecule	α	p (induced) = αE	$C m^2 V^{-1}$
activity (of a radioactive substance)	A	$A = -dN_B/dt$	Bq
decay (rate) constant, disintegration (rate) constant	λ	$A = \lambda N_B$	s^{-1}
half life	$t_{\frac{1}{2}}, T_{\frac{1}{2}}$		s
mean life	τ		s
level width	Γ	$\Gamma = \hbar/\tau$	J

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
disintegration energy	Q		J
cross section (of a nuclear reaction)	σ		m ²
SPECTROSCOPY			
total term	T	$T = E_{\text{tot}}/hc$	m ⁻¹
transition wavenumber	$\tilde{\nu}, (\nu)$	$\tilde{\nu} = T' - T''$	m ⁻¹
transition frequency	ν	$\nu = (E' - E'')/h$	Hz
electronic term	T_e	$T_e = E_e/hc$	m ⁻¹
vibrational term	G	$G = E_{\text{vib}}/hc$	m ⁻¹
rotational term	F	$F = E_{\text{rot}}/hc$	m ⁻¹
spin orbit coupling constant	A	$T_{\text{s.o.}} = A \langle \hat{L} \cdot \hat{S} \rangle$	m ⁻¹
principal moments of inertia	$I_A; I_B; I_C$	$I_A \leq I_B \leq I_C$	kg m ²
rotational constants, in wavenumber	$\tilde{A}; \tilde{B}; \tilde{C}$	$\tilde{A} = h/8\pi^2 c I_A$	m ⁻¹
in frequency	$A; B; C$	$A = h/8\pi^2 I_A$	Hz
inertial defect	Δ	$\Delta = I_C - I_A - I_B$	kg m ²
asymmetry parameter	κ	$\kappa = \frac{(2B - A - C)}{(A - C)}$	1
centrifugal distortion constants, S reduction	$D_J; D_{JK}; D_K; d_1; d_2$		m ⁻¹
A reduction	$\Delta_J; \Delta_{JK}; \Delta_K; \delta_J; \delta_K$		m ⁻¹
harmonic vibration wavenumber	$\omega_e; \omega_r$		m ⁻¹
vibrational anharmonicity constant	$\omega_e x_e; x_{rs}; g_{ll'}$		m ⁻¹
vibrational quantum numbers	$v_r; l_t$		1
Coriolis zeta constant	ζ_{rs}^a		1
angular momentum quantum numbers	see additional information below		
degeneracy, statistical weight	g, d, β		1
electric dipole moment of a molecule	p, μ	$E_p = -p \cdot E$	C m
transition dipole moment of a molecule	M, R	$M = \int \psi' p \psi'' d\tau$	C m
molecular geometry, interatomic distances, equilibrium distance	r_e		m
zero-point average distance	r_z		m
ground state distance	r_0		m

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit	
substitution structure distance	r_s		m	
vibrational coordinates, internal coordinates	R_i, r_i, θ_j , etc.		(varies)	
symmetry coordinates	S_i		(varies)	
normal coordinates				
mass adjusted	Q_r		$\text{kg}^{\frac{1}{2}} \text{m}$	
dimensionless	q_r		1	
vibrational force constants, diatomic	$f, (k)$	$f = \partial^2 V / \partial r^2$	J m^{-2}	
polyatomic, internal coordinates	f_{ij}	$f_{ij} = \partial^2 V / \partial r_i \partial r_j$	(varies)	
symmetry coordinates	F_{ij}	$F_{ij} = \partial^2 V / \partial S_i \partial S_j$	(varies)	
dimensionless normal coordinates	$\phi_{rst...}$ $k_{rst...}$		m^{-1}	
nuclear magnetic resonance (NMR), magnetogyric ratio	γ	$\gamma = \mu / I \hbar$	C kg^{-1}	
shielding constant	σ_A	$B_A = (1 - \sigma_A) B$	1	
chemical shift, δ scale	δ	$\delta = 10^6 (\nu - \nu_0) / \nu_0$	1	
(indirect) spin-spin coupling constant	J_{AB}	$\hat{H} / h = J_{AB} \hat{I}_A \cdot \hat{I}_B$	Hz	
direct (dipolar) coupling constant	D_{AB}		Hz	
longitudinal relaxation time	T_1		s	
transverse relaxation time	T_2		s	
electron spin resonance, electron paramagnetic resonance (ESR, EPR), magnetogyric ratio	γ	$\gamma = \mu / s \hbar$	C kg^{-1}	
g factor	g	$h\nu = g \mu_B B$	1	
hyperfine coupling constant, in liquids	a, A	$\hat{H}_{\text{hfs}} / h = a \hat{S} \cdot \hat{I}$	Hz	
in solids	T	$\hat{H}_{\text{hfs}} / h = \hat{S} \cdot T \cdot \hat{I}$	Hz	
	Operator symbol	Quantum number symbol		
Angular momentum		Total	Z-axis	z-axis
electron orbital	\hat{L}	L	M_L	Λ
one electron only	\hat{l}	l	m_l	λ

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Angular momentum	Operator symbol	Quantum number symbol		
		Total	Z-axis	z-axis
electron spin	\hat{S}	S	M_S	Σ
one electron only	\hat{s}	s	m_s	σ
electron orbital + spin	$\hat{L} + \hat{S}$			$\Omega = \Lambda + \Sigma$
nuclear orbital (rotational)	\hat{R}	R		K_R, k_R
nuclear spin	\hat{I}	I	M_I	
internal vibrational				
spherical top	\hat{I}	$I(I\zeta)$		K_I
other	$\hat{j}, \hat{\pi}$			$I(I\zeta)$
sum of $R + L(+j)$	\hat{N}	N		K, k
sum of $N + S$	\hat{J}	J	M_J	K, k
sum of $J + I$	\hat{F}	F	M_F	

ELECTROMAGNETIC RADIATION

Name	Symbol	Definition	SI unit
wavelength	λ		m
speed of light			
in vacuum	c_0		m s^{-1}
in a medium	c	$c = c_0/n$	m s^{-1}
wavenumber in vacuum	$\tilde{\nu}$	$\tilde{\nu} = \nu/c_0 = 1/n\lambda$	m^{-1}
wavenumber (in a medium)	σ	$\sigma = 1/\lambda$	m^{-1}
frequency	ν	$\nu = c/\lambda$	Hz
circular frequency, pulsatance	ω	$\omega = 2\pi\nu$	$\text{s}^{-1}, \text{rad s}^{-1}$
refractive index	n	$n = c_0/c$	1
Planck constant	h		J s
Planck constant/ 2π	\hbar	$\hbar = h/2\pi$	J s
radiant energy	Q, W		J
radiant energy density	ρ, w	$\rho = Q/V$	J m^{-3}
spectral radiant energy density			
in terms of frequency	ρ_ν, w_ν	$\rho_\nu = d\rho/d\nu$	$\text{J m}^{-3} \text{Hz}^{-1}$
in terms of wavenumber	$\rho_{\tilde{\nu}}, w_{\tilde{\nu}}$	$\rho_{\tilde{\nu}} = d\rho/d\tilde{\nu}$	J m^{-2}
in terms of wavelength	ρ_λ, w_λ	$\rho_\lambda = d\rho/d\lambda$	J m^{-4}
Einstein transition probabilities			
spontaneous emission	A_{nm}	$dN_n/dt = -A_{nm}N_n$	s^{-1}
stimulated emission	B_{nm}	$dN_n/dt = -\rho_{\tilde{\nu}}(\tilde{\nu}_{nm}) \times$ $B_{nm}N_n$	s kg^{-1}
stimulated absorption	B_{mn}	$dN_n/dt = \rho_{\tilde{\nu}}(\tilde{\nu}_{nm})B_{mn}N_m$	s kg^{-1}
radiant power, radiant energy per time	Φ, P	$\Phi = dQ/dt$	W

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
radiant intensity	I	$I = d\Phi/d\Omega$	W sr^{-1}
radiant exitance, (emitted radiant flux)	M	$M = d\Phi/dA_{\text{source}}$	W m^{-2}
irradiance, (radiant flux received)	$E, (I)$	$E = d\Phi/dA$	W m^{-2}
emittance	ε	$\varepsilon = M/M_{\text{bb}}$	1
Stefan–Boltzmann constant	σ	$M_{\text{bb}} = \sigma T^4$	$\text{W m}^{-2} \text{K}^{-4}$
first radiation constant	c_1	$c_1 = 2\pi hc_0^2$	W m^2
second radiation constant	c_2	$c_2 = hc_0/k$	K m
transmittance, transmission factor	τ, T	$\tau = \Phi_{\text{tr}}/\Phi_0$	1
absorptance, absorption factor	α	$\alpha = \Phi_{\text{abs}}/\Phi_0$	1
reflectance, reflection factor	ρ	$\rho = \Phi_{\text{refl}}/\Phi_0$	1
(decadic) absorbance	A	$A = -\lg(1 - \alpha_i)$	1
napierian absorbance	B	$B = -\ln(1 - \alpha_i)$	1
absorption coefficient (linear) decadic	a, K	$a = A/l$	m^{-1}
(linear) napierian	α	$\alpha = B/l$	m^{-1}
molar (decadic)	ε	$\varepsilon = a/c = A/cl$	$\text{m}^2 \text{mol}^{-1}$
molar napierian	κ	$\kappa = \alpha/c = B/cl$	$\text{m}^2 \text{mol}^{-1}$
absorption index	k	$k = \alpha/4\pi\tilde{\nu}$	1
complex refractive index	\hat{n}	$\hat{n} = n + ik$	1
molar refraction	R, R_m	$R = \frac{(n^2 - 1)}{(n^2 + 2)} V_m$	$\text{m}^3 \text{mol}^{-1}$
angle of optical rotation	α		1, rad

SOLID STATE

lattice vector	R, R_0		m
fundamental translation vectors for the crystal lattice	$a_1; a_2; a_3,$ $a; b; c$	$R = n_1 a_1 + n_2 a_2 + n_3 a_3$	m
(circular) reciprocal lattice vector	G	$G \cdot R = 2\pi m$	m^{-1}
(circular) fundamental translation vectors for the reciprocal lattice	$b_1; b_2; b_3,$ $a^*; b^*; c^*$	$a_i \cdot b_k = 2\pi \delta_{ik}$	m^{-1}
lattice plane spacing	d		m
Bragg angle	θ	$n\lambda = 2d \sin \theta$	1, rad

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit
order of reflection	n		1
order parameters			
short range	σ		1
long range	s		1
Burgers vector	b		m
particle position vector	r, R_j		m
equilibrium position	R_0		m
vector of an ion			
displacement vector	u	$u = R - R_0$	m
of an ion			
Debye–Waller factor	B, D		1
Debye circular	q_D		m^{-1}
wavenumber			
Debye circular	ω_D		s^{-1}
frequency			
Grüneisen parameter	γ, Γ	$\gamma = \alpha V / \kappa C_V$	1
Madelung constant	α, \mathcal{M}	$E_{\text{coul}} = \frac{\alpha N_A z_+ z_- e^2}{4\pi\epsilon_0 R_0}$	1
density of states	N_E	$N_E = dN(E)/dE$	$J^{-1} m^{-3}$
(spectral) density of	N_ω, g	$N_\omega = dN(\omega)/d\omega$	$s m^{-3}$
vibrational modes			
resistivity tensor	ρ_{ik}	$E = \rho \cdot j$	Ωm
conductivity tensor	σ_{ik}	$\sigma = \rho^{-1}$	$S m^{-1}$
thermal conductivity	λ_{ik}	$J_q = -\lambda \cdot \text{grad } T$	$W m^{-1} K^{-1}$
tensor			
residual resistivity	ρ_R		Ωm
relaxation time	τ	$\tau = l/v_F$	s
Lorenz coefficient	L	$L = \lambda/\sigma T$	$V^2 K^{-2}$
Hall coefficient	A_H, R_H	$E = \rho \cdot j + R_H(B \times j)$	$m^3 C^{-1}$
thermoelectric force	E		V
Peltier coefficient	Π		V
Thomson coefficient	$\mu, (\tau)$		$V K^{-1}$
work function	Φ	$\Phi = E_\infty - E_F$	J
number density,	$n, (p)$		m^{-3}
number concentration			
gap energy	E_g		J
donor ionization energy	E_d		J
acceptor ionization	E_a		J
energy			
Fermi energy	E_F, ϵ_F		J
circular wave vector,	k, q	$k = 2\pi/\lambda$	m^{-1}
propagation vector			
Bloch function	$u_k(r)$	$\psi(r) = u_k(r) \exp(ik \cdot r)$	$m^{-3/2}$
charge density of	ρ	$\rho(r) = -e\psi^*(r)\psi(r)$	$C m^{-3}$
electrons			

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
effective mass	m^*		kg
mobility	μ	$\mu = v_{\text{drift}}/E$	$\text{m}^2 \text{V}^{-1} \text{s}^{-1}$
mobility ratio	b	$b = \mu_n/\mu_p$	1
diffusion coefficient	D	$dN/dt = -DA(dn/dx)$	$\text{m}^2 \text{s}^{-1}$
diffusion length	L	$L = \sqrt{D\tau}$	m
characteristic (Weiss) temperature	θ, θ_w		K
Curie temperature	T_C		K
Néel temperature	T_N		K
STATISTICAL THERMODYNAMICS			
number of entities	N		1
number density of entities, number concentration	n, C	$n = N/V$	m^{-3}
Avogadro constant	L, N_A		mol^{-1}
Boltzmann constant	k, k_B		J K^{-1}
gas constant (molar)	R	$R = Lk$	$\text{J K}^{-1} \text{mol}^{-1}$
molecular position vector	$\mathbf{r} (x, y, z)$		m
molecular velocity vector	$\mathbf{c}(c_x, c_y, c_z),$ $\mathbf{u}(u_x, u_y, u_z)$	$\mathbf{c} = d\mathbf{r}/dt$	m s^{-1}
molecular momentum vector	$\mathbf{p}(p_x, p_y, p_z)$	$\mathbf{p} = m\mathbf{c}$	kg m s^{-1}
velocity distribution function (Maxwell)	$f(c_x)$	$f(c_x) = (m/2\pi kT)^{1/2}$ $\times \exp(-mc_x^2/2kT)$	$\text{m}^{-1} \text{s}$
speed distribution function (Maxwell-Boltzmann)	$F(c)$	$F(c) = (m/2\pi kT)^{3/2}$ $\times 4\pi c^2 \exp(-mc^2/2kT)$	$\text{m}^{-1} \text{s}$
average speed	$\bar{c}, \bar{u},$ $\langle c \rangle, \langle u \rangle$	$\bar{c} = \int cF(c)dc$	m s^{-1}
generalized coordinate	q		(m)
generalized momentum	p	$p = \partial L/\partial \dot{q}$	(kg m s^{-1})
volume in phase space	Ω	$\Omega = (1/h) \int p dq$	1
probability	P		1
statistical weight, degeneracy	g, d, W, ω, β		1
density of states partition function, sum over states,	$\rho(E)$	$\rho(E) = dN/dE$	J^{-1}
for a single molecule	q, z	$q = \sum_i g_i \exp(-\varepsilon_i/kT)$	1
for a canonical ensemble (system, or assembly)	Q, Z		1

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit
microcanonical ensemble	Ω		1
grand (canonical ensemble)	Ξ		1
symmetry number	σ, s		1
reciprocal temperature parameter	β	$\beta = 1/kT$	J^{-1}
characteristic temperature	Θ		K
GENERAL CHEMISTRY			
number of entities (e.g. molecules, atoms, ions, formula units)	N		1
amount (of substance)	n	$n_B = N_B/L$	mol
Avogadro constant	L, N_A		mol^{-1}
mass of atom, atomic mass	m_a, m		kg
mass of entity (molecule, or formula unit)	m_r, m		kg
atomic mass constant	m_u	$m_u = m_a(^{12}C)/12$	kg
molar mass	M	$M_B = m/n_B$	$kg\ mol^{-1}$
relative molecular mass (relative molar mass, molecular weight)	M_r	$M_{r,B} = m_B/m_u$	1
molar volume	V_m	$V_{m,B} = V/n_B$	$m^3\ mol^{-1}$
mass fraction	w	$w_B = m_B/\Sigma m_i$	1
volume fraction	ϕ	$\phi_B = V_B/\Sigma V_i$	1
mole fraction, amount fraction, number fraction	x, y	$x_B = n_B/\Sigma n_i$	1
(total) pressure	p, P		Pa
partial pressure	p_B	$p_B = y_B p$	Pa
mass concentration (mass density)	γ, ρ	$\gamma_B = m_B/V$	$kg\ m^{-3}$
number concentration, number density of entities	C, n	$C_B = N_B/V$	m^{-3}
amount concentration, concentration	c	$c_B = n_B/V$	$mol\ m^{-3}$
solubility	s	$s_B = c_B$ (saturated solution)	$mol\ m^{-3}$
molality (of a solute)	$m, (b)$	$m_B = n_B/m_A$	$mol\ kg^{-1}$

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit
surface concentration	Γ	$\Gamma_{\text{B}} = n_{\text{B}}/A$	mol m^{-2}
stoichiometric number	ν		1
extent of reaction, advancement	ξ	$\Delta\xi = \Delta n_{\text{B}}/\nu_{\text{B}}$	mol
degree of dissociation	α		1
CHEMICAL THERMODYNAMICS			
heat	q, Q		J
work	w, W		J
internal energy	U	$\Delta U = q + w$	J
enthalpy	H	$H = U + pV$	J
thermodynamic temperature	T		K
Celsius temperature	θ, t	$\theta/^{\circ}\text{C} = T/\text{K} - 273.15$	$^{\circ}\text{C}$
entropy	S	$dS \geq dq/T$	JK^{-1}
Helmholtz energy, (Helmholtz function)	A	$A = U - TS$	J
Gibbs energy, (Gibbs function)	G	$G = H - TS$	J
Massieu function	J	$J = -A/T$	JK^{-1}
Planck function	Y	$Y = -G/T$	JK^{-1}
surface tension	γ, σ	$\gamma = (\partial G/\partial A_s)_{T, p}$	$\text{J m}^{-2}, \text{N m}^{-1}$
molar quantity X	X_{m}	$X_{\text{m}} = X/n$	(varies)
specific quantity X	x	$x = X/m$	(varies)
pressure coefficient	β	$\beta = (\partial p/\partial T)_{\text{V}}$	Pa K^{-1}
relative pressure coefficient	α_p	$\alpha_p = (1/p)(\partial p/\partial T)_{\text{V}}$	K^{-1}
compressibility, isothermal	κ_T	$\kappa_T = -(1/V)(\partial V/\partial p)_T$	Pa^{-1}
isentropic	κ_S	$\kappa_S = -(1/V)(\partial V/\partial p)_S$	Pa^{-1}
linear expansion coefficient	α_l	$\alpha_l = (1/l)(\partial l/\partial T)$	K^{-1}
cubic expansion coefficient	$\alpha, \alpha_{\text{V}}, \gamma$	$\alpha = (1/V)(\partial V/\partial T)_p$	K^{-1}
heat capacity, at constant pressure	C_p	$C_p = (\partial H/\partial T)_p$	JK^{-1}
at constant volume	C_{V}	$C_{\text{V}} = (\partial U/\partial T)_{\text{V}}$	JK^{-1}
ratio of heat capacities	$\gamma, (\kappa)$	$\gamma = C_p/C_{\text{V}}$	1
Joule–Thomson coefficient	μ, μ_{JT}	$\mu = (\partial T/\partial p)_H$	K Pa^{-1}
second virial coefficient	B	$pV_{\text{m}} = RT(1 + B/V_{\text{m}} + \dots)$	$\text{m}^3 \text{mol}^{-1}$
compression factor (compressibility factor)	Z	$Z = pV_{\text{m}}/RT$	1

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

Name	Symbol	Definition	SI unit
partial molar quantity X	$X_B, (X'_B)$	$X_B = (\partial X / \partial n_B)_{T, p, n_{j \neq B}}$	(varies)
chemical potential (partial molar Gibbs energy)	μ	$\mu_B = (\partial G / \partial n_B)_{T, p, n_{j \neq B}}$	J mol^{-1}
absolute activity	λ	$\lambda_B = \exp(\mu_B / RT)$	1
standard chemical potential	μ°, μ^\ominus		J mol^{-1}
standard partial molar enthalpy	H_B°	$H_B^\circ = \mu_B^\circ + TS_B^\circ$	J mol^{-1}
standard partial molar entropy	S_B°	$S_B^\circ = -(\partial \mu_B^\circ / \partial T)_p$	$\text{J mol}^{-1} \text{K}^{-1}$
standard reaction Gibbs energy (function)	$\Delta_r G^\circ$	$\Delta_r G^\circ = \sum_B \nu_B \mu_B^\circ$	J mol^{-1}
affinity of reaction	$A, (\mathcal{A})$	$A = -(\partial G / \partial \xi)_{p, T}$ $= -\sum_B \nu_B \mu_B$	J mol^{-1}
standard reaction enthalpy	$\Delta_r H^\circ$	$\Delta_r H^\circ = \sum_B \nu_B H_B^\circ$	J mol^{-1}
standard reaction entropy	$\Delta_r S^\circ$	$\Delta_r S^\circ = \sum_B \nu_B S_B^\circ$	$\text{J mol}^{-1} \text{K}^{-1}$
equilibrium constant	K°, K	$K^\circ = \exp(-\Delta_r G^\circ / RT)$	1
equilibrium constant, pressure basis	K_p	$K_p = \prod_B p_B^{\nu_B}$	$\text{Pa}^{\sum \nu}$
concentration basis	K_c	$K_c = \prod_B c_B^{\nu_B}$	$(\text{mol m}^{-3})^{\sum \nu}$
molality basis	K_m	$K_m = \prod_B m_B^{\nu_B}$	$(\text{mol kg}^{-1})^{\sum \nu}$
fugacity	f, \tilde{p}	$f_B = \lambda_B \lim_{p \rightarrow 0} (p_B / \lambda_B)_T$	Pa
fugacity coefficient	ϕ	$\phi_B = f_B / p_B$	1
activity and activity coefficient referenced to Raoult's law, (relative) activity	a	$a_B = \exp\left[\frac{\mu_B - \mu_B^*}{RT}\right]$	1
activity coefficient	f	$f_B = a_B / x_B$	1
activities and activity coefficients referenced to Henry's law, (relative) activity, molality basis	a_m	$a_{m, B} = \exp\left[\frac{\mu_B - \mu_B^\circ}{RT}\right]$	1
concentration basis	a_c	$a_{c, B} = \exp\left[\frac{\mu_B - \mu_B^\circ}{RT}\right]$	1

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI Unit</i>
mole fraction basis	a_x	$a_{x, B} = \exp \left[\frac{\mu_B - \mu_B^\circ}{RT} \right]$	1
activity coefficient, molality basis	γ_m	$a_{m, B} = \gamma_{m, B} m_B / m^\circ$	1
concentration basis	γ_c	$a_{c, B} = \gamma_{c, B} c_B / c^\circ$	1
mole fraction basis	γ_x	$a_{x, B} = \gamma_{x, B} x_B$	1
ionic strength, molality basis	I_m, I	$I_m = \frac{1}{2} \sum m_B z_B^2$	mol kg ⁻¹
concentration basis	I_c, I	$I_c = \frac{1}{2} \sum c_B z_B^2$	mol m ⁻³
osmotic coefficient, molality basis	ϕ_m	$\phi_m = (\mu_A^* - \mu_A) / (RT M_A \sum m_B)$	1
mole fraction basis	ϕ_x	$\phi_x = (\mu_A - \mu_A^*) / (RT \ln x_A)$	1
osmotic pressure	Π	$\Pi = c_B RT$ (ideal dilute solution)	Pa

(i) *Symbols used as subscripts to denote a chemical process or reaction*

These symbols should be printed in roman (upright) type, without a full stop (period).

vaporization, evaporation (liquid→gas)	vap
sublimation (solid→gas)	sub
melting, fusion (solid→liquid)	fus
transition (between two phases)	trs
mixing of fluids	mix
solution (of solute in solvent)	sol
dilution (of a solution)	dil
adsorption	ads
displacement	dpl
immersion	imm
reaction in general	r
atomization	at
combustion reaction	c
formation reaction	f

(ii) *Recommended superscripts*

standard	⊖, o
pure substance	*
infinite dilution	∞
ideal	id
activated complex, transition state	‡
excess quantity	E

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
CHEMICAL KINETICS			
rate of change of quantity X	\dot{X}	$\dot{X} = dX/dt$	(varies)
rate of conversion	$\dot{\xi}$	$\dot{\xi} = d\xi/dt$	mol s^{-1}
rate of concentration change (due to chemical reaction)	r_B, v_B	$r_B = dc_B/dt$	$\text{mol m}^{-3} \text{s}^{-1}$
rate of reaction (based on amount concentration)	v	$v = \dot{\xi}/V$ $= v_B^{-1} dc_B/dt$	$\text{mol m}^{-3} \text{s}^{-1}$
partial order of reaction	n_B	$v = k \Pi c_B^{n_B}$	1
overall order of reaction	n	$n = \sum n_B$	1
rate constant, rate coefficient	k	$v = k \Pi c_B^{n_B}$	$(\text{mol}^{-1} \text{m}^3)^{n-1} \text{s}^{-1}$
Boltzmann constant	k, k_B		J K^{-1}
half life	$t_{1/2}$	$c(t_{1/2}) = c_0/2$	s
relaxation time	τ	$\tau = 1/(k_1 + k_{-1})$	s
energy of activation, activation energy	E_a, E	$E_a = RT^2 d \ln k/dT$	J mol^{-1}
pre-exponential factor	A	$k = A \exp(-E_a/RT)$	$(\text{mol}^{-1} \text{m}^3)^{n-1} \text{s}^{-1}$
volume of activation	$\Delta^\ddagger V$	$\Delta^\ddagger V = -RT \times (\partial \ln k / \partial p)_T$	$\text{m}^3 \text{mol}^{-1}$
collision diameter	d	$d_{AB} = r_A + r_B$	m
collision cross-section	σ	$\sigma_{AB} = \pi d_{AB}^2$	m^2
collision frequency	Z_A		s^{-1}
collision number	Z_{AB}, Z_{AA}		$\text{m}^{-3} \text{s}^{-1}$
collision frequency factor	z_{AB}, z_{AA}	$z_{AB} = Z_{AB}/Lc_Ac_B$	$\text{m}^3 \text{mol}^{-1} \text{s}^{-1}$
standard enthalpy of activation	$\Delta^\ddagger H^\circ, \Delta H^\ddagger$		J mol^{-1}
standard entropy of activation	$\Delta^\ddagger S^\circ, \Delta S^\ddagger$		$\text{J mol}^{-1} \text{K}^{-1}$
standard Gibbs energy of activation	$\Delta^\ddagger G^\circ, \Delta G^\ddagger$		J mol^{-1}
quantum yield, photochemical yield	ϕ		1
ELECTROCHEMISTRY			
elementary charge (proton charge)	e		C
Faraday constant	F	$F = eL$	C mol^{-1}

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
charge number of an ion	z	$z_B = Q_B/e$	1
ionic strength	I_c, I	$I_c = \frac{1}{2} \sum c_i z_i^2$	mol m^{-3}
mean ionic activity	a_{\pm}	$a_{\pm} = m_{\pm} \gamma_{\pm} / m^{\circ}$	1
mean ionic molality	m_{\pm}	$m_{\pm}^{(v_+ + v_-)} = m_+^{v_+} m_-^{v_-}$	mol kg^{-1}
mean ionic activity coefficient	γ_{\pm}	$\gamma_{\pm}^{(v_+ + v_-)} = \gamma_+^{v_+} \gamma_-^{v_-}$	1
charge number of electrochemical cell reaction	$n, (z)$		1
electric potential difference (of a galvanic cell)	$\Delta V, E, U$	$\Delta V = V_R - V_L$	V
emf, electromotive force	E	$E = \lim_{I \rightarrow 0} \Delta V$	V
standard emf, standard potential of the electrochemical cell reaction	E°	$E^{\circ} = -\Delta_r G^{\circ} / nF$ $= (RT/nF) \ln K^{\circ}$	V
standard electrode potential	E°		V
emf of the cell, potential of the electro- chemical cell reaction	E	$E = E^{\circ} - (RT/nF) \times \sum v_i \ln a_i$	V
pH	pH	$\text{pH} \approx -\lg \left[\frac{c(\text{H}^+)}{\text{mol dm}^{-3}} \right]$	1
inner electric potential	ϕ	$\nabla \phi = -E$	V
outer electric potential	ψ	$\psi = Q/4\pi\epsilon_0 r$	V
surface electric potential	χ	$\chi = \phi - \psi$	V
Galvani potential difference	$\Delta\phi$	$\Delta_{\alpha}^{\beta} \phi = \phi^{\beta} - \phi^{\alpha}$	V
volta potential difference	$\Delta\psi$	$\Delta_{\alpha}^{\beta} \psi = \psi^{\beta} - \psi^{\alpha}$	V
electrochemical potential	$\tilde{\mu}$	$\tilde{\mu}_B^{\alpha} = (\partial G / \partial n_B^{\alpha})$	J mol^{-1}
electric current	I	$I = dQ/dt$	A
(electric) current density	j	$j = I/A$	A m^{-2}
(surface) charge density	σ	$\sigma = Q/A$	C m^{-2}
electrode reaction rate constant	k	$k_{\text{ox}} = I_a / (nFA \prod_i c_i^{n_i})$	(varies)
mass transfer coefficient, diffusion rate constant	k_d	$k_{d,B} = |v_B| I_{1,B} / nFcA$	m s^{-1}
thickness of diffusion layer	δ	$\delta_B = D_B / k_{d,B}$	m

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
transfer coefficient (electrochemical)	α	$\alpha_c = \frac{-|v|RT}{nF} \frac{\partial \ln |I_c|}{\partial E}$	1
overpotential	η	$\eta = E_I - E_{I=0} - IR_u$	V
electrokinetic potential (zeta potential)	ζ		V
conductivity	$\kappa, (\sigma)$	$\kappa = j/E$	$S m^{-1}$
conductivity cell constant	K_{cell}	$K_{cell} = \kappa R$	m^{-1}
molar conductivity (of an electrolyte)	Λ	$\Lambda_B = \kappa/c_B$	$S m^2 mol^{-1}$
ionic conductivity, molar conductivity of an ion	λ	$\lambda_B = |z_B| F u_B$	$S m^2 mol^{-1}$
electric mobility	$u, (\mu)$	$u_B = v_B/E$	$m^2 V^{-1} s^{-1}$
transport number	t	$t_B = j_B/\Sigma j_i$	1
reciprocal radius of ionic atmosphere	κ	$\kappa = (2F^2 I/\epsilon RT)^{1/2}$	m^{-1}
COLLOID AND SURFACE CHEMISTRY			
specific surface area	a, a_s, s	$a = A/m$	$m^2 kg^{-1}$
surface amount of B, adsorbed amount of B	n_B^s, n_B^a		mol
surface excess of B	n_B^σ		mol
surface excess concentration of B	$\Gamma_B, (\Gamma_B^\sigma)$	$\Gamma_B = n_B^\sigma/A$	$mol m^{-2}$
total surface excess concentration	$\Gamma, (\Gamma^\sigma)$	$\Gamma = \Sigma_i \Gamma_i$	$mol m^{-2}$
area per molecule	a, σ	$a_B = A/N_B^\sigma$	m^2
area per molecule in a filled monolayer	a_m, σ_m	$a_{m,B} = A/N_{m,B}$	m^2
surface coverage	θ	$\theta = N_B^\sigma/N_{m,B}$	1
contact angle	θ		1, rad
film thickness	t, h, δ		m
thickness of (surface or interfacial) layer	τ, δ, t		m
surface tension, interfacial tension	γ, σ	$\gamma = (\partial G/\partial A_s)_{T,p}$	$N m^{-1}, J m^{-2}$
film tension	Σ_f	$\Sigma_f = 2\gamma_f$	$N m^{-1}$
reciprocal thickness of the double layer	κ	$\kappa = [2F^2 I_c/\epsilon RT]^{1/2}$	m^{-1}
average molar masses			
number-average	M_n	$M_n = \Sigma n_i M_i/\Sigma n_i$	$kg mol^{-1}$
mass-average	M_m	$M_m = \Sigma n_i M_i^2/\Sigma n_i M_i$	$kg mol^{-1}$

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
Z-average	M_z	$M_z = \sum n_i M_i^3 / \sum n_i M_i^2$	kg mol^{-1}
sedimentation coefficient	s	$s = v/a$	s
van der Waals constant	λ		J
retarded van der Waals constant	β, B		J
van der Waals–Hamaker constant	A_H		J
surface pressure	π^s, π	$\pi^s = \gamma^0 - \gamma$	N m^{-1}

TRANSPORT PROPERTIES

flux (of a quantity X)	J_X, J	$J_X = A^{-1} dX/dt$	(varies)
volume flow rate	q_v, \dot{V}	$q_v = dV/dt$	$\text{m}^3 \text{s}^{-1}$
mass flow rate	q_m, \dot{m}	$q_m = dm/dt$	kg s^{-1}
mass transfer coefficient	k_d		m s^{-1}
heat flow rate	ϕ	$\phi = dq/dt$	W
heat flux	J_q	$J_q = \phi/A$	W m^{-2}
thermal conductance	G	$G = \phi/\Delta T$	W K^{-1}
thermal resistance	R	$R = 1/G$	K W^{-1}
thermal conductivity	λ, k	$\lambda = J_q/(dT/dl)$	$\text{W m}^{-1} \text{K}^{-1}$
coefficient of heat transfer	$h, (k, K, \alpha)$	$h = J_q/\Delta T$	$\text{W m}^{-2} \text{K}^{-1}$
thermal diffusivity	a	$a = \lambda/\rho c_p$	$\text{m}^2 \text{s}^{-1}$
diffusion coefficient	D	$D = J_n/(dc/dl)$	$\text{m}^2 \text{s}^{-1}$

The following symbols are used in the definitions of the dimensionless quantities: mass (m), time (t), volume (V), area (A), density (ρ), speed (v), length (l), viscosity (η), pressure (p), acceleration of free fall (g), cubic expansion coefficient (α), temperature (T), surface tension (γ), speed of sound (c), mean free path (λ), frequency (f), thermal diffusivity (a), coefficient of heat transfer (h), thermal conductivity (k), specific heat capacity at constant pressure (c_p), diffusion coefficient (D), mole fraction (x), mass transfer coefficient (k_d), permeability (μ), electric conductivity (κ), and magnetic flux density (B).

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI unit</i>
Reynolds number	Re	$Re = \rho v l / \eta$	1
Euler number	Eu	$Eu = \Delta p / \rho v^2$	1
Froude number	Fr	$Fr = v / (lg)^{1/2}$	1
Grashof number	Gr	$Gr = l^3 g \alpha \Delta T \rho^2 / \eta^2$	1
Weber number	We	$We = \rho v^2 l / \gamma$	1
Mach number	Ma	$Ma = v / c$	1
Knudsen number	Kn	$Kn = \lambda / l$	1
Strouhal number	Sr	$Sr = lf / v$	1
Fourier number	Fo	$Fo = at / l^2$	1
Péclet number	Pe	$Pe = vl / a$	1
Rayleigh number	Ra	$Ra = l^3 g \alpha \Delta T \rho / \eta a$	1
Nusselt number	Nu	$Nu = hl / k$	1
Stanton number	St	$St = h / \rho v c_p$	1

SYMBOLS AND TERMINOLOGY FOR PHYSICAL AND CHEMICAL QUANTITIES (continued)

<i>Name</i>	<i>Symbol</i>	<i>Definition</i>	<i>SI units</i>
Fourier number for mass transfer	Fo^*	$Fo^* = Dt/l^2$	1
Péclet number for mass transfer	Pe^*	$Pe^* = vl/D$	1
Grashof number for mass transfer	Gr^*	$Gr^* = l^3 g \left(\frac{\partial \rho}{\partial x} \right)_{T,p} \left(\frac{\Delta x \rho}{\eta} \right)$	1
Nusselt number for mass transfer	Nu^*	$Nu^* = k_d l/D$	1
Stanton number for mass transfer	St^*	$St^* = k_d/v$	1
Prandtl number	Pr	$Pr = \eta/\rho a$	1
Schmidt number	Sc	$Sc = \eta/\rho D$	1
Lewis number	Le	$Le = a/D$	1
magnetic Reynolds number	Rm, Re_m	$Rm = v\mu kl$	1
Alfvén number	Al	$Al = v(\rho\mu)^{1/2}/B$	1
Hartmann number	Ha	$Ha = Bl(\kappa/\eta)^{1/2}$	1
Cowling number	Co	$Co = B^2/\mu\rho v^2$	1

NOMENCLATURE OF CHEMICAL COMPOUNDS

The International Union of Pure and Applied Chemistry (IUPAC) maintains several commissions that deal with the naming of chemical substances. In general, the approach of IUPAC is to present rules for arriving at names in a systematic manner, rather than recommending a unique name for each compound. Thus there are often several alternative "IUPAC names", depending on which nomenclature system is used, each of which may have advantages in specific applications. However, each of these names will be unambiguous.

Organizations such as the Chemical Abstracts Service and the Beilstein Institute that prepare indexes to the chemical literature must adopt a system for selecting unique names in order to avoid excessive cross referencing. Chemical Abstracts Service uses a system which groups together compounds derived from a single parent compound. Thus most index names are inverted (e.g., Benzene, bromo rather than bromobenzene; Acetic acid, sodium salt rather than sodium acetate). In this *Handbook* the CAS Index Names are used only in the table "Physical Constants of Organic Compounds". Other tables use more familiar names which, with a few possible exceptions, conform to one of the IUPAC naming systems.

Recommended names for the most common substituent groups, ligands, ions, and organic rings are given in the two following tables, "Nomenclature for Inorganic Ions and Ligands" and "Organic Substituent Groups and Ring Systems". For the basics of macromolecular nomenclature, see "Naming Organic Polymers" in Section 13.

Some of the most useful recent guides to chemical nomenclature, prepared by IUPAC and other organizations such as the International Union of Biochemistry and Molecular Biology (IUBMB) and the American Chemical Society are listed below. These books contain citations to the more detailed nomenclature documents in each area.

Inorganic Chemistry

International Union of Pure and Applied Chemistry, *Nomenclature of Inorganic Chemistry, Recommendations 1990*, edited by Leigh, G.J., Blackwell Scientific Publications, Oxford, 1990.

Block, B.P., Powell, W.H., and Fernelius, W.C., *Inorganic Chemical Nomenclature, Principles and Practice*, American Chemical Society, Washington, 1990.

Organic Chemistry

International Union of Pure and Applied Chemistry, *A Guide to IUPAC Nomenclature of Organic Compounds, Recommendations 1993*, edited by Panico, R., Powell, W.H., and Richer, J.-C., Blackwell Scientific Publications, Oxford, 1993.

International Union of Pure and Applied Chemistry, *Glossary of Class Names of Organic Compounds and Reactive Intermediates Based on Structure*, edited by Moss, G.P., Smith, P.A.S., and Tavernier, D., *Pure & Appl. Chem.*, 67, 1307, 1995.

Rhodes, P.H., *The Organic Chemist's Desk Reference*, Chapman & Hall, London, 1995.

International Union of Pure and Applied Chemistry, *Basic Terminology of Stereochemistry*, edited by Moss, G.P., *Pure & Applied Chemistry*, 68, 2193, 1966.

Macromolecular Chemistry

International Union of Pure and Applied Chemistry, *Compendium of Macromolecular Nomenclature*, edited by, Metanomski, W.V., Blackwell Scientific Publications, Oxford, 1991.

International Union of Pure and Applied Chemistry, *Glossary of Basic Terms in Polymer Science*, edited by Jenkins, A.D., Kratochvil, P., Stepto, R.F.T., and Suter, U.W., *Pure & Appl. Chem.*, 68, in press.

Biochemistry

International Union of Biochemistry and Molecular Biology, *Biochemical Nomenclature and Related Documents, 2nd Edition, 1992*, Portland Press, London, 1993; includes recommendations of the IUPAC-IUBMB Joint Commission on Biochemical Nomenclature.

International Union of Biochemistry and Molecular Biology, *Enzyme Nomenclature, 1992*, Academic Press, Orlando, FL, 1992.

IUPAC-IUBMB Joint Commission on Biochemical Nomenclature, *Nomenclature of Carbohydrates, Recommendations 1996*, edited by McNaught, A.D., *Pure & Appl. Chem.*, 68, 1919, 1996.

General

Chemical Abstracts Service, *Naming and Indexing Chemical Substances for Chemical Abstracts, Appendix IV, Chemical Abstracts 1994 Index Guide*.

NOMENCLATURE FOR INORGANIC IONS AND LIGANDS

See the table *Nomenclature of Chemical Compounds* for references. The assistance of Warren H. Powell in preparing this list is gratefully acknowledged.

Group	As cation	As anion	As ligand	As prefix in organic compounds
H	hydrogen	hydride	hydrido	
F	fluorine	fluoride	fluoro	fluoro
Cl	chlorine	chloride	chloro	chloro
Br	bromine	bromide	bromo	bromo
I	iodine	iodide	iodo	iodo
ClO	chlorosyl	hypochlorite	hypochlorito	chlorosyl
ClO ₂	chloryl	chlorite	chlorito	chloryl
ClO ₃	perchloryl	chlorate	chlorato	perchloryl
ClO ₄		perchlorate		
IO	iodosyl	hypoiodite		iodoso
IO ₂	iodyl			iodyl; iodoxy
O		oxide	oxo	oxo
O ₂		peroxide (O ₂ ²⁻) hyperoxide (O ₂ ⁻)	peroxo	peroxy
HO		hydroxide	hydroxo	hydroxy
HO ₂		hydrogen peroxide	hydrogen peroxo	hydroperoxy
S		sulfide	thio; sulfido	thio; thioxo
HS		hydrogen sulfide	thiolo	mercapto
S ₂		disulfide	disulfido	
SO	sulfinyl; thionyl			sulfinyl
SO ₂	sulfonyl; sulfuryl	sulfoxylate		sulfonyl
SO ₃		sulfite	sulfito	
HSO ₃		hydrogen sulfite	hydrogen sulfito	
S ₂ O ₃		thiosulfate	thiosulfato	
SO ₄		sulfate	sulfato	
Se		selenide	seleno	seleno; selenoxo
SeO	seleninyl			seleninyl
SeO ₂	selenonyl			selenonyl
SeO ₃		selenite	selenito	
SeO ₄		selenate	selenato	
Te		telluride	telluro	telluro; telluroxo
CrO ₂	chromyl			
UO ₂	uranyl			
NpO ₂	neptunyl			
PuO ₂	plutonyl			
AmO ₂	americyl			
N		nitride	nitrido	
N ₃		azide	azido	
NH		imide	imido	imino
NH ₂		amide	amido	amino
NHOH		hydroxylamide	hydroxylamido	hydroxyamino
N ₂ H ₃		hydrazide	hydrazido	hydrazino; diazanyl
NO	nitrosyl		nitrosyl	nitroso
NO ₂	nitryl		nitro	nitro
ONO		nitrite	nitrito	
NS	thionitrosyl			
NO ₃		nitrate	nitrato	
N ₂ O ₃		hyponitrite	hyponitrito	
P		phosphide	phosphido	phosphinidyne phosphoroso; phosphinylidyne
PO	phosphoryl			
PO ₂	phospho			
PS	thiophosphoryl			phosphinothioylidyne; thiophosphorozo
PH ₂ O ₃		hypophosphite	hypophosphito	
PHO ₃		phosphite	phosphito	

NOMENCLATURE FOR INORGANIC IONS AND LIGANDS (continued)

Group	As cation	As anion	As ligand	As prefix in organic compounds
PO ₄		phosphate	phosphato	
AsO ₄		arsenate	arsenato	
VO	vanadyl			
CO	carbonyl		carbonyl	carbonyl
CS	thiocarbonyl			thiocarbonyl
CH ₃ O		methanolate	methoxo	methoxy
C ₂ H ₅ O		ethanolate	ethoxo	ethoxy
CH ₃ S		methanethiolate	methanethiolato	methylthio
C ₂ H ₅ S		ethanethiolate	ethanethiolato	ethylthio
CN	cyanogen	cyanide	cyano	cyano
OCN		cyanate	cyanato	cyanato
SCN		thiocyanate	thiocyanato	thiocyanato
SeCN		selenocyanate	selenocyanato	selenocyanato
TeCN		tellurocyanate	tellurocyanato	tellurocyanato
CO ₃		carbonate	carbonato	
HCO ₃		hydrogen carbonate	hydrogen carbonato	carboxycarbonyl
C ₂ O ₄		oxalate	oxalato	

ORGANIC SUBSTITUENT GROUPS AND RING SYSTEMS

The first part of this table lists substituent groups and their line formulas. A substituent group is defined by IUPAC as a group that replaces one or more hydrogen atoms attached to a parent structure. Such groups are sometimes called radicals, but IUPAC now reserves the term radical for a free molecular species with unpaired electrons. IUPAC does not recommend some of these names, which are marked here with asterisks (e.g., amyl*), but they are included in this list because they are often encountered in the older literature. Substituent group names which are formed by systematic rules (e.g., methyl from methane, ethyl from ethane, etc.) are included here only for the first few members of a homologous series.

In the second part of the table a number of common organic ring compounds are shown, with the conventional numbering of the ring positions indicated.

The help of Warren H. Powell in preparing this table is greatly appreciated. Pertinent references may be found in the table *Nomenclature of Chemical Compounds*.

SUBSTITUENT GROUPS

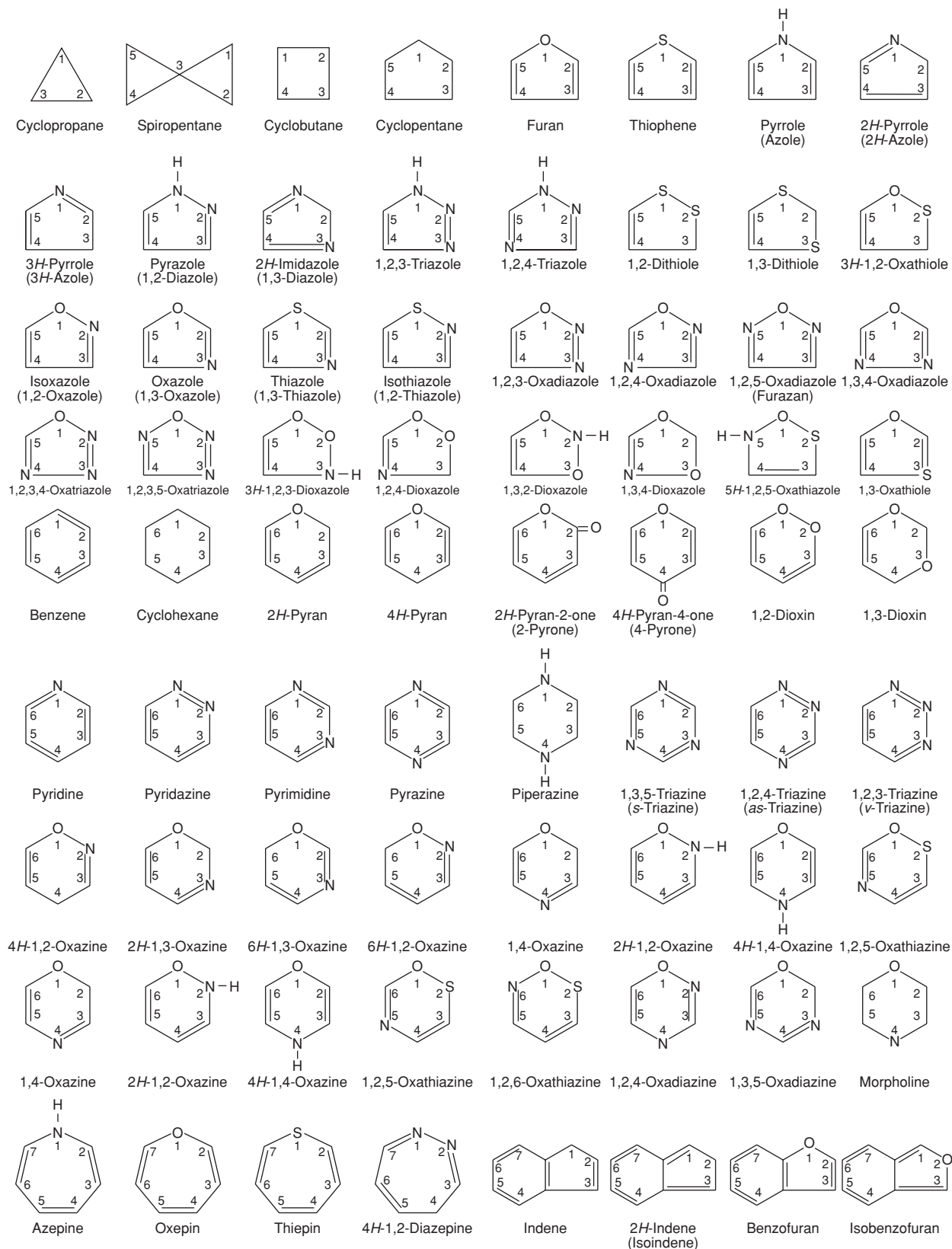
acetamido (acetylamino)	$\text{CH}_3\text{CONH-}$	cyanamido (cyanoamino)	NCNH-
acetoacetyl	$\text{CH}_3\text{COCH}_2\text{CO-}$	cyanato	NCO-
acetonyl	$\text{CH}_3\text{COCH}_2\text{-}$	cyano	NC-
acetyl	$\text{CH}_3\text{CO-}$	decanedioyl	$-\text{OC}(\text{CH}_2)_8\text{CO-}$
acryloyl* (1-oxo-2-propenyl)	$\text{CH}_2=\text{CHCO-}$	decanoyl	$\text{CH}_3(\text{CH}_2)_8\text{CO-}$
alanyl (from alanine)	$\text{CH}_3\text{CH}(\text{NH}_2)\text{CO-}$	diazo	$\text{N}_2=$
β -alanyl	$\text{H}_2\text{N}(\text{CH}_2)_2\text{CO-}$	diazoamino	$-\text{NHN}=\text{N-}$
allyl (2-propenyl)	$\text{CH}_2=\text{CHCH}_2\text{-}$	disilanyl	$\text{H}_2\text{SiSiH}_2\text{-}$
allylidene (2-propenyldiene)	$\text{CH}_2=\text{CHCH=}$	disiloxanyloxy	$\text{H}_3\text{SiOSiH}_2\text{O-}$
amidino (aminoiminomethyl)	$\text{H}_2\text{NC}(\text{=NH})\text{-}$	disulfinyl	$-\text{S}(\text{O})\text{S}(\text{O})\text{-}$
amino	$\text{H}_2\text{N-}$	dithio	$-\text{SS-}$
amyl* (pentyl)	$\text{CH}_3(\text{CH}_2)_4\text{-}$	enanthoyl* (heptanoyl)	$\text{CH}_3(\text{CH}_2)_5\text{CO-}$
anilino (phenylamino)	$\text{C}_6\text{H}_5\text{NH-}$	epoxy	$-\text{O-}$
anisidino	$\text{CH}_3\text{OC}_6\text{H}_4\text{NH-}$	ethenyl (vinyl)	$\text{CH}_2=\text{CH-}$
anthranoyl (2-aminobenzoyl)	$2\text{-H}_2\text{NC}_6\text{H}_4\text{CO-}$	ethynyl	$\text{HC}\equiv\text{C-}$
arsino	$\text{AsH}_2\text{-}$	ethoxy	$\text{C}_2\text{H}_5\text{O-}$
azelaoyl (from azelaic acid)	$-\text{OC}(\text{CH}_2)_7\text{CO-}$	ethyl	$\text{CH}_3\text{CH}_2\text{-}$
azido	$\text{N}_3\text{-}$	ethylene	$-\text{CH}_2\text{CH}_2\text{-}$
azino	$=\text{N-N=}$	ethylidene	$\text{CH}_2\text{CH=}$
azo	$-\text{N}=\text{N-}$	ethylthio	$\text{C}_2\text{H}_5\text{S-}$
azoxy	$-\text{N}(\text{O})=\text{N-}$	formamido (formylamino)	HCONH-
benzal* (benzylidene)	$\text{C}_6\text{H}_5\text{CH=}$	formyl	HCO-
benzamido (benzoylamino)	$\text{C}_6\text{H}_5\text{CONH-}$	fumaroyl (from fumaric acid)	$-\text{OCC}=\text{CHCO-}$
benzhydrl (diphenylmethyl)	$(\text{C}_6\text{H}_5)_2\text{CH-}$	furfuryl (2-furanylmethyl)	$\text{OC}_4\text{H}_7\text{CH}_2\text{-}$
benzoxy* (benzoyloxy)	$\text{C}_6\text{H}_5\text{COO-}$	furfurylidene (2-furanylmethylene)	$\text{OC}_4\text{H}_7\text{CH=}$
benzoyl	$\text{C}_6\text{H}_5\text{CO-}$	glutamoyl (from glutamic acid)	$-\text{OC}(\text{CH}_2)_2\text{CH}(\text{NH}_2)\text{CO-}$
benzyl	$\text{C}_6\text{H}_5\text{CH}_2\text{-}$	glutaryl (from glutaric acid)	$-\text{OC}(\text{CH}_2)_3\text{CO-}$
benzylidene	$\text{C}_6\text{H}_5\text{CH=}$	glycylamino	$\text{H}_2\text{NCH}_2\text{CONH-}$
benzylidene	$\text{C}_6\text{H}_5\text{C=}$	glycoloyl; glycolyl (hydroxyacetyl)	$\text{HOCH}_2\text{CO-}$
biphenyl	$\text{C}_6\text{H}_5\text{C}_6\text{H}_5\text{-}$	glycyl (aminoacetyl)	$\text{H}_2\text{NCH}_2\text{CO-}$
biphenylene	$-\text{C}_6\text{H}_4\text{-C}_6\text{H}_4\text{-}$	glyoxyloyl; glyoxylyl (oxoacetyl)	HCOCO-
butoxy	$\text{C}_4\text{H}_9\text{O-}$	guanidino	$\text{H}_2\text{NC}(\text{=NH})\text{NH-}$
sec-butoxy (1-methylpropoxy)	$\text{C}_2\text{H}_5\text{CH}(\text{CH}_3)\text{O-}$	guanyl (aminoiminomethyl)	$\text{H}_2\text{NC}(\text{=NH})\text{-}$
tert-butoxy (1,1-dimethylethoxy)	$(\text{CH}_3)_3\text{CO-}$	heptadecanoyl	$\text{CH}_3(\text{CH}_2)_{15}\text{CO-}$
butyl	$\text{CH}_3(\text{CH}_2)_3\text{-}$	heptanamido	$\text{CH}_3(\text{CH}_2)_5\text{CONH-}$
sec-butyl (1-methylpropyl)	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{-}$	heptanedioyl	$-\text{OC}(\text{CH}_2)_5\text{CO-}$
tert-butyl (1,1-dimethylethyl)	$(\text{CH}_3)_3\text{C-}$	heptanoyl	$\text{CH}_3(\text{CH}_2)_5\text{CO-}$
butyryl (1-oxobutyl)	$\text{CH}_3(\text{CH}_2)_2\text{CO-}$	hexadecanoyl	$\text{CH}_3(\text{CH}_2)_{14}\text{CO-}$
caproyl* (hexanoyl)	$\text{CH}_3(\text{CH}_2)_4\text{CO-}$	hexamethylene (1,6-hexanediy)	$-(\text{CH}_2)_6\text{-}$
capryl* (decanoyl)	$\text{CH}_3(\text{CH}_2)_6\text{CO-}$	hexanedioyl	$-\text{OC}(\text{CH}_2)_4\text{CO-}$
capryloyl* (octanoyl)	$\text{CH}_3(\text{CH}_2)_6\text{CO-}$	hippuryl (N-benzoylglycyl)	$\text{C}_6\text{H}_5\text{CONHCH}_2\text{CO-}$
carbamido (carbamoylamino)	$\text{H}_2\text{NCONH-}$	hydrazino	$\text{H}_2\text{NNH-}$
carbamoyl (aminocarbonyl)	$\text{H}_2\text{NCO-}$	hydrazo	$-\text{HNNH-}$
carbamyl (aminocarbonyl)	$\text{H}_2\text{NCO-}$	hydrocinnamoyl	$\text{C}_6\text{H}_5(\text{CH}_2)_2\text{CO-}$
carbazoyle (hydrazinocarbonyl)	$\text{H}_2\text{NNHCO-}$	hydroperoxy	HOO-
carbathoxy (ethoxycarbonyl)	$\text{C}_2\text{H}_5\text{OCO-}$	hydroxyamino	HONH-
carbonyl	$=\text{C}=\text{O}$	hydroxy	HO-
carboxy	HOOC-	imino	HN=
cetyl* (hexadecyl)	$\text{CH}_3(\text{CH}_2)_{15}\text{-}$	iodoso* (iodosyl)	OI-
chloroformyl (chlorcarbonyl)	ClCO-	iodyl	$\text{O}_2\text{I-}$
cinnamoyl	$\text{C}_6\text{H}_5\text{CH}=\text{CHCO-}$	isoamyl* (isopentyl; 3-methylbutyl)	$(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{-}$
cinnamyl (3-phenyl-2-propenyl)	$\text{C}_6\text{H}_5\text{CH}=\text{CHCH}_2\text{-}$	isobutenyl (2-methyl-1-propenyl)	$(\text{CH}_3)_2\text{C}=\text{CH-}$
cinnamylidene	$\text{C}_6\text{H}_5\text{CH}=\text{CHCH=}$	isobutoxy (2-methylpropoxy)	$(\text{CH}_3)_2\text{CHCH}_2\text{O-}$
cresyl* (hydroxymethylphenyl)	$\text{HO}(\text{CH}_2)\text{C}_6\text{H}_4\text{-}$	isobutyl (2-methylpropyl)	$(\text{CH}_3)_2\text{CHCH}_2\text{-}$
crotonoyl	$\text{CH}_3\text{CH}=\text{CHCO-}$	isobutylidene (3-methylpropylidene)	$(\text{CH}_3)_2\text{CHCH=}$
crotyl (2-butenyl)	$\text{CH}_3\text{CH}=\text{CHCH}_2\text{-}$	isobutyryl (2-methyl-1-oxopropyl)	$(\text{CH}_3)_2\text{CHCO-}$

ORGANIC SUBSTITUENT GROUPS AND RING SYSTEMS (continued)

isocyanato	OCN-	picryl (2,4,6-trinitrophenyl)	2,4,6-(NO ₂) ₃ C ₆ H ₂ -
isocyano	CN-	pimeloyl (from pimelic acid)	-OC(CH ₂) ₅ CO-
isohexyl (4-methylpentyl)	(CH ₃) ₂ CH(CH ₂) ₃ -	piperidino (1-piperidinyl)	C ₅ H ₁₀ N-
isoleucyl (from isoleucine)	C ₂ H ₅ CH(CH ₃)CH(NH ₂)CO-	pivaloyl (from pivalic acid)	(CH ₃) ₃ CCO-
isonitroso* (hydroxyamino)	HON=	prenyl (3-methyl-2-butenyl)	(CH ₃) ₂ C=CHCH ₂ -
isopentyl (3-methylbutyl)	(CH ₃) ₂ CH(CH ₂) ₂ -	propargyl (2-propynyl)	HC≡CCH ₂ -
isopentylidene (3-methylbutylidene)	(CH ₃) ₂ CHCH ₂ CH=	1-propenyl	-CH=CHCH ₂
isopropenyl (1-methylethenyl)	CH ₂ =C(CH ₃)-	2-propenyl (allyl)	CH ₂ =CHCH ₂ -
isopropoxy (1-methylethoxy)	(CH ₃) ₂ CHO-	propionyl* (propanyl)	CH ₃ CH ₂ CO-
isopropyl (1-methylethyl)	(CH ₃) ₂ CH-	propoxy	CH ₃ CH ₂ CH ₂ O-
isopropylidene (1-methylethylidene)	(CH ₃) ₂ C=	propyl	CH ₃ CH ₂ CH ₂ -
isothiocyanato (isothiocyano)	SCN-	propylidene	CH ₃ CH ₂ CH=
isovaleryl* (3-methyl-1-oxobutyl)	(CH ₃) ₂ CHCH ₂ CO-	pyrryl (pyrrolyl)	C ₄ H ₄ N-
lactoyl (from lactic acid)	CH ₃ CH(OH)CO-	salicyloyl (2-hydroxybenzoyl)	2-HOC ₆ H ₄ CO-
lauroyl (from lauric acid)	CH ₃ (CH ₂) ₁₀ CO-	selenyl* (selanyl; hydroseleno)	HS-
lauryl (dodecyl)	CH ₃ (CH ₂) ₁₁ -	seryl (from serine)	HOCH ₂ CH(NH ₂)CO-
leucyl (from leucine)	(CH ₃) ₂ CHCH ₂ CH(NH ₂)CO-	siloxyl	H ₃ SiO-
levulinoyl (from levulinic acid)	CH ₃ CO(CH ₂) ₂ CO-	silyl	H ₃ Si-
malonyl (from malonic acid)	-OCC ₂ CO-	silylene	H ₂ Si=
mandeloyl (from mandelic acid)	C ₆ H ₅ CH(OH)CO-	sorboyl (from sorbic acid)	CH ₃ CH=CHCH=CHCO-
mercapto	HS-	stearoyl (from stearic acid)	CH ₃ (CH ₂) ₁₄ CO-
mesityl	2,4,6-(CH ₃) ₃ C ₆ H ₂ -	stearyl (octadecyl)	CH ₃ (CH ₂) ₁₇ -
methacryloyl (from methacrylic acid)	CH ₂ =C(CH ₃)CO-	styryl (2-phenylethenyl)	C ₆ H ₅ CH=CH-
methallyl (2-methyl-2-propenyl)	CH ₂ =C(CH ₃)CH ₂ -	suberoyl (from suberic acid)	-OC(CH ₂) ₆ CO-
methionyl (from methionine)	CH ₃ SCH ₂ CH ₂ CH(NH ₂)CO-	succinyl (from succinic acid)	-OCC ₂ CH ₂ CO-
methoxy	CH ₃ O-	sulfamino (sulfoamino)	HOSO ₂ NH-
methyl	H ₃ C-	sulfamoyl (sulfamyl)	H ₂ NSO ₂ -
methylene	H ₂ C=	sulfanilyl [(4-aminophenyl)sulfonyl]	4-H ₂ NC ₆ H ₄ SO ₂ -
methylthio	CH ₃ S-	sulfeno	HOS-
myristoyl (from myristic acid)	CH ₃ (CH ₂) ₁₂ CO-	sulfhydryl (mercapto)	HS-
myristyl (tetradecyl)	CH ₃ (CH ₂) ₁₃ -	sulfinyl	OS=
naphthyl	(C ₁₀ H ₇)-	sulfo	HO ₃ S-
naphthylene	-(C ₁₀ H ₆)-	sulfonyl (sulfuryl)	-SO ₂ -
neopentyl (2,2-dimethylpropyl)	(CH ₃) ₃ CCH ₂ -	terephthaloyl	1,4-C ₆ H ₄ (CO) ₂
nitramino (nitroamino)	O ₂ NNH-	tetramethylene	-(CH ₂) ₄ -
nitro	O ₂ N-	thienyl (from thiophene)	(C ₄ H ₃ S)-
nitrosamino (nitrosoamino)	ONNH-	thiocarbonyl (carbothionyl)	=CS
nitrosimino (nitrosoimino)	ONN=	thiocarboxy	HOSC-
nitroso	ON-	thiocyanato (thiocyano)	NCS-
nonanoyl (from nonanoic acid)	CH ₃ (CH ₂) ₇ CO-	thionyl* (sulfinyl)	-SO-
oleoyl (from oleic acid)	CH ₃ (CH ₂) ₇ CH=CH(CH ₂) ₇ CO-	threonyl (from threonine)	CH ₃ CH(OH)CH(NH ₂)CO-
oxalyl (from oxalic acid)	-OCCO-	toluidino [(methylphenyl)amino]	CH ₃ C ₆ H ₄ NH-
oxo	O=	toluoyl (methylbenzoyl)	CH ₃ C ₆ H ₄ CO-
palmitoyl (from palmitic acid)	CH ₃ (CH ₂) ₁₄ CO-	tolyl (methylphenyl)	CH ₃ C ₆ H ₄ -
pentamethylene (1,5-pentanediy)	-(CH ₂) ₅ -	α-tolyl (benzyl)	C ₆ H ₅ CH ₂ -
pentyl	CH ₃ (CH ₂) ₄ -	tolylene (methylphenylene)	-(CH ₃ C ₆ H ₃)-
tert-pentyl	CH ₃ CH ₂ C(CH ₃) ₂ -	tosyl [(4-methylphenyl) sulfonyl]	4-CH ₃ C ₆ H ₄ SO ₂ -
phenacyl	C ₆ H ₅ COCH ₂ -	triazeno	H ₂ NNHNH-
phenacylidene	C ₆ H ₅ COCH=	trimethylene (1,3-propanediy)	-(CH ₂) ₃ -
phenethyl (2-phenylethyl)	C ₆ H ₅ CH ₂ CH ₂ -	trityl (triphenylmethyl)	(C ₆ H ₅) ₃ C-
phenoxy	C ₆ H ₅ O-	valeryl* (pentanoyl)	CH ₃ (CH ₂) ₃ CO-
phenyl	C ₆ H ₅ -	valyl (from valine)	(CH ₃) ₂ CHCH(NH ₂)CO-
phenylene (benzenediyl)	-C ₆ H ₄ -	vinyl (ethenyl)	CH ₂ =CH-
phosphino* (phosphanyl)	H ₂ P-	vinylidene (ethenylidene)	CH ₂ =C=
phosphinyl* (phosphinoyl)	H ₂ P(O)-	xylidino [(dimethylphenyl)amino]	(CH ₃) ₂ C ₆ H ₃ NH-
phospho	O ₂ P-	xylyl (dimethylphenyl)	(CH ₃) ₂ C ₆ H ₃ -
phosphono	(HO) ₂ P(O)-	xylylene [phenylenebis(methylene)]	-CH ₂ C ₆ H ₄ CH ₂ -
phthaloyl (from phthalic acid)	1,2-C ₆ H ₄ (CO) ₂		

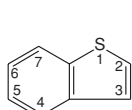
ORGANIC SUBSTITUENT GROUPS AND RING SYSTEMS (continued)

ORGANIC RING COMPOUNDS

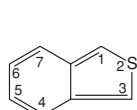


ORGANIC SUBSTITUENT GROUPS AND RING SYSTEMS (continued)

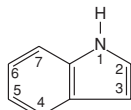
ORGANIC RING COMPOUNDS (continued)



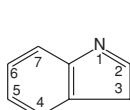
Benzo[b]thiophene



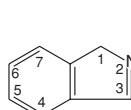
Benzo[c]thiophene



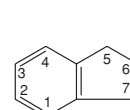
Indole



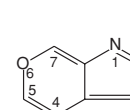
3H-Indole



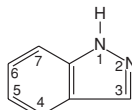
1H-Indole



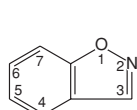
Cyclopenta[b]pyridine



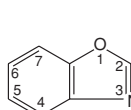
Pyrano[3,4-b]-pyrrole



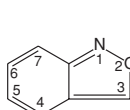
Indazole



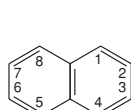
Benzisoxazole (Indoxazine)



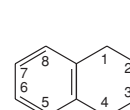
Benzoxazole



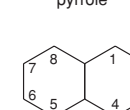
2,1-Benzisoxazole



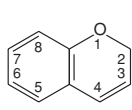
Naphthalene



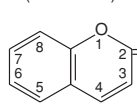
1,2,3,4-Tetrahydronaphthalene (Tetralin)



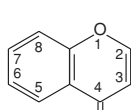
Octahydronaphthalene (Decalin)



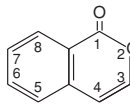
2H-1-Benzopyran (2H-Chromene)



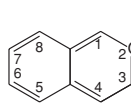
2H-1-Benzopyran-2-one (Coumarin)



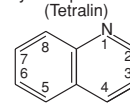
4H-1-Benzopyran-4-one (Chromen-4-one)



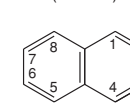
1H-2-Benzopyran-1-one (Isocoumarin)



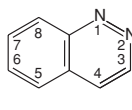
3H-2-Benzopyran-1-one (Isochromen-3-one)



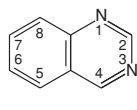
Quinoline



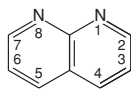
Isoquinoline



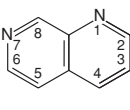
Cinnoline



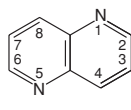
Quinazoline



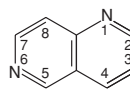
1,8-Naphthyridine



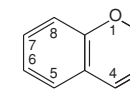
1,7-Naphthyridine



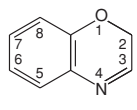
1,5-Naphthyridine



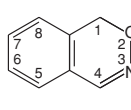
1,6-Naphthyridine



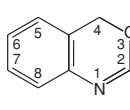
2H-1,3-Benzoxazine



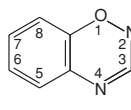
2H-1,4-Benzoxazine



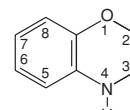
1H-2,3-Benzoxazine



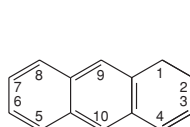
4H-3,1-Benzoxazine



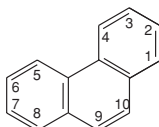
2H-1,2-Benzoxazine



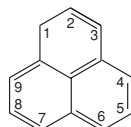
4H-1,4-Benzoxazine



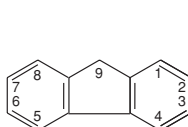
Anthracene



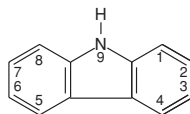
Phenanthrene



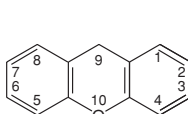
Phenalene



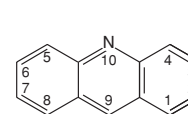
Fluorene



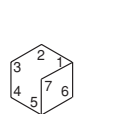
Carbazole



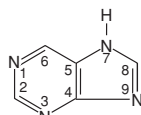
Xanthene



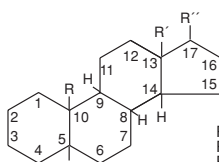
Acridine



Norpinane (Bicyclo[3.1.1]heptane)



7H-Purine



Steroid ring system

R = Nearly always methyl
R' = Usually methyl
R'' = Various groups

SCIENTIFIC ABBREVIATIONS AND SYMBOLS

This table lists some symbols, abbreviations, and acronyms encountered in the physical sciences. Most entries in italic type are symbols for physical quantities; for more details on these, see the table "Symbols and Terminology for Physical and Chemical Quantities" in this section. Additional information on units may be found in the table "International System of Units" in Section 1. Many of the terms to which these abbreviations refer are included in the tables "Definitions of Scientific Terms" in Section 2 and "Techniques for Materials Characterization" in Section 12.

Publication practices vary with regard to the use of capital or lower case letters for many abbreviations. An effort has been made to follow the most common practices in this table, but much variation is found in the literature. Likewise, policies on the use of periods in an abbreviation vary considerably. Periods are generally omitted in this table unless they are necessary for clarity. Periods should never appear in SI units. The SI prefixes (m, k, M, etc.) are not listed here, since they should never be used alone, but selected combinations with SI units (e.g., mg, kV, MW) are included.

Abbreviations are listed in alphabetical order without regard to case. Entries beginning with Greek letters fall at the end of the table.

<i>a</i>	absorption coefficient, acceleration, activity	<i>as, asym</i>	asymmetrical (as chemical descriptor)
a_0	Bohr radius	ASCII	American National Standard Code for Information Interchange
A	ampere, adenine (in genetic code)	ASE	aromatic stabilization energy
Å	ångstrom	Asn	asparagine
<i>A</i>	absorbance, area, Helmholtz energy, mass number	Asp	aspartic acid
A_H	Hall coefficient	at	atomization
A_r	atomic weight (relative atomic mass)	atm	standard atmosphere
AAS	atomic absorption spectroscopy	ATP	adenosine 5'-triphosphate
Abe	abequose	ATR	attenuated total internal reflection
abs	absolute	at.wt.	atomic weight
ac	alternating current	AU	astronomical unit
Ac	acetyl	av	average
AcOH	acetic acid	avdp	avoirdupois
ACT	activated complex theory	b	barn
ACTH	adrenocorticotrophic hormone	<i>B</i>	magnetic flux density, second virial coefficient, susceptance
Ade	adenine	bar	bar (pressure unit)
ADP	adenosine diphosphate	bbl	barrel
ads	adsorption	bcc	body centered cubic
ae	eon (10^9 years)	BCS	Bardeen-Cooper-Schrieffer (theory)
AES	atomic emission spectroscopy, Auger electron spectroscopy	BDE	bond dissociation energy
AF	audio frequency	Bé	Baumé
AFM	atomic force microscopy	BET	Brunauer-Emmett-Teller (method)
AI	artificial intelligence	BeV	billion electronvolt
AIM	atoms in molecules	Bhn	Brinell hardness number
<i>A_l</i>	Alfen number	Bi	biot
Ala	alanine	BN	bond number
alc	alcohol	BNS	nuclear backscattering spectroscopy
aliph.	aliphatic	BO	bond order, Born-Oppenheimer (approximation)
alk.	alkaline	BOD	biochemical oxygen demand
All	allose	bp	boiling point
Alt	altrose	bpy	2,2'-bipyridine
am	amorphous solid	Bq	becquerel
Am	amyl	BRE	bond resonance energy
AM	amplitude modulation	BSSE	basis set superposition error
AMP	adenosine 5'-monophosphate	Btu	British thermal unit
amu	atomic mass unit (recommended symbol is u)	bu	bushel
anh, anhyd	anhydrous	Bu	butyl
antilog	antilogarithm	Bz	benzoyl
AO	atomic orbital	Bzl	benzyl
AOM	angular overlap model	c	combustion reaction
Api	apiose	<i>c</i>	amount concentration, specific heat, velocity
APS	appearance potential spectroscopy	c_0	speed of light in vacuum
APW	augmented plane wave	C	coulomb, cytosine (in genetic code)
aq	aqueous	°C	degree Celsius
Ar	aryl	<i>C</i>	capacitance, heat capacity, number concentration
Ara	arabinose	ca.	approximately
Ara-ol	arabinitol	cal	calorie
Arg	arginine		

SCIENTIFIC ABBREVIATIONS AND SYMBOLS (continued)

calc	calculated	cwt	hundredweight (112 pounds)
CARS	coherent anti-Stokes Raman spectroscopy	Cy	cyclohexyl
CAS RN	Chemical Abstracts Service Registry Number	cyl	cylinder
CAT	clear-air turbulence, computerized axial tomography	Cys	cysteine
CBS	complete basis set	d	day, deuteron
cc	cubic centimeter	<i>d</i>	distance, density, dextrorotatory
CCD	charge-coupled device	D	debye unit
cd	candela, condensed phase	<i>D</i>	diffusion coefficient, dissociation energy, electric displacement
c.d.	current density	Da	dalton
CD	circular dichroism	DA	donor-acceptor (complex)
CDP	cytidine 5'-diphosphate	dB	decibel
CEPA	couplet electron pair approximation	dc	direct current
cf.	compare	DE	delocalization energy
cfm	cubic feet per minute	dec	decomposes
cg	centimeter-gram-second system	deg	degree
CHF	coupled Hartree-Fock (method)	den	density
Ci	curie	det	determinant
CI	configuration interaction, chemical ionization	dev	deviation
CIDEP	chemically induced dynamic electron polarization	DFT	density functional theory
CIDNP	chemically induced dynamic nuclear polarization	diam	diameter
cir	circular	dil	dilute, dilution
CKFF	Cotton-Kraihanzel force field	DIM	diatomics in molecules
CL	cathode luminescence	dm	decimeter
cm	centimeter	dmf, DMF	<i>N,N</i> -dimethylformamide
c.m.	center of mass	dms _o , DMSO	dimethylsulfoxide
c.m.c.	critical micelle concentration	DNA	deoxyribonucleic acid
CMO	canonical molecular orbital	DNase	deoxyribonuclease
CMP	cytidine 5'-monophosphate	DNMR	dynamic nuclear magnetic resonance
CN	coordination number	DOS	density of states
CNDO	complete neglect of differential overlap	doz	dozen
<i>Co</i>	Cowling number	d.p.	degree of polymerization
COD	chemical oxygen demand	dpl	displacement
conc	concentrated, concentration	dpm	disintegrations per minute
const	constant	dps	disintegrations per second
cos	cosine	dr	dram
cosh	hyperbolic cosine	dRib	2-deoxyribose
COSY	correlation spectroscopy (in NMR)	DRIFT	diffuse reflectance infrared Fourier transform
cot	cotangent	DRS	diffuse reflectance spectroscopy
coth	hyperbolic cotangent	DSC	differential scanning calorimetry
cp	candle power	DTA	differential thermal analysis
cP	centipoise	dyn	dyne
Cp	cyclopentadienyl	e	electron, base of natural logarithms
CP	chemically pure	<i>e</i>	elementary charge, linear strain
CPA	coherent potential approximation	<i>E</i>	electric field strength, electromotive force, energy, modulus of elasticity, entgegen (<i>trans</i> configuration)
cpd	contact potential difference	<i>E_h</i>	Hartree energy
cps	cycles per second	EA	electron affinity
CPT	charge conjugation-space inversion-time reversal (theorem)	EAN	effective atomic number
CPU	central processing unit	ECP	effective core potential
cr, cryst	crystalline (phase)	ECR	electron cyclotron resonance
CRU	constitutional repeating unit	ED	electron diffraction, effective dose
csc	cosecant	EDS	energy dispersive X-ray spectroscopy
ct	carat	EDTA	ethylenediaminetetraacetic acid
CT	charge transfer	EELS	electron energy loss spectroscopy
CTEM	conventional transmission electron microscopy	EFFF	energy factored force field
CTP	cytidine 5'-triphosphate	EHMO	extended Hückel molecular orbital
CTR	controlled thermonuclear reaction	EHT	extended Hückel theory
cu	cubic	emf	electromotive force
CV	cyclic voltammetry	emu	electromagnetic unit system
CVD	chemical vapor deposition	en	ethylenediamine
cw	continuous wave		

SCIENTIFIC ABBREVIATIONS AND SYMBOLS (continued)

ENDOR	electron-nuclear double resonance	G	gauss, guanine (in genetic code)
EOS	equation of state	<i>G</i>	electrical conductance, Gibbs energy, gravitational constant, shear modulus
EPMA	electron probe microanalysis	gal	gallon
EPR	electron paramagnetic (spin) resonance	Gal	gal, galileo, galactose
eq, eqn	equation	GalN	galactosamine
<i>eqQ</i>	quadrupole coupling constant	GC	gas chromatography
erf	error function	GC-MS	gas chromatography-mass spectrometry
erg	erg	GDMS	glow discharge mass spectroscopy
ESCA	electron spectroscopy for chemical analysis	<i>gem</i>	geminal (on the same carbon atom)
e.s.d.	estimated standard deviation	GeV	gigaelectronvolt
ESD	electron stimulated desorption	GIAO	gauge invariant atomic orbital
ESR	electron spin resonance	gl	glacial
est	estimate, estimated	GLC	gas-liquid chromatography
esu	electrostatic unit system	Glc	glucose
Et	ethyl	GlcN	glucosamine
ET	electron transfer, ephemeris time	Glc-ol	glucitol
Et ₂ O	diethyl ether	Gln	glutamine
e.u.	entropy unit	Glu	glutamic acid
<i>Eu</i>	Euler number	Gly	glycine
eV	electronvolt	GMP	guanosine 5'-triphosphate
EWG	electron withdrawing group	GMT	Greenwich mean time
EXAFS	extended x-ray absorption fine structure	gpm	gallons per minute
EXELFS	extended energy loss fine structure	gps	gallons per second
exp	exponential function	gr	grain
expt	experimental	<i>Gr</i>	Grashof number
ext	external	GTO	gaussian type atomic orbital
<i>f</i>	formation reaction	Gua	guanine
<i>f</i>	activity coefficient, aperture ratio, focal length, force constant, frequency, fugacity	Gul	gulose
F	farad	GUT	grand unified theory
°F	degree Fahrenheit	GVB	generalized valence bond
<i>F</i>	Faraday constant, force, angular momentum	GWS	Glashow-Weinberg-Salam (theory)
FAD	flavin adenine dinucleotide	Gy	gray, gigayear
fcc	face centered cubic	h	helion, hour
FEL	free electron laser	<i>h</i>	Planck constant
FEM	field emission microscopy	H	henry
FEMO	free electron molecular orbital	<i>H</i>	enthalpy, Hamiltonian function, magnetic field
FET	field effect transistor	<i>H</i> ₀	Hubble constant
fid	free induction decay	ha	hectare
FIM	field ion microscopy	<i>Ha</i>	Hartmann number
FIR	far infrared	Hacac	acetylacetone
fl	fluid (phase)	HAM	hydrogenic atoms in molecules
FM	frequency modulation	hav	haversine
<i>Fo</i>	Fourier number	Hb	hemoglobin
fp	freezing point	hcp	hexagonal closed packed
fpm	feet per minute	Hea	ethanolamine
fps	feet per second, foot-pound-second system	HEIS	high energy ion scattering
Fr	franklin	HEP	high energy physics
<i>Fr</i>	Froude number	HF	high frequency
Fru	fructose	hfs	hyperfine structure
FSGO	floating spherical Gaussian orbital	Him	imidazole
ft	foot	His	histidine
ft-lb	foot pound	HMO	Hückel molecular orbital
FT	Fourier transform	HOMO	highest occupied molecular orbital
FTIR	Fourier transform infrared spectroscopy	hp	horsepower
Fuc	fucose	HPLC	high-performance liquid chromatography
Fuc-ol	fucitol	Hpz	pyrazole
fus	fusion (melting)	hr	hour
g	gram, gas	HREELS	high resolution electron energy loss spectroscopy
<i>g</i>	acceleration due to gravity, degeneracy, statistical weight, Landé <i>g</i> -factor	HREM	high resolution electron microscopy
		HSAB	hard-soft acid-base (theory)

SCIENTIFIC ABBREVIATIONS AND SYMBOLS (continued)

HSE	homodesmotic stabilization energy	kPa	kilopascal
Hz	hertz	kt	karat
<i>i</i>	square root of minus one	kV	kilovolt
<i>I</i>	electric current, ionic strength, moment of inertia, nuclear spin angular momentum, radiant intensity	kva	kilovolt ampere
IAT	international atomic time	kW	kilowatt
<i>i</i> -Bu	isobutyl	kwh	kilowatt hour
IC	integrated circuit	l	liquid, liter
ICP	inductively coupled plasma	<i>l</i>	angular momentum, length, levorotatory
ICR	ion cyclotron resonance	L	liter, lambert
id	ideal (solution)	<i>L</i>	Avogadro constant, inductance, Lagrange function
ID	inside diameter	lat.	latitude
Ido	idose	lb	pound
IDP	inosine 5'-diphosphate	lbf	pound force
IE	ionization energy	lc	liquid crystal
i.e.p.	isoelectric point	LC	liquid chromatography
IEPA	independent electron pair approximation	LCAO	linear combination of atomic orbitals
IF	intermediate frequency	LD	lethal dose
IGLO	individual gauge for localized orbitals	<i>Le</i>	Lewis function
Ile	isoleucine	LED	light emitting diode
Im	imaginary part	LEED	low-energy electron diffraction
imm	immersion	LEIS	low energy ion scattering
IMPATT	impact ionization avalanche transit time	Leu	leucine
in.	inch	LFER	linear free energy relationship
INDO	intermediate neglect of differential overlap	lim	limit
INS	inelastic neutron scattering, ion neutralization spectroscopy	LIMS	laser ionization mass spectroscopy, laboratory information management system
int	internal	liq	liquid
I/O	input/output	lm	lumen
IP	ionization potential	ln	logarithm (natural)
IPN	interpenetrating polymer network	LNDO	local neglect of differential overlap
<i>i</i> -Pr	isopropyl	log	logarithm (common)
IPR	isotopic perturbation of resonance	long.	longitude
IPTS	International Practical Temperature Scale	LST	local sidereal time
IR	infrared	LT	local time
IRAS	reflection-absorption infrared spectroscopy	LTE	local thermodynamic equilibrium
IRC	intrinsic reaction coordinate	LUMO	lowest unoccupied molecular orbital
isc	intersystem crossing	lut	lutidine
ISE	isodesmic stabilization energy	lx	lux
ISS	ion scattering spectroscopy	ly	langley
ITP	inosine 5'-triphosphate	l.y.	light year
ITS	International Temperature Scale (1990)	Lys	lysine
IU	international unit	Lyx	lyxose
<i>j</i>	angular momentum, electric current density	m	meter, molal (as in 0.1 m solution), metastable (isotope)
J	joule	<i>m</i>	magnetic dipole moment, mass, molality, angular momentum component, <i>meta</i> (as chemical descriptor)
<i>J</i>	angular momentum, electric current density, flux, Massieu function	M	molar (as in 0.1 M solution), metal (in chemical formulas)
<i>k</i>	absorption index, Boltzmann constant, rate constant, thermal conductivity, wave vector	<i>M</i>	magnetization, molar mass, mutual inductance, torque, angular momentum component
K	kelvin	<i>M_r</i>	molecular weight (relative molar mass)
<i>K</i>	absorption coefficient, bulk modulus, equilibrium constant, kinetic energy	<i>Ma</i>	Mach number
kb	kilobar, kilobase (DNA or RNA)	Man	mannose
kcal	kilocalorie	MASNMR	magic angle spinning nuclear magnetic resonance
KE	kinetic energy	max	maximum
keV	kiloelectronvolt	MBE	molecular beam epitaxy
kg	kilogram	MBPT	many body perturbation theory
kgf	kilogram force	MC	Monte Carlo (method)
kJ	kilojoule	MCD	magnetic circular dichroism
km	kilometer	MCPF	modified couple pair functional
<i>Kn</i>	Knudsen number	MCSCF	multi-configurational self-consistent field

SCIENTIFIC ABBREVIATIONS AND SYMBOLS (continued)

MD	molecular dynamics	NEXAFS	near-edge x-ray absorption fine structure
Me	methyl	ng	nanogram
MEP	molecular electrostatic potential	NIR	near infrared
MERP	minimum energy reaction path	nm	nanometer
Mes	mesityl	NMR	nuclear magnetic resonance
MESFET	metal-semiconductor field-effect transistor	NNDO	neglect of nonbonded differential overlap
Met	methionine	NO	natural orbital
meV	millielectronvolt	NOE	nuclear Overhauser effect
MeV	megaelectronvolt	NPA	natural population analysis
MF	molecular formula	NQR	nuclear quadrupole resonance
mg	milligram	NRA	prompt nuclear reaction analysis
MHD	magnetohydrodynamics	ns	nanosecond
mi	mile	NTP	normal temperature and pressure
MIM	molecules-in-molecules	Nu	nucleophile
min	minimum, minute	<i>Nu</i>	Nusselt number
MINDO	modified intermediate neglect of differential overlap	<i>o</i>	<i>ortho</i> (as chemical descriptor)
MIR	mid-infrared	obs, obsd	observed
misc	miscible	OD	optical density, outside diameter
MKS	meter-kilogram-second system	Oe	oersted
MKSA	meter-kilogram-second-ampere system	ORD	optical rotatory dispersion
mL, ml	milliliter	<i>oz</i>	ounce
mm	millimeter	<i>p</i>	proton
MM	molecular mechanics	<i>p</i>	dielectric polarization, electric dipole moment, momentum, pressure, <i>para</i> (as chemical descriptor)
mmf	magnetomotive force	<i>P</i>	poise
mmHg	millimeter of mercury	<i>P</i>	power, pressure, probability, sound energy flux
MO	molecular orbital	Pa	pascal
mol	mole	PA	proton affinity
mol.wt.	molecular weight	PAS	photoacoustic spectroscopy
mon	monomeric form	pc	parsec
MOS	metal-oxide semiconductor	PCR	polymerase chain reaction
MOSFET	metal-oxide semiconductor field-effect transistor	PD	potential difference
mp	melting point	pdl	poundal
MPa	megapascal	pe	probable error
MPA	Mulliken population analysis	<i>Pe</i>	Péclet number
Mpc	megaparsec	PES	photoelectron spectroscopy
MRI	magnetic resonance imaging	PET	positron emission tomography
mRNA	messenger RNA	peth	petroleum ether
ms	millisecond	pf	power factor
MS	mass spectroscopy	pg	picogram
MSL	mean sea level	pH	negative log of hydrogen ion concentration
Mur	muramic acid	Ph	phenyl
mV	millivolt	Phe	phenylalanine
mW	milliwatt	pI	isoelectric point
MW	megawatt, microwave, molecular weight	pip	piperidine
Mx	maxwell	<i>pK</i>	negative log of ionization constant
<i>n</i>	neutron	pm	picometer
<i>n</i>	amount of substance, number density, principal quantum number, refractive index, normal (in chemical formulas)	PMO	perturbational molecular orbital
<i>N</i>	newton	PNDO	partial neglect of differential overlap
<i>N</i>	angular momentum, neutron number	PNRA	prompt nuclear reaction analysis
N_A	Avogadro constant	pol	polymeric form
N_E	density of states	ppb	parts per billion
NAA	neutron activation analysis	ppm	parts per million
NAD	nicotinamide adenine dinucleotide	PPP	Pariser-Parr-Pople (method)
NADH	reduced NAD	ppt	parts per thousand, precipitate
NADP	nicotinamide adenine dinucleotide phosphate	Pr	propyl
NAO	natural atomic orbital	<i>Pr</i>	Prandtl number
NBO	natural bond order	PRDDO	partial retention of diatomic differential overlap
nbp	normal boiling point	Pro	proline
Neu	neuraminic acid	ps	picosecond
		PS	photoelectron spectroscopy

SCIENTIFIC ABBREVIATIONS AND SYMBOLS (continued)

PSD	photon stimulated desorption	S	siemens
Psi	psicose	<i>S</i>	area, entropy, probability current density, Poynting vector, symmetry coordinate, spin angular momentum
psi	pounds per square inch	SALC	symmetry adapted linear combinations
psia	pounds per square inch absolute	SALI	surface analysis by laser ionization
psig	pounds per square inch gage	SAM	scanning Auger microscopy
pt	pint	SANS	small angle neutron scattering
PVT	pressure-volume-temperature	Sar	sarcosine
py	pyridine	sat, satd	saturated
<i>q</i>	electric field gradient, flow rate, heat, wave vector (phonons)	SAXS	small angle x-ray scattering
<i>Q</i>	electric charge, heat, partition function, quadrupole moment, radiant energy, vibrational normal coordinate	<i>s</i> -Bu	<i>sec</i> -butyl
QCD	quantum chromodynamics	<i>Sc</i>	Schmidt number
QED	quantum electrodynamics	SCE	saturated calomel electrode
Q.E.D.	quod erat demonstrandum (which was to be proved)	SCF	self-consistent field
QSAR	quantitative structure-activity relationship	SCR	silicon-controlled rectifier
QSO	quasi-stellar object (quasar)	sd	standard deviation
qt	quart	sec	secant, second
quad	quadrillion Btu (= 1.05510 ¹⁸ J)	<i>sec</i>	secondary (in chemical name)
Qui	quinovose	SEELFS	surface sensitive energy loss fine structure
q.v.	quod vide (which you should see)	SEM	scanning electron microscope
r	reaction	sepn	separation
<i>r</i>	position vector, radius	Ser	serine
R	roentgen, alkyl radical (in chemical formulas)	SERS	surface-enhanced Raman spectroscopy
°R	degree Rankine	SET	single electron transfer
<i>R</i>	electrical resistance, gas constant, molar refraction, Rydberg constant	SEXAFS	surface extended x-ray absorption fine structure
RA	right ascension	<i>Sh</i>	Sherwood number
rad	radian	SI	International System of Units
RAIRS	reflection-absorption infrared spectroscopy	SIMS	secondary ion mass spectroscopy
RAM	random access memory	sin	sine
RBS	Rutherford backscattering spectroscopy	SINDO	symmetrically orthogonalized INDO method
RE	resonance energy	sinh	hyperbolic sine
Re	real part	SIPN	semi-interpenetrating polymer network
RED	radial electron distribution	SLAM	scanning laser acoustic microscopy
REM	reflection electron microscopy	sln	solution
rem	roentgen equivalent man	SMO	semiempirical molecular orbital
RF	radiofrequency	SMOW	Standard Mean Ocean Water
Rha	rhamnose	SNMS	sputtered neutral mass spectroscopy
RHEED	reflection high-energy electron diffraction	SNU	solar neutrino unit
RHF	restricted Hartree-Fock (theory)	SO	spin orbital
RIA	radioimmunoassay	sol	soluble, solution
Rib	ribose	soln	solution
Ribulo	ribulose	SOMO	singly occupied molecular orbital
rms	root mean square	Sor	sorbose
RNA	ribonucleic acid	sp gr	specific gravity
RNase	ribonuclease	SPM	scanned probe microscopy
rRNA	ribosomal RNA	sq	square
ROHF	restricted open shell Hartree-Fock	sr	steradian
ROM	read only memory	<i>Sr</i>	Strouhal number
RPA	random phase approximation	SSMS	spark source mass spectroscopy
rpm	revolutions per minute	St	stoke
rps	revolutions per second	<i>St</i>	Stanton number
RRK	Rice-Ramsperger-Kassel (theory)	std, stnd	standard (state)
RRKM	Rice-Ramsperger-Kassel-Marcus (theory)	STEM	scanning transmission electron microscope
RRS	resonance Raman spectroscopy	STM	scanning tunneling microscopy
RS	Raman spectroscopy	STO	Slater type orbital
Ry	rydberg	STP	standard temperature and pressure
s	second, solid	sub	sublimation, sublimes
<i>s</i>	path length, solubility, spin angular momentum, symmetry number, symmetrical (as stereochemical descriptor)	Sv	sievert
		t	metric tonne, triton
		<i>t</i>	Celsius temperature, thickness, time, transport number
		T	tesla

SCIENTIFIC ABBREVIATIONS AND SYMBOLS (continued)

<i>T</i>	kinetic energy, period, term value, temperature (thermodynamic), torque, transmittance	<i>vic</i>	vicinal (on adjacent carbon atoms)
Tag	tagatose	VIS	visible region of the spectrum
Tal	talose	vit	vitreous
tan	tangent	VSEPR	valence shell electron pair repulsion
tanh	hyperbolic tangent	VSLI	very large scale integrated (circuit)
<i>t</i> -Bu	<i>tert</i> -butyl	VUV	vacuum ultraviolet
TCA	trichloroacetic acid	v/v	volume per volume (volume of solute divided by volume of solution, expressed as percent)
TCE	trichloroethylene	<i>w</i>	energy density, mass fraction, velocity, work
tcne	tetracyanoethylene	W	watt
TCSCF	two configuration self-consistent field	<i>W</i>	radiant energy, statistical weight, work
TE	transverse electric	WAXS	wide angle x-ray scattering
TED	transmission electron diffraction, transferred electron device	Wb	weber
TEM	transmission electron microscopy, transverse electromagnetic	<i>W_e</i>	Weber number
temp	temperature	WKB	Wentzel-Kramers-Brillouin (method)
<i>tert</i>	tertiary (in chemical name)	wt	weight
TFD	Thomas-Fermi-Dirac (method)	w/v	weight per volume (mass of solute divided by volume of solution, generally expressed as g/100 mL)
TGA	thermo-gravimetric analysis	w/w	weight per weight (mass of solute divided by mass of solution, expressed as percent)
theor	theoretical	<i>x</i>	mole fraction
thf, THF	tetrahydrofuran	X	X unit, halogen (in chemical formula)
Thr	threonine	<i>X</i>	reactance
Thy	thymine	XAFS	x-ray absorption fine structure
TL	thermoluminescence	XANES	x-ray absorption near-edge structure
TLC	thin-layer chromatography	XPES	x-ray photoelectron spectroscopy
TM	transverse magnetic	XPS	x-ray photoelectron spectroscopy
Tol	tolyl	XRD	x-ray diffraction
Torr	torr	XRF	x-ray fluorescence
tRNA	transfer RNA	XRS	x-ray spectroscopy
Trp	tryptophan	Xyl	xylose
trs	transition	y, yr	year
TS	transition state	Y	admittance, Planck function, Young's modulus
tsp	teaspoon	yd	yard
Tyr	tyrosine	<i>z</i>	charge number (of an ion), collision frequency factor
u	unified atomic mass unit	Z	atomic number, compression factor, collision number, impedance, partition function, zusammen (<i>cis</i> configuration)
<i>u</i>	Bloch function, electric mobility, velocity	ZDO	zero differential overlap
U	uracil (in genetic code)	ZPE, ZPVE	zero point vibrational energy
<i>U</i>	electric potential difference, internal energy	ZULU	Greenwich mean time
UDP	uridine 5'-diphosphate	α	alpha particle
UHF	ultrahigh frequency, unrestricted Hartree-Fock (theory)	α	absorption coefficient, degree of dissociation, electric polarizability, expansion coefficient, fine structure constant
UMP	uridine 5'-monophosphate	β	beta particle
<i>uns, unsym</i>	unsymmetrical (as chemical descriptor)	γ	photon
UPES	ultraviolet photoelectron spectroscopy	γ	activity coefficient, conductivity, magnetogyric ratio, mass concentration, ratio of heat capacities, surface tension
UPS	ultraviolet photoelectron spectroscopy	Γ	Grüneisen parameter, level width, surface concentration
ur	urea	δ	chemical shift, Dirac delta function, Kronecker delta, loss angle
Ura	uracil	Δ	inertia defect, mass defect
USP	United States Pharmacopeia	ϵ	emittance, Levi-Civita symbol, linear strain, molar absorption coefficient, permittivity
UT	universal time	η	overpotential, viscosity
UTP	uridine 5'-triphosphate	θ	Bragg angle, temperature, scattering angle, surface coverage
UV	ultraviolet	Θ	quadrupole moment
<i>v</i>	reaction rate, specific volume, velocity, vibrational quantum number, vicinal (as chemical descriptor)		
V	volt		
<i>V</i>	electric potential, potential energy, volume		
Val	valine		
vap	vaporization		
VB	valence band, valence bond		
VCD	vibrational circular dichroism		
VHF	very high frequency		

SCIENTIFIC ABBREVIATIONS AND SYMBOLS (continued)

κ	compressibility, conductivity, magnetic susceptibility, molar absorption coefficient, transmission coefficient	ρ	density, reflectance, resistivity
λ	absolute activity, radioactive decay constant, thermal conductivity, wavelength	σ	electrical conductivity, cross section, normal stress, shielding constant (NMR), Stefan-Boltzmann constant, surface tension
Λ	angular momentum, ionic conductivity	τ	transmittance, chemical shift, shear stress, relaxation time
μ	muon	ϕ	electrical potential, fugacity coefficient, osmotic coefficient, quantum yield, volume fraction, wavefunction
μ	chemical potential, electric dipole moment, electric mobility, friction coefficient, Joule-Thompson coefficient, magnetic dipole moment, mobility, permeability	Φ	magnetic flux, potential energy, radiant power, work function
μF	microfarad	χ	magnetic susceptibility, electronegativity
μg	microgram	χ_e	electric susceptibility
μm	micrometer	Ψ	wavefunction
μs	microsecond	ω	circular frequency, angular velocity, harmonic vibration wavenumber, statistical weight
ν	frequency, kinematic velocity, stoichiometric number, wavenumber	Ω	ohm
ν_e	neutrino	Ω	axial angular momentum, solid angle
π	pion		
Π	osmotic pressure, Peltier coefficient		

GREEK, RUSSIAN, AND HEBREW ALPHABETS

The following table presents the Hebrew, Greek, and Russian alphabets, their letters, the names of the letters, and the English equivalents.

HEBREW ^{1,3}			GREEK ⁴			RUSSIAN		
א	aleph	' ²	Α α	alpha	a	А а		a
ב	beth	b, bh	Β β	beta	b	Б б		b
ג	gimel	g, gh	Γ γ	gamma	g, n	В в		v
ד	daleth	d, dh	Δ δ	delta	d	Г г		g
ה	he	h	Ε ε	epsilon	e	Д д		d
ו	waw	w	Ζ ζ	zeta	z	Е е		e
ז	zayin	z	Ζ ζ	zeta	z	Ж ж		zh
ח	heth	h	Η η	eta	ē	З з		z
ט	teth	t	Θ θ	theta	th	И и	Й й	ī, ī
י	yodh	y	Ι ι	iota	i	К к		k
כ	kaph	k, kh	Κ κ	kappa	k	Л л		l
ל	lamedh	l	Λ λ	lambda	l	М м		m
מ	mem	m	Μ μ	mu	m	Н н		n
נ	nun	n	Ν ν	nu	n	О о		o
ס	samekh	s	Ξ ξ	xi	x	П п		p
ע	ayin	'	Ο ο	omicron	o	Р р		r
פ	pe	p, ph	Π π	pi	p	С с		s
צ	sadhe	ś	Ρ ρ	rho	r, rh	Т т		t
ק	qoph	q	Σ σ	sigma	s	У у		u
ר	resh	r	Π π	pi	p	Ф ф		f
ש	sin	ś	Ρ ρ	rho	r, rh	Х х		kh
שׁ	shin	sh	Σ σ	sigma	s	Ц ц		ts
ת	taw	t, th	Τ τ	tau	t	Ч ч		ch
			Τ υ	upsilon	y, u	Ш ш		sh
			Φ φ	phi	ph	Щ щ		shch
			Υ υ	upsilon	y, u	Ъ ъ	⁵	''
			Φ φ	phi	ph	Ы ы		y
			Χ χ	chi	ch	Ь ь	⁶	'
			Ψ ψ	psi	ps	Э э		e
			Ω ω	omega	ō	Ю ю		yu
						Я я		ya

¹ Where two forms of a letter are given, the second one is the form used at the end of a word.

² Not represented in transliteration when initial.

³ The Hebrew letters are primarily consonants; a few of them are also used secondarily to represent certain vowels, when provided at all, is by means of a system of dots or strokes adjacent to the consonated characters.

⁴ The letter gamma is transliterated "n" only before velars; the letter upsilon is transliterated "u" only as the final element in diphthongs.

⁵ This sign indicates that the immediately preceding consonant is not palatized even though immediately followed by a palatized vowel.

⁶ This sign indicates that the immediately preceding consonant is palatized even though not immediately followed by a palatized vowel.

DEFINITIONS OF SCIENTIFIC TERMS

Brief definitions of selected terms of importance in chemistry, physics, and related fields of science are given in this section. The selection process emphasizes the following types of terms:

- Physical quantities
- Units of measure
- Classes of chemical compounds and materials
- Important theories, laws, and basic concepts.

Individual chemical compounds are not included.

Definitions have taken wherever possible from the recommendations of international or national bodies, especially the International Union of Pure and Applied Chemistry (IUPAC) and International Organization for Standardization (ISO). For physical quantities and units, the recommended symbol is also given. The source of such definitions is indicated by the reference number in brackets following the definition. In many cases these official definitions have been edited in the interest of stylistic consistency and economy of space. The user is referred to the original source for further details.

* An asterisk following a term indicates that further information can be found by consulting the index of this handbook under the entry for that term.

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Ab initio method - An approach to quantum-mechanical calculations on molecules which starts with the Schrödinger equation and carries out a complete integration, without introducing empirical factors derived from experimental measurement.

Absorbance (A) - Defined as $-\log(1-\alpha) = \log(1/\tau)$, where α is the absorbance and τ the transmittance of a medium through which a light beam passes. [2]

Absorbed dose (D) - For any ionizing radiation, the mean energy imparted to an element of irradiated matter divided by the mass of that element. [1]

Absorptance (α) - Ratio of the radiant or luminous flux in a given spectral interval absorbed in a medium to that of the incident radiation. Also called absorption factor. [1]

Absorption coefficient (a) - The relative decrease in the intensity of a collimated beam of electromagnetic radiation, as a result of absorption by a medium, during traversal of an infinitesimal layer of the medium, divided by the length traversed. [1]

Absorption coefficient, molar (ϵ) - Absorption coefficient divided by amount-of-substance concentration of the absorbing material in the sample solution ($\epsilon = a/c$). The SI unit is m^2/mol . Also called extinction coefficient, but usually in units of $\text{mol}^{-1}\text{dm}^3\text{cm}^{-1}$. [2]

Acceleration - Rate of change of velocity with respect to time.

Acceleration due to gravity (g)* - The standard value (9.80665 m/s^2) of the acceleration experienced by a body in the earth's gravitational field. [1]

Acenenes - Polycyclic aromatic hydrocarbons consisting of fused benzene rings in a rectilinear arrangement. [5]

Acid - Historically, a substance that yields an H^+ ion when it dissociates in solution, resulting in a $\text{pH} < 7$. In the Brønsted definition, an acid is a substance that donates a proton in any type of reaction. The most general definition, due to G.N. Lewis, classifies any chemical species capable of accepting an electron pair as an acid.

Acid dissociation constant (K_a)* - The equilibrium constant for the dissociation of an acid HA through the reaction $\text{HA} + \text{H}_2\text{O} \rightleftharpoons \text{A}^- + \text{H}_3\text{O}^+$. The quantity $\text{p}K_a = -\log K_a$ is often used to express the acid dissociation constant.

Actinides - The elements of atomic number 89 through 103, e.g., Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr. [7]

Activation energy* - In general, the energy that must be added to a system in order for a process to occur, even though the process may already be thermodynamically possible. In chemical kinetics, the activation energy is the height of the potential barrier separating the products and reactants. It determines the temperature dependence of the reaction rate.

Activity - For a mixture of substances, the absolute activity λ of substance B is defined as $\lambda_B = \exp(\mu_B/RT)$, where μ_B is the chemical potential of substance B, R the gas constant, and T the thermodynamic temperature. The relative activity a is defined as $a_B = \exp[(\mu_B - \mu_B^\circ)/RT]$, where μ_B° designates the chemical potential in the standard state. [2]

Activity coefficient (γ)* - Ratio of the activity a_B of component B of a mixture to the concentration of that component. The value of γ depends on the method of stating the composition. For mole fraction x_B , the relation is $a_B = \gamma_B x_B$; for molarity c_B , it is $a_B = \gamma_B c_B/c^\circ$, where c° is the standard state composition (typically chosen as 1 mol/L); for molality

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- m_B , it is $a_B = \gamma_B m_B / m^\circ$, where m° is the standard state molality (typically 1 mol/kg). [2]
- Activity, of radioactive substance (A)** - The average number of spontaneous nuclear transitions from a particular energy state occurring in an amount of a radionuclide in a small time interval divided by that interval. [1]
- Acyl groups** - Groups formed by removing the hydroxy groups from oxoacids that have the general structure $RC(=O)(OH)$ and replacement analogues of such acyl groups. [5]
- Adiabatic process** - A thermodynamic process in which no heat enters or leaves the system.
- Admittance (Y)** - Reciprocal of impedance. $Y = G + iB$, where G is conductance and B is susceptance. [1]
- Adsorption** - A process in which molecules of gas, of dissolved substances in liquids, or of liquids adhere in an extremely thin layer to surfaces of solid bodies with which they are in contact. [10]
- Albedo*** - The ratio of the light reflected or scattered from a surface to the intensity of incident light. The term is often used in reference to specific types of terrain or to entire planets.
- Alcohols** - Compounds in which a hydroxy group, $-OH$, is attached to a saturated carbon atom. [5]
- Aldehydes** - Compounds $RC(=O)H$, in which a carbonyl group is bonded to one hydrogen atom and to one R group. [5]
- Aldoses** - Aldehydic parent sugars (polyhydroxyaldehydes $H[CH(OH)]_n C(=O)H$, $n > 1$) and their intramolecular hemiacetals. [5]
- Alloximes** - Oximes of aldehydes: $RCH=NOH$. [5]
- Alfvén number (Al)** - A dimensionless quantity used in plasma physics, defined by $Al = v(\rho\mu)^{1/2}/B$, where ρ is density, v is velocity, μ is permeability, and B is magnetic flux density. [2]
- Alfvén waves** - Very low frequency waves which can exist in a plasma in the presence of a uniform magnetic field. Also called magnetohydrodynamic waves.
- Alicyclic compounds** - Aliphatic compounds having a carbocyclic ring structure which may be saturated or unsaturated, but may not be a benzenoid or other aromatic system. [5]
- Aliphatic compounds** - Acyclic or cyclic, saturated or unsaturated carbon compounds, excluding aromatic compounds. [5]
- Alkali metals** - The elements lithium, sodium, potassium, rubidium, cesium, and francium.
- Alkaline earth metals** - The elements calcium, strontium, barium, and radium. [7]
- Alkaloids** - Basic nitrogen compounds (mostly heterocyclic) occurring mostly in the plant kingdom (but not excluding those of animal origin). Amino acids, peptides, proteins, nucleotides, nucleic acids, and amino sugars are not normally regarded as alkaloids. [5]
- Alkanes** - Acyclic branched or unbranched hydrocarbons having the general formula $C_n H_{2n+2}$, and therefore consisting entirely of hydrogen atoms and saturated carbon atoms. [5]
- Alkenes** - Acyclic branched or unbranched hydrocarbons having one carbon-carbon double bond and the general formula $C_n H_{2n}$. Acyclic branched or unbranched hydrocarbons having more than one double bond are alkadienes, alkatrienes, etc. [5]
- Alkoxides** - Compounds, ROM, derivatives of alcohols, ROH, in which R is saturated at the site of its attachment to oxygen and M is a metal or other cationic species. [5]
- Alkyl groups** - Univalent groups derived from alkanes by removal of a hydrogen atom from any carbon atom: $C_n H_{2n+1}$ -. The groups derived by removal of a hydrogen atom from a terminal carbon atom of unbranched alkanes form a subclass of normal alkyl (n -alkyl) groups. The groups RCH_2 -, R_2CH -, and R_3C - (R not equal to H) are primary, secondary, and tertiary alkyl groups, respectively. [5]
- Alkynes** - Acyclic branched or unbranched hydrocarbons having a carbon-carbon triple bond and the general formula $C_n H_{2n-2}$, $RC\equiv CR'$. Acyclic branched or unbranched hydrocarbons having more than one triple bond are known as alkadiynes, alkatriynes, etc. [5]
- Allotropy** - The occurrence of an element in two or more crystalline forms.
- Allylic groups** - The group $CH_2=CHCH_2$ - (allyl) and derivatives formed by substitution. The term 'allylic position' or 'allylic site' refers to the saturated carbon atom. A group, such as $-OH$, attached at an allylic site is sometimes described as "allylic". [5]
- Amagat volume unit** - A non-SI unit previously used in high pressure science. It is defined as the molar volume of a real gas at one atmosphere pressure and 273.15 K. The approximate value is 22.4 L/mol.
- Amides** - Derivatives of oxoacids $R(C=O)(OH)$ in which the hydroxy group has been replaced by an amino or substituted amino group. [5]
- Amine oxides** - Compounds derived from tertiary amines by the attachment of one oxygen atom to the nitrogen atom: $R_3N^+-O^-$. By extension the term includes the analogous derivatives of primary and secondary amines. [5]
- Amines** - Compounds formally derived from ammonia by replacing one, two, or three hydrogen atoms by hydrocarbyl groups, and having the general structures RNH_2 (primary amines), R_2NH (secondary amines), R_3N (tertiary amines). [5]
- Amino acids*** - Compounds containing both a carboxylic acid group ($-COOH$) and an amino group ($-NH_2$). The most important are the α -amino acids, in which the $-NH_2$ group is attached to the C atom adjacent to the $-COOH$ group. In the β -amino acids, there is an intervening carbon atom. [4]
- Ampere (A)*** - The SI base unit of electric current. [1]
- Ampere's law** - The defining equation for the magnetic induction B , viz., $dF = Idl \times B$, where dF is the force produced by a current I flowing in an element of the conductor dl pointing in the direction of the current.
- Ångström (Å)** - A unit of length used in spectroscopy, crystallography, and molecular structure, equal to 10^{-10} m.
- Angular momentum (L)** - The angular momentum of a particle about a point is the vector product of the radius vector from this point to the particle and the momentum of the particle; i.e., $L = r \times p$. [1]
- Angular velocity (ω)** - The angle through which a body rotates per unit time.
- Anilides** - Compounds derived from oxoacids $R(C=O)(OH)$ by replacing the $-OH$ group by the $-NHPh$ group or derivative formed by ring substitution. Also used for salts formed by replacement of a nitrogen-bound hydrogen of aniline by a metal. [5]
- Anion** - A negatively charged atomic or molecular particle.
- Antiferroelectricity*** - An effect analogous to antiferromagnetism in which electric dipoles in a crystal are ordered in two sublattices that are polarized in opposite directions, leading to zero net polarization. The effect vanishes above a critical temperature.
- Antiferromagnetism*** - A type of magnetism in which the magnetic moments of atoms in a solid are ordered into two antiparallel aligned sublattices. Antiferromagnets are characterized by a zero or small positive magnetic susceptibility. The susceptibility increases with temperature up to a critical value, the Néel temperature, above which the material becomes paramagnetic.
- Antiparticle** - A particle having the same mass as a given elementary particle and a charge equal in magnitude but opposite in sign.
- Appearance potential*** - The lowest energy which must be imparted to the parent molecule to cause it to produce a particular specified parent ion. This energy, usually stated in eV, may be imparted by electron impact, photon impact, or in other ways. More properly called appearance energy. [3]
- Appearance potential spectroscopy (APS)** - See Techniques for Materials Characterization, page 12-1.
- Are (a)** - A unit of area equal to 100 m². [1]

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Arenes** - Monocyclic and polycyclic aromatic hydrocarbons. See aromatic compounds. [5]
- Aromatic compounds** - Compounds whose structure includes a cyclic delocalized π -electron system. Historical use of the term implies a ring containing only carbon (e.g., benzene, naphthalene), but it is often generalized to include heterocyclic structures such as pyridine and thiophene. [5]
- Arrhenius equation** - A key equation in chemical kinetics which expresses the rate constant k as $k = A \exp(-E_a/RT)$, where E_a is the activation energy, R the molar gas constant, and T the temperature. A is called the preexponential factor and, for simple gas phase reactions, may be identified with the collision frequency.
- Arsines** - AsH_3 and compounds derived from it by substituting one, two or three hydrogen atoms by hydrocarbyl groups. $RAsH_2$, R_2AsH , R_3As (R not equal to H) are called primary, secondary and tertiary arsines, respectively. [5]
- Aryl groups** - Groups derived from arenes by removal of a hydrogen atom from a ring carbon atom. Groups similarly derived from heteroarenes are sometimes subsumed in this definition. [5]
- Astronomical unit (AU)*** - The mean distance of the earth from the sun, equal to $1.49597870 \times 10^{11}$ m.
- Atomic absorption spectroscopy (AAS)** - See Techniques for Materials Characterization, page 12-1.
- Atomic emission spectroscopy (AES)** - See Techniques for Materials Characterization, page 12-1.
- Atomic force microscopy (AFM)** - See Techniques for Materials Characterization, page 12-1.
- Atomic mass*** - The mass of a nuclide, normally expressed in unified atomic mass units (u).
- Atomic mass unit (u)*** - A unit of mass used in atomic, molecular, and nuclear science, defined as the mass of one atom of ^{12}C divided by 12. Its approximate value is 1.66054×10^{-27} kg. Also called the unified atomic mass unit. [1]
- Atomic number (Z)** - A characteristic property of an element, equal to the number of protons in the nucleus.
- Atomic weight (A_r)*** - The ratio of the average mass per atom of an element to 1/12 of the mass of nuclide ^{12}C . An atomic weight can be defined for a sample of any given isotopic composition. The standard atomic weight refers to a sample of normal terrestrial isotopic composition. The term relative atomic mass is synonymous with atomic weight. [2]
- Attenuated total reflection (ATR)** - See Techniques for Materials Characterization, page 12-1.
- Auger effect** - An atomic process in which an electron from a higher energy level fills a vacancy in an inner shell, transferring the released energy to another electron which is ejected.
- Aurora** - An atmospheric phenomenon in which streamers of light are produced when electrons from the sun are guided into the thermosphere by the earth's magnetic field. It occurs in the polar regions at altitudes of 95–300 km.
- Avogadro constant (N_A)*** - The number of elementary entities in one mole of a substance.
- Azeotrope** - A liquid mixture in a state where the variation of vapor pressure with composition at constant temperature (or, alternatively, the variation of normal boiling point with composition) shows either a maximum or a minimum. Thus when an azeotrope boils the vapor has the same composition as the liquid.
- Azides** - Compounds bearing the group $-N_3$, viz. $-N=N^+=N^-$; usually attached to carbon, e.g. PhN_3 , phenyl azide or azidobenzene. Also used for salts of hydrazoic acid, HN_3 , e.g. NaN_3 , sodium azide. [5]
- Azines** - Condensation products, $R_2C=NN=CR_2$, of two moles of a carbonyl compound with one mole of hydrazine. [5]
- Azo compounds** - Derivatives of diazene (diimide), $HN=NH$, wherein both hydrogens are substituted by hydrocarbyl groups, e.g., $PhN=NPh$, azobenzene or diphenyldiazene. [5]
- Balmer series** - The series of lines in the spectrum of the hydrogen atom which corresponds to transitions between the state with principal quantum number $n = 2$ and successive higher states. The wavelengths are given by $1/\lambda = R_H(1/4 - 1/n^2)$, where $n = 3, 4, \dots$ and R_H is the Rydberg constant for hydrogen. The first member of the series ($n = 2 \rightarrow 3$), which is often called the H_α line, falls at a wavelength of 6563 Å.
- Bar (bar)** - A unit of pressure equal to 10^5 Pa.
- Bardeen-Cooper-Schrieffer (BCS) theory** - A theory of superconductivity which is based upon the formation of electron pairs as a result of an electron-lattice interaction. The theory relates the superconducting transition temperature to the density of states and the Debye temperature.
- Barn (b)** - A unit used for expressing cross sections of nuclear processes, equal to 10^{-28} m².
- Barrel** - A unit of volume equal to 158.9873 L.
- Baryon** - Any elementary particle built up from three quarks. Examples are the proton, neutron, and various short-lived hyperons. Baryons have odd half-integer spins.
- Base** - Historically, a substance that yields an OH^- ion when it dissociates in solution, resulting in a $pH > 7$. In the Brønsted definition, a base is a substance capable of accepting a proton in any type of reaction. The more general definition, due to G.N. Lewis, classifies any chemical species capable of donating an electron pair as a base.
- Becquerel (Bq)*** - The SI unit of radioactivity (disintegrations per unit time), equal to s^{-1} . [1]
- Beer's law** - An approximate expression for the change in intensity of a light beam that passes through an absorbing medium, viz., $\log(I/I_0) = -\epsilon cl$, where I_0 is the incident intensity, I is the final intensity, ϵ is the molar (decadic) absorption coefficient, c is the molar concentration of the absorbing substance, and l is the path length. Also called the Beer-Lambert law
- Binding energy*** - A generic term for the energy required to decompose a system into two or more of its constituent parts. In nuclear physics, the binding energy is the energy difference between a nucleus and the separated nucleons of which it is composed (the energy equivalent of the mass defect). In atomic physics, it is the energy required to remove an electron from an atom.
- Biot (Bi)** - A name sometimes used for the unit of current in the emu system.
- Birefringence** - A property of certain crystals in which two refracted rays result from a single incident light ray. One, the ordinary ray, follows the normal laws of refraction, while the other, the extraordinary ray, exhibits a variable refractive index which depends on the direction in the crystal.
- Black body radiation*** - The radiation emitted by a perfect black body, i.e., a body which absorbs all radiation incident on it and reflects none. The wavelength dependence of the radiated energy density ρ (energy per unit volume per unit wavelength range) is given by the Planck formula
- $$\rho = \frac{8\pi hc}{\lambda^5 \left(e^{hc/\lambda kT} - 1 \right)}$$
- where λ is the wavelength, h is Planck's constant, c is the speed of light, k is the Boltzmann constant, and T is the temperature.
- Black hole** - A very dense object, formed in a supernova explosion, whose gravitational field is so large that no matter or radiation can escape from the object.
- Bloch wave function** - A solution of the Schrödinger equation for an electron moving in a spatially periodic potential; used in the band theory of solids.
- Bohr magneton (μ_B)*** - The atomic unit of magnetic moment, defined as

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- $eh/4\pi m_e$, where h is Planck's constant, m_e the electron mass, and e the elementary charge. It is the moment associated with a single electron spin.
- Bohr, bohr radius (a_0)*** - The radius of the lowest orbit in the Bohr model of the hydrogen atom, defined as $\epsilon_0 h^2 / \pi m_e e^2$, where ϵ_0 is the permittivity of a vacuum, h is Planck's constant, m_e the electron mass, and e the elementary charge. It is customarily taken as the unit of length when using atomic units.
- Boiling point** - The temperature at which the liquid and gas phases of a substance are in equilibrium at a specified pressure. The normal boiling point is the boiling point at normal atmospheric pressure (101.325 kPa).
- Boltzmann constant (k)*** - The molar gas constant R divided by Avogadro's constant.
- Boltzmann distribution** - An expression for the equilibrium distribution of molecules as a function of their energy, in which the number of molecules in a state of energy E is proportional to $\exp(-E/kT)$, where k is the Boltzmann constant and T is the temperature.
- Bond strength** - See Dissociation energy.
- Born-Haber cycle*** - A thermodynamic cycle in which a crystalline solid is converted to gaseous ions and then reconverted to the solid. The cycle permits calculation of the lattice energy of the crystal.
- Bose-Einstein distribution** - A modification of the Boltzmann distribution which applies to a system of particles that are bosons. The number of particles of energy E is proportional to $[e^{(E-\mu)/kT} - 1]^{-1}$, where μ is a normalization constant, k is the Boltzmann constant, and T is the temperature.
- Boson** - A particle that obeys Bose-Einstein Statistics; specifically, any particle with spin equal to zero or an integer. This includes the photon, pion, deuteron, and all nuclei of even mass number.
- Boyle's law** - The empirical law, exact only for an ideal gas, which states that the volume of a gas is inversely proportional to its pressure at constant temperature.
- Bragg angle (θ)** - Defined by the equation $n\lambda = 2d\sin\theta$, which relates the angle θ between a crystal plane and the diffracted x-ray beam, the wavelength λ of the x-rays, the crystal plane spacing d , and the diffraction order n (any integer).
- Bravais lattices*** - The 14 distinct crystal lattices that can exist in three dimensions. They include three in the cubic crystal system, two in the tetragonal, four in the orthorhombic, two in the monoclinic, and one each in the triclinic, hexagonal, and trigonal systems.
- Breakdown voltage** - The potential difference at which an insulating substance undergoes a physical or chemical change that causes it to become a conductor, thus allowing current to flow through the sample.
- Bremsstrahlung** - Electromagnetic radiation generated when the velocity of a charged particle is reduced (literally, "braking radiation"). An example is the x-ray continuum resulting from collisions of electrons with the target in an x-ray tube.
- Brewster angle** - The angle of incidence for which the maximum degree of plane polarization occurs when a beam of unpolarized light is incident on the surface of a medium of refractive index n . At this angle, the angle between the reflected and refracted beams is 90° . The value of the Brewster angle is $\tan^{-1}n$.
- Brillouin scattering** - The scattering of light by acoustic phonons in a solid or liquid.
- Brillouin zone** - A region of allowed wave vectors and energy levels in a crystalline solid, which plays a part in the propagation of waves through the lattice.
- British thermal unit (Btu)** - A non-SI unit of energy, equal to approximately 1055 J. Several values of the Btu, defined in slightly different ways, have been used.
- Brownian motion** - The random movements of small particles suspended in a fluid, which arise from collisions with the fluid molecules.
- Brunauer-Emmett-Teller method (BET)** - See Techniques for Materials Characterization, page 12-1.
- Buffer*** - A solution designed to maintain a constant pH when small amounts of a strong acid or base are added. Buffers usually consist of a fairly weak acid and its salt with a strong base. Suitable concentrations are chosen so that the pH of the solution remains close to the pK_a of the weak acid.
- Calorie (cal)** - A non-SI unit of energy, originally defined as the heat required to raise the temperature of 1 g of water by 1°C . Several calories of slightly different values have been used. The thermochemical calorie is now defined as 4.184 J.
- Candela (cd)*** - The SI base unit of luminous intensity. [1]
- Capacitance (C)** - Ratio of the charge acquired by a body to the change in potential. [1]
- Carbamates** - Salts or esters of carbamic acid, $\text{H}_2\text{NC}(=\text{O})\text{OH}$, or of N-substituted carbamic acids: $\text{R}_2\text{NC}(=\text{O})\text{OR}'$, (R' = hydrocarbyl or a cation). The esters are often called urethanes or urethans, a usage that is strictly correct only for the ethyl esters. [5]
- Carbenes** - The electrically neutral species H_2C : and its derivatives, in which the carbon is covalently bonded to two univalent groups of any kind or a divalent group and bears two nonbonding electrons, which may be spin-paired (singlet state) or spin-non-paired (triplet state). [5]
- Carbinols** - An obsolete term for substituted methanols, in which the name carbinol is synonymous with methanol. [5]
- Carbohydrates** - Originally, compounds such as aldoses and ketoses, having the stoichiometric formula $\text{C}_n(\text{H}_2\text{O})_n$ (hence "hydrates of carbon"). The generic term carbohydrate now includes mono-, oligo-, and polysaccharides, as well as their reaction products and derivatives. [5]
- Carboranes** - A contraction of carbaboranes. Compounds in which a boron atom in a polyboron hydride is replaced by a carbon atom with maintenance of the skeletal structure. [5]
- Carboxylic acids** - Oxoacids having the structure $\text{RC}(=\text{O})\text{OH}$. The term is used as a suffix in systematic name formation to denote the $-\text{C}(=\text{O})\text{OH}$ group including its carbon atom. [5]
- Carnot cycle** - A sequence of reversible changes in a heat engine using a perfect gas as the working substance, which is used to demonstrate that entropy is a state function. The Carnot cycle also provides a means to calculate the efficiency of a heat engine.
- Catalyst** - A substance that participates in a particular chemical reaction and thereby increases its rate but without a net change in the amount of that substance in the system. [3]
- Catenanes, catena compounds** - Hydrocarbons having two or more rings connected in the manner of links of a chain, without a covalent bond. More generally, the class catena compounds embraces functional derivatives and hetero analogues. [5]
- Cation** - A positively charged atomic or molecular particle.
- Centipoise (cP)** - A common non-SI unit of viscosity, equal to mPa s.
- Centrifugal distortion** - An effect in molecular spectroscopy in which rotational levels are lowered in energy, relative to the values of a rigid rotor, as the rotational angular momentum increases. The effect may be understood classically as a stretching of the bonds in the molecule as it rotates faster, thus increasing the moment of inertia.
- Ceramic** - A nonmetallic material of very high melting point.
- Cerenkov radiation** - Light emitted when a beam of charged particles travels through a medium at a speed greater than the speed of light in the medium. It is typically blue in color.
- Cgs system of units** - A system of units based upon the centimeter, gram, and second. The cgs system has been supplanted by the International System (SI).
- Chalcogens** - The Group VIA elements (oxygen, sulfur, selenium, tellurium, and polonium). Compounds of these elements are called chalcogenides. [7]

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Chaotic system** - A complex system whose behavior is governed by deterministic laws but whose evolution can vary drastically when small changes are made in the initial conditions.
- Charge** - See Electric charge.
- Charles' law** - The empirical law, exact only for an ideal gas, which states that the volume of a gas is directly proportional to its temperature at constant pressure.
- Charm** - A quantum number introduced in particle physics to account for certain properties of elementary particles and their reactions.
- Chelate** - A compound characterized by the presence of bonds from two or more bonding sites within the same ligand to a central metal atom. [3]
- Chemical potential** - For a mixture of substances, the chemical potential of constituent B is defined as the partial derivative of the Gibbs energy G with respect to the amount (number of moles) of B, with temperature, pressure, and amounts of all other constituents held constant. Also called partial molar Gibbs energy. [2]
- Chemical shift*** - A small change in the energy levels (and hence in the spectra associated with these levels) resulting from the effects of chemical binding in a molecule. The term is used in fields such as NMR, Mössbauer, and photoelectron spectroscopy, where the energy levels are determined primarily by nuclear or atomic effects.
- Chiral molecule** - A molecule which cannot be superimposed on its mirror image. A common example is an organic molecule containing a carbon atom to which four different atoms or groups are attached. Such molecules exhibit optical activity, i.e., they rotate the plane of a polarized light beam.
- Chlorocarbons** - Compounds consisting solely of chlorine and carbon. [5]
- Chromatography*** - A method for separation of the components of a sample in which the components are distributed between two phases, one of which is stationary while the other moves. In gas chromatography the gas moves over a liquid or solid stationary phase. In liquid chromatography the liquid mixture moves through another liquid, a solid, or a gel. The mechanism of separation of components may be adsorption, differential solubility, ion-exchange, permeation, or other mechanisms. [6]
- Clapeyron equation** - A relation between pressure and temperature of two phases of a pure substance that are in equilibrium, viz., $dp/dT = \Delta_{\text{trs}}S/\Delta_{\text{trs}}V$, where $\Delta_{\text{trs}}S$ is the difference in entropy between the phases and $\Delta_{\text{trs}}V$ the corresponding difference in volume.
- Clathrates** - Inclusion compounds in which the guest molecule is in a cage formed by the host molecule or by a lattice of host molecules. [5]
- Clausius (Cl)** - A non-SI unit of entropy or heat capacity defined as cal/K = 4.184 J/K. [2]
- Clausius-Clapeyron equation** - An approximation to the Clapeyron equation applicable to liquid-gas and solid-gas equilibrium, in which one assumes an ideal gas with volume much greater than the condensed phase volume. For the liquid-gas case, it takes the form $d(\ln p)/dT = \Delta_{\text{vap}}H/RT^2$, where R is the molar gas constant and $\Delta_{\text{vap}}H$ is the molar enthalpy of vaporization. For the solid-gas case, $\Delta_{\text{vap}}H$ is replaced by the molar enthalpy of sublimation, $\Delta_{\text{sub}}H$.
- Clausius-Mosotti equation** - A relation between the dielectric constant ϵ_r at optical frequencies and the polarizability α :
- $$\frac{\epsilon_r - 1}{\epsilon_r + 2} = \frac{\rho N_A \alpha}{3M\epsilon_0}$$
- where ρ is density, N_A is Avogadro's number, M is molar mass, and ϵ_0 is the permittivity of a vacuum.
- Clebsch-Gordon coefficients** - A set of coefficients used to describe the vector coupling of angular momenta in atomic and nuclear physics.
- Codon** - A set of three bases, chosen from the four primary bases found in the DNA molecule (uracil, cytosine, adenine, and guanine), which specifies the production of a particular amino acid or carries some other genetic instruction. For example, the codon UCA specifies the amino acid serine, CAG specifies glutamine, etc. There are a total of 64 codons.
- Coercive force** - The magnetizing force at which the magnetic flux density is equal to zero. [10]
- Coercivity*** - The maximum value of coercive force that can be attained when a magnetic material is symmetrically magnetized to saturation induction. [10]
- Coherent anti-Stokes Raman spectroscopy (CARS)** - See Techniques for Materials Characterization, page 12-1.
- Colloid** - Molecules or polymolecular particles dispersed in a medium that have, at least in one direction, a dimension roughly between 1 nm and 1 μm . [3]
- Color center** - A defect in a crystal that gives rise to optical absorption, thus changing the color of the material. A common type is the F-center, which results when an electron occupies the site of a negative ion.
- Compressibility (κ)*** - The fractional change of volume as pressure is increased, viz., $\kappa = -(1/V)(dV/dp)$. [1]
- Compton wavelength (λ_C)*** - In the scattering of electromagnetic radiation by a free particle (e.g., electron, proton), $\lambda_C = h/mc$ is the increase in wavelength, at a 90° scattering angle, corresponding to the transfer of energy from radiation to particle. Here h is Planck's constant, c the speed of light, and m the mass of the particle.
- Conductance (G)*** - For direct current, the reciprocal of resistance. More generally, the real part of admittance. [1]
- Conductivity, electrical (σ)*** - The reciprocal of the resistivity. [1]
- Conductivity, thermal** - See Thermal conductivity.
- Congruent transformation** - A phase transition (melting, vaporization, etc.) in which the substance preserves its exact chemical composition.
- Constitutional repeating unit (CRU)** - In polymer science, the smallest constitutional unit, the repetition of which constitutes a regular macromolecule, i.e., a macromolecule with all units connected identically with respect to directional sense. [8]
- Copolymer** - A polymer derived from more than one species of monomer. [8]
- Coriolis effect** - The deviation from simple trajectories when a mechanical system is described in a rotating coordinate system. It affects the motion of projectiles on the earth and in molecular spectroscopy leads to an important interaction between the rotational and vibrational motions. The effect may be described by an additional term in the equations of motion, called the Coriolis force.
- Cosmic rays*** - High energy nuclear particles, electrons, and photons, originating mostly outside the solar system, which continually bombard the earth's atmosphere.
- Coulomb (C)*** - The SI unit of electric charge, equal to A s. [1]
- Coulomb's law** - The statement that the force F between two electrical charges q_1 and q_2 separated by a distance r is $F = (4\pi\epsilon_0)^{-1}q_1q_2/r^2$, where ϵ_0 is the permittivity of a vacuum.
- Covalent bond** - A chemical bond between two atoms whose stability results from the sharing of two electrons, one from each atom.
- Cowling number (Co)** - A dimensionless quantity used in plasma physics, defined by $Co = B^2/\mu\rho v^2$, where ρ is density, v is velocity, μ is permeability, and B is magnetic flux density. [2]
- CPT theorem** - A theorem in particle physics which states that any local Lagrangian theory that is invariant under proper Lorentz transformations is also invariant under the combined operations of charge conjugation, C, space inversion, P, and time reversal, T, taken in any order.
- Critical point*** - In general, the point on the phase diagram of a two-phase system at which the two coexisting phases have identical properties

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- and therefore represent a single phase. At the liquid-gas critical point of a pure substance, the distinction between liquid and gas vanishes, and the vapor pressure curve ends. The coordinates of this point are called the critical temperature and critical pressure. Above the critical temperature, it is not possible to liquefy the substance.
- Cross section (σ)*** - A measure of the probability of collision (or other interaction) between a beam of particles and a target which it encounters. In rough terms it is the effective area the target particles present to the incident ones; however, the precise definition depends on the nature of the interaction. A general definition of σ is the number of encounters per unit time divided by nv , where n is the concentration of incident particles and v their velocity.
- Crosslink** - In polymer science, a small region in a macromolecule from which at least four chains emanate, and formed by reactions involving sites or groups on existing macromolecules or by interactions between existing macromolecules. [8]
- Crown compounds** - Macrocyclic polydentate compounds, usually uncharged, in which three or more coordinating ring atoms (usually oxygen or nitrogen) are or may become suitably close for easy formation of chelate complexes with metal ions or other cationic species. [5]
- Crust*** - The outer layer of the solid earth, above the Mohorovicic discontinuity. Its thickness averages about 35 km on the continents and about 7 km below the ocean floor.
- Cryoscopic constant (E_f)*** - The constant that expresses the amount by which the freezing point T_f of a solvent is lowered by a non-dissociating solute, through the relation $\Delta T_f = E_f m$, where m is the molality of the solute.
- Curie (Ci)** - A non-SI unit of radioactivity (disintegrations per unit time), equal to $3.7 \times 10^{10} \text{ s}^{-1}$.
- Curie temperature (T_C)*** - For a ferromagnetic material, the critical temperature above which the material becomes paramagnetic. Also applied to the temperature at which the spontaneous polarization disappears in a ferroelectric solid. [1]
- Cyanohydrins** - Alcohols substituted by a cyano group, most commonly, but not limited to, examples having a CN and an OH group attached to the same carbon atom. They are formally derived from aldehydes or ketones by the addition of hydrogen cyanide. [5]
- Cycloalkanes** - Saturated monocyclic hydrocarbons (with or without side chains). See alicyclic compounds. Unsaturated monocyclic hydrocarbons having one endocyclic double or one triple bond are called cycloalkenes and cycloalkynes, respectively. [5]
- Cyclotron resonance** - The resonant absorption of energy from a system in which electrons or ions that are orbiting in a uniform magnetic field are subjected to radiofrequency or microwave radiation. The resonance frequency is given by $\nu = eH/2\pi m^*c$, where e is the elementary charge, H is the magnetic field strength, m^* is the effective mass of the charged particle, and c is the speed of light. The effect occurs in both solids (involving electrons or holes) and in low pressure gases (involving ions)
- Dalton (Da)** - A name sometimes used in biochemistry for the unified atomic mass unit (u).
- De Broglie wavelength** - The wavelength associated with the wave representation of a moving particle, given by h/mv , where h is Planck's constant, m the particle mass, and v the velocity.
- De Haas-Van Alphen effect** - An effect observed in certain metals and semiconductors at low temperatures and high magnetic fields, characterized by a periodic variation of magnetic susceptibility with field strength.
- Debye equation*** - The relation between the relative permittivity (dielectric constant) ϵ_r , polarizability α , and permanent dipole moment μ in a dielectric material whose molecules are free to rotate. It takes the form
- $$\frac{\epsilon_r - 1}{\epsilon_r + 2} = \frac{\rho N_A}{3M\epsilon_0} \left(\alpha + \frac{\mu^2}{3kT} \right)$$
- where ρ is density, N_A is Avogadro's number, M is molar mass, and ϵ_0 is the permittivity of a vacuum.
- Debye length** - In the Debye-Hückel theory of ionic solutions, the effective thickness of the cloud of ions of opposite charge which surrounds each given ion and shields the Coulomb potential produced by that ion.
- Debye temperature (θ_D)*** - In the Debye model of the heat capacity of a crystalline solid, $\theta_D = hv_D/k$, where h is Planck's constant, k is the Boltzmann constant, and v_D is the maximum vibrational frequency the crystal can support. For $T \ll \theta_D$, the heat capacity is proportional to T^3 .
- Debye unit (D)** - A non-SI unit of electric dipole moment used in molecular physics, equal to $3.335641 \times 10^{-30} \text{ C m}$.
- Debye-Waller factor (D)** - The factor by which the intensity of a diffraction line is reduced because of lattice vibrations. [1]
- Defect** - Any departure from the regular structure of a crystal lattice. A Frenkel defect results when an atom or ion moves to an interstitial position and leaves behind a vacancy. A Schottky defect involves either a vacancy where the atom has moved to the surface or a structure where a surface atom has moved to an interstitial position.
- Degree of polymerization** - The number of monomeric units in a macromolecule or an oligomer molecule. [8]
- Dendrite** - A tree-like crystalline pattern often observed, for example, in ice crystals and alloys in which the crystal growth branches repeatedly.
- Density (ρ)*** - In the most common usage, mass density or mass per unit volume. More generally, the amount of some quantity (mass, charge, energy, etc.) divided by a length, area, or volume.
- Density of states (N_E, ρ)** - The number of one-electron states in an infinitesimal interval of energy, divided by the range of that interval and by volume. [1]
- Dew point*** - The temperature at which liquid begins to condense as the temperature of a gas mixture is lowered. In meteorology, it is the temperature at which moisture begins to condense on a surface in contact with the air.
- Diamagnetism** - A type of magnetism characterized by a negative magnetic susceptibility, so that the material, when placed in an external magnetic field, becomes weakly magnetized in the direction opposite to the field. This magnetization is independent of temperature.
- Diazo compounds** - Compounds having the divalent diazo group, $=N^+=N^+$, attached to a carbon atom, e.g., $\text{CH}_2=\text{N}_2$ diazomethane. [5]
- Dielectric constant (ϵ)*** - Ratio of the electric displacement in a medium to the electric field strength. Also called permittivity. [1]
- Dienes** - Compounds that contain two fixed double bonds (usually assumed to be between carbon atoms). Dienes in which the two double-bond units are linked by one single bond are termed conjugated. [5]
- Differential scanning calorimetry (DSC)** - See Techniques for Materials Characterization, page 12-1.
- Differential thermal analysis (DTA)** - See Techniques for Materials Characterization, page 12-1.
- Diffusion*** - The migration of atoms, molecules, ions, or other particles as a result of some type of gradient (concentration, temperature, etc.).
- Dioptr** - A unit used in optics, formally equal to m^{-1} . It is used in expressing dioptric power, which is the reciprocal of the focal length of a lens.
- Dipole moment, electric (p, μ)*** - For a distribution of equal positive and

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- negative charge, the magnitude of the dipole moment vector is the positive charge multiplied by the distance between the centers of positive and negative charge distribution. The direction is given by the line from the center of negative charge to the center of positive charge.
- Dipole moment, magnetic (m, μ)** - Formally defined in electromagnetic theory as a vector quantity whose vector product with the magnetic flux density equals the torque. The magnetic dipole generated by a current I flowing in a small loop of area A has a magnetic moment of magnitude IA . In atomic and nuclear physics, a magnetic moment is associated with the angular momentum of a particle; e.g., an electron with orbital angular momentum l exhibits a magnetic moment of $-e\hbar/2m_e$ where e is the elementary charge and m_e the mass of the electron. [1]
- Disaccharides** - Compounds in which two monosaccharides are joined by a glycosidic bond. [5]
- Dislocation** - An extended displacement of a crystal from a regular lattice. An edge dislocation results when one portion of the crystal has partially slipped with respect to the other, resulting in an extra plane of atoms extending through part of the crystal. A screw dislocation transforms successive atomic planes into the surface of a helix.
- Dispersion** - Splitting of a beam of light (or other electromagnetic radiation) of mixed wavelengths into the constituent wavelengths as a result of the variation of refractive index of the medium with wavelength.
- Dissociation constant*** - The equilibrium constant for a chemical reaction in which a compound dissociates into its constituent parts.
- Dissociation energy (D_0)*** - For a diatomic molecule, the difference between the energies of the free atoms at rest and the minimum in the potential energy curve. The term bond dissociation energy (D_0), which can be applied to polyatomic molecules as well, is used for the difference between the energies of the fragments resulting when a bond is broken and the energy of the original molecule in its lowest energy state. The term bond strength implies differences in enthalpy rather than energy.
- Domain** - A small region of a solid in which the magnetic or electric moments of the individual units (atoms, molecules, or ions) are aligned in the same direction.
- Domain wall** - The transition region between adjacent ferromagnetic domains, generally a layer with a thickness of a few hundred ångström units. Also called Bloch wall.
- Doppler effect** - The change in the apparent frequency of a wave (sound, light, or other) when the source of the wave is moving relative to the observer.
- Dose equivalent (H)** - The product of the absorbed dose of radiation at a point of interest in tissue and various modifying factors which depend on the type of tissue and radiation. [1]
- Drift velocity** - The velocity of charge carriers (electrons, ions, etc.) moving under the influence of an electric field in a medium which subjects the carriers to some frictional force.
- Dyne (dyn)** - A non-SI (cgs) unit of force, equal to 10^{-5} N.
- Ebullioscopic constant (E_b)*** - The constant that expresses the amount by which the boiling point T_b of a solvent is raised by a non-dissociating solute, through the relation $\Delta T_b = E_b m$, where m is the molality of the solute.
- Eddy currents** - Circulating currents set up in conducting bulk materials or sheets by varying magnetic fields.
- Effinghausen effect** - The appearance of a temperature gradient in a current carrying conductor that is placed in a transverse magnetic field. The direction of the gradient is perpendicular to the current and the field.
- Eigenvalue** - An allowed value of the constant a in the equation $Au = au$, where A is an operator acting on a function u (which is called an eigenfunction). In quantum mechanics, the outcome of any observation is an eigenvalue of the corresponding operator. Also called characteristic value.
- Einstein** - A non-SI unit used in photochemistry, equal to one mole of photons.
- Einstein temperature (θ_v)** - In the Einstein theory of the heat capacity of a crystalline solid, $\theta_v = h\nu/k$, where h is Planck's constant, k is the Boltzmann constant, and ν is the vibrational frequency of the crystal.
- Einstein transition probability** - A constant in the Einstein relation $A_{ij} + B_{ij}\rho$ for the probability of a transition between two energy levels i and j in a radiation field of energy density ρ . The A_{ij} coefficient describes the probability of spontaneous emission, while B_{ij} and B_{ji} govern the probability of stimulated emission and absorption, respectively ($B_{ij} = B_{ji}$).
- Elastic limit** - The greatest stress which a material is capable of sustaining without any permanent strain remaining after complete release of the stress. [10]
- Elastic modulus** - See Young's modulus.
- Electric charge (Q)** - The quantity of electricity; i.e., the property that controls interactions between bodies through electrical forces.
- Electric current (I)** - The charge passing through a circuit per unit time. [1]
- Electric displacement (D)** - A vector quantity whose magnitude equals the electric field strength multiplied by the permittivity of the medium and whose direction is the same as that of the field strength.
- Electric field strength (E)** - The force exerted by an electric field on a point charge divided by the electric charge. [1]
- Electric potential (V)** - A scalar quantity whose gradient is equal to the negative of the electric field strength.
- Electrical conductance** - See Conductance
- Electrical resistance** - See Resistance
- Electrical resistivity** - See Resistivity.
- Electrochemical series*** - An arrangement of reactions which produce or consume electrons in an order based on standard electrode potentials. A common arrangement places metals in decreasing order of their tendency to give up electrons.
- Electrode potential*** - The electromotive force of a cell in which the electrode on the left is the standard hydrogen electrode and that on the right is the electrode in question. [2]
- Electrolysis** - The decomposition of a substance as a result of passing an electric current between two electrodes immersed in the sample.
- Electromotive force (emf)** - The energy supplied by a source divided by the charge transported through the source. [1]
- Electron*** - An elementary particle in the family of leptons, with negative charge and spin of $1/2$.
- Electron affinity*** - The energy difference between the ground state of a gas-phase atom or molecule and the lowest state of the corresponding negative ion.
- Electron cyclotron resonance (ECR)** - See Techniques for Materials Characterization, page 12-1.
- Electron energy loss spectroscopy (EELS)** - See Techniques for Materials Characterization, page 12-1.
- Electron nuclear double resonance (ENDOR)** - See Techniques for Materials Characterization, page 12-1.
- Electron paramagnetic resonance (EPR)** - See Techniques for Materials Characterization, page 12-1.
- Electron probe microanalysis (EPMA)** - See Techniques for Materials Characterization, page 12-1.
- Electron spectroscopy for chemical analysis (ESCA)** - See Techniques for Materials Characterization, page 12-1.
- Electron spin (s)** - The quantum number, equal to $1/2$, that specifies the intrinsic angular momentum of the electron.

DEFINITIONS OF SCIENTIFIC TERMS (continued)

Electron stimulated desorption (ESD) - See Techniques for Materials Characterization, page 12-1.

Electron volt (eV)* - A non-SI unit of energy used in atomic and nuclear physics, equal to approximately 1.602177×10^{-19} J. The electron volt is defined as the kinetic energy acquired by an electron upon acceleration through a potential difference of 1 V. [1]

Electronegativity* - A parameter originally introduced by Pauling which describes, on a relative basis, the power of an atom or group of atoms to attract electrons from the same molecular entity. [3]

Electrophoresis - The motion of macromolecules or colloidal particles in an electric field. [3]

Emissivity (ϵ)* - Ratio of the radiant flux emitted per unit area to that of an ideal black body at the same temperature. Also called emittance. [1]

Emu - The electromagnetic system of units, based upon the cm, g, and s plus the emu of current (sometimes called the abampere).

Enantiomers - A chiral molecule and its non-superposable mirror image. The two forms rotate the plane of polarized light by equal amounts in opposite directions. Also called optical isomers.

Energy (E, U)* - The characteristic of a system that enables it to do work.

Energy gap* - In the theory of solids, the region between two energy bands, in which no bound states can occur.

Enols, alkenols - The term refers specifically to vinylic alcohols, which have the structure $\text{HOOCR}'=\text{CR}_2$. Enols are tautomeric with aldehydes ($\text{R}' = \text{H}$) or ketones (R' not equal to H). [5]

Enthalpy (H)* - A thermodynamic function, especially useful when dealing with constant-pressure processes, defined by $H = E + PV$, where E is energy, P pressure, and V volume. [1]

Enthalpy of combustion* - The enthalpy change in a combustion reaction. Its negative is the heat released in combustion.

Enthalpy of formation, standard* - The enthalpy change for the reaction in which a substance is formed from its constituent elements, each in its standard reference state (normally refers to 1 mol, sometimes to 1 g, of the substance).

Enthalpy of fusion* - The enthalpy change in the transition from solid to liquid state.

Enthalpy of sublimation - The enthalpy change in the transition from solid to gas state.

Enthalpy of vaporization* - The enthalpy change in the transition from liquid to gas state.

Entropy (S)* - A thermodynamic function defined such that when a small quantity of heat dQ is received by a system at temperature T , the entropy of the system is increased by dQ/T , provided that no irreversible change takes place in the system. [1]

Entropy unit (e.u.) - A non-SI unit of entropy, equal to 4.184 J/K mol.

Ephemeris time - Time measured in tropical years from January 1, 1900.

Epoxy compounds - Compounds in which an oxygen atom is directly attached to two adjacent or non-adjacent carbon atoms of a carbon chain or ring system; thus cyclic ethers. [5]

Equation of continuity - Any of a class of equations that express the fact that some quantity (mass, charge, energy, etc.) cannot be created or destroyed. Such equations typically specify that the rate of increase of the quantity in a given region of space equals the net current of the quantity flowing into the region.

Equation of state* - An equation relating the pressure, volume, and temperature of a substance or system.

Equilibrium constant (K)* - For a chemical reaction $aA + bB \rightleftharpoons cC + dD$, the equilibrium constant is defined by:

$$K = \frac{a_C^c \cdot a_D^d}{a_A^a \cdot a_B^b}$$

where a_i is the activity of component i . To a certain approximation, the activities can be replaced by concentrations. The equilibrium constant

is related to $\Delta_r G^\circ$, the standard Gibbs energy change in the reaction, by $RT \ln K = -\Delta_r G^\circ$.

Equivalent conductance - See Conductivity, electrical

Erg (erg) - A non-SI (cgs) unit of energy, equal to 10^{-7} J.

Esters - Compounds formally derived from an oxoacid $\text{RC}(=\text{O})(\text{OH})$ and an alcohol, phenol, heteroarenol, or enol by linking, with formal loss of water from an acidic hydroxy group of the former and a hydroxy group of the latter. [5]

esu - The electrostatic system of units, based upon the cm, g, and s plus the esu of charge (sometimes called the statcoulomb or franklin).

Ethers - Compounds with formula ROR , where R is not equal to H. [5]

Euler number (Eu) - A dimensionless quantity used in fluid mechanics, defined by $Eu = \Delta p / \rho v^2$, where p is pressure, ρ is density, and v is velocity. [2]

Eutectic - The point on a two-component solid-liquid phase diagram which represents the lowest melting point of any possible mixture. A liquid having the eutectic composition will freeze at a single temperature without change of composition.

Excitance (M) - Radiant energy flux leaving an element of a surface divided by the area of that element. [1]

Exciton - A localized excited state consisting of a bound electron-hole pair in a molecular or ionic crystal. The exciton can propagate through the crystal.

Exosphere - The outermost part of the earth's atmosphere, beginning at about 500 to 1000 km above the surface. It is characterized by densities so low that air molecules can escape into outer space.

Expansion coefficient - See thermal expansion coefficient.

Extended electron energy loss fine structure (EXELFS) - See Techniques for Materials Characterization, page 12-1.

Extended x-ray absorption fine structure (EXAFS) - See Techniques for Materials Characterization, page 12-1.

Extinction coefficient - See Absorption coefficient, molar

F-Center - See Color center

Fahrenheit temperature ($^\circ\text{F}$) - The temperature scale based on the assignment of $32^\circ\text{F} = 0^\circ\text{C}$ and a temperature interval of $^\circ\text{F} = (5/9)^\circ\text{C}$; i.e., $t/^\circ\text{F} = (9/5)t/^\circ\text{C} + 32$.

Farad (F)* - The SI unit of electric capacitance, equal to C/V. [1]

Faraday constant (F)* - The electric charge of 1 mol of singly charged positive ions; i.e., $F = N_A e$, where N_A is Avogadro's constant and e is the elementary charge. [1]

Faraday effect* - The rotation of the plane of plane-polarized light by a medium placed in a magnetic field parallel to the direction of the light beam. The effect can be observed in solids, liquids, and gasses.

Fatty acids - Aliphatic monocarboxylic acids derived from or contained in esterified form in an animal or vegetable fat, oil, or wax. Natural fatty acids commonly have a chain of 4 to 28 carbons (usually unbranched and even-numbered), which may be saturated or unsaturated. By extension, the term is sometimes used to embrace all acyclic aliphatic carboxylic acids. [5]

Fermat's principle - The law that a ray of light traversing one or more media will follow a path which minimizes the time required to pass between two given points.

Fermi (f) - Name sometimes used in nuclear physics for the femtometer.

Fermi level - The highest energy of occupied states in a solid at zero temperature. Sometimes called Fermi energy. The Fermi surface is the surface in momentum space formed by electrons occupying the Fermi level.

Fermi resonance - An effect observed in vibrational spectroscopy when an overtone of one fundamental vibration closely coincides in energy with another fundamental of the same symmetry species. It leads to a splitting of vibrational bands.

Fermi-Dirac distribution - A modification of the Boltzmann distribu-

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- tion which takes into account the Pauli exclusion principle. The number of particles of energy E is proportional to $[e^{(E-\mu)/kT} + 1]^{-1}$, where μ is a normalization constant, k the Boltzmann constant, and T the temperature. The distribution is applicable to a system of fermions.
- Fermion** - A particle that obeys Fermi-Dirac statistics. Specifically, any particle with spin equal to an odd multiple of $1/2$. Examples are the electron, proton, neutron, muon, etc.
- Ferrimagnetism*** - A type of magnetism in which the magnetic moments of atoms in a solid are ordered into two nonequivalent sublattices with unequal magnetic moments, leading to a nonzero magnetic susceptibility.
- Ferrite** - A ferrimagnetic material of nominal formula MFe_2O_4 , where M is a divalent metal; widely used in microwave switches and other solid state devices.
- Ferroelectricity*** - The retention of electric polarization by certain materials after the external field that produced the polarization has been removed.
- Ferromagnetism*** - A type of magnetism in which the magnetic moments of atoms in a solid are aligned within domains which can in turn be aligned with each other by a weak magnetic field. Some ferromagnetic materials can retain their magnetization when the external field is removed, as long as the temperature is below a critical value, the Curie temperature. They are characterized by a large positive magnetic susceptibility.
- Fick's law** - The statement that the flux J of a diffusing substance is proportional to the concentration gradient, i.e., $J = -D(dc/dx)$, where D is called the diffusion coefficient.
- Field** - A mathematical construct which describes the interaction between particles resulting from gravity, electromagnetism, or other physical phenomena. In classical physics a field is described by equations. Quantum field theory introduces operators to represent the physical observables.
- Field emission microscopy (FEM)** - See Techniques for Materials Characterization, page 12-1.
- Field ion microscopy (FIM)** - See Techniques for Materials Characterization, page 12-1.
- Fine structure** - The splitting in spectral lines that results from interactions of the electron spin with the orbital angular momentum.
- Fine structure constant (α)*** - Defined as $e^2/2hc\epsilon_0$, where e is the elementary charge, h Planck's constant, c the speed of light, and ϵ_0 the permittivity of a vacuum. It is a measure of the strength of the electromagnetic interaction between particles.
- First radiation constant (e_1)*** - Constant ($= 2\pi hc^2$) in the equation for the radiant exitance M_λ of a black body:
- $$M_\lambda = \frac{c_1 \lambda^{-5} \Delta\lambda}{e^{c_2/\lambda T} - 1}$$
- where λ is the wavelength, T is the temperature, and $c_2 = hc/k$ is the second radiation constant.
- Flash point** - The lowest temperature at which vapors above a volatile combustible substance will ignite in air when exposed to a flame. [10]
- Fluence (F)** - Term used in photochemistry to specify the energy per unit area delivered in a given time interval, for example by a laser pulse. [2]
- Fluorocarbons** - Compounds consisting solely of fluorine and carbon. [5]
- Fluxoid** - The quantum of magnetic flux in superconductivity theory, equal to $hc/2e$, where h is Planck's constant, c the velocity of light, and e the elementary charge.
- Force (F)** - The rate of change of momentum with time. [1]
- Force constants (f, k)*** - In molecular vibrations, the coefficients in the expression of the potential energy in terms of atom displacements from their equilibrium positions. In a diatomic molecule, $f = d^2V/dr^2$, where $V(r)$ is the potential energy and r is the interatomic distance. [2]
- Fourier number (Fo)** - A dimensionless quantity used in fluid mechanics, defined by $Fo = at/l^2$, where a is thermal diffusivity, t is time, and l is length. [2]
- Fourier transform infrared spectroscopy (FTIR)** - A technique for obtaining an infrared spectrum by use of an interferometer in which the path length of one of the beams is varied. A Fourier transformation of the resulting interferogram yields the actual spectrum. The technique is also used for NMR and other types of spectroscopy.
- Fractals** - Geometrical objects that are self-similar under a change of scale; i.e., they appear similar at all levels of magnification. They can be considered to have fractional dimensionality. Examples occur in diverse fields such as geography (rivers and shorelines), biology (trees), and solid state physics (amorphous materials).
- Franck-Condon principle** - An important principle in molecular spectroscopy which states that the nuclei in a molecule remain essentially stationary while an electronic transition is taking place. The physical interpretation rests on the fact that the electrons move much more rapidly than the nuclei because of their much smaller mass.
- Franklin (Fr)** - Name sometimes given to the unit of charge in the esu system.
- Fraunhofer diffraction** - Diffraction of light in situations where the source and observation point are so far removed that the wave surfaces may be considered planar.
- Fraunhofer lines** - Sharp absorption lines in the spectrum of sunlight, caused by absorption of the solar blackbody radiation by atoms near the sun's surface.
- Free radical** - See Radicals. The term "free radical" is often used more broadly for molecules that have a paramagnetic ground state (e.g., O_2) and sometimes for any transient or highly reactive molecular species.
- Freezing point** - See Melting point
- Frequency (ν)*** - Number of cycles of a periodic phenomenon divided by time. [1]
- Fresnel diffraction** - Diffraction of light in a situation where the source and observation point are sufficiently close together that the curvature of the wave surfaces must be taken into account.
- Froude number (Fr)** - A dimensionless quantity used in fluid mechanics, defined by $Fr = v/(lg)^{1/2}$, where v is velocity, l is length, and g is acceleration due to gravity. [2]
- Fugacity (f_B)** - For a gas mixture, the fugacity of component B is defined as the absolute activity λ_B times the limit, as the pressure p approaches zero at constant temperature, of p_B/λ_B . [2]
- Fullerenes** - Compounds composed solely of an even number of carbon atoms, which form a cage-like fused-ring polycyclic system with twelve five-membered rings and the rest six-membered rings. The archetypal example is [60]fullerene, where the atoms and bonds delineate a truncated icosahedron. The term has been broadened to include any closed cage structure consisting entirely of three-coordinate carbon atoms. [5]
- Fulvalenes** - The hydrocarbon fulvalene and its derivatives formed by substitution (and by extension, analogues formed by replacement of one or more carbon atoms of the fulvalene skeleton by a heteroatom). [5]
- Fulvenes** - The hydrocarbon fulvene and its derivatives formed by substitution (and by extension, analogues formed by replacement of one or more carbon atoms of the fulvene skeleton by a heteroatom). [5]
- Fundamental vibrational frequencies*** - In molecular spectroscopy, the characteristic vibrational frequencies obtained when the vibrational energy is expressed in normal coordinates. They determine the primary features of the infrared and Raman spectra of the molecule.
- γ - Name sometimes used for microgram.
- γ -rays*** - Electromagnetic radiation (photons) with energy greater than about 0.1 MeV (wavelength less than about 1 pm).
- g -Factor of the electron*** - The proportionality factor in the equation

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- relating the magnetic moment μ of an electron to its total angular momentum quantum number J , i.e., $\mu = -g\mu_B J$, where μ_B is the Bohr magneton. Also called Landé factor.
- Gal** - A non-SI unit of acceleration, equal to 0.01 m/s. Also called galileo.
- Gallon (US)** - A unit of volume equal to 3.785412 L.
- Gallon (UK, Imperial)** - A unit of volume equal to 4.546090 L.
- Gauss (G)** - A non-SI unit of magnetic flux density (B) equal to 10^{-4} T.
- Gaussian system of units** - A hybrid system used in electromagnetic theory, which combines features of both the esu and emu systems.
- Gel** - A colloidal system with a finite, but usually rather small, yield stress (the shear stress at which yielding starts abruptly). [3]
- Genetic code*** - The set of relations between each of the 64 codons of DNA and a specific amino acid (or other genetic instruction).
- Gibbs energy (G)*** - An important function in chemical thermodynamics, defined by $G = H - TS$, where H is the enthalpy, S the entropy, and T the thermodynamic temperature. Sometimes called Gibbs free energy and, in older literature, simply "free energy". [2]
- Gibbs phase rule** - The relation $F = C - P + 2$, where C is the number of components in a mixture, P is the number of phases, and F is the degrees of freedom, i.e., the number of intensive variables that can be changed independently without affecting the number of phases.
- Glass transition temperature*** - The temperature at which an amorphous polymer is transformed, in a reversible way, from a viscous or rubbery condition to a hard and relatively brittle one. [10]
- Glow discharge mass spectroscopy (GDMS)** - See Techniques for Materials Characterization, page 12-1.
- Gluon** - A hypothetical particle postulated to take part in the binding of quarks, in analogy to the role of the photon in electromagnetic interactions.
- Glycerides** - Esters of glycerol (propane-1,2,3-triol) with fatty acids, widely distributed in nature. They are by long-established custom subdivided into triglycerides, 1,2- or 1,3-diglycerides, and 1- or 2-monoglycerides, according to the number and positions of acyl groups. [5]
- Glycols** - Dihydric alcohols in which two hydroxy groups are on different carbon atoms, usually but not necessarily adjacent. Also called diols. [5]
- Grain (gr)** - A non-SI unit of mass, equal to 64.79891 mg.
- Grain boundary** - The interface between two regions of different crystal orientation.
- Grashof number (Gr)** - A dimensionless quantity used in fluid mechanics, defined by $Gr = \beta g \alpha \Delta T p^2 / \eta^2$, where T is temperature, p is density, l is length, η is viscosity, α is cubic expansion coefficient, and g is acceleration of gravity. [2]
- Gravitational constant (G)*** - The universal constant in the equation for the gravitational force between two particles, $F = Gm_1m_2/r^2$, where r is the distance between the particles and m_1 and m_2 are their masses. [1]
- Gray (Gy)*** - The SI unit of absorbed dose of radiation, equal to J/kg. [1]
- Gregorian calendar** - The modification of the Julian calendar introduced in 1582 by Pope Gregory XII which specified that a year divisible by 100 is a leap year only if divisible by 400.
- Grignard reagents** - Organomagnesium halides, RMgX , having a carbon-magnesium bond (or their equilibrium mixtures in solution with $\text{R}_2\text{Mg} + \text{MgX}_2$). [5]
- Grüneisen parameter (γ)** - Defined by $\gamma = \alpha_V / \kappa c_V \rho$, where α_V is the cubic thermal expansion coefficient, κ is the isothermal compressibility, c_V is the specific heat capacity at constant volume, and ρ is the mass density. γ is independent of temperature for most crystalline solids. [1]
- Gyromagnetic ratio (γ)** - Ratio of the magnetic moment of a particle to its angular momentum. Also called magnetogyric ratio.
- Hadron** - Any elementary particle that can take part in the strong interaction. Hadrons are subdivided into baryons, with odd half integer spins, and mesons, which have zero or integral spin.
- Hall effect*** - The development of a transverse potential difference V in a conducting material when subjected to a magnetic field H perpendicular to the direction of the current. The potential difference is given by $V = R_H B J t$, where B is the magnetic induction, J the current density, t the thickness of the specimen in the direction of the potential difference, and R_H is called the Hall coefficient.
- Halocarbon** - A compound containing no elements other than carbon, hydrogen, and one or more halogens. In common practice, the term is used mainly for compounds of no more than four or five carbon atoms.
- Halogens** - The elements F, Cl, Br, I, and At. Compounds of these elements are called halogenides or halides. [7]
- Hamiltonian (H)** - An expression for the total energy of a mechanical system in terms of the momenta and positions of constituent particles. In quantum mechanics, the Hamiltonian operator appears in the eigenvalue equation $H\psi = E\psi$, where E is an energy eigenvalue and ψ the corresponding eigenfunction.
- Hardness*** - The resistance of a material to deformation, indentation, or scratching. Hardness is measured on various scales, such as Mohs, Brinell, Knoop, Rockwell, and Vickers. [10]
- Hartmann number (Ha)** - A dimensionless quantity used in plasma physics, defined by $Ha = Bl(\kappa/\eta)^{1/2}$, where B is magnetic flux density, l is length, κ is electric conductivity, and η is viscosity. [2]
- Hartree (E_h)*** - An energy unit used in atomic and molecular science, equal to approximately $4.3597482 \times 10^{-18}$ J.
- Hartree-Fock method** - A iterative procedure for solving the Schrödinger equation for an atom or molecule in which the equation is solved for each electron in an initial assumed potential from all the other electrons. The new potential that results is used to repeat the calculation and the procedure continued until convergence is reached. Also called self-consistent field (SCF) method.
- Heat capacity*** - Defined in general as dQ/dT , where dQ is the amount of heat that must be added to a system to increase its temperature by a small amount dT . The heat capacity at constant pressure is $C_p = (\partial H / \partial T)_p$; that at constant volume is $C_V = (\partial E / \partial T)_V$, where H is enthalpy, E is internal energy, p is pressure, V is volume, and T is temperature. An upper case C normally indicates the molar heat capacity, while a lower case c is used for the specific (per unit mass) heat capacity. [1]
- Heat of formation, vaporization, etc.** - See corresponding terms under Enthalpy.
- Hectare (ha)** - A unit of area equal to 10^4 m². [1]
- Heisenberg uncertainty principle** - The statement that two observable properties of a system that are complementary, in the sense that their quantum-mechanical operators do not commute, cannot be specified simultaneously with absolute precision. An example is the position and momentum of a particle; according to this principle, the uncertainties in position Δq and momentum Δp must satisfy the relation $\Delta p \Delta q \geq h/4\pi$, where h is Planck's constant.
- Heitler-London model** - An early quantum-mechanical model of the hydrogen atom which introduced the concept of the exchange interaction between electrons as the primary reason for stability of the chemical bond.
- Helicon** - A low-frequency wave generated when a metal at low temperature is exposed to a uniform magnetic field and a circularly polarized electric field.
- Helmholtz energy (A)** - A thermodynamic function defined by $A = E - TS$, where E is the energy, S the entropy, and T the thermodynamic temperature. [2]
- Hemiacetals** - Compounds having the general formula $\text{R}_2\text{C}(\text{OH})\text{OR}'$ (R' not equal to H). [5]
- Henry (H)*** - The SI unit of inductance, equal to Wb/A . [1]

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Henry's law *** - An expression which applies to an ideal dilute solution in which one or more gasses are dissolved, viz., $p_i = H_i x_i$, where p_i is the partial pressure of component i above the solution, x_i is its mole fraction in the solution, and H_i is the Henry's law constant (a characteristic of the given gas and solvent, as well as the temperature).
- Hermitian operator** - An operator A that satisfies the relation $\int u_m^* A u_n dx = (\int u_n^* A u_m dx)^*$, where $*$ indicates the complex conjugate. The eigenvalues of Hermitian operators are real, and eigenfunctions belonging to different eigenvalues are orthogonal.
- Hertz (Hz)** - The SI unit of frequency, equal to s^{-1} . [1]
- Heterocyclic compounds** - Cyclic compounds having as ring members atoms of at least two different elements, e.g., quinoline, 1,2-thiazole, bicyclo[3.3.1]tetrasiloxane. [5]
- Heusler alloys** - Alloys of manganese, copper, aluminum, nickel, and sometimes other metals which find important uses as permanent magnets.
- Holography** - A technique for creating a three-dimensional image of a object by recording the interference pattern between a light beam diffracted from the object and a reference beam. The image can be reconstructed from this pattern by a suitable optical system.
- Homopolymer** - A polymer derived from one species of (real, implicit, or hypothetical) monomer. [8]
- Hooke's law** - The statement that the ratio of stress to strain is a constant in a totally elastic medium.
- Horse power** - A non-SI unit of energy, equal to approximately 746 W.
- Hubble constant** - The ratio of the recessional velocity of an extragalactic object to the distance of that object. Its value is about $2 \times 10^{-18} s^{-1}$.
- Huckel theory** - A simple approximation for calculating the energy of conjugated molecules in which only the resonance integrals between neighboring bonds are considered. Also called CNDO method (complete neglect of differential overlap).
- Hume-Rothery rules** - A set of empirical rules for predicting the occurrence of solid solutions in metallic systems. The rules involve size, crystal structure, and electronegativity.
- Hund's rules** - A series of rules for predicting the sequence of energy states in atoms and molecules. One of the important results is that when two electrons exist in different orbitals, the state with their spins parallel (triplet state) lies at lower energy than the state with antiparallel spins (singlet).
- Hydrazines** - Hydrazine (diazane), H_2NNH_2 , and its hydrocarbyl derivatives. When one or more substituents are acyl groups, the compound is a hydrazide. [5]
- Hydrocarbon** - A compound containing only carbon and hydrogen. [5]
- Hydrolysis** - A reaction occurring in water in which a chemical bond is cleaved and a new bond formed with the oxygen atom of water.
- Hyperfine structure** - Splitting of energy levels and spectral lines into several closely spaced components as a result of interaction of nuclear spin angular momentum with other angular momenta in the atom or molecule.
- Hysteresis*** - An irreversible response of a system (parameter A) as a function of an external force (parameter F), usually symmetric with respect to the origin of the A vs. F graph after the initial application of the force. A common example is magnetic induction vs. magnetic field strength in a ferromagnet.
- Ideal gas law** - The equation of state $pV = RT$, which defines an ideal gas, where p is pressure, V molar volume, T temperature, and R the molar gas constant.
- Ideal solution** - A solution in which solvent-solvent and solvent-solute interactions are identical, so that properties such as volume and enthalpy are exactly additive. Ideal solutions follow Raoult's law, which states that the vapor pressure p_i of component i is $p_i = x_i p_i^*$, where x_i is the mole fraction of component i and p_i^* the vapor pressure of the pure substance i .
- Ignition temperature*** - The lowest temperature at which combustion of a material will occur spontaneously under specified conditions. Sometimes called autoignition temperature, kindling point. [10]
- Imides** - Diacyl derivatives of ammonia or primary amines, especially those cyclic compounds derived from diacids. Also used for salts having the anion RN_2^- . [5]
- Impedance (Z)** - The complex representation of potential difference divided by the complex representation of current. In terms of reactance X and resistance R , the impedance is given by $Z = R + iX$. [1]
- Index of refraction (n)*** - For a non-absorbing medium, the ratio of the velocity of electromagnetic radiation *in vacuo* to the phase velocity of radiation of a specified frequency in the medium. [1]
- Inductance** - The ratio of the electromagnetic force induced in a coil by a current to the rate of change of the current.
- Inductive coupled plasma mass spectroscopy (ICPMS)** - See Techniques for Materials Characterization, page 12-1.
- Inertial defect** - In molecular spectroscopy, the quantity $I_c - I_a - I_b$ for a molecule whose equilibrium configuration is planar, where I_a , I_b , and I_c are the effective principal moments of inertia. The inertial defect for a rigid planar molecule would be zero, but vibration-rotation interactions in a real molecule lead to a positive inertial defect.
- Insulator** - A material in which the highest occupied energy band (valence band) is completely filled with electrons, while the next higher band (conduction band) is empty. Solids with an energy gap of 5 eV or more are generally considered as insulators at room temperature. Their conductivity is less than $10^{-6} S/m$ and increases with temperature.
- Intercalation compounds** - Compounds resulting from reversible inclusion, without covalent bonding, of one kind of molecule in a solid matrix of another compound, which has a laminar structure. The host compound, a solid, may be macromolecular, crystalline, or amorphous. [5]
- International System of Units (SI)*** - The unit system adopted by the General Conference on Weights and Measures in 1960. It consists of seven base units (meter, kilogram, second, ampere, kelvin, mole, candela), plus derived units and prefixes. [1]
- International Temperature Scale (ITS-90)*** - The official international temperature scale adopted in 1990. It consists of a set of fixed points and equations which enable the thermodynamic temperature to be determined from operational measurements. [9]
- Ion** - An atomic or molecular particle having a net electric charge. [3]
- Ion exchange** - A process involving the adsorption of one or several ionic species accompanied by the simultaneous desorption (displacement) of one or more other ionic species. [3]
- Ion neutralization spectroscopy (INS)** - See Techniques for Materials Characterization, page 12-1.
- Ionic strength (I)** - A measure of the total concentration of ions in a solution, defined by $I = 1/2 \sum_i z_i^2 m_i$, where z_i is the charge of ionic species i and m_i is its molality. For a 1-1 electrolyte at molality m , $I = m$.
- Ionization constant*** - The equilibrium constant for a reaction in which a substance in solution dissociates into ions.
- Ionization potential*** - The minimum energy required to remove an electron from an isolated atom or molecule (in its vibrational ground state) in the gaseous phase. More properly called ionization energy. [3]
- Irradiance (E)** - The radiant energy flux incident on an element of a surface, divided by the area of that element. [1]
- Isentropic process** - A thermodynamic process in which the entropy of the system does not change.
- Ising model** - A model describing the coupling between two atoms in a ferromagnetic lattice, in which the interaction energy is proportional to the negative of the product of the spin components along a specified axis.

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Isobar** - A line connecting points of equal pressure on a graphical representation of a physical system.
- Isochore** - A line or surface of constant volume on a graphical representation of a physical system.
- Isoelectric point*** - The pH of a solution or dispersion at which the net charge on the macromolecules or colloidal particles is zero. In electrophoresis there is no motion of the particles in an electric field at the isoelectric point.
- Isomers** - In chemistry, compounds that have identical molecular formulas but differ in the nature or sequence of bonding of their atoms or in the arrangement of their atoms in space. In physics, nuclei of the same atomic number Z and mass number A but in different energy states. [3]
- Isomorphs** - Substances of different chemical nature but having the same crystal structure.
- Isotactic macromolecule** - A tactic macromolecule, essentially comprising only one species of repeating unit which has chiral or prochiral atoms in the main chain in a unique arrangement with respect to its adjacent constitutional units. [8]
- Isotherm** - A line connecting points of equal temperature on a graphical representation of a physical system.
- Isothermal process** - A thermodynamic process in which the temperature of the system does not change.
- Isotones** - Nuclides having the same neutron number N but different atomic number Z . [3]
- Isotopes** - Two or more nuclides with the same atomic number Z but different mass number A . The term is sometimes used synonymously with nuclide, but it is preferable to reserve the word nuclide for a species of specific Z and A . [3]
- Jahn-Teller effect** - An interaction of vibrational and electronic motions in a nonlinear molecule which removes the degeneracy of certain electronic energy levels. It can influence the spectrum, crystal structure, and magnetic properties of the substance.
- Johnson noise** - Electrical noise generated by random thermal motion of electrons in a conductor or semiconductor. Also called thermal noise.
- Josephson effect** - The tunneling of electron pairs through a thin insulating layer which separates two superconductors. When a potential difference is applied to the superconductors, an alternating current is generated whose frequency is precisely proportional to the potential difference. This effect has important applications in metrology and determination of fundamental physical constants.
- Joule (J)*** - The SI unit of energy, equal to N m. [1]
- Joule-Thomson coefficient (μ)** - A parameter which describes the temperature change when a gas expands adiabatically through a nozzle from a high pressure to a low pressure region. It is defined by $\mu = (\partial T / \partial p)_H$, where H is enthalpy.
- Julian calendar** - The calendar introduced by Julius Caesar in 46 B.C. which divided the year into 365 days with a leap year of 366 days every fourth year.
- Julian date (JD)** - The number of days elapsed since noon Greenwich Mean Time on January 1, 4713 B.C. Thus January 1, 2000, 0h (midnight) will be JD 2,451,543.5. This dating system was introduced by Joseph Scaliger in 1582.
- Kaon** - One of the elementary particles in the family of mesons. Kaons have a spin of zero and may be neutral or charged.
- Kelvin (K)*** - The SI base unit of thermodynamic temperature. [1]
- Kepler's laws** - The three laws of planetary motion, which established the elliptical shape of planetary orbits and the relation between orbital dimensions and the period of rotation.
- Kerr effect*** - An electrooptical effect in which birefringence is induced in a liquid or gas when a strong electric field is applied perpendicular to the direction of an incident light beam. The Kerr constant k is given by $n_1 - n_2 = k\lambda E^2$, where λ is the wavelength, E is the electric field strength, and n_1 and n_2 are the indices of refraction of the ordinary and extraordinary rays, respectively.
- Ketenes** - Compounds in which a carbonyl group is connected by a double bond to an alkylidene group: $R_2C=C=O$. [5]
- Ketones** - Compounds in which a carbonyl group is bonded to two carbon atoms: $R_1R_2C=O$ (neither R may be H). [5]
- Kilogram (kg)*** - The SI base unit of mass. [1]
- Kinetic energy (E_k, T)** - The energy associated with the motion of a system of particles in a specified reference frame. For a single particle of mass m moving at velocity v , $E_k = 1/2mv^2$.
- Kirchhoff's laws** - Basic rules for electric circuits, which state (a) the algebraic sum of the currents at a network node is zero and (b) the algebraic sum of the voltage drops around a closed path is zero.
- Klein-Gordon equation** - A relativistic extension of the Schrödinger equation.
- Klein-Nishina formula** - An expression for the scattering cross section of a photon by an unbound electron, based upon the Dirac electron theory.
- Knight shift** - The change in magnetic resonance frequency of a nucleus in a metal relative to the same nucleus in a diamagnetic solid. The effect is due to the polarization of the conduction electrons in the metal.
- Knudsen number (Kn)** - A dimensionless quantity used in fluid mechanics, defined by $Kn = \lambda/l$, where λ is mean free path and l is length. [2]
- Kondo effect** - A large increase in electrical resistance observed at low temperatures in certain dilute alloys of a magnetic metal in a nonmagnetic material.
- Kramers-Kronig relation** - A set of equations relating the real and imaginary parts of the index of refraction of a medium
- Lactams** - Cyclic amides of amino carboxylic acids, having a 1-azacycloalkan-2-one structure, or analogues having unsaturation or heteroatoms replacing one or more carbon atoms of the ring. [5]
- Lactones** - Cyclic esters of hydroxy carboxylic acids, containing a 1-oxacycloalkan-2-one structure, or analogues having unsaturation or heteroatoms replacing one or more carbon atoms of the ring. [5]
- Lagrangian function (L)** - A function used in classical mechanics, defined as the kinetic energy minus the potential energy for a system of particles.
- Lamb shift** - The small energy difference between the $^2S_{1/2}$ and $^2P_{1/2}$ levels in the hydrogen atom, which results from interactions between the electron and the radiation field.
- Laminar flow** - Smooth, uniform, non-turbulent flow of a gas or liquid in parallel layers, with little mixing between layers. It is characterized by small values of the Reynolds number.
- Landé g -factor** - See g -Factor of the electron
- Langevin function** - The mathematical function $L(x) = (e^x + e^{-x}) / (e^x - e^{-x}) - 1/x$, which occurs in the expression for the average dipole moment of a group of rotating polar molecules in an electric field: $\mu_{av} = \mu L(\mu E / kT)$, where μ is the electric dipole moment of a single molecule, E is the electric field strength, k is the Boltzmann constant, and T is the temperature.
- Lanthanides** - The elements of atomic number 57 through 71, which share common chemical properties: La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu. [7]
- Larmor frequency (ν_L)** - The precession frequency of a magnetic dipole in an applied magnetic field. In particular, a nucleus in a magnetic field of strength B has a Larmor frequency of $\gamma B / 2\pi$, where γ is the magnetogyric ratio of the nucleus.
- Laser*** - A device in which an optical cavity is filled with a medium where a population inversion can be produced by some means. When the resonant frequency of the cavity bears the proper relation to the separation of the inverted energy levels, stimulated emission occurs, producing a highly monochromatic, coherent beam of light.

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Laser ionization mass spectroscopy (LIMS)** - See Techniques for Materials Characterization, page 12-1.
- Lattice constants*** - Parameters specifying the dimensions of a unit cell in a crystal lattice, specifically the lengths of the cell edges and the angles between them.
- Lattice energy*** - The energy per ion pair required to separate completely the ions in a crystal lattice at a temperature of absolute zero.
- Laue diagram** - A diffraction pattern produced when an x-ray beam passes through a thin slice of a crystal and impinges on a detector behind the crystal.
- Lenz's law** - The statement that the current induced in a circuit by a change in magnetic flux is so directed as to oppose the change in flux.
- Leonard-Jones potential** - A simple but useful function for approximating the interaction between two neutral atoms or molecules separated by a distance r by writing the potential energy as $U(r) = 4\epsilon\{(r_0/r)^{12} - (r_0/r)^6\}$, where ϵ and r_0 are adjustable parameters. In this form the depth of the potential well is ϵ and the minimum occurs at $2^{1/6}r_0$. The $(1/r)^{12}$ term is often replaced by other powers of $1/r$.
- Lepton** - One of the class of elementary particles that do not take part in the strong interaction. Included are the electron, muon, and neutrino. All leptons have a spin of $1/2$.
- Lewis number (Le)** - A dimensionless quantity used in fluid mechanics, defined by $Le = a/D$, where a is thermal diffusivity and D is diffusion coefficient. [2]
- Ligand field theory** - A description of the structure of crystals containing a transition metal ion surrounded by nonmetallic ions (ligands). It is based on construction of molecular orbitals involving the d -orbitals of the central metal ion and combinations of atomic orbitals of the ligands.
- Light year (l.y.)** - A unit of distance used in astronomy, defined as the distance light travels in one year in a vacuum. Its approximate value is 9.46073×10^{15} m.
- Lignins** - Macromolecular constituents of wood related to lignans, composed of phenolic propylbenzene skeletal units, linked at various sites and apparently randomly. [5]
- Ligroin** - The petroleum fraction consisting mostly of C_7 and C_8 hydrocarbons and boiling in the range 90-140°C; commonly used as a laboratory solvent.
- Lipids** - A loosely defined term for substances of biological origin that are soluble in nonpolar solvents. They consist of saponifiable lipids, such as glycerides (fats and oils) and phospholipids, as well as nonsaponifiable lipids, principally steroids. [5]
- Lipoproteins** - Clathrate complexes consisting of a lipid enwrapped in a protein host without covalent binding, in such a way that the complex has a hydrophilic outer surface consisting of all the protein and the polar ends of any phospholipids. [5]
- Liter (L)*** - A synonym for cubic decimeter. [1]
- Lithosphere*** - The outer layer of the solid earth, extending from the base of the mantle to the surface of the crust.
- Lorentz contraction** - The reduction in length of a moving body in the direction of motion, given by the factor $(1-v^2/c^2)^{1/2}$, where v is the velocity of the body and c the velocity of light. Also known as the FitzGerald-Lorentz contraction.
- Lorentz force** - The force exerted on a point charge Q moving at velocity v in the presence of external fields E and B . It is given (in SI units) by $F = Q(E + v \times B)$.
- Loss angle (δ)** - For a dielectric material in an alternating electromagnetic field, δ is the phase difference between the current and the potential difference. The function $\tan \delta$ is a measure of the ratio of the power dissipated in the dielectric to the power stored.
- Low energy electron diffraction (LEED)** - See Techniques for Materials Characterization, page 12-1.
- Lumen (lm)*** - The SI unit of luminous flux, equal to cd sr . [1]
- Luminous flux (Φ)** - The intensity of light from a source multiplied by the solid angle. The SI unit is lumen. [1]
- Lux (lx)*** - The SI unit of illuminance, equal to cd sr m^{-2} . [1]
- Lyddane-Sachs-Teller relation** - A relation between the phonon frequencies and dielectric constants of an ionic crystal which states that $(\omega_T/\omega_L)^2 = \epsilon(\infty)/\epsilon(0)$, where ω_T is the angular frequency of transverse optical phonons, ω_L that of longitudinal optical phonons, $\epsilon(0)$ is the static dielectric constant, and $\epsilon(\infty)$ the dielectric constant at optical frequencies.
- Lyman series** - The series of lines in the spectrum of the hydrogen atom which corresponds to transitions between the ground state (principal quantum number $n = 1$) and successive excited states. The wavelengths are given by $1/\lambda = R_H(1-1/n^2)$, where $n = 2, 3, 4, \dots$ and R_H is the Rydberg constant for hydrogen. The first member of the series ($n = 1 \leftrightarrow 2$), which is often called the Lyman- α line, falls at a wavelength of 1216 Å, and the series converges at 912 Å, the ionization limit of hydrogen.
- Mach number (Ma)** - A dimensionless quantity used in fluid mechanics, defined by $Ma = v/c$, where v is velocity and c is the speed of sound. [2]
- Macromolecule** - A molecule of high relative molecular mass (molecular weight), the structure of which essentially comprises the multiple repetition of units derived, actually or conceptually, from molecules of low relative molecular mass [8]
- Madelung constant*** - A constant characteristic of a particular crystal-line material which gives a measure of the electrostatic energy binding the ions in the crystal.
- Magnetic field strength (H)** - An axial vector quantity, the curl of which is equal to the current density, including the displacement current. [1]
- Magnetic induction (B)** - An axial vector quantity such that the force exerted on an element of current is equal to the vector product of this element and the magnetic induction. [1]
- Magnetic moment** - See Dipole moment, magnetic.
- Magnetic susceptibility (χ_m, κ)*** - Defined by $\chi_m = (\mu - \mu_0)/\mu_0$, where μ is the permeability of the medium and μ_0 the permeability of a vacuum. [1]
- Magnetization (M)** - Defined by $M = (B/\mu_0) - H$, where B is magnetic induction, H magnetic field strength, and μ_0 the permeability of a vacuum. [1]
- Magnetogyric ratio (γ)** - Ratio of the magnetic moment of a particle to its angular momentum. Also called gyromagnetic ratio.
- Magneton** - See Bohr magneton, Nuclear magneton.
- Magnetostriction*** - The change in dimensions of a solid sample when it is placed in a magnetic field.
- Magnon** - A quantum of magnetic energy associated with a spin wave in a ferromagnetic or antiferromagnetic crystal.
- Mantle** - The layer of the earth between the crust and the liquid outer core, which begins about 2900 km below the earth's surface.
- Maser** - A device in which a microwave cavity is filled with a medium where a population inversion can be produced by some means. When the resonant frequency of the cavity bears the proper relation to the separation of the inverted energy levels, the device can serve as an amplifier or oscillator at that frequency.
- Mass (m)*** - Quantity of matter. Mass can also be defined as "resistance to acceleration".
- Mass defect (B)** - Defined by $B = Zm(^1\text{H}) + Nm_n - m_a$, where Z is the atomic number, $m(^1\text{H})$ is the mass of the hydrogen atom, N is the neutron number, m_n is the rest mass of the neutron, and m_a is the mass of the atom in question. Thus Bc^2 can be equated to the binding energy of the nucleus if the binding energy of atomic electrons is neglected. [1]
- Mass excess (Δ)** - Defined by $\Delta = m_a - Am_u$, where m_a is the mass of the

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- atom, A the number of nucleons, and m_u the unified atomic mass constant ($m_u = 1 \text{ u}$). [1]
- Mass fraction (w_B)** - The ratio of the mass of substance B to the total mass of a mixture. [1]
- Mass number (A)** - A characteristic property of a specific isotope of an element, equal to the sum of the number of protons and neutrons in the nucleus.
- Mass spectrometry** - An analytical technique in which ions are separated according to the mass/charge ratio and detected by a suitable detector. The ions may be produced by electron impact on a gas, a chemical reaction, energetic vaporization of a solid, etc. [6]
- Massieu function** - A thermodynamic function defined by $J = -A/T$, where A is the Helmholtz energy and T the thermodynamic temperature. [2]
- Matthiessen's rule** - The statement that the electrical resistivity ρ of a metal can be written as $\rho = \rho_L + \rho_i$, where ρ_L is due to scattering of conduction electrons by lattice vibrations and ρ_i to scattering by impurities and imperfections. If the impurity concentration is small, ρ_i is temperature independent.
- Maxwell (Mx)*** - A non-SI unit of magnetic field strength (H) equal to 10^{-8} Wb. [1]
- Maxwell's equations** - The fundamental equations of electromagnetism. In a form appropriate to SI units, they are:
- $$\text{curl } \mathbf{H} = \partial \mathbf{D} / \partial t + \mathbf{j}$$
- $$\text{div } \mathbf{B} = 0$$
- $$\text{curl } \mathbf{E} = -\partial \mathbf{B} / \partial t$$
- $$\text{div } \mathbf{D} = \rho$$
- where \mathbf{H} is the magnetic field strength, \mathbf{B} the magnetic induction, \mathbf{E} the electric field strength, \mathbf{D} the electric displacement, \mathbf{j} the current density, ρ the charge density, and t is time.
- Maxwell-Boltzmann distribution** - An expression for the fraction of molecules $f(v)$ in a gas that have velocity v within a specified interval. It takes the form
- $$f(v) = 4\pi(M/2\pi RT)^{3/2} v^2 e^{-Mv^2/2RT}$$
- where M is the molar mass, R the molar gas constant, and T the temperature.
- Mean free path*** - The average distance a gas molecule travels between collisions.
- Meissner effect** - The complete exclusion of magnetic induction from the interior of a superconductor.
- Melting point*** - The temperature at which the solid and liquid phases of a substance are in equilibrium at a specified pressure (normally taken to be atmospheric unless stated otherwise).
- Mercaptans** - A traditional term abandoned by IUPAC, synonymous with thiols. This term is still widely used. [5]
- Meson** - Any elementary particle that has zero or integral spin. Mesons are responsible for the forces between protons and neutrons in the nucleus.
- Mesosphere** - The part of the earth's atmosphere extending from the top of the stratosphere (about 50 km above the surface) to 80-90 km. It is characterized by a decrease in temperature with increasing altitude.
- Metal** - A material in which the highest occupied energy band (conduction band) is only partially filled with electrons. The electrical conductivity of metals generally decreases with temperature.
- Metalloenes** - Organometallic coordination compounds in which one atom of a transition metal such as iron, ruthenium or osmium is bonded to and only to the face of two cyclopentadienyl ligands which lie in parallel planes. [5]
- Meter (m)*** - The SI base unit of length. [1]
- Methine group** - In organic compounds, the $-C=$ group. [5]
- Mho** - An archaic name for the SI unit siemens (reciprocal ohm).
- Micelle** - A particle formed by the aggregation of surfactant molecules (typically, 10 to 100 molecules) in solution. For aqueous solutions, the hydrophilic end of the molecule is on the surface of the micelle, while the hydrophobic end (often a hydrocarbon chain) points toward the center. At the critical micelle concentration (cmc) the previously dissolved molecules aggregate into a micelle.
- Micron (μ)** - An obsolete name for micrometer.
- Mie scattering** - The scattering of light by spherical dielectric particles whose diameter is comparable to the wavelength of the light.
- Milky way** - The band of light in the night sky resulting from the stars in the galactic plane. The term is also used to denote the galaxy in which the sun is located.
- Miller indices (hkl)** - A set of indices used to label planes in a crystal lattice. [2]
- Millimeter of mercury (mmHg)** - A non-SI unit of pressure, equal to 133.322 Pa. The name is generally considered interchangeable with torr.
- Mobility (μ)*** - In solid state physics, the drift velocity of electrons or holes in a solid divided by the applied electric field strength. The term is used in a similar sense in other fields.
- Molality (m)** - A measure of concentration of a solution in which one states the amount of substance (i.e., number of moles) of solute per kilogram of solvent. Thus a 0.1 molal solution (often written as 0.1 m) has $m = 0.1 \text{ mol/kg}$.
- Molar mass** - The mass of one mole of a substance. It is normally expressed in units of g/mol, in which case its numerical value is identical with the molecular weight (relative molecular mass). [1]
- Molar quantity** - It is often convenient to express an extensive quantity (e.g., volume, enthalpy, heat capacity, etc.) as the actual value divided by amount of substance (number of moles). The resulting quantity is called molar volume, molar enthalpy, etc
- Molar refraction (R)** - A property of a dielectric defined by the equation $R = V_m[(n^2-1)/(n^2+2)]$, where n is the index of refraction of the medium (at optical wavelengths) and V_m the molar volume. It is related to the polarizability α of the molecules that make up the medium by the Lorenz-Lorentz equation, $R = N_A \alpha / 3\epsilon_0$, where N_A is Avogadro's constant and ϵ_0 is the permittivity of a vacuum.
- Molarity (c)** - A measure of concentration of a solution in which one states the amount of substance (i.e., number of moles) of solute per liter of solution. Thus a 0.1 molar solution (often referred to as 0.1 M) has a concentration $c = 0.1 \text{ mol/L}$.
- Mole (mol)*** - The SI base unit of amount of substance. [1]
- Mole fraction (x_B)** - The ratio of the amount of substance (number of moles) of substance B to the total amount of substance in a mixture. [1]
- Molecular orbital** - See Orbital.
- Molecular weight (M_r)*** - The ratio of the average mass per molecule or specified entity of a substance to 1/12 of the mass of nuclide ^{12}C . Also called relative molar (or molecular) mass. [1]
- Moment of inertia (I)** - The moment of inertia of a body about an axis is the sum (or integral) of the products of its elements of mass and the squares of their distances from the axis. [1]
- Momentum (p)** - The product of mass and velocity. [1]
- Monomer** - A substance consisting of molecules which can undergo polymerization, thereby contributing constitutional units to the essential structure of a macromolecule. [8]
- Monosaccharides** - A term which includes aldoses, ketoses, and a wide variety of derivatives. [5]
- Mössbauer effect** - The recoilless emission of γ -rays from nuclei bound in a crystal under conditions where the recoil energy associated with the γ emission is taken up by the crystal as a whole. This results in a very narrow line width, which can be exploited in various types of precise measurements.

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Muon*** - An unstable elementary particle of spin 1/2 and mass about 200 times that of the electron.
- Naphtha** - The petroleum fraction consisting mostly of C₆ to C₈ hydrocarbons and boiling in the range 80-120°C. Solvents derived from this fraction include ligroin and petroleum ether.
- Nautical mile** - A non-SI unit of length, equal to exactly 1852 m.
- Navier-Stokes equations** - A set of complex equations for the motion of a viscous fluid subject to external forces.
- Néel temperature (T_N)*** - The critical temperature above which an antiferromagnetic substance becomes paramagnetic. [1]
- Nernst effect** - The production of an electric field in a conductor subject to an applied magnetic field and containing a transverse temperature gradient. The electric field is perpendicular to the magnetic field and the temperature gradient.
- Network** - In polymer science, a highly ramified macromolecule in which essentially each constitutional unit is connected to each other constitutional unit and to the macroscopic phase boundary by many permanent paths through the macromolecule, the number of such paths increasing with the number of intervening bonds. The paths must on the average be coextensive with the macromolecule. [8]
- Neutrino** - A stable elementary particle in the lepton family. Neutrinos have zero (or at least near-zero) rest mass and spin 1/2.
- Neutron*** - An elementary particle on spin 1/2 and zero charge. The free neutron has a mean lifetime of 887 seconds. Neutrons and protons, which are collectively called nucleons, are the constituents of the nucleus.
- Neutron activation analysis (NAA)** - See Techniques for Materials Characterization, page 12-1.
- Neutron number (N)** - A characteristic property of a specific isotope of an element, equal to the number of neutrons in the nucleus.
- Newton (N)*** - The SI unit of force, equal to m kg s⁻². [1]
- Nitriles** - Compounds having the structure RC≡N; thus C-substituted derivatives of hydrocyanic acid, HC≡N. [5]
- Nitrosamines** - N-Nitroso amines: compounds of the structure R₂NNO. Compounds RNHNO are not ordinarily isolatable, but they, too, are nitrosamines. The name is a contraction of N-nitrosoamine and, as such, does not require the N locant. [5]
- Nuclear magnetic resonance (NMR)*** - A widely used technique in which the resonant absorption of radiofrequency radiation by magnetic nuclei in a magnetic field is measured. The results give important information on the local environment of each nucleus.
- Nuclear magneton (μ_N)*** - The unit of nuclear magnetic moment, defined as $eh/4\pi m_p$, where h is Planck's constant, m_p the proton mass, and e the elementary charge.
- Nuclear quadrupole resonance (NQR)** - See Techniques for Materials Characterization, page 12-1.
- Nuclear reaction analysis (NRA)** - See Techniques for Materials Characterization, page 12-1.
- Nuclear spin (I)** - The quantum number that specifies the intrinsic angular momentum of a particular nucleus. The magnitude of the angular momentum is given by $[I(I+1)]^{1/2} h/2\pi$, where h is Planck's constant.
- Nucleic acids*** - Macromolecules, the major organic matter of the nuclei of biological cells, made up of nucleotide units, and hydrolyzable into certain pyrimidine or purine bases (usually adenine, cytosine, guanine, thymine, uracil), D-ribose or 2-deoxy-D-ribose. [5]
- Nucleon** - A collective term for the proton and neutron.
- Nucleosides** - Ribosyl or deoxyribosyl derivatives (rarely, other glycosyl derivatives) of certain pyrimidine or purine bases. They are thus glycosylamines or N-glycosides related to nucleotides by the lack of phosphorylation. [5]
- Nucleotides** - Compounds formally obtained by esterification of the 3' or 5' hydroxy group of nucleosides with phosphoric acid. They are the monomers of nucleic acids and are formed from them by hydrolytic cleavage. [5]
- Nuclide** - A species of atoms in which each atom has identical atomic number Z and identical mass number A . [3]
- Nusselt number (Nu)** - A dimensionless quantity used in fluid mechanics, defined by $Nu = hl/k$, where h is coefficient of heat transfer, l is length, and k is thermal conductivity. [2]
- Nyquist theorem** - An expression for the mean square thermal noise voltage across a resistor, given by $4RkT\Delta f$ where R is the resistance, k the Boltzmann constant, T the temperature, and Δf the frequency band within which the voltage is measured.
- Octanol-water partition coefficient (P)*** - A measure of the way in which a compound will partition itself between the octanol and water phases in the two-phase octanol-water system, and thus an indicator of certain types of biological activity. Specifically, P is the ratio of the concentration (in moles per liter) of the compound in the octanol phase to that in the water phase at infinite dilution. The quantity normally reported is $\log P$.
- Oersted (Oe)** - A non-SI unit of magnetic field (H), equal to 79.57747 A/m.
- Ohm (Ω)*** - The SI unit of electric resistance, equal to V/A. [1]
- Ohm's law** - A relation among electric current I , potential difference V , and resistance R , viz., $I = V/R$. The resistance is constant at constant temperature to high precision for many materials.
- Olefins** - Acyclic and cyclic hydrocarbons having one or more carbon-carbon double bonds, apart from the formal ones in aromatic compounds. The class olefins subsumes alkenes and cycloalkenes and the corresponding polyenes. [5]
- Oligomer** - A substance consisting of molecules of intermediate relative molecular mass (molecular weight), the structure of which essentially comprises the multiple repetition of units derived, actually or conceptually, from molecules of low relative molecular mass. In contrast to a polymer, the properties of an oligomer can vary significantly with the removal of one or a few of its units. [8]
- Oligopeptides** - Peptides containing from three to nine amino groups. [5]
- Onsager relations** - An important set of equations in the thermodynamics of irreversible processes. They express the symmetry between the transport coefficients describing reciprocal processes in systems with a linear dependence of flux on driving forces.
- Optical rotary power** - Angle by which the plane of polarization of a light beam is rotated by an optically active medium, divided by path length and by concentration of the active constituent. Depending on whether mass or molar concentration is used, the modifier "specific" or "molar" is attached. [2]
- Orbital** - A one-electron wavefunction. Atomic orbitals are classified as s -, p -, d -, or f -orbitals according to whether the angular momentum quantum number $l = 0, 1, 2, \text{ or } 3$. Molecular orbitals, which are usually constructed as linear combinations of atomic orbitals, describe the distribution of electrons over the entire molecule.
- Oscillator strength (f)** - A measure of the intensity of a spectroscopic transition, defined by
- $$f = \frac{8\pi^2 M e v}{3 h e^2} |\mu_{ij}|^2$$
- where v is the frequency, μ_{ij} the transition dipole moment, m_e the mass of the electron, e the elementary charge, and h Planck's constant.
- Osmosis** - The flow of a solvent in a system in which two solutions of different concentration are separated by a semipermeable membrane which cannot pass solute molecules. The solvent will flow from the side of lower concentration to that of higher concentration, thus tending to equalize the concentrations. The pressure that must be

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- applied to the more concentrated side to stop the flow is called the osmotic pressure.
- Osmotic coefficient (ϕ)** - Defined by $\phi = \ln a_A / (M_A \sum m_B)$, where M_A is the molar mass of substance A (normally the solvent), a_A is its activity, and the m_B are molalities of the solutes. [1]
- Osmotic pressure (Π)** - The excess pressure necessary to maintain osmotic equilibrium between a solution and the pure solvent separated by a membrane permeable only to the solvent. In an ideal dilute solution $\Pi = c_B RT$, where c_B is the amount-of-substance concentration of the solute, R is the molar gas constant, and T the temperature. [1,2]
- Ostwald dilution law** - A relation for the concentration dependence of the molar conductivity Λ of an electrolyte solution, viz.,
- $$\frac{1}{\Lambda} = \frac{1}{\Lambda^\circ} + \frac{\Lambda c}{K(\Lambda^\circ)^2}$$
- where c is the solute concentration, K is the equilibrium constant for dissociation of the solute, and Λ° is the conductivity at $c\Lambda = 0$.
- Ounce (oz)** - A non-SI unit of mass. The avoirdupois ounce equals 28.34952 g, while the troy ounce equals 31.10348 g.
- Overpotential (η)** - In an electrochemical cell, the difference between the potential of an electrode and its zero-current value.
- Oximes** - Compounds of structure $R_2C=NOH$ derived from condensation of aldehydes or ketones with hydroxylamine. Oximes from aldehydes may be called aldioximes; those from ketones may be called ketoximes. [5]
- Oxo compounds** - Compounds containing an oxygen atom, =O, doubly bonded to carbon or another element. The term thus embraces aldehydes, carboxylic acids, ketones, sulfonic acids, amides and esters. [5]
- Ozonides** - The 1,2,4-trioxolanes formed by the reaction of ozone at a carbon-carbon double bond, or the analogous compounds derived from acetylenic compounds. [5]
- Pair production** - A process in which a photon is converted into a particle and its antiparticle (e.g., an electron and positron) in the electromagnetic field of a nucleus.
- Paraffins** - Obsolete term for saturated hydrocarbons, commonly but not necessarily acyclic. Still widely used in the petrochemical industry, where the term designates acyclic saturated hydrocarbons, and stands in contradistinction to naphthenes. [5]
- Paramagnetism*** - A type of magnetism characterized by a positive magnetic susceptibility, so that the material becomes weakly magnetized in the direction of an external field. The magnetization disappears when the field is removed. In the simplest approximation (Curie's law) the susceptibility is inversely proportional to temperature.
- Parity** - The property of a quantum-mechanical wave function that describes its behavior under the symmetry operation of coordinate inversion. A parity of +1 (or even) is assigned if the wave function does not change sign when the signs of all the coordinates are changed; the parity is -1 (or odd) if the wave function changes sign under this operation.
- Parsec (pc)** - A unit of distance defined as the distance at which 1 astronomical unit (AU) subtends an angle of 1 second of arc. It is equal to 206264.806 AU or 3.085678×10^{16} m.
- Particle induced x-ray emission (PIXE)** - See Techniques for Materials Characterization, page 12-1.
- Partition function (q, z)** - For a single molecule, $q = \sum_i g_i \exp(\epsilon_i/kT)$, where ϵ_i is an energy level of degeneracy g_i , k the Boltzmann constant, and T the absolute temperature; the summation extends over all energy states. For a system of N non-interacting molecules which are indistinguishable, as in an ideal gas, the canonical partition function $Q = q^N/N!$.
- Pascal (Pa)*** - The SI unit of pressure, equal to N/m^2 . [1]
- Paschen series** - The series of lines in the spectrum of the hydrogen atom which corresponds to transitions between the state with principal quantum number $n = 3$ and successive higher states. The wavelengths are given by $1/\lambda = R_H(1/9 - 1/n^2)$, where $n = 4, 5, 6, \dots$ and R_H is the Rydberg constant. The first member of the series ($n = 3 \leftrightarrow 4$), which is often called the P_α line, falls in the infrared at a wavelength of 1.875 μm .
- Paschen-Back effect** - In atomic spectroscopy, the decoupling of electron spin from orbital angular momentum as the strength of an external magnetic field is increased.
- Pauli exclusion principle** - The statement that two electrons in an atom cannot have identical quantum numbers; thus if there are two electrons in the same orbital, their spin quantum numbers must be of opposite sign.
- Pearson symbol** - A code for designating crystallographic information, including the crystal system, the lattice type, and the number of atoms per unit cell.
- Péclet number (Pe)** - A dimensionless quantity used in fluid mechanics, defined by $Pe = vl/a$, where v is velocity, l is length, and a is thermal diffusivity. [2]
- Peltier effect** - The absorption or generation of heat (depending on the current direction) which occurs when an electric current is passed through a junction between two materials.
- Peptides** - Amides derived from two or more amino carboxylic acid molecules (the same or different) by formation of a covalent bond from the carbonyl carbon of one to the nitrogen atom of another with formal loss of water. [5]
- Permeability (μ)** - Magnetic induction divided by magnetic field strength; i.e. $\mu = B/H$. The relative permeability $\mu_r = \mu/\mu_0$, where μ_0 is the permeability of a vacuum. [1]
- Permittivity (ϵ)** - Ratio of the electric displacement in a medium to the electric field strength. Also called dielectric constant. [1]
- Peroxides** - Compounds of structure ROOR in which R may be any organic group. In inorganic chemistry, salts of the anion O_2^{2-} [5]
- Peroxy acids** - Acids in which an acidic -OH group has been replaced by an -OOH group; e.g. $\text{CH}_3\text{C}(=\text{O})\text{OOH}$ peroxyacetic acid, $\text{PhS}(=\text{O})_2\text{OOH}$ benzeneperoxy sulfonic acid. [5]
- Petroleum ether** - The petroleum fraction consisting of C_5 and C_6 hydrocarbons and boiling in the range 35-60°C; commonly used as a laboratory solvent.
- pH*** - A convenient measure of the acid-base character of a solution, usually defined by $\text{pH} = -\log [c(\text{H}^+)/\text{mol L}^{-1}]$, where $c(\text{H}^+)$ is the concentration of hydrogen ions. The more precise definition is in terms of activity rather than concentration. [2]
- Phenols** - Compounds having one or more hydroxy groups attached to a benzene or other arene ring. [5]
- Phonon** - A quantum of energy associated with a vibrational mode of a crystal lattice.
- Phosphines** - PH_3 and compounds derived from it by substituting one, two or three hydrogen atoms by hydrocarbyl groups. RPH_2 , R_2PH and R_3P (R not equal to H) are called primary, secondary and tertiary phosphines, respectively. [5]
- Phosphonium compounds** - Salts (and hydroxides) $[\text{R}_4\text{P}]^+\text{X}^-$ containing tetracoordinate phosphonium ion and the associated anion. [5]
- Phosphonium ylides** - Compounds having the structure $\text{R}_3\text{P}^+-\text{C}^-\text{R}_2$ 1 $\text{R}_3\text{P}=\text{CR}_2$ 2. Also known as Wittig reagents. [5]
- Phosphorescence** - The process by which a molecule is excited by light to a higher electronic state and then undergoes a radiationless transition to a state of different multiplicity from which it decays, after some delay, to the ground state. The emitted light is normally of longer wavelength than the exciting light because vibrational energy has been dissipated.

DEFINITIONS OF SCIENTIFIC TERMS (continued)

Photoelectric effect - The complete absorption of a photon by a solid with the emission of an electron.

Photon - An elementary particle of zero mass and spin 1/2. The photon is involved in electromagnetic interactions and is the quantum of electromagnetic radiation.

Photon stimulated desorption (PSD) - See Techniques for Materials Characterization, page 12-1.

Pinacols - Tetra(hydrocarbyl)ethane-1,2-diols, $R_2C(OH)C(OH)R_2$, of which the tetramethyl example is the simplest one and is itself commonly known as pinacol. [5]

Pion - An elementary particle in the family of mesons. Pions have zero spin and may be neutral or charged. They participate in the strong interaction which holds the nucleus together.

pK* - The negative logarithm (base 10) of an equilibrium constant K . For pK_a , see Acid dissociation constant.

Planck constant (h)* - The elementary quantum of action, which relates energy to frequency through the equation $E = hv$.

Planck distribution - See Black body radiation

Planck function - A thermodynamic function defined by $Y = -G/T$, where G is Gibbs energy and T thermodynamic temperature. [2]

Plasma - A highly ionized gas in which the charge of the electrons is balanced by the charge of the positive ions, so that the system as a whole is electrically neutral.

Plasmon - A quantum associated with a plasma oscillation in the electron gas of a solid.

Point group* - A group of symmetry operations (rotations, reflections, etc.) that leave a molecule invariant. Every molecular conformation can be assigned to a specific point group, which plays a major role in determining the spectrum of the molecule.

Poise (P) - A non-SI unit of viscosity, equal to 0.1 Pa s.

Poiseuille's equation - A formula for the rate of flow of a viscous fluid through a tube:

$$\frac{dV}{dt} = \frac{(p_1^2 - p_2^2)\pi r^4}{16l\eta p_0}$$

where V is the volume as measured at pressure p_0 ; p_1 and p_2 are the pressures at each end of the tube; r is the radius and l the length of the tube; and η is the viscosity.

Poisson ratio (μ) - The absolute value of the ratio of the transverse strain to the corresponding axial strain resulting from uniformly distributed axial stress below the proportional limit (i.e., where Hooke's law is valid). [10]

Polariton - A quantum associated with the coupled modes of photons and optical phonons in an ionic crystal.

Polarizability (α)* - The change in dipole moment of a molecule produced by an external electric field; specifically, $\alpha_{ab} = \partial p_a / \partial E_b$, where p_a is the dipole moment component on the a axis and E_b is the component of the electric field strength along the b axis. [2]

Polymer - A substance composed of molecules of high relative molecular mass (molecular weight), the structure of which essentially comprises the multiple repetition of units derived, actually or conceptually, from molecules of low relative molecular mass. A single molecule of a polymer is called a macromolecule. [8]

Polypeptides - Peptides containing 10 or more amino acid residues. See also Peptides. [5]

Polysaccharides - Compounds consisting of a large number of monosaccharides linked glycosidically. This term is commonly used only for those containing more than ten monosaccharide residues. Also called glycans. [5]

Porphyryns - Natural pigments containing a fundamental skeleton of four pyrrole nuclei united through the α -positions by four methine groups

to form a macrocyclic structure (porphyrin is designated porphine in Chemical Abstracts indexes). [5]

Positron - The antiparticle of the electron. It has the same mass and spin as an electron, and an equal but opposite charge.

Positronium - The hydrogen-like "atom" formed from a positron nucleus and an electron. Its lifetime is very short because of annihilation of the positron and electron.

Potential - See Electric potential

Potential energy (E_p, V, U) - The portion of the energy of a system that is associated with its position in a force field.

Pound (lb) - A non-SI unit of mass, equal to 0.4535924 kg.

Power (P) - Rate of energy transfer. For electrical circuits, this is equal to the product of current and potential difference, $P = IV$. [1]

Poynting vector (S) - For electromagnetic radiation, the vector product of the electric field strength and the magnetic field strength. [1]

Prandtl number (Pr) - A dimensionless quantity used in fluid mechanics, defined by $Pr = \eta/\rho a$, where η is viscosity, ρ is density, and a is thermal diffusivity. [2]

Pressure* - Force divided by area. [1]

Proteins - Naturally occurring and synthetic polypeptides having molecular weights greater than about 10,000 (the limit is not precise). See also Peptides. [5]

Proton* - A stable elementary particle of unit positive charge and spin 1/2. Protons and neutrons, which are collectively called nucleons, are the constituents of the nucleus.

Pulsar - A neutron star which rotates rapidly and emits electromagnetic radiation in regular pulses at a frequency related to the rotation period.

Purine bases* - Purine and its substitution derivatives, especially naturally occurring examples. [5]

Pyrimidine bases* - Pyrimidine and its substitution derivatives, especially naturally occurring examples. [5]

Q-switching - A technique for obtaining very high power from a laser by keeping the Q factor of the laser cavity low while the population inversion builds up, then suddenly increasing the Q to initiate the stimulated emission.

Quad - A unit of energy defined as 10^{15} Btu, equal to approximately 1.055056×10^{18} J.

Quadrupole moment - A coefficient of the third term (after monopole and dipole) in the power series expansion of the electric potential of an array of charges. A nucleus of spin greater than 1/2 has a non-vanishing nuclear quadrupole moment which can interact with the electric field gradient of the surrounding electrons. Molecular quadrupole moments have an influence on intermolecular forces.

Quality factor (Q) - The ratio of the absolute value of the reactance of an electrical system to the resistance; thus a measure of the energy stored per cycle relative to the energy dissipated.

Quantum yield - In photochemistry, the number of moles transformed in a specific process, either physically (e.g., by emission of photons) or chemically, per mole of photons absorbed by the system. [3]

Quark - An elementary entity which has not been directly observed but is considered a constituent of protons, neutrons, and other hadrons.

Quasar - An extragalactic object emitting electromagnetic radiation at a very high power level and showing a very large red shift, thus indicating that the object is receding at a speed approaching the speed of light.

Quasicrystal - A solid having conventional crystalline properties but whose lattice does not display translational periodicity.

Quaternary ammonium compounds - Derivatives of ammonium compounds, $NH_4^+ Y^-$, in which all four of the hydrogens bonded to nitrogen have been replaced with hydrocarbyl groups. Compounds having a carbon-nitrogen double bond (i.e. $R_2C=N^+R_2 Y^-$) are more accurately called iminium compounds. [5]

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Quinones** - Compounds having a fully conjugated cyclic dione structure, such as that of benzoquinones, derived from aromatic compounds by conversion of an even number of -CH= groups into -C(=O)- groups with any necessary rearrangement of double bonds. [5]
- Racemic mixture** - A mixture of equal amounts of a pair of enantiomers (optical isomers); such a mixture is not optically active.
- Rad** - A non-SI unit of absorbed dose of radiation, equal to 0.01 Gy.
- Radiance (*L*)** - The radiant intensity in a given direction from an element of a surface, divided by the area of the orthogonal projection of this element on a plane perpendicular to the given direction. [1]
- Radiant intensity (*I*)** - The radiant energy flux leaving an element of a source within an element of solid angle, divided by that element of solid angle. [1]
- Radicals** - Molecular entities possessing an unpaired electron, such as ·CH₃, ·SnH₃, ·Cl. (In these formulas the dot, symbolizing the unpaired electron, should be placed so as to indicate the atom of highest spin density, if this is possible). [5]
- Raman effect** - The inelastic scattering of light by a molecule, in which the incident photon either gives up to, or receives energy from, one of the internal vibrational modes of the molecule. The scattered light thus has either a lower frequency (Stokes radiation) or higher frequency (anti-Stokes radiation) than the incident light. These shifts provide a measure of the normal vibrational frequencies of the molecule.
- Rankine cycle** - A thermodynamic cycle which can be used to calculate the ideal performance of a heat engine that uses a condensable vapor as the working fluid (e.g., a steam engine or a heat pump).
- Rankine temperature** - A thermodynamic temperature scale based on a temperature interval °R = (5/9) K; i.e., $T/^{\circ}\text{R} = (9/5)T/\text{K} = t/^{\circ}\text{F} + 459.67$.
- Raoult's law** - The expression for the vapor pressure p_i of component i in an ideal solution, viz., $p_i = x_i p_{i0}$, where x_i is the mole fraction of component i and p_{i0} the vapor pressure of the pure substance i .
- Rare earth elements** - The elements Sc, Y, and the lanthanides (La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu). [7]
- Rayleigh number (*Ra*)** - A dimensionless quantity used in fluid mechanics, defined by $Ra = \beta g \alpha \Delta T l^3 / \eta a$, where l is length, g is acceleration of gravity, α is cubic expansion coefficient, T is temperature, ρ is density, η is viscosity, and a is thermal diffusivity. [2]
- Rayleigh scattering** - The scattering of light by particles which are much smaller than the wavelength of the light. It is characterized by a scattered intensity which varies as the inverse fourth power of the wavelength.
- Rayleigh wave** - A guided elastic wave along the surface of a solid; also called surface acoustic wave.
- Reactance (*X*)** - The imaginary part of impedance. For an inductive reactance L and a capacitive reactance C in series, the reactance is $X = L\omega - 1/(C\omega)$, where ω is 2π times the frequency of the current. [1]
- Red shift** - A displacement of a spectral line toward longer wavelengths. This can occur through the Doppler effect (e.g., in the light from receding galaxies) or, in the general theory of relativity, from the effects of a star's gravitational field.
- Reflectance (ρ)** - Ratio of the radiant or luminous flux at a given wavelength that is reflected to that of the incident radiation. Also called reflection factor. [1]
- Reflection high energy electron diffraction (RHEED)** - See Techniques for Materials Characterization, page 12-1.
- Relative humidity*** - The ratio of the partial pressure of water vapor in air to the saturation vapor pressure of water at the same temperature, expressed as a percentage. [10]
- Relative molar mass** - See Molecular weight.
- Rem** - A non-SI unit of dose equivalent, equal to 0.01 Sv.
- Resistance (*R*)** - Electric potential difference divided by current when there is no electromotive force in the conductor. This definition applies to direct current. More generally, resistance is defined as the real part of impedance. [1]
- Resistivity (ρ)** - Electric field strength divided by current density when there is no electromotive force in the conductor. Resistivity is an intrinsic property of a material. For a conductor of uniform cross section with area A and length L , and whose resistance is R , the resistivity is given by $\rho = RA/L$. [1]
- Reynolds number (*Re*)** - A dimensionless quantity used in fluid mechanics, defined by $Re = \rho vl/\eta$, where ρ is density, v is velocity, l is length, and η is viscosity. [2]
- Rheology** - The study of the flow of liquids and deformation of solids. Rheology addresses such phenomena as creep, stress relaxation, anelasticity, nonlinear stress deformation, and viscosity.
- Ribonucleic acids (RNA)** - Naturally occurring polyribonucleotides. See also nucleic acids, nucleosides, nucleotides, ribonucleotides. [5]
- Ribonucleotides** - Nucleotides in which the glycosyl group is a ribosyl group. See also nucleotides. [5]
- Roentgen (*R*)** - A unit used for expressing the charge (positive or negative) liberated by x-ray or γ radiation in air, divided by the mass of air. A roentgen is defined as 2.58×10^{-4} C/kg.
- Rotational constants** - In molecular spectroscopy, the constants appearing in the expression for the rotational energy levels as a function of the angular momentum quantum numbers. These constants are proportional to the reciprocals of the principal moments of inertia, averaged over the vibrational motion.
- Rutherford back scattering (RBS)** - See Techniques for Materials Characterization, page 12-1.
- Rydberg constant (R_{∞})*** - The fundamental constant which appears in the equation for the energy levels of hydrogen-like atoms; i.e., $E_n = hcR_{\infty} Z^2 \mu/n^2$, where h is Planck's constant, c the speed of light, Z the atomic number, μ the reduced mass of nucleus and electron, and n the principal quantum number ($n = 1, 2, \dots$).
- Rydberg series** - A regular series of lines in the spectrum of an atom or molecule, with the spacing between successive lines becoming smaller as the frequency increases (wavelength decreases). The series eventually converges to a limit which usually corresponds to the complete removal of an electron from the atom or molecule.
- Sackur-Tetrode equation*** - An equation for the molar entropy S_m of an ideal monatomic gas: $S_m = R \ln(e^{5/2} V/N_A \Lambda^3)$, where R is the molar gas constant, V is the volume, and N_A is Avogadro's number. The constant Λ is given by $\Lambda = h/(2\pi mkT)^{1/2}$, where h is Planck's constant, m the atomic mass, k the Boltzmann constant, and T the temperature.
- Salinity (*S*)*** - A parameter used in oceanography to describe the concentration of dissolved salts in seawater. It is defined in terms of electrical conductivity relative to a standard solution of KCl. When expressed in units of parts per thousand, S may be roughly equated to the concentration of dissolved material in grams per kilogram of seawater.
- Salt** - An ionic compound formed by the reaction of an acid and a base.
- Scanned probe microscopy (SPM)** - See Techniques for Materials Characterization, page 12-1.
- Scanning electron microscopy (SEM)** - See Techniques for Materials Characterization, page 12-1.
- Scanning laser acoustic microscopy (SLAM)** - See Techniques for Materials Characterization, page 12-1.
- Scanning transmission electron microscopy (STEM)** - See Techniques for Materials Characterization, page 12-1.
- Scanning tunneling microscopy (STM)** - See Techniques for Materials Characterization, page 12-1.
- Schiff bases** - Imines bearing a hydrocarbyl group on the nitrogen atom: $R_2C=NR'$ (R' not equal to H). Considered by many to be synonymous with azomethines. [5]

DEFINITIONS OF SCIENTIFIC TERMS (continued)

Schmidt number (Sc) - A dimensionless quantity used in fluid mechanics, defined by $Sc = \eta/\rho D$, where η is viscosity, ρ is density, and D is diffusion coefficient. [2]

Schottky barrier - A potential barrier associated with a metal-semiconductor contact. It forms the basis for the rectifying device known as the Schottky diode.

Schrödinger equation - The basic equation of wave mechanics which, for systems not dependent on time, takes the form:

$$-(\hbar/2m)\nabla^2\psi + V\psi = E\psi$$

where ψ is the wavefunction, V is the potential energy expressed as a function of the spatial coordinates, E is an energy eigenvalue, ∇^2 is the Laplacian operator, \hbar is Planck's constant divided by 2π , and m is the mass.

Second (s)* - The SI base unit of time. [1]

Second radiation constant (c_2)* - See First radiation constant.

Secondary ion mass spectroscopy (SIMS) - See Techniques for Materials Characterization, page 12-1.

Seebeck effect - The development of a potential difference in a circuit where two different metals or semiconductors are joined and their junctions maintained at different temperatures. It is the basis of the thermocouple.

Selenides - Compounds having the structure $RSeR$ (R not equal to H). They are thus selenium analogues of ethers. Also used for metal salts of H_2Se . [5]

Semicarbazones - Compounds having the structure $R_2C=NNHC(=O)NH_2$, formally derived by condensation of aldehydes or ketones with semicarbazide $[NH_2NHC(=O)NH_2]$. [5]

Semiconductor - A material in which the highest occupied energy band (valence band) is completely filled with electrons at $T = 0$ K, and the energy gap to the next highest band (conduction band) ranges from 0 to 4 or 5 eV. With increasing temperature electrons are excited into the conduction band, leading to an increase in the electrical conductivity.

Semiquinones - Radical anions having the structure $-O-Z-O\cdot$ where Z is an ortho- or para-arylene group or analogous heteroarylene group; they are formally generated by the addition of an electron to a quinone. [5]

SI units* - The International System of Units adopted in 1960 and recommended for use in all scientific and technical fields. [1]

Siemens (S)* - The SI unit of electric conductance, equal to Ω^{-1} . [1]

Sievert (Sv)* - The SI unit of dose equivalent (of radiation), equal to J/kg. [1]

Silanes - Saturated silicon hydrides, analogues of the alkanes; i.e. compounds of the general formula Si_nH_{2n+2} . Silanes may be subdivided into silane, oligosilanes, and polysilanes. Hydrocarbyl derivatives are often referred to loosely as silanes. [5]

Silicones - Polymeric or oligomeric siloxanes, usually considered unbranched, of general formula $[-OSiR_2-]_n$ (R not equal to H). [5]

Siloxanes - Saturated silicon-oxygen hydrides with unbranched or branched chains of alternating silicon and oxygen atoms (each silicon atom is separated from its nearest silicon neighbors by single oxygen atoms). [5]

Skin effect - The concentration of high frequency alternating currents near the surface of a conductor.

Slater orbital - A particular mathematical expression for the radial part of the wave function of a single electron, which is used in quantum-mechanical calculations of the energy and other properties of atoms and molecules.

Small angle neutron scattering (SANS) - See Techniques for Materials Characterization, page 12-1.

Snell's law - The relation between the angle of incidence i and the angle

of refraction r of a light beam which passes from a medium of refractive index n_0 to a medium of index n_1 , viz., $\sin i/\sin r = n_1/n_0$.

Solar constant* - The mean radiant energy flux from the sun on a unit surface normal to the direction of the rays at the mean distance of the earth from the sun. The value is approximately 1373 W/m².

Solar wind - The stream of high velocity hydrogen and helium ions emitted by the sun which flows through the solar system and beyond.

Soliton - A spatially localized wave in a solid or liquid that can interact strongly with other solitons but will afterwards regain its original form.

Solubility* - A quantity expressing the maximum concentration of some material (the solute) that can exist in another liquid or solid material (the solvent) at thermodynamic equilibrium at specified temperature and pressure. Common measures of solubility include the mass of solute per unit mass of solution (mass fraction), mole fraction of solute, molality, molarity, and others.

Solubility product constant (K_{sp})* - The equilibrium constant for the dissolution of a sparsely soluble salt into its constituent ions.

Space group* - A group of symmetry operations (reflections, rotations, etc.) that leave a crystal invariant. A total of 230 space groups have been identified.

Spark source mass spectroscopy (SSMS) - See Techniques for Materials Characterization, page 12-1.

Specific gravity - Ratio of the mass density of a material to that of water. Since one must specify the temperature of both the sample and the water to have a precisely defined quantity, the use of this term is now discouraged.

Specific heat - Heat capacity divided by mass. See Heat capacity.

Specific quantity - It is often convenient to express an extensive quantity (e.g., volume, enthalpy, heat capacity, etc.) as the actual value divided by mass. The resulting quantity is called specific volume, specific enthalpy, etc.

Specific rotation $[\alpha]_D^t$ - For an optically active substance, defined by $[\alpha]_D^t = \alpha/\gamma l$, where α is the angle through which plane polarized light is rotated by a solution of mass concentration γ and path length l . Here θ is the Celsius temperature and λ the wavelength of the light at which the measurement is carried out. Also called specific optical rotatory power. [2]

Spin (s, I)* - A measure of the intrinsic angular momentum of a particle, which it possesses independent of its orbital motion. The symbol s is used for the spin quantum number of an electron, while I is generally used for nuclear spin.

Spiro compounds - Compounds having one atom (usually a quaternary carbon) as the only common member of two rings. [5]

Stacking fault - An error in the normal sequence of layer growth in a crystal.

Standard mean ocean water (SMOW) - A standard sample of pure water of accurately known isotopic composition which is maintained by the International Atomic Energy Agency. It is used for precise calibration of density and isotopic composition measurements.

Standard reduction potential (E°) - The zero-current potential of a cell in which the specified reduction reaction occurs at the right-hand electrode and the left-hand electrode is the standard hydrogen electrode. Also called Standard electrode potential.

Standard state - A defined state (specified temperature, pressure, concentration, etc.) for tabulating thermodynamic functions and carrying out thermodynamic calculations. The standard state pressure is usually taken as 100,000 Pa (1 bar), but various standard state temperatures are used. [2]

Stanton number (St) - A dimensionless quantity used in fluid mechanics, defined by $St = h/\rho v c_p$, where h is coefficient of heat transfer, ρ is

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- density, v is velocity, and c_p is specific heat capacity at constant pressure. [2]
- Stark effect** - The splitting of an energy level of an atom or molecule, and hence a splitting of spectral lines arising from that level, as a result of the application of an external electric field.
- Statistical weight (g)** - The number of distinct states corresponding to the same energy level. Also called degeneracy.
- Stefan-Boltzmann constant (σ)*** - Constant in the equation for the radiant exitance M (radiant energy flux per unit area) from a black body at thermodynamic temperature T , viz. $M = \sigma T^4$. [1]
- Stibines** - SbH_3 and compounds derived from it by substituting one, two or three hydrogen atoms by hydrocarbyl groups: R_3Sb , RSbH_2 , R_2SbH , and R_3Sb (R not equal to H) are called primary, secondary and tertiary stibines, respectively. [5]
- Stochastic process** - A process which involves random variables and whose outcome can thus be described only in terms of probabilities.
- Stoichiometric number (ν)** - The number appearing before the symbol for each compound in the equation for a chemical reaction. By convention, it is negative for reactants and positive for products. [2]
- Stokes (St)** - A non-SI unit of kinematic viscosity, equal to $10^{-4} \text{ m}^2/\text{s}$.
- Stokes' law** - The statement, valid under certain conditions, that the viscous force F experienced by a sphere of radius a moving at velocity v in a medium of viscosity η is given by $F = -6\pi\eta av$.
- Strain** - The deformation of a body that results from an applied stress.
- Stratosphere** - The part of the earth's atmosphere extending from the top of the troposphere (typically 10 to 15 km above the surface) to about 50 km. It is characterized by an increase in temperature with increasing altitude.
- Stress** - Force per unit area (pressure) applied to a body. Tensile stress tends to stretch or compress the body in the direction of the applied force. Shear stress results from a tangential force which tends to twist the body.
- Strong interaction** - The short range (order of 1 fm) attractive forces between protons, neutrons, and other hadrons which are responsible for the stability of the nucleus.
- Strouhal number (Sr)** - A dimensionless quantity used in fluid mechanics, defined by $Sr = lf/v$, where l is length, f is frequency, and v is velocity. [2]
- Structure factor** - In x-ray crystallography, the sum of the scattering factors of all the atoms in a unit cell, weighted by an appropriate phase factor. The intensity of a given reflection is proportional to the square of the structure factor.
- Sublimation pressure** - The pressure of a gas in equilibrium with a solid at a specified temperature.
- Sulfides** - Compounds having the structure RSR (R not equal to H). Such compounds were once called thioethers. In an inorganic sense, salts or other derivatives of hydrogen sulfide. [5]
- Sulfones** - Compounds having the structure, $\text{RS(=O)}_2\text{R}$ (R not equal to H), e.g. $\text{C}_2\text{H}_5\text{S(=O)}_2\text{CH}_3$, ethyl methyl sulfone. [5]
- Sulfonic acids** - $\text{HS(=O)}_2\text{OH}$, sulfonic acid, and its S-hydrocarbyl derivatives. [5]
- Sulfoxides** - Compounds having the structure $\text{R}_2\text{S=O}$ (R not equal to H), e.g. $\text{Ph}_2\text{S=O}$, diphenyl sulfoxide. [5]
- Superconductor** - A material that experiences a nearly total loss of electrical resistivity below a critical temperature T_c . The effect can occur in pure metals, alloys, semiconductors, organic compounds, and certain inorganic solids.
- Superfluid** - A fluid with near-zero viscosity and extremely high thermal conductivity. Liquid helium exhibits these properties below 2.186 K (the λ point).
- Supernova** - A star in the process of exploding because of instabilities which follow the exhaustion of its nuclear fuel.
- Surface analysis by laser ionization (SALI)** - See Techniques for Materials Characterization, page 12-1.
- Surface tension (γ, σ)*** - The force per unit length in the plane of the interface between a liquid and a gas, which resists an increase in the area of that surface. It can also be equated to the surface Gibbs energy per unit area.
- Surfactant** - A substance which lowers the surface tension of the medium in which it is dissolved, and/or the interfacial tension with other phases, and accordingly is positively adsorbed at the liquid-vapor or other interfaces. [3]
- Susceptance (B)** - Imaginary part of admittance. [1]
- Svedberg** - A non-SI unit of time, used to express sedimentation coefficients, equal to 10^{-13} s .
- Syndiotactic macromolecule** - A tactic macromolecule, essentially comprising alternating enantiomeric configurational base units which have chiral or prochiral atoms in the main chain in a unique arrangement with respect to their adjacent constitutional units. In this case the repeating unit consists of two configurational base units that are enantiomeric. [8]
- Tacticity** - The orderliness of the succession of configurational repeating units of a macromolecule or oligomer molecule. In a tactic macromolecule essentially all the configurational repeating units are identical with respect to directional sense. See Configurational repeating unit, Isotactic, Syndiotactic. [8]
- Tautomerism** - Isomerism of the general form G-X-Y=Z 1 X=Y-Z-G , where the isomers (called tautomers) are readily interconvertible; the atoms connecting the groups X, Y, Z are typically any of C, H, O, or S, and G is a group which becomes an electrofuge (i.e., a group that does not carry away the bonding electron pair when it leaves its position in the molecule) or nucleofuge (a group that does carry away the bonding electrons when leaving) during isomerization. The commonest case, when the electrofuge is H^+ , is also known as prototropy. A common example, written so as to illustrate the general pattern given above, is keto-enol tautomerism, such as
- $\text{H-O-C(CH}_3\text{)=CH-CO}_2\text{Et}$ (enol) 1 $(\text{CH}_3\text{)C(=O)-CH}_2\text{-CO}_2\text{Et}$ (keto)
- In some cases the interconversion rate between tautomers is slow enough to permit isolation of the separate keto and enol forms. [5]
- Tensile strength*** - In tensile testing, the ratio of maximum load a body can bear before breaking to original cross-sectional area. Also called ultimate strength. [11]
- Terpenes** - Hydrocarbons of biological origin having carbon skeletons formally derived from isoprene [$\text{CH}_2=\text{C}(\text{CH}_3)\text{CH}=\text{CH}_2$]. [5]
- Terpenoids** - Natural products and related compounds formally derived from isoprene units. They contain oxygen in various functional groups. The skeleton of terpenoids may differ from strict additivity of isoprene units by the loss or shift of a methyl (or other) group. [5]
- Tesla (T)*** - The SI unit of magnetic flux density (B), equal to V s/m^2 . [1]
- Thermal conductivity*** - Rate of heat flow divided by area and by temperature gradient. [1]
- Thermal diffusivity** - Thermal conductivity divided by density and by specific heat capacity at constant pressure. [1]
- Thermal expansion coefficient (α)*** - The linear expansion coefficient is defined by $\alpha_l = (1/l)(dl/dT)$; the volume expansion coefficient by $\alpha_v = (1/V)(dV/dT)$. [1]
- Thermionic emission** - The emission of electrons from a solid as a result of heat. The effect requires a high enough temperature to impart sufficient kinetic energy to the electrons to exceed the work function of the solid.
- Thermodynamic laws** - The foundation of the science of thermodynamics:

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- First law:** The internal energy of an isolated system is constant; if energy is supplied to the system in the form of heat dq and work dw , then the change in energy $dU = dq + dw$.
- Second law:** No process is possible in which the only result is the transfer of heat from a reservoir and its complete conversion to work.
- Third law:** The entropy of a perfect crystal approaches zero as the thermodynamic temperature approaches zero.
- Thermoelectric power** - For a bar of a pure material whose ends are at different temperatures, the potential difference divided by the difference in temperature of the ends. See also Seebeck effect.
- Thermogravimetric analysis (TGA)** - See Techniques for Materials Characterization, page 12-1.
- Thermosphere** - The layer of the earth's atmosphere extending from the top of the mesosphere (typically 80-90 km above the surface) to about 500 km. It is characterized by a rapid increase in temperature with increasing altitude up to about 200 km, followed by a leveling off in the 300-500 km region.
- Thiols** - Compounds having the structure RSH (R not equal to H). Also known by the term mercaptans (abandoned by IUPAC); e.g. $\text{CH}_3\text{CH}_2\text{SH}$, ethanethiol. [5]
- Thomson coefficient** (μ , τ) - The heat power developed in the Thomson effect (whereby heat is evolved in a conductor when a current is flowing in the presence of a temperature gradient), divided by the current and the temperature difference. [1]
- Tonne (t)** - An alternative name for megagram (1000 kg). [1]
- Torque (T)** - For a force F that produces a torsional motion, $T = r \times F$, where r is a vector from some reference point to the point of application of the force.
- Torr** - A non-SI unit of pressure, equal to 133.322 Pa. The name is generally considered interchangeable with millimeter of mercury.
- Townsend coefficient** - In a radiation counter, the number of ionizing collisions by an electron per unit path length in the direction of an applied electric field.
- Transducer** - Any device that converts a signal from acoustical, optical, or some other form of energy into an electrical signal (or vice versa) while preserving the information content of the original signal.
- Transistor** - A voltage amplifier using controlled electron currents inside a semiconductor.
- Transition metals** - Elements characterized by a partially filled d subshell. The First Transition Series comprises Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu. The Second and Third Transition Series include the lanthanides and actinides, respectively. [7]
- Transition probability*** - See Einstein transition probability.
- Transmittance** (τ) - Ratio of the radiant or luminous flux at a given wavelength that is transmitted to that of the incident radiation. Also called transmission factor. [1]
- Tribology** - The study of frictional forces between solid surfaces.
- Triple point*** - The point in p, T space where the solid, liquid, and gas phases of a substance are in thermodynamic equilibrium. The corresponding temperature and pressure are called the triple point temperature and triple point pressure.
- Troposphere** - The lowest part of the earth's atmosphere, extending to 10-15 km above the surface. It is characterized by a decrease in temperature with increasing altitude. The exact height varies with latitude and season.
- Tunnel diode** - A device involving a p-n junction in which both sides are so heavily doped that the Fermi level on the p-side lies in the valence band and on the n-side in the conduction band. This leads to a current-voltage curve with a maximum, so that the device exhibits a negative resistance in some regions.
- Ultraviolet photoelectron spectroscopy (UPS)** - See Techniques for Materials Characterization, page 12-1.
- Umklapp process** - A process involving the interaction of three or more waves (lattice or electron) in a solid in which the sum of the wave vectors does not equal zero.
- Unified atomic mass unit (u)*** - A unit of mass used in atomic, molecular, and nuclear science, defined as the mass of one atom of ^{12}C divided by 12. Its approximate value is 1.66054×10^{-27} kg. [1]
- Universal time (t_U , UT)** - Mean solar time counted from midnight at the Greenwich meridian. Also called Greenwich mean time (GMT). The interval of mean solar time is based on the average, over one year, of the time between successive transits of the sun across the observer's meridian.
- Vacancy** - A missing atom or ion in a crystal lattice.
- Van Allen belts** - Two toroidal regions above the earth's atmosphere containing protons and electrons. The outer belt at about 25,000 km above the surface is probably of solar origin. The inner belt at about 3000 km contains more energetic particles from outside the solar system.
- Van der Waals' equation*** - An equation of state for fluids which takes the form:
- $$pV_m = RT \left(\frac{1}{V_m - b} - \frac{a}{V_m^2} \right)$$
- where p is pressure, V_m is molar volume, T is temperature, R is the molar gas constant, and a and b are characteristic parameters of the substance which describe the effect of attractive and repulsive intermolecular forces, respectively.
- Van der Waals' force** - The weak attractive force between two molecules which arises from electric dipole interactions. It can lead to the formation of stable but weakly bound dimer molecules or clusters.
- Van't Hoff equation** - The equation expressing the temperature dependence of the equilibrium constant K of a chemical reaction:
- $$\frac{d \ln k}{dT} = \frac{\Delta_r H^\circ}{RT^2}$$
- where $\Delta_r H^\circ$ is the standard enthalpy of reaction, R the molar gas constant, and T the temperature. Also called van't Hoff isochore.
- Vapor pressure*** - The pressure of a gas in equilibrium with a liquid (or, in some usage, a solid) at a specified temperature.
- Varistor** - A device that utilizes the properties of certain metal oxides with small amounts of impurities, which show abrupt nonlinearities at specific voltages where the material changes from a semiconductor to an insulator.
- Velocity (v)** - Rate of change of distance with time.
- Verdet constants (V)*** - Angle of rotation of a plane polarized light beam passing through a medium in a magnetic field, divided by the field strength and by the path length.
- Virial equation of state*** - An equation relating the pressure p , molar volume V_m , and temperature T of a real gas in the form of an expansion in powers of the molar volume, viz., $pV_m = RT(1 + BV_m^{-1} + CV_m^{-2} + \dots)$, where R is the molar gas constant. B is called the second virial coefficient, C the third virial coefficient, etc. The virial coefficients are functions of temperature.
- Viscosity (η)*** - The proportionality factor between shear rate and shear stress, defined through the equation $F = \eta A(dv/dx)$, where F is the tangential force required to move a planar surface of area A at velocity v relative to a parallel surface separated from the first by a distance x . Sometimes called dynamic or absolute viscosity. The term kinematic viscosity (symbol ν) is defined as η divided by the mass density.
- Volt (V)*** - The SI unit of electric potential, equal to W/A. [1]
- Volume fraction (ϕ_j)** - Defined as $V_j/\Sigma_i V_i$, where V_j is the volume of the specified component and the V_i are the volumes of all the components of a mixture prior to mixing. [2]

DEFINITIONS OF SCIENTIFIC TERMS (continued)

- Watt (W)*** - The SI unit of power, equal to J/s. [1]
- Wave function** - A function of the coordinates of all the particles in a quantum mechanical system (and, in general, of time) which fully describes the state of the system. The product of the wave function and its complex conjugate is proportional to the probability of finding a particle at a particular point in space.
- Weak interaction** - The weak forces (order of 10^{-12} of the strong interaction) between elementary particles which are responsible for beta decay and other nuclear effects.
- Weber (Wb)*** - The SI unit of magnetic flux, equal to V s. [1]
- Weber number (We)** - A dimensionless quantity used in fluid mechanics, defined by $We = \rho v^2 l / \gamma$, where ρ is density, v is velocity, l is length, and γ is surface tension. [2]
- Weight** - That force which, when applied to a body, would give it an acceleration equal to the local acceleration of gravity. [1]
- Wiedeman-Franz law** - The law stating that the thermal conductivity k and electrical conductivity σ of a pure metal are related by $k = L\sigma T$, where T is the temperature and L (called the Lorenz ratio) has the approximate value $2.45 \times 10^{-8} \text{ V}^2/\text{K}^2$.
- Wien displacement law** - The relation, which can be derived from the Planck formula for black body radiation, that $\lambda_{\text{max}} T = 0.0028978 \text{ m K}$, where λ_{max} is the wavelength of maximum radiance at temperature T .
- Wigner-Seitz method** - A method of calculating electron energy levels in a solid using a model in which each electron is subject to a spherically symmetric potential.
- Wittig reagents** - See phosphonium ylides.
- Work (W)** - Force multiplied by the displacement in the direction of the force. [1]
- Work function (Φ)*** - The energy difference between an electron at rest at infinity and an electron at the Fermi level in the interior of a substance. It is thus the minimum energy required to remove an electron from the interior of a solid to a point just outside the surface. [1]
- X unit (X)** - A unit of length used in x-ray crystallography, equal to approximately $1.002 \times 10^{-13} \text{ m}$.
- X-ray photoelectron spectroscopy (XPS)** - See Techniques for Materials Characterization, page 12-1.
- Yield strength** - The stress at which a material exhibits a specified deviation (often chosen as 0.2% for metals) from proportionality of stress and strain. [11]
- Young's modulus (E)** - In tension or compression of a body below its elastic limit, the ratio of stress to corresponding strain. Since strain is normally expressed on a fractional basis, Young's modulus has dimensions of pressure. Also called elastic modulus. [11]
- Zeeman effect** - The splitting of an energy level of an atom or molecule, and hence a splitting of spectral lines arising from that level, as a result of the application of an external magnetic field.
- Zener diode** - A control device utilizing a p-n junction with a well defined reverse-bias avalanche breakdown voltage.
- Zeotrope** - A liquid mixture that shows no maximum or minimum when vapor pressure is plotted against composition at constant temperature. See Azeotrope.
- Zero-point energy** - The energy possessed by a quantum mechanical system as a result of the uncertainty principle even when it is in its lowest energy state; e.g., the difference between the lowest energy level of a harmonic oscillator and the minimum in the potential well.
- Zeta potential (ζ)** - The electric potential at the surface of a colloidal particle relative to the potential in the bulk medium at a long distance. Also called electrokinetic potential.
- Zwitterions** - Neutral compounds having formal unit electrical charges of opposite sign. Some chemists restrict the term to compounds with the charges on non-adjacent atoms. Sometimes referred to as inner salts, dipolar ions (a misnomer). [5]

THERMODYNAMIC FUNCTIONS AND RELATIONS

p = pressure V = volume T = temperature
 n_i = amount of substance i
 $x_i = n_i/\Sigma_j n_j$ = mole fraction of substance i

Energy	U
Entropy	S
Enthalpy	$H = U + pV$
Helmholtz energy	$A = U - TS$
Gibbs energy	$G = U + pV - TS$
Isobaric heat capacity	$C_p = (\partial H/\partial T)_p$
Isochoric heat capacity	$C_V = (\partial U/\partial T)_V$
Isobaric expansivity	$\alpha = V^{-1}(\partial V/\partial T)_p$
Isothermal compressibility	$\kappa_T = -V^{-1}(\partial V/\partial p)_T$
Isentropic compressibility	$\kappa_S = -V^{-1}(\partial V/\partial p)_S$
	$\kappa_T - \kappa_S = T\alpha^2 V/C_p$
	$C_p - C_V = T\alpha^2 V/\kappa_T$
Gibbs-Helmholtz equation	$H = G - T(\partial G/\partial T)_p$
Maxwell relations	$(\partial S/\partial p)_T = -(\partial V/\partial T)_p$
	$(\partial S/\partial V)_T = -(\partial p/\partial T)_V$
Joule-Thomson expansion	$\mu_{JT} = (\partial T/\partial p)_H = -\{V - T(\partial V/\partial T)_p\}/C_p$
	$\phi_{JT} = (\partial H/\partial p)_T = V - T(\partial V/\partial T)_p$
Partial molar quantity	$X_i = (\partial X/\partial n_i)_{T,p,n_{j\neq i}}$
Chemical potential	$\mu_i = (\partial G/\partial n_i)_{T,p,n_{j\neq i}}$
Perfect gas [symbol ^{pg}]	$pV = (\Sigma_i n_i)RT$
	$\mu_i^{pg} = \mu_i^\theta + RT \ln(x_i p/p^\theta)$
Fugacity	$f_i = (x_i p) \exp\{(\mu_i - \mu_i^{pg})/RT\}$
Activity coefficient	$\gamma_i = f_i/(x_i f_i^\theta)$
Gibbs-Duhem relation	$0 = SdT - Vdp + \Sigma_i n_i d\mu_i$

[Superscript θ in above equations indicates standard state]

Notation for chemical and physical changes ($X = H, S, G$, etc.):

Chemical reaction	$\Delta_r X$
Formation from elements	$\Delta_f X$
Combustion	$\Delta_c X$
Fusion (cry→liq)	$\Delta_{fus} X$
Vaporization (liq→gas)	$\Delta_{vap} X$
Sublimation (cry→gas)	$\Delta_{sub} X$
Phase transition	$\Delta_{trs} X$
Solution	$\Delta_{sol} X$
Mixing	$\Delta_{mix} X$
Dilution	$\Delta_{dil} X$

PHYSICAL CONSTANTS OF ORGANIC COMPOUNDS

The basic physical constants and structure diagrams for about 10,900 organic compounds are presented in this table. An effort has been made to include the compounds most frequently encountered in the laboratory, the workplace, and the environment. Particular emphasis has been given to substances that are considered environmental or human health hazards. In making the selection of compounds for the table, added weight was assigned to the appearance of a compound in various lists or reference sources such as:

- Laboratory reagent lists, e.g., the *ACS Reagent Chemicals* volume (Ref. 1)
- The DIPPR list of industrially important compounds (Ref. 2) and the (much larger) TSCA Inventory of chemicals used in commerce
- The Hazardous Substance Data Bank (Ref. 3)
- The UNEP list of Persistent Organic Pollutants (Ref. 4)
- Chemicals on Reporting Rules (CORR), a database of about 7500 regulated compounds prepared by the Environmental Protection Agency (Ref. 5)
- The EPA Integrated Risk Information System (IRIS), a database of human health effects of exposure to chemicals in the environment (Ref. 6)
- Compendia of chemicals of biochemical or medical importance, such as *The Merck Index* (Ref. 10)
- Specialized tables in this *Handbook*

It should be noted that the above lists vary widely in their choice of chemical names, and even in the use of Chemical Abstracts Registry Numbers. To the extent possible, we have attempted to systematize the names and registry numbers for this table.

Clearly, criteria of this type are somewhat subjective, and compounds considered important by some users have undoubtedly been omitted. Suggestions for additional compounds or other improvements are welcomed.

The data in the table have been derived from many sources, including both the primary literature and evaluated compilations. The *Handbook of Data on Organic Compounds, Third Edition* (Reference 7) and the *Chapman & Hall/CRC Combined Chemical Dictionary* (Reference 8) were important sources. Other useful compilations of physical property data for organic compounds are listed in References 9-19. Many boiling point values (and some melting point and density values) were taken from recent physical chemistry literature dealing with fluid properties. Where conflicts were found, the value deemed most reliable was chosen.

The table is arranged alphabetically by substance name, which generally is either an IUPAC systematic name or, in the case of pesticides, pharmaceuticals, and other complex compounds, a simple trivial name. Names in ubiquitous use, such as acetic acid and formaldehyde, are adopted rather than their systematic equivalents. Synonyms are given in the column following the primary name, and structure diagrams are given below the data listing. The explanation of the data columns follows:

- **No.:** An identification number used in the indexes.
- **Name:** Primary name of the substance
- **Synonym:** A synonym in common use. When the primary name is non-systematic, a systematic name may appear here.
- **Mol. Form.:** The molecular formula written in the Hill convention.
- **CAS RN.:** The Chemical Abstracts Service Registry Number for the compound.
- **Mol. Wt.:** Molecular weight (relative molar mass) as calculated with the 2001 IUPAC Standard Atomic Weights.
- **Physical Form:** A notation of the physical phase, color, crystal type, or other features of the compound at ambient temperature. Abbreviations are given below.
- **mp:** Normal melting point in °C. A value is sometimes followed by “dec”, indicating decomposition is observed at the stated temperature (so that it is probably not a true melting point). The notation “tp” indicates a triple point, where solid, liquid, and gas are in equilibrium.
- **bp:** Normal boiling point in °C, if it is available. This is the temperature at which the liquid phase is in equilibrium with the vapor at a pressure of 760 mmHg (101.325 kPa). A notation “sp” following the value indicates a sublimation point, where the vapor pressure of the solid phase reaches 760 mmHg. When a notation such as “dec” or “exp” (explodes) follows the value, the temperature may not be a true boiling point. A simply entry “sub” indicates the solid has a significant sublimation pressure at ambient temperatures. The boiling point at reduced pressure is listed in some cases, with or without the normal boiling point. Here the superscript indicates the pressure in mmHg.
- **den:** Density (mass per unit volume) in g/cm³. The temperature in °C is indicated by a superscript. Values refer to the liquid or solid phase, and all values are true densities, not specific gravities. The number of decimal places gives a rough estimate of the accuracy of the value.
- **n_D:** Refractive index, at the temperature in °C indicated by the superscript. Unless otherwise indicated, all values refer to a wavelength of 589 nm (sodium D line). Values are given only for liquids and solids.
- **Solubility:** Qualitative indication of solubility in common solvents. Abbreviations are:
 - i insoluble
 - sl slightly soluble
 - s soluble
 - vs very soluble
 - misc miscible
 - dec decomposes

Abbreviations for solvents are given below.

PHYSICAL CONSTANTS OF ORGANIC COMPOUNDS (continued)

In order to facilitate the location of compounds in the table, three indexes are provided:

- **Synonym Index:** Includes common synonyms, but not the primary name by which the table is arranged.
- **Molecular Formula Index:** Lists compounds by molecular formula in the Hill Order (see Introduction to this *Handbook*).
- **CAS Registry Number Index:** Lists compounds by Chemical Abstracts Service Registry Number. Note there is some redundancy in this index, because many compounds have several Registry Numbers associated with them. Thus the CAS RN in a table entry may differ from the CAS RN which points to it in the index. For example, CAS RN 1319-77-3 in the index points to all three cresol isomers, each of which has its own specific CAS RN.

The assistance of Fiona Macdonald in checking names and formulas is gratefully acknowledged, as well as the efforts of Janice Shackleton, Trupti Desai, Nazila Kamaly, Matt Griffiths, and Lawrence Braschi in preparing the structure diagrams.

LIST OF ABBREVIATIONS

Ac	acet yl	flr	fluorescent	Pr	propyl
Ac ₂ O	acet ic anhydri de	f um	f umes, f umi ng	PrOH	1-propanol
AcOEt	et hyl acet at e	gl	glaci al	pr	pri sms
ac	aci d	gr	gray	purp	purpl e
ace	acet one	gran	granular	py	pyri di ne
al	alcohol (et hanol)	grn	green	pym	pyrami ds, pyrami dal
alk	alkal i	hex	hexagonal	reac	react s
amor	amorphous	HOAc	acet ic aci d	rhomb	rhombi c
anh	anhydrous	hp	hept ane	s	sol ubl e
aq	aqueous	hx	hexane	sat	sat urat ed
bi pym	bi pyrami dal	hyd	hydrat e	sc	scales
bl	bl ue	hyg	hygroscopi c	sl	sl i ght ly sol ubl e
blk	black	i	i nsol ubl e	sol n	sol ut ion
bp	boi li ng poi nt	i -	i so-	sp	subl i mat i on poi nt
br	brown	i so	i sooct ane	st ab	st abl e
bt	bri ght	lf	l eaves	sub	subl i mes
Bu	but yl	li g	li groi n	sulf	sul f uri c aci d
BuOH	1-but anol	li q	li qui d	syr	syrup
bz	benzene	lo	long	t ab	t ablet s
chl	chl orof orm	mcl	monocli ni c	t cl	t ri cli ni c
col	col orl ess	Me	met hyl	t et r	t et ragonal
con, conc	concent rat ed	MeCN	acet oni t ri l e	t f a	t ri fluoroacet ic aci d
cry	cryst als	MeOH	met hanol	t hf , THF	t et rahydrof uran
ct c	carbon t et rachori de	mi sc, msc	mi sci bl e	t ol	t ol uene
cy, cyhex	cycl ohexane	mp	mel t i ng poi nt	t p	t ri ple poi nt
dec	decomposes	n	ref ract i ve i ndex	t rg	t ri gonal
den	densi ty	nd	needl es	unst ab	unst abl e
dil	di l ut e	oct	oct ahedra, oct ahedral	vap	vapor
di ox	di oxane	oran	orange	vi ol	vi olet
dk	dark	ort h	ort horhombi c	vi sc	vi scous
DMF	di met hyl f ormami de	os	organi c sol vent s	vol	vol at i l e
DMSO	di met hyl sul f oxi de	pa	pale	vs	very sol ubl e
ef flor	ef florescent	pet h	pet rol eum et her	w	wat er
Et	et hyl	Ph	phenyl	wh	whi t e
Et OH	et hanol	PhCl	chl orobenzene	xyl	xylene
et h	di et hyl et her	PhNH ₂	ani li ne	ye	yel low
exp	expl odes	PhNO ₂	ni t robenzene		
fl	flakes	pl	pl at es		
		pow	powder		

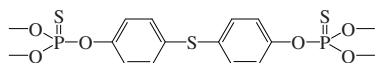
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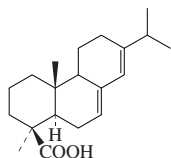
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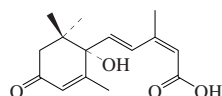
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1	Abate	Temephos	C ₆ H ₂₀ O ₆ P ₂ S ₃	3383-96-8	466.469		30		1.32		
2	Abietic acid		C ₂₀ H ₃₀ O ₂	514-10-3	302.451	mcl pl (al-w)	173.5	250			vs ace, bz, et h, Et OH
3	Abietic acid		C ₂₀ H ₃₀ O ₄	21293-29-8	264.318	cry (chl-pet h)	160	sub 120			vs ace, et h, chl
4	Acetamin	5,7-Di hydroxy-2-(4-met hoxypheyl)4H-1-benzopyran-4-one	C ₁₆ H ₁₂ O ₅	480-44-4	284.263	ye nd (95% al)	263				vs Et OH
5	Acetolol, (±)		C ₈ H ₁₂ N ₂ O ₄	37517-30-9	336.426	cry	121				
6	Acetapstone		C ₁₆ H ₁₆ N ₂ O ₄ S	77-46-3	332.374	paye nd (et h) lf (di l al)	290				sl H ₂ O
7	Acenaphthene	1,2-Di hydroacenaphthylene	C ₁₀ H ₈	83-32-9	154.207		93.4	279	1.222 ²⁰	1.6048 ⁹⁵	i H ₂ O; sl Et OH, chl; vs bz; s HOAc
8	Acenaphthylene	Acenaphthalene	C ₁₀ H ₈	208-96-8	152.192		91.8	280	0.8987 ¹⁶		i H ₂ O; vs Et OH, et h, bz; sl chl
9	1,2-Acenaphthylene diene		C ₁₀ H ₆ O ₂	82-86-0	182.175	ye nd (HOAc)	261	sub	1.4800 ²⁰		i H ₂ O; sl Et OH, bz, HOAc; s li g
10	Acenocoumarol	Nicoumalone	C ₁₅ H ₁₂ NO ₆	152-72-7	353.325	cry (ace aq)	198				i H ₂ O
11	Acephate	Phosphoramidohydroxyacetic acid, acetyl O,S-di methyl ester	C ₄ H ₁₀ NO ₃ PS	30560-19-1	183.166		88		1.35 ²⁰		
12	Acetpromazine		C ₁₉ H ₂₂ N ₂ OS	61-00-7	326.455	oran oi l		230 ^F			
13	Acetulfame		C ₇ H ₁₀ N ₂ S	33665-90-6	163.153	nd (bz)	123.2				s bz, chl
14	Acetaldehyde	Ethanal	C ₂ H ₄ O	75-07-0	44.052	vol li q or gas	-123.37	20.1	0.7834	1.3316 ²⁰	msc H ₂ O, Et OH, et h, bz; sl chl
15	Acetaldehyde phenyl hydrazone		C ₁₁ H ₁₀ N ₂	935-07-9	134.178		99.5	150 ⁴⁰ , 135 ²¹			vs Et OH
16	Acetaldoxime	Acetaldehyde oxime	C ₂ H ₅ NO	107-29-9	59.067	nd	45	115	0.9656 ²⁰	1.4264 ²⁰	s H ₂ O, chl; msc Et OH, et h
17	Acetamide	Ethanamide	C ₂ H ₅ NO	60-35-5	59.067	trg mcl (al-et h)	80.16	222.0	0.9986	1.4278	vs H ₂ O, Et OH
18	Acetanilide	<i>M</i> -Phenylacetamide	C ₈ H ₉ NO	103-84-4	135.163		114.3	304	1.2190 ¹⁵		sl H ₂ O; vs Et OH, ace; s et h, s bz, t ol
19	Acetamidine	<i>M</i> -[5-(Aminosulfonyl)-1,3,4-thiadiazol-2-yl]acetamide	C ₆ H ₈ N ₄ O ₃ S ₂	59-66-5	222.246		260.5				sl H ₂ O
20	Acetone		C ₃ H ₆ O	67-64-1	58.079	li q		56	0.7845	1.3588 ²⁰	msc H ₂ O, Et OH, et h, ace, bz, chl
21	Acetic acid	Ethanoic acid	C ₂ H ₄ O ₂	64-19-7	60.052		16.64	117.9	1.0446 ²⁵	1.3720 ²⁰	msc H ₂ O, Et OH, et h, ace, bz; s chl, CS ₂
22	Acetic acid, 2-phenylhydrazide		C ₉ H ₉ N ₂ O	114-83-0	150.177	hex pr (et h)	130.0				vs H ₂ O, Et OH; sl et h, chl, t f a; s bz
23	Acetic anhydride		C ₄ H ₆ O ₃	108-24-7	102.089	li q	-74.1	139.5	1.082	1.3901 ²⁰	vs H ₂ O; s Et OH, bz; msc et h; sl ct c
24	Acetoacetanilide		C ₁₀ H ₉ NO ₂	102-01-2	177.200	pr or nd (bz or li g)	86				sl H ₂ O; s Et OH, et h, bz, chl, aci d, li g
25	Acetoacetic acid		C ₃ H ₄ O ₃	541-50-4	102.089	cry (et h)	36.5	dec 100			vs H ₂ O, et h, Et OH
26	2-Acetoacetylmethacrylate	2-(Methacryloyloxy)ethyl acetoacetate	C ₁₀ H ₁₄ O ₅	21282-97-3	214.215	li q		100 ^F	1.122	1.4560 ²⁰	
27	Acetyl chloride		C ₂ H ₃ ClO	34256-82-1	269.768	ye li q		134 ^F		1.5272 ²⁰	sl H ₂ O
28	Acetamide		C ₂ H ₅ NO	60-35-5	59.067	cry (Et OH aq)	188				i H ₂ O, et h; sl Et OH, chl; s py
29	Acetohydrazide		C ₃ H ₆ N ₂ O	1068-57-1	74.081		67	137 ²⁵			s H ₂ O, Et OH; sl et h
30	Acetohydroxamic acid	<i>M</i> -Hydroxyacetamide	C ₂ H ₅ NO ₂	546-88-3	75.067	hyg cry	90				
31	1-Acetonaphthol		C ₁₀ H ₈ O	941-98-0	170.206		34	297	1.1171 ²¹	1.6280 ²²	i H ₂ O; s Et OH, et h, ace, chl
32	2-Acetonaphthol		C ₁₀ H ₈ O	93-08-3	170.206	nd (li g, di l al)	56	302			sl Et OH, ct c
33	Acetone	2-Propanone	C ₃ H ₆ O	67-64-1	58.079	li q	-94.7	56.05	0.7845	1.3588 ²⁰	msc H ₂ O, Et OH, et h, ace, bz, chl
34	Acetone cyanohydrin		C ₃ H ₇ NO	75-86-5	85.105		-19	82 ²³	0.932 ¹⁹	1.3992 ²⁰	vs H ₂ O, Et OH, et h; s ace, bz, chl; i pet h
35	Acetone (2,4-dinitrophenyl)hydrazone		C ₉ H ₇ N ₃ O ₄	1567-89-1	238.200	ye nd or pl (al)	128				i H ₂ O; s Et OH, et h, bz, chl, AcOEt
36	Acetone (1-methyl ethylidene)hydrazone	Dimethyl ketazine	C ₆ H ₁₀ N ₂	627-70-3	112.172	li q	-12.5	133	0.8390	1.4535 ²⁰	msc H ₂ O, Et OH, et h; s ace
37	Acetone thiourea		C ₂ H ₄ N ₂ S	1752-30-3	131.199	ye cry	176				s ace
38	Acetonitrile	Methyl cyanide	C ₂ H ₃ NC	75-05-8	41.052	li q	-43.82	81.65	0.7857	1.3442 ³⁰	msc H ₂ O, Et OH, et h, ace, bz, ct c



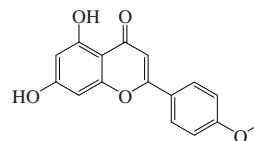
Abat e



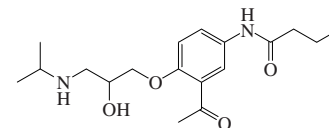
Abietic acid



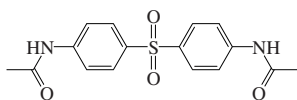
Abscisic acid



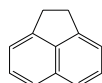
Acacetin



Acebutolol(±)



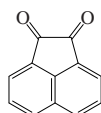
Acedapsone



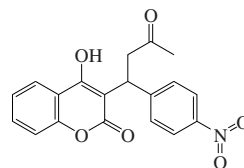
Acenaphthene



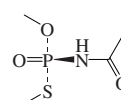
Acenaphthylene



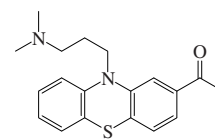
1,2-Acenaphthylenedione



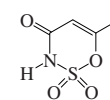
Acenocoumarol



Acepate



Acepromazine

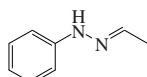


Acesulfame

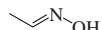
3-5



Acetaldehyde



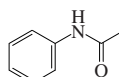
Acetaldehydephenylhydrazone



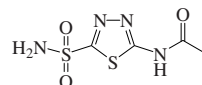
Acetaldoxime



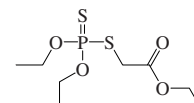
Acetamide



Acetanilide



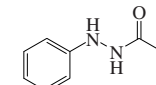
Acetazolamide



Acetehion



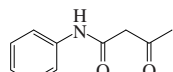
Acetic acid



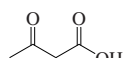
Acetic acid2-phenylhydrazone



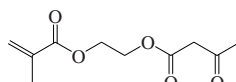
Acetic anhydride



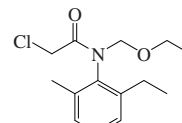
Acetic anilide



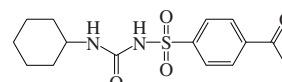
Acetic acid



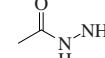
2-Acetic acid ethyl acrylate



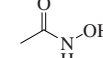
Acetyl chloride



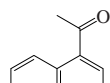
Acetohexamide



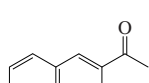
Acetohydrazide



Acetohydroxamic acid



1-Acetonaphthene



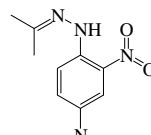
2-Acetonaphthene



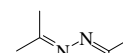
Acetone



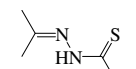
Acetonitrile



Acetone(2,4-dinitrophenyl)hydrazone



Acetone(1-methyl ethylidene)hydrazone

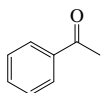


Acetone(1-oxoethylidene)carbazide

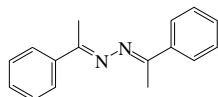


Acetonitrile

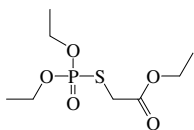
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
39	Acetophenone	Met hyl phenyl ketone	$\text{C}_8\text{H}_8\text{O}$	98-86-2	120.149	mcl pr or pl	20.5	202	1.0287 ⁹	1.5372 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz, con sul f, chl
40	Acetophenoneazine	Met hyl phenyl ketazine	$\text{C}_8\text{H}_8\text{N}_2$	729-43-1	236.311		120				
41	Acetoxon	Acetophos	$\text{C}_8\text{H}_7\text{O}_3\text{PS}$	2425-25-4	256.257	liq		79 ⁹⁰⁵			
42	N-Acetylacetamide		$\text{C}_4\text{H}_7\text{NO}_2$	625-77-4	101.105	nd (et h)	79	223.5			s H ₂ O, Et OH, et h, chl, liq
43	N-Acetyl-L-alanine		$\text{C}_6\text{H}_9\text{NO}_3$	97-69-8	131.130		125				
44	4-(Acetylaminophenyl)benzenesulfonamide	Acetyl sulfanilamide	$\text{C}_{12}\text{H}_{11}\text{N}_2\text{O}_4\text{S}$	121-60-8	233.673	nd (bz), pr (bz-chl)	149				vs Et OH, et h; s bz, chl
45	2-(Acetylaminophenyl)benzoic acid		$\text{C}_{13}\text{H}_{11}\text{NO}_3$	89-52-1	179.172	nd (HOAc)	187.5				sl H ₂ O; s Et OH; vs et h, ace, bz, HOAc
46	4-(Acetylaminophenyl)benzoic acid		$\text{C}_{13}\text{H}_{11}\text{NO}_3$	556-08-1	179.172	nd (HOAc)	256.5				i H ₂ O; s Et OH; sl et h, t f a
47	2-(Acetylaminophenyl)-2-deoxy-D-glucose	N-Acetyl-D-glucosamine	$\text{C}_{12}\text{H}_{19}\text{NO}_6$	7512-17-6	221.208		205				
48	2-(Acetylaminophenyl)-2-deoxy-D-mannose	N-Acetyl-D-mannosamine	$\text{C}_{12}\text{H}_{19}\text{NO}_6$	3615-17-6	221.208	cry (ace aq)	128				dec alk
49	2-(Acetylaminophenyl)fluorene		$\text{C}_{19}\text{H}_{13}\text{NO}$	53-96-3	223.270	cry (di l al)	193				i ₂ Et s Et OH, et h, HOAc
50	4-(Acetylaminophenyl)fluorene		$\text{C}_{19}\text{H}_{13}\text{NO}$	28322-02-3	223.270	br cry (bz)	200				
51	6-(Acetylaminophenyl)hexanoic acid	ε-Acetylaminocaproic acid	$\text{C}_{13}\text{H}_{19}\text{NO}_3$	57-08-9	173.210	cry (ace)	104.5				
52	4-Acetylaminophenol		$\text{C}_8\text{H}_9\text{NO}_2$	100-06-1	150.174	pl (pet h)	38.5	258	1.0818	1.5474 ¹	sl H ₂ O; s Et OH, et h, ace, chl
53	2-Acetylbenzoic acid		$\text{C}_8\text{H}_7\text{O}_3$	577-56-0	164.158	nd (w), pr (bz)	114.5	111 ²			vs H ₂ O, et h, Et OH
54	3-Acetylbenzoic acid		$\text{C}_8\text{H}_7\text{O}_3$	586-42-5	164.158		172	111 ²			s H ₂ O; msc Et OH
55	4-Acetylbenzoic acid		$\text{C}_8\text{H}_7\text{O}_3$	586-89-0	164.158	nd (w)	208	sub			vs H ₂ O
56	Acetyl benzoyl peroxide	Acetozone	$\text{C}_9\text{H}_7\text{O}_4$	644-31-5	180.158	wh nd (liq)	37	130			vs et h
57	Acetyl bromide	Ethanoyl bromide	$\text{C}_2\text{H}_3\text{BrO}$	506-96-7	122.948	liq	-96	76	1.6625	1.4486 ²⁰	msc et h, bz, chl; s ace
58	Acetyl chloride	Ethanoyl chloride	$\text{C}_2\text{H}_3\text{ClO}$	75-36-5	78.497	liq	-112.8	50.7	1.1059	1.3886 ²⁰	msc et h, ace, bz, chl; s ct c
59	Acetylchlorobromide		$\text{C}_2\text{H}_2\text{BrClO}$	66-23-9	226.112	hyg cry	146				vs H ₂ O
60	Acetylchlorobromide		$\text{C}_2\text{H}_2\text{BrClO}$	60-31-1	181.661		150				s H ₂ O, Et OH; i et h
61	Acetylchloroiodide		$\text{C}_2\text{H}_2\text{ClIO}$	2260-50-6	273.112	hyg	163				
62	2-Acetylcyclohexanone		$\text{C}_8\text{H}_{12}\text{O}_2$	874-23-7	140.180		-11	112 ¹⁸ , 101 ¹⁴	1.0782 ²⁵	1.5138 ²⁰	s ct c
63	2-Acetylcyclopentanone		$\text{C}_7\text{H}_{10}\text{O}_2$	1670-46-8	126.153			73 ²⁰	1.0431 ²⁵	1.4906 ²⁰	
64	N-Acetyl-L-cysteine	Acetyl cysteine	$\text{C}_3\text{H}_7\text{NO}_2\text{S}$	616-91-1	163.195	cry (w)	109.5				
65	3-Acetyl dihydro-2H-uranone	α-Acetylbutyrolactone	$\text{C}_6\text{H}_8\text{O}_3$	517-23-7	128.126			107 ⁵	1.1846 ²⁰	1.4585 ²⁰	vs H ₂ O
66	1-Acetyl-2,5-dihydroxybenzene	2,5-Dihydroxyacetophenone	$\text{C}_8\text{H}_8\text{O}_3$	490-78-8	152.148	ye grn nd (di l al or w)	205.3				sl H ₂ O, et h, bz; s Et OH
67	Acetylene	Ethyne	C_2H_2	74-86-2	26.037	col gas	-80.7 (tri ple point)	-84.7 sp	0.377 ²⁵ (p>1 atm)		sl H ₂ O, Et OH, CS ₂ ; s ace, bz, chl
68	N-Acetyl ethanolamine		$\text{C}_4\text{H}_9\text{NO}_2$	142-26-7	103.120		63.5	166 ⁸	1.1079 ²⁵	1.4674 ²⁰	msc H ₂ O; s ace; sl bz, liq
69	Acetyl fluoride	Ethanoyl fluoride	$\text{C}_2\text{H}_3\text{FO}$	557-99-3	62.042	vol liq or gas	-84	20.8	1.032		msc Et OH, et h; s bz, chl; sl CS
70	N-Acetylglutamic acid		$\text{C}_8\text{H}_{13}\text{NO}_5$	1188-37-0	189.166	pr (w)	199				s H ₂ O, Et OH
71	N-Acetylglucine	Acetyluracilic acid	$\text{C}_8\text{H}_{11}\text{NO}_5$	543-24-8	117.104	lo nd (w, MeOH)	206				vs H ₂ O, ace, Et OH
72	trans-1-Acetyl-4-hydroxy-L-proline	Oxaceprol	$\text{C}_7\text{H}_{11}\text{NO}_4$	33996-33-7	173.167	cry (Ac)	132				vs H ₂ O, MeOH
73	1-Acetyl-β-imidazole		$\text{C}_5\text{H}_6\text{N}_2\text{O}$	2466-76-4	110.114		104.5				sl H ₂ O; s Et OH, et h, chl, THF
74	Acetyl iodide	Ethanoyl iodide	$\text{C}_2\text{H}_3\text{IO}$	507-02-8	169.948			108	2.0673 ²⁰	1.5491 ²⁰	vs et h
75	Acetyl isothiocyanate		$\text{C}_2\text{H}_3\text{NOS}$	13250-46-9	101.127			132.5	1.1523 ¹³	1.5231 ¹⁸	s et h, CS
76	N-Acetyl-L-lysine		$\text{C}_{11}\text{H}_{19}\text{N}_3\text{O}_3$	692-04-6	188.224		265 dec				
77	N-Acetyl-L-methionine		$\text{C}_9\text{H}_{19}\text{NO}_2\text{S}$	1115-47-5	191.248		114.5				
78	N-Acetyl-L-methionine	Methionine	$\text{C}_9\text{H}_{19}\text{NO}_2\text{S}$	65-82-7	191.248		105.5				



Acetophenone



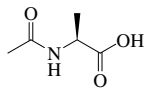
Acetophenone azine



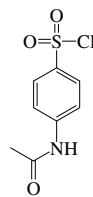
Acetyl phosphate



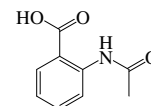
N-Acetylacetamide



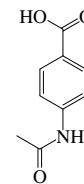
N-Acetyl-L-alanine



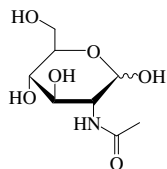
4-(Acetylamino)benzenesulfonyl chloride



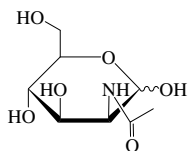
2-(Acetylamino)benzoic acid



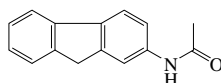
4-(Acetylamino)benzoic acid



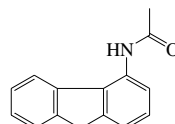
2-(Acetylamino)-2-deoxy-D-glucose



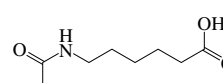
2-(Acetylamino)-2-deoxy-D-mannose



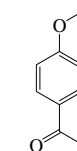
2-(Acetylamino)fluorene



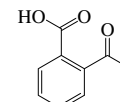
4-(Acetylamino)fluorene



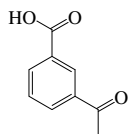
6-(Acetylamino)hexanoic acid



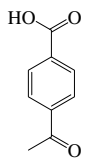
4-Acetylanisole



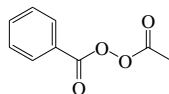
2-Acetylbenzoic acid



3-Acetylbenzoic acid



4-Acetylbenzoic acid



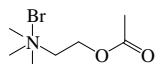
Acetyl benzoyl peroxide



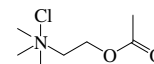
Acetyl bromide



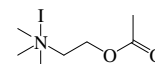
Acetyl chloride



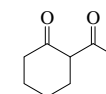
N-Acetylcholine bromide



N-Acetylcholine chloride



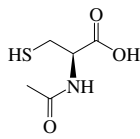
N-Acetylcholine iodide



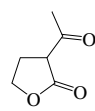
2-Acetylcyclohexanone



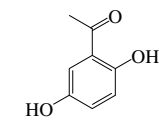
2-Acetylcyclopentanone



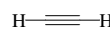
N-Acetyl-L-cysteine



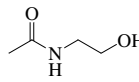
3-Acetyl-2-thiouranone



1-Acetyl-2,5-dihydroxybenzene



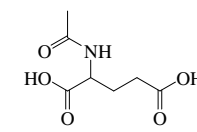
Acetylene



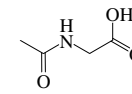
N-Acetyl ethanolamine



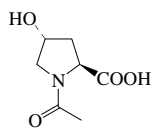
Acetyl fluoride



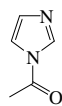
N-Acetyl glutamic acid



N-Acetyl glycine



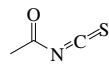
trans-1-Acetyl-4-hydroxy-L-proline



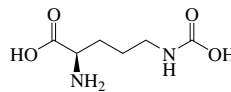
1-Acetyl-4-methylimidazole



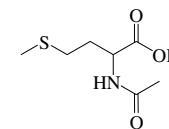
Acetyl iodide



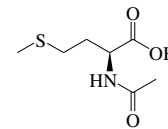
Acetyl isothiocyanate



N⁶-Acetyl-L-lysine

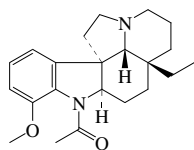


N-Acetyl-DL-methionine



N-Acetyl-L-methionine

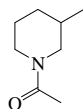
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
79	1-Acet yl-17-met hoxyaspi dospermi di ne	Aspi dospermi ne	$C_{27}H_{30}N_2O_2$	466-49-9	354.485	nd or pr (al) nd (pet h)	208	220 ²			sl H ₂ O, et h; s Et OH, bz, chl
80	N-Acet yl N-met hyl acet ami de		$C_8H_{10}NO_2$	1113-68-4	115.131	li q	-25	195; 114.5	1.0663 ²⁵	1.4502 ²⁵	msc H ₂ O; i et h
81	1-Acet yl-3-met hyl pi peri di ne		$C_8H_{10}NO$	4593-16-2	141.211	li q	-13.6	239	0.9684	1.4731 ²⁵	vs H ₂ O
82	3-Acet yl-6-met hyl pyran-2,4(3H)-di one	Dehydroacet i c aci d	$C_8H_8O_4$	520-45-6	168.148		109	270			vs H ₂ O, et h; sl Et OH, chl
83	4-Acet yl morphol i ne		$C_8H_{11}NO_2$	1696-20-4	129.157		14.5	152 ⁵⁰ , 118 ¹²	1.1145 ²⁰	1.4827 ²⁰	msc H ₂ O; s Et OH, ace, ct c
84	N-Acet yl neurami ni c aci d	Aceneurami c aci d	$C_{11}H_{19}NO_9$	131-48-6	309.271		186				
85	Acet yl ni t rat e		$C_2H_3NO_4$	591-09-3	105.050			exp 60; 227 ⁰	1.24 ¹⁵		
86	2-(Acet yl oxy)benzoi c aci d	Acet yl sal i cyl i c aci d	$C_8H_8O_4$	50-78-2	180.158	nd (w), mcl t ab (w)	135				s H ₂ O, et h, chl; vs Et OH; sl bz
87	4-(Acet yl oxy)benzoi c aci d		$C_8H_8O_4$	2345-34-8	180.158		188.5				
88	2-(Acet yl oxy)-5-bromobenzoi c aci d	5-Bromoacet yl sal i cyl i c aci d	$C_8H_7BrO_4$	1503-53-3	259.054	nd (al)	60				i H ₂ O; vs Et OH, et h
89	4-(Acet yl oxy)-3-met hoxyl benzal dehyde		$C_{10}H_{10}O_4$	881-68-5	194.184		78				sl H ₂ O; vs Et OH, et h
90	2-(Acet yl oxy)-1-phenyl et hanone		$C_{10}H_{10}O_3$	2243-35-8	178.184	ort h pl	49	270	1.1169	1.5036 ⁶⁵	i H ₂ O; vs Et OH, et h, chl; sl bz, li g
91	1-(Acet yl oxy)-2-propanone	Acet oxyacet one	$C_5H_8O_3$	592-20-1	116.116			171; 63 ¹¹	1.0757 ²⁰	1.4141 ²⁰	vs H ₂ O, et h, Et OH
92	(Acet yl oxy)t ri but yl st annane	Tri but yl t i n acet at e	$C_{14}H_{30}O_2Si$	56-36-0	349.097		84.7				
93	(Acet yl oxy)t ri phenyl st annane	Tri phenyl t i n acet at e	$C_{20}H_{18}O_2Sn$	900-95-8	409.066		121.5				
94	4-Acet yl phenyl acet at e		$C_{10}H_{10}O_3$	13031-43-1	178.184						s ct c, C ₅
95	N-Acet yl L-phenyl al ani ne		$C_9H_{13}NO_3$	2018-61-3	207.226		173.5				s Et OH
96	N-Acet yl L-phenyl al ani ne, et hyl est er		$C_{13}H_{17}NO_3$	2361-96-8	235.279	cry (Et OH aq)	93				
97	N-Acet yl L-phenyl al ani ne, met hyl est er		$C_{12}H_{15}NO_3$	3618-96-0	221.252	nd (pet h) or vi sc oi l (chl)	91				
98	Acet yl phosphat e		$C_2H_5O_2P$	590-54-5	140.032	unst ab i n sol n					
99	1-Acet yl pi peri di ne		C_7H_9NO	618-42-8	127.184	li q	-13.4	226.5	1.014	1.4790 ²⁵	vs H ₂ O, Et OH
100	1-Acet yl-4-pi peri di none		$C_7H_9NO_2$	32161-06-1	141.168			218; 124 ⁰²	1.146 ²⁵	1.5026 ²⁰	
101	3-Acet yl pyri di ne adeni ne di nucl eot i de	3-Acet yl NAD	$C_{22}H_{28}N_6O_{14}P_2$	86-08-8	662.436	sol i d					
102	4-Acet yl t hi oani sol e		C_7H_9OS	1778-09-2	166.239		81.5				
103	Acet yl t hi ochol i ne i odi de		C_7H_9IOS	1866-15-5	289.177		205				
104	N-Acet yl L-tyrpt ophan		$C_9H_{14}N_2O_3$	1218-34-4	246.261	nd (di l MeOH)	189.5				s H ₂ O, Et OH, al k
105	N-Acet yl L-tyrosi ne		$C_9H_{13}NO_4$	537-55-3	223.226	cry (w); pl (di ox)	153				
106	N-Acet yl L-tyrosi ne et hyl est er		$C_{13}H_{17}NO_4$	840-97-1	251.279		80.5				
107	N-Acet yl L-val i ne		$C_9H_{13}NO_3$	96-81-1	159.183		164				
108	Acid Fuchsi n	Fuchsi n, aci d	$C_{20}H_7N_3Na_2O_9S_3$	3244-88-0	585.539						sl H ₂ O, Et OH
109	Acid fluorfen	5-[2-Chl oro-4-(t ri fluoromet hyl phenoxy)-2-ni t robenzoi c aci d	$C_{14}H_7ClF_3NO_5$	50594-66-6	361.658		150				
110	Aconi ne		$C_{25}H_{41}NO_9$	509-20-6	499.596	amor	132				s H ₂ O, Et OH, chl; sl et h, li g
111	Aconi t i ne		$C_{27}H_{47}NO_{11}$	302-27-2	645.737	ort h lf	204				vs bz, Et OH, chl
112	9-Acri di nami ne	Ami nacri ne	$C_{13}H_9N_2$	90-45-9	194.231	ye nd (ace or al)	241				s Et OH, ace; sl DMSO; vs di l HCl
113	Acridi ne	Di benzol[b,e]pyri di ne	$C_{13}H_9N$	260-94-6	179.217	ort h nd or pr (al)	106(f orm a); 110(f orm b)	344.86	1.005 ²⁰		i H ₂ O; sl ct c; vs Et OH, et h, bz
114	3,6-Acri di nedi ami ne	Proflavi ne	$C_{13}H_9N_3$	92-62-6	209.246	ye nd (al or w)	285				s H ₂ O; vs Et OH; sl et h, bz
115	9(10H)-Acridi none		$C_{13}H_9NO$	578-95-0	195.216	ye lf (al)	>300				i H ₂ O et h, bz; sl Et OH; s HOAc, al k
116	Acrolei n	2-Propenal	C_3H_4O	107-02-8	56.063	li q	-87.7	52.6	0.840	1.4017 ²⁰	vs H ₂ O; s Et OH, et h, ace; sl chl



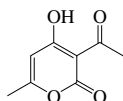
1-Acetyl-17-met hoxyaspi dospermi di



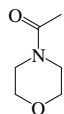
N-Acetyl N-met hylacet ami de



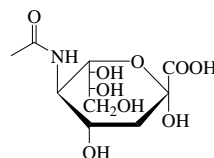
1-Acetyl-3-met hyl pi peri di



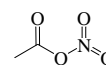
6-Acetyl-6-met hyl pyran-2,4(3H)-di one



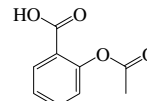
4-Acetyl morpho li ne



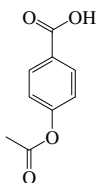
N-Acetyl yl neurami na cci d



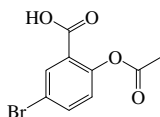
Acetyl ni t rat e



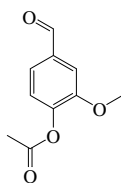
2-(Acetyl oxy)benzoi cci d



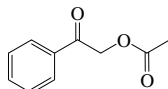
4-(Acetyl oxy)benzoi cci d



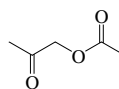
2-(Acetyl oxy)-5-bromobenzoi cci d



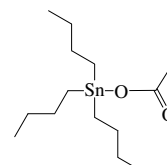
4-(Acetyl oxy)-3-met hoxybenzal dehyde



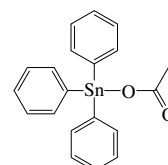
2-(Acetyl oxy)-1-phenyl et hanone



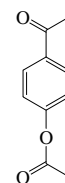
1-(Acetyl oxy)-2-propanone



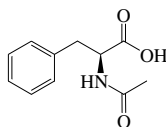
(Acetyl oxy)t ri but yl st annane



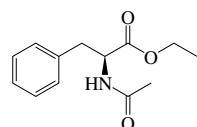
(Acetyl oxy)t ri phenyl st annane



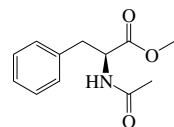
4-Acetyl yl phenylacet at e



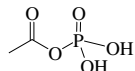
N-Acetyl yl L-phenyl al ani ne



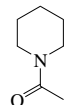
N-Acetyl yl L-phenyl al ani ne et hylest er



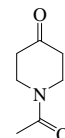
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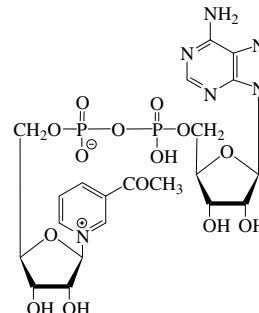
Acetyl phospha t e



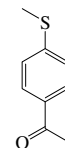
1-Acetyl pi peri di ne



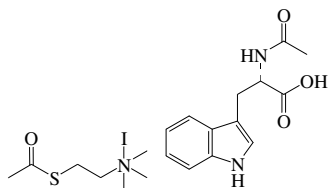
N-Acetyl yl-4-pi peri di none



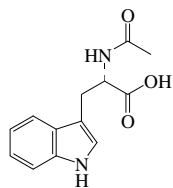
3-Acetyl yl pyri di neni nedi nucl eot i de



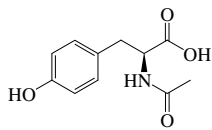
4-Acetyl th i oani so l e



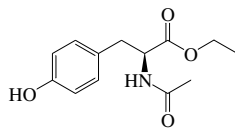
Acetyl th i ochol i nedi de



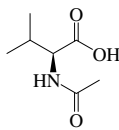
N-Acetyl yl L-trypt ophan



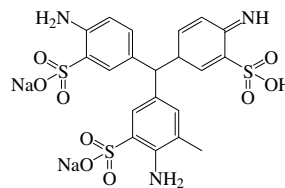
N-Acetyl yl L-tyrosi ne



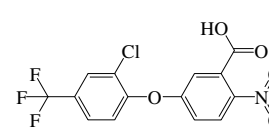
N-Acetyl yl L-tyrosi ne et hylest er



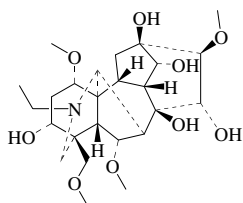
N-Acetyl yl-val i ne



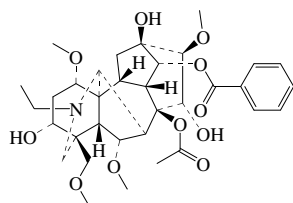
Acri dFuchsi n



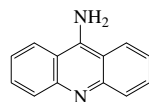
Acri f luor en



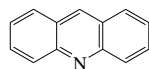
Aconi ne



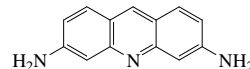
Aconi ti ne



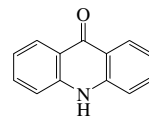
9-Acri di nami ne



Acri di ne



3,6-Acri di nedi ami ne

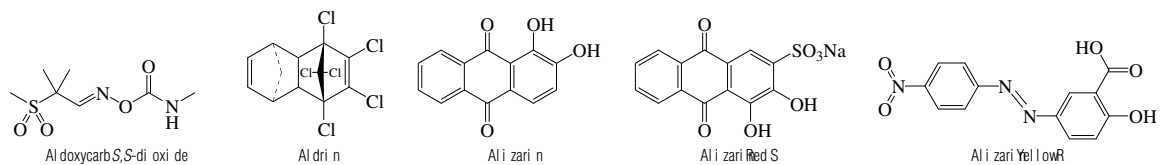
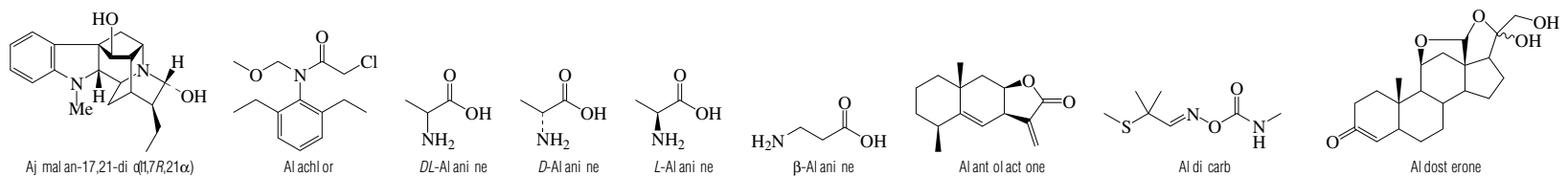
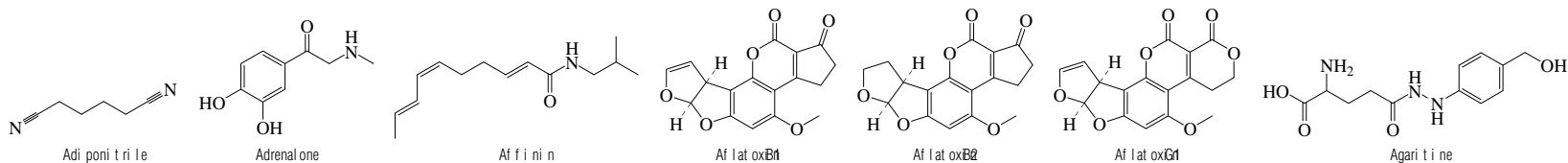
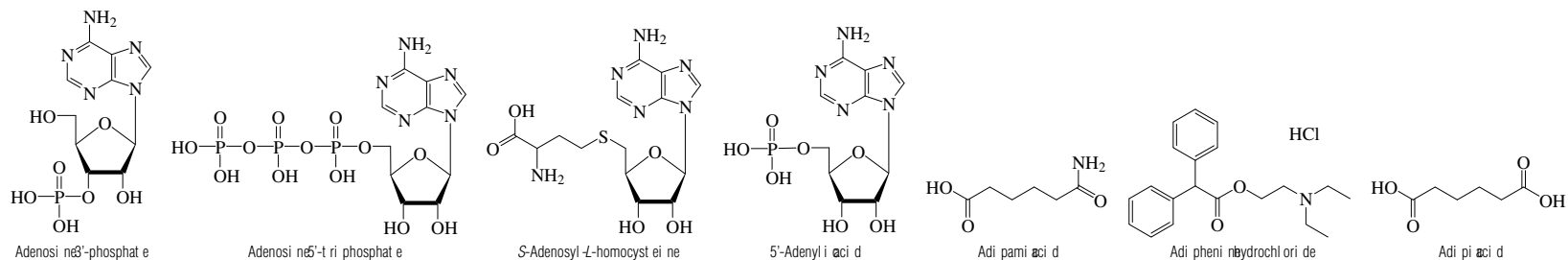


9(10H)-Acri di none

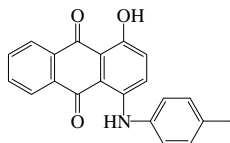


Acrolei n

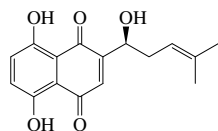
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
117	Acrylami de	2-Propenami de	$\text{C}_3\text{H}_5\text{NO}$	79-06-1	71.078	lf (bz)	84.5	192.6			vs H ₂ O, chl; s Et OH, et h, ace
118	Acryli c aci d	2-Propenoic aci d	$\text{C}_3\text{H}_4\text{O}_2$	79-10-7	72.063		12.5	141	1.0511 ²⁰	1.4224 ²⁰	msc H ₂ O, Et OH, et h; s ace, bz, ct c
119	Acryloni tri le	Propenenitri le	$\text{C}_3\text{H}_3\text{N}$	107-13-1	53.063	liq	-83.48	77.3	0.8007 ⁹	1.3911 ²⁰	s H ₂ O; vs ace, bz, et h, Et OH
120	Acyclovi r		$\text{C}_7\text{H}_7\text{N}_3\text{O}_3$	59277-89-3	225.205	cry (Et OH)	225				
121	Adeni ne	1H-Purin-6-ami ne	$\text{C}_5\text{H}_4\text{N}_6$	73-24-5	135.128	ort h nd (+3w)	360 dec	sub 220			s H ₂ O; sl Et OH; i et h, chl
122	Adenosi ne	β-D-Ribofuranosi de, adeni ne-9	$\text{C}_{10}\text{H}_{13}\text{N}_5\text{O}_4$	58-61-7	267.242	n(w+3/2)	235.5				sl H ₂ O; i Et OH
123	Adenosi ne cycli c 3',5'-(hydrogen phosphat e)	cAMP	$\text{C}_{10}\text{H}_{12}\text{N}_5\text{O}_6\text{P}$	60-92-4	329.206	cry	219				
124	Adenosi ne 3',5'-di phosphat e	3'-Adenyli c aci d, 5'-(di hydrogen phosphat e)	$\text{C}_{10}\text{H}_{15}\text{N}_5\text{O}_{10}\text{P}_2$	1053-73-2	427.202	amor pow					
125	Adenosi ne 5'-met hylenedi phosphonate	Adenosi ne, 5'-(hydrogen (phosphonomet hyl)phosphonate)	$\text{C}_{11}\text{H}_{17}\text{N}_5\text{O}_9\text{P}_2$	3768-14-7	425.229	cry (w)	204				s H ₂ O
126	Adenosi ne 3'-phosphat e	3'-Adenyli c aci d	$\text{C}_{10}\text{H}_{16}\text{N}_5\text{O}_7\text{P}$	84-21-9	347.222	col nd	195 dec				
127	Adenosi ne 5'-tri phosphat e	ATP	$\text{C}_{10}\text{H}_{16}\text{N}_5\text{O}_{13}\text{P}_3$	56-65-5	507.181		144 dec				
128	S-Adenosyl-L-homocyst ei ne		$\text{C}_9\text{H}_{20}\text{N}_6\text{O}_5\text{S}$	979-92-0	384.411		210 dec				
129	5'-Adenyli c aci d	Adenosi ne 5'-monophosphat e	$\text{C}_{10}\text{H}_{16}\text{N}_5\text{O}_7\text{P}$	61-19-8	347.222		195 dec				vs H ₂ O; s Et OH, 10% HCl
130	Adi pami c aci d		$\text{C}_6\text{H}_6\text{N}_2\text{O}_3$	334-25-8	145.156	nd (w)	161.5				
131	Adi pheni ne hydrochl ori de		$\text{C}_{20}\text{H}_{26}\text{ClNO}_2$	50-42-0	347.879	cry	113.5				vs H ₂ O; sl Et OH, et h
132	Adi pi c aci d	1,6-Hexanedi oi c aci d	$\text{C}_6\text{H}_{12}\text{O}_4$	124-04-9	146.141	mcl pr (w, ace, li g)	152.5	337.5	1.360 ²⁵		sl H ₂ O; vs Et OH; s et h; i HOAc, li g
133	Adi poni tri le	Hexanedi nitri le	$\text{C}_6\text{H}_8\text{N}_2$	111-69-3	108.141	nd (et h)	1	295	0.9676 ⁹	1.4380 ²⁰	sl H ₂ O, et h; s chl, Et OH
134	Adrenal one		$\text{C}_9\text{H}_{11}\text{NO}_3$	99-45-6	181.188	nd	235 dec				sl H ₂ O, Et OH, et h
135	Af fini n	N-(2-Met hyl propyl)-2,6,8-decat ri enami de	$\text{C}_{14}\text{H}_{23}\text{NO}$	25394-57-4	221.339	ye oi l	23	162 ⁹		1.5134 ²⁵	i H ₂ O
136	Aflatoxi n B1		$\text{C}_{17}\text{H}_{12}\text{O}_6$	1162-65-8	312.273	cry	268				
137	Aflatoxi n B2		$\text{C}_{17}\text{H}_{14}\text{O}_6$	7220-81-7	314.289		287.5				
138	Aflatoxi n G1		$\text{C}_{17}\text{H}_{12}\text{O}_7$	1165-39-5	328.273	cry	245				
139	Agari ti ne	L-Glutami c aci d, 5-[2-[4-(hydroxymet hyl)phenyl]hydrazi de]	$\text{C}_{12}\text{H}_{17}\text{N}_3\text{O}_4$	2757-90-6	267.281	cry (di l al)	207 dec				vs f0
140	Aj mal an-17,21-di ol, (RZ1α)	Aj mali ne	$\text{C}_{26}\text{H}_{46}\text{N}_2\text{O}_2$	4360-12-7	326.432	pl (+3.5w) (aq AcOEt)	206				i H ₂ O; s Et OH, chl; sl et h, bz
141	Al achl or		$\text{C}_4\text{H}_9\text{ClNO}_2$	15972-60-8	269.768		40	100 ^{0.02}	1.133 ²⁵		
142	DL-Al ani ne	DL-2-Aminopropanoi c aci d	$\text{C}_3\text{H}_7\text{NO}_2$	302-72-7	89.094	ort h pr or nd (w)	300 dec	sub 250	1.424 ²⁵		s H ₂ O; vs Et OH
143	D-Al ani ne	2-Aminopropanoi c aci d, (S)	$\text{C}_3\text{H}_7\text{NO}_2$	338-69-2	89.094	nd (w, al)	314 dec	sub			s H ₂ O; sl Et OH; i et h
144	L-Al ani ne	2-Aminopropanoi c aci d, (R)	$\text{C}_3\text{H}_7\text{NO}_2$	56-41-7	89.094	ort h (w)	297 dec	sub 250	1.432 ²		s H ₂ O; sl Et OH, py; i et h, ace
145	β-Al ani ne	3-Aminopropanoi c aci d	$\text{C}_3\text{H}_7\text{NO}_2$	107-95-9	89.094	nd, ort h pr (al)	200 dec		1.437 ⁹		s H ₂ O; sl Et OH; i et h, ace
146	Al ant ol act one		$\text{C}_6\text{H}_{10}\text{O}_2$	546-43-0	232.319	nd	76	275			vs bz, et h, Et OH, chl
147	Al di carb		$\text{C}_7\text{H}_{14}\text{N}_2\text{O}_2\text{S}$	116-06-3	190.263		99		1.195 ²⁵		
148	Al dost erone		$\text{C}_{27}\text{H}_{46}\text{O}_5$	52-39-1	360.444	cry (HOAc)	166.5				
149	Al doxycarb S,S-di oxi de		$\text{C}_7\text{H}_{11}\text{N}_2\text{O}_5\text{S}$	1646-88-4	222.262	cry	141				sl H ₂ O
150	Al dri n		$\text{C}_{12}\text{H}_8\text{Cl}_6$	309-00-2	364.910		104				i H ₂ O; s Et OH, et h, ace, bz
151	Al i zari n	1,2-Di hydroxy-9,10-ant hracenedi one	$\text{C}_{14}\text{H}_8\text{O}_4$	72-48-0	240.212	oran or red t cl nd or pr (al)	289.5				sl H ₂ O; s Et OH, et h, ace, bz; i chl
152	Al i zari n Red S	Sodi um ali zari nesul fonate	$\text{C}_{14}\text{H}_7\text{NaO}_5\text{S}$	130-22-3	342.257						vs H ₂ O; s Et OH
153	Al i zari n Yellow R		$\text{C}_{13}\text{H}_9\text{N}_3\text{O}_5$	2243-76-7	287.227	oran-br nd (di l HOAc)	253 dec				vs H ₂ O, Et OH



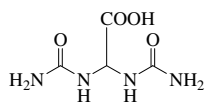
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
154	Ali zuroł purple	1-Hydroxy-4-[(4-methylphenyl)amino]-9,10-antihracenedione	C ₂₁ H ₁₅ NO ₃	81-48-1	329.349	flat viol nd					s, BO ₄
155	Alkanni n		C ₆ H ₁₆ O ₅	23444-65-7	288.295	br-red pr (bz)	149	sub 140			vs Et OH
156	Allantoin caci d	Bis((amino carbonyl)amino)acetamide	C ₄ H ₈ N ₄ O ₄	99-16-1	176.132	nd	170 dec				sl H ₂ O, os, di l aci d
157	Allantoin		C ₄ H ₈ N ₄ O ₃	97-59-6	158.116	mcl pl or	239				sl H ₂ O; s Et OH, NaOH; i et h, MeOH
158	Allene		CH ₄	463-49-0	40.064	col gas	-136.6	-34.4	0.584 ⁶⁵ (p>1 at m)	1.4168	vs bz, pet h
159	Allet hri n		C ₆ H ₁₂ O ₃	584-79-2	302.407				1.010 ²⁰		
160	Alliin		C ₆ H ₁₀ OS ₂	539-86-6	162.272			dec	1.112 ²⁰	1.561 ²⁰	vs H ₂ O
161	Allopregnane-3β,21-di-ol-11,20-dione		C ₂₁ H ₃₂ O ₄	566-02-9	348.477	cry (aq, ac, +w) nd (bz, ac)	190				
162	Allopregnan-20β-ol-3-one	5α-Pregnan-20β-ol-3-one	C ₂₁ H ₃₄ O ₂	516-58-5	318.494		185				
163	Allopurinol	1,5-Dihydro-4H-pyrazolo[3,4-d]pyrimidin-4-one	C ₅ H ₄ N ₂ O	315-30-0	136.112	cry	350				
164	D-Allose		CH ₁₂ O ₆	2595-97-3	180.155	cry (w)	128				vs H ₂ O
165	Alloxanic acid		C ₄ H ₄ N ₂ O ₃	470-44-0	160.085	tbl pr (et h)	162 dec				vs H ₂ O, Et OH
166	Alloxantin		C ₄ H ₄ N ₂ O ₃	76-24-4	286.156	orth pr (w+2)	254 dec				sl H ₂ O, Et OH, et h
167	Allyl acetate		C ₅ H ₈ O ₂	591-87-7	100.117			103.5	0.9275 ²⁰	1.4049 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
168	Allyl acetate		C ₅ H ₈ O ₂	1118-84-9	142.152	li q	-85	196; 66.5	1.0366 ²⁰	1.4398 ²⁰	s H ₂ O, li g; msc Et OH, bz
169	Allyl acrylate		C ₆ H ₁₀ O ₂	999-55-3	112.127			121	0.9441 ²⁰	1.4320 ²⁰	sl H ₂ O; s Et OH, et h, aci d
170	Allyl alcohol	2-Propen-1-ol	C ₃ H ₆ O	107-18-6	58.079	li q	-129	97.0	0.854 ⁴⁰	1.4135 ²⁰	msc H ₂ O, Et OH, et h; s chl
171	Allylamine	2-Propen-1-amine	C ₃ H ₇ N	107-11-9	57.095	li q	-88.2	53.3	0.75 ⁸⁰	1.4205 ²⁰	msc H ₂ O, Et OH, et h; s chl
172	N-Allylamine	Allylphenylamine	C ₉ H ₁₁ NC	589-09-3	133.190			219; 106 ¹²	0.9736 ²⁵	1.563 ²⁰	sl H ₂ O; s Et OH, ace; msc et h
173	Allylbenzene	2-Propenylbenzene	C ₉ H ₁₀	300-57-2	118.175	li q	-40	156	0.892 ²⁰	1.5131 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
174	α-Allylbenzenemethanol		C ₉ H ₁₂ O	936-58-3	148.201			228.5	1.004 ¹⁸	1.5289 ²¹	
175	Allyl benzoate		C ₁₀ H ₁₀ O ₂	583-04-0	162.185				1.0569 ¹⁵	1.5178 ²⁰	i H ₂ O; s Et OH, et h, ace, MeOH
176	Allyl butanoate		C ₉ H ₁₆ O ₂	2051-78-7	128.169			142; 44.5 ¹⁵	0.9017 ²⁰	1.4158 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
177	Allyl carbamate		C ₆ H ₁₁ NO ₂	2114-11-6	101.105						sl ct c
178	Allylchlorosilane		C ₃ H ₇ ClSi	4028-23-3	134.680			111	0.896 ⁴⁰	1.4195 ²⁰	
179	Allylchloroformate		C ₄ H ₇ ClO ₂	2937-50-0	120.535	hygli q		109.5	1.136	1.422 ²⁰	
180	Allyltrans-3-phenyl-2-propenoate	Allyltrans-3-phenyl-2-propenoate	C ₁₂ H ₁₂ O ₂	1866-31-5	188.222			dec 268; 163 ¹⁷	1.048 ²³	1.530 ²⁰	i H ₂ O; vs Et OH; msc et h; sl ct c
181	1-Allylcyclohexanol		C ₉ H ₁₆ O	1123-34-8	140.222			190	0.9341 ²²	1.4756 ²²	
182	1-Allylcyclohexene	1-(2-Propenyl)cyclohexene	C ₉ H ₁₄	13511-13-2	122.207	li q		156			
183	Allylcyclohexane		C ₉ H ₁₄	3524-75-2	110.197	li q	-110.7	125	0.79 ³⁰	1.4412 ²⁰	s chl
184	Allyldiethylsilylamine		C ₁₁ H ₁₈ OSi	18388-45-9	174.314			155	0.857 ²⁵	1.4104 ²⁰	
185	Allyldiethylamine	M,N-Diethyl-2-propen-1-amine	C ₈ H ₁₅ N	5666-17-1	113.201			110	0.7477 ²⁵	1.4209 ²⁰	
186	Allyldimethylamine	M,N-Dimethyl-2-propen-1-amine	C ₇ H ₁₃ N	2155-94-4	85.148			63.5	0.7094 ²⁵	1.4010 ²⁰	
187	Allylethyl ether		C ₅ H ₁₀ O	557-31-3	86.132			67.6	0.7651 ²⁰	1.3881 ²⁰	i H ₂ O; msc Et OH, et h; s ace
188	Allylformate		C ₄ H ₆ O ₂	1838-59-1	86.090			83.6	0.9460 ²⁰		sl H ₂ O; s Et OH; msc et h
189	Allyl 2-furancarboxylate	Allyl 2-furanoate	C ₈ H ₁₀ O ₃	4208-49-5	152.148			207.5	1.115 ²⁵	1.4945 ²⁰	s et h, ace; sl ct c
190	Allyl glycidyl ether		C ₅ H ₈ O ₂	106-92-3	114.142			154	0.9698 ²⁰	1.4332 ²⁰	
191	Allyl hexanoate		C ₉ H ₁₆ O ₂	123-68-2	156.222			186	0.8869 ²⁰		
192	Allyl (hydroxymethyl)carbamate		C ₅ H ₉ NO ₃	24935-97-5	131.130	cry (t ol)	57				
193	Allyl isocyanate		C ₃ H ₅ NO	1476-23-9	83.089			88			



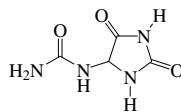
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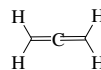
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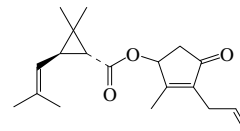
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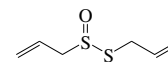
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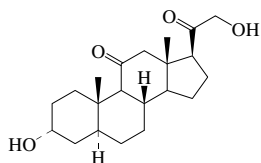
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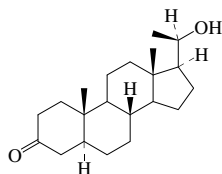
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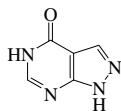
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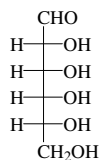
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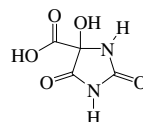
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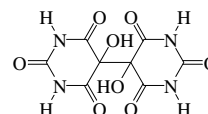
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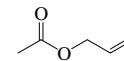
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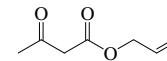
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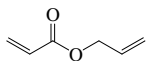


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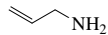
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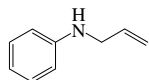
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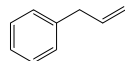
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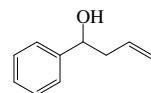
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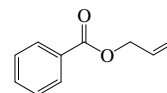
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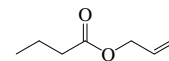
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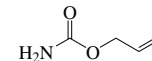
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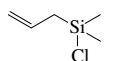
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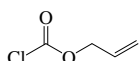
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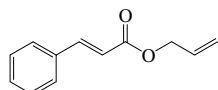
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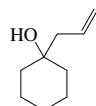
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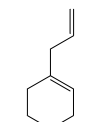
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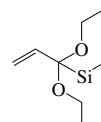
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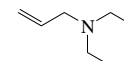
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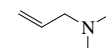
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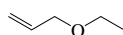
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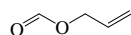
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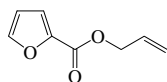
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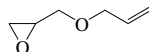
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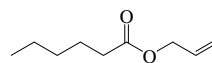
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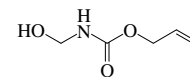
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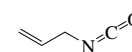
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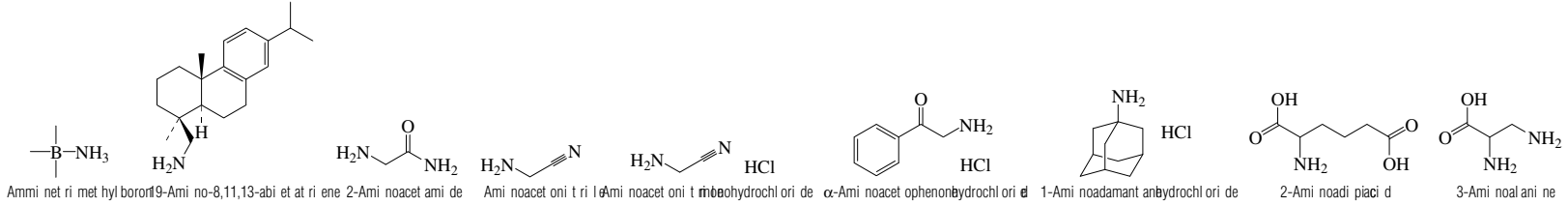
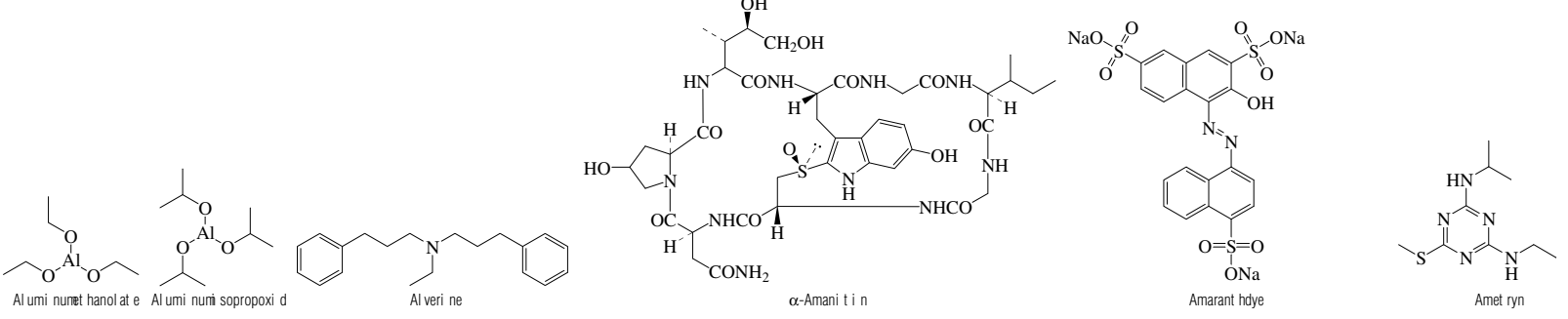
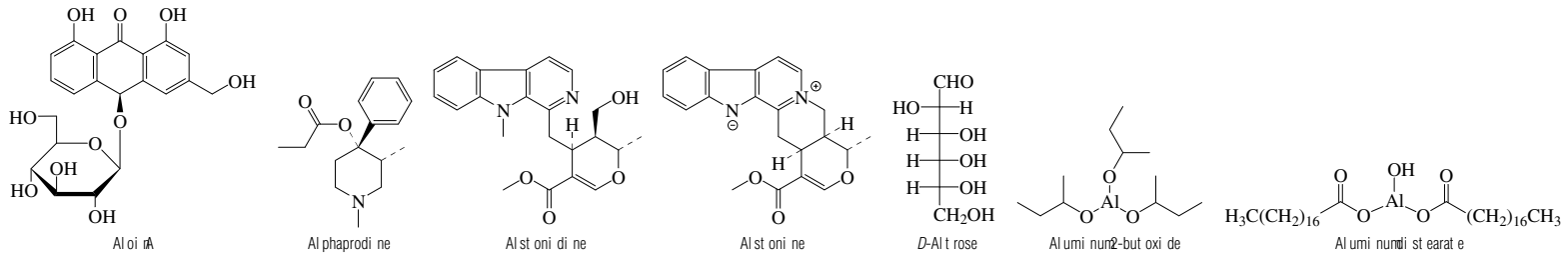
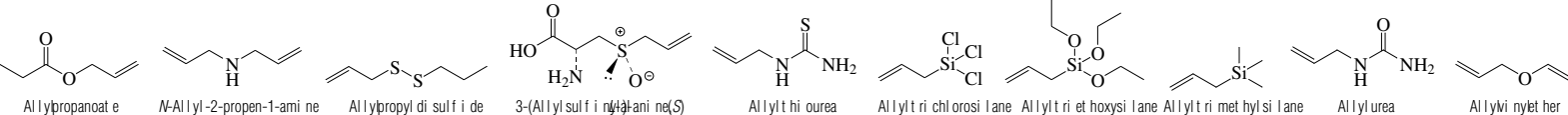
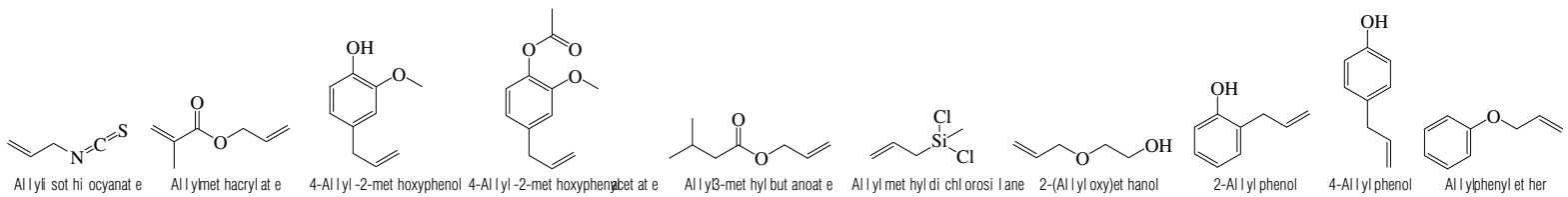


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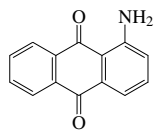


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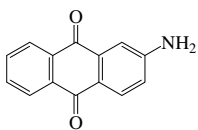
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
194	Allyl isothiocyanate		C ₃ H ₃ NS	57-06-7	99.155	liquid	-80	152	1.0126	1.5306 ²⁰	vs bz, et h, Et OH
195	Allyl methacrylate		C ₉ H ₁₀ O ₂	96-05-9	126.153			67 ²⁰ , 55 ³⁰	0.9335 ²⁰	1.4360 ²⁰	
196	4-Allyl-2-methoxyphenol	Eugenol	C ₁₀ H ₁₂ O ₂	97-53-0	164.201	liquid	-7.5	253.2	1.0652	1.5405 ²⁰	i H ₂ O; misc Et OH, et h; s chl, HOAc, oils
197	4-Allyl-2-methoxyphenyl acetate	1,3,4-Eugenol acetate	C ₁₂ H ₁₄ O ₃	93-28-7	206.237	pr (al)	30.5	281; 127 ²	1.0806 ²⁰	1.5205 ²⁰	i H ₂ O; s Et OH; sl ct c
198	Allyl 3-methylbutanoate		C ₁₀ H ₁₈ O ₂	2835-39-4	142.196			154			
199	Allyl methyl dimethylsilyl ether		C ₈ H ₁₆ O ₂ Si	1873-92-3	155.099			119.5	1.0758 ⁹	1.4419 ²⁰	
200	2-Allyloxyethanol	Ethylene glycol monoallyl ether	C ₅ H ₁₀ O ₂	111-45-5	102.132			158.5	0.9580 ²⁰	1.4358 ²⁰	misc H ₂ O; vs Et OH; s bz, ct c, MeOH
201	2-Allylphenol		C ₉ H ₁₀ O	1745-81-9	134.174	liquid	-6	220	1.0246	1.5181 ²⁰	vs et h
202	4-Allylphenol	Chavicol	C ₉ H ₁₀ O	501-92-8	134.174		15.8	238	1.0203 ¹⁵	1.5441 ¹⁸	vs et h, Et OH, chl
203	Allyl phenyl ether		C ₉ H ₁₀ O	1746-13-0	134.174			191.7	0.9811 ²⁰	1.5223 ²⁰	i H ₂ O; s Et OH; misc et h; sl ct c
204	Allyl propanoate	2-Propenyl propanoate	C ₈ H ₁₄ O ₂	2408-20-0	114.142			123	0.9140 ²⁰	1.4105 ²⁰	s Et OH, et h, ace
205	N-Allyl-2-propen-1-amine	Di allylamine	C ₆ H ₁₁ N	124-02-7	97.158			111		1.4387 ²⁰	s Et OH, et h
206	Allyl propyl disulfide		C ₆ H ₁₂ S ₂	2179-59-1	148.289			79 ¹³		1.5219 ²⁰	
207	3-(Allylsulfanyl)alanine, (S)	Alliin	C ₆ H ₁₁ NO ₃ S	556-27-4	177.221	nd (di l ac)	165				vs H ₂ O
208	Allyl thiourea	Thiosinamine	C ₄ H ₈ NCS	109-57-9	116.185	mcl or orth pr (w)	78		1.217 ²⁰	1.5936 ⁷⁸	s H ₂ O, Et OH; sl et h; i bz
209	Allyl trichloroethane	Trichloro-2-propenylsilane	C ₃ H ₂ Cl ₃ Si	107-37-9	175.517		35	117.5	1.201 ⁹	1.4460 ²⁰	
210	Allyl triethoxysilane		C ₉ H ₂₀ O ₃ Si	2550-04-1	204.339			100 ⁹ , 82 ²⁸	0.9030 ²⁰	1.4072 ²⁰	
211	Allyl trimethylsilane		C ₆ H ₁₄ Si	762-72-1	114.261			85	0.7158 ⁶	1.4074 ²⁰	i H ₂ O
212	Allyl urea		C ₄ H ₈ N ₂ O	557-11-9	100.119	nd (al)	85				misc H ₂ O, Et OH; sl et h, chl; i pet h
213	Allyl vinyl ether	3-(Ethenyloxy)-1-propene	C ₅ H ₈ O	3917-15-5	84.117			66	0.7900 ²⁰	1.4062 ²⁰	i H ₂ O; s et h, ace, chl
214	Alon A		C ₆ H ₁₂ O ₃	1415-73-2	418.395		149.3				s H ₂ O, Et OH, ace; sl et h, bz; i chl
215	Alphaprodine		C ₆ H ₁₃ NO ₂	15867-21-7	261.360	cry	103				
216	Alstonidine		C ₂₂ H ₂₄ N ₂ O ₄	25394-75-6	380.437	cry (et h)	189				vs ace, Et OH
217	Alstonine		C ₈ H ₂₀ N ₂ O ₃	642-18-2	348.395	ye nd (ace)	207 dec				
218	D-Altrose		C ₆ H ₁₂ O ₆	1990-29-0	180.155	pr (MeOH, al)	103.5				vs H ₂ O
219	Aluminum 2-butoxide	2-Butanol, aluminum salt	C ₁₂ H ₂₇ AlO ₃	2269-22-9	246.322			197 ²⁰			
220	Aluminum distearate	Hydroxyl aluminum distearate	C ₃₆ H ₇₁ AlO ₃	300-92-5	610.928	wh pow	145				i H ₂ O
221	Aluminum ethanoate	Aluminum ethoxide	C ₆ H ₁₅ AlO ₃	555-75-9	162.163	liquid/wh solid	140	200			dec H ₂ O; sl xyl
222	Aluminum isopropoxide		C ₆ H ₉ AlO ₃	555-31-7	204.243	hyg wh solid	119	135 ⁹ , 94 ⁰⁵			reac H ₂ O; s Et OH, bz, pet h, chl
223	Alverine	N-Ethylbis(3-phenylpropyl)amine	C ₂₀ H ₂₇ N	150-59-4	281.435	oil		166 ⁹			
224	α-Amanitin		C ₃₉ H ₅₄ N ₁₀ O ₁₂ S	23109-05-9	918.970	nd	254 dec				
225	Amaranth dye		C ₂₀ H ₁₁ N ₂ Na ₃ O ₁₀ S ₃	915-67-3	604.472	dk red pow					s H ₂ O
226	Ametrin		C ₆ H ₇ N ₃ S	834-12-8	227.330		88				
227	Ammonium methylboron		C ₃ H ₉ BN	1830-95-1	72.945		73.5				
228	19-Amino-8,11,13-abiateriene		C ₂₀ H ₁₉ N	1446-61-3	285.467	cry	44.5				
229	2-Aminoacetamide		C ₂ H ₅ N ₂ O	598-41-4	74.081	hyg nd (chl)	67.5				vs H ₂ O, Et OH; sl et h, bz; s ace, chl
230	Aminoacetamide triethyl ether		C ₈ H ₁₇ N	540-61-4	56.066			58 ¹⁵			vs Et OH
231	Aminoacetamide triethyl hydrochloride		C ₈ H ₁₇ ClN	6011-14-9	92.527	hyg cry (al)	165 dec				
232	α-Aminoacetophenone hydrochloride		C ₈ H ₉ ClNO	5468-37-1	171.624		194 dec				
233	1-Aminoadamantane hydrochloride	Adamantamine hydrochloride	C ₁₀ H ₁₅ ClN	665-66-7	187.710	cry (al-et h)	360 dec				vs H ₂ O, Et OH
234	2-Aminoadipic acid		C ₆ H ₁₁ NO ₄	626-71-1	161.156	pl (w)	207.0				sl H ₂ O, Et OH, et h
235	3-Aminoalanine	2,3-Diaminopropanoic acid	C ₃ H ₈ N ₂ O ₂	515-94-6	104.108	hyg rosettes	110				vs H ₂ O



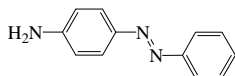
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
236	1-Amino-9,10-antihracenedione	1-Aminoanthraquinone	C ₁₄ H ₈ O ₂	82-45-1	223.227	red nd (al)	253.5	sub			vs ace, bz, Et OH, chl
237	2-Amino-9,10-antihracenedione	2-Aminoanthraquinone	C ₁₄ H ₈ O ₂	117-79-3	223.227	red nd (al, HOAc)	304.5	sub			i H ₂ O, et h; sl Et OH; s ace, bz, chl
238	4-Aminoazobenzene		C ₁₂ H ₁₁ N ₃	60-09-3	197.235	orange mcl nd (al)	127	>360			sl H ₂ O, li g; s Et OH, et h, bz, chl
239	2-Aminobenzaldehyde		C ₇ H ₇ NO	529-23-7	121.137	silvlf	40.5	80			sl H ₂ O; vs Et OH, et h; s bz, chl; i li g
240	3-Aminobenzaldehyde		C ₇ H ₇ NO	1709-44-0	121.137	nd (AcOEt)	29				s et h, aci d
241	4-Aminobenzaldehyde		C ₇ H ₇ NO	556-18-3	121.137	pl (w)	71.5				s H ₂ O, Et OH, et h, aci d
242	2-Aminobenzamide		C ₇ H ₈ N ₂ O	88-68-6	136.151		110.5 dec				s H ₂ O, Et OH; sl et h, bz; vs AcOEt
243	4-Aminobenzamide		C ₇ H ₈ N ₂ O	2835-68-9	136.151	ycry (+1/4w)	183				sl H ₂ O; s Et OH, et h
244	α-Aminobenzeneacetamide (±)	α-Phenylglycine	C ₈ H ₉ NO ₂	2835-06-5	151.163	pl	292 dec	sub 255			s alk; sl os
245	4-Aminobenzeneacetamide	p-Aminophenylacetamide	C ₈ H ₉ NO ₂	1197-55-3	151.163	pl (w)	200 dec				i H ₂ O; sl Et OH, DMSO
246	5-Amino-1,3-benzenedicarboxylic acid		C ₈ H ₇ NO ₄	99-31-0	181.147	pr(al), pl (w)	360	sub			i H ₂ O; sl Et OH
247	4-Aminobenzamide		C ₇ H ₈ N ₂ O	104-10-9	137.179	nd (al)	108				
248	2-Aminobenzamide		C ₇ H ₈ N ₂ O	4403-69-4	122.167		61	269			vs Et OH
249	2-Aminobenzamide		C ₇ H ₈ N ₂ O	5344-90-1	123.152		83.5	273			s H ₂ O, Et OH, et h, HOAc; vs bz, chl
250	4-Aminobenzenesulfonamide	Sulfanilamide	C ₆ H ₇ N ₂ O ₂ S	63-74-1	172.205	lf (di l al)	165.5		1.08		s H ₂ O, Et OH, et h, ace; sl chl, pet h
251	2-Aminobenzenesulfonamide	Orthaniamide	C ₆ H ₇ NO ₂ S	88-21-1	173.190	pr (+ 1/2w)	>320 dec				sl H ₂ O; i Et OH, et h
252	3-Aminobenzenesulfonamide	Metaniamide	C ₆ H ₇ NO ₂ S	121-47-1	173.190	nd, pr (w +1)	dec				sl H ₂ O, Et OH; i et h
253	4-Aminobenzenesulfonamide	Sulfanilamide	C ₆ H ₇ NO ₂ S	121-57-3	173.190	orthpl or mcl (w+2)	288		1.485 ²⁵		sl H ₂ O; i Et OH, et h
254	4-Aminobenzenesulfonamide	p-Sulfanilamide	C ₆ H ₇ NO ₂ S	98-62-4	175.181		68.5				
255	2-Aminobenzonitrile		C ₇ H ₆ N ₂	137-07-5	125.192		26	234		1.4606 ²⁰	s Et OH, et h
256	4-Aminobenzonitrile		C ₇ H ₆ N ₂	1193-02-8	125.192		46	143 ¹⁷			s H ₂ O, Et OH
257	2-Aminobenzonitrile		C ₇ H ₆ N ₂	1885-29-6	118.136	ycpr (CS ₂) nd (pet h)	51	263			sl H ₂ O; vs Et OH, et h, ace, bz; i pet h
258	3-Aminobenzonitrile		C ₇ H ₆ N ₂	2237-30-1	118.136	nd (di l al or CCl ₄)	54.3	289			sl H ₂ O; vs Et OH, et h, ace, chl
259	4-Aminobenzonitrile		C ₇ H ₆ N ₂	873-74-5	118.136	pr or pl (w)	87.0				sl H ₂ O, ct c; vs Et OH, et h, ace, bz
260	4-Aminobenzophenone		C ₁₅ H ₁₁ NO	1137-41-3	197.232	lf (di l al)	124	246			sl H ₂ O, t f a; s Et OH, et h, HOAc
261	N-(4-Aminobenzoyl)glutamic acid		C ₁₂ H ₁₄ N ₂ O ₅	4271-30-1	266.249	cry (w)	173				
262	N-(4-Aminobenzoyl)glycine	p-Aminophenylglycine	C ₉ H ₉ N ₂ O ₃	61-78-9	194.186	pr or nd (w)	198.5				vs ace, bz, Et OH
263	2-Aminobiphenyl		C ₁₂ H ₁₁ N	90-41-5	169.222	lf (di l al)	51	299			s Et OH, et h, bz; sl DMSO, pet h
264	3-Aminobiphenyl		C ₁₂ H ₁₁ N	2243-47-2	169.222	nd	31.5				sl H ₂ O; s Et OH, et h, ace, bz
265	4-Aminobiphenyl	p-Biphenylamine	C ₁₂ H ₁₁ N	92-67-1	169.222	lf (di l al)	53.5	302			s Et OH, et h, ace, chl
266	2-Amino-5-bromobenzonitrile	5-Bromoanthranilic acid	C ₇ H ₆ BrNO ₂	5794-88-7	216.033	nd	219.5				s DMSO
267	1-Amino-4-bromo-9,10-dihydro-9,10-dioxo-2-antihracenesulfonamide	1-Amino-4-bromoanthraquinone-2-sulfonamide	C ₁₄ H ₈ BrNO ₃ S	116-81-4	382.187	red nd (w)					
268	DL-2-Aminobutanamide		C ₄ H ₉ NO ₂	2835-81-6	103.120	lf (w)	304 dec	sub	1.2300		vs H ₂ O; sl Et OH; i et h, bz
269	L-2-Aminobutanamide		C ₄ H ₉ NO ₂	1492-24-6	103.120	lf (di l al), cry (al)	292 dec				s H ₂ O; sl Et OH, et h; i bz
270	DL-3-Aminobutanamide		C ₄ H ₉ NO ₂	2835-82-7	103.120	nd (al)	194.3				vs H ₂ O; i Et OH, et h, bz
271	4-Aminobutanamide	γ-Aminobutyramide	C ₄ H ₉ NO ₂	56-12-2	103.120	pr or nd (al) lf (MeOH-et h)	203 dec				vs H ₂ O; sl Et OH, ace; i et h, bz
272	2-Amino-1-butanol (±)		C ₄ H ₁₁ NO	13054-87-0	89.136	li q	-1.0	178	0.9162 ⁹	1.4489 ²⁵	msc H ₂ O, Et OH, et h; sl chl
273	4-Amino-1-butanol		C ₄ H ₁₁ NO	13325-10-5	89.136			205; 125 ³⁴	0.967 ¹²	1.4625 ²⁰	s H ₂ O, Et OH; i et h



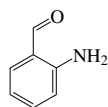
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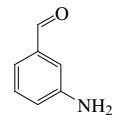
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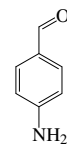
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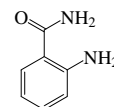
2-Ami nobenzaldehyde



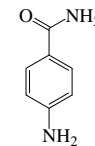
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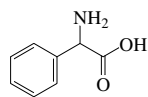
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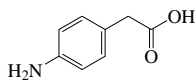
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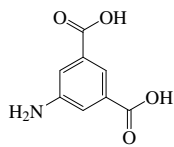
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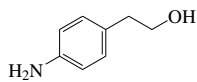
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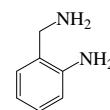
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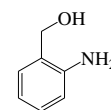
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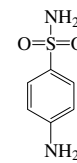
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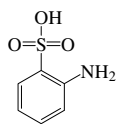
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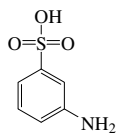
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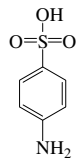
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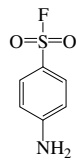
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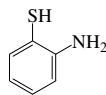
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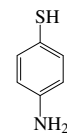
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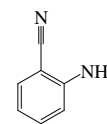
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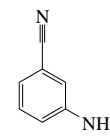
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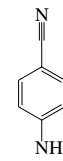
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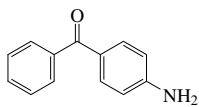
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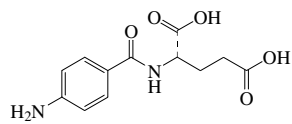
3-Ami nobenzoni t ri le



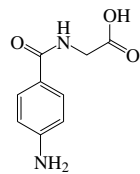
4-Ami nobenzoni t ri le



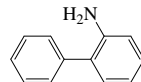
4-Ami nobenzophenone



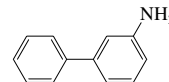
N-(4-Ami nobenzoyl) gl ut ami aci d



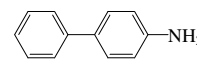
N-(4-Ami nobenzoyl) gl yci ne



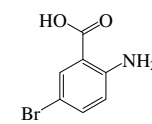
2-Ami nobi phenyl



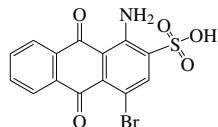
3-Ami nobi phenyl



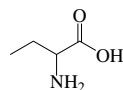
4-Ami nobi phenyl



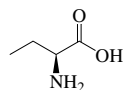
2-Ami no-5-bromobenzo i aci d



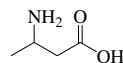
1-Ami no-4-bromo-9,10-di hydro-9,10-di oxo-2-ant hracenesul f aci d



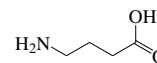
DL-2-Ami nobut anoiaci d



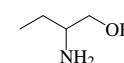
L-2-Ami nobut anoiaci d



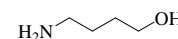
DL-3-Ami nobut anoiaci d



4-Ami nobut anoiaci d

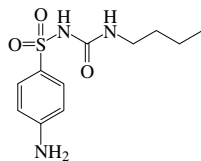


2-Ami no-1-but anol(\pm)

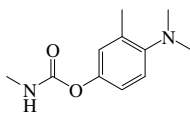


4-Ami no-1-but anol

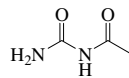
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
274	4-Ami no <i>N</i> -[(but yl ami no) carbonyl]benzenesul f onami de	Carbut ami de	C ₇ H ₁₇ N ₃ O ₃ S	339-43-5	271.336		144.5				
275	Ami nocarb		C ₇ H ₁₆ N ₂ O ₂	2032-59-9	208.257	cry	94				sl H ₂ O, bz; s ace
276	<i>N</i> -(Ami nocarbonyl)acet ami de		C ₇ H ₁₂ N ₂ O ₂	591-07-1	102.092		218	sub 180			sl H ₂ O, et h; s Et OH
277	[4-((Ami nocarbonyl) ami no)phenyl]arsoni c aci d	Carbarsone	C ₇ H ₅ AsN ₂ O ₄	121-59-5	260.079	nd (w)	174				sl H ₂ O, DMSO, Et OH; i et h, chl; s alk
278	<i>N</i> -(Ami nocarbonyl)-2-bromo-2-et hyl but anami de	Carbromal	C ₇ H ₁₃ BrN ₂ O ₂	77-65-6	237.094	ort h (di l al)	118		1.544		sl H ₂ O, chl; s ace, bz
279	<i>N</i> -(Ami nocarbonyl)-2-bromo-3-met hyl but anami de	Bromi soval um	C ₇ H ₁₃ BrN ₂ O ₂	496-67-3	223.067	nd or lf (t o)	154	sub	1.56		vs ace, bz, et h, Et OH
280	[2-(Ami nocarbonyl)phenoxy]acet i c aci d	Sal i c yl ami d acet i c aci d	C ₉ H ₉ NO ₄	25395-22-6	195.172		221				s alk
281	7-Ami nocephal osporani c aci d		C ₁₀ H ₁₂ N ₂ O ₅ S	957-68-6	272.277	cry					
282	1-Ami no-5-chl oro-9,10-ant hracenedi one	1-Ami no-5-chl oroant hraceni none	C ₁₄ H ₉ Cl NO ₂	117-11-3	257.673		212				
283	4-Ami no-6-chl oro-1,3-benzenedi sul f onami de	Chlorami nophenami de	C ₆ H ₄ Cl N ₂ O ₂ S ₂	121-30-2	285.729		254.5				
284	5-Ami no-2-chl orobenzenesul f oni c aci d	6-Chl oromet ani l i c aci d	C ₆ H ₄ Cl NO ₂ S	88-43-7	207.635	nd (w)	280 dec				
285	2-Ami no-5-chl orobenzo i c aci d		C ₇ H ₅ Cl NO ₂	635-21-2	171.582		211				
286	5-Ami no-2-chl orobenzo i c aci d		C ₇ H ₅ Cl NO ₂	89-54-3	171.582		188		1.519 ¹⁵		vs Et OH
287	2-Ami no-5-chl orobenzophenone	2-Benzoyl-4-chl oroani l i ne	C ₁₃ H ₉ Cl NO	719-59-5	231.677	ye nd	100.5				vs H ₂ O, Et OH, pet h, chl
288	2-Ami no-4-chl oro-5-met hyl benzenesul f oni c aci d	2-Chl oro- <i>p</i> -t ol u i d ne-5-sul f oni c aci d	C ₈ H ₇ Cl NO ₂ S	88-51-7	221.662	short nd (w)					
289	2-Ami no-4-chl orophenol	2-Hydroxy-5-chl oroani l i ne	C ₆ H ₄ Cl NO	95-85-2	143.571		140				sl DMSO
290	1-Ami nocycl opent anecarboxyl i c aci d	Cycl oleuci ne	C ₆ H ₉ NO ₂	52-52-8	129.157	cry (al -w)	330 dec				
291	7-Ami nodeacet oxycephal osporani c aci d		C ₈ H ₁₀ N ₂ O ₃ S	22252-43-3	214.241		241 dec				
292	1-Ami no-1-deoxy- <i>D</i> -gl uci t ol	Gl ucam i ne	C ₆ H ₁₂ NO ₅	488-43-7	181.187	cry (MeOH)	127				vs H ₂ O, Et OH
293	2-Ami no-2-deoxy- <i>D</i> -gl uucose	<i>D</i> -Gl ucosami ne	C ₆ H ₁₃ NO ₅	3416-24-8	179.171						vs H ₂ O
294	1-Ami no-2,4-di bromo-9,10-ant hracenedi one		C ₁₄ H ₇ Br ₂ NO ₂	81-49-2	381.020	red nd (xyl)	226				
295	3-Ami no-2,5-di chl orobenzo i c aci d	Chl oramben	C ₇ H ₃ Cl ₂ NO ₂	133-90-4	206.027		200				sl DMSO
296	2-Ami no-2',5-di chl orobenzophenone		C ₁₃ H ₇ Cl ₂ NO	2958-36-3	266.122		=80				
297	2-Ami no-4,6-di chl orophenol		C ₆ H ₂ Cl ₂ NO	527-62-8	178.016	long nd (CS ₂)	95.5	sub 70			
298	4-Ami no-2,6-di chl orophenol		C ₆ H ₂ Cl ₂ NO	5930-28-9	178.016	nd or lf (w, bz)	168	sub			i H ₂ O; vs Et OH, et h; s ace; sl bz, HOAc
299	2-Ami no-1,7-di hydro-7-met hyl-6-puri n-6-one	7-Met hyl guani ne	C ₈ H ₇ N ₅ O	578-76-7	165.153		370				
300	5-Ami no-2,3-di hydro-1,4-pht halazi nedi one	Lumi nol	C ₇ H ₇ N ₃ O ₂	521-31-3	177.161	ye nd (al)	330.5				i H ₂ O; sl Et OH, et h; vs al k; s HOAc
301	2-Ami no-1,7-di hydro-6-puri n-6-t hi one	Thi uguani ne	C ₈ H ₇ N ₃ S	154-42-7	167.193		>360				
302	6-Ami no-1,3-di hydro- <i>H</i> -puri n-2-one	Isoguani ne	C ₇ H ₇ N ₃ O	3373-53-3	151.127		>360				i H ₂ O
303	2-Ami no-3,4-di met hyl i mi dazo[4,5- <i>M</i>]qui nol i ne		C ₁₂ H ₁₂ N ₄	77094-11-2	212.250	cry	297				
304	2-Ami no-4,6-di ni t rophenol	Pi crami c aci d	C ₆ H ₃ N ₂ O ₃	96-91-3	199.121	dk red nd (al) pr (chl)	169				vs bz, Et OH



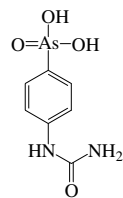
4-Ami no-*N*-((butylami no)carbonyl)benzenesul f onami de



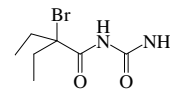
Ami nocarb



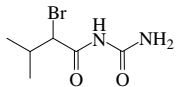
N-(Ami nocarbonyl)acet ami de



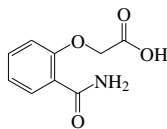
[4-((Ami nocarbonyl)ami no)phenyl]arsorač d



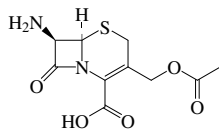
N-(Ami nocarbonyl)-2-bromo-2-et hyl but anam



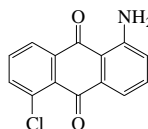
N-(Ami nocarbonyl)-2-bromo-3-met hyl but anami de



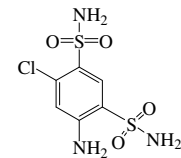
[2-(Ami nocarbonyl)phenoxy]acet aci d



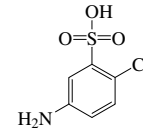
7-Ami nocephal osporaniaci d



1-Ami no-5-chl oro-9,10-ant hracenedi one

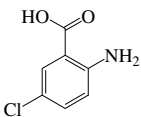


4-Ami no-6-chl oro-1,3-benzenedi sul f onami de

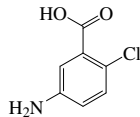


5-Ami no-2-chl orobenzenesul f orač d

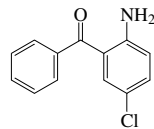
3-19



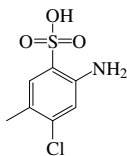
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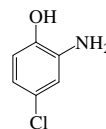
5-Ami no-2-chl orbenzoi aci d



2-Ami no-5-chl orbenzophenone



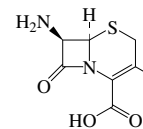
2-Ami no-4-chl oro-5-met hyl benzenesul f aci d



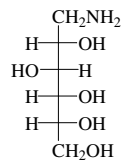
2-Ami no-4-chl orophenol



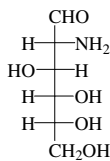
1-Ami nocycl opent anecarboxylaci d



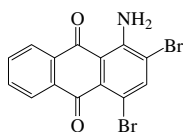
7-Ami nodeacet oxycephal osporaniaci d



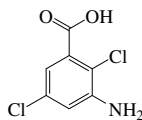
1-Ami no-1,2-deoxy-*D*-gl uci t ol



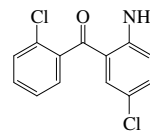
2-Ami no-2-deoxy-*D*-gl ucoze



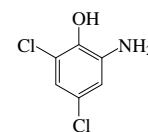
1-Ami no-2,4-di bromo-9,10-ant hracenedi one



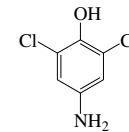
3-Ami no-2,5-di chl orbenzoi aci d



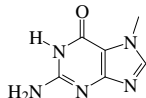
2-Ami no-2',5'-di chl orbenzophenone



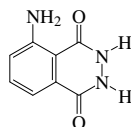
2-Ami no-4,6-di chl orophenol



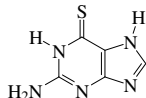
4-Ami no-2,6-di chl orophenol



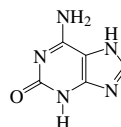
2-Ami no-1,7-di hydro-7-met hyl-puri n-6-one



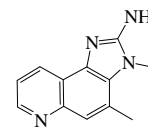
5-Ami no-2,3-di hydro-1,4-pht halazi nedi one



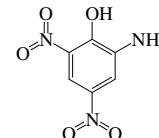
2-Ami no-1,7-di hydro-7-puri ne-6-t hi one



6-Ami no-1,3-di hydro-2-puri n-2-one

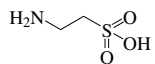


2-Ami no-3,4-di met hyl-i mi dazo[4,5-f]qui nol i ne



2-Ami no-4,6-di ni t rophenol

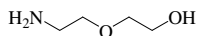
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
305	2-Ami noet hanesul f oni c aci d	Tauri ne	$\text{C}_2\text{H}_7\text{NO}_3\text{S}$	107-35-7	125.147	mcl pr (w)	328				vs H ₂ O
306	1-Ami noet hanol	Acet al dehyde ammoni a	$\text{C}_2\text{H}_5\text{NO}$	75-39-8	61.083	ort h (et h-al)	97	dec 110			s H ₂ O; sl et h
307	2-(2-Ami noet hoxy)et hanol	Di gl ycol ami ne	$\text{C}_4\text{H}_{11}\text{NO}_2$	929-06-6	105.136		-12.5	221	1.0572 ²⁰		
308	N-(2-Ami noet hyl)acet ami de		$\text{C}_4\text{H}_9\text{N}_2\text{O}$	1001-53-2	102.134		51				s H ₂ O, Et OH, bz; i et h
309	6-Ami no-3-et hyl -1-al l yl -2,4-(3 <i>H</i>)-pyri mi di nedi one	Ami nomet radi ne	$\text{C}_8\text{H}_{13}\text{N}_3\text{O}_2$	642-44-4	195.218	cry (+1w, w)	143				
310	1-[(2-Ami noet hyl)ami no]-2-propanol N-(2-Hydroxypropyl)et hyl enedi ami ne		$\text{C}_8\text{H}_{16}\text{N}_2\text{O}$	123-84-2	118.177			94 ⁵	0.9837 ²⁵	1.4738 ²⁰	
311	4-(2-Ami noet hyl)-1,2-benzenedi ol , hydrochl ori de	Dopami ne hydrochl ori de	$\text{C}_8\text{H}_{12}\text{ClNO}_2$	62-31-7	189.640	nd (w)	241 dec				vs H ₂ O, MeOH
312	α-(1-Ami noet hyl)benzenemet hanol , [S-(<i>R</i> *, <i>R</i> *)]-		$\text{C}_9\text{H}_{13}\text{NO}$	492-39-7	151.205	pl (MeOH)	77.5				vs et h, Et OH, chl
313	α-(1-Ami noet hyl)benzenemet hanol , hydrochl ori de		$\text{C}_9\text{H}_{14}\text{ClNO}$	53631-70-2	187.666		198.5				s H ₂ O
314	N-(2-Ami noet hyl)et hanol ami ne		$\text{C}_8\text{H}_{11}\text{NO}$	111-41-1	104.150			239; 105 ¹⁰	1.0286 ²⁰	1.4863 ²⁰	msc H ₂ O, Et OH; s ace; sl bz, l i g
315	4-(2-Ami noet hyl)phenol	Tyrami ne	$\text{C}_8\text{H}_9\text{NO}$	51-67-2	137.179	pl or nd (bz, w), cry (al)	164.5	206 ²⁵			sl H ₂ O, bz, DMSO; s Et OH, xyl; i t ol
316	N-(2-Ami noet hyl)-1,3-propanedi ami ne	N-(3-Ami nopropyl)et hyl enedi ami ne	$\text{C}_5\text{H}_{11}\text{N}_3$	13531-52-7	117.193			87 ³		1.4805 ²⁵	
317	2-Ami no-2-et hyl -1,3-propanedi ol		$\text{C}_5\text{H}_{12}\text{NO}_2$	115-70-8	119.163		37.5	152 ¹⁰	1.099 ²⁰	1.490 ²⁰	msc H ₂ O
318	L-2-Ami nohexanedi oi c aci d	2-Ami noadi pi c aci d	$\text{C}_6\text{H}_{11}\text{NO}_4$	542-32-5	161.156	cry (Et OH, w)	205 dec				sl H ₂ O, Et OH, et h
319	6-Ami nohexaneni t ri l e	5-Cyano-1-pent yl ami ne	$\text{C}_6\text{H}_{12}\text{N}_2$	2432-74-8	112.172	l i q		118			
320	6-Ami nohexanoi c aci d	ε-Ami nocaproi c aci d	$\text{C}_6\text{H}_{13}\text{NO}_2$	60-32-2	131.173	l f (et h)	205				vs H ₂ O; i Et OH; sl MeOH
321	6-Ami no-1-hexanol		$\text{C}_7\text{H}_{15}\text{NO}$	4048-33-3	117.189		57	137 ³⁰			
322	1-Ami no-4-hydroxy-9,10-ant hracenedi one		$\text{C}_{14}\text{H}_9\text{NO}_3$	116-85-8	239.226		216.5				s Et OH, ace
323	3-Ami no-4-hydroxybenzenesul f oni c aci d		$\text{C}_6\text{H}_7\text{NO}_3\text{S}$	98-37-3	189.190	ort h (w+1)	>300				sl H ₂ O; i Et OH, et h
324	4-Ami no-2-hydroxybenzohydrazi de	ρ-Ami nosal i cyl i c aci d hydrazi de	$\text{C}_7\text{H}_9\text{N}_2\text{O}_2$	6946-29-8	167.165	nd (al)	195				vs Et OH
325	2-Ami no-3-hydroxybenzoi c aci d		$\text{C}_7\text{H}_7\text{NO}_3$	548-93-6	153.136	l f (w)	253.5				sl H ₂ O; s Et OH, et h, chl
326	4-Ami no-2-hydroxybenzoi c aci d	ρ-Ami nosal i cyl i c aci d	$\text{C}_7\text{H}_9\text{NO}_3$	65-49-6	153.136	nd, pl (al-et h)	150 dec				s H ₂ O, Et OH, et h, ace; i bz, pet h, chl
327	5-Ami no-2-hydroxybenzoi c aci d	Mesal ami ne	$\text{C}_7\text{H}_9\text{NO}_3$	89-57-6	153.136		283				sl H ₂ O; i Et OH
328	3-Ami no-4-hydroxybutanoi c aci d	γ-Hydroxy-β-ami nobut yri c aci d	$\text{C}_4\text{H}_9\text{NO}_3$	589-44-6	119.119	pr	216				vs H ₂ O; sl Et OH, chl, et h, AcOEt
329	4-Ami no-3-hydroxybutanoi c aci d, (±)		$\text{C}_4\text{H}_9\text{NO}_3$	924-49-2	119.119	pr (w), cry (di l al)	218				vs H ₂ O
330	4-(2-Ami no-1-hydroxyet hyl)-1,2-benzenedi ol, (±)		$\text{C}_8\text{H}_{11}\text{NO}_3$	138-65-8	169.178			189 dec			
331	1-Ami no-4-hydroxy-2-met hoxy-9,10-ant hracenedi one		$\text{C}_{15}\text{H}_{11}\text{NO}_4$	2379-90-0	269.253						sl chl
332	4-Ami no-5-(hydroxymet hyl)-2(<i>f</i>)-pyri mi di none	5-Hydroxymet hyl cyt osi ne	$\text{C}_5\text{H}_7\text{N}_5\text{O}_2$	1123-95-1	141.129			>300 dec			
333	4-Ami no-5-hydroxy-2,7-naphthalenedi sul f oni c aci d	1-Napht hol -8-ami no-3,6-di sul f oni aci d	$\text{C}_{10}\text{H}_9\text{NO}_5\text{S}_2$	90-20-0	319.311						sl H ₂ O, Et OH, et h
334	4-Ami no-3-hydroxy-1-naphthalenesul f oni c aci d	1-Ami no-2-napht hol -4-sul f oni c aci d	$\text{C}_{10}\text{H}_9\text{NO}_3\text{S}$	116-63-2	239.248	gray nd					i H ₂ O, Et OH, bz; s al k
335	2-Ami no-4-hydroxypt eri di ne		$\text{C}_8\text{H}_9\text{N}_3\text{O}$	2236-60-4	163.137	ye cry	>360				
336	5-Ami no-7 <i>i</i> mi dazol e-4-carboxami de		$\text{C}_4\text{H}_6\text{N}_4\text{O}$	360-97-4	126.117	cry (Et OH)	170				



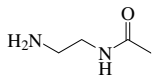
2-Ami noet hanesulfonični d



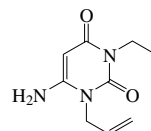
1-Ami noet hanol



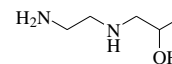
2-(2-Ami noet hoxy)et hanol



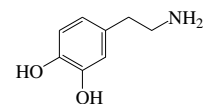
N-(2-Ami noet hyl)acet ami de



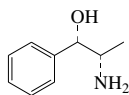
6-Ami no-3-et hyl -1-al lyl -2,4(3H)-pyri mi di nedni one



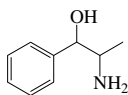
1-[(2-Ami noet hyl)ami no]-2-propanol



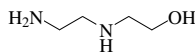
4-(2-Ami noet hyl)-1,2-benzenedi hydrochl ori de HCl



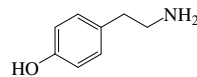
α -(1-Ami noet hyl)benzenemet han(S;R*,R*)-



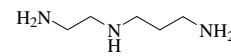
α -(1-Ami noet hyl)benzenemet hanhydrochl ori d HCl



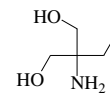
N-(2-Ami noet hyl)et hanolami ne



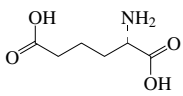
4-(2-Ami noet hyl)phenol



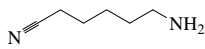
N-(2-Ami noet hyl)-1,3-propanedi ami ne



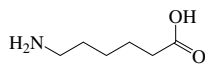
2-Ami no-2-et hyl-1,3-propanedi ol



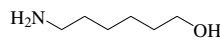
L-2-Ami nohexanedi oiaci d



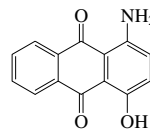
6-Ami nohexaneni trile



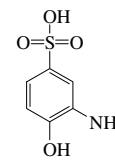
6-Ami nohexanoi aci d



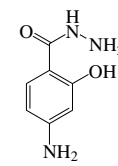
6-Ami no-1-hexanol



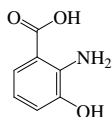
1-Ami no-4-hydroxy-9,10-ant hracenedi one



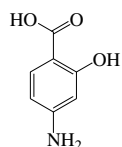
3-Ami no-4-hydroxybenzesulf onični d



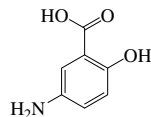
4-Ami no-2-hydroxybenzohydrazi de



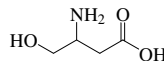
2-Ami no-3-hydroxybenzoi aci c



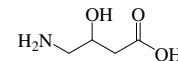
4-Ami no-2-hydroxybenzoi aci d



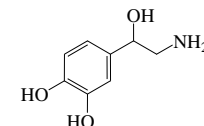
5-Ami no-2-hydroxybenzoi aci d



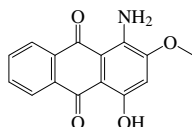
3-Ami no-4-hydroxybutanoi aci d



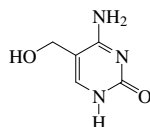
4-Ami no-3-hydroxybutanoi aci d(\pm)



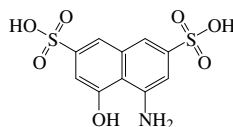
4-(2-Ami no-1-hydroxyet hyl)-1,2-benzenedi (d)



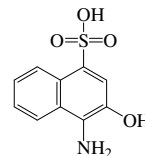
1-Ami no-4-hydroxy-2-met hoxy-9,10-ant hracenedi one



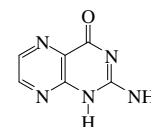
4-Ami no-5-(hydroxymet hyl)-2H-pyri mi di none



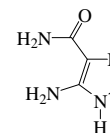
4-Ami no-5-hydroxy-2,7-napht hal enedi sulf onični d



4-Ami no-3-hydroxy-1-napht hal enesulf onični d

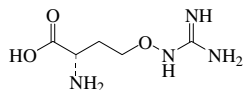


2-Ami no-4-hydroxypt eri di ne

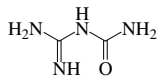


5-Ami no-1H-i mi dazol e-4-carboxami de

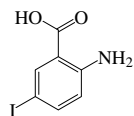
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
337	O-[(Ami noi mi nomet hyl)ami]no- homoseri ne	Canavani ne	C ₇ H ₁₂ N ₄ O ₃	543-38-4	176.174	cry (al)					vs H ₂ O
338	(Ami noi mi nomet hyl)urea		C ₂ H ₄ N ₂ O	141-83-3	102.095	pr	105	dec 160			s H ₂ O, py; sl Et OH; i et h, bz, chl, CS ₂
339	2-Ami no-5-i odobenzoil c aci d		C ₇ H ₉ NO ₂	5326-47-6	263.033		220 dec				sl H ₂ O, t f a; vs Et OH, et h, ace; s bz
340	4-Ami no-7 <i>H</i> i soi ndole-1,3(2 <i>H</i>)-di one		C ₇ H ₇ N ₂ O ₂	2518-24-3	162.146		269.5				
341	4-Ami no-3-i soxazol i di norf (	Cycl oseri ne	C ₇ H ₇ N ₂ O ₂	68-41-7	102.092		155 dec				s H ₂ O; sl MeOH
342	1-Ami no-2-met hyl -9,10- ant hracenedi one	1-Ami no-2-met hyl ant hraqui none	C ₁₅ H ₉ N ₂ O ₂	82-28-0	237.254		205.5				i H ₂ O; s Et OH, bz, chl; sl et h
343	α-(Ami nomet hyl)benzenemet hanol	Phenyl et hanol ami ne	C ₆ H ₇ NO	7568-93-6	137.179		56.5	160 ¹⁷			vs H ₂ O; s Et OH
344	β-(Ami nomet hyl)benzenepropanoi c aci d	4-Ami no-3-phenyl but yri c aci d	C ₁₀ H ₉ NO ₂	1078-21-3	179.216		252 dec				
345	2-Ami no-5-met hyl benzenesul f oni c aci d		C ₇ H ₇ NO ₃ S	88-44-8	187.216	lt ye nd	132 dec				vs H ₂ O
346	<i>t rans</i> -4-(Ami nomet hyl) cycl ohexanecarboxyl i c aci d	Tranexami c aci d	C ₈ H ₁₃ NO ₂	1197-18-8	157.211		>300				vs H ₂ O
347	4-Ami no-4-met hyl -2-pent anone	Di acet onami ne	C ₆ H ₁₁ NO	625-04-7	115.173			25 ¹⁴			s H ₂ O; msc Et OH, et h
348	2-Ami no-4-met hyl phenol		C ₆ H ₇ NO	95-84-1	123.152	cry (w), ort h (bz), lf or nd	136	sub			sl H ₂ O, bz; s Et OH, et h, chl; i li g
349	4-Ami no-2-met hyl phenol		C ₆ H ₇ NO	2835-96-3	123.152	nd or lf (bz)	176.5	sub			sl H ₂ O, bz; s Et OH, et h
350	4-Ami no-3-met hyl phenol		C ₆ H ₇ NO	2835-99-6	123.152	pr (di l al) cry (bz)	179				sl H ₂ O; vs Et OH, et h; s DMSO
351	(Ami nomet hyl)phosphoni c aci d		C ₆ H ₁₁ P	1066-51-9	111.038	cry	309				
352	2-Ami no-2-met hyl -1,3-propanedi ol		C ₄ H ₉ NO ₂	115-69-5	105.136		110	151 ¹⁰			vs H ₂ O; s Et OH
353	L-3-Ami no-2-met hyl propanoi c aci d		C ₄ H ₉ NO ₂	144-90-1	103.120	cry (w)	182				
354	2-Ami no-2-met hyl -1-propanol	2-Ami noi sobut anol	C ₄ H ₉ NO	124-68-5	89.136		25.5	165.5	0.934 ²⁰	1.449 ²⁰	msc H ₂ O; s ct c
355	4-Ami no-5-met hyl -2(<i>H</i>)- pyri mi di none	5-Met hyl cyt osi ne	C ₄ H ₇ N ₃ O	554-01-8	125.129	pr (w+1/2)	270 dec				s H ₂ O, aci d; sl Et OH; i et h
356	3-(Ami nomet hyl)-3,5,5- t ri met hyl cycl ohexanol	1-Hydroxy-3-ami nomet hyl -3,5,5- t ri met hyl cycl ohexane	C ₁₀ H ₂₁ NO	15647-11-7	171.280		45.5	265	0.969 ²⁵	1.4904 ²⁰	
357	3-Ami no-2-napht hal enecarboxyl i c aci d	3-Ami no-2-napht hoi c aci d	C ₁₁ H ₉ NO ₂	5959-52-4	187.195	ye lf (di l al)	216.5				s Et OH, et h
358	2-Ami no-1,4-napht hal enedi one		C ₁₀ H ₇ NO ₂	2348-81-4	173.169		207				i H ₂ O, al k; s Et OH, et h, HOAc
359	7-Ami no-1,3-napht hal enedi sul f oni c aci d	Ami do-G-Aci d	C ₈ H ₇ NO ₃ S ₂	86-65-7	303.311	mcl pr or nd (w+4)	274				vs H ₂ O, Et OH
360	2-Ami no-1,5-napht hal enedi sul f oni c aci d	2-Napht hyl ami ne-1,5-di sul f oni c aci d	C ₈ H ₇ NO ₃ S ₂	117-62-4	303.311		>300				
361	4-Ami no-1,6-napht hal enedi sul f oni c aci d	4-Napht hyl ami ne-4,7-di sul f oni c aci d	C ₈ H ₇ NO ₃ S ₂	85-75-6	303.311						vs H ₂ O
362	4-Ami no-1,7-napht hal enedi sul f oni c aci d	4-Napht hyl ami ne-4,6-di sul f oni c aci d	C ₈ H ₇ NO ₃ S ₂	85-74-5	303.311						vs H ₂ O, Et OH
363	2-Ami no-1-napht hal enesul f oni c aci d	2-Napht hyl ami ne-1-sul f oni c aci d	C ₈ H ₇ NO ₃ SC	81-16-3	223.248	sc(hot w)					s DMSO
364	4-Ami no-1-napht hal enesul f oni c aci d	1-Napht hyl ami ne-4-sul f oni c aci d	C ₈ H ₇ NO ₃ SC	84-86-6	223.248	wh nd (w+1/2) red-br cry	dec		1.6703 ²⁵		i H ₂ O; sl Et OH; s MeOH, py
365	5-Ami no-1-napht hal enesul f oni c aci d	1-Napht hyl ami ne-5-sul f oni c aci d	C ₈ H ₇ NO ₃ SC	84-89-9	223.248	wh cry					s H ₂ O; i et h
366	6-Ami no-1-napht hal enesul f oni c aci d	2-Napht hyl ami ne-5-sul f oni c aci d	C ₈ H ₇ NO ₃ SC	81-05-0	223.248	nd(w)					i H ₂ O, Et OH, et h
367	7-Ami no-1-napht hal enesul f oni c aci d	Badi sche aci d	C ₁₀ H ₉ NO ₃ S	86-60-2	223.248	nd (w+1), pl (aq ace)					vs HOAc
368	8-Ami no-1-napht hal enesul f oni c aci d	1-Napht hyl ami ne-8-sul f oni c aci d	C ₈ H ₇ NO ₃ SC	82-75-7	223.248	nd					vs gl HOAc



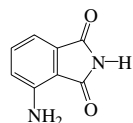
O-((2-Ami noi mi no met hyl)ami)urea



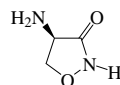
(Ami noi mi no met hyl)urea



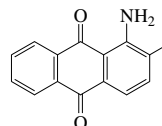
2-Ami no-5-i odobenzoici d



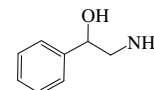
4-Ami no-7*H*-i soi ndole-1,3-di one



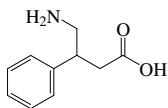
4-Ami no-3-i soxazol i di none



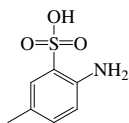
1-Ami no-2-met hyl-9,10-ant hracenedi one



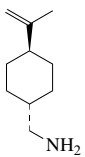
α -(Ami no met hyl)benzenemet hanol



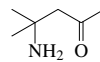
β -(Ami no met hyl)benzenepropanoici d



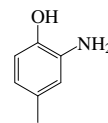
2-Ami no-5-met hyl benzenesul f oacidi c



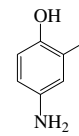
*t rans*4-(Ami no met hyl)cycl ohexanecarboxyici d



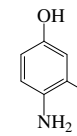
4-Ami no-4-met hyl-2-pent anone



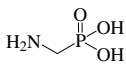
2-Ami no-4-met hyl phenol



4-Ami no-2-met hyl phenol



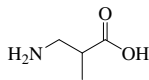
4-Ami no-3-met hyl phenol



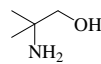
(Ami no met hyl)phosphoici d



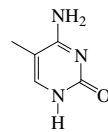
2-Ami no-2-met hyl-1,3-propanedi ol



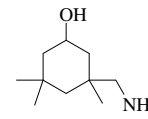
L-3-Ami no-2-met hyl propanoici d



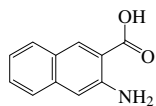
2-Ami no-2-met hyl-1-propanol



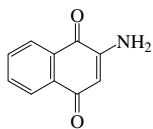
4-Ami no-5-met hyl-2*H*-pyri mi di none



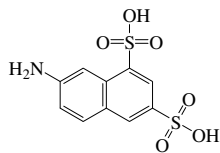
3-(Ami no met hyl)-3,5,5-*t ri* met hyl cycl ohexanol



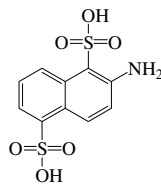
3-Ami no-2-napt hal enecarboxyici d



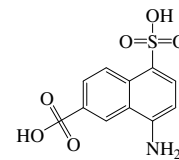
2-Ami no-1,4-napt hal enedi o



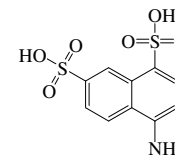
7-Ami no-1,3-napt hal enedi sul f aci d



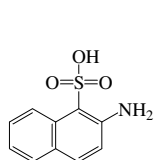
2-Ami no-1,5-napt hal enedi sul f aci d



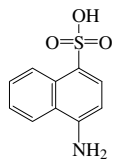
4-Ami no-1,6-napt hal enedi sul f aci d



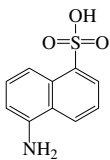
4-Ami no-1,7-napt hal enedi sul f aci d



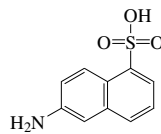
2-Ami no-1-napt hal enesul f oacidi c



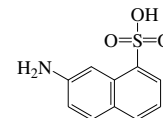
4-Ami no-1-napt hal enesul f oacidi c



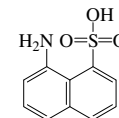
5-Ami no-1-napt hal enesul f oacidi c



6-Ami no-1-napt hal enesul f oacidi c

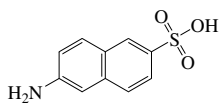


7-Ami no-1-napt hal enesul f oacidi c

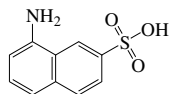


8-Ami no-1-napt hal enesul f oacidi c

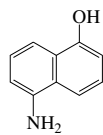
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
369	6-Ami no-2-napht hal enesulf oni c aci d	Bronner aci d	$_{10}H_9NO_3S$	93-00-5	223.248	lf					i col d; sl hot H ₂ O
370	8-Ami no-2-napht hal enesulf oni c aci d	1,7-Cl eve's aci d	$_{10}H_9NO_3S$	119-28-8	223.248	nd or pr (w)					sl Et OH; s et h
371	5-Ami no-1-napht hol	1-Ami no-6-hydroxynapht hal ene	$_{10}H_9NO$	83-55-6	159.184		170				sl DMSO
372	1-Ami no-2-napht hol		$_{10}H_9NO$	2834-92-6	159.184	sl i very lf (bz, et h)	150 dec				sl H ₂ O, et h; s Et OH; vs di l al k, aci d
373	8-Ami no-2-napht hol	8-Ami no-napht hol	$_{10}H_9NO$	118-46-7	159.184	nd (w, al)	206	sub			s H ₂ O, et h; vs Et OH; sl bz, li g
374	2-Ami no-4-ni t robenzoi c aci d		$_{7}H_5NO_4$	619-17-0	182.134	oran pr (di l al)	269				i ₂ OH vs Et OH, et h, ace; s xyl
375	2-Ami no-5-ni t robenzoi c aci d		$_{7}H_5NO_4$	616-79-5	182.134	lf (al), ye nd (w, di l al)	269				i H ₂ O, bz, chl, xyl; s Et OH, et h
376	2-Ami no-5-ni t robenzoni t ri le		$_{7}H_5NCO_2$	17420-30-3	163.134		203.5				sl DMSO
377	3-Ami no-1-ni t roguani di ne		$_{5}H_7NO_2$	18264-75-0	119.084		187.8				sl H ₂ O
378	2-Ami no-4-ni t rophenol		$_{6}H_7NO_3$	99-57-0	154.123	oran pr (+w)	146				sl H ₂ O, ace; vs Et OH; s et h, bz, HOAc
379	2-Ami no-5-ni t rophenol		$_{6}H_7NO_3$	121-88-0	154.123		205.8				s H ₂ O, Et OH, bz
380	4-Ami no-2-ni t rophenol		$_{6}H_7NO_3$	119-34-6	154.123	dk red pl or nd (w, al)	131	110 ¹²			s H ₂ O, Et OH, et h; sl DMSO
381	2-Ami nooct anoi c aci d, (±)		$_{8}H_9NO_2$	644-90-6	159.227	lf (w)	270	sub			sl H ₂ O, Et OH, et h, bz; s HOAc
382	Ami nooxacet ohydrazi de	Semi oxamazi de	$_{2}H_3NO_2$	515-96-8	103.080		221 dec				sl H ₂ O; i Et OH, et h; vs al k, aci d
383	<i>ci s</i> -4-Ami no-4-oxo-2-but enoi c aci d	Mal eami c aci d	$_{4}H_5NO_3$	557-24-4	115.088	cry (al)	172.5				vs H ₂ O, Et OH
384	5-Ami no-4-oxopent anoi c aci d	5-Ami nolevul i ni c aci d	$_{5}H_7NO_3C$	106-60-5	131.130	cry (Et OH)	145				
385	(Ami nooxy)acet i c aci d, hydrochl ori de (2:1)		$_{12}H_{11}ClNO_6$	2921-14-4	218.592		152.5				
386	6-Ami nopeni ci l lami c aci d	Peni ci n	$_{6}H_{12}NO_3S$	551-16-6	216.257	cry (w)	208				
387	5-Ami nopenant anoi c aci d		$_{5}H_9NO_2$	660-88-8	117.147	lf (di l al)	157 dec	dec			s OH sl Et OH; i et h, bz, li g
388	5-Ami no-1-pent anol		$_{5}H_{13}NO$	2508-29-4	103.163		38.5	221.5	0.9488 ¹⁷	1.4618 ¹⁷	msc H ₂ O, Et OH, ace
389	2-Ami nophenol		$_{6}H_7NO$	95-55-6	109.126	wh ort h bi pym nd (bz)	174	sub 153	1.328 ²⁵		s H ₂ O, et h; vs Et OH; sl bz, t f a
390	3-Ami nophenol		$_{6}H_7NO$	591-27-5	109.126	pr (t o)	123	164 ¹			s H ₂ O, t ol; vs Et OH, et h; sl bz, DMSO
391	4-Ami nophenol		$_{6}H_7NO$	123-30-8	109.126	wh pl (w)	187.5	110 ³			sl H ₂ O, t f a; vs Et OH; i bz, chl; s al k
392	<i>N</i> -(3-Ami nophenyl)acet ami de		$_{8}H_9N_2O$	102-28-3	150.177	nd or pl (bz)	88				vs H ₂ O, Et OH, ace; sl et h, bz
393	<i>N</i> -(4-Ami nophenyl)acet ami de	<i>p</i> -Ami noacet ani l i de	$_{8}H_9N_2O$	122-80-5	150.177	nd (w)	166.5	267			s H ₂ O; vs Et OH, et h
394	(4-Ami nophenyl)arsoni c aci d	Arsani l i c aci d	$_{6}H_7AsNO_3$	98-50-0	217.055	mcl nd (w, al)	232		1.9571 ⁹		s H ₂ O, et h; sl Et OH, DMSO; i ace, bz
395	<i>N</i> -(4-Ami nophenyl)-1,4-benzenedi ami ne	4,4'-Di ami nodi phenyl ami ne	$_{12}H_9N_3$	537-65-5	199.251	lf (w)	158	dec			vs et h, Et OH
396	2-Ami no-1-phenyl et hanone	Phenacyl ami ne	$_{8}H_9NO$	613-89-8	135.163	ye cry	20	251		1.6160 ²⁰	i H ₂ O; s et h; sl ct c
397	1-(3-Ami nophenyl) et hanone	<i>m</i> -Ami noacet ophenone	$_{8}H_7NO$	99-03-6	135.163	pa ye pl (al), lf (et h)	98.5	289.5			sl H ₂ O; s Et OH
398	1-(4-Ami nophenyl) et hanone	<i>p</i> -Ami noacet ophenone	$_{8}H_7NO$	99-92-3	135.163	ye mcl pr (al)	106	294; 195 ⁵			vs et h, Et OH
399	1-(4-Ami nophenyl)-1-pent anone		$_{11}H_{15}NO$	38237-74-0	177.243	cry (bz-pet h)	74.5	16f			i H ₂ O; s Et OH, et h
400	1-(4-Ami nophenyl)-1-propanone	<i>p</i> -Ami nopropi ophenone	$_{8}H_9NO$	70-69-9	149.189	pl (al, w), nd (w)	140				s DMSO
401	<i>N</i> -[(4-Ami nophenyl)sulf onyl]acet ami de	Sulf acet ami de	$_{8}H_9N_2O_3S$	144-80-9	214.241		183				sl H ₂ O; s Et OH; i et h; vs ace, al k
402	5-[(4-Ami nophenyl)sulf onyl]-2-thi azolami ne	Thi azol sulf one	$_{8}H_6N_2O_2S_2$	473-30-3	255.316	nd (al)	220 dec				vs ace, et h, Et OH, di ox



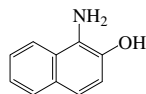
6-Ami no-2-napht hal enesul f oatiid



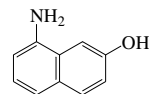
8-Ami no-2-napht hal enesul f oatiid



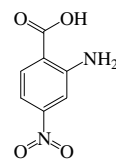
5-Ami no-1-napht hol



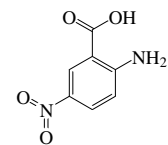
1-Ami no-2-napht hol



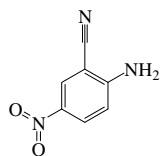
8-Ami no-2-napht hol



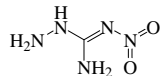
2-Ami no-4-ni t robenzoiid d



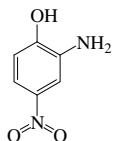
2-Ami no-5-ni t robenzoiid d



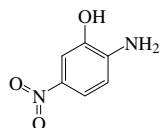
2-Ami no-5-ni t robenzoni t ri le



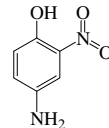
3-Ami no-1-ni t roguani di ne



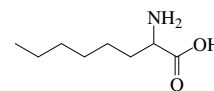
2-Ami no-4-ni t rophenol



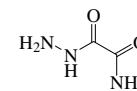
2-Ami no-5-ni t rophenol



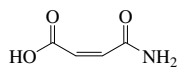
4-Ami no-2-ni t rophenol



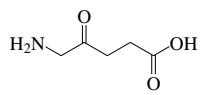
2-Ami nooct anoiaci d(±)



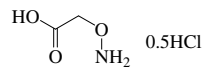
Ami nooxoacet ohydrazi de



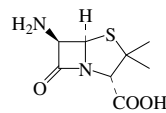
ci s4-Ami no-4-oxo-2-but enoiaci d



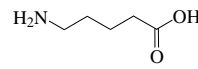
5-Ami no-4-oxopent anoiaci d



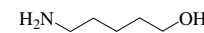
(Ami nooxy)acet iaci d(hydrochl ori d)(2:1)



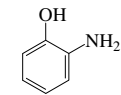
6-Ami nopeni ci l i i aci d



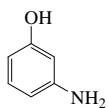
5-Ami nopent anoiaci d



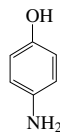
5-Ami no-1-pent anol



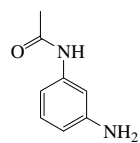
2-Ami nophenol



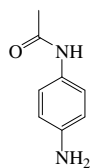
3-Ami nophenol



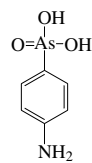
4-Ami nophenol



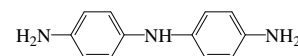
N-(3-Ami nophenyl)acet ami de



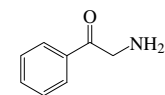
N-(4-Ami nophenyl)acet ami de



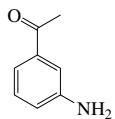
(4-Ami nophenyl)arsoni aci d



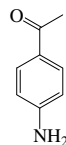
N-(4-Ami nophenyl)-1,4-benzenedi ami ne



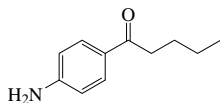
2-Ami no-1-phenyl et hanor



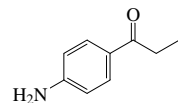
1-(3-Ami nophenyl)et hanone



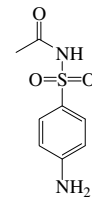
1-(4-Ami nophenyl)et hanone



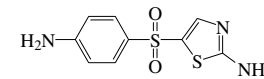
1-(4-Ami nophenyl)-1-pent anone



1-(4-Ami nophenyl)-1-propanone

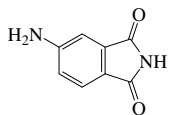


N-(4-Ami nophenyl)sul f onyl]acet ami de

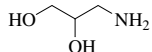


5-(4-Ami nophenyl)sul f onyl]-2-t hi azol ami ne

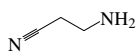
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
403	4-Aminophthalimide	5-Amino-1H-benzotriazol-4-one	C ₈ H ₆ N ₂ O ₂	3676-85-5	162.146			224 ^{0.5}			
404	3-Amino-1,2-propanediol, (±)		C ₃ H ₇ NO ₂	13552-31-3	91.109			dec 265; 145 ⁹	1.1752 ²⁰	1.4910 ²⁵	s H ₂ O, Et OH; i et h, bz
405	3-Aminopropanetriole	3-Aminopropionitriole	C ₃ H ₆ N ₂	151-18-8	70.093			185; 88 ²⁰	0.9584 ²⁰	1.4396 ²⁰	
406	2-Amino-1-propanol, (±)		C ₃ H ₇ NO	6168-72-5	75.109			174.5		1.4502 ²⁰	vs H ₂ O, Et OH, et h; sl chl
407	3-Amino-1-propanol	Propanolamine	C ₃ H ₇ NO	156-87-6	75.109		12.4	187.5	0.9824 ²⁶	1.4617 ²⁰	s H ₂ O, Et OH, et h
408	1-Amino-2-propanol	Isopropanolamine	C ₃ H ₇ NO	1674-56-2	75.109		0.9	159.4	0.9611 ²⁰	1.4479 ²⁰	misc H ₂ O, Et OH, et h, ace, bz, ct c
409	α-(1-Aminopropyl)benzenemethanol	α-(α-Aminopropyl)benzyl alcohol	C ₁₀ H ₁₃ NO	5897-76-7	165.232	pl (bz-et h)	79.5				
410	N-(3-Aminopropyl)N-methyl-1,3-propanediolamine		C ₇ H ₁₃ N ₃	105-83-9	145.246			232.5; 112 ⁶	0.9023 ²⁰	1.4705 ²⁵	
411	Aminopropylolone		C ₆ H ₁₂ N ₂ O ₂	3690-04-8	302.372	pr (bz)	181				vs H ₂ O
412	4-(2-Aminopropyl)phenol, (±)	Hydroxyamphetamine	C ₉ H ₁₁ NO	1518-86-1	151.205	cry (bz)	125.5				s H ₂ O, Et OH, bz, chl, AcOEt
413	N-(3-Aminopropyl)-1,3-propanediolamine	Bis(3-aminopropyl)amine	C ₈ H ₁₇ N ₃	56-18-8	131.219		-14	151 ⁵⁰	0.938 ²⁵	1.4810 ²⁰	s chl
414	Aminopterin		C ₁₀ H ₁₆ N ₆ O ₅	54-62-6	440.413	ye cry	262 dec				
415	4-Amino-N-pyridylbenzenesulfonamide	Sulfapyridine	C ₁₀ H ₁₀ N ₄ O ₂ S	116-44-9	250.277	nd (PhNO ₂)	251				i H ₂ O, Et OH, et h, bz, chl; s py, sl ace
416	3-Amino-4-pyridyl-4-carbonitriole	3-Amino-4-cyanopyridole	C ₅ H ₄ N ₄	16617-46-2	108.102	cry (w)	173				
417	2-Amino-3-pyridinecarboxylic acid		C ₆ H ₆ N ₂ O ₂	5345-47-1	138.124			296 dec			sl H ₂ O
418	6-Amino-3-pyridinecarboxylic acid	6-Aminopyridine-3-carboxylic acid	C ₆ H ₆ N ₂ O ₂	3167-49-5	138.124	cry (di l HOAc, +2w)	312				
419	4-Amino-N-2-pyridylbenzenesulfonamide	Sulfapyridine	C ₁₁ H ₁₁ N ₃ O ₂ S	144-83-2	249.289	ye oran (al)	192				i H ₂ O, bz, ct c; s Et OH
420	5-Amino-2,4,6-triazolopyridine	5-Aminouracil	C ₄ H ₃ N ₃ O ₂	932-52-5	127.102	nd (w)	dec				i H ₂ O; s alk, aci d
421	6-Amino-2,4,6-triazolopyridine		C ₄ H ₃ N ₃ O ₂	873-83-6	127.102	cry (w)	dec				vs H ₂ O
422	4-Amino-2-thiazolopyridine	2-Thiazolopyridine	C ₄ H ₃ N ₃ S	333-49-3	127.168						sl DMSO
423	5-Amino-2,4,6-triazolopyridine	Uramil	C ₄ H ₃ N ₃ O ₃	118-78-5	143.101	nd or pl (w)	>400				s H ₂ O, chl; i et h, bz
424	4-Amino-N-2-pyridylbenzenesulfonamide	Sulfadiazine	C ₁₀ H ₁₀ N ₄ O ₂ S	68-35-9	250.277	cry (w), wh pow	255 dec				sl H ₂ O, Et OH, ace, DMSO
425	Aminopyridine		C ₅ H ₆ N ₂ O	58-15-1	231.293	pr or pl (li g or AcOEt)	134.5				vs H ₂ O, bz, Et OH
426	4-Amino-2-thiazolopyridine	Sulfathiazole	C ₆ H ₆ N ₂ O ₂ S	59-40-5	300.336			247.5			sl H ₂ O, Et OH, ace; s aq alk
427	4-(Aminophenyl)benzothiazole	Carzidine	C ₇ H ₇ N ₃ S	138-41-0	201.201	pr or lf (w)	291 dec				i H ₂ O; vs Et OH; sl et h; i bz
428	N-[4-(Aminophenyl)phenyl]acetamide	Acetyl sulfanilamide	C ₁₄ H ₁₀ N ₂ O ₃ S	121-61-9	214.241	nd (HOAc)	219.5				s H ₂ O, Et OH, ace
429	5-Amino-1,3,4-thiazolopyridine		C ₄ H ₃ N ₃ S ₂	2349-67-9	133.195			243.0			
430	2-Amino-4-thiazolopyridine		C ₄ H ₃ N ₂ OS	556-90-1	116.141	pr or nd (w)	256 dec				sl H ₂ O; i Et OH, et h
431	N-(Aminothioxomethyl)acetamide	Acetylthiourea	C ₃ H ₆ N ₂ OS	591-08-2	118.157	pr (w), ort h (al)	165				sl H ₂ O, et h; s DMSO, Et OH
432	N-Amino-2-thioxo-4-thiazolopyridine	3-Aminothiodanone	C ₃ H ₃ N ₂ OS ₂	1438-16-0	148.206			101.5			s DMSO
433	1-Amino-2,2,2-trichloroethanol	Chloroformamide	C ₂ H ₂ Cl ₃ NO	507-47-1	164.418	nd (al)	73	dec 100			vs bz, et h, Et OH
434	4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid	Picloram	C ₇ H ₃ Cl ₃ N ₂ O ₂	1918-02-1	241.459			218.5			
435	11-Aminoundecanoic acid		C ₁₁ H ₂₃ NO ₂	2432-99-7	201.307			189.0			



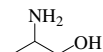
4-Ami nophthalimi de



3-Ami no-1,2-propanedi ol(±)



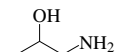
3-Ami nopropaneni tri le



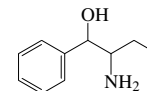
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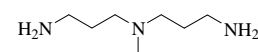
3-Ami no-1-propanol



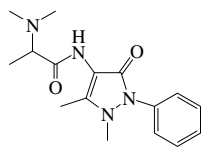
1-Ami no-2-propanol



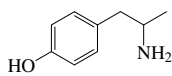
α-(1-Ami nopropyl)benzenemet hanol



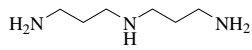
N-(3-Ami nopropyl)N-met hyl-1,3-propanedi ami ne



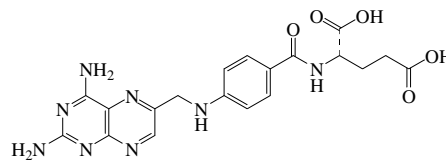
Ami nopropyl on



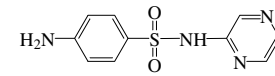
4-(2-Ami nopropyl)pheno(±)



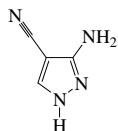
N-(3-Ami nopropyl)-1,3-propanedi ami ne



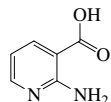
Ami nopt eri n



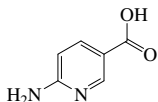
4-Ami noN-pyrazi nyl benzenesul f onami de



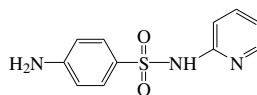
3-Ami no-*H*-pyrazole-4-carboni tri le



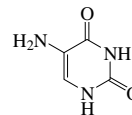
2-Ami no-3-pyri di ncarboxylaci d



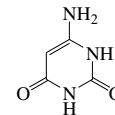
6-Ami no-3-pyri di ncarboxylaci d



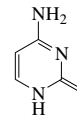
4-Ami noN-2-pyri di nyl benzenesul f onami de



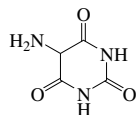
5-Ami no-2,4,6(*H*,3*H*)-pyri mi di nedi one



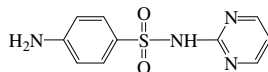
6-Ami no-2,4,6(*H*,3*H*)-pyri mi di nedi one



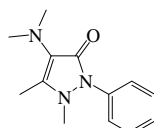
4-Ami no-2(*H*)-pyri mi di net hi one



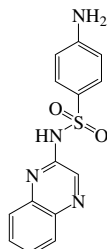
5-Ami no-2,4,6(*H*,3*H*,5*H*)-pyri mi di net ri on



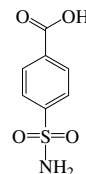
4-Ami noN-2-pyri mi di nyl benzenesul f onami de



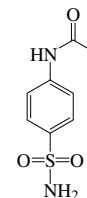
Ami nopyri ne



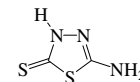
4-Ami noN-2-qui noxali nyl benzenesul f onami de



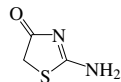
4-Ami nosul f onyl)benzylaci d



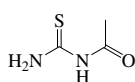
N-[4-(Ami nosul f onyl)phenyl]acet arr



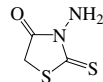
5-Ami no-1,3,4-t hi azi olone(*H*)



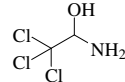
2-Ami no-4(3*H*)-t hi azi olone



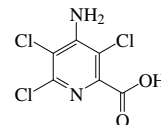
N-(Ami not hi oxomet hyl)acet ami d



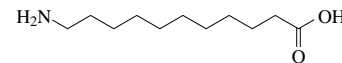
2-Ami no-2-t hi azi olone



2-Ami no-2,2,2-t ri chl oroet hanol

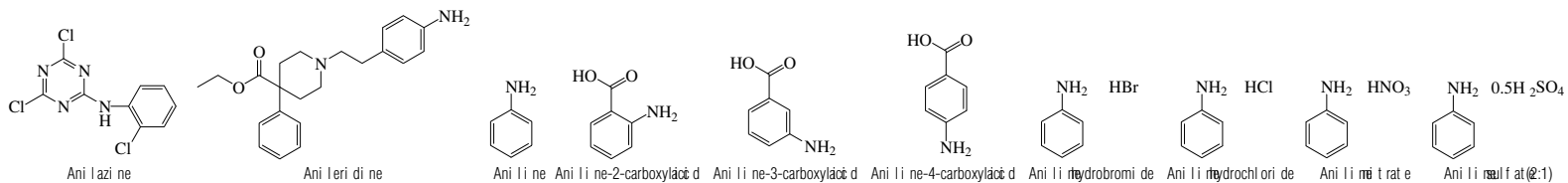
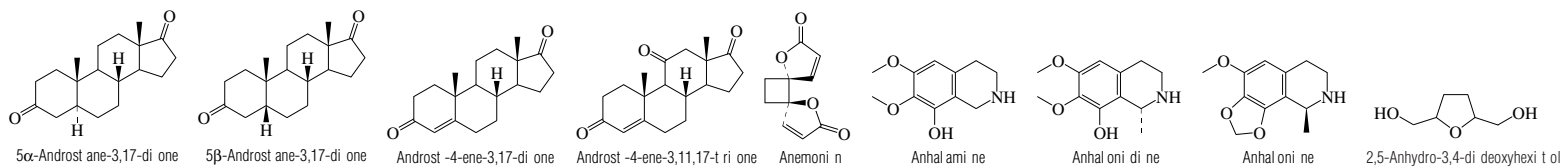
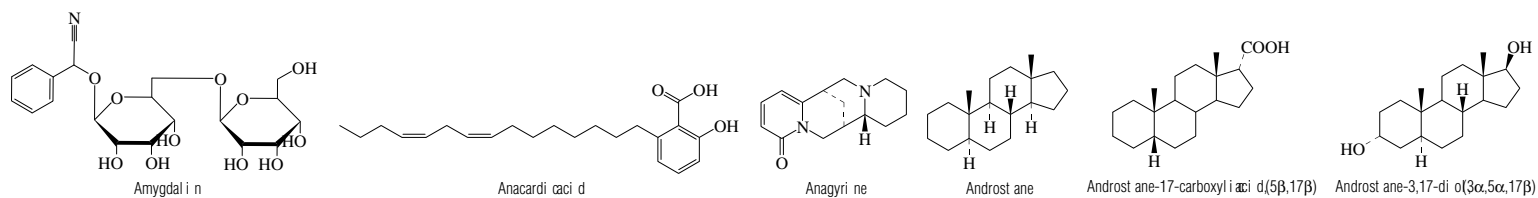
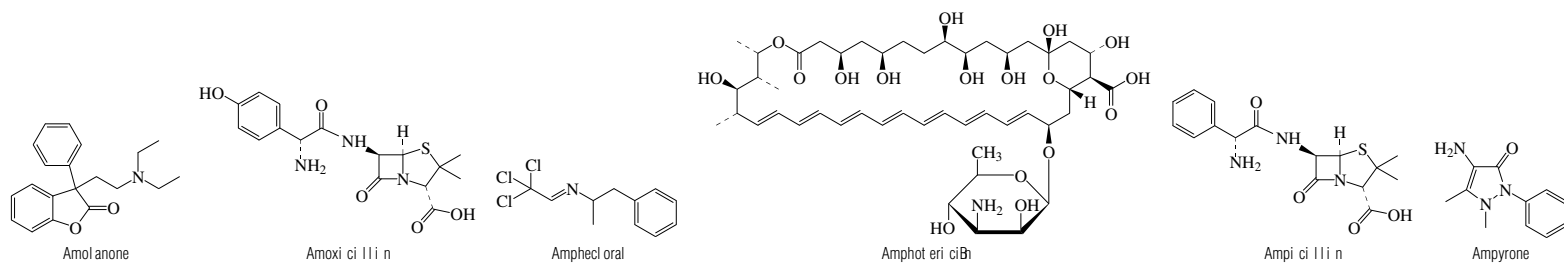
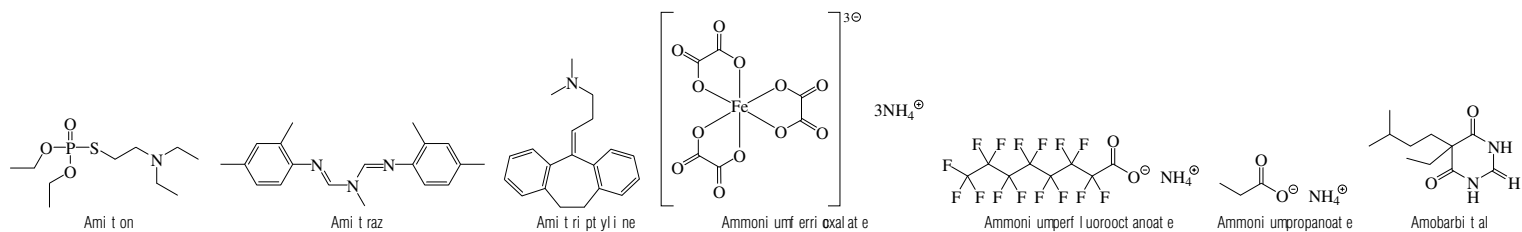


4-Ami no-3,5,6-t ri chl oro-2-pyri di ncarboxylaci d

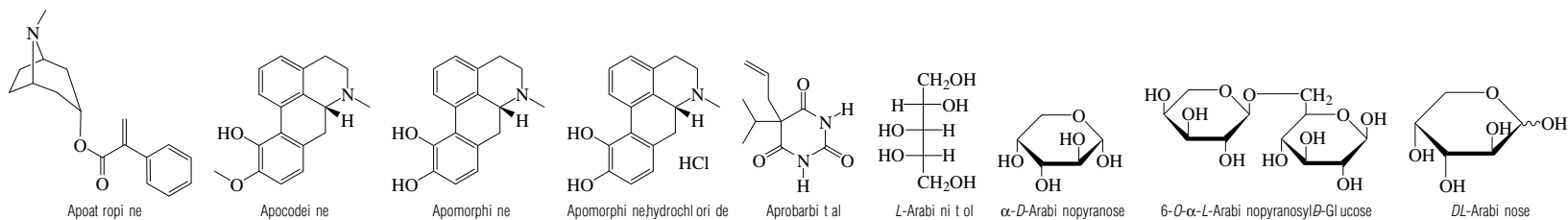
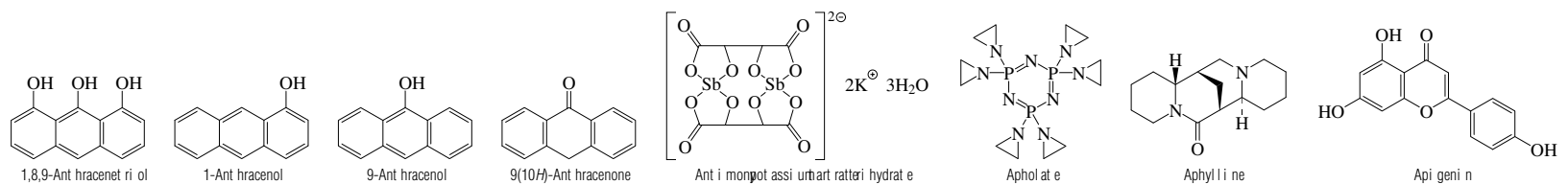
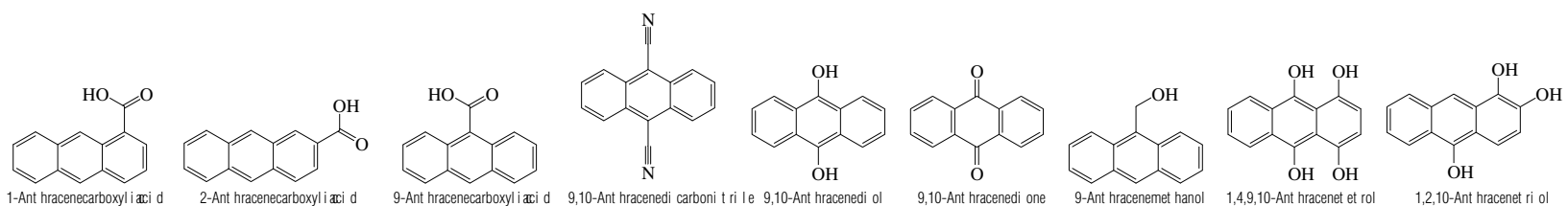
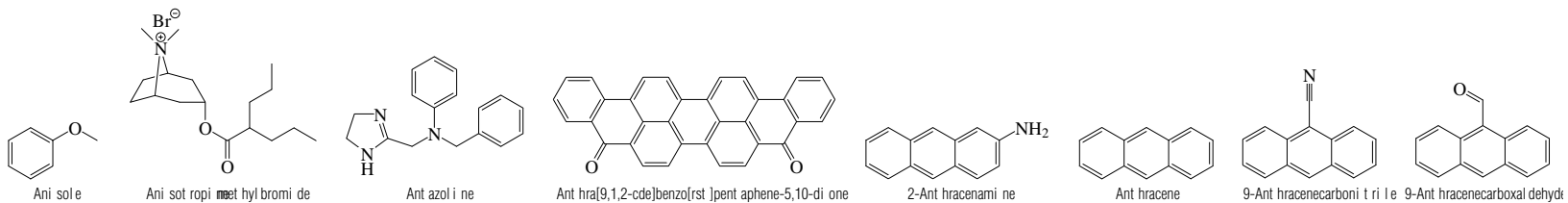


11-Ami noundecanoi aci d

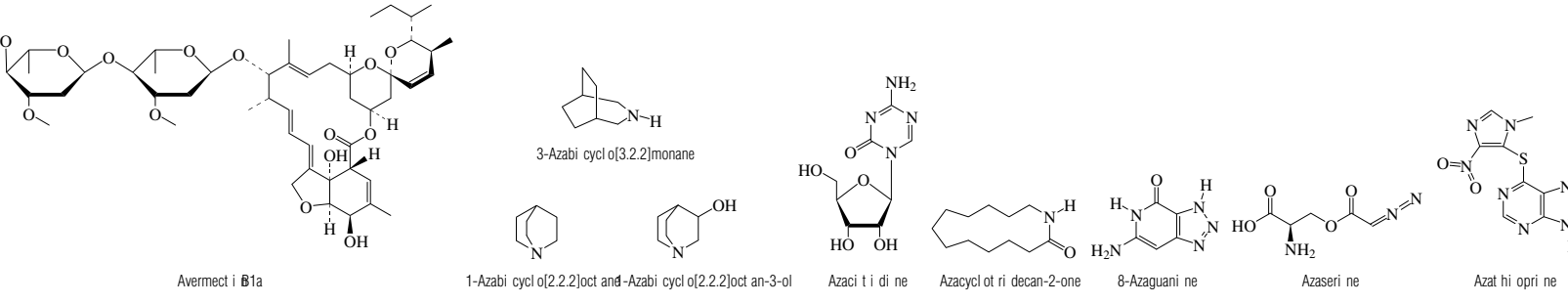
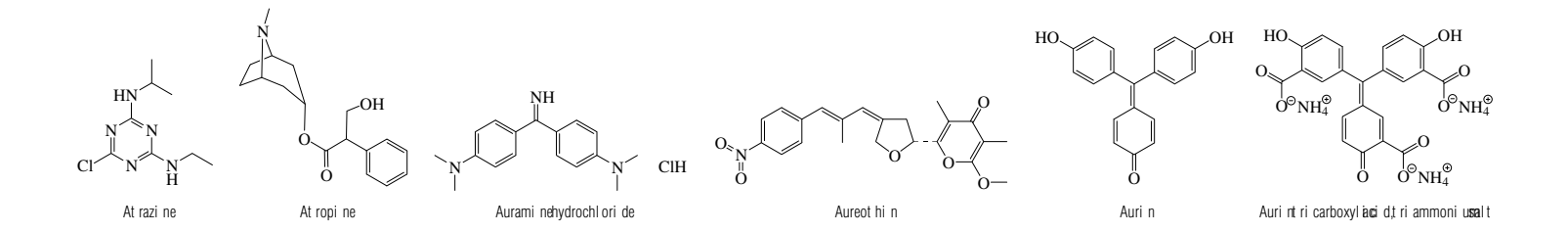
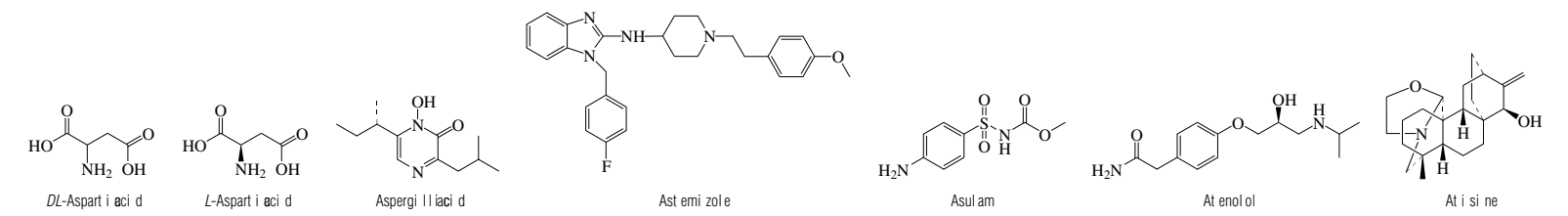
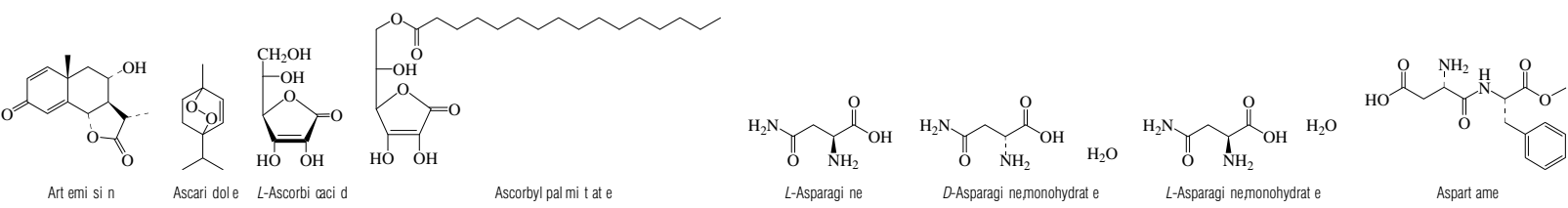
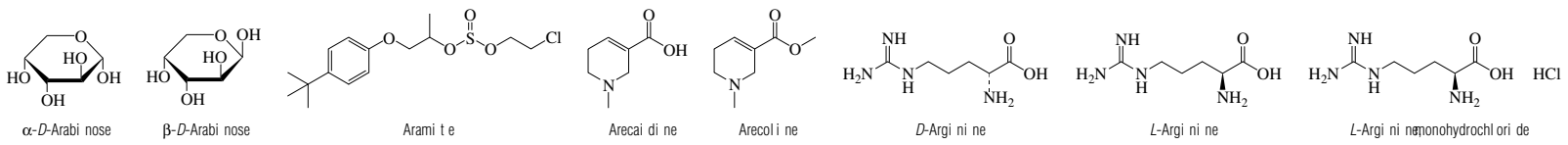
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
436	Ami t on		C ₆ H ₂₄ N ₃ PS	78-53-5	269.342	l i q		76 ²¹		1.4655 ²⁷	
437	Ami t raz	<i>N</i> -Met hyl b s(2,4-xyl yl i mi nomet hyl)ami ne	C ₁₉ H ₂₃ N ₃	33089-61-1	293.406		86		1.128 ²⁰		
438	Ami t ri pt yl i ne		C ₂₀ H ₁₂ N	50-48-6	277.404	cry	196 (HCl)				
439	Ammoni um f erri c oxal ate		C ₆ H ₂ FeN ₃ O ₁₂	14221-47-7	374.017		165 dec		1.78 ^{17,5}		vs H ₂ O; i Et OH
440	Ammoni um perfluorooct anoate		C ₈ F ₁₅ NO ₂	3825-26-1	431.100	sol i d					
441	Ammoni um propanoate		C ₃ H ₇ NO ₂	17496-08-1	91.109	hyg cry	45				s H ₂ O
442	Amobarbital	5-Et hyl -5-i sopent yl -2-pyri mi di net ri one	C ₁₁ H ₁₈ N ₂ O ₃	57-43-2	226.272		157				vs bz, Et OH, chl
443	Amol anone	3-[2-(Di et hyl ami no)et hyl]-3-phenyl-2(3 <i>H</i>)-benzof uranone	C ₂₀ H ₂₃ NO ₂	76-65-3	309.403	cry (pet h)	43.4	193 ⁹		1.5614 ²⁵	
444	Amoxi ci lli n		C ₁₆ H ₉ N ₃ O ₅ S	26787-78-0	365.404	cry (w)					s H ₂ O
445	Amphocl oral		C ₆ H ₁₂ Cl ₃ N	5581-35-1	264.579			96.0 ⁵		1.530	
446	Amphot eri ci n B		C ₄ H ₇ N ₃ O ₁₇	1397-89-3	924.080	ye pr (DMF)	170 dec				i H ₂ O; sl DMF; s DMSO
447	Ampi ci lli n		C ₁₆ H ₁₉ N ₃ O ₄ S	69-53-4	349.405	cry	200 dec				sl H ₂ O
448	Ampyrone		C ₁₁ H ₁₃ N ₃ O	83-07-8	203.240	pa ye cry (bz)	109				s H ₂ O, Et OH, bz, chl; sl et h
449	Amygdali n		C ₆ H ₇ NO ₁₁	29883-15-6	457.428		224.5				vs H ₂ O; sl Et OH; i et h, chl
450	Anacardi c aci d		C ₂₄ H ₃₂ O ₃	11034-77-8	344.487	cry (ace)	35.5				vs et h, Et OH, pet h
451	Anagryri ne		C ₆ H ₂₀ N ₂ O	486-89-5	244.332	pe ye gl ass		265 ² , 212 ⁴			s H ₂ O, et h, bz; vs Et OH, chl; i i g
452	Androst ane		C ₁₉ H ₃₂	24887-75-0	260.457	l f (ace-MeOH)	50	60 ¹⁰³			vs ace, et h, Et OH, pet h
453	Androst ane-17-carboxyl i c aci d, (5β,17β)	Et i ochol ani c aci d	C ₂₀ H ₃₂ O ₂	438-08-4	304.467	nd (gl HOAc)	228.5	sub 160			
454	Androst ane-3,17-di ol, (25α,17β)	Epi androst anedi ol	C ₁₉ H ₃₂ O ₂	1852-53-5	292.456	nd (ace aq)	223				
455	5α-Androst ane-3,17-di one		C ₁₉ H ₂₈ O ₂	846-46-8	288.424	cry (MeOH)	135				
456	5β-Androst ane-3,17-di one		C ₁₉ H ₂₈ O ₂	1229-12-5	288.424	cry (ace-hx)	135				
457	Androst -4-ene-3,17-di one	4-Androst ene-3,17-di one	C ₁₉ H ₂₆ O ₂	63-05-8	286.408			143(f orm a); 173(f orm b)			
458	Androst -4-ene-3,11,17-t ri one	Adrenost erone	C ₁₉ H ₂₄ O ₃	382-45-6	300.392	nd (al)	222	sub			sl H ₂ O; s Et OH, et h, ace, chl
459	Anemoni n	<i>t rans</i> 1,7-Di oxadi spi ro[4.0.4.2]dodeca-3,9-di ene-2,8-di one	C ₁₀ H ₁₆ O ₄	508-44-1	192.169	ort h pl (chl) nd (al or bz)	158				vs chl
460	Anhal ami ne		C ₆ H ₁₅ NO ₃	643-60-7	209.242	nd (al)	187.5				vs et h, Et OH
461	Anhal oni di ne		C ₇ H ₁₇ NO ₃	17627-77-9	223.268	oct cry (bz, et h)	160.5				vs H ₂ O, Et OH
462	Anhal oni ne		C ₆ H ₁₅ NO ₃	519-04-0	221.252	rhom nd	86	140 ^{0,02}			vs Et OH, bz, chl, et h, pet h
463	2,5-Anhydro-3,4-di deoxyhexi t ol	Tet rahydro-2,5-f urandi met hanol	C ₆ H ₁₂ O ₂	104-80-3	132.157		<-50	265	1.154 ²⁰		vs H ₂ O, ace, bz, Et OH
464	Ani lazi ne	2,4-Di chl oro-6-chl oroani li no- <i>t ri azi ne</i>	C ₉ H ₅ Cl ₃ N ₄	101-05-3	275.522		160		1.8 ²⁰		
465	Ani leri di ne		C ₂₂ H ₂₈ N ₂ O ₂	144-14-9	352.469	cry	83				s H ₂ O
466	Ani li ne	Benzenami ne	C ₆ H ₇ N	62-53-3	93.127	oi lyl i q	-6.02	184.17	1.02 ⁴⁷	1.5863 ²⁰	s H ₂ O, ct c, l i g; msc Et OH, et h, ace, bz
467	Ani li ne-2-carboxyl i c aci d	<i>o</i> -Ant hrani li c aci d	C ₇ H ₇ NO ₂	118-92-3	137.137	l f (al)	146.5	sub	1.41 ²		s H ₂ O, Et OH, et h; sl bz, t f a; vs chl, py
468	Ani li ne-3-carboxyl i c aci d	<i>m</i> -Ant hrani li c aci d	C ₇ H ₇ NO ₂	99-05-8	137.137		173		1.51 ²⁵		sl H ₂ O, Et OH; s et h, t f a; vs ace; i bz
469	Ani li ne-4-carboxyl i c aci d	<i>p</i> -Ant hrani li c aci d	C ₇ H ₇ NO ₂	150-13-0	137.137	mcl pr (w)	188.2		1.374 ⁰		s H ₂ O, Et OH, et h; sl ace; i bz, chl
470	Ani li ne hydrobromi de		C ₆ H ₆ BrN	542-11-0	174.039		286				
471	Ani li ne hydrochl ori de	Benzenami ne hydrochl ori de	C ₆ H ₆ ClN	142-04-1	129.588	l f or nd	198		1.22 ¹⁵		vs H ₂ O, Et OH; i et h, chl; sl DMSO
472	Ani li ne ni t rat e		C ₆ H ₅ N ₂ O ₃	542-15-4	156.139	ort h	190 dec		1.356		vs H ₂ O, et h, Et OH
473	Ani li ne sulf ate (2:1)		C ₁₂ H ₆ N ₂ O ₄ S	542-16-5	284.331				1.377 ⁴		s H ₂ O; sl Et OH, t f a; i et h



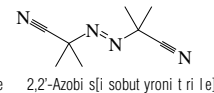
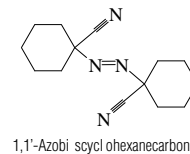
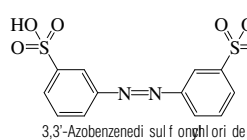
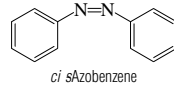
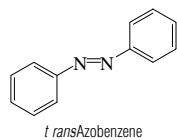
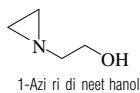
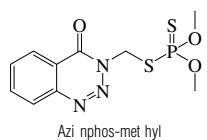
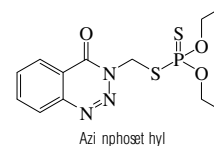
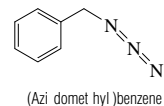
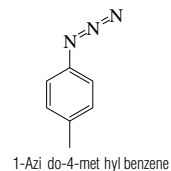
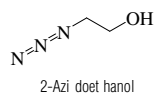
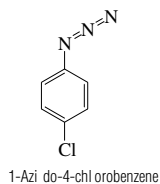
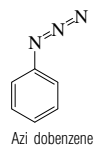
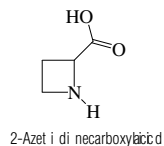
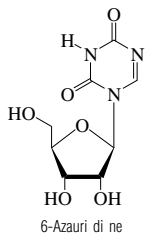
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
474	Ani sol e	Met hox benzene	C ₆ H ₆ O	100-66-3	108.138	liq	-37.13	153.7	0.9940	1.5174 ²⁰	i H ₂ O; s Et OH, et h, chl; vs ace, bz
475	Ani sot ropi ne met hyl bromi de	Oct at ropi ne met hyl bromi de	C ₁₇ H ₃₂ BrNO ₂	80-50-2	362.346	cry (ace)	329				
476	Ant azol i ne		C ₄ H ₃ N ₃	91-75-8	265.353	cry	122				
477	Ant hra[9,1,2-cde]benzo[rst]pent aphen e-5,10-di one		C ₃₄ H ₁₆ O ₂	116-71-2	456.490	vi ol-bl or blk nd (PhNO ₂)	492 dec				i Et OH, bz, HOAc; s xyl, py, sul f
478	2-Ant hracenam i ne		C ₈ H ₁₁ N	613-13-8	193.244	ye lf (al)	238.8	sub			i ₂ OH; s Et OH; i con sul f
479	Ant hracene		C ₁₄ H ₁₀	120-12-7	178.229	t ab or mcl pr (al)	215.76	339.9	1.28 ²⁵		i H ₂ O; sl Et OH, et h, ace, bz, chl, ct c
480	9-Ant hracencarboni t ri le		C ₁₅ H ₉ N	1210-12-4	203.239		177.5		1.3000 ²⁰		
481	9-Ant hracencarboxal dehyde		C ₆ H ₁₀ O	642-31-9	206.239	oran nd (di l HOAc)	104.5				i H ₂ O; s bz, HOAc
482	1-Ant hracencarboxyl i c aci d	1-Ant hroi c aci d	C ₁₅ H ₁₀ O ₂	607-42-1	222.239	ye nd (HOAc) ye pr (al)	251.5	sub			i H ₂ O; s Et OH, et h; sl bz, chl
483	2-Ant hracencarboxyl i c aci d	2-Ant hroi c aci d	C ₁₅ H ₁₀ O ₂	613-08-1	222.239	ye lf (al) nd, lf (sub)	281	sub			vs HOAc
484	9-Ant hracencarboxyl i c aci d	9-Ant hroi c aci d	C ₁₅ H ₁₀ O ₂	723-62-6	222.239		217 dec	sub			i H ₂ O; s Et OH
485	9,10-Ant hracenedi carboni t ri le		C ₁₆ H ₁₀ O ₂	1217-45-4	228.248		337 dec				
486	9,10-Ant hracenedi ol		C ₁₆ H ₁₀ O ₂	4981-66-2	210.228	br or ye nd	180				vs et h, Et OH
487	9,10-Ant hracenedi one	Ant hraqui none	C ₁₄ H ₈ O ₂	84-65-1	208.213	ye ort h nd (al, bz)	286	377	1.438 ²⁰		i H ₂ O; sl Et OH, et h, bz, chl
488	9-Ant hracenet hanol		C ₉ H ₁₂ O	1468-95-7	208.255		160.5				
489	1,4,9,10-Ant hracenet et rol		C ₁₄ H ₁₀ O ₄	476-60-8	242.227		148				
490	1,2,10-Ant hracenet ri ol	Ant hrarobi n	C ₁₄ H ₁₀ O ₃	577-33-3	226.227	ye lf, nd (al-w)	208				sl ₂ B; vs Et OH, et h, ace; s bz
491	1,8,9-Ant hracenet ri ol	Ant hral i n	C ₁₄ H ₁₀ O ₃	1143-38-0	226.227	ye pl or nd (li g)	179				i ₂ OH; s Et OH, ace, bz; sl et h; vs py
492	1-Ant hracenet ol		C ₆ H ₁₀ O	610-50-4	194.228	cry (bz), br nd or lf (al)	158	234 ¹³			i H ₂ O; vs Et OH, et h; s NaOH
493	9-Ant hracenet ol	Ant hranol	C ₉ H ₁₀ O	529-86-2	194.228	ye red lf (di l al)	152				
494	9(10 <i>H</i>)-Ant hracenet one	Ant hrone	C ₉ H ₁₀ O	90-44-8	194.228	nd (bz-li g, HOAc)	155				s ace, bz, con sul f, di l al k
495	Ant i mony pot assi um t art rat et ri hydrat e	Tart ar emet i c	C ₈ H ₁₀ K ₂ O ₁₅ Sb ₂	28300-74-5	667.873	col cry			2.6		sl H ₂ O
496	Aphol at e		C ₆ H ₂ N ₃ P ₃	52-46-0	387.300		148				
497	Aphyll i ne		C ₈ H ₂₄ N ₂ O	577-37-7	248.364	cry	52.5	200 ⁴			vs ace, bz, et h, Et OH
498	Api geni n	5,7-Di hydroxy-2-(4-hydroxyphenyl)-4 <i>H</i> -1-benzopyran-4-one	C ₁₅ H ₁₀ O ₅	520-36-5	270.237	ye nd (aq py)	347.5				i H ₂ O; s Et OH, py; vs di l al k
499	Apoat ropi ne		C ₇ H ₂₁ NO ₂	500-55-0	271.355	pr (chl)	62				sl H ₂ O, li g; vs Et OH, et h, ace, bz
500	Apocodei ne		C ₈ H ₁₉ NO ₂	641-36-1	281.350	pr (MeOH)	123.5				sl Et OH; s et h, ace, bz, li g
501	Apomorphi ne		C ₇ H ₁₇ NO ₂	58-00-4	267.323	hex pl (chl-pet h) rods (et h)	195 dec				sl H ₂ O; s Et OH, et h, ace, bz, al k
502	Apomorphi ne, hydrochl ori de		C ₇ H ₁₅ ClNO ₂	314-19-2	303.784	grn i nai r mcl pr	205 dec				
503	Aprobarbi t al	5-Isopropyl-5- <i>al</i> lyl-2,4,6(3 <i>H</i> ,5 <i>H</i>)-pyri mi di net ri one	C ₁₀ H ₁₄ N ₂ O ₃	77-02-1	210.229	cry	141				vs ace, et h, Et OH, chl
504	<i>L</i> -Arabi ni t ol		C ₅ H ₈ O ₅	7643-75-6	152.146		102.5				vs H ₂ O; sl Et OH; i et h
505	α - <i>D</i> -Arabi nopyranose		C ₆ H ₁₀ O ₅	608-45-7	150.130	cry (MeOH)	155.5		1.585 ²⁵		
506	6- <i>O</i> - α - <i>L</i> -Arabi nopyranosyl- β -Glucose	Vi ci anose	C ₁₈ H ₃₀ O ₁₀	14116-69-9	312.271	nd (di l al)	210 dec				vs H ₂ O
507	<i>DL</i> -Arabi nose		C ₆ H ₁₀ O ₅	20235-19-2	150.130	pr, nd (al)	164.5		1.585 ²⁰		vs H ₂ O; sl Et OH; i et h, bz



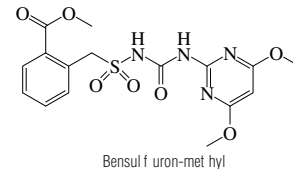
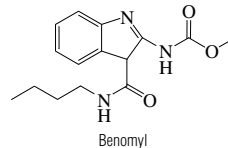
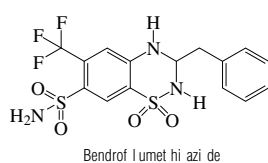
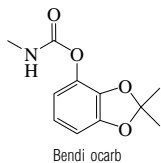
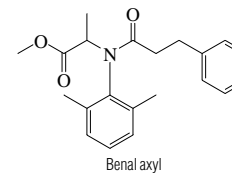
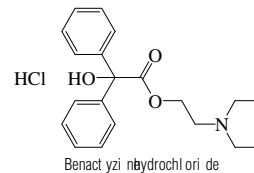
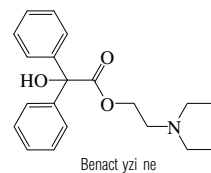
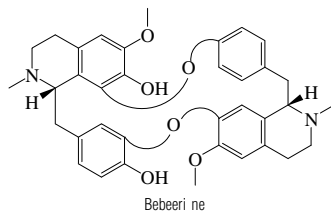
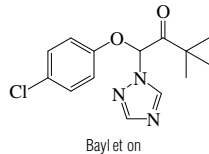
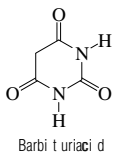
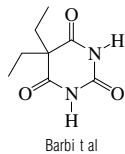
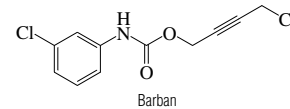
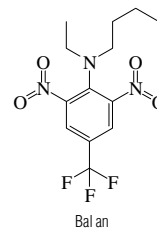
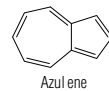
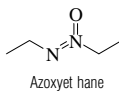
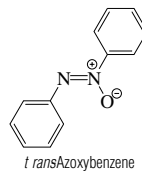
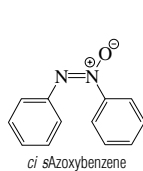
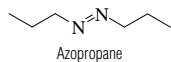
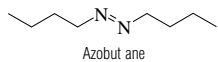
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
508	α -D-Arabi nose		$\text{C}_7\text{H}_{10}\text{O}_5$	31178-68-4	150.130		156		1.585 ²⁵		vs H ₂ O; sl Et OH; i et h, ace, MeOH
509	β -D-Arabi nose		$\text{C}_7\text{H}_{10}\text{O}_5$	31178-69-5	150.130		156		1.625 ²⁵		vs H ₂ O; sl Et OH; i et h, ace, MeOH
510	Arami t e		$\text{C}_7\text{H}_{23}\text{Cl O}_5\text{S}$	140-57-8	334.860		-37.3	195 ²	1.143 ²⁰	1.5100 ²⁰	vs ace, bz, et h, Et OH
511	Arecai di ne	1,2,5,6-Tetrahydro-1-methyl-3-pyridinecarboxylic acid	$\text{C}_7\text{H}_{11}\text{NO}_2$	499-04-7	141.168	pl (di l al) tab (di l al +1w)	232 dec				vs H ₂ O; i Et OH, et h, bz, chl
512	Arecoli ne		$\text{C}_7\text{H}_{13}\text{NO}_2$	63-75-2	155.195			209	1.0485 ²⁰	1.486 ⁻²⁰	msc H ₂ O, Et OH, et h; s chl
513	D-Argi ni ne		$\text{C}_6\text{H}_{11}\text{N}_2\text{O}_2$	7200-25-1	174.201		217 dec				i H ₂ O, Et OH, et h, bz
514	L-Argi ni ne		$\text{C}_6\text{H}_{11}\text{N}_2\text{O}_2$	74-79-3	174.201		244 dec				s H ₂ O; sl Et OH; i et h
515	L-Argi ni ne, monohydrochloride		$\text{C}_6\text{H}_{15}\text{Cl N}_2\text{O}_2$	1119-34-2	210.662		219				
516	Art emisi n	8-Hydroxysantonin	$\text{C}_{15}\text{H}_{16}\text{O}_4$	481-05-0	262.302	cry	203	260 ^{0.1}			sl H ₂ O, chl; s AcOEt; i pet h
517	Ascaridole	1-Methyl-4-isopropyl-2,3-dioxabicyclo[2.2.2]oct-5-ene	$\text{C}_{10}\text{H}_{16}\text{O}_2$	512-85-6	168.233	liq	3.3	exp; 115, 39 ^{0.2}	1.0103 ²⁰	1.4769 ²⁰	i H ₂ O; s Et OH, ace, bz, t ol; sl chl
518	L-Ascorbic acid	Vitamin C	$\text{C}_6\text{H}_8\text{O}_6$	50-81-7	176.124		191 dec		1.65 ²⁵		vs H ₂ O; s Et OH; i et h, bz, chl, pet h
519	Ascorbyl palmitate	6-Hexadecanoyl ascorbic acid	$\text{C}_{22}\text{H}_{38}\text{O}_7$	137-66-6	414.533		112				
520	L-Asparagine	α -Aminosuccinamide	$\text{C}_4\text{H}_7\text{NO}_3$	70-47-3	132.118	orth (w+1)	235		1.543 ⁵		s H ₂ O; i Et OH, et h, MeOH
521	D-Asparagine, monohydrate		$\text{C}_4\text{H}_{10}\text{N}_2\text{O}_4$	5794-24-1	150.133		215		1.523 ¹⁵		sl H ₂ O; i Et OH, et h, bz, MeOH
522	L-Asparagine, monohydrate		$\text{C}_4\text{H}_{10}\text{N}_2\text{O}_4$	5794-13-8	150.133		234		1.543 ¹⁵		sl H ₂ O; i Et OH, et h, bz, MeOH
523	Aspartame	L- α -Aspartyl-L-phenylalanine, 2-methyl ester	$\text{C}_{14}\text{H}_{18}\text{N}_2\text{O}_5$	22839-47-0	294.303	nd (w)	246.5				
524	DL-Aspartic acid		$\text{C}_4\text{H}_7\text{NO}_4$	617-45-8	133.104	mcl pr (w)	277.5		1.6622 ³		sl H ₂ O; i Et OH, et h, bz, py
525	L-Aspartic acid	L-Aminosuccinic acid	$\text{C}_4\text{H}_7\text{NO}_4$	56-84-8	133.104	orth lf (w)	270		1.6608		sl H ₂ O; i Et OH, et h, bz; s dil HCl, py
526	Aspergilliacid		$\text{C}_{12}\text{H}_{20}\text{N}_2\text{O}_2$	490-02-8	224.299	pa ye rods	98				vs bz, et h, Et OH
527	Astemizole		$\text{C}_{21}\text{H}_{31}\text{FN}_3\text{O}$	68844-77-9	458.570	wh cry	149.1				i H ₂ O; s os
528	Asulam	Methyl [(4-aminophenyl)sulfonyl]carbamate	$\text{C}_8\text{H}_{10}\text{N}_2\text{O}_4\text{S}$	3337-71-1	230.241		144				
529	Atenolol		$\text{C}_9\text{H}_{22}\text{N}_2\text{O}_3$	29122-68-7	266.336	cry (AcOEt)	147				sl H ₂ O, di ox, ace; i chl; s MeOH, HOAc
530	Atisine	Antihistone	$\text{C}_{22}\text{H}_{35}\text{NO}_2$	466-43-3	343.503	orth bi pym	58.5				vs et h, Et OH, chl
531	Atrazine		$\text{C}_4\text{H}_4\text{Cl N}_3$	1912-24-9	215.684		173				
532	Atropine		$\text{C}_{17}\text{H}_{23}\text{NO}_3$	51-55-8	289.370	orth nd (di l al)	118.5	sub 95			vs Et OH; i et h; sl chl
533	Auramine hydrochloride		$\text{C}_{16}\text{H}_{24}\text{Cl N}_4\text{O}$	2465-27-2	321.845	ye nd (w)	267				sl H ₂ O
534	Aureothin		$\text{C}_6\text{H}_{23}\text{NO}_6$	2825-00-5	397.421	ye pr	158				vs ace, Et OH, chl
535	Aurin		$\text{C}_9\text{H}_{14}\text{O}_3$	603-45-2	290.312	dk red lf or orth	309 dec				i ₂ O; bz; s Et OH, al k; sl et h, chl
536	Aurintricarboxylic acid, triammonium salt	Aluminon	$\text{C}_7\text{H}_{23}\text{N}_3\text{O}_9$	569-58-4	473.433	red-br pow					s H ₂ O; sl Et OH; i pet h
537	Avermectin B1a	Abamectin	$\text{C}_{48}\text{H}_{72}\text{O}_{14}$	71751-41-2	873.078		152				
538	3-Azabicyclo[3.2.2]nonane		$\text{C}_7\text{H}_{15}\text{N}$	283-24-9	125.212			166 ⁵⁰⁰			
539	1-Azabicyclo[2.2.2]octane	Quinuclidine	$\text{C}_7\text{H}_{13}\text{N}$	100-76-5	111.185	cry (et h)	158				vs H ₂ O, ace, et h, Et OH
540	1-Azabicyclo[2.2.2]octan-3-ol	3-Quinuclidinol	$\text{C}_7\text{H}_{13}\text{NO}$	1619-34-7	127.184	cry (bz)	221	sub 120			s ace
541	Azaticidine	4-Amino- β -D-ribofuranosyl-1,3,5-triazine-2(1H)-one	$\text{C}_8\text{H}_{12}\text{N}_4\text{O}_5$	320-67-2	244.205	cry	229				
542	Azacyclotridecan-2-one		$\text{C}_{13}\text{H}_{23}\text{NO}$	947-04-6	197.317		152.5				
543	8-Azaguanine		$\text{C}_4\text{H}_5\text{N}_5\text{O}$	134-58-7	152.114		300				
544	Azaserine		$\text{C}_4\text{H}_7\text{N}_5\text{O}_4$	115-02-6	173.128	ye-grn orth h cry	150 dec				vs H ₂ O; sl Et OH, ace, MeOH
545	Azathiazoprine	6-[(1-methyl-4-nitro-1H-imidazol-5-yl)thio]-	$\text{C}_8\text{H}_9\text{N}_5\text{O}_2\text{S}$	446-86-6	277.263	ye cry	243 dec				sl H ₂ O, Et OH, chl



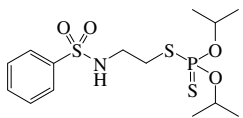
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
546	6-Azauri di ne	<i>B-D</i> -Ri bof uranosyl -1,2,4-tri azi ne 3,5-(2 <i>H</i> ,4 <i>H</i>)-di one	C ₈ H ₁₁ N ₃ O ₆	54-25-1	245.189		158				s H ₂ O
547	Azet i di ne		C ₂ H ₃ N	503-29-7	57.095	liq	-70.0	63	0.843 ⁹	1.4287 ²⁵	vs ace, bz, et h, Et OH
548	2-Azet i di necarboxyl i c aci d		C ₄ H ₅ NO ₂	2517-04-6	101.105	cry (95% MeOH)	217 dec				
549	2-Azet i di none		C ₂ H ₃ NO	930-21-2	71.078		73.5	106 ¹⁵			vs et h, Et OH, chl
550	Azi do benzene		C ₆ H ₃ N ₃	622-37-7	119.124	pa ye oi l	-27.5	70	1.0860 ²⁰	1.5589 ²⁵	i H ₂ O; sl Et OH, et h
551	1-Azi do-4-chl oro benzene		C ₆ H ₄ ClN ₃	3296-05-7	153.569		20	96 ²⁰	1.2634 ²⁵		i H ₂ O; s et h
552	2-Azi do et hanol		C ₆ H ₃ N ₃ O	1517-05-1	87.080			75 ⁴⁰	1.146 ²⁴		vs H ₂ O
553	1-Azi do-4-met hyl benzene		C ₇ H ₇ N ₃	2101-86-2	133.151		-29.0	dec 180; 80 ¹⁰	1.0527 ²³		vs et h, Et OH
554	(Azi do met hyl) benzene		C ₇ H ₇ N ₃	622-79-7	133.151			108 ²³ , 78 ¹²	1.0730 ¹⁹	1.5341 ²⁵	i H ₂ O; msc Et OH, et h
555	Azi nphos et hyl		C ₆ H ₁₀ N ₃ O ₃ PS ₂	2642-71-9	345.377	nd	53	111 ^{0,001}	1.284 ²⁰		reac al k
556	Azi nphos-met hyl		C ₆ H ₁₂ N ₃ O ₃ PS ₂	86-50-0	317.324		73		1.44 ²⁰		
557	1-Azi ri di ne et hanol		C ₄ H ₇ NO	1072-52-2	87.120			168	1.088 ²⁵	1.4560 ²⁰	
558	<i>t rans</i> Azobenzene	<i>t rans</i> Di phenyl di azene	C ₁₀ H ₁₀ N ₂	17082-12-1	182.220	oran-red mcl l f (al)	67.88	293	1.203 ²⁰	1.6266 ⁷⁸	sl H ₂ O; s Et OH, et h, bz, chl; vs py
559	<i>cis</i> Azobenzene	<i>cis</i> Di phenyl di azene	C ₁₀ H ₁₀ N ₂	1080-16-6	182.220	oran-red pl (pet h)	71				sl H ₂ O; s Et OH, et h, bz, HOAc, li g
560	3,3'-Azobenzenedi sul f onyl chl ori de		C ₁₂ H ₈ Cl ₂ N ₂ O ₄ S ₂	104115-88-0	379.239	red nd (et h)	166.5				vs et h
561	1,1'-Azobi scycl ohexanecarboni t ri le		C ₁₄ H ₁₆ N ₄	2094-98-6	244.336		100				i H ₂ O; s li g
562	2,2'-Azobi s[li sobut yroni t ri le]	2,2'-Azobi s[2-met hyl propi oni t ri le]	C ₁₆ H ₂₀ N ₄	78-67-1	164.208						i H ₂ O; sl Et OH, et h
563	Azobut ane		C ₈ H ₁₀ N ₂	2159-75-3	142.242			60 ¹⁸			
564	Azopropane		C ₆ H ₁₀ N ₂	821-67-0	114.188			114			
565	<i>cis</i> Azoxybenzene	Di phenyl di azene 1-oxi de (c)	C ₁₂ H ₁₀ N ₂ O	21650-65-7	198.219		87		1.166 ²⁰	1.633 ²⁰	
566	<i>t rans</i> Azoxybenzene	Di phenyl di azene 1-oxi de (z)	C ₁₂ H ₁₀ N ₂ O	20972-43-4	198.219		34.6		1.1590 ²⁶		i H ₂ O; s Et OH, et h
567	Azoxyet hane	Di et hyl di azi ne 1-oxi de	C ₄ H ₁₀ N ₂ O	16301-26-1	102.134	liq		46			
568	Azul ene	Bi cycl ol[5.3.0]decapent aene	C ₁₀ H ₈	275-51-4	128.171	bl or gr-bl k l f (al)	99	dec 270; 125 ¹⁰			i H ₂ O; s Et OH, et h, ace, aci d; sl chl
569	Balan	<i>N</i> -But yl <i>N</i> -et hyl -2,6-di ni t ro-4-(t ri fluoromet hyl)ani li ne	C ₁₃ H ₁₆ F ₃ N ₃ O ₄	1861-40-1	335.279		66	121 ^{0,5} , 148 ⁷			
570	Barban		C ₁₁ H ₉ Cl ₂ NO ₂	101-27-9	258.101		75				
571	Barbi t al	5,5-Di et hyl barbi t uri c aci d	C ₈ H ₁₂ N ₂ O ₃	57-44-3	184.192	nd (w)	190		1.220 ²⁵		sl H ₂ O; s Et OH, et h, ace, chl, li g, t f a
572	Barbi t uri c aci d		C ₄ H ₄ N ₂ O ₃	67-52-7	128.086	ort h pr (w +2)	248	dec 260			s H ₂ O, et h; sl Et OH
573	Bayl et on	Tri adi mef on	C ₁₄ H ₁₆ Cl ₂ N ₂ O ₂	43121-43-3	293.749		82		1.22 ²⁰		
574	Bebeeri ne		C ₃₆ H ₃₈ N ₂ O ₆	477-60-1	594.696	cry (bz, et h, chl -MeOH)	221				s Et OH, MeOH, et h; vs ace, chl
575	Benact yzi ne	2-(Di et hyl ami no)et hyl benzi lat e	C ₂₀ H ₂₅ N ₃	302-40-9	327.418	cry	51				
576	Benact yzi ne hydrochl ori de	2-Di et hyl ami noet hyl benzi lat e hydrochl ori de	C ₂₀ H ₂₆ ClN ₃ O	57-37-4	363.878		177.5				s H ₂ O; i et h
577	Benal axyl		C ₉ H ₁₃ NO ₃	71626-11-4	325.402		79		1.27 ²⁵		
578	Bendi ocarb	1,3-Benzodi oxol-4-ol, 2,2-di met hyl	C ₁₁ H ₁₃ NO ₄	22781-23-3	223.226		130		1.25 ²⁰		
579	Bendroflumet hi azi de		C ₁₉ H ₁₄ F ₃ N ₃ O ₄ S ₂	73-48-3	421.415	cry	225				i H ₂ O, bz, et h; s Et OH, ace
580	Benomyl		C ₇ H ₁₃ N ₃ O ₃	17804-35-2	290.318			dec			
581	Bensul f uron-met hyl		C ₁₀ H ₁₃ N ₄ O ₇ S	83055-99-6	410.402		187				



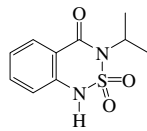
3-35



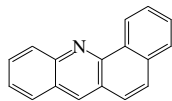
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
582	Bensulide		C ₆ H ₂₄ NO ₄ PS ₃	741-58-2	397.514		34.4		1.224 ²⁰		
583	Bentazon		C ₁₀ H ₁₂ N ₂ O ₃ S	25057-89-0	240.278		138				
584	Benz[c]acridine	12-Azabenz[a]anthracene	C ₁₇ H ₁₁ N	225-51-4	229.276	nd (di l al)	132				vs bz, et h, Et OH
585	Benzaldehyde	Benzenecarboxaldehyde	C ₇ H ₆ O	100-52-7	106.122	li q	-57.1	178.8	1.040 ⁶	1.5463 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace, bz
586	Benzaldehyde hydrazone	Benzylidenehydrazine	C ₇ H ₈ N ₂	5281-18-5	120.152	lf	16	140			s Et OH
587	<i>cis</i> -Benzaldehyde oxime		C ₇ H ₉ NO	622-32-2	121.137	pr	36.5	200	1.1111 ²⁰	1.5908 ²⁰	vs bz, et h, Et OH
588	<i>trans</i> -Benzaldehyde oxime		C ₇ H ₉ NO	622-31-1	121.137	nd (et h)	35	119 ⁹	1.145 ²⁰		s H ₂ O; vs Et OH, et h
589	Benzaldehyde, phenylhydrazone		C ₁₅ H ₁₂ N ₂	588-64-7	196.247	nd (li g), pr	157.0				sl Et OH, et h; s ace, bz, li q NH
590	Benzaldehyde, (phenylmethylene)hydrazone		C ₁₄ H ₁₂ N ₂	588-68-1	208.258	ye pr (al)	93				i H ₂ O; s Et OH, et h, ace, bz, chl; sl ct c
591	Benzamide	Benzoylamine	C ₇ H ₇ NO	55-21-0	121.137	mcl pr or pl (w)	127.3	290	1.0792 ²⁰		sl H ₂ O, et h, bz; vs Et OH, ct c, CS
592	Benz[a]anthracene	1,2-Benzanthracene	C ₁₈ H ₁₂	56-55-3	228.288	lf (al)	160.5	438			i ₂ OH vs Et OH
593	Benz[a]anthracene-7,12-dione		C ₁₈ H ₁₀ O ₂	2498-66-0	258.271		170.5				sl Et OH, et h, li g; s ace; vs bz, chl
594	Benzanthrone		C ₁₇ H ₁₀ O	82-05-3	230.260		170				sl bz
595	Benzene	[6]Annulene	C ₆ H ₆	71-43-2	78.112	ort h pr or li q	5.49	80.09	0.8785	1.5011 ²⁰	sl H ₂ O; msc Et OH, et h, ace, chl; s ct c
596	Benzeneacetaldehyde	Phenylacetaldehyde	C ₈ H ₈ O	122-78-1	120.149		33.5	195	1.0272 ²⁰	1.5255 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
597	Benzeneacetamide	α-Phenylacetamide	C ₈ H ₉ NO	103-81-1	135.163		157				sl H ₂ O, et h, bz; s Et OH
598	Benzeneacetamide	Phenylacetamide	C ₈ H ₉ NO	103-82-2	136.149	lf, pl (pet h)	76.5	265.5	1.228		sl H ₂ O, chl; vs Et OH, et h; s ace; li g
599	Benzeneacetamide, hydrazide		C ₈ H ₈ N ₂ O	937-39-3	150.177		115.5				
600	Benzeneacetamide anhydride		C ₁₀ H ₈ O ₃	1555-80-2	254.280	pr or nd (et h)	73.3	195 ²			vs et h, chl
601	Benzeneacetonitrile	Benzyl cyanide	C ₈ H ₇ NC	140-29-4	117.149	li q	-23.8	233.5	1.0205	1.5211 ²⁵	
602	Benzeneacetyl chloride	Phenylacetyl chloride	C ₈ H ₇ ClO	103-80-0	154.594			170 ³⁰ , 105 ²⁴	1.1682 ²⁰	1.5325 ²⁰	vs et h
603	Benzenearsenic acid		C ₆ H ₅ AsO ₃	98-05-5	202.040	cry (w)	158 dec				vs H ₂ O, Et OH
604	Benzeneboronic acid		C ₆ H ₅ BO ₂	98-80-6	121.930		219				sl H ₂ O; s Et OH, et h, bz
605	Benzenebutanoic acid		C ₁₀ H ₁₂ O ₂	1821-12-1	164.201	lf (w)	52	290			s H ₂ O, Et OH, et h
606	Benzenebutanol		C ₁₀ H ₁₄ O	3360-41-6	150.217			140 ¹⁴		1.5214 ²⁰	
607	Benzenebiperoxydic acid	Perbenzoic acid	C ₇ H ₆ O ₃	93-59-4	138.121	mcl pl (pet h)	42	100			vs ace, bz, et h, Et OH
608	Benzenebiphenylamine		C ₁₂ H ₉ NS	2227-79-4	137.203		117				
609	Benzenebiphenylamine		C ₁₂ H ₉ OS	98-91-9	138.187	ye pl (HOAc)	24	86 ⁰	1.28 ²⁰	1.6040 ²⁰	vs ace, bz, et h, Et OH
610	Benzenebiphenylamine, monohydrochloride		C ₁₇ H ₉ ClN	1670-14-0	156.612	ort h pr (w +2)	169				s H ₂ O, Et OH; sl t f a
611	1,2-Benzenediamine	o-Phenylenediamine	C ₆ H ₈ N ₂	95-54-5	108.141	brsh ye lf (w) pl (chl)	102.1	257			s H ₂ O, et h, bz, chl; vs Et OH
612	1,3-Benzenediamine	m-Phenylenediamine	C ₆ H ₈ N ₂	108-45-2	108.141	ort h (al)	66.0	285	1.0096	1.6339 ⁵⁸	vs H ₂ O; s Et OH, et h, bz
613	1,4-Benzenediamine	p-Phenylenediamine	C ₆ H ₈ N ₂	106-50-3	108.141	wh pl (bz, et h)	141.1	267			sl H ₂ O; s Et OH, et h, bz, chl
614	1,2-Benzenediamine, dihydrochloride		C ₆ H ₁₀ Cl ₂ N ₂	615-28-1	181.062		250 dec				
615	1,3-Benzenediamine, dihydrochloride		C ₆ H ₁₀ Cl ₂ N ₂	541-69-5	181.062						s H ₂ O
616	1,4-Benzenediamine, dihydrochloride		C ₆ H ₁₀ Cl ₂ N ₂	624-18-0	181.062						s H ₂ O
617	1,2-Benzenediamine carbonyl dihydrochloride	Phthaloyl dihydrochloride	C ₈ H ₆ Cl ₂ O ₂	88-95-9	203.023		15.5	281.1	1.4089 ²⁰	1.5684 ²⁰	
618	1,3-Benzenediamine carbonyl dihydrochloride		C ₈ H ₆ Cl ₂ O ₂	99-63-8	203.023	pr(et h)	43.5	276	1.3880 ⁷	1.570 ⁴⁷	sl H ₂ O, Et OH; s et h
619	1,4-Benzenediamine carbonyl dihydrochloride		C ₈ H ₆ Cl ₂ O ₂	100-20-9	203.023	nd or pl (li g)	83.5	258; 125			s et h
620	1,2-Benzenediamine carboxaldehyde		C ₇ H ₆ O ₂	643-79-8	134.133	ye cry or nd (li g)	55.8	83 ^{9,8}			vs et h, Et OH
621	1,3-Benzenediamine carboxaldehyde		C ₇ H ₆ O ₂	626-19-7	134.133	nd (di l al)	89.5	246; 136			sl H ₂ O, et h, chl; vs Et OH; s ace, bz



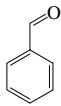
Bensulide



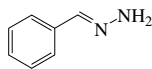
Bentazon



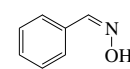
Benz[c]acridine



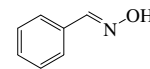
Benzaldehyde



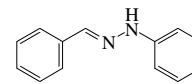
Benzaldehydehydrazone



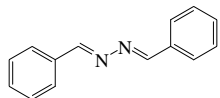
cis-Benzaldehydeoxime



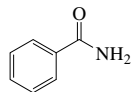
trans-Benzaldehydeoxime



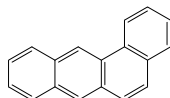
Benzaldehyde, phenyl hydrazone



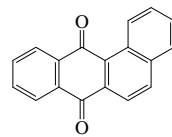
Benzaldehyde, (phenylmethylene)hydrazone



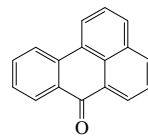
Benzamide



Benz[a]anthracene



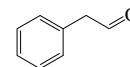
Benz[a]anthracene-7,12-dione



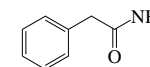
Benzanthrone



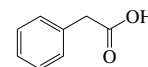
Benzene



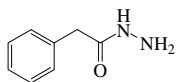
Benzeneacet aldehyde



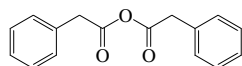
Benzeneacet amide



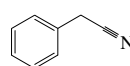
Benzeneacet ic acid



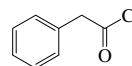
Benzeneacet ic acidhydrazide



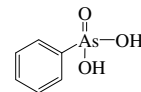
Benzeneacet ic anhydride



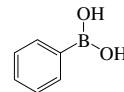
Benzeneacet onitrile



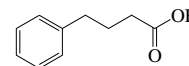
Benzeneacet ylchloride



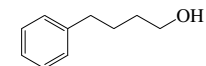
Benzenearsonic acid



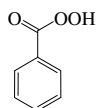
Benzeneboronic acid



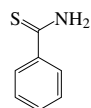
Benzenebut anoid acid



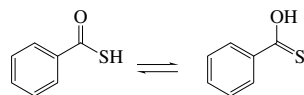
Benzenebut anol



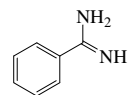
Benzenecarboxylic acid



Benzenecarbothioamide

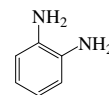


Benzenecarbothioic acid

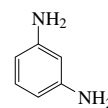


Benzenecarboximidamide monohydrochloride

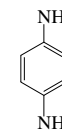
HCl



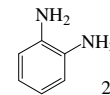
1,2-Benzenediamine



1,3-Benzenediamine

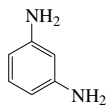


1,4-Benzenediamine



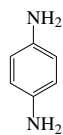
1,2-Benzenediamine dihydrochloride

2HCl



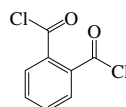
1,3-Benzenediamine dihydrochloride

2HCl

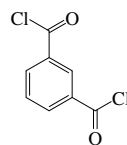


1,4-Benzenediamine dihydrochloride

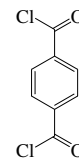
2HCl



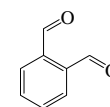
1,2-Benzenedicarbonyl chloride



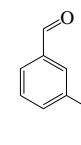
1,3-Benzenedicarbonyl chloride



1,4-Benzenedicarbonyl chloride

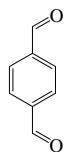


1,2-Benzenedicarboxaldehyde

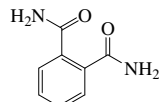


1,3-Benzenedicarboxaldehyde

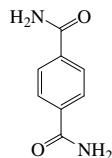
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
622	1,4-Benzenedi carboxyl dehyde		$\text{C}_6\text{H}_4\text{O}_2$	623-27-8	134.133	nd (w)	117	246			sl H_2O ; vs Et OH; s et h, chl, al k
623	1,2-Benzenedi carboxami de	Pht hal ami de	$\text{C}_6\text{H}_4\text{N}_2\text{O}_2$	88-96-0	164.162	cry	222	dec			sl H_2O , Et OH; i et h
624	1,4-Benzenedi carboxami de		$\text{C}_6\text{H}_4\text{N}_2\text{O}_2$	3010-82-0	164.162	nd (w), pl (HOAc)	322.3				
625	1,2-Benzenedi carboxyl i c aci d, bi s(2-Bi s(2-but oxyet hyl) pht hal at e but oxyet hyl) est er		$\text{C}_{20}\text{H}_{30}\text{O}_6$	117-83-9	366.448			270			
626	1,2-Benzenedi carboxyl i c aci d, bi s(2-Bi s(2-met hoxyet hyl) pht hal at e met hoxyet hyl) est er		$\text{C}_{14}\text{H}_{18}\text{O}_6$	117-82-8	282.289		-60.0	230 ¹⁰	1.1596 ²⁰		
627	1,2-Benzenedi carboxyl i c aci d, di al lyl pht hal at e est er		$\text{C}_{14}\text{H}_{16}\text{O}_4$	131-17-9	246.259			161 ⁴			
628	1,2-Benzenedi carboxyl i c aci d, di propyl pht hal at e di propyl est er		$\text{C}_{14}\text{H}_{18}\text{O}_4$	131-16-8	250.291	li q	-31.0	304.5	1.076 ⁷		i H_2O ; s Et OH, et h
629	1,3-Benzenedi met hanami ne	<i>m</i> -Xyl ene di ami ne	$\text{C}_6\text{H}_{12}\text{N}_2$	1477-55-0	136.194			247	1.052 ²⁰		vs H_2O , et h, Et OH
630	1,2-Benzenedi met hanol		$\text{C}_6\text{H}_{10}\text{O}_2$	612-14-6	138.164	pl (et h, pet h)	64.8	145			s H_2O , Et OH; vs et h; sl bz
631	1,3-Benzenedi met hanol		$\text{C}_6\text{H}_{10}\text{O}_2$	626-18-6	138.164	nd (bz)	57	156 ¹³	1.1610 ¹⁸		vs H_2O , et h, Et OH
632	1,4-Benzenedi met hanol		$\text{C}_6\text{H}_{10}\text{O}_2$	589-29-7	138.164	nd (w)	117.5	140 ¹			vs H_2O , ace, et h, Et OH
633	1,2-Benzenedi ol, di acet at e		$\text{C}_{10}\text{H}_{10}\text{O}_4$	635-67-6	194.184	nd (al)	64.5	142 ²			i H_2O ; vs Et OH, et h, chl; s pet h
634	1,4-Benzenedi ol, di acet at e		$\text{C}_{10}\text{H}_{10}\text{O}_4$	1205-91-0	194.184	pl (w, al)	123.5		0.873 ¹⁵		s H_2O ; vs Et OH, et h, chl, li g
635	1,3-Benzenedi ol, monobenzoat e		$\text{C}_9\text{H}_{10}\text{O}_3$	136-36-7	214.216		134.5				
636	1,3-Benzenedi sulf oni c aci d		$\text{C}_6\text{H}_6\text{O}_2\text{S}_2$	98-48-6	238.238	hyg cry					
637	1,3-Benzenedi sulf onyl di chl ori de		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2\text{S}_2$	585-47-7	275.130		61.8	195 ^{10,5}			
638	1,2-Benzenedi thi ol		$\text{C}_6\text{H}_6\text{S}_2$	17534-15-5	142.242		28.5	238.5			vs Et OH, et h, bz; s AcOEt
639	1,3-Benzenedi thi ol		$\text{C}_6\text{H}_6\text{S}_2$	626-04-0	142.242	lf	27	245			vs bz, et h, Et OH
640	Benzeet hanami ne	1-Ami no-2-phenyl et hane	$\text{C}_6\text{H}_7\text{CN}$	64-04-0	121.180	li q	<0	195	0.964 ⁸	1.5290 ²⁵	s H_2O , ct c; vs Et OH, et h
641	Benzeet hanami ne, hydrochl ori de		$\text{C}_6\text{H}_7\text{ClN}$	156-28-5	157.641	pl or lf (al)	218.5				vs H_2O , Et OH
642	Benzeet hanol	Phenet hyl al cohol	$\text{C}_6\text{H}_7\text{O}$	60-12-8	122.164	li q	-27	218.2	1.020 ⁸	1.5325 ²⁰	sl H_2O ; msc Et OH, et h
643	Benzenehexacarboxyl i c aci d	Melli ti c aci d	$\text{C}_{12}\text{H}_6\text{O}_6$	517-60-2	342.169	nd (al)	287 dec				vs H_2O ; s Et OH, sulf
644	Benzenemet hanami ne, hydrochl ori de		$\text{C}_6\text{H}_7\text{ClN}$	3287-99-8	143.614		258.3	93			vs H_2O , Et OH
645	Benzenemet hanesulf onyl chl ori de		$\text{C}_6\text{H}_5\text{ClO}_2\text{S}$	1939-99-7	190.648	pr (et h), nd (bz)		92.0			vs et h, bz
646	Benzenemet hanesulf onyl fluori de		$\text{C}_6\text{H}_5\text{FO}_2\text{S}$	329-98-6	174.193			92.0			
647	Benzenemet hanet hi ol	Thi obenyl al cohol	$\text{C}_7\text{H}_9\text{S}$	100-53-8	124.204	li q	-30	194.5	1.05 ⁸	1.5151 ²⁰	i H_2O ; vs Et OH, et h; sl ct c; s CS_2
648	Benzenepent anoi c aci d	5-Phenyl val eri c aci d	$\text{C}_{11}\text{H}_{13}\text{O}_2$	2270-20-4	178.228	pl (w), pr (pet h)	57.5	19 ⁸			sl H_2O ; vs Et OH; s os
649	Benzenepent anol		$\text{C}_9\text{H}_{16}\text{O}$	10521-91-2	164.244			155 ²⁰ , 150 ¹⁸	0.9725 ²⁰	1.5156 ²⁰	vs et h, Et OH
650	Benzenepropanal	Hydroci nnami c al dehyde	$\text{C}_9\text{H}_{10}\text{O}$	104-53-0	134.174	mcl	47	224; 117 ²⁰	1.0190 ²⁰		i H_2O ; vs Et OH; msc et h
651	Benzenepropaneni t ri le	Hydroci nnamoni t ri le	$\text{C}_9\text{H}_9\text{N}$	645-59-0	131.174	li q	-1	261; 14 ¹⁵	1.0016 ²⁰	1.5266 ²⁸	s Et OH, et h; sl chl
652	Benzenepropanet hi ol		$\text{C}_9\text{H}_{12}\text{S}$	24734-68-7	152.256			121 ²³ , 109 ¹⁰	1.01 ²⁵	1.5494 ²⁰	
653	Benzenepropanoi c aci d	Hydroci nnami c aci d	$\text{C}_9\text{H}_8\text{O}_2$	501-52-0	150.174	nd (w)	48	279.8	1.0712 ⁴⁹		s H_2O , Et OH, et h, ct c, CS_2 vs bz
654	Benzenepropanol	Hydroci nnamyl al cohol	$\text{C}_9\text{H}_{10}\text{O}$	122-97-4	136.190		<-18	235	0.995 ²⁵	1.5357 ²⁵	s H_2O , ct c; msc Et OH, et h
655	Benzenepropanol carbamat e	Phenprobamat e	$\text{C}_9\text{H}_{13}\text{NO}_2$	673-31-4	179.216		102				i H_2O ; s Et OH, chl
656	Benzenepropanoyl chl ori de		$\text{C}_9\text{H}_9\text{ClO}$	645-45-4	168.619			dec 225; 105 ¹⁰	1.135 ²¹		s et h, CS_2
657	Benzenesel eni ni c aci d	Phenyl sel eni ni c aci d	$\text{C}_6\text{H}_5\text{O}_2\text{Se}$	6996-92-5	189.07		124.5		1.93 ²⁰		sl H_2O ; i bz; vs al k
658	Benzenesel enol		$\text{C}_6\text{H}_5\text{Se}$	645-96-5	157.07			183.6; 84 ²⁵	1.4865 ¹⁵		i H_2O ; s Et OH; vs et h, ct c
659	Benzenesul fini c aci d		$\text{C}_6\text{H}_5\text{O}_2\text{S}$	618-41-7	142.176	pr (w)	84	dec			sl H_2O ; s Et OH, et h, bz; i pet h
660	Benzenesul finyl chl ori de		$\text{C}_6\text{H}_5\text{ClOS}$	4972-29-6	160.621	pl (pet h)	38	7 ¹⁵	1.3469 ²⁵	1.3470 ²⁵	s et h, chl
661	Benzenesul fonami de		$\text{C}_6\text{H}_5\text{NO}_2\text{S}$	98-10-2	157.191	lf, nd (w)	156				sl H_2O , t f a; s Et OH, et h
662	Benzenesul foni c aci d	Besyl i c aci d	$\text{C}_6\text{H}_5\text{OCS}$	98-11-3	158.175	nd (bz)	65				vs H_2O , Et OH; i et h; sl bz; s HOAc



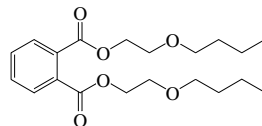
1,4-Benzenedi-carboxaldehyde



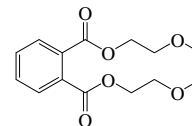
1,2-Benzenedi-carboxamide



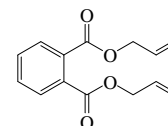
1,4-Benzenedi-carboxamide



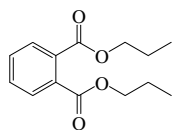
1,2-Benzenedi-carboxylic acid dibis(2-butoxyethyl) ester



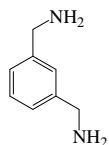
1,2-Benzenedi-carboxylic acid bis(2-methoxyethyl) ester



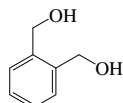
1,2-Benzenedi-carboxylic acid diallyl ester



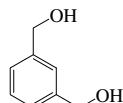
1,2-Benzenedi-carboxylic acid dipropyl ester



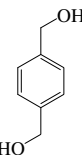
1,3-Benzenedi-methanamine



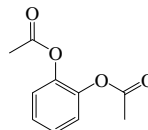
1,2-Benzenedi-methanol



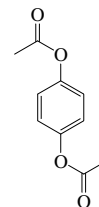
1,3-Benzenedi-methanol



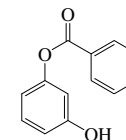
1,4-Benzenedi-methanol



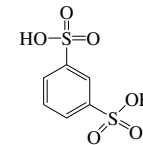
1,2-Benzenedi-ol diacetate



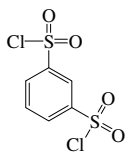
1,4-Benzenedi-ol diacetate



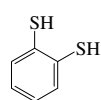
1,3-Benzenedi-ol monobenzoate



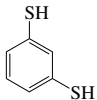
1,3-Benzenedi-sulfonic acid



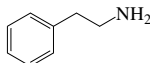
1,3-Benzenedi-sulfonil chloride



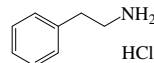
1,2-Benzenedi-thiol



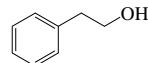
1,3-Benzenedi-thiol



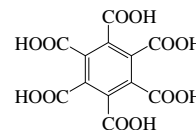
Benzenetri-amine



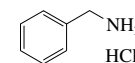
Benzenetri-amine hydrochloride



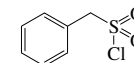
Benzenetri-ol



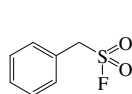
Benzenetri-carboxylic acid



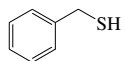
Benzenetri-amine hydrochloride



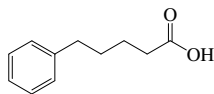
Benzenetri-sulfonil chloride



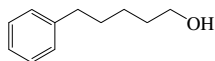
Benzenetri-sulfonil fluoride



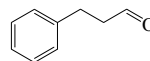
Benzenetri-mercaptan



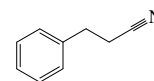
Benzenetri-carboxylic acid



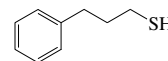
Benzenetri-ol



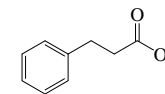
Benzenetri-propanal



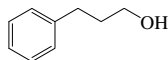
Benzenetri-propanenitrile



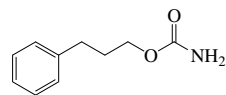
Benzenetri-propanethiol



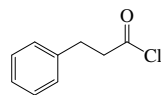
Benzenetri-propanoic acid



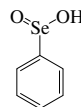
Benzenetri-propanol



Benzenetri-propanoic acid carbamate



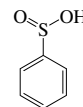
Benzenetri-propanoyl chloride



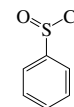
Benzenetri-selenic acid



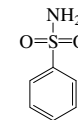
Benzenetri-selenol



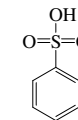
Benzenetri-sulfonic acid



Benzenetri-sulfonil chloride

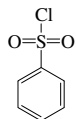


Benzenetri-sulfonamide

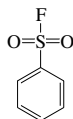


Benzenetri-sulfonic acid

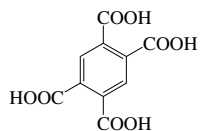
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
663	Benzenesulfonyl chloride	Phenylsulfonyl chloride	$\text{C}_6\text{H}_5\text{ClO}_2\text{S}$	98-09-9	176.621		14.5	dec 251	1.3470 ¹⁵		i H ₂ O; vs Et OH; s et h, ct c
664	Benzenesulfonyl fluoride	Phenylsulfonyl fluoride	$\text{C}_6\text{H}_5\text{FO}_2\text{S}$	368-43-4	160.166			203.5	1.3286 ²⁰	1.4932 ¹⁸	s Et OH, et h
665	1,2,4,5-Benzenetetra-carboxylic acid	Pyromellitic acid	$\text{C}_{10}\text{H}_2\text{O}_8$	89-05-4	254.150	tbl pr (w+2)	276				sl H ₂ O; s Et OH
666	Benzenethiol	Phenyl mercaptan	$\text{C}_6\text{H}_5\text{S}$	108-98-5	110.177	liq	-14.93	169.1	1.0779	1.5893 ²⁰	i H ₂ O; s Et OH, et h, bz; sl ct c
667	1,3,5-Benzenetricarbonyl chloride		$\text{C}_6\text{H}_3\text{Cl}_3\text{O}_3$	4422-95-1	265.477		36.3	180 ¹⁶			s chl
668	1,2,3-Benzenetricarboxylic acid	Hemimellitic acid	$\text{C}_6\text{H}_3\text{O}_6$	569-51-7	210.140	pr (al)	200		1.546 ²⁰		vs et h, Et OH
669	1,2,4-Benzenetricarboxylic acid	Trimellitic acid	$\text{C}_6\text{H}_3\text{O}_6$	528-44-9	210.140	nd (w) cry (al) cry (HOAc)	219				vs H ₂ O, et h, Et OH
670	1,3,5-Benzenetricarboxylic acid		$\text{C}_6\text{H}_3\text{O}_6$	554-95-0	210.140	pr or nd (w+1)	380				sl H ₂ O; vs Et OH, et h
671	1,2,4-Benzenetricarboxylic acid 1,2,4-(Chloroformyl)phthalic anhydride, 4-chloride		$\text{C}_6\text{H}_3\text{ClO}_4$	1204-28-0	210.571		66				
672	1,2,4-Benzenetricarboxylic acid, triallyl ester		$\text{C}_{18}\text{H}_{18}\text{O}_6$	2694-54-4	330.332		<-30		1.164 ²⁰		
673	1,2,3-Benzenetriol	Pyrogallol	$\text{C}_6\text{H}_3\text{O}_3$	87-66-1	126.110	lf or nd (bz)	133	309	1.458	1.561 ¹³⁴	vs H ₂ O, Et OH, et h, NH ₃ s ace; i bz
674	1,2,4-Benzenetriol	Hydroxyhydroquinone	$\text{C}_6\text{H}_4\text{O}_3$	533-73-3	126.110	pl (et h), lf or pl (w)	140.5				vs H ₂ O, Et OH, et h; i bz, chl
675	1,3,5-Benzenetriol	Phloroglucinol	$\text{C}_6\text{H}_3\text{O}_3$	108-73-6	126.110	lf or pl (w+2)	218.5	sub	1.46		sl H ₂ O; vs Et OH, et h, bz, py; s ace
676	1,2,4-Benzenetriol triacetate		$\text{C}_{12}\text{H}_9\text{O}_6$	613-03-6	252.219		99	300			s Et OH, chl, MeOH
677	Benzestrol		$\text{C}_{20}\text{H}_{26}\text{O}_2$	85-95-0	298.419	cry (al)	164				vs ace, et h, Et OH, HOAc
678	Benzethionium chloride		$\text{C}_{12}\text{H}_{14}\text{ClNO}_2$	121-54-0	448.081	pl (chl/et h)	165 (hyd)				vs H ₂ O; s ace, chl, Et OH
679	Benzene-3,3'-dicarboxylic acid	3,3'-Dicarboxybenzidine	$\text{C}_{14}\text{H}_{12}\text{N}_2\text{O}_4$	2130-56-5	272.256	nd	300 dec				
680	p-Benzidine	[1,1'-Bi(phenyl)]-4,4'-diamine	$\text{C}_{12}\text{H}_{10}\text{N}_2$	92-87-5	184.236	nd (w)	120	401			sl H ₂ O, et h, DMSO; s Et OH
681	Benzidine	Di phenylethanedione	$\text{C}_{14}\text{H}_{10}\text{O}_2$	134-81-6	210.228	ye pr (al)	94.87	347	1.084 ⁰²		i H ₂ O; vs Et OH, et h; s ace; sl ct c
682	1H-Benzimidazole-2-amine		$\text{C}_7\text{H}_7\text{N}_3$	934-32-7	133.151	pl (w)	224				s H ₂ O, Et OH, ace; sl et h, bz, DMSO
683	1H-Benzimidazole	N,N'-Methylen-bis(phenyl)ethylenediamine	$\text{C}_{12}\text{H}_{14}\text{N}_2$	51-17-2	118.136	ort h bi pym pl (w)	170.5	>360			sl H ₂ O, et h; vs Et OH; i bz; s di l al k
684	1H-Benzimidazole-2-acetone		$\text{C}_9\text{H}_7\text{N}_2\text{O}$	4414-88-4	157.172		208.4				
685	1H-Benzimidazole-1,2-dione		$\text{C}_{12}\text{H}_7\text{N}_2\text{O}_2$	81-83-4	197.190	nd (chl-al)	300				
686	Benzo[<i>c</i>]chrysene		$\text{C}_{22}\text{H}_{14}$	194-69-4	278.346	nd (AcOH)	126.5				
687	Benzo[<i>g</i>]chrysene	Benzo[<i>a</i>]anthracene	$\text{C}_{22}\text{H}_{14}$	196-78-1	278.346	nd (AcOH)	114.5				
688	1H,3H-Benzo[1,2- <i>c</i> :4,5- <i>c'</i>]diphenyl-1,3,5,7-tetrol		$\text{C}_{10}\text{H}_2\text{O}_6$	89-32-7	218.119		285.3				
689	1,3,2-Benzodioxaborole		$\text{C}_5\text{H}_5\text{BO}_2$	274-07-7	119.914		12	88 ¹⁵⁶ , 50 ⁵⁰	1.2700 ²⁰	1.5070 ²⁰	
690	1,3-Benzodioxole-5-amine		$\text{C}_7\text{H}_7\text{NO}_2$	14268-66-7	137.137		42	144 ¹⁶			
691	1,3-Benzodioxole		$\text{C}_7\text{H}_6\text{O}_2$	274-09-9	122.122			172.5; 77 ²⁷	1.064 ²⁵	1.5398 ²⁰	
692	1,3-Benzodioxole-5-carboxaldehyde	Piperonal	$\text{C}_8\text{H}_6\text{O}_3$	120-57-0	150.132		37	263			sl H ₂ O; vs Et OH; msc et h; s ace, chl
693	1,3-Benzodioxole-5-carboxylic acid	Piperonylic acid	$\text{C}_8\text{H}_6\text{O}_4$	94-53-1	166.132		229				
694	1,3-Benzodioxole-5-ethanamine		$\text{C}_8\text{H}_9\text{NO}_2$	1484-85-1	165.189			166 ²⁰ , 101 ¹	1.225 ²⁰	1.5620 ²⁰	
695	1,3-Benzodioxole-5-methanamine		$\text{C}_8\text{H}_8\text{NO}_2$	2620-50-0	151.163			139 ¹³ , 100 ⁰⁷	1.214 ²⁵	1.5635 ²⁰	
696	1,3-Benzodioxole-5-methanol		$\text{C}_8\text{H}_8\text{O}_3$	495-76-1	152.148	nd (pet h)	58	157 ²⁵			sl H ₂ O; s Et OH, et h, bz, chl; i li g
697	1,3-Benzodioxole-5-ol		$\text{C}_8\text{H}_8\text{O}_3$	533-31-3	138.121		64.9				
698	trans-5-(1,3-Benzodioxole-5-yl)-2,4-pentadienol	Piperonal-5-yl-2,4-pentadienol	$\text{C}_{12}\text{H}_{10}\text{O}_4$	136-72-1	218.205	nd (al), ye nd (sub)	215.8	sub			vs Et OH



Benzene sulfenyl chloride



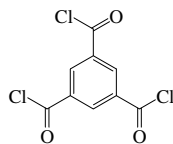
Benzene sulfonyl fluoride



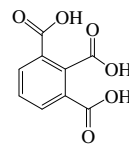
1,2,4,5-Benzenetetracarboxylic acid



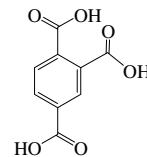
Benzenethiol



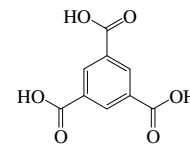
1,3,5-Benzenetricarbonyl chloride



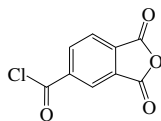
1,2,3-Benzenetricarboxylic acid



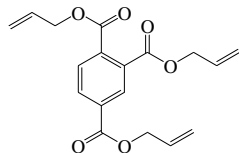
1,2,4-Benzenetricarboxylic acid



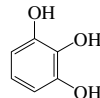
1,3,5-Benzenetricarboxylic acid



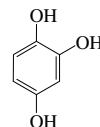
1,2,4-Trichlorobenzene



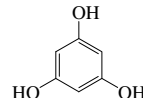
1,2,4-Tris(allyloxy)benzene



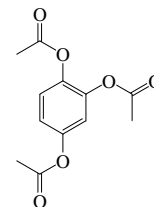
1,2,3-Trisubstituted benzene



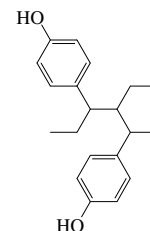
1,2,4-Trisubstituted benzene



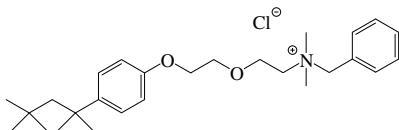
1,3,5-Trisubstituted benzene



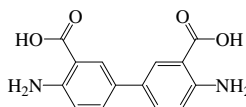
1,2,4-Trisubstituted benzene



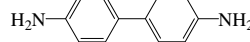
Benzene



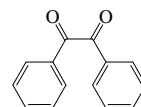
Benzene



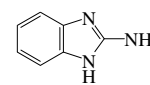
1,3,5-Trisubstituted benzene



p-Benzenediamine



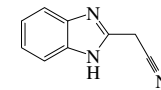
Benzene



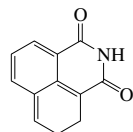
1H-Benzimidazole-2-amine



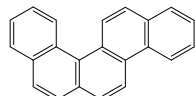
1H-Benzimidazole



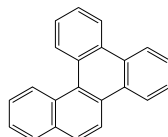
1H-Benzimidazole-2-acetonitrile



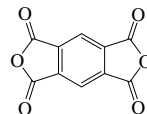
1H-Benz[e]indole



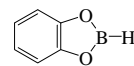
Benzo[c]chrysene



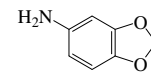
Benzo[g]chrysene



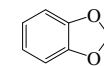
1,3,5-Trisubstituted benzene



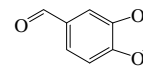
1,3-Benzoxaborole



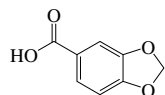
1,3-Benzoxazole-5-amine



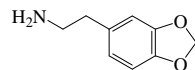
1,3-Benzoxazole



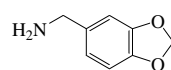
1,3-Benzoxazole-5-carboxaldehyde



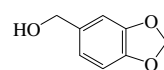
1,3-Benzoxazole-5-carboxylic acid



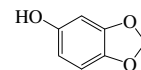
1,3-Benzoxazole-5-ethanamine



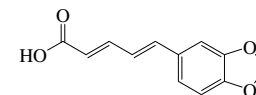
1,3-Benzoxazole-5-methanamine



1,3-Benzoxazole-5-methanol

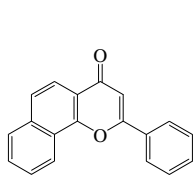


1,3-Benzoxazole-5-ol

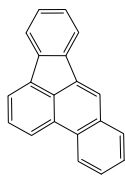


trans-5-(1,3-Benzoxazol-5-yl)-2,4-pentadiene

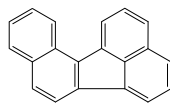
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
699	7,8-Benzoflavone	2-Phenyl-4 <i>H</i> -naphtho[1,2-b]pyran-4-one	C ₁₉ H ₁₂ O ₂	604-59-1	272.297	ye pl (al)	157				sl Et OH, chl; s sulf
700	Benzo[b]fluoranthene	Benz[e]acephenanthrylene	C ₁₈ H ₁₂	205-99-2	252.309	nd (bz)	168				i H ₂ O; msc bz
701	Benzo[j]fluoranthene	Di benzo[a,j]kfluorene	C ₂₀ H ₁₂	205-82-3	252.309	ye pl (al) nd (HOAc)	166				i H ₂ O; sl Et OH, HOAc
702	Benzo[k]fluoranthene	2,3,1',8'-Bi naphthylene	C ₂₀ H ₁₂	207-08-9	252.309	pa ye nd (bz)	217	480			i H ₂ O; s Et OH, bz, HOAc
703	11 <i>H</i> -Benzo[a]fluorene		C ₁₇ H ₁₂	238-84-6	216.277	pl (ace or HOAc)	189.5	405			i H ₂ O; sl Et OH; s et h, bz, chl
704	11 <i>H</i> -Benzo[b]fluorene		C ₁₇ H ₁₂	243-17-4	216.277		212	401			i H ₂ O
705	Benzo[<i>f</i>]uran	Coumarone	C ₉ H ₆ O	271-89-6	118.133		<-18	174	1.0913 ²⁵	1.5615 ¹⁷	i H ₂ O; s Et OH, et h
706	2-Benzofurancarboxylic acid	Coumarilic acid	C ₉ H ₆ O ₃	496-41-3	162.142	nd (w)	192.5	312.5			vs Et OH
707	2(3 <i>H</i>)-Benzofuranone		C ₈ H ₆ O ₂	553-86-6	134.133		50	249	1.2236 ¹⁴		
708	3(2 <i>H</i>)-Benzofuranone		C ₈ H ₆ O ₂	7169-34-8	134.133	red nd (al)	102.5	152 ⁵			vs bz
709	1-(2-Benzofuryl)ethanone		C ₁₀ H ₈ O ₂	1646-26-0	160.170		76	126 ¹¹			s H ₂ O
710	Benzo[<i>f</i>]urazan, 1-oxide		C ₈ H ₄ N ₂ O ₂	480-96-6	136.108		71.5		1.280 ⁸⁰		
711	Benzohydrazide	Benzoyl chloride, hydrazide	C ₇ H ₆ N ₂ O	613-94-5	136.151	pl (w)	115	dec 267			s H ₂ O, Et OH; sl et h, ace, chl
712	Benzoyl chloride	Benzenecarboxylic acid	C ₇ H ₅ ClO ₂	65-85-0	122.122	mcl lf or nd	122.35	249.2	1.2659	1.504 ¹³²	sl H ₂ O; vs Et OH, et h; s ace, bz, chl
713	Benzoyl chloride		C ₇ H ₅ ClO ₂	93-97-0	226.227	pr (et h)	42.5	360	1.989 ⁵	1.5767 ¹⁵	i H ₂ O, li g; s Et OH, et h; sl chl
714	Benzoin	2-Hydroxy-1,2-diphenylethanone, (±)	C ₁₄ H ₁₂ O ₂	579-44-2	212.244		137	344; 194 ¹²	1.310 ²⁰		vs Et OH, chl
715	Benzoin triole	Phenyl cyanide	C ₇ H ₅ N	100-47-0	103.122	li q	-13.99	191.1	1.009 ⁹	1.5289 ²⁰	sl H ₂ O; msc Et OH; vs ace, bz; s ct c
716	Benzoghiniperylene	1,12-Benzoperylene	C ₂₂ H ₁₂	191-24-2	276.330	ye-grn lf (bz)	272.5				i H ₂ O
717	Benzo[<i>c</i>]phenanthrene	Tetrahydronaphthalene	C ₁₀ H ₈	195-19-7	228.288		68				i H ₂ O; sl Et OH, li g
718	Benzophenone	Di phenyl ketone	C ₁₃ H ₁₀ O	119-61-9	182.217	(α) ort h pr (al); (β) mcl pr	47.9 (α); 26 (β)	305.4	1.111 ¹⁶	1.6077 ¹⁹	i H ₂ O; vs Et OH, et h, chl, ace; s bz
719	Benzophenone hydrazone		C ₁₃ H ₁₂ N ₂	5350-57-2	196.247		97.3	227 ⁵⁵			
720	Benzophenone, oxime	Di phenyl ketoxime	C ₁₃ H ₁₁ NO	574-66-3	197.232	nd (al)	144				i H ₂ O; vs Et OH, et h, chl, ace; s bz
721	3,3',4,4'-Benzophenonetetracarboxylic acid dihydride	4,4'-Carbonyl diphenyl dihydride	C ₁₇ H ₁₀ O ₇	2421-28-5	322.226		216				
722	Benzo-2-phenylhydrazide		C ₈ H ₁₂ N ₂ O	532-96-7	212.246	pr (al), nd (w)	168	314			sl H ₂ O, et h; s Et OH, bz, chl
723	Benzopurpurine 4B	C.I. Di rect Red 2, disodium salt	C ₃₄ H ₂₀ N ₆ Na ₂ O ₆ S ₂	992-59-6	724.716	br pow					s H ₂ O, Et OH, ac, H ₂ SO ₄
724	2 <i>H</i> -1-Benzopyran	1,2-Chromene	C ₉ H ₈ O	254-04-6	132.159			132 ¹⁰² , 91 ¹³	1.0993 ¹⁶	1.5869 ²⁴	i H ₂ O
725	[2]Benzopyrano[6,5,4-def][2]benzopyran-1,3,6,8-tetrone	1,4,5,8-Naphthalenetetracarboxylic acid dihydride	C ₁₄ H ₄ O ₆	81-30-1	268.178	nd (al)	450	sub 320			i H ₂ O; s Na ₂ CO ₃ , HOAc
726	1 <i>H</i> -2-Benzopyran-1-one	Isocoumarin	C ₉ H ₆ O ₂	491-31-6	146.143	pl (bz)	47	286			i H ₂ O; vs Et OH, et h, bz, C ₆ H ₆
727	2 <i>H</i> -1-Benzopyran-2-one	Coumarin	C ₉ H ₆ O ₂	91-64-5	146.143	ort h pym (et h)	71	301.7	0.93 ⁵		s H ₂ O, Et OH, al k; vs et h, chl, py
728	4 <i>H</i> -1-Benzopyran-4-one		C ₉ H ₆ O ₂	491-38-3	146.143	nd (pet h w)	59	sub	1.290 ⁸⁹		sl H ₂ O; s Et OH, et h, bz, chl
729	Benzo[<i>a</i>]pyrene	2,3-Benzopyrene	C ₂₀ H ₁₂	50-32-8	252.309		181.1				i H ₂ O; vs chl
730	Benzo[<i>e</i>]pyrene	1,2-Benzopyrene	C ₂₀ H ₁₂	192-97-2	252.309	pa ye nd (bz-MeOH)	181.4	311			i H ₂ O
731	Benzo[<i>f</i>]quinoline	β-Naphthoquinoline	C ₁₃ H ₉ N	85-02-9	179.217	lf (pet h or w)	94	352; 283			sl H ₂ O; vs Et OH, bz, et h; s ace
732	Benzo[<i>h</i>]quinoline		C ₁₃ H ₉ N	230-27-3	179.217	lf (et h), pl (pet h)	52	339; 233 ⁴⁷	1.2340 ²⁰		sl H ₂ O; s Et OH, et h, ace, bz, ct c
733	p-Benzoquinone	2,5-Cyclohexadiene-1,4-dione	C ₆ H ₄ O ₂	106-51-4	108.095	ye mcl pr (w)	115	sub	1.318 ⁸⁰		sl H ₂ O, pet h; s Et OH, et h, chl
734	2,1,3-Benzotriazole		C ₆ H ₄ N ₃ S	273-13-2	136.174		43	206			
735	2-Benzotriazole	2-Aminobenzotriazole	C ₆ H ₅ N ₃ S	136-95-8	150.201	pl (w), lf (w)	132				sl H ₂ O; s Et OH, et h, chl, con HCl
736	6-Benzotriazole	6-Aminobenzotriazole	C ₆ H ₅ N ₃ S	533-30-2	150.201	pr (w)	87				i H ₂ O, et h; s Et OH



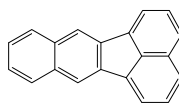
7,8-Benzoflavone



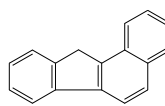
Benzo[b]fluoranthene



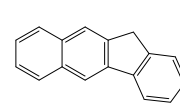
Benzo[j]fluoranthene



Benzo[k]fluoranthene



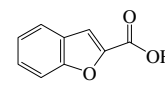
11H-Benzo[a]fluorene



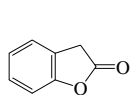
11H-Benzo[b]fluorene



Benzofuran



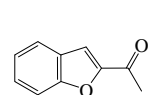
2-Benzofuran-2-carboxylic acid



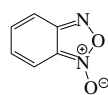
2(3H)-Benzofuranone



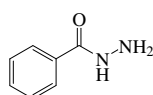
3(2H)-Benzofuranone



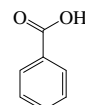
1-(2-Benzofuryl)ethanone



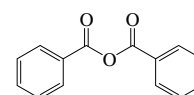
Benzofuran, 1-oxide



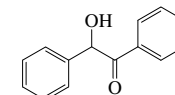
Benzohydrazide



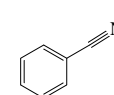
Benzoic acid



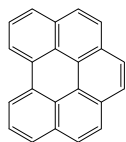
Benzoin anhydride



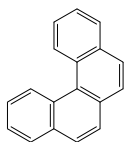
Benzoin



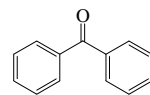
Benzonitrile



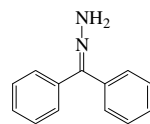
Benzo[ghi]perylene



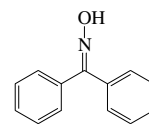
Benzo[c]phenanthrene



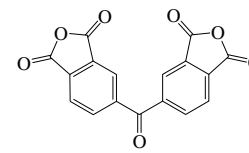
Benzophenone



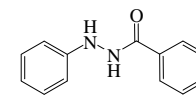
Benzophenone hydrazone



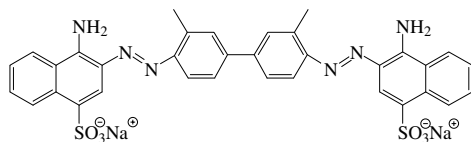
Benzophenone, oxime



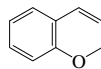
3,3',4,4'-Benzophenonetetracarboxylic dianhydride



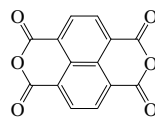
Benzo-2-phenylhydrazide



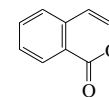
Benzopurpurin 4B



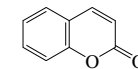
2H-1-Benzopyran



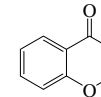
[2]Benzopyrano[6,5,4-def][2]benzopyran-1,3,6,8-tetraone



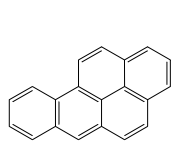
1H-2-Benzopyran-1-one



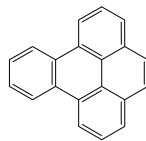
2H-1-Benzopyran-2-one



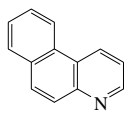
4H-1-Benzopyran-4-one



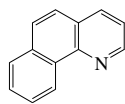
Benzo[a]pyrene



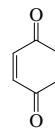
Benzo[e]pyrene



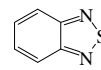
Benzo[f]quinoline



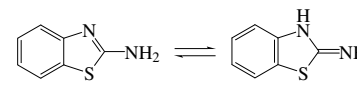
Benzo[h]quinoline



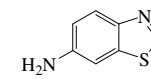
p-Benzoquinone



2,1,3-Benzothiazole

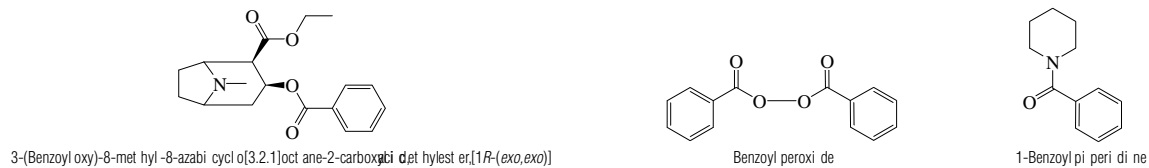
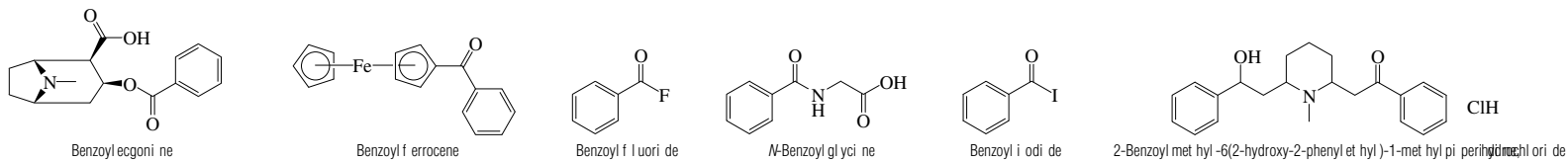
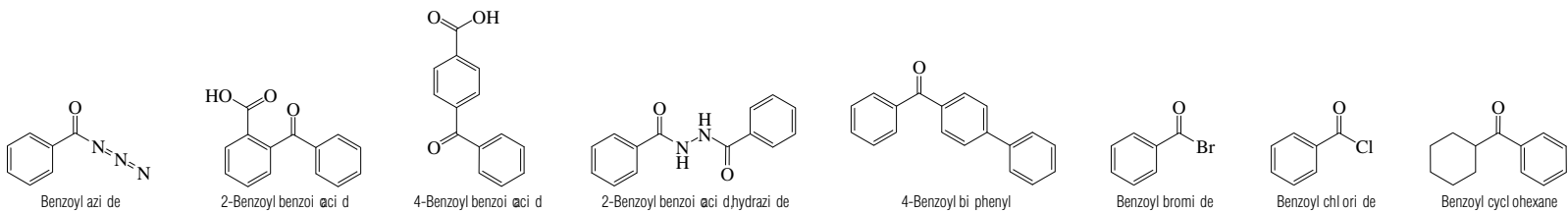
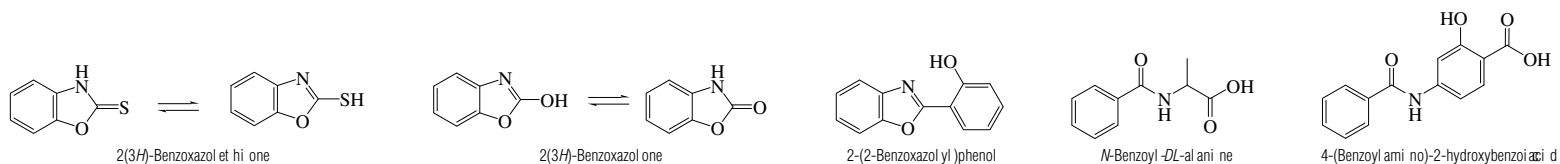
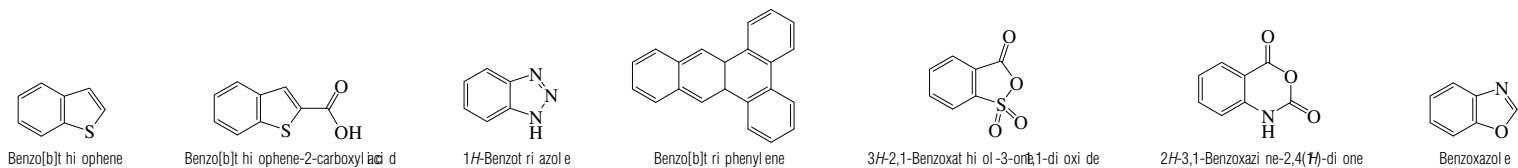
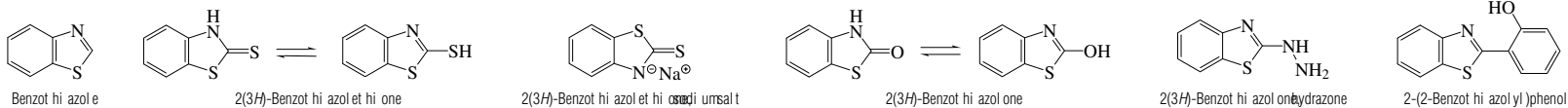


2-Benzothiazolamine

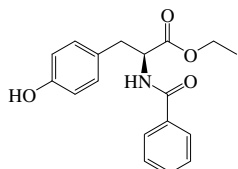


6-Benzothiazolamine

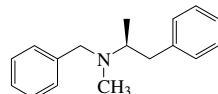
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
737	Benzothiazole	Benzothiazole	C ₇ H ₅ N ₂ S	95-16-9	135.187	cr (al), nd	1.0	231	1.2460 ²⁰	1.6379 ²⁰	sl H ₂ O; vs Et OH, et h, C ₆ H ₆ , CS ₂ , s ace
738	2-(3H)-Benzothiazole	2-Mercaptobenzothiazole	C ₇ H ₅ N ₂ S ₂	149-30-4	167.252	mp (al), nd (MeOH)	181		1.42 ²⁰		i H ₂ O; s Et OH; sl et h, bz, DMSO
739	2-(3H)-Benzothiazole sodium salt		C ₇ H ₄ NNaS ₂	2492-26-4	189.234						sl H ₂ O
740	2-(3H)-Benzothiazole		C ₇ H ₅ NOS	934-34-9	151.186	pr (di l al), nd	139	360			i ₂ OH vs Et OH, et h
741	2-(3H)-Benzothiazole, hydrazone		C ₇ H ₅ N ₃ S	615-21-4	165.216		202.8				
742	2-(2-Benzothiazolyl)phenol		C ₁₃ H ₉ NOS	3411-95-8	227.281	nd or lf (al)	131	179			s Et OH
743	Benzobenzothiazole	Thianthrene	C ₈ H ₆ S	95-15-8	134.199	lf	32	221	1.148 ⁴	1.6374 ³⁷	i H ₂ O; vs Et OH; s et h, ace, bz; sl chl
744	Benzobenzothiazole-2-carboxylic acid	Thianthrene-2-carboxylic acid	C ₉ H ₆ O ₂ S	6314-28-9	178.208	nd (w)	240.5				vs et h
745	1H-Benzothiazole	1,2,3-Triazafluorene	C ₇ H ₅ N ₃	95-14-7	119.124	nd (chl or bz)	100	204 ⁵			sl H ₂ O; s Et OH, bz, chl, t ol, DMF
746	Benzobenzothiazole		C ₁₄ H ₁₁	215-58-7	278.346	nd (al, HOAc)	205				i H ₂ O; vs bz
747	3H-2,1-Benzoxathiazole-1,1-dioxide		C ₇ H ₄ O ₂ S	81-08-3	184.170	nd or pr (bz)	129.5	184 ¹⁸			vs bz, chl
748	2H-3,1-Benzoxathiazole-2,4(1H)-dione		C ₇ H ₄ N ₂ O ₃	118-48-9	163.131	pr (al, gl HOAc cry (al))	243 dec				sl H ₂ O, Et OH, ace; i et h, bz, chl
749	Benzoxazole	1-Oxa-3-azaindene	C ₇ H ₅ NO	273-53-0	119.121	pr (di l al)	31	182.5	1.175 ⁴	1.5594 ²⁰	i H ₂ O; s Et OH, sul f
750	2-(3H)-Benzoxazole		C ₇ H ₅ NOS	2382-96-9	151.186	nd (w)	196				sl H ₂ O, ace, Et OH; vs et h, HOAc
751	2-(3H)-Benzoxazole		C ₇ H ₅ NO ₂	59-49-4	135.121		138	335; 230 ³⁰			sl H ₂ O; s Et OH, et h, t f a
752	2-(2-Benzoxazolyl)phenol		C ₈ H ₇ NO ₂	835-64-3	211.216	pl nk nd (al, HOAc)	123.5	338			sl H ₂ O; vs Et OH; s et h, ace, bz
753	N-Benzoyl-DL-phenylalanine		C ₁₆ H ₁₅ NO ₃	1205-02-3	193.199	pl, pr or lf (et h)	165.5	dec			s ₂ OH, Et OH; sl et h, DMSO
754	4-(Benzoylamino)-2-hydroxybenzoic acid	Benzoylparacetamol	C ₁₇ H ₁₅ NO ₃	13898-58-3	257.242		260.5				
755	Benzoylazide	Benzazide	C ₇ H ₅ N ₃ O	582-61-6	147.134	pl (ace)	32	exp	1.1680 ⁵		vs et h, Et OH
756	2-Benzoylbenzoic acid		C ₁₄ H ₉ O ₃	85-52-9	226.227	t cl nd (w+1)	129.0				vs Et OH, et h; s bz; sl chl
757	4-Benzoylbenzoic acid		C ₁₄ H ₉ O ₃	611-95-0	226.227	nd (HOAc), pl (al) mcl lf (w)	199	sub			sl H ₂ O, t f a, bz; s Et OH, et h, HOAc
758	2-Benzoylbenzohydrazide		C ₁₄ H ₁₁ N ₂ O ₂	787-84-8	240.257	nd (al)	242.3				sl H ₂ O; i Et OH, et h, chl; s MeOH
759	4-Benzoylphenyl	4-Phenylbenzophenone	C ₁₅ H ₁₃ O	2128-93-0	258.313		101.5	420; 156 ^{0.1}			
760	Benzoylbromide	Benzoyl bromide	C ₇ H ₅ BrO	618-32-6	185.018	li q	-24	218.5	1.570 ⁷	1.5868 ²⁵	msc et h
761	Benzoylchloride	Benzoyl chloride	C ₇ H ₅ ClO	98-88-4	140.567	li q	-0.4	197.2; 71	1.2120 ²⁰	1.5537 ²⁰	msc et h; s bz, ct c, C ₆ H ₆
762	Benzoylcyclohexane	Cyclohexyl phenyl ketone	C ₁₃ H ₁₇ O	712-50-5	188.265	nd (pet h)	59.5	164 ⁸			
763	Benzoylcerone		C ₁₆ H ₁₃ NO ₄	519-09-5	289.327	nd (w)	195				vs bz, Et OH
764	Benzoylferrocene		C ₁₄ H ₉ FeO	1272-44-2	290.137		110.0				
765	Benzoyl fluoride	Benzoyl fluoride	C ₇ H ₅ FO	455-32-3	124.112	li q	-28	154.5	1.1400 ⁹		vs Et OH, et h; s ct c
766	N-Benzoylglycine	Hydroxybenzoylamine	C ₈ H ₉ NO ₃	495-69-2	179.172	pr (w or al)	191.5		1.37 ²⁰		s H ₂ O, Et OH; sl et h, bz, chl; i pet h
767	Benzoyl iodide	Benzoyl iodide	C ₇ H ₅ IO	618-38-2	232.018	nd	1.5	128 ²⁰	1.746 ¹⁸		vs et h, Et OH
768	2-Benzoylmetahydroxy-6-(2-hydroxy-2-phenylethyl)-1-methylpiperidine, hydrochloride		C ₂₂ H ₂₆ ClNO ₂	63990-84-1	373.916		183.5				sl H ₂ O; s Et OH; vs chl
769	3-(Benzoyloxy)-8-methyl-8-azabicyclo[3.2.1]octane-2-carboxylic acid, ethylester [1-(exo,exo)]	Cocaine	C ₁₈ H ₂₃ NO ₄	529-38-4	317.381	pr (et h)	109				vs et h, Et OH
770	Benzoylperoxide		C ₁₄ H ₁₀ O ₄	94-36-0	242.227	ort h (et h), pr	105	exp		1.543	sl H ₂ O; s Et OH, et h, ace, bz, C ₆ H ₆
771	1-Benzoylpiperidine		C ₁₂ H ₁₅ NO	776-75-0	189.253	t cl	49	320.5			i H ₂ O; s Et OH, et h; sl ct c



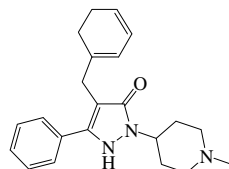
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
772	<i>N</i> -Benzoyl- <i>L</i> -tyrosine ethyl ester		$\text{C}_{18}\text{H}_{19}\text{NO}_4$	3483-82-7	313.349		119.5				
773	Benzphetamine		$\text{C}_7\text{H}_{11}\text{N}$	156-08-1	239.356			127 ^{0.02}		1.5515 ¹⁹	vs et h, Et OH, MeOH, chl
774	Benzperylene		$\text{C}_{25}\text{H}_{16}\text{N}_2\text{O}$	53-89-4	347.453	cry (al)	182 dec				
775	Benzquinone		$\text{C}_{12}\text{H}_8\text{N}_2\text{O}_5$	63-12-7	404.499	cry	131				
776	Benzthiazide		$\text{C}_7\text{H}_7\text{ClN}_2\text{O}_2\text{S}_2$	91-33-8	431.938	cry (Et OH)	236				i H ₂ O; s al k
777	<i>N</i> -Benzylacetamide		$\text{C}_9\text{H}_{11}\text{NO}$	588-46-5	149.189		61	157 ²			vs Et OH, et h
778	Benzylacetate		$\text{C}_{10}\text{H}_{10}\text{O}_2$	140-11-4	150.174	liq	-51.3	213	1.0550	1.5232 ²⁰	sl H ₂ O; msc Et OH; s et h, ace, chl
779	Benzylacrylate		$\text{C}_{10}\text{H}_{10}\text{O}_2$	2495-35-4	162.185			228	1.0573 ²⁰	1.5143 ²⁰	i H ₂ O; s Et OH, et h, ace, ct c
780	Benzylalcohol	Benzenemetanol	$\text{C}_7\text{H}_8\text{O}$	100-51-6	108.138	liq	-15.4	205.31	1.0419	1.5396 ²⁰	s H ₂ O, Et OH, et h, ace, bz, MeOH, chl
781	Benzylamine	Benzenemetanamine	$\text{C}_7\text{H}_9\text{N}$	100-46-9	107.153			185; 90 ¹²	0.9813 ²⁰	1.5401 ²⁰	msc H ₂ O, Et OH, et h; vs ace; s bz; sl chl
782	4-(Benzylamino)benzenesulfonamide	<i>N</i> -(4-Benzylsulfonylphenyl)amine	$\text{C}_{13}\text{H}_{15}\text{N}_2\text{O}_2\text{S}$	104-22-3	262.327		171				
783	2-(Benzylamino)ethanol		$\text{C}_9\text{H}_{13}\text{NO}$	104-63-2	151.205			225; 154 ¹²	1.065 ²⁵	1.5430 ²⁰	
784	4-Benzylaniline		$\text{C}_{13}\text{H}_{13}\text{N}$	1135-12-2	183.249	mcl (liq)	34.5	300	1.038		vs et h, Et OH, liq
785	<i>N</i> -Benzylaniline	<i>N</i> -Phenylbenzenemetanamine	$\text{C}_{13}\text{H}_{13}\text{N}$	103-32-2	183.249	pr	37.5	306.5	1.0298 ⁶⁵	1.6118 ²⁵	vs et h, Et OH
786	α -Benzylbenzenepropanoic acid		$\text{C}_{16}\text{H}_{16}\text{O}_2$	618-68-8	240.297	pl (pet h HOAc) nd (w)	90	235 ¹⁸			vs bz, et h, Et OH
787	2-Benzyl-1 <i>H</i> -benzimidazole	Benzimidazol	$\text{C}_{12}\text{H}_{12}\text{N}_2$	621-72-7	208.258	nd (bz)	187				vs bz, Et OH, gl HOAc
788	Benzylbenzoate		$\text{C}_{14}\text{H}_{12}\text{O}_2$	120-51-4	212.244	nd or lf	21	323.5	1.112 ⁴	1.5680 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, MeOH, chl
789	4-Benzyl-1,1'-bi-phenyl		$\text{C}_{16}\text{H}_{16}$	613-42-3	244.330	lf	85	285 ⁰	1.171 ⁰		i H ₂ O; s Et OH, ct c; vs et h, bz
790	Benzylbutanoate		$\text{C}_{11}\text{H}_{14}\text{O}_2$	103-37-7	178.228			239	1.0111 ²⁰	1.4920 ²⁰	i H ₂ O; vs Et OH, et h; s ct c
791	Benzylbutylphthalate	Butylbenzylphthalate	$\text{C}_{19}\text{H}_{20}\text{O}_4$	85-68-7	312.360	liq		370	1.119		i H ₂ O
792	Benzylchloroacetate		$\text{C}_8\text{H}_9\text{ClO}_2$	140-18-1	184.619			147 ⁹ ; 85 ^{0.4}	1.2223 ⁴	1.5426 ¹⁸	vs et h, Et OH
793	Benzylchloroformate	Carbobenzoylchloride	$\text{C}_7\text{H}_7\text{ClO}_2$	501-53-1	170.594	oi ly liq		103	1.195 ²⁵	1.5190 ²⁰	s et h, ace, bz
794	Benzyltranscinnamate	Benzyltrans-3-phenyl-2-propenoate	$\text{C}_{14}\text{H}_{14}\text{O}_2$	78277-23-3	238.281	pr	39	dec 350; 244 ⁵	1.109 ¹⁵		i H ₂ O; s Et OH, et h; sl bz
795	Benzyl dodecanoate	Benzyl laurate	$\text{C}_{19}\text{H}_{30}\text{O}_2$	140-25-0	290.440		8.5	210 ¹²	0.9429 ²⁵	1.4812 ²⁴	vs bz, et h, Et OH, pet h
796	Benzylethanamine	<i>N</i> -Ethylbenzenemetanamine	$\text{C}_9\text{H}_{11}\text{N}$	14321-27-8	135.206			194	0.9342 ¹⁷	1.5117 ²⁰	sl H ₂ O, ct c; s Et OH, et h, bz, chl
797	<i>N</i> -Benzylethanamine	Ethanylethanamine	$\text{C}_{11}\text{H}_{17}\text{N}$	92-59-1	211.303	pa ye oi l	35	288; 185	1.001 ⁵⁵	1.5943 ²³	i H ₂ O; s Et OH, et h, chl
798	Benzylethanol		$\text{C}_8\text{H}_{10}\text{O}$	539-30-0	136.190			186	0.9478 ²⁰	1.4955 ²⁰	i H ₂ O; msc Et OH, et h
799	Benzylformate		$\text{C}_8\text{H}_8\text{O}_2$	104-57-4	136.149			203; 84 ¹⁰	1.081 ²⁰	1.5154 ²⁰	i H ₂ O; s Et OH, ace; msc et h; sl ct c
800	Benzylformamide		$\text{C}_8\text{H}_{10}\text{O}_2$	538-64-7	296.318	cry pow	59	210 ⁵			vs et h, Et OH, chl
801	Benzylidene diacetate	Toluene diol, diacetate	$\text{C}_{11}\text{H}_{12}\text{O}_4$	581-55-5	208.211	pl (et h)	46	220	1.1 ⁴		vs bz, et h, Et OH
802	Benzylidenebis(methoxyphenyl)methane		$\text{C}_{22}\text{H}_{21}\text{NO}_2$	524-96-9	331.408	pa ye cry	90				vs et h, chl
803	2-Benzyl-1 <i>H</i> -indole-1,3-dione		$\text{C}_{15}\text{H}_{11}\text{NO}_2$	2142-01-0	237.254	ye nd (al)	116		1.343 ⁸		s Et OH, HOAc; sl DMSO
804	Benzylisopropylamine	<i>N</i> -Isopropylbenzenemetanamine	$\text{C}_{10}\text{H}_{15}\text{N}$	102-97-6	149.233			200; 93 ¹⁰	0.892 ²⁵	1.5025 ²⁰	
805	Benzylisocyanate	(Isocyanatobenzyl)benzene	$\text{C}_8\text{H}_7\text{NCO}$	622-78-6	149.214	ye oi l		243	1.124 ⁶	1.6049 ¹⁵	i H ₂ O; msc Et OH; s et h
806	Benzylmethacrylate		$\text{C}_{11}\text{H}_{12}\text{O}_2$	2495-37-6	176.212			144 ⁵⁰			
807	Benzyl 3-methylbutanoate		$\text{C}_{12}\text{H}_{16}\text{O}_2$	103-38-8	192.254			245; 136 ²⁵	0.9983 ¹⁵	1.4884 ²⁰	
808	Benzylmethanol		$\text{C}_8\text{H}_{10}\text{O}$	538-86-3	122.164	liq	-52.6	170	0.9634 ⁴	1.5008 ²⁰	i H ₂ O, liq; vs Et OH, et h; s bz
809	1-Benzyl-2-methylhydrazine	1-Methylethan-2-phenylmethylethanhydrazine	$\text{C}_9\text{H}_{12}\text{N}_2$	10309-79-2	136.194	liq		117			
810	Benzyl 2-methylpropanoate	Benzyl isobutyrate	$\text{C}_{11}\text{H}_{14}\text{O}_2$	103-28-6	178.228			228; 114 ²⁰	1.0159 ¹⁶	1.4883 ²⁰	
811	Benzyl nitrite		$\text{C}_7\text{H}_7\text{NO}_2$	935-05-7	137.137	oi l		8 ⁴	1.075 ²⁵	1.4989 ²⁵	



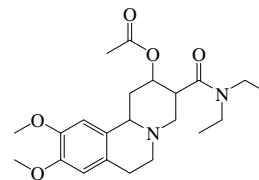
N-Benzoyl-*L*-tyrosine ethyl ester



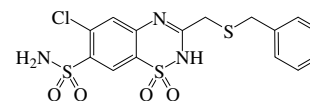
Benzphetamine



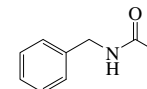
Benzperlon



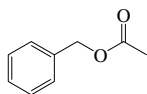
Benzquinamide



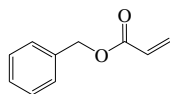
Benzthiazide



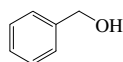
N-Benzylacetamide



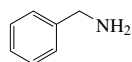
Benzyl acetate



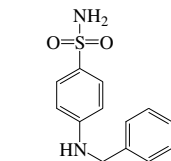
Benzyl acrylate



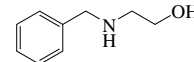
Benzyl alcohol



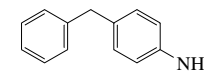
Benzylamine



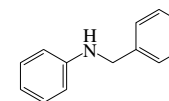
4-(Benzylamino)benzenesulfonamide



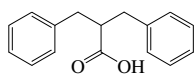
2-(Benzylamino)ethanol



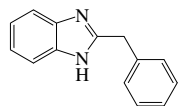
4-Benzylaniline



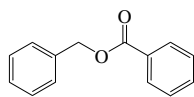
N-Benzylaniline



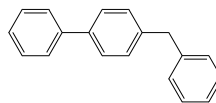
α -Benzylbenzenepropanoic acid



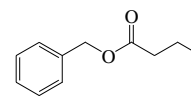
2-Benzyl-1*H*-benzimidazole



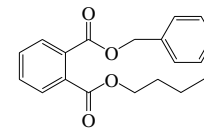
Benzyl benzoate



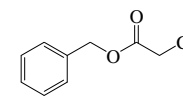
4-Benzyl-1,1'-bi-phenyl



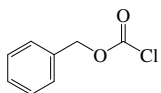
Benzyl butanoate



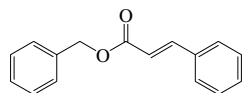
Benzyl 2-phenylacetate



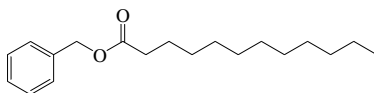
Benzyl chloroacetate



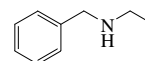
Benzyl chloroformate



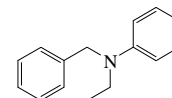
Benzyl *trans*-cinnamate



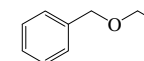
Benzyl dodecanoate



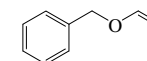
Benzyl ethylamine



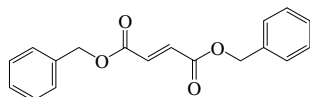
N-Benzyl-*N*-ethylaniline



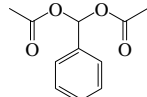
Benzyl ethyl ether



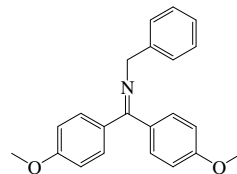
Benzyl formate



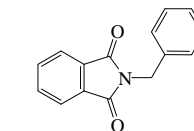
Benzyl fumarate



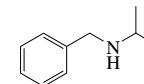
Benzyl diethylacetate



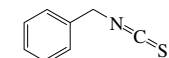
Benzyl dimethyl(4-hydroxyphenyl)met hane



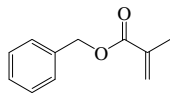
2-Benzyl-1*H*-indole-1,3-dione



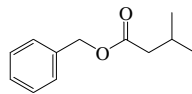
Benzyl isopropylamine



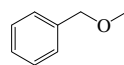
Benzyl isothiocyanate



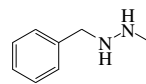
Benzyl methacrylate



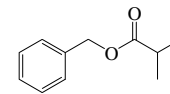
Benzyl 3-methylbutanoate



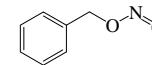
Benzyl methyl ether



1-Benzyl-2-methylhydrazine

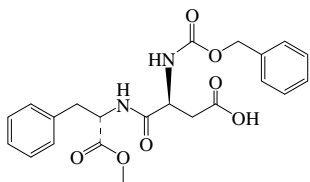


Benzyl 2-methylpropanoate

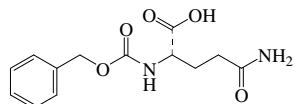


Benzyl nitrite

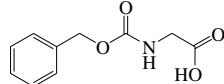
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
812	<i>N</i> -Benzyl oxycarbonyl aspartame		C ₂₁ H ₂₄ N ₂ O ₇	33605-72-0	428.435	cry	122				
813	Benzyl oxycarbonyl <i>L</i> -glutamine		C ₁₉ H ₁₈ N ₂ O ₅	2650-64-8	280.276		134.5				s DMSO
814	Benzyl oxycarbonyl glycine		C ₁₁ H ₁₁ NO ₄	1138-80-3	209.199		121				s ace
815	Benzyl oxycarbonyl glycyl-L-leucine		C ₁₆ H ₂₂ N ₂ O ₅	1421-69-8	322.356		100				
816	Benzyl oxycarbonyl glycyl-L-phenylalanine		C ₁₉ H ₂₀ N ₂ O ₅	1170-76-9	356.372		126				
817	2-(Benzyl oxy)ethanol	Ethylene glycol monobenzyl ether	C ₉ H ₁₀ O ₂	622-08-2	152.190	oil	<-75	256	1.0640	1.5233 ²⁰	vs H ₂ O, et h, Et OH
818	Benzyl penicillin sodium		C ₁₆ H ₁₈ N ₂ NaO ₄ S	69-57-8	356.372	nd (BuOH aq)	215		1.41		vs H ₂ O; s MeOH; i ace, et h, chl
819	2-Benzylphenol	<i>o</i> -Benzylphenol	C ₉ H ₁₀ O	28994-41-4	184.233		21	312		1.5994 ²⁰	vs ace, bz, Et OH
820	4-Benzylphenol	<i>p</i> -Benzylphenol	C ₉ H ₁₀ O	101-53-1	184.233		84	322			s H ₂ O, Et OH, et h, bz, ct c, HOAc, chl
821	Benzyl phenyl ether		C ₁₂ H ₁₂ O	946-80-5	184.233	lf (al)	40	286.5			
822	1-Benzylpiperazine		C ₁₁ H ₁₆ N ₂	2759-28-6	176.258			146 ¹²		1.5430 ²⁸	s H ₂ O, Et OH, et h; sl chl
823	1-Benzylpiperidine		C ₁₂ H ₁₇ N	2905-56-8	175.270			245	0.9625 ¹⁶	1.5227 ²⁰	
824	4-Benzylpiperidine		C ₁₂ H ₁₇ N	31252-42-3	175.270		16.8	270; 150 ¹⁷	0.9970 ²⁰	1.5337 ²⁵	i H ₂ O; s Et OH, et h
825	Benzyl propanoate		C ₁₀ H ₁₂ O ₂	122-63-4	164.201			221	1.0335 ²⁰		
826	2-Benzylpyridine		C ₁₁ H ₁₁ N	101-82-6	169.222	nd	12.5	277; 149 ¹⁶	1.067 ⁰	1.5785 ²⁰	i H ₂ O; s Et OH, et h, chl
827	4-Benzylpyridine		C ₁₁ H ₁₁ N	2116-65-6	169.222		12.4	288; 180 ³¹	1.0612 ²⁰	1.5818 ²⁰	i H ₂ O; s Et OH, ct c; vs et h
828	Benzyl 3-pyridinecarboxylate	Benzyl nicotinate	C ₁₃ H ₁₁ NO ₂	94-44-0	213.232			170 ³			
829	1-Benzyl-1 <i>H</i> -pyrrole		C ₉ H ₁₁ N	2051-97-0	157.212		15	247	1.0183 ²⁰	1.5655 ²⁴	i H ₂ O; vs Et OH, et h
830	Benzyl 1,2-pyrrolidinedicarboxylate <i>N</i> -(Benzyl oxycarbonyl)-L-proline (S)		C ₁₈ H ₁₅ NO ₄	1148-11-4	249.263		78.5			1.5310 ²⁰	sl chl
831	Benzyl salicylate		C ₁₄ H ₁₂ O ₃	118-58-1	228.243			320	1.1799 ²⁰	1.5805 ²⁰	sl H ₂ O; s Et OH, et h, ct c
832	<i>O</i> -Benzyl-L-serine	3-(Benzyl oxy)-L-alanine	C ₉ H ₁₃ NO ₃	4726-96-9	195.215		218 dec				
833	Benzyl sulfonamide		C ₇ H ₇ NO ₂ S	100-87-8	172.202	hyg cry					
834	4-[(Benzyl sulfonyl)amino]benzoic acid	<i>p</i> -(Benzyl sulfonamido)benzoic acid	C ₁₄ H ₁₃ NO ₄ S	536-95-8	291.323			229.5			vs Et OH
835	(Benzyl sulfonyl)benzene		C ₁₁ H ₁₂ O ₂ S	3112-88-7	232.298	nd (al)	146		1.126 ¹⁵³		i H ₂ O; sl Et OH, et h, bz
836	(Benzyl thio)benzene		C ₁₁ H ₁₂ S	831-91-4	200.299	lf (al)	43.5	197			i H ₂ O; s Et OH, et h, con sul f
837	Benzyl thiocyanate	α -Thiocyanatoethane	C ₈ H ₇ NS	3012-37-1	149.214	pr (al)	43	232			i H ₂ O; s Et OH, et h, chl, CS
838	Benzyl trimethylammonium chloride		C ₁₀ H ₁₅ ClN	56-93-9	185.694			243			vs H ₂ O; s ace
839	Benzyl urea		C ₈ H ₁₀ N ₂ O	538-32-9	150.177	nd (al)	148	dec 200			vs ace, Et OH
840	Bephenium chloride		C ₁₇ H ₂₂ ClNO	13928-81-9	291.816	cry (ace)	135				
841	Berberine		C ₂₀ H ₁₉ NO ₅	2086-83-1	353.369	red-ye nd (w+6) cry (chl)	145				vs et h, Et OH
842	Berberine chloride dihydrate		C ₂₀ H ₁₉ ClNO ₅	633-65-8	407.845	ye cry					
843	Bergienin		C ₂₄ H ₁₆ O ₃	477-90-7	328.272	cry (MeOH)	238				vs H ₂ O, Et OH
844	Beryllium 2,4-pentanedioate	Beryllium acetate	C ₁₀ H ₁₄ BeO ₄	10210-64-7	207.228			108	270	1.168 ²⁰	
845	Betaine	1-Carboxy- <i>N,N,N</i> -trimethylmethanamine, inner salt	C ₅ H ₁₁ NO ₂	107-43-7	117.147	pr or lf (al)	293 dec				vs H ₂ O, MeOH; s Et OH; sl et h, chl
846	Betaine, hydrochloride		C ₅ H ₁₀ ClNO ₂	590-46-5	153.608	mcl cry (al)	227.5				vs H ₂ O
847	Betametasonone		C ₂₇ H ₂₉ FO ₅	378-44-9	392.460	cry (AcOMe)	232 dec				
848	Bethanidine		C ₁₀ H ₁₃ N ₃	55-73-2	177.246	cry (aq MeOH)	196				
849	Betonidine		C ₁₃ H ₁₃ NO ₃	515-25-3	159.183	pr (dil al, +1w)	252 dec				vs Et OH
850	Betulaprenolol	Nonai soprenol	C ₂₅ H ₃₄ O	13190-97-1	631.069	oil or cry	41				s chl
851	9,9'-Bi-antracene		C ₂₈ H ₁₈	1055-23-8	354.443			321.3			



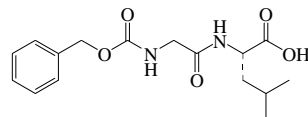
N-Benzyl oxycarbonyl aspartame



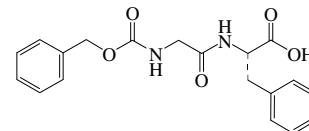
Benzyl oxycarbonyl L-glutamine



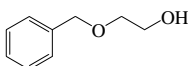
Benzyl oxycarbonyl glycine



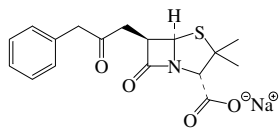
Benzyl oxycarbonyl L-leucine



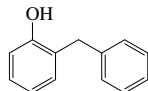
Benzyl oxycarbonyl L-phenylalanine



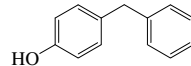
2-(Benzyl oxy)ethanol



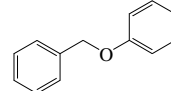
Benzyl penicillin sodium salt



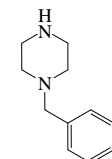
2-Benzyl phenol



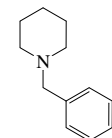
4-Benzyl phenol



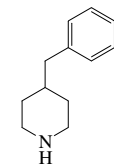
Benzyl phenyl ether



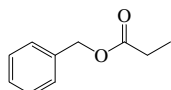
1-Benzyl piperazine



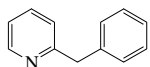
1-Benzyl piperidine



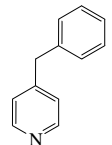
4-Benzyl piperidine



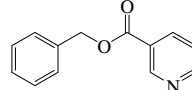
Benzyl propanoate



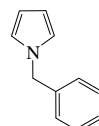
2-Benzyl pyridine



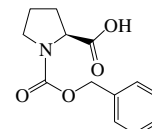
4-Benzyl pyridine



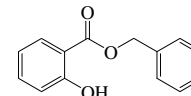
Benzyl 3-pyridinecarboxylate



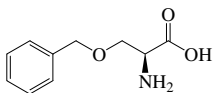
1-Benzyl-1H-pyrrole



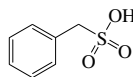
Benzyl 1,2-pyrrolidinedicarboxylate



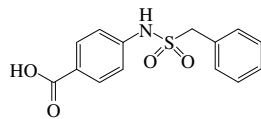
Benzyl salicylate



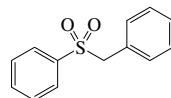
O-Benzyl-L-serine



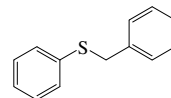
Benzyl sulfonate



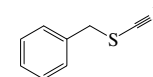
4-[(Benzylsulfonyl)amino]benzoic acid



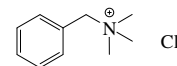
(Benzylsulfonyl)benzene



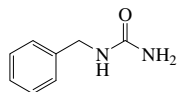
(Benzylthio)benzene



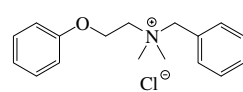
Benzyl thiocyanate



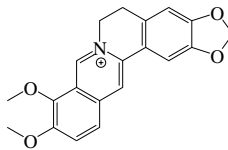
Benzyl trimethylammonium chloride



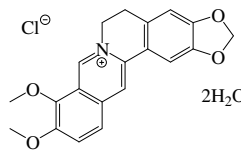
Benzyl urea



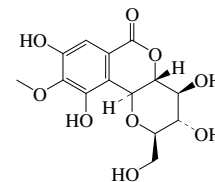
Bephenium chloride



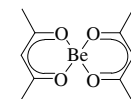
Berberine



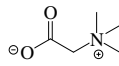
Berberine hydrochloride hydrate



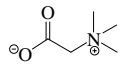
Bergienin



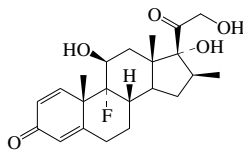
Beryllium tetrakis(4-pentenoate)



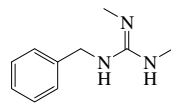
Betaine



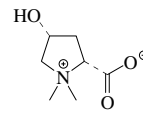
Betaine hydrochloride



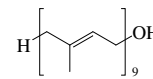
Betametason



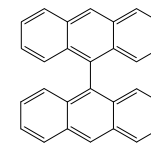
Betanidine



Betonine

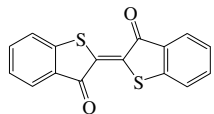


Butylacrylate



9,9'-Bi(anthracene)

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
852	Δ ^{2,2'} (3 <i>H</i> ,3' <i>H</i>)-Bi benzo[<i>b</i>]t hi ophene-3,3'-di one	Duri ndone Red	C ₁₆ H ₈ O ₂ S ₂	522-75-8	296.364	br nd (xyl) red mcl nd (bz)	359	sub			i H ₂ O, Et OH; sl chl, C ₆ S ₆ bz, xyl
853	Bi cycl o[2.2.1]hept ane		C ₇ H ₁₂	279-23-2	96.170		87.5	105.3			vs ace, bz, et h, Et OH
854	Bi cycl o[4.1.0]hept ane	Norcarane	C ₇ H ₁₂	286-08-8	96.170			116.5	0.853 ²⁵	1.4564 ²⁰	
855	Bi cycl o[2.2.1]hept an-2-one		C ₇ H ₁₀ O	497-38-1	110.153		89.5	170			
856	Bi cycl o[2.2.1]hept -2-ene		C ₇ H ₁₀	498-66-8	94.154		45	96			
857	Bi cycl o[2.2.1]hept -5-ene-2-carboni t ri le		C ₈ H ₈ N	95-11-4	119.164		13	84 ¹⁰	0.999 ²⁵	1.4885 ²⁰	
858	Bi cycl o[2.2.1]hept -5-ene-2-carboxal dehyde		C ₈ H ₁₀ O	5453-80-5	122.164			71 ²⁰	1.018 ²⁵	1.4893 ²⁰	
859	Bi cycl o[2.2.1]hept -5-ene-2-met hanol		C ₈ H ₁₂ O	95-12-5	124.180			103 ²⁰			
860	[1,1'-Bi cycl ohexyl]-2-one	2-Cycl ohexyl cycl ohexanone	C ₁₂ H ₂₀ O	90-42-6	180.286	li q	-32	264	0.969 ⁶	1.4877 ²⁵	
861	1,1'-Bi cycl opent yl		C ₁₀ H ₁₈	1636-39-1	138.250						s ct c, C ₆ S ₆
862	[1,1'-Bi cycl opent yl]-2-ol	2-Hydroxybi cycl opent yl	C ₁₀ H ₁₈ O	4884-25-7	154.249		20	235.5	0.9785 ¹⁵	1.4884 ¹⁷	
863	[1,1'-Bi cycl opent yl]-2-one		C ₁₀ H ₁₆ O	4884-24-6	152.233	li q	-13	232.5	0.974 ⁶	1.4763	
864	Bi f enox	Met hyl 5-(2,4-di chl orophenoxy)-2-ni t robenzoat e	C ₁₄ H ₉ Cl ₂ NO ₅	42576-02-3	342.131		85				
865	Bi f ent hri n		C ₂₃ H ₂₂ Cl ₂ F ₂ O ₂	82657-04-3	422.868		69		1.2 ²⁵		
866	Bi guani de	Imi dodi carboni mi di c di ami de	C ₂ H ₄ N ₆	56-03-1	101.111	pr or nd (al)	136	dec 142			vs H ₂ O; s Et OH; i bz, chl
867	Bi khaconi t i ne	3-Deoxyseudaconi t i ne	C ₃₈ H ₅₁ O ₁₁	6078-26-8	673.790		164				vs et h, Et OH, chl
868	Bi li rubi n		C ₃₃ H ₃₆ N ₄ O ₆	635-65-4	584.662	red mcl pr or pl (chl)					i H ₂ O; sl Et OH, et h; s bz, chl
869	Bi li verdi ne	Dehydrobi li rubi n	C ₃₃ H ₃₄ N ₄ O ₆	114-25-0	582.646	dk gm pl or pr (MeOH)	>300				i H ₂ O; s Et OH, bz; sl et h, chl, C ₆ S ₆
870	Bi napacrlyl		C ₆ H ₁₈ N ₂ O ₆	485-31-4	322.313		70		1.27 ²⁰		
871	1,1'-Bi napht hal ene	1,1'-Bi napht hyl	C ₂₀ H ₁₄	604-53-5	254.325	(i) pl (HOAc) (i) j ort h (pet h)	160	>360; 240 ¹²	1.3000 ²⁰		i H ₂ O; sl Et OH; s et h, ace, bz, C ₆ S ₆
872	2,2'-Bi napht hal ene		C ₂₀ H ₁₄	612-78-2	254.325	bl flr pl (al)	187.9	452			i ₂ Θ; sl Et OH; s et h, bz, C ₆ S ₆
873	[1,1'-Bi napht hal ene]-2,2'-di ol		C ₂₀ H ₁₄ O ₂	602-09-5	286.324	nd (al), cry (w)	220				i H ₂ O; s Et OH, et h, al k; sl chl
874	Bi ot i n	Coenzyme R	C ₁₀ H ₁₆ N ₂ O ₃ S	58-85-5	244.310	nd (w)	232 dec				s H ₂ O, Et OH; sl et h, chl
875	2,2'-Bi oxi rane	Di epoxybut ane	C ₄ H ₆ O ₂	1464-53-5	86.090		2.0	144	1.113 ²⁰	1.435 ²⁰	vs H ₂ O, Et OH
876	Bi phenyl	Di phenyl	C ₁₂ H ₁₀	92-52-4	154.207	lf (di l al)	68.93	256.1	1.04	1.588 ⁷⁷	i H ₂ O; s Et OH, et h; vs bz, ct c, MeOH
877	[1,1'-Bi phenyl]-4-acet i c aci d	Fel bi nac	C ₁₄ H ₁₀ O ₂	5728-52-9	212.244		160.5				
878	[1,1'-Bi phenyl]-4-carboni t ri le		C ₁₃ H ₉ N	2920-38-9	179.217		88	190 ²⁰			i H ₂ O; vs Et OH, et h
879	[1,1'-Bi phenyl]-4-carbonyl chl ori de		C ₁₃ H ₉ Cl O	14002-51-8	216.662		111	160 ⁷			
880	[1,1'-Bi phenyl]-2,2'-di ami ne		C ₁₂ H ₁₂ N ₂	1454-80-4	184.236	pr or nd (al)	81	162 ⁷	1.3090 ²⁰		s H ₂ O, ace, bz
881	[1,1'-Bi phenyl]-2,4'-di ami ne		C ₁₂ H ₁₂ N ₂	492-17-1	184.236	nd (di l al)	54.5	363			i ₂ Θ s Et OH, et h
882	[1,1'-Bi phenyl]-4,4'-di ami ne, di hydrochl ori de		C ₁₂ H ₁₄ Cl ₂ N ₂	531-85-1	257.158		>300				
883	[1,1'-Bi phenyl]-2,2'-di carboxyl i c aci d	α,α'-Di pheni c aci d	C ₁₆ H ₁₀ O ₄	482-05-3	242.227	mcl pr or lf (w) cry (HOAc)	233.5	sub			i H ₂ O; s Et OH, et h
884	[1,1'-Bi phenyl]-2,2'-di ol		C ₁₂ H ₁₀ O ₂	1806-29-7	186.206		109	320	1.3420 ²⁰		s H ₂ O, Et OH, et h, ace, bz; sl pet h, chl
885	[1,1'-Bi phenyl]-2,5-di ol		C ₁₂ H ₁₀ O ₂	1079-21-6	186.206	nd (di l al)	97.5				vs Et OH
886	[1,1'-Bi phenyl]-4,4'-di ol		C ₁₂ H ₁₀ O ₂	92-88-6	186.206		278 dec				sl H ₂ O, bz, DMSO; s Et OH, et h
887	[1,1'-Bi phenyl]-4,4'-di sul f oni c aci d		C ₁₂ H ₁₀ O ₆ S ₂	5314-37-4	314.333	pr	72.5	>200			vs H ₂ O



Δ2,2(3H,3H)-Bi benzo[b]thiophene-3,3'-di one



Bi cycl o[2.2.1]hept ane



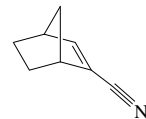
Bi cycl o[4.1.0]hept ane



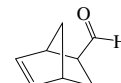
Bi cycl o[2.2.1]hept an-2-one



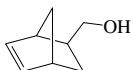
Bi cycl o[2.2.1]hept -2-ene



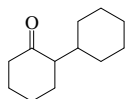
Bi cycl o[2.2.1]hept -5-ene-2-carboni tri le



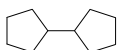
Bi cycl o[2.2.1]hept -5-ene-2-carboxal dehyde



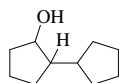
Bi cycl o[2.2.1]hept -5-ene-2-met hanol



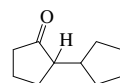
[1,1'-Bi cycl ohexyl]-2-one



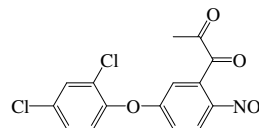
1,1'-Bi cycl opent yl



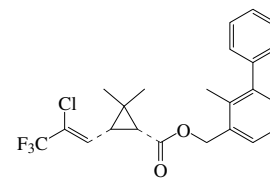
[1,1'-Bi cycl opent yl]-2-ol



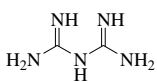
[1,1'-Bi cycl opent yl]-2-one



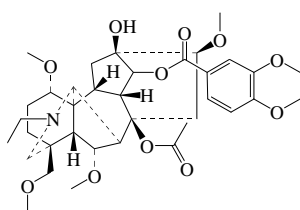
Bi f enox



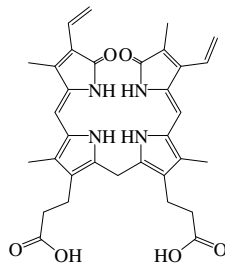
Bi f ent hri n



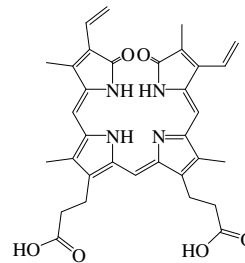
Bi guani de



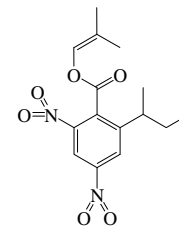
Bi khaconi t i ne



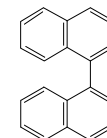
Bi li rubi n



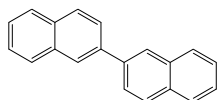
Bi li verdi ne



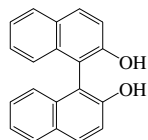
Bi napacryl



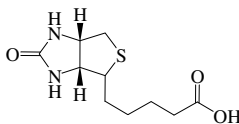
1,1'-Bi napht hal ene



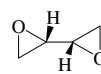
2,2'-Bi napht hal ene



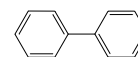
[1,1'-Bi napht hal ene]-2,2'-di ol



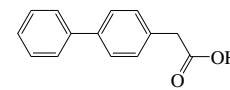
Bi ot i n



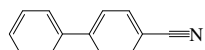
2,2'-Bi oxi rane



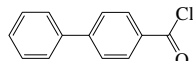
Bi phenyl



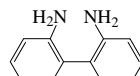
[1,1'-Bi phenyl]-4-acet aci d



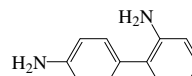
[1,1'-Bi phenyl]-4-carboni tri le



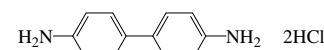
[1,1'-Bi phenyl]-4-carboxyl chl ori de



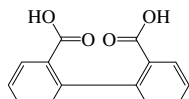
[1,1'-Bi phenyl]-2,2'-di ami



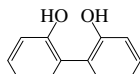
[1,1'-Bi phenyl]-2,4'-di ami ne



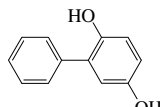
[1,1'-Bi phenyl]-4,4'-di ami ne hydrochl ori de



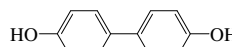
[1,1'-Bi phenyl]-2,2'-di carboxyl aci d



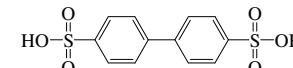
[1,1'-Bi phenyl]-2,2'-di ol



[1,1'-Bi phenyl]-2,5'-di ol

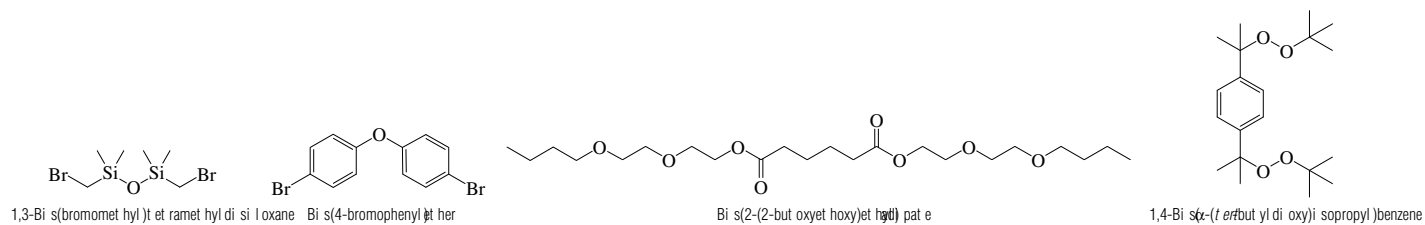
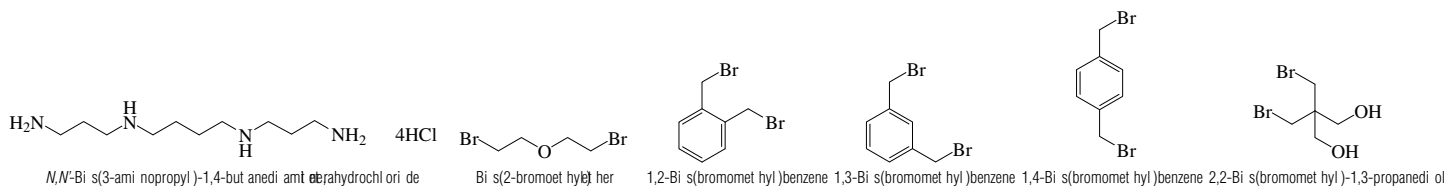
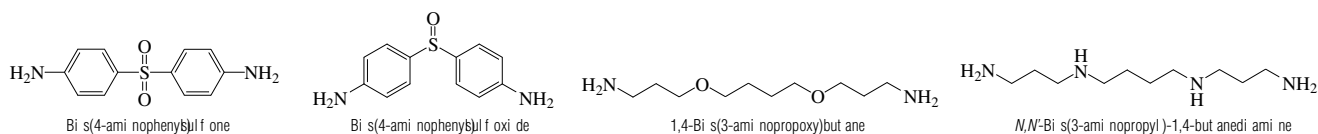
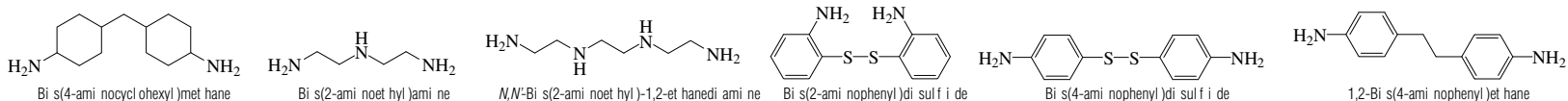
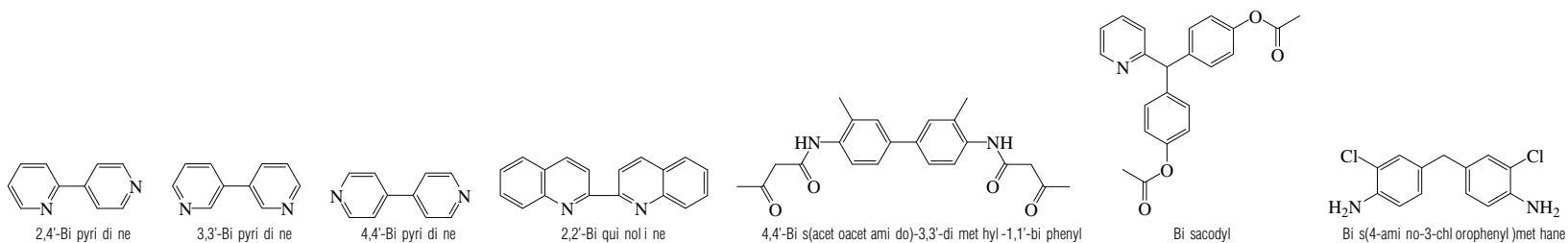
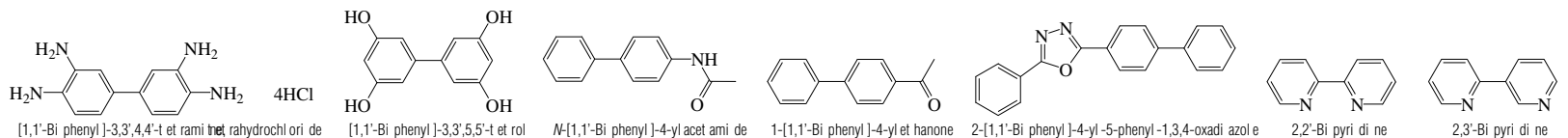


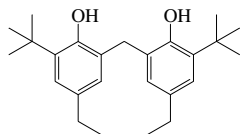
[1,1'-Bi phenyl]-4,4'-di ol



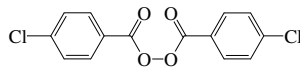
[1,1'-Bi phenyl]-4,4'-di sulf onic aci d

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
888	[1,1'-Bi phenyl]-3,3',4,4'-t et rami ne, t et rahydrochl ori de		C ₁₂ H ₁₈ Cl ₄ N ₄	7411-49-6	360.110		245 dec				
889	[1,1'-Bi phenyl]-3,3',5,5'-t et rol	Di resorci nol	C ₁₂ H ₁₀ O ₄	531-02-2	218.205	pl or nd (w+2)	310				vs H ₂ O, et h, Et OH
890	<i>N</i> -[1,1'-Bi phenyl]-4-yl acet ami de		C ₁₄ H ₁₃ NO	4075-79-0	211.259	cry (di l MeOH)	172.8				i ₂ B; vs Et OH, ace, MeOH
891	1-[1,1'-Bi phenyl]-4-yl et hanone		C ₁₄ H ₁₁ O	92-91-1	196.244	pr (ace), cry (al)	121	326	1.2510 ⁰		i H ₂ O; vs Et OH, ace; sl chl
892	2-[1,1'-Bi phenyl]-4-yl-5-phenyl-1,3,4-oxadi azole		C ₂₀ H ₁₄ N ₂ O	852-38-0	298.337		168				
893	2,2'-Bi pyri di ne	α,α'-Di pyri dyl	C ₈ H ₈ N ₂	366-18-7	156.184	pr (pet h)	72	273.5			sl H ₂ O; vs Et OH, et h, bz, chl
894	2,3'-Bi pyri di ne	2,3'-Bi pyri dyl	C ₁₀ H ₁₀ O ₂	581-50-0	156.184			295.5	1.140 ²⁰	1.6223 ²⁰	i H ₂ O; vs Et OH, et h, bz, chl; sl pet h
895	2,4'-Bi pyri di ne	2,4'-Bi pyri dyl	C ₁₀ H ₁₀ O ₂	581-47-5	156.184		61.5	281			sl H ₂ O; vs Et OH, et h, chl
896	3,3'-Bi pyri di ne	3,3'-Bi pyri dyl	C ₁₀ H ₁₀ O ₂	581-46-4	156.184		68	291.5	1.1614 ²⁰		vs H ₂ O, Et OH; sl et h
897	4,4'-Bi pyri di ne	γ,γ'-Di pyri dyl	C ₁₀ H ₁₀ N ₂	553-26-4	156.184	nd (w+2)	114	305			sl H ₂ O; vs Et OH, bz, chl; s et h
898	2,2'-Bi qui nol i ne		C ₁₈ H ₁₂ N ₂	119-91-5	256.301	pl or lf (al)	196				i ₂ OH vs Et OH; s et h, ace, bz
899	4,4'-Bi s(acet oacet ami do)-3,3'-di met hyl-1,1'-bi phenyl	<i>N,N</i> -Bi s(acet oacet yl)-3,3'-di met hyl benzi di ne	C ₂₂ H ₂₄ N ₂ O ₄	91-96-3	380.437		212				sl DMSO
900	Bi sacodyl		C ₈ H ₁₃ NO ₄	603-50-9	361.391		133.5				
901	Bi s(4-ami no-3-chl orophenyl)met hane	4,4-Met hyl ene bi s(2-chl oroani li ne)	C ₁₂ H ₁₂ Cl ₂ N ₂	101-14-4	267.153						s ct c
902	Bi s(4-ami nocylohexyl)met hane		C ₁₃ H ₂₀ N ₂	1761-71-3	210.358		15	320	0.92 ⁷⁵		
903	Bi s(2-ami noet hyl)ami ne	Di et hyl enet ri ami ne	C ₄ H ₁₂ N ₂	111-40-0	103.166	ye hyg li q	-39	207	0.956 ⁹	1.4810 ²⁵	msc H ₂ O, Et OH; i et h; s li g
904	<i>N,N</i> -Bi s(2-ami noet hyl)-1,2-et hanedi ami ne	Tri et hyl enet et rami ne	C ₈ H ₁₆ N ₄	112-24-3	146.234		12	266.5		1.4971 ²⁰	s H ₂ O, Et OH, aci d
905	Bi s(2-ami nophenyl)di sul fide		C ₁₂ H ₈ N ₂ S ₂	1141-88-4	248.366		93				i H ₂ O; vs Et OH, et h
906	Bi s(4-ami nophenyl)di sul fide		C ₁₂ H ₈ N ₂ S ₂	722-27-0	248.366		85				s H ₂ O; vs Et OH, et h, chl; sl bz, li g
907	1,2-Bi s(4-ami nophenyl)et hane		C ₁₂ H ₁₆ N ₂	621-95-4	212.290	pl (w)	137	sub			i H ₂ O; vs Et OH
908	Bi s(4-ami nophenyl) sul f one	Dapsone	C ₁₂ H ₈ N ₂ O ₂ S	80-08-0	248.300	cry (95% al)	175.5				s Et OH; sl DMSO
909	Bi s(4-ami nophenyl) sul f oxide	4,4'-Sul fnyl di ani li ne	C ₁₂ H ₁₂ N ₂ O ₂ S	119-59-5	232.300	pr (w, al)	175 dec				s H ₂ O, Et OH
910	1,4-Bi s(3-ami nopropoxy)but ane et her	1,4-But anedi ol bi s(3-ami nopropoxy)et her	C ₁₀ H ₂₄ N ₂ O ₂	7300-34-7	204.310	li q		135	0.96 ²⁰	1.4619 ²⁰	
911	<i>N,N</i> -Bi s(3-ami nopropyl)-1,4-but anedi ami ne	Spermi ne	C ₁₀ H ₂₆ N ₄	71-44-3	202.340		29	150 ⁵			
912	<i>N,N</i> -Bi s(3-ami nopropyl)-1,4-but anedi ami ne, t et rahydrochl ori de		C ₁₀ H ₃₀ Cl ₄ N ₄	306-67-2	348.184			301.5			s H ₂ O
913	Bi s(2-bromoet hyl)et her	Bromex	C ₄ H ₆ Br ₂ O	5414-19-7	231.914			115 ³² , 92 ¹²	1.8452 ²⁰	1.5131 ²⁷	
914	1,2-Bi s(bromomet hyl)benzene		C ₆ H ₈ Br ₂	91-13-4	263.958	ort h (chl)	95	129 ⁵	1.988 ²⁵		i H ₂ O; s Et OH, et h, ct c, chl, pet h, li g
915	1,3-Bi s(bromomet hyl)benzene		C ₆ H ₈ Br ₂	626-15-3	263.958	nd (chl), pr (ace)	77	137 ²⁰	1.959 ²⁵		i H ₂ O; s Et OH, et h, chl, li g
916	1,4-Bi s(bromomet hyl)benzene		C ₆ H ₈ Br ₂	623-24-5	263.958	mcl pr (al), cry (chl, bz)	144.5	245	2.012 ²⁵		i H ₂ O; vs Et OH, chl; sl et h; s bz
917	2,2-Bi s(bromomet hyl)-1,3-propanedi ol	Pent aeryt hri t ol di bromi de	C ₈ H ₁₆ Br ₂ O ₂	3296-90-0	261.940	nd (bz)	113				
918	1,3-Bi s(bromomet hyl)et et ramet hyl di si l oxane		C ₆ H ₁₆ Br ₂ OSi ₂	2351-13-5	320.169			233; 103 ¹⁵	1.3918 ²⁵	1.4719 ²⁵	
919	Bi s(4-bromophenyl)et her		C ₈ H ₈ Br ₂ O	2050-47-7	327.999	lf (al)	60.5	339	1.8		i H ₂ O; s Et OH, bz; vs et h; sl chl
920	Bi s(2-(2-but oxyet hoxy)et hyl)adi pat e		C ₂₂ H ₄₀ O ₈	141-17-3	434.563	li q			1.8		
921	1,4-Bi s(4- <i>t</i> et but yl di oxy)si sopropyl)benzene		C ₂₀ H ₃₄ O ₄	2781-00-2	338.482	cry	79				

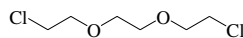




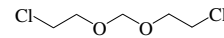
Bi s(3-*tert*-butyl-5-et hyl-2-hydroxyphenyl)met hane



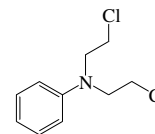
Bi s(4-chl orobenzoyl)peroxi de



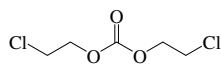
1,2-Bi s(2-chl oroet hoxy)et hane



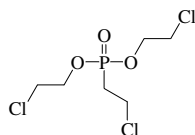
Bi s(2-chl oroet hoxy)met hane



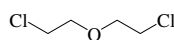
N,N-Bi s(2-chl oroet hyl)ani li ne



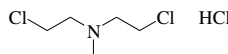
Bi s(2-chl oroet hyl)carbonat e



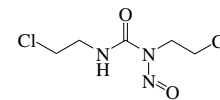
Bi s(2-chl oroet hyl)2chl oroet hyl phosphonat e



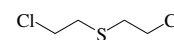
Bi s(2-chl oroet hyl)et her



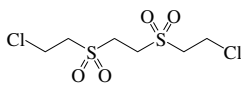
Bi s(2-chl oroet hyl)met hyl aminohydrochl ori de



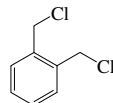
N,N'-Bi s(2-chl oroet hyl)nit rosourea



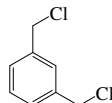
Bi s(2-chl oroet hyl)sulf i de



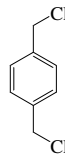
1,2-Bi s(2-chl oroet hyl sulf onyl)et hane



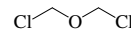
1,2-Bi s(chl oromet hyl)benzene



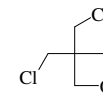
1,3-Bi s(chl oromet hyl)benzene



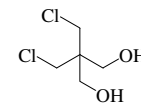
1,4-Bi s(chl oromet hyl)benzene



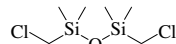
Bi s(chl oromet hyl)et her



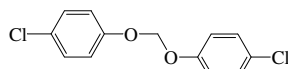
3,3-Bi s(chl oromet hyl)oxet ane



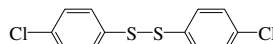
2,2-Bi s(chl oromet hyl)-1,3-propanedi ol



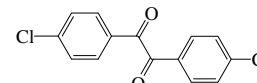
1,3-Bi s(chl oromet hyl)dit et ramet hyl di si



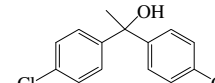
Bi s(4-chl orophenoxy)met hane



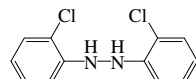
Bi s(4-chl orophenyl)di sulf i de



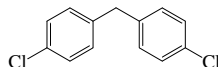
Bi s(4-chl orophenyl)et hanedi one



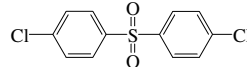
1,1-Bi s(4-chl orophenyl)et hanol



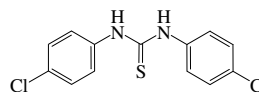
1,2-Bi s(2-chl orophenyl)hydrazi



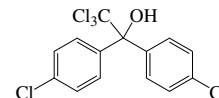
Bi s(4-chl orophenyl)met hane



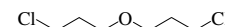
Bi s(4-chl orophenyl)sulf one



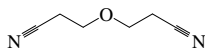
N,N'-Bi s(4-chl orophenyl)ti hourea



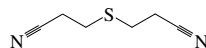
1,1-Bi s(4-chl orophenyl)-2,2,2-tri chl oroet hanol



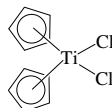
Bi s(3-chl oropropyl)et her



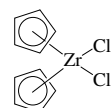
Bi s(2-cyanoet hyl)et her



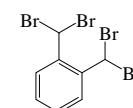
Bi s(2-cyanoet hyl)sulf i de



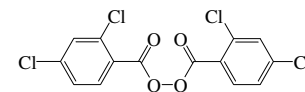
Bi s(cycl opent adi enyl)ti t tetrachloridi de



Bi s(cycl opent adi enyl)zi rconi chloridi de

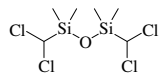


1,2-Bi s(di bromomet hyl)benzene

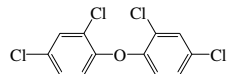


Bi s(2,4-di chl orobenzoyl)peroxi de

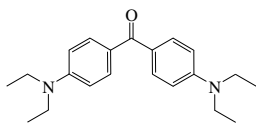
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
957	1,3-Bi s(di chl oromet hyl) t et ramet hyl di si l oxane		C ₆ H ₁₄ Cl ₄ OSi ₂	2943-70-6	300.157			149 ⁵⁰ , 117 ¹¹	1.2213 ²⁰	1.4660 ²⁰	
958	Bi s(2,4-di chl orophenyl)et her	2,2',4,4'-Tet rachl orodi phenyl et her	¹² H ₁₆ CCO	28076-73-5	307.987	cry (et h)	71				
959	4,4'-Bi s(di et hyl ami no)benzophenone	Mi chl er's et hyl ket one	²¹ H ₂₈ NO	90-93-7	324.459	lf (al)	95.3				
960	Bi s(di et hyl di t hi ocarbamat e)ni ckel		¹⁰ H ₂₀ N ₂ Si	14267-17-5	355.232			202 ^{0.02}			
961	Bi s(di et hyl di t hi ocarbamat e)zi nc		¹⁰ H ₂₀ N ₂ Zn	14324-55-1	361.948			178 ^{0.05}			
962	Bi s(di fluoromet hyl) et her	Di fluoromet hyl et her	² H ₂ F ₂ O	1691-17-4	118.030	col gas		2	1.43 ⁹		
963	Bi s(2-di met hyl ami noet hyl) et her	2,2'-Oxymet hyl s[di met hyl et hanami ne]	C ₈ H ₂₀ N ₂ O	3033-62-3	160.257	li q		80			
964	Bi s[4-(di met hyl ami no) phenyl]met hane	Mi chl er's Base	C ₁₇ H ₂₂ N ₂	101-61-1	254.370	pl or t ab (al, li q)	91.5	dec 390; 183 ³			i H ₂ O; sl Et OH; vs et h, bz; s aci d
965	Bi s[4-(di met hyl ami no) phenyl]met hanet hi one	4,4'-Bi s(di met hyl ami no) t hi obenzophenone	C ₁₇ H ₂₀ N ₂ S	1226-46-6	284.419	pl	204				i H ₂ O, Et OH, li g; sl et h; s bz, chl, HOAc
966	Bi s(4-di met hyl ami nophenyl)met hanol	4,4'-Bi s(di met hyl ami no)benzhydrone	C ₁₆ H ₂₂ N ₂ OC	119-58-4	270.369		102.0				i H ₂ O; vs Et OH; s et h, bz, HOAc
967	1,3-Bi s(di met hyl ami no)-2-propanol		¹ H ₈ N ₂ O	5966-51-8	146.230			181.5	0.8788 ²⁰	1.4418 ²⁰	vs H ₂ O
968	4,4'-Bi s(di met hyl ami no) t ri phenyl met hane		C ₂₃ H ₂₆ N ₂	129-73-7	330.465	nd or lf (al, bz)	102				vs bz, et h
969	Bi s(di met hyl di t hi ocarbamat e)copper		⁶ H ₁₂ ON ₂ S ₄	137-29-1	303.978			206 ^{0.01}			
970	Bi s(di met hyl di t hi ocarbamat e)ni ckel		⁶ H ₁₂ N ₂ Si ₄	15521-65-0	299.125			208 ^{0.002}			
971	2,5-Bi s(1,1-di met hyl propyl)-1,4-benzenedi ol	2,5-Di t erpent yl hydroqui none	¹⁰ H ₂₂ O ₂	79-74-3	250.376			180			
972	2,4-Bi s(1,1-di met hyl propyl)phenol		¹⁶ H ₂₆ O	120-95-6	234.376		26.0	169 ²²			
973	1,2-Bi s(di phenyl phosphi no)et hane	Di phos	²⁶ H ₄₂ P ₂	1663-45-2	398.417		143.5				
974	1,3-Bi s(2,3-epoxypropoxy)benzene	Di glyci dyl resorci nol et her	¹² H ₁₈ O ₄	101-90-6	222.237		42.5	147 ^{0.4}	1.2183 ³⁰	1.5408 ²⁰	
975	Bi s(2-et hoxyet hyl) pht hal at e		¹⁶ H ₂₀ O ₆	605-54-9	310.342		34	345	1.1229 ²¹		
976	Bi s(et hoxymet hyl) et her		⁶ H ₁₀ O ₃	5648-29-3	134.173			140.6			
977	<i>N,N'</i> -Bi s(4-et hoxphenyl) et hani mi dami de monohydrochl ori de	Phenacai ne hydrochl ori de	¹⁸ H ₂₃ Cl N ₂ O ₂	620-99-5	334.841	cry (w+1)	191				vs H ₂ O, Et OH, chl
978	Bi s(et hyl enedi ami ne)copper	Cupri et hyl enedi ami ne di chl ori de	⁴ H ₁₆ Cl ₂ CuN ₄	15243-01-3	254.649	dk bl cry					s Et OH
979	Bi s(2-et hyl hexyl) adi pat e		²² H ₃₆ O ₄	103-23-1	370.566		-67.8	214 ⁵	0.922 ²⁵	1.4474 ²⁰	vs ace, et h, Et OH
980	Bi s(2-et hyl hexyl)ami ne		¹⁶ H ₂₆ N	106-20-7	241.456			161 ²¹			
981	Bi s(2-et hyl hexyl)azel at e		²⁶ H ₄₂ O ₄	103-24-2	412.647		-78	237 ⁵	0.915 ²⁵	1.446 ²⁵	i H ₂ O; s Et OH, ace, bz; sl ct c
982	Bi s(2-et hyl hexyl) et her	2,2'-Di et hyl di hexyl et her	¹⁶ H ₃₄ OC	10143-60-9	242.440			269; 144 ¹³		1.4325 ²⁰	sl ct c
983	Bi s(2-et hyl hexyl) phosphat e		¹⁶ H ₂₆ O ₃ P	298-07-7	322.420	vi sc li q		155 ⁵	0.975 ²⁵		sl H ₂ O; s bz, hx
984	Bi s(2-et hyl hexyl) phosphonat e	Bi s(2-et hyl hexyl) phosphi t e	¹⁶ H ₃₅ OP	3658-48-8	306.421	li q		150	0.93 ²⁵	1.4420 ²⁰	
985	Bi s(2-et hyl hexyl) phosphorodi t hi oat e		¹⁶ H ₃₅ O ₂ PS ₂	5810-88-8	354.552	cry					s bz, hp, chl
986	Bi s(2-et hyl hexyl) pht hal at e	2,2'-Di et hyl pht hal at e	²⁴ H ₃₈ O ₄	117-81-7	390.557	li q	-55	384	0.98 ⁴	1.4853 ²⁰	sl ct c
987	Bi s(2-et hyl hexyl) sebacat e		²⁶ H ₄₂ O ₄	122-62-3	426.673		-48	256 ⁵	0.912 ²⁵	1.451 ²⁵	vs ace, bz, Et OH
988	Bi s(2-et hyl hexyl) sodi um sul f osuoci nat e	Docusat e sodi um	²⁶ H ₃₇ NaO ₇ S	577-11-7	444.559	waxy sol i d					s pet h, ct c, et h, ace
989	Bi s(2-et hyl hexyl) t erepht hal at e		²⁴ H ₃₈ O ₄	6422-86-2	390.557			383			
990	2,2-Bi s(et hyl sul f onyl)but ane	Sul f onet hyl met hane	⁸ H ₁₈ O ₂ S ₂	76-20-0	242.357	pl (w)	76	dec	1.199 ⁶⁵		s chl
991	Bi s[4-(hexyl oxy)phenyl]di azene, 1-oxi de		C ₂₄ H ₃₄ N ₂ O ₃	2587-42-0	398.538						s chl
992	<i>N,N'</i> -Bi s(2-hydroxybenzyl i dene)-1,2-di sal i cyl i dene-1,2-et hanedi ami ne		¹⁶ H ₁₆ O ₂	94-93-9	268.310			125.5			sl Et OH, et h; s bz, chl



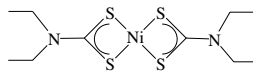
1,3-Bi s(di chl oromet hyl)t et ramet hyl di si loxan



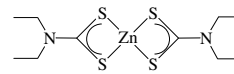
Bi s(2,4-di chl orophenyl)et her



4,4'-Bi s(di et hyl ami no)benzophenone



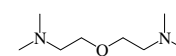
Bi s(di et hyl di t hi ocarbamate)ni ckel



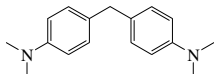
Bi s(di et hyl di t hi ocarbamate)zi nc



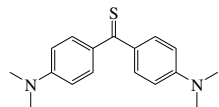
Bi s(di f luoromet hyl)et her



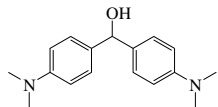
Bi s(2-di met hyl ami noet hyl)et her



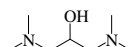
Bi s(4-di met hyl ami no)phenyl]met han



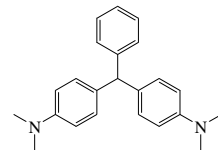
Bi s(4-di met hyl ami no)phenyl]met hanet hi



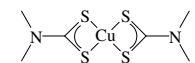
Bi s(4-di met hyl ami no)phenyl]met hanol



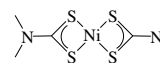
Bi s(di met hyl ami no)-2-propanol



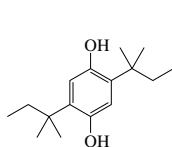
Bi s(di met hyl ami no)ri phenyl met han



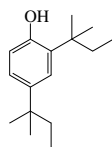
Bi s(di met hyl di t hi ocarbamate)cop



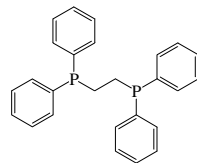
Bi s(di met hyl di t hi ocarbamate)ni ckel



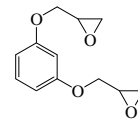
2,5-Bi s(1,1-di met hyl propyl)-1,4-benzenedi ol



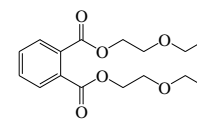
2,4-Bi s(1,1-di met hyl propyl)phenol



1,2-Bi s(di phenyl phosphi no)et hane



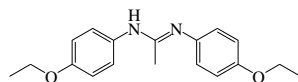
1,3-Bi s(2,3-epoxypropyl)benzene



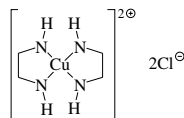
Bi s(2-et hoxet hyl)et hal at e



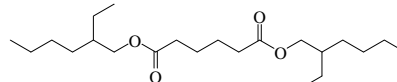
Bi s(et hoxymet hyl)et her



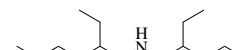
N,N'-Bi s(4-et hoxyphenyl)et hani mi damio



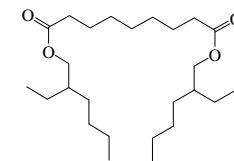
Bi s(et hyl enedi ami ne)cop



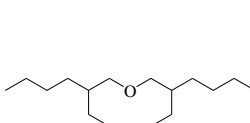
Bi s(2-et hyl hexyl)et hal at e



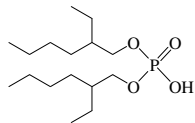
Bi s(2-et hyl hexyl)ami ne



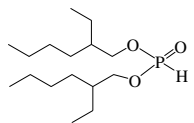
Bi s(2-et hyl hexyl)et hal at e



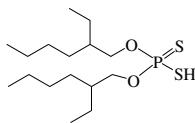
Bi s(2-et hyl hexyl)et her



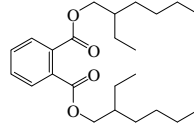
Bi s(2-et hyl hexyl)phosphat e



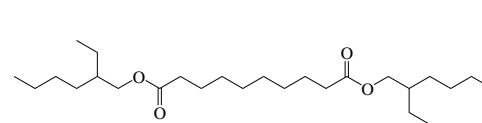
Bi s(2-et hyl hexyl)phosphonat e



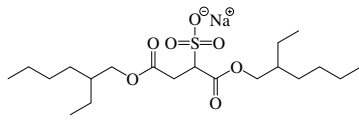
Bi s(2-et hyl hexyl)phosphorodit hi o



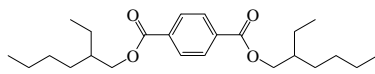
Bi s(2-et hyl hexyl)et hal at e



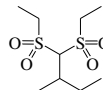
Bi s(2-et hyl hexyl)sebacat e



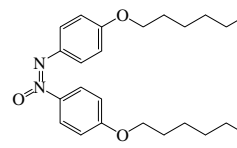
Bi s(2-et hyl hexyl)disul f osucci nat e



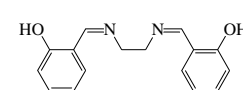
Bi s(2-et hyl hexyl)phrept hal at e



2,2-Bi s(et hyl sul f onyl)but ane

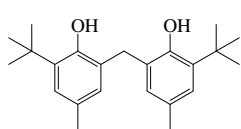


Bi s(4-(hexyl oxy)phenyl)di azen

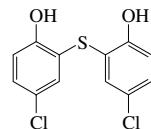


N,N'-Bi s(2-hydroxybenzyl i dene)-1,2-et hyl enedi ami ne

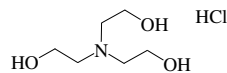
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
993	Bi s(2-hydroxy-3- <i>tert</i> -butyl-5-methylphenyl)met hane		C ₂₃ H ₃₂ O ₂	119-47-1	340.499	nd (pet h)	131				
994	Bi s(2-hydroxy-5-chlorophenyl) sulfide	Fent i cl or	C ₇ H ₆ Cl ₂ O ₂ S	97-24-5	287.162		174				i H ₂ O; s Et OH, et h, gl HOAc
995	2-[Bi s(2-hydroxyethyl)amino]ethanol hydrochloride	et hanol ami ne hydrochl ori de	C ₈ H ₁₀ ClNO ₃	637-39-8	185.649	cry (al)	179.5				vs H ₂ O
996	<i>N,N</i> -Bi s(2-hydroxyethyl)butylamine	But yl bi s(2-hydroxyethyl)ami ne	C ₁₀ H ₁₈ NO ₂	102-79-4	161.243			275; 80 ³⁵	0.9681 ²⁰	1.4625 ²⁰	s chl
997	Bi s(2-hydroxyethyl) disulfide		C ₄ H ₆ O ₂ S ₂	1892-29-1	154.251		26	160 ^{3,5}			
998	<i>N,N</i> -Bi s(2-hydroxyethyl) dodecanamine		C ₁₆ H ₃₃ NO ₃	120-40-1	287.438	waxy sol i d	38.7				
999	<i>N,N</i> -Bi s(2-hydroxyethyl)ethylamine <i>N</i> -Ethyl diethanolamine	<i>N</i> -Et hyl di et hanol ami ne	C ₈ H ₁₆ NO ₂	139-87-7	133.189	ye li q	-50	247	1.013 ⁹	1.4663 ²⁰	vs H ₂ O, Et OH; sl et h
1000	<i>N,N</i> -Bi s(2-hydroxyethyl) ethylenediamine		C ₆ H ₁₀ N ₂ O ₂	4439-20-7	148.203		97.5	136 ¹			s H ₂ O
1001	<i>N,N</i> -Bi s(2-hydroxyethyl)glycine	Bi ci ne	C ₈ H ₁₂ NO ₄	150-25-4	163.172	nd (al)	194 dec				vs H ₂ O; i Et OH
1002	Bi s(2-hydroxyethyl)met hylamine	Met hyl di et hanol ami ne	C ₅ H ₁₃ NO ₂	105-59-9	119.163	li q	-21	247	1.04 ⁹	1.4685 ²⁰	vs H ₂ O
1003	<i>N,N</i> -Bi s(2-hydroxyethyl)-3-methylamine	Di et hanol t ol ui di ne	C ₁₁ H ₁₇ NO ₂	91-99-6	195.259		64.5	160 ¹			sl chl
1004	<i>N,N</i> -Bi s(2-hydroxyethyl)-1,3-propanediamine	3-(Ami nopropyl)di et hanol ami ne	C ₇ H ₁₄ N ₂ O ₂	4985-85-7	162.230			160 ¹			
1005	Bi s(2-hydroxyethyl) sulfide	2,2'-Thi odi et hanol	C ₄ H ₁₀ O ₂ S	111-48-8	122.186	li q	-10.2	282	1.179 ⁹	1.5211 ²⁰	msc H ₂ O, Et OH, chl, AcOEt; s et h; sl bz
1006	Bi s(2-hydroxyethyl) terephthalate	Bi s(2-hydroxyethyl) 1,4-benzenedi carboxyl at e	C ₁₂ H ₁₄ O ₆	959-26-2	254.235	cry (w)	109.5				
1007	1,2-Bi s(2-hydroxyethyl) ether		C ₈ H ₁₆ O ₂ S ₂	5244-34-8	182.304		64.8	170 ^{0,5}			s H ₂ O, Et OH, bz, pet h
1008	Bi s(2-hydroxy-4-methoxyphenyl)met hane	2,2'-Di hydroxy-4,4'-di met hoxybenzophenone	C ₁₅ H ₁₄ O ₅	131-54-4	274.269		139.5				
1009	1,3-Bi s(hydroxymethyl)-2-imidazole	1,3-Di met hyl ol et hyl eneurea	C ₅ H ₈ N ₂ O ₃	136-84-5	146.144	cry (MeOH)	101				
1010	2,2-Bi s(4-hydroxy-3-methylphenyl)propane	Bi sphenol C	C ₁₄ H ₂₀ O ₂	79-97-0	256.340	nd (xyl)	140				
1011	2,2-Bi s(hydroxymethyl)-1,3-propanediol, <i>trans</i> -(2-propenyl) ester	Pent aeryt hri t ol t et raacryl at e	C ₁₇ H ₂₀ O ₆	4986-89-4	352.336		17.3		1.185 ²⁵		
1012	2,2-Bi s(hydroxymethyl)-1,3-propanediol, <i>cis</i> -(2-propenyl) ester	Pent aeryt hri t ol t ri acryl at e	C ₁₄ H ₁₈ O ₆	3524-68-3	298.289				1.180 ²⁰		
1013	2,2-Bi s(4-hydroxyphenyl)butane	Bi sphenol B	C ₁₆ H ₁₈ O ₂	77-40-7	242.313		120.5				vs ace, MeOH
1014	Bi s(4-hydroxyphenyl)met hane	Bi sphenol AD	C ₁₃ H ₁₂ O ₂	620-92-8	200.233		162.5	sub			s Et OH, et h, chl, al k; sl DMSO; i CS ₂
1015	2,2-Bi s(4-hydroxyphenyl)propane	Bi sphenol A	C ₁₅ H ₁₆ O ₂	80-05-7	228.287	cry or fl	153	220 ⁴ , 222 ³			i H ₂ O; vs Et OH, et h, bz, al k; s HOAc
1016	2,2-Bi s(4-hydroxyphenyl)propanediol, <i>trans</i> -(2-propenyl) ester	Bi sphenol A di met hacryl at e	C ₂₃ H ₂₆ O ₄	3253-39-2	364.435		73				
1017	Bi s(4-hydroxyphenyl) sulfone	Bi sphenol S	C ₁₂ H ₁₀ O ₄ S	80-09-1	250.270	nd (w), ort h bi pym	240.5		1.3663 ¹⁵		i H ₂ O; s Et OH, et h; sl bz, DMSO
1018	Bi s(2-mercapt ethyl) sulfide	2,2'-Di mercapt odi et hyl sulfide	C ₄ H ₁₀ S ₂	3570-55-6	154.317		-11	135 ¹⁸	1.183 ²⁵	1.5982 ²⁰	
1019	Bi s(2-methyl) carbonate		C ₉ H ₁₀ O ₃	64057-79-0	170.205		201.3	66 ³	0.943 ²⁵	1.4371 ²⁰	
1020	Bi s(2-methoxyethyl)amine	2-Met hoxyl(2-met hoxyl) et hanami ne	C ₆ H ₁₅ NO ₂	111-95-5	133.189						s ct c
1021	Bi s(4-methoxyphenyl) diazene, 1-oxide		C ₁₄ H ₁₄ N ₂ O ₃	1562-94-3	258.272	ye nd (al)			1.1711 ¹		s Et OH, ace, bz; sl chl



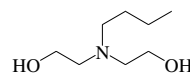
Bis(2-hydroxy-3-tert-butyl-5-methylphenyl) methane



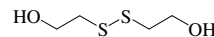
Bis(2-hydroxy-5-chlorophenyl) sulfide



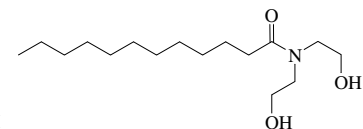
Bis(2-hydroxyethyl)amine hydrochloride



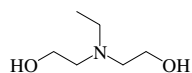
N,N-Bis(2-hydroxyethyl)butylamine



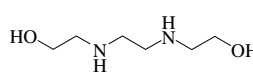
Bis(2-hydroxyethyl) disulfide



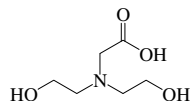
N,N-Bis(2-hydroxyethyl) dodecanamide



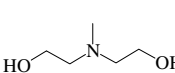
N,N-Bis(2-hydroxyethyl) ethylamine



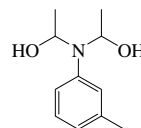
N,N'-Bis(2-hydroxyethyl) ethane-1,2-diamine



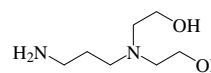
N-Bis(2-hydroxyethyl) glycolic acid



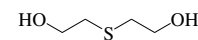
N-Bis(2-hydroxyethyl) methylamine



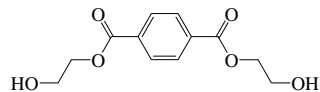
N,N-Bis(2-hydroxyethyl) 3-methylphenylamine



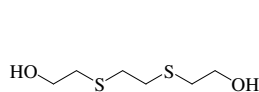
N-Bis(2-hydroxyethyl) 1,3-propanediamine



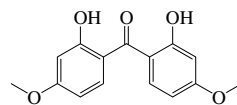
Bis(2-hydroxyethyl) disulfide



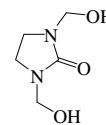
Bis(2-hydroxyethyl) terephthalate



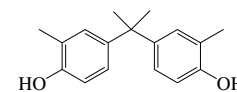
1,2-Bis(2-hydroxyethyl) ethane-1,2-dithiolane



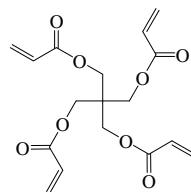
Bis(2-hydroxy-4-methoxyphenyl) methanone



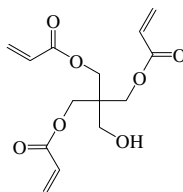
1,3-Bis(hydroxymethyl)-2-imidazolidone



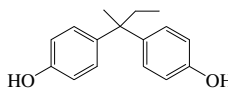
2,2-Bis(4-hydroxy-3-methylphenyl) propane



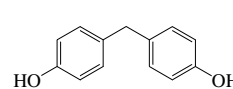
2,2-Bis(4-hydroxyphenyl) 1,3-propanediol bis(2-propenoylether)



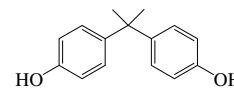
2,2-Bis(4-hydroxyphenyl) 1,3-propanediol bis(2-propenoylether)



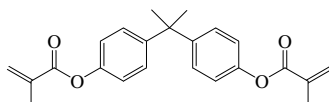
2,2-Bis(4-hydroxyphenyl) butane



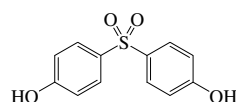
Bis(4-hydroxyphenyl) methane



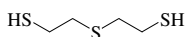
2,2-Bis(4-hydroxyphenyl) propane



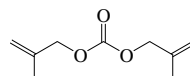
2,2-Bis(4-hydroxyphenyl) propanediol methacrylate



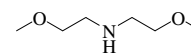
Bis(4-hydroxyphenyl) sulfone



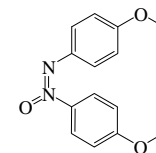
Bis(2-mercaptoethyl) sulfide



Bis(2-methylallyl) carbonate

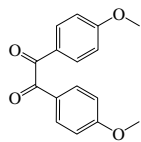


Bis(2-methoxyethyl)amine

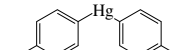
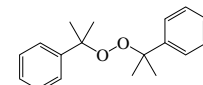
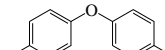
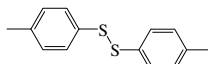
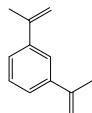
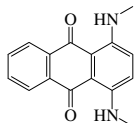


Bis(4-methoxyphenyl) di azerone

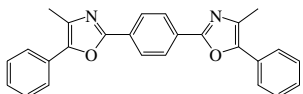
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1022	Bi s(4-met hoxypheyl)et hanedi one		$_{16}C_{14}O_4$	1226-42-2	270.280		133				sl Et OH, chl
1023	1,4-Bi s(met hyl ami no)-9,10-ant hracenedi one		$C_{16}H_{14}N_2O_2$	2475-44-7	266.294						sl chl
1024	1,3-Bi s(1-met hyl et heny l)benzene	1,3-Di i sopropenyl benzene	$_{12}H_{14}C$	3748-13-8	158.239	li q		231	0.925	1.5570	
1025	Bi s(4-met hyl phenyl) di sul fide	β Tol yl di sul fide	$_{10}H_{14}S_2$	103-19-5	246.391	nd or lf (al)	47.5	212	1.114 ⁵¹		i H ₂ O; s Et OH, ace; vs et h
1026	Bi s(4-met hyl phenyl) et her	p -Tol yl et her	$_{10}H_{14}O$	1579-40-4	198.260		51	285			vs bz, et h, Et OH
1027	Bi s(1-met hyl -1-phenyl et hyl)peroxi de	Di cumyl peroxi de	$_{18}H_{22}O_2$	80-43-3	270.367	cry (Et OH)	40	100 ²			
1028	Bi s(4-met hyl phenyl)mercury	β -tol-yl mercury	$_{10}H_{14}Hg$	537-64-4	382.85		245.7				
1029	1,4-Bi s(4-met hyl -5-phenyl oxazol -2-yl)benzene	2,2'- p -Phenylenebi s(4-met hyl -5-phenyl oxazol e)	$C_{26}H_{20}N_2O_2$	3073-87-8	392.449		232				sl chl
1030	Bi s(4-met hyl phenyl) sul fide	β it-ol-yl sul fide	$_{10}H_{14}S$	620-94-0	214.326	nd (al)	57.3	>300; 175 ⁶			i H ₂ O; s Et OH, ace, bz, HOAc; sl chl
1031	Bi s(4-met hyl phenyl) sul f one	β it-ol-yl sul f one	$_{10}H_{14}O_2S$	599-66-6	246.325	pr(bz), nd(w,al)	159	406			sl H ₂ O, et h; s Et OH, bz, chl, C ₂ S
1032	<i>N,N'</i> -Bi s(2-met hyl phenyl) hi ourea		$_{15}H_{16}N_2S$	137-97-3	256.366	nd (al, sub)					vs bz, Et OH, chl
1033	1,3-Bi s(1-met hyl -4-pi peri dyl)propane		$_{15}H_{16}N_2$	64168-11-2	238.412		13.7	215 ⁵⁰	0.8962 ²⁵	1.4804 ²⁵	
1034	Bi s(met hyl t hi o)met hane		$_{3}H_6S_2$	1618-26-4	108.226			148			
1035	1,2-Bi s <i>N</i> -morphol i no)et hane		$_{10}H_{20}N_2O_2$	1723-94-0	200.278	wh-ye (et h,li g)	75	285; 100			vs H ₂ O, ace, bz, Et OH
1036	Bi smut h acet at e		$_{6}H_6Bi Q$	22306-37-2	386.111	col t ablet s	250				i ₂ OH
1037	Bi smut h subsal i cyl at e		$_{7}H_6Bi Q$	14882-18-9	362.093	pr					i H ₂ O, Et OH; reac al k
1038	Bi s(2-ni t rophenyl) di sul fide		$_{12}H_{10}N_2O_4S_2$	1155-00-6	308.333		198.5				i H ₂ O, et h; sl Et OH, ace, bz, HOAc
1039	Bi s(3-ni t rophenyl) di sul fide	Ni t ropheni de	$_{12}H_{10}N_2O_4S_2$	537-91-7	308.333		84				sl Et OH, chl ; s et h
1040	Bi s(4-ni t rophenyl) di sul fide		$_{12}H_{10}N_2O_4S_2$	100-32-3	308.333		182	255 ^{0.1}			sl Et OH, HOAc
1041	1,2-Bi s(4-ni t rophenyl)et hane	4,4'-Di ni t robi benzyl	$_{14}H_{12}N_2O_4$	736-30-1	272.256	ye nd (al, bz)	181.8				i Et OH; sl et h, bz, chl, HOAc
1042	<i>N,N'</i> -Bi s(4-ni t rophenyl)jurea	4,4'-Di ni t rocarbani li de	$_{13}H_{10}N_4O_6$	587-90-6	302.242		312 dec				
1043	Bi s(2,4-pent anedi onat o)cobal t	Cobal t (II) bi s(acet yl acet onat e)	$_{10}H_{14}CoO_4$	14024-48-7	257.149	bl -vi ol cry	167				
1044	Bi s(1-phenyl et hyl)jami ne		$_{16}H_{19}N$	10024-74-5	225.329			296.5	1.018 ¹⁵	1.573	
1045	1,2-Bi s(2,4,6-t ri bromophenoxy) et hane		$C_{17}H_6Br_6O_2$	37853-59-1	687.637	nd (bz/Et OH)	222				
1046	<i>N,N'</i> -Bi s(2,2,2-t ri chl oro-1-hydroxyet hyl)jurea		$C_5H_6Cl_6N_2O_3$	116-52-9	354.831		196				vs ace, Et OH
1047	1,4-Bi s(ri chl oromet hyl)benzene		$_{8}H_6Cl_6$	68-36-0	312.836	cry (bz, et h)	109				s chl
1048	Bi s(ri chl oromet hyl) carbonat e	Tri phosgene	$_{3}Cl_6O_3$	32315-10-9	296.748	cry (et h, pet h)	79	203	1.6290		
1049	Bi s(ri deci l) t hi odi propanoat e	Di t ri deci l t hi odi propi onat e	$_{22}H_{32}O_3S$	C 10595-72-9	542.897			265 ^{0.25}			vs Et OH
1050	3,5-Bi s(ri fluoromet hyl)ani li ne		$_{8}H_6F_6N$	328-74-5	229.123			85 ¹⁵ , 76 ¹⁰	1.487 ²⁵	1.4335 ²⁰	
1051	1,3-Bi s(ri fluoromet hyl)benzene		$_{8}H_6F_6$	402-31-3	214.108			116	1.3790 ²⁵	1.3916 ²⁵	i H ₂ O
1052	1,4-Bi s(ri fluoromet hyl)benzene		$_{8}H_6F_6$	433-19-2	214.108	li q		115			
1053	Bi s(ri fluoromet hyl) di sul fide		$_{2}F_6S_2$	372-64-5	202.141			34.6			vs Et OH, pet h
1054	1,2-Bi s(ri met hyl si lyl)acet yl ene		$_{8}H_{12}Si_2$	14630-40-1	170.400		26	134	0.770 ²⁰	1.413 ²⁰	
1055	Bi s(2,4,6-t ri ni t rophenyl) sul fide	Di pi cryl sul fide	$_{12}H_6N_6O_{12}S$	2217-06-3	456.258	ye cry	230	exp			
1056	Bi s[2-(vi nyl oxy)et hyl] et her	Di et hyl ene glycol di vi nyl et her	$_{14}H_{14}O_3$	C 764-99-8	158.195			81 ¹⁰			
1057	Bi t hi onol		$_{12}H_6Cl_6O_2S$	97-18-7	356.052		188		1.73 ²⁵		vs ace
1058	2,2'-Bi t hi ophene		$_{8}H_6S_2$	492-97-7	166.264		33	260			i H ₂ O; vs Et OH; s et h, ct c, HOAc
1059	Bi xi n		$_{29}H_{30}O_4$	6983-79-5	394.504	vi ol pr (ace)	198				i ₂ B; s Et OH, ace; sl et h, bz, HOAc
1060	Bol denone	Dehydrot est ost erone	$_{16}H_{26}O_2$	846-48-0	286.408		165				
1061	Bol di ne		$_{12}H_{21}NO_4$	476-70-0	327.375	cry (et h)	163				vs Et OH, chl
1062	Bomyl		$C_8H_{15}O_8P$	122-10-1	282.184	ye oi l		160			sl H ₂ O; vs ace, Et OH, xyl



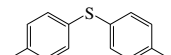
Bi s(4-met hoxypenyl)et hane di one 1,4-Bi s(met hyl ami no)-9,10-ant hracenedi onef,3-Bi s(1-met hyl et heny l)benzene



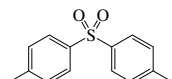
Bi s(1-met hyl -1-phenyl et hyl)peroxi de Bi s(4-met hyl phenyl)mercury



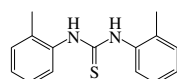
1,4-Bi s(4-met hyl -5-phenyl oxazol -2-yl)benzene



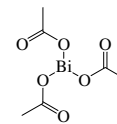
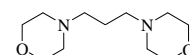
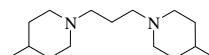
Bi s(4-met hyl phenyl)sul f i de



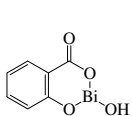
Bi s(4-met hyl phenyl)sul f one



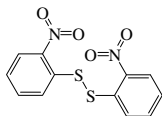
N,N'-Bi s(2-met hyl phenyl) thi oureat,3-Bi s(1-met hyl -4-pi eri dy l)propanBi s(met hyl ti o)met hane



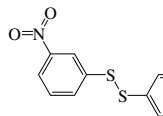
1,2-Bi s(4-mor phol i no)et hane Bi smut acet at e



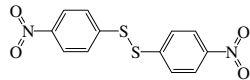
Bi smut subsal i cyl at e



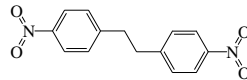
Bi s(2-ni t rophenyl)sul f i de



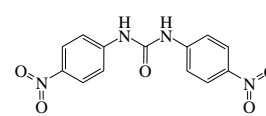
Bi s(3-ni t rophenyl)sul f i de



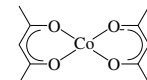
Bi s(4-ni t rophenyl)sul f i de



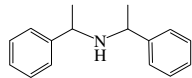
1,2-Bi s(4-ni t rophenyl)et hane



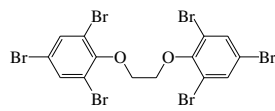
N,N'-Bi s(4-ni t rophenyl)urea



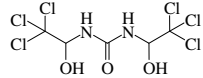
Bi s(2,4-pent anedi onat o)cobal t



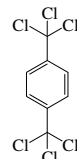
Bi s(1-phenyl et hyl)ami ne



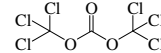
1,2-Bi s(2,4,6-t ri bromophenoxy)et hane



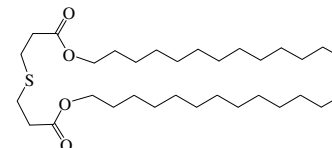
N,N'-Bi s(2,2,2-t ri chl oro-1-hydroxyet hyl)urea



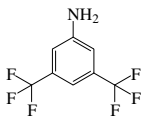
1,4-Bi s(t ri chl omet hyl)benzene



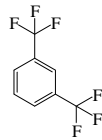
Bi s(t ri chl omet hyl)car bonat e



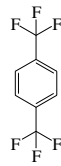
Bi s(t ri decyl)di et hyl propanoat e



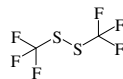
3,5-Bi s(t ri f luoromet hyl)ani li n



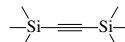
1,3-Bi s(t ri f luoromet hyl)benzene



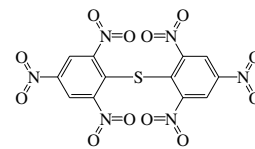
1,4-Bi s(t ri f luoromet hyl)benzene



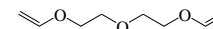
Bi s(t ri f luoromet hyl)sul f i de



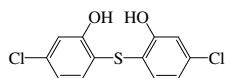
1,2-Bi s(t ri met hyl si lyl)acet ylene



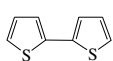
Bi s(2,4,6-t ri ni t rophenyl)sul f i de



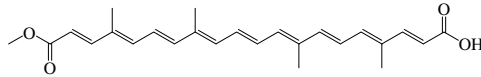
Bi s(2-vi nyl oxy)et hyl et her



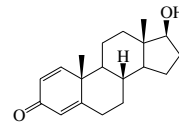
Bi t hi onol



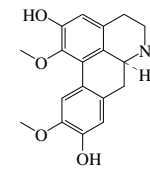
2,2'-Bi t hi ophene



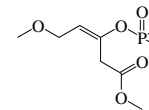
Bi xi n



Bol denone



Bol di ne

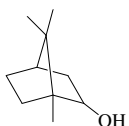


Bomyl

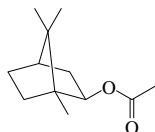
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1063	Borane carbonyl		CH ₃ BO	13205-44-2	41.845	col gas	-137	-64			dec H ₂ O
1064	Borneol, (±)		C ₁₀ H ₁₈ O	6627-72-1	154.249	lf (li g)	208	sub	1.071		i H ₂ O; vs Et OH, Et h, bz
1065	<i>t</i> -Bornyl acetate		C ₁₀ H ₂₀ O ₂	5655-61-8	196.286		27	223.5	0.982 ²⁵	1.4626 ²⁰	sl H ₂ O; s Et OH, Et h
1066	Bornylamine		C ₉ H ₁₉ N	32511-34-5	153.265		163				vs ace, bz, Et h, Et OH
1067	Bornyl chloride	2-Chloro-1,7,7-trimethylbicyclo[2.2.1]heptane, <i>endo</i>	C ₁₀ H ₁₇ Cl	464-41-5	172.695	nd	132	207.5			vs bz, Et h, Et OH, pet h
1068	Bornyl 3-methylbutanoate	<i>d</i> -Bornyl isovalerate	C ₁₉ H ₂₆ O ₂	53022-14-3	238.366			257.5	0.955 ²⁵		vs Et h, Et OH
1069	Boron trifluoride-dimethyl ether complex		C ₂ H ₆ BF ₃ O	353-42-4	113.874		-14	dec 127	1.2410 ²⁰	1.302 ²⁰	
1070	Boron trifluoride etherate		C ₄ H ₁₀ BF ₃ O	109-63-7	141.927	li q	-60.4	125.5	1.125	1.348 ²⁰	dec H ₂ O; vs Et h, Et OH
1071	Briiliant Green		C ₂₇ H ₃₄ N ₂ O ₄ S	633-03-4	482.635	small gold cry					vs H ₂ O, Et OH
1072	Briiliant Yellow		C ₂₆ H ₂₀ N ₄ Na ₂ O ₃ S ₂	3051-11-4	626.569	ye cry (w)					s H ₂ O, Et OH; sl ace
1073	Brodifacoum		C ₉ H ₁₃ BrO ₃	56073-10-0	523.417	of f -wh pow	230				i ₂ OH sl Et OH, bz; s ace, chl
1074	Bromacil	5-Bromo-3sec-butyl-6-methyluracil	C ₉ H ₉ BrN ₂ O ₂	314-40-9	261.115		158		1.55 ²⁵		
1075	Bromadiolone		C ₉ H ₁₃ BrO ₄	28772-56-7	527.406	ye-wh pow	205				vs DMF; sl ace, chl, Et OH, Et h; i hx
1076	Bromal hydrate		C ₃ H ₃ Br ₂ O ₂	507-42-6	298.756	mcl pr (w+1)	53.5	dec	2.566 ¹⁹		vs Et h, Et OH
1077	Bromdian	Tetrabromobiphenyl A	C ₁₂ H ₆ Br ₄ O ₂	79-94-7	543.871		179				s Et OH, Et h, bz, chl
1078	<i>N</i> -Bromoacetamide		C ₂ H ₄ BrNO	79-15-2	137.963	nd (chl-hx)	103.5				vs Et h
1079	Bromoacetic acid		C ₂ H ₃ BrO ₂	79-08-3	138.948	hex or orth cry	50	208	1.9335 ⁹	1.4804 ⁵⁰	msc H ₂ O, Et OH, Et h; s ace, bz; sl chl
1080	Bromoacetone		C ₃ H ₅ BrO	598-31-2	136.975	li q	-36.5	138; 31.5	1.634 ²³	1.4697 ¹⁵	sl H ₂ O; s Et OH, Et h, ace
1081	α -Bromoacetophenone	ω -Bromoacetophenone	C ₈ H ₇ BrO	70-11-1	199.045	nd (al) orth pr (al) pl (pet h)	50.5	135 ¹⁸	1.647 ²⁰		i H ₂ O; s Et OH, pet h; vs Et h, bz, chl
1082	4-(Bromoacetyl)phenyl	2-Bromo-4'-phenylacetophenone	C ₁₄ H ₉ BrO	135-73-9	275.140	nd (95% al)	127				
1083	Bromoacetyl bromide		C ₂ H ₃ Br ₂ O	598-21-0	201.844			148.5	2.312 ²²	1.5449 ²⁰	s ace, ct c
1084	Bromoacetylene		C ₂ HBr	593-61-3	104.933	col gas		4.7			vs Et h
1085	5-(2-Bromoethyl)-5sec-butylbarbituric acid	Butalylonal	C ₁₅ H ₁₅ BrN ₂ O ₃	1142-70-7	303.152			131.5			vs Et h, Et OH
1086	5-(2-Bromoethyl)-5-isopropylbarbituric acid	Propalylonal	C ₁₃ H ₁₃ BrN ₂ O ₃	545-93-7	289.125	cry (di l HOAc, di l al)	181				sl H ₂ O, Et h, bz; vs Et OH, ace, HOAc
1087	2-Bromoaniline		C ₆ H ₆ BrN	615-36-1	172.023		32	229	1.578 ²⁰	1.6113 ²⁰	i H ₂ O; s Et OH, Et h
1088	3-Bromoaniline		C ₆ H ₆ BrN	591-19-5	172.023		18.5	251	1.5793 ²⁰	1.6260 ²⁰	sl H ₂ O; s Et OH, Et h
1089	4-Bromoaniline		C ₆ H ₆ BrN	106-40-1	172.023	orth bi pym nd (60% al)	66.4	dec	1.4970 ¹⁰⁰		i H ₂ O; s Et OH, Et h; sl chl
1090	2-Bromoaniline		C ₆ H ₇ BrO	578-57-4	187.034			216	1.5018 ²⁰	1.5727 ²⁰	i H ₂ O; vs Et OH, Et h
1091	3-Bromoaniline		C ₆ H ₇ BrO	2398-37-0	187.034			211; 105 ¹⁶		1.5635 ²⁰	i H ₂ O; s Et OH, Et h, bz, C ₆ S
1092	4-Bromoaniline		C ₆ H ₇ BrO	104-92-7	187.034		13.5	215	1.4564 ²⁰	1.5642 ²⁰	sl H ₂ O; vs Et OH, Et h, chl; s ct c
1093	2-Bromobenzaldehyde		C ₇ H ₅ BrO	6630-33-7	185.018		21.5	230	1.5925 ²⁰		i H ₂ O; vs Et OH, bz; sl ct c
1094	3-Bromobenzaldehyde		C ₇ H ₅ BrO	3132-99-8	185.018			234	1.5935 ²⁰		i H ₂ O; vs Et OH, Et h; sl ct c
1095	4-Bromobenzaldehyde		C ₇ H ₅ BrO	1122-91-4	185.018	lf (di l al)	58	²⁶⁷			i H ₂ O; vs Et OH, bz; sl chl
1096	Bromobenzene	Phenyl bromide	C ₆ H ₅ Br	108-86-1	157.008	li q	-30.72	156.06	1.495 ⁹	1.5597 ²⁰	i H ₂ O; vs Et OH, Et h, bz; s ct c
1097	4-Bromobenzeneacetate		C ₈ H ₇ BrO ₂	1878-68-8	215.045	nd (w)	116	sub			sl H ₂ O; vs Et OH, Et h, C ₆ S
1098	4-Bromobenzeneacetone		C ₈ H ₇ BrO	16532-79-9	196.045	pa ye cry (al)	48.0				vs bz, Et OH
1099	α -Bromobenzeneacetone	α -Bromobenzyl cyanide	C ₇ H ₅ BrN	5798-79-8	196.045	ye cry (di l al)	29	dec 242; 133 ¹²	1.539 ²⁹		i H ₂ O; vs Et OH, Et h, ace, bz, chl



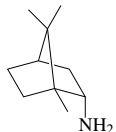
Borane carbonyl



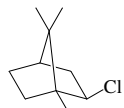
Borneol, (±)



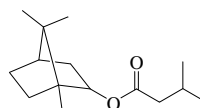
(-)-Borneyl acetate



Borneylamine



Borneyl chloride



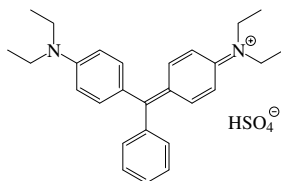
Borneyl 3-methylbutanoate (d,l)



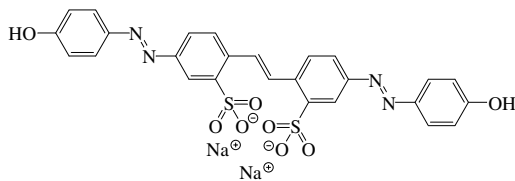
Boron trifluoride etherate



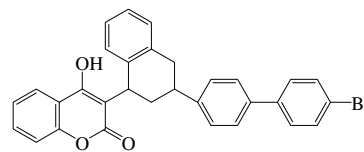
Boron trifluoride diethyl etherate



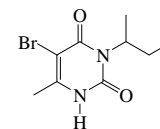
Bromocresol green



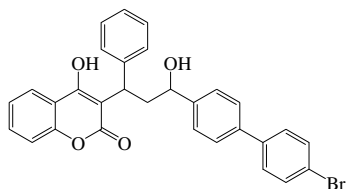
Bromocresol purple



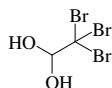
Bromofluorescein



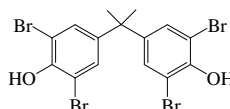
Bromocresol red



Bromocresol blue



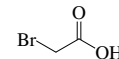
Bromal hydrate



Bromindane



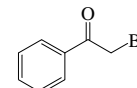
N-Bromoacetamide



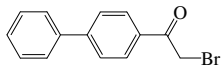
Bromoacetic acid



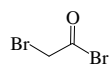
Bromoacetone



alpha-bromoacetophenone



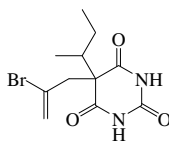
4-(bromoacetyl)phenyl



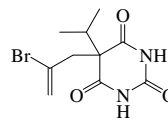
Bromoacetyl bromide



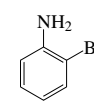
Bromoacetylene



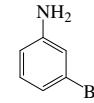
5-(2-bromoethyl)-5-sec-butylbarbituric acid



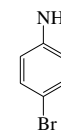
5-(2-bromoethyl)-5-isopropylbarbituric acid



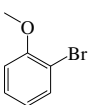
2-bromoaniline



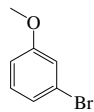
3-bromoaniline



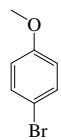
4-bromoaniline



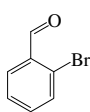
2-bromoanisole



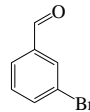
3-bromoanisole



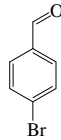
4-bromoanisole



2-bromobenzaldehyde



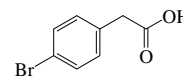
3-bromobenzaldehyde



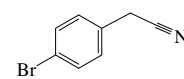
4-bromobenzaldehyde



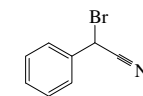
Bromobenzene



4-bromobenzeneacetic acid

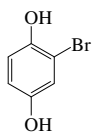


4-bromobenzeneacetonitrile

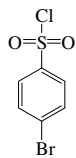


alpha-bromobenzeneacetonitrile

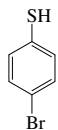
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1100	2-Bromo-1,4-benzenediol		C ₆ H ₃ BrO ₂	583-69-7	189.007	lf (li g), cry (chl)	111.5	sub			vs O; Et OH, et h, bz; sl chl, li g, s HOAc
1101	4-Bromobenzenesulfonyl chloride	<i>p</i> -Brosyl chloride	C ₆ H ₄ BrClO ₂ S	98-58-8	255.517	tbl or mcl pl (et h)	76	153 ¹⁵			i H ₂ O; vs et h; s chl
1102	4-Bromobenzenethiol		C ₆ H ₄ BrS	106-53-6	189.073	lf (al)	73	230.5	1.526 ⁶		sl H ₂ O, Et OH; vs et h, ct c, chl
1103	2-Bromobenzoic acid		C ₆ H ₄ BrO ₂	88-65-3	201.018	mcl pr (w), nd	150	sub	1.929 ⁵		sl H ₂ O, DMSO; s Et OH, et h, ace, chl
1104	3-Bromobenzoic acid		C ₆ H ₄ BrO ₂	585-76-2	201.018	mcl nd (di l al)	155	>280	1.845		i H ₂ O; s Et OH, et h
1105	4-Bromobenzoic acid		C ₆ H ₄ BrO ₂	586-76-5	201.018	nd (et h), lf (w), mcl pr	254.5		1.894 ²⁰		sl H ₂ O, DMSO; s Et OH, et h
1106	2-Bromobenzonitrile		C ₆ H ₄ BrN	2042-37-7	182.018	nd (w)	55.5	252			s H ₂ O; vs Et OH; sl chl
1107	3-Bromobenzonitrile		C ₆ H ₄ BrN	6952-59-6	182.018		39.5	225			vs Et OH, et h; sl chl
1108	4-Bromobenzonitrile		C ₆ H ₄ BrN	623-00-7	182.018	nd (w, al)	114	236			s H ₂ O, Et OH, et h, chl
1109	6-Bromobenzo[a]pyrene		C ₂₀ H ₁₁ Br	21248-00-0	331.205	cry (ace/MeOH)	223				
1110	2-Bromobenzoyl chloride		C ₆ H ₄ BrClO	7154-66-7	219.463	nd	11	243		1.5963 ³⁰	sl ct c
1111	4-Bromobenzoyl chloride		C ₆ H ₄ BrClO	586-75-4	219.463	nd (pet h)	42	246; 181 ²⁵			vs Et OH, et h, bz, li g
1112	2-Bromobiphenyl		C ₁₂ H ₉ Br	2052-07-5	233.103		0.8	297	1.2175 ²⁶	1.6248 ²⁵	vs et h, Et OH
1113	3-Bromobiphenyl		C ₁₂ H ₉ Br	2113-57-7	233.103			300; 171 ¹⁷		1.6411 ²⁰	i H ₂ O
1114	4-Bromobiphenyl		C ₁₂ H ₉ Br	92-66-0	233.103	pl (al)	91.5	310	0.932 ⁷		i H ₂ O; s Et OH, et h, bz, HOAc; sl chl
1115	1-Bromo-2-(bromomethyl)benzene		C ₆ H ₇ Br ₂	3433-80-5	249.931	cry (al, li g)	31	129			vs et h, Et OH, HOAc
1116	1-Bromo-3-(bromomethyl)benzene		C ₆ H ₇ Br ₂	823-78-9	249.931	nd or lf	42	122			s chl
1117	1-Bromo-4-(bromomethyl)benzene	<i>p</i> -Bromobenzyl bromide	C ₆ H ₇ Br ₂	589-15-1	249.931	nd (al)	63				sl H ₂ O; s Et OH, bz, chl; vs et h, CS
1118	2-Bromo-2-(bromomethyl)pentane-1,1-diol	1,2-Di bromo-2,4-di cyanobutane	C ₆ H ₈ Br ₂ N ₂	35691-65-7	265.933		52				i H ₂ O; vs ace, bz, DMF
1119	2-Bromo-1-(4-bromophenyl)ethanone	<i>p</i> -Bromophenacyl bromide	C ₈ H ₇ Br ₂ O	99-73-0	277.941	nd (al)	111				i H ₂ O; s Et OH, et h, chl
1120	2-Bromo-1,3-butadiene		C ₄ H ₅ Br	1822-86-2	132.987			42 ¹⁶⁵	1.397 ²⁰	1.4988 ²⁰	vs et h, Et OH
1121	1-Bromobutane	Butyl bromide	C ₄ H ₉ Br	109-65-9	137.018	li q	-112.6	101.6	1.275 ⁸	1.4401 ²⁰	i H ₂ O; msc Et OH, et h, ace; sl ct c; s chl
1122	2-Bromobutane, (±)	(±)- <i>sec</i> -Butyl bromide	C ₄ H ₉ Br	5787-31-5	137.018	li q	-112.65	91.3	1.258 ⁹	1.4366 ²⁰	vs ace, et h, chl
1123	Bromobutanediol, (±)	Bromosuccinic acid	C ₄ H ₇ BrO ₄	584-98-5	196.985		161		2.073 ²⁵		s H ₂ O, Et OH; sl HOAc
1124	4-Bromobutanetriol		C ₄ H ₇ BrO ₃	5332-06-9	148.002			206	1.4967 ²⁰	1.4818 ²⁰	s Et OH, et h, chl
1125	2-Bromobutanedioic acid, (±)	<i>DL</i> -α-Bromobutyric acid	C ₄ H ₆ BrO ₄	2385-70-8	167.002		-2.0	dec 217; 127 ²⁵	1.5641 ²⁰		s H ₂ O, Et OH, et h
1126	4-Bromobutanedioic acid		C ₄ H ₆ BrO ₄	2623-87-2	167.002		33	142 ²⁵ , 125 ⁷			
1127	3-Bromo-2-butanone		C ₄ H ₇ BrO	814-75-5	151.002			36 ¹¹			
1128	<i>cis</i> -1-Bromo-1-butene		C ₄ H ₇ Br	31849-78-2	135.003			86.1	1.3265 ¹⁵	1.4536 ²⁰	i H ₂ O; s et h, ace, bz, chl; sl ct c
1129	<i>trans</i> -1-Bromo-1-butene		C ₄ H ₇ Br	32620-08-9	135.003	li q	-100.3	94.7	1.320 ⁹	1.4527 ²⁰	i H ₂ O; s et h, ace, bz, chl; sl ct c
1130	2-Bromo-1-butene		C ₄ H ₇ Br	23074-36-4	135.003	li q	-133.4	88	1.320 ⁹	1.4527 ²⁰	i H ₂ O; s et h, ace, bz, chl; sl ct c
1131	4-Bromo-1-butene		C ₄ H ₇ Br	5162-44-7	135.003			98.5	1.3230 ²⁰	1.4622 ²⁰	sl H ₂ O; vs bz, et h, Et OH
1132	1-Bromo-2-butene		C ₄ H ₇ Br	4784-77-4	135.003			104.5	1.3371 ²⁵	1.4822 ²⁰	i H ₂ O; s Et OH, et h, ct c; vs chl, bz
1133	<i>cis</i> -2-Bromo-2-butene		C ₄ H ₇ Br	3017-68-3	135.003	li q	-111.5	93.9	1.341 ⁶	1.4631 ¹⁹	i H ₂ O; s Et OH, et h, ct c; vs chl, bz
1134	<i>trans</i> -2-Bromo-2-butene		C ₄ H ₇ Br	3017-71-8	135.003	li q	-114.6	85.6	1.332 ⁵	1.4602 ¹⁶	i H ₂ O; s Et OH, et h, ct c; vs chl, bz
1135	(4-Bromobutoxy)benzene		C ₁₀ H ₁₃ BrO	1200-03-9	229.113	cry (al)	41	154 ⁹			sl Et OH, ct c
1136	1-Bromo-4- <i>tert</i> -butylbenzene		C ₁₀ H ₁₃ Br	3972-65-4	213.114		19	231.5	1.2286 ²⁰	1.5436 ²⁰	i H ₂ O; s et h, bz, chl
1137	2-Bromo-3-chloroacetophenone	3-Chlorophenacyl bromide	C ₈ H ₇ BrClO	41011-01-2	233.490	nd	40	397.5			vs Et OH



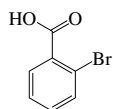
2-Bromo-1,4-benzenediol



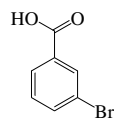
4-Bromobenzenesulfonyl chloride



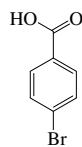
4-Bromobenzenethiol



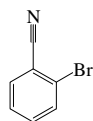
2-Bromobenzoic acid



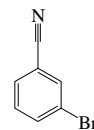
3-Bromobenzoic acid



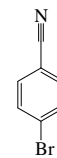
4-Bromobenzoic acid



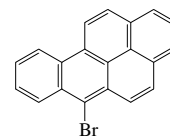
2-Bromobenzonitrile



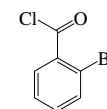
3-Bromobenzonitrile



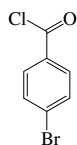
4-Bromobenzonitrile



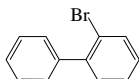
6-Bromobenzo[a]pyrene



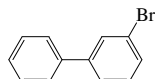
2-Bromobenzoyl chloride



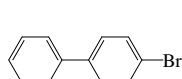
4-Bromobenzoyl chloride



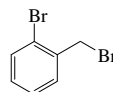
2-Bromobiphenyl



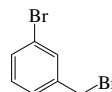
3-Bromobiphenyl



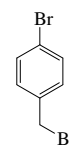
4-Bromobiphenyl



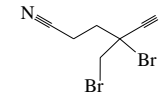
1-Bromo-2-(bromomethyl)benzene



1-Bromo-3-(bromomethyl)benzene

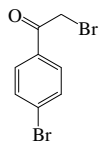


1-Bromo-4-(bromomethyl)benzene



2-Bromo-2-(bromomethyl)pentanenitrile

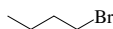
3-65



2-Bromo-1-(4-bromophenyl)ethanone



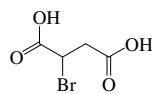
2-Bromo-1,3-butadiene



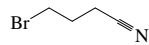
1-Bromobutane



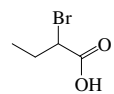
2-Bromobutane(±)



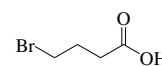
Bromobutanediol(±)



4-Bromobutanenitrile



2-Bromobutan-2-ol(±)



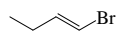
4-Bromobutan-1-ol



3-Bromo-2-butanone



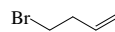
cis-1-Bromo-1-butene



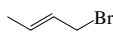
trans-1-Bromo-1-butene



2-Bromo-1-butene



4-Bromo-1-butene



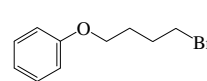
1-Bromo-2-butene



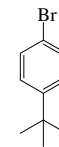
cis-2-Bromo-2-butene



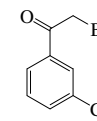
trans-2-Bromo-2-butene



(4-Bromobutoxy)benzene



1-Bromo-4-tert-butylbenzene

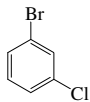


2-Bromo-3-chlorobenzoyl chloride

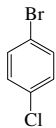
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1138	1-Bromo-2-chl orobenzene		C ₆ H ₄ BrCl	694-80-4	191.453	li q	-12.3	204	1.6387	1.5809 ²⁰	i H ₂ O; vs bz; sl ct c
1139	1-Bromo-3-chl orobenzene		C ₆ H ₄ BrCl	108-37-2	191.453	li q	-21.5	196	1.6302	1.5771 ²⁰	i H ₂ O; vs Et OH, et h
1140	1-Bromo-4-chl orobenzene		C ₆ H ₄ BrCl	106-39-8	191.453	nd or pl (al, et h)	68	196	1.576	1.5531 ⁷⁰	i H ₂ O; sl Et OH; s et h, bz, ct c, chl
1141	1-Bromo-4-chl orobut ane		C ₈ H ₇ BrCl	6940-78-9	171.464			175; 63 ⁰	1.489 ²⁰	1.4885 ²⁰	i H ₂ O; s Et OH, et h, chl; sl ct c
1142	Bromochl orodl fluoromet hane	Hal on 1211	CBrClF	353-59-3	165.365	col gas	-159.5	-3.7			
1143	3-Bromo-1-chl oro-5,5-di met hyl hydant oi n		C ₅ H ₈ BrClN ₂ O ₂	126-06-7	241.471		162				
1144	1-Bromo-1-chl oroet hane		C ₄ H ₇ BrCl	593-96-4	143.410			83	1.667 ⁰	1.4660 ²⁰	
1145	1-Bromo-2-chl oroet hane		C ₄ H ₇ BrCl	107-04-0	143.410	li q	-16.7	107	1.7392	1.4908 ²⁰	sl H ₂ O; s Et OH, et h, chl
1146	Bromochl orofluoromet hane		CHBrClF	593-98-6	147.374	li q	-115	36	1.9771	1.4144 ²⁵	i H ₂ O; s et h, ace, chl
1147	Bromochl oromet hane	Hal on 1011	C ₂ H ₄ BrCl	74-97-5	129.384	li q	-87.9	68.0	1.9344	1.4838 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
1148	1-Bromo-4-(chl oromet hyl)benzene	<i>p</i> -Bromobenzyl chl ori de	C ₇ H ₇ BrCl	589-17-3	205.480	nd (al, pet h)	50	236			i ₂ Et vs Et OH, et h; s pet h
1149	2-Bromo-1-(4-chl orophenyl) et hanone	<i>p</i> -Chl orophenacyl bromi de	C ₉ H ₇ BrClO	536-38-9	233.490	nd	96.5				
1150	1-Bromo-2-chl oropropane		C ₃ H ₅ BrCl	3017-96-7	157.437			118	1.53 ²⁰	1.4745 ²⁰	vs ace, bz, et h, Et OH
1151	1-Bromo-3-chl oropropane		C ₃ H ₅ BrCl	109-70-6	157.437	li q	-58.9	143.3	1.5969	1.4864 ²⁰	i H ₂ O; vs Et OH, et h, chl
1152	2-Bromo-1-chl oropropane		C ₃ H ₅ BrCl	3017-95-6	157.437			117	1.53 ²⁰	1.4795 ²⁰	i H ₂ O; vs Et OH, et h; s ace, bz
1153	2-Bromo-2-chl oropropane		C ₃ H ₅ BrCl	2310-98-7	157.437			95	1.495 ⁰	1.4575 ²⁰	vs ace, bz, et h, Et OH
1154	1-Bromo-2-chl oro-1,1,2-t ri fluoroet hane		C ₂ HBrClF ₃	354-06-3	197.381			52.5	1.8574 ²⁵	1.3738 ²⁰	
1155	2-Bromo-2-chl oro-1,1,1-t ri fluoroet hane	Hal ot hane	C ₂ HBrClF ₃	151-67-7	197.381			50.2; 20 ²⁴³	1.8563 ²⁵	1.3697 ⁰	sl H ₂ O; s pet h
1156	Bromocresol Green	Bromocresol Green	C ₁₄ H ₁₄ Br ₂ O ₃ S	76-60-8	698.014	wh or red (+7w) ye (HOAc)	218.5				sl H ₂ O; vs Et OH, et h, AcOEt; s bz
1157	Bromocresol Purpl e	Bromocresol Purpl e	C ₁₆ H ₁₆ Br ₂ O ₃ S	115-40-2	540.222		241.5				
1158	Bromocycl ohept ane	Cycl ohept yl bromi de	C ₇ H ₁₃ Br	2404-35-5	177.082			101 ⁴⁰ ; 75 ¹²	1.3080 ²⁰	1.4996 ²⁰	i H ₂ O; vs et h, chl
1159	Bromocycl ohexane	Cycl ohexyl bromi de	C ₆ H ₁₁ Br	108-85-0	163.055	li q	-56.5	166.2	1.3359	1.4957 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
1160	<i>t rans</i> -4-Bromocycl ohexanol		C ₆ H ₁₁ BrO	32388-22-0	179.054	pl (hx)	81.5				
1161	2-Bromocycl ohexanone		C ₆ H ₁₀ BrO	822-85-5	177.038			114 ³² ; 90 ¹⁴	1.340 ²⁵	1.5085 ²⁵	
1162	3-Bromocycl ohexene		C ₆ H ₉ Br	1521-51-3	161.039			81 ⁴⁰ ; 56 ¹¹	1.3890 ²⁰	1.5320 ²⁰	i H ₂ O; s et h, bz, chl
1163	Bromocycl opent ane	Cycl opent yl bromi de	C ₅ H ₉ Br	137-43-9	149.029			137.5	1.3873 ²⁰	1.4886 ²⁰	sl ct c
1164	1-Bromodecane		C ₁₀ H ₂₁ Br	112-29-8	221.178	li q	-29.2	240.6	1.0702	1.4557 ²⁰	i H ₂ O; vs et h, chl; s ct c
1165	2-Bromodecanoic aci d		C ₁₀ H ₁₉ BrO ₂	2623-95-2	251.161		2.0	140 ²	1.1912 ²⁴	1.4595 ²⁴	vs et h
1166	1-Bromo-3,5-di chl orobenzene		C ₆ H ₃ BrCl ₂	19752-55-7	225.898	pr (al)	83	232			i H ₂ O; s Et OH, et h, chl; vs bz
1167	4-Bromo-1,2-di chl orobenzene		C ₆ H ₃ BrCl ₂	18282-59-2	225.898	pr	25	237			i H ₂ O; sl Et OH; vs et h, bz, chl
1168	Bromodl chl orofluoromet hane	Hal on 1121	CBr ₂ ClF	353-58-2	181.819	li q		52.8	1.95		
1169	Bromodl chl oromet hane		CHBr ₂ Cl	75-27-4	163.829	li q	-57	90	1.980	1.4964 ²⁰	i H ₂ O; vs Et OH, et h, ace, bz; sl ct c
1170	4-Bromo-2,5-di chl orophenol		C ₆ H ₃ BrCl ₂ O	1940-42-7	241.897	nd	71.5				
1171	2-Bromo-1,1-di et hoxet hane		C ₄ H ₇ BrO ₂	2032-35-1	197.070			170; 66 ¹⁸	1.283 ²⁰	1.4387 ²⁰	s Et OH, et h
1172	4-Bromo- <i>N,N</i> -di et hyl ani li ne		C ₁₀ H ₁₆ BrN	2052-06-4	228.129	nd or pr	38	270			i H ₂ O; vs Et OH, et h
1173	Bromodl fluoromet hane		CHBrF ₂	1511-62-2	130.920		-145	-14.6	1.55 ¹⁶		s H ₂ O; vs Et OH
1174	3-Bromo-4,5-di hydro-2(3 <i>H</i>)-f uranone	α -Bromo- γ -but yrol act one	C ₄ H ₅ BrO ₂	5061-21-2	164.986			130 ²⁰	1.8 ²⁰	1.5059 ²⁰	
1175	5-Bromo- <i>N</i> ,2-di hydroxybenzami de	5-Bromosal i cyl hydroxami c aci d	C ₇ H ₇ BrNO ₃	5798-94-7	232.032	cry (al)	232 dec				
1176	2-Bromo-1,4-di met hoxybenzene		C ₈ H ₉ BrO ₂	25245-34-5	217.060	oi l		262; 130	1.445	1.5700 ²⁰	
1177	4-Bromo-1,2-di met hoxybenzene		C ₈ H ₉ BrO ₂	2859-78-1	217.060			254.5	1.702 ²⁵	1.5743 ²⁰	



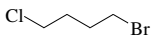
1-Bromo-2-chlorobenzene



1-Bromo-3-chlorobenzene



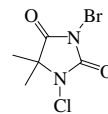
1-Bromo-4-chlorobenzene



1-Bromo-4-chlorobutane



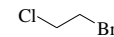
Bromochlorodifluoromethane



3-Bromo-1-chloro-5,5-dimethylhydantoin



1-Bromo-1-chloroethane



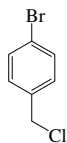
1-Bromo-2-chloroethane



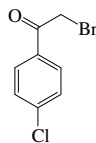
Bromochlorofluoromethane



Bromochloromethane



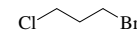
1-Bromo-4-(chloromethyl)benzene



2-Bromo-1-(4-chlorophenyl)ethanone



1-Bromo-2-chloropropane



1-Bromo-3-chloropropane



2-Bromo-1-chloropropane



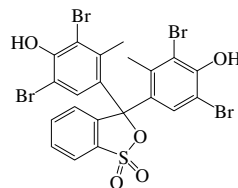
2-Bromo-2-chloropropane



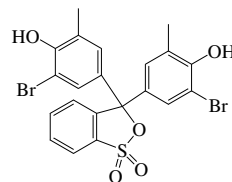
1-Bromo-2-chloro-1,1,2,2-tetrafluoroethane



2-Bromo-2-chloro-1,1,1,1-tetrafluoroethane



Bromocresol Green



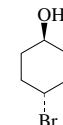
Bromocresol Purple



Bromocycloheptane



Bromocyclohexane



trans-4-Bromocyclohexanol



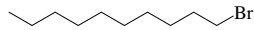
2-Bromocyclohexanone



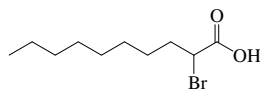
3-Bromocyclohexene



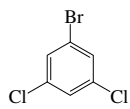
Bromocyclopentane



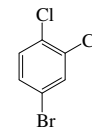
1-Bromodecane



2-Bromodecanoic acid



1-Bromo-3,5-dichlorobenzene



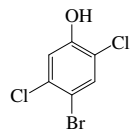
4-Bromo-1,2-dichlorobenzene



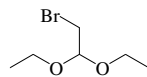
Bromodichlorofluoromethane



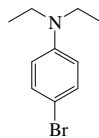
Bromodichloromethane



4-Bromo-2,5-dichlorophenol



2-Bromo-1,1-diethoxyethane



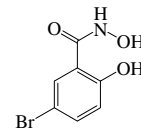
4-Bromo-N,N-diethylamine



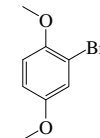
Bromodifluoromethane



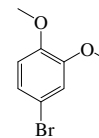
3-Bromo-4,5-dihydro-2(3H)-furanone



5-Bromo-N,2-dihydroxybenzamide

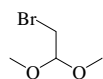


2-Bromo-1,4-dimethoxybenzene

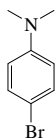


4-Bromo-1,2-dimethoxybenzene

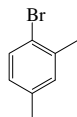
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1178	2-Bromo-1,1-di met hoxyet hane		$\text{C}_2\text{H}_3\text{Br}_2$	7252-83-7	169.017			149	1.430 ²⁰	1.4450 ²⁰	s et h, ace, chl
1179	4-Bromo- <i>N,N</i> -di met hyl ani li ne		$\text{C}_6\text{H}_{10}\text{BrN}$	586-77-6	200.076		55	264	1.3220 ¹⁰⁰		i H ₂ O; s Et OH; vs et h
1180	1-Bromo-2,4-di met hyl benzene		$\text{C}_6\text{H}_4\text{Br}$	583-70-0	185.061	li q	-17	205	1.3419	1.5501 ²⁰	i H ₂ O; vs Et OH, et h, ace
1181	1-Bromo-3,5-di met hyl benzene		$\text{C}_6\text{H}_4\text{Br}$	556-96-7	185.061			204	1.362 ²⁰	1.5462 ²²	vs et h; s ace, bz
1182	2-Bromo-1,3-di met hyl benzene		$\text{C}_6\text{H}_4\text{Br}$	576-22-7	185.061			203.5; 100 ²⁰		1.5552 ²⁰	vs et h; s ace, bz
1183	2-Bromo-1,4-di met hyl benzene		$\text{C}_6\text{H}_4\text{Br}$	553-94-6	185.061	lf or pl	9	199; 88	1.3582 ¹⁸	1.5514 ¹⁸	i H ₂ O; vs Et OH; s bz
1184	4-Bromo-1,2-di met hyl benzene		$\text{C}_6\text{H}_4\text{Br}$	583-71-1	185.061	li q	-0.2	214.5	1.3708	1.5530 ²⁰	i H ₂ O; vs Et OH, et h
1185	<i>trans</i> -1-Bromo-3,7-di met hyl -2,6-oct adi ene	<i>trans</i> Geranyl bromi de	$\text{C}_{10}\text{H}_{17}\text{Br}$	6138-90-5	217.146			101 ¹² ; 47 ^{0.005}	1.0940 ²²	1.5027 ²⁰	
1186	1-Bromo-2,2-di met hyl propane		$\text{C}_3\text{H}_7\text{Br}$	630-17-1	151.045			106	1.1997 ²⁰	1.4370 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; vs chl
1187	2-Bromo-4,6-di ni t roani li ne		$\text{C}_6\text{H}_2\text{BrN}_2\text{O}_4$	1817-73-8	262.018	ye nd (al or HOAc)	153.5	sub			vs Et OH, ace; s HOAc
1188	1-Bromo-2,4-di ni t robenzene		$\text{C}_6\text{H}_3\text{BrN}_2\text{O}_4$	584-48-5	247.003	ye nd (al)	75				vs Et OH
1189	α -Bromodi phenyl met hane		$\text{C}_{12}\text{H}_{11}\text{Br}$	776-74-9	247.130		45	184 ²⁰ ; 152 ²			s Et OH, chl; vs bz
1190	1-Bromododecane	Lauryl bromi de	$\text{C}_{12}\text{H}_{25}\text{Br}$	143-15-7	249.231	li q	-9.5	276	1.0399	1.4583 ²⁰	i H ₂ O; s Et OH, et h, ct c; msc ace
1191	2-Bromododecanol c aci d		$\text{C}_{12}\text{H}_{23}\text{BrO}_2$	111-56-8	279.214	pl	32	158 ⁷	1.1474 ¹⁴	1.4585 ²⁴	vs bz, et h, Et OH, li g
1192	Bromoet hane	Et hyl bromi de	$\text{C}_2\text{H}_5\text{Br}$	74-96-4	108.965	li q	-118.6	38.5	1.4604	1.4239 ²⁰	sl H ₂ O; msc Et OH, et h, chl
1193	2-Bromoet hanol	Et hyl ene bromohydr i n	$\text{C}_2\text{H}_4\text{BrO}$	540-51-2	124.964			150; 51 ⁴	1.7629 ²⁰	1.4915 ²⁰	msc H ₂ O, Et OH, et h; sl li g
1194	Bromoet hene	Vi nyl bromi de	$\text{C}_2\text{H}_3\text{Br}$	593-60-2	106.949	vol li q or gas	-139.54	15.8	1.4933	1.4380 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl
1195	1-Bromo-2-et hoxybenzene		$\text{C}_7\text{H}_7\text{BrO}$	583-19-7	201.060			223	1.4223 ²⁰		vs et h, Et OH
1196	1-Bromo-4-et hoxybenzene		$\text{C}_7\text{H}_7\text{BrO}$	588-96-5	201.060		2.0	231	1.4071 ²⁵	1.5517 ²⁰	i H ₂ O; vs Et OH, et h; s chl
1197	(2-Bromoet hoxy)benzene		$\text{C}_7\text{H}_7\text{BrO}$	589-10-6	201.060		39	dec 240; 128 ²⁰	1.3555 ²⁰		i H ₂ O; vs Et OH, et h
1198	1-Bromo-2-et hoxyet hane	2-Bromoet hyl et hyl et her	$\text{C}_4\text{H}_7\text{BrO}$	592-55-2	153.017			127.5	1.3852 ⁰	1.4447 ²⁰	sl H ₂ O; msc Et OH, et h
1199	2-Bromoet hyl acet at e		$\text{C}_4\text{H}_7\text{BrO}_2$	927-68-4	167.002	li q	-13.8	162.5	1.514 ⁴	1.457 ²³	vs H ₂ O, chl; msc Et OH, et h
1200	2-Bromoet hyl ami ne hydrobromi de	2-Bromoet hanami ne hydrobromi de	$\text{C}_2\text{H}_5\text{Br}_2\text{N}$	2576-47-8	204.892		174.0				
1201	(1-Bromoet hyl)benzene		$\text{C}_7\text{H}_7\text{Br}$	585-71-7	185.061			219; 92 ¹¹	1.3535 ²⁵	1.5543 ²⁵	
1202	(2-Bromoet hyl)benzene		$\text{C}_7\text{H}_7\text{Br}$	103-63-9	185.061	li q	-55.9	219; 105 ⁹	1.3643 ²⁰	1.5372 ²⁰	i H ₂ O; s et h, bz; sl ct c
1203	1-Bromo-2-et hyl benzene		$\text{C}_7\text{H}_7\text{Br}$	1973-22-4	185.061	li q	-67.9	199.3	1.3548	1.5472 ²⁰	vs ace, bz, et h, Et OH
1204	1-Bromo-3-et hyl benzene		$\text{C}_7\text{H}_7\text{Br}$	2725-82-8	185.061			202	1.3493 ²⁰	1.5465 ²⁰	
1205	1-Bromo-4-et hyl benzene		$\text{C}_7\text{H}_7\text{Br}$	1585-07-5	185.061	li q	-43.5	204	1.3423	1.5445 ²⁰	vs ace, bz, et h, Et OH
1206	(2-Bromoet hyl)cycl ohexane		$\text{C}_8\text{H}_{15}\text{Br}$	1647-26-3	191.109	li q	-57	212	1.2357 ⁷	1.4899 ²⁰	
1207	<i>N</i> -(2-Bromoet hyl)pht hal i mi de		$\text{C}_{10}\text{H}_9\text{BrNO}_2$	574-98-1	254.081	nd (w)	83				vs et h; sl chl
1208	1-Bromo-4-et hynyl benzene		$\text{C}_7\text{H}_7\text{Br}$	766-96-1	181.030		64.5	89 ¹⁶			s chl
1209	1-Bromo-2-fluorobenzene		$\text{C}_6\text{H}_4\text{BrF}$	1072-85-1	174.998			154	1.0738 ²¹	1.5337 ²⁰	
1210	1-Bromo-3-fluorobenzene		$\text{C}_6\text{H}_4\text{BrF}$	1073-06-9	174.998			150	1.7081 ²⁰	1.5257 ²⁰	s ct c
1211	1-Bromo-4-fluorobenzene		$\text{C}_6\text{H}_4\text{BrF}$	460-00-4	174.998	li q	-17.4	151.5	1.593 ⁷	1.5310 ¹⁵	i H ₂ O; s Et OH, et h, chl
1212	1-Bromo-2-fluoroet hane		$\text{C}_2\text{H}_4\text{BrF}$	762-49-2	126.955			71.5	1.7044 ²⁵	1.4236 ²⁰	vs et h, Et OH
1213	Bromofluoromet hane		CH_2BrF	373-52-4	112.929	vol li q or gas		19			s Et OH; vs chl
1214	2-Bromof uran		$\text{C}_2\text{H}_3\text{BrO}$	584-12-3	146.970			103	1.6500 ²⁰	1.4980 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz
1215	3-Bromof uran		$\text{C}_2\text{H}_3\text{BrO}$	22037-28-1	146.970			103	1.6606 ²⁰	1.4958 ²⁰	vs ace, bz, et h, Et OH
1216	5-Bromo-2-f urancarboxal dehyde		$\text{C}_7\text{H}_7\text{BrO}_2$	1899-24-7	174.981	cry (50% al)	83.5	201; 112 ⁶			vs et h, Et OH
1217	1-Bromohept adecane		$\text{C}_{17}\text{H}_{35}\text{Br}$	3508-00-7	319.364		29.6	349	0.9916 ²⁰	1.4625 ²⁰	i H ₂ O; vs chl
1218	1-Bromohept ane	Hept yl bromi de	$\text{C}_7\text{H}_{15}\text{Br}$	629-04-9	179.098	li q	-56.1	178.9	1.1400	1.4502 ²⁰	i H ₂ O; vs Et OH, et h; sl ct c; s chl
1219	2-Bromohept ane	2-Hept yl bromi de	$\text{C}_7\text{H}_{15}\text{Br}$	1974-04-5	179.098		47	166	1.1277 ²⁰	1.4503 ²⁰	i H ₂ O; vs bz; s ct c, chl
1220	4-Bromohept ane	4-Hept yl bromi de	$\text{C}_7\text{H}_{15}\text{Br}$	998-93-6	179.098			161; 84 ⁷²	1.1351 ²⁰	1.4495 ²⁰	i H ₂ O; s bz, ct c, chl



2-Bromo-1,1-di met hoxyet hane



4-Bromo-*N,N*-di met hyl ani li ne



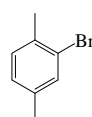
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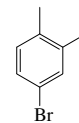
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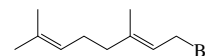
2-Bromo-1,3-di met hyl benzene



2-Bromo-1,4-di met hyl benzene



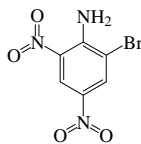
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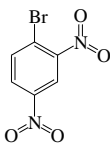
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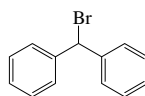
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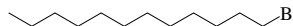
2-Bromo-4,6-di ni t ro ani li ne



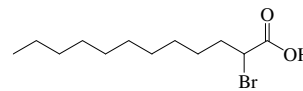
1-Bromo-2,4-di ni t ro benzene



α -Bromodi phenyl met hane



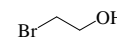
1-Bromododecane



2-Bromododecano i aci d



Bromoet hane

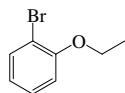


2-Bromoet hanol

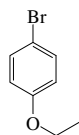
3-69



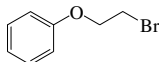
Bromoet hene



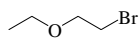
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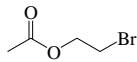
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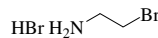
(2-Bromoet hoxy)benzene



1-Bromo-2-et hoxyet hane



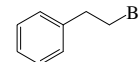
2-Bromoet hylacet ate



2-Bromoet hyl ami nehydrobromi de



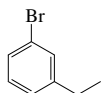
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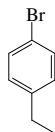
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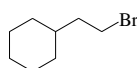
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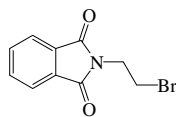
1-Bromo-3-et hyl benzene



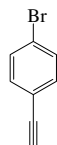
1-Bromo-4-et hyl benzene



(2-Bromoet hyl)cyclohexane



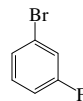
N-(2-Bromoet hyl) pht hal i mi de



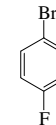
1-Bromo-4-et hynyl benzene



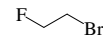
1-Bromo-2-f l uorobenzene



1-Bromo-3-f l uorobenzene



1-Bromo-4-f l uorobenzene



1-Bromo-2-f l uoroet hane



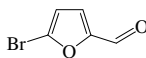
Bromof l uoromet hane



2-Bromof uran



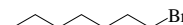
3-Bromof uran



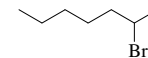
5-Bromo-2-f urancarboxal dehyde



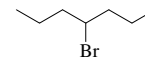
1-Bromohept adecane



1-Bromohept ane

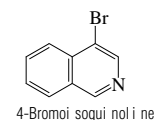
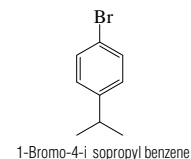
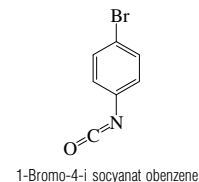
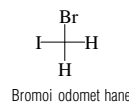
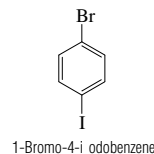
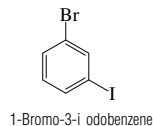
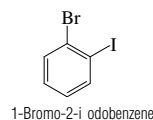
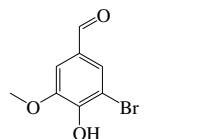
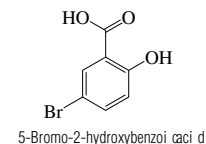
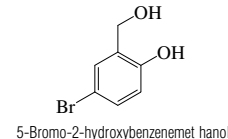
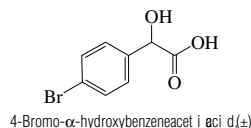
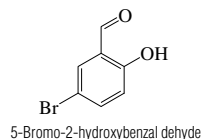
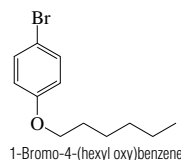
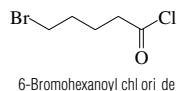
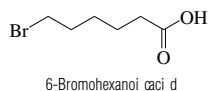
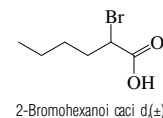
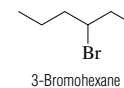
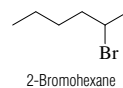
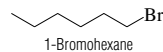
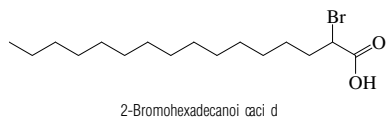
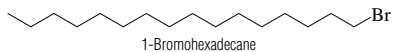


2-Bromohept ane

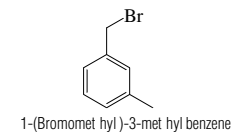
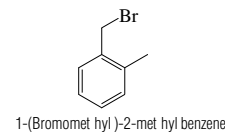
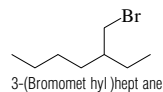
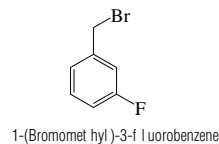
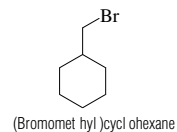
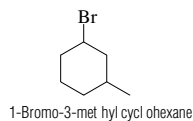
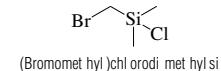
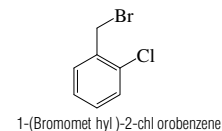
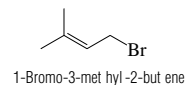
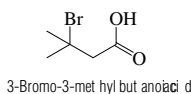
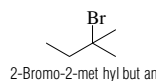
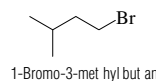
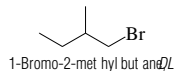
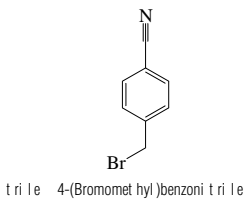
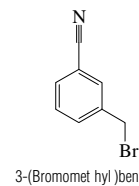
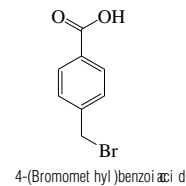
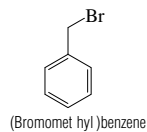
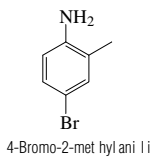
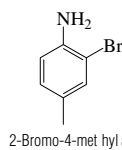
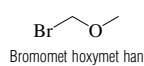
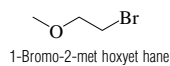
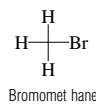


4-Bromohept ane

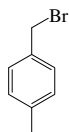
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1221	1-Bromohexadecane		C ₁₆ H ₃₃ Br	112-82-3	305.337		18	336	0.9991 ²⁰	1.4618 ²⁵	i H ₂ O; s et h
1222	2-Bromohexadecanoic acid		C ₁₆ H ₃₁ BrO ₂	18263-25-7	335.320		52.8				
1223	1-Bromohexane	Hexyl bromide	C ₆ H ₁₃ Br	111-25-1	165.071	liq	-83.7	155.3	1.1744 ⁴	1.4478 ²⁰	i H ₂ O; msc Et OH, et h; s ace; vs chl
1224	2-Bromohexane		C ₆ H ₁₃ Br	3377-86-4	165.071			143; 78 ⁹⁰	1.1658 ²⁰	1.4832 ²⁵	i H ₂ O; vs Et OH; s et h, ace; sl ct c
1225	3-Bromohexane		C ₆ H ₁₃ Br	3377-87-5	165.071			142	1.1799 ²⁰	1.4472 ²⁰	vs ace, et h, Et OH, chl
1226	2-Bromohexanoic acid, (±)		C ₆ H ₁₁ BrO ₂	2681-83-6	195.054		2.0	240; 140 ²³	1.2810 ³³		s Et OH, et h
1227	6-Bromohexanoic acid		C ₆ H ₁₁ BrO ₂	4224-70-8	195.054	cry (pet h)	35	167 ⁹⁰			vs pet h
1228	6-Bromohexanoyl chloride		C ₆ H ₁₁ BrClO	22809-37-6	213.499			10 ¹⁸			
1229	1-Bromo-4-(hexyloxy)benzene		C ₁₂ H ₁₇ BrO	30752-19-3	257.166			156 ¹³	1.2306 ²⁰	1.5262 ²⁰	
1230	5-Bromo-2-hydroxybenzaldehyde		C ₇ H ₅ BrO ₂	1761-61-1	201.018	nd (al), lf (et h)	105.5				i ₂ OHs Et OH, et h; sl chl
1231	4-Bromo-α-hydroxybenzoic acid, (±)	ρ-Bromomandelic acid, (±)	C ₈ H ₇ BrO ₃	7021-04-7	231.044		119				vs H ₂ O, Et OH, et h, bz, chl
1232	5-Bromo-2-hydroxybenzenemethanol	Bromosaligenin	C ₇ H ₇ BrO ₂	2316-64-5	203.034	lf (bz)	113				vs bz, et h, Et OH, chl
1233	5-Bromo-2-hydroxybenzoic acid		C ₇ H ₅ BrO ₃	89-55-4	217.017	nd (w, dil al)	169.8	sub 100			sl ₂ H ₂ O, ace; vs Et OH, et h
1234	3-Bromo-4-hydroxy-5-methoxybenzaldehyde		C ₈ H ₇ BrO ₃	2973-76-4	231.044	pl (HOAc), nd, pl (al)	167.0				i H ₂ O; s Et OH, DMSO; sl et h, bz
1235	1-Bromo-2-iodobenzene		C ₆ H ₄ BrI	583-55-1	282.904		9.5	257; 120 ¹⁵	2.2570 ²⁵	1.6618 ²⁵	i H ₂ O; sl Et OH, HOAc; s ace
1236	1-Bromo-3-iodobenzene		C ₆ H ₄ BrI	591-18-4	282.904	liq	-9.3	252; 120 ¹⁵			i H ₂ O; sl Et OH, HOAc
1237	1-Bromo-4-iodobenzene		C ₆ H ₄ BrI	589-87-7	282.904	pr or pl (et h-al)	92	252			i ₂ H ₂ O; sl Et OH, chl; s et h
1238	Bromiodomethane		CH ₂ BrI	557-68-6	220.835			139.5	2.926 ¹⁷	1.6410 ²⁰	vs chl
1239	1-Bromo-4-iodobenzene	ρ-Bromophenyl isocyanate	C ₇ H ₄ BrNO	2493-02-9	198.017	nd		226			vs et h
1240	1-Bromo-4-iodobenzene		C ₆ H ₄ BrI	586-61-8	199.087	liq	-22.5	218.7	1.314 ⁵	1.5569 ²⁰	i H ₂ O; s et h, bz, chl; sl ct c
1241	4-Bromoiodobenzene		C ₆ H ₄ BrI	1532-97-4	208.055	cry (pet h)	41.5	282.5			vs et h
1242	Bromomethane	Methyl bromide	CH ₃ Br	74-83-9	94.939	col gas	-93.68	3.5	1.6755 ⁵⁰	1.4218 ²⁰	sl H ₂ O; msc Et OH, et h, chl, CS ₂
1243	1-Bromo-2-methoxyethane		C ₃ H ₇ BrO	6482-24-2	138.991			110	1.4623 ²⁰	1.44753 ²⁰	
1244	Bromomethoxyethane		C ₃ H ₇ BrO	13057-17-5	124.964			87	1.5976 ²⁰	1.4562 ²⁰	
1245	2-Bromo-4-methylanioline		C ₈ H ₈ BrN	583-68-6	186.050	lf	26	240	1.51 ¹⁰	1.5999 ²⁰	i H ₂ O; s Et OH, et h
1246	4-Bromo-2-methylanioline		C ₈ H ₈ BrN	583-75-5	186.050	cry (al)	59.5	240			sl H ₂ O, chl; s Et OH; vs et h, HOAc
1247	(Bromomethyl)benzene	Benzyl bromide	C ₇ H ₇ Br	100-39-0	171.035	liq	-1.5	201	1.438 ¹⁰	1.5752 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
1248	4-(Bromomethyl)benzoic acid		C ₈ H ₇ BrO ₂	6232-88-8	215.045		226.3				
1249	3-(Bromomethyl)benzonitrile		C ₈ H ₆ BrN	28188-41-2	196.045		96.5	130 ⁴			
1250	4-(Bromomethyl)benzonitrile		C ₈ H ₆ BrN	17201-43-3	196.045		114				
1251	1-Bromo-2-methylbutane		C ₅ H ₁₁ Br	5973-11-5	151.045			119	1.2205 ²⁰	1.4452 ²⁰	i H ₂ O; s Et OH, et h; vs chl
1252	1-Bromo-3-methylbutane	Isopentyl bromide	C ₅ H ₁₁ Br	107-82-4	151.045	liq	-112	120.4	1.207 ⁹	1.4420 ²⁰	i H ₂ O; s Et OH, et h; sl ct c; vs chl
1253	2-Bromo-2-methylbutane	tert-Pentyl bromide	C ₅ H ₁₁ Br	507-36-8	151.045			108	1.197 ¹⁸	1.4421	
1254	3-Bromo-3-methylbutanoic acid	β-Bromoisovaleric acid	C ₅ H ₉ BrO ₂	5798-88-9	181.028	nd (liq)	74				vs bz, et h, Et OH
1255	1-Bromo-3-methyl-2-butene		C ₅ H ₉ Br	870-63-3	149.029			dec 131; 50 ⁴⁰	1.2930 ¹⁵	1.4930 ¹⁵	vs ace, bz, et h, Et OH
1256	1-(Bromomethyl)-2-chlorobenzene		C ₆ H ₄ BrCl	611-17-6	205.480			109 ⁹⁰			
1257	(Bromomethyl)chlorosilane		C ₁ H ₂ BrClSi	16532-02-8	187.539			131	1.37 ⁵	1.4630 ²⁵	
1258	1-Bromo-3-methylcyclohexane	3-Methylcyclohexyl bromide	C ₇ H ₁₃ Br	13905-48-1	177.082			181; 60 ¹¹	1.2676 ¹⁵	1.4979 ²⁰	i H ₂ O; vs et h; s bz
1259	(Bromomethyl)cyclohexane		C ₆ H ₁₁ Br	2550-36-9	177.082			76 ²⁵	1.283 ²⁰	1.4907 ³⁰	vs bz, et h, chl
1260	1-(Bromomethyl)-3-fluorobenzene		C ₆ H ₄ BrF	456-41-7	189.025			88 ²⁰		1.5474 ²⁰	
1261	3-(Bromomethyl)heptane		C ₇ H ₁₅ Br	18908-66-2	193.125			67 ¹⁰			
1262	1-(Bromomethyl)-2-methylbenzene		C ₇ H ₇ Br	89-92-9	185.061	pr	21	217; 108 ¹⁶	1.3811 ²³	1.5730 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
1263	1-(Bromomethyl)-3-methylbenzene		C ₇ H ₇ Br	620-13-3	185.061			212.5	1.3711 ²³	1.5660 ²⁰	i H ₂ O; vs Et OH, et h



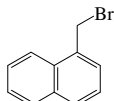
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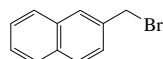
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1264	1-(Bromomet hyl)-4-met hyl benzene		₆ C ₁₀ Br	104-81-4	185.061	nd (al)	35	220	1.324 ²⁵		i H ₂ O; s Et OH; vs et h, chl
1265	1-(Bromomet hyl)napht hal ene		₁ H ₁₃ Br	3163-27-7	221.093	cry (pet h, al)	56	183 ⁹ ; 167 ¹⁰			vs ace, bz, et h, Et OH
1266	2-(Bromomet hyl)napht hal ene		₁ H ₁₃ Br	939-26-4	221.093	lf (al)	56	219 ⁹ ; 167 ¹⁴			s Et OH, et h, chl, HOAc
1267	1-(Bromomet hyl)-3-ni t robenzene		₇ H ₇ BrNO ₂	3958-57-4	216.033	nd or pl (al)	59.3	162 ⁹			i H ₂ O; s Et OH
1268	1-(Bromomet hyl)-4-ni t robenzene		₇ H ₇ BrNO ₂	100-11-8	216.033	nd (al)	99.5				sl H ₂ O, chl; vs Et OH, et h; s HOAc
1269	2-(Bromomet hyl)-4-ni t rophenol		₇ H ₇ BrNO ₂	772-33-8	232.032		148				
1270	(Bromomet hyl)oxi rane, (±)		₃ O ₂ BrO	82584-73-4	136.975	li q	-40	137	1.615 ⁹	1.4841 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
1271	1-Bromo-2-met hyl pent ane	2-Met hyl pent yl bromi de	₆ H ₁₃ Br	25346-33-2	165.071			141	1.1624 ²⁰	1.4495 ²⁰	vs et h, chl
1272	1-Bromo-4-met hyl pent ane		₆ H ₁₃ Br	626-88-0	165.071			145	1.1683 ²⁰	1.4490	vs et h, chl
1273	2-Bromo-2-met hyl pent ane		₆ H ₁₃ Br	4283-80-1	165.071			142.5; 70 ¹⁰⁰		1.442 ²³	vs et h, chl
1274	3-Bromo-3-met hyl pent ane		₆ H ₁₃ Br	25346-31-0	165.071			130; 76 ¹⁰⁰	1.1835 ²⁰	1.4525 ²⁰	vs et h, chl
1275	2-Bromo-4-met hyl phenol		₆ H ₇ BrO	6627-55-0	187.034	nd (pet h)	56.5	213.5	1.5422 ⁵	1.5772 ²⁰	sl H ₂ O; s Et OH, bz, chl
1276	1-(Bromomet hyl)-3-phenoxybenzene	3-Phenoxybenzyl bromi de	₁₃ H ₁₁ BrO	51632-16-7	263.129	oi l					
1277	2-Bromo-1-(4-met hyl phenyl) et hanone		C ₉ H ₉ BrO	619-41-0	213.070	nd or lf (al)	51	157			vs et h, Et OH
1278	N-(Bromomet hyl)pht hal i mi de	2-(Bromomet hyl)-4-oi ndol e-1,3(2H)-di one	C ₉ H ₈ BrNO ₂	5332-26-3	240.054	pr (chl, bz)	151.5				s ace; sl bz, chl; vs AcOEt
1279	1-Bromo-2-met hyl propane	Isobut yl bromi de	₄ H ₉ Br	78-77-3	137.018	li q	-119	91.1	1.272 ²	1.4348 ²⁰	i H ₂ O; vs Et OH, et h, ace, chl, bz, s ct c
1280	2-Bromo-2-met hyl propane	<i>t</i> erBut yl bromi de	₄ H ₉ Br	507-19-7	137.018	li q	-16.2	73.3	1.4278 ⁹	1.4278 ²⁰	i H ₂ O; sl ct c
1281	2-Bromo-2-met hyl propanoi c aci d	α-Bromoi sobut yri c aci d	₄ H ₇ BrO ₂	2052-01-9	167.002	cry (pet h)	48.5	199; 115 ⁴	1.4969 ⁶⁰		
1282	2-Bromo-2-met hyl propanoyl bromi de		₄ H ₇ Br ₂ O	20769-85-1	229.898			163	1.4067 ¹⁴		vs ace, CS ₂
1283	1-Bromo-2-met hyl propene		₃ H ₅ Br	3017-69-4	135.003			91	1.336 ²⁰		
1284	3-Bromo-2-met hyl propene		₃ H ₅ Br	1458-98-6	135.003			95	1.313 ²⁰		
1285	2-(Bromomet hyl) et rahydrof uran		₅ H ₇ BrO	1192-30-9	165.028			170; 70 ²²	1.4679 ²⁰	1.4850 ²⁰	s Et OH, et h
1286	(Bromomet hyl) t ri met hyl si l ane		₄ H ₁₁ BrSi	18243-41-9	167.120			116.5	1.179 ⁶	1.4460 ²⁰	
1287	1-Bromonapht hal ene	1-Napht hyl bromi de	₁₀ H ₇ Br	90-11-9	207.067	oi ly li q	6.1	281	1.4785	1.658 ²⁰	s H ₂ O, ace; msc Et OH, et h, bz; sl ct c
1288	2-Bromonapht hal ene		C ₁₀ H ₇ Br	580-13-2	207.067	pl or ort h lf (al)	55.9	281.5	1.695	1.6382 ⁶⁰	i H ₂ O; s Et OH, et h, bz, CS ₂ sl ct c
1289	4-Bromo-1,8-napht hal enedi carboxyl i c anhydri de		C ₁₂ H ₆ BrO ₃	81-86-7	277.070		222				
1290	1-Bromo-2-napht hol	1-Bromoβ-napht hol	C ₁₀ H ₇ BrO	573-97-7	223.066	ort h pr (bz-li g) nd (HOAc)	84	130			i H ₂ O; s Et OH, et h, bz; sl chl; vs HOAc
1291	4-Bromo-2-ni t roani li ne		₈ H ₇ BrN ₂ O ₂	875-51-4	217.020	oran-ye nd (w)	111.5	sub			vs Et OH
1292	1-Bromo-2-ni t robenzene		₇ H ₇ BrNO ₂	577-19-5	202.006	pa ye (al)	43	258	1.6245 ⁹		i H ₂ O; vs Et OH; s et h, ace, bz; sl chl
1293	1-Bromo-3-ni t robenzene		₇ H ₇ BrNO ₂	585-79-5	202.006	ort h	56	265	1.7036 ⁹	1.5979 ²⁰	sl H ₂ O; s Et OH, et h, bz
1294	1-Bromo-4-ni t robenzene	<i>p</i> -Ni t robromobenzene	₇ H ₇ BrNO ₂	586-78-7	202.006	ort h or mcl pr (al)	127	256	1.948 ²⁵		i H ₂ O; s Et OH, et h, bz; sl chl
1295	Bromoni t romet hane		₇ C ₇ BrNO ₂	563-70-2	139.937			149; 71 ⁴⁰		1.4880 ²⁰	vs Et OH
1296	2-Bromo-2-ni t ro-1,3-propanedi ol	Bronopol	₃ H ₅ BrNO ₄	52-51-7	199.989		131.5				
1297	1-Bromononane		C ₉ H ₁₉ Br	693-58-3	207.151	li q	-29.0	221.4; 88	1.0845 ²⁵	1.4522 ²⁵	
1298	1-Bromooct adecane		C ₁₈ H ₃₇ Br	112-89-0	333.391	cry (al)	28.2	362; 210 ⁹	0.9848 ²⁰	1.4631 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
1299	1-Bromooct ane	Oct yl bromi de	₈ H ₁₇ Br	111-83-1	193.125	li q	-55.0	200.8	1.1072 ²	1.4503 ²⁵	i H ₂ O; msc Et OH, et h; sl ct c
1300	2-Bromooct ane, (±)		₈ H ₁₇ Br	60251-57-2	193.125			188.5	1.0878 ²⁵	1.4442 ²⁵	i H ₂ O; msc Et OH, et h
1301	8-Bromooct anoi c aci d		₈ H ₁₅ BrO ₂	17696-11-6	223.108	nd (pet h)	38.5	147			vs bz, et h, Et OH



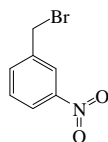
1-(Bromomethyl)-4-methylbenzene



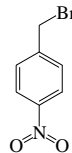
1-(Bromomethyl)naphthalene



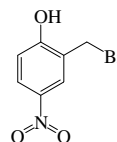
2-(Bromomethyl)naphthalene



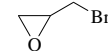
1-(Bromomethyl)-3-nitrobenzene



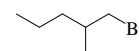
1-(Bromomethyl)-4-nitrobenzene



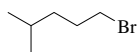
2-(Bromomethyl)-4-nitrophenol



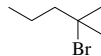
(Bromomethyl)oxirane(±)



1-Bromo-2-methylpentane



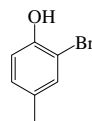
1-Bromo-4-methylpentane



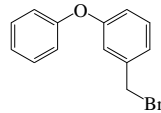
2-Bromo-2-methylpentane



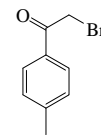
3-Bromo-3-methylpentane



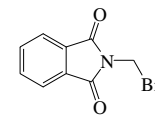
2-Bromo-4-methylphenol



1-(Bromomethyl)-3-phenoxybenzene



2-Bromo-1-(4-methylphenyl)ethanone



N-(Bromomethyl)phthalimide

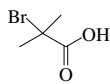


1-Bromo-2-methylpropane

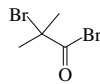
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2-Bromo-2-methylpropane



2-Bromo-2-methylpropanoic acid



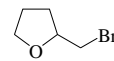
2-Bromo-2-methylpropanoic acid



1-Bromo-2-methylpropene



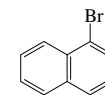
3-Bromo-2-methylpropene



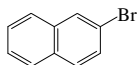
2-(Bromomethyl)tetrahydrofuran



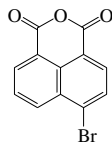
(Bromomethyl)trimethylsilane



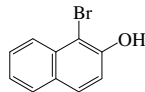
1-Bromonaphthalene



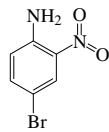
2-Bromonaphthalene



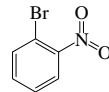
4-Bromo-1,8-naphthalenedicarboxylic acid



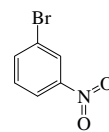
1-Bromo-2-naphthol



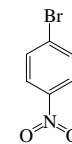
4-Bromo-2-nitroaniline



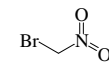
1-Bromo-2-nitrobenzene



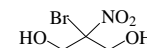
1-Bromo-3-nitrobenzene



1-Bromo-4-nitrobenzene



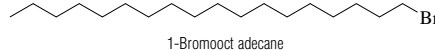
Bromoform



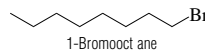
2-Bromo-2-nitro-1,3-propanediol



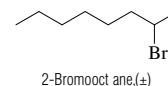
1-Bromononane



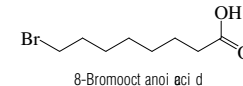
1-Bromooctadecane



1-Bromooctane

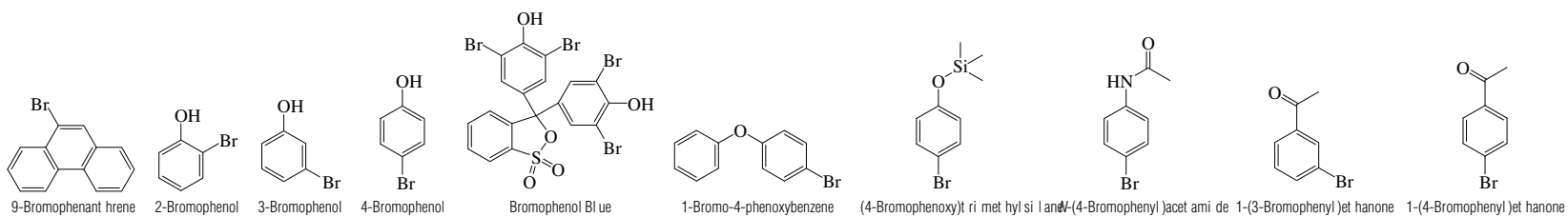
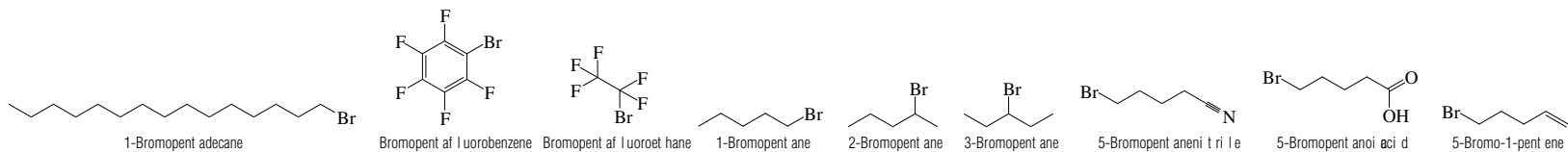


2-Bromooctane(±)

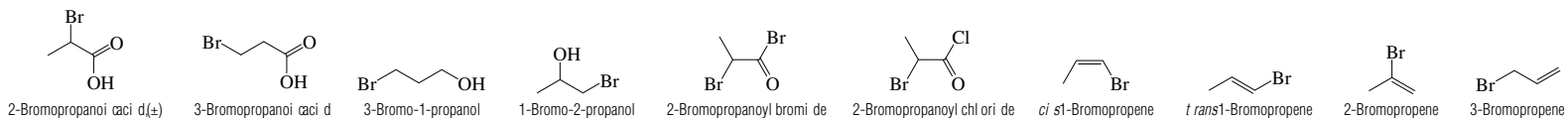
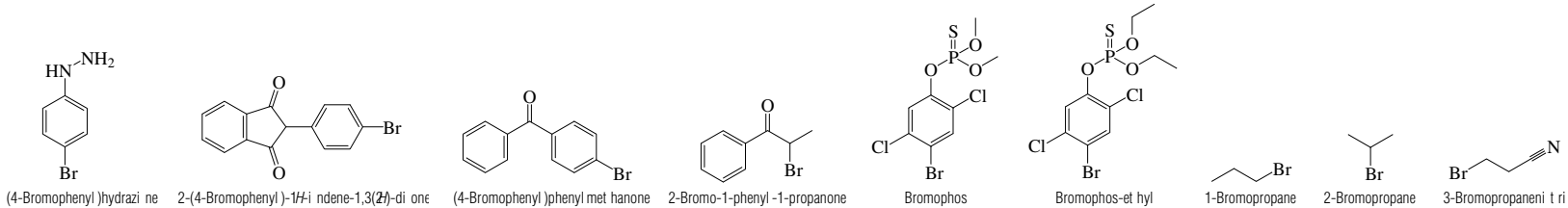


8-Bromooctanoic acid

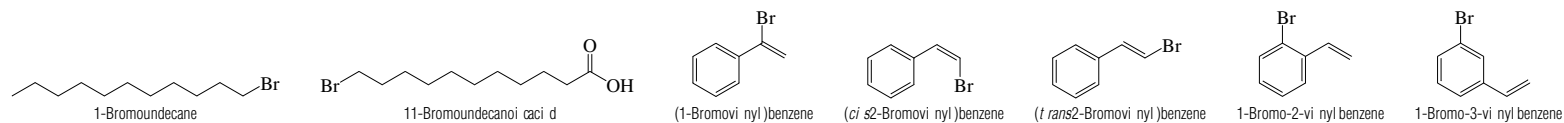
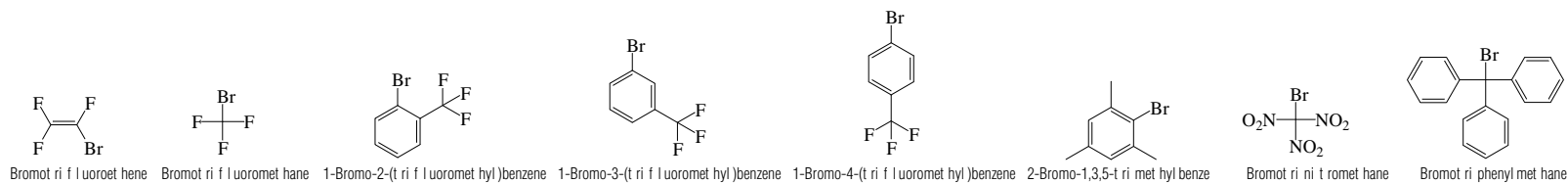
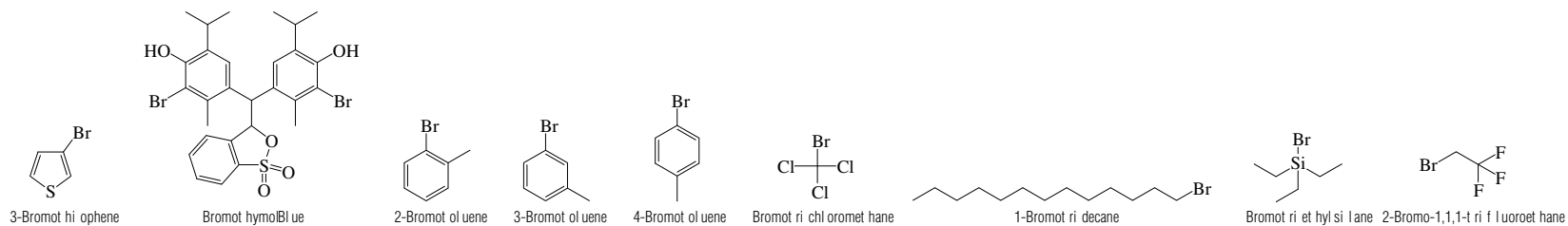
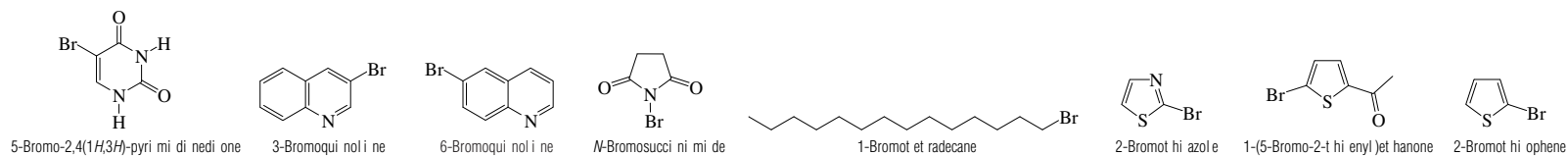
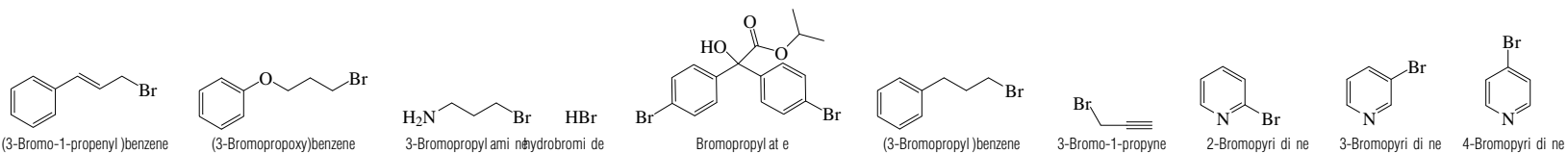
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1302	1-Bromopentadecane		C ₁₅ H ₃₁ Br	629-72-1	291.311		19	322	1.0675 ²⁰	1.4611 ²⁰	i H ₂ O; s ace; vs chl
1303	Bromopentafuorobenzene		C ₅ BrF ₅	344-04-7	246.960	li q	-31	137	1.987 ⁷	1.4490 ²⁰	
1304	Bromopentafuoroethane		C ₂ BrF ₅	354-55-2	198.917	col gas		-21	1.8098 ⁸		
1305	1-Bromopentane	Pentyl bromide	C ₅ H ₁₁ Br	110-53-2	151.045	li q	-88.0	129.8	1.218 ²	1.4447 ²⁰	i H ₂ O; s Et OH, bz, chl; sl ct c; msc et h
1306	2-Bromopentane		C ₅ H ₁₁ Br	107-81-3	151.045	li q	-95.5	117.4	1.207 ⁹	1.4413 ²⁰	vs bz, et h, Et OH, chl
1307	3-Bromopentane		C ₅ H ₁₁ Br	1809-10-5	151.045	li q	-126.2	118.6	1.214 ⁴	1.4441 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
1308	5-Bromopentanenitrile		C ₅ H ₉ BrN	5414-21-1	162.029			111 ¹² , 103 ¹⁰	1.3989 ²⁰	1.4780 ²⁰	
1309	5-Bromopentanoic acid		C ₅ H ₉ BrO ₂	2067-33-6	181.028		40.0	142 ¹³			s chl
1310	5-Bromo-1-pentene		C ₅ H ₉ Br	1119-51-3	149.029			125.5	1.2581 ²⁰	1.4640 ²⁰	
1311	9-Bromophenanthrene	9-Phenanthryl bromide	C ₁₄ H ₉ Br	573-17-1	257.125	pr (al)	64.5	>360	1.4093 ¹⁰		i H ₂ O; s Et OH, et h, C ₆ S ₂ sl chl
1312	2-Bromophenol		C ₆ H ₅ BrO	95-56-7	173.007		5.6	194.5	1.4924 ²⁰	1.589 ²⁰	sl H ₂ O, chl; s Et OH, et h, al k
1313	3-Bromophenol		C ₆ H ₅ BrO	591-20-8	173.007		33	236.5			sl H ₂ O, ct c; vs Et OH, et h; s chl, al k
1314	4-Bromophenol		C ₆ H ₅ BrO	106-41-2	173.007		66.4	238	1.840 ¹⁵		s H ₂ O, chl; vs Et OH, et h
1315	Bromophenol Blue	Bromphenol Blue	C ₁₀ H ₆ Br ₂ O ₅ S	115-39-9	669.960	hex pr (HOAc-ace)	279 dec				sl H ₂ O; s Et OH, bz, HOAc
1316	1-Bromo-4-phenoxybenzene	4-Bromophenyl phenyl ether	C ₁₁ H ₉ BrO	101-55-3	249.102		18.72	126 ^{3,5}	1.6088 ²⁰	1.6084 ²⁰	i H ₂ O; s et h, ct c
1317	(4-Bromophenoxy)trimethylsilane		C ₇ H ₁₃ BrOSi	17878-44-3	245.188			126 ⁶	1.2610 ²⁰	1.5145 ²⁰	
1318	<i>N</i> -(4-Bromophenyl)acetamide	<i>p</i> -Bromoacetanilide	C ₉ H ₈ BrNO	103-88-8	214.060	nd (60% al)	168		1.717 ²⁵		i H ₂ O; s Et OH, chl; sl et h, bz
1319	1-(3-Bromophenyl)ethanone		C ₈ H ₇ BrO	2142-63-4	199.045		7.5	133 ¹⁹		1.5755 ²⁰	i H ₂ O; s ace, bz
1320	1-(4-Bromophenyl)ethanone	<i>p</i> -Bromoacetophenone	C ₈ H ₇ BrO	99-90-1	199.045	lf (al)	50.5	257; 130	1.647 ²⁵	1.647	i H ₂ O; s Et OH, et h, bz, ct c, HOAc
1321	(4-Bromophenyl)hydrazine	<i>p</i> -Bromophenylhydrazine	C ₈ H ₈ BrN ₂	589-21-9	187.037	nd (w), lf (li g), 108 cry (al)					vs et h, Et OH, li g
1322	2-(4-Bromophenyl)-1 <i>H</i> -indene-1,3(2 <i>H</i>)-dione	Bromindione	C ₁₃ H ₇ BrO ₂	1146-98-1	301.135	cry (li g)	138				
1323	(4-Bromophenyl)phenylmethanone		C ₁₁ H ₉ BrO	90-90-4	261.113	lf (al)	82.5	350			i ₂ OH sl Et OH, et h, bz, pet h
1324	2-Bromo-1-phenylpropanone		C ₉ H ₉ BrO	2114-00-3	213.070			247.5	1.4298 ²⁰	1.5720 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, ct c
1325	Bromophos		C ₉ H ₅ BrCl ₂ PS	2104-96-3	317.999	ye cry	54	141 ^{0,01}			sl H ₂ O; s et h, ct c, t ol
1326	Bromophos-ethyl		C ₉ H ₇ BrCl ₂ O ₃ PS	4824-78-6	394.049	pal e-ye li q		122 ⁰⁴			
1327	1-Bromopropane	Propyl bromide	C ₃ H ₇ Br	106-94-5	122.992	li q	-110.3	71.1	1.3537 ⁷	1.4343 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz, chl, ct c
1328	2-Bromopropane	Isopropyl bromide	C ₃ H ₇ Br	75-26-3	122.992	li q	-89.0	59.5	1.314 ⁹	1.4251 ²⁰	sl H ₂ O; s ace, bz, chl; msc Et OH, et h
1329	3-Bromopropanenitrile		C ₃ H ₅ BrN	2417-90-5	133.975			92 ²⁵ , 69 ⁷	1.6152 ²⁰	1.4800 ²⁰	vs Et OH, et h; sl ct c
1330	2-Bromopropanoic acid, (±)		C ₃ H ₅ BrO ₂	10327-08-9	152.975	pr	25.7	203.5	1.7000 ²⁰	1.4753 ²⁰	vs H ₂ O, Et OH, et h; sl chl
1331	3-Bromopropanoic acid	<i>β</i> -Bromopropionic acid	C ₃ H ₅ BrO ₂	590-92-1	152.975	pl (CCl ₄)	62.5	141 ⁴⁵	1.48 ²⁵		s H ₂ O, Et OH, et h, bz, chl
1332	3-Bromo-1-propanol		C ₃ H ₇ BrO	627-18-9	138.991			105 ¹⁸⁵ , 80 ²²	1.5374 ²⁰	1.4834 ²⁵	s H ₂ O; msc Et OH, et h
1333	1-Bromo-2-propanol		C ₃ H ₇ BrO	19686-73-8	138.991			146.5	1.5585 ³⁰	1.4801 ²⁰	s H ₂ O; vs Et OH, et h
1334	2-Bromopropanoyl bromide		C ₃ H ₅ Br ₂ O	563-76-8	215.871			153	2.0611 ¹⁶		
1335	2-Bromopropanoyl chloride		C ₃ H ₅ BrClO	7148-74-5	171.420			132	1.697 ¹¹	1.4780 ²⁰	s et h, chl; sl ct c
1336	<i>cis</i> -1-Bromopropene		C ₃ H ₅ Br	590-13-6	120.976	li q	-113	57.8	1.429 ⁴	1.4560 ²⁰	i H ₂ O; s et h, ace, chl
1337	<i>trans</i> -1-Bromopropene		C ₃ H ₅ Br	590-15-8	120.976			63.2			
1338	2-Bromopropene		C ₃ H ₅ Br	557-93-7	120.976	li q	-126	48.4	1.396 ⁵	1.4467 ¹⁶	i H ₂ O; s et h, ace, chl
1339	3-Bromopropene	Allyl bromide	C ₃ H ₅ Br	106-95-6	120.976	li q	-119	70.1	1.39 ⁸	1.4697 ²⁰	i H ₂ O; msc Et OH, et h; s ct c, chl, CS ₂



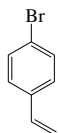
3-75



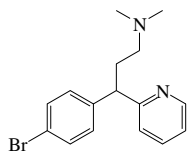
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1340	(3-Bromo-1-propenyl)benzene		C ₉ H ₉ Br	4392-24-9	197.071	nd (al, et h)	34	130	1.3428 ²⁰	1.613 ²⁰	vs Et OH
1341	(3-Bromopropoxy)benzene		C ₉ H ₉ BrO	588-63-6	215.086		10.7	127 ¹⁸	1.364 ¹⁶		vs et h
1342	3-Bromopropylami ne hydrobromi de	3-Bromo-1-propanami ne hydrobromi de	C ₃ H ₆ Br ₂ N	5003-71-4	218.918		171.5				
1343	Bromopropyl at e	4,4'-Di bromobenzi li c aci d i sopropyl ester	C ₁₁ H ₁₆ Br ₂ O ₃	18181-80-1	428.115		77		1.59 ²⁰		
1344	(3-Bromopropyl)benzene		C ₉ H ₉ Br	637-59-2	199.087			219.5; 117 ²⁵	1.3106 ²⁵	1.5440 ²⁵	i H ₂ O; vs et h
1345	3-Bromo-1-propyne	Propargyl bromi de	C ₃ H ₃ Br	106-96-7	118.960			89	1.579 ¹⁹	1.4922 ²⁰	s Et OH, et h, bz, ct c, chl
1346	2-Bromopyri di ne		C ₄ H ₅ BrN	109-04-6	157.997	li q	-40.1	193; 79	1.6337 ²⁰	1.5734 ²⁰	sl H ₂ O; s Et OH, et h, ct c
1347	3-Bromopyri di ne		C ₄ H ₅ BrN	626-55-1	157.997	li q	-27.3	173; 69	1.645 ⁰	1.5694 ²⁰	s H ₂ O; vs Et OH, et h
1348	4-Bromopyri di ne		C ₄ H ₅ BrN	1120-87-2	157.997		0.5	299 ⁴	1.6450 ⁰	1.5694 ²⁰	s ace, bz
1349	5-Bromo-2,4(1 <i>H</i> ,3 <i>H</i>)-pyri mi di nedi one	5-Bromouraci l	C ₄ H ₃ BrN ₂ O ₂	51-20-7	190.983		310				
1350	3-Bromoqui nol i ne		C ₉ H ₇ BrN	5332-24-1	208.055	ye oi l	13.3	275		1.664 ¹¹	s chl; vs HOAc
1351	6-Bromoqui nol i ne		C ₉ H ₇ BrN	5332-25-2	208.055		24	281			s Et OH, et h, aci d
1352	<i>N</i> -Bromosucci ni mi de		C ₄ H ₆ BrNO ₂	128-08-5	177.985	cry (bz)	174		2.098 ²⁵		sl H ₂ O, AcOEt, et h; vs ace; i hx
1353	1-Bromot et radecane		C ₁₁ H ₂₃ Br	112-71-0	277.284		5.6	307	1.0170 ²⁰	1.4603 ²⁰	vs ace, bz, Et OH
1354	2-Bromot hi azol e		C ₄ H ₄ BrNS	3034-53-5	164.024			171	1.82 ²⁵	1.5927 ²⁰	
1355	1-(5-Bromo-2-t hi enyl)et hanone		C ₆ H ₇ BrOS	5370-25-2	205.072	nd (al)	94.5	103 ¹			sl Et OH; s ct c
1356	2-Bromot hi ophene	2-Thi enyl bromi de	C ₆ H ₆ BrS	1003-09-4	163.036			150	1.684 ²⁰	1.5868 ²⁰	i H ₂ O; vs et h, ace; s ct c
1357	3-Bromot hi ophene		C ₆ H ₆ BrS	872-31-1	163.036			159.5	1.735 ²⁰	1.5919 ²⁰	i H ₂ O; s ace, bz; sl chl
1358	Bromt hymol Bl ue	Bromt hymol Bl ue	C ₂₇ H ₂₆ Br ₂ O ₅ S	76-59-5	624.381		201				vs et h, Et OH
1359	2-Bromot ol uene		C ₇ H ₇ Br	95-46-5	171.035	li q	-27.8	181.7	1.423 ²⁰	1.5565 ²⁰	i H ₂ O; vs Et OH, et h, bz; msc ct c
1360	3-Bromot ol uene		C ₇ H ₇ Br	591-17-3	171.035	li q	-39.8	183.7	1.409 ⁹	1.5510 ²⁰	i H ₂ O; s Et OH, ace, chl; msc et h; sl ct c
1361	4-Bromot ol uene		C ₇ H ₇ Br	106-38-7	171.035	cry (al)	28.5	184.3	1.3959 ⁵	1.5477 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl; sl ct c
1362	Bromot ri chl oromet hane		CBr ₃ Cl	75-62-7	198.274	li q	-5.65	105	2.01 ²	1.5065 ²⁰	vs et h, Et OH
1363	1-Bromot ri decane		C ₁₁ H ₂₃ Br	765-09-3	263.257		6.2	292	1.0234 ²⁵	1.4574 ²⁵	i H ₂ O; vs chl
1364	Bromot ri et hyl si l ane		C ₆ H ₁₃ BrSi	1112-48-7	195.173	li q	-49.3	163; 86	1.143 ²⁰	1.4561 ²⁰	
1365	2-Bromo-1,1,1-t ri fluorot hane		C ₂ H ₂ BrF ₃	421-06-7	162.936	vol li q or gas	-93.9	26	1.788 ¹	1.3331 ²⁰	
1366	Bromot ri fluorot hane		CBrF ₃	598-73-2	160.920	col gas		-2.5			
1367	Bromot ri fluoromet hane		CBrF ₃	75-63-8	148.910	col gas	-172	-57.8	1.5800 ⁰		i H ₂ O; vs chl
1368	1-Bromo-2-(t ri fluoromet hyl)benzene		C ₇ H ₄ BrF ₃	392-83-6	225.006			167.5	1.652 ²⁵	1.4817 ²⁰	
1369	1-Bromo-3-(t ri fluoromet hyl)benzene		C ₇ H ₄ BrF ₃	401-78-5	225.006		1	151.5	1.613 ²⁵	1.4716 ²⁰	
1370	1-Bromo-4-(t ri fluoromet hyl)benzene		C ₇ H ₄ BrF ₃	402-43-7	225.006			160	1.607 ²⁵	1.4705 ²⁵	
1371	2-Bromo-1,3,5-t ri met hyl benzene		C ₆ H ₃ Br	576-83-0	199.087	li q	-1	225	1.319 ¹¹	1.5510 ²⁰	i H ₂ O; vs et h; s bz; sl ct c
1372	Bromot ri ni t romet hane		C ₆ H ₅ BrN	560-95-2	229.931		17.5	56 ¹⁰	2.0312 ²⁰	1.4808 ²⁰	vs Et OH, chl
1373	Bromot ri phenyl met hane	Tri phenyl met hyl bromi de	C ₁₉ H ₁₅ Br	596-43-0	323.226		153	230 ¹⁵	1.5500 ²⁰		
1374	1-Bromoundecane		C ₁₁ H ₂₃ Br	693-67-4	235.205	li q	-9.7	258.8	1.049 ⁴	1.4552 ²⁵	sl ct c
1375	11-Bromoundecanoi c aci d		C ₁₁ H ₂₁ BrO ₂	2834-05-1	265.188	nd (li q)	57	188			vs ace, bz, et h, Et OH
1376	(1-Bromovi nyl)benzene		C ₈ H ₇ Br	98-81-7	183.046		-44	86 ¹⁴ , 71 ³	1.4025 ²³	1.5881 ²⁰	
1377	(<i>cis</i> -2-Bromovi nyl)benzene		C ₈ H ₇ Br	588-73-8	183.046		-7	55 ²	1.4322 ¹⁰	1.5990 ²²	
1378	(<i>trans</i> -2-Bromovi nyl)benzene		C ₈ H ₇ Br	588-72-7	183.046		7	dec 219; 108 ²⁰	1.4269 ¹⁶	1.6093 ²⁰	i H ₂ O; msc Et OH, et h; s chl
1379	1-Bromo-2-vi nyl benzene		C ₈ H ₇ Br	2039-88-5	183.046	li q	-52.8	209.2; 98	1.4160 ²⁰	1.5927 ²⁰	
1380	1-Bromo-3-vi nyl benzene		C ₈ H ₇ Br	2039-86-3	183.046			92 ²⁰	1.4059 ²⁰	1.5933 ²⁰	



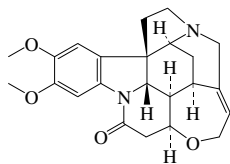
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1381	1-Bromo-4-vinyl benzene		C ₉ H ₉ Br	2039-82-9	183.046		7.7	212; 103 ²⁰	1.3984 ²⁰	1.5947 ²⁰	i H ₂ O; vs chl; s HOAc
1382	Bromphenylamine		C ₉ H ₉ BrN ₂	86-22-6	319.239	yellow liquid		150			s dil acid
1383	Brunellin		C ₂₃ H ₂₆ N ₂ O ₄	357-57-3	394.463	micropr (w +4)	178				sl H ₂ O, et h, bz; vs Et OH, chl
1384	Brunellin hydrochloride	2,3-Dimethyl-2,3-dihydro-1H-imidazo[4,5-b]pyridine hydrochloride	C ₂₃ H ₂₇ ClN ₂ O ₄	5786-96-9	430.924	pr					vs H ₂ O, Et OH
1385	Brunellin sulfate heptahydrate	2,3-Dimethyl-2,3-dihydro-1H-imidazo[4,5-b]pyridine sulfate heptahydrate	C ₂₃ H ₂₉ N ₂ O ₁₃ S	60583-39-3	1013.113	nd (w)					s H ₂ O; sl Et OH, chl, t f a; vs MeOH; i bz
1386	Bucolone	5-Butyl-1-cyclohexyl-2,4,6-trimethylpyridine	C ₁₄ H ₂₂ N ₂ O ₃	841-73-6	266.336	nd (MeOH)	84	186 ⁹⁵			
1387	Bufonin		C ₂₆ H ₃₆ O ₆	471-95-4	444.560	cryst (+1 al)	223 dec				i H ₂ O; s Et OH, chl
1388	Bulbocapnine		C ₈ H ₁₉ NO ₄	298-45-3	325.359	pr (al)	199.5				i H ₂ O; s Et OH; vs chl
1389	sec-Butameton	N-sec-Butyl-N'-ethyl-6-methoxy-1,3,5-triazine-2,4-diamine	C ₁₀ H ₁₉ N ₅ O	26259-45-0	225.291		87				
1390	BUSAN 72A	(2-Benzothiazolyl)ethylmethylthiocyanate	C ₈ H ₆ N ₂ S ₃	21564-17-0	238.352	liquid		dec			
1391	Butachlor		C ₇ H ₂₆ ClNO ₂	23184-66-9	311.847		<-5	156 ⁵	1.070 ²⁵		
1392	1,2-Butadiene	Methylallene	C ₄ H ₆	590-19-2	54.091	volatile liquid or gas	-136.2	10.9	0.676	1.4205 ¹	i H ₂ O; msc Et OH, et h; vs bz
1393	1,3-Butadiene	Divinyl	C ₄ H ₆	106-99-0	54.091	col gas	-108.91	-4.41	0.6149 ⁹⁵ (p>1 at m)	1.4292 ⁻²⁵	i H ₂ O; s Et OH, et h, bz; vs acet
1394	1,3-Butadiene-1-ol acetate		C ₆ H ₁₀ O ₂	1515-76-0	112.127			58 ⁴⁰	0.945 ²⁵	1.4690 ²⁰	
1395	(trans)-1,3-Butadienylbenzene		C ₁₀ H ₁₀	16939-57-4	130.186		2.3	76 ¹¹	0.9286 ²⁰	1.6089 ²⁵	i H ₂ O; s Et OH, et h, ace, bz
1396	1,3-Butadiene	Diacetylene	C ₄ H ₂	460-12-8	50.059	volatile liquid or gas	-36.4	10.3	0.7364	1.4189 ⁹⁵	vs H ₂ O, et h, ace; s chl, Et OH
1397	Butabital	5-Isobutyl-5-allyl-2,4,6-trimethylpyridine	C ₁₁ H ₁₆ N ₂ O ₃	77-26-9	224.256	pr	138.5				sl H ₂ O; s Et OH, et h, ace, chl; i i g
1398	Butanal	Butyraldehyde	C ₄ H ₈ O	123-72-8	72.106	liquid	-96.86	74.8	0.8016	1.3843 ²⁰	s H ₂ O; msc Et OH; vs ace, bz; sl chl
1399	Butanal oxime		C ₄ H ₉ NO	110-69-0	87.120	liquid	-29.5	154	0.929		vs H ₂ O, ace, bz; msc Et OH, et h; s chl
1400	Butanamide	Butyramide	C ₄ H ₉ NO	541-35-5	87.120	lf (bz)	114.8	216	0.8850 ⁰	1.4087 ¹³⁰	sl H ₂ O, et h; i bz; s Et OH
1401	Butane		C ₄ H ₁₀	106-97-8	58.122	col gas	-138.3	-0.5	0.573 ⁹⁵ (p>1 at m)	1.3326 ²⁰	i H ₂ O; vs Et OH, et h, chl
1402	Butanediol		C ₄ H ₁₀ O ₂	638-37-9	86.090			dec 170; 58 ⁹	1.065 ²⁰	1.4262 ¹⁸	vs H ₂ O, ace, et h, Et OH
1403	1,4-Butanediolamine	Putrescine	C ₄ H ₁₁ N	110-60-1	88.151	lf	21.91	158.5	0.877	1.4969 ²⁰	s H ₂ O
1404	1,4-Butanediolamine dihydrochloride		C ₄ H ₁₃ Cl ₂ N ₂	333-93-7	161.073	nd or lf (al, w)	280 dec	sub			vs H ₂ O, Et OH; i et h, bz, MeOH
1405	1,2-Butanediol, (±)		C ₄ H ₁₀ O ₂	26171-83-5	90.121			190.5	1.0024 ²⁰	1.4378 ²⁰	s H ₂ O, Et OH, ace
1406	1,3-Butanediol	1,3-Butylene glycol	C ₄ H ₁₀ O ₂	107-88-0	90.121		<-50	207.5	1.0053 ²⁰	1.4401 ²⁰	
1407	1,4-Butanediol	Tetraerythritol	C ₄ H ₁₀ O ₂	110-63-4	90.121		20.4	235	1.0171 ²⁰	1.4460 ²⁰	msc H ₂ O; s Et OH, DMSO; sl et h
1408	2,3-Butanediol		C ₄ H ₁₀ O ₂	6982-25-8	90.121	cryst (et h)	7.6	182.5	1.0033 ⁹	1.4310 ²⁵	msc H ₂ O, Et OH; s et h, ace, chl
1409	1,4-Butanediol diacetate		C ₈ H ₁₆ O ₄	628-67-1	174.195		12	229	1.0479 ¹⁵	1.4251 ¹⁵	
1410	1,4-Butanediol diacrylate		C ₁₀ H ₁₄ O ₄	1070-70-8	198.216			83 ^{9,3}	1.105 ²⁵		
1411	1,4-Butanediol diglycidyl ether	1,4-Bis(2,3-epoxypropoxy)butane	C ₁₀ H ₁₈ O ₃	2425-79-8	202.248			266; 155 ¹¹	1.1 ²⁵	1.4611 ²⁰	
1412	1,3-Butanediol dimethacrylate		C ₁₂ H ₁₈ O ₄	1189-08-8	226.269			290	1.4495 ²⁵	1.4560 ²⁰	vs ace, et h, Et OH, i g
1413	1,4-Butanediol dimethacrylate		C ₁₂ H ₁₈ O ₄	2082-81-7	226.269	liquid		138; 76 ^{0,027}	1.025 ²⁰		sl H ₂ O
1414	1,4-Butanediol dimethylsulfonate	Busulfan	C ₈ H ₁₆ O ₂ S ₂	55-98-1	246.301	cryst	116				i H ₂ O; sl Et OH, ace
1415	2,3-Butanediolone	Diacetyl	C ₄ H ₈ O ₂	431-03-8	86.090	liquid	-1.2	88	0.9808	1.3951 ²⁰	vs H ₂ O; msc Et OH, et h; s bz, ct c
1416	2,3-Butanediolone monooxime		C ₄ H ₉ NO ₂	57-71-6	101.105	pr (chl), lf (w)	76.8	185.5			sl H ₂ O; vs Et OH, et h, chl; s alk
1417	Butanedioldichloride	Succinylchloride	C ₄ H ₆ Cl ₂ O ₂	543-20-4	154.980	pl or lf	20	193.3	1.3748	1.4683 ²⁰	s et h, ace, bz
1418	1,4-Butanediolthiol	Tetraerythritolthiol	C ₄ H ₁₀ S ₂	1191-08-8	122.252	liquid	-53.9	195.5	1.0024	1.5290 ²⁰	i H ₂ O; vs Et OH; sl ct c



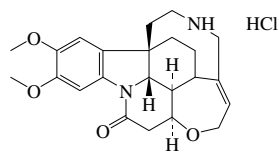
1-Bromo-4-vinylbenzene



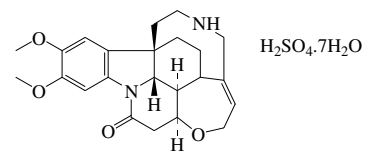
Brompheniramine



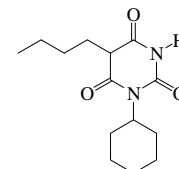
Brucine



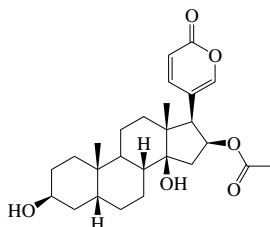
Bruceine hydrochloride



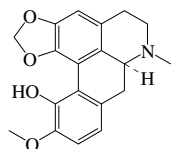
Bruceine sulfate heptahydrate



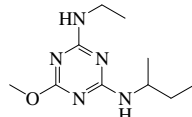
Bucolone



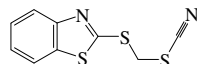
Bufotalin



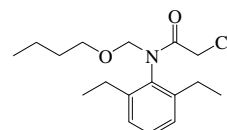
Bulbocapnine



sec-Bumeton



BUSAN 72A



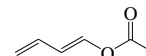
Butachlor



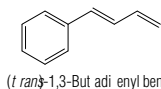
1,2-Butadiene



1,3-Butadiene



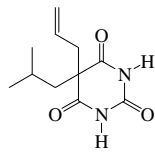
1,3-Butadiene-1-yl acetate



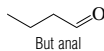
(trans)-1,3-Butadiene



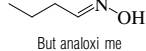
1,3-Butadiyne



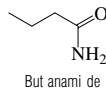
Butalbitol



Butanal



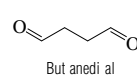
Butanaloxime



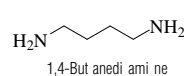
Butanamide



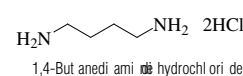
Butane



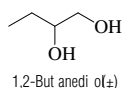
Butanedial



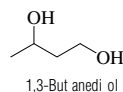
1,4-Butanediamine



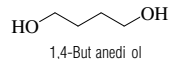
1,4-Butanediamine dihydrochloride



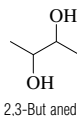
1,2-Butanediol



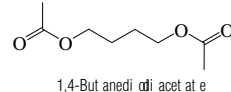
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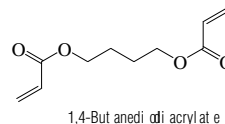
1,4-Butanediol



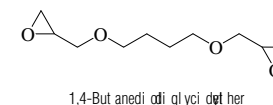
2,3-Butanediol



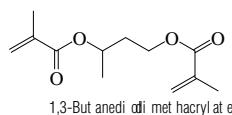
1,4-Butanediol diacetate



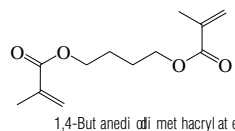
1,4-Butanediol diacrylate



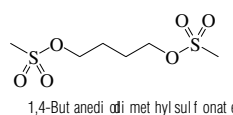
1,4-Butanediol diglycidyl ether



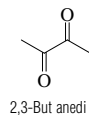
1,3-Butanediol dimethacrylate



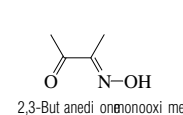
1,4-Butanediol dimethacrylate



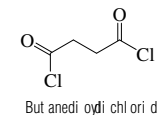
1,4-Butanediol dimethylsulfonate



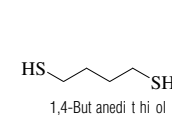
2,3-Butanone



2,3-Butanedione

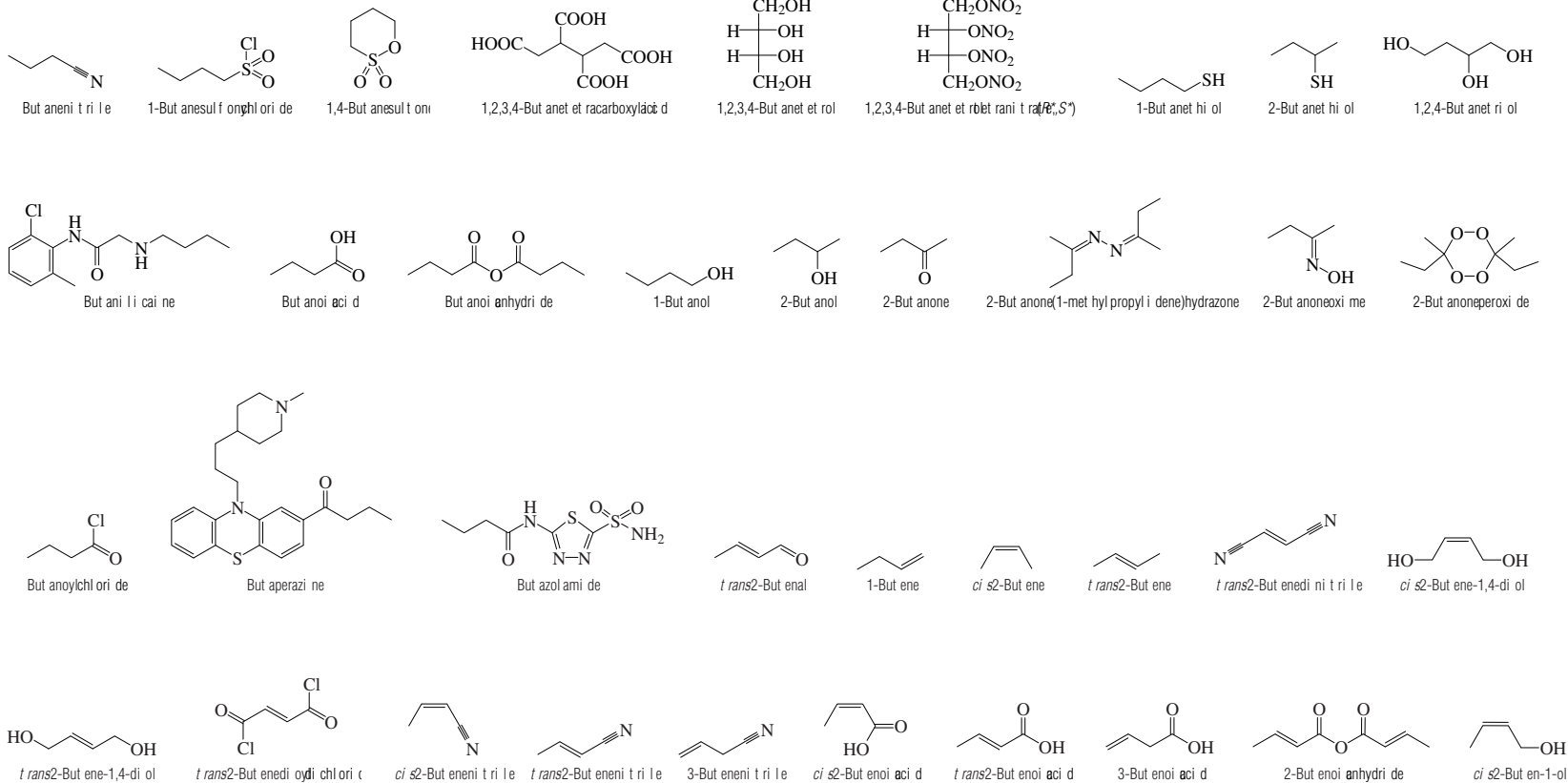


Butanedioyl chloride

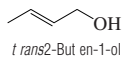


1,4-Butanethiol

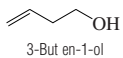
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1419	But aneni t ri le	Propyl cyani de	$\text{C}_4\text{H}_7\text{N}$	109-74-0	69.106	li q	-111.9	117.6	0.793 6	1.3842 ²⁰	sl H ₂ O; ct c; msc Et OH, et h; s bz
1420	1-But anesul f onyl chl ori de		$\text{C}_4\text{H}_9\text{Cl}_2\text{OS}$	2386-60-9	156.631			75 ¹⁰		1.4559 ²⁰	
1421	1,4-But ane sul t one	1,2-Oxat hi ane 2,2-di oxi de	$\text{C}_4\text{H}_6\text{O}_2\text{S}$	1633-83-6	136.170	li q	13.5	135	1.331 ²⁰	1.4640 ²⁰	
1422	1,2,3,4-But anet et racarboxyl i c aci d		$\text{C}_4\text{H}_6\text{O}_8$	1703-58-8	234.160	lf (w) cry (ace)	236.5				vs H ₂ O, Et OH
1423	1,2,3,4-But anet et rol	Eryt hri t ol	$\text{C}_4\text{H}_{10}\text{O}_4$	149-32-6	122.120	bi pym t et r pr	121.5	330.5	1.45 ¹		s H ₂ O; i et h, bz
1424	1,2,3,4-But anet et rol t et rani t rat e, (<i>R,R,S,S</i>)	Eryt hri t yl t et rani t rat e	$\text{C}_4\text{H}_8\text{N}_4\text{O}_{12}$	7297-25-8	302.111		61				vs Et OH
1425	1-But anet hi ol	But yl mercapt an	$\text{C}_4\text{H}_{10}\text{S}$	109-79-5	90.187	li q	-115.7	98.5	0.841 6	1.4440 ²⁰	sl H ₂ O, chl; vs Et OH, et h
1426	2-But anet hi ol	sec-But yl mercapt an	$\text{C}_4\text{H}_{10}\text{S}$	91840-99-2	90.187	li q	-165	85.0	0.829 5	1.4366 ²⁰	s Et OH, et h, bz, pet h; sl ct c
1427	1,2,4-But anet ri ol		$\text{C}_4\text{H}_{10}\text{O}_3$	3068-00-6	106.120			190 ¹⁸ , 172 ¹²	1.18 ²⁰	1.4688 ²⁰	vs H ₂ O, Et OH
1428	But ani li cai ne	2-(But yl am yl)ehl oro-6- met hyl phenyl)acet ami de	$\text{C}_{13}\text{H}_{19}\text{ClN}_2\text{O}$	3785-21-5	254.755	cry	46	145 ^{0,001}			
1429	Butanoi c aci d	But yri c aci d	$\text{C}_4\text{H}_6\text{O}_2$	107-92-6	88.106	li q	-5.1	163.75	0.952 8	1.3980 ²⁰	msc H ₂ O, Et OH, et h; sl ct c
1430	Butanoi c anhydri de	But yri c anhydri de	$\text{C}_4\text{H}_4\text{O}_3$	106-31-0	158.195	li q	-75	200	0.966 8	1.4070 ²⁰	s et h; sl ct c
1431	1-But anol	But yl al cohol	$\text{C}_4\text{H}_{10}\text{O}$	71-36-3	74.121	li q	-88.6	117.73	0.809 5	1.3988 ²⁰	s H ₂ O, bz; msc Et OH, et h; vs ace
1432	2-But anol	sec-But yl al cohol	$\text{C}_4\text{H}_{10}\text{O}$	78-92-2	74.121	li q	-88.5	99.51	0.806 3	1.3978 ²⁰	vs H ₂ O; msc Et OH, et h; s bz, ct c
1433	2-But anone	Met hyl et hyl ket one	$\text{C}_4\text{H}_8\text{O}$	78-93-3	72.106	li q	-86.64	79.59	0.799 9	1.3788 ²⁰	vs H ₂ O; msc Et OH, et h, ace, bz; s chl
1434	2-But anone (1-met hyl propyl i dene) hydrazone		$\text{C}_8\text{H}_{16}\text{N}_2$	5921-54-0	140.226			171.5	0.8404 ²⁰	1.4511 ²⁰	
1435	2-But anone oxi me		$\text{C}_4\text{H}_8\text{NO}$	96-29-7	87.120	li q	-29.5	152.5	0.923 2	1.4410 ²⁰	s H ₂ O, chl; msc Et OH, et h
1436	2-But anone peroxi de	Met hyl et hyl ket one peroxi de	$\text{C}_8\text{H}_{16}\text{O}_4$	1338-23-4	176.211	col li q		exp 110			sl l ; mi sc os
1437	But anoyl chl ori de	<i>n</i> -But yryl chl ori de	$\text{C}_4\text{H}_7\text{ClO}$	141-75-3	106.551	li q	-89	102	1.02 77	1.4121 ²⁰	msc et h
1438	But aperazi ne		$\text{C}_4\text{H}_{31}\text{N}_3\text{OS}$	653-03-2	409.587			275 ^{0,05}			
1439	But azol ami de	<i>N</i> -[5-(Ami nosul f onyl)-1,3,4- t hi adi azol -2-yl]but anami de	$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_3\text{S}_2$	16790-49-1	250.298	cry	261 dec				
1440	<i>t rans</i> 2-But enal	<i>t rans</i> Crot onal dehyde	$\text{C}_4\text{H}_6\text{O}$	123-73-9	70.090	li q	-76	102.2	0.851 6	1.4366 ²⁰	s H ₂ O, chl; vs Et OH, et h, ace; msc bz
1441	1-But ene	1-But yl ene	C_4H_8	106-98-9	56.107	col gas	-185.34	-6.26	0.588 ⁵ (p>1 at m)	1.3962 ²⁰	i H ₂ O; vs Et OH, et h; s bz
1442	<i>ci s</i> 2-But ene		C_4H_8	590-18-1	56.107	col gas	-138.88	3.71	0.616 ⁵ (p>1 at m)	1.3931 ⁻²⁵	i H ₂ O; vs Et OH, et h; s bz
1443	<i>t rans</i> 2-But ene		C_4H_8	624-64-6	56.107	col gas	-105.52	0.88	0.599 ⁵ (p>1 at m)	1.3848 ⁻²⁵	s bz
1444	<i>t rans</i> 2-But enedi ni t ri le		$\text{C}_4\text{H}_6\text{N}_2$	764-42-1	78.072	nd (bz-pet h)	96.8	186	0.9416 ¹¹	1.4349 ¹¹¹	s H ₂ O, Et OH, et h, ace, bz, chl; sl pet h
1445	<i>ci s</i> 2-But ene-1,4-di ol		$\text{C}_4\text{H}_8\text{O}_2$	6117-80-2	88.106		2.0	235	1.0698 ²⁰	1.4782 ²⁰	s H ₂ O; vs Et OH
1446	<i>t rans</i> 2-But ene-1,4-di ol		$\text{C}_4\text{H}_8\text{O}_2$	821-11-4	88.106		25	131 ¹³	1.0700 ²⁰	1.4755 ²⁰	vs H ₂ O, Et OH
1447	<i>t rans</i> 2-But enedi oyl di chl ori de	Fumari c aci d di chl ori de	$\text{C}_4\text{H}_2\text{Cl}_2\text{O}_2$	627-63-4	152.964	pa ye li g		159	1.40 8	1.5004 ¹⁸	
1448	<i>ci s</i> 2-But eneni t ri le	Isocrot ononi t ri le	$\text{C}_4\text{H}_6\text{N}$	1190-76-7	67.090	li q		107.4			
1449	<i>t rans</i> 2-But eneni t ri le	Crot ononi t ri le	$\text{C}_4\text{H}_6\text{N}$	627-26-9	67.090	li q	-51.5	120	0.823 9	1.4225 ²⁰	s et h, ace
1450	3-But eneni t ri le	Allyl cyani de	$\text{C}_4\text{H}_5\text{NC}$	109-75-1	67.090	li q	-87	119	0.834 4	1.4060 ²⁰	sl H ₂ O; msc Et OH, et h
1451	<i>ci s</i> 2-But enoi c aci d	Isocrot oni c aci d	$\text{C}_4\text{H}_6\text{O}_2$	503-64-0	86.090	nd or pr (pet h)	15	169	1.026 ⁷⁰	1.4450 ²⁰	vs H ₂ O; s Et OH
1452	<i>t rans</i> 2-But enoi c aci d	Crot oni c aci d	$\text{C}_4\text{H}_6\text{O}_2$	107-93-7	86.090	mcl pr or nd (w, li g)	71.5	184.7	0.9604 ⁷⁷	1.4249 ⁷⁷	vs H ₂ O, Et OH; s et h, ace, li g
1453	3-But enoi c aci d		$\text{C}_4\text{H}_6\text{O}_2$	625-38-7	86.090	li q	-35	169	1.009 4	1.4239 ²⁰	s H ₂ O; msc Et OH, et h
1454	2-But enoi c anhydri de	Crot oni c aci d anhydri de	$\text{C}_4\text{H}_6\text{O}_3$	623-68-7	154.163			247; 129 ¹⁹	1.0397 ²⁰	1.4745 ²⁰	vs et h
1455	<i>ci s</i> 2-But en-1-ol	<i>ci s</i> Crot yl al cohol	$\text{C}_4\text{H}_8\text{O}$	4088-60-2	72.106			123	0.8662 ²⁰	1.4342 ²⁵	s H ₂ O



No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1456	<i>t</i> -rans2-But en-1-ol	<i>t</i> -ransCrot yl alcohol	C ₄ H ₈ O	504-61-0	72.106		<-30	121.2	0.8521 ²⁰	1.4288 ²⁰	vs H ₂ O; msc Et OH, et h; s chl
1457	3-But en-1-ol		C ₄ H ₈ O	627-27-0	72.106			113.5	0.8424 ²⁰	1.4224 ²⁰	s H ₂ O, ace; msc Et OH, et h; sl ct c
1458	3-But en-2-ol		C ₄ H ₈ O	598-32-3	72.106			97			
1459	3-But en-2-one	Met hyl vi nyl ket one	C ₄ H ₆ O	78-94-4	70.090			81.4	0.864 ²⁰	1.4081 ²⁰	s H ₂ O, Et OH, bz; vs et h, ace; sl ct c
1460	2-But enoyl chl ori de		C ₈ H ₁₂ ClO	10487-71-5	104.535			124.5	1.0905 ²⁰	1.460 ¹⁸	vs ace
1461	(<i>t</i> -rans1-But enyl)benzene		C ₁₀ H ₁₂	1005-64-7	132.202	li q	-43.1	198.7	0.901 ⁹	1.5420 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
1462	2-But enyl benzene		C ₁₀ H ₁₂	1560-06-1	132.202			176	0.8831 ²⁰	1.5101 ²⁰	
1463	3-But enyl benzene		C ₁₀ H ₁₂	768-56-9	132.202	li q	-70	177	0.883 ⁹	1.5059 ²⁰	i H ₂ O; s et h, bz
1464	1-But en-3-yne	Vi nyl acet yl ene	C ₄ H ₄	689-97-4	52.075	col gas		5.1	0.709 ⁴	1.4161 ¹	i H ₂ O; s bz
1465	But et hami ne hydrochl ori de	2-Isobut yl ami noet hyl 4-ami nobenzoat e	C ₁₃ H ₂₁ ClN ₂ O ₂	553-68-4	272.771	cry	194				s H ₂ O; sl Et OH, bz, chl; i et h
1466	But hal i t al sodi um		C ₁₁ H ₁₉ N ₂ NaO ₂ S	510-90-7	262.304						vs H ₂ O; sl Et OH; i et h, bz
1467	But hi azi de		C ₁₆ H ₁₆ ClN ₂ O ₂ S	2043-38-1	353.846		221.5				
1468	But hi obat e	Denmert	C ₂₁ H ₂₈ N ₂ S ₂	51308-54-4	372.590	ye oi l	32		1.086 ⁵	1.596 ²⁵	i H ₂ O; s os
1469	But onat e		C ₈ H ₁₄ Cl ₃ O ₅ P	126-22-7	327.527			129 ^{0.5}			
1470	But oxyacet yl ene		C ₈ H ₁₆ O	3329-56-4	98.142			104	0.8200 ²⁰	1.4067	vs et h, Et OH
1471	4-But oxyani li ne		C ₁₀ H ₁₅ NO	4344-55-2	165.232			132 ⁴			
1472	4-But oxybenzaldehyde		C ₈ H ₁₀ O ₂	5736-88-9	178.228			148 ¹⁰			
1473	2-But oxyet hanol	Et hyl ene glycol monobut yl et her	C ₆ H ₁₄ O ₂	111-76-2	118.174	li q	-74.8	168.4	0.901 ⁵	1.4198 ²⁰	msc H ₂ O, Et OH, et h; sl ct c
1474	2-[2-(2-But oxyet hoxyl)et hoxyl]et hanol		C ₁₀ H ₂₂ O ₄	143-22-6	206.280			278	0.9890 ²⁰	1.4389 ²⁰	vs Et OH, MeOH
1475	2-(2-But oxyet hoxyl)et hyl t hi ocyanat e	Let hane 384	C ₇ H ₁₁ NO ₂ S	112-56-1	203.302	li q		122 ²⁵			i H ₂ O; vs os
1476	1-(2-But oxyet hoxyl)-2-propanol		C ₈ H ₁₈ O ₃	124-16-3	176.253	col li q	-90	230	0.93 ¹		s H ₂ O
1477	2-But oxyet hyl acet at e	Et hyl ene glycol monobut yl et her	C ₈ H ₁₆ O ₃	112-07-2	160.211	li q		192			
1478	2-But oxyet hyl (2,4-di chl orophenoxy)2,4-D 2-But oxyet hyl est er acet at e		C ₁₈ H ₁₈ Cl ₂ O ₄	1929-73-3	321.197			159 ¹	1.232 ²⁰		
1479	2-But oxyet hyl (2,4,5-tri chl orophenoxy)acet at e	2,4,5-T But oxyet hyl est er	C ₁₈ H ₁₇ Cl ₃ O ₄	2545-59-7	355.642			164 ¹	1.280 ²⁰		s ct c
1480	4-But oxy- <i>N</i> -hydroxybenzeneacet ami de	Buf examac	C ₈ H ₁₇ NO ₃	2438-72-4	223.268	nd (ace)	154				
1481	1-But oxy-4-met hyl benzene		C ₉ H ₁₆ O	10519-06-9	164.244			229.5	0.9205 ²⁵	1.4970 ²⁰	s et h
1482	4-But oxyphenol		C ₁₀ H ₁₄ O ₂	122-94-1	166.217		65.5	125 ⁴			vs ace, bz, et h, Et OH
1483	4-[3-(4-But oxyphenoxy)propyl]morphol i ne	Pramoxi ne	C ₁₇ H ₂₇ NO ₃	140-65-8	293.401			196 ⁶			
1484	1-But oxy-2-propanol		C ₇ H ₁₆ O ₂	5131-66-8	132.201			171.5; 71 ²⁰	0.882 ²⁰	1.4168 ²⁰	s Et OH, et h, bz, ct c, MeOH
1485	But ral i n	4- <i>tert</i> But yl <i>N</i> - <i>sec</i> -but yl -2,6-di ni t roani li ne	C ₁₄ H ₂₁ N ₃ O ₄	33629-47-9	295.335		60	135 ^{0.5}			
1486	<i>N</i> -But yl acet ami de		C ₈ H ₁₅ NO	1119-49-9	115.173			229	0.8960 ²⁵	1.4388 ²⁵	
1487	But yl acet at e		C ₆ H ₁₂ O ₂	123-86-4	116.158	li q	-78	126.1	0.882 ⁵	1.3941 ²⁰	sl H ₂ O; msc Et OH, et h; s ace, chl
1488	<i>sec</i> -But yl acet at e		C ₆ H ₁₂ O ₂	105-46-4	116.158	li q	-98.9	112	0.874 ⁸	1.3888 ²⁰	sl H ₂ O, ct c; s Et OH, et h
1489	<i>t</i> - <i>tert</i> But yl acet at e		C ₆ H ₁₂ O ₂	540-88-5	116.158			95.1	0.8665 ²⁰	1.3855 ²⁰	s Et OH, et h, chl, HOAc
1490	<i>t</i> - <i>tert</i> But yl acet i c aci d		C ₈ H ₁₄ O ₂	1070-83-3	116.158		6.5	190	0.9124 ²⁰	1.4096 ²⁰	s Et OH, et h
1491	But yl acet oacet at e		C ₈ H ₁₄ O ₃	591-60-6	158.195		-35.6	127 ³⁰ , 85 ⁸	0.9671 ²⁵	1.4137 ²⁰	sl H ₂ O; msc Et OH, bz, li g
1492	But yl acryl at e		C ₇ H ₁₂ O ₂	141-32-2	128.169	li q	-64.6	145	0.889 ⁸	1.4185 ²⁰	i H ₂ O; s Et OH, et h, ace; sl ct c
1493	<i>t</i> - <i>tert</i> But yl acryl at e		C ₇ H ₁₂ O ₂	1663-39-4	128.169	li q		120; 62 ²	0.879 ²⁵	1.4110 ²⁰	
1494	But yl ami ne	1-But anami ne	C ₄ H ₉ N	109-73-9	73.137	li q	-49.1	77.00	0.741 ⁴	1.4031 ²⁰	msc H ₂ O; s Et OH, et h



trans-2-But en-1-ol



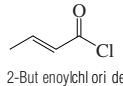
3-But en-1-ol



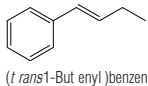
3-But en-2-ol



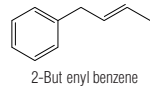
3-But en-2-one



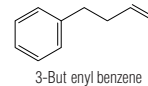
2-But enoylchl ori de



(*trans*-1-But enyl)benzene



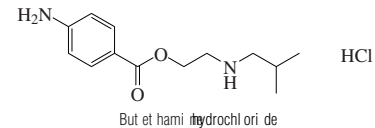
2-But enyl benzene



3-But enyl benzene

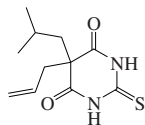


1-But en-3-yne



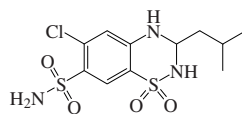
But et hami hydrochl ori de

HCl

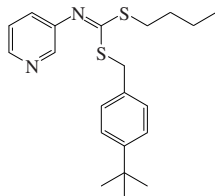


But hal i tsidi um

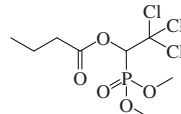
Na⁺



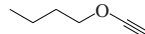
But hi azi de



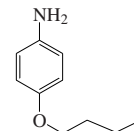
But hi obat e



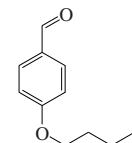
But onat e



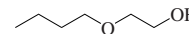
But oxyacet yl ene



4-But oxyani li ne

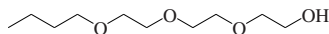


4-But oxybenzal dehyde

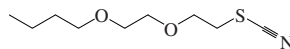


2-But oxyet hanol

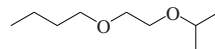
3-83



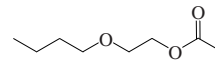
2-[2-(2-But oxyet hoxy)et hoxy]et hanol



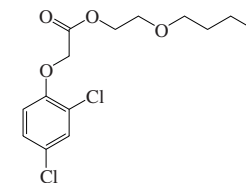
2-(2-But oxyet hoxy)et hyl i ocyanat e



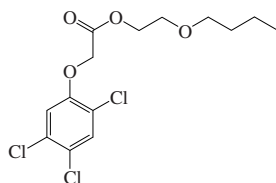
1-(2-But oxyet hoxy)-2-propanol



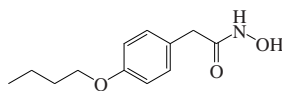
2-But oxyet hylacet at e



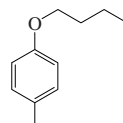
2-But oxyet hyl(2,4-di chl orophenoxy)acet at e



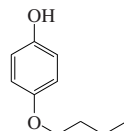
2-But oxyet hyl(2,4,5-t ri chl orophenoxy)acet at e



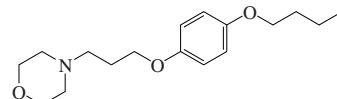
4-But oxy-N-hydroxybenzeneacet ami de



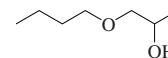
1-But oxy-4-met hyl benzer



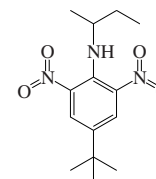
4-But oxyphenol



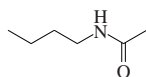
4-[3-(4-But oxyphenoxy)propyl]morphol i ne



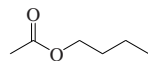
1-But oxy-2-propanol



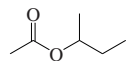
But ral i n



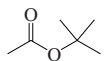
N-But yl acet ami de



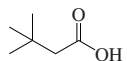
But ylacet at e



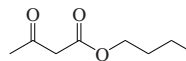
sec-But ylacet at e



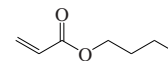
*ter*But ylacet at e



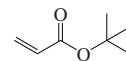
*ter*But yl acet aci d



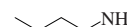
But ylacet oacet at e



But ylacryl at e

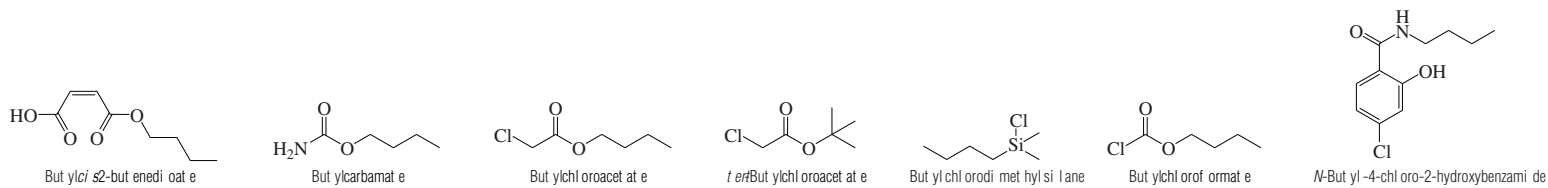
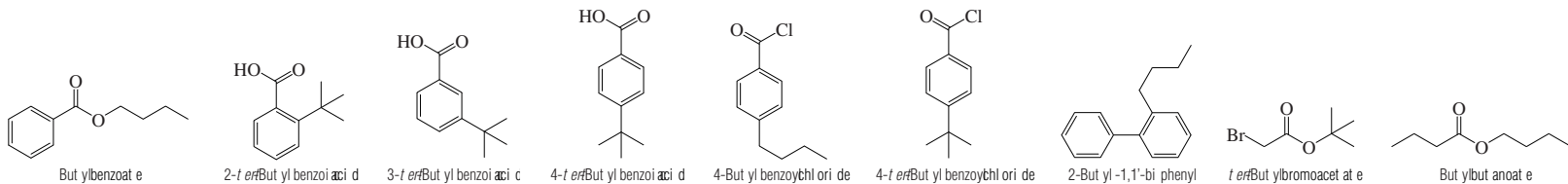
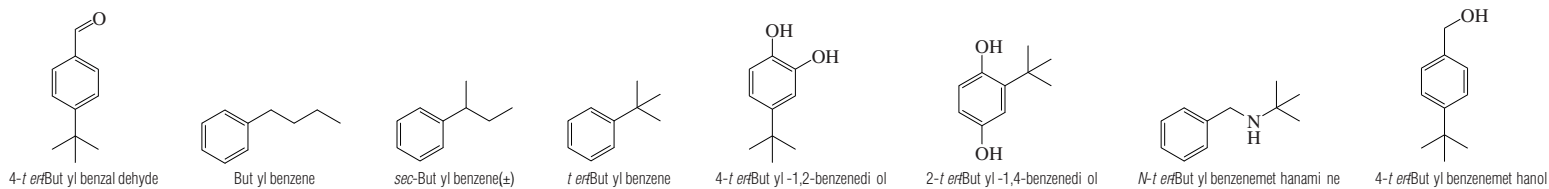
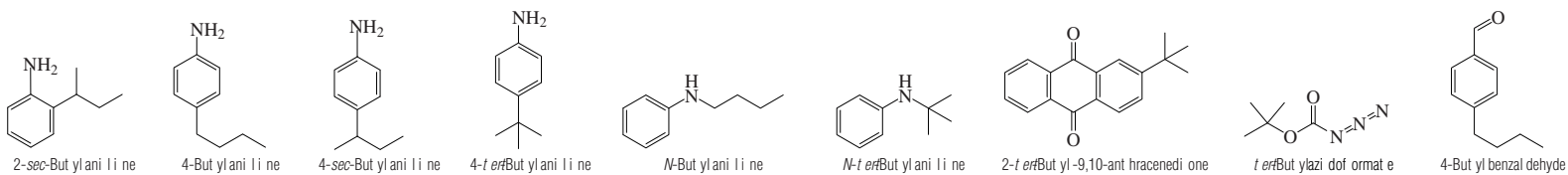
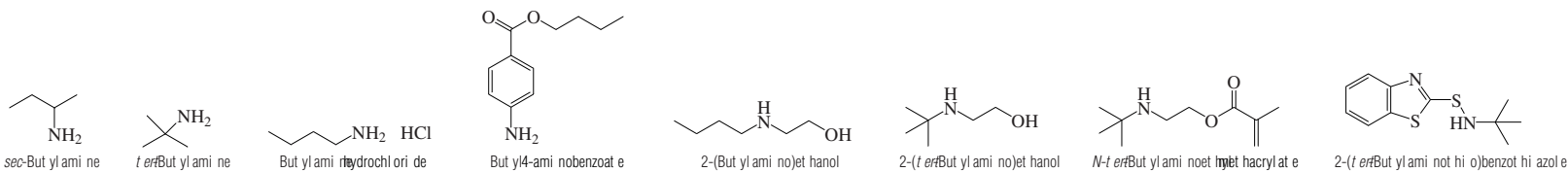


*ter*But ylacryl at e

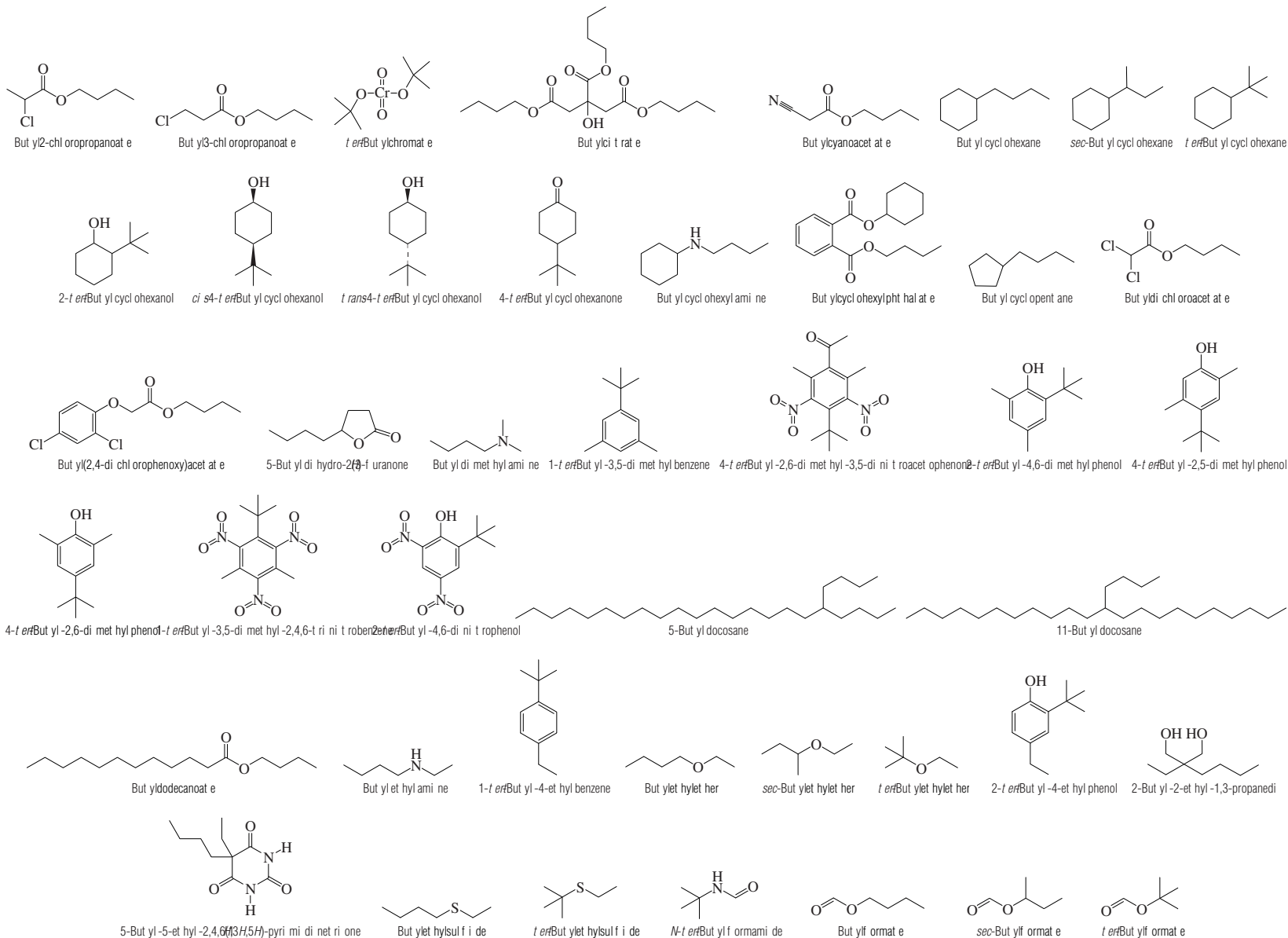


But yl ami ne

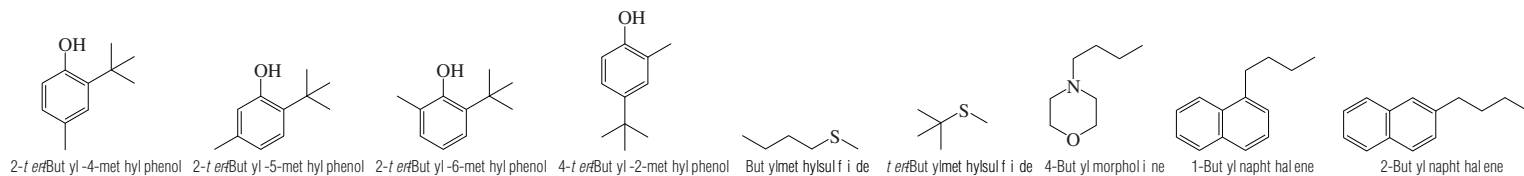
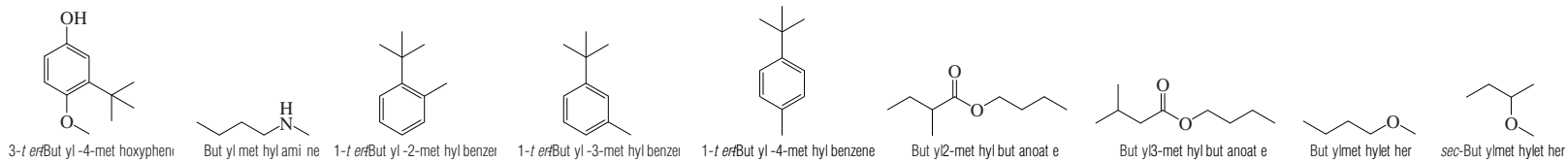
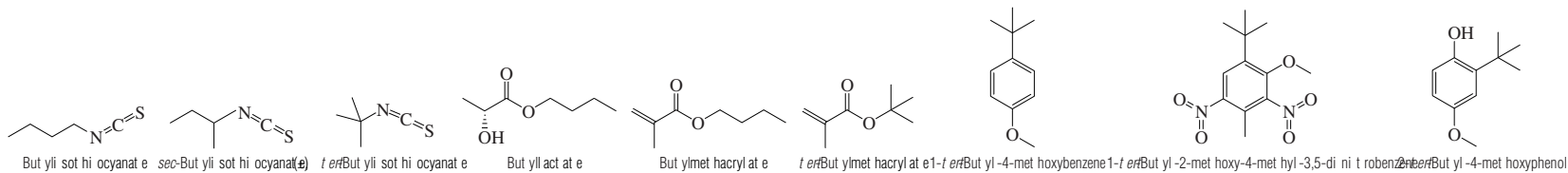
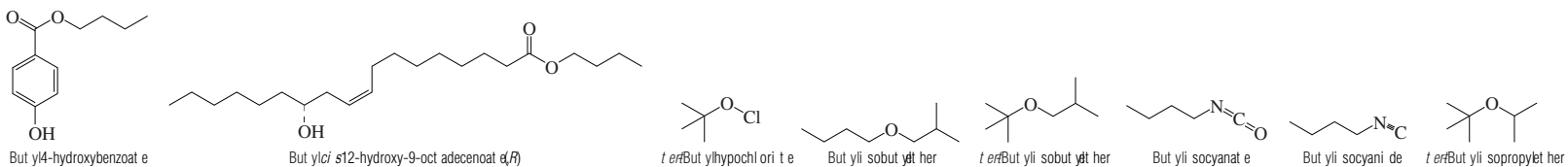
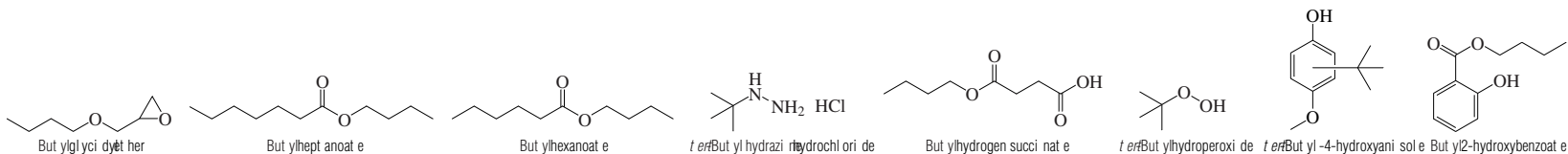
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1495	sec-Butyl amine	2-Butylamine, (±)-	C ₄ H ₉ N	33966-50-6	73.137		<-72	62.73	0.7246 ²⁰	1.3932 ²⁰	s H ₂ O, chl; msc Et OH, et h; vs ace
1496	t-erButyl amine	2-Methyl-2-propanamine	C ₄ H ₉ N	75-64-9	73.137	liq	-66.94	44.04	0.6958	1.3784 ²⁰	msc H ₂ O, Et OH, et h; s chl
1497	Butylamine hydrochloride	1-Butylamine hydrochloride	C ₄ H ₁₂ ClN	3858-78-4	109.598		213		0.982 ²⁰		sl H ₂ O, Et OH
1498	Butyl 4-aminobenzoate	Butylamine	C ₁₁ H ₁₅ NO ₂	94-25-7	193.243	cry (al or bz)	58	173			i H ₂ O; s Et OH, et h, bz, chl
1499	2-(t-erButylamino)ethanol		C ₈ H ₁₇ NO	111-75-1	117.189			199; 91 ¹¹	0.8907 ²⁰	1.4437 ²⁰	vs H ₂ O, Et OH, et h
1500	2-(t-erButylamino)ethanol		C ₈ H ₁₇ NO	4620-70-6	117.189		44	176.5; 72 ¹⁴	0.8818 ²⁰		
1501	N-t-erButylamine hydrochloride		C ₁₀ H ₁₉ NO ₂	3775-90-4	185.264			102 ¹²			s chl
1502	2-(t-erButylamino)ethanol		C ₁₁ H ₁₄ N ₂ S ₂	95-31-8	238.372		108				
1503	2-sec-Butylamine		C ₁₀ H ₁₅ N	55751-54-7	149.233			120 ¹⁶	0.9574 ²⁰		s Et OH, ace, bz; sl ct c
1504	4-Butylamine		C ₁₀ H ₁₅ N	104-13-2	149.233	pa ye		261	0.945 ²⁰		sl ct c
1505	4-sec-Butylamine		C ₁₀ H ₁₅ N	30273-11-1	149.233			238; 118 ¹⁵	0.949 ¹⁵	1.5360 ²⁹	vs bz, et h
1506	4-t-erButylamine		C ₁₀ H ₁₅ N	769-92-6	149.233	ye rd (pet h)	17	241	0.9525 ⁵	1.5380 ²⁰	sl H ₂ O; msc Et OH, et h; vs bz; s ct c
1507	N-Butylamine		C ₁₀ H ₁₅ N	1126-78-9	149.233	liq	-14.4	243.5	0.932 ³	1.5341 ²⁰	vs et h, Et OH
1508	N-t-erButylamine		C ₁₀ H ₁₅ N	937-33-7	149.233			215; 95 ¹⁹		1.5270 ²⁰	s Et OH; vs ace, bz, chl
1509	2-t-erButyl-9,10-antihydroxy-1-one		C ₁₈ H ₁₆ O ₂	84-47-9	264.319		99				s ct c, C ₆ H ₆
1510	t-erButyl azide	t-erButyl azide	C ₈ H ₁₅ N ₃	1070-19-5	143.144	unst ab >80		73 ⁰			
1511	4-Butylbenzaldehyde		C ₁₂ H ₁₄ O	1200-14-2	162.228			123 ⁷		1.5265	
1512	4-t-erButylbenzaldehyde		C ₁₂ H ₁₄ O	939-97-9	162.228	liq		107; 130 ²⁵	0.970	1.5270 ²⁰	
1513	Butylbenzene		C ₁₀ H ₁₄	104-51-8	134.218	liq	-87.85	183.31	0.8609 ⁹	1.4898 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
1514	sec-Butylbenzene, (±)	2-Phenylbutane	C ₁₀ H ₁₄	36383-15-0	134.218	liq	-82.7	173.3	0.8624 ⁹	1.4902 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
1515	t-erButylbenzene		C ₁₀ H ₁₄	98-06-6	134.218	liq	-57.8	169.1	0.8665 ⁹	1.4927 ²⁰	i H ₂ O; vs Et OH, et h; msc ace, bz
1516	4-t-erButyl-1,2-benzenediol		C ₁₀ H ₁₄ O ₂	98-29-3	166.217		54.3	285; 160 ²²			s t f a
1517	2-t-erButyl-1,4-benzenediol		C ₁₀ H ₁₄ O ₂	1948-33-0	166.217		128				
1518	N-t-erButylbenzenemethanamine		C ₁₁ H ₁₇ N	3378-72-1	163.260			75 ⁵		1.4951 ²⁵	
1519	4-t-erButylbenzenemethanol		C ₁₁ H ₁₆ O	877-65-6	164.244			236; 140 ²⁰	0.928 ²⁵	1.5179 ²⁰	
1520	Butyl benzoate		C ₁₁ H ₁₄ O ₂	136-60-7	178.228	liq	-22.4	250.3	1.000 ⁹	1.4940 ²⁵	i H ₂ O; msc Et OH, et h; s ace; sl ct c
1521	2-t-erButylbenzoic acid		C ₁₁ H ₁₄ O ₂	1077-58-3	178.228	pl (di l al)	80.5				vs Et OH
1522	3-t-erButylbenzoic acid		C ₁₁ H ₁₄ O ₂	7498-54-6	178.228	nd (pet h)	128.8				vs Et OH, pet h
1523	4-t-erButylbenzoic acid		C ₁₁ H ₁₄ O ₂	98-73-7	178.228	nd (di l al)	164.5				i ₂ OH vs Et OH, bz; s chl
1524	4-Butylbenzoyl chloride		C ₁₁ H ₁₃ ClO	28788-62-7	196.673			155 ⁶	1.051 ²⁵	1.5351 ²⁰	
1525	4-t-erButylbenzoyl chloride		C ₁₁ H ₁₃ ClO	1710-98-1	196.673			266; 135 ⁰	1.007 ²⁵	1.5364 ²⁰	
1526	2-Butyl-1,1'-bi-phenyl		C ₁₈ H ₁₈	54532-97-7	210.314	liq	-9.65	291.2	0.967 ⁶	1.5604 ²⁰	
1527	t-erButyl bromoacetate		C ₈ H ₁₅ BrO ₂	5292-43-3	195.054			73 ²⁵		1.4430 ²⁰	vs et h, Et OH
1528	Butyl butanoate		C ₁₀ H ₁₈ O ₂	109-21-7	144.212	liq	-91.5	166	0.870 ⁰	1.4075 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
1529	Butyl acetylacetonate	Monobutyl malonate	C ₈ H ₁₂ O ₄	925-21-3	172.179	oi l			1.09		
1530	Butyl carbamate		C ₈ H ₁₁ NO ₂	592-35-8	117.147	pr	53	dec 204; 108 ¹⁴			vs Et OH; sl chl
1531	Butyl chloroacetate		C ₈ H ₁₁ ClO ₂	590-02-3	150.603			183	1.0704 ²⁰	1.4297 ²⁰	vs et h, Et OH
1532	t-erButyl chloroacetate		C ₈ H ₁₁ ClO ₂	107-59-5	150.603			150; 50 ¹⁰		1.4260 ²⁰	dec H ₂ O
1533	Butyl chlorosilane		C ₈ H ₁₆ ClSi	1000-50-6	150.722			139	0.87 ⁶	1.5145 ²⁰	
1534	Butyl chloroformate		C ₈ H ₁₅ ClO ₂	592-34-7	136.577			142	1.074 ²⁵	1.4114 ²⁰	msc et h; s ace; sl ct c
1535	N-Butyl-4-chloro-2-hydroxybenzamide	Butyl 4-chloro-2-hydroxybenzamide	C ₁₁ H ₁₄ ClNO ₂	575-74-6	227.688		91.5				



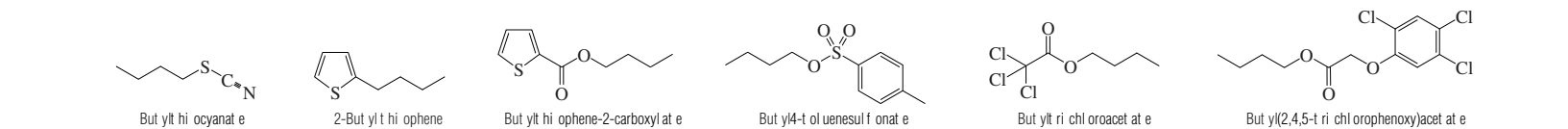
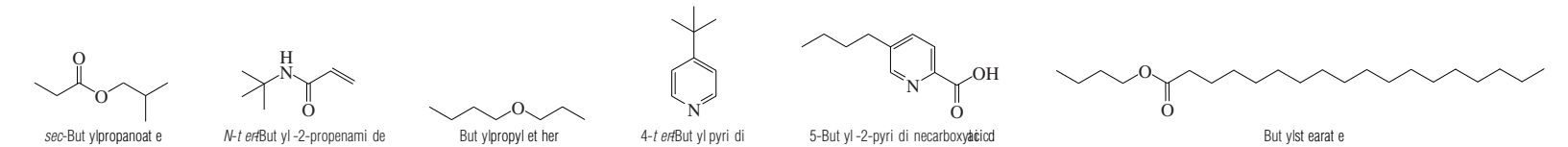
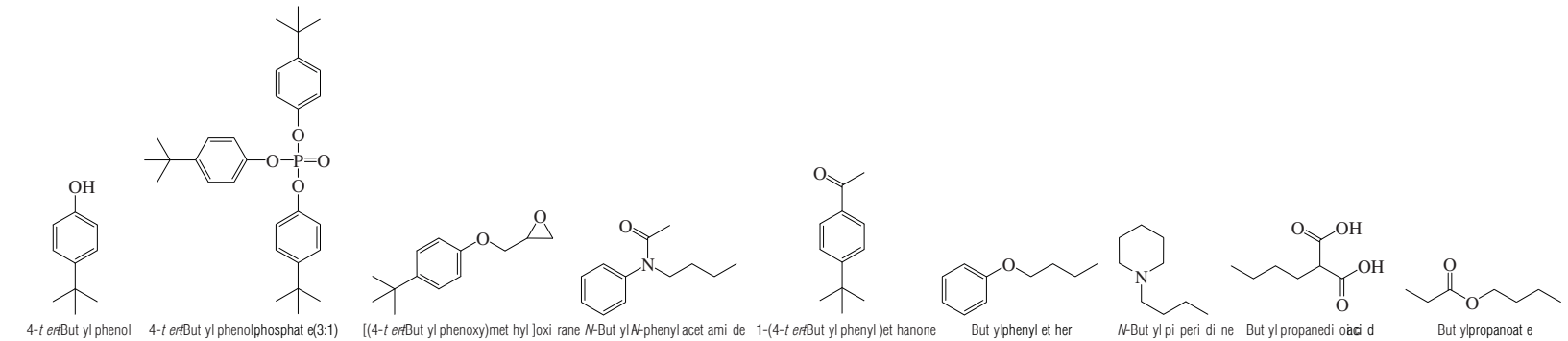
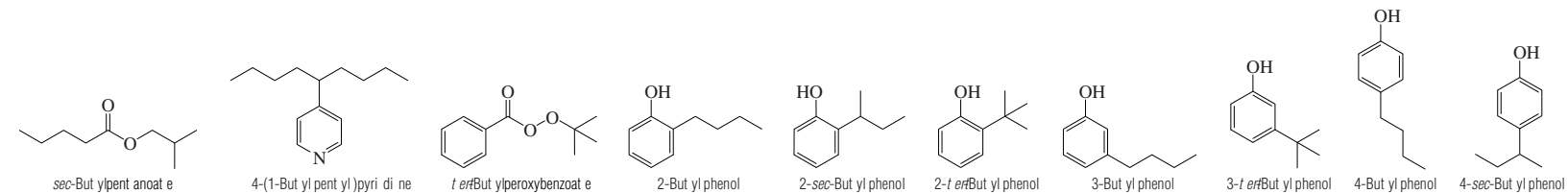
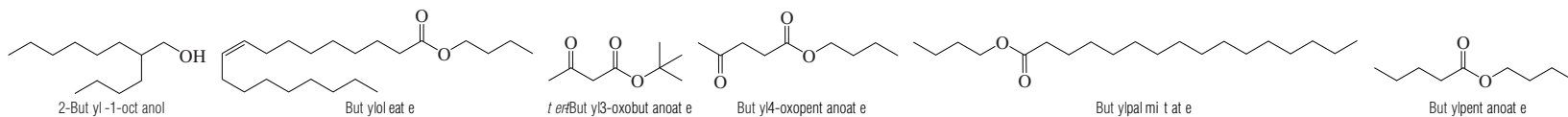
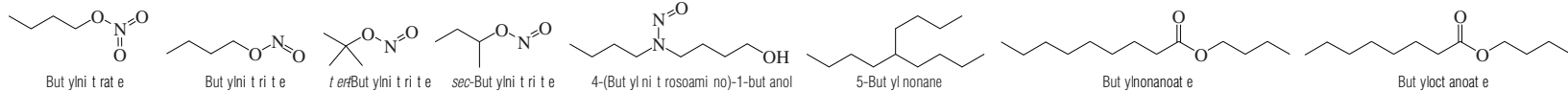
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1536	Butyl 2-chloropropanoate		C ₇ H ₁₃ ClO ₂	54819-86-2	164.630			184	1.0253 ²⁰	1.4263 ²⁰	vs et h
1537	Butyl 3-chloropropanoate		C ₇ H ₁₃ ClO ₂	27387-79-7	164.630			104 ²² , 92 ⁶	1.0370 ²⁰	1.4321 ²⁰	vs H ₂ O, et h
1538	<i>t</i> - <i>tert</i> -Butyl chromate		C ₈ H ₁₈ CrO ₄	1189-85-1	230.223	red cry (pet h)	-5				reac H ₂ O
1539	Butyl citrate		C ₁₈ H ₃₂ O ₇	77-94-1	360.443		-20	233 ²²	1.043 ²⁰	1.4460 ²⁰	
1540	Butyl cyanoacetate		C ₇ H ₁₁ NO ₂	5459-58-5	141.168			231; 115 ¹⁵	1.0010 ²⁰	1.4200 ²⁰	
1541	Butyl cyclohexane		C ₁₀ H ₂₀	1678-93-9	140.266	liq	-74.73	180.9	0.790 ²	1.4408 ²⁰	i H ₂ O
1542	<i>sec</i> -Butyl cyclohexane		C ₁₀ H ₂₀	7058-01-7	140.266			179.3	0.8131 ²⁰	1.4467 ²⁰	i H ₂ O; s ace
1543	<i>t</i> - <i>tert</i> -Butyl cyclohexane		C ₁₀ H ₂₀	3178-22-1	140.266	liq	-41.2	171.5	0.812 ⁷	1.4469 ²⁰	i H ₂ O
1544	2- <i>t</i> - <i>tert</i> -Butyl cyclohexanol		C ₁₀ H ₂₀ O	13491-79-7	156.265		45	139 ⁹⁵	0.902 ²⁵		
1545	<i>cis</i> -4- <i>t</i> - <i>tert</i> -Butyl cyclohexanol		C ₁₀ H ₂₀ O	937-05-3	156.265		83	112 ¹⁵			
1546	<i>trans</i> -4- <i>t</i> - <i>tert</i> -Butyl cyclohexanol		C ₁₀ H ₂₀ O	21862-63-5	156.265		83	112 ¹⁵			
1547	4- <i>t</i> - <i>tert</i> -Butyl cyclohexanone		C ₁₀ H ₁₈ O	98-53-3	154.249		48	90 ⁹			
1548	Butyl cyclohexylamine	<i>N</i> -Butyl cyclohexylamine	C ₁₀ H ₂₁ N	10108-56-2	155.281		208.3				sl H ₂ O, ct c; vs Et OH, et h
1549	Butyl cyclohexylphthalate		C ₁₈ H ₃₀ O ₄	84-64-0	304.382	col liq		≈205 ⁵	1.076 ²⁵		sl H ₂ O; mi sc os
1550	Butyl cyclopentane		C ₉ H ₁₈	2040-95-1	126.239	liq	-108	156.6	0.784 ⁶	1.4316 ²⁰	vs ace, bz, et h, Et OH
1551	Butyl dichloroacetate		C ₈ H ₁₅ Cl ₂ O ₂	29003-73-4	185.048			193.5	1.1820 ²⁰	1.4420 ²⁰	vs et h, Et OH
1552	Butyl (2,4-dichlorophenoxy)acetate	2,4-D Butyl ester	C ₁₂ H ₁₄ Cl ₂ O ₃	94-80-4	277.143		9	133 ¹			
1553	5-Butyl dihydro-2(1 <i>H</i>)-uranone		C ₇ H ₁₄ O ₂	104-50-7	142.196			132 ²⁰	0.9796 ¹⁹	1.4451 ¹⁹	s Et OH; sl ct c
1554	Butyl dimethylamine	<i>N,N</i> -Dimethyl-1-butylamine	C ₈ H ₁₇ N	927-62-8	101.190			95	0.7206 ²⁰	1.3970 ²⁰	msc H ₂ O, Et OH, et h, ace, bz
1555	1- <i>t</i> - <i>tert</i> -Butyl-3,5-dimethylbenzene		C ₁₂ H ₁₈	98-19-1	162.271	liq	-18	207	0.866 ⁸		s ct c
1556	4- <i>t</i> - <i>tert</i> -Butyl-2,6-dimethyl-3,5-dinitroacetophenone	Musk ketone	C ₁₄ H ₁₈ N ₂ O ₅	81-14-1	294.303	ye cry	135.5				vs chl
1557	2- <i>t</i> - <i>tert</i> -Butyl-4,6-dimethylphenol		C ₁₂ H ₁₆ O	1879-09-0	178.270		22.3	249	0.917 ⁸⁰	1.5183 ²⁰	i al k
1558	4- <i>t</i> - <i>tert</i> -Butyl-2,5-dimethylphenol		C ₁₂ H ₁₆ O	17696-37-6	178.270		71.2	264	0.939 ⁸⁰	1.5311 ²⁰	s al k
1559	4- <i>t</i> - <i>tert</i> -Butyl-2,6-dimethylphenol		C ₁₂ H ₁₆ O	879-97-0	178.270		82.4	248	0.916 ⁸⁰		s al k
1560	1- <i>t</i> - <i>tert</i> -Butyl-3,5-dimethyl-2,4,6-trinitrobenzene		C ₁₂ H ₁₅ N ₃ O ₆	81-15-2	297.263	pl, nd (al)	110				i H ₂ O; sl Et OH; s et h, chl
1561	2- <i>t</i> - <i>tert</i> -Butyl-4,6-dimethylphenol		C ₁₀ H ₁₄ N ₂ O ₅	1420-07-1	240.212	ye solid	126				
1562	5-Butyl docosane		C ₂₆ H ₅₄	55282-16-1	366.707		208	244 ¹⁰	0.8058 ²⁰	1.4503 ²⁰	
1563	11-Butyl docosane		C ₂₆ H ₅₄	13475-76-8	366.707			242.5 ¹⁰	0.8041 ²⁰	1.4499 ²⁰	
1564	Butyl dodecanoate		C ₁₄ H ₂₈ O ₂	106-18-3	256.424			180 ¹⁸			
1565	Butyl ethylamine	<i>N</i> -Ethyl-1-butylamine	C ₈ H ₁₇ N	13360-63-9	101.190			107.5	0.7398 ²⁰	1.4040 ²⁰	msc Et OH, et h, ace, bz
1566	1- <i>t</i> - <i>tert</i> -Butyl-4-ethylbenzene		C ₁₀ H ₁₈	7364-19-4	162.271	liq	-38.4	211	0.864 ⁴		
1567	Butyl ethyl ether		C ₈ H ₁₈ O	628-81-9	102.174	liq	-124	92.3	0.749 ⁹	1.3818 ²⁰	i H ₂ O; msc Et OH, et h; vs ace
1568	<i>sec</i> -Butyl ethyl ether		C ₈ H ₁₈ O	2679-87-0	102.174			81	0.7503 ²⁰	1.3802 ²⁰	i H ₂ O; vs Et OH, et h
1569	<i>t</i> - <i>tert</i> -Butyl ethyl ether	Ethyl <i>tert</i> -butyl ether	C ₈ H ₁₈ O	637-92-3	102.174	liq	-94	72.6	0.73 ⁶	1.3756 ²⁰	i H ₂ O; vs Et OH, et h
1570	2- <i>t</i> - <i>tert</i> -Butyl-4-ethylphenol		C ₁₂ H ₁₈ O	96-70-8	178.270		23	250			
1571	2-Butyl-2-ethyl-1,3-propanediol		C ₈ H ₁₆ O ₂	115-84-4	160.254	wh cry	43.8	262	0.927 ⁵⁰	1.4587 ²⁵	sl H ₂ O, ace; s Et OH
1572	5-Butyl-5-ethyl-2,4,6-trimethylpyrimidine	But ethal	C ₉ H ₁₅ N ₂ O ₃	77-28-1	212.245		128.5				
1573	Butyl ethyl sulfide		C ₈ H ₁₈ S	638-46-0	118.240	liq	-95.1	144.3	0.837 ⁶	1.4492 ¹⁰	vs Et OH; s chl
1574	<i>t</i> - <i>tert</i> -Butyl ethyl sulfide	2-Methyl-2-propanethiol	C ₈ H ₁₈ S	14290-92-7	118.240	liq	-88.9	120.4; 56 ⁹			
1575	<i>N</i> - <i>t</i> - <i>tert</i> -Butylformamide		C ₅ H ₁₁ NO	2425-74-3	101.147	liq	16	202	0.903	1.433 ⁰	
1576	Butyl formate		C ₇ H ₁₄ O ₂	592-84-7	102.132	liq	-91.5	106.1	0.895 ⁸	1.3887 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
1577	<i>sec</i> -Butyl formate		C ₇ H ₁₄ O ₂	589-40-2	102.132			97	0.8846 ²⁰	1.3865 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
1578	<i>t</i> - <i>tert</i> -Butyl formate	1,1-Dimethyl ethyl formate	C ₇ H ₁₄ O ₂	762-75-4	102.132	liq		82	0.872	1.379 ⁰	



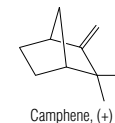
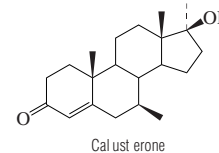
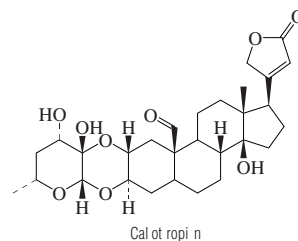
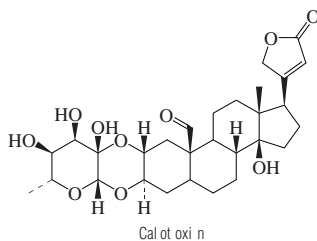
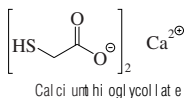
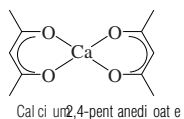
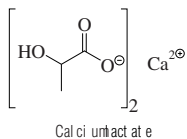
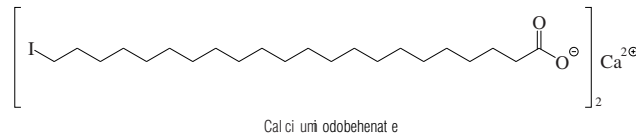
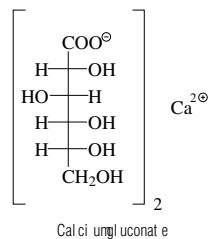
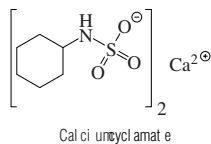
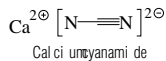
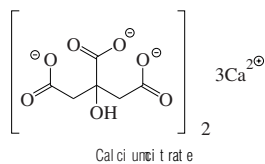
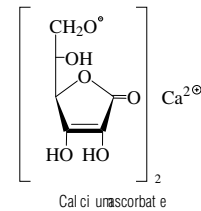
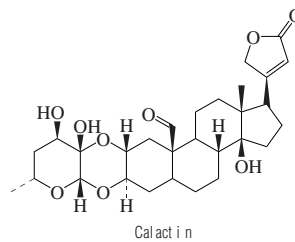
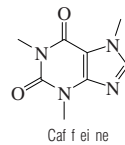
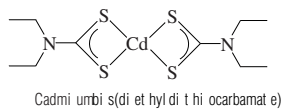
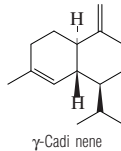
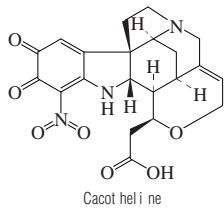
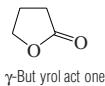
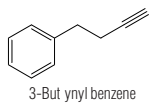
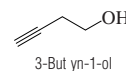
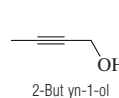
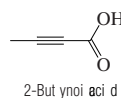
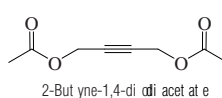
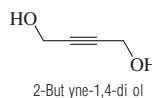
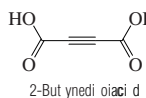
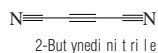
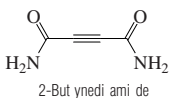
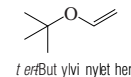
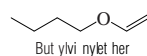
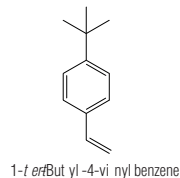
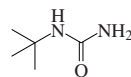
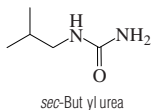
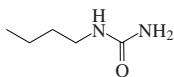
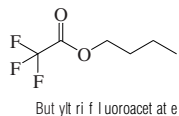
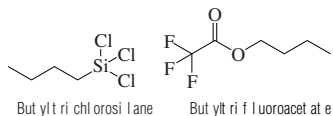
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1579	But yl glyci dyl et her		$\text{H}_2\text{C}_2\text{O}_2$	2426-08-6	130.185			169; 75 ²⁶	0.918 ²⁰		
1580	But yl hept anoat e	But yl enant hat e	$\text{C}_{11}\text{H}_{22}\text{O}_2$	5454-28-4	186.292	li q	-67.5	226.2	0.863 ³⁸	1.4204 ²⁰	vs ace, bz, et h, Et OH
1581	But yl hexanoat e	But yl caproat e	$\text{C}_{10}\text{H}_{20}\text{O}_2$	626-82-4	172.265	li q	-64.3	208	0.865 ³⁸	1.4152 ²⁰	i H ₂ O; s Et OH; msc et h
1582	<i>t</i> - <i>erf</i> But yl hydrazi ne hydrochl ori de		$\text{H}_2\text{C}_2\text{Cl}_2\text{N}_2$	7400-27-3	124.612		192.5				
1583	But yl hydrogen succi nat e	Monobut yl succi nat e	$\text{C}_4\text{H}_8\text{O}_4$	5150-93-6	174.195		8.6	136.5 ³	1.0732 ²⁰	1.4360 ²⁰	
1584	<i>t</i> - <i>erf</i> But yl hydroperoxi de		$\text{C}_4\text{H}_{10}\text{O}_2$	75-91-2	90.121		6	dec 89; 36 ¹⁷	0.8960 ²⁰	1.4015 ²⁰	s H ₂ O, Et OH, et h, ct c, chl
1585	<i>t</i> - <i>erf</i> But yl -4-hydroxyani sol e	But yl at ed hydroxyani sol e	$\text{C}_{11}\text{H}_{16}\text{O}_2$	25013-16-5	180.244	wax	51	268			i H ₂ O; s pet h, Et OH
1586	But yl 2-hydroxybenzoat e		$\text{C}_8\text{H}_8\text{O}_3$	2052-14-4	194.227	li q	-5.9	271	1.072 ³⁸	1.5115 ²⁰	sl ct c
1587	But yl 4-hydroxybenzoat e	But yl paraben	$\text{C}_{10}\text{H}_{10}\text{O}_3$	94-26-8	194.227		68.5				sl H ₂ O, ct c; s Et OH
1588	But yl ci s12-hydroxy-9-oct adecenoat e, <i>f</i>)	But yl ri ci nol eat e	$\text{C}_{22}\text{H}_{42}\text{O}_3$	151-13-3	354.566			275 ¹³	0.9058 ²²	1.4566 ²²	vs et h
1589	<i>t</i> - <i>erf</i> But yl hypochl ori t e		$\text{H}_2\text{CCl}_2\text{O}$	507-40-4	108.566	ye li q		77.5	0.958 ³	1.403 ²⁰	i H ₂ O; vs et h, bz; s ace
1590	But yl i sobut yl et her		$\text{C}_6\text{H}_{12}\text{O}$	17071-47-5	130.228	li q		151	0.76 ³	1.4077 ²¹	vs ace, et h, Et OH
1591	<i>t</i> - <i>erf</i> But yl i sobut yl et her		$\text{C}_6\text{H}_{12}\text{O}$	33021-02-2	130.228	li q		112.0			
1592	But yl i socyanat e		H_2CNO	111-36-4	99.131			115	0.880 ²⁰	1.4060 ²⁰	
1593	But yl i socyani de		H_2CN	2769-64-4	83.132			120	0.78 ²⁰		vs et h, Et OH
1594	<i>t</i> - <i>erf</i> But yl i sopropyl et her		$\text{C}_6\text{H}_{12}\text{O}$	17348-59-3	116.201	li q	-88	87.6	0.736 ⁵		s chl
1595	But yl i sot hi ocyanat e	1-Isot hi ocyanat obut ane	$\text{C}_4\text{H}_8\text{NSC}$	592-82-5	115.197			168	0.9546 ²⁰	1.501 ²⁰	vs et h, Et OH
1596	<i>sec</i> -But yl i sot hi ocyanat e, (\pm)	2-Isot hi ocyanat obut ane, (\pm)	$\text{C}_4\text{H}_8\text{NSC}$	116724-11-9	115.197			159.5	0.944 ¹²		vs et h, Et OH
1597	<i>t</i> - <i>erf</i> But yl i sot hi ocyanat e	2-Isot hi ocyanat o-2-met hyl propano	H_3NSC	590-42-1	115.197		10.5	140	0.9187 ¹⁰		
1598	But yl l act at e		$\text{H}_2\text{C}_2\text{O}_3$	34451-18-8	146.184			77 ¹⁰	0.9744 ²⁷		vs et h, Et OH
1599	But yl met hacryl at e		$\text{C}_6\text{H}_8\text{O}_2$	97-88-1	142.196			160	0.8936 ²⁰	1.4240 ²⁰	vs et h, Et OH
1600	<i>t</i> - <i>erf</i> But yl met hacryl at e		$\text{C}_6\text{H}_8\text{O}_2$	585-07-9	142.196			135.2			
1601	1- <i>t</i> - <i>erf</i> But yl -4-met hoxyl benzene		$\text{C}_9\text{H}_{10}\text{O}$	5396-38-3	164.244		19.0	238	0.9383 ²⁰	1.5039 ²⁰	
1602	1- <i>t</i> - <i>erf</i> But yl -2-met hoxyl -3,5-di ni t robenzene		$\text{C}_{12}\text{H}_{16}\text{N}_2\text{O}_5$	83-66-9	268.265	pa ye li f (al)	85	185			i H ₂ O; sl Et OH; s et h, chl
1603	2- <i>t</i> - <i>erf</i> But yl -4-met hoxyl phenol		$\text{C}_9\text{H}_{10}\text{O}_2$	121-00-6	180.244			184 ⁵⁰			
1604	3- <i>t</i> - <i>erf</i> But yl -4-met hoxyl phenol		$\text{C}_9\text{H}_{10}\text{O}_2$	88-32-4	180.244		65				
1605	But yl met hyl ami ne	<i>N</i> -Met hyl -1-but anami ne	$\text{C}_5\text{H}_{13}\text{N}$	110-68-9	87.164			91	0.7637 ¹⁵		
1606	1- <i>t</i> - <i>erf</i> But yl -2-met hyl benzene	<i>terf</i> But yl t ol uene	C_9H_{10}	1074-92-6	148.245	li q	-50.3	200.4	0.889 ⁷	1.5076 ²⁰	vs ace, bz, et h, Et OH
1607	1- <i>t</i> - <i>erf</i> But yl -3-met hyl benzene	<i>terf</i> But yl t ol uene	C_9H_{10}	1075-38-3	148.245	li q	-41.4	189.3	0.865 ⁷	1.4944 ²⁰	vs ace, bz, et h, Et OH
1608	1- <i>t</i> - <i>erf</i> But yl -4-met hyl benzene	<i>terf</i> But yl t ol uene	C_9H_{10}	98-51-1	148.245	li q	-52	190	0.861 ²	1.4918 ²⁰	i H ₂ O; sl Et OH; vs et h, chl; s ace, bz
1609	But yl 2-met hyl but anoat e	But yl but uat e	$\text{C}_{10}\text{H}_{20}\text{O}_2$	15706-73-7	158.238			179	0.8620 ²⁰	1.4135 ²⁰	
1610	But yl 3-met hyl but anoat e	But yl but uat e	$\text{C}_{10}\text{H}_{20}\text{O}_2$	109-19-3	158.238					1.4058 ²⁵	
1611	But yl met hyl et her		$\text{C}_4\text{H}_8\text{O}$	628-28-4	88.148	li q	-115.7	70.16	0.739 ²	1.3736 ²⁰	i H ₂ O; msc Et OH, et h; s ace
1612	<i>sec</i> -But yl met hyl et her		$\text{C}_4\text{H}_8\text{O}$	116783-23-4	88.148			59.1	0.7415 ²⁰	1.3680 ²⁵	vs ace, et h, Et OH
1613	2- <i>t</i> - <i>erf</i> But yl -4-met hyl phenol		$\text{C}_{10}\text{H}_{12}\text{O}$	2409-55-4	164.244		51.5	237	0.9247 ⁷⁵	1.4969 ⁷⁵	sl H ₂ O; s ace, bz, chl
1614	2- <i>t</i> - <i>erf</i> But yl -5-met hyl phenol		$\text{C}_{10}\text{H}_{12}\text{O}$	88-60-8	164.244		46.5	127 ¹¹	0.922 ⁸⁰	1.5250 ²⁰	i H ₂ O; s Et OH, et h, ace
1615	2- <i>t</i> - <i>erf</i> But yl -6-met hyl phenol		$\text{C}_{10}\text{H}_{12}\text{O}$	2219-82-1	164.244		31	230	0.9240 ⁸⁰	1.5195 ²⁰	
1616	4- <i>t</i> - <i>erf</i> But yl -2-met hyl phenol		$\text{C}_{10}\text{H}_{12}\text{O}$	98-27-1	164.244		27.5	237; 132 ²⁰	0.965 ²⁰	1.5230 ²⁰	i H ₂ O; s et h, ace, bz
1617	But yl met hyl sul fide		$\text{C}_4\text{H}_8\text{S}$	628-29-5	104.214	li q	-97.8	123.4	0.842 ⁹	1.4477 ²⁰	vs Et OH, MeOH
1618	<i>t</i> - <i>erf</i> But yl met hyl sul fide		$\text{C}_4\text{H}_8\text{S}$	6163-64-0	104.214	li q		98.9			
1619	4-But yl morphol i ne		$\text{C}_8\text{H}_{17}\text{NO}$	1005-67-0	143.227	li q	-57.1	213.5	0.906 ⁸	1.4451 ²⁰	vs H ₂ O, ace, bz, Et OH
1620	1-But yl napht hal ene		$\text{C}_{10}\text{H}_{16}$	1634-09-9	184.277	li q	-19.8	289.3	0.973 ³⁸	1.5819 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
1621	2-But yl napht hal ene		$\text{C}_{10}\text{H}_{16}$	1134-62-9	184.277	li q	-2.5	292	0.967 ³⁸	1.5777 ²⁰	vs ace, bz, Et OH



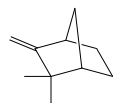
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1622	Butyl nitrate		C ₈ H ₁₆ O ₃	928-45-0	119.119			133	1.0228 ³⁰	1.4013 ²³	i H ₂ O; s Et OH, et h; sl ct c
1623	Butyl nitrite		C ₈ H ₁₆ O ₂	544-16-1	103.120			78	0.9114 ²⁵	1.3762 ²⁰	msc Et OH, et h
1624	<i>t</i> -Butyl nitrite		C ₈ H ₁₆ O ₂	540-80-7	103.120	pa ye li q		63	0.867 ⁹	1.368 ²⁰	sl H ₂ O; s Et OH, et h, chl, C ₅
1625	<i>sec</i> -Butyl nitrite		C ₈ H ₁₆ O ₂	924-43-6	103.120			68.5	0.8726 ²⁰	1.3710 ²⁰	vs et h, Et OH, chl
1626	4-(Butyl nitrosoamino)-1-butanol	<i>N</i> -Butyl <i>N</i> -(4-hydroxybutyl)nitrosamine	C ₈ H ₁₈ N ₂ O ₂	3817-11-6	174.241			115 ^{0.01}			
1627	5-Butyl nonane		C ₁₄ H ₂₈	17312-63-9	184.361			217.5	0.7635 ¹⁸	1.4273 ¹⁸	
1628	Butyl nonanoate	Butyl pelargonate	C ₁₃ H ₂₆ O ₂	50623-57-9	214.344		-38	123 ²⁰	0.8520 ²⁵	1.4262 ²⁵	
1629	Butyl octanoate		C ₁₂ H ₂₄ O ₂	589-75-3	200.318	li q	-42.9	240.5	0.862 ⁹	1.4232 ²⁵	vs ace, et h, Et OH
1630	2-Butyl-1-octanol		C ₁₂ H ₂₆ O	3913-02-8	186.333			246.5; 132 ¹⁵	0.891 ²⁰		
1631	Butyl oleate	Butyl <i>s</i> 9-octadecanoate	C ₁₈ H ₃₆ O ₂	142-77-8	338.567	ye cry	-26.4	227 ¹⁵	0.8704 ¹⁵	1.4480 ²⁵	vs Et OH
1632	<i>t</i> -Butyl 3-oxobutanoate		C ₈ H ₁₄ O ₃	1694-31-1	158.195			71.5 ¹¹	0.9756 ²⁰	1.4180 ²⁰	
1633	Butyl 4-oxopentanoate	Butyl levulinat e	C ₉ H ₁₆ O ₃	2052-15-5	172.221			237.5	0.9735 ²⁰	1.4290 ²⁰	sl chl
1634	Butyl palmitate	Butyl hexadecanoate	C ₂₀ H ₄₀ O ₂	111-06-8	312.531	cry (di l al)	16.9			1.43 ¹²	i H ₂ O; s Et OH, et h
1635	Butyl pentanoate		C ₉ H ₁₈ O ₂	591-68-4	158.238	li q	-92.8	185.8	0.871 ⁹	1.4128 ²⁰	sl H ₂ O; s Et OH, et h
1636	<i>sec</i> -Butyl pentanoate		C ₉ H ₁₈ O ₂	116836-32-9	158.238			174.5	0.8605 ²⁰	1.4070 ²⁰	vs bz, et h, py, Et OH
1637	4-(1-Butylpentyl)pyridine		C ₁₄ H ₂₅ N	2961-47-9	205.340			265; 181 ⁵⁰	0.8878 ²⁵	1.4846 ²⁵	
1638	<i>t</i> -Butyl peroxybenzoate	Benzoyl <i>t</i> -butyl peroxide	C ₁₁ H ₁₄ O ₃	614-45-9	194.227			75 ^{9.2}	1.021 ²⁵	1.4990 ²⁰	
1639	2-Butyl phenol		C ₉ H ₁₀ O	3180-09-4	150.217	li q	-20	235	0.97 ⁹	1.5180 ²⁵	i H ₂ O; s Et OH, et h, al k
1640	2- <i>sec</i> -Butyl phenol		C ₉ H ₁₀ O	89-72-5	150.217		16	228; 116 ²¹	0.9804 ²⁵	1.5200 ²⁵	
1641	2- <i>t</i> -Butyl phenol		C ₉ H ₁₀ O	88-18-6	150.217	li q	-6.8	223	0.978 ⁹	1.5160 ²⁰	s Et OH, ct c, al k; vs et h
1642	3-Butyl phenol		C ₉ H ₁₀ O	4074-43-5	150.217			248	0.974 ²⁰		vs et h, Et OH
1643	3- <i>t</i> -Butyl phenol		C ₉ H ₁₀ O	585-34-2	150.217	nd (pet h)	42.3	240			s Et OH, al k; vs et h
1644	4-Butyl phenol		C ₉ H ₁₀ O	1638-22-8	150.217		22	248	0.976 ²²	1.5165 ²⁵	i H ₂ O; s Et OH, et h, al k; sl ct c
1645	4- <i>sec</i> -Butyl phenol	4-(1-Methylpropyl)phenol	C ₁₀ H ₁₄ O	99-71-8	150.217		61.5	241	0.986 ²⁰	1.5182 ²¹	i H ₂ O; s Et OH, al k; vs et h
1646	4- <i>t</i> -Butyl phenol		C ₉ H ₁₀ O	98-54-4	150.217	nd (li g)	98	237	0.90 ⁹	1.4787 ¹⁴	s H ₂ O, Et OH, et h, chl, al k
1647	4- <i>t</i> -Butyl phenol, phosphate (3:1)		C ₉ H ₁₀ O ₄ P	78-33-1	494.602						i Et OH; sl et h, bz
1648	[(4- <i>t</i> -Butylphenoxy)methyl]oxide		C ₁₃ H ₁₈ O ₂	3101-60-8	206.281			167 ¹⁴ ; 145 ^{0.5}	1.036 ²⁵	1.5145 ²⁰	
1649	<i>N</i> -Butyl <i>N</i> -phenylacetamide		C ₉ H ₁₁ NO	91-49-6	191.269		24.5	281	0.9912 ²⁰	1.5146 ²⁰	sl chl
1650	1-(4- <i>t</i> -Butylphenyl)ethanone		C ₁₃ H ₁₈ O	943-27-1	176.254		17.7	263; 137 ²⁰	0.9635 ²⁰	1.518 ¹⁵	
1651	Butyl phenylether	Butoxybenzene	C ₁₀ H ₁₄ O	1126-79-0	150.217	li q	-19.4	210	0.935 ⁹	1.4969 ²⁰	s et h, ace
1652	<i>N</i> -Butylpiperidine		C ₉ H ₁₇ N	4945-48-6	141.254			176	0.8245 ²⁰	1.4467 ²⁰	
1653	Butyl propanediolacetate	Butyl malonate	C ₁₁ H ₂₀ O ₄	534-59-8	160.168	pr (w)	104.5				vs H ₂ O; s Et OH, et h
1654	Butyl propanoate	Butyl propionate	C ₉ H ₁₈ O ₂	590-01-2	130.185	li q	-89	146.8	0.875 ⁴	1.4014 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
1655	<i>sec</i> -Butyl propanoate		C ₉ H ₁₈ O ₂	591-34-4	130.185			133	0.8657 ²⁰	1.3952 ²⁰	s Et OH, et h
1656	<i>N</i> - <i>t</i> -Butyl-2-propanamide	<i>N</i> - <i>t</i> -Butylacrylamide	C ₇ H ₁₃ NO	107-58-4	127.184	cry (bz)	128				sl H ₂ O; i pet h
1657	Butyl propylether		C ₁₀ H ₁₈ O	3073-92-5	116.201			118.1	0.7772 ⁹		i H ₂ O; vs Et OH, et h
1658	4- <i>t</i> -Butylpyridine		C ₉ H ₁₃ N	3978-81-2	135.206	li q	-41	196.5	0.91 ⁵	1.4958 ²⁰	s ct c, C ₅
1659	5-Butyl-2-pyridinecarboxylic acid	Fusaric acid	C ₁₀ H ₁₃ NO ₂	536-69-6	179.216		97				
1660	Butyl stearate		C ₂₂ H ₄₄ O ₂	123-95-5	340.583		27	343	0.854 ²⁵	1.4328 ⁵⁰	i H ₂ O; s Et OH; vs ace
1661	Butyl thiocyanate	1-Thiocyanobutane	C ₅ H ₉ NS	628-83-1	115.197			186	0.9563 ¹⁵	1.4360 ²⁰	i H ₂ O; s Et OH, et h
1662	2-Butylthiophene		C ₆ H ₈ S	1455-20-5	140.246			181.5	0.9537 ²⁰	1.5090 ²⁰	
1663	Butylthiophene-2-carboxylate	Butyl 2-thiophenecarboxylate	C ₉ H ₁₂ O ₂ S	56053-84-0	184.255			58 ^{0.15}			
1664	Butyl 4-toluenesulfonate		C ₁₁ H ₁₄ O ₃ S	778-28-9	228.308			165 ⁶	1.1319 ²⁰	1.5050 ²⁰	i H ₂ O; s et h; sl ct c
1665	Butyl trichloroacetate		C ₈ H ₉ Cl ₃ O ₂	3657-07-6	219.493			204	1.2778 ²⁰	1.4525 ²⁵	s ct c
1666	Butyl (2,4,5-trichlorophenoxy)acetate	2,4,5-T Butyl ester	C ₁₂ H ₁₃ Cl ₃ O ₃	93-79-8	311.588		28.5	337			



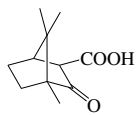
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1667	Butyl trichlorosilane	Trichlorobutylsilane	$\text{C}_4\text{H}_9\text{Cl}_3\text{Si}$	7521-80-4	191.559			148.5	1.1600 ⁹	1.4363 ²⁰	s et h, bz, t ol, AcOEt
1668	Butyl trifluoroacetate		$\text{C}_6\text{H}_9\text{F}_3\text{O}_2$	367-64-6	170.129			102	1.0268 ²²	1.353 ²²	s chl
1669	Butyl urea		$\text{C}_4\text{H}_9\text{N}_2\text{O}$	592-31-4	116.161	tab (w), nd (bz)	97.0				vs H ₂ O, Et OH; sl chl
1670	sec-Butyl urea	(1-Methylpropyl)urea	$\text{C}_4\text{H}_9\text{N}_2\text{O}$	689-11-2	116.161	pr (w)	169				
1671	tert-Butyl urea		$\text{C}_4\text{H}_9\text{N}_2\text{O}$	1118-12-3	116.161		176 dec				s H ₂ O; vs Et OH; sl bz
1672	1-tert-Butyl-4-vinylbenzene	p-tert-Butylstyrene	$\text{C}_{11}\text{H}_{16}$	1746-23-2	160.255	liq	-36.9	99	0.89 ²⁰		
1673	Butylvinyl ether	1-(Ethoxy)butane	$\text{C}_6\text{H}_{12}\text{O}$	111-34-2	100.158	liq	-92	94	0.788 ⁸	1.4026 ²⁰	i H ₂ O; vs Et OH, ace, msc et h; s bz
1674	tert-Butylvinyl ether	2-(Ethoxy)-2-methylpropane	$\text{C}_6\text{H}_{12}\text{O}$	926-02-3	100.158	liq	-112	75	0.769 ⁹	1.3922 ²⁰	
1675	1-Butyne	Ethylacetylene	C_4H_6	107-00-6	54.091	col gas	-125.7	8.08	0.678 ³	1.3962 ²⁰	i H ₂ O; s Et OH, et h
1676	2-Butyne	Dimethylacetylene	C_4H_6	503-17-3	54.091	vol liq or gas	-32.2	26.9	0.691 ⁰	1.3921 ²⁰	i H ₂ O; s Et OH, et h, ct c
1677	2-Butynediol	Cellodiol	$\text{C}_4\text{H}_8\text{O}_2$	543-21-5	112.087	cry (di MeOH)	217 dec				sl H ₂ O, chl, i, Et OH, et h, gl HOAc
1678	2-Butynediol triole		$\text{C}_8\text{H}_{14}\text{O}_4$	1071-98-3	76.056		20.5	76.5	0.9708 ²⁵	1.4647 ²⁵	
1679	2-Butynediol carbonate		$\text{C}_6\text{H}_{10}\text{O}_4$	142-45-0	114.057		183 dec				vs H ₂ O, Et OH, et h
1680	2-Butyne-1,4-diol	Bis(hydroxymethyl)acetylene	$\text{C}_4\text{H}_6\text{O}_2$	110-65-6	86.090	pl (bz, AcOEt)	50	238		1.480 ⁴	vs H ₂ O, Et OH, ace; sl et h; i bz, pet h
1681	2-Butyne-1,4-diol diacetate	1,4-Diacetyloxy-2-butene	$\text{C}_8\text{H}_{10}\text{O}_4$	1573-17-7	170.163			122 ¹⁰		1.4611 ²⁰	s ct c
1682	2-Butynediol carbonate		$\text{C}_6\text{H}_{10}\text{O}_4$	590-93-2	84.074	pl (et h, pet h)	78	203	0.964 ¹		vs H ₂ O, Et OH, et h, Et OH, chl
1683	2-Butyn-1-ol		$\text{C}_4\text{H}_6\text{O}$	764-01-2	70.090	liq	-1.1	148	0.937 ⁰	1.4530 ²⁰	vs et h, Et OH
1684	3-Butyn-1-ol		$\text{C}_4\text{H}_6\text{O}$	927-74-2	70.090	liq	-63.6	129	0.925 ⁷	1.4409 ²⁰	vs H ₂ O, Et OH
1685	3-Butyn-2-ol		$\text{C}_4\text{H}_6\text{O}$	2028-63-9	70.090	liq	-1.5	106.5	0.861 ⁸	1.4207 ²⁰	vs H ₂ O, et h, Et OH
1686	3-Butyn-2-one	Ethynyl methyl ketone	$\text{C}_4\text{H}_6\text{O}$	1423-60-5	68.074			84	0.8793 ²⁰	1.4070 ²⁰	
1687	3-Butynylbenzene		C_9H_{10}	16520-62-0	130.186			190	0.9258 ²⁰	1.5208 ²⁰	
1688	γ-Butyrolactone	Oxolan-2-one	$\text{C}_4\text{H}_6\text{O}_2$	96-48-0	86.090	liq	-43.61	204	1.129 ⁶	1.4341 ²⁰	vs ace, bz, et h, Et OH
1689	Cacotheline		$\text{C}_{21}\text{H}_{21}\text{N}_3\text{O}_7$	561-20-6	427.408	ye cry	>300				sl H ₂ O
1690	γ-Cadinene		$\text{C}_{15}\text{H}_{24}$	39029-41-9	204.352			126 ¹²	0.9182 ¹⁵	1.3166 ²⁰	
1691	Cadmium bis(diethylthiocarbamate)		$\text{C}_{10}\text{H}_{20}\text{CdN}_2\text{S}_4$	14239-68-0	408.950	wh cry	255				
1692	Caffeine		$\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$	58-08-2	194.191	wh nd (w+1), hex pr (sub)	238	sub 90	1.23 ¹⁹		sl H ₂ O, Et OH; i et h, ct c; s chl, py
1693	Calactin	19-Oxogomphoside	$\text{C}_{29}\text{H}_{40}\text{O}_9$	20304-47-6	532.623	small pr (ace)	271				
1694	Calcium ascorbate		$\text{C}_{12}\text{H}_{14}\text{CaO}_{12}$	5743-27-1	390.310	tri cr cry (w)					s H ₂ O; i MeOH, Et OH
1695	Calcium citrate		$\text{C}_{12}\text{H}_{10}\text{Ca}_3\text{O}_{14}$	7693-13-2	498.433	cry (w)	≈100 dec (hyd)				sl H ₂ O; i Et OH
1696	Calcium cyanamide	Calcium carbimide	C_2CaN	156-62-7	80.102	col hex cry	≈1340	sub	2.29		dec H ₂ O
1697	Calcium cyclamate		$\text{C}_6\text{H}_{12}\text{CaN}_2\text{O}_6\text{S}_2$	139-06-0	396.535	cry					vs H ₂ O
1698	Calcium gluconate		$\text{C}_{12}\text{H}_{22}\text{CaO}_{14}$	299-28-5	430.373	cry					i Et OH, os
1699	Calcium iodobenzenate	Iododocosanoic acid, calcium salt	$\text{C}_{44}\text{H}_{84}\text{CaI}_2\text{O}_4$	1319-91-1	971.023	wh-ye pow					i H ₂ O, Et OH, et h; s chl
1700	Calcium lactate		$\text{C}_6\text{H}_{10}\text{CaO}_6$	814-80-2	218.217	wh pow (w)					s H ₂ O; i Et OH
1701	Calcium 2,4-pentanedioate	Calcium acetylacetonate	$\text{C}_{10}\text{H}_{14}\text{CaO}_4$	19372-44-2	238.294	col cry (MeOH)	dec				
1702	Calcium thioglycolate		$\text{C}_4\text{H}_6\text{CaO}_2\text{S}_2$	814-71-1	222.297	pr (w)	220 dec				s H ₂ O, chl; sl Et OH; i et h, bz
1703	Calotxin	β-Hydroxy-19-oxogomphoside	$\text{C}_{29}\text{H}_{40}\text{O}_{10}$	20304-49-8	548.622	cry (Et OH)	268				
1704	Calotropin		$\text{C}_{40}\text{H}_{60}\text{O}_9$	1986-70-5	532.623	pl (Et OH)	221				s H ₂ O, Et OH; i et h
1705	Calusterone		$\text{C}_{26}\text{H}_{46}\text{O}$	17021-26-0	400.680	cry (ace)	157.5				
1706	Camphene, (+)	2,2-Dimethyl-3-methylenecyclo[2.2.1]heptane, (1R)-	$\text{C}_{10}\text{H}_{16}$	5794-03-6	136.234	nd	52	161	0.8950 ⁵⁰	1.4570 ²⁵	vs et h



No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1707	Camphene, (-)	2,2-Di met hyl -3-met hyl enebi cycl o[2.2.1]hept ane, (1S)-	C ₁₀ H ₁₆	5794-04-7	136.234		52	158	0.8446 ⁵⁰	1.4564 ⁵⁴	vs et h
1708	<i>α</i> -Camphocarboxyl i c aci d		C ₁₀ H ₁₆ O ₃	18530-30-8	196.243	pr (et h, 50% al)	127.5				vs bz, et h, Et OH
1709	Camphor, (±)	1,7,7-Tri met hyl bi cycl o[2.2.1]hept ane-2-one, (±)	C ₁₀ H ₁₆ O	21368-68-3	152.233	wh rhom cry (Et OH)	178.3	sub			i H ₂ O; vs Et OH, et h; s ace, bz, ct c
1710	Camphor, (+)	1,7,7-Tri met hyl bi cycl o[2.2.1]hept ane-2-one, (1 <i>R</i>)	C ₁₀ H ₁₆ O	464-49-3	152.233	pl	178.8	207.4	0.990 ⁵⁵	1.5462	i H ₂ O; vs Et OH, et h; s ace, bz
1711	Camphor, (-)	1,7,7-Tri met hyl bi cycl o[2.2.1]hept ane-2-one, (1 <i>S</i>)	C ₁₀ H ₁₆ O	464-48-2	152.233		178.6		0.9853 ¹⁶		i H ₂ O; vs Et OH, et h, HOAc; s ace, bz
1712	Camphori c aci d, (±)	1,2,2-Tri met hyl -1,3-cycl opent ane-1,2-dicarboxyl i c aci d, (1 <i>R</i> ,3 <i>S</i>)	C ₁₀ H ₁₆ O ₄	5394-83-2	200.232	pr, lf	202		1.186		sl H ₂ O; s chl, et h, Et OH
1713	<i>α</i> -Camphorsulf oni c aci d		C ₁₀ H ₁₆ O ₃ S	3144-16-9	232.297	pr (HOAc)	195 dec				vs H ₂ O; i et h; sl HOAc
1714	Canadi ne, (±)	<i>DL</i> -Tet rahydroberberi ne	C ₁₀ H ₂₁ NO ₄	29074-38-2	339.386	mcl nd (al)	134				vs Et OH, chl
1715	Cannabi di ol		C ₂₁ H ₃₀ O ₂	13956-29-1	314.462	rods (pet h)	67	188	1.040 ⁴⁰	1.5404 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
1716	Cannabi nol	6,6,9-Tri met hyl -3-pent yl-6-di benzo[b,d]pyran-1-ol	C ₂₁ H ₂₆ O ₂	521-35-7	310.430	pl, lf (pet h)	77	185			i H ₂ O; s Et OH, et h, ace, bz, pet h, al k
1717	Canrenone		C ₂₂ H ₂₈ O ₃	976-71-6	340.455	cry (AcOEt)	150				
1718	Cant hari di n		C ₁₆ H ₁₂ O ₄	56-25-7	196.200	ort h pl	218	sub 84			i H ₂ O; sl Et OH, et h, ace, bz; s HOAc
1719	Caprol act am	6-Hexanel act am	C ₆ H ₁₁ NO	105-60-2	113.157	lf (li g)	69.3	270			vs Et bz, Et OH, chl
1720	Capsai ci n		C ₁₈ H ₂₇ NO ₃	404-86-4	305.412	mcl pl or sc (pet h)	65	215 ^{0.01}			i H ₂ O; vs Et OH; s et h, bz, pet h; sl con HCl
1721	Capsant hi n	3,3'-Di hydroxy- <i>α</i> -carot en-6'-one, (3 <i>R</i> ,3' <i>S</i> ,5' <i>R</i>)	C ₄₀ H ₅₆ O ₃	465-42-9	584.871		176				
1722	Capt af ol		C ₁₀ H ₆ Cl ₄ NO ₂ S	2425-06-1	349.061	cry	161				
1723	Capt an		C ₁₀ H ₆ Cl ₃ NO ₂ S	133-06-2	300.590	cry (CCl ₄)	172.5		1.74 ²⁵		vs chl
1724	Capt opri l	1-(3-Mercapt o-2-met hyl -1-oxypropyl)proli ne	C ₉ H ₁₅ NO ₃ S	62571-86-2	217.285	cry (AcOEt)	105				s H ₂ O, Et OH, chl
1725	Carbachol		C ₈ H ₁₀ ClN ₂ O ₂	51-83-2	182.648			210 dec			vs H ₂ O, MeOH; sl Et OH; i et h, chl
1726	Carbami c chl ori de	Carbamyl chl ori de	C ₂ H ₅ NO	463-72-9	79.486			dec 62			
1727	Carbamodi t hi oi c aci d		C ₃ H ₃ N ₃	594-07-0	93.172						vs Et OH, et h
1728	Carbamoyl di hydrogen phosphat e		C ₂ H ₅ NO ₃ P	590-55-6	141.021	unst ab i n sol n					
1729	Carbaryl		C ₁₂ H ₁₁ NO ₂	63-25-2	201.221		145		1.228 ²⁵		vs ace, DMF
1730	Carbazol e	Di benzopyrol e	C ₁₂ H ₉ N	86-74-8	167.206	pl or lf	246.3	354.69			i H ₂ O; sl Et OH, et h, bz, chl; s ace
1731	9 <i>H</i> -Carbazol e-9-acet i c aci d		C ₁₄ H ₁₁ NO ₂	524-80-1	225.243	lf (AcOEt)	215				vs et h, Et OH, chl, HOAc
1732	Carbendazi m	Carbami c aci d/ <i>H</i> benzi mi dazol -2-yl -, met hyl est er	C ₉ H ₉ N ₃ O ₂	10605-21-7	191.186		300 dec		1.45		
1733	Carbet apent ane	Pent oxyveri ne	C ₂₀ H ₃₁ NO ₃	77-23-6	333.465			165 ^{0.01}			
1734	<i>N</i> -Carbet hoxypht hal i mi de	<i>N</i> -(Et hoxycarbonyl)pht hal i mi de	C ₁₁ H ₁₁ NO ₄	22509-74-6	219.194		91				
1735	Carbi c anhydri de		C ₆ H ₆ O ₃	129-64-6	164.158	ort h cry (pet h)	164.5		1.41 ⁷⁷		vs ace, bz, Et OH, chl
1736	Carbi mazol e		C ₁₀ H ₁₀ N ₂ O ₂ S	22232-54-8	186.231	cry, pow	123.5				vs ace, chl
1737	Carbobenzoxhydrazi ne	Benzyl carbat e	C ₈ H ₁₀ N ₂ O ₂	5331-43-1	166.177		69.5				
1738	Carbof uran		C ₂ H ₁₅ NO ₃	1563-66-2	221.252		151		1.18		
1739	Carboi mi di c di fluori de		C ₂ H ₂ Cl ₂ F ₂	2712-98-3	65.023	gas	-90	-13 dec			
1740	<i>γ</i> -Carboli ne	<i>β</i> -Pyri do[4,3- <i>b</i>]ndol e	C ₁₀ H ₈ N ₂	244-69-9	168.195	nd	225		1.352		sl H ₂ O, bz; vs MeOH; s Et OH
1741	Carbon di oxi de	Carboni c anhydri de	C ₂ O	124-38-9	44.010	col gas	-56.56 t p	-78.5 sp	0.72 ⁷⁸ (p>1 at m)		sl H ₂ O



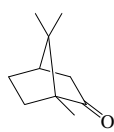
Camphene, (-)



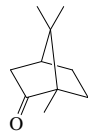
d-Camphocarboxylic acid



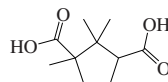
Camphor, (±)



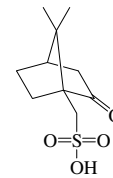
Camphor, (+)



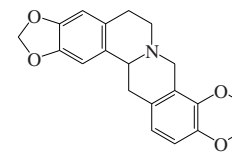
Camphor, (-)



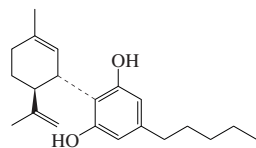
Camphoric acid, (±)



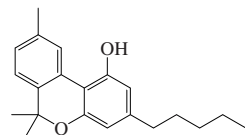
d-Camphorsulfonic acid



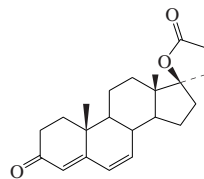
Canadine(±)



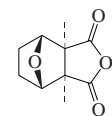
Cannabidiol



Cannabinol



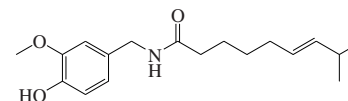
Canrenone



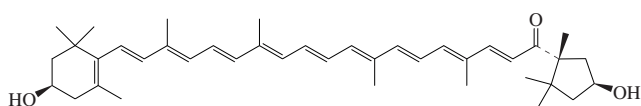
Cantaridin



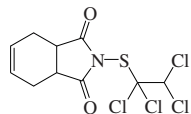
Caprolactam



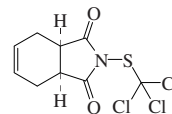
Capsaicin



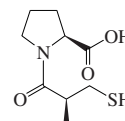
Capsanthin



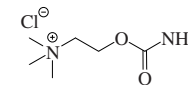
Captafol



Captan



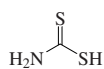
Captopril



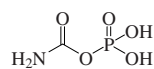
Carbachol



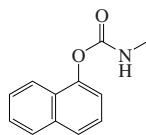
Carbamyl chloride



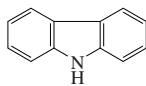
Carbamodithiolic acid



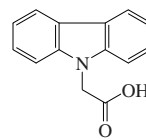
Carbamoyl dihydrogenphosphate



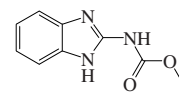
Carbaryl



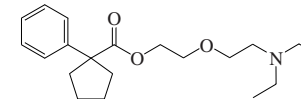
Carbazole



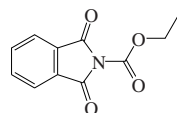
9H-Carbazole-9-acetic acid



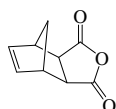
Carbendazim



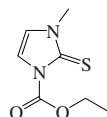
Carbetapentane



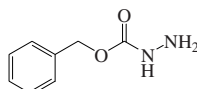
M-Carboxyphenylhydrazide



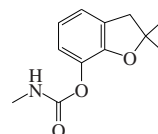
Carbicanhydride



Carbimazole



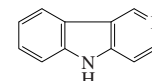
Carbobenzoylhydrazide



Carbofuran



Carbonyl difluoride

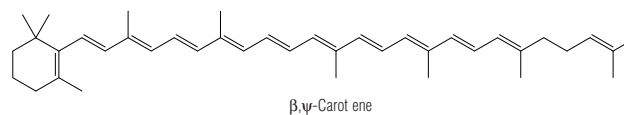
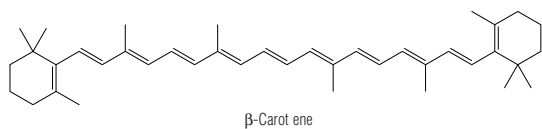
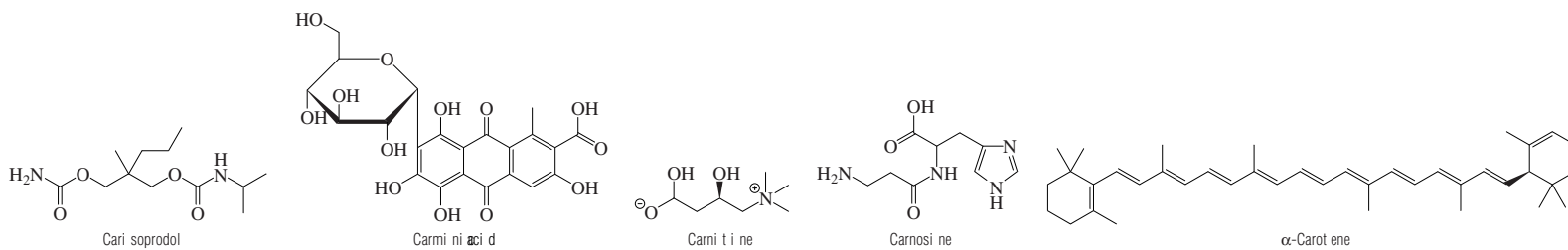
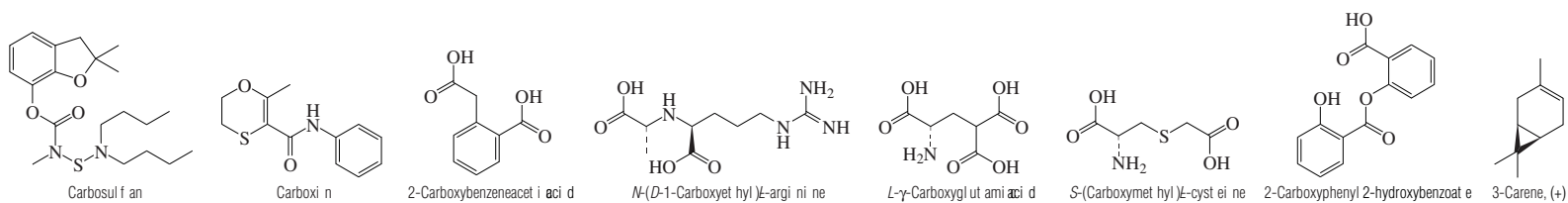
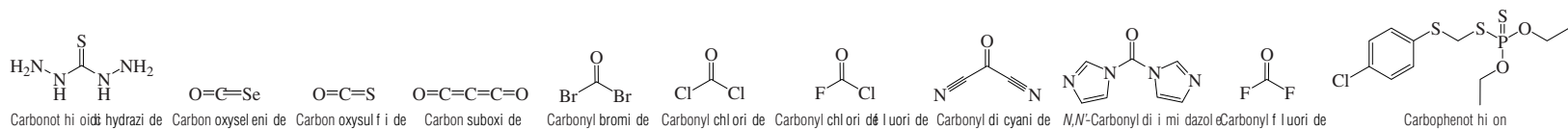
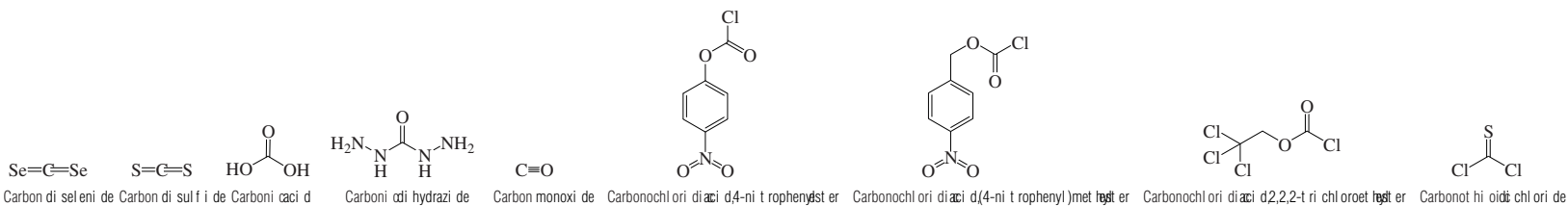


γ-Carboline

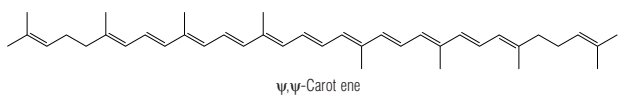


Carbon dioxide

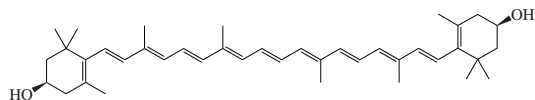
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1742	Carbon di seleni de	Carbon sel eni de	CSe	506-80-9	169.93	ye li q	-43.7	125.5	2.682 ²⁹	1.8454 ²⁰	
1743	Carbon di sul fide	Carbon bi sul fide	CS	75-15-0	76.141	col li q	-112.1	46	1.263 ²	1.6319 ²⁰	s H ₂ O, chl; msc Et OH, et h
1744	Carboni c aci d		C ₂ H ₂ O ₃	463-79-6	62.025						Aq. sol n. of C ₂ O
1745	Carboni c di hidrazi de	Carbohidrazi de	C ₂ H ₂ N ₂ O	497-18-7	90.085	nd (di l al)	154		1.61 ⁶		vs H ₂ O, Et OH
1746	Carbon monoxi de	Carbon oxide	CO	630-08-0	28.010	col gas	-205.02	-191.5	0.7909		sl H ₂ O; s bz, HOAc
1747	Carbonochloridi c aci d, 4-nitrophenyl ester		C ₇ H ₅ ClNO ₂	7693-46-1	201.565		80	160 ¹⁹			
1748	Carbonochloridi c aci d, (4-nitrophenyl)methyl ester		C ₈ H ₇ ClNO ₂	4457-32-3	215.592		32.8				
1749	Carbonochloridi c aci d, 2,2,2-trichloroethyl ester		C ₃ H ₂ Cl ₃ O ₂	17341-93-4	211.859			63 ¹¹			
1750	Carbonotiochloride	Thiophosgene	₂ SCCl	463-71-8	114.982	red li q		73	1.50 ⁸	1.5442 ²⁰	dec H ₂ O, Et OH; s et h
1751	Carbonotiochloride	1,3-Diamino-2-thiourea	₆ N ₂ SC	2231-57-4	106.151	nd, pl (w) nd, pl (w)	170 dec				vs H ₂ O
1752	Carbon oxyselenide	Carbonyl selenide	COSe	1603-84-5	106.97	col gas; unst ab	-122	-21.5			d ₂₀ H
1753	Carbon oxysulfide	Carbonyl sulfide	COS	463-58-1	60.075	col gas	-138.8	-50	1.02 ⁸	1.24 ⁻⁸⁷	sl H ₂ O; s Et OH; vs KOH
1754	Carbon suboxide	1,2-Propadiene-1,3-dione	₃ C ₃ O ₂	504-64-3	68.031	col gas	-107	6.8	1.114 ⁴	1.4538 ⁰	s et h, bz, CS ₂
1755	Carbonyl bromide	Bromophosgene	CB ₂ O	593-95-3	187.818			64.5	2.52 ¹⁵		
1756	Carbonyl chloride	Phosgene	CO ₂	75-44-5	98.916	col gas	-127.78	8		1.3719 ²⁵ (p>1 at m)	s bz, ct c, chl, t ol, HOAc
1757	Carbonyl chloride fluoride	Carbonic chloride fluoride	CClFO	353-49-1	82.461	col gas	-148	-47.2			d ₂₀ ac H
1758	Carbonyl dicyanide		₂ C ₂ N ₂ O	1115-12-4	80.044	li q	-36	65.5	1.12 ⁴	1.3919 ²⁰	s et h, ace, ct c, chl
1759	N,N'-Carbonyldiimidazole		₇ H ₁₀ N ₂ O	530-62-1	162.149	cry (bz)	119				
1760	Carbonyl fluoride		CF ₂ O	353-50-4	66.007	col gas	-111.2	-84.5	1.139 ⁵		
1761	Carbophenothion		C ₇ H ₁₆ Cl ₂ OP ₂ S ₃	786-19-6	342.866			82 ^{9,01}	1.271 ²⁰		
1762	Carbosulfan		C ₆ H ₁₂ N ₂ O ₃ S	55285-14-8	380.544			126	1.056 ²⁰		
1763	Carboxin		C ₆ H ₁₃ NO ₂ S	5234-68-4	235.302		94				
1764	2-Carboxybenzoic acid		₈ H ₆ O ₄	89-51-0	180.158		184.5		1.4100 ²⁰		s H ₂ O, Et OH; sl et h; i bz, chl
1765	N-(D-1-Carboxyethyl)-arginine	Octopine	₉ H ₁₆ N ₄ O ₄	34522-32-2	246.264	nd (w)	281				
1766	L-γ-Carboxyglutamic acid		₈ H ₉ NO ₅	53861-57-7	191.138	cry	167				
1767	S-(Carboxymethyl)-cysteine	Carboxycysteine	₃ H ₇ NO ₄ S	638-23-3	179.195	nd	206				
1768	2-Carboxyphenyl 2-hydroxybenzoate	Salicylate	₁₄ H ₁₀ O ₅	552-94-3	258.226		147				sl ace
1769	3-Carene, (+)		C ₁₀ H ₁₆	498-15-7	136.234			171; 123 ²⁰⁰	0.8549 ³⁰	1.469 ³	vs ace, bz, et h
1770	Carisoprodol		C ₁₂ H ₂₄ N ₂ O ₄	78-44-4	260.330	cry	92				s os
1771	Carnitine		₂₂ H ₃₉ O ₁₃	1260-17-9	492.386	red mcl pr (aq, MeOH)	136 dec				s H ₂ O, Et OH; sl et h; i bz, chl
1772	Carnitine	4-Amino-3-hydroxybutanoic acid trimethylbetaine	C ₇ H ₁₅ NO ₃	541-15-1	161.199	cry (al-ace), hyg	197 dec				vs H ₂ O, Et OH
1773	Carnosine	N-β-Alanyl-L-histidine	₉ H ₁₂ N ₄ O ₃	305-84-0	226.232		260				vs H ₂ O
1774	α-Carotene		C ₄₀ H ₅₆	7488-99-5	536.873	red pl or pr (pet h, bz-MeOH)	187.5		1.00 ²⁰		vs bz, et h, chl
1775	β-Carotene		C ₄₀ H ₅₆	7235-40-7	536.873	red red br hex pr (bz-MeOH)	183		1.00 ²⁰		i H ₂ O; sl Et OH, chl; s et h, ace, bz
1776	β,ψ-Carotene	γ-Carotene	C ₄₀ H ₅₆	472-93-5	536.873	red pr (bz-MeOH), viol pr (et h)	153				i H ₂ O, Et OH; sl et h, pet h; s bz, chl



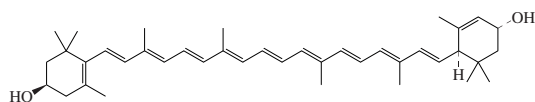
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1777	ψ,ψ-Carotene	<i>trans</i> Lycopene	C ₄₀ H ₅₆	502-65-8	536.873	red pr or nd (pet h)	175				sl Et OH, pet h; s et h; vs bz, chl, CS ₂
1778	β,β-Carotene-3,3'-diol, (β,β')	Zeaxanthin	C ₄₀ H ₅₆ O ₂	144-68-3	568.872	ye pr (MeOH) ort h (chl-et h)	215.5	227 ^{0.06}			i H ₂ O; sl Et OH; s et h, ace, bz, py, chl
1779	β,ε-Carotene-3,3'-diol, (β,β',ε,ε')	Xanthophyll	C ₄₀ H ₅₆ O ₂	127-40-2	568.872	ye or vi ol pr (et h-MeOH)	196				vs bz, et h, Et OH, pet h
1780	β,β-Carotene-3-ol, (β)	Cryptoxanthin	C ₄₀ H ₅₆ O	472-70-8	552.872	garnet red pr (bz-MeOH)	160				vs bz, chl
1781	β,ψ-Carotene-3-ol, (β)	Rubixanthin	C ₄₀ H ₅₆ O	3763-55-1	552.872	dk red nd (bz-MeOH) oran-red (bz-pet h)	160				sl Et OH, pet h; s bz, chl
1782	ψ,ψ-Caroten-16-ol	Lycoxanthin	C ₄₀ H ₅₆ O	19891-74-8	552.872	red pl (bz-MeOH)	168				i H ₂ O; sl Et OH; s bz, CCl ₄
1783	Caroverine		C ₂₇ H ₂₇ N ₃ O ₂	23465-76-1	365.468	cry	69	202 ^{0.01}			sl i-PrOH
1784	Carpaine		C ₂₆ H ₂₉ N ₂ O ₄	3463-92-1	478.708	mcl pr (al, ace)	121				vs ace, bz, et h, Et OH
1785	Carap hydrochloride		C ₁₆ H ₁₆ ClN ₂ O ₂ S ₂	22042-59-7	273.804	cry	180				s H ₂ O; sl Et OH, MeOH
1786	Carvenone, (S)		C ₁₀ H ₁₆ O	10395-45-6	152.233			233	0.9289 ²⁰	1.4805 ²⁰	i H ₂ O; s ace
1787	(R)-Carvone	<i>p</i> -Menthyl-1,8-dien-6-one, (R)	C ₁₀ H ₁₄ O	6485-40-1	150.217		25.2	231	0.9593 ²⁰	1.4988 ²⁰	sl H ₂ O; vs Et OH; s et h, ct c, chl
1788	(S)-Carvone	<i>p</i> -Menthyl-1,8-dien-6-one, (S)	C ₁₀ H ₁₄ O	2244-16-8	150.217		<15	231	0.965 ²⁰	1.4989 ²⁰	sl H ₂ O; vs Et OH; s et h, chl
1789	Caryophyllene		C ₁₅ H ₂₄	87-44-5	204.352			122 ^{13.5}	0.9075 ²⁰	1.4986 ²⁰	vs bz
1790	Casimiroin	6-Methoxy-9-methyl-1,3-dioxolane(4,5-h)quinoline-9-one	C ₁₂ H ₁₁ N ₃ O ₄	477-89-4	232.220						sl chl
1791	Cassaine		C ₂₄ H ₃₉ N ₃ O ₄	468-76-8	405.572	fl (et h)	142.5				s Et OH, ace, chl, et h, bz, MeOH
1792	Caulophylline		C ₁₆ H ₁₆ N ₂ O	486-86-2	204.267	cry (w+2), nd (al, bz)	137				vs H ₂ O, ace, bz, Et OH
1793	α-Cedrene		C ₁₅ H ₂₄	469-61-4	204.352	oi l		262.5; 125			
1794	Cedrol		C ₁₅ H ₂₆ O	77-53-2	222.366		86		0.9479 ⁹⁰	1.4824 ⁹⁰	
1795	Cefazolin		C ₁₆ H ₁₄ N ₆ O ₄ S ₃	25953-19-9	454.508	nd (ace aq)	200 dec				s DMF, py; sl MeOH; i chl, bz, et h
1796	β-Cellobiose		C ₁₂ H ₂₂ O ₁₁	13360-52-6	342.296	cry (di l al)	225 dec				s H ₂ O; i Et OH, et h, ace, bz
1797	Celastrol		C ₁₈ H ₃₂ O ₁₆	33404-34-1	504.437			208			
1798	Cephalixin		C ₁₆ H ₁₇ N ₃ O ₄ S	15686-71-2	347.389	cry					
1799	Cephaloglycin	Kafocin	C ₁₈ H ₁₉ N ₃ O ₅ S	3577-01-3	405.425	cry (w)	≈220 dec				
1800	Cephaloridine		C ₁₈ H ₁₇ N ₃ O ₄ S ₂	50-59-9	415.486	cry					s H ₂ O
1801	Cephalothin		C ₁₈ H ₁₆ N ₂ O ₄ S ₂	153-61-7	396.437			160			
1802	Cephadrin		C ₁₇ H ₁₇ N ₃ O ₅ S ₂	21593-23-7	423.463	cry (ace aq)	155				
1803	Cepharanthin		C ₁₈ H ₃₈ N ₂ O ₆	481-49-2	606.707	ye amor pow	150				
1804	Cephradine		C ₁₆ H ₁₉ N ₃ O ₄ S	38821-53-3	349.405	col cry (w)	141 dec				
1805	Cerulenin	2,3-Epoxy-4-oxo-7,10-dodecadienamide, (2,3S)-	C ₁₂ H ₁₇ N ₃ O ₃	17397-89-6	223.268	wh nd	94				sl H ₂ O; s bz, Et OH, ace; i pet h
1806	Cevadine		C ₂₂ H ₄₃ N ₃ O ₉	62-59-9	591.733	flat nd (et h)	213 dec				
1807	Chavicine		C ₁₇ H ₁₉ N ₃ O ₃	495-91-0	285.338						vs et h, Et OH, pet h
1808	Chelrolin		C ₈ H ₉ N ₂ O ₂ S ₂	505-34-0	179.261	cry (et h)	47.5	200			vs Et OH, chl
1809	Chelerythrine		C ₁₉ H ₁₉ N ₃ O ₅	34316-15-9	365.380	cry (chl - MeOH)		207			vs chl
1810	Chelidonium	Stylophorin	C ₂₀ H ₁₉ N ₃ O ₅	476-32-4	353.369	mcl pr (al)	135.5	220 ^{0.02}			i H ₂ O; s Et OH, et h, chl
1811	Chinomethionat		C ₁₀ H ₁₃ N ₂ O ₂ S ₂	2439-01-2	234.297		170				
1812	Chloral hydrate		C ₂ H ₃ Cl ₃ O ₂	302-17-0	165.403		57	dec 96	1.9081 ²⁰		vs H ₂ O, bz, et h, Et OH
1813	Chlorambucil		C ₁₉ H ₁₉ Cl ₂ N ₂ O ₂	305-03-3	304.213		65				



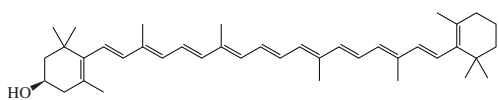
ψ,ψ-Carotene



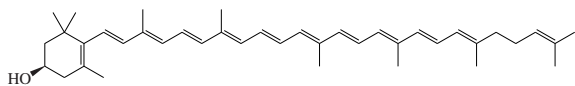
β,β-Carotene-3,3'-diol (3R,3'R)



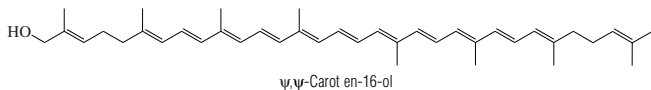
β,ε-Carotene-3,3'-diol (3R,3'R,6'R)



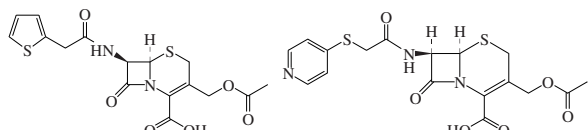
β,β-Carotene-3-ol (3R)



β,ψ-Carotene-3-ol (3R)

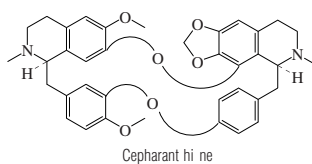


ψ,ψ-Carotene-16-ol

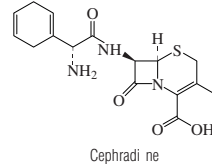


Cephalothin

Cephapirin

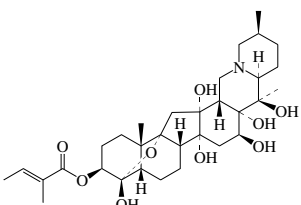


Cepharanthin

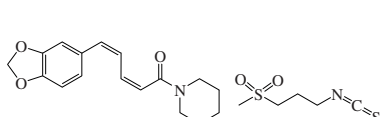


Cephradine

Cerulenin

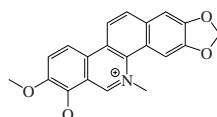


Cevadine

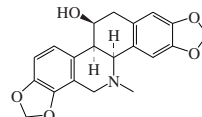


Chavicine

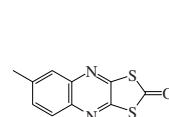
Cheilonein



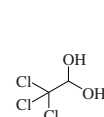
Chelerythrine



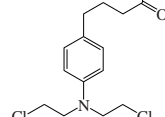
Chelidonein



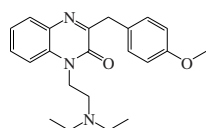
Chionemthionat



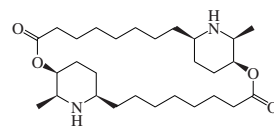
Chloralhydrate



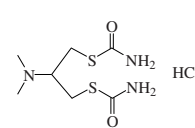
Chlorambucil



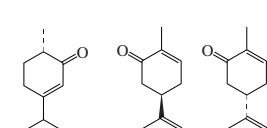
Caroverine



Caripaine



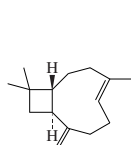
Cartaphrochloride



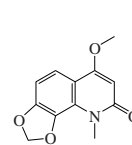
Carvone, (S)

(R)-Carvone

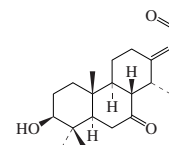
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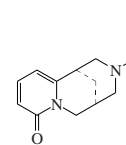
Caryophyllene



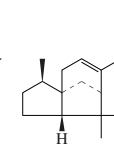
Casimiroin



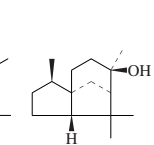
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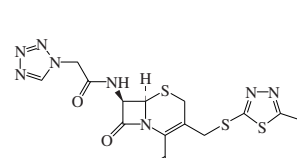
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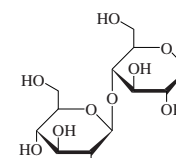
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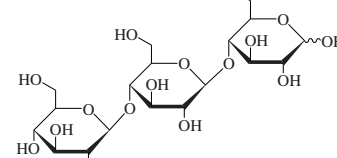
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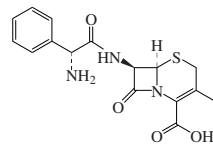
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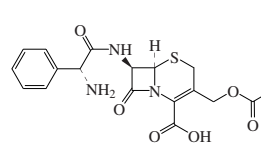
β-Cellobiose



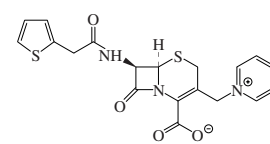
Cellotriose



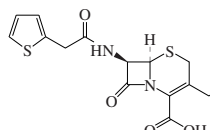
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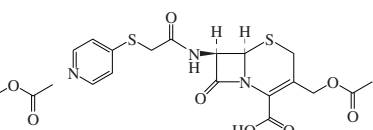
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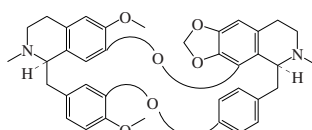
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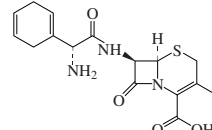
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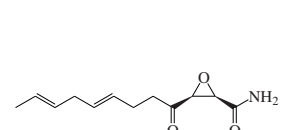
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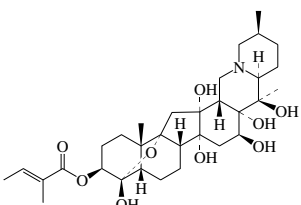
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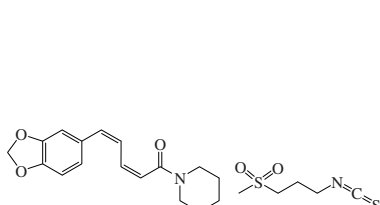
Cephradine



Cerulenin

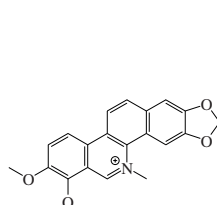


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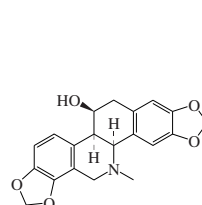


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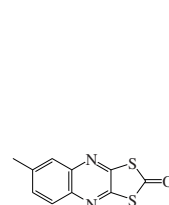
Cheilonein



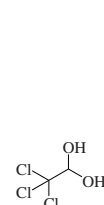
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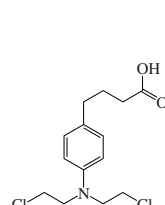
Chelidonein



Chionemthionat

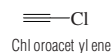
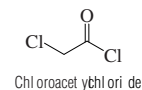
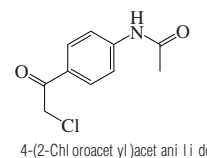
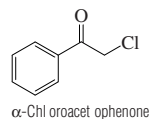
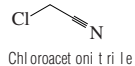
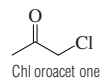
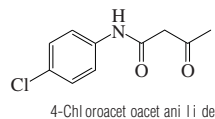
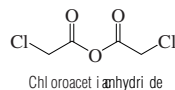
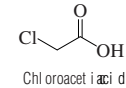
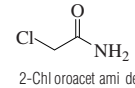
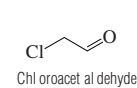
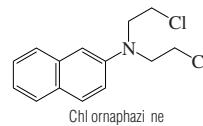
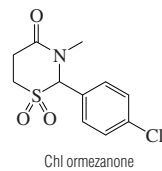
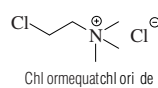
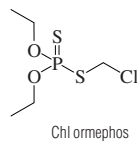
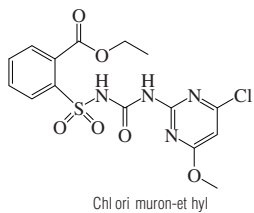
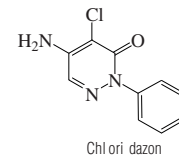
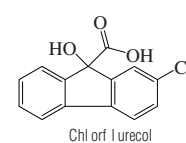
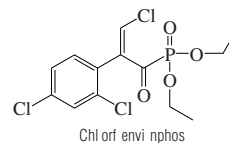
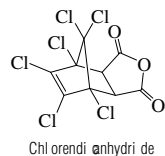
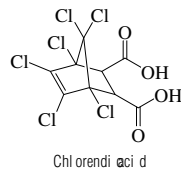
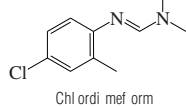
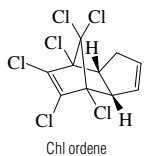
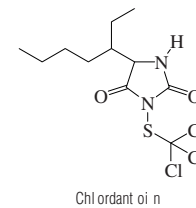
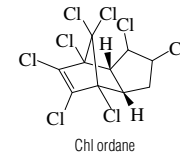
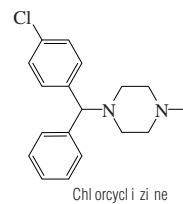
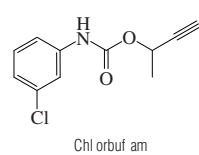
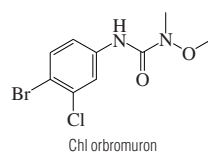
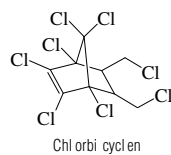
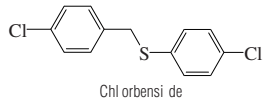
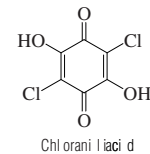
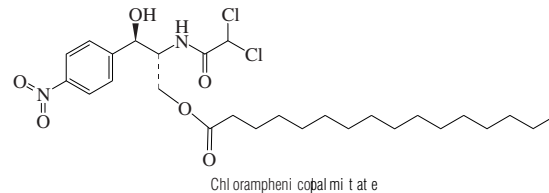
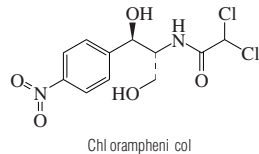
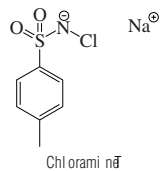
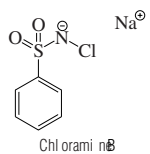


Chloralhydrate

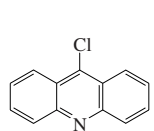


Chlorambucil

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1814	Chloramine B	<i>N</i> -Chlorobenzene sulfonamide sodium	C ₆ H ₄ ClNNaO ₂ S	127-52-6	213.618	pr (w)	190				sl Et OH; i chl, et h
1815	Chloramine T	<i>N</i> -Chloro-4-methylbenzene sulfonamide sodium	C ₇ H ₇ ClNNaO ₂ S	127-65-1	227.645	pr (hyd)	180 (hyd)				s H ₂ O; i bz, chl, et h
1816	Chloramphenicol		C ₁₆ H ₁₂ Cl ₂ N ₂ O ₅	56-75-7	323.129	pa ye pl or nd (w)	150.5	sub			vs ace, Et OH, chl
1817	Chloramphenicol palmitate		C ₂₇ H ₄₂ Cl ₂ N ₂ O ₆	530-43-8	561.537	cry (bz)	90				vs bz, et h, Et OH
1818	Chloranilic acid	2,5-Dichloro-3,6-dihydroxy-2,5-cyclohexadiene-1,4-dione	C ₆ H ₂ Cl ₂ O ₄	87-88-7	208.984	red lf (w+2)	283.5				s H ₂ O
1819	Chlorbenside	1-Chloro-4-[(4-chlorophenyl)methyl]thiobenzene	C ₁₃ H ₁₀ Cl ₂ S	103-17-3	269.189		75		1.4210 ²⁰		
1820	Chlorbicyclen		C ₈ H ₈ Cl ₂	2550-75-6	397.768	pow	105	174 ²			
1821	Chlorbromuron	<i>N'</i> -(4-Bromo-3-chlorophenyl)- <i>N</i> -methoxy- <i>N</i> -methylurea	C ₉ H ₁₀ BrClN ₂ O ₂	13360-45-7	293.544		96		1.69 ²⁰		
1822	Chlorbutam	1-Methyl-2-propynyl (3-chlorophenyl)carbamate	C ₁₁ H ₁₀ ClNO ₂	1967-16-4	223.656	cry	45.5				sl H ₂ O; s MeOH, Et OH, ace
1823	Chlorcyclizine		C ₁₈ H ₂₁ ClN ₂	82-93-9	300.826	oi l		140 ¹²			
1824	Chlordane		C ₁₀ H ₆ Cl ₈	57-74-9	409.779		106	175 ¹	1.60 ²⁵		
1825	Chlordantoin		C ₁₇ H ₁₇ Cl ₃ N ₂ O ₂ S	5588-20-5	347.689						s CS ₂
1826	Chlordene		C ₁₀ H ₆ Cl ₆	3734-48-3	338.873	cry (Et OH)	155				
1827	Chlordimeform		C ₁₀ H ₁₃ ClN ₂	6164-98-3	196.676		35	156 ^{0.4}	1.105 ²⁵	1.5885 ²⁵	vs bz, et h, Et OH
1828	Chlorendic acid	1,4,5,6,7,7-Hexachloro-5-norbornene-2,3-dicarboxylic acid	C ₉ H ₄ Cl ₆ O ₄	115-28-6	388.844	cry (w)	232				
1829	Chlorendic anhydride		C ₈ H ₂ Cl ₆ O ₃	115-27-5	370.828		235				
1830	Chlorfeniphos		C ₁₂ H ₁₄ Cl ₃ O ₄ P	470-90-6	359.569			170 ^{0.05}			
1831	Chlorflorecol	<i>9</i> -Fluorene-9-carboxylic acid, 2-chloro-9-hydroxy-	C ₁₇ H ₈ ClO ₃	2464-37-1	260.672				1.496 ²⁰		
1832	Chloridazon	3-(<i>2</i>)-Pyridazinone, 5-amino-4-chloro-2-phenyl-	C ₁₀ H ₈ ClN ₂ O	1698-60-8	221.643		205				
1833	Chlorimuron-ethyl		C ₁₅ H ₁₅ ClN ₂ O ₂ S	90982-32-4	414.821		186				
1834	Chloromephos	Chloromethyl <i>O,O</i> -diethyl dithiophosphate	C ₈ H ₁₂ ClO ₂ PS ₂	24934-91-6	234.705	oi l		88 ¹		1.5244	sl H ₂ O; mi sc os
1835	Chloromequat chloride		C ₈ H ₁₃ Cl ₂ N	999-81-5	158.069			239 dec			
1836	Chloromezanone		C ₇ H ₁₂ ClNO ₂ S	80-77-3	273.736	cry	117				sl Et OH
1837	Chloromaphazine		C ₈ H ₁₅ Cl ₂ N	494-03-1	268.182	pl (pet h)	55	210			vs ace, bz, et h, Et OH
1838	Chloroacetaldehyde		C ₂ H ₃ ClO	107-20-0	78.497	li q	-16.3	85.5	1.19		s et h
1839	2-Chloroacetamide		C ₂ H ₄ ClNO	79-07-2	93.512		121	225			s H ₂ O; vs Et OH; sl et h
1840	Chloroacetic acid		C ₂ H ₃ ClO ₂	79-11-8	94.497	mcl pl	63	189.3	1.404 ³⁰	1.4351 ⁵⁵	vs H ₂ O; s Et OH, et h, bz, chl; sl ct c
1841	Chloroacetic anhydride		C ₂ H ₂ Cl ₂ O ₃	541-88-8	170.979	pr (bz)	46	203	1.5497 ²⁰		
1842	4-Chloroacetanilide	<i>N</i> -Acetamidyl-4-chloroaniline	C ₁₀ H ₉ ClNO ₂	101-92-8	211.645		132				
1843	Chloroacetone		C ₃ H ₅ ClO	78-95-5	92.524	li q	-44.5	119	1.195		s H ₂ O, Et OH, et h, chl
1844	Chloroacetone trile	Chloromethyl cyanide	C ₂ H ₂ ClN	107-14-2	75.497			126.5	1.1930 ³⁰	1.4202 ²⁵	vs et h, Et OH
1845	α -Chloroacetophenone	ω -Chloroacetophenone	C ₈ H ₇ ClO	532-27-4	154.594	pl (di l al) lf (pet h)	56.5	247	1.324 ¹⁵		i H ₂ O; vs Et OH, et h, bz; s ace, pet h
1846	4-(2-Chloroacetyl)acetanilide		C ₁₀ H ₉ ClNO ₂	140-49-8	211.645		218				
1847	Chloroacetyl chloride		C ₂ H ₂ Cl ₂ O	79-04-9	112.942	li q	-22	106	1.420 ²⁰	1.4530 ²⁰	msc et h; s ace, ct c
1848	Chloroacetylene		C ₂ HCl	593-63-5	60.482	col gas	-126	-30			sl Et OH



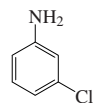
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1849	9-Chloroacridine		C ₁₃ H ₉ ClN	1207-69-8	213.663	nd (al)	121	sub			vs H ₂ O, Et OH
1850	2-Chloroacridine		C ₁₃ H ₉ ClN	95-51-2	127.572	liq	-1.9	208.8		1.5895	i H ₂ O; msc Et OH; s et h, ace
1851	3-Chloroacridine		C ₁₃ H ₉ ClN	108-42-9	127.572	liq	-10.28	230.5	1.2164	1.5941 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; s chl
1852	4-Chloroacridine		C ₁₃ H ₉ ClN	106-47-8	127.572	orth pr	70.5	232	1.429	1.5546 ⁸⁷	s H ₂ O, Et OH, et h, chl
1853	2-Chloroacridine hydrochloride		C ₁₃ H ₉ Cl ₂ N	137-04-2	164.033	pl (w, aq al)	235		1.5059		vs H ₂ O
1854	3-Chloroacridine hydrochloride		C ₁₃ H ₉ Cl ₂ N	141-85-5	164.033	pl	222				vs H ₂ O, Et OH
1855	2-Chloroanisole	1-Chloro-2-methoxybenzene	C ₇ H ₇ ClO	766-51-8	142.583	liq	-26.8	198.5	1.1914	1.5480 ²⁰	i H ₂ O; s Et OH, et h; sl chl
1856	3-Chloroanisole	1-Chloro-3-methoxybenzene	C ₇ H ₇ ClO	2845-89-8	142.583			193.5	1.1759 ²	1.5365 ²⁰	i H ₂ O; s Et OH, et h
1857	4-Chloroanisole	1-Chloro-4-methoxybenzene	C ₇ H ₇ ClO	623-12-1	142.583		<-18	197.5	1.204 ²⁰	1.5390 ²⁰	i H ₂ O; vs Et OH, et h, chl; s ct c
1858	1-Chloroanthracene		C ₁₄ H ₉ Cl	4985-70-0	212.674	lf (HOAc)	83.5		1.1707 ⁹⁰	1.6959 ¹⁰⁰	i H ₂ O; s Et OH, et h, bz, ct c
1859	1-Chloro-9,10-anthracenedione		C ₁₄ H ₇ ClO ₂	82-44-0	242.658	ye nd (t o or al)	163	sub			i H ₂ O; sl Et OH, ct c; msc et h; s bz
1860	2-Chloro-9,10-anthracenedione		C ₁₄ H ₇ ClO ₂	131-09-9	242.658	pa ye nd (al, HOAc)	211	sub			i H ₂ O, et h; sl Et OH, bz; vs t ol; s PhNO ₂
1861	2-Chlorobenzaldehyde		C ₇ H ₅ ClO	89-98-5	140.567	nd	12.4	211.9	1.2483 ⁹⁰	1.5662 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz, ct c
1862	3-Chlorobenzaldehyde		C ₇ H ₅ ClO	587-04-2	140.567	pr	17.5	213.5	1.2410 ⁹⁰	1.5650 ²⁰	sl H ₂ O, chl; s Et OH, et h, ace, bz
1863	4-Chlorobenzaldehyde		C ₇ H ₅ ClO	104-88-1	140.567	pl	47.5	213.5	1.196 ¹	1.555 ⁸¹	s H ₂ O, ace, chl; vs Et OH, et h, bz
1864	2-Chlorobenzamide		C ₇ H ₆ ClNO	609-66-5	155.582	orth nd (w)	141.8				s H ₂ O, Et OH, et h
1865	Chlorobenzene	Phenyl chloride	C ₆ H ₅ Cl	108-90-7	112.557	liq	-45.31	131.72	1.1058	1.5241 ²⁰	i H ₂ O; msc Et OH, et h; vs bz, ct c
1866	2-Chlorobenzeneacetate		C ₈ H ₇ ClO ₂	2444-36-2	170.594	nd (w)	96				sl H ₂ O; vs Et OH
1867	3-Chlorobenzeneacetate		C ₈ H ₇ ClO ₂	1878-65-5	170.594	pl (di l al), nd (li g)	77.5				sl H ₂ O, bz, ct c, Et OH; msc et h
1868	4-Chlorobenzeneacetate		C ₈ H ₇ ClO ₂	1878-66-6	170.594	nd (w)	105.5				s H ₂ O, Et OH, et h, bz
1869	2-Chlorobenzeneacetone		C ₈ H ₇ ClN	2856-63-5	151.594		24	251	1.1737 ⁶		
1870	3-Chlorobenzeneacetone		C ₈ H ₇ ClN	1529-41-5	151.594		11.5	261; 135 ⁹	1.1806 ³⁰	1.5437 ²⁰	
1871	4-Chlorobenzeneacetone		C ₈ H ₇ ClN	140-53-4	151.594		29	265.0	1.1778 ⁹⁰		s ct c
1872	α-Chlorobenzeneacetyl chloride		C ₈ H ₆ Cl ₂ O	2912-62-1	189.039			120 ²³ , 110 ¹⁴	1.196 ²⁵	1.5440 ²⁰	
1873	3-Chlorobenzeneazobisoxalacetate		C ₁₀ H ₇ ClO ₄	937-14-4	172.566		92 dec				
1874	4-Chloro-1,2-benzenediamine	4-Chloro- <i>o</i> -phenylenediamine	C ₆ H ₄ ClN ₂	95-83-0	142.586	pl (bz-li g) lf (w)	76				s H ₂ O; vs Et OH, et h; s bz, li g
1875	4-Chloro-1,3-benzenediamine		C ₆ H ₄ ClN ₂	5131-60-2	142.586	pl or nd	91				vs Et OH
1876	2-Chloro-1,4-benzenediamine	2-Chloro- <i>p</i> -phenylenediamine	C ₆ H ₄ ClN ₂	615-66-7	142.586	nd	64				
1877	3-Chloro-1,2-benzenediol		C ₆ H ₃ ClO ₂	4018-65-9	144.556	cry (li g)	48.5	110			vs li g
1878	4-Chloro-1,2-benzenediol		C ₆ H ₃ ClO ₂	2138-22-9	144.556	lf (bz-pet h)	90.5	139 ⁹			vs H ₂ O, ace, et h, Et OH
1879	4-Chloro-1,3-benzenediol		C ₆ H ₃ ClO ₂	95-88-5	144.556			257			vs H ₂ O, Et OH, et h, ace, bz, C ₆ S
1880	2-Chloro-1,4-benzenediol		C ₆ H ₃ ClO ₂	615-67-8	144.556	red lf (chl), nd (bz)	108	263			vs H ₂ O, chl; s Et OH, et h; vs bz
1881	2-Chlorobenzeneamine		C ₆ H ₆ ClN	89-97-4	141.599			72		1.5594 ²⁵	
1882	3-Chlorobenzeneamine		C ₆ H ₆ ClN	4152-90-3	141.599			89		1.5570 ²⁵	
1883	4-Chlorobenzeneamine		C ₆ H ₆ ClN	104-86-9	141.599			109 ³		1.5566 ²⁵	
1884	4-Chlorobenzeneamine hydrochloride		C ₆ H ₆ Cl ₂ N	6258-66-8	158.649		19.5	113 ⁷	1.202 ²⁵	1.5893 ²⁰	
1885	2-Chlorobenzeneamine hydrochloride		C ₆ H ₆ Cl ₂ N	17849-38-6	142.583	lf or nd (di l al)	73	230			s H ₂ O; vs Et OH, et h, li g
1886	4-Chlorobenzeneamine hydrochloride		C ₆ H ₆ Cl ₂ N	873-76-7	142.583	nd (w), pl (bz or bz-li g)	75	235			vs bz, et h, Et OH
1887	2-Chlorobenzeneamine sulfate		C ₆ H ₆ ClN ₂ O ₄ S	6961-82-6	191.636	lf (al)	188				vs Et OH
1888	4-Chlorobenzeneamine sulfate		C ₆ H ₆ ClN ₂ O ₄ S	98-64-6	191.636	pr or pl (et h)	146				vs bz, et h
1889	4-Chlorobenzeneamine sulfonate	<i>p</i> -Chlorobenzeneamine sulfonate	C ₆ H ₆ ClN ₂ O ₃ S	98-66-8	192.620	nd (w+1)	67	147 ²⁵			s H ₂ O, Et OH; i et h, bz



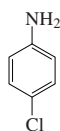
9-Chloroacridine



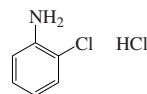
2-Chloroaniline



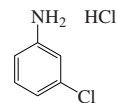
3-Chloroaniline



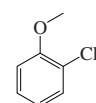
4-Chloroaniline



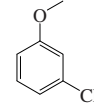
2-Chloroaniline hydrochloride



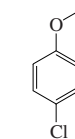
3-Chloroaniline hydrochloride



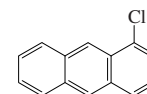
2-Chloroanisole



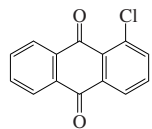
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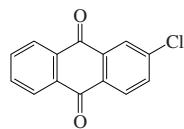
4-Chloroanisole



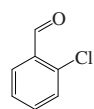
1-Chloroanthracene



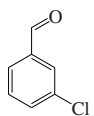
1-Chloro-9,10-anthracenedione



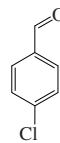
2-Chloro-9,10-anthracenedione



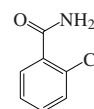
2-Chlorobenzaldehyde



3-Chlorobenzaldehyde



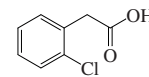
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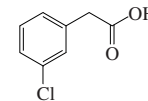
2-Chlorobenzamide



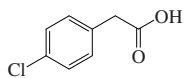
Chlorobenzene



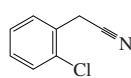
2-Chlorobenzeneacetic acid



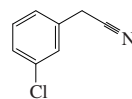
3-Chlorobenzeneacetic acid



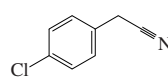
4-Chlorobenzeneacetic acid



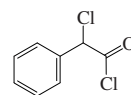
2-Chlorobenzeneacetonitrile



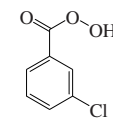
3-Chlorobenzeneacetonitrile



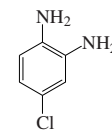
4-Chlorobenzeneacetonitrile



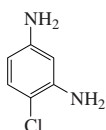
α -Chlorobenzeneacetyl chloride



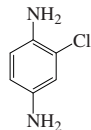
3-Chlorobenzeneperoxyacetic acid



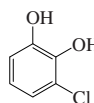
4-Chloro-1,2-benzenediamine



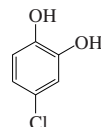
4-Chloro-1,3-benzenediamine



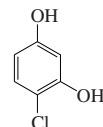
2-Chloro-1,4-benzenediamine



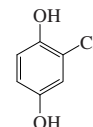
3-Chloro-1,2-benzenediol



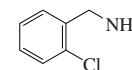
4-Chloro-1,2-benzenediol



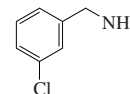
4-Chloro-1,3-benzenediol



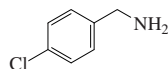
2-Chloro-1,4-benzenediol



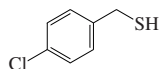
2-Chlorobenzeneethanamine



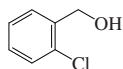
3-Chlorobenzeneethanamine



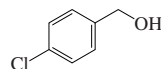
4-Chlorobenzeneethanamine



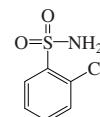
4-Chlorobenzeneethanethiol



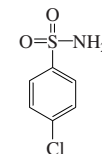
2-Chlorobenzeneethanol



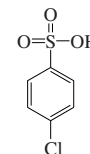
4-Chlorobenzeneethanol



2-Chlorobenzeneethanesulfonamide

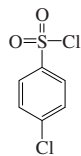


4-Chlorobenzeneethanesulfonamide



4-Chlorobenzeneethanesulfonic acid

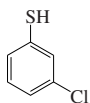
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1890	4-Chl orobenzenesulfonyl chl ori de		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2\text{S}$	98-60-2	211.066		51	141 ¹⁵			vs et h, bz
1891	2-Chl orobenzenet hi ol		$\text{C}_6\text{H}_4\text{Cl}_2\text{S}$	6320-03-2	144.622			205.5	1.2752 ⁰		sl H ₂ O, Et OH
1892	3-Chl orobenzenet hi ol		$\text{C}_6\text{H}_4\text{Cl}_2\text{S}$	2037-31-2	144.622			206	1.2637 ³		i H ₂ O; s Et OH, et h, chl, pet h
1893	4-Chl orobenzenet hi ol		$\text{C}_6\text{H}_4\text{Cl}_2\text{S}$	106-54-7	144.622		61	206	1.191 ⁹⁰	1.5480 ²⁰	i H ₂ O; vs Et OH, et h, bz; sl chl
1894	Chl orobenzi late		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_3$	510-15-6	325.186		37	157 ^{0,07}	1.2816 ²⁰		
1895	2-Chl oro-1,3,2-benzodi oxaphosphol e		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2\text{P}$	1641-40-3	174.522		30	80 ²⁰	1.4650 ²⁰	1.5712 ²⁰	
1896	2-Chl orobenzoi c aci d		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2$	118-91-2	156.567	mcl pr (w)	140.2	sub	1.544 ⁶⁰		s H ₂ O, bz; vs Et OH, et h, ace; sl CS ₂
1897	3-Chl orobenzoi c aci d		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2$	535-80-8	156.567	pr (w)	158	sub	1.496 ²⁵		sl H ₂ O, bz, ct c, CS ₂ ; s Et OH, et h
1898	4-Chl orobenzoi c aci d		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2$	74-11-3	156.567	t cl pr (al-et h)	243				i CH ₂ Cl ₂ , ct c; vs Et OH; sl et h, ace
1899	2-Chl orobenzoni tri le		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}$	873-32-5	137.567	nd	46.3	232			sl H ₂ O; s Et OH, et h, chl
1900	3-Chl orobenzoni tri le		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}$	766-84-7	137.567		41	100 ⁵			i H ₂ O; s Et OH, et h
1901	4-Chl orobenzoni tri le		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}$	623-03-0	137.567	nd (al)	95	223; 95	1.1133 ¹⁷		sl H ₂ O, li g; s Et OH, et h, bz, chl
1902	2-Chl orobenzophenone	2-Chl orophenyl phenyl ket one	$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	5162-03-8	216.662	pl (chl-li g)	54	330			
1903	4-Chl oro-2-benzot hi azol ami ne		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}_2\text{S}$	19952-47-7	184.646			204			
1904	6-Chl oro-2-benzot hi azol ami ne		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}_2\text{S}$	95-24-9	184.646			200			
1905	2-Chl orobenzot hi azol e		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}_2\text{S}$	615-20-3	169.632		24	248	1.3715 ⁰	1.6338 ¹⁰	vs ace, et h, Et OH
1906	5-Chl oro-1 <i>H</i> -benzot ri azol e		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}_2$	94-97-3	153.569			158			
1907	6-Chl oro-2 <i>H</i> -3,1-benzoxazi ne-2,4(1 <i>H</i>)-di one	5-Chl oro-1,3,4-benzoxazi ne-2,4(1 <i>H</i>)-di one	$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2\text{O}_2$	4743-17-3	197.576			280 dec			
1908	5-Chl oro-2-benzoxazol ami ne	Zoxazol ami ne	$\text{C}_6\text{H}_4\text{Cl}_2\text{N}_2\text{O}$	61-80-3	168.580	pl (bz)		184.5			vs Et OH
1909	2-Chl orobenzoxazol e		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}_2\text{O}$	615-18-9	153.566		7	201.5	1.3453 ⁸	1.5678 ²⁰	
1910	5-Chl oro-2(3 <i>H</i>)-benzoxazol one	Chl oroxazol one	$\text{C}_6\text{H}_4\text{Cl}_2\text{N}_2\text{O}_2$	95-25-0	169.566	cry (ace)	191.5				vs Et OH, MeOH
1911	2-Chl orobenzoyl chl ori de		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	609-65-4	175.012	li q	-4	238		1.572 ⁶	s ct c
1912	3-Chl orobenzoyl chl ori de		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	618-46-2	175.012			225		1.5677 ²⁰	
1913	4-Chl orobenzoyl chl ori de		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	122-01-0	175.012			16	1.3770 ²⁰	1.5756 ²⁰	sl chl
1914	1-Chl oro-4-benzyl benzene		$\text{C}_6\text{H}_4\text{H}_2\text{Cl}$	831-81-2	202.679		7.5	299; 147 ⁶	1.1247 ²⁰		vs ace
1915	α -Chl orobenzyl i dene mal ononi tri le		$\text{C}_{10}\text{H}_8\text{Cl}_2\text{N}_2$	2698-41-1	188.613	wh cry	96	312			sl H ₂ O; s bz, di ox, Et OAc, ace
1916	2-Chl orobi phenyl		$\text{C}_6\text{H}_4\text{Cl}$	2051-60-7	188.652	mcl (di l al)	34	274	1.1499		i H ₂ O; vs et h, Et OH, li g
1917	3-Chl orobi phenyl		$\text{C}_6\text{H}_4\text{Cl}$	2051-61-8	188.652		16	284.5	1.1579 ⁵	1.6181 ²⁵	vs ace, et h, Et OH
1918	4-Chl orobi phenyl		$\text{C}_6\text{H}_4\text{Cl}$	2051-62-9	188.652	lf (li g or al)	78.8	292.9; 146			i H ₂ O; s Et OH, et h, li g
1919	4'-Chl oro-[1,1'-bi phenyl]-4-ami ne	4-Ami no-4'-chl orodi phenyl	$\text{C}_{12}\text{H}_9\text{Cl}_2\text{N}$	135-68-2	203.667	cry (pet h)	134				vs ace, bz, et h
1920	3-Chl oro-[1,1'-bi phenyl]-2-ol	2-Phenyl-6-chl orophenol	$\text{C}_{12}\text{H}_9\text{Cl}_2\text{O}$	85-97-2	204.651		6	dec 317	1.24 ⁸	1.6237 ³⁰	i H ₂ O; s Et OH, et h, ace, bz
1921	4-Chl oro-1,2-but adi ene		$\text{C}_6\text{H}_4\text{Cl}$	25790-55-0	88.536			88	0.989 ⁹⁰	1.4775 ²⁰	vs ace, bz, et h
1922	1-Chl oro-1,3-but adi ene		$\text{C}_6\text{H}_4\text{Cl}$	627-22-5	88.536			68	0.9606 ⁹⁰	1.4712 ²⁰	vs et h, Et OH, chl
1923	2-Chl oro-1,3-but adi ene	Chl oroprene	$\text{C}_6\text{H}_4\text{Cl}$	126-99-8	88.536	li q	-130	59.4	0.956	1.4583 ²⁰	sl H ₂ O; msc et h, ace, bz
1924	4-Chl orobut anal		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	6139-84-0	106.551			51 ¹³	1.106 ⁸	1.4466 ⁸	vs ace, et h, Et OH
1925	1-Chl orobut ane	But yl chl ori de	$\text{C}_6\text{H}_4\text{Cl}$	109-69-3	92.567	li q	-123.1	78.4	0.8857	1.4023 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
1926	2-Chl orobut ane	(\pm) <i>sec</i> -But yl chl ori de	$\text{C}_6\text{H}_4\text{Cl}$	53178-20-4	92.567	li q	-131.3	68.2	0.8732	1.3971 ²⁰	vs bz, et h, Et OH, chl
1927	4-Chl orobut aneni tri le		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}$	628-20-6	103.551			192	1.0934 ⁵	1.4413 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
1928	2-Chl orobutanoi c aci d		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2$	4170-24-5	122.551			189 ⁶²⁷ ; 101 ¹⁵	1.1796 ²⁰	1.441 ²⁰	sl H ₂ O; vs Et OH, et h
1929	3-Chl orobutanoi c aci d		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2$	625-68-3	122.551	cry (et h)	16	116 ²	1.1898 ²⁰	1.4221 ²⁰	s Et OH; vs et h; sl ct c
1930	4-Chl orobutanoi c aci d		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2$	627-00-9	122.551		16	196 ²² ; 68 ^{0,2}	1.2236 ²⁰	1.4642 ²⁰	vs Et OH
1931	4-Chl oro-1-but anol		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	928-51-8	108.566			84 ⁶	1.0883 ²⁰	1.4518 ²⁰	vs et h, Et OH
1932	1-Chl oro-2-but anol	α -But yl ene chl orohydr i n	$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	1873-25-2	108.566			141	1.068 ⁵	1.4400 ²⁰	s Et OH, et h



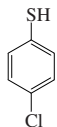
4-Chlorobenzenesulfonyl chloride



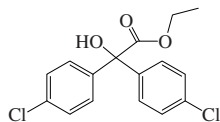
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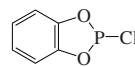
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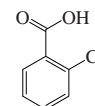
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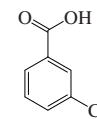
Chlorobenzilate



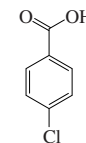
2-Chloro-1,3,2-benzodioxaphosphol



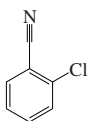
2-Chlorobenzoic acid



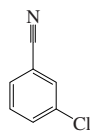
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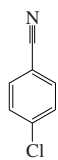
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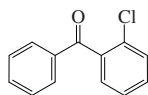
2-Chlorobenzonitrile



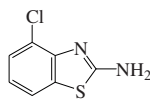
3-Chlorobenzonitrile



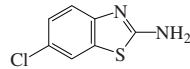
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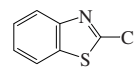
2-Chlorobenzophenone



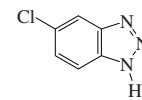
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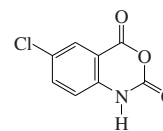
6-Chloro-2-benzothiazolamine



2-Chlorobenzothiazole

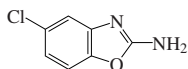


5-Chloro-1H-benzotriazole

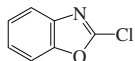


6-Chloro-2H-3,1-benzoxazin-2,4(1H)-dione

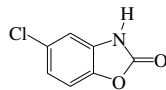
3-105



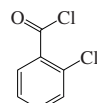
5-Chloro-2-benzoxazolamine



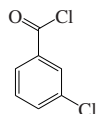
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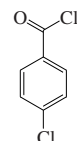
5-Chloro-2(3H)-benzoxazolone



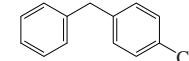
2-Chlorobenzoyl chloride



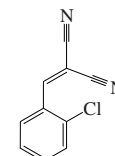
3-Chlorobenzoyl chloride



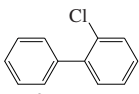
4-Chlorobenzoyl chloride



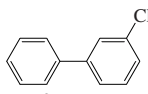
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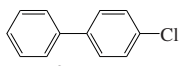
o-Chlorobenzylidene malonitrile



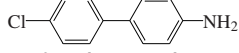
2-Chlorobiphenyl



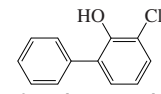
3-Chlorobiphenyl



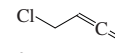
4-Chlorobiphenyl



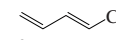
4-Chloro-[1,1'-biphenyl]-4-amine



3-Chloro-[1,1'-biphenyl]-2-ol



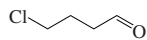
4-Chloro-1,2-butadiene



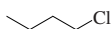
1-Chloro-1,3-butadiene



2-Chloro-1,3-butadiene



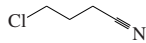
4-Chlorobutanal



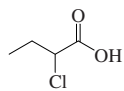
1-Chlorobutane



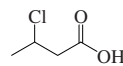
2-Chlorobutane



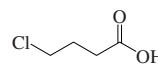
4-Chlorobutanenitrile



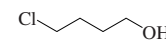
2-Chlorobutanoic acid



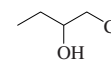
3-Chlorobutanoic acid



4-Chlorobutanoic acid



4-Chloro-1-butanol

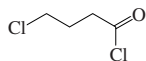


1-Chloro-2-butanol

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1933	3-Chl oro-2-but anone		CH ₇ ClO	4091-39-8	106.551			115	1.0554 ⁵	1.4219 ²⁰	
1934	4-Chl orobut anoyl chl ori de		H ₇ Cl ₂ O	4635-59-0	140.996			173.5	1.2581 ²⁰	1.4616 ²⁰	s et h
1935	2-Chl oro-1-but ene		CH ₇ Cl	2211-70-3	90.552			58.5	0.9107 ⁵	1.4165 ²¹	vs ace, bz, et h, Et OH
1936	3-Chl oro-1-but ene		CH ₇ Cl	563-52-0	90.552			64.5	0.8978 ⁹	1.4149 ²⁰	vs et h, ace; s chl
1937	4-Chl oro-1-but ene		CH ₇ Cl	927-73-1	90.552			75	0.921 ²⁰	1.4233 ²⁰	vs ace, et h, chl
1938	<i>ci s</i> 1-Chl oro-2-but ene		CH ₇ Cl	4628-21-1	90.552			84.1	0.9426 ²⁰	1.4390 ²⁰	i H ₂ O; s Et OH, ace, chl
1939	<i>t rans</i> 1-Chl oro-2-but ene		CH ₇ Cl	4894-61-5	90.552			85	0.9295 ²⁰	1.4350 ²⁰	i H ₂ O; s ace, chl
1940	<i>ci s</i> 2-Chl oro-2-but ene		CH ₇ Cl	2211-69-0	90.552	li q	-117.3	70.6	0.9239	1.4240 ²⁰	i H ₂ O; msc Et OH; s ace, chl
1941	<i>t rans</i> 2-Chl oro-2-but ene		CH ₇ Cl	2211-68-9	90.552	li q	-105.8	62.8	0.9138	1.4190 ²⁰	i H ₂ O; msc Et OH; s ace, chl
1942	1-Chl oro-4- <i>t er</i> but yl benzene		C ₁₀ H ₁₃ Cl	3972-56-3	168.663			213	1.0079 ⁵	1.5123 ²⁰	
1943	Chl oro-(<i>t er</i> but yl)di met hyl si l ane		₈ H ₁₇ ClSi	18162-48-6	150.722		89.5	125			
1944	Chl oro-(<i>t er</i> but yl)di phenyl si l ane		₁₆ H ₁₉ ClSi	58479-61-1	274.861			120 ⁶	1.07 ²⁰	1.5675 ²⁰	
1945	2-Chl oro-4- <i>t er</i> but yl phenol		CH ₁₃ ClO	98-28-2	184.662			114 ⁴			
1946	3-Chl oro-1-but yne		CH ₅ Cl	21020-24-6	88.536			68.5	1.4218 ⁵	1.4218 ²⁵	
1947	2-Chl oro- <i>N</i> -(2-chl oroet hyl) et hanami ne, hydrochl ori de		C ₄ H ₁₀ Cl ₂ N	821-48-7	178.488		215.0				
1948	2-Chl oro- <i>N</i> -(2-chl oroet hyl)- <i>N</i> -et hyl et hanami ne	HN1	C ₆ H ₁₃ Cl ₂ N	538-07-8	170.080	col li q	-34	66	1.0861 ²³	1.4653 ²⁵	i H ₂ O
1949	2-Chl oro- <i>N</i> -(2-chl oroet hyl)- <i>N</i> -met hyl et hanami ne	Mechl oret hami ne	₈ H ₁₁ Cl ₂ N	51-75-2	156.053		-60	87 ¹⁸ , 64 ⁵			sl H ₂ O; msc ct c, DMF
1950	1-Chl oro-2-(chl oromet hyl)benzene	2-Chl orobenzyl chl ori de	₇ H ₆ Cl ₂	611-19-8	161.029	li q	-17	217	1.2699	1.5530 ²⁰	i H ₂ O; sl Et OH, ct c; vs et h, bz
1951	1-Chl oro-3-(chl oromet hyl)benzene	3-Chl orobenzyl chl ori de	₇ H ₆ Cl ₂	620-20-2	161.029			216; 110 ²⁵	1.2695 ¹⁵	1.5554 ²⁰	vs Et OH
1952	1-Chl oro-4-(chl oromet hyl)benzene	4-Chl orobenzyl chl ori de	₇ H ₆ Cl ₂	104-83-6	161.029	nd (di l al)	31	223			sl ct c
1953	Chl oro(chl oromet hyl)di met hyl si l ane		₃ H ₁₀ Cl ₂ Si	1719-57-9	143.088			115.5	1.0869 ⁹	1.4360 ²⁰	
1954	3-Chl oro-2-(chl oromet hyl)-1-propene		C ₄ H ₆ Cl ₂	1871-57-4	124.997	li q	-14	138	1.178 ²	1.4753	vs Et OH, chl
1955	1-Chl oro-4-((chl oromet hyl)thi o)benzene		C ₇ H ₆ Cl ₂ S	7205-90-5	193.094		21.5	128 ¹²	1.346 ²⁵	1.6055 ²⁰	
1956	2-Chl oro-1-(4-chl orophenyl)et hanone		C ₈ H ₆ Cl ₂ O	937-20-2	189.039	nd (al)	101.5	270			s Et OH, bz, MeOH
1957	3-Chl orocholest -5-ene, (β)		C ₂₇ H ₄₅ Cl	910-31-6	405.099	nd (al, ace)	96				i H ₂ O; s Et OH, ace, bz, chl; vs C ₆ H ₆
1958	<i>t rans</i> - <i>o</i> Chl oroci nnami c aci d		₈ H ₇ ClO ₂	939-58-2	182.604		212				vs et h, Et OH
1959	<i>t rans</i> - <i>m</i> Chl oroci nnami c aci d		₈ H ₇ ClO ₂	14473-90-6	182.604		165				s Et OH, et h
1960	<i>t rans</i> - <i>p</i> Chl oroci nnami c aci d		₈ H ₇ ClO ₂	940-62-5	182.604		249.5				vs ace, et h, Et OH
1961	Chl orocycl ohexane	Cycl ohexyl chl ori de	₆ H ₉ Cl	542-18-7	118.604	li q	-43.81	142	1.000	1.4626 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; vs chl
1962	2-Chl orocycl ohexanone		CH ₉ ClO	822-87-7	132.587		23	82 ⁵	1.160 ²⁰	1.4825 ²⁰	s et h, bz, di ox; sl ct c
1963	1-Chl orocycl ohexene		CH ₉ Cl	930-66-5	116.588			142.5	1.0361 ⁹	1.4797 ²⁰	s et h, ace, ct c, chl
1964	Chl orocycl opent ane	Cycl opent yl chl ori de	₅ H ₆ Cl	930-28-9	104.578			114	1.005 ²⁰	1.4510 ²⁰	i H ₂ O; s et h, ace, bz, ct c
1965	2-Chl orocycl opent anone		₅ H ₇ ClO	694-28-0	118.562			87 ⁹ , 73 ¹²	1.185 ²⁵	1.4750 ²⁰	
1966	3-Chl orocycl opent ene		₅ H ₇ Cl	96-40-2	102.563			40 ⁹ , 27 ³⁰	1.0388 ²⁵	1.4708 ²⁶	vs et h, Et OH, chl
1967	4-Chl oro-2-cycl opent yl phenol	Dowi ci de 9	₁₁ H ₉ ClO	13347-42-7	196.673			183 ⁸			
1968	1-Chl orodecane		C ₁₀ H ₂₁ Cl	1002-69-3	176.727	li q	-31.3	225.9	0.8696	1.4380 ²⁰	i H ₂ O; vs et h, chl; s ct c
1969	10-Chl oro-1-decanol		C ₁₀ H ₂₁ ClO	51309-10-5	192.726			187 ⁵	0.9630 ²⁵	1.4578 ²⁰	vs et h, Et OH
1970	2-Chl oro- <i>N,N</i> -di al lyl acet ami de	All i dochl or	₈ H ₁₂ ClNO	93-71-0	173.640	li q		116 ^{920.7}	1.088 ²⁵	1.4932 ²⁵	sl H ₂ O; s Et OH



3-Chloro-2-butanone



4-Chlorobutanoyl chloride



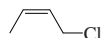
2-Chloro-1-butene



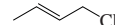
3-Chloro-1-butene



4-Chloro-1-butene



cis-1-Chloro-2-butene



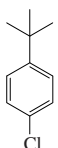
trans-1-Chloro-2-butene



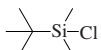
cis-2-Chloro-2-butene



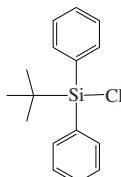
trans-2-Chloro-2-butene



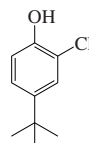
1-Chloro-4-tert-butylbenzene



Chlorotriethylsilane



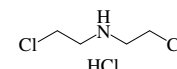
Chlorotriphenylsilane



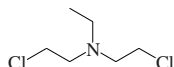
2-Chloro-4-tert-butylphenol



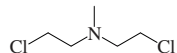
3-Chloro-1-butyne



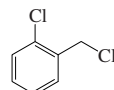
2-Chloro-N-(2-chloroethyl)ethanamine hydrochloride



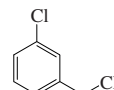
2-Chloro-N-(2-chloroethyl)N-ethylmethanamine



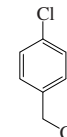
2-Chloro-N-(2-chloroethyl)N-methylmethanamine



1-Chloro-2-(chloromethyl)benzene



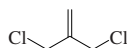
1-Chloro-3-(chloromethyl)benzene



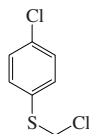
1-Chloro-4-(chloromethyl)benzene



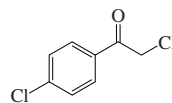
Chloro(chloromethyl)dimethylsilane



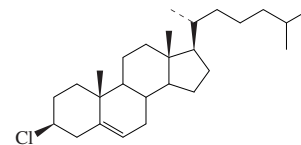
3-Chloro-2-(chloromethyl)-1-propene



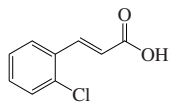
1-Chloro-4-((chloromethyl)thio)benzene



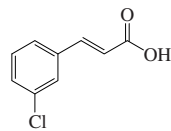
2-Chloro-1-(4-chlorophenyl)ethanone



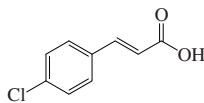
3-Chlorochol-5-ene(3β)



trans-ortho-chlorocinnamic acid



trans-meta-chlorocinnamic acid



trans-para-chlorocinnamic acid



Chlorocyclohexane



2-Chlorocyclohexanone



1-Chlorocyclohexene



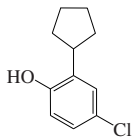
Chlorocyclopentane



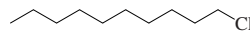
2-Chlorocyclopentanone



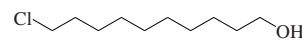
3-Chlorocyclopentene



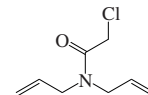
4-Chloro-2-cyclopentylphenol



1-Chlorodecane

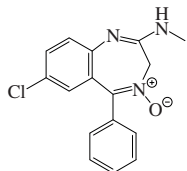


10-Chloro-1-decanol



2-Chloro-N,N-diethylacetamide

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
1971	Chlorodi azepoxi de		$\text{C}_7\text{H}_{14}\text{Cl}_2\text{N}_2\text{O}$	58-25-3	299.754		236.2				
1972	Chlorodi bromomet hane		$\text{C}_2\text{H}_4\text{BrCl}$	124-48-1	208.280	liq	-20	120	2.451	1.5482 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
1973	Chloro(di chl oromet hyl) di met hyl silane (Di chl oromet hyl) di met hyl chl orosi lane		$\text{C}_3\text{H}_7\text{Cl}_3\text{Si}$	18171-59-0	177.533	liq	-48	149	1.2309	1.461 ²⁰	
1974	5-Chloro- <i>N</i> -(3,4-di chl orophenyl)-2- hydroxybenzami de	3',4',5-Tri chl orosalicylani li de	$\text{C}_{13}\text{H}_{14}\text{Cl}_3\text{NO}_2$	642-84-2	316.568		247				
1975	2-Chloro-1,1-di et hoxyet hane		$\text{C}_2\text{H}_3\text{Cl}_2\text{O}$	621-62-5	152.619			157.4	1.0180 ²⁰	1.4170 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
1976	3-Chloro-1,1-di et hoxypropane		$\text{C}_3\text{H}_7\text{Cl}_2\text{O}$	35573-93-4	166.646			84 ²⁵	0.9951 ¹⁹	1.4268 ²⁰	vs ace, bz
1977	2-Chloro- <i>N,N</i> -di et hyl acet ami de		$\text{C}_6\text{H}_{11}\text{Cl}_2\text{NO}$	2315-36-8	149.618			192 ²⁵			
1978	2-Chloro- <i>N,N</i> -di et hyl et hanami ne, hydrochl ori de		$\text{C}_6\text{H}_{15}\text{Cl}_2\text{N}$	869-24-9	172.096		200				sl H ₂ O
1979	Chlorodi fluoroacet i c aci d		$\text{C}_2\text{HCl}_2\text{F}_2\text{O}_2$	76-04-0	130.478	hyg	25	122		1.3559 ²⁰	s chl
1980	1-Chloro-1,1-di fluoroet hane	Ref ri gerant 142b	$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$	75-68-3	100.495	col gas	-130.8	-9.1	1.107 ²⁵		i H ₂ O; s bz
1981	1-Chloro-2,2-di fluoroet hane		$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$	338-65-8	100.495			35.1			
1982	1-Chloro-2,2-di fluoroet hene	1-Chloro-2,2-di fluoroet hyl ene	$\text{C}_2\text{HClClF}_2$	359-10-4	98.479	col gas	-138.5	-18.5			
1983	Chlorodi fluoroet hane	Ref ri gerant 22	CHClF	75-45-6	86.469	col gas	-157.42	-40.7	1.4909 ⁶⁹		sl H ₂ O; s et h, ace, chl
1984	7-Chloro-2,3-di hydro- <i>H</i> -inden-4-ol	Chlori ndanol	$\text{C}_9\text{H}_9\text{ClO}$	145-94-8	168.619	nd (pet h)	92				
1985	10-Chloro-5,10-di hydrophenarsazi ne	Phenarsazi ne chl ori de	$\text{C}_{12}\text{H}_9\text{AsClN}$	578-94-9	277.581	ye cry	195		1.65		i H ₂ O; sl ct c, bz, xyl
1986	5-Chloro-2,4-di met hoxyani li ne		$\text{C}_8\text{H}_9\text{ClNO}_2$	97-50-7	187.624		91				
1987	2-Chloro-1,1-di met hoxyet hane		$\text{C}_2\text{H}_3\text{Cl}_2\text{O}$	97-97-2	124.566			127.5	1.068 ²⁰	1.4150 ²⁰	sl Et OH, et h, bz, ct c
1988	<i>N</i> -(4-Chloro-2,5-di met hoxyphenyl)-3-oxobutanami de		$\text{C}_{12}\text{H}_{14}\text{Cl}_2\text{NO}_4$	4433-79-8	271.697		107				s chl
1989	Chlorodi met hyl al umi num	Di met hyl al umi num chl ori de	$\text{C}_2\text{H}_2\text{AlCl}$	1184-58-3	92.504	hyg liq	-21	126	0.996		reac; s hx
1990	2-Chloro-10-(3-di met hyl ami nopropyl)phenol hi azi ne monohydrochl ori de	Ami nazi n hydrochl ori de	$\text{C}_{17}\text{H}_{20}\text{Cl}_2\text{N}_2\text{S}$	69-09-0	355.325		195 dec				s H ₂ O; i et h, bz; vs chl, Et OH
1991	2-Chloro- <i>N,N</i> -di met hyl ani li ne		$\text{C}_8\text{H}_{11}\text{Cl}_2\text{N}$	698-01-1	155.625			205	1.1067 ²⁰	1.5578 ²⁰	vs bz, Et OH
1992	3-Chloro- <i>N,N</i> -di met hyl ani li ne		$\text{C}_8\text{H}_{11}\text{Cl}_2\text{N}$	6848-13-1	155.625			232			sl H ₂ O; s Et OH, ace, bz
1993	4-Chloro- <i>N,N</i> -di met hyl ani li ne		$\text{C}_8\text{H}_{11}\text{Cl}_2\text{N}$	698-69-1	155.625	nd (al)	35.5	231	1.0480 ⁶⁰		s Et OH
1994	2-Chloro-1,4-di met hyl benzene		$\text{C}_8\text{H}_9\text{Cl}$	95-72-7	140.610		0.8	187	1.0589 ⁵		i H ₂ O; s ace, ct c; vs bz
1995	4-Chloro-1,2-di met hyl benzene		$\text{C}_8\text{H}_9\text{Cl}$	615-60-1	140.610	liq	-6	194	1.0682		i H ₂ O; s ace, ct c; vs bz
1996	2-Chloro- <i>N,N</i> -di met hyl et hanami ne, hydrochl ori de		$\text{C}_6\text{H}_{11}\text{Cl}_2\text{N}$	4584-46-7	144.043		201.0				sl H ₂ O
1997	(2-Chloro-1,1-di met hyl et hyl)benzene	Neophyl chl ori de	$\text{C}_{10}\text{H}_{13}\text{Cl}$	515-40-2	168.663			223; 105 ⁸	1.047 ²⁰	1.5247 ²⁰	vs ace, bz, et h, Et OH
1998	4-Chloro-2,5-di met hyl phenol		$\text{C}_6\text{H}_4\text{ClO}$	1124-06-7	156.609	si lv-grn nd (li g)	74.5				sl OH; vs bz, Et OH, pet h
1999	4-Chloro-2,6-di met hyl phenol		$\text{C}_6\text{H}_4\text{ClO}$	1123-63-3	156.609	nd (w)	83				sl H ₂ O; vs bz, Et OH, HOAc
2000	4-Chloro-3,5-di met hyl phenol	Chloroxylenol	$\text{C}_6\text{H}_4\text{ClO}$	88-04-0	156.609		115	246			sl H ₂ O, bz, pet h; s Et OH, et h
2001	Chlorodi met hyl phenyl silane		$\text{C}_8\text{H}_9\text{ClSi}$	768-33-2	170.712			195; 82 ⁸	1.032 ²⁰	1.5082 ²⁰	
2002	1-Chloro- <i>N,N</i> -di met hyl-2-propanami ne, hydrochl ori de		$\text{C}_6\text{H}_{13}\text{Cl}_2\text{N}$	17256-39-2	158.069						s chl
2003	1-Chloro-2,2-di met hyl propane		$\text{C}_3\text{H}_7\text{Cl}_2$	753-89-9	106.594	liq	-20	84.3	0.8660	1.4044 ²⁰	vs bz, et h, Et OH, chl
2004	3-Chloro-2,2-di met hyl propanoi c aci d		$\text{C}_3\text{H}_5\text{Cl}_2\text{O}_2$	13511-38-1	136.577		41.5	110 ¹⁰			vs ct c
2005	Chlorodi met hyl silane		$\text{C}_2\text{H}_5\text{ClSi}$	1066-35-9	94.616	liq	-111	34.7	0.852	1.3830	
2006	2-Chloro-4,6-di ni troani li ne		$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2\text{O}_4$	3531-19-9	217.567	ye cry (DMF aq)	157				
2007	4-Chloro-2,6-di ni troani li ne		$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2\text{O}_4$	5388-62-5	217.567	oran-ye nd (al)	147				s Et OH
2008	1-Chloro-2,4-di ni trobenzene		$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2\text{O}_4$	97-00-7	202.552	ye ort h (et h) nd (al) ye cry	53	315	1.4982 ⁷⁵	1.5857 ⁶⁰	i H ₂ O; sl Et OH; s et h, bz, CS



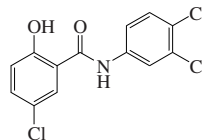
Chloroazepoxide



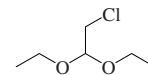
Chlorobromomethane



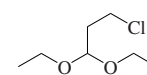
Chlorodichlorosilylhydramine



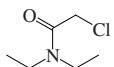
5-Chloro-N-(3,4-dichlorophenyl)-2-hydroxybenzamide



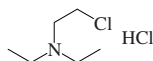
1,1-Dichloro-2-ethoxyethane



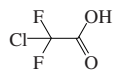
1,1-Dichloro-2-ethoxypropane



2-Chloro-N,N-diethylacetamide



2-Chloro-N,N-diethylhydrochloride



Chlorofluoroacetic acid



1,1-Dichloro-1,1-difluoroethane



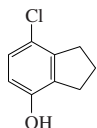
1,1-Difluoro-2-chloroethane



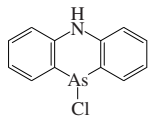
1,1-Difluoro-2,2-dichloroethene



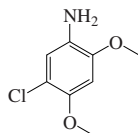
Chlorodifluoromethane



7-Chloro-2,3-dihydro-1H-inden-4-ol



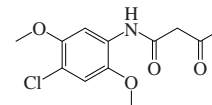
10-Chloro-5,10-dihydrophenarsazine



5-Chloro-2,4-dimethoxyaniline



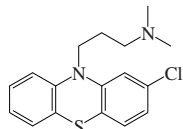
1,1-Dichloro-2-methoxyethane



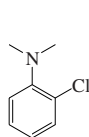
N-(4-Chloro-2,5-dimethoxyphenyl)-3-oxobutanamide



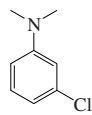
Chloroaluminum hydride



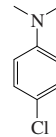
2-Chloro-10-(3-dimethylaminopropyl)phenothiazine hydrochloride



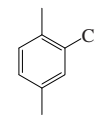
2-Chloro-N,N-dimethylaniline



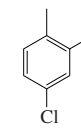
3-Chloro-N,N-dimethylaniline



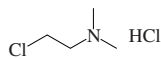
4-Chloro-N,N-dimethylaniline



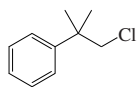
1,4-Dimethyl-2-chlorobenzene



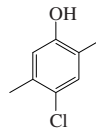
1,2-Dimethyl-4-chlorobenzene



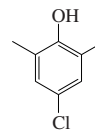
2-Chloro-N,N-diethylhydrochloride



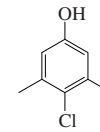
1,1-Dichloro-2-phenylpropane



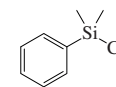
4-Chloro-2,5-dihydroxyphenol



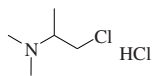
2,6-Dichloro-4-hydroxyphenol



3,5-Dichloro-4-hydroxyphenol



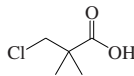
Chlorophenylsilane



1-Chloro-N,N-dimethyl-2-propanamine hydrochloride



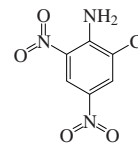
1-Chloro-2,2-dimethylpropane



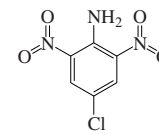
3-Chloro-2,2-dimethylpropanoic acid



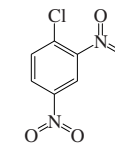
Chlorosilane



4-Chloro-6-amino-2,4-dinitrobenzene

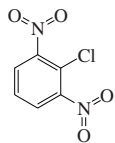


2,6-Dichloro-4-amino-1,3,5-trinitrobenzene

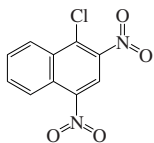


1-Chloro-2,4-dinitrobenzene

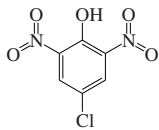
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2009	2-Chloro-1,3-dinitrobenzene		$\text{C}_6\text{H}_3\text{ClN}_2\text{O}_4$	606-21-3	202.552	yellow (al, HOAc)	88	315	1.6867 ¹⁶		in H ₂ O; soluble in EtOH, ether, toluene; slightly soluble in chloroform
2010	1-Chloro-2,4-dinitrobenzene		$\text{C}_6\text{H}_3\text{ClN}_2\text{O}_4$	2401-85-6	252.611	yellow (benzene)	146.5				
2011	4-Chloro-2,6-dinitrophenol		$\text{C}_6\text{H}_3\text{ClN}_2\text{O}_5$	88-87-9	218.551	partially crystalline	81		1.74 ²²		soluble in ether, EtOH, chloroform
2012	2-Chloro-3,5-dinitrobenzopyridine		$\text{C}_7\text{H}_5\text{ClN}_3\text{O}_4$	2578-45-2	203.541		66.5				
2013	2-Chloro-1,3-dinitro-5-(trifluoromethyl)benzene		$\text{C}_7\text{H}_2\text{ClF}_3\text{N}_2\text{O}_4$	393-75-9	270.550		57				
2014	4-Chloro-1,3-dioxolan-2-one	Chloroethylene carbonate	$\text{C}_3\text{H}_2\text{ClO}_3$	3967-54-2	122.507	liquid	110	213; 122 ²	1.504	1.4540 ²⁰	
2015	2-Chloro-1,2-diphenylethane		$\text{C}_{14}\text{H}_{11}\text{ClO}$	447-31-4	230.689	solid (alcohol)	68.5	dec			soluble in EtOH; slightly soluble in alcohol
2016	Chlorodiphenylmethane		$\text{C}_{14}\text{H}_{11}\text{Cl}$	90-99-3	202.679		16	140 ⁶	1.140 ²⁵	1.5951 ²⁰	soluble in chloroform
2017	1-Chlorododecane	Lauryl chloride	$\text{C}_{12}\text{H}_{25}\text{Cl}$	112-52-7	204.780	liquid	-9.3	263.2	0.867 ³	1.4434 ²⁰	in H ₂ O; soluble in EtOH; miscible with acetone, carbon tetrachloride; soluble in benzene
2018	Chloroethane	Ethyl chloride	$\text{C}_2\text{H}_5\text{Cl}$	75-00-3	64.514	volatile liquid or gas	-138.4	12.3	0.890 ² (at 20°C)	1.3676 ²⁰	soluble in H ₂ O, chloroform; soluble in EtOH; miscible with ether
2019	2-Chloroethanesulfonyl chloride		$\text{C}_2\text{H}_3\text{Cl}_2\text{O}_2\text{S}$	1622-32-8	163.023			201.5	1.555 ²⁰	1.4920 ²⁰	
2020	2-Chloroethanol	Ethylene chlorohydrin	$\text{C}_2\text{H}_4\text{ClO}$	107-07-3	80.513	liquid	-67.5	128.6	1.201 ⁹	1.4419 ²⁰	miscible with H ₂ O, EtOH; soluble in ether; slightly soluble in chloroform
2021	2-Chloroethanol, 4-methylbenzenesulfonyl ether		$\text{C}_9\text{H}_{11}\text{ClO}_2\text{S}$	80-41-1	234.699			210 ²¹			in H ₂ O; soluble in carbon tetrachloride
2022	Chloroethene	Vinyl chloride	$\text{C}_2\text{H}_3\text{Cl}$	75-01-4	62.498	colorless gas	-153.84	-13.8	0.910 ⁶	1.3700 ²⁰	soluble in H ₂ O; soluble in EtOH; soluble in ether
2023	1-Chloro-4-ethoxybenzene		$\text{C}_8\text{H}_9\text{ClO}$	622-61-7	156.609		21	213	1.1254 ⁹	1.5252 ²⁰	soluble in EtOH, ether, HOAc; soluble in benzene; slightly soluble in carbon tetrachloride
2024	(2-Chloroethoxy)benzene		$\text{C}_8\text{H}_9\text{ClO}$	622-86-6	156.609		28	218.5			in H ₂ O; soluble in EtOH, ether, acetone, benzene; slightly soluble in carbon tetrachloride
2025	1-Chloro-1-ethoxyethane		$\text{C}_6\text{H}_{13}\text{ClO}$	7081-78-9	108.566			93.5	0.965 ⁵⁰	1.4053 ²⁰	
2026	2-(2-Chloroethoxy)ethanol		$\text{C}_6\text{H}_{13}\text{ClO}_2$	628-89-7	124.566			180; 80 ⁵	1.18 ²⁵	1.4529 ²⁰	soluble in H ₂ O; miscible with EtOH, ether
2027	2-Chloroethyl acetate	β-Chloroethyl acetate	$\text{C}_6\text{H}_9\text{ClO}_2$	542-58-5	122.551			145	1.178 ²⁰	1.4234 ²⁰	in H ₂ O; miscible with EtOH, ether; soluble in carbon tetrachloride
2028	2-Chloroethyl acetate		$\text{C}_6\text{H}_9\text{ClO}_2$	54527-68-3	164.586			198; 120 ¹⁹	1.205 ²¹	1.4430 ²⁰	soluble in benzene, ether, EtOH
2029	2-Chloroethylamine hydrochloride	2-Chloroethanamine hydrochloride	$\text{C}_2\text{H}_5\text{Cl}_2\text{N}$	870-24-6	115.990		146.3				soluble in H ₂ O, acetone, EtOH
2030	(1-Chloroethyl)benzene		$\text{C}_8\text{H}_9\text{Cl}$	672-65-1	140.610			105 ⁵⁰			
2031	(2-Chloroethyl)benzene		$\text{C}_8\text{H}_9\text{Cl}$	622-24-2	140.610			197.5; 92 ²⁰	1.069 ²⁵	1.5276 ²⁰	in H ₂ O; soluble in EtOH, ether, acetone, benzene, carbon disulfide
2032	1-Chloro-2-ethylbenzene		$\text{C}_8\text{H}_9\text{Cl}$	89-96-3	140.610	liquid	-82.7	178.4	1.056 ⁹	1.5218 ²⁰	in H ₂ O; soluble in acetone, benzene, carbon tetrachloride, chloroform
2033	1-Chloro-3-ethylbenzene		$\text{C}_8\text{H}_9\text{Cl}$	620-16-6	140.610	liquid	-55	183.8	1.052 ⁹	1.5195 ²⁰	soluble in acetone, benzene, ether, EtOH
2034	1-Chloro-4-ethylbenzene		$\text{C}_8\text{H}_9\text{Cl}$	622-98-0	140.610	liquid	-62.6	184.4	1.045 ⁵	1.5175 ²⁰	in H ₂ O; miscible with EtOH, ether, acetone, petroleum ether; soluble in HOAc
2035	2-Chloroethyl chloroformate		$\text{C}_3\text{H}_4\text{Cl}_2\text{O}_2$	627-11-2	142.969			155	1.3847 ²⁰	1.4483 ²⁰	in H ₂ O; soluble in EtOH, ether, acetone, benzene; slightly soluble in carbon tetrachloride
2036	1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea	Lomustin	$\text{C}_{16}\text{H}_{18}\text{ClN}_2\text{O}_2$	13010-47-4	233.695	yellow powder	90				in H ₂ O; soluble in EtOH
2037	N-(2-Chloroethyl)diethylamine	Diethylamine	$\text{C}_{10}\text{H}_{18}\text{ClN}$	51-50-3	259.774	oil liquid		69			
2038	N-(2-Chloroethyl)diethylamine hydrochloride	Diethylamine hydrochloride	$\text{C}_{10}\text{H}_{19}\text{Cl}_2\text{N}$	55-43-6	296.235	crystalline	194				in H ₂ O; soluble in EtOH, diethylamine
2039	Chloroethyl dimethylsilane		$\text{C}_4\text{H}_{11}\text{ClSi}$	6917-76-6	122.669			89.5	0.867 ⁹	1.4105 ²⁰	
2040	2-Chloroethyl ethyl ether		$\text{C}_6\text{H}_{13}\text{ClO}$	628-34-2	108.566			107.5	0.989 ⁵⁰	1.4113 ²⁰	soluble in H ₂ O; miscible with ether; slightly soluble in chloroform
2041	2-Chloroethyl isocyanate		$\text{C}_3\text{H}_4\text{ClNO}$	1943-83-5	105.523			44 ⁷			
2042	1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea	Semustine	$\text{C}_{18}\text{H}_{23}\text{ClN}_2\text{O}_2$	13909-09-6	247.722	crystalline	64 dec				
2043	5-(2-Chloroethyl)-4-methylimidazole	Chlometimidazole	$\text{C}_6\text{H}_8\text{ClNS}$	533-45-9	161.653	oil		92	1.233 ²⁵		
2044	N-(2-Chloroethyl)morpholine		$\text{C}_6\text{H}_9\text{ClNO}$	3240-94-6	149.618			42			
2045	4-(2-Chloroethyl)morpholine hydrochloride		$\text{C}_6\text{H}_{13}\text{Cl}_2\text{NO}$	3647-69-6	186.079		185				
2046	1-Chloro-2-(ethylthio)ethane		$\text{C}_4\text{H}_9\text{ClS}$	693-07-2	124.632			157	1.0663 ⁵		



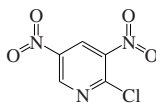
2-Chloro-1,3-dinitrobenzene



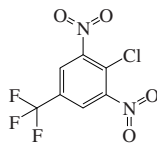
1-Chloro-2,4-dinitrophenol



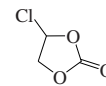
4-Chloro-2,6-dinitrophenol



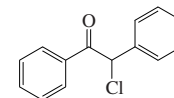
2-Chloro-3,5-dinitropyridine



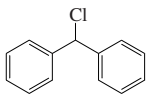
2-Chloro-1,3-difluoro-5-nitrobenzene



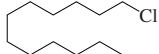
4-Chloro-1,3-dioxolan-2-one



2-Chloro-1,2-diphenylethanone



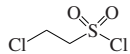
Chlorobenzophenone



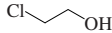
1-Chlorododecane



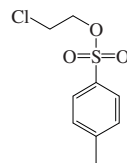
Chloroethane



2-Chloroethylsulfonate



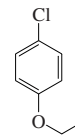
2-Chloroethanol



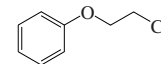
2-Chloroethyl 4-methylbenzenesulfonate



Chloroethene



1-Chloro-4-ethoxybenzene

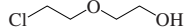


(2-Chloroethoxy)benzene

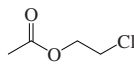
3-111



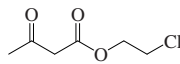
1-Chloro-1-ethoxyethane



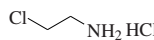
2-(2-Chloroethoxy)ethanol



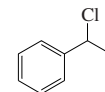
2-Chloroethyl acetate



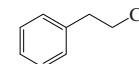
2-Chloroethyl propanoate



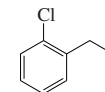
2-Chloroethylamine hydrochloride



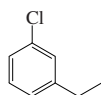
(1-Chloro-2-ethyl)benzene



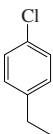
(2-Chloro-1-ethyl)benzene



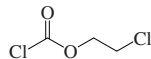
1-Chloro-2-ethylbenzene



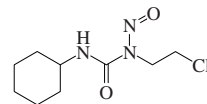
1-Chloro-3-ethylbenzene



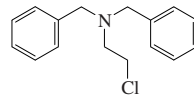
1-Chloro-4-ethylbenzene



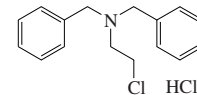
2-Chloroethyl chloroformate



1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea



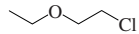
N-(2-Chloroethyl)diethylamine



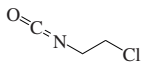
N-(2-Chloroethyl)diethylamine hydrochloride



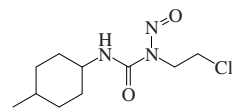
Chloroethyl dimethylsilane



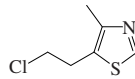
2-Chloroethyl ether



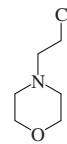
2-Chloroethyl isocyanate



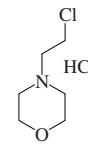
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea



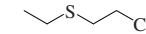
5-(2-Chloroethyl)-4-methylthiazole



N-(2-Chloroethyl)morpholine

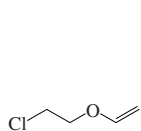


4-(2-Chloroethyl)morpholine hydrochloride

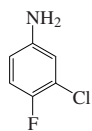


1-Chloro-2-ethylthioethane

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2047	2-Chloroethyl vinyl ether		$\text{C}_4\text{H}_7\text{ClO}$	110-75-8	106.551	liq	-70	108	1.0495	1.4378 ²⁰	vs Et OH, et h; sl chl
2048	3-Chloro-4-fluorobenzonitrile		$\text{C}_7\text{H}_5\text{ClFN}$	367-21-5	145.562		45.0	227.0			
2049	1-Chloro-2-fluorobenzene		$\text{C}_6\text{H}_4\text{ClF}$	348-51-6	130.547	liq	-43	137.6	1.2233	1.4918 ³⁰	i H ₂ O; s ace, bz
2050	1-Chloro-3-fluorobenzene		$\text{C}_6\text{H}_4\text{ClF}$	625-98-9	130.547			127.6	1.221 ²⁵	1.4911	
2051	1-Chloro-4-fluorobenzene		$\text{C}_6\text{H}_4\text{ClF}$	352-33-0	130.547	liq	-26.8	130	1.4990	1.4990 ¹⁵	i H ₂ O; s Et OH, et h, bz
2052	1-Chloro-1-fluoroethane		$\text{C}_2\text{H}_4\text{ClF}$	1615-75-4	82.504	vol liq or gas		16.2			
2053	1-Chloro-2-fluoroethane		$\text{C}_2\text{H}_4\text{ClF}$	762-50-5	82.504			52.8	1.174 ⁷⁰	1.3775 ²⁰	vs et h, Et OH
2054	Chlorofluoroethane		$\text{C}_2\text{H}_3\text{ClF}$	593-70-4	68.478	col gas	-135.1	-9.1			sl H ₂ O; vs chl
2055	1-Chloro-3-fluoro-2-methylbenzene		$\text{C}_8\text{H}_7\text{ClF}$	443-83-4	144.574			154	1.191 ²⁵	1.5026 ²⁰	
2056	2-Chloro-1-fluoro-4-nitrobenzene	3-Chloro-4-fluoronitrobenzene	$\text{C}_6\text{H}_3\text{ClFNO}_2$	350-30-1	175.545		41.5	229.5			
2057	4-Chloro-1-(4-fluorophenyl)-1-butanol		$\text{C}_{10}\text{H}_{10}\text{ClFO}$	3874-54-2	200.636			130	1.22 ²⁵	1.5255 ²⁰	
2058	3-Chloro-2,5-difluorobenzonitrile		$\text{C}_7\text{H}_3\text{ClF}_2\text{N}$	96-02-6	132.502		33	196	1.5375 ²⁵	1.4980 ²⁰	
2059	1-Chloro-1,2,2,3,3,4,4-heptafluorocyclohexane	Refri gerant C317	$\text{C}_6\text{Cl}_2\text{F}_7$	377-41-3	216.485	liq or gas	-39.1	25	1.602 ²		
2060	1-Chloroheptane	Heptyl chloride	$\text{C}_7\text{H}_{15}\text{Cl}$	629-06-1	134.647	liq	-69.5	160.4	0.876 ²	1.4264 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c; s chl
2061	2-Chloroheptane		$\text{C}_7\text{H}_{15}\text{Cl}$	1001-89-4	134.647			61 ² ; 46 ¹⁹	0.8672 ²⁰	1.4221 ²⁰	i H ₂ O; vs et h; s bz, chl, HOAc
2062	3-Chloroheptane		$\text{C}_7\text{H}_{15}\text{Cl}$	999-52-0	134.647			144; 48 ⁰	0.8690 ²⁰	1.4228 ²⁰	vs bz, et h
2063	4-Chloroheptane		$\text{C}_7\text{H}_{15}\text{Cl}$	998-95-8	134.647			144	0.8710 ⁰	1.4237 ²⁰	vs bz, et h
2064	7-Chloro-1-heptanol	Heptamethylene chlorohydrin	$\text{C}_7\text{H}_{15}\text{ClO}$	55944-70-2	150.646	cry (pet h, bz)	11	150	0.9998 ¹⁵	1.4537 ²⁵	vs Et OH, pet h
2065	1-Chlorohexadecane		$\text{C}_{16}\text{H}_{33}\text{Cl}$	4860-03-1	260.886		17.9	326.6	0.8635 ⁰	1.4503 ²⁰	i H ₂ O
2066	1-Chlorohexane	Hexyl chloride	$\text{C}_6\text{H}_{13}\text{Cl}$	544-10-5	120.620	liq	-94.0	135.1	0.878 ¹	1.4200 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; vs chl; sl ct c
2067	2-Chlorohexane	2-Hexyl chloride	$\text{C}_6\text{H}_{13}\text{Cl}$	638-28-8	120.620			122.5	0.8694 ¹	1.4142 ²²	vs ace, bz, et h, Et OH
2068	3-Chlorohexane	3-Hexyl chloride	$\text{C}_6\text{H}_{13}\text{Cl}$	2346-81-8	120.620			123	0.8684 ⁰	1.4163 ²⁰	vs ace, bz, et h, Et OH
2069	6-Chloro-1-hexanol		$\text{C}_6\text{H}_{13}\text{ClO}$	2009-83-8	136.619			107 ²	1.0241 ²⁰	1.4550 ²⁰	sl H ₂ O; vs Et OH, et h
2070	4-Chloro-17-hydroxyandrost-4-en-3-one, (17 β)	Cl ostebolone, (17 β)	$\text{C}_{27}\text{H}_{42}\text{ClO}_2$	1093-58-9	322.869		189				
2071	5-Chloro-2-hydroxybenzaldehyde		$\text{C}_7\text{H}_5\text{ClO}_2$	635-93-8	156.567	pl (al)	100.3	105 ²			i H ₂ O; vs Et OH; s et h, al k
2072	4-Chloro- α -hydroxybenzoic acid		$\text{C}_7\text{H}_5\text{ClO}_3$	492-86-4	186.593		120.3				vs bz, Et OH
2073	3-Chloro-4-hydroxybenzoic acid		$\text{C}_7\text{H}_5\text{ClO}_3$	3964-58-7	172.566	nd (w)	171	sub			sl H ₂ O, bz, chl; vs Et OH, et h, ace
2074	5-Chloro-2-hydroxybenzoic acid		$\text{C}_7\text{H}_5\text{ClO}_3$	321-14-2	172.566	nd (w, al)	174.8				s H ₂ O, et h; vs Et OH, bz; sl ace
2075	2-Chloro-5-hydroxybenzophenone		$\text{C}_{13}\text{H}_9\text{ClO}_2$	85-19-8	232.662		95.3				i H ₂ O
2076	3-Chloro-4-hydroxy-5-methylbenzaldehyde		$\text{C}_8\text{H}_7\text{ClO}_2$	19463-48-0	186.593	ter	165				i ₂ Et; s Et OH, HOAc
2077	1-Chloro-2-iodobenzene		$\text{C}_6\text{H}_4\text{ClI}$	615-41-8	238.453		0.7	234.5	1.9515 ²⁵	1.6331 ²⁵	i H ₂ O; s ace; sl ct c
2078	1-Chloro-3-iodobenzene		$\text{C}_6\text{H}_4\text{ClI}$	625-99-0	238.453			230	1.9255 ⁰		i H ₂ O; s ace
2079	1-Chloro-4-iodobenzene		$\text{C}_6\text{H}_4\text{ClI}$	637-87-6	238.453	lf (ace, al)	57	227	1.886		i H ₂ O; s Et OH, PhNQ; sl chl
2080	1-Chloro-4-iodobutane		$\text{C}_4\text{H}_8\text{ClI}$	10297-05-9	218.464	liq		116; 89	1.785	1.5400 ²⁰	
2081	Chloroiodoethane		$\text{C}_2\text{H}_4\text{ClI}$	593-71-5	176.384			109	2.422 ⁰	1.5822 ²⁰	vs ace, bz, et h, Et OH
2082	1-Chloro-3-iodopropane		$\text{C}_3\text{H}_6\text{ClI}$	6940-76-7	204.437			171	1.904 ⁰	1.5472 ²⁰	i H ₂ O; s et h, bz, chl; sl ct c
2083	5-Chloro-7-iodooctane	iodochlorohydroquinone	$\text{C}_8\text{H}_{17}\text{ClINO}$	130-26-7	305.499	ye br nd (al)	178.5				sl Et OH; s HOAc
2084	1-Chloro-2-iodocyanobenzene		$\text{C}_6\text{H}_4\text{ClINO}$	3320-83-0	153.566		30.5	200; 115 ³			sl ct c
2085	1-Chloro-3-iodocyanobenzene		$\text{C}_6\text{H}_4\text{ClINO}$	2909-38-8	153.566			113 ³			sl chl
2086	1-Chloro-2-iodopropylbenzene		$\text{C}_9\text{H}_{11}\text{ClI}$	2077-13-6	154.636	liq	-74.4	191.1	1.034 ¹	1.5168 ²⁰	vs ace, bz, et h, Et OH



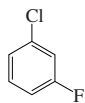
2-Chloroethyl vinyl ether



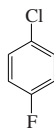
3-Chloro-4-fluoroaniline



1-Chloro-2-fluorobenzene



1-Chloro-3-fluorobenzene



1-Chloro-4-fluorobenzene



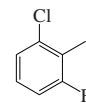
1-Chloro-1-fluoroethane



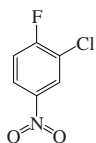
1-Chloro-2-fluoroethane



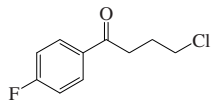
Chloroform



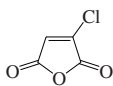
1-Chloro-3-fluoro-2-methylbenzene



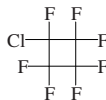
2-Chloro-1-fluoro-4-nitrobenzene



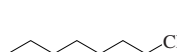
4-Chloro-1-(4-fluorophenyl)-1-butanol



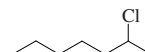
3-Chloro-2,5-furandione



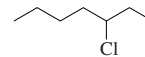
1,1,1,2,2,3,3,4,4,4,5,5,5-dodecafluoroheptane



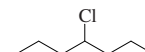
1-Chloroheptane



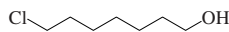
2-Chloroheptane



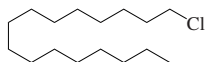
3-Chloroheptane



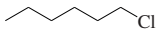
4-Chloroheptane



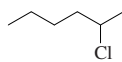
7-Chloro-1-heptanol



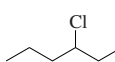
1-Chlorohexadecane



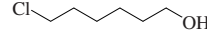
1-Chlorohexane



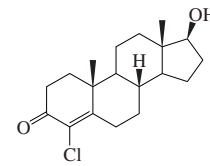
2-Chlorohexane



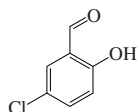
3-Chlorohexane



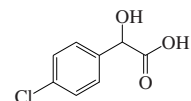
6-Chloro-1-hexanol



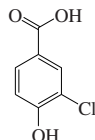
4-Chloro-17-hydroxyandrost-4-en-3-one(17β)



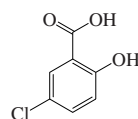
5-Chloro-2-hydroxybenzaldehyde



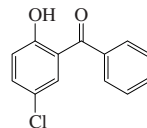
4-Chloro-α-hydroxybenzoic acid



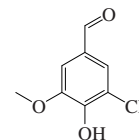
3-Chloro-4-hydroxybenzoic acid



5-Chloro-2-hydroxybenzoic acid



2-Chloro-5-hydroxybenzophenone



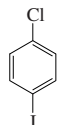
3-Chloro-4-hydroxy-5-methoxybenzaldehyde



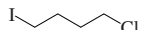
1-Chloro-2-iodobenzene



1-Chloro-3-iodobenzene



1-Chloro-4-iodobenzene



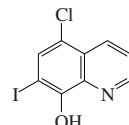
1-Chloro-4-iodobutane



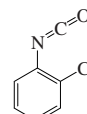
Chloroform



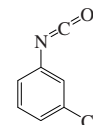
1-Chloro-3-iodopropane



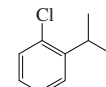
5-Chloro-7-iodo-8-quinolinol



1-Chloro-2-isocyanatobenzene

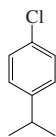


1-Chloro-3-isocyanatobenzene

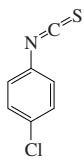


1-Chloro-2-isopropylbenzene

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2087	1-Chloro-4-isopropylbenzene		$\text{C}_9\text{H}_{11}\text{Cl}$	2621-46-7	154.636	liq	-12.3	198.3	1.0208	1.5117 ²⁰	i H ₂ O; misc Et OH, et h, ace, ct c; vs bz
2088	1-Chloro-4-isocyanatobenzene		$\text{C}_6\text{H}_4\text{ClNS}$	2131-55-7	169.632	nd (al)	46	249.5			i H ₂ O; s Et OH
2089	Chlorometane	Met hyl chl ori de	CH_3Cl	74-87-3	50.488	col gas	-97.7	-24.09	0.911 ⁸ (p>1 at m)	1.3389 ²⁰	sl H ₂ O; s Et OH; misc et h, ace, bz, chl
2090	4-Chloro-2-methoxyaniline	4-Chloro-2-aminodiphenyl ether	$\text{C}_8\text{H}_7\text{ClNO}$	93-50-5	157.598	nd or pr (di l al)	52	260			s Et OH, et h, bz, chl
2091	5-Chloro-2-methoxyaniline		$\text{C}_8\text{H}_7\text{ClNO}$	95-03-4	157.598	nd (di l al)	84				s Et OH; sl li g
2092	(Chloromethoxy)ethane	Chloromethyl ethyl ether	$\text{C}_3\text{H}_7\text{ClO}$	3188-13-4	94.540			83	1.0188 ⁵	1.4040 ²⁰	
2093	1-Chloro-2-methoxyethane		$\text{C}_3\text{H}_7\text{ClO}$	627-42-9	94.540			92.5	1.0345 ²⁰	1.4111 ²⁰	vs H ₂ O, et h
2094	[(Chloromethoxy)methyl]benzene		$\text{C}_7\text{H}_7\text{ClO}$	3587-60-8	156.609			103 ³	1.1350 ²⁰	1.5192 ²⁰	
2095	1-(Chloromethoxy)propane		$\text{C}_4\text{H}_9\text{ClO}$	3587-57-3	108.566			109	0.9884 ²⁰	1.4125 ²⁰	vs et h, Et OH
2096	Chloromethyl acetate		$\text{C}_3\text{H}_5\text{ClO}_2$	625-56-9	108.524			116	1.194 ²⁰	1.409 ²⁰	vs et h, Et OH
2097	5-Chloro-2-(methylanilino)benzophenone	N-Methyl-2-amino-5-chlorobenzophenone	$\text{C}_{14}\text{H}_{12}\text{ClNO}$	1022-13-5	245.704		92				
2098	4-Chloro-N-methylaniline		$\text{C}_7\text{H}_7\text{ClN}$	932-96-7	141.599			240	1.169 ¹	1.5835 ²⁰	s Et OH, ace, bz
2099	2-Chloro-4-methylaniline		$\text{C}_7\text{H}_7\text{ClN}$	615-65-6	141.599		7	220	1.15 ²⁰	1.5748 ²²	sl Et OH, bz
2100	2-Chloro-6-methylaniline		$\text{C}_7\text{H}_7\text{ClN}$	87-63-8	141.599			215; 97 ⁰			
2101	3-Chloro-2-methylaniline		$\text{C}_7\text{H}_7\text{ClN}$	87-60-5	141.599		1	245		1.5880 ³⁰	s H ₂ O, Et OH; i et h, bz
2102	3-Chloro-4-methylaniline		$\text{C}_7\text{H}_7\text{ClN}$	95-74-9	141.599		26	243			s Et OH; sl ct c
2103	4-Chloro-2-methylaniline	p-Chloro-ortho-aminodiphenyl ether	$\text{C}_8\text{H}_7\text{ClN}$	95-69-2	141.599	lf (al)	30.3	244			s Et OH; sl ct c
2104	5-Chloro-2-methylaniline		$\text{C}_7\text{H}_7\text{ClN}$	95-79-4	141.599		26	239; 140 ³			vs Et OH
2105	1-Chloro-2-methyl-9,10-anthracenedione		$\text{C}_{15}\text{H}_9\text{ClO}_2$	129-35-1	256.684		170.5				i Et OH, et h; sl py
2106	(Chloromethyl)benzene	Benzyl chloride	$\text{C}_7\text{H}_7\text{Cl}$	100-44-7	126.584	liq	-45	179	1.1004	1.5391 ²⁰	i H ₂ O; misc Et OH, et h, chl; sl ct c
2107	3-Chloro-N-methylbenzenemethanamine		$\text{C}_8\text{H}_{10}\text{ClN}$	39191-07-6	155.625			88 ⁸		1.5350 ²⁵	s chl
2108	α-(Chloromethyl)benzenemethanol		$\text{C}_7\text{H}_7\text{ClO}$	1674-30-2	156.609			128 ⁷ ; 121 ¹¹	1.1926 ²⁰	1.5523 ²⁰	s Et OH; vs et h
2109	4-Chloro-α-methylbenzenemethanol		$\text{C}_8\text{H}_9\text{ClO}$	3391-10-4	156.609			121 ¹⁵		1.5505 ²⁰	s ct c
2110	5-(Chloromethyl)-1,3-benzodioxole		$\text{C}_8\text{H}_7\text{ClO}_2$	20850-43-5	170.594		20.5	134 ¹⁴	1.312 ²⁵	1.5660 ²⁰	
2111	1-Chloro-3-methylbutane	Isopentyl chloride	$\text{C}_5\text{H}_{11}\text{Cl}$	107-84-6	106.594	liq	-104.4	98.9	0.875 ⁰	1.4084 ²⁰	sl H ₂ O; misc Et OH, et h; vs chl
2112	2-Chloro-2-methylbutane		$\text{C}_5\text{H}_{11}\text{Cl}$	594-36-5	106.594	liq	-73.5	85.6	0.865 ³	1.4055 ²⁰	sl H ₂ O; s Et OH, et h, ct c
2113	2-Chloro-3-methylbutane		$\text{C}_5\text{H}_{11}\text{Cl}$	631-65-2	106.594			91.5	0.878 ⁰		
2114	1-Chloro-3-methyl-2-butene		$\text{C}_5\text{H}_9\text{Cl}$	503-60-6	104.578			109	0.9273 ⁰	1.4485 ²⁰	vs ace, et h, Et OH, chl
2115	3-Chloro-3-methyl-1-butene		$\text{C}_5\text{H}_9\text{Cl}$	1111-97-3	102.563	liq	-61	76	0.906 ¹		
2116	(Chloromethyl)cyclopropane		$\text{C}_3\text{H}_5\text{Cl}$	5911-08-0	90.552	liq	-90.9	88	0.98	1.4350 ²⁰	
2117	1-(Chloromethyl)-2,4-dimethylbenzene		$\text{C}_9\text{H}_{11}\text{Cl}$	824-55-5	154.636			215.5; 110 ³⁰	1.0580 ¹⁹		vs bz, et h, Et OH
2118	(Chloromethyl)dimethylphenylsilane		$\text{C}_9\text{H}_{13}\text{ClSi}$	1833-51-8	184.738			225	1.024 ⁰		s ct c, CS ₂
2119	Chloromethyl diphenylsilane		$\text{C}_{13}\text{H}_{15}\text{ClSi}$	144-79-6	232.781			295	1.127 ⁷	1.5742 ²⁰	
2120	1-Chloro-3-(1-methyl ethoxy)-2-propanol		$\text{C}_6\text{H}_{13}\text{ClO}_2$	4288-84-0	152.619			182; 87 ²⁰	1.0910 ²⁰	1.4370 ²⁵	s Et OH, et h
2121	1-(Chloromethyl)-4-ethylbenzene		$\text{C}_{10}\text{H}_{13}\text{Cl}$	1467-05-6	154.636			95 ⁵		1.5290 ²⁵	vs bz, Et OH, chl
2122	(1-Chloro-1-methyl ethyl)benzene		$\text{C}_{10}\text{H}_{13}\text{Cl}$	934-53-2	154.636			98	1.192 ²⁵	1.5290 ²⁵	
2123	1-(Chloromethyl)-2-fluorobenzene		$\text{C}_6\text{H}_4\text{ClF}$	345-35-7	144.574			172; 86 ⁰	1.216 ²⁵	1.5150 ²⁰	
2124	1-(Chloromethyl)-4-fluorobenzene		$\text{C}_6\text{H}_4\text{ClF}$	352-11-4	144.574			82 ²⁵ ; 76 ²⁰	1.2143 ³⁰	1.5130	
2125	2-(Chloromethyl)furan		$\text{C}_5\text{H}_7\text{ClO}$	617-88-9	116.546			49 ⁶	1.1783 ²⁰	1.4941 ²⁰	vs bz, et h, Et OH
2126	3-(Chloromethyl)heptane		$\text{C}_7\text{H}_{15}\text{Cl}$	123-04-6	148.674			172	0.8769 ²⁰	1.4319 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; sl ct c



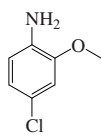
1-Chloro-4-isopropylbenzene



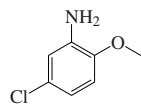
1-Chloro-4-isothiocyanatobenzene



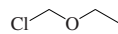
Chloroethane



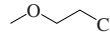
4-Chloro-2-methoxyaniline



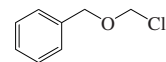
5-Chloro-2-methoxyaniline



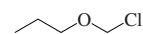
(Chloroethyl) ether



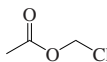
1-Chloro-2-methoxyethane



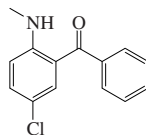
[(Chloromethyl)methyl]benzene



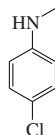
1-(Chloroethoxy)propane



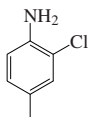
Chloroacetate



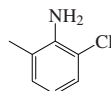
5-Chloro-2-(N-methylamino)benzophenone



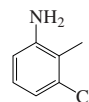
4-Chloro-N-methylaniline



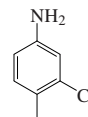
2-Chloro-4-methylaniline



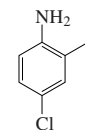
2-Chloro-6-methylaniline



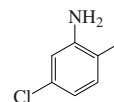
3-Chloro-2-methylaniline



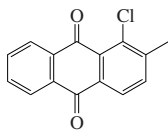
3-Chloro-4-methylaniline



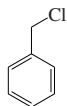
4-Chloro-2-methylaniline



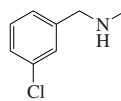
5-Chloro-2-methylaniline



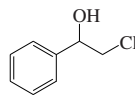
1-Chloro-2-methyl-9,10-anthracenedione



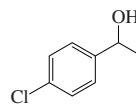
(Chloromethyl)benzene



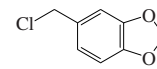
3-Chloro-N-methylbenzenamine



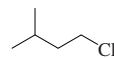
alpha-(Chloromethyl)benzenamine



4-Chloro-alpha-methylbenzenamine



5-(Chloromethyl)-1,3-benzodioxole



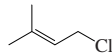
1-Chloro-3-methylbutane



2-Chloro-2-methylbutane



2-Chloro-3-methylbutane



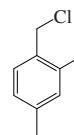
1-Chloro-3-methyl-2-butene



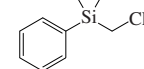
3-Chloro-3-methyl-1-butyne



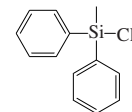
(Chloromethyl)cyclopropane



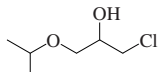
1-(Chloromethyl)-2,4-dimethylbenzene



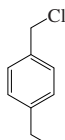
(Chloromethyl)dimethylphenylsilane



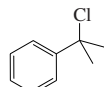
Chloromethyl diphenylsilane



1-Chloro-3-(1-methoxyethoxy)-2-propanol



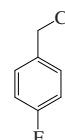
1-(Chloromethyl)-4-ethylbenzene



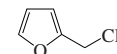
1-(Chloromethyl)-1-ethylbenzene



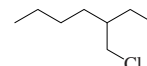
1-(Chloromethyl)-2-fluorobenzene



1-(Chloromethyl)-4-fluorobenzene

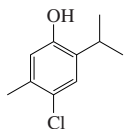


2-(Chloromethyl)furan

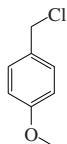


3-(Chloromethyl)heptane

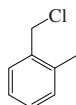
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2127	4-Chl oro-5-met hyl-2-i sopropyl phenol	Chl orot hymol	C ₁₃ H ₁₃ ClO	89-68-9	184.662		63	258.5			vs H ₂ O; s Et OH, et h, bz, ct c, pet h, al k
2128	1-(Chl oromet hyl)-4-met hoxybenzene		C ₁₀ H ₉ ClO	824-94-2	156.609	nd	24.5	262.5	1.26 ⁴⁰	1.580 ²⁰	vs ace, bz, et h
2129	1-(Chl oromet hyl)-2-met hyl benzene		C ₁₀ H ₉ Cl	552-45-4	140.610			198; 90 ²⁰	1.063 ²⁵	1.5410 ²⁵	vs et h, Et OH
2130	1-(Chl oromet hyl)-3-met hyl benzene		C ₁₀ H ₉ Cl	620-19-9	140.610			195.5	1.064 ²⁰	1.5345 ²⁰	i H ₂ O; s Et OH, et h
2131	1-(Chl oromet hyl)-4-met hyl benzene		C ₁₀ H ₉ Cl	104-82-5	140.610			201; 90 ²⁰	1.0512 ²⁰	1.5380	i H ₂ O; s Et OH; msc et h
2132	Chl oromet hyl met hyl et her		C ₁₀ H ₉ ClO	107-30-2	80.513	li q	-103.5	59.5	1.069	1.397 ²⁰	s Et OH, et h, ace, chl
2133	2-(Chl oromet hyl)-2-met hyl oxi rane		C ₁₀ H ₉ ClO	598-09-4	106.551			122	1.101 ⁴⁰	1.4310 ²⁰	vs H ₂ O, et h
2134	1-(Chl oromet hyl)napht hal ene		C ₁₁ H ₉ Cl	86-52-2	176.642	pr	32	291.5	1.181 ³⁰	1.6380 ²⁰	i H ₂ O; s Et OH, ct c, pet h
2135	2-(Chl oromet hyl)napht hal ene		C ₁₁ H ₉ Cl	2506-41-4	176.642	lf (al)	48.5	169			i H ₂ O; s Et OH, pet h
2136	1-(Chl oromet hyl)-2-ni t robenzene		C ₁₀ H ₇ ClNO ₂	612-23-7	171.582	cry (li g)	50.0	125		1.5557 ⁶²	i H ₂ O; s Et OH, et h, HOAc; vs ace, bz
2137	1-(Chl oromet hyl)-3-ni t robenzene		C ₁₀ H ₇ ClNO ₂	619-23-8	171.582	pa ye nd (li g)	46	179		1.5577 ⁶²	vs ace, bz, et h, Et OH
2138	1-(Chl oromet hyl)-4-ni t robenzene	4-Ni t robenzyl chl ori de	C ₁₀ H ₇ ClNO ₂	100-14-1	171.582	pl or nd (al)	71			1.564 ⁷²	i H ₂ O; s Et OH, et h; vs ace, bz, AcOEt
2139	1-Chl oro-2-met hyl-3-ni t robenzene		C ₁₀ H ₇ ClNO ₂	83-42-1	171.582	nd (di l al)	37.8	238		1.537 ⁷	i H ₂ O; s Et OH
2140	1-Chl oro-2-met hyl-4-ni t robenzene		C ₁₀ H ₇ ClNO ₂	13290-74-9	171.582	ye cry	42.5	249			vs et h
2141	1-Chl oro-4-met hyl-2-ni t robenzene	4-Chl oro-3-ni t rot ol uene	C ₁₀ H ₇ ClNO ₂	89-60-1	171.582		7	261; 118 ¹¹		1.5572 ²⁰	i H ₂ O; s ct c
2142	2-Chl oro-1-met hyl-4-ni t robenzene		C ₁₀ H ₇ ClNO ₂	121-86-8	171.582	nd (al)	66.5	260		1.5470 ⁹	sl H ₂ O, chl; s Et OH, et h, HOAc
2143	4-Chl oro-1-met hyl-2-ni t robenzene		C ₁₀ H ₇ ClNO ₂	89-59-8	171.582	mcl nd	38	242; 115.5 ¹	1.2559 ⁸⁰		i H ₂ O; s Et OH, et h; sl chl
2144	2-Chl oro-4-met hyl pent ane		C ₁₀ H ₁₃ Cl	25346-32-1	120.620			113	0.861 ⁰⁹	1.4113 ²⁰	vs et h
2145	3-(Chl oromet hyl)pent ane		C ₁₀ H ₁₃ Cl	4737-41-1	120.620			126; 83 ⁰²	0.8914 ²⁰	1.4222 ²⁰	vs bz, et h, chl
2146	2-Chl oro-4-met hyl phenol	2-Chl oro-cresol	C ₇ H ₇ ClO	6640-27-3	142.583			195.5	1.1785 ⁷	1.5200 ²⁷	vs bz, et h, Et OH
2147	2-Chl oro-5-met hyl phenol	6-Chl oro-cresol	C ₇ H ₇ ClO	615-74-7	142.583	pr (pet h)	45.5	196	1.215 ⁵		vs H ₂ O, Et OH
2148	2-Chl oro-6-met hyl phenol	6-Chl oro-cresol	C ₇ H ₇ ClO	87-64-9	142.583			189; 80 ²⁰		1.5449 ²⁰	sl H ₂ O; s et h
2149	3-Chl oro-4-met hyl phenol	3-Chl oro-cresol	C ₇ H ₇ ClO	615-62-3	142.583	nd (al)	55.5	228			vs bz, et h, Et OH
2150	4-Chl oro-2-met hyl phenol	4-Chl oro-cresol	C ₇ H ₇ ClO	1570-64-5	142.583	nd (pet h)	51	223			sl H ₂ O; s pet h
2151	4-Chl oro-3-met hyl phenol	4-Chl oro-cresol	C ₇ H ₇ ClO	59-50-7	142.583	nd (pet h)	67	235			sl H ₂ O, chl; s Et OH, et h, pet h
2152	(4-Chl oro-2-met hyl phenoxy)acet i c aci d	MCPA	C ₉ H ₉ ClO ₃	94-74-6	200.618	pl (bz, t o)	120				sl H ₂ O; vs Et OH, et h; s bz, ct c
2153	4-(4-Chl oro-2-met hyl phenoxy)but anoi c aci d		C ₁₁ H ₁₃ ClO ₃	94-81-5	228.672		100				
2154	Chl oromet hyl phenyl si l ane		C ₁₀ H ₉ ClSi	1631-82-9	156.685			119 ⁰	1.043 ²⁰	1.5171 ²⁰	
2155	(Chl oromet hyl)phosphoni c aci d		C ₁₀ H ₉ ClO ₃ P	2565-58-4	130.468	nd (bz/MeNO ₂)	90				
2156	<i>N</i> -Chl oromet hyl pht hal i mi de		C ₉ H ₆ ClNO ₂	17564-64-6	195.603			135.5			
2157	2-Chl oro-2-met hyl propanal		C ₆ H ₇ ClO	917-93-1	106.551			90	1.053 ⁵	1.4160 ¹⁶	vs et h, Et OH
2158	1-Chl oro-2-met hyl propane	Isobut yl chl ori de	C ₆ H ₉ Cl	513-36-0	92.567	li q	-130.3	68.5	0.877 ³	1.3984 ²⁰	sl H ₂ O, ct c; s et h, ace, chl
2159	2-Chl oro-2-met hyl propane	<i>tert</i> But yl chl ori de	C ₆ H ₉ Cl	507-20-0	92.567	li q	-25.60	50.9	0.842 ⁰	1.3857 ²⁰	sl H ₂ O; msc Et OH, et h; s bz, ct c, chl
2160	1-Chl oro-2-met hyl propene	Di met hyl vi nyl chl ori de	C ₅ H ₇ Cl	513-37-1	90.552			68	0.9186 ²⁰	1.4221 ²⁰	sl H ₂ O; s chl
2161	3-Chl oro-2-met hyl propene		C ₅ H ₇ Cl	563-47-3	90.552			71.5	0.9165 ²⁰	1.4291 ²⁰	msc Et OH, et h; s ace; vs chl
2162	3-(Chl oromet hyl)pyri di ne, hydrochl ori de		C ₆ H ₇ Cl ₂ N	6959-48-4	164.033	hyg	143.8				
2163	Chl oromet hyl si l ane		C ₁₀ H ₉ Si	993-00-0	80.590	col gas	-135	7; -45			
2164	1-Chl oro-4-(met hyl sul f onyl)benzene	4-Chl orobenzenet ol met hyl S,S-di oxi de	C ₇ H ₇ ClOS ₂	98-57-7	190.648		98				
2165	1-Chl oro-4-(met hyl t hi o)benzene		C ₇ H ₇ ClS	123-09-1	158.649			105 ⁰			



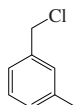
4-Chloro-5-methyl-2-isopropylphenol



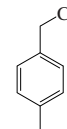
1-(Chloromethyl)-4-methoxybenzene



1-(Chloromethyl)-2-methylbenzene



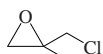
1-(Chloromethyl)-3-methylbenzene



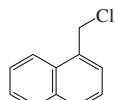
1-(Chloromethyl)-4-methylbenzene



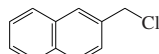
Chloromethyl ether



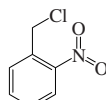
2-(Chloromethyl)-2-methyloxirane



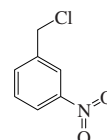
1-(Chloromethyl)naphthalene



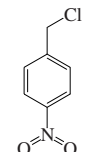
2-(Chloromethyl)naphthalene



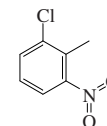
1-(Chloromethyl)-2-nitrobenzene



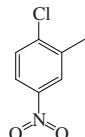
1-(Chloromethyl)-3-nitrobenzene



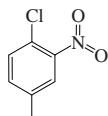
1-(Chloromethyl)-4-nitrobenzene



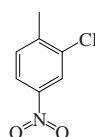
1-Chloro-2-methyl-3-nitrobenzene



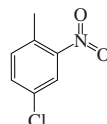
1-Chloro-2-methyl-4-nitrobenzene



1-Chloro-4-methyl-2-nitrobenzene



2-Chloro-1-methyl-4-nitrobenzene



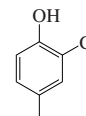
4-Chloro-1-methyl-2-nitrobenzene



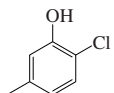
2-Chloro-4-methylpentane



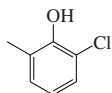
3-(Chloromethyl)pentane



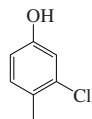
2-Chloro-4-methylphenol



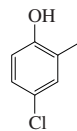
2-Chloro-5-methylphenol



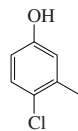
2-Chloro-6-methylphenol



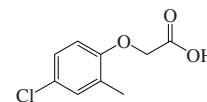
3-Chloro-4-methylphenol



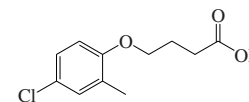
4-Chloro-2-methylphenol



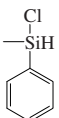
4-Chloro-3-methylphenol



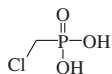
(4-Chloro-2-methylphenoxy)acetic acid



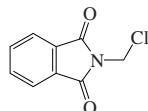
4-(4-Chloro-2-methylphenoxy)butanoic acid



Chloromethylphenylsilane



(Chloromethyl)phosphonic acid



N-Chloromethylphthalimide



2-Chloro-2-methylpropane



1-Chloro-2-methylpropane



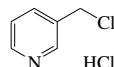
2-Chloro-2-methylpropane



1-Chloro-2-methylpropene



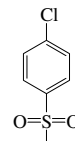
3-Chloro-2-methylpropene



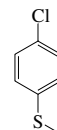
3-(Chloromethyl)pyridine hydrochloride



Chlorosilane

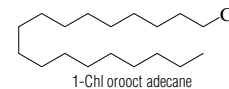
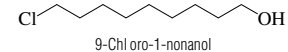
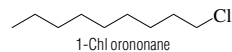
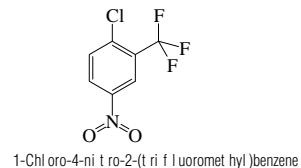
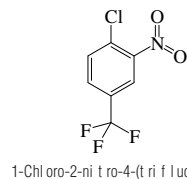
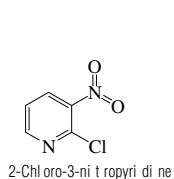
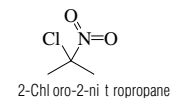
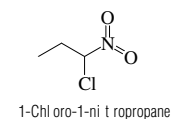
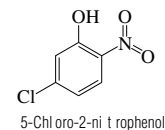
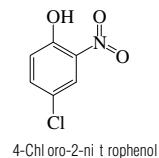
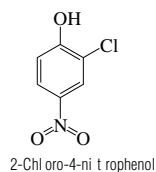
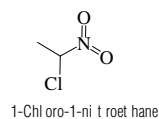
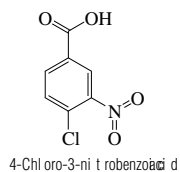
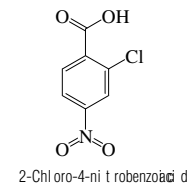
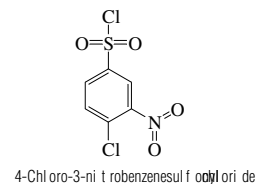
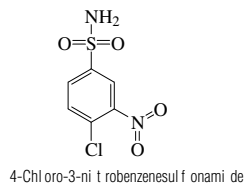
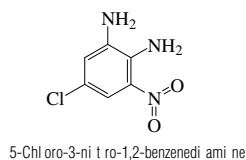
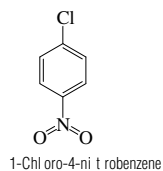
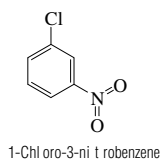
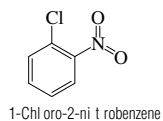
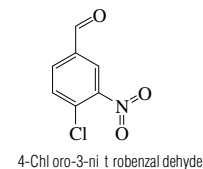
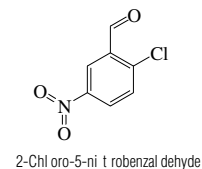
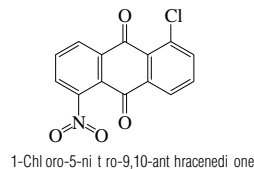
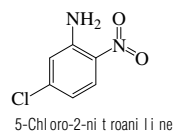
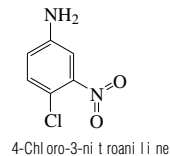
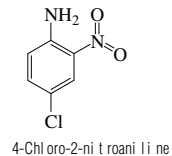
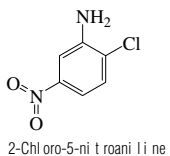
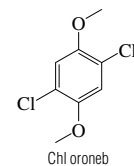
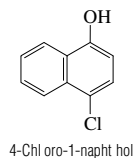
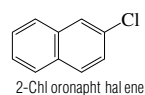
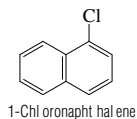
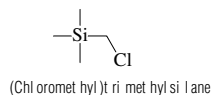
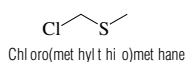
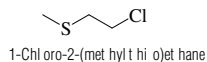


1-Chloro-4-(methylsulfonyl)benzene



1-Chloro-4-(methylthio)benzene

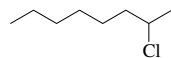
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2166	1-Chloro-2-(methylthio)ethane		$\text{C}_2\text{H}_5\text{CS}$	542-81-4	110.606			140; 60 ⁰	1.123 ²⁰	1.4902 ²⁰	s Et OH, et h, ace
2167	Chloro(methylthio)ethane		$\text{C}_2\text{H}_5\text{CS}$	2373-51-5	96.579			105	1.153 ⁵	1.4963 ²⁰	
2168	(Chloromethyl)triethylsilane		$\text{C}_4\text{H}_{11}\text{ClSi}$	2344-80-1	122.669			98.5	0.87 ⁹	1.4175 ²⁰	
2169	1-Chloronaphthalene	1-Naphthyl chloride	$\text{C}_{10}\text{H}_7\text{Cl}$	90-13-1	162.616	oil y li q	-2.5	259; 106.5	1.1880 ²⁵	1.6326 ²⁰	i H ₂ O; s Et OH, et h, bz, C ₆ S sl ct c
2170	2-Chloronaphthalene		$\text{C}_{10}\text{H}_7\text{Cl}$	91-58-7	162.616	pl (di l al), lf	58.0	256	1.1377	1.6079 ¹³	i H ₂ O; s Et OH, et h, bz, chl, C ₆ S
2171	4-Chloro-1-naphthol		$\text{C}_{10}\text{H}_7\text{ClO}$	604-44-4	178.615	nd (chl, aq al)	120.5				s Et OH, et h, ace, bz, chl
2172	Chloroneb	1,4-Dichloro-2,5-dimethoxybenzene	$\text{C}_8\text{H}_6\text{Cl}_2\text{O}_2$	2675-77-6	207.055			134	268		
2173	2-Chloro-4-nitroaniline		$\text{C}_6\text{H}_4\text{ClNO}_2$	121-87-9	172.569	ye nd (w)	108				vs et h, Et OH, HOAc
2174	2-Chloro-5-nitroaniline		$\text{C}_6\text{H}_4\text{ClNO}_2$	6283-25-6	172.569	ye nd (li g)	121				vs et h, Et OH, HOAc
2175	4-Chloro-2-nitroaniline		$\text{C}_6\text{H}_4\text{ClNO}_2$	89-63-4	172.569	dk oran-ye pr (di l al)	116.5				vs Et OH, et h, HOAc; sl ace, li g
2176	4-Chloro-3-nitroaniline		$\text{C}_6\text{H}_4\text{ClNO}_2$	635-22-3	172.569	ye nd or pr (w) nd (pet h)	103				s H ₂ O, et h, chl; vs Et OH; sl li g
2177	5-Chloro-2-nitroaniline		$\text{C}_6\text{H}_4\text{ClNO}_2$	1635-61-6	172.569	ye nd (CS ₂)ye lf (al, bz)	127.8	sub			vs et h, Et OH
2178	1-Chloro-5-nitro-9,10-antanthracenedione		$\text{C}_{14}\text{H}_6\text{ClNO}_4$	129-40-8	287.656		315.3				i H ₂ O, Et OH, et h, li g; sl bz; s py
2179	2-Chloro-5-nitrobenzaldehyde		$\text{C}_7\text{H}_4\text{ClNO}_3$	6361-21-3	185.565	cry (al)	81.3				vs Et OH, chl
2180	4-Chloro-3-nitrobenzaldehyde		$\text{C}_7\text{H}_4\text{ClNO}_3$	16588-34-4	185.565		64.5				sl H ₂ O; s chl
2181	1-Chloro-2-nitrobenzene	<i>o</i> -Chloronitrobenzene	$\text{C}_6\text{H}_4\text{ClNO}_2$	88-73-3	157.555	mcl nd	32.1	245.5	1.368 ⁴²		i H ₂ O; s Et OH, et h, bz; vs ace, t ol, py
2182	1-Chloro-3-nitrobenzene	<i>m</i> -Chloronitrobenzene	$\text{C}_6\text{H}_4\text{ClNO}_2$	121-73-3	157.555	pa ye ort h pr (al)	44.4	235.5	1.343 ⁵⁰	1.5374 ⁸⁰	i H ₂ O; s Et OH, et h, bz, chl, C ₆ S
2183	1-Chloro-4-nitrobenzene	<i>p</i> -Chloronitrobenzene	$\text{C}_6\text{H}_4\text{ClNO}_2$	100-00-5	157.555	mcl pr	82	242	1.2979 ⁰	1.5376 ¹⁰⁰	i H ₂ O; sl Et OH; s et h, chl, C ₆ S
2184	5-Chloro-3-nitro-1,2-benzenediamine		$\text{C}_6\text{H}_4\text{ClN}_2\text{O}$	42389-30-0	187.584		167				
2185	4-Chloro-3-nitrobenzenesulfonamide		$\text{C}_6\text{H}_4\text{ClN}_2\text{O}_2\text{S}$	97-09-6	236.633	ye cry (Et OH)	175				
2186	4-Chloro-3-nitrobenzenesulfonyl chloride		$\text{C}_6\text{H}_3\text{Cl}_2\text{NO}_4\text{S}$	97-08-5	256.064		60.8				
2187	2-Chloro-4-nitrobenzoic acid		$\text{C}_7\text{H}_4\text{ClNO}_4$	99-60-5	201.565	nd (w)	141.8				s H ₂ O, Et OH, et h, bz
2188	2-Chloro-5-nitrobenzoic acid		$\text{C}_7\text{H}_4\text{ClNO}_4$	2516-96-3	201.565	nd or pr (w)	166.5		1.608 ¹⁸		sl H ₂ O, ace; s Et OH, et h, bz
2189	4-Chloro-3-nitrobenzoic acid		$\text{C}_7\text{H}_4\text{ClNO}_4$	96-99-1	201.565	nd or pl (w)	182.8		1.645 ⁸		i H ₂ O; sl Et OH, ace
2190	1-Chloro-1-nitroethane		$\text{C}_2\text{H}_4\text{ClNO}_2$	598-92-5	109.512			124.5	1.2837 ²⁰	1.4224 ²⁰	i H ₂ O; s Et OH, ct c, al k
2191	2-Chloro-4-nitrophenol		$\text{C}_6\text{H}_4\text{ClNO}_3$	619-08-9	173.554	wh nd (50% al)	111				s H ₂ O, Et OH, et h, chl; sl bz
2192	4-Chloro-2-nitrophenol		$\text{C}_6\text{H}_4\text{ClNO}_3$	89-64-5	173.554	ye mcl pr (al)	88.5				i H ₂ O; s Et OH, et h, chl; sl ace
2193	5-Chloro-2-nitrophenol		$\text{C}_6\text{H}_4\text{ClNO}_3$	611-07-4	173.554	ye pr or nd (w)	41	sub			sl H ₂ O; s Et OH, et h, HOAc
2194	1-Chloro-1-nitropropane		$\text{C}_3\text{H}_6\text{ClNO}_2$	600-25-9	123.539			142	1.207 ²⁰	1.4251 ²⁰	sl H ₂ O, chl; s Et OH, et h, oi l s
2195	2-Chloro-2-nitropropane		$\text{C}_3\text{H}_6\text{ClNO}_2$	594-71-8	123.539		-21.5	dec 134; 57 ⁵⁰	1.2 ²⁰	1.4378 ¹⁹	sl H ₂ O; s Et OH, et h, ct c, oi l s; i KOH
2196	2-Chloro-3-nitropyridine		$\text{C}_5\text{H}_4\text{ClN}_2\text{O}$	5470-18-8	158.543	nd (w)	104.0				
2197	1-Chloro-2-nitro-4-(trifluoromethyl)benzene		$\text{C}_7\text{H}_3\text{ClF}_3\text{NO}_2$	121-17-5	225.553	li q	-1.3	222; 9 ⁹	1.511 ²⁵	1.4893 ²⁰	
2198	1-Chloro-4-nitro-2-(trifluoromethyl)benzene		$\text{C}_7\text{H}_3\text{ClF}_3\text{NO}_2$	777-37-7	225.553		22	232	1.527 ²⁵	1.5083 ²⁶	
2199	1-Chlorononane		$\text{C}_9\text{H}_{19}\text{Cl}$	2473-01-0	162.700	li q	-39.4	205.2	0.870 ⁶	1.4343 ²⁰	i H ₂ O; s et h, chl
2200	9-Chloro-1-nonanol		$\text{C}_9\text{H}_{19}\text{ClO}$	51308-99-7	178.699		28	147 ⁴		1.4575 ²⁰	vs et h, Et OH
2201	1-Chlorooctadecane		$\text{C}_{18}\text{H}_{37}\text{Cl}$	3386-33-2	288.940		28.6	352	0.8616 ⁹	1.4524 ²⁰	i H ₂ O; sl ct c



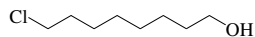
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2202	1-Chl orooct ane	Oct yl chl ori de	$\text{C}_8\text{H}_{17}\text{Cl}$	111-85-3	148.674	liq	-57.8	183.5	0.8734	1.4309 ²⁰	i H ₂ O; vs Et OH, et h; sl ct c
2203	2-Chl orooct ane		$\text{C}_8\text{H}_{17}\text{Cl}$	628-61-5	148.674			172; 75 ²⁸	0.8658 ¹⁷	1.4273 ²¹	i H ₂ O; vs Et OH, et h
2204	8-Chl oro-1-oct anol		$\text{C}_8\text{H}_{17}\text{ClO}$	23144-52-7	164.673			139 ⁹		1.4563 ²⁵	vs et h, Et OH
2205	Chl oropent afluroacet one		$\text{C}_5\text{ClF}_5\text{O}$	79-53-8	182.476	col gas	-133	8			
2206	Chl oropent aflurobenzene		C_5ClF_5	344-07-0	202.509			117.96	1.568 ²⁵	1.4256 ²⁰	
2207	Chl oropent afluroet hane	Ref ri gerant 115	C_5ClF_6	76-15-3	154.466	col gas	-99.4	-39.1	1.5678 ⁴²	1.2678 ⁴²	i H ₂ O; s Et OH, et h
2208	1-Chl oropent ane	Pent yl chl ori de	$\text{C}_5\text{H}_{11}\text{Cl}$	543-59-9	106.594	liq	-99.0	108.4	0.8820	1.4126 ²⁰	i H ₂ O; msc Et OH, et h; s bz, ct c; vs chl
2209	2-Chl oropent ane, (+)	sec-Pent yl chl ori de	$\text{C}_5\text{H}_{11}\text{Cl}$	29882-57-3	106.594	liq	-137	97.0	0.8698	1.4069 ²⁰	i H ₂ O; s Et OH, et h, bz; vs chl
2210	3-Chl oropent ane		$\text{C}_5\text{H}_{11}\text{Cl}$	616-20-6	106.594	liq	-105	97.5	0.8731	1.4082 ²⁰	i H ₂ O; s Et OH, et h, bz; sl ace
2211	5-Chl oropent anoi c aci d		$\text{C}_5\text{H}_9\text{ClO}_2$	1119-46-6	136.577		18	230	1.3416 ²⁵	1.4555 ²⁰	vs et h, Et OH
2212	5-Chl oro-1-pent anol		$\text{C}_5\text{H}_{11}\text{ClO}$	5259-98-3	122.593			112 ²²		1.4518 ²⁰	vs et h, Et OH
2213	5-Chl oro-2-pent anone		$\text{C}_5\text{H}_9\text{ClO}$	5891-21-4	120.577			106 ¹⁰ , 76 ³⁴	1.0523 ²⁰	1.4375 ²⁰	s et h, ace; sl ct c
2214	1-Chl oro-3-pent anone		$\text{C}_5\text{H}_9\text{ClO}$	32830-97-0	120.577			68 ⁰		1.4361 ²⁰	vs et h, Et OH
2215	5-Chl oropent anoyl chl ori de		$\text{C}_5\text{H}_9\text{Cl}_2\text{O}$	1575-61-7	155.022			83 ¹²	1.210 ¹⁸	1.4639 ²⁰	vs et h
2216	4-Chl oro-2-pent ene		$\text{C}_5\text{H}_9\text{Cl}$	1458-99-7	104.578			103; 47 ²⁵	0.8988 ²⁰	1.4322 ²⁰	vs ace, et h, chl
2217	2-Chl orophenol		$\text{C}_6\text{H}_9\text{ClO}$	95-57-8	128.556		9.4	174.9	1.2634 ⁰	1.5524 ²⁰	sl H ₂ O, chl; s Et OH, et h; vs bz
2218	3-Chl orophenol		$\text{C}_6\text{H}_9\text{ClO}$	108-43-0	128.556		32.6	214	1.245 ⁶⁵	1.5565 ⁴⁰	sl H ₂ O, chl; s Et OH, et h; vs bz
2219	4-Chl orophenol		$\text{C}_6\text{H}_9\text{ClO}$	106-48-9	128.556		42.8	220	1.265 ⁴⁰	1.5579 ⁴⁰	sl H ₂ O; vs Et OH, et h, bz; s al k
2220	Chl orophenol Red		$\text{C}_6\text{H}_{12}\text{Cl}_2\text{O}_3\text{S}$	4430-20-0	423.266	grn-br cry	261				sl H ₂ O; s Et OH
2221	2-Chl oro-10H-phenot hi azi ne		$\text{C}_6\text{H}_8\text{Cl}_2\text{NS}$	92-39-7	233.717			198.5			
2222	2-Chl orophenoxyacet i c aci d		$\text{C}_8\text{H}_7\text{ClO}_2$	614-61-9	186.593	nd (w, al)		148.5			s H ₂ O, Et OH
2223	3-Chl orophenoxyacet i c aci d		$\text{C}_8\text{H}_7\text{ClO}_2$	588-32-9	186.593	cry (w)	110				i H ₂ O
2224	(4-Chl orophenoxy)acet i c aci d		$\text{C}_8\text{H}_7\text{ClO}_2$	122-88-3	186.593	pr or nd (w)	156.5				vs H ₂ O; sl chl
2225	1-Chl oro-4-phenoxybenzene	4-Chl orophenyl phenyl et her	$\text{C}_{12}\text{H}_9\text{ClO}$	7005-72-3	204.651			284.5	1.2026 ⁵	1.599	
2226	3-(4-Chl orophenoxy)-1,2-propanedi ol	Chl orphenesi n	$\text{C}_7\text{H}_{11}\text{ClO}_2$	104-29-0	202.634	cry	78	214 ¹⁹			i H ₂ O; vs Et OH, et h; s bz, con sul f
2227	2-(3-Chl orophenoxy)propanoi c aci d	Cl oprop	$\text{C}_9\text{H}_7\text{ClO}_2$	101-10-0	200.618	cry	113	100 ^{1,5}			
2228	2-Chl oro-N-phenyl acet ami de		$\text{C}_8\text{H}_9\text{ClNO}$	587-65-5	169.609	nd (di l HOAc)		sub			vs bz, et h, Et OH
2229	N-(2-Chl orophenyl)acet ami de		$\text{C}_8\text{H}_9\text{ClNO}$	533-17-5	169.609		88.3				i H ₂ O; s Et OH, bz, chl; vs et h
2230	N-(3-Chl orophenyl)acet ami de		$\text{C}_8\text{H}_9\text{ClNO}$	588-07-8	169.609	nd	79	333			sl H ₂ O; vs Et OH, et h, bz, C ₂ S ₂ s chl
2231	N-(4-Chl orophenyl)acet ami de		$\text{C}_8\text{H}_9\text{ClNO}$	539-03-7	169.609		179	333	1.385 ²		i H ₂ O; s Et OH; vs et h; sl ct c
2232	4-Chl oro- α -phenyl benzenet hanol		$\text{C}_9\text{H}_{11}\text{ClO}$	119-56-2	218.678		59				sl chl
2233	4-Chl orophenyl benzenesul f onat e		$\text{C}_{12}\text{H}_9\text{ClQS}$	80-38-6	268.715	col cry	62		1.33		sl H ₂ O
2234	4-Chl oro-1-phenyl -1-but anone		$\text{C}_9\text{H}_{11}\text{ClO}$	939-52-6	182.646		19.5	131 ¹	1.137 ²⁵	1.5459 ²⁰	
2235	4-Chl orophenyl 4-chl orobenzenesul f onat e	Ovex	$\text{C}_{12}\text{H}_9\text{Cl}_2\text{O}_3\text{S}$	80-33-1	303.161		86.5				i H ₂ O; sl Et OH; s ace
2236	(2-Chl orophenyl)(4-chl orophenyl) met hanone	2,4-Di chl orodi phenyl ket one	$\text{C}_{13}\text{H}_9\text{Cl}_2\text{O}$	85-29-0	251.108	pr (al)	67	214 ²	1.393 ¹⁴		s Et OH; sl chl
2237	N'-(4-Chl orophenyl)-N,N-di met hyl urea	Monuron	$\text{C}_9\text{H}_{11}\text{ClN}_2\text{O}$	150-68-5	198.648	wh pl (MeOH)	170.5				i H ₂ O; sl Et OH, ace
2238	1-(3-Chl orophenyl)et hanone	m-Chl oroacet ophenone	$\text{C}_7\text{H}_7\text{ClO}$	99-02-5	154.594			244; 129 ⁰	1.2130 ⁴⁰	1.5494 ²⁰	s Et OH, et h, ace
2239	1-(4-Chl orophenyl)et hanone	p-Chl oroacet ophenone	$\text{C}_7\text{H}_7\text{ClO}$	99-91-2	154.594		20	232	1.192 ²⁰	1.5550 ²⁰	i H ₂ O; msc Et OH, et h; s chl
2240	5-(4-Chl orophenyl)-6-et hyl -2,4-pyri mi di nedi ami ne	Pyri met hami ne	$\text{C}_{13}\text{H}_{13}\text{ClN}_4$	58-14-0	248.711		233.5				
2241	2-(4-Chl orophenyl)-7-i ndene-1,3(2H)-di one	Cl ori ndi one	$\text{C}_9\text{H}_9\text{ClO}_2$	1146-99-2	256.684	dk red nd (al)	145.5				vs bz, et h, Et OH



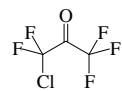
1-Chlorooctane



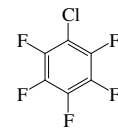
2-Chlorooctane



8-Chloro-1-octanol



Chloroform



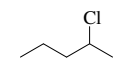
Chlorobenzene



Chloroethane



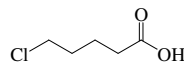
1-Chloropentane



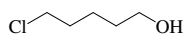
2-Chloropentane



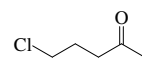
3-Chloropentane



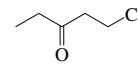
5-Chloropentanoic acid



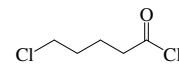
5-Chloro-1-pentanol



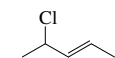
5-Chloro-2-pentanone



1-Chloro-3-pentanone



5-Chloropentanoic chloride



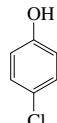
4-Chloro-2-pentene



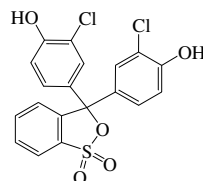
2-Chlorophenol



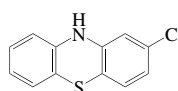
3-Chlorophenol



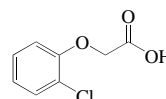
4-Chlorophenol



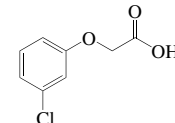
Chlorophenol red



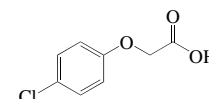
2-Chloro-10H-phenothiazine



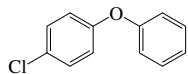
2-Chlorophenoxyacetic acid



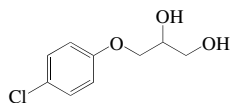
3-Chlorophenoxyacetic acid



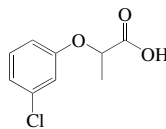
(4-Chlorophenoxy)acetic acid



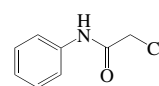
1-Chloro-4-phenoxybenzene



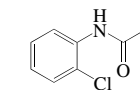
3-(4-Chlorophenoxy)-1,2-propanediol



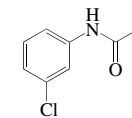
2-(3-Chlorophenoxy)propanoic acid



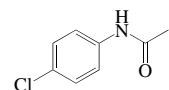
2-Chloro-N-phenylacetamide



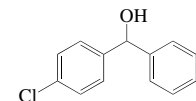
N-(2-Chlorophenyl)acetamide



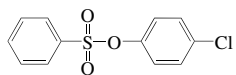
N-(3-Chlorophenyl)acetamide



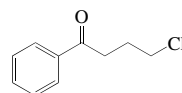
N-(4-Chlorophenyl)acetamide



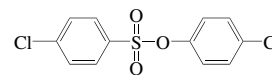
4-Chloro-α-phenylbenzenemethanol



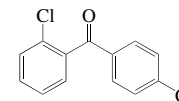
4-Chlorophenyl benzenesulfonate



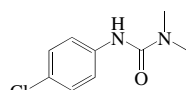
4-Chloro-1-phenyl-1-butane



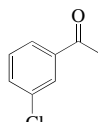
4-Chlorophenyl 4-chlorobenzenesulfonate



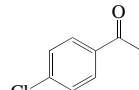
(2-Chlorophenyl)(4-chlorophenyl)methanone



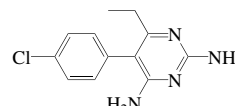
N-(4-Chlorophenyl)-N,N-dimethylurea



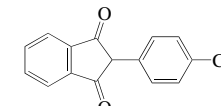
1-(3-Chlorophenyl)ethanone



1-(4-Chlorophenyl)ethanone

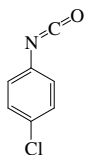


5-(4-Chlorophenyl)-6-ethyl-2,4-pyridinediamine

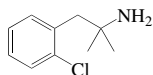


2-(4-Chlorophenyl)-1H-indene-1,3-dione

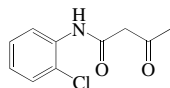
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2242	4-Chl orophenyl i socyanat e		$\text{C}_7\text{H}_5\text{ClNO}$	104-12-1	153.566		31.3	116 ⁶			
2243	1-(2-Chl orophenyl)-2-met hyl -2-propyl ami ne	Cl ort ermi ne	$\text{C}_{10}\text{H}_{14}\text{ClN}$	10389-73-8	183.678	li q		117			
2244	<i>N</i> -(2-Chl orophenyl)-3-oxobut anami de		$\text{C}_{10}\text{H}_{10}\text{ClNO}_2$	93-70-9	211.645		106.5				s Et OH; i et h, li g
2245	(4-Chl orophenyl)phenyl met hanone		$\text{C}_{13}\text{H}_9\text{ClO}$	134-85-0	216.662	nd (al)	77.5	332			s Et OH, et h, ace; sl ct c
2246	3-(2-Chl orophenyl)propanoi c aci d		$\text{C}_9\text{H}_7\text{ClO}_2$	1643-28-3	184.619	nd or lf (w)	102				
2247	3-(3-Chl orophenyl)propanoi c aci d		$\text{C}_9\text{H}_7\text{ClO}_2$	21640-48-2	184.619	lf (pet h)	77				
2248	3-(4-Chl orophenyl)propanoi c aci d		$\text{C}_9\text{H}_7\text{ClO}_2$	2019-34-3	184.619		126				
2249	3-Chl oro-1-phenyl-1-propanone	2-Chl oroet hyl phenyl ket one	$\text{C}_9\text{H}_9\text{ClO}$	936-59-4	168.619	lf (et h), cry (al, pet h)	49.5	113 ⁴			
2250	1-(4-Chl orophenyl)-1-propanone		$\text{C}_9\text{H}_9\text{ClO}$	6285-05-8	168.619		37.3	135 ¹ , 114 ²			i H ₂ O; s Et OH, C ₂ S; sl chl
2251	3-(3-Chl orophenyl)-2-propynoi c aci d		$\text{C}_9\text{H}_5\text{ClO}_2$	7396-28-3	180.588	cry (HOAc, bz-pet h)	144.5				vs HOAc
2252	Chl orophenyl si l ane	Phenyl chl orosi l ane	$\text{C}_8\text{H}_7\text{ClSi}$	4206-75-1	142.659			162.5	1.068 ⁹	1.5340 ²⁰	
2253	1-Chl oro-4-(phenyl sul f onyl)benzene	Sul phenone	$\text{C}_{12}\text{H}_9\text{ClO}_2\text{S}$	80-00-2	252.716		94				i H ₂ O; sl Et OH; s et h; vs ace, bz
2254	5-Chl oro-1-phenyl t et razol e		$\text{C}_7\text{H}_5\text{ClN}_4$	14210-25-4	180.595		123				
2255	(2-Chl orophenyl) hi ourea		$\text{C}_7\text{H}_7\text{ClN}_2\text{S}$	5344-82-1	186.662	nd or pl	146				vs bz, Et OH
2256	α -Chl orophyl l		$\text{C}_6\text{H}_7\text{MgN}_4\text{O}_5$	479-61-8	893.490	bl bl k hex pl	152.3				i C_2H_5 ; vs Et OH, et h; s li g
2257	β -Chl orophyl l		$\text{C}_6\text{H}_7\text{MgN}_4\text{O}_5$	519-62-0	907.473	bl-bl k or grn pow	125				i H ₂ O; vs Et OH, et h, py; s MeOH
2258	Chl oropropami de	4-Chl oro- <i>N</i> -(propyl ami no)carbonylbenzenesul f onami de	$\text{C}_{10}\text{H}_{13}\text{ClN}_2\text{O}_3\text{S}$	94-20-2	276.739	cry (Et OH)	128				i H ₂ O; s Et OH; sl et h, bz
2259	2-Chl oropropanal		$\text{C}_4\text{H}_7\text{ClO}$	683-50-1	92.524			86	1.182 ⁵	1.431 ¹⁷	vs bz, et h
2260	1-Chl oropropane	Propyl chl ori de	$\text{C}_3\text{H}_7\text{Cl}$	540-54-5	78.541	li q	-122.9	46.5	0.889 ⁹	1.3879 ²⁰	sl H ₂ O, ct c; msc Et OH, et h; s bz, chl
2261	2-Chl oropropane	Isopropyl chl ori de	$\text{C}_3\text{H}_7\text{Cl}$	75-29-6	78.541	li q	-117.18	35.7	0.861 ⁷	1.3777 ²⁰	sl H ₂ O; msc Et OH, et h; s bz, ct c, chl
2262	3-Chl oro-1,2-propanedi ol	α -Chl orohydr i n	$\text{C}_3\text{H}_7\text{ClO}_2$	96-24-2	110.540	ye li q		dec 213; 116 ¹¹	1.325 ¹⁸	1.4809 ²⁰	s H ₂ O, Et OH, et h
2263	2-Chl oro-1,3-propanedi ol	Gl ycerol-chl orohydr i n	$\text{C}_3\text{H}_7\text{ClO}_2$	497-04-1	110.540			146 ¹⁸ , 124 ¹⁴	1.3219 ²⁰	1.4831 ²⁰	vs H ₂ O, ace, Et OH
2264	3-Chl oro-1,2-propanedi ol di ni t rat e	Cl oni t rat e	$\text{C}_3\text{H}_5\text{ClN}_2\text{O}_6$	2612-33-1	200.534	sl ye li q		192.5	1.511 ²		vs ace, Et OH, chl
2265	3-Chl oropropaneni t ri l e	β -Chl oropropi oni t ri l e	$\text{C}_3\text{H}_4\text{ClN}$	542-76-7	89.524	li q	-51	175.5	1.157 ⁸	1.4360 ²⁰	sl ct c
2266	2-Chl oropropanoi c aci d	2-Chl oropropi oni c aci d	$\text{C}_3\text{H}_5\text{ClO}_2$	598-78-7	108.524			185	1.2585 ²⁰	1.4380 ²⁰	msc H ₂ O, Et OH, et h; s ace
2267	3-Chl oropropanoi c aci d	β -Chl oropropi oni c aci d	$\text{C}_3\text{H}_5\text{ClO}_2$	107-94-8	108.524	lf (w), hyg cry (li g)	41	dec 204			s H ₂ O, Et OH, chl; msc et h
2268	2-Chl oro-1-propanol	Propyl ene chl orohydr i n	$\text{C}_3\text{H}_7\text{ClO}$	78-89-7	94.540			133.5	1.103 ³⁰	1.4390 ²⁰	vs H ₂ O, et h, Et OH
2269	3-Chl oro-1-propanol		$\text{C}_3\text{H}_7\text{ClO}$	627-30-5	94.540			165	1.1309 ³⁰	1.4459 ²⁰	vs H ₂ O; s Et OH, et h; sl ct c
2270	1-Chl oro-2-propanol	<i>sec</i> -Propyl ene chl orohydr i n	$\text{C}_3\text{H}_7\text{ClO}$	127-00-4	94.540			127	1.113 ³⁰	1.4392 ²⁰	msc H ₂ O, Et OH, et h; sl ct c
2271	3-Chl oropropanoyl chl ori de		$\text{C}_3\text{H}_4\text{Cl}_2\text{O}$	625-36-5	126.969			144	1.3307 ¹³	1.4549 ²⁰	sl H ₂ O; vs Et OH, et h, chl
2272	<i>ci si</i> -Chl oropropene		$\text{C}_3\text{H}_5\text{Cl}$	16136-84-8	76.525	li q	-134.8	32.8	0.934 ⁷	1.4055 ²⁰	i H ₂ O; s et h, ace, bz, chl
2273	<i>t rans</i> -1-Chl oropropene		$\text{C}_3\text{H}_5\text{Cl}$	16136-85-9	76.525	li q	-99	37.4	0.934 ⁹	1.4054 ²⁰	i H ₂ O; s et h, ace, bz, chl
2274	2-Chl oropropene	Isopropenyl chl ori de	$\text{C}_3\text{H}_5\text{Cl}$	557-98-2	76.525	vol li q or gas	-137.4	22.6	0.901 ⁷	1.3973 ²⁰	i H ₂ O; s et h, ace, bz, chl
2275	3-Chl oropropene	Al lyl chl ori de	$\text{C}_3\text{H}_5\text{Cl}$	107-05-1	76.525	li q	-134.5	45.1	0.937 ⁶	1.4157 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g; sl ct c
2276	2-Chl oro-2-propene ni t ri l e		$\text{C}_3\text{H}_3\text{ClN}$	920-37-6	87.508	li q	-65	88.5	1.096	1.4290 ²⁰	
2277	2-Chl oropropeni c aci d	2-Chl oroacryl i c aci d	$\text{C}_3\text{H}_3\text{ClO}_2$	598-79-8	106.508		66	sub			
2278	<i>t rans</i> (3-Chl oro-1-propenyl)benzene		$\text{C}_9\text{H}_7\text{Cl}$	21087-29-6	152.620		8.5	106 ³	1.0926 ²⁰	1.5851 ²⁰	vs ace, bz, et h, Et OH



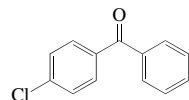
4-Chlorophenyl isocyanate



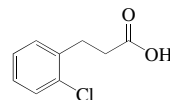
1-(2-Chlorophenyl)-2-methyl-2-propylamine



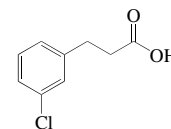
N-(2-Chlorophenyl)-3-oxobutanamide



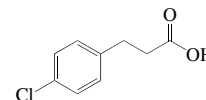
(4-Chlorophenyl)phenylmethanone



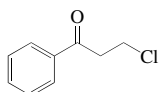
3-(2-Chlorophenyl)propanoic acid



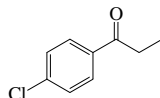
3-(3-Chlorophenyl)propanoic acid



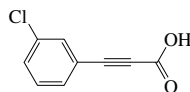
3-(4-Chlorophenyl)propanoic acid



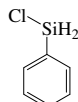
3-Chloro-1-phenyl-1-propanone



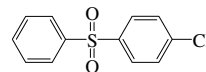
1-(4-Chlorophenyl)-1-propanone



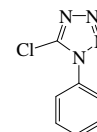
3-(3-Chlorophenyl)-2-propynoic acid



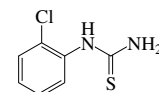
Chlorophenylsilane



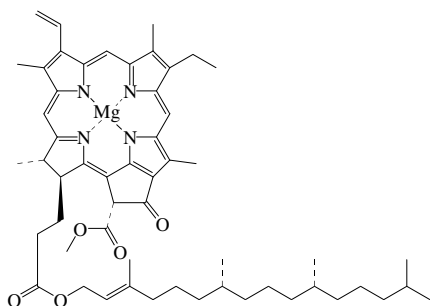
1-Chloro-4-(phenylsulfonyl)benzene



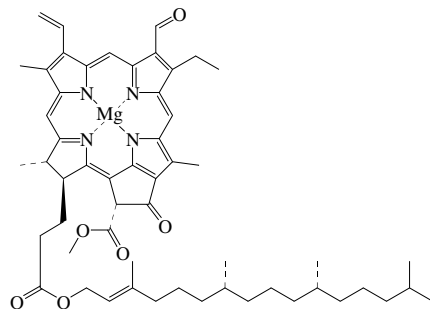
5-Chloro-1-phenyltetrazole



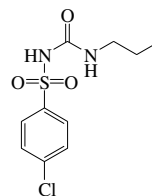
(2-Chlorophenyl)thiourea



α -Chlorophyll



β -Chlorophyll



Chloropropanamide



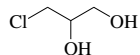
2-Chloropropanal



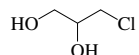
1-Chloropropane



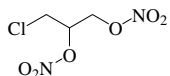
2-Chloropropane



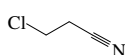
3-Chloro-1,2-propanediol



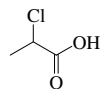
2-Chloro-1,3-propanediol



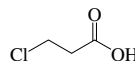
3-Chloro-1,2-dinitroethane



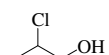
3-Chloropropanenitrile



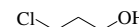
2-Chloropropanoic acid



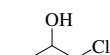
3-Chloropropanoic acid



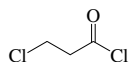
2-Chloro-1-propanol



3-Chloro-1-propanol



1-Chloro-2-propanol



3-Chloropropanoyl chloride



cis-1-Chloropropene



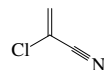
trans-1-Chloropropene



2-Chloropropene



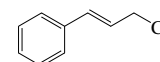
3-Chloropropene



2-Chloro-2-propenenitrile

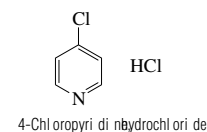
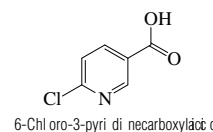
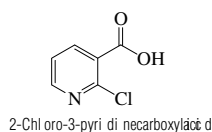
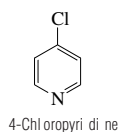
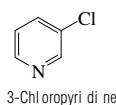
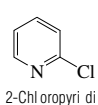
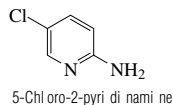
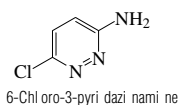
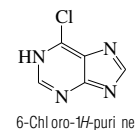
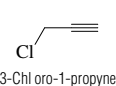
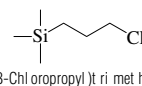
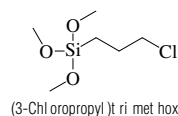
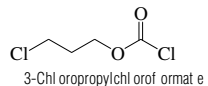
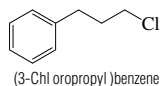
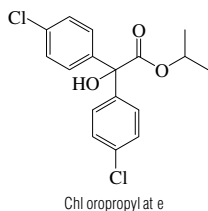
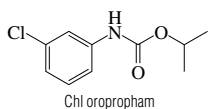


2-Chloropropenoic acid

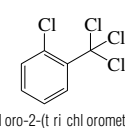
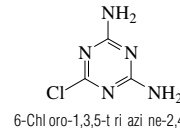
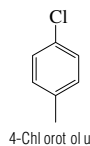
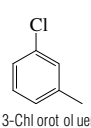
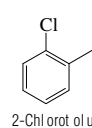
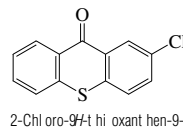
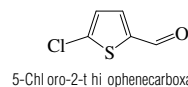
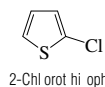
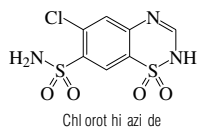
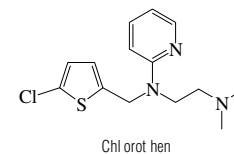
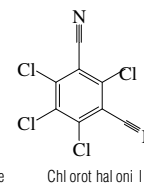
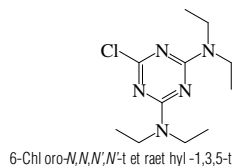
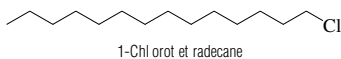
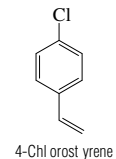
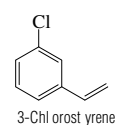
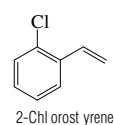
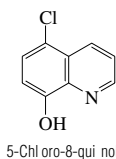
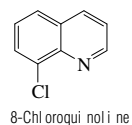
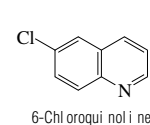
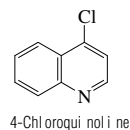
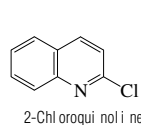
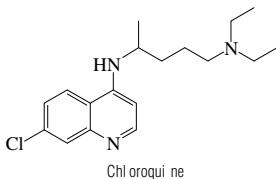


trans-(3-Chloro-1-propenyl)benzene

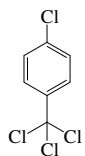
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2279	Chloroprotham		C ₁₀ H ₁₂ ClNO ₂	101-21-3	213.661		41	149 ²	1.18 ³⁰	1.5388 ²⁰	
2280	Chloropropylate		C ₇ H ₁₆ Cl ₂ O ₃	5836-10-2	339.213	pow	73				sl H ₂ O; s os
2281	(3-Chloropropyl)benzene		C ₉ H ₁₁ Cl	104-52-9	154.636			219.5	1.056 ¹	1.5160 ²⁵	sl ct c
2282	3-Chloropropyl chloroformate		C ₃ H ₅ Cl ₂ O ₂	628-11-5	156.996			177	1.2926 ²⁵	1.4456 ²⁰	i H ₂ O
2283	(3-Chloropropyl)trimethoxysilane		C ₆ H ₁₃ ClO ₃ Si	2530-87-2	198.720			91	1.077 ⁵	1.4183 ²⁵	
2284	(3-Chloropropyl)trimethylsilane		C ₆ H ₁₃ ClSi	2344-83-4	150.722			151	0.878 ⁹	1.4319 ²⁰	
2285	3-Chloro-1-propyne	Propargyl chloride	C ₃ H ₃ Cl	624-65-7	74.509		-78				i H ₂ O; msc Et OH, et h, bz; s ct c
2286	6-Chloro-1H-purine	6-Chloropurine	C ₄ H ₄ ClN ₄	87-42-3	154.558	nd (w)	176 dec				
2287	6-Chloro-3-pyridazine		C ₄ H ₄ ClN ₂	5469-69-2	129.548		220				
2288	5-Chloro-2-pyridazine		C ₄ H ₄ ClN ₂	1072-98-6	128.560	pl	137	127 ¹			s H ₂ O, Et OH; sl DMSO; i pet h, li g
2289	2-Chloropyridine		C ₅ H ₄ ClN	109-09-1	113.546	oil		170	1.205	1.5320 ²⁰	sl H ₂ O; s Et OH, et h
2290	3-Chloropyridine		C ₅ H ₄ ClN	626-60-8	113.546			148; 86 ⁰⁰		1.5304 ²⁰	sl H ₂ O
2291	4-Chloropyridine		C ₅ H ₄ ClN	626-61-9	113.546	liq	-43.5	147.5	1.200 ⁰		s H ₂ O; msc Et OH
2292	2-Chloro-3-pyridinecarboxylic acid		C ₆ H ₄ ClNO ₂	2942-59-8	157.555		>175 dec				
2293	6-Chloro-3-pyridinecarboxylic acid		C ₆ H ₄ ClNO ₂	5326-23-8	157.555		198 dec				
2294	4-Chloropyridine, hydrochloride		C ₅ H ₄ Cl ₂ N	7379-35-3	150.006				sub 210		
2295	Chloroquine		C ₁₆ H ₂₆ ClN ₄	54-05-7	319.872		90				
2296	2-Chloroquinoline		C ₈ H ₆ ClN	612-62-4	163.604	nd (aq al)	38	266; 153 ²	1.2464 ²⁵	1.6342 ²⁵	i H ₂ O; vs Et OH, et h; s bz, chl
2297	4-Chloroquinoline		C ₈ H ₆ ClN	611-35-8	163.604	cry	34.5	262; 130 ⁵	1.251 ²⁵		sl H ₂ O; vs Et OH, et h; s dil HCl
2298	6-Chloroquinoline		C ₈ H ₆ ClN	612-57-7	163.604	pr (et h), nd (al)	43.8	263		1.611 ⁰	
2299	8-Chloroquinoline		C ₈ H ₆ ClN	611-33-6	163.604	liq	-20	288.5	1.2834	1.6408 ¹⁴	s H ₂ O; vs Et OH, et h, ace, bz, chl
2300	5-Chloro-8-quinoline	Chloroquinoline	C ₈ H ₆ ClNO	130-16-5	179.603	cry (al)	130				
2301	2-Chlorostyrene		C ₈ H ₇ Cl	2039-87-4	138.595	liq	-63.1	188.7	1.100 ⁰	1.5649 ²⁰	s Et OH, et h, ace, ct c, HOAc; msc pet h
2302	3-Chlorostyrene		C ₈ H ₇ Cl	2039-85-2	138.595			63 ²	1.1033 ²⁰	1.5625 ²⁰	i H ₂ O; s Et OH, et h
2303	4-Chlorostyrene		C ₈ H ₇ Cl	1073-67-2	138.595		15.9	192	1.0868 ⁰	1.5660 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, ct c
2304	N-Chlorosuccinimide		C ₄ H ₅ ClNO ₂	128-09-6	133.534	pl (CCl ₄)	150		1.65 ²⁵		sl H ₂ O, Et OH, bz, li g; s ace, HOAc
2305	1-Chlorodecane		C ₁₀ H ₂₁ Cl	2425-54-9	232.833		4.9	296.8	0.8654 ⁰	1.4474 ²⁰	i H ₂ O; s Et OH, chl; vs ace, bz; sl ct c
2306	6-Chloro-N,N,N',N'-tetraethyl-1,3,5-triazine-2,4-diamine		C ₁₁ H ₂₀ ClN ₄	580-48-3	257.764	oil y li q	27	155	1.0956 ²⁰	1.5320 ²⁰	vs bz, chl, Et OH, li g
2307	1-Chloro-1,1,2,2-tetrafluoroethane		C ₂ HClF ₄	354-25-6	136.476	col gas	-117	-11.7			
2308	1-Chloro-1,2,2,2-tetrafluoroethane		C ₂ HClF ₃	2837-89-0	136.476	col gas		-12			
2309	Chloroethanol		C ₂ H ₅ ClO	1897-45-6	265.911		250	350	1.7 ²⁵		i H ₂ O; sl ace, cyhex
2310	Chloroethane	Chloroethane	C ₂ H ₅ Cl	148-65-2	295.831			155 ¹⁰ , 192 ⁵	1.1751 ²⁵		
2311	Chloroethane		C ₂ H ₅ Cl	58-94-6	295.724		350 dec				
2312	2-Chloroethanethiol	2-Thiethyl chloride	C ₂ H ₄ ClS	96-43-5	118.585	liq	-71.9	128.3	1.288 ³	1.5487 ²⁰	i H ₂ O; msc Et OH, et h; sl chl
2313	5-Chloro-2-thiophenecarboxaldehyde		C ₆ H ₄ ClOS	7283-96-7	146.595			77.5 ²		1.6036 ²⁵	sl chl
2314	2-Chloro-2-thiophenethanol		C ₆ H ₄ ClOS	86-39-5	246.712		153.5				
2315	2-Chloroethanol		C ₂ H ₅ Cl	95-49-8	126.584	liq	-35.8	159.0	1.082 ⁵	1.5268 ²⁰	i H ₂ O; s Et OH, bz; msc et h, ace, chl
2316	3-Chloroethanol		C ₂ H ₅ Cl	108-41-8	126.584	liq	-47.8	161.8	1.07 ⁵	1.5214 ¹⁹	i H ₂ O; s Et OH, bz, ct c, chl; msc et h
2317	4-Chloroethanol		C ₂ H ₅ Cl	106-43-4	126.584		7.5	162.4	1.0697 ²⁰	1.5150 ²⁰	i H ₂ O; s Et OH, ct c, chl; msc et h
2318	6-Chloro-1,3,5-triazine-2,4-diamine		C ₃ H ₄ ClN ₄	3397-62-4	145.551		>330				
2319	1-Chloro-2-(trimethylsilyl)benzene		C ₇ H ₁₀ Cl ₃	2136-89-2	229.919		29.4	264.3	1.5187 ²⁰	1.5836 ²⁰	i H ₂ O; s et h, ace; sl ct c



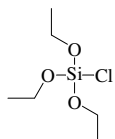
3-125



No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2320	1-Chloro-4-(<i>t</i> -trichloromethyl)benzene		$\text{C}_7\text{H}_7\text{Cl}_4$	5216-25-1	229.919			245	1.4463 ²⁰		vs ace, et h
2321	Chlorotriethoxysilane		$\text{C}_3\text{H}_7\text{ClO}_3\text{Si}$	4667-99-6	198.720	liq	-51	156	1.090	1.3999 ²⁰	vs Et OH
2322	Chlorotriethylphosphane	Lead triethylchloride	$\text{C}_6\text{H}_{15}\text{ClP}$	1067-14-7	329.8		123 dec				s H ₂ O
2323	Chlorotriethylsilane		$\text{C}_6\text{H}_{15}\text{ClSi}$	994-30-9	150.722			144.5	0.8967 ⁷	1.4314 ²⁰	
2324	1-Chloro-1,1,2-trifluoroethane		C_2HClF_3	421-04-5	118.485	vol liq or gas		12			
2325	1-Chloro-1,2,2-trifluoroethane		C_2HClF_3	431-07-2	118.485	vol liq or gas		17.3			
2326	2-Chloro-1,1,1-trifluoroethane		C_2HClF_3	75-88-7	118.485	col gas	-105.5	6.1	1.389 ⁹	1.3090 ⁰	
2327	Chlorotrifluoroethene	Chlorotrifluoroethylene	C_2ClF_3	79-38-9	116.469	col gas	-158.2	-27.8	1.54 ⁶⁰	1.38 ⁹	s bz, chl
2328	Chlorotrifluoromethane	Refrigerant 13	CClF_3	75-72-9	104.459	col gas	-181	-81.4			i H ₂ O
2329	2-Chloro-5-(trifluoromethyl)aniline		$\text{C}_7\text{H}_6\text{ClF}_3\text{N}$	121-50-6	195.570			103 ²⁵	1.428 ²⁵	1.4975 ²⁰	
2330	4-Chloro-3-(trifluoromethyl)aniline		$\text{C}_7\text{H}_6\text{ClF}_3\text{N}$	320-51-4	195.570		36.5	132 ²⁷			
2331	1-Chloro-2-(trifluoromethyl)benzene	<i>o</i> -Chlorobenzotrifluoride	$\text{C}_7\text{H}_5\text{ClF}_3$	88-16-4	180.555	liq	-6	152.2	1.254 ⁰	1.4513 ²⁵	s chl
2332	1-Chloro-3-(trifluoromethyl)benzene	<i>m</i> -Chlorobenzotrifluoride	$\text{C}_7\text{H}_5\text{ClF}_3$	98-15-7	180.555	liq	-56	137.5	1.331 ⁴	1.4438 ²⁵	
2333	1-Chloro-4-(trifluoromethyl)benzene	<i>p</i> -Chlorobenzotrifluoride	$\text{C}_7\text{H}_5\text{ClF}_3$	98-56-6	180.555	liq	-33	138.5	1.334 ⁰	1.4431 ³⁰	
2334	3-Chloro-1,1,1-trifluoropropane		$\text{C}_3\text{H}_2\text{ClF}_3$	460-35-5	132.512	liq	-106.5	45.1	1.325 ⁹	1.3350 ²⁰	i H ₂ O
2335	2-Chloro-2,4,4-trimethylpentane		$\text{C}_8\text{H}_{17}\text{Cl}$	6111-88-2	148.674		-26	dec 147; 44 ¹⁶	0.8746 ²⁰	1.4308 ²⁰	vs Et OH
2336	Chlorotrimethylstannane		$\text{C}_3\text{H}_9\text{ClSn}$	1066-45-1	199.266		38.5	148			s H ₂ O, chl, os
2337	2-Chloro-1,3,5-trinitrobenzene	Picryl chloride	$\text{C}_6\text{H}_2\text{ClNO}_6$	88-88-0	247.549	wh nd or pl (chl, al-liq)	83		1.797 ²⁰		i H ₂ O; s Et OH, bz; sl et h; vs ace, tolu
2338	Chlorotrimethylamine		$\text{C}_3\text{H}_9\text{ClN}$	1943-16-4	185.480		2.3	dec 134; 56 ⁴⁰	1.6769 ²⁰	1.4500 ²⁰	vs et h, Et OH, chl
2339	Chlorotriphenylmethane		$\text{C}_{19}\text{H}_{15}\text{Cl}$	76-83-5	278.775	nd or pr (bz-pet h)	113.5	310			i H ₂ O; sl Et OH; vs et h, bz, chl; s ace
2340	Chlorotriphenylsilane		$\text{C}_{18}\text{H}_{15}\text{ClSi}$	76-86-8	294.851			24 ⁴			
2341	Chlorotriphenylstannane	Triphenyltin chloride	$\text{C}_{18}\text{H}_{15}\text{ClSn}$	639-58-7	385.475		103.5				s chl
2342	Chlorotripropylstannane		$\text{C}_9\text{H}_{19}\text{ClSn}$	2279-76-7	283.426		-23.5	123 ³	1.2678 ²⁸	1.49102 ²⁸	s ct c, os
2343	Chlorotripropylsilyl ether		$\text{C}_9\text{H}_{19}\text{ClSi}$	1719-58-0	120.653			83.5	0.874 ⁴	1.4141 ²⁰	
2344	Chloroxuron	<i>N</i> '-[4-(4-chlorophenoxy)phenyl]- <i>N,N</i> -dimethylurea	$\text{C}_{15}\text{H}_{15}\text{ClN}_2\text{O}_2$	1982-47-4	290.745		151				
2345	Chlorooxocin		$\text{C}_{16}\text{H}_{16}\text{ClN}_2\text{O}_7$	54749-90-5	313.692	cry	147 dec				s H ₂ O
2346	Chlorophenyl carbamate		$\text{C}_7\text{H}_7\text{ClNO}_2$	886-74-8	245.660	cry (bz)	90				vs ace, Et OH, di ox
2347	Chlorophenylamine		$\text{C}_6\text{H}_7\text{ClN}$	132-22-9	274.788	oil liq		142			
2348	Chlorophenylmalonamide	Chloroprophenylpyridamide	$\text{C}_{12}\text{H}_{13}\text{ClN}_2\text{O}_4$	113-92-8	390.861		132.5				
2349	Chlorophenylamine	2-(4-chlorobenzyl)-2-propylamine	$\text{C}_{10}\text{H}_{14}\text{ClN}$	461-78-9	183.678	liq		231; 10 ¹			
2350	Chloropromazine	2-Chloro- <i>N,N</i> -dimethyl-10-phenothiazine-10-propanamine	$\text{C}_{17}\text{H}_{19}\text{ClN}_2\text{S}$	50-53-3	318.864			202 ^{0,8}			i H ₂ O; vs Et OH, et h, bz, chl; s di HCl
2351	Chloropropylxene		$\text{C}_{18}\text{H}_{18}\text{ClNS}$	113-59-7	315.861	pale ye cry	97				i H ₂ O, Et OH, et h, chl
2352	Chloropyrifos		$\text{C}_{11}\text{Cl}_3\text{NO}_3\text{PS}$	2921-88-2	350.586		42				
2353	Chloropyrifos-methyl		$\text{C}_{12}\text{HCl}_3\text{NO}_3\text{PS}$	5598-13-0	322.534		43				
2354	Chlorosulfuron		$\text{C}_7\text{H}_7\text{ClN}_2\text{O}_4\text{S}$	64902-72-3	357.773		176				
2355	Chlorotetracycline		$\text{C}_{22}\text{H}_{23}\text{ClN}_7\text{O}_6$	57-62-5	478.879	gol d-ye	168.5				i H ₂ O, et h; sl Et OH, ace, bz; s di ox
2356	Chlorothalidone		$\text{C}_{11}\text{H}_9\text{ClN}_2\text{O}_2\text{S}$	77-36-1	338.765	wh pow or cry	225 dec				s al k, Et OH; sl et h
2357	Chlorothionon		$\text{C}_8\text{H}_8\text{ClN}_2\text{O}_3\text{PS}$	500-28-7	297.653	ye cry	21	125 ^{0,1}	1.437 ²⁰	1.5661 ²⁰	i H ₂ O; vs bz, et h, Et OH
2358	Chlorothionophos		$\text{C}_{15}\text{Cl}_3\text{O}_3\text{PS}_2$	21923-23-9	361.245			150 ^{0,001}			
2359	Chlorotoluron	<i>N</i> '-(3-chloro-4-methylphenyl)- <i>N,N</i> -dimethylurea	$\text{C}_{10}\text{H}_{13}\text{ClN}_2\text{O}$	15545-48-9	212.675	cry	147				sl H ₂ O; s os



1-Chloro-4-(trichloromethyl)benzene



Chlorotriethoxysilane



Chlorotriethylplumbane



Chlorotriethylsilane



1-Chloro-1,1,2-trifluoroethane



1-Chloro-1,2,2-trifluoroethane



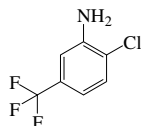
2-Chloro-1,1,1-trifluoroethane



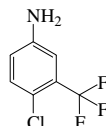
Chlorotrifluoroethene



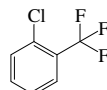
Chlorotrifluoromethane



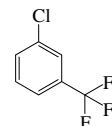
2-Chloro-5-(trifluoromethyl)aniline



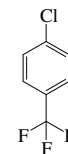
4-Chloro-3-(trifluoromethyl)aniline



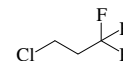
1-Chloro-2-(trifluoromethyl)benzene



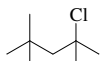
1-Chloro-3-(trifluoromethyl)benzene



1-Chloro-4-(trifluoromethyl)benzene



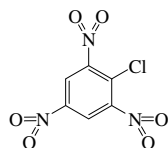
3-Chloro-1,1,1-trifluoropropane



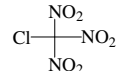
2-Chloro-2,4,4-trimethylpentane



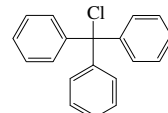
Chlorotrimethylstannane



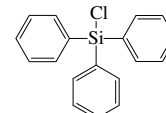
2-Chloro-1,3,5-trinitrobenzene



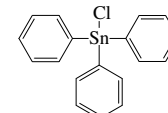
Chlorotri-nitromethane



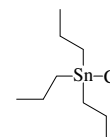
Chlorotriphenylmethane



Chlorotriphenylsilane



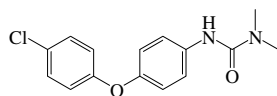
Chlorotriphenylstannane



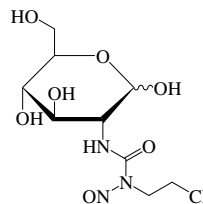
Chlorotripropylstannane



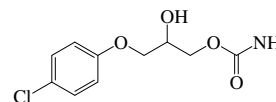
Chlorovinyl dimethylsilane



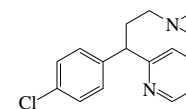
Chloroxuron



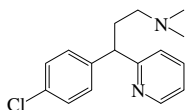
Chlorozotocin



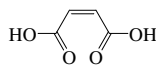
Chlorphenesin carbamate



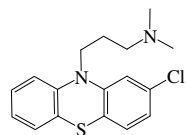
Chlorpheniramine



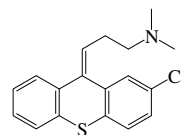
Chlorpheniramine maleate



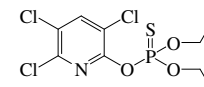
Chlorpheniramine



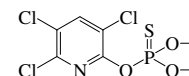
Chlorpromazine



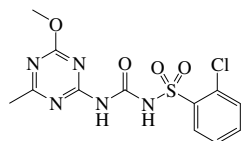
Chlorpromazine



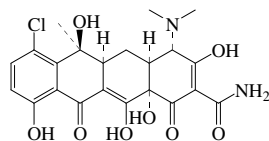
Chlorpyrifos



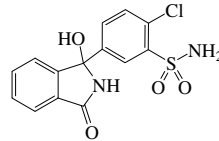
Chlorpyrifos-methyl



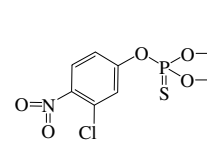
Chlorzoxazone



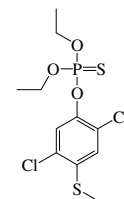
Chlorzoxazone



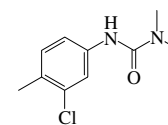
Chlorzoxazone



Chlorzoxazone

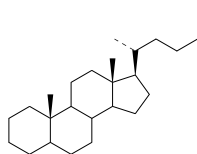


Chlorzoxazone

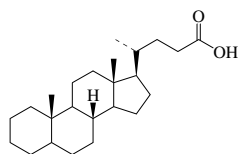


Chlorzoxazone

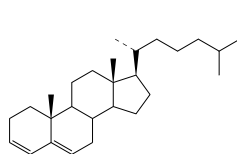
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2360	Cholane		C ₂₄ H ₄₂	548-98-1	330.590	pr (al)	90	190 ⁰⁰¹			
2361	Cholan-24-oi c aci d	Cholani c aci d	C ₂₄ H ₄₀ O ₂	25312-65-6	360.574	nd (al), cry (HOAc)	163.5				s Et OH, chl, HOAc
2362	Cholest a-3,5-di ene		C ₂₇ H ₄₄	747-90-0	368.638	wh nd (al)	80	260 ³	0.925 ¹⁰⁰		i H ₂ O; s Et OH; msc et h, bz, chl; vs li g
2363	Cholest a-5,7-di en-3-ol, (β)	7-Dehydrochol est erol	C ₂₇ H ₄₄ O	434-16-2	384.637	pl (+1w), (et h-MeOH)	150.5				i H ₂ O; sl Et OH; s et h, ace
2364	Cholest a-8,24-di en-3-ol, (β,5α)		C ₂₇ H ₄₄ O	128-33-6	384.637	pl (MeOH),nd	110	160 ⁰⁰¹			s ace, chl, MeOH
2365	Cholest ane, (6α)	28,29,30-Tri norl anost ane	C ₂₈ H ₄₈	481-21-0	372.670	sc or pl (et h-al, ace)	80	250 ¹	0.9090 ⁹⁸	1.4887 ⁹⁸	i H ₂ O; sl Et OH; vs et h, bz, chl
2366	Cholest ane, (β)	Coprost ane	C ₂₇ H ₄₈	481-20-9	372.670	ort h nd (al, ace)	72		0.911 ⁹	1.4884 ⁹⁸	vs et h, chl
2367	Cholest anol	Di hydrochol est erol	C ₂₇ H ₄₆ O	80-97-7	388.669	sc (al, +1w)	141.5				vs et h, chl
2368	Cholest an-3-ol, (α,5α)	Epi chol est anol	C ₂₇ H ₄₆ O	516-95-0	388.669	nd (al)	185.5				s chl
2369	Cholest -4-en-3-ol, (β)	Al l ochol est erol	C ₂₇ H ₄₆ O	517-10-2	386.653	nd (et h-MeOH)	132				i H ₂ O; s Et OH; vs et h, ace, bz, chl
2370	Cholest -5-en-3-ol, (α)	Epi chol est erol	C ₂₇ H ₄₆ O	474-77-1	386.653	cry (al, chl - MeOH)	141.5				sl Et OH
2371	Cholest -5-en-3-ol (β), acet at e		C ₂₉ H ₄₈ O ₂	604-35-3	428.690	wh nd (ace, al)	115.5				vs bz, et h, chl
2372	Cholest -5-en-3-ol (β), benzoat e		C ₃₄ H ₅₀ O ₂	604-32-0	490.760	wh nd	151.3		0.9413 ²⁰⁰		i Et OH; s et h, chl
2373	Cholest -5-en-3-ol (β)-, hexadecanoat e		C ₄₃ H ₇₆ O ₂	601-34-3	625.062	wh nd (et h al)	79.3				vs bz, chl
2374	Cholest -5-en-3-ol (β)-, ci s-9-oct adecenoat e		C ₄₅ H ₇₈ O ₂	303-43-5	651.100		46.3				s chl
2375	Cholest -4-en-3-one		C ₂₇ H ₄₄ O	601-57-0	384.637	nd or pl (al)	81.5	245 ⁹³			
2376	Cholest erol		C ₂₇ H ₄₆ O	57-88-5	386.653	ort h or t cl lf (al) nd (et h)	148.5	dec 360; 233 ^{0.5}	1.067 ²⁰		i H ₂ O; sl Et OH, ace; s bz, HOAc; vs di ox
2377	Chol i c aci d	3,7,12-Tri hydroxychol an-24-oi c aci d (3α,5β,7α,12α)	C ₂₄ H ₄₀ O ₅	81-25-4	408.572		198				sl H ₂ O; s Et OH, ace, alk; vs et h, chl
2378	Chol i ne chl ori de		C ₂₆ H ₄₄ ClNO	67-48-1	139.624	hyg cry	305 dec				vs H ₂ O, Et OH
2379	Chol i ne chl ori de di hydrogen phosphat e	Phosphoryl chol i ne	C ₂₆ H ₄₄ Cl ₂ N ₂ O ₈ P	107-73-3	219.605	vi sc li q					
2380	Chori smi c aci d		C ₁₈ H ₁₀ O ₆	617-12-9	226.182	cry	148				s H ₂ O
2381	Chromi um carbonyl		CrO ₆	13007-92-6	220.056	col ort h cry	dec 130	sub	1.77		i H ₂ O, Et OH; s et h, chl
2382	Chromi um(II) oxal at e		CrO ₄	814-90-4	140.015	ye-grn pow (hyd)					i H ₂ O, Et OH; s di l aci d
2383	Chromi um(III) 2,4-pent anedi oat e	Chromi um acet yl acet onat e	C ₁₅ H ₂₁ O ₆	21679-31-2	349.320	red mcl cry	208	345	1.34		i H ₂ O; s bz
2384	Chromot rope 2B		C ₆ H ₃ N ₃ Na ₂ O ₁₀ S ₂	548-80-1	513.366	red-br pow	300				s H ₂ O; i Et OH
2385	Chrysammi ni c aci d	1,8-Di hydroxy-2,4,5,7-t et rani t ro-C ₁₄ H ₁₄ N ₄ O ₁₂ 9,10-ant hracenedi one		517-92-0	420.202	ye pl or lf	exp	dec			vs et h, Et OH
2386	6-Chrysenami ne	6-Ami nochrysene	C ₁₈ H ₁₃ N	2642-98-0	243.303	lf (al)	210.5				
2387	Chrysene	Benzo[a]phenant hrene	C ₁₈ H ₁₂	218-01-9	228.288	red bl fl or ort h pl (bz, HOAc)	255.5	448	1.274 ²⁰		i H ₂ O; sl Et OH, et h, ace, bz, C ₆ S ₆ t ol
2388	Ci af os		C ₁₀ H ₁₀ N ₂ O ₂ PS	2636-26-2	243.219	ye t o red-ye li q	15	120 ⁹ dec		1.5404 ³²	sl H ₂ O; vs chl, Et OH, ace, MeOH
2389	Ci cut oxi n	8,10,12-Hept adecat ri ene-4,6-di yn-1,14-di ol	C ₂₇ H ₄₀ O ₂	505-75-9	258.356	pr (et h/pet h)	54				s hot H ₂ O, Et OH, et h, chl
2390	C.I. Di rect Bl ue 6, t et rasodi um salt	Di rect Bl ue 6	C ₃₂ H ₂₀ N ₄ Na ₄ O ₁₄ S ₃	2602-46-2	932.752	dk bronze pow					
2391	Ci met i di ne		C ₁₀ H ₆ N ₆ S	51481-61-9	252.339	cry	142				



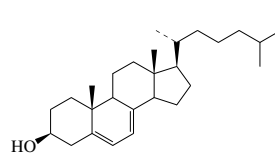
Cholane



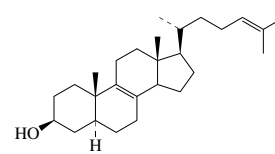
Cholan-24-oi aci d



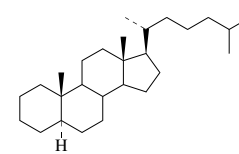
Chol est a-3,5-di ene



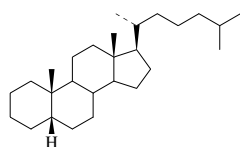
Chol est a-5,7-di en-3-ol(3β)



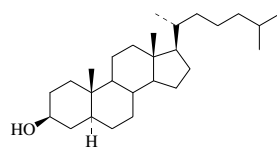
Chol est a-8,24-di en-3-ol(3β,5α)



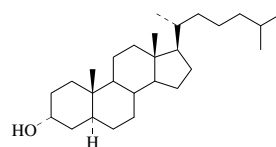
Chol est ane(5α)



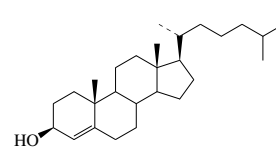
Chol est ane(5β)



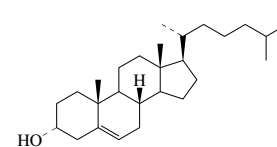
Chol est anol



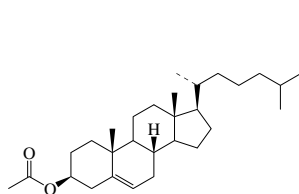
Chol est an-3-ol(3α,5α)



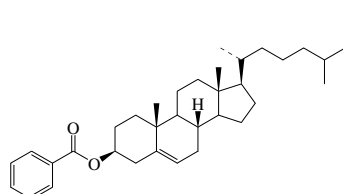
Chol est -4-en-3-ol(3β)



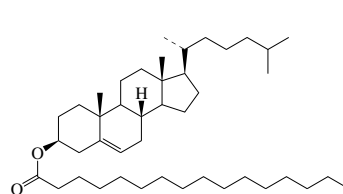
Chol est -5-en-3-ol(3α)



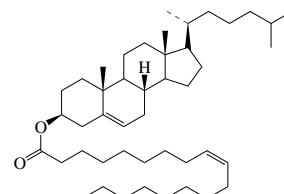
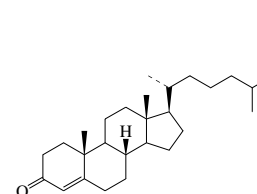
Chol est -5-en-3-ol(3β), acetate



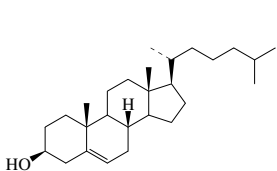
Chol est -5-en-3-ol(3β), benzoate



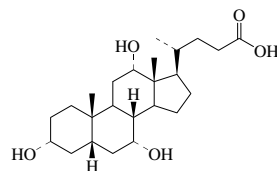
Chol est -5-en-3-ol(3β)-, hexadecanoate

Chol est -5-en-3-ol(3β)-, *cis*-9-ocadecenoate

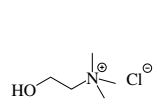
Chol est -4-en-3-one



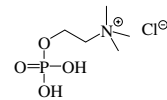
Chol est erol



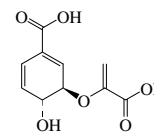
Chol i aci d



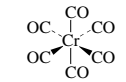
Chol i nehlori de



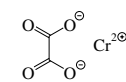
Chol i nehlori dei hydrogenphosphat e



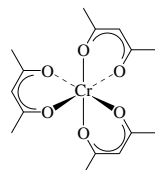
Chori smi aci d



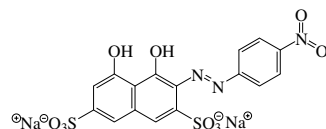
Chromi umcarbonyl



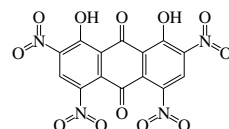
Chromi um(II)oxalat e



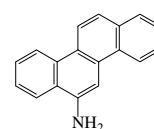
Chromi um(III)2,4-pent anedi oat



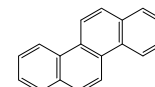
Chromot rope2B



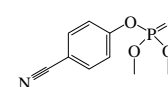
Chrysammi ni aci d



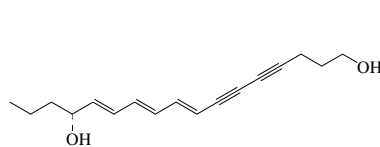
6-Chrysenami ne



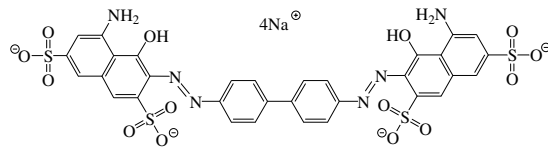
Chrysene



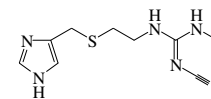
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Ci cut oxi n

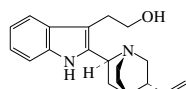


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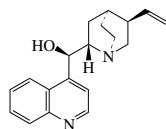


Ci met i di ne

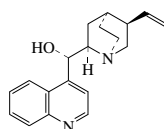
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2392	Cinchonamine		C ₂₁ H ₂₄ N ₂ O	482-28-0	296.406	orthorhombic (al) orthorhombic (MeOH)	186				insoluble; vs Et OH, eth, hex, benz, chl
2393	Cinchonidine		C ₂₁ H ₂₂ N ₂ O	485-71-2	294.390	orthorhombic or prismatic (al)	210.5	sub			insoluble; benz, vs Et OH, chl, py, sl eth
2394	Cinchonine		C ₂₁ H ₂₂ N ₂ O	118-10-5	294.390	prismatic (al, eth)	265				
2395	Cinchonidine		C ₂₁ H ₂₂ N ₂ O	69-24-9	294.390	orthorhombic or prismatic (eth)	59				insoluble; vs Et OH, eth, hex, benz, chl
2396	trans-Cinnamaldehyde	3-Phenyl-2-propenal E-	C ₉ H ₈ O	14371-10-9	132.159	yellow liquid	-7.5	246	1.0497	1.6195 ²⁰	sl H ₂ O; vs Et OH, eth, chl; insoluble
2397	Cinchonidine	α-[1-(Methyl(3-phenylallyl)amino)ethyl]benzenemethanol	C ₁₉ H ₂₃ NO	90-86-8	281.392		75				
2398	Cinchonidine	3-Phenyl-2-propenoic acid	C ₉ H ₈ O ₂	102-94-3	148.159	microprismatic (w)	42				vs Et OH, HOAc, insoluble
2399	trans-Cinchonidine	3-Phenyl-2-propenoic acid E-	C ₉ H ₈ O ₂	140-10-3	148.159	microprismatic (diagonal)	133	300	1.2475		insoluble; H ₂ O, liq; vs Et OH; sl eth, hex, benz
2400	trans-Cinchonidine	antihistamine	C ₁₆ H ₁₅ NO ₂	87-29-6	253.296	crystalline	64				
2401	Cinchonidine		C ₁₆ H ₁₅ O ₂	122-69-0	264.319	orthorhombic (al)	44		1.1565		insoluble; H ₂ O; vs Et OH, chl; vs eth
2402	Cinchonidine	3-Phenyl-2-propen-1-ol, formate	C ₁₀ H ₁₀ O ₂	104-65-4	162.185		0	252	1.086 ²⁵		
2403	Cinchonidine	1,2-Benzodiazine	C ₈ H ₈ N ₂	253-66-7	130.147	paracrystalline (liquid)	38	114 ⁶			vs eth, Et OH
2404	Cinchonidine	3-(4-Methoxyphenyl)-2-propenoic acid, 2-ethyl ester	C ₁₄ H ₁₆ O ₄	104-28-9	250.291	colorless liquid	-25	185	1.102 ²⁵	1.567 ²⁰	insoluble; misc Et OH
2405	Cinchonidine	Quinine	C ₂₀ H ₂₄ N ₂ O ₂	1047-16-1	312.321	red-violet crystals	390				insoluble, os
2406	Cinchonidine		C ₁₉ H ₁₉ O ₆ P	7700-17-6	314.271			135 ^{0.03}	1.19 ²⁵		
2407	Cinchonidine	Red 170	C ₁₂ H ₂₂ N ₄ O ₄	2786-76-7	454.478	red solid					
2408	Cinchonidine	Yellow 1	C ₁₆ H ₁₆ N ₄ O ₄	2512-29-0	340.334	yellow crystals	256				
2409	Cinchonidine	Yellow 12	C ₂₆ H ₂₆ Cl ₂ N ₄ O ₄	6358-85-6	629.492	yellow crystals	317				
2410	Cinchonidine		C ₁₂ H ₂₀ Cl ₂ FN ₄ O ₄	81098-60-4	465.945	crystalline (hp)	132				
2411	Cinchonidine	3,7-Dimethyl-2,6-octadienal	C ₁₀ H ₁₆ O	5392-40-5	152.233			228.3	0.8888 ²⁰	1.4898 ²⁰	insoluble; misc Et OH, eth
2412	Cinchonidine		C ₈ H ₈ O ₂	650-69-1	432.638	plastic (bzipet h), crystalline (al)	147				insoluble; vs Et OH, eth, hex, benz; sl liq
2413	Cinchonidine	1,2-Dihydro-6-hydroxy-2-oxo-4-pyridinecarboxylic acid	C ₆ H ₆ NO ₄	99-11-6	155.109	yellow powder	>300 dec				soluble H ₂ O, alk; sl HCl
2414	Cinchonidine	2-Hydroxy-1,2,3-propanetri-carboxylic acid	C ₆ H ₈ O ₇	77-92-9	192.124	orthorhombic (w+1)	153	dec	1.668 ⁰		vs H ₂ O, Et OH; sl eth, AcOEt; insoluble, chl
2415	Cinchonidine	2-Hydroxy-1,2,3-propanetri-carboxylic acid, monohydrate	C ₆ H ₁₀ O ₈	5949-29-1	210.138	crystalline (w)	135		1.542		vs H ₂ O; vs Et OH, eth
2416	Cinchonidine	Antimycin	C ₁₃ H ₁₄ O ₅	518-75-2	250.247	yellow needles (MeOH)	178 dec				insoluble; H ₂ O; sl Et OH, eth, hex; vs ace, benz
2417	Cinchonidine	N5-(Aminocarbonyl)-ornithine	C ₈ H ₁₃ N ₃ O ₃	372-75-8	175.185	prismatic (aq MeOH)	222				soluble H ₂ O; insoluble Et OH, MeOH
2418	Cinchonidine	Red 2	C ₁₈ H ₁₈ N ₂ O ₃	6358-53-8	308.331	crystalline	156				sl H ₂ O; vs Et OH
2419	Cinchonidine	7,16-Dichloro-6,15-dihydro-5,9,14,18-antihistamine	C ₂₈ H ₁₂ Cl ₂ N ₂ O ₄	130-20-1	511.312	white-brown powder					
2420	Cinchonidine	Anthrone	C ₁₂ H ₁₂ O ₂	128-66-5	332.351	yellow crystals					
2421	Cinchonidine	Thiazol Yellow G	C ₂₈ H ₁₉ N ₅ Na ₂ O ₆ S ₄	1829-00-1	695.721	yellow-brown powder					soluble H ₂ O, Et OH, H ₂ SO ₄
2422	Cinchonidine	Emastine fumarate	C ₂₅ H ₃₀ Cl ₂ NO ₄	14976-57-9	459.963		181				
2423	Cinchonidine	Indamycin	C ₁₉ H ₁₃ Cl ₂ N ₃ O ₅ S	18323-44-9	424.983	yellow amorphous solid					
2424	Cinchonidine	Iconazole	C ₁₈ H ₁₅ Cl ₂ N ₃ O	77175-51-0	310.777		73				soluble Et OAc
2425	Cinchonidine	3,6-Bis(2-chlorophenyl)-1,2,4,5-tetraza	C ₁₄ H ₈ Cl ₂ N ₄	74115-24-5	303.147		182				
2426	Cinchonidine	Clonidine	C ₉ H ₁₅ Cl ₂ O	637-07-0	242.698			149 ²⁰			
2427	Cinchonidine	Clonidine	C ₉ H ₁₅ Cl ₂ NO	14261-75-7	255.741	crystalline	52.8	89 ^{0.05}			



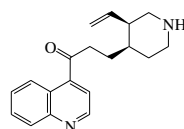
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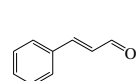
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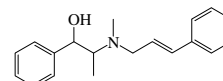
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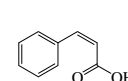
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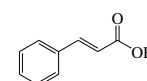
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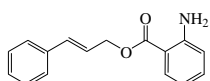
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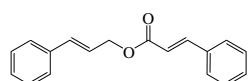
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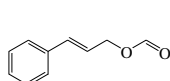
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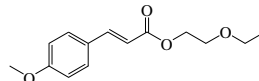
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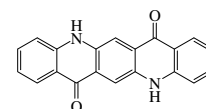
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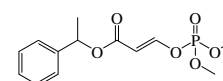
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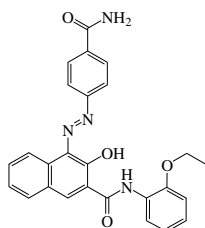
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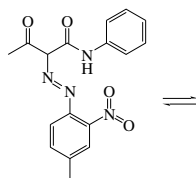
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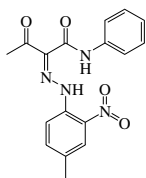
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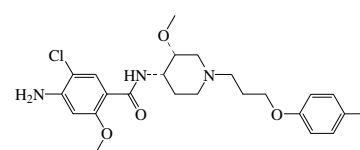
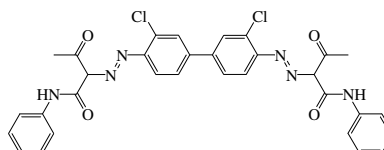
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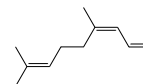
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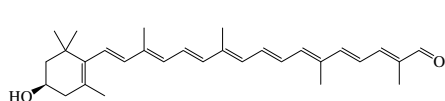
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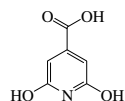
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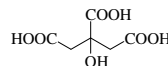
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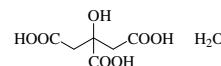
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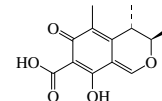
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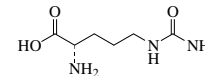
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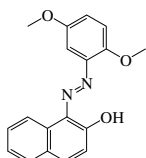
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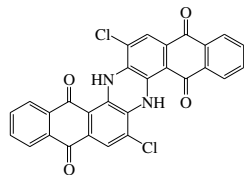
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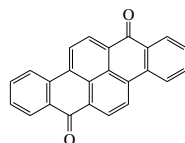
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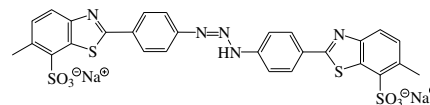
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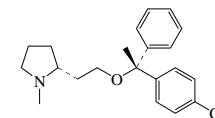
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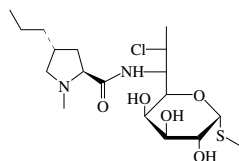
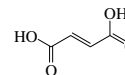
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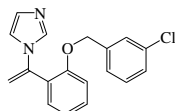
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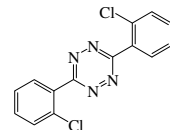
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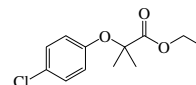
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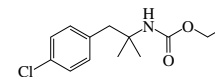
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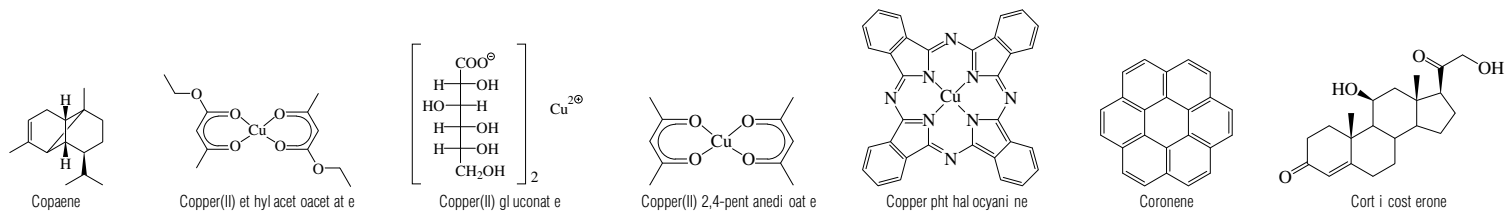
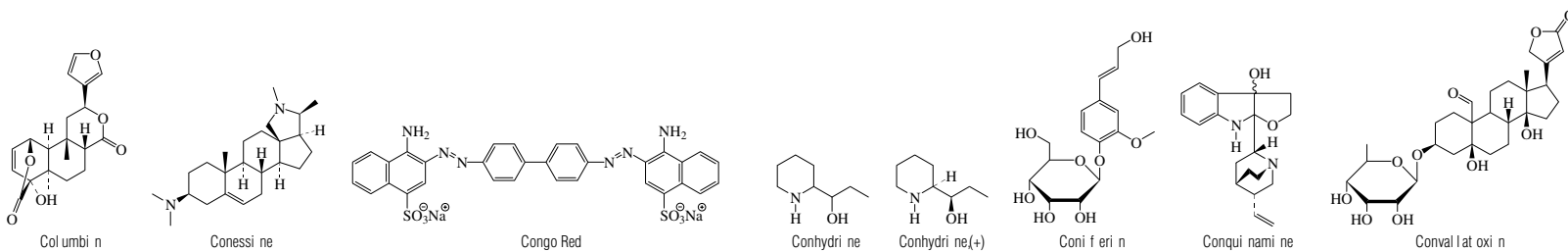
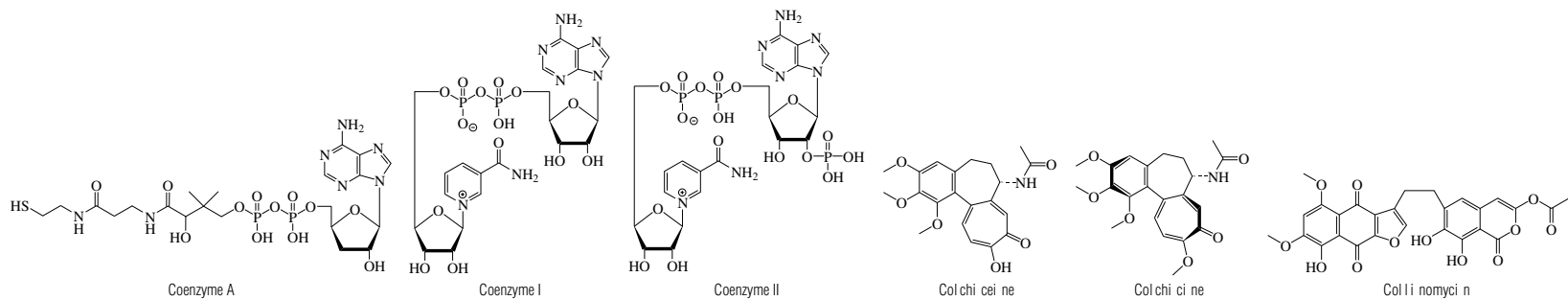
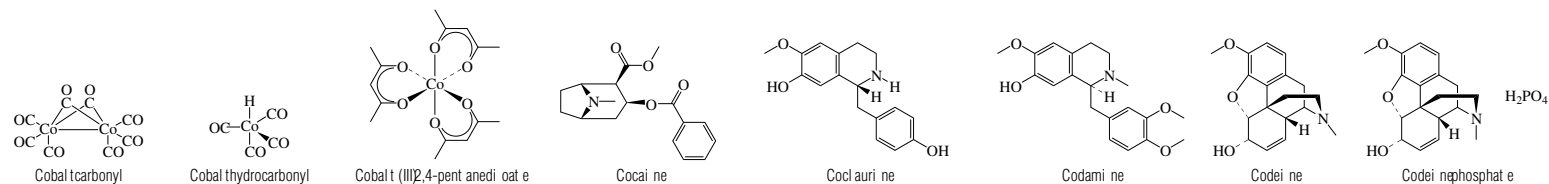
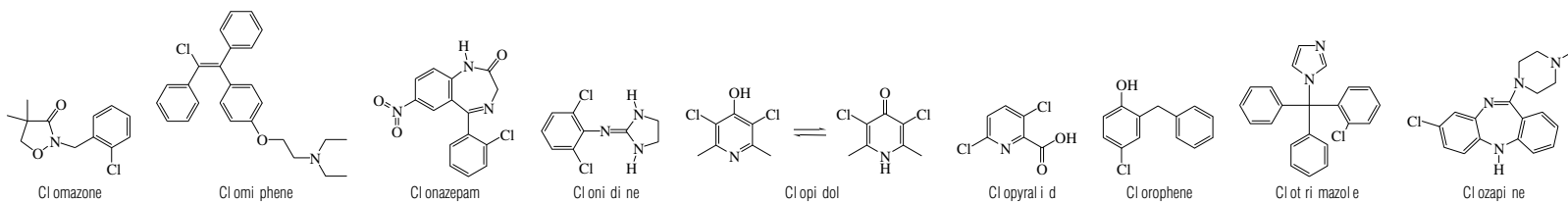


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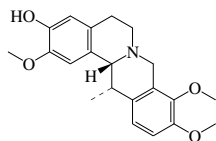


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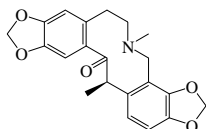
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2428	Clomazone	2-(2-Chlorobenzyl)-4,4-di methyl-1,2-oxazolol di n-3-one	C ₁₂ H ₁₄ ClNO ₂	81777-89-1	239.698				1.192 ²⁰		
2429	Clomiphen		C ₆ H ₂₈ ClNO	911-45-5	405.959		117				
2430	Clonazepam		C ₁₅ H ₁₀ ClN ₂ O ₃	1622-61-3	315.711	wh cry	237.5				i H ₂ O, bz; sl ace, MeOH, chl
2431	Clonidine		C ₉ H ₈ Cl ₂ N ₃	4205-90-7	230.093	cry	137				
2432	Clonidine		C ₉ H ₈ Cl ₂ NO	2971-90-6	192.043	pow	>320				i H ₂ O
2433	Clonidine	3,6-Di chloro-2-pyridinecarboxylic acid	C ₆ H ₃ Cl ₂ NO ₂	1702-17-6	192.000		151				
2434	Clorophene		C ₃ H ₁₁ ClO	120-32-1	218.678		48.5	16 ³⁵	1.185 ⁵⁸		s ct c, C ₅
2435	Clotrimazole		C ₂₂ H ₁₇ ClN ₄	23593-75-1	344.836	cry	148				sl H ₂ O, bz; s ace, chl, AcOEt, DMF
2436	Clotrimazole	Clotrimazole	C ₁₈ H ₁₃ ClN ₄	5786-21-0	326.824	ye cry	183.5				
2437	Cobalt carbonyl	Dicobalt octacarbonyl	C ₈ Co ₂ O ₈	10210-68-1	341.947	oran cry	51 dec		1.78		i H ₂ O; s Et OH, et h, C ₅
2438	Cobalt hydrocarbonyl	Tetracarbonylhydrocobalt	C ₄ HCoO ₄	16842-03-8	171.982	ye li q or gas	-30	10			s os
2439	Cobalt (III) 2,4-pentanedioate	Cobalt (III) acetylacetonate	C ₁₅ H ₂₁ O ₆	21679-46-9	356.257		240				
2440	Cocaine		C ₁₇ H ₂₁ NO ₄	50-36-2	303.354	mcl pr (al)	98	187 ¹		1.5022 ⁹⁸	sl H ₂ O; vs Et OH, et h, bz, py; s C ₅
2441	Cocaine		C ₁₇ H ₁₉ NO ₃	486-39-5	285.338	pl (al)	220.5				
2442	Codamine		C ₉ H ₂₅ NO ₄	21040-59-5	343.418	pr (bz, et h)	127				vs et h, Et OH, chl
2443	Codeine		C ₁₈ H ₂₁ NO ₃	76-57-3	299.365	ort h cry (w, di l al, et h)	157.5	250 ²² , 140 ¹⁵	1.32 ²⁵		s H ₂ O, et h, bz, chl, t ol; vs Et OH; i pet h
2444	Codeine phosphate		C ₁₈ H ₂₄ NO ₇ P	52-28-8	397.361	lf or pr (di l al)	227 dec				vs Et OH, chl
2445	Coenzyme A		C ₂₁ H ₃₈ N ₇ O ₁₆ P ₃ S	85-61-0	767.535	pow; unst ab in air					s H ₂ O
2446	Coenzyme I	Nicotinamide adenine dinucleotide	C ₂₇ H ₂₇ N ₇ O ₁₄ P ₂	53-84-9	663.425	hyg pow					s H ₂ O
2447	Coenzyme II	Nicotinamide adenine dinucleotide phosphate	C ₂₈ H ₂₈ N ₇ O ₁₇ P ₃	53-59-8	743.405	gray-wh pow					s H ₂ O
2448	Colchicine		C ₂₃ H ₂₃ NO ₆	477-27-0	385.411	pa ye nd (di ox)	178.5		1.24 ⁴		sl H ₂ O; vs Et OH, chl; i et h, bz
2449	Colchicine		C ₂₃ H ₂₅ NO ₆	64-86-8	399.437	ye, pl (w + 1/2) ye cry (bz)	156				vs H ₂ O, Et OH
2450	Colistin A		C ₅₃ H ₁₀₀ N ₁₆ O ₁₃	7722-44-3	1169.47	amorp pow					sl H ₂ O, Et OH, hx; s aci ds, MeOH
2451	Colistin N		C ₂₇ H ₂₀ O ₁₂	27267-69-2	536.441	oran pr (chl - MeOH)	281				vs ace, di ox, chl
2452	Colubamine		C ₆ H ₂₂ O ₆	546-97-4	358.385	nd (MeOH)	195.5				i H ₂ O; sl ace, AcOEt, MeOH; s chl
2453	Conessine		C ₂₄ H ₄₀ N ₂	546-06-5	356.588	lf or pl (ace)	125.5	166			sl H ₂ O; s chl, HOAc
2454	Congo Red		C ₂₂ H ₂₂ N ₆ Na ₂ O ₆ S ₂	573-58-0	696.663	pow	>360				sl H ₂ O; s Et OH; i et h
2455	Conhydrine		C ₇ H ₁₇ NO	3238-62-8	143.227	nd (pet h)	121	226			sl H ₂ O; vs bz, et h, Et OH
2456	Copper(I) conhydrine	2-(2-Hydroxypropyl)pyridine	C ₇ H ₉ NO	495-20-5	143.227	lf (et h)	121	226			sl H ₂ O; vs et h, Et OH, chl
2457	Coniferyl		C ₁₀ H ₁₂ O ₃	531-29-3	342.341	nd (w+2)	186				s H ₂ O, py; sl Et OH; i et h
2458	Conquiamine		C ₇ H ₂₄ N ₂ O ₂	464-86-8	312.406	ye t et r	123				sl H ₂ O; s Et OH, et h, chl
2459	Convalinaxin		C ₂₃ H ₄₂ O ₁₀	508-75-8	550.637	pr (et h/MeOH)	238				s Et OH, ace; sl chl; i et h
2460	Copaene		C ₁₅ H ₁₂	3856-25-5	204.352			248.5	0.8996 ²⁰	1.4894 ²⁰	i H ₂ O; s et h, ace, HOAc, li g
2461	Copper(II) ethylacetate	Bis(ethylacetate)copper	C ₁₂ H ₁₈ CO ₆	14284-06-1	321.813	grn cry (Et OH)	192				s Et OH, chl
2462	Copper(II) gluconate	Cupric gluconate	C ₁₂ H ₂₂ O ₁₄	527-09-3	453.841	bl-grn cry	156				sl Et OH; i os
2463	Copper(II) 2,4-pentanedioate	Copper(II) acetylacetonate	C ₁₀ H ₆ CuO ₄	13395-16-9	261.762	bl pow	284 dec	sub			sl H ₂ O; s chl
2464	Copper phthalocyanine	Pigment Blue 15	C ₃₂ H ₁₆ CuN ₈	147-14-8	576.069	bl-purp cry					i H ₂ O, Et OH; s conc H ₂ SO ₄
2465	Coronene		C ₂₂ H ₁₂	191-07-1	300.352	ye nd (bz)	437.4	525	1.371 ²⁵		i H ₂ O, con sul f; sl bz
2466	Corticotestosterone		C ₂₇ H ₃₀ O ₄	50-22-6	346.461	nd (al, pl) (ace)	181				i H ₂ O; s Et OH, et h, ace



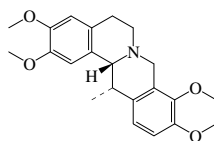
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2467	Corybulbi ne		C ₇ H ₂₅ NO ₄	518-77-4	355.429	nd (al)	237.5				i H ₂ O; sl Et OH, et h; s ace, bz, HCl
2468	Corycavami ne		C ₂₁ H ₂₁ NO ₅	521-85-7	367.396	pr (et h, al)	149				vs Et OH, chl
2469	Corydali ne		C ₈ H ₂₇ NO ₄	518-69-4	369.454	pr (al)	136				vs bz, et h, Et OH, chl
2470	Corydi ne		C ₈ H ₂₃ NO ₄	476-69-7	341.402	t et r pr (et h)	149				vs et h, Et OH, chl
2471	Corynanti he ne		C ₂₀ H ₂₅ N ₂ O ₃	18904-54-6	366.452		165.5				vs Et OH
2472	Cotarni ne		C ₈ H ₁₃ NO ₄	82-54-2	237.252	nd (bz), cry (et h)	132 dec				sl H ₂ O; s Et OH, et h, bz, chl, NH ₄ OH
2473	Coumaphos		C ₁₄ H ₁₆ ClO ₃ PS	56-72-4	362.766		93		1.474		
2474	Coumestrol	3,9-Di hydroxy-6-benzofuro[3,2-c][1]benzopyran-6-one	C ₁₅ H ₈ O ₅	479-13-0	268.222	cry rods	385 dec				i H ₂ O; sl Et OH, ace; i et h
2475	Creatine		C ₄ H ₉ N ₃ O ₂	57-00-1	131.133	mcl pr (w+1)	303 dec		1.33 ⁹		s H ₂ O; sl Et OH; i et h
2476	Creatinine		C ₄ H ₇ N ₃ O	60-27-5	113.118	ort h pr (w+2) l f (w)	300 dec				s H ₂ O; sl Et OH; i et h, ace, chl
2477	<i>o</i> -Cresol	2-Methyl phenol	C ₇ H ₈ O	95-48-7	108.138		31.03	191.04	1.0327 ³⁵	1.5386 ³⁵	s H ₂ O; vs Et OH, et h; msc ace, bz, ct c
2478	<i>m</i> -Cresol	3-Methyl phenol	C ₇ H ₈ O	108-39-4	108.138		12.24	202.27	1.0339 ²⁰	1.5401 ²⁰	sl H ₂ O; msc Et OH, et h, ace, bz, ct c
2479	<i>p</i> -Cresol	4-Methyl phenol	C ₇ H ₈ O	106-44-5	108.138	pr	34.77	201.98	1.0185 ⁴⁰	1.5312 ²⁰	sl H ₂ O; msc Et OH, et h, ace, bz, ct c
2480	<i>o</i> -Cresol phosphate		C ₁₀ H ₁₀ O ₄	596-27-0	346.376	cry (al)	223				vs Et OH
2481	<i>o</i> -Cresol phosphate compl exone	Methyl phosphate	C ₃₂ H ₃₂ N ₂ O ₁₂	2411-89-4	636.602	ye cry pow	186				i H ₂ O; s Et OH, ace, al k
2482	Cresol Red	<i>o</i> -Cresol sulfonate	C ₂₁ H ₁₆ O ₅ S	1733-12-6	382.430	red-br cry pow	>300				vs H ₂ O, Et OH
2483	<i>p</i> -Cresol di phenyl phosphate		C ₁₈ H ₁₇ O ₄ P	78-31-9	340.309	col li q	-40		1.208		i H ₂ O; s os
2484	Crimidine		C ₇ H ₆ ClN ₃	535-89-7	171.627	br wax	87	143 ⁴			vs Et OH
2485	Cromolyn	Cromoglicic acid	C ₂₃ H ₁₆ O ₁₁	16110-51-3	468.366	col cry	241 dec				
2486	Crufomate		C ₇ H ₁₃ ClNO ₃ P	299-86-5	291.711		60	118 ⁰⁰¹			
2487	Cryptonine	Cryptonine	C ₂₁ H ₂₃ NO ₅	482-74-6	369.412	pr or pl (bz) nd (chl - MeOH)	223		1.315 ²⁰		i H ₂ O; sl Et OH, et h, bz; s chl, HOAc
2488	Crystall violet	Gentian violet	C ₂₅ H ₃₀ ClN ₃	548-62-9	407.979	grn pow	215 dec				vs H ₂ O, chl
2489	Cubebine		C ₂₀ H ₂₀ O ₆	18423-69-3	356.369	nd (al, bz)	131.5				vs et h, Et OH, chl
2490	Cucurbitacin B		C ₃₀ H ₄₆ O ₈	6199-67-3	558.702	cry (Et OH)	181				
2491	Cucurbitacin C		C ₃₂ H ₄₈ O ₈	5988-76-1	560.718	cry (AcOEt)	207.5				
2492	Cupferron		C ₈ H ₈ N ₂ O ₂	135-20-6	155.154		163.5				sl DMSO
2493	Cupreine		C ₁₉ H ₂₂ N ₂ O ₂	524-63-0	310.390	pr (et h)	202				vs Et OH
2494	Curan-17-ol, (16 α)	Geissoschizoline	C ₁₉ H ₂₆ N ₂ O	18397-07-4	298.421	pa ye amor pow	135 dec				i H ₂ O; vs Et OH, et h, chl
2495	Curcumin	Turmeric	C ₂₁ H ₂₀ O ₆	458-37-7	368.380	oran ye pr, ort h pr (MeOH)	183				vs Et OH, HOAc
2496	Curine		C ₈ H ₁₃ N ₂ O ₆	436-05-5	594.696	pr, nd (chl - MeOH)	221				vs ace, bz, py
2497	Cuscohygrine		C ₉ H ₂₄ N ₂ O	454-14-8	224.342	oi l		169, 122 ²	0.9733 ²⁰	1.4832 ²⁰	vs H ₂ O, bz, et h, Et OH
2498	Cusparine	2-[2-(1,3-Benzodioxol-5-yl)ethyl]-4-cyclohexyl-1-nitro-3-oxo-1,2,3,4-tetrahydroquinoline	C ₁₉ H ₁₇ NO ₃	529-92-0	307.343	(α) wh or ye nd (pet h); (β) amber pr	92(α f orm); 111(β f orm)				i H ₂ O; vs ace, bz, et h, Et OH
2499	Cyamemazine		C ₁₉ H ₂₁ N ₃ S	3546-03-0	323.455	ye pow	92	212 ⁰²⁵			i H ₂ O; s Et OH
2500	Cyanamide	Cyanogenamide	C ₂ H ₂ N ₂	420-04-2	42.040	nd	45.56	140 ¹⁹	1.282 ²⁰	1.4418 ⁴⁸	vs H ₂ O, Et OH; s et h, ace, bz; sl CS ₂
2501	Cyanazine		C ₄ H ₃ ClN ₃	21725-46-2	240.692		168				
2502	Cyanic acid	Hydrogen cyanate	CHNO	420-05-3	43.025	unst ab li q or gas	-86	23	1.140 ²⁰		vs H ₂ O, bz, et h, chl
2503	2-Cyanoacetamide		C ₃ H ₄ N ₂ O	107-91-5	84.076	pl (w)	121.5				vs H ₂ O



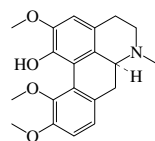
Corybulbine



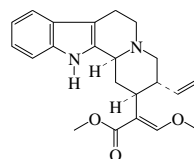
Corycavamine



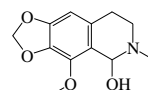
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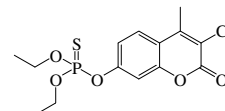
Corydine



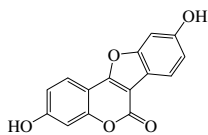
Corynanthine



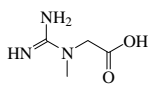
Cotarnine



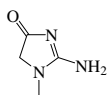
Coumaphos



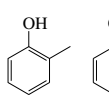
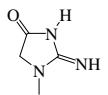
Coumestrol



Creatine



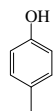
Creatinine



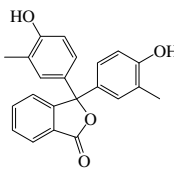
o-Cresol



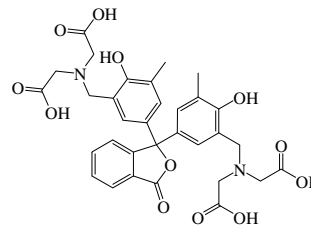
m-Cresol



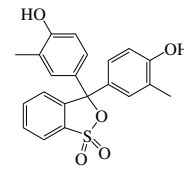
p-Cresol



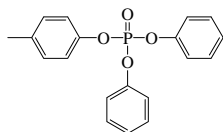
o-Cresol phtalate



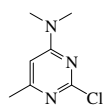
o-Cresol phtalate dimplexone



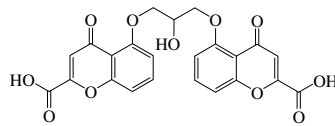
Cresol Red



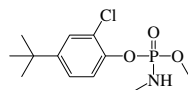
p-Cresyl di phenylphosphate



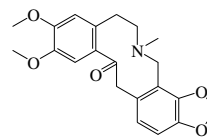
Criidine



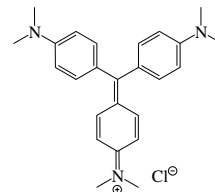
Cromolyn



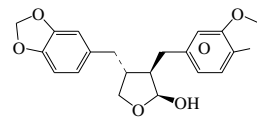
Crufomate



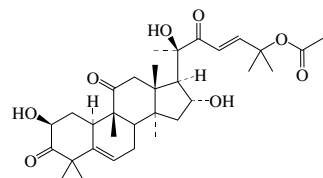
Cryptopine



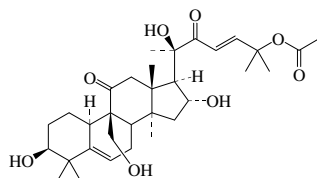
Crystalline



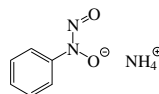
Cubebine



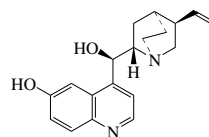
Cucurbitacin



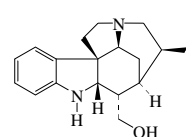
Cucurbitacin



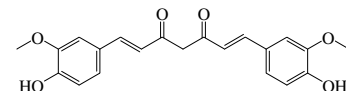
Cupferron



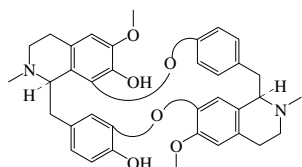
Cupreine



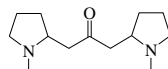
Curan-17-ol, (16α)



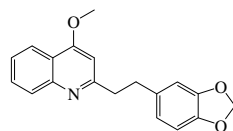
Curcumin



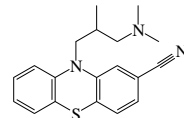
Curine



Cuscohygrine



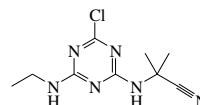
Cusparine



Cyamemazine



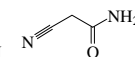
Cyanamide



Cyanazine

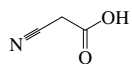


Cyanic acid

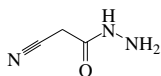


2-Cyanoacetamide

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2504	Cyanoacet i c aci d		$\text{C}_3\text{H}_3\text{NO}_2$	372-09-8	85.062		66	dec 160; 108 ¹⁵			s H ₂ O, Et OH, et h; sl chl, HOAc
2505	Cyanoacet ohydrazide	Cyacet aci de	$\text{C}_3\text{H}_3\text{N}_2\text{O}$	140-87-4	99.091	pr (al)	114.5				vs H ₂ O, Et OH
2506	Cyanoacet yl ene		CHN	1070-71-9	51.047		5	42.5	0.8167 ¹⁷	1.3868 ²⁵	sl H ₂ O; s Et OH
2507	3-Cyanobenzoi c aci d		$\text{C}_7\text{H}_5\text{NO}_2$	1877-72-1	147.132	nd (w)	219	sub			sl H ₂ O; s Et OH, et h
2508	4-Cyanobenzoi c aci d		$\text{C}_7\text{H}_5\text{NO}_2$	619-65-8	147.132		219				s H ₂ O, Et OH, et h, HOAc; sl t f a
2509	4-Cyanobut anoi c aci d		$\text{C}_4\text{H}_7\text{NO}_2$	39201-33-7	113.116	hyg cry	45				s H ₂ O, Et OH, et h, bz
2510	2-Cyanoet hyl acryl at e		$\text{C}_5\text{H}_7\text{NO}_2$	106-71-8	125.126			108 ¹²	1.062 ²⁰		
2511	Cyanof enphos		$\text{C}_{15}\text{H}_{14}\text{NO}_2\text{PS}$	13067-93-1	303.317		83			1.5839 ²⁵	sl H ₂ O
2512	Cyanogen		C_2N_2	460-19-5	52.034	col gas	-27.83	-21.1	0.9537 ²¹		s H ₂ O, Et OH, et h
2513	Cyanogen bromi de	Bromi ne cyani de	CBrN	506-68-3	105.922	nd	52	61.5	2.01 ⁵		s H ₂ O, Et OH, et h
2514	Cyanogen chl ori de	Chl ori ne cyani de	CClN	506-77-4	61.471	col vol li q	66.5	13	1.186 ²⁰		s H ₂ O, Et OH; vs et h
2515	Cyanogen fluori de	Fluori ne cyani de	CFN	1495-50-7	45.016	col gas	-82	-46			
2516	Cyanogen i odi de	Iodi ne cyani de	CIN	506-78-5	152.922	nd (al, et h)	146.7	sub	1.84		vs et h, Et OH
2517	Cyanoguanidi ne	Di cyanodi ami de	$\text{C}_2\text{H}_4\text{N}_4$	461-58-5	84.080		211		1.404 ¹⁴		s H ₂ O, Et OH, ace; i et h, bz, chl
2518	Cyanomet hyl mercury	Met hyl mercuryri t ri le	$\text{C}_2\text{H}_3\text{HgN}$	2597-97-9	241.64	cry (chl)	92	subl			vs H ₂ O, Et OH, bz; s et h
2519	(4-Cyanophenoxy)acet i c aci d		$\text{C}_9\text{H}_7\text{NO}_3$	1878-82-6	177.157	cry (w)	178				
2520	2-Cyano-N-phenylacet ami de		$\text{C}_9\text{H}_9\text{N}_2\text{O}$	621-03-4	160.172	nd (al)	199.5				
2521	4-Cyanot hi azol e		$\text{C}_4\text{H}_3\text{N}_2\text{S}$	1452-15-9	110.137	nd	58				
2522	Cyanuri c aci d	1,3,5-Tri azi ne-2,4,6-(3H,5H)-t ri one	$\text{C}_3\text{H}_3\text{N}_3\text{O}_3$	108-80-5	129.074	wh cry	>330	sub	1.75 ²⁵		sl hot H ₂ O, ace, bz, Et OH; s conc HCl
2523	Cyanuri c fluori de	2,4,6-Tri fluoro-1,3,5-t ri azi ne	$\text{C}_3\text{F}_3\text{N}_3$	675-14-9	135.047			72.8			
2524	Cycasi n		$\text{C}_7\text{H}_8\text{N}_2\text{O}_7$	14901-08-7	252.222	nd (ace aq)	154 dec				
2525	Cycl andel at e		$\text{C}_7\text{H}_{12}\text{O}_3$	456-59-7	276.371		52	193 ¹⁴			i H ₂ O
2526	Cycl i zi ne		$\text{C}_8\text{H}_{12}\text{N}_2$	82-92-8	266.381	cry (pet h)	106				i H ₂ O; s chl; sl Et OH
2527	Cycl oat e	Carbamot hi oi caci d, cycl ohexyl et hyl S-et hyl est er	$\text{C}_8\text{H}_{17}\text{NOS}$	1134-23-2	215.356		11.5	145 ¹⁰	1.0156 ³⁰		
2528	Cycl obarbi t al		$\text{C}_8\text{H}_{16}\text{N}_2\text{O}_3$	52-31-3	236.266	lf (w)	173				i H ₂ O; vs Et OH; s et h, di l al k; sl HOAc
2529	Cycl obut anami ne	Ami nocycl obut ane	$\text{C}_4\text{H}_9\text{N}$	2516-34-9	71.121			82	0.8328 ²⁰	1.4363 ¹⁹	
2530	Cycl obut ane	Tet ramet hyl ene	C_4H_8	287-23-0	56.107	vol li q or gas	-90.7	12.6	0.7038	1.375 ²⁰	i H ₂ O; vs Et OH, ace; msc et h; s bz
2531	Cycl obut ane carboni t ri le	Cyanocycl obut ane	$\text{C}_4\text{H}_4\text{NC}$	4426-11-3	81.117			149.6			
2532	Cycl obut ane carboxyl i c aci d		$\text{C}_5\text{H}_8\text{O}_2$	3721-95-7	100.117	li q	-1.0	190; 74	1.0599 ²⁰	1.4400 ²⁰	sl H ₂ O; msc Et OH, et h
2533	1,1-Cycl obut anedi carboxyl i c aci d		$\text{C}_5\text{H}_8\text{O}_4$	5445-51-2	144.126	pr (w, et h)	158.0				vs H ₂ O; s Et OH, et h, bz; sl li g
2534	Cycl obut anol	Hydroxycycl obut ane	$\text{C}_4\text{H}_8\text{O}$	2919-23-5	72.106			124	0.9218 ¹⁵	1.4371 ²⁰	
2535	Cycl obut anone		$\text{C}_4\text{H}_6\text{O}$	1191-95-3	70.090	li q	-50.9	99	0.9547	1.4215 ²⁰	s H ₂ O, et h, bz, chl, t ol; vs Et OH; i pet h
2536	Cycl obut ene		C_4H_6	822-35-5	54.091	col gas		2	0.733 ⁹		vs ace; s bz, pet h
2537	Cycl ochl orot i ne		$\text{C}_{31}\text{H}_{31}\text{Cl}_2\text{N}_5\text{O}_7$	12663-46-6	572.439	nd (MeOH)	255 dec				
2538	Cycl odecane		$\text{C}_{10}\text{H}_{20}$	293-96-9	140.266		10	202	0.8538 ²⁵	1.4716 ²⁰	
2539	1,2-Cycl odecane di one	Sebaci l	$\text{C}_{10}\text{H}_{16}\text{O}_2$	96-01-5	168.233		40.5	104 ¹⁰			
2540	Cycl odecanol		$\text{C}_{10}\text{H}_{20}\text{O}$	1502-05-2	156.265		40.5	125 ¹²	0.9606 ²⁰	1.4926 ²⁰	s Et OH
2541	Cycl odecanone		$\text{C}_{10}\text{H}_{18}\text{O}$	1502-06-3	154.249	amor pow	28	106 ¹³	0.9654 ²⁰	1.4806 ²⁰	vs bz, et h, chl
2542	α-Cycl odext ri n	Cycl omal t ohexaose	$\text{C}_{36}\text{H}_{64}\text{O}_{30}$	10016-20-3	972.843	hx pl or nd					vs col d H ₂ O; i hot H ₂ O
2543	β-Cycl odext ri n	Cycl omal t oheptaose	$\text{C}_{42}\text{H}_{76}\text{O}_{35}$	7585-39-9	1134.984	mcl cry (w)	260 dec				
2544	γ-Cycl odext ri n	Cycl omal t ooct aose	$\text{C}_{48}\text{H}_{88}\text{O}_{40}$	17465-86-0	1297.125	sq pl or rods					



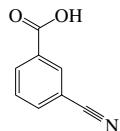
Cyanoacetic acid



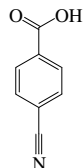
Cyanoacetohydrazide



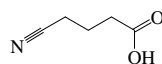
Cyanoacetylene



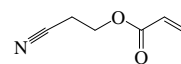
3-Cyanobenzoic acid



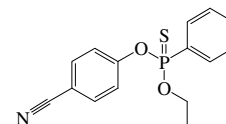
4-Cyanobenzoic acid



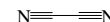
4-Cyanobutanoic acid



2-Cyanoethyl acrylate



Cyanophosphorothioic acid diethyl ester



Cyanogen



Cyanogen bromide



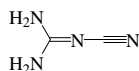
Cyanogen chloride



Cyanogen fluoride



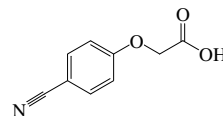
Cyanogen iodide



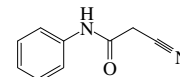
Cyanoguanidine



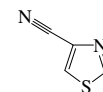
Cyanomethyl mercury



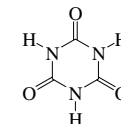
(4-Cyanophenoxy)acetic acid



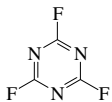
2-Cyano-N-phenylacetamide



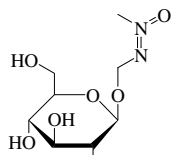
4-Cyanothiazole



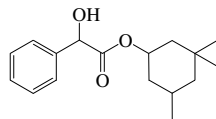
Cyanuric acid



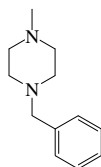
2,4,6-Trifluorocyanuric acid



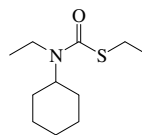
Cycasin



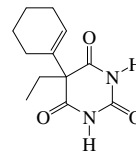
Cycloandelate



Cyclozine



Cycloate



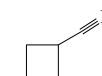
Cyclobarbital



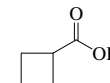
Cyclobutanamine



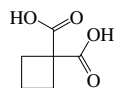
Cyclobutane



Cyclobutanecarbonitrile



Cyclobutanecarboxylic acid



1,1-Cyclobutanedicarboxylic acid



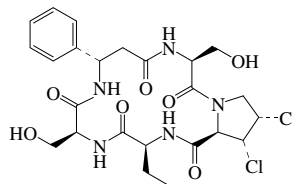
Cyclobutanol



Cyclobutanone



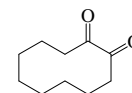
Cyclobutene



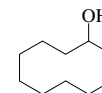
Cyclochlorogenic acid



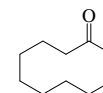
Cyclodecane



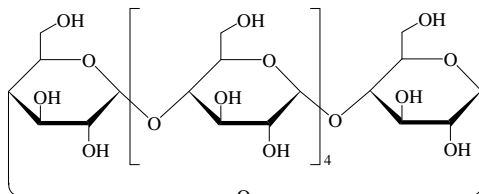
1,2-Cyclodecanedione



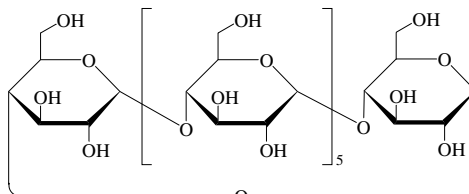
Cyclodecanol



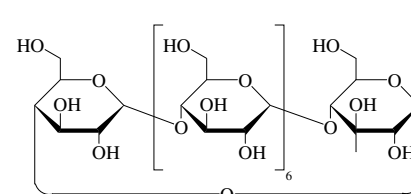
Cyclodecanone



α -Cyclodextrin

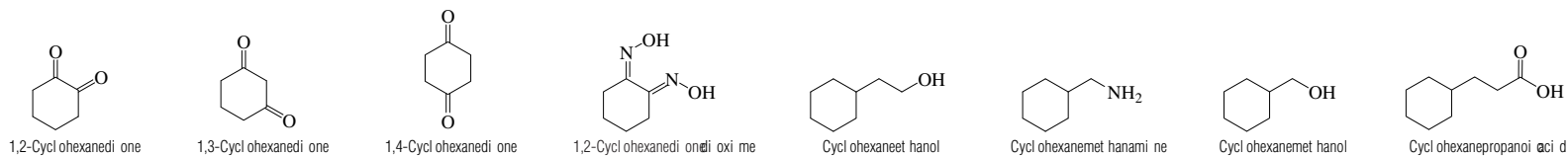
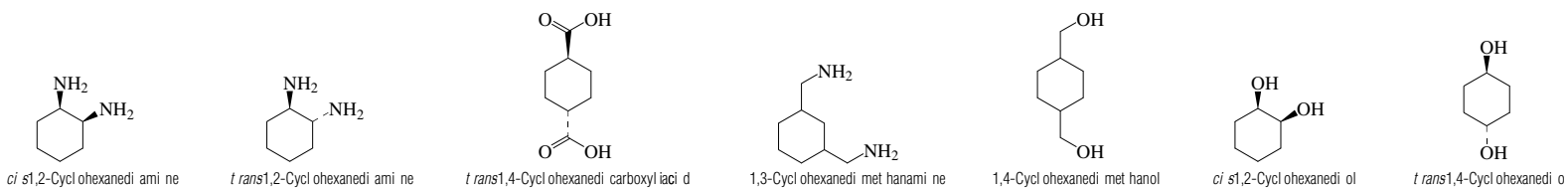
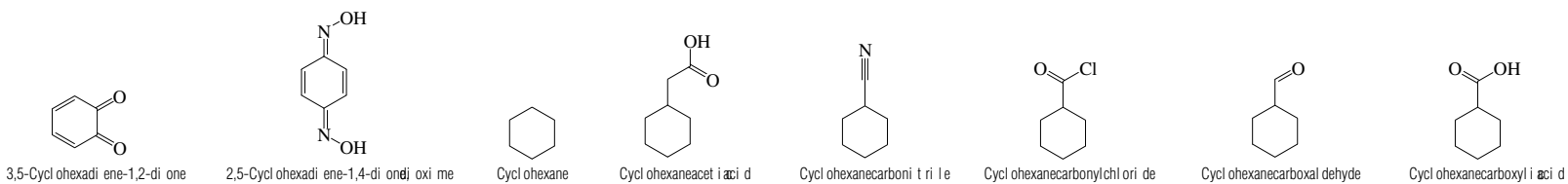
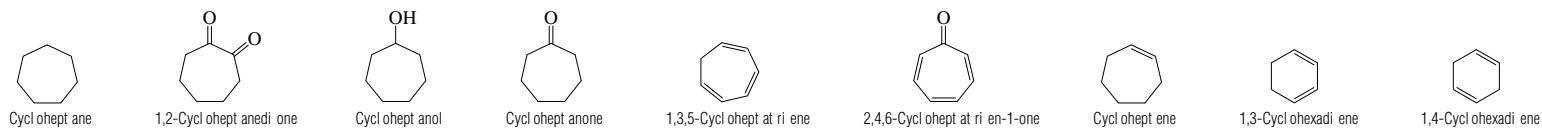
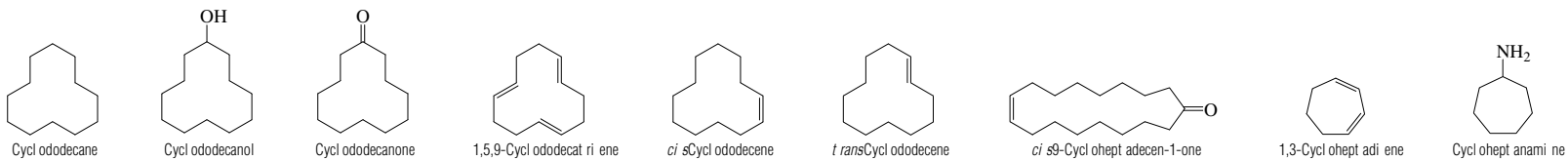


β -Cyclodextrin



γ -Cyclodextrin

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2545	Cycl ododecane		C ₂₂ H ₄₄	294-62-2	168.319	nd (al)	60.4	247	0.82 ²⁰		
2546	Cycl ododecanol		C ₂₂ H ₄₄ O	1724-39-6	184.318			286			
2547	Cycl ododecanone		C ₂₂ H ₄₂ O	830-13-7	182.302		59	127 ¹²	0.9059 ⁶⁸	1.4571 ⁶⁰	
2548	1,5,9-Cycl ododecat ri ene	CDT	C ₁₈ H ₃₄	4904-61-4	162.271	li q	-17	240	0.84 ⁴⁰		
2549	<i>ci s</i> Cycl ododecene		C ₂₂ H ₄₂	1129-89-1	166.303			133 ³⁵ , 71 ²		1.4840 ²⁰	vs bz, chl
2550	<i>t rans</i> Cycl ododecene		C ₂₂ H ₄₂	1486-75-5	166.303			113 ¹⁷		1.4850 ²⁰	vs bz, chl
2551	<i>ci s</i> 9-Cycl ohept adecen-1-one	Ci vet one	C ₁₇ H ₃₀ O	542-46-1	250.419			32.5		343; 159 ²	
2552	1,3-Cycl ohept adi ene		C ₁₀ H ₁₆	4054-38-0	94.154	li q	-110.4	120.5	0.86 ⁶⁸	1.4978 ²⁰	
2553	Cycl ohept anami ne		C ₁₀ H ₁₅ N	5452-35-7	113.201			54 ¹¹		1.4724 ²⁰	
2554	Cycl ohept ane		C ₁₄ H ₂₈	291-64-5	98.186	li q	-8.46	118.4	0.809 ⁸	1.4436 ²⁰	i H ₂ O; vs Et OH, et h; s bz, chl
2555	1,2-Cycl ohept anedi one		C ₁₀ H ₁₆ O ₂	3008-39-7	126.153		-40	108 ¹⁷	1.0583 ²²	1.4689 ²²	s Et OH
2556	Cycl ohept anol		C ₁₄ H ₂₈ O	502-41-0	114.185		7.2	185	0.9554 ²⁰	1.40705 ²⁰	sl H ₂ O; vs Et OH, et h
2557	Cycl ohept anone	Suberone	C ₁₂ H ₂₀ O	502-42-1	112.169			178.5	0.9508 ²⁰	1.4608 ²⁰	i H ₂ O; vs Et OH, et h
2558	1,3,5-Cycl ohept adi ri ene	Tropi li dene	C ₁₀ H ₁₆	544-25-2	92.139	li q; cub cry (-80°C)	-79.5	117; 60.5 ¹²²	0.8875 ¹⁹	1.5343 ²⁰	i H ₂ O; s Et OH, et h; vs bz, chl
2559	2,4,6-Cycl ohept adi ri en-1-one		C ₁₀ H ₁₆ O	539-80-0	106.122		-7	113 ¹⁵ , 84 ⁶	1.095 ²²	1.6172 ²²	vs bz, chl
2560	Cycl ohept ene		C ₁₂ H ₂₂	628-92-2	96.170	li q	-56	115	0.822 ⁸	1.4552 ²⁰	i H ₂ O; s Et OH, et h, bz, chl; sl ct c
2561	1,3-Cycl ohexadi ene		C ₈ H ₁₄	592-57-4	80.128	li q	-89	80.5	0.840 ⁵	1.4755 ²⁰	i H ₂ O; s Et OH, bz, chl; pet h; vs et h
2562	1,4-Cycl ohexadi ene	1,4-Di hydrobenzene	C ₈ H ₁₀	628-41-1	80.128	li q	-49.2	85.5	0.847 ⁹	1.4725 ²⁰	i H ₂ O; msc Et OH, et h; s bz, chl, pet h
2563	3,5-Cycl ohexadi ene-1,2-di one		C ₈ H ₁₀ O ₂	583-63-1	108.095	red pl or pr	-65 dec				s et h, ace, bz; i pet h
2564	2,5-Cycl ohexadi ene-1,4-di one, di oxime		C ₈ H ₁₀ N ₂ O ₂	105-11-3	138.124	pa ye nd (w)	240 dec				s H ₂ O
2565	Cycl ohexane	Hexahydrobenzene	C ₆ H ₁₂	110-82-7	84.159		6.59	80.73	0.7739 ²⁵	1.4235 ²⁵	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
2566	Cycl ohexaneacet i c aci d		C ₈ H ₁₄ O ₂	5292-21-7	142.196	nd (HCO ₂ H)	33	245	1.0423 ¹⁸	1.4775 ²⁰	sl H ₂ O; s et h, ace
2567	Cycl ohexanecarboni t ri le	Cycl ohexyl cyani de	C ₇ H ₁₁ N	766-05-2	109.169	li q	11	184; 7 ⁶	0.919	1.4505 ²⁰	
2568	Cycl ohexanecarbonyl chl ori de		C ₈ H ₁₃ ClO	2719-27-9	146.614			180	1.0962 ⁵	1.4711 ²⁹	
2569	Cycl ohexanecarboxal dehyde		C ₈ H ₁₂ O	2043-61-0	112.169			159.3	0.9035 ²⁰	1.4496 ²⁰	s H ₂ O, et h
2570	Cycl ohexanecarboxyl i c aci d	Hexahydrobenzoi c aci d	C ₇ H ₁₀ O ₂	98-89-5	128.169	mcl pr	31.5	232.5	1.0334 ²	1.4530 ²⁰	sl H ₂ O, ct c; vs Et OH, bz, chl
2571	<i>ci s</i> 1,2-Cycl ohexanedi ami ne	<i>ci s</i> 1,2-Di ami nocycl ohexane	C ₆ H ₁₀ N ₂	1436-59-5	114.188	li q		40	0.952 ²⁰	1.4951 ²⁰	
2572	<i>t rans</i> 1,2-Cycl ohexanedi ami ne	<i>t rans</i> 1,2-Di ami nocycl ohexane	C ₆ H ₁₀ N ₂	1121-22-8	114.188		14.8	80 ¹⁵ , 41 ²	0.951 ²⁰		
2573	<i>t rans</i> 1,4-Cycl ohexanedi carboxyl i c aci d		C ₈ H ₁₂ O ₄	619-82-9	172.179	pr (w)	312.5	sub 300			sl H ₂ O, et h; vs Et OH; s ace; i chl
2574	1,3-Cycl ohexanedi met hanami ne		C ₇ H ₁₃ N	2579-20-6	142.242		<-70	220	0.945 ²⁰		vs H ₂ O, et h, Et OH
2575	1,4-Cycl ohexanedi met hanol		C ₈ H ₁₆ O ₂	105-08-8	144.212		43	283; 167 ¹⁰			
2576	<i>ci s</i> 1,2-Cycl ohexanedi ol		C ₈ H ₁₆ O ₂	1792-81-0	116.158		100	120 ¹⁵	1.0297 ¹⁰¹		s Et OH, ace, bz; sl chl
2577	<i>t rans</i> 1,4-Cycl ohexanedi ol		C ₈ H ₁₆ O ₂	6995-79-5	116.158	mcl pr (ace)	143		1.18 ⁹		s H ₂ O, Et OH, MeOH; i et h; sl ace
2578	1,2-Cycl ohexanedi one	1,2-Di oxocycl ohexane	C ₆ H ₁₀ O ₂	765-87-7	112.127	cry (pet h)	40	194	1.1187 ¹	1.4995 ²⁰	s H ₂ O, Et OH, et h, bz
2579	1,3-Cycl ohexanedi one	Di hydroresorci nol	C ₆ H ₁₀ O ₂	504-02-9	112.127	pr (bz)	105.5		1.0861 ⁹¹	1.4576 ¹⁰²	s H ₂ O, Et OH, ace, chl; sl et h, bz
2580	1,4-Cycl ohexanedi one	Tet rahydroqui none	C ₆ H ₁₀ O ₂	637-88-7	112.127	mcl pl (w),nd (pet h)	78	132 ²⁰	1.0861 ⁹¹		s H ₂ O, Et OH, et h, ace, bz, chl
2581	1,2-Cycl ohexanedi one di oxime	Ni oxime	C ₆ H ₁₀ N ₂ O ₂	492-99-9	142.155	nd (w, HOAc)	192				s H ₂ O, ace, chl; sl t f a
2582	Cycl ohexaneet hanol		C ₈ H ₁₆ O	4442-79-9	128.212			208	0.9229 ²⁰	1.4641 ²⁰	s Et OH, et h, bz
2583	Cycl ohexanemet hanami ne		C ₇ H ₁₃ N	3218-02-8	113.201			160	0.87 ²⁵	1.4630 ²⁰	
2584	Cycl ohexanemet hanol	Cycl ohexyl carbi nol	C ₇ H ₁₄ O	100-49-2	114.185	li q	-43	183	0.929 ⁷	1.4644 ²⁰	vs et h, Et OH
2585	Cycl ohexanepropanoi c aci d		C ₉ H ₁₆ O ₂	701-97-3	156.222		16	276.5	0.912 ²⁵	1.4638 ²⁰	s H ₂ O, et h; sl ct c



No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2586	Cycl hexanet hi ol	Cycl ohexyl mercapt an	$\text{C}_6\text{H}_{13}\text{S}$	1569-69-3	116.224			158.8	0.9782 ²⁰	1.4921 ²⁰	vs ace, bz, et h, Et OH
2587	Cycl hexanol	Cycl ohexyl alcohol	$\text{C}_6\text{H}_{12}\text{O}$	108-93-0	100.158	hyg nd	25.93	160.84	0.9624 ²⁰	1.4641 ²⁰	s H ₂ O, Et OH, et h, ace; msc bz; sl chl
2588	Cycl hexanone	Pi mel i c ket one	$\text{C}_6\text{H}_{10}\text{O}$	108-94-1	98.142	li q	-27.9	155.43	0.9478	1.4507 ²⁰	s H ₂ O, Et OH, et h, ace, bz, chl, ct c
2589	Cycl hexanone oxi me		$\text{C}_6\text{H}_{11}\text{NO}$	100-64-1	113.157	hex pr (li g)	90	206			s H ₂ O, Et OH, et h, MeOH; sl chl
2590	Cycl hexanone peroxi de		$\text{C}_6\text{H}_{12}\text{O}_5$	78-18-2	246.300	cry or long nd	79				
2591	Cycl hexene	Tet rahydrobenzene	C_6H_{10}	110-83-8	82.143	li q	-103.5	82.98	0.8110	1.4465 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
2592	1-Cycl hexenecarboni t ri le	1-Cyanocycl hexene	$\text{C}_6\text{H}_9\text{N}$	1855-63-6	107.153			81 ¹²			
2593	1-Cycl hexene-1-carboxal dehyde		$\text{C}_7\text{H}_{10}\text{O}$	1192-88-7	110.153			69 ¹⁸	0.9694 ²⁰	1.5005 ²⁰	s Et OH, et h
2594	3-Cycl hexene-1-carboxal dehyde		$\text{C}_7\text{H}_{10}\text{O}$	100-50-5	110.153		1.0	105	0.9692 ²⁰	1.4745 ²⁰	s ace, MeOH; sl ct c
2595	1-Cycl hexene-1-carboxyl i c aci d		$\text{C}_7\text{H}_{10}\text{O}_2$	636-82-8	126.153		38	241	1.109 ²⁰	1.4902 ²⁰	sl H ₂ O; s Et OH, ace
2596	3-Cycl hexene-1-carboxyl i c aci d		$\text{C}_7\text{H}_{10}\text{O}_2$	4771-80-6	126.153		17	234.5	1.082 ²⁰	1.4814 ²⁰	vs H ₂ O; s Et OH, ace
2597	4-Cycl hexene-1,2-di carboxyl i c aci d		$\text{C}_8\text{H}_{12}\text{O}_4$	88-98-2	170.163	pr (w)	173.0				
2598	2-Cycl hexen-1-ol		$\text{C}_6\text{H}_{10}\text{O}$	822-67-3	98.142			164	0.9923 ¹⁵	1.4790 ²⁵	s Et OH, ace
2599	2-Cycl hexen-1-one		$\text{C}_6\text{H}_{10}\text{O}$	930-68-7	96.127	li q	-53	170	0.9620	1.4883 ²⁰	vs Et OH; s ace
2600	1-Cycl hexen-1-yl benzene		$\text{C}_{12}\text{H}_{14}$	771-98-2	158.239	li q	-11	252	0.9930	1.5718 ²⁰	vs MeOH
2601	2-(1-Cycl hexen-1-yl)cycl hexanone		$\text{C}_{12}\text{H}_{18}\text{O}$	1502-22-3	178.270			116 ³		1.5070 ²⁰	
2602	1-(1-Cycl hexen-1-yl)et hanone		$\text{C}_7\text{H}_{12}\text{O}$	932-66-1	124.180		73	201.5	0.9655 ²⁰	1.4881 ²⁰	s Et OH, et h
2603	3-Cycl hexenyl met hyl 3-cycl hexenecarboxyl at e		$\text{C}_{14}\text{H}_{20}\text{O}_2$	2611-00-9	220.308	li q		153	109 ¹⁶		
2604	4-(3-Cycl hexen-1-yl)pyri di ne		$\text{C}_{13}\text{H}_{13}\text{N}$	70644-46-1	159.228		22.1	226	1.0222 ²⁵	1.5466 ²⁵	
2605	Cycl hexi mi de		$\text{C}_6\text{H}_{11}\text{N}_3$	66-81-9	281.349	pl (al)	119				vs Et OH
2606	Cycl ohexyl acet at e		$\text{C}_8\text{H}_{16}\text{O}_2$	622-45-7	142.196			173; 96 ⁷⁵	0.968 ²⁰	1.442 ²⁰	vs et h, Et OH
2607	Cycl ohexyl acryl at e		$\text{C}_8\text{H}_{14}\text{O}_2$	3066-71-5	154.206			183; 88 ²⁰	1.0275 ²⁰	1.4673 ²⁰	i H ₂ O; msc Et OH, et h; s chl
2608	Cycl ohexyl ami ne	Cycl hexanam i ne	$\text{C}_6\text{H}_{13}\text{N}$	108-91-8	99.174	li q	-17.8	134	0.8199	1.4625 ¹⁵	s H ₂ O, ct c; vs Et OH; msc et h, ace, bz
2609	Cycl ohexyl ami ne hydrochl ori de	Cycl hexanam i ne hydrochl ori de	$\text{C}_6\text{H}_{14}\text{ClN}$	4998-76-9	135.635	nd (w, al -et h)	206.5				vs H ₂ O, Et OH
2610	2-(Cycl ohexyl ami not hi o) benzot hi azol e		$\text{C}_{13}\text{H}_{16}\text{N}_2\text{S}_2$	95-33-0	264.409		103				
2611	N-Cycl ohexyl ani li ne		$\text{C}_{12}\text{H}_{17}\text{N}$	1821-36-9	175.270	mcl pr	16	279; 192 ³	1.0155 ²⁰	1.5610 ²⁰	i H ₂ O; s Et OH, et h, bz
2612	Cycl ohexyl benzene		$\text{C}_{12}\text{H}_{16}$	827-52-1	160.255	pl	7.07	240.1	0.942 ⁷⁰	1.5329 ²⁰	i H ₂ O; vs Et OH; s et h; sl ct c
2613	Cycl ohexyl benzoat e		$\text{C}_{18}\text{H}_{16}\text{O}_2$	2412-73-9	204.265		<-10	285	1.0429 ²⁰	1.5200 ²⁰	i H ₂ O; s Et OH, et h
2614	Cycl ohexyl but anoat e		$\text{C}_{18}\text{H}_{18}\text{O}_2$	1551-44-6	170.249			213	0.9572 ²⁰		i H ₂ O; s Et OH; sl ct c
2615	3-Cycl ohexyl -2-but enoi c aci d	Ci crot oi c aci d	$\text{C}_{10}\text{H}_{16}\text{O}_2$	25229-42-9	168.233	pr (aq-MeOH)	85.5				
2616	Cycl ohexyl chl orof ormat e		$\text{C}_7\text{H}_{11}\text{ClO}_2$	13248-54-9	162.614			87.5 ²⁷			vs et h
2617	Cycl ohexyl cycl hexane		$\text{C}_{12}\text{H}_{22}$	92-51-3	166.303		4	238			sl H ₂ O; s Et OH, et h
2618	Cycl ohexyl di et hyl ami ne	M,N-Di et hyl cycl hexanam i ne	$\text{C}_{10}\text{H}_{21}\text{N}$	91-65-6	155.281			192; 85 ²⁰	0.8443 ²⁵		s Et OH; sl ct c
2619	Cycl ohexyl di met hyl ami ne	M,N-Di met hyl cycl hexanam i ne	$\text{C}_8\text{H}_{17}\text{N}$	98-94-2	127.228			162			
2620	2-Cycl ohexyl -4,6-di ni t rophenol		$\text{C}_{12}\text{H}_{14}\text{N}_2\text{O}_5$	131-89-5	266.249	cry	104				sl H ₂ O; s bz, DMF
2621	(1,2-Cycl ohexyl)enedi ni t ri lo t et raacet i c aci d monohydrat e	CDTA	$\text{C}_{14}\text{H}_{24}\text{N}_2\text{O}_9$	13291-61-7	364.349	cry (w)	215				
2622	1-Cycl ohexyl et hanone		$\text{C}_7\text{H}_{14}\text{O}$	823-76-7	126.196			180.5	0.9176 ²⁰	1.4565 ¹⁶	i H ₂ O; s et h
2623	Cycl ohexyl et hyl ami ne	N-Et hyl cycl hexanam i ne	$\text{C}_8\text{H}_{17}\text{N}$	5459-93-8	127.228			164	0.868 ⁰		sl H ₂ O, ct c; msc Et OH, et h
2624	4-Cycl ohexyl -3-et hyl -1,2,4-t ri azol e	Hexazol e	$\text{C}_{10}\text{H}_{17}\text{N}_3$	4671-03-8	179.262	pr (et h)	89.5	227 ⁰			vs H ₂ O, bz, chl



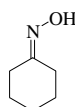
Cycl ohexanet hi ol



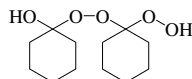
Cycl ohexanol



Cycl ohexanone



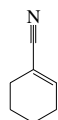
Cycl ohexanoneoxi me



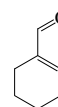
Cycl ohexanoneperoxi de



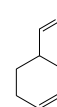
Cycl ohexene



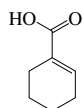
1-Cycl ohexenecarboni t ri le



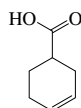
1-Cycl ohexene-1-carboxal dehyde



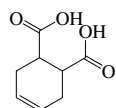
3-Cycl ohexene-1-carboxal dehyde



1-Cycl ohexene-1-carboxyl i aci d



3-Cycl ohexene-1-carboxyl i aci d



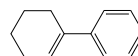
4-Cycl ohexene-1,2-di carboxyl i aci d



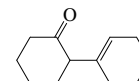
2-Cycl ohexen-1-ol



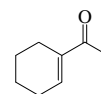
2-Cycl ohexen-1-one



1-Cycl ohexen-1-yl benzene

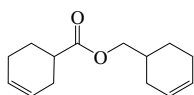


2-(1-Cycl ohexen-1-yl)cycl ohexanone

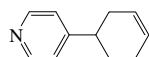


1-(1-Cycl ohexen-1-yl)et hanone

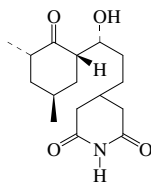
3-141



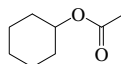
3-Cycl ohexenyl met hyl 3-cycl ohexenecarboxyl at e



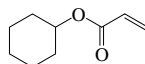
4-(3-Cycl ohexen-1-yl)pyri di ne



Cycl ohexi mi de



Cycl ohexylacet at e



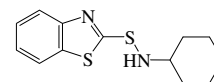
Cycl ohexylacryl at e



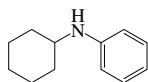
Cycl ohexyl ami ne



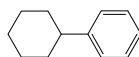
Cycl ohexyl ami n hydrochl ori de



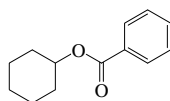
2-(Cycl ohexyl ami not hi o)benzot hi azole



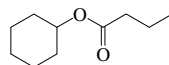
N-Cycl ohexyl ani li ne



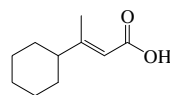
Cycl ohexyl benzene



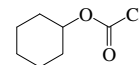
Cycl ohexylbenzoat e



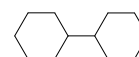
Cycl ohexylbut anoat e



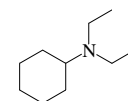
3-Cycl ohexyl-2-but enoi aci c



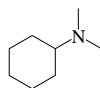
Cycl ohexylchl orof ormat e



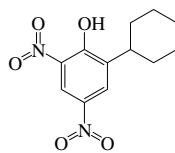
Cycl ohexyl cycl ohexane



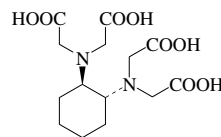
Cycl ohexyl di et hyl ami ne



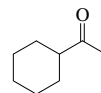
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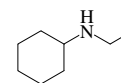
2-Cycl ohexyl-4,6-di ni t rophenol



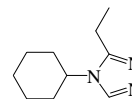
(1,2-Cycl ohexylenedi ni t ri o)l et riaceti c



1-Cycl ohexylet hanone

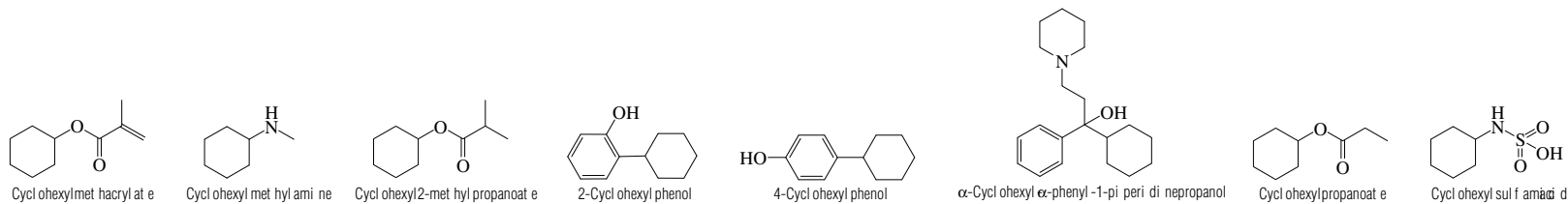
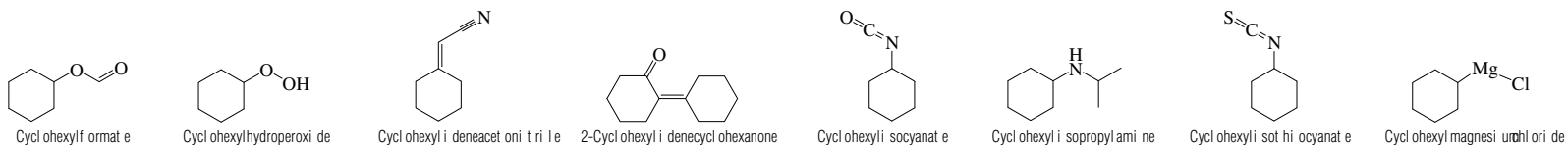


Cycl ohexylet hyl ami ne

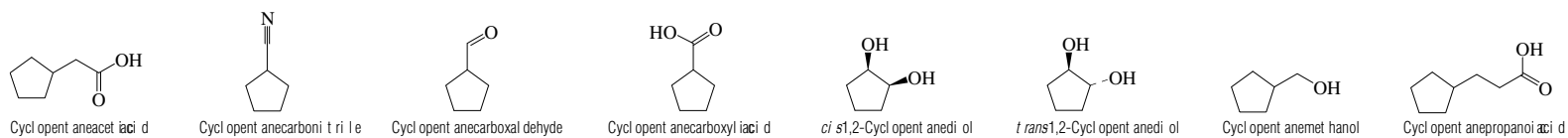
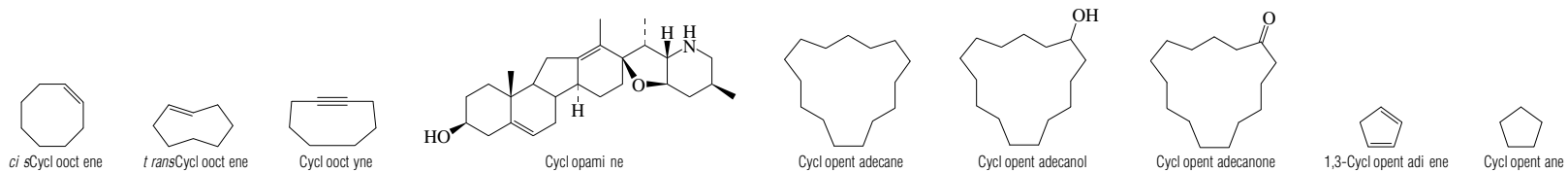
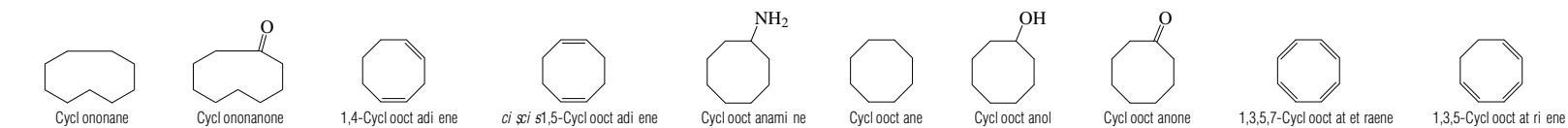


4-Cycl ohexyl-3-et hyl 1,2,4-tr i azole

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2625	Cycl ohexyl format e		$C_{12}H_{22}O_2$	4351-54-6	128.169			162	1.0057 ⁰	1.4430 ²⁰	i H ₂ O; s Et OH, HOAc, HCOOH; vs et h
2626	Cycl ohexyl hydroperoxi de		$C_{12}H_{22}O_2$	766-07-4	116.158		-20	42 ^{0,1}	1.019 ²⁰	1.4645 ²⁵	vs et h, Et OH, HOAc
2627	Cycl ohexyl i deneacet oni t ri l e		$C_{11}H_{20}$	4435-18-1	121.180			107 ²²	0.9483 ¹⁵	1.4382 ²⁵	vs et h, Et OH
2628	2-Cycl ohexyl i deneacycl ohexanone		$C_{18}H_{32}O$	1011-12-7	178.270	cry (MeOH aq)	56.5				
2629	Cycl ohexyl i socyanat e	Isocyanat ocycl ohexane	$C_7H_{12}NO$	3173-53-3	125.168			172	0.98 ²⁵	1.4551 ²⁰	
2630	Cycl ohexyl i sopropyl ami ne	<i>N</i> -Isopropyl cycl ohexanami ne	$C_{13}H_{25}N$	1195-42-2	141.254			62 ¹²	0.859 ²⁵	1.4480 ²⁰	
2631	Cycl ohexyl i sot hi ocyanat e	Isot hi ocyanat ocycl ohexane	$C_7H_{11}NS$	1122-82-3	141.234			221	1.0339 ²⁰	1.5375 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
2632	Cycl ohexyl magnesi um chl ori de		$C_6H_{11}ClMg$	931-51-1	142.909	hyg li q					s et h
2633	Cycl ohexyl met hacryl at e		$C_{16}H_{26}O_2$	101-43-9	168.233			210	0.9626 ²⁰	1.4578 ²⁰	
2634	Cycl ohexyl met hyl ami ne	<i>N</i> -Met hyl cycl ohexanami ne	$C_8H_{15}N$	100-60-7	113.201			147	0.8660 ²³	1.4560 ²⁰	sl H ₂ O; vs Et OH; msc et h; s chl
2635	Cycl ohexyl 2-met hyl propanoat e		$C_{16}H_{28}O_2$	1129-47-1	170.249			204	0.9489 ⁹		vs et h, Et OH
2636	2-Cycl ohexyl phenol		$C_{16}H_{16}O$	119-42-6	176.254	nd (li g)	56.5				vs Et OH, HOAc
2637	4-Cycl ohexyl phenol		$C_{16}H_{16}O$	1131-60-8	176.254	nd (bz)	133	294; 133 ⁴			i H ₂ O; vs Et OH, et h; s bz; sl li g
2638	α -Cycl ohexyl α -phenyl -1-pi peri di nepropanol	Tri hexpheni dyl	$C_{26}H_{31}NO$	144-11-6	301.466		114				
2639	Cycl ohexyl propanoat e		$C_{16}H_{30}O_2$	6222-35-1	156.222			193; 93 ³⁵	0.9359 ²⁰	1.4403 ²⁰	i H ₂ O; s Et OH, et h, ace, ct c
2640	Cycl ohexyl sul f ami c aci d	Cycl ami c aci d	$C_6H_{13}NO_3S$	100-88-9	179.237		169.5				vs al k
2641	Cycl ononane		C_9H_{18}	293-55-0	126.239		11	178.4	0.8463 ²⁵	1.4666 ²⁰	
2642	Cycl ononanone		$C_9H_{16}O$	3350-30-9	140.222		34	148 ²⁴ , 94 ¹²	0.9560 ²⁰	1.4729 ²⁰	s Et OH
2643	1,4-Cycl ooct adi ene		C_8H_{12}	1073-07-0	108.181	li q	-53	145	0.875 ⁴		
2644	<i>ci sci</i> 1,5-Cycl ooct adi ene		C_8H_{12}	111-78-4	108.181	li q	-56.4	150.5	0.88 ³	1.4905 ²⁵	vs bz
2645	Cycl ooct anami ne	Ami nocycl ooct ane	$C_8H_{17}N$	5452-37-9	127.228	li q	-48	190	0.92 ⁸	1.4804 ²⁰	
2646	Cycl ooct ane		C_8H_{16}	292-64-8	112.213		14.59	149	0.8349 ²⁰	1.4586 ²⁰	i H ₂ O; s bz, li g
2647	Cycl ooct anol		$C_8H_{16}O$	696-71-9	128.212		25.1	99 ¹⁶	0.9740 ²⁰	1.4871 ²⁰	s Et OH
2648	Cycl ooct anone		$C_8H_{14}O$	502-49-8	126.196		29	196	0.9581 ²⁰	1.4694 ²⁰	i H ₂ O; s Et OH, ace, bz; sl ct c
2649	1,3,5,7-Cycl ooct at et raene	[8]Annul ene	C_8H_6	629-20-9	104.150	li q	-2.4	140.5	0.920 ⁶	1.5381 ²⁰	s Et OH, et h, ace, bz
2650	1,3,5-Cycl ooct at ri ene		C_8H_{10}	1871-52-9	106.165	li q	-83	145.5	0.897 ⁴	1.5035 ²⁵	
2651	<i>ci sci</i> Cycl ooct ene		C_8H_{14}	931-87-3	110.197	li q	-12	138	0.847 ²	1.4698 ²⁰	s Et OH, et h, ct c
2652	<i>trans</i> Cycl ooct ene		C_8H_{14}	931-89-5	110.197	li q	-59	143	0.848 ³	1.4741 ²⁵	s Et OH, chl ; sl ct c
2653	Cycl ooct yne		C_8H_{12}	1781-78-8	108.181			158	0.868 ²⁰	1.4850 ²⁰	
2654	Cycl opami ne	11-Deoxoj ervi ne	$C_{27}H_{41}NO_2$	4449-51-8	411.621	nd (Et OH)	237				
2655	Cycl opent adecane		$C_{13}H_{26}$	295-48-7	210.399	nd (MeOH)	61.3		0.8364 ⁶¹	1.4592 ⁶¹	
2656	Cycl opent adecanol	Exal t ol	$C_{13}H_{26}O$	4727-17-7	226.398	cry (MeOH)	80.5	177 ¹¹ , 145 ^{0,3}	0.930 ²⁰	1.4555 ⁹⁸	
2657	Cycl opent adecanone		$C_{13}H_{24}O$	502-72-7	224.382		63	120 ^{0,3}	0.8895 ²⁵	1.4637 ⁶⁰	sl H ₂ O; s Et OH, ace
2658	1,3-Cycl opent adi ene	Pyropent yl ene	C_5H_6	542-92-7	66.102	li q	-85	41	0.802 ⁴	1.4440 ²⁰	i H ₂ O; msc Et OH, et h, bz; s ace
2659	Cycl opent ane	Pent amet hyl ene	C_5H_{10}	287-92-3	70.133	li q	-93.4	49.3	0.745 ⁷	1.4065 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
2660	Cycl opent aneacet i c aci d		$C_7H_{12}O_2$	1123-00-8	128.169	pl	13.5	228	1.0216 ⁵	1.4523 ¹⁸	
2661	Cycl opent anecarboni t ri l e	Cyanocycl opent ane	C_5H_7N	4254-02-8	95.142	li q	-76	170; 6 ⁷	0.912	1.4410 ²⁰	
2662	Cycl opent anecarboxal dehyde		C_5H_8O	872-53-7	98.142			133.5	0.9371 ²⁰	1.4432 ²⁰	vs H ₂ O, et h, Et OH
2663	Cycl opent anecarboxyl i c aci d	Cycl opent anoi c aci d	$C_5H_8O_2$	3400-45-1	114.142	li q	-7	212; 10 ⁴	1.0527 ²⁰	1.4532 ²⁰	sl H ₂ O, ct c; s MeOH
2664	<i>ci sci</i> 1,2-Cycl opent anedi ol		$C_5H_{10}O_2$	5057-98-7	102.132		30	124 ²⁸ , 100 ¹⁰			
2665	<i>trans</i> 1,2-Cycl opent anedi ol		$C_5H_{10}O_2$	5057-99-8	102.132		54.7	226; 136 ²¹			
2666	Cycl opent anemet hanol		$C_5H_{10}O$	3637-61-4	100.158			163	0.9332 ²⁰	1.4579 ²⁰	
2667	Cycl opent anepropanoi c aci d		$C_7H_{12}O_2$	140-77-2	142.196			158 ²⁶ , 131 ¹²	1.0100 ¹⁷	1.4570 ²⁰	



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No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2668	Cycl opent anet hi ol	Cycl opent yl mercapt an	$\text{C}_5\text{H}_{10}\text{S}$	1679-07-8	102.198			132.1	0.9550 ²⁰		
2669	Cycl opent anol	Cycl opent yl alcohol	$\text{C}_5\text{H}_{10}\text{O}$	96-41-3	86.132	li q	-17.5	140.42	0.9488	1.4530 ²⁰	sl H ₂ O, ct c; s Et OH, et h, ace
2670	Cycl opent anone	Adi pi c ket one	$\text{C}_5\text{H}_8\text{O}$	120-92-3	84.117	li q	-51.90	130.57	0.9487	1.4366 ²⁰	i H ₂ O; s Et OH, ace, ct c, hx; msc et h
2671	Cycl opent anone oxime		$\text{C}_5\text{H}_9\text{NO}$	1192-28-5	99.131		57.8	196			vs H ₂ O, bz
2672	Cycl opent ene		C_5H_8	142-29-0	68.118	li q	-135.0	44.2	0.7720	1.4225 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c, pet h
2673	1-Cycl opent enecarboni tri le	1-Cyanocycl opent ene	$\text{C}_5\text{H}_7\text{NC}$	3047-38-9	93.127	li q		89			
2674	1-Cycl opent ene-1-carboxaldehyde		$\text{C}_5\text{H}_8\text{O}_2$	6140-65-4	96.127	li q	-32	146	0.970	1.4872 ¹⁷	
2675	2-Cycl opent ene-1-tri decanoi c aci d	Chaul moogri c aci d (S)	$\text{C}_{18}\text{H}_{32}\text{O}_2$	29106-32-9	280.446	pl or lf (al, HOAc)	68.5	247 ²⁰			vs et h, chl
2676	2-Cycl opent ene-1-undecanoi c aci d	Hydnocarpi c aci d (R)	$\text{C}_{16}\text{H}_{28}\text{O}_2$	459-67-6	252.392		60.5				vs Et OH, chl, pet h
2677	2-Cycl opent en-1-one		$\text{C}_5\text{H}_8\text{O}$	930-30-3	82.101			136; 40 ¹²	0.989 ¹⁵	1.4629 ¹⁵	vs et h, Et OH
2678	3-Cycl opent en-1-one		$\text{C}_5\text{H}_8\text{O}$	14320-37-7	82.101	li q		28			
2679	N-(1-Cycl opent en-1-yl)pyrrolidi ne	1-Pyrrolidi nyl cycl opent ene	$\text{C}_9\text{H}_{15}\text{N}$	7148-07-4	137.222			105 ¹⁵		1.5128 ²⁰	
2680	Cycl opent hi azi de		$\text{C}_{18}\text{H}_{18}\text{Cl}_2\text{N}_2\text{O}_4\text{S}_2$	742-20-1	379.883			238			
2681	Cycl opent obari tal		$\text{C}_{12}\text{H}_{14}\text{N}_2\text{O}_3$	76-68-6	234.250	cry (w, di l al)	139.5				sl B; vs Et OH
2682	Cycl opent yl ami ne	Cycl opent anami ne	$\text{C}_5\text{H}_9\text{N}$	1003-03-8	85.148	li q	-82.7	108	0.8689	1.4728 ²⁵	s ace, bz, chl
2683	Cycl opent yl benzene		C_7H_{14}	700-88-9	146.229			219	0.9462 ²⁰	1.5280 ²⁰	vs et h
2684	2-Cycl opent yl i denecycl opent anone		$\text{C}_{10}\text{H}_{16}\text{O}$	825-25-2	150.217			135 ²⁵	1.0179 ¹⁸	1.5215 ¹⁸	
2685	Cycl opent yl met hyl sulfide		$\text{C}_6\text{H}_{12}\text{S}$	7133-36-0	116.224			156.2			
2686	Cycl ophosphami de	Cycl ophosphane	$\text{P}_2\text{H}_2\text{Cl}_2\text{N}_2\text{O}_2$	50-18-0	261.086		43				vs H ₂ O; sl bz, chl, di ox, Et OH
2687	Cycl oposi ne		$\text{C}_6\text{H}_{15}\text{NO}_7$	23185-94-6	573.761		268				
2688	Cycl opropane	Tri met hyl ene	C_3H_6	75-19-4	42.080	col gas	-127.58	-32.81	0.617 ²⁵ (p>1 at m)	1.3799 ⁴²	s H ₂ O, bz, pet h; vs Et OH, et h
2689	Cycl opropanecarboni tri le	Cycl opropyl cyani de	$\text{C}_3\text{H}_3\text{NC}$	5500-21-0	67.090			135.1	0.8946 ²⁰	1.4229 ²⁰	s et h, hx; sl ct c
2690	Cycl opropanecarbonyl chl ori de		$\text{C}_3\text{H}_3\text{ClO}$	4023-34-1	104.535			119	1.1516 ²⁰		
2691	Cycl opropanecarboxaldehyde	Formyl cycl opropane	$\text{C}_3\text{H}_4\text{O}$	1489-69-6	70.090	li q		100	0.938	1.4298	
2692	Cycl opropanecarboxyli c aci d		$\text{C}_3\text{H}_4\text{O}_2$	1759-53-1	86.090		18.5	183	1.0885 ²⁰	1.4390 ²⁰	s H ₂ O, Et OH, et h; sl ct c
2693	1,1-Cycl opropanedi carboxyli c aci d		$\text{C}_3\text{H}_4\text{O}_4$	598-10-7	130.100	pr or nd (chl) pr (w +1)	140.5				vs H ₂ O, et h
2694	Cycl opropanemet hanol		$\text{C}_3\text{H}_8\text{O}$	2516-33-8	72.106			124	0.911 ²⁵		sl ct c
2695	Cycl opropanone		$\text{C}_3\text{H}_6\text{O}$	5009-27-8	56.063						st able onl y at low t emp.
2696	Cycl opropane		C_3H_6	2781-85-3	40.064	gas		dec -36			
2697	Cycl opropyl ami ne	Cycl opropanami ne	$\text{C}_3\text{H}_7\text{N}$	765-30-0	57.095	li q	-35.39	50.5	0.8240	1.4210 ²⁰	msc H ₂ O; s Et OH, et h, chl
2698	Cycl opropyl benzene		C_7H_{10}	873-49-4	118.175	li q	-31	173.6; 80	0.9317 ²⁰	1.5285 ²⁰	i H ₂ O; s et h, ace, chl
2699	Cycl opropyl met hyl et her		$\text{C}_4\text{H}_8\text{O}$	540-47-6	72.106	li q	-119	44.7	0.8100	1.3802 ²⁰	vs H ₂ O, bz, et h, Et OH
2700	Cycl opropyl met hyl ket one		$\text{C}_4\text{H}_8\text{O}$	765-43-5	84.117	li q	-68.3	111.3	0.8984	1.4251 ²⁰	vs H ₂ O, et h, Et OH
2701	Cycl ot et ramet hyl enet et rani t rami ne	HMX	$\text{C}_4\text{H}_8\text{N}_6\text{O}_6$	2691-41-0	296.156	cry	286	exp			
2702	Cycl ot hi azi de		$\text{C}_{18}\text{H}_{18}\text{Cl}_2\text{N}_2\text{O}_4\text{S}_2$	2259-96-3	389.878			234			
2703	Cycl uron	N'-Cycl ooct yl/N,N-di met hyl urea	$\text{C}_8\text{H}_{22}\text{N}_2\text{O}$	2163-69-1	198.305	cry	138				sl H ₂ O; s bz, ace; vs MeOH
2704	Cyflut hri n		$\text{C}_{18}\text{H}_{18}\text{Cl}_2\text{FNO}_3$	68359-37-5	434.287		60				
2705	Cygon		$\text{C}_8\text{H}_{12}\text{NO}_2\text{PS}_2$	60-51-5	229.258		52	117 ⁰¹	1.277 ⁶⁵		



Cycl opent anet hi ol



Cycl opent anol



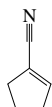
Cycl opent anone



Cycl opent anonæxi me



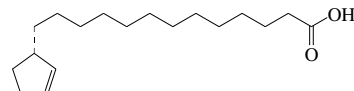
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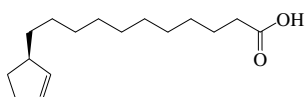
1-Cycl opent enecarboni t ri le



1-Cycl opent ene-1-carboxal dehyde



2-Cycl opent ene-1-t ri decanæccid(S)



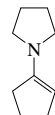
2-Cycl opent ene-1-undecanoci æci d(R)



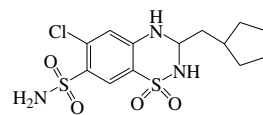
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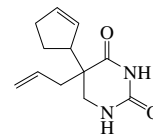
3-Cycl opent en-1-one



N-(1-Cycl opent en-1-yl)pyrrol i di ne



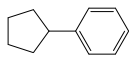
Cycl opent hi azi de



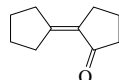
Cycl opent obarbi t al



Cycl opent yli ami ne



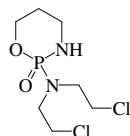
Cycl opent yl benzene



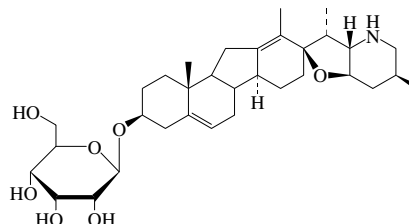
2-Cycl opent yl i denecycl opent anone



Cycl opent ymet hylsulf i de



Cycl ophosphami de



Cycl oposi ne



Cycl opropane



Cycl opropanecarboni t ri le



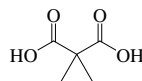
Cycl opropanecarbonylchl ori de



Cycl opropanecarboxal dehyde



Cycl opropanecarboxyl i æci d



1,1-Cycl opropanedi carboxyl iæci d



Cycl opropanemet hanol



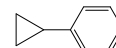
Cycl opropanone



Cycl opropane



Cycl opropyl ami ne



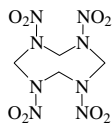
Cycl opropyl benzene



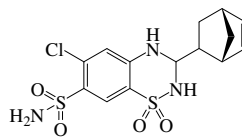
Cycl opropylmet hylet her



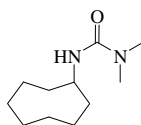
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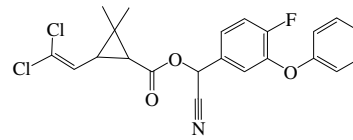
Cycl ot et ramet hylet enet et rani t rami ne



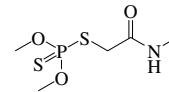
Cycl ot hi azi de



Cycl uron

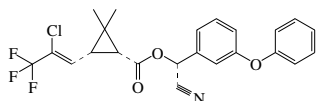


Cyl lut hri n

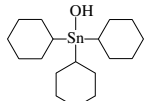


Cylgon

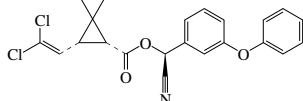
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2706	Cyhalot hri n	2,2-Di met hyl cycl opropanecarboxyl at e	C ₂₃ H ₁₉ Cl F ₃ NO ₃	91465-08-6	449.850		49.2				
2707	Cyhexat i n	St annane, t ri cycl ohexyl hydroxy-	H ₁₈ Cl ₃ O ₃ Sn	13121-70-5	385.172		196				
2708	Cypermethri n		C ₁₅ H ₁₉ Cl ₂ NO ₃	52315-07-8	416.297		70		1.25 ²⁰		
2709	Cyprazine		C ₁₄ H ₁₄ Cl ₂ N ₂	22936-86-3	227.694		167				
2710	Cyproheptadi ne		C ₁₂ H ₂₁ N	129-03-3	287.399	cry (Et OH aq)	113				
2711	Cyromazine	N-Cycl opropyl -1,3,5-t ri azi ne-2,4,6-t ri ami ne	C ₈ H ₁₀ N ₆	66215-27-8	166.183	cry	220				
2712	Cystamine di hydrochloride		H ₄ Cl ₂ N ₂ S ₂	56-17-7	225.203	nd (MeOH)	218 dec				vs H ₂ O, Et OH
2713	Cysteamine		H ₇ NS	60-23-1	77.149	cry (sub)	99.5	dec			vs H ₂ O, Et OH
2714	L-Cysteine diacid		C ₃ H ₇ NO ₃ S	13100-82-8	169.157	cry					s H ₂ O; i Et OH
2715	L-Cysteine	Propanoic acid, 2-ami no-3-mercapt o-, (R)-	C ₃ H ₇ NO ₂ S	52-90-4	121.159	cry (w)	240 dec				vs H ₂ O, ace, Et OH
2716	L-Cysteine, ethylester, hydrochloride		H ₇ Cl ₂ NO ₃ S	868-59-7	185.673		125.8				vs H ₂ O
2717	L-Cysteine, hydrochloride		H ₇ Cl ₂ NO ₃ S	52-89-1	157.620	cry	175 dec				s H ₂ O
2718	L-Cystine	3,3'-Di thi obi s(2-ami nopropionic acid)	C ₈ H ₁₂ N ₂ O ₄ S ₂	56-89-3	240.300	hex pl or pr (w)	260 dec		1.67 ²⁵		sl H ₂ O; i Et OH, et h, bz; s aci d, alk
2719	Cytarabine	Cytosine arabinoside	H ₁₃ O ₅	147-94-4	243.216	pr (Et OH aq)	212				s H ₂ O
2720	Cytidine	4-Amin o-2(1H)-pyri mi di none	C ₈ H ₁₃ N ₃ O ₅	65-46-3	243.216	nd (di l al)	230 dec				vs H ₂ O; sl Et OH
2721	2'-Cytidylic acid	Cytidine 2'-monophosphate	H ₁₄ N ₃ O ₈ P	85-94-9	323.196		239 dec				
2722	3'-Cytidylic acid	Cytidine 3'-monophosphate	H ₁₄ N ₃ O ₈ P	84-52-6	323.196		233 dec				s H ₂ O, Et OH
2723	5'-Cytidylic acid	Cytidine 5'-monophosphate	H ₁₄ N ₃ O ₈ P	63-37-6	323.196	ort h nd	233 dec				vs H ₂ O, Et OH
2724	Cytisine	Sophorine	H ₁₁ N ₃ O ₂	485-35-8	190.241	pr	153	218 ²			vs H ₂ O, Et OH, MeOH; s bz, ace
2725	Cytochalasin B		H ₃₇ N ₅ O ₅	14930-96-2	479.608	nd (ace)	219				
2726	Cytochalasin D	Zygosporin A	H ₃₇ N ₅ O ₆	22144-77-0	507.618	nd (ace/pet h)	270				
2727	Cytochalasin E		H ₃₃ N ₇ O ₇	36011-19-5	495.565		207				
2728	Cytosine		H ₄ N ₃ O	71-30-7	111.102	mcl or t cl pl (w+1)	322 dec				s H ₂ O; sl Et OH, chl ; i et h
2729	Dacarbazine	5-(3,3-Di met hyl -1-t ri azenyl)-1-i mi dazol e-4-carboxamide	C ₈ H ₁₀ N ₆ O	4342-03-4	182.182	cry	205				
2730	Dactinomycin		H ₈₅ N ₁₂ O ₁₆	50-76-0	1255.416		245 dec				
2731	Daidzein	7-Hydroxy-3-(4-hydroxyphenyl)-1-benzopyran-4-one	C ₁₅ H ₁₀ O ₄	486-66-8	254.238	pa ye pr (50% al)	323 dec	sub			s Et OH, et h
2732	Daminozide	Butanedioic acid, mono(2,2-di met hyl hydrazide)	C ₈ H ₁₂ N ₂ O ₃	1596-84-5	160.170		154.5				
2733	Dantrolene		C ₁₈ H ₁₀ N ₂ O ₅	7261-97-4	314.253	cry (DMF aq)	280				
2734	Datisetron		H ₁₅ O ₆	480-15-9	286.236	pa ye nd (al , aq HOAc)	277.5				vs ace, et h, Et OH
2735	Daucal		C ₁₅ H ₂₆ O ₂	887-08-1	238.366	cry	114	128 ²			
2736	Daunorubicin		H ₂₉ N ₁₀	20830-81-3	527.520	red nd	208				
2737	Dazomet		C ₁₀ H ₁₀ N ₂ S ₂	533-74-4	162.276	nd (bz)	106				reac H ₂ O; s Et OH
2738	Decabromobiphenyl ether	Bis(pentabromophenyl) ether	H ₂ Br ₁₀ O	1163-19-5	959.167	ye pr (t ol)	305				i H ₂ O
2739	Decachlorobiphenyl		Cl ₁₀	2051-24-3	498.658	cry (bz)	309				i H ₂ O
2740	1,3-Decalene	1-Hexyl-1,3-butadiene	H ₁₈	2051-25-4	138.250			169	0.752 ³⁰		vs bz
2741	1,9-Decalene		H ₁₈	1647-16-1	138.250			167	0.75 ²⁵	1.4325 ²⁰	
2742	2,2',3,3',4,4',5,5',6,6'-Decafluoro-1,1'-biphenyl		C ₁₂ F ₁₀	434-90-2	334.112		67.5	206	1.785 ²⁰		



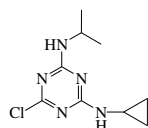
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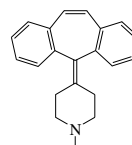
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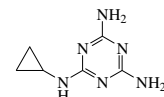
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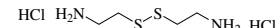
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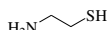
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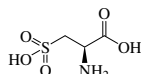
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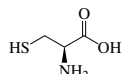
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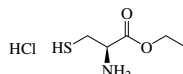
Cyst eami ne



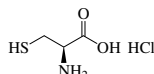
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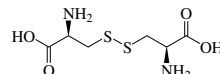
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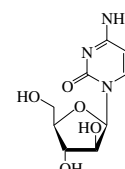
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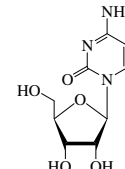
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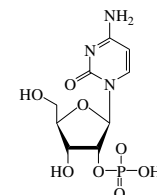
L-Cyst i ne



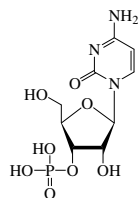
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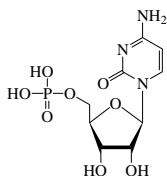
Cyt i di ne



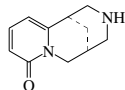
2'-Cyt i dyl aci d



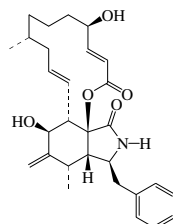
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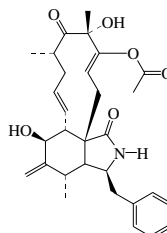
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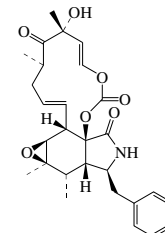
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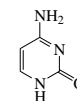
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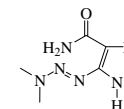
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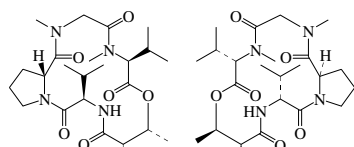
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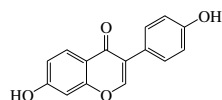
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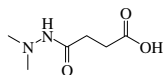
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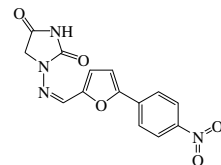
Dact i nomyci n



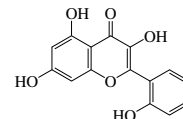
Dai dzei n



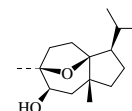
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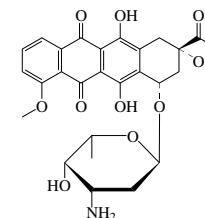
Dant rol ene



Dat i scet i n



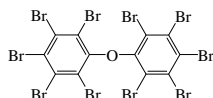
Daucol



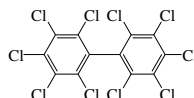
Daunorubi ci n



Dazomet



Decabromobi phenyl et her



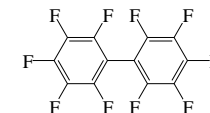
Decachl orobi phenyl



1,3-Decadi ene

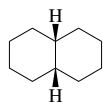


1,9-Decadi ene

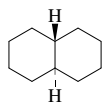


2,2',3,3',4,4',5,5',6,6'-Decaf l uoro-1,1'-bi phenyl

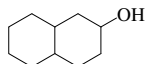
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2743	<i>ci</i> -sDecahydronapht hal ene	<i>ci</i> -sDecal i n	C ₁₀ H ₁₈	493-01-6	138.250	li q	-42.9	195.8	0.8965	1.4810 ²⁰	i H ₂ O; msc Et OH; vs et h, ace, chl
2744	<i>t rans</i> Decahydronapht hal ene	<i>t rans</i> Decal i n	C ₁₀ H ₁₈	493-02-7	138.250	li q	-30.4	187.3	0.8659	1.4695 ²⁰	i H ₂ O; vs Et OH, et h, ace; msc bz; sl MeOH
2745	Decahydro-2-napht hol	Decahydroβ-napht hol	C ₁₀ H ₁₈ O	825-51-4	154.249			109 ¹⁴	0.996 ²⁵	1.4992 ²⁰	
2746	Decamet honi um di bromi de		¹⁶ Br ₂ Br ₂ N ₂	541-22-0	418.294	cry (MeOH/ace)	269 dec				i et h
2747	Decamet hyl cycl opent asi l oxane		¹⁰ H ₃₀ O ₅ Si ₅	541-02-6	370.770	li q	-38	210	0.9593	1.3982 ²⁰	i H ₂ O
2748	Decamet hyl t et rasi l oxane		¹⁰ H ₃₀ O ₅ Si ₄	141-62-8	310.685	li q	-76	194	0.8536	1.3895 ²⁰	i H ₂ O; sl Et OH; s bz, pet h
2749	Decanal	Capral dehyde	C ₁₀ H ₂₀ O	112-31-2	156.265	li q	-4.0	208.5	0.830	1.4287 ²⁰	i H ₂ O; s Et OH, et h, ace; sl ct c
2750	Decane		C ₁₀ H ₂₂	124-18-5	142.282	li q	-29.6	174.15	0.7266	1.4090 ²⁵	i H ₂ O; msc Et OH; s et h; sl ct c
2751	1,10-Decanedi ami ne		C ₁₀ H ₂₁ N ₂	646-25-3	172.311		59.73	140 ¹²			
2752	Decanedi ni t ri l e		¹⁰ H ₁₆ N ₂	1871-96-1	164.247		7.6	204 ¹⁶	0.913 ²⁰	1.4474 ²⁰	i H ₂ O; s chl
2753	1,10-Decanedi ol	Decamet hyl ene glycol	¹⁰ H ₂₂ O ₂	112-47-0	174.281	nd (w, di l al)	74	192			sl H ₂ O, et h; vs Et OH; s DMSO; i li g
2754	Decanedi oyl di chl ori de		¹⁰ H ₁₆ Cl ₂ O ₂	111-19-3	239.139		-1.3	220 ⁷⁵ , 165 ¹¹	1.1212 ²⁰	1.4684 ¹⁸	
2755	Decaneni t ri l e	Capri ni t ri l e	¹⁰ H ₁₉ NC	1975-78-6	153.265	li q	-17.9	243; 106 ⁹	0.8199 ²⁰	1.4296 ²⁰	vs ace, et h, Et OH, chl
2756	1-Decanet hi ol	Decyl mercapt an	¹⁰ H ₂₂ S	143-10-2	174.347	li q	-26	240.6	0.8443	1.4509 ²⁰	i H ₂ O; s Et OH, et h
2757	Decanoi c aci d	Capri c aci d	¹⁰ H ₂₀ O ₂	334-48-5	172.265	nd	31.4	268.7	0.8858 ⁴⁰	1.4288 ⁴⁰	i H ₂ O; vs ace, bz, et h, Et OH
2758	1-Decanol	Capri c al cohoh	¹⁰ H ₂₂ O	112-30-1	158.281		6.9	231.1	0.8297 ²⁰	1.4372 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, chl; s ct c
2759	2-Decanol		C ₁₀ H ₂₂ O	74742-10-2	158.281	li q	-1.2	211	0.8250	1.4326 ²⁵	s Et OH, bz; msc et h, ace; sl ct c
2760	3-Decanol		C ₁₀ H ₂₂ O	1565-81-7	158.281	li q	-7.5	213; 10 ⁹	0.827 ²⁰	1.434 ²⁰	
2761	4-Decanol	1-Propyl hept yl al cohoh	¹⁰ H ₂₂ O	2051-31-2	158.281	li q	-11	210.5	0.826 ⁹	1.4320 ²⁰	i H ₂ O; s Et OH, ct c
2762	5-Decanol		C ₁₀ H ₂₂ O	5205-34-5	158.281	li q	8.7	201	0.824 ⁹	1.4333 ²⁰	
2763	2-Decanone	Met hyl oct yl ket one	¹⁰ H ₂₀ O	693-54-9	156.265	nd	14	210; 96 ¹²	0.8248 ²⁰	1.4255 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
2764	3-Decanone	Et hyl hept yl ket one	¹⁰ H ₂₀ O	928-80-3	156.265	li q	1.3	203	0.825 ⁹	1.4252 ²⁰	s Et OH, et h, ct c
2765	4-Decanone	Hexyl propyl ket one	¹⁰ H ₂₀ O	624-16-8	156.265	li q	-9	206.5	0.824 ⁹	1.4240 ²¹	i H ₂ O; msc Et OH, et h
2766	Decanoyl chl ori de	Capri noyl chl ori de	¹⁰ H ₁₉ ClO	112-13-0	190.710	li q	-34.5	95	0.919	1.4410 ²⁰	s et h, ct c
2767	<i>t rans</i> 2-Decenal		C ₁₀ H ₁₈ O	3913-81-3	154.249			230; 107 ¹¹			
2768	1-Decene		C ₁₀ H ₂₀	872-05-9	140.266	li q	-66.3	170.5	0.7408	1.4215 ²⁰	i H ₂ O; msc Et OH, et h
2769	<i>ci</i> -s2-Decene		C ₁₀ H ₂₀	20348-51-0	140.266	col li q		174.2			
2770	<i>t rans</i> 2-Decene		C ₁₀ H ₂₀	20063-97-2	140.266	col li q		173.3			
2771	<i>ci</i> -s5-Decene		C ₁₀ H ₂₀	7433-78-5	140.266	col li q	-112	171; 73	0.7445 ²⁰	1.4258 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
2772	<i>t rans</i> 5-Decene		C ₁₀ H ₂₀	7433-56-9	140.266	col li q	-73	171	0.740 ⁹	1.4243 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
2773	9-Decenoi c aci d	Caprolei c aci d	¹⁰ H ₁₆ O ₂	14436-32-9	170.249		26.5	158 ²¹ , 142 ⁴	0.9238 ¹⁵	1.4507 ¹⁵	vs et h, Et OH
2774	9-Decen-1-ol	Decyl eni c al cohoh	¹⁰ H ₁₈ O	13019-22-2	156.265			236	0.876 ²⁵	1.4480 ²⁰	
2775	3-Decen-2-one	Hept yl i dene acet one	¹⁰ H ₁₈ O	10519-33-2	154.249			102 ^{15,3}	0.8473 ²⁰	1.4480 ²⁰	
2776	Decyl myci n	Demecyl ocycl i ne	²¹ H ₄₂ Cl ₂ N ₂ O ₈	127-33-3	464.853	cry	176 dec				
2777	Decyl acet at e		¹⁰ H ₂₄ O ₂	112-17-4	200.318	li q	-15	244	0.867 ⁹	1.4273 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c, HOAc
2778	Decyl ami ne	1-Decanam i ne	¹⁰ H ₂₃ N	2016-57-1	157.297		17	220.5	0.7936 ²⁰	1.4369 ²⁰	sl H ₂ O; msc Et OH, et h, ace, bz, chl
2779	Decyl benzene		C ₁₀ H ₂₆	104-72-3	218.377	li q	-14.4	293	0.8555	1.4832 ²⁰	vs ace, bz, et h, Et OH
2780	Decyl cycl ohexane		C ₁₆ H ₃₂	1795-16-0	224.425	li q	-0.9	299	0.8186	1.4534 ²⁰	
2781	Decyl cycl opent ane		C ₁₅ H ₃₀	1795-21-7	210.399	li q	-22	279	0.8110	1.4486 ²⁰	vs ace, bz, et h, Et OH
2782	Decyl decanoat e		C ₂₀ H ₄₀ O ₂	1654-86-0	312.531		9.7	219 ¹⁵	0.8586 ²⁰	1.4423 ²⁰	vs et h
2783	Decyl f ormat e		¹⁰ H ₂₂ O ₂	5451-52-5	186.292	li q		243			
2784	11-Decyl henei cosine		C ₁₆ H ₃₄	55320-06-4	436.840		10.0	282.0 ¹⁰	0.8116 ²⁰	1.4540 ²⁰	



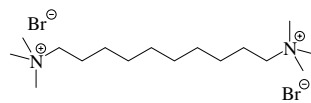
cis-Decahydronaphthalene



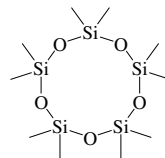
trans-Decahydronaphthalene



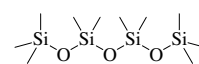
Decahydro-2-naphthol



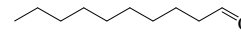
Decamethionium bromide



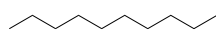
Decamethylcyclotrioxane



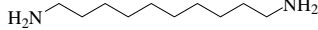
Decamethyltetrasiloxane



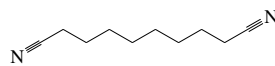
Decanal



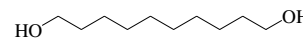
Decane



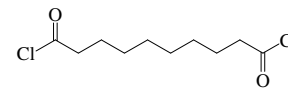
1,10-Decanediamine



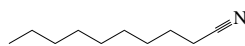
Decanedinitrile



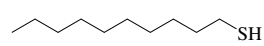
1,10-Decanediol



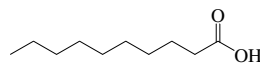
Decanedioyl dichloride



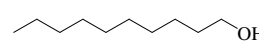
Decanenitrile



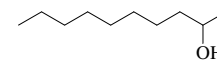
1-Decanethiol



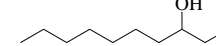
Decanoic acid



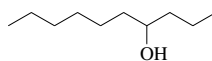
1-Decanol



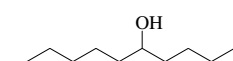
2-Decanol



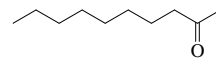
3-Decanol



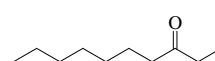
4-Decanol



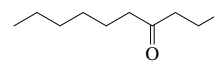
5-Decanol



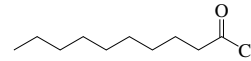
2-Decanone



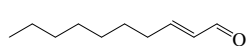
3-Decanone



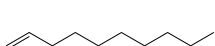
4-Decanone



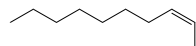
Decanoyl chloride



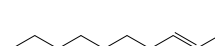
trans-2-Decenal



1-Decene



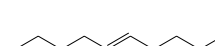
cis-2-Decene



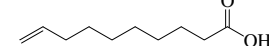
trans-2-Decene



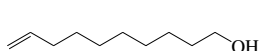
cis-5-Decene



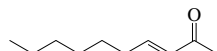
trans-5-Decene



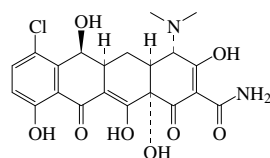
9-Decenoic acid



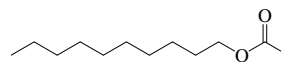
9-Decen-1-ol



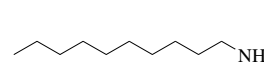
3-Decen-2-one



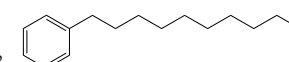
Decomycin



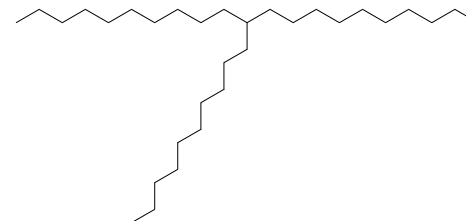
Decyl acetate



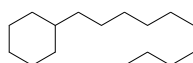
Decylamine



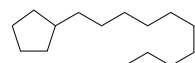
Decylbenzene



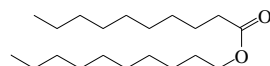
11-Decylhenicosane



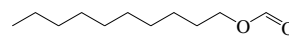
Decylcyclohexane



Decylcyclopentane

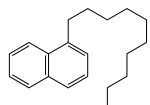


Decyldecanoate

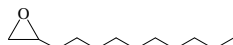


Decylformate

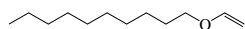
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2785	1-Decyl naphthalene		C ₂₈ H ₄₈	26438-27-7	268.436		15	379	0.9322 ²⁰	1.5435 ²⁰	
2786	Decyl oxirane		C ₁₂ H ₂₄ O	2855-19-8	184.318					1.4347 ²⁵	sl ct c
2787	Decyl vinyl ether	1-(Ethoxy)decane	C ₁₂ H ₂₄ O	765-05-9	184.318		-41	101 ¹⁰	0.812 ²⁰	1.4346 ²⁰	
2788	1-Decyne	Octyl acetylene	C ₁₈ H ₃₆	764-93-2	138.250	liquid	-44	174	0.7659	1.4265 ²⁰	i H ₂ O; s Et OH, et h
2789	5-Decyne	Diethyl acetylene	C ₁₈ H ₃₆	1942-46-7	138.250	liquid	-73	177, 78.8	0.7690 ²⁰	1.4331 ²⁰	i H ₂ O; s Et OH, et h
2790	Dehydroabietyl acylate	8,11,13-Abietic acid	C ₂₀ H ₃₀ O ₂	1740-19-8	300.435	crystal (Et OH aq)	172				
2791	Delphinidin		C ₁₅ H ₁₁ ClO ₇	528-53-0	338.697		>350				vs H ₂ O, Et OH, MeOH; s AcOEt
2792	Delphinine		C ₁₅ H ₁₅ N ₉ O ₉	561-07-9	599.712	orthorhombic (al)	199				i H ₂ O; s chl, ace, et h; vs Et OH
2793	Delphinine		C ₂₂ H ₁₉ Br ₂ NO ₃	52918-63-5	505.199		99				
2794	Demecarium bromide		C ₁₂ H ₁₂ Br ₂ N ₂ O ₄	56-94-0	716.588	hygroscopic powder	165 dec				vs H ₂ O; sl ace; i ace, et h
2795	Demeton	Systox	C ₁₁ H ₁₅ O ₃ PS ₂	8065-48-3	258.339	oil liquid		184			i H ₂ O; s Et OH, t ol
2796	Demeton-S-methyl		C ₁₁ H ₁₅ O ₃ PS ₂	919-86-8	230.285	ye liquid		89 ¹⁵ , 118 ¹	1.20 ²⁰	1.5063 ²⁰	i H ₂ O; s os
2797	2'-Deoxyadenosine		C ₁₀ H ₁₃ N ₅ O ₃	958-09-8	251.242						sl H ₂ O
2798	2'-Deoxyadenosine 5'-triphosphate		C ₁₆ H ₁₉ N ₅ O ₁₂ P ₃	1927-31-7	491.182	crystal (Et OH aq)					
2799	6-Deoxy-L-ascorbic acid		C ₁₂ H ₁₆ O ₅	528-81-4	160.125	pr (AcOEt)	168	sub 160			vs H ₂ O, ace, Et OH
2800	Deoxycholic acid	3,12-Dihydroxycholestan-24-oid (3α,5β,12α)	C ₂₆ H ₄₆ O ₄	83-44-3	392.573	crystal (al)	177				
2801	2'-Deoxycytidine 5'-monophosphate	2'-Deoxy-5'-cytidylic acid	C ₉ H ₁₄ N ₂ O ₇ P	1032-65-1	307.197	powder	183 dec				
2802	2'-Deoxy-5-fluorouridine	Floxuridine	C ₉ H ₁₂ FN ₂ O ₅	50-91-9	246.191	crystal	150				
2803	2-Deoxy-D-glucose		C ₆ H ₁₂ O ₅	154-17-6	164.156		146.5				
2804	2'-Deoxyguanosine 5'-monophosphate	2'-Deoxy-5'-guanylic acid	C ₁₀ H ₁₄ N ₂ O ₇ P	902-04-5	347.222						s H ₂ O
2805	2-Deoxy-D-chiroinositol	D-Quercitol	C ₆ H ₁₂ O ₅	488-73-3	164.156	pr (w, dil al)	236		1.5845		vs H ₂ O
2806	1-Deoxy-1-(methylamino)-D-glucitol	N-Methylglucamine	C ₇ H ₁₇ N ₃ O ₅	6284-40-8	195.214	crystal (MeOH)	128.5				s H ₂ O
2807	6-Deoxy-3-O-methylgalactose	Digitalexose	C ₇ H ₁₄ O ₅	4481-08-7	178.183	nd (AcOEt)	119				vs H ₂ O
2808	D-2-Deoxyribose		C ₅ H ₁₀ O ₄	533-67-5	134.131		90				
2809	Deserpinine		C ₁₃ H ₂₀ N ₂ O ₈	131-01-1	578.652	nd or pr	230.5				i H ₂ O; s Et OH, chl
2810	Desethylazine	6-Chlorobisopropyl-1,3,5-triazine-2,4-diamine	C ₆ H ₁₀ ClN ₃	6190-65-4	187.630	crystal	136				
2811	Desferrioxamine	Desferoxamine	C ₂₅ H ₄₃ N ₅ O ₈	70-51-9	560.684	crystal (Et OH aq)	139				
2812	Desipramine		C ₁₆ H ₂₂ N ₂	50-47-5	266.381			173 ^{0.02}			
2813	Desmedipham		C ₁₀ H ₁₆ N ₂ O ₄	13684-56-5	300.309		120				
2814	Desmetryne		C ₇ H ₁₃ N ₃ S	1014-69-3	213.304	crystal	85				
2815	Desthiobiotin		C ₁₀ H ₁₆ N ₂ O ₃	533-48-2	214.261	liquid (H ₂ O)	157				s H ₂ O
2816	Dexamethasone		C ₂₂ H ₂₆ FO ₅	50-02-2	392.460		262				
2817	Dexon	Sodium dimethylaminobenzenediazosulfonate	C ₈ H ₁₀ N ₃ NaO ₃ S	140-56-7	251.238	ye-br powder					sl H ₂ O; s DMF
2818	Dexpanthenol		C ₁₃ H ₂₃ NO ₄	81-13-0	205.252	hygroscopic solid		dec	1.20	1.497 ²⁰	vs H ₂ O, Et OH, MeOH; sl et h
2819	Dextroamphetamine sulfate		C ₁₆ H ₂₅ N ₂ O ₄ S	51-63-8	368.491		>300		1.15 ²⁵		vs H ₂ O
2820	Dextroamphetamine hydrobromide		C ₁₆ H ₂₅ BrNO	125-69-9	352.309	wh cry powder	123				s Et OH, chl; i et h
2821	Diacetone alcohol	4-Hydroxy-4-methyl-2-pentanone	C ₈ H ₁₆ O ₂	123-42-2	116.158	liquid	-44	167.9	0.9387	1.4213 ²⁰	msc H ₂ O, Et OH, et h; s chl
2822	3,3-Diacetoxypropene		C ₇ H ₁₀ O ₄	869-29-4	158.152	liquid	-37.6	180	1.0760	1.4193 ²⁰	vs ace, bz, et h, Et OH
2823	1,3-Diacetylbenzene		C ₁₀ H ₁₀ O ₂	6781-42-6	162.185		32	152 ¹⁵			sl H ₂ O, pet h; s Et OH, bz, chl, HOAc
2824	1,4-Diacetylbenzene	4-Acetylacetophenone	C ₁₀ H ₁₀ O ₂	1009-61-6	162.185		113.0	128 ³			vs Et OH; sl chl
2825	N,N'-Diacetyl-4,4'-diaminodiphenyl		C ₁₆ H ₁₈ N ₂ O ₂	613-35-4	268.310	nd (HOAc)	328.3				



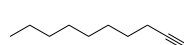
1-Decyl naphthalene



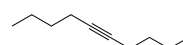
Decyl oxirane



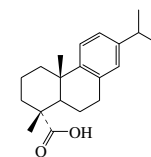
Decyl vinyl ether



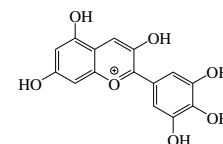
1-Decyne



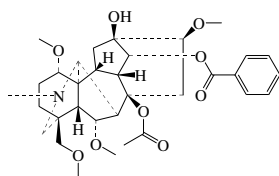
5-Decyne



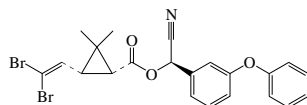
Dehydroabietyl acid



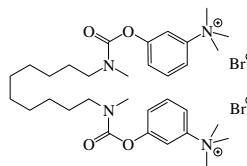
Delphinidin



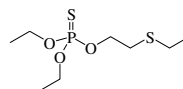
Delphinine



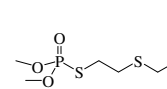
Deltamethrin



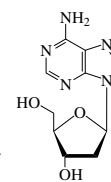
Demecarium bromide



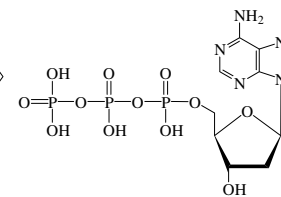
Demeton



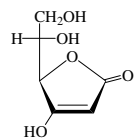
Demeton-S-methyl



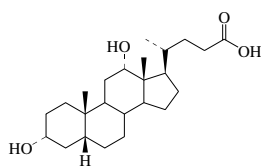
2'-Deoxyadenosine



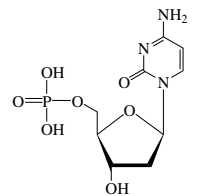
2'-Deoxyadenosine 5'-triphosphate



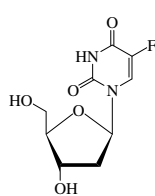
6-Deoxy-L-ascorbic acid



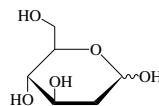
Deoxycholic acid



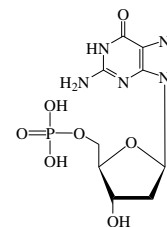
2'-Deoxycytidine 5'-monophosphate



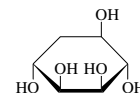
2'-Deoxy-5-fluorouridine



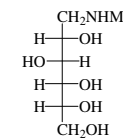
2-Deoxy-D-glucose



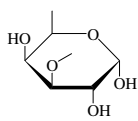
2'-Deoxyguanosine 5'-monophosphate



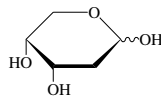
2-Deoxy-D-chiroinositol 1-Deoxy-1-(methylamino)-D-glucitol



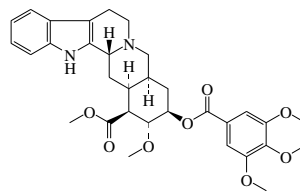
2-Deoxy-D-chiroinositol 1-Deoxy-1-(methylamino)-D-glucitol



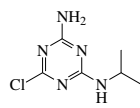
6-Deoxy-3-O-methylgalactose



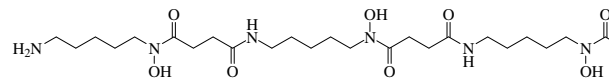
D-2-Deoxyribose



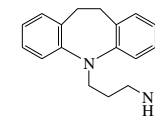
Deserpinine



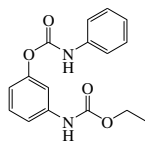
Desethylazine



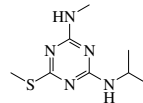
Desferrioxamine



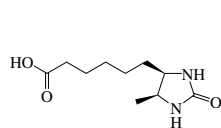
Desipramine



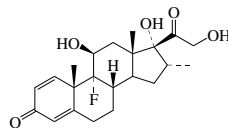
Desmedipham



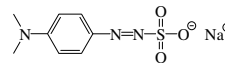
Desmetryne



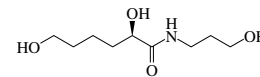
Desflorfenone



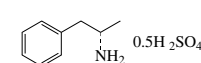
Dexamethasone



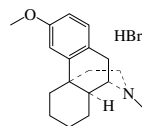
Dexon



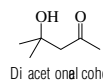
Dexpanthenol



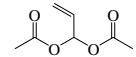
Dexroamphetamine sulfate



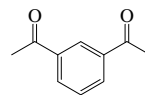
Dextromethorphan hydrobromide



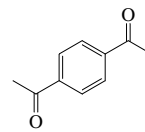
Diacetone alcohol



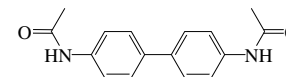
3,3-Diacetoxypropene



1,3-Diacetylbenzene

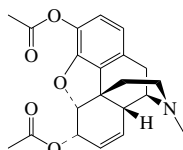


1,4-Diacetylbenzene

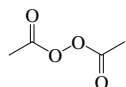


N,N'-Diacetyl-4,4'-diaminobiphenyl

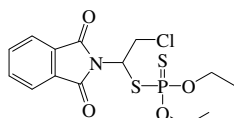
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2826	Diacetylmorphine		$C_{21}H_{23}NO_5$	561-27-3	369.412	orth	173	273 ²	1.56 ²⁵		vs bz, chl
2827	Diacetylperoxide	Acetylperoxide	$C_8H_8O_4$	110-22-5	118.089	nd (et h) lf	30	69			vs et h, Et OH
2828	Dialifor		$C_{17}Cl_2NO_4P$ S_2	10311-84-9	393.846		68				
2829	Diallate		$C_{17}Cl_2NOS$	2303-16-4	270.219			150 ⁹			
2830	Diallylcyanamide		$C_6H_8N_2$	538-08-9	122.167			142 ⁹⁰ , 95 ⁹			s Et OH; sl et h, ct c
2831	Diallyldiethylene glycol carbonate	Diethylene glycol bis(diallyl carbonate)	$C_{18}H_{24}O_6$	142-22-3	274.267	col liq	-4	161	1.14 ²⁰		i H ₂ O; s os
2832	Diallyldimethylsilane		$C_8H_{16}Si$	1113-12-8	140.299			137; 68 ⁰	0.7679 ²⁰	1.4420 ²⁰	
2833	Diallyldisulfide		$C_6H_6S_2$	2179-57-9	146.273			100 ⁴⁸ , 79 ¹⁶	1.0237 ¹⁵		
2834	Diallyl ether	Allyl ether	$C_6H_{10}O$	557-40-4	98.142	liq	-6	94	0.826 ⁰	1.4163 ²⁰	i H ₂ O; msc Et OH, et h; vs ace; s chl
2835	Diallyl fumarate		$C_{10}H_{12}O_4$	2807-54-7	196.200			140 ³	1.0768 ²⁰	1.4670 ²⁵	vs ace, bz, et h, Et OH
2836	Diallyl isophthalate	Di-2-propenyl 1,3-benzenedicarboxylate	$C_{14}H_{14}O_4$	1087-21-4	246.259			176 ⁵			
2837	Diallyl malate		$C_{10}H_{12}O_4$	999-21-3	196.200			129 ¹⁰ , 109 ³	1.075 ²⁰	1.4699 ²⁰	s chl
2838	Diallyl oxalate		$C_8H_{10}O_4$	615-99-6	170.163			217	1.1582 ²⁰	1.4481 ²⁰	i H ₂ O; s Et OH, ace, bz; sl chl
2839	N,N-Diallyl-2-propen-1-amine	Triallylamine	$C_8H_{15}NC$	102-70-5	137.222		94	155.5	0.809 ²⁰	1.4502 ²⁰	s Et OH, et h, ace, bz, aci d
2840	5,5-Diallyl-2,4,6-tris(5H)-pyrimidinone	Allobarbital	$C_{10}H_{12}N_2O_3$	52-43-7	208.213	lf	172				sl H ₂ O, DMSO; s Et OH, et h, bz
2841	Diallyl sulfide		$C_6H_{10}S$	592-88-1	114.208	liq	-85	138.6	0.887 ⁷	1.4870 ²⁵	vs et h, Et OH
2842	Diallyl trisulfide		$C_6H_6S_3$	2050-87-5	178.338			117 ¹⁶	1.0845 ¹⁵		vs et h
2843	Diamantane	Congressane	C_{120}	2292-79-7	188.309	cry	236				
2844	1,2-Diamino-9,10-antihracenedione		$C_{14}H_{10}N_2O_2$	1758-68-5	238.241	viol nd	303.5				sl Et OH, et h, chl, xyl; s py, con sul f
2845	1,4-Diamino-9,10-antihracenedione		$C_{14}H_{10}N_2O_2$	128-95-0	238.241	dk viol nd (py)	268				sl H ₂ O; s Et OH, bz, PhNQ; vs py
2846	1,5-Diamino-9,10-antihracenedione		$C_{14}H_{10}N_2O_2$	129-44-2	238.241	dk red nd (al, HOAc)	319	sub			i H ₂ O; sl Et OH, et h, ace, bz; s PhNO ₂
2847	1,8-Diamino-9,10-antihracenedione		$C_{14}H_{10}N_2O_2$	129-42-0	238.241	red nd (al, HOAc)	265				i H ₂ O; s Et OH, py; sl et h, HOAc
2848	2,6-Diamino-9,10-antihracenedione		$C_{14}H_{10}N_2O_2$	131-14-6	238.241	red-br pr (aq-py)	320 dec				sl H ₂ O; s Et OH, chl, con sul f, xyl, py
2849	4,4'-Diaminoazobenzene		$C_{12}H_{12}N_4$	538-41-0	212.250	ye nd (al), oran-ye pr (al)	250.5				sl H ₂ O, li g; s Et OH; vs bz, chl
2850	3,5-Diaminobenzoic acid		$C_7H_7NO_2$	535-87-5	152.151	nd (+1w)	228				sl H ₂ O, li f a; s Et OH; vs et h
2851	2,4-Diaminobenzoic acid		$C_7H_7NO_2$	305-62-4	118.134	hyg cry					s H ₂ O; sl Et OH, MeOH
2852	2,3-Diaminobenzoic acid		$C_7H_7NO_2$	1187-42-4	108.102			178.5	1.41 ²⁰		
2853	1,8-Diamino-4,5-dihydroxy-9,10-antihracenedione		$C_{14}H_{10}N_2O_4$	128-94-9	270.240	bl nd (xyl)					i H ₂ O; s bz, xyl, Et OH
2854	4,4'-Diaminodiphenyl ether	4,4'-Oxydianiline	$C_{12}H_{12}NO$	101-80-4	200.235			189 dec	>300		
2855	4,4'-Diaminodiphenylmethane	4,4'-Methylenedianiline	$C_{13}H_{14}N_2C$	101-77-9	198.263	pl or nd (w) pl (bz)	92.5	398; 257 ¹⁸			sl H ₂ O; vs Et OH, et h, bz
2856	4,4'-Diaminodiphenyl sulfide	4,4'-Thiodianiline	$C_{12}H_{12}NS$	139-65-1	216.301	nd (w)	108.5				sl H ₂ O; vs Et OH, et h, bz; s t f a
2857	3,3'-Diaminodiphenyl sulfone	3,3'-Sulfonyldianiline	$C_{12}H_{12}N_2OS$	599-61-1	248.300			168.5			vs H ₂ O, Et OH
2858	meso-2,6-Diaminoheptanediol diacid	2,6-Diaminopimelic acid	$C_7H_{12}N_2O_4$	922-54-3	190.197	nd (w)	314 dec				s H ₂ O
2859	1,4-Diamino-2-methoxy-9,10-antihracenedione		$C_{15}H_{12}N_2O_3$	2872-48-2	268.267			235			
2860	1,4-Diamino-5-nitro-9,10-antihracenedione		$C_{14}H_{10}N_3O_4$	82-33-7	283.239			278			



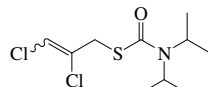
Di acet yl morphi ne



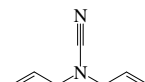
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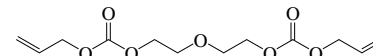
Di ali f or



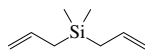
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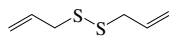
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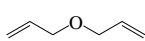
Di al lyl di et hyl enyl ycol carbonat e



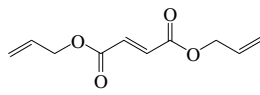
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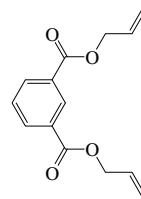
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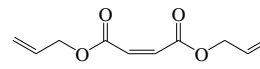
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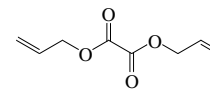
Di al lyl fumarat e



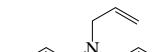
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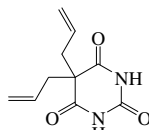
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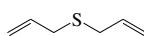
Di al lyl gxl at e



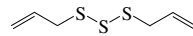
N,N-Di al lyl -2-propen-1-ami ne



5,5-Di al lyl -2,4,6-(*H*/*H*/*H*)-pyri mi di net ri one



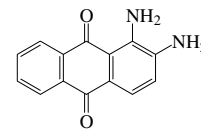
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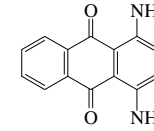
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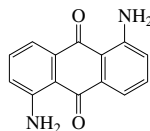
Di amant ane



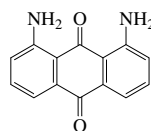
1,2-Di ami no-9,10-ant hracenedi one



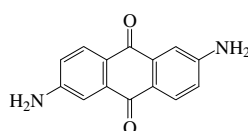
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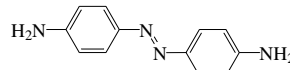
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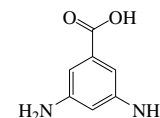
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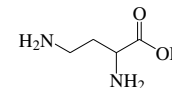
2,6-Di ami no-9,10-ant hracenedi one



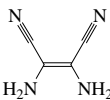
4,4'-Di ami noazobenze



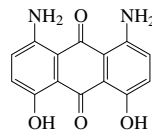
3,5-Di ami nobenzoici d



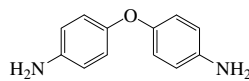
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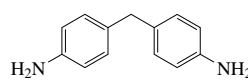
ci s-2,3-Di ami no-2-but enedi ni



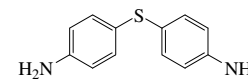
1,8-Di ami no-4,5-di hydroxy-9,10-ant hracenedi



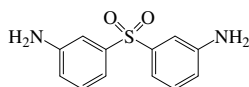
4,4'-Di ami nodi phenyl et her



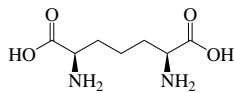
4,4'-Di ami nodi phenyl met hane



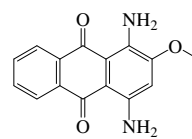
4,4'-Di ami nodi phenyl sul fi de



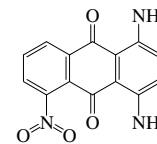
3,3'-Di ami nodi phenyl sul f one



meso-2,6-Di ami nohept anedi aci d

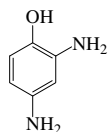


1,4-Di ami no-2-met hoxy-9,10-ant hracenedi one

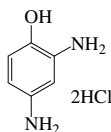


1,4-Di ami no-5-ni t ro-9,10-ant hracenedi one

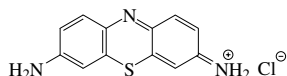
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2861	2,4-Di ami nophenol		C_6H_7NO	95-86-3	124.140	lf	79 dec				vs EtO, ace, Et OH
2862	2,4-Di ami nophenol, di hydrochl ori de		$C_{10}H_9Cl_2N_2O$	137-09-7	197.061	nd	235 dec				vs H ₂ O
2863	3,7-Di ami nophenot hi azi n-5-i um chl ori de	Thi oni ne chl ori de	$C_{10}H_9ClNS$	581-64-6	263.745						sl H ₂ O, Et OH, et h; s bz, chl, aci d
2864	4-[(2,4-Di ami nophenyl) azo]benzenesul f onami de	Pront osi l	$C_{14}H_{11}ClN_2O_2S$	103-12-8	327.790		249.5				sl H ₂ O; s Et OH, ace, oi l s, f at s
2865	1,3-Di ami no-2-propanol		$C_3H_9N_2O$	616-29-5	90.123	cry	42.8				i et h, bz
2866	4,4'-Di ami no-2,2'-st i l benedi sul f onami c aci d	Amosoni c aci d	$C_{14}H_{14}N_2O_6S_2$	81-11-8	370.400	ye nd	300				sl H ₂ O
2867	4,6-Di ami no-1,3,5-tri azi n-2-one		$C_3H_3N_3O$	645-92-1	127.105	nd (aq Na ₂ CO ₃)	dec				i H ₂ O, Et OH, et h, bz, HOAc; s aci d, alk
2868	8,8'-Di apo- ψ , ψ -carot enedi oi c aci d	Crocet i n	$C_{40}H_{56}O_4$	27876-94-4	328.403	bri ck red ort h	286				sl Et OH; i et h, bz; s py; vs NaOH
2869	Di at ri zoi c aci d	<i>M,N</i> -Di acet yl -3,5-di ami no-2,4,6-tri i odobenzo i c aci d	$C_{11}H_3I_3N_2O_4$	117-96-4	613.913	cry (Et OH aq)	300				
2870	Di azenedi carboxami de	Azodi carbonami de	$H_2N_2O_2$	123-77-3	116.079		212 dec				
2871	Di azi non		$C_{12}H_{21}N_2O_3PS$	333-41-5	304.345			87 ^{0.05}	1.1088 ²⁰	1.4922 ²⁰	
2872	Di azomet hane		CHN_2	334-88-3	42.040	ye gas	-145	-23			vs et h, di ox
2873	Di benz[a,h]acri di ne		$C_{13}H_9N$	226-36-8	279.335	ye cry	228				
2874	Di benz[a,j]acri di ne	7-Azadi benz[a,j]ant hracene	$C_{13}H_9N$	224-42-0	279.335		216				i H ₂ O
2875	Di benz[c,h]acri di ne		$C_{13}H_9N$	224-53-3	279.335	ye cry (Et OH)	189				
2876	Di benz[a,h]ant hracene	1,2,5,6-Di benzant hracene	$C_{14}H_{10}$	53-70-3	278.346	pl (di l ace)	269.5				i Et OH; s ace, bz, CS
2877	Di benz[a,j]ant hracene		$C_{14}H_{10}$	224-41-9	278.346	oran lf or nd (bz)	197.5				i H ₂ O, HOAc; sl Et OH, et h, bz; s pet h
2878	5 <i>H</i> -Di benz[b,f]jazepi ne-5-carboxami de	Carbamazepi ne	$C_8H_{12}N_2O$	298-46-4	236.268		190.2				
2879	Di benzepi n		$C_{12}H_{11}N_2O$	4498-32-2	295.379		117	185 ^{0.01}			
2880	7 <i>H</i> -Di benzo[c,g]carbazol e		$C_{13}H_9N$	194-59-2	267.324	cry (Et OH)	158				
2881	13 <i>H</i> -Di benzo[a,i]carbazol e		$C_{13}H_9N$	239-64-5	267.324		221.3				i H ₂ O
2882	Di benzo[b,k]chrysene		$C_{18}H_{12}$	217-54-9	328.405		400				
2883	Di benzo[b,e][1,4]di oxi n	Di phenyl ene di oxi de	$C_{12}H_8O_2$	262-12-4	184.191	nd (MeOH)	120.5				
2884	Di benzof uran	2,2'-Bi phenyl ene oxi de	$C_{12}H_8O$	132-64-9	168.191	lf or nd (al)	86.5	287	1.088 ⁸⁶	1.6079 ⁹⁹	i H ₂ O; s Et OH, ace, bz; vs et h, HOAc
2885	Di benzo[a,e]pyrene	Napht ho[1,2,3,4-def]chrysene	$C_{14}H_{10}$	192-65-4	302.368	pa ye nd(xyl)	233.5				sl Et OH, ace, bz, HOAc; s t ol, con sul f
2886	Di benzo[a,h]pyrene	Di benzo[b,def]chrysene	$C_{14}H_{10}$	189-64-0	302.368	oran pl	315				
2887	Di benzo[a,i]pyrene	Benzo[<i>rst</i>]pent aphene	$C_{14}H_{10}$	189-55-9	302.368		281.5	275 ^{0.05}			
2888	Di benzo[a,l]pyrene	Di benzo[def,p]chrysene	$C_{14}H_{10}$	191-30-0	302.368	ye pl (bz/Et OH)	164.5				
2889	Di benzot hi ophene		C_8H_6S	132-65-0	184.257	nd (di l al, li g)	98.2	332.5			sol chl, MeOH; vs Et OH, bz
2890	Di benz[c,e]oxepi n-5,7-di one		$C_8H_6O_3$	6050-13-1	224.212	nd (HOAc or bz)	217	sub			i H ₂ O; sl et h
2891	Di benzoyl di sul fide	Benzoyl di sul fide	$C_4H_4O_2S_2$	644-32-6	274.358	pr(al), sc(chl - pet h)	134.5	dec			i H ₂ O; sl Et OH, et h; s CS
2892	Di benzyl ami ne	<i>N</i> -Benzyl benzenemet hanami ne	$C_{15}H_{15}N$	103-49-1	197.276		-26	dec 300; 270 ²⁵⁰	1.0256 ²²	1.5781 ²⁰	i H ₂ O; vs Et OH, et h; s ct c
2893	Di benzyl di sul fide		$C_{14}H_{14}S_2$	150-60-7	246.391	lf (al)	71.5				sl Et OH, et h, bz, MeOH
2894	<i>N,N</i> -Di benzyl -1,2-et hanedi ami ne	Benzat hi ne	$C_{16}H_{18}N_2$	140-28-3	240.343	oi ly li g	26	195	1.024 ²⁰	1.5635 ²⁰	vs bz, et h, Et OH
2895	Di benzyl et her	Benzyl et her	$C_{14}H_{14}O$	103-50-4	198.260		1.8	298	1.0428 ²⁰	1.5168 ²⁰	i H ₂ O; msc Et OH, et h; s ct c



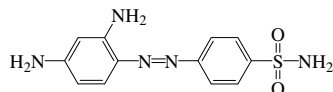
2,4-Di ami nophenol



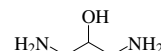
2,4-Di ami nophenol di hydrochlori de



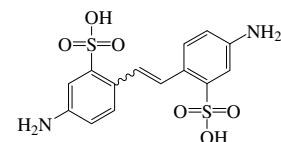
3,7-Di ami nophenol hi azi n-5-tiluri de



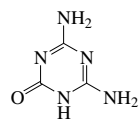
4-[(2,4-Di ami nophenyl)azo]benzenesulfonyl ami de



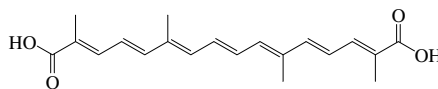
1,3-Di ami no-2-propanol



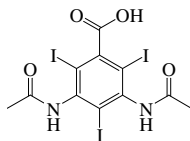
4,4-Di ami no-2,2-stilbenedi sulfoacidi c



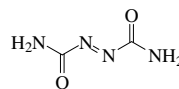
4,6-Di ami no-1,3,5-triazinone



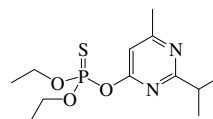
8,8'-Di apo ψ , ψ -carotenedi oiaci d



Di at ri zoiaci d



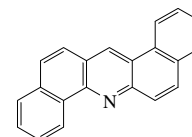
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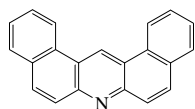
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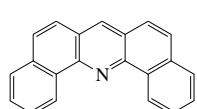
Di azomet hane



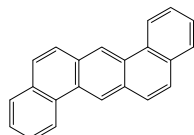
Di benz[a,h]iacri di ne



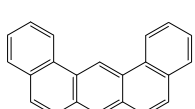
Di benz[a,j]iacri di ne



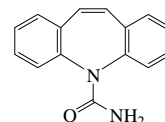
Di benz[c,h]iacri di ne



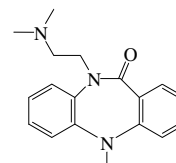
Di benz[a,h]iant hracene



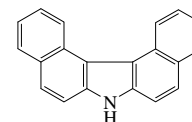
Di benz[a,j]iant hracene



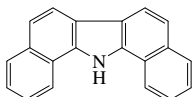
5H-Di benz[b,f]jazepi ne-5-carboxami de



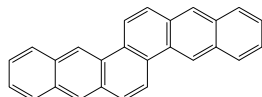
Di benzepi n



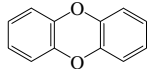
7H-Di benzo[c,g]carbazole



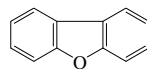
13H-Di benzo[a,i]carbazole



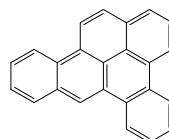
Di benzo[b,k]chrysene



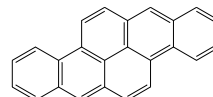
Di benzo[b,e][1,4]di oxi n



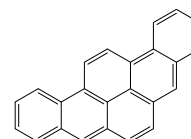
Di benzof uran



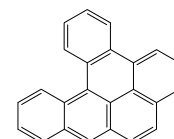
Di benzo[a,e]pyrene



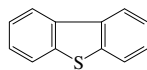
Di benzo[a,h]pyrene



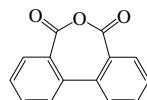
Di benzo[a,i]pyrene



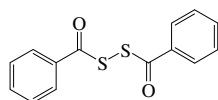
Di benzo[a,l]pyrene



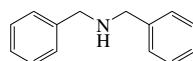
Di benzot hi ophene



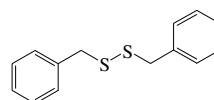
Di benz[c,e]oxepi n-5,7-di one



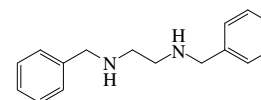
Di benzoyldi sulfi de



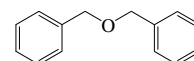
Di benzylami ne



Di benzylti sulfi de

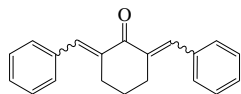


N,N-Di benzyl-1,2-et hane di ami ne

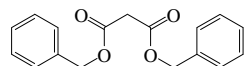


Di benzylet her

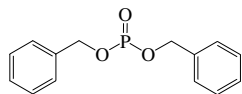
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2896	2,6-Di benzylidene cyclohexanone		$C_{26}H_{30}O$	897-78-9	274.356		117.5	190 ²⁰			sl Et OH; s bz, HOAc
2897	Di benzyl malonate		$C_{17}H_{16}O_4$	15014-25-2	284.307			187 ²	1.137 ²⁵	1.5447 ²⁰	
2898	Di benzyl phosphite		$C_{14}H_{15}O_3P$	17176-77-1	262.241		-2.5	162 ^{0.1}		1.5521 ¹⁸	
2899	Di benzyl sulfide	Benzyl sulfide	$C_{14}H_{14}S$	538-74-9	214.326	pl (et h or chl)	49.5	dec	1.0588		i H ₂ O; s Et OH, et h, C ₆ H ₆
2900	Di benzyl sulfone		$C_{14}H_{12}O_2S$	620-32-6	246.325	nd (al-bz)	152	dec 290			i H ₂ O; sl Et OH; vs ace; s bz, HOAc
2901	Di benzyl sulfoxide		$C_{14}H_{14}OS$	621-08-9	230.325	lf (al, w)	134	dec 210			i ₂ H ₂ O vs Et OH, et h
2902	1,3-Di benzyl urea		$C_{15}H_{15}N_2O$	1466-67-7	240.300	nd (al)	169.5				vs Et OH, HOAc
2903	Di bromoacetate		$C_2H_2Br_2O_2$	631-64-1	217.844	hyg cry	49	195 ²⁰ , 130 ¹⁶			vs H ₂ O; vs Et OH, et h
2904	Di bromoacetamide		$C_2H_3Br_2N$	3252-43-5	198.844			169; 68 ²⁴	2.369 ²⁰	1.5393 ²⁰	
2905	2,4-Di bromoaniline		$C_6H_4Br_2N$	615-57-6	250.919	orth bi pym (chl) nd or lf (al)	79.5	156 ⁷⁴	2.260 ²⁰		s Et OH, et h, chl, HOAc
2906	3,5-Di bromoaniline		$C_6H_4Br_2N$	626-40-4	250.919	nd (di l al)	57				vs Et OH, et h, bz
2907	9,10-Di bromoanthracene		$C_{14}H_8Br_2$	523-27-3	336.022	yellow (t o or xyl)	226	sub			i ₂ H ₂ O; sl Et OH, et h, bz; s chl
2908	<i>o</i> -Di bromobenzene	1,2-Di bromobenzene	$C_6H_4Br_2$	583-53-9	235.904		7.1	225	1.9843 ²⁰	1.6155 ²⁰	i H ₂ O; s Et OH; msc et h, ace, bz, ct c
2909	<i>m</i> -Di bromobenzene	1,3-Di bromobenzene	$C_6H_4Br_2$	108-36-1	235.904	liq	-7	218	1.952 ³	1.6083 ¹⁷	i H ₂ O; s Et OH; msc et h
2910	<i>p</i> -Di bromobenzene	1,4-Di bromobenzene	$C_6H_4Br_2$	106-37-6	235.904	pl	87.43	218.5	2.261 ¹⁷	1.5742	i H ₂ O; s Et OH, bz; vs et h, ace, C ₆ H ₆
2911	4,4'-Di bromobenzophenone	Bis(4-bromophenyl) ketone	$C_{18}H_{10}Br_2O$	3988-03-2	340.010	pl (al)	177	395			vs bz, HOAc, chl
2912	4,4'-Di bromo-1,1'-biphenyl		$C_{18}H_{10}Br_2$	92-86-4	312.000	mcl pr (MeOH)	164	357.5			i H ₂ O; sl Et OH; s bz
2913	1,3-Di bromo-2,2-bis(bromomethyl)propane	Pentabromodipropyl ether	$C_9H_8Br_4$	3229-00-3	387.734	cry (ace), nd (liq)	163	305.5	2.596 ¹⁵		s Et OH, bz, toluene; sl et h, chl
2914	3,5-Di bromo-4-(4-bromophenyl)-2-hydroxybenzamide	Tri bromsalan	$C_{18}H_{10}Br_3NO_2$	87-10-5	449.921		227				
2915	1,1-Di bromobutane		$C_4H_8Br_2$	62168-25-6	215.915			158; 91 ¹⁰¹	1.784 ²⁵	1.4988 ²⁵	
2916	1,2-Di bromobutane	α -Butylene dibromide	$C_4H_8Br_2$	533-98-2	215.915	liq	-65.4	166.3	1.791 ⁹	1.4025 ²⁰	i H ₂ O; s et h, chl
2917	1,3-Di bromobutane		$C_4H_8Br_2$	107-80-2	215.915			174	1.800 ²⁰	1.507 ²⁰	i H ₂ O; s et h, chl; sl ct c
2918	1,4-Di bromobutane		$C_4H_8Br_2$	110-52-1	215.915	liq	-16.5	197	1.819 ⁹	1.5167 ²⁵	i H ₂ O; sl ct c; s chl
2919	2,3-Di bromobutane		$C_4H_8Br_2$	5408-86-6	215.915	liq	-24	161	1.789 ³	1.5133 ²²	i H ₂ O; s et h
2920	<i>trans</i> -1,4-Di bromo-2-butene		$C_4H_6Br_2$	821-06-7	213.899	pl (pet h)	53.4	203; 7 [#]			sl H ₂ O, chl; vs Et OH, pet h; s ace
2921	1,4-Di bromo-2-butene		$C_4H_6Br_2$	2219-66-1	211.883			92 ¹⁵	2.014 ¹⁸	1.588 ¹⁸	s et h, ace; vs chl
2922	α,α' -Di bromo- <i>trans</i> -camphor		$C_{10}H_{14}Br_2O$	514-12-5	310.025		61		1.854 ²¹		i H ₂ O; vs Et OH, et h, bz, chl; s AcOEt
2923	Di bromochlorofluoromethane		$CBrClF$	353-55-9	226.270			80.3	2.3173 ²	1.4570 ²⁰	
2924	1,2-Di bromo-3-chloropropane		$C_3H_4Br_2Cl$	96-12-8	236.333			196	2.093 ⁴	1.553 ¹⁴	i H ₂ O
2925	1,2-Di bromo-1-chloro-1,2,2-trifluoroethane		$C_2Br_2ClF_3$	354-51-8	276.277		50	93			
2926	2,2-Di bromo-2-cyanoacetamide		$C_3Br_2N_2O$	10222-01-2	241.868	cry (bz)	126				
2927	<i>trans</i> -1,2-Di bromocyclohexane, (\pm)		$C_6H_{10}Br_2$	5183-77-7	241.951		-2.0	145 ¹⁰⁰ , 105 ²⁰	1.7759 ²⁰	1.5445 ¹⁹	vs ace, bz, et h, Et OH
2928	1,10-Di bromodecane	Decamethylene dibromide	$C_{10}H_{20}Br_2$	4101-68-2	300.074	pl (al)	28	161; 128 ⁴	1.335 ³⁰	1.4927 ²⁵	i H ₂ O; sl Et OH; s et h
2929	1,2-Di bromo-1,1-dichloroethane		$C_2H_2Br_2Cl_2$	75-81-0	256.751	liq	-26	195	2.13 ⁹	1.5662 ²⁰	vs ace, bz, et h, Et OH
2930	1,2-Di bromo-1,2-dichloroethane		$C_2H_2Br_2Cl_2$	683-68-1	256.751	liq	-26	195	2.13 ⁹	1.5662 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
2931	Di bromodichloromethane		CBr_2Cl_2	594-18-3	242.725		38	150.2	2.42 ²⁵		i H ₂ O; s Et OH, et h, ace, bz
2932	1,2-Di bromo-1,1-difluoroethane	Genetron 132b-B2	$C_2H_2Br_2F_2$	75-82-1	223.842	liq	-61.3	92.5	2.223 ⁹	1.4456 ²⁰	
2933	Di bromodifluoromethane		CBr_2F_2	75-61-6	209.816	volatile liq or gas	-110.1	22.76			s H ₂ O, et h, ace, bz



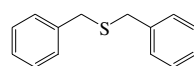
2,6-Di benzylidene cyclohexanone



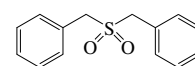
Di benzylmalonate



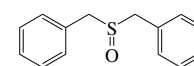
Di benzylphosphate



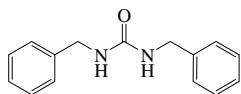
Di benzylsulfide



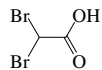
Di benzylsulfone



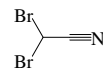
Di benzylsulfoxide



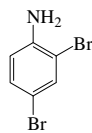
1,3-Di benzyl urea



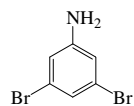
Di bromoacetate



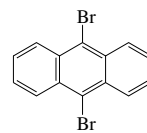
Di bromoacetonitrile



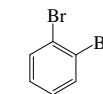
2,4-Di bromoaniline



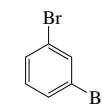
3,5-Di bromoaniline



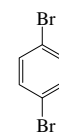
9,10-Di bromoanthracene



o-Di bromobenzene

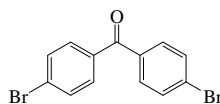


m-Di bromobenzene

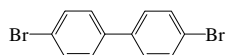


p-Di bromobenzene

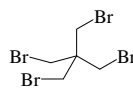
3-157



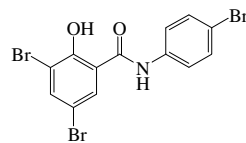
4,4'-Di bromobenzophenone



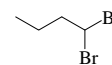
4,4'-Di bromo-1,1'-bi phenyl



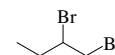
1,3-Di bromo-2,2-bis(bromomethyl)propane



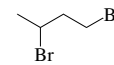
3,5-Di bromo-N-(4-bromophenyl)-2-hydroxybenzamide



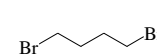
1,1-Di bromobutane



1,2-Di bromobutane



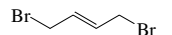
1,3-Di bromobutane



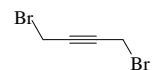
1,4-Di bromobutane



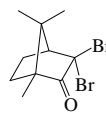
2,3-Di bromobutane



trans-1,4-Di bromo-2-butene



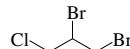
1,4-Di bromo-2-butyne



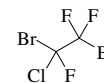
α,α' -Di bromo-camphor



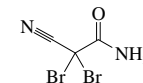
Di bromochlorofluoromethane



1,2-Di bromo-3-chloropropane



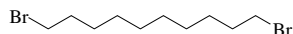
1,2-Di bromo-1-chloro-1,2,2-trifluoroethane



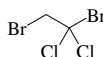
2,2-Di bromo-2-cyanoacetamide



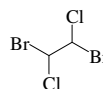
trans-1,2-Di bromocyclohexane(±)



1,10-Di bromodecane



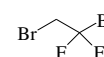
1,2-Di bromo-1,1-dichloroethane



1,2-Di bromo-1,2-dichloroethane



Di bromodichloroethane

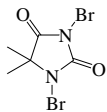


1,2-Di bromo-1,1-difluoroethane



Di bromodifluoroethane

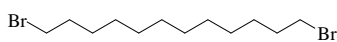
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2934	1,3-Di bromo-5,5-di met hyl -2,4-i mi dazol i di ned i one	Di bromant i ne	$\text{C}_6\text{H}_7\text{Br}_2\text{N}_2\text{O}_2$	77-48-5	285.922		198 dec				
2935	1,3-Di bromo-2,2-di met hyl propane		$\text{C}_3\text{H}_5\text{Br}_2$	5434-27-5	229.941			184; 80 ²⁶	1.6775 ²⁰	1.5090	
2936	1,12-Di bromododecane		$\text{C}_{12}\text{H}_{24}\text{Br}_2$	3344-70-5	328.127	nd (al, HOAc)	41	215 ⁵			i H ₂ O; vs Et OH, chl; s et h, HOAc
2937	1,1-Di bromoet hane	Et hyl i dene di bromi de	$\text{C}_2\text{H}_4\text{Br}_2$	557-91-5	187.861	li q	-63	108.0	2.055 ⁵	1.5128 ²⁰	i H ₂ O; s Et OH, ace, bz, sl chl; vs et h
2938	1,2-Di bromoet hane	Et hyl ene di bromi de	$\text{C}_2\text{H}_4\text{Br}_2$	106-93-4	187.861		9.84	131.6	2.1683 ²⁵	1.5356 ²⁵	vs ace, bz, et h, Et OH
2939	<i>ci s</i> 1,2-Di bromoet hene	<i>ci s</i> 1,2-Di bromoet hyl ene	$\text{C}_2\text{H}_2\text{Br}_2$	590-11-4	185.845	li q	-53	112.5	2.246 ⁴	1.5428 ²⁰	i H ₂ O; vs Et OH, et h; s ace, bz, chl
2940	<i>t rans</i> 1,2-Di bromoet hene	<i>t rans</i> 1,2-Di bromoet hyl ene	$\text{C}_2\text{H}_2\text{Br}_2$	590-12-5	185.845	li q	-6.5	108	2.230 ⁸	1.5505 ¹⁸	i H ₂ O; vs Et OH, et h; s ace, bz, chl
2941	1,2-Di bromo-1-et hoxet hane		$\text{C}_2\text{H}_3\text{Br}_2\text{O}$	2983-26-8	231.914		80 ²⁰	1.7320 ²⁰		1.5044 ²⁰	vs Et OH, chl
2942	1,2-Di bromoet hyl acet at e		$\text{C}_2\text{H}_3\text{Br}_2\text{O}_2$	24442-57-7	245.898	li q	89.5	89.5	1.91 ²⁰		
2943	(1,2-Di bromoet hyl)benzene		$\text{C}_6\text{H}_4\text{Br}_2$	93-52-7	263.958		75	133 ¹⁹			s Et OH, et h, bz, chl, HOAc, MeOH, li g
2944	Di bromofluoromet hane		CH_2BrF	1868-53-7	191.825	li q	-78	64.9	2.42 ⁴	1.4685 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl
2945	1,2-Di bromohept ane		$\text{C}_7\text{H}_{14}\text{Br}_2$	42474-21-5	257.994			228	1.5086 ²⁰	1.4986 ²⁰	
2946	1,7-Di bromohept ane	Hept amet hyl ene di bromi de	$\text{C}_7\text{H}_{14}\text{Br}_2$	4549-31-9	257.994		41.7	263	1.5306 ²⁰	1.5034 ²⁰	i H ₂ O; s et h, ace, bz, ct c, chl
2947	2,3-Di bromohept ane		$\text{C}_7\text{H}_{14}\text{Br}_2$	21266-88-6	257.994			101 ¹⁷	1.5139 ²⁰	1.4992 ²⁰	
2948	3,4-Di bromohept ane		$\text{C}_7\text{H}_{14}\text{Br}_2$	21266-90-0	257.994			107 ²⁴	1.5182 ²⁰	1.5010 ²⁰	
2949	1,2-Di bromo-1,1,2,3,3,3-hexafluoropropane		$\text{C}_3\text{Br}_2\text{F}_6$	661-95-0	309.830			72.8	2.1630 ²⁰		i H ₂ O
2950	1,2-Di bromohexane		$\text{C}_6\text{H}_{12}\text{Br}_2$	624-20-4	243.967			103 ³⁶	1.5774 ²⁰	1.5024 ²⁰	vs bz, et h, chl
2951	1,6-Di bromohexane		$\text{C}_6\text{H}_{12}\text{Br}_2$	629-03-8	243.967	li q	-1.2	245.5	1.602 ⁵	1.5054 ²⁵	i H ₂ O; s et h, ace, chl; sl ct c
2952	3,4-Di bromohexane		$\text{C}_6\text{H}_{12}\text{Br}_2$	89583-12-0	243.967			80 ¹³	1.6027 ²⁰	1.5043 ²⁰	
2953	3,5-Di bromo-2-hydroxybenzaldehyde	3,5-Di bromosal i cyl aldehyde	$\text{C}_7\text{H}_5\text{Br}_2\text{O}_2$	90-59-5	279.914	pa ye pr	86	sub			vs bz, et h, chl
2954	3,5-Di bromo-2-hydroxybenzoic acid	3,5-Di bromosal i cyl i c aci d	$\text{C}_7\text{H}_3\text{Br}_2\text{O}_3$	3147-55-5	295.913	nd	228				s ace
2955	3,5-Di bromo-4-hydroxybenzoni t r i l e	Bromoxyn i l	$\text{C}_7\text{H}_5\text{Br}_2\text{NO}$	1689-84-5	276.913		190				
2956	Di bromomet hane	Met hyl ene bromi de	$\text{C}_2\text{H}_2\text{Br}_2$	74-95-3	173.835	li q	-52.5	97	2.496 ⁹	1.5420 ²⁰	sl H ₂ O; msc Et OH, et h, ace; s ct c
2957	1,4-Di bromo-2-met hyl benzene	2,5-Di bromot ol uene	$\text{C}_8\text{H}_8\text{Br}_2$	615-59-8	249.931		5.6	236	1.8127 ¹⁷	1.5982 ¹⁸	i H ₂ O
2958	2,4-Di bromo-1-met hyl benzene		$\text{C}_8\text{H}_8\text{Br}_2$	31543-75-6	249.931		-9.7	103 ¹¹	1.8176 ²⁵	1.5964 ²⁵	
2959	(Di bromomet hyl)benzene		$\text{C}_6\text{H}_4\text{Br}_2$	618-31-5	249.931		1.0	156 ²³	1.8365 ²⁸	1.6147 ²⁰	i H ₂ O; msc Et OH, et h
2960	2,3-Di bromo-2-met hyl but ane		$\text{C}_6\text{H}_{10}\text{Br}_2$	594-51-4	229.941		7	62 ¹⁷	1.6717 ²⁰	1.5729 ²⁵	
2961	2,4-Di bromo-6-met hyl phenol		$\text{C}_8\text{H}_7\text{Br}_2\text{O}$	609-22-3	265.930	nd (pet h)	58	dec 265; 105 ⁴			s chl
2962	1,2-Di bromo-2-met hyl propane		$\text{C}_3\text{H}_5\text{Br}_2$	594-34-3	215.915		10.5	150	1.7827 ²⁰	1.5119 ²⁰	s Et OH, et h, chl
2963	1,4-Di bromonapht hal ene		$\text{C}_{10}\text{H}_6\text{Br}_2$	83-53-4	285.963		83	310			i H ₂ O; s Et OH, et h; sl HOAc
2964	2,6-Di bromo-4-ni t roani l i ne		$\text{C}_8\text{H}_6\text{Br}_2\text{N}_2\text{O}_2$	827-94-1	295.916	ye nd (al, HOAc)	207				sl H ₂ O; s HOAc
2965	2,6-Di bromo-4-ni t rophenol		$\text{C}_8\text{H}_5\text{Br}_2\text{NO}_3$	99-28-5	296.901	pa ye pr or li f (al)	145 dec				i H ₂ O; vs Et OH, et h; sl ace, bz, HOAc
2966	1,9-Di bromononane		$\text{C}_9\text{H}_{18}\text{Br}_2$	4549-33-1	286.047	li q	-22.5	285; 15 ⁴	1.4229 ²⁰		
2967	1,4-Di bromooct afluorobut ane		$\text{C}_8\text{Br}_2\text{F}_8$	335-48-8	359.838			97			
2968	1,8-Di bromooct ane	Oct amet hyl ene di bromi de	$\text{C}_8\text{H}_{16}\text{Br}_2$	4549-32-0	272.021		15.5	271	1.4594 ²⁵	1.4971 ²⁵	i H ₂ O; s et h, ct c, chl
2969	1,2-Di bromopent ane		$\text{C}_5\text{H}_{10}\text{Br}_2$	3234-49-9	229.941			184	1.668 ¹⁸		
2970	1,4-Di bromopent ane		$\text{C}_5\text{H}_{10}\text{Br}_2$	626-87-9	229.941		-34.4	146 ¹⁵⁰ , 99 ¹⁴	1.6222 ²⁰	1.5086 ²⁰	
2971	1,5-Di bromopent ane		$\text{C}_5\text{H}_{10}\text{Br}_2$	111-24-0	229.941	li q	-39.5	222.3	1.692 ⁸	1.5102 ²⁵	i H ₂ O; s bz, chl; sl ct c
2972	2,4-Di bromopent ane		$\text{C}_5\text{H}_{10}\text{Br}_2$	19398-53-9	229.941			75 ²¹ , 60 ¹²	1.6659 ²⁰	1.4987 ²⁰	
2973	2,4-Di bromophenol		$\text{C}_6\text{H}_4\text{Br}_2\text{O}$	615-58-7	251.903	nd (pet h)	38	238.5	2.070 ⁹		sl H ₂ O, ct c; vs Et OH, et h, bz



1,3-Di bromo-5,5-di met hyl-2,4-i mi dazoli di nedi one



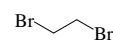
1,3-Di bromo-2,2-di met hyl propane



1,12-Di bromododecane



1,1-Di bromoet hane



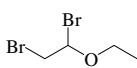
1,2-Di bromoet hane



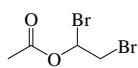
cis 1,2-Di bromoet hene



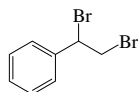
trans 1,2-Di bromoet hene



1,2-Di bromo-1-et hoxyet hane



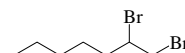
1,2-Di bromoet hylcet ate



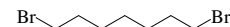
(1,2-Di bromoet hyl) benzene



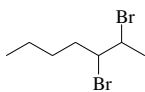
Di bromof luoromet hane



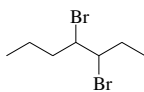
1,2-Di bromohept ane



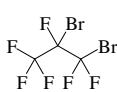
1,7-Di bromohept ane



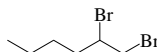
2,3-Di bromohept ane



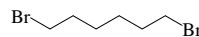
3,4-Di bromohept ane



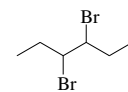
1,2-Di bromo-1,1,2,2,3,3-hexaf luoropropane



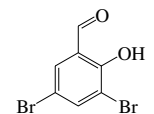
1,2-Di bromohexane



1,6-Di bromohexane

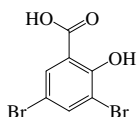


3,4-Di bromohexane

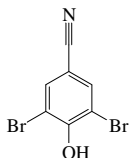


3,5-Di bromo-2-hydroxybenzaldehyde

3-159



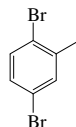
3,5-Di bromo-2-hydroxybenzoi aci d



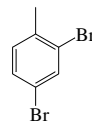
3,5-Di bromo-4-hydroxybenzoni t ri le



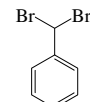
Di bromomet hane



1,4-Di bromo-2-met hyl benzene



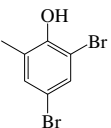
2,4-Di bromo-1-met hyl benzene



(Di bromoet hyl) benzene



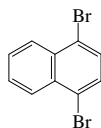
2,3-Di bromo-2-met hyl but ane



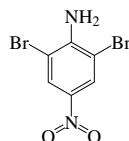
2,4-Di bromo-6-met hyl phen



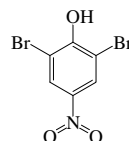
1,2-Di bromo-2-met hyl propane



1,4-Di bromonapht hal er



2,6-Di bromo-4-ni t roani li ne



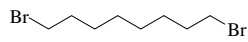
2,6-Di bromo-4-ni t rophenol



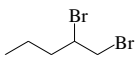
1,9-Di bromononane



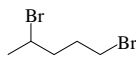
1,4-Di bromoet af luorobut ane



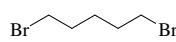
1,8-Di bromooct ane



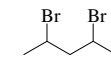
1,2-Di bromopent ane



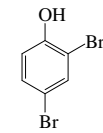
1,4-Di bromopent ane



1,5-Di bromopent ane

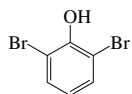


2,4-Di bromopent ane

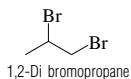


2,4-Di bromophenol

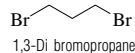
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
2974	2,6-Di bromophenol		C ₆ H ₃ Br ₂ O	608-33-3	251.903	nd (w)	56.5	255; 162 ²¹			s H ₂ O; vs Et OH, et h
2975	1,2-Di bromopropane	Propylene di bromi de	C ₃ H ₄ Br ₂	78-75-1	201.888	li q	-55.49	141.9	1.9324 ⁹	1.5201 ²⁰	s Et OH, et h, chl; sl ct c
2976	1,3-Di bromopropane		C ₃ H ₄ Br ₂	109-64-8	201.888	li q	-34.5	167.3	1.9704 ⁹	1.5204 ²⁵	i H ₂ O; s Et OH, et h, chl; sl ct c
2977	2,2-Di bromopropane		C ₃ H ₄ Br ₂	594-16-1	201.888			113	1.880 ²⁰		vs et h, Et OH, chl
2978	2,3-Di bromopropanoi c aci d		C ₃ H ₃ Br ₂ O ₂	600-05-5	231.871		66.5	160 ²⁰ , 138 ¹²			vs bz, et h, Et OH
2979	2,3-Di bromo-1-propanol		C ₃ H ₄ Br ₂ O	96-13-9	217.887			219	2.120 ²⁰		
2980	1,3-Di bromo-2-propanol		C ₃ H ₄ Br ₂ O	96-21-9	217.887	ye li q		dec 219; 105 ¹⁶	2.1364 ²⁰	1.5495 ²⁵	vs ace, et h, Et OH
2981	2,3-Di bromo-1-propanol, phosphat e (3:1)	Tri s(2,3-di bromopropyl) phosphat e	C ₆ H ₈ Br ₆ O ₄ P	126-72-7	697.610						s chl
2982	1,3-Di bromo-2-propanone	1,3-Di bromoacet one	C ₃ H ₃ Br ₂ O	816-39-7	215.871	nd	26	97 ²²	2.1670 ¹⁸		vs et h, C ₆ H ₆
2983	1,1-Di bromo-1-propene		C ₃ H ₂ Br ₂	13195-80-7	199.872			125	1.9767 ²⁰	1.5260 ²⁰	sl H ₂ O; s bz, ct c, chl
2984	1,2-Di bromo-1-propene		C ₃ H ₂ Br ₂	26391-16-2	199.872			131.5	2.0076 ²⁰		
2985	2,3-Di bromo-1-propene		C ₃ H ₂ Br ₂	513-31-5	199.872			141; 37.7 ¹¹	2.0345 ²⁵	1.5416 ²⁵	i H ₂ O; s et h, ace, chl
2986	3,5-Di bromopyri di ne		C ₄ H ₂ Br ₂ N	625-92-3	236.893	nd (al)	112	222			sl H ₂ O; s Et OH, et h
2987	5,7-Di bromo-8-qui nol i nol	Broxyqui nol i ne	C ₈ H ₆ Br ₂ NO	521-74-4	302.950	nd (al)	196	sub			i H ₂ O; s Et OH, ace, bz, chl, HOAc; sl et h
2988	2,6-Di bromoqui none-4-chl ori mi de	2,6-Di bromo-4-(chl ori mi no)-2,6-cycl hexadi en-1-one	C ₆ H ₂ Br ₂ ClNO	537-45-1	299.347	ye pr (al or HOAc)	83				vs Et OH
2989	1,14-Di bromot et radecane	Tet radecamet hylene di bromi de	C ₁₄ H ₂₈ Br ₂	37688-96-3	356.180	lf (al-et h) cry (al)	50.4	190 ⁶			vs et h, Et OH, chl
2990	1,2-Di bromot et rafluorot hane	Ref ri gerant 114B2	C ₂ Br ₂ F ₂	124-73-2	259.823	li q	-110.32	47.35	2.14 ⁹	1.361 ²⁵	i H ₂ O
2991	2,3-Di bromot hi ophene		C ₈ H ₆ Br ₂ S	3140-93-0	241.932	li q	-17.5	218.5; 8 ⁹		1.6304 ²²	
2992	2,5-Di bromot hi ophene		C ₈ H ₆ Br ₂ S	3141-27-3	241.932	li q	-6	210.3	2.14 ²	1.6288 ²⁰	i H ₂ O; vs Et OH, et h; s ct c
2993	3,4-Di bromot hi ophene		C ₈ H ₆ Br ₂ S	3141-26-2	241.932		4.5	221.5			
2994	1,2-Di bromo-1,1,2-t ri fluoroet hane	Hal on 2302	C ₂ HBr ₂ F ₃	354-04-1	241.832			76	2.274 ²⁷	1.4191 ²⁴	
2995	2,6-Di bromo-3,4,5-t ri hydroxybenzoi daci d	Di bromogal li c aci d	C ₇ H ₂ Br ₂ O ₅	602-92-6	327.912	nd, pr or lf (w+1)	150				vs H ₂ O, et h, Et OH
2996	3,5-Di bromoL-t yrosi ne		C ₉ H ₇ Br ₂ NO ₃	300-38-9	338.980	nd or pl	245				sl H ₂ O, Et OH; i et h; s alk, aci d
2997	Di bucai ne	Ci nchocai ne	C ₂₀ H ₂₃ N ₃ O ₂	85-79-0	343.463	hyg cry	64				
2998	Di bucai ne hydrochl ori de		C ₂₀ H ₂₃ ClN ₃ O ₂	61-12-1	379.924			94 dec			s chl
2999	1,4-Di but oxybenzene		C ₁₂ H ₂₂ O ₂	104-36-9	222.324			45.5	158 ¹⁵		s ct c
3000	1,2-Di but oxyet hane	Et hylene glycol di but yl et her	C ₁₀ H ₂₂ O ₂	112-48-1	174.281	li q	-69.1	203.3	0.831 ⁹	1.4112 ²⁵	
3001	Di but oxymet hane	But yl al	C ₈ H ₁₆ O ₂	2568-90-3	160.254	li q	-58.1	179.2	0.833 ⁹	1.4072 ¹⁷	
3002	Di but yl adi pat e		C ₁₄ H ₂₆ O ₄	105-99-7	258.354		-32.4	165 ¹⁰	0.9613 ²⁰	1.4369 ²⁰	i H ₂ O; msc Et OH, et h
3003	Di but ylami ne	N-But yl but anami ne	C ₈ H ₁₉ N	111-92-2	129.244	li q	-62	159.6	0.767 ⁹	1.4177 ²⁰	s H ₂ O, ace, bz; vs Et OH, et h
3004	Di sec-but ylami ne	N-sec-But yl-2-but anami ne	C ₈ H ₁₉ N	626-23-3	129.244			134	0.7534 ²⁰	1.4162 ²⁰	vs H ₂ O; s Et OH
3005	2-Di but ylami noet hanol		C ₁₀ H ₂₁ NO	102-81-8	173.296			114 ¹⁸			
3006	N,N-Di but ylami li i ne		C ₁₄ H ₂₉ N	613-29-6	205.340	li q	-32.2	274.8	0.903 ⁷	1.5186 ²⁰	i H ₂ O; msc Et OH, et h; vs ace, bz; s ct c
3007	1,4-Di t er#but yl benzene		C ₁₄ H ₂₂	1012-72-2	190.325	nd (MeOH)	79.5	238; 109 ¹⁵	0.9850 ²⁰		i H ₂ O; s Et OH, et h
3008	2,5-Di t er#but yl-1,4-benzenedi ol		C ₁₄ H ₁₈ O ₂	88-58-4	222.324	cry (aq HOAc)	213.5				
3009	Di but yl bi s(dodecyl t hi o)st annane	Di but yl t i n bi s(dodecyl sul fide)	C ₆₈ H ₁₃₈ S ₂ Sn C	1185-81-5	635.722	col li q		122	1.05 ²⁰		s t ol, hp
3010	Di but yl carbonat e		C ₈ H ₁₆ O ₃	542-52-9	174.237			207	0.9251 ²⁰	1.4117 ²⁰	i H ₂ O; s Et OH, et h
3011	Di t er#but yl carbonat e		C ₁₈ H ₃₆ O ₃	34619-03-9	174.237	cry (al)	40	158			vs Et OH
3012	2,5-Di t er#but yl-2,5-cycl hexadi en-1,4-di one		C ₁₄ H ₂₀ O ₂	2460-77-7	220.308	ye cry (al)	152.5				i H ₂ O; s Et OH, et h, bz, chl, HOAc



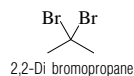
2,6-Di bromophenol



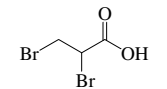
1,2-Di bromopropane



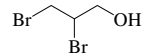
1,3-Di bromopropane



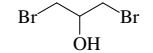
2,2-Di bromopropane



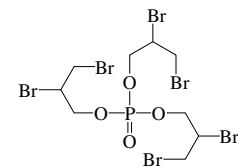
2,3-Di bromopropanoic acid



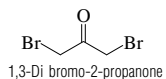
2,3-Di bromo-1-propanol



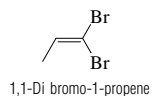
1,3-Di bromo-2-propanol



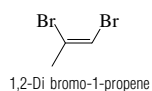
2,3-Di bromo-1-propanol phosphate (3:1)



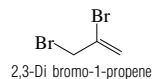
1,3-Di bromo-2-propanone



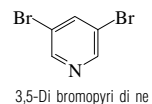
1,1-Di bromo-1-propene



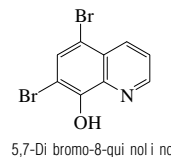
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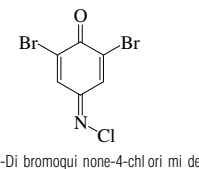
2,3-Di bromo-1-propene



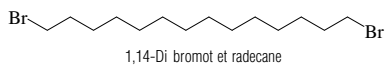
3,5-Di bromopyridine



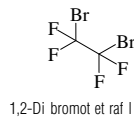
5,7-Di bromo-8-quinolinol



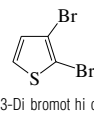
2,6-Di bromo-4-chloroquinone



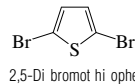
1,14-Di bromotetradecane



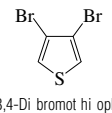
1,2-Di bromo-1,1,2,2-tetrafluoroethane



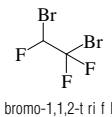
2,3-Di bromothiophene



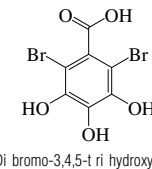
2,5-Di bromothiophene



3,4-Di bromothiophene

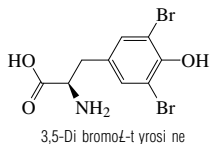


1,2-Di bromo-1,1,2,2-tetrafluoroethane

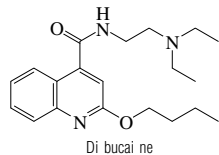


2,6-Di bromo-3,4,5-trihydroxybenzoic acid

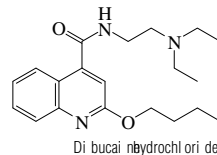
3-161



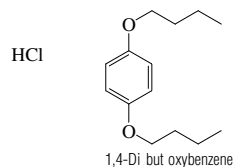
3,5-Di bromo-L-tyrosine



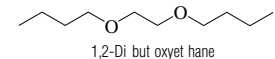
Diethylcucurbitine



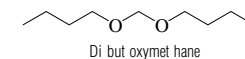
Diethylcucurbitine hydrochloride



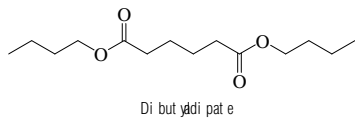
1,4-Di butoxybenzene



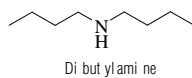
1,2-Di butoxyethane



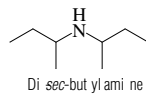
Diethylbutyl ether



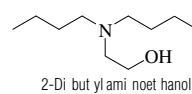
Diethylbutyl sebacate



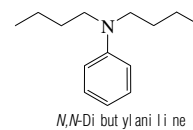
Diethylbutylamine



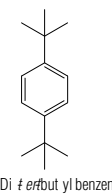
Diisobutylamine



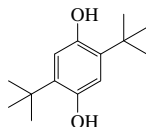
2-Diethylbutyl ethanolamine



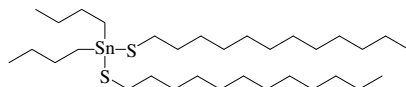
N,N-Diethylbutylbenzylamine



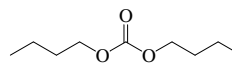
1,4-Di tert-butylbenzene



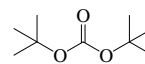
2,5-Di tert-butyl-1,4-benzenediol



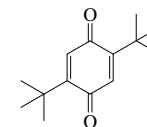
Diethylbutyl bis(dodecylthio)stannane



Diethylbutyl carbonate

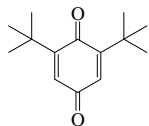
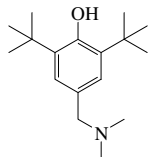
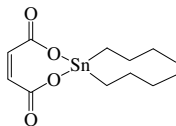
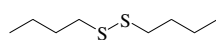


Di-tert-butyl carbonate

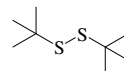
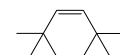
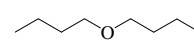


2,5-Di tert-butyl-2,5-cyclohexadiene-1,4-dione

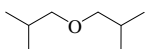
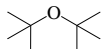
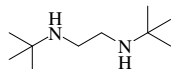
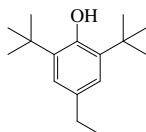
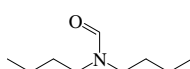
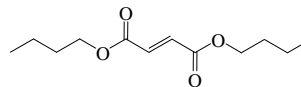
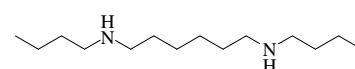
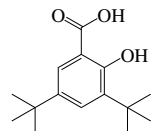
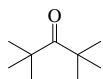
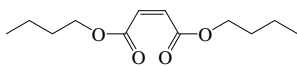
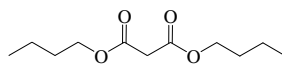
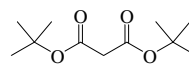
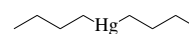
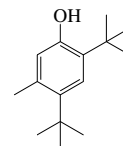
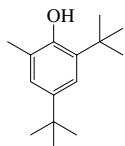
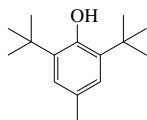
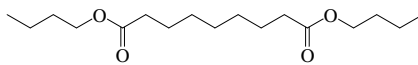
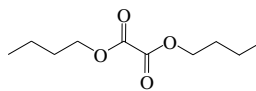
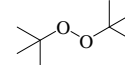
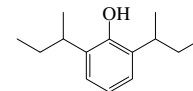
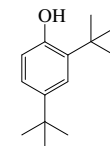
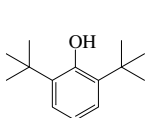
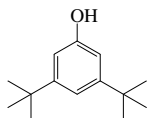
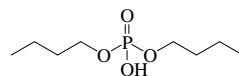
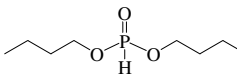
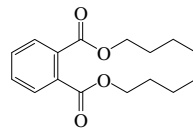
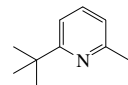
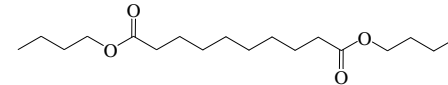
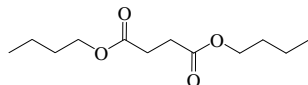
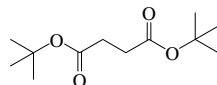
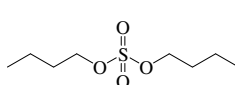
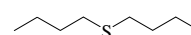
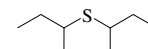
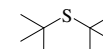
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3013	2,6-Di <i>tert</i> -butyl-2,5-cyclohexadiene-1,4-dione		C ₁₄ H ₂₀ O ₂	719-22-2	220.308		69	60 ⁰¹			
3014	2,6-Di <i>tert</i> -butyl-4-(diethylamino)phenol		C ₁₇ H ₂₅ NO	88-27-7	263.418	pl (Et OH)	94	17 ⁹			
3015	2,2-Di <i>tert</i> -butyl-1,3,2-dioxastannepine-4,7-dione		C ₁₂ H ₂₀ O ₄ Sn	78-04-6	346.995	ye solid	110				
3016	Di <i>tert</i> -butyl disulfide		C ₈ H ₁₆ S ₂	629-45-8	178.359	oil		226; 117 ⁹	0.938 ²⁰	1.4923 ²⁰	i H ₂ O; msc Et OH, et h
3017	Di <i>tert</i> -butyl disulfide		C ₈ H ₁₆ S ₂	110-06-5	178.359		-2.5	88 ²¹	0.9226 ²⁰	1.4899 ²⁰	
3018	<i>cis</i> -1,2-Di <i>tert</i> -butyl ethene	<i>cis</i> -2,2,5,5-Tetramethyl-3-hexene	C ₁₀ H ₂₀	692-47-7	140.266	liq		144	0.744 ⁹	1.4270 ²⁰	
3019	Di <i>tert</i> -butyl ether		C ₈ H ₁₈ O	142-96-1	130.228	liq	-95.2	140.28	0.7684 ⁹	1.3992 ²⁰	i H ₂ O; msc Et OH, et h; vs ace; sl ct c
3020	Di <i>sec</i> -butyl ether		C ₈ H ₁₈ O	6863-58-7	130.228	liq		121.1	0.756 ⁹		
3021	Di <i>tert</i> -butyl ether		C ₈ H ₁₈ O	6163-66-2	130.228	liq		107.23	0.7658 ⁹	1.3949 ²⁰	
3022	<i>N,N</i> -Di <i>tert</i> -butyl ethylenediamine	<i>N,N</i> -Di <i>tert</i> -butyl ethanediamine	C ₁₀ H ₂₄ N ₂	4062-60-6	172.311	cry	53.3	189	0.69		
3023	2,6-Di <i>tert</i> -butyl-4-ethylphenol		C ₁₆ H ₂₆ O	4130-42-1	234.376		44	272			i alk
3024	<i>N,N</i> -Di <i>tert</i> -butylformamide		C ₉ H ₁₉ NO	761-65-9	157.253						s ct c, CS ₂
3025	Di <i>tert</i> -butyl fumarate		C ₁₂ H ₂₀ O ₄	105-75-9	228.285	liq	-13.5	285; 150	0.9775 ²⁰	1.4469 ²⁰	i H ₂ O; s ace, chl
3026	<i>N,N</i> -Di <i>tert</i> -butyl-1,6-hexanediamine		C ₁₄ H ₃₀ N ₂	4835-11-4	228.417			138 ^{3,5}		1.4470 ²⁵	
3027	3,5-Di <i>tert</i> -butyl-2-hydroxybenzoic acid		C ₁₅ H ₂₂ O ₃	19715-19-6	250.334		163.3				s chl
3028	Di <i>tert</i> -butyl ketone		C ₈ H ₁₈ O	815-24-7	142.238	liq	-25.2	152	0.824 ⁹	1.4194 ²⁰	i H ₂ O; s Et OH, et h, ace, chl, HOAc
3029	Di <i>tert</i> -butyl malate		C ₁₂ H ₂₀ O ₄	105-76-0	228.285		<-80	280; 142 ¹⁰			
3030	Di <i>tert</i> -butyl malonate		C ₁₁ H ₂₀ O ₄	1190-39-2	216.275	liq	-83	251.5	0.9824 ⁹	1.4262 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, HOAc, ct c
3031	Di <i>tert</i> -butyl malonate		C ₁₁ H ₂₀ O ₄	541-16-2	216.275		-6	113 ³¹ , 66 ²	1.4184 ²⁰	1.4184 ²⁹	s ace, chl
3032	Di <i>tert</i> -butylmercury		C ₈ H ₁₈ Hg	629-35-6	314.82			223; 105 ¹⁰	1.7779 ²⁰	1.5057 ²⁰	
3033	2,4-Di <i>tert</i> -butyl-5-methylphenol	DBMC	C ₁₆ H ₂₄ O	497-39-2	220.351		62.1	282	0.912 ⁸⁰		i H ₂ O; s Et OH, et h, ace, bz, ct c
3034	2,4-Di <i>tert</i> -butyl-6-methylphenol		C ₁₅ H ₂₄ O	616-55-7	220.351		51	269	0.891 ⁸⁰		i alk
3035	2,6-Di <i>tert</i> -butyl-4-methylphenol		C ₁₅ H ₂₄ O	128-37-0	220.351		71	265	0.8937 ⁷⁵	1.4859 ⁷⁵	i H ₂ O; s Et OH, ace, bz, pet h; i alk
3036	Di <i>tert</i> -butyl nonanedioate		C ₁₇ H ₃₂ O ₄	2917-73-9	300.434			170 ²			sl chl
3037	Di <i>tert</i> -butyl oxalate		C ₁₀ H ₁₈ O ₄	2050-60-4	202.248	liq	-30.5	241; 96	0.9873 ²⁰	1.4234 ²⁰	i H ₂ O; s Et OH, et h
3038	Di <i>tert</i> -butyl peroxide	DTBP	C ₈ H ₁₈ O ₂	110-05-4	146.228	liq	-40	111	0.704 ⁹	1.3890 ²⁰	i H ₂ O; msc ace; s ct c, li g
3039	2,6-Di <i>sec</i> -butylphenol		C ₁₄ H ₂₂ O	5510-99-6	206.324	liq	-42	257.5		1.508 ⁹	
3040	2,4-Di <i>tert</i> -butylphenol		C ₁₄ H ₂₂ O	96-76-4	206.324		56.5	263.5		1.5080 ²⁰	sl ct c; i alk
3041	2,6-Di <i>tert</i> -butylphenol		C ₁₄ H ₂₂ O	128-39-2	206.324	pr (al)	39	16 ^{9,0} , 133 ²⁰		1.5001 ²⁰	sl Et OH; s ct c; i alk
3042	3,5-Di <i>tert</i> -butylphenol		C ₁₄ H ₂₂ O	1138-52-9	206.324		88				
3043	Di <i>tert</i> -butyl phosphate		C ₈ H ₁₈ O ₃ P	107-66-4	210.208	oil		136 ^{9,5}	1.06 ²⁰		s ct c, BuOH
3044	Di <i>tert</i> -butyl phosphonate		C ₈ H ₁₈ O ₃ P	1809-19-4	194.209	oil		230; 13 ⁹	0.985 ²⁵	1.4220 ²⁰	
3045	Di <i>tert</i> -butyl phthalate		C ₁₆ H ₂₂ O ₄	84-74-2	278.344	liq	-35	340	1.046 ⁹	1.4911 ²⁰	i H ₂ O; msc Et OH, et h, bz; s ct c
3046	2,6-Di <i>tert</i> -butylpyridine		C ₁₃ H ₂₁ N	585-48-8	191.313			120 ²⁰			
3047	Di <i>tert</i> -butyl sebacate		C ₁₈ H ₃₄ O ₄	109-43-3	314.461	liq	-10	344.5	0.940 ⁵	1.4433 ¹⁵	i H ₂ O; s et h, ct c
3048	Di <i>tert</i> -butyl succinate		C ₁₂ H ₂₂ O ₄	141-03-7	230.301	liq	-29.2	274.5	0.975 ²	1.4299 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
3049	Di <i>tert</i> -butyl succinate		C ₁₂ H ₂₂ O ₄	926-26-1	230.301		36.5	109 ⁹			
3050	Di <i>tert</i> -butyl sulfatate	Butyl sulfatate	C ₈ H ₁₈ O ₆ S	625-22-9	210.292	liq		115			
3051	Di <i>tert</i> -butyl sulfide		C ₈ H ₁₈ S	544-40-1	146.294	liq	-79.7	185	0.838 ⁹	1.4530 ²⁰	vs et h, Et OH, chl
3052	Di <i>sec</i> -butyl sulfide		C ₈ H ₁₈ S	626-26-6	146.294			165	0.8348 ²⁰	1.4506 ²⁰	i H ₂ O; vs Et OH, et h
3053	Di <i>tert</i> -butyl sulfide		C ₈ H ₁₈ S	107-47-1	146.294	liq	-9.0	149.1	0.815 ⁹	1.4506 ²⁰	

2,6-Di-*tert*-butyl-2,5-cycl ohexadi ene-1,4-di one2,6-Di-*tert*-butyl-4-(di met hyl ami no met hyl)phenolDi-*n*-butyl-1,3,2-di oxast an nepi n-4,7-di one

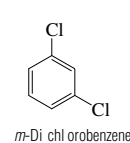
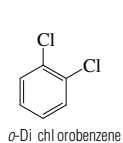
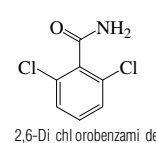
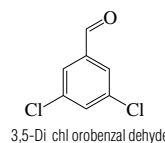
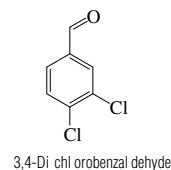
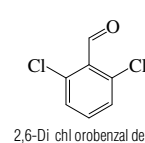
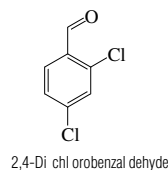
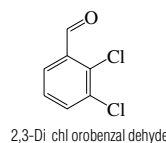
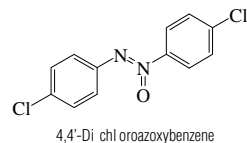
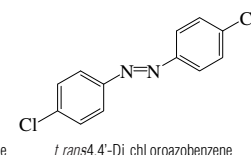
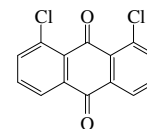
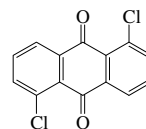
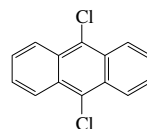
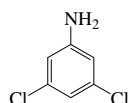
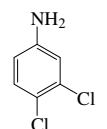
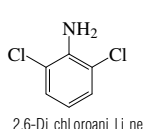
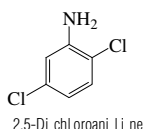
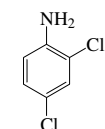
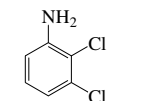
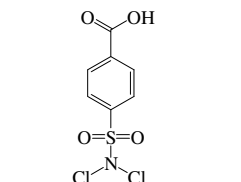
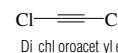
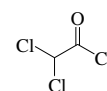
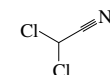
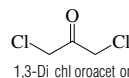
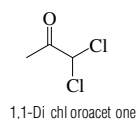
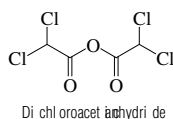
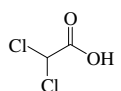
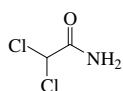
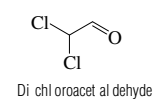
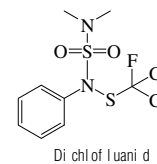
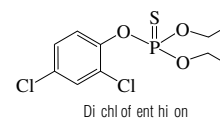
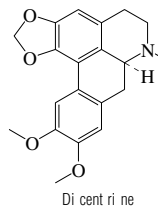
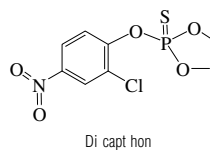
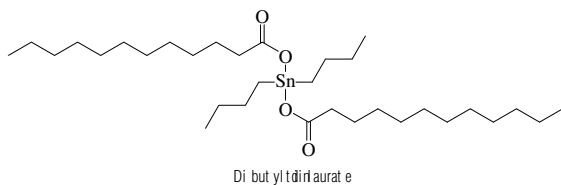
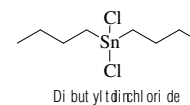
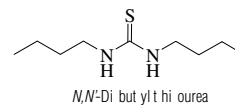
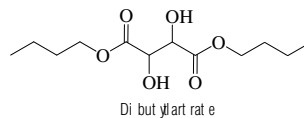
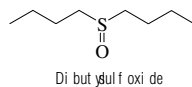
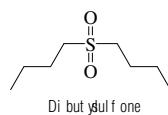
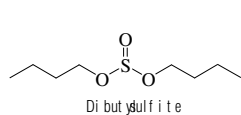
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Di-*tert*-butyl di sul f i de*cis*-1,2-Di-*tert*-butyl et hene

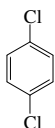
Di but yd et her

Di *sec*-but ylet herDi-*tert*-but ylet her*N,N'*-Di-*tert*-butyl et hyl enedi ami ne2,6-Di-*tert*-butyl-4-et hyl phenol*N,N'*-Di-*tert*-butyl f ormami deDi-*tert*-butyl umarat e*N,N'*-Di-*tert*-butyl-1,6-hexanedi ami ne3,5-Di-*tert*-butyl-2-hydroxybenzoi aci dDi-*tert*-butyl ket oneDi-*tert*-butyl umarat eDi-*tert*-butyl mal onat eDi-*tert*-butyl succi nat eDi-*tert*-butyl mercur y2,4-Di-*tert*-butyl-5-met hyl phenol2,4-Di-*tert*-butyl-6-met hyl phenol2,6-Di-*tert*-butyl-4-met hyl phenolDi-*tert*-butyl tereft al at eDi-*tert*-butyl ft al at eDi-*tert*-butyl yperoxi de2,6-Di-*sec*-butyl phenol2,4-Di-*tert*-butyl phenol2,6-Di-*tert*-butyl phenol3,5-Di-*tert*-butyl phenolDi-*tert*-butyl fosphat eDi-*tert*-butyl fosphonat eDi-*tert*-butyl ft hal at e2,6-Di-*tert*-butyl pylri di neDi-*tert*-butyl tereft al at eDi-*tert*-butyl succi nat eDi-*tert*-butyl succi nat eDi-*tert*-butyl sul f at eDi-*tert*-butyl sulf i deDi-*sec*-butyl sulf i deDi-*tert*-butyl sulf i de

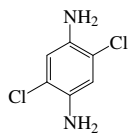
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3054	Di but yl sul fit e	But yl sul fit e	$\text{C}_8\text{H}_{18}\text{OS}$	626-85-7	194.292			230	0.9957 ²⁰	1.4310 ²⁰	s Et OH, et h
3055	Di but yl sul f one		$\text{C}_8\text{H}_{16}\text{O}_2\text{S}$	598-04-9	178.293		45	291	0.9885 ⁴⁷		i H ₂ O; s Et OH, et h
3056	Di but yl sul f oxi de		$\text{C}_8\text{H}_{16}\text{O}_3\text{S}$	2168-93-6	162.293	nd (di l al)	32.6	dec	0.8317	1.4669 ²⁰	i H ₂ O; s Et OH, et h
3057	Di but yl t art rat e		$\text{C}_{12}\text{H}_{20}\text{O}_6$	87-92-3	262.299	pr	22	320	1.0909 ²⁰	1.4451 ²⁰	vs H ₂ O, ace, Et OH
3058	<i>N,N'</i> -Di but yl t hi ourea		$\text{C}_8\text{H}_{16}\text{N}_2\text{S}$	109-46-6	188.333	nd (al)	78				
3059	Di but yl t i n di chl ori de	Di but yl di chl orost annane	$\text{C}_8\text{H}_{18}\text{Cl}_2\text{SiC}$	683-18-1	303.845	sol i d	43	135			s hx, et h, t hf
3060	Di but yl t i n di laurat e		$\text{C}_{32}\text{H}_{64}\text{O}_4\text{Sn}$	77-58-7	631.558	ye li q or cry	23				i H_2O , MeOH; s et h, bz, ct c
3061	Di capt hon		$\text{C}_{11}\text{H}_9\text{Cl}_3\text{N}_3\text{PS}$	2463-84-5	297.653	cry (MeOH)	53				i H ₂ O; s ace, t ol, xyl, AcOEt
3062	Di cent ri ne		$\text{C}_{20}\text{H}_{21}\text{NO}_4$	517-66-8	339.386						s chl
3063	Di chl of ent hi on		$\text{C}_{10}\text{H}_9\text{Cl}_3\text{O}_3\text{PS}$	97-17-6	315.153						s ct c, C S_2
3064	Di chl ofluani d		$\text{C}_8\text{H}_9\text{Cl}_2\text{FN}_2\text{O}_2\text{S}_2$	1085-98-9	333.229	wh pow	105.3				i H ₂ O; s ace, MeOH, xyl
3065	Di chl oracet al dehyde		$\text{C}_2\text{H}_3\text{Cl}_2\text{O}$	79-02-7	112.942			90.5	1.436 ²⁵		sl Et OH
3066	2,2-Di chl oracet ami de		$\text{C}_2\text{H}_3\text{Cl}_2\text{NO}$	683-72-7	127.957		99.4	234			s H ₂ O, Et OH, et h; sl ace
3067	Di chl oracet i c aci d		$\text{C}_2\text{H}_2\text{Cl}_2\text{O}_2$	79-43-6	128.942		13.5	194; 102 ²⁰	1.5634 ²⁰	1.4658 ²⁰	msc H ₂ O, Et OH, et h; s ace; sl ct c
3068	Di chl oracet i c anhydry de		$\text{C}_2\text{H}_2\text{Cl}_2\text{O}_3$	4124-30-5	239.869		18.0	dec 215; 100 ¹⁰	1.574 ²⁴		
3069	1,1-Di chl oracet one		$\text{C}_2\text{H}_2\text{Cl}_2\text{O}$	513-88-2	126.969			120	1.304 ¹⁸		sl H ₂ O; s Et OH; msc et h
3070	1,3-Di chl oracet one		$\text{C}_2\text{H}_2\text{Cl}_2\text{O}$	534-07-6	126.969	pr or nd	45	173.4	1.3826 ⁴⁶	1.4716 ⁴⁰	s H ₂ O, Et OH, et h
3071	Di chl oracet oni t ri le		$\text{C}_2\text{HCl}_3\text{N}$	3018-12-0	109.942			112.5	1.369 ²⁰	1.4391 ²⁵	s MeOH
3072	Di chl oracet yl chl ori de		$\text{C}_2\text{HCl}_3\text{O}$	79-36-7	147.387			108	1.5315 ¹⁶	1.4591 ²⁰	dec H ₂ O, Et OH; msc et h
3073	Di chl oracet ylene		C_2Cl_2	7572-29-4	94.927	li q	-66	33	1.26 ⁹	1.42790 ²⁰	s Et OH, et h, ace
3074	4-[(Di chl oroami no)sul f onyl]benzoi dHal azone aci d		$\text{C}_7\text{H}_5\text{Cl}_2\text{NO}_3\text{S}$	80-13-7	270.091	pr (HOAc)	195 dec				sl H ₂ O, chl; vs HOAc; i pet h
3075	2,3-Di chl oroani li ne		$\text{C}_6\text{HCl}_2\text{N}$	608-27-5	162.017	nd (li g)	24	252			s Et OH, ace; vs et h; sl bz, ct c, li g
3076	2,4-Di chl oroani li ne		$\text{C}_6\text{HCl}_2\text{N}$	554-00-7	162.017	pr (ace) nd (di l al) (li g)	63.5	245	1.567 ²⁰		sl H ₂ O, chl; s Et OH, et h
3077	2,5-Di chl oroani li ne		$\text{C}_6\text{HCl}_2\text{N}$	95-82-9	162.017	nd (li g)	50	251			sl H ₂ O; s Et OH, et h, bz, chl, C S_2
3078	2,6-Di chl oroani li ne		$\text{C}_6\text{HCl}_2\text{N}$	608-31-1	162.017		39				sl H ₂ O; s Et OH, et h
3079	3,4-Di chl oroani li ne		$\text{C}_6\text{HCl}_2\text{N}$	95-76-1	162.017	nd (li g)	72	272			s Et OH, et h; sl bz, chl
3080	3,5-Di chl oroani li ne		$\text{C}_6\text{HCl}_2\text{N}$	626-43-7	162.017	nd (li g, di l al)	52	261			H_2O ; Et OH, et h, ct c, li g
3081	9,10-Di chl orant hracene		$\text{C}_{10}\text{H}_8\text{Cl}_2$	605-48-1	247.120	ye nd (MeCOEt or CCl ₄)	213.5				sl Et OH, et h, chl; s bz
3082	1,5-Di chl oro-9,10-ant hracenedi one		$\text{C}_{14}\text{H}_8\text{Cl}_2\text{O}_2$	82-46-2	277.103	ye nd (t o)	252				i H ₂ O; sl Et OH, ace; s bz, HOAc
3083	1,8-Di chl oro-9,10-ant hracenedi one		$\text{C}_{14}\text{H}_8\text{Cl}_2\text{O}_2$	82-43-9	277.103	ye nd (HOAc)	202.5				i H ₂ O; sl Et OH; s bz, t ol, Ph N_2O
3084	<i>t rans</i> -4,4'-Di chl oraozobenzene		$\text{C}_8\text{H}_6\text{Cl}_2\text{N}_2$	1602-00-2	251.111	ye nd (ace)	189				
3085	4,4'-Di chl oraoxybenzene		$\text{C}_8\text{H}_6\text{Cl}_2\text{N}_2\text{O}$	614-26-6	267.110	ye nd (Et OH)	158				
3086	2,3-Di chl orobenzal dehyde		$\text{C}_8\text{H}_6\text{Cl}_2\text{O}$	6334-18-5	175.012	cry (di l al)	66				vs et h, Et OH
3087	2,4-Di chl orobenzal dehyde		$\text{C}_8\text{H}_6\text{Cl}_2\text{O}$	874-42-0	175.012	pr	73.3	105 ¹⁵			i H ₂ O; s Et OH, et h, bz, chl, HOAc
3088	2,6-Di chl orobenzal dehyde		$\text{C}_8\text{H}_6\text{Cl}_2\text{O}$	83-38-5	175.012	nd (li g)	71.8				vs et h, Et OH, li g
3089	3,4-Di chl orobenzal dehyde		$\text{C}_8\text{H}_6\text{Cl}_2\text{O}$	6287-38-3	175.012		44	247.5			i H ₂ O; s Et OH, et h; sl ct c
3090	3,5-Di chl orobenzal dehyde		$\text{C}_8\text{H}_6\text{Cl}_2\text{O}$	10203-08-4	175.012	nd or lf (di l HOAc)	65	240			vs ace, bz, et h, Et OH
3091	2,6-Di chl orobenzami de		$\text{C}_8\text{H}_7\text{Cl}_2\text{NO}$	2008-58-4	190.027	cry	198				
3092	<i>o</i> -Di chl orobenzene	1,2-Di chl orobenzene	$\text{C}_6\text{H}_4\text{Cl}_2$	95-50-1	147.002	li q	-17.0	180	1.305 ⁹	1.5515 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, ct c
3093	<i>m</i> -Di chl orobenzene	1,3-Di chl orobenzene	$\text{C}_6\text{H}_4\text{Cl}_2$	541-73-1	147.002	li q	-24.8	173	1.288 ⁴	1.5459 ²⁰	i H ₂ O; s Et OH, et h, bz; msc ace



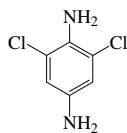
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3094	p-Di chl orobenzene	1,4-Di chl orobenzene	$\text{C}_6\text{H}_4\text{Cl}_2$	106-46-7	147.002	mcl pr, lf (ace)	53.09	174	1.2476	1.5285 ²⁰	i H ₂ O; msc Et OH, ace, bz; s et h, ct c
3095	2,5-Di chl oro-1,4-benzenedi ami ne		$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2$	20103-09-7	177.031	pr (w)	170				
3096	2,6-Di chl oro-1,4-benzenedi ami ne		$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2$	609-20-1	177.031	nd, pr (di l al)	125				s Et OH, et h, ace, bz
3097	3,5-Di chl oro-1,2-benzenedi ol		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	13673-92-2	179.001	pr	83.5				sl H ₂ O; s Et OH; vs ace
3098	4,5-Di chl oro-1,2-benzenedi ol		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	3428-24-8	179.001	pr(chl-CS ₂) nd(bz-pet h)	116.5				s H ₂ O; vs Et OH, bz
3099	4,6-Di chl oro-1,3-benzenedi ol		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	137-19-9	179.001		113	254			vs H ₂ O, Et OH, et h, ace; sl i g
3100	2,5-Di chl oro-1,4-benzenedi ol		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	824-69-1	179.001	nd or pr w, ace, bz)	172.5		1.8150 ²⁴		s H ₂ O; vs Et OH, et h, ace
3101	4,5-Di chl oro-1,3-benzenedi sul f onami de	Di chl orphenami de	$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2\text{O}_4\text{S}_2$	120-97-8	305.159		228.7				
3102	2,4-Di chl orobenzenemet hanami ne		$\text{C}_6\text{H}_4\text{Cl}_2\text{N}$	95-00-1	176.044			125 ¹³		1.5762 ²⁵	s chl
3103	2,4-Di chl orobenzenemet hanol	2,4-Di chl orobenzyl al cohoh	$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	1777-82-8	177.028		59.5	150 ²⁵			s chl
3104	M,M-Di chl orobenzenesul f onami de		$\text{C}_6\text{H}_3\text{Cl}_2\text{NO}_2\text{S}$	473-29-0	226.081	ye mcl or pl	76				s Et OH; sl ct c
3105	2,5-Di chl orobenzenet hi ol		$\text{C}_6\text{H}_3\text{Cl}_2\text{S}$	5858-18-4	179.067			115 ⁵⁰			
3106	2,2'-Di chl orop-benzi di ne	[1,1'-Bi phenyl]-4,4'-di ami ne, 2,2'- di chl oro-	$\text{C}_{12}\text{H}_{10}\text{Cl}_2\text{N}_2$	84-68-4	253.126	nd (w), pr (al)	165				vs et h, Et OH
3107	3,3'-Di chl orop-benzi di ne	[1,1'-Bi phenyl]-4,4'-di ami ne, 3,3'- di chl oro-	$\text{C}_{12}\text{H}_{10}\text{Cl}_2\text{N}_2$	91-94-1	253.126	nd	132.5				i H ₂ O; s Et OH, bz, HOAc
3108	3,3'-Di chl orop-benzi di ne di hydrochl ori de		$\text{C}_{12}\text{H}_{12}\text{Cl}_4\text{N}_2$	612-83-9	326.048						i H ₂ O; vs Et OH
3109	2,4-Di chl orobenzoi c aci d		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	50-84-0	191.012	nd (w or bz)	164.2	sub			s H ₂ O, Et OH, et h, bz, chl; sl ace
3110	2,5-Di chl orobenzoi c aci d		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	50-79-3	191.012	nd (w)	154.4	301			sl H ₂ O, DMSO; s Et OH, et h
3111	2,6-Di chl orobenzoi c aci d		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	50-30-6	191.012	nd (al), pr (w)	144	sub			s H ₂ O, Et OH, et h, bz, chl
3112	3,4-Di chl orobenzoi c aci d		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	51-44-5	191.012	nd (w, al, bz)	208.5				s H ₂ O, et h; vs Et OH; sl DMSO
3113	3,5-Di chl orobenzoi c aci d		$\text{C}_6\text{H}_3\text{Cl}_2\text{O}_2$	51-36-5	191.012	nd (al, w)	188	sub			sl H ₂ O, i g, DMSO; s Et OH, et h
3114	2,6-Di chl orobenzoni t ri le	Di chl obeni l	$\text{C}_6\text{H}_3\text{Cl}_2\text{N}$	1194-65-6	172.012	cry (pet h)	144.5	270			
3115	4,4'-Di chl orobenzophenone	Bi s(4-chl orophenyl) ket one	$\text{C}_{13}\text{H}_8\text{Cl}_2\text{O}$	90-98-2	251.108	pl (al)	147.5	353	1.450 ⁹		i H ₂ O; s Et OH; vs et h, chl; sl ace
3116	3,4-Di chl orobenzot ri fluori de	1,2-Di chl oro-4-(t ri fluoromet hyl) benzene	$\text{C}_7\text{H}_3\text{Cl}_2\text{F}_3$	328-84-7	215.000	l i q		173.5; 6#	1.4729 ²⁵		
3117	2,3-Di chl orobenzoyl chl ori de		$\text{C}_7\text{H}_4\text{Cl}_2\text{O}$	2905-60-4	209.457	l i q		140			
3118	2,4-Di chl orobenzoyl chl ori de		$\text{C}_7\text{H}_4\text{Cl}_2\text{O}$	89-75-8	209.457		16.5	150 ³⁴ , 111 ^{7,5}		1.5895 ²⁰	s ct c
3119	2,5-Di chl orobenzoyl chl ori de		$\text{C}_7\text{H}_4\text{Cl}_2\text{O}$	2905-61-5	209.457	l i q		95.4			
3120	3,4-Di chl orobenzoyl chl ori de		$\text{C}_7\text{H}_4\text{Cl}_2\text{O}$	3024-72-4	209.457		25	242			sl ct c
3121	2,5-Di chl orobi phenyl		$\text{C}_6\text{H}_4\text{Cl}_2$	34883-39-1	223.098			182 ³⁰ , 171 ¹⁵			i H ₂ O
3122	2,6-Di chl orobi phenyl		$\text{C}_6\text{H}_4\text{Cl}_2$	33146-45-1	223.098	cry	35.5				i H ₂ O
3123	3,3'-Di chl orobi phenyl		$\text{C}_6\text{H}_4\text{Cl}_2$	2050-67-1	223.098	nd (di l al)	29	320			vs bz, et h, Et OH
3124	4,4'-Di chl orobi phenyl		$\text{C}_6\text{H}_4\text{Cl}_2$	2050-68-2	223.098	pr or nd (al, t o- pet h)	149.3	317	1.4420 ⁹		i H ₂ O; sl Et OH, chl; s bz
3125	1,1-Di chl oro-2,2-bi s(chl orophenyl) et hane		$\text{C}_{14}\text{H}_{10}\text{Cl}_4$	72-54-8	320.041		109.5	193 ¹			sl chl
3126	2,2-Di chl oro-1,1-bi s(4-chl orophenyl) et hane		$\text{C}_{14}\text{H}_8\text{Cl}_4$	72-55-9	318.026		89				
3127	2,3-Di chl oro-1,3-but adi ene		$\text{C}_4\text{H}_2\text{Cl}_2$	1653-19-6	122.981			98	1.1829 ²⁰	1.4890 ²⁰	vs chl
3128	1,1-Di chl orobut ane	But yl i dene chl ori de	$\text{C}_4\text{H}_6\text{Cl}_2$	541-33-3	127.013			113.8	1.0863 ²⁰	1.4355 ²⁰	i H ₂ O; s chl
3129	1,2-Di chl orobut ane		$\text{C}_4\text{H}_6\text{Cl}_2$	616-21-7	127.013			124.1	1.1116 ²⁵	1.4450 ²⁰	i H ₂ O; s et h, chl; sl ct c
3130	1,3-Di chl orobut ane		$\text{C}_4\text{H}_6\text{Cl}_2$	1190-22-3	127.013			134	1.1158 ²⁰	1.4445 ²⁰	i H ₂ O; s et h, chl; sl ct c



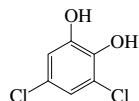
p-Di chl orobenzene



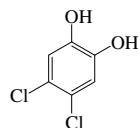
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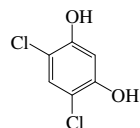
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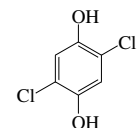
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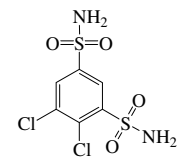
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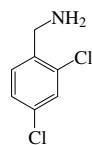
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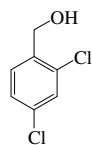
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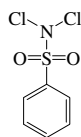
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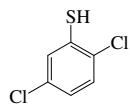
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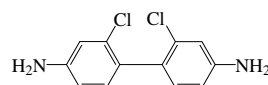
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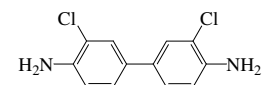
N,N-Di chl orobenzene sul f onami de



2,5-Di chl orobenze nethi ol

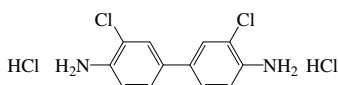


2,2'-Di chl or**o**p-benzi di ne

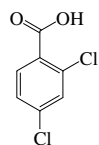


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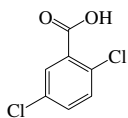
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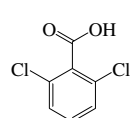
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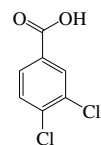
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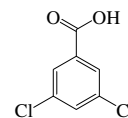
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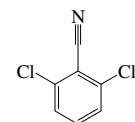
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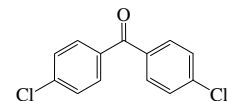
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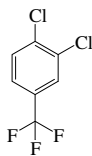
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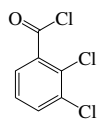
2,6-Di chl orobenzoni t r i le



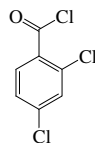
4,4'-Di chl orobenzophenone



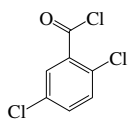
3,4-Di chl orobenzot r i f l uori de



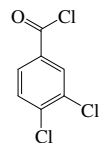
2,3-Di chl orobenzoychl ori de



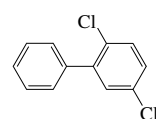
2,4-Di chl orobenzoychl ori de



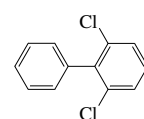
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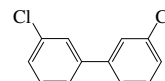
3,4-Di chl orobenzoychl ori de



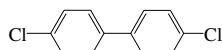
2,5-Di chl orobi phenyl



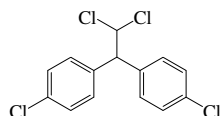
2,6-Di chl orobi phenyl



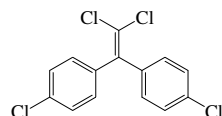
3,3'-Di chl orobi phenyl



4,4'-Di chl orobi phenyl



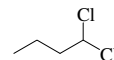
1,1-Di chl oro-2,2-bi s(4chl orophenyl) et hane



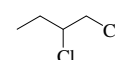
2,2-Di chl oro-1,1-bi s(4-chl orophenyl) et hane



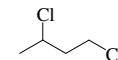
2,3-Di chl oro-1,3-but adi ene



1,1-Di chl orobut ane

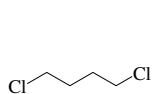


1,2-Di chl orobut ane



1,3-Di chl orobut ane

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3131	1,4-Di chl orobut ane		$\text{C}_4\text{H}_8\text{Cl}_2$	110-56-5	127.013	li q	-37.3	161	1.133 ⁷	1.4522 ²⁵	i H ₂ O; vs chl
3132	2,2-Di chl orobut ane		$\text{C}_4\text{H}_8\text{Cl}_2$	4279-22-5	127.013	li q	-74	104	1.104 ⁸	1.4295	i H ₂ O; s chl
3133	2,3-Di chl orobut ane, (±)		$\text{C}_4\text{H}_8\text{Cl}_2$	2211-67-8	127.013	li q	-80	119; 5 ⁸	1.105 ²⁵	1.4409 ²⁵	i H ₂ O
3134	1,4-Di chl oro-2,3-but anedi ol		$\text{C}_4\text{H}_8\text{Cl}_2\text{O}_2$	2419-73-0	159.012		126.5	150 ³⁰			vs Et OH
3135	3,4-Di chl oro-1-but ene		$\text{C}_4\text{H}_8\text{Cl}_2$	760-23-6	124.997	li q	-61	116	1.117 ⁹	1.4641 ²⁰	i H ₂ O; s Et OH, et h, ct c; vs chl, bz
3136	<i>ci s</i> 1,3-Di chl oro-2-but ene		$\text{C}_4\text{H}_8\text{Cl}_2$	10075-38-4	124.997			130; 34 ²⁰	1.1605 ²⁰	1.4735 ²⁰	vs ace, bz, et h, Et OH
3137	<i>t rans</i> 1,3-Di chl oro-2-but ene		$\text{C}_4\text{H}_8\text{Cl}_2$	7415-31-8	124.997			132; 53 ⁵⁰	1.160 ²⁰	1.4719 ²⁰	vs ace, bz, et h, Et OH
3138	<i>ci s</i> 1,4-Di chl oro-2-but ene		$\text{C}_4\text{H}_8\text{Cl}_2$	1476-11-5	124.997	li q	-48	152.5	1.18 ⁸	1.4887 ²⁵	vs ace, bz, et h, Et OH
3139	<i>t rans</i> 1,4-Di chl oro-2-but ene		$\text{C}_4\text{H}_8\text{Cl}_2$	110-57-6	124.997		1.0	155.4	1.183 ²⁵	1.4871 ²⁵	vs ace, bz, et h, Et OH
3140	1,4-Di chl oro-2-but yne		$\text{C}_4\text{H}_4\text{Cl}_2$	821-10-3	122.981			165.5	1.258 ²⁰	1.5058 ²⁰	s et h, ace; sl ct c; vs chl
3141	2,6-Di chl oro-4-(chl oroi mi no)-2,5-cycl ohexadi en-1-one	Gi bbs' reagent	$\text{C}_6\text{H}_8\text{Cl}_2\text{NO}$	101-38-2	210.445		66				
3142	1,2-Di chl oro-4-(chl oromet hyl) benzene		$\text{C}_7\text{H}_8\text{Cl}_2$	102-47-6	195.474		37.5	241			i H ₂ O; s Et OH, ct c
3143	2,4-Di chl oro-1-(chl oromet hyl) benzene		$\text{C}_7\text{H}_8\text{Cl}_2$	94-99-5	195.474			120 ¹³			
3144	Di chl oro(chl oromet hyl)met hyl si l ane		$\text{C}_2\text{H}_4\text{Cl}_2\text{Si}$	1558-33-4	163.506			121.5	1.285 ⁸	1.4500 ²⁰	
3145	Di chl oro(2-chl orovi nyl)arsi ne		$\text{C}_2\text{H}_4\text{AsCl}_2$	541-25-3	207.318	li q	0.1	190	1.88 ⁸		
3146	2,5-Di chl oro-2,5-cycl ohexadi ene-1,4-di one		$\text{C}_6\text{H}_8\text{Cl}_2\text{O}_2$	615-93-0	176.985	pa ye mcl pr (al)	162.3				i H ₂ O; sl Et OH; s et h, chl
3147	2,6-Di chl oro-2,5-cycl ohexadi ene-1,4-di one		$\text{C}_6\text{H}_8\text{Cl}_2\text{O}_2$	697-91-6	176.985	ye ort h (li g, bz)	121.8				sl ₂ Et OH; s chl
3148	1,1-Di chl orocycl ohexane		$\text{C}_6\text{H}_{10}\text{Cl}_2$	2108-92-1	153.049	li q	-47	171	1.155 ⁹	1.4803 ²⁰	
3149	<i>ci s</i> 1,2-Di chl orocycl ohexane		$\text{C}_6\text{H}_{10}\text{Cl}_2$	10498-35-8	153.049	li q	-1.5	206.9	1.202 ⁹	1.4967 ²⁰	vs bz
3150	1,10-Di chl orodecane		$\text{C}_{10}\text{H}_{20}\text{Cl}_2$	2162-98-3	211.172		15.6	167 ²⁸	0.9945 ²⁵	1.4586 ²⁵	
3151	2,7-Di chl orodi benz p -di ox i n		$\text{C}_7\text{H}_6\text{Cl}_2\text{O}_2$	33857-26-0	253.081	cry	201				
3152	1,2-Di chl oro-4-(di chl oromet hyl) benzene		$\text{C}_7\text{H}_8\text{Cl}_4$	56961-84-3	229.919			257	1.515 ²²		vs bz, et h, Et OH
3153	Di chl oro(di chl oromet hyl)met hyl si l ane		$\text{C}_2\text{H}_4\text{Cl}_2\text{Si}$	1558-31-2	197.951			149	1.411 ⁸	1.4700 ²⁰	
3154	2,3-Di chl oro-5,6-di cyanobenzoqui none		$\text{C}_8\text{Cl}_2\text{N}_2\text{O}_2$	84-58-2	227.004	ye-oran cry	214.5				vs bz, HOAc, di ox
3155	Di chl orodi et hyl si l ane		$\text{C}_2\text{H}_4\text{Cl}_2\text{Si}$	1719-53-5	157.114		-96.5	dec 129	1.050 ⁴	1.4309 ²⁰	
3156	1,1-Di chl oro-1,2-di fluoroet hane		$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$	25915-78-0	134.940	col li q		48.4			
3157	1,2-Di chl oro-1,1-di fluoroet hane		$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$	1649-08-7	134.940	li q	-101.2	46.2	1.416 ³	1.36193 ²⁰	sl H ₂ O
3158	1,2-Di chl oro-1,2-di fluoroet hane		$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$	431-06-1	134.940	li q	-101.2	59.6	1.416 ³	1.3619 ²⁰	
3159	1,1-Di chl oro-2,2-di fluoroet hene	1,1-Di chl oro-2,2-di fluoroet hyl ene	$\text{C}_2\text{Cl}_2\text{F}_2$	79-35-6	132.924	vol li q or gas	-116	19	1.55 ⁵	1.383 ²⁰	
3160	<i>ci s</i> 1,2-Di chl oro-1,2-di fluoroet hene	Fluorocarbon 1112	$\text{C}_2\text{Cl}_2\text{F}_2$	311-81-9	132.924	vol li q	-119.6	21.1	1.495		
3161	<i>t rans</i> 1,2-Di chl oro-1,2-di fluoroet hene		$\text{C}_2\text{Cl}_2\text{F}_2$	381-71-5	132.924	vol li q	-93.3	22	1.494		
3162	Di chl orodi fluoroet hane	Ref ri gerant 12	$\text{C}_2\text{F}_2\text{Cl}_2$	75-71-8	120.914	col gas	-158	-29.8			sl H ₂ O; s Et OH, et h, HOAc
3163	2,2-Di chl oro-1,1-di fluoro-1-met hoxyl et hane	Met hoxylflurane	$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2\text{O}$	76-38-0	164.966	col li q	-35	105	1.43	1.3861 ²⁰	
3164	2,2-Di chl orodi i sopropyl et her		$\text{C}_3\text{H}_6\text{Cl}_2\text{O}$	108-60-1	171.064			187	1.103 ²⁰	1.4505 ²⁰	i H ₂ O; msc Et OH, et h, ace; vs bz
3165	1,4-Di chl oro-2,5-di met hyl benzene		$\text{C}_6\text{H}_4\text{Cl}_2$	1124-05-6	175.056		71	222			s chl
3166	2,5-Di chl oro-2,5-di met hyl hexane		$\text{C}_6\text{H}_4\text{Cl}_2$	6223-78-5	183.119	lf, nd	67.5		0.954 ³		vs bz, et h, Et OH, chl
3167	1,3-Di chl oro-5,5-di met hyl dydant oi n		$\text{C}_5\text{H}_8\text{Cl}_2\text{N}_2\text{O}_2$	118-52-5	197.019	pr	132		1.5 ²⁰		sl H ₂ O; s chl, ct c, bz
3168	2,4-Di chl oro-3,5-di met hyl phenol	Di chl oroxyl enol	$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	133-53-9	191.055		83				vs et h



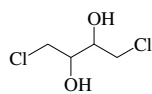
1,4-Di chl orobut ane



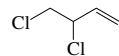
2,2-Di chl orobut ane



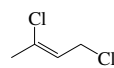
2,3-Di chl orobut ane*



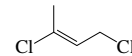
1,4-Di chl oro-2,3-but anedi ol



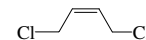
3,4-Di chl oro-1-but ene



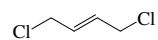
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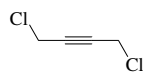
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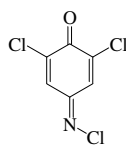
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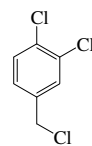
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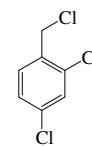
1,4-Di chl oro-2-but yne



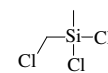
2,6-Di chl oro-4-(chl oroi mi no)-2,5-cycl ohexadi ene-1-one



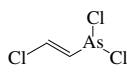
1,2-Di chl oro-4-(chl oromet hyl)benzene



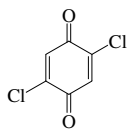
2,4-Di chl oro-1-(chl oromet hyl)benzene



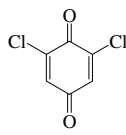
Di chl oro(chl oromet hyl)met hyl si lane



Di chl oro(2-chl orovinyl)arsi ne



2,5-Di chl oro-2,5-cycl ohexadi ene-1,4-di one



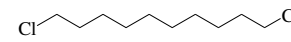
2,6-Di chl oro-2,5-cycl ohexadi ene-1,4-di one



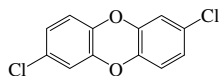
1,1-Di chl orocycl ohexane



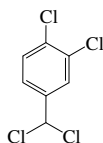
*ci s*1,2-Di chl orocycl ohexane



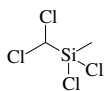
1,10-Di chl orodecane



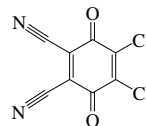
2,7-Di chl orodi benzo-di oxi n



1,2-Di chl oro-4-(di chl oromet hyl)benzene



Di chl oro(di chl oromet hyl)met hyl si lane



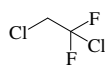
2,3-Di chl oro-5,6-di cyanobenzoqui nc



Di chl orodi et hyl si lane



1,1-Di chl oro-1,2-di f luoroet hane



1,2-Di chl oro-1,1-di f luoroet hane



1,2-Di chl oro-1,2-di f luoroet hane



1,1-Di chl oro-2,2-di f luoroet hene



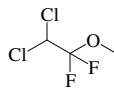
*ci s*1,2-Di chl oro-1,2-di f luoroet hene



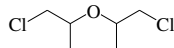
*t rans*1,2-Di chl oro-1,2-di f luoroet hene



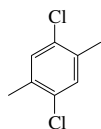
Di chl orodi f luoromet hane



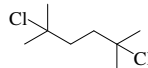
2,2-Di chl oro-1,1-di f luoro-1-met hoyet hane



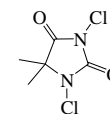
2,2-Di chl orodi i sopropylher



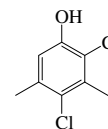
1,4-Di chl oro-2,5-di met hyl benzene



2,5-Di chl oro-2,5-di met hyl hexane



1,3-Di chl oro-5,5-di met hyl dant oi n

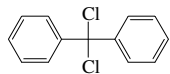


2,4-Di chl oro-3,5-di met hyl phenol

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3169	Di chlorodi met hyl si l ane		$\text{C}_2\text{H}_4\text{Cl}_2\text{Si}$	75-78-5	129.061	li q	-16	70.3	1.084	1.4038 ²⁰	dec H ₂ O, Et OH
3170	2,3-Di chl oro-1,4-di oxane		$\text{C}_4\text{H}_6\text{Cl}_2\text{O}_2$	95-59-0	156.996		30	81 ¹⁰	1.468 ²⁰	1.4928 ²⁰	i H ₂ O; vs et h, ace, bz, ct c, di ox
3171	Di chl orodi phenyl met hane		$\text{C}_{13}\text{H}_{10}\text{Cl}_2$	2051-90-3	237.124			dec 305; 190 ²¹	1.235 ¹⁸		s et h, bz, ct c
3172	Di chl orodi phenyl si l ane		$\text{C}_{12}\text{H}_{10}\text{Cl}_2\text{Si}$	80-10-4	253.199			305	1.204 ⁶	1.5800 ²⁰	s Et OH, et h, ace, bz, ct c
3173	1,1-Di chl oroet hane	Et hyl i dene di chl ori de	$\text{C}_2\text{H}_4\text{Cl}_2$	75-34-3	98.959	li q	-96.9	57.3	1.175 ⁷	1.4164 ²⁰	sl H ₂ O; vs Et OH, et h; s ace, bz
3174	1,2-Di chl oroet hane	Et hyl ene di chl ori de	$\text{C}_2\text{H}_4\text{Cl}_2$	107-06-2	98.959	li q	-35.7	83.5	1.245 ⁴	1.4422 ²⁵	sl H ₂ O; vs Et OH; msc et h; s ace, bz, chl
3175	2,2-Di chl oroet hanol		$\text{C}_2\text{H}_4\text{Cl}_2\text{O}$	598-38-9	114.958			146	1.4040 ²⁵	1.4626 ²⁵	sl H ₂ O, ct c; s Et OH, et h
3176	1,1-Di chl oroet hene	Vi nyl i dene chl ori de	$\text{C}_2\text{H}_2\text{Cl}_2$	75-35-4	96.943	li q	-122.56	31.6	1.21 ⁹	1.4249 ²⁰	i H ₂ O; s Et OH, ace, bz; vs et h, chl
3177	<i>ci s</i> 1,2-Di chl oroet hene	<i>ci s</i> 1,2-Di chl oroet hyl ene	$\text{C}_2\text{H}_2\text{Cl}_2$	156-59-2	96.943	li q	-80.0	60.1	1.283 ⁷	1.4490 ²⁰	sl H ₂ O; msc Et OH, et h, ace; vs bz, chl
3178	<i>t rans</i> 1,2-Di chl oroet hene	<i>t rans</i> 1,2-Di chl oroet hyl ene	$\text{C}_2\text{H}_2\text{Cl}_2$	156-60-5	96.943	li q	-49.8	48.7	1.256 ⁵	1.4454 ²⁰	sl H ₂ O; msc Et OH, et h, ace; vs bz, chl
3179	1,2-Di chl oro-1-et hoxyet hane		$\text{C}_2\text{H}_4\text{Cl}_2\text{O}$	623-46-1	143.012			145	1.1370 ²⁰	1.4435 ²⁰	sl chl
3180	1,2-Di chl oroet hyl acet at e		$\text{C}_2\text{H}_4\text{Cl}_2\text{O}_2$	10140-87-1	156.996	li q		79, 32 ¹⁰			
3181	Di chl oroet hyl al umi num	Et hyl al umi num chl ori de	$\text{C}_2\text{H}_4\text{AlCl}_2$	563-43-9	126.949	hyg sol i d or li q	32	1 ¹⁵	1.207		reac H ₂ O
3182	Di chl oroet hyl met hyl si l ane		$\text{C}_3\text{H}_6\text{Cl}_2\text{Si}$	4525-44-4	143.088			101	1.004 ⁷	1.4197 ²⁰	
3183	2,7-Di chl orofluorescei n	2,7-Di chl oro-3,6-fluorandi ol	$\text{C}_{20}\text{H}_{12}\text{Cl}_2\text{O}_5$	76-54-0	401.196						sl DMSO
3184	1,1-Di chl oro-1-fluoroet hane		$\text{C}_2\text{H}_3\text{Cl}_2\text{F}$	1717-00-6	116.949	li q	-103.5	32.0	1.25 ⁹	1.3600 ¹⁰	i H ₂ O
3185	1,2-Di chl oro-1-fluoroet hane		$\text{C}_2\text{H}_3\text{Cl}_2\text{F}$	430-57-9	116.949	li q	-60	73.8	1.381 ⁴	1.4132 ²⁰	
3186	1,1-Di chl oro-2-fluoroet hene	1,1-Di chl oro-2-fluoroet hyl ene	$\text{C}_2\text{HCl}_2\text{F}$	359-02-4	114.933	li q	-108.8	37.5	1.373 ²	1.4031 ¹⁶	
3187	Di chl orofluoromet hane	Ref ri gerant 21	CFCl_2	75-43-4	102.923	col gas	-135	8.9	1.405 ⁵	1.3724 ⁹	i H ₂ O; s Et OH, et h, ct c, chl, HOAc
3188	(Di chl orofluoromet hyl) benzene		$\text{C}_7\text{H}_5\text{Cl}_2\text{F}$	498-67-9	179.019	li q	-26.8	179	1.313 ⁸	1.5180 ¹¹	vs Et OH
3189	1,1-Di chl oro-2-fluoropropene		$\text{C}_3\text{H}_3\text{Cl}_2\text{F}$	430-95-5	128.960			78	1.3026 ²⁵	1.4196 ²⁵	
3190	1,7-Di chl orohept ane		$\text{C}_7\text{H}_{14}\text{Cl}_2$	821-76-1	169.092			124 ³⁵	1.0408 ²⁵	1.4565 ²⁵	
3191	1,2-Di chl oro-1,2,3,3,4,4-hexafluorocycl obut ane		$\text{C}_4\text{Cl}_2\text{F}_6$	356-18-3	232.939	li q	-24.2	59.5			
3192	1,2-Di chl oro-3,3,4,4,5,5-hexafluorocycl opent ene		$\text{C}_5\text{Cl}_2\text{F}_6$	706-79-6	244.949	li q	-105.8	90.7	1.654 ⁶	1.3676 ²⁰	
3193	1,2-Di chl oro-1,1,2,3,3,3-hexafluoropropane		$\text{C}_3\text{Cl}_2\text{F}_6$	661-97-2	220.928			34.1			i H ₂ O
3194	1,3-Di chl oro-1,1,2,2,3,3-hexafluoropropane	Ref ri gerant 216	$\text{C}_3\text{Cl}_2\text{F}_6$	662-01-1	220.928	li q	-125.4	35.7	1.57 ³	1.3030 ²⁰	
3195	1,5-Di chl oro-1,1,3,3,5,5-hexamet hyl t ri si l oxane		$\text{C}_6\text{H}_{18}\text{Cl}_2\text{O}_2\text{Si}_3$	3582-71-6	277.369	li q	-53	184	1.01 ⁸		dec H ₂ O
3196	1,2-Di chl orohept ane		$\text{C}_7\text{H}_{14}\text{Cl}_2$	2162-92-7	155.065			173	1.085 ¹⁵		vs et h, chl
3197	1,6-Di chl orohept ane		$\text{C}_7\text{H}_{14}\text{Cl}_2$	2163-00-0	155.065			204	1.0676 ²⁵	1.4555 ²⁵	i H ₂ O; s et h, ct c, chl
3198	3,5-Di chl oro-2-hydroxybenzal dehyde		$\text{C}_8\text{H}_6\text{Cl}_2\text{O}_2$	90-60-8	191.012	ye ort h (HOAc)	95				i H ₂ O
3199	3,5-Di chl oro-2-hydroxybenzoi c aci d		$\text{HC}_8\text{Cl}_2\text{O}_3$	320-72-9	207.011	nd (di l al) ort h	220.5 pr	sub			sl H ₂ O; vs Et OH, et h
3200	2,6-Di chl oroindophenol, sodi um sal t	Ti l l man's reagent	$\text{C}_{12}\text{H}_6\text{Cl}_2\text{ONaO}_2$	620-45-1	290.078	dk grn cry					s H ₂ O, Et OH, ace
3201	5,6-Di chl oro-1,3-i sobenzof urandi one	4,5-Di chl oropt hal i c anhydri de	$\text{C}_8\text{H}_4\text{Cl}_2\text{O}_2$	942-06-3	217.006	t ab or pr (t o)	188	313			vs et h, Et OH, t ol
3202	Di chl oromet hane	Met hyl ene chl ori de	C_2Cl_2	75-09-2	84.933	li q	-97.2	40	1.326 ⁶	1.4242 ²⁰	sl H ₂ O; msc Et OH, et h; s ct c
3203	1,2-Di chl oro-3-met hoxybenzene		$\text{C}_8\text{H}_8\text{Cl}_2\text{O}$	1984-59-4	177.028			32			
3204	1,3-Di chl oro-2-met hoxybenzene	2,6-Di chl oroani sol e	$\text{C}_8\text{H}_8\text{Cl}_2\text{O}$	1984-65-2	177.028	li q	10	10 ⁵	1.291	1.5430 ²⁰	
3205	2,4-Di chl oro-1-met hoxybenzene		$\text{C}_8\text{H}_8\text{Cl}_2\text{O}$	553-82-2	177.028	pr	28.5	232; 125 ¹⁰			sl chl
3206	3,6-Di chl oro-2-met hoxybenzoi c aci d	Di camba	$\text{C}_8\text{H}_6\text{Cl}_2\text{O}_3$	1918-00-9	221.038	cry (pent)	115		1.57 ⁵		



Di chl orodi met hyl si l ane 2,3-Di chl oro-1,4-di oxane



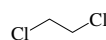
Di chl orodi phenyl met hane



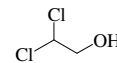
Di chl orodi phenyl si l ane



1,1-Di chl oroet hane



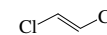
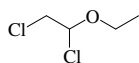
1,2-Di chl oroet hane



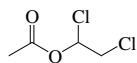
2,2-Di chl oroet hanol



1,1-Di chl oroet hene


cis-1,2-Di chl oroet hene

trans-1,2-Di chl oroet hene


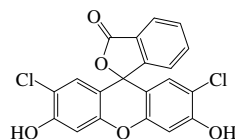
1,2-Di chl oro-1-et hoxyet hane



1,2-Di chl oroet hyl acet at e



Di chl oroet hyl al umi num Di chl oroet hyl met hyl si l ane



2',7'-Di chl orof luorescei n



1,1-Di chl oro-1-f luoroet hane



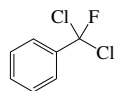
1,2-Di chl oro-1-f luoroet hane



1,1-Di chl oro-2-f luoroet hene



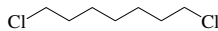
Di chl orof luoromet hane



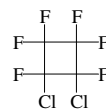
(Di chl orof luoromet hyl) benzene



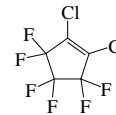
1,1-Di chl oro-2-f luoropropene



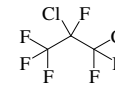
1,7-Di chl orohept ane



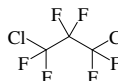
1,2-Di chl oro-1,2,3,3,4,4-hexaf luorocycl obut ane



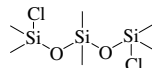
1,2-Di chl oro-3,3,4,4,5,5-hexaf luorocycl opent ene



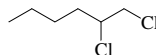
1,2-Di chl oro-1,1,2,3,3,3-hexaf luoropropane



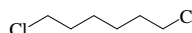
1,3-Di chl oro-1,1,2,2,3,3-hexaf luoropropa



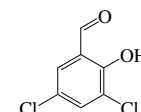
1,5-Di chl oro-1,1,3,3,5,5-hexamet hyl t ri si l oxane



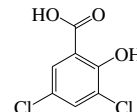
1,2-Di chl orohexane



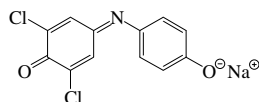
1,6-Di chl orohexane



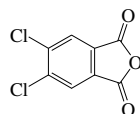
3,5-Di chl oro-2-hydroxybenzaldehyde



3,5-Di chl oro-2-hydroxybenzoici d



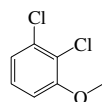
2,6-Di chl oroi ndophenol di umsal t



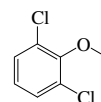
5,6-Di chl oro-1,3-i sobenzof urandi one



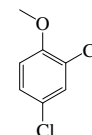
Di chl oromet hane



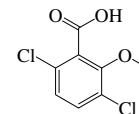
1,2-Di chl oro-3-met hoxybenzene



1,3-Di chl oro-2-met hoxybenzene

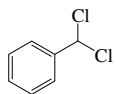


2,4-Di chl oro-1-met hoxybenzene

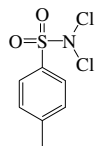


3,6-Di chl oro-2-met hoxybenzoici d

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3207	(Di chl oromet hyl)benzene	Benzal chl ori de	$\text{C}_6\text{H}_5\text{Cl}_2$	98-87-3	161.029	li q	-17	205	1.26	1.5502 ²⁰	i H ₂ O; vs et h, Et OH
3208	<i>N,N</i> -Di chl oro-4-met hyl benzenesul f onami de	Di chl orami ne-T	$\text{C}_6\text{H}_4\text{Cl}_2\text{NO}_2\text{S}$	473-34-7	240.108	pr(chl -pet h)	83				i H ₂ O; s Et OH, et h, bz, ct c, HOAc
3209	Di chl oromet hyl borane	Met hyl di chl oroborane	$\text{B}_2\text{Cl}_4\text{H}$	7318-78-7	96.752	col gas		11			
3210	2,3-Di chl oro-2-met hyl but ane	Amyl ene di chl ori de	$\text{C}_4\text{H}_{10}\text{Cl}_2$	507-45-9	141.038			129	1.0696 ¹⁵	1.4450 ¹⁸	i H ₂ O; vs et h, Et OH
3211	1,1-Di chl oromet hyl met hyl et her	Met hoxidi chl oromet hane	$\text{C}_2\text{H}_4\text{Cl}_2\text{O}$	4885-02-3	114.958			85	1.271 ²⁵	1.4300 ²⁰	
3212	2,4-Di chl oro-3-met hyl phenol		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	17788-00-0	177.028	pr (pet h)	58	236; 77 ^a			vs et h, chl
3213	2,4-Di chl oro-6-met hyl phenol		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	1570-65-6	177.028	nd (w, pet h)	55				sl H ₂ O; vs Et OH, et h, chl, C ₆ S
3214	2,6-Di chl oro-4-met hyl phenol		$\text{C}_6\text{H}_4\text{Cl}_2\text{O}$	2432-12-4	177.028	nd (li g)	39	231; 138 ^b			i H ₂ O; vs et h, Et OH, HOAc
3215	Di chl oromet hyl phenyl si l ane		$\text{C}_6\text{H}_5\text{Cl}_2\text{Si}$	149-74-6	191.131			206.5	1.1866 ⁹	1.5180 ²⁰	
3216	Di chl oromet hyl phosphi ne	Met hyl phosphonous di chl ori de	$\text{C}_2\text{Cl}_2\text{PH}$	676-83-5	116.915			12 ⁵⁰	1.304 ²⁰	1.4940 ²⁰	
3217	1,2-Di chl oro-2-met hyl propane	1,2-Di chl oroi sobut ane	$\text{C}_3\text{H}_6\text{Cl}_2$	594-37-6	127.013			106.5	1.093 ²⁰	1.4370 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, ct c
3218	2,4-Di chl oro-5-met hyl pyri mi di ne		$\text{C}_4\text{H}_4\text{Cl}_2\text{N}_2$	1780-31-0	163.004	pl (al)	26	235			sl H ₂ O; vs Et OH, et h, bz, chl
3219	2,4-Di chl oro-6-met hyl pyri mi di ne		$\text{C}_4\text{H}_4\text{Cl}_2\text{N}_2$	5424-21-5	163.004	nd (li g)	46.5	219			vs bz, et h, Et OH, chl
3220	Di chl oromet hyl si l ane		$\text{C}_4\text{H}_5\text{Si}$	75-54-7	115.035	li q	-93	41	1.105		
3221	1,2-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2050-69-3	197.061	pl (al)	36	296.5	1.3147 ⁹	1.5338 ⁴⁹	s Et OH, et h
3222	1,3-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2198-75-6	197.061	nd or pr (al)	62.3	291			s Et OH
3223	1,4-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	1825-31-6	197.061	nd or pr (al, ace)	67.5	288; 147 ¹²	1.2997 ⁷⁶	1.6228 ⁷⁶	i H ₂ O; sl Et OH; s et h, bz, HOAc; vs ace
3224	1,5-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	1825-30-5	197.061	nd or lf (al) pr (sub)	107	sub	1.4900 ²⁰		i H ₂ O; sl Et OH; s et h
3225	1,6-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2050-72-8	197.061	nd or pr (al, pet h)	49	sub			
3226	1,7-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2050-73-9	197.061	nd or pr (al, HOAc)	63.5	285.5	1.2611 ¹⁰⁰	1.6092 ¹⁰⁰	s Et OH, et h, bz, HOAc
3227	1,8-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2050-74-0	197.061	ort h pl (hx) nd (al, sub)	89	sub	1.2924 ¹⁰⁰	1.6236 ¹⁰⁰	s Et OH, pet h
3228	2,3-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2050-75-1	197.061	ort h lf (al)	120				i OH; sl Et OH; vs et h
3229	2,6-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2065-70-5	197.061	nd or lf (al) pl (et h, bz)	140.5	285			sl Et OH; s et h, bz, chl, HOAc
3230	2,7-Di chl oronapht hal ene		$\text{C}_{10}\text{H}_6\text{Cl}_2$	2198-77-8	197.061	pl or lf (al)	115.0				vs Et OH; s hx, HOAc
3231	2,3-Di chl oro-1,4-napht hal enedi one	Di chl one	$\text{C}_{10}\text{H}_6\text{Cl}_2\text{O}_2$	117-80-6	227.044	ye nd (al)	195				i H ₂ O; sl Et OH, et h, bz; s chl
3232	2,4-Di chl oro-1-napht hol	2,4-Di chl oronapht hol	$\text{C}_{10}\text{H}_6\text{Cl}_2\text{O}$	2050-76-2	213.060	nd (al, bz)	107.5	180			vs bz, et h, Et OH
3233	2,6-Di chl oro-4-ni troani li ne		$\text{C}_6\text{H}_3\text{Cl}_2\text{N}_2\text{O}_2$	99-30-9	207.014	ye nd (al, HOAc)	191				s Et OH, aci d; sl DMSO
3234	1,2-Di chl oro-3-ni trobenzene		$\text{C}_6\text{H}_3\text{Cl}_2\text{NO}_2$	3209-22-1	192.000	mcl nd (pet h, HOAc)	61.5	257.5	1.721 ¹⁴		i H ₂ O; s Et OH, et h, ace, bz, pet h; sl chl
3235	1,2-Di chl oro-4-ni trobenzene		$\text{C}_6\text{H}_3\text{Cl}_2\text{NO}_2$	99-54-7	192.000	nd (al)	43	255.5	1.4558 ⁵		i H ₂ O; s Et OH, et h; sl ct c
3236	1,3-Di chl oro-5-ni trobenzene		$\text{C}_6\text{H}_3\text{Cl}_2\text{NO}_2$	618-62-2	192.000	mcl pr or lf (HOAc, al)	65.4		1.4000 ¹⁰⁰		i H ₂ O; s Et OH, et h
3237	1,4-Di chl oro-2-ni trobenzene		$\text{C}_6\text{H}_3\text{Cl}_2\text{NO}_2$	89-61-2	192.000	pl or pr (al) pl (AcOEt)	56	267	1.439 ⁷⁵	1.4390 ⁷⁵	i H ₂ O; s Et OH, et h, bz, C ₆ S; sl ct c
3238	2,4-Di chl oro-1-ni trobenzene		$\text{C}_6\text{H}_3\text{Cl}_2\text{NO}_2$	611-06-3	192.000	nd (al)	34	258.5	1.4790 ⁹	1.5512 ⁷⁰	i H ₂ O; s Et OH, et h; sl chl
3239	1,1-Di chl oro-1-ni troet hane	Et hi de	$\text{C}_2\text{H}_2\text{Cl}_2\text{NO}_2$	594-72-9	143.957			123.5			s ct c
3240	2,6-Di chl oro-4-ni trophenol		$\text{C}_6\text{H}_2\text{Cl}_2\text{NO}_3$	618-80-4	207.999	br nd (w)	127 exp		1.822 ²⁵		vs et h, chl
3241	1,1-Di chl oro-1-ni tropropane		$\text{C}_3\text{H}_4\text{Cl}_2\text{NO}_2$	595-44-8	157.984			145	1.312 ²⁰		s ct c
3242	1,9-Di chl orononane		$\text{C}_9\text{H}_{18}\text{Cl}_2$	821-99-8	197.145			260; 138 ¹⁷	1.0173 ²⁵	1.4586 ²⁵	
3243	1,8-Di chl orooct ane		$\text{C}_8\text{H}_{16}\text{Cl}_2$	2162-99-4	183.119			241	1.0248 ²⁵	1.4572 ²⁵	



(Di chl oromet hyl)benzene

*N,N*-Di chl oro-4-met hyl benzenesul f onami de

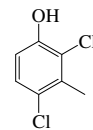
Di chl oromet hyl borane



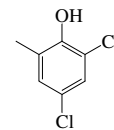
2,3-Di chl oro-2-met hyl but ane



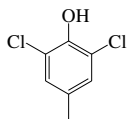
1,1-Di chl oromet hyl et hyl et her



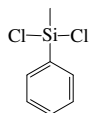
2,4-Di chl oro-3-met hyl phenol



2,4-Di chl oro-6-met hyl phenol



2,6-Di chl oro-4-met hyl phenol



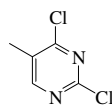
Di chl oromet hyl phenyl si l ane



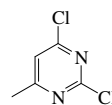
Di chl oromet hyl phosphi ne



1,2-Di chl oro-2-met hyl propane



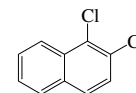
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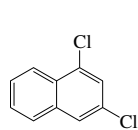
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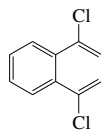
Di chl oromet hyl si l ane



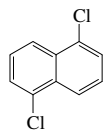
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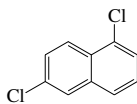
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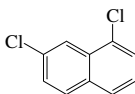
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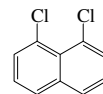
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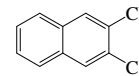
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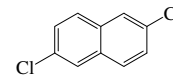
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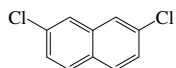
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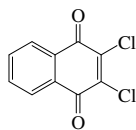
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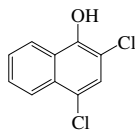
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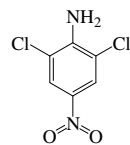
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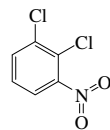
2,3-Di chl oro-1,4-napt hal enedi c



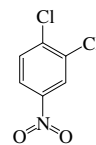
2,4-Di chl oro-1-napt h



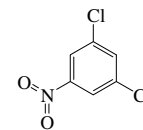
2,6-Di chl oro-4-ni t roani li ne



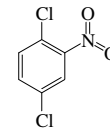
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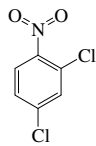
1,2-Di chl oro-4-ni t robenzene



1,3-Di chl oro-5-ni t robenze



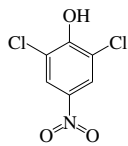
1,4-Di chl oro-2-ni t robenzene



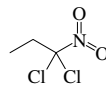
2,4-Di chl oro-1-ni t robenzene



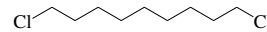
1,1-Di chl oro-1-ni t roet hane



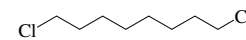
2,6-Di chl oro-4-ni t rophenol



1,1-Di chl oro-1-ni t ropropane

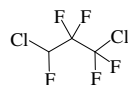


1,9-Di chl orononane

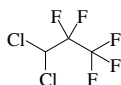


1,8-Di chl oroct ane

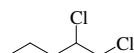
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3244	1,3-Di chl oro-1,1,2,2,3-pent afluoropropane		C ₃ HCl ₂ F ₅	507-55-1	202.938	li q		52	1.55		
3245	3,3-Di chl oro-1,1,1,2,2-pent afluoropropane	Ref ri gerant 225ca	C ₃ HCl ₂ F ₅	422-56-0	202.938	li q		45.5	1.54		
3246	1,2-Di chl oropent ane		C ₅ H ₁₀ Cl ₂	1674-33-5	141.038			148.3	1.0872 ²⁰	1.4485 ²⁰	i H ₂ O; s Et OH; vs chl
3247	1,5-Di chl oropent ane		C ₅ H ₁₀ Cl ₂	628-76-2	141.038	li q	-72.8	179	1.0956	1.4545 ²⁵	i H ₂ O; s Et OH, et h, bz, ct c
3248	2,3-Di chl oropent ane		C ₅ H ₁₀ Cl ₂	600-11-3	141.038	li q	-77.3	139	1.0789	1.4464 ²⁰	i H ₂ O
3249	Di chl orophene		C ₈ H ₁₀ Cl ₂ O ₂	97-23-4	269.123	cry (bz, pet h)	177.5				i H ₂ O; s Et OH, ace
3250	2,3-Di chl orophenol		C ₆ H ₄ Cl ₂ O	576-24-9	163.001	cry (li g, bz)	58				s Et OH, et h, bz, li g
3251	2,4-Di chl orophenol		C ₆ H ₄ Cl ₂ O	120-83-2	163.001	hex nd (bz)	45	210			sl H ₂ O; s Et OH, et h, bz, chl
3252	2,5-Di chl orophenol		C ₆ H ₄ Cl ₂ O	583-78-8	163.001	pr (bz, pet h)	59	211			sl H ₂ O; vs Et OH, et h; s bz, pet h
3253	2,6-Di chl orophenol		C ₆ H ₄ Cl ₂ O	87-65-0	163.001	nd (pet h)	68.5	220; 82	1.653 ²⁰		vs Et OH, et h; s bz, pet h
3254	3,4-Di chl orophenol		C ₆ H ₄ Cl ₂ O	95-77-2	163.001	nd (bz-pet h)	68	253			sl H ₂ O; vs Et OH, et h; s bz, pet h
3255	3,5-Di chl orophenol		C ₆ H ₄ Cl ₂ O	591-35-5	163.001	pr (pet h)	68	233			sl H ₂ O; vs Et OH, et h; s pet h
3256	(2,4-Di chl orophenoxy)acet i c aci d	2,4-D	C ₈ H ₈ Cl ₂ O ₃	94-75-7	221.038	cry (bz)	140.5	160 ⁰⁴			i H ₂ O; s Et OH; sl bz, DMSO
3257	4-(2,4-Di chl orophenoxy)but anoi c aci d	But yrac 118 aci d	C ₁₀ H ₁₀ Cl ₂ O ₃	94-82-6	249.090		118				
3258	2-(2,4-Di chl orophenoxy)propanoi c aci d	Di chl orprop aci d	C ₈ H ₈ Cl ₂ O ₃	120-36-5	235.064		117.5				sl H ₂ O, li g; s Et OH, et h
3259	Di chl orophenyl arsi ne		C ₆ H ₅ AsCl ₂	696-28-6	222.932	li q	-19	255	1.6516	1.6386 ¹⁵	vs bz, et h, Et OH
3260	2,4-Di chl orophenyl benzenesul f onat e	Geni t e	C ₁₂ H ₈ Cl ₂ O ₂ S	97-16-5	303.161		45.5				s ct c, CS ₂
3261	2,2-Di chl oro-1-phenyl et hanone		C ₈ H ₈ Cl ₂ O	2648-61-5	189.039	amor	20.5	249	1.340 ¹⁶	1.5686 ²⁰	s Et OH, bz, ct c
3262	1-(2,4-Di chl orophenyl)et hanone		C ₈ H ₈ Cl ₂ O	2234-16-4	189.039		33.5				i H ₂ O
3263	1-(2,5-Di chl orophenyl)et hanone		C ₈ H ₈ Cl ₂ O	2476-37-1	189.039		12	118 ¹²	1.321 ³⁰	1.5595 ³⁰	
3264	1-(3,4-Di chl orophenyl)et hanone		C ₈ H ₈ Cl ₂ O	2642-63-9	189.039	nd (pet h)	76	135 ²			i H ₂ O; s ct c, li g
3265	3,4-Di chl orophenyl i socyanat e	1,2-Di chl oro-5-i socyanat obenzene	C ₇ H ₅ Cl ₂ NO	102-36-3	188.011	cry	42	112 ¹²			
3266	3,5-Di chl orophenyl i socyanat e	1,3-Di chl oro-5-i socyanat obenzene	C ₇ H ₅ Cl ₂ NO	34893-92-0	188.011		33		1.380		
3267	N-(3,4-Di chl orophenyl)-2-met hyl-2- Di cryl propenami de		C ₁₀ H ₈ Cl ₂ NO	2164-09-2	230.090	cry (al -pet h)	128				vs ace, Et OH
3268	3-(2,4-Di chl orophenyl)-2-propenoi c aci d		C ₉ H ₆ Cl ₂ O ₂	1201-99-6	217.049		234				s DMSO
3269	Di chl orophenyl si lane	Phenyl di chl orosi lane	C ₆ H ₄ Cl ₂ Si	1631-84-1	177.104			181	1.224 ⁵		dec H ₂ O
3270	1,1-Di chl oropropane	Propyl i dene chl ori de	C ₃ H ₄ Cl ₂	78-99-9	112.986			88.1	1.1321 ²⁰	1.4289 ²⁰	s Et OH, et h, bz, chl
3271	1,2-Di chl oropropane, (±)	Propyl ene di chl ori de	C ₃ H ₄ Cl ₂	26198-63-0	112.986	li q	-100.53	96.4	1.1566	1.4394 ²⁰	sl H ₂ O; s Et OH, et h, bz, chl
3272	1,3-Di chl oropropane		C ₃ H ₄ Cl ₂	142-28-9	112.986	li q	-99.5	120.9	1.1785	1.4455 ²⁵	sl H ₂ O; vs Et OH, et h; s bz, chl
3273	2,2-Di chl oropropane		C ₃ H ₄ Cl ₂	594-20-7	112.986	li q	-33.9	69.3	1.1136	1.4148 ²⁰	i H ₂ O; s Et OH, bz, chl; msc et h
3274	2,2-Di chl oropropanoi c aci d	2,2-Di chl oropropi oni c aci d	C ₃ H ₄ Cl ₂ O ₂	75-99-0	142.969			187.5; 92 ¹⁴	1.389 ¹²		vs H ₂ O, al k, Et OH; s et h, ct c
3275	2,3-Di chl oro-1-propanol		C ₃ H ₆ Cl ₂ O	616-23-9	128.985	vi sc		184	1.360 ⁷⁰	1.4819 ²⁰	sl H ₂ O, li g; msc Et OH, et h, ace, bz
3276	1,3-Di chl oro-2-propanol		C ₃ H ₆ Cl ₂ O	96-23-1	128.985			176	1.3506 ¹⁷	1.4837 ²⁰	vs H ₂ O, Et OH; msc et h; s ace, chl
3277	2,3-Di chl oro-1-propanol, phosphat e (3:1)		C ₃ H ₅ Cl ₂ O ₃ P	78-43-3	430.904			190 ⁰¹	1.517 ²²		
3278	2,3-Di chl oropropanoyl chl ori de		C ₃ H ₃ Cl ₃ O	7623-13-4	161.414			53 ¹⁷	1.4757 ²⁰	1.4764 ²⁰	
3279	1,1-Di chl oropropene		C ₃ H ₂ Cl ₂	563-58-6	110.970			76.5	1.1864 ²⁵	1.4430 ²⁵	i H ₂ O; s et h, ace, chl
3280	<i>ci s</i> -1,2-Di chl oropropene		C ₃ H ₂ Cl ₂	6923-20-2	110.970			93		1.4549 ²⁰	i H ₂ O; s ace, bz, chl
3281	<i>t rans</i> -1,2-Di chl oropropene		C ₃ H ₂ Cl ₂	7069-38-7	110.970			77	1.1818 ²⁰	1.4471 ²⁰	i H ₂ O; vs Et OH, ct c, MeOH
3282	<i>ci s</i> -1,3-Di chl oropropene	<i>ci s</i> -1,3-Di chl oropropyl ene	C ₃ H ₂ Cl ₂	10061-01-5	110.970			104.3	1.224 ²⁰	1.4682 ²⁰	i H ₂ O; s et h, bz, chl
3283	<i>t rans</i> -1,3-Di chl oropropene	<i>t rans</i> -1,3-Di chl oropropyl ene	C ₃ H ₂ Cl ₂	10061-02-6	110.970			112	1.217 ²⁰	1.4730 ²⁰	i H ₂ O; s et h, bz, chl



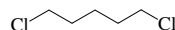
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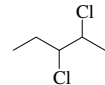
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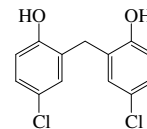
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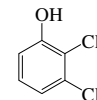
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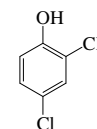
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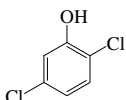
Di chl orophene



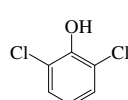
2,3-Di chl orophenol



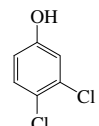
2,4-Di chl orophenol



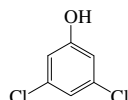
2,5-Di chl orophenol



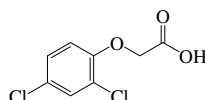
2,6-Di chl orophenol



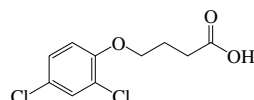
3,4-Di chl orophenol



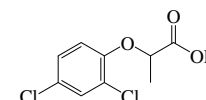
3,5-Di chl orophenol



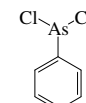
(2,4-Di chl orophenoxy)acet aci d



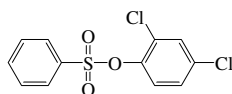
4-(2,4-Di chl orophenoxy)but anoaci d



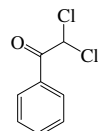
2-(2,4-Di chl orophenoxy)propanoaci d



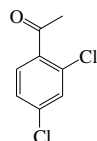
Di chl orophenyl arsi ne



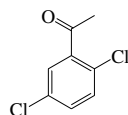
2,4-Di chl orophenyl benzenesul f onat e



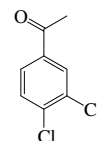
2,2-Di chl oro-1-phenyl et hanone



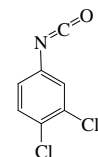
1-(2,4-Di chl orophenyl)et hanone



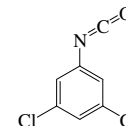
1-(2,5-Di chl orophenyl)et hanone



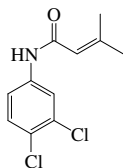
1-(3,4-Di chl orophenyl)et hanone



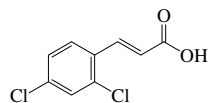
3,4-Di chl orophenyl socyanat e



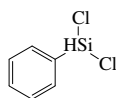
3,5-Di chl orophenyl socyanat e



N-(3,4-Di chl orophenyl)-2-met hyl-2-propenamí de



3-(2,4-Di chl orophenyl)-2-propenoaci d



Di chl orophenyl sí lane



1,1-Di chl oropropane



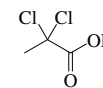
1,2-Di chl oropropane(±)



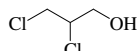
1,3-Di chl oropropane



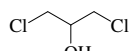
2,2-Di chl oropropane



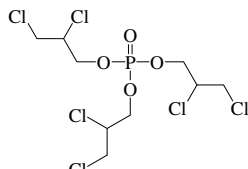
2,2-Di chl oropropanoaci d



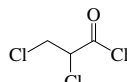
2,3-Di chl oro-1-propanol



1,3-Di chl oro-2-propanol



2,3-Di chl oro-1-propanolphosphat e(3:1)



2,3-Di chl oropropanoyl chl ori de



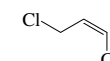
1,1-Di chl oropropene



cis 1,2-Di chl oropropene



trans 1,2-Di chl oropropene

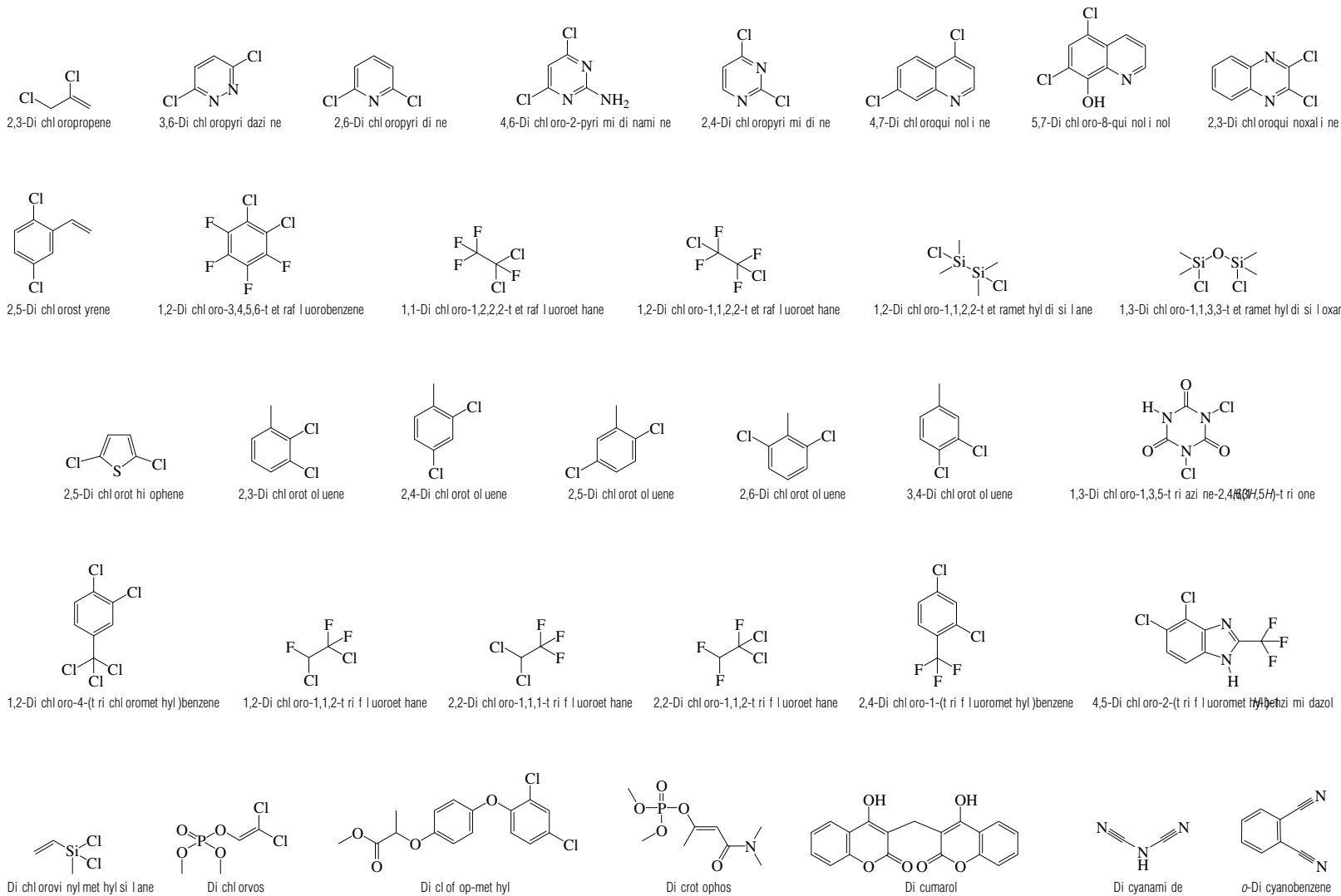


cis 1,3-Di chl oropropene

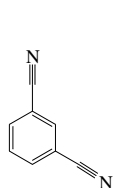


trans 1,3-Di chl oropropene

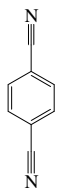
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3284	2,3-Di chl oropropene		C ₃ H ₄ Cl ₂	78-88-6	110.970		10	94	1.211 ²⁰	1.4603 ²⁰	i H ₂ O; msc Et OH; s et h, bz, chl
3285	3,6-Di chl oropyri dazi ne		C ₈ H ₆ Cl ₂ N ₂	141-30-0	148.978		68.8	89 ^{0,2}			s chl
3286	2,6-Di chl oropyri di ne		C ₈ H ₆ Cl ₂ N	2402-78-0	147.990		87	211			
3287	4,6-Di chl oro-2-pyri mi di nami ne		C ₈ H ₆ Cl ₂ N ₃	56-05-3	163.993		215				s DMSO
3288	2,4-Di chl oropyri mi di ne		C ₈ H ₆ Cl ₂ N ₂	3934-20-1	148.978		59	198; 101 ²³			
3289	4,7-Di chl oroqui nol i ne		C ₉ H ₆ Cl ₂ N	86-98-6	198.049	cry (MeOH), nd (80% al)	93	148 ¹⁰			sl chl
3290	5,7-Di chl oro-8-qui nol i nol	Chl oroxi ne	C ₉ H ₆ Cl ₂ NO	773-76-2	214.048	cry (al)	179.5				sl Et OH, ace, chl, DMSO; s al k, bz, pet h
3291	2,3-Di chl oroqui nol i ne		C ₈ H ₆ Cl ₂ N ₂	2213-63-0	199.037	cry (al, bz)	152				i H ₂ O; vs Et OH, bz, chl, HOAc
3292	2,5-Di chl orost yrene		C ₈ H ₆ Cl ₂	1123-84-8	173.040		8.0	93 ⁵ , 74 ³	1.246 ²⁰	1.5798 ²⁰	
3293	1,2-Di chl oro-3,4,5,6-t et rafluorobenzene		C ₆ Cl ₂ F ₄	1198-59-0	218.964			157.7			
3294	1,1-Di chl oro-1,2,2,2-t et rafluoroet hane	Ref ri gerant 114a	C ₂ Cl ₂ F ₄	374-07-2	170.921	col gas	-56.6	3.4	1.455 ²⁵ (p>1 at m)	1.3092 ⁰	vs bz, et h, Et OH
3295	1,2-Di chl oro-1,1,2,2-t et rafluoroet hane	Ref ri gerant 114	C ₂ Cl ₂ F ₄	76-14-2	170.921	col gas	-92.53	3.5	1.455 ²⁵ (p>1 at m)	1.3092 ⁰	i H ₂ O; vs et h, Et OH
3296	1,2-Di chl oro-1,1,2,2-t et ramet hyl di si l ane		C ₄ H ₁₂ Cl ₂ Si ₂	4342-61-4	187.215			148; 49 ¹⁸	1.010 ²⁰	1.4548 ²⁰	
3297	1,3-Di chl oro-1,1,3,3-t et ramet hyl di si l oxane		C ₄ H ₁₂ Cl ₂ O ₂ Si ₂	2401-73-2	203.214	li q	-37.5	138	1.03 ⁸		
3298	2,5-Di chl orot hi ophene		C ₈ H ₆ Cl ₂ S	3172-52-9	153.030	li q	-40.5	162	1.442 ²⁰	1.5626 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
3299	2,3-Di chl orot ol uene		C ₈ H ₆ Cl ₂	32768-54-0	161.029		6	207.5	1.2458 ²⁰	1.5511 ²⁰	vs bz
3300	2,4-Di chl orot ol uene		C ₈ H ₆ Cl ₂	95-73-8	161.029	li q	-13.5	201	1.247 ⁶	1.5511 ²⁰	i H ₂ O; s ct c
3301	2,5-Di chl orot ol uene		C ₈ H ₆ Cl ₂	19398-61-9	161.029		2.5	200	1.2535 ²⁰	1.5449 ²⁰	i H ₂ O; s bz
3302	2,6-Di chl orot ol uene		C ₈ H ₆ Cl ₂	118-69-4	161.029		25.8	198	1.2686 ²⁰	1.5507 ²⁰	i H ₂ O; s chl
3303	3,4-Di chl orot ol uene		C ₈ H ₆ Cl ₂	95-75-0	161.029	li q	-15.2	208.9	1.256 ⁴	1.5471 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
3304	1,3-Di chl oro-1,3,5-t ri azi ne-2,4,6-(1 <i>H</i> ,3 <i>H</i> ,5 <i>H</i>)-t ri one	Di chl orocyanuri c aci d	C ₃ HCl ₂ N ₃ O ₃	2782-57-2	197.964	cry	226.6				
3305	1,2-Di chl oro-4-(t ri chl oromet hyl) benzene		C ₆ H ₂ Cl ₅	13014-24-9	264.364		25.8	283.1	1.5913 ²⁰	1.5886 ²⁰	
3306	1,2-Di chl oro-1,1,2-t ri fluoroet hane	Ref ri gerant 123a	C ₂ HCl ₂ F ₃	354-23-4	152.930	vol li q or gas	-78	29.5	1.5 ⁶		
3307	2,2-Di chl oro-1,1,1-t ri fluoroet hane		C ₂ HCl ₂ F ₃	306-83-2	152.930	vol li q or gas	-107	27.82	1.463 ⁸		sl H ₂ O
3308	2,2-Di chl oro-1,1,2-t ri fluoroet hane	Ref ri gerant 123b	C ₂ HCl ₂ F ₃	812-04-4	152.930			30.2			
3309	2,4-Di chl oro-1-(t ri fluoromet hyl) benzene	2,4-Di chl orobenzot ri fluori de benzene	C ₇ H ₃ Cl ₂ F ₃	320-60-5	215.000					1.4802 ²⁰	
3310	4,5-Di chl oro-2-(t ri fluoromet hyl)-1 benzimi dazol e	Chl oroflurazol e	C ₇ H ₃ Cl ₂ F ₃ N ₂	3615-21-2	255.024		213.5				
3311	Di chl orovi nyl met hyl si l ane		C ₃ H ₆ Cl ₂ Si	124-70-9	141.072			92.5	1.086 ⁸	1.4270 ²⁰	dec H ₂ O
3312	Di chl orvos	Phosphori c aci d, 2,2-di chl oroet her di met hyl est er	C ₂ H ₂ Cl ₂ O ₂ P	62-73-7	220.976			140 ²⁰ , 84 ¹	1.415 ²⁵		
3313	Di chl of op-met hyl	Met hyl 2-[4-(2,4-di chl orophenoxy)phenoxy]propanoat e	C ₁₆ H ₁₄ Cl ₂ O ₄	51338-27-3	341.186		40		176 ^{0,1}		
3314	Di crot ophos		C ₁₁ H ₁₆ NO ₃ P	141-66-2	237.191			400; 130 ^{0,1}	1.216 ¹⁵		
3315	Di cumarol		C ₆ H ₁₂ O ₆	66-76-2	336.294	nd	290				
3316	Di cyanami de	Cyanocyanami de	C ₂ H ₂ N ₃	504-66-5	67.049	aq sol n only					
3317	α-Di cyanobenzene	α-Pht hal odi ni t ri l e	C ₈ H ₄ N ₂	91-15-6	128.131	nd (w, li g)	141	15 ⁰	1.1250 ²⁵		sl H ₂ O, li g; vs Et OH, bz; s et h, ace



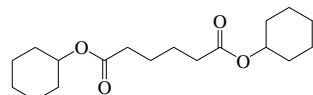
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3318	<i>m</i> -Di cyanobenzene	<i>m</i> -Pht hal odi ni tri le	$\text{C}_8\text{H}_4\text{N}_2$	626-17-5	128.131	nd(al)	162	sub	0.992 ²⁰		sl H ₂ O; vs Et OH; s et h, bz, chl; i pet h
3319	<i>p</i> -Di cyanobenzene	<i>p</i> -Pht hal odi ni tri le	$\text{C}_8\text{H}_4\text{N}_2$	623-26-7	128.131	nd (w, MeOH)	224	sub			i H ₂ O; sl Et OH, et h; s bz; vs HOAc
3320	Di cycl ohexyl adi pate		$\text{C}_{18}\text{H}_{30}\text{O}_4$	849-99-0	310.429		35				s chl
3321	Di cycl ohexyl ami ne	<i>N</i> -Cycl ohexyl cycl ohexanami ne	$\text{C}_{12}\text{H}_{23}\text{N}$	101-83-7	181.318		-0.1	dec 256; 114 ⁹	0.9123 ²⁰	1.4842 ²⁰	sl H ₂ O, ct c; s Et OH, et h, bz
3322	Di cycl ohexyl ami ne ni tri t e	<i>N</i> -Cycl ohexyl cycl ohexanami ne, ni tri t e	$\text{C}_{12}\text{H}_{21}\text{N}_2\text{O}_2$	3129-91-7	228.331	cry	182 dec				
3323	Di cycl ohexyl carbodi i mi de		$\text{C}_{13}\text{H}_{22}\text{N}_2$	538-75-0	206.327		34.5	123 ⁶ , 99 ^{0.5}			
3324	Di cycl ohexyl di sul fide		$\text{C}_{12}\text{H}_{22}\text{S}_2$	2550-40-5	230.433	li q		19 ⁹			
3325	Di cycl ohexyl et her		$\text{C}_{12}\text{H}_{22}\text{O}$	4645-15-2	182.302	li q	-36	242.5	0.9227 ⁹	1.4741 ²⁰	
3326	Di cycl ohexyl met hanone		$\text{C}_{12}\text{H}_{22}\text{O}$	119-60-8	194.313		57	159 ²⁰	0.986 ⁰	1.4860 ²⁰	s et h, ace, ct c
3327	Di cycl ohexyl phosphi ne		$\text{C}_{12}\text{H}_{23}\text{P}$	829-84-5	198.285			281; 129 ⁸	0.904 ²⁵	1.5163 ²⁰	
3328	Di cycl ohexyl pht hal at e		$\text{C}_{20}\text{H}_{36}\text{O}_4$	84-61-7	330.418	pr (al)	66	225 ⁹	1.383 ²⁰	1.431 ²⁰	i H ₂ O; s Et OH, et h; sl chl
3329	<i>N,N'</i> -Di cycl ohexyl t hi ourea		$\text{C}_{13}\text{H}_{24}\text{N}_2\text{S}$	1212-29-9	240.408	cry (MeOH)	180				
3330	1,3-Di cycl ohexyl urea		$\text{C}_{12}\text{H}_{24}\text{N}_2\text{O}$	2387-23-7	224.342		233.8				
3331	Di cycl omi ne hydrochl ori de	Di cycl overi ne hydrochl ori de	$\text{C}_{19}\text{H}_{35}\text{CCNO}_2$	67-92-5	345.948	cry	165				
3332	Di cycl opent adi ene		$\text{C}_{10}\text{H}_{12}$	1755-01-7	132.202		32	dec 170; 65 ¹⁴	0.9302 ²⁸	1.5050 ³⁵	vs et h, Et OH
3333	Di cycl opent yl et her	Cycl opent yl et her	$\text{C}_{10}\text{H}_{18}\text{O}$	10137-73-2	154.249	li q		8 ⁰			
3334	Di cycl opropyl ket one		$\text{C}_{10}\text{H}_{18}\text{O}$	1121-37-5	110.153			161	0.977 ²⁵	1.4670 ²⁰	
3335	Di decyl ami ne	<i>N</i> -Decyl -1-decanami ne	$\text{C}_{18}\text{H}_{37}\text{N}$	1120-49-6	297.562			359.0			
3336	Di decyl et her		$\text{C}_{18}\text{H}_{36}\text{O}$	2456-28-2	298.546		16	196 ^{15.5}	0.8187 ²⁰		
3337	Di decyl pht hal at e		$\text{C}_{26}\text{H}_{46}\text{O}_4$	84-77-5	446.663		2.5	240 ³	0.9639 ²⁰		
3338	3',4'-Di dehydro β , ψ -carot en-16'-oi c aci d	Torularhodi n	$\text{C}_{40}\text{H}_{52}\text{O}_2$	514-92-1	564.840	purp nd (MeOH-et h)	211				vs py, chl , CS ₂
3339	2',3'-Di deoxy nosi ne	Di danosi ne	$\text{C}_{10}\text{H}_{16}\text{N}_4\text{O}_3$	69655-05-6	236.227	wh cry (Et OH aq)	162				
3340	2,6-Di deoxy-3- <i>O</i> -met hyl <i>\beta</i> -D-hexose	Cymarose	$\text{C}_7\text{H}_{14}\text{O}_4$	579-04-4	162.184	pr (et h-pet h) nd (ace)	101				vs H ₂ O, ace, Et OH
3341	Di dodecanoyl peroxi de	Lauroyl peroxi de	$\text{C}_{24}\text{H}_{46}\text{O}_4$	105-74-8	398.620	wh pl	49				i H ₂ O; s chl
3342	Di dodecyl ami ne	<i>N</i> -Dodecyl -1-dodecanami ne	$\text{C}_{24}\text{H}_{51}\text{N}$	3007-31-6	353.669		53.7	263 ²⁷			vs bz, et h, Et OH, chl
3343	Di dodecyl phosphat e		$\text{C}_{24}\text{H}_{51}\text{O}_4\text{P}$	7057-92-3	434.633	cry (MeOH)	59				
3344	Di dodecyl pht hal at e	1,2-Benzenedi carboxyl i c aci d, di dodecyl est er	$\text{C}_{32}\text{H}_{54}\text{O}_4$	2432-90-8	502.769		22.0	256 ¹	0.9389 ²⁰		
3345	Di el dri n		$\text{C}_6\text{H}_6\text{Cl}_6\text{O}$	60-57-1	380.909		175.5		1.75 ²⁵		i H ₂ O; sl Et OH; s ace, bz
3346	Di enest rol		$\text{C}_{10}\text{H}_{18}\text{O}_2$	84-17-3	266.335	cry (di l al)	227.5	sub 130			vs ace, et h, Et OH
3347	1,2,8,9-Di epoxy β -ment hane	Li monene di epoxi de	$\text{C}_{10}\text{H}_{16}\text{O}_2$	96-08-2	168.233		242				
3348	Di et hanol ami ne	Bi s(2-hydroxyet hyl)ami ne	$\text{C}_4\text{H}_{11}\text{NO}_2$	111-42-2	105.136		28	268.8	1.0966 ²⁰	1.4776 ²⁰	vs H ₂ O, Et OH; sl et h, bz
3349	Di et hat yl , et hyl est er		$\text{C}_{16}\text{H}_{33}\text{ClNO}_3$	38727-55-8	311.804	cry	49.5				
3350	4,4'-Di et hoxyazobenzene		$\text{C}_{18}\text{H}_{18}\text{N}_2\text{O}_2$	588-52-3	270.326	ye lf (al)	162	dec			i H ₂ O; sl Et OH; s et h, bz, chl ; vs HOAc
3351	3,4-Di et hoxybenzal dehyde		$\text{C}_8\text{H}_{10}\text{O}_3$	2029-94-9	194.227		22	279; 200 ⁵⁰	1.0100 ²²		vs Et OH
3352	1,2-Di et hoxybenzene		$\text{C}_8\text{H}_{10}\text{O}_2$	2050-46-6	166.217	pr (pet h, di l al)	44	219	1.0075	1.5083 ²⁵	s Et OH, ct c; vs et h
3353	1,4-Di et hoxybenzene		$\text{C}_8\text{H}_{10}\text{O}_2$	122-95-2	166.217	pl (di l al)	72	246			vs Et OH; s et h, bz, ct c, chl
3354	4,4-Di et hoxy-1-but anami ne		$\text{C}_8\text{H}_{13}\text{NO}_2$	6346-09-4	161.243			196	0.933 ²⁵	1.4275 ²⁰	
3355	1,1-Di et hoxy N,N' -di met hyl met hanami ne		$\text{C}_4\text{H}_{17}\text{NO}_2$	1188-33-6	147.216			129	0.859 ²⁵	1.4007 ²⁰	



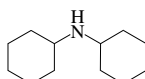
m-Di cyanobenzene



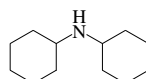
p-Di cyanobenzene



Di cycl ohexydi pat e

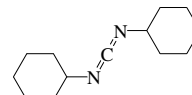


Di cycl ohexyl ami ne

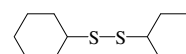


Di cycl ohexyl ami nē trī te

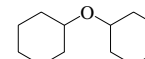
HNO₂



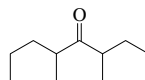
Di cycl ohexyl carbodi i mi de



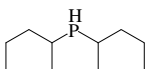
Di cycl ohexyli sul f i de



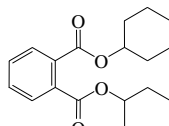
Di cycl ohexylēt her



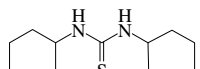
Di cycl ohexyl met hanone



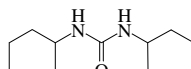
Di cycl ohexyl phosphi ne



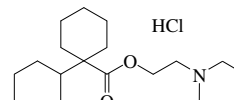
Di cycl ohexyphthalate



N,N'-Di cycl ohexyl t hi ourea



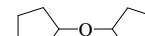
1,3-Di cycl ohexyl urea



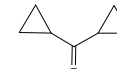
Di cycl omi rhydrochlori de



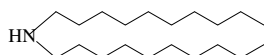
Di cycl opent adi ene



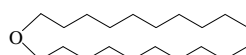
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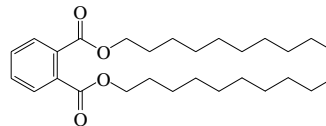
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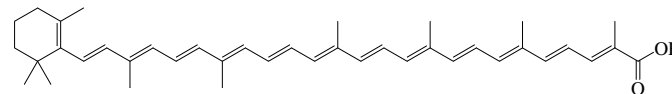
Di decyl ami ne



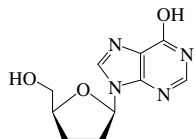
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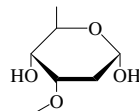
Di decyphthalate



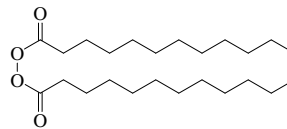
3',4'-Di dehydroβ,γ-carot en-16'-oi aci d



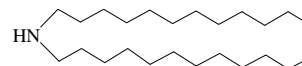
2',3'-Di deoxy nosi ne



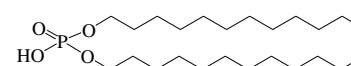
2,6-Di deoxy-3-O-met hylβ behexose



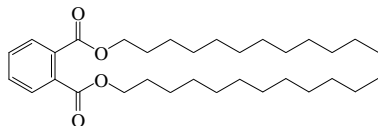
Di dodecanoylperoxi de



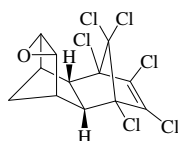
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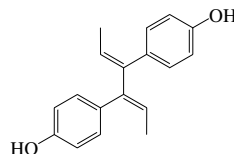
Di dodecylphosphat e



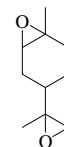
Di dodecylphthalate



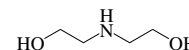
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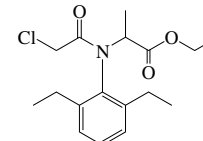
Di enest rol



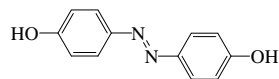
1,2,8,9-Di epoxyγ-ment hane



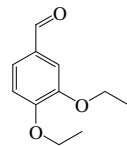
Di et hanol ami ne



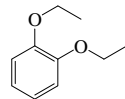
Di et hat ylt, hylest er



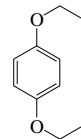
4,4'-Di et hoxyzobenzene



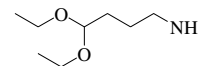
3,4-Di et hoxybenzal dehyd e



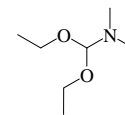
1,2-Di et hoxybenzene



1,4-Di et hoxybenzene

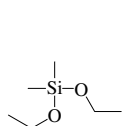


4,4-Di et hoxy-1-but anami ne

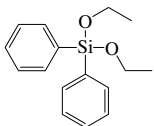


1,1-Di et hoxW,N-di met ylt met hanami ne

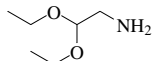
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3356	Di et hoxydi met hyl si l ane	Di met hyl di et hoxysi l ane	$\text{C}_6\text{H}_{16}\text{O}_2\text{Si}$	78-62-6	148.276	li q	-87	114	0.865	1.3811 ²⁰	s ct c
3357	Di et hoxydi phenyl si l ane		$\text{C}_{10}\text{H}_{16}\text{O}_2\text{Si}$	2553-19-7	272.415			302; 167 ⁹	1.0329 ²⁰	1.5269 ²⁰	
3358	2,2-Di et hoxyet hanami ne		$\text{C}_6\text{H}_8\text{NO}_2$	645-36-3	133.189	li q	-78	163	0.9159	1.4123 ²⁵	vs H ₂ O, et h, Et OH, chl
3359	1,1-Di et hoxyet hane	Acet al	$\text{C}_6\text{H}_8\text{O}_2$	105-57-7	118.174	li q	-100	102.25	0.8254	1.3834 ²⁰	s H ₂ O, chl; msc Et OH, et h; vs ace
3360	1,2-Di et hoxyet hane	Et hyl ene glycol di et hyl et her	$\text{C}_6\text{H}_{10}\text{O}_2\text{C}$	629-14-1	118.174	li q	-74.0	121.2	0.8357	1.3898 ²⁵	vs ace, bz, et h, Et OH
3361	1,1-Di et hoxyet hene		$\text{C}_8\text{H}_{12}\text{O}_2$	2678-54-8	116.158			68 ¹⁰⁰	0.7932 ²⁰	1.3643 ²¹	
3362	Di et hoxymet hane		$\text{C}_8\text{H}_{12}\text{O}_2$	462-95-3	104.148	li q	-66.5	88	0.8319	1.3748 ¹⁸	s H ₂ O; msc Et OH; vs ace, bz; sl chl
3363	2-(Di et hoxymet hyl) f uran		$\text{C}_8\text{H}_8\text{O}_3$	13529-27-6	170.205			191.5	0.9976 ²⁰	1.4451 ²⁰	vs Et OH
3364	Di et hoxymet hyl phenyl si l ane		$\text{C}_{11}\text{H}_{16}\text{O}_2\text{Si}$	775-56-4	210.346			218	0.9627	1.4690 ²⁰	
3365	Di et hoxymet hyl si l ane		$\text{C}_8\text{H}_{16}\text{O}_2\text{Si}$	2031-62-1	134.250			98	0.829		
3366	1,1-Di et hoxypent ane		$\text{C}_8\text{H}_{20}\text{O}_2$	3658-79-5	160.254			59 ¹²	0.829 ²²	1.4029 ²²	
3367	1,1-Di et hoxipropane		$\text{C}_8\text{H}_{16}\text{O}_2$	4744-08-5	132.201			123	0.825 ²⁰	1.3924 ¹⁹	s H ₂ O, ace, bz; vs Et OH, et h
3368	2,2-Di et hoxipropane		$\text{C}_8\text{H}_{16}\text{O}_2$	126-84-1	132.201			114	0.8200 ²¹	1.3891 ²⁰	s Et OH, ace, bz; vs et h; sl ct c
3369	3,3-Di et hoxi-1-propene	Acrol ei n, di et hyl acet al	$\text{C}_7\text{H}_{14}\text{O}$	3054-95-3	130.185			123.5	0.8543 ¹⁵	1.4000 ²⁰	sl H ₂ O; msc Et OH, et h
3370	3,3-Di et hoxi-1-propyne		$\text{C}_8\text{H}_{12}\text{O}_2$	10160-87-9	128.169			139	0.8942 ²²	1.4140 ²⁰	vs ace, et h, Et OH, chl
3371	<i>N,N</i> -Di et hyl acet ami de		$\text{C}_8\text{H}_{15}\text{NO}$	685-91-6	115.173			185.5	0.9130 ¹⁷	1.4374 ¹⁷	s H ₂ O, Et OH; msc et h, ace, bz; sl ct c
3372	Di et hyl 2-acet ami domal onat e		$\text{C}_8\text{H}_{15}\text{NO}_5$	1068-90-2	217.219	cry (al, bz-pet h)	96.3	185			sl H ₂ O, et h; s t f a, Et OH
3373	<i>N,N</i> -Di et hyl acet oacet ami de		$\text{C}_8\text{H}_{15}\text{NO}_2$	2235-46-3	157.211	li q		78			
3374	Di et hyl acet yl phosphonat e		$\text{C}_8\text{H}_{15}\text{O}_4\text{P}$	919-19-7	180.138			114 ²⁰	1.1005 ²⁰	1.4200 ²⁶	
3375	Di et hyl 2-acet yl succi nat e		$\text{C}_{10}\text{H}_{19}\text{O}_5$	1115-30-6	216.231			255; 133 ¹⁷	1.081 ²⁰	1.4346 ²⁰	i H ₂ O; s Et OH, et h, bz; sl chl
3376	Di et hyl adi pat e		$\text{C}_{10}\text{H}_{18}\text{O}_4$	141-28-6	202.248	li q	-19.8	245	1.0078	1.4272 ²⁰	i H ₂ O; s Et OH, et h
3377	Di et hyl 2-ali l mal onat e		$\text{C}_{10}\text{H}_{18}\text{O}_4$	2049-80-1	200.232			222.5; 93 ⁶	1.0098 ²⁰	1.4305 ²⁰	i H ₂ O; vs Et OH, et h; s ct c
3378	Di et hyl ami ne	<i>N</i> -Et hyl et hanami ne	$\text{C}_6\text{H}_{11}\text{N}$	109-89-7	73.137	li q	-49.8	55.5	0.7058	1.3864 ²⁰	vs H ₂ O; msc Et OH; s et h, ct c
3379	Di et hyl ami ne hydrochl ori de	<i>N</i> -Et hyl et hanami ne hydrochl ori de	$\text{C}_6\text{H}_{12}\text{ClN}$	660-68-4	109.598	lf (al-et h)	228.5		1.0477		vs H ₂ O, Et OH
3380	(Di et hyl ami no)acet oni t ri l e		$\text{C}_8\text{H}_{17}\text{NO}$	3010-02-4	112.172			170	0.8660 ²⁰	1.4260 ²⁰	s H ₂ O
3381	4-(Di et hyl ami no)benzal dehyde		$\text{C}_{11}\text{H}_{15}\text{NO}$	120-21-8	177.243	ye nd (w)	41	172 ¹⁰			vs H ₂ O; s Et OH, et h, bz, ct c
3382	2-(Di et hyl ami no)(2,6-di met hyl phenyl)acet ami de	Li docai ne	$\text{C}_{14}\text{H}_{22}\text{N}_2\text{O}$	137-58-6	234.337	nd (bz, al)	68.5	181 ⁴			vs bz, et h, Et OH, chl
3383	2-(Di et hyl ami no)(2,6-di met hyl phenyl)acet ami de, monohydrochl ori de		$\text{C}_{14}\text{H}_{23}\text{ClN}_2\text{O}$	73-78-9	270.798		128				vs H ₂ O
3384	2-Di et hyl ami noet hanol		$\text{C}_8\text{H}_{15}\text{NO}$	100-37-8	117.189	hyg		163	0.8921 ²⁰	1.4412 ²⁰	msc H ₂ O; s Et OH, et h, ace, bz, pet h; sl ct c
3385	2-[2-(Di et hyl ami no)et hoxyl et hanol		$\text{C}_8\text{H}_{15}\text{NO}_2$	140-82-9	161.243			221.5; 92 ⁷	0.9421 ²⁵	1.4480 ²⁰	
3386	2-(Di et hyl ami no)et hyl acryl at e		$\text{C}_8\text{H}_{17}\text{NO}_2$	2426-54-2	171.237		<-60	81 ¹⁰	0.937 ²⁰	1.4376 ²⁵	
3387	2-Di et hyl ami noet hyl 4-ami nobenzoat e	Procai ne	$\text{C}_{13}\text{H}_{20}\text{NO}_2$	59-46-1	236.310	nd (w+2) pl (li g 61 or et h)					sl H ₂ O; s Et OH, et h, bz, chl
3388	2-(<i>N,N</i> -Di et hyl ami no)et hyl met hacryl at e		$\text{C}_{10}\text{H}_{19}\text{NO}_2$	105-16-8	185.264			80 ¹⁰	0.92 ³⁰		
3389	2-(Di et hyl ami no)et hyl 2-phenyl but anoa t e	But et hamat e	$\text{C}_{16}\text{H}_{25}\text{NO}_2$	14007-64-8	263.376			168 ¹¹		1.4909 ²⁰	
3390	4-(Di et hyl ami no)-2-hydroxybenzal dehyde		$\text{C}_{11}\text{H}_{15}\text{NO}_2$	17754-90-4	193.243		65.0				
3391	Di et hyl 2-ami nomal onat e		$\text{C}_7\text{H}_9\text{NO}_4$	6829-40-9	175.183			122 ¹⁶ , 116 ¹²	1.100 ¹⁶	1.4353 ¹⁶	vs H ₂ O, Et OH, et h; s ace, bz; i li g
3392	7-(Di et hyl ami no)-4-met hyl-2-benzopyran-2-one		$\text{C}_{14}\text{H}_{17}\text{NO}_2$	91-44-1	231.291	cry (al, bz-li g)					sl; s Et OH, et h, ace



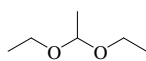
Di et hoxydi met hyl si l ane



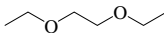
Di et hoxydi phenyl si l ane



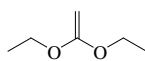
2,2-Di et hoxyet hanami ne



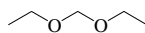
1,1-Di et hoxyet hane



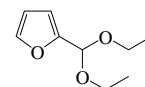
1,2-Di et hoxyet hane



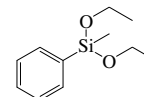
1,1-Di et hoxyet hene



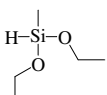
Di et hoxymet hane



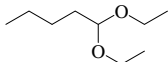
2-(Di et hoxymet hyl) f uran



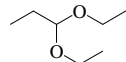
Di et hoxymet hyl phenyl si l ane



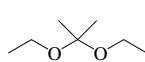
Di et hoxymet hyl si l ane



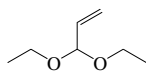
1,1-Di et hoxypent ane



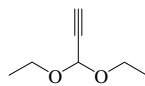
1,1-Di et hoxypropane



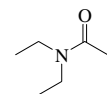
2,2-Di et hoxypropane



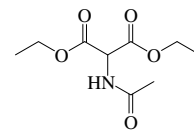
3,3-Di et hoxyl-propene



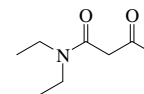
3,3-Di et hoxyl-propyne



N,N-Di et hyl acet ami de

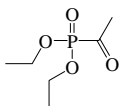


Di et hyl²-acet ami domal onat e

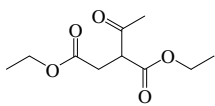


N,N-Di et hyl acet oacet ami de

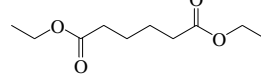
3-181



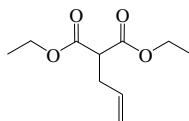
Di et hyl²et yl phosphonat e



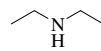
Di et hyl²-acet yl succi nat e



Di et hyl²di pat e



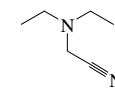
Di et hyl²-al lyl mal onat e



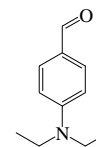
Di et hyl ami ne



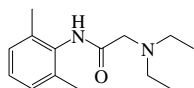
Di et hyl ami hydrochl ori de



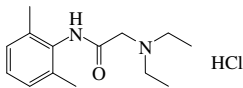
(Di et hyl ami no)acet oni t ri l



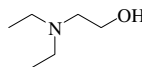
(Di et hyl ami no)benzal dehyde



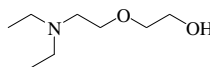
2-(Di et hyl ami no)^{2,6}-di met hyl phenyl)acet ami de



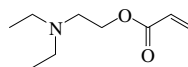
2-(Di et hyl ami no)^{2,6}-di met hyl phenyl)acet ami dehydrochl ori de



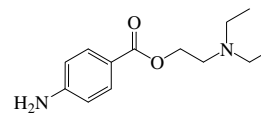
2-Di et hyl ami noet hanol



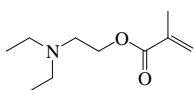
2-[2-(Di et hyl ami no)et hoxyl]et hanol



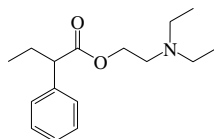
2-(Di et hyl ami no)et hyl acryl at e



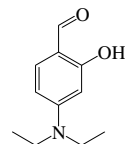
2-Di et hyl ami noet hyl ami nobenzoat e



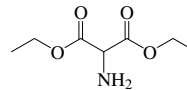
2-(*N,N*-Di et hyl ami no)et hyl acryl at e



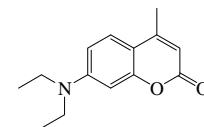
2-(Di et hyl ami no)et hyl phenyl but anoat e



4-(Di et hyl ami no)-2-hydroxybenzal dehyde

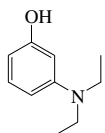


Di et hyl²-ami nomal onat e

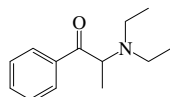


7-(Di et hyl ami no)-4-met hyl-2-benzopyran-2-one

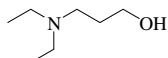
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3393	3-(Di et hyl ami no)phenol		$_{10}C_{15}NO$	91-68-9	165.232	ort h bi pym (CS ₂ -li g)	78	276; 170 ¹⁵			s H ₂ O, Et OH, et h, C ₈ S ₂ li g
3394	2-(Di et hyl ami no)-1-phenyl-1-propanone	Di et hyl propi on	$_{13}C_{15}NO$	90-84-6	205.296	li q		11 ¹⁴			
3395	3-(Di et hyl ami no)-1-propanol		$_{7}HCNO$	622-93-5	131.216			189.5	0.8600 ²⁰	1.4439 ²⁰	s Et OH; s et h, ace, bz; sl chl
3396	3-(Di et hyl ami no)-1-propyne	<i>M,M</i> -Di et hyl -2-propargyl ami ne	$_{7}HC_3N$	4079-68-9	111.185	li q		120			
3397	2,6-Di et hyl ani li ne		$_{10}HC_6N$	579-66-8	149.233		1.5	243	0.906 ²⁵	1.5452 ²⁰	
3398	<i>N,M</i> -Di et hyl ani li ne		$_{10}HC_6N$	91-66-7	149.233	ye oi l	-38.8	216.3	0.930 ⁷	1.5409 ²⁰	sl H ₂ O; s Et OH, ace, ct c; vs et h, chl
3399	Di et hyl arsi ne		$_{4}HC_2As$	692-42-2	134.052			105	1.1338 ²⁴	1.4709	vs ace, bz, et h, Et OH
3400	<i>M,M</i> -Di et hyl benzami de		$_{11}H_{15}NO$	1696-17-9	177.243			132 ⁵			
3401	<i>o</i> -Di et hyl benzene	1,2-Di et hyl benzene	$_{10}HC_8$	135-01-3	134.218	li q	-31.2	184	0.880 ⁰	1.5035 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
3402	<i>m</i> -Di et hyl benzene	1,3-Di et hyl benzene	$_{10}HC_8$	141-93-5	134.218	li q	-83.9	181.1	0.860 ²	1.4955 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
3403	<i>p</i> -Di et hyl benzene	1,4-Di et hyl benzene	$_{10}HC_8$	105-05-5	134.218	li q	-42.83	183.7	0.862 ⁰	1.4967 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
3404	<i>N,M</i> -Di et hyl -1,4-benzenedi ami ne		$_{10}HC_6N_2$	93-05-0	164.247			261			vs bz
3405	Di et hyl benzyl i denemal onat e	Di et hyl benzal mal onat e	$_{14}H_{16}O_4C$	5292-53-5	248.275		32	216 ³⁰ , 196 ¹⁴	1.1045 ²⁰	1.5389 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
3406	Di et hyl benzyl mal onat e		$_{14}HC_8O_4$	607-81-8	250.291			300	1.076 ¹⁵	1.4872 ²⁰	i H ₂ O; sl chl
3407	Di et hyl benzyl phosphonat e		$_{11}H_7O_3P$	1080-32-6	228.225			110 ²		1.4930 ²⁰	s ct c
3408	Di et hyl bromoacet ami de	2-Bromo-2-et hyl but anami de	$_{6}H_9BrNO$	511-70-6	194.069		67				sl H ₂ O, chl ; vs Et OH, et h, bz
3409	Di et hyl 2-bromomal onat e	Et hyl bromomal onat e	$_{7}H_{11}BrO_4$	685-87-0	239.064		-54	dec 254	1.4022 ²⁵	1.4521 ²⁰	i H ₂ O; msc Et OH, et h; s ace, ct c
3410	<i>M,M</i> -Di et hyl but anami de		$_{8}HCNO$	1114-76-7	143.227			206	0.8884 ²⁰	1.4403 ²⁵	vs H ₂ O, Et OH
3411	Di et hyl 2-but yl mal onat e	Pent ane-1,1-di carboxyl i caci d, d ₂ est er	$_{10}H_{16}O_4$	133-08-4	216.275			238	0.9764 ²⁰	1.4250 ²⁰	vs Et OH, et h
3412	Di et hyl 2-but ynedi oat e		$_{8}H_{10}O_4$	762-21-0	170.163		0.8	184 ²⁰⁰	1.0075 ²⁰	1.4425 ²⁰	s Et OH, et h, ct c
3413	Di et hyl carbamazi ne ci t rat e		$_{10}H_{16}O_8$	1642-54-2	391.416	cry	138				
3414	Di et hyl carbami c chl ori de		$_{5}H_6ClNO$	88-10-8	135.592			186			
3415	<i>N,N</i> -Di et hyl carbani li de		$_{17}HC_9N_2O$	85-98-3	268.353	cry (al)	79				i H ₂ O; vs Et OH; s chl
3416	Di et hyl carbonat e	Et hyl carbonat e	$_{2}H_2O_3$	105-58-8	118.131	li q	-43	126	0.969 ²	1.3845 ²⁰	i H ₂ O; s Et OH, et h, chl
3417	<i>O,O</i> -Di et hyl chl ori dot hi onophosphat e	Di et hyl t hi ophosphoryl chl ori de	$_{10}ClO_4P$	2524-04-1	188.613			45 ³			s ct c
3418	Di et hyl chl oral umi num		$_{4}HC_6AlCl$	96-10-6	120.557			134 ⁴			
3419	Di et hyl chl oromal onat e	Et hyl chl oromal onat e	$_{7}H_9CCO_3$	14064-10-9	194.613			222	1.2040 ²⁰	1.4327 ²⁰	i H ₂ O; msc Et OH, et h, chl ; s C ₈ S
3420	Di et hyl chl orophosphonat e	Di et hoxylphosphoryl chl ori de	$_{4}H_{10}CCO_3P$	814-49-3	172.547			93.5	1.205 ¹⁹	1.4170 ²⁰	
3421	Di et hyl cyanami de		$_{5}HC_3N_2$	617-83-4	98.146	li q	-80.6	188	0.854 ⁴	1.4126 ²⁵	i H ₂ O; s Et OH, et h
3422	Di et hyl 1,1-cycl obut anedi carboxyl at e		$_{10}H_{16}O_4$	3779-29-1	200.232			224	1.0456 ²⁰	1.4330 ²⁶	vs Et OH; sl ct c
3423	1,1-Di et hyl cycl ohexane		$_{10}H_{20}$	78-01-3	140.266			179.5			
3424	Di et hyl 1,1-cycl opropanedi carboxyl at e		$_{6}H_{10}O_4$	1559-02-0	186.205			215; 100 ¹²	1.055 ²⁵	1.4345 ¹⁸	vs Et OH, et h
3425	Di et hyl di but yl mal onat e		$_{15}H_{22}O_4$	596-75-8	272.381			150 ¹²	0.9457 ²⁰	1.4341 ²⁰	i H ₂ O; s Et OH, et h, ct c
3426	Di et hyl di carbonat e	Pyrocarboni c aci d di et hyl est er	$_{10}H_{10}O_5C$	1609-47-8	162.140			93 ¹⁸	1.120 ²⁰	1.3960 ²⁰	vs ace, Et OH, li g
3427	Di et hyl [(di et hanol ami no) met hyl]phosphonat e		$_{9}H_{22}NO_3P$	2781-11-5	255.249	li q		150 ¹¹			
3428	5,5-Di et hyl di hydr ² 2,3-oxazi ne-2,4(3 <i>H</i>)-di one	Di et hadi one	$_{8}H_9NO_3$	702-54-5	171.194	cry (et h)	97.5				
3429	Di et hyl 1,4-di hydro-2,4,6-tri met hy3,5-Di et hoxycarbonyl -1,4-3,5-pyri di nedi carboxyl at e	Di et hydrocol i di ne	$_{14}H_{21}NO_4$	632-93-9	267.322	lt bl flr pl (al)	131				sl ₂ O Et OH, et h, C ₈ S vs chl



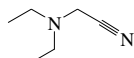
3-(Diethylamino)phenol



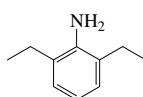
2-(Diethylamino)-1-phenylpropanone



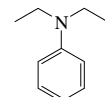
3-(Diethylamino)propan-1-ol



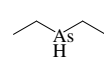
3-(Diethylamino)prop-1-yn-1-ol



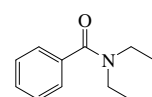
2,6-Diethylaniline



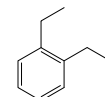
N,N-Diethylaniline



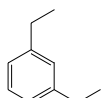
Diethylarsine



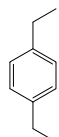
N,N-Diethylbenzamide



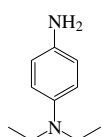
o-Diethylbenzene



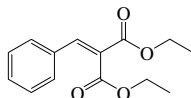
m-Diethylbenzene



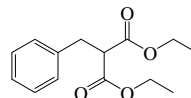
p-Diethylbenzene



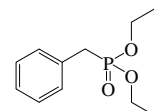
N,N-Diethyl-1,4-benzenediamine



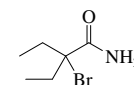
Diethyl benzylidene malonate



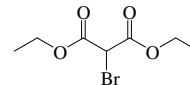
Diethyl benzyl malonate



Diethyl benzyl phosphonate

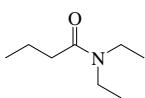


Diethyl bromoacetamide

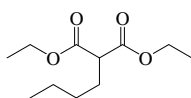


Diethyl bromomalonate

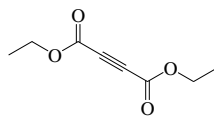
3-183



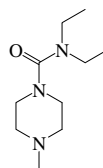
N,N-Diethylbutanamide



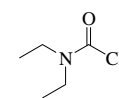
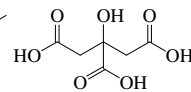
Diethylbutyl malonate



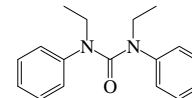
Diethylbut-2-ynedioate



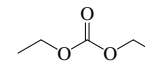
Diethyl carbamazepine



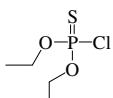
Diethyl carbamoyl chloride



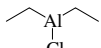
N,N-Diethylcarbaniline



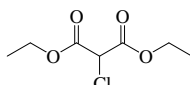
Diethyl carbonate



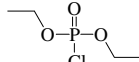
O,O-Diethyl dichlorophosphate



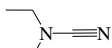
Diethyl chloroaluminum



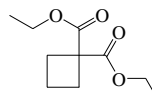
Diethyl chloromalonate



Diethyl chlorophosphate



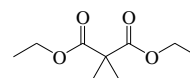
Diethyl cyanamide



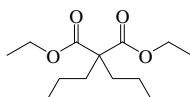
Diethyl 1,1-cyclobutanedicarboxylate



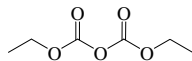
1,1-Diethylcyclohexane



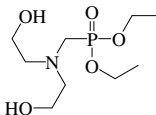
Diethyl 1,1-cyclopropanedicarboxylate



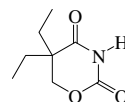
Diethylbutyl malonate



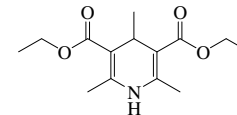
Diethyl carbonate



Diethylbis(hydroxyethyl)phosphonate



5,5-Diethyl-2,3-dihydro-2,3-oxazepine-2,4-dione

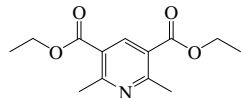


Diethyl 1,4-dihydro-2,4,6-trimethyl-3,5-pyridinedicarboxylate

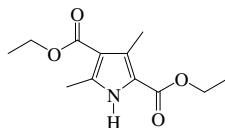
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3430	Di et hyl di met hyl lead	Di et hyl di met hyl plumbane	$\text{Pb}_2\text{H}_{16}\text{C}$	1762-27-2	295.4	col li q		51	1.79 ²⁰		
3431	Di et hyl 2,6-di met hyl -3,5-pyridi nedi carboxyl at e		$\text{C}_{13}\text{H}_{17}\text{NO}_4$	1149-24-2	251.279		71	301; 208 ⁴⁰			i H ₂ O; s Et OH, et h, bz, chl, li g
3432	Di et hyl 3,5-di met hyl pyrrol e-2,4-di carboxyl at e		$\text{C}_{12}\text{H}_{17}\text{NO}_4$	2436-79-5	239.268	nd (di l al)	137.8				i ₂ OH sl Et OH, et h; s ace, bz, HOAc
3433	Di et hyl di sul fide		H_2CS_2	110-81-6	122.252	li q	-101.5	154.0	0.993 ⁴⁹	1.5073 ²⁰	sl H ₂ O; msc Et OH, et h
3434	N,N-Di et hyl dodecanami de		$\text{C}_{33}\text{H}_{69}\text{NO}$	3352-87-2	255.439			166 ²	0.847 ²⁵	1.4545 ²⁰	s chl
3435	Di et hyl ene glycol	Di glycol	$\text{C}_2\text{H}_4\text{O}_2$	111-46-6	106.120	li q	-10.4	245.8	1.119 ⁷	1.4472 ²⁰	s H ₂ O, Et OH, et h, chl
3436	Di et hyl ene glycol, bi schl orof ormat e	Oxydi -2,1-et hanedi yl carbonochlori dat e	$\text{C}_6\text{H}_8\text{Cl}_2\text{O}_5$	106-75-2	231.031	li q		126	1.39 ²⁰	1.4542 ²⁰	
3437	Di et hyl ene glycol di acet at e		$\text{C}_4\text{H}_{10}\text{O}_5$	628-68-2	190.194		18	200	1.1068 ¹⁵	1.4348 ²⁰	vs Et OH
3438	Di et hyl ene glycol di benzoat e		$\text{C}_{18}\text{H}_{16}\text{O}_5$	120-55-8	314.333		33.5	280 ²⁴ , 250 ¹	1.1690 ¹⁵		vs H ₂ O, Et OH
3439	Di et hyl ene glycol di but yl et her	Bi s(2-but oxyet hyl) et her	$\text{C}_{12}\text{H}_{26}\text{O}_3$	112-73-2	218.332	li q	-60	256	0.885 ⁵	1.4235 ²⁰	
3440	Di et hyl ene glycol di et hyl et her	Bi s(2-et hoxyet hyl) et her	$\text{C}_8\text{H}_{18}\text{O}_3$	112-36-7	162.227	li q	-45	188	0.906 ³	1.4115 ²⁰	vs H ₂ O, Et OH; s et h
3441	Di et hyl ene glycol di met hacryl at e	Oxydi et hyl ene met hacryl at e	$\text{C}_{12}\text{H}_{18}\text{O}_5$	2358-84-1	242.268			>200; 150 ³	1.0821 ²⁰	1.4571 ²⁵	
3442	Di et hyl ene glycol di met hyl et her	Di glyme	$\text{C}_4\text{H}_{10}\text{O}_2$	111-96-6	134.173	li q	-68	162	0.943 ⁴	1.4097 ²⁰	msc H ₂ O, Et OH, et h
3443	Di et hyl ene glycol di ni t rat e	2,2'-Oxybi set hanol, di ni t rat e	$\text{C}_4\text{H}_{10}\text{N}_2\text{O}_7$	693-21-0	196.116			44 ⁰¹			
3444	Di et hyl ene glycol monobut yl et her		$\text{C}_8\text{H}_{18}\text{O}_3$	112-34-5	162.227	li q	-68	231	0.955 ³	1.4306 ²⁰	msc H ₂ O; vs Et OH, et h, ace; s bz
3445	Di et hyl ene glycol monobut yl et her 2-(2-But oxyet hoxy)et hyl acet at e	2-(2-But oxyet hoxy)et hyl acet at e	$\text{C}_{10}\text{H}_{20}\text{O}_4$	124-17-4	204.264	li q	-32	245	0.985 ⁵	1.4262 ²⁰	vs ace, et h, Et OH
3446	Di et hyl ene glycol monododecanoat e	2-(2-Hydroxyet hoxy)et hyl laurat e	$\text{C}_{16}\text{H}_{32}\text{O}_4$	141-20-8	288.423	lt ye	17.5	>270	0.96 ⁵		msc Et OH, et h, ace; s bz, t ol
3447	Di et hyl ene glycol monoet hyl et her	Carbi t ol	$\text{C}_4\text{H}_{10}\text{O}_2$	111-90-0	134.173	hyg li q		196	0.988 ⁵	1.4300 ²⁰	msc H ₂ O, Et OH, ace, bz; vs et h
3448	Di et hyl ene glycol monoet hyl et her Carbi t ol acet at e	Carbi t ol acet at e	$\text{C}_6\text{H}_{12}\text{O}_4$	112-15-2	176.211	li q	-25	218.5	1.009 ⁶	1.4213 ²⁰	vs H ₂ O, ace, et h, Et OH
3449	Di et hyl ene glycol monohexyl et her	2-[2-(Hexyl oxy)et hoxy]et hanol	$\text{C}_{10}\text{H}_{22}\text{O}_2$	112-59-4	190.280	col li q	-28	258; 192 ⁰			
3450	Di et hyl ene glycol monomet hyl et her	2-(2-Met hoxyet hoxy)et hanol	$\text{C}_8\text{H}_{18}\text{O}_3$	111-77-3	120.147			193	1.035 ²⁰	1.4264 ²⁰	msc H ₂ O, ace; vs Et OH, et h
3451	Di et hyl ene glycol monopropyl et her		$\text{C}_7\text{H}_{14}\text{O}_3$	6881-94-3	148.200	li q	-53.3	213; 124 ¹			
3452	N,N-Di et hyl -1,2-et hanedi ami ne	N,N-Di et hyl et hyl enedi ami ne	$\text{C}_8\text{H}_{18}\text{O}_2$	100-36-7	116.204			144	0.8280 ²⁰	1.4340 ²⁰	msc H ₂ O; s Et OH, et h, ct c, t ol
3453	N,N-Di et hyl -1,2-et hanedi ami ne		$\text{C}_8\text{H}_{18}\text{O}_2$	111-74-0	116.204			146	0.8280 ²⁰	1.4340 ²⁰	vs H ₂ O, et h, Et OH, t ol
3454	Di et hyl et her	Et hyl et her	$\text{C}_2\text{H}_6\text{O}$	60-29-7	74.121	li q	-116.2	34.5	0.713 ³	1.3526 ²⁰	sl H ₂ O; msc Et OH, bz, et h; vs ace
3455	Di et hyl (et hoxyet hyl ene)mal onat e	2-Et hoxy-1,1-bi s(et hoxy)carbonyl et hene	$\text{C}_{10}\text{H}_{18}\text{O}_5$	87-13-8	216.231			dec 280; 165 ¹⁹		1.4600 ²⁰	i H ₂ O; s Et OH, et h; sl chl
3456	Di et hyl et hyl i denemal onat e		$\text{C}_8\text{H}_{14}\text{O}_4$	1462-12-0	186.205			116 ¹⁷ , 86 ³	1.0404 ²⁰	1.4308 ¹⁷	vs et h, Et OH
3457	Di et hyl et hyl mal onat e		$\text{C}_8\text{H}_{14}\text{O}_4$	133-13-1	188.221			208; 98 ¹²	1.006 ²⁰	1.4166 ²⁰	sl H ₂ O; vs Et OH, et h, ace, chl
3458	Di et hyl et hyl phenyl mal onat e		$\text{C}_{13}\text{H}_{16}\text{O}_4$	76-67-5	264.318			170 ¹⁹	1.071 ²⁰	1.4896 ²⁵	i H ₂ O; s Et OH, et h; sl chl
3459	Di et hyl et hyl fosphonat e		$\text{C}_3\text{H}_7\text{O}_3\text{P}$	78-38-6	166.155			198; 90 ¹⁶	1.0259 ²⁰	1.4163 ²⁰	sl H ₂ O; s Et OH, et h
3460	N,N-Di et hyl f ormati de		$\text{C}_5\text{H}_9\text{NO}$	617-84-5	101.147			177.5	0.9080 ¹⁹	1.4321 ²⁵	msc H ₂ O, ace, bz; vs Et OH, et h
3461	Di et hyl f umarat e		$\text{C}_8\text{H}_{16}\text{O}_4$	623-91-6	172.179		0.8	214	1.0452 ²⁰	1.4412 ²⁰	i H ₂ O; s ace, chl
3462	Di et hyl gl ut arat e		$\text{C}_6\text{H}_{12}\text{O}_4$	818-38-2	188.221	syr li q	-24.1	236.5	1.022 ⁰	1.4241 ²⁰	vs et h
3463	3,4-Di et hyl hexane		C_8H_{18}	19398-77-7	142.282			163.9	0.7472 ²⁵	1.4190 ²⁰	
3464	Di -2-et hyl hexyl mal eat e		$\text{C}_{20}\text{H}_{38}\text{O}_4$	142-16-5	340.498			156 ⁷	0.94 ²⁰		
3465	1,2-Di et hyl hidrazi ne		$\text{C}_2\text{H}_4\text{N}_2$	1615-80-1	88.151			85.5	0.797 ²⁶	1.4204 ²⁰	vs bz, et h, Et OH
3466	Di et hyl 1,2-hidrazi nedi carboxyl at e	Di et hyl bi carbamat e	$\text{C}_6\text{H}_{12}\text{N}_2\text{O}_6$	4114-28-7	176.170	nd (chl), pr (w)	135	dec 250	1.32 ⁴		vs et h, Et OH
3467	Di et hyl hydrogen fosphat e	Di et hyl fosphat e	$\text{C}_4\text{H}_{11}\text{O}_6\text{P}$	598-02-7	154.101	syr		dec 203; 87 ^{0.0001}	1.1800 ²⁰	1.4170 ²⁰	vs et h
3468	N,N-Di et hyl -4-hydroxy-3-met hoxybenzami de	Et hami van	$\text{C}_9\text{H}_{17}\text{NO}_3$	304-84-7	223.268		95				s chl



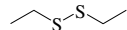
Di et hyl di met hyl lead



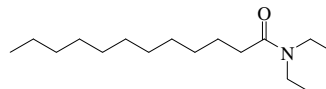
Di et hyl 2,6-di met hyl -3,5-pyri di nedi carboxyl at e



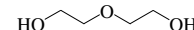
Di et hyl 3,5-di met hyl pyrrol e-2,4-di carboxyl at e



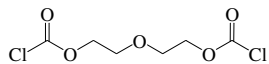
Di et hyl sul f i de



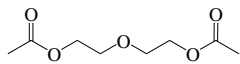
N,N-Di et hyl dodecanami de



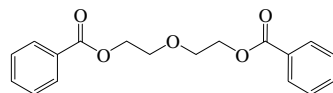
Di et hyl engly col



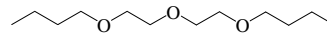
Di et hyl engly col di schlor of ormat e



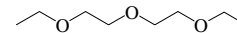
Di et hyl engly col di acet at e



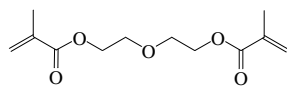
Di et hyl engly col di benzoat e



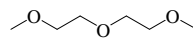
Di et hyl engly col di but ylt her



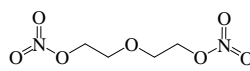
Di et hyl engly col di et hylt her



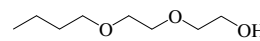
Di et hyl engly col di met hacryl at e



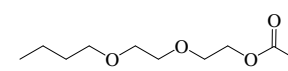
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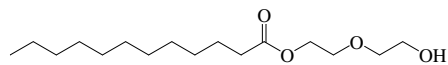
Di et hyl engly col di ni t rat e



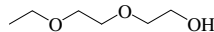
Di et hyl engly col monobut ylet her



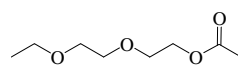
Di et hyl engly col monobut ylet heracet at e



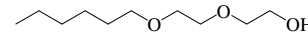
Di et hyl engly col monododecanoat e



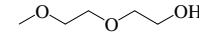
Di et hyl engly col monoet hylet her



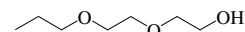
Di et hyl engly col monoet hylet heracet at e



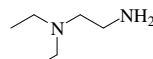
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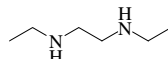
Di et hyl engly col monomet hylet her



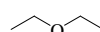
Di et hyl engly col monopropyl et her



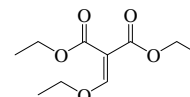
N,N-Di et hyl -1,2-et hanedi ami ne



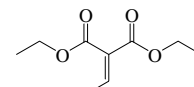
N,N'-Di et hyl -1,2-et hanedi ami ne



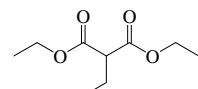
Di et hylt her



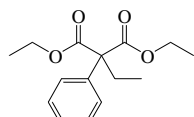
Di et hyl (et hoxymet hyl ene)mal onat e



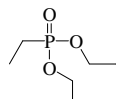
Di et hylt hyl i denemal onat e



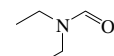
Di et hylt hyl mal onat e



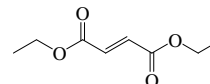
Di et hylt hyl phenyl mal onat e



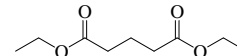
Di et hylt hyl fosphonat e



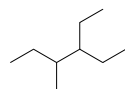
N,N-Di et hyl f ormami de



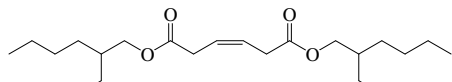
Di et hylt umarat e



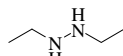
Di et hylt ut arat e



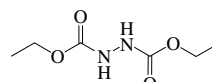
3,4-Di et hyl hexane



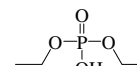
Di -2-et hyl hexyl seac at e



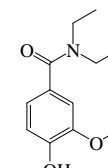
1,2-Di et hyl hydrazi ne



Di et hyl,2-hydrazi nedi carboxyl at e

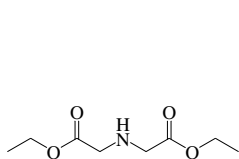


Di et hyl hydrogen fosphat e

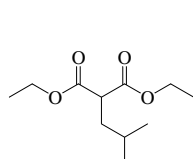


N,N-Di et hyl -4-hydroxy-3-met hoxybenzami de

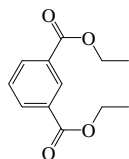
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3469	Di et hyl i mi nodi acet at e		$\text{C}_8\text{H}_{15}\text{NO}_4$	6290-05-7	189.210	ort h cry	247 dec				
3470	Di et hyl i sobut yl mal onat e		$\text{C}_{11}\text{H}_{20}\text{O}_4$	10203-58-4	216.275				0.9804 ²⁰	1.4236 ²⁰	i H ₂ O; vs Et OH, et h; s chl
3471	Di et hyl i sopht hal at e		$\text{C}_{12}\text{H}_{20}\text{O}_4$	636-53-3	222.237		11.5	302	1.1239 ¹⁷	1.508 ¹⁸	i H ₂ O
3472	Di et hyl i sopropyl i denemal onat e		$\text{C}_{10}\text{H}_{18}\text{O}_4$	6802-75-1	200.232			176.5; 116 ¹⁴	1.0282 ¹⁸	1.4486 ¹⁷	vs ace, Et OH
3473	Di et hyl i sopropyl mal onat e	Et hyl i sopropyl mal onat e	$\text{C}_{10}\text{H}_{18}\text{O}_4$	759-36-4	202.248			215	0.9961 ²⁰	1.4188 ²¹	sl H ₂ O, ct c; vs Et OH, et h; s chl
3474	Di et hyl ket omal onat e	Et hyl mesoxal at e	$\text{C}_7\text{H}_{10}\text{O}_5$	609-09-6	174.151	pa ye grn oi l	-30	210; 10 ⁹	1.1419 ¹⁶	1.4310 ²²	vs H ₂ O; s Et OH, et h, chl; i CS
3475	Di et hyl mal at e	Di et hyl hydroxybut anedi oat e	$\text{C}_8\text{H}_{14}\text{O}_5$	7554-12-3	190.194			253; 124 ¹³	1.1290 ²⁰		
3476	Di et hyl mal eat e		$\text{C}_8\text{H}_{14}\text{O}_4$	141-05-9	172.179	li q	-8.8	223	1.0662 ⁹	1.4416 ²⁰	i H ₂ O; s Et OH, et h; sl chl
3477	Di et hyl mal onat e		$\text{C}_7\text{H}_{10}\text{O}_4$	105-53-3	160.168	li q	-50	200	1.055 ⁹	1.4139 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace, bz
3478	Di et hyl mercury		$\text{C}_8\text{H}_{10}\text{Hg}$	627-44-1	258.71			159; 57 ¹⁶	2.43 ²⁰		s et h; sl Et OH
3479	Di et hyl met hyl ami ne	<i>N</i> -Et hyl <i>N</i> -met hyl et hanami ne	$\text{C}_7\text{H}_{13}\text{N}$	616-39-7	87.164	li q	-196	66	0.70 ⁹	1.3879 ²⁵	vs H ₂ O, Et OH, et h
3480	<i>N,N</i> -Di et hyl -2-met hyl ani li ne		$\text{C}_{11}\text{H}_{17}\text{N}$	606-46-2	163.260	li q	-60	209	0.928 ⁶	1.5153 ²⁰	sl H ₂ O; msc Et OH, et h; s ct c
3481	<i>N,N</i> -Di et hyl -4-met hyl ani li ne		$\text{C}_{11}\text{H}_{17}\text{N}$	613-48-9	163.260			229	0.9242 ¹⁵		sl H ₂ O; msc Et OH, et h
3482	<i>N,N</i> -Di et hyl -3-met hyl benzami de	DEET	$\text{C}_{12}\text{H}_{17}\text{NO}$	134-62-3	191.269			160 ¹⁹ , 111 ¹	0.996 ²⁰	1.5212 ²⁰	vs H ₂ O, bz, et h, Et OH
3483	1,3-Di et hyl -5-met hyl benzene		$\text{C}_{11}\text{H}_{16}$	2050-24-0	148.245	li q	-74.1	205	0.874 ⁸	1.5027 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
3484	<i>N,N,N</i> -Di et hyl -2-met hyl -1,4-benzenedi ami ne, monohydrochl ori de	4- <i>N,N</i> -Di et hyl -1,4-di ami no-2-met hyl benzene, hydrochl ori de	$\text{C}_{11}\text{H}_{15}\text{ClN}_2$	2051-79-8	214.735	cry	250 dec				
3485	<i>N,N</i> -Di et hyl -3-met hyl but anami de	Isovaleryl di et hyl ami de	$\text{C}_9\text{H}_{19}\text{NO}$	533-32-4	157.253			211	0.8764 ²⁰	1.4422 ²⁰	vs et h, Et OH
3486	Di et hyl met hyl enesucci nat e		$\text{C}_8\text{H}_{14}\text{O}_4$	2409-52-1	186.205		58.5	228	1.0467 ²⁰	1.4377 ²⁰	msc Et OH; s et h, bz; vs ace
3487	Di et hyl met hyl mal onat e		$\text{C}_8\text{H}_{14}\text{O}_4$	609-08-5	174.195			201	1.0225 ²⁰	1.4126 ²⁰	sl H ₂ O; vs Et OH, et h, ace, chl
3488	Di et hyl met hyl phosphonat e		$\text{C}_8\text{H}_{13}\text{O}_3\text{P}$	683-08-9	152.129			194	1.0406 ³⁰	1.4101 ³⁰	s H ₂ O, Et OH, et h; i bz
3489	<i>N,N</i> -Di et hyl -4-met hyl -1-pi perazi necarboxami de	Di et hyl carbamazi ne	$\text{C}_{10}\text{H}_{21}\text{N}_5\text{O}$	90-89-1	199.293		48	110 ³			
3490	3,3-Di et hyl -5-met hyl -2,4-pi peri di nedi one		$\text{C}_{10}\text{H}_{17}\text{NO}_2$	125-64-4	183.248		75.5				s H ₂ O, bz, chl, Et OH
3491	<i>N,N</i> -Di et hyl -1-napht hal enami ne		$\text{C}_{14}\text{H}_{17}\text{N}$	84-95-7	199.292			285	1.013 ²⁰	1.5961 ²⁰	s Et OH, et h, bz; sl ct c
3492	<i>N,N</i> -Di et hyl -4-ni t roani li ne		$\text{C}_{10}\text{H}_{14}\text{O}_2$	2216-15-1	194.230	ye nd (li g) pl (al)	77.5		1.225 ²⁵		s Et OH; sl li g
3493	<i>N,N</i> -Di et hyl -4-ni t rosoani li ne		$\text{C}_{10}\text{H}_{14}\text{O}_2$	120-22-9	178.230	grn mcl pr (et h) grn lf (ace)	87.5		1.24 ¹⁵		sl H ₂ O; s Et OH, et h, ace, chl
3494	Di et hyl nonanedi oat e	Di et hyl azel at e	$\text{C}_{13}\text{H}_{24}\text{O}_4$	624-17-9	244.328	li q	-18.5	291.5	0.972 ⁹	1.4351 ²⁰	i H ₂ O; s Et OH, et h
3495	Di et hyl oxal at e		$\text{C}_8\text{H}_{14}\text{O}_4$	95-92-1	146.141	li q	-40.6	185.7	1.078 ⁹	1.4101 ²⁰	sl H ₂ O; msc Et OH, et h, ace; s ct c
3496	Di et hyl oxobut anedi oat e	Di et hyl oxal acet at e	$\text{C}_8\text{H}_{12}\text{O}_5$	108-56-5	188.178			131 ²⁴	1.131 ²⁰	1.4561 ¹⁷	i H ₂ O; msc Et OH, et h, bz; vs ace
3497	Di et hyl 3-oxo-1,5-pent anedi oat e	Di et hyl 1,3-acet onedi carboxyl at	$\text{C}_8\text{H}_{14}\text{O}_5$	105-50-0	202.204			250	1.113 ²⁰		sl H ₂ O; msc Et OH
3498	3,3-Di et hyl pent ane	Tet raet hyl met hane	C_9H_{20}	1067-20-5	128.255	li q	-33.1	146.3	0.753 ⁶	1.4206 ²⁰	i H ₂ O; s et h, bz
3499	<i>N,N</i> -Di et hyl -1,4-pent anedi ami ne	Novol di ami ne	$\text{C}_9\text{H}_{22}\text{N}_2$	140-80-7	158.284			201	0.814 ²⁰	1.4429 ²⁰	
3500	2,2-Di et hyl -4-pent enami de	Novonal	$\text{C}_9\text{H}_{16}\text{NO}$	512-48-1	155.237	wh pow	75.5				vs et h, Et OH
3501	Di et hyl 2-pent enedi oat e	Di et hyl gl ut aconat e	$\text{C}_9\text{H}_{16}\text{O}_4$	2049-67-4	186.205			237	1.0496 ²⁰	1.4411 ²⁰	vs et h, Et OH
3502	Di et hyl peroxi de		$\text{C}_8\text{H}_{16}\text{O}_2$	628-37-5	90.121	li q	-70	65	0.824 ⁹	1.3715 ¹⁷	sl H ₂ O; msc Et OH, et h
3503	<i>N,N</i> -Di et hyl - β -phenot hi azi ne-10-et hanami ne	Di et hazi ne et hanami ne	$\text{C}_{12}\text{H}_{22}\text{N}_2\text{S}$	60-91-3	298.446	oi l		167 ⁹			i H ₂ O; s di l HCl
3504	<i>N,N</i> -Di et hyl β -phenyl benzenemet hanami ne	<i>N,N</i> -Di et hyl benzhydryl ami ne	$\text{C}_{17}\text{H}_{21}\text{N}$	519-72-2	239.356		58.5	170 ¹⁷			
3505	Di et hyl phenyl mal onat e		$\text{C}_{13}\text{H}_{16}\text{O}_4$	83-13-6	236.264		16.5	dec 205; 168 ¹²	1.0950 ²⁰	1.4977 ²⁰	vs ace, Et OH
3506	Di et hyl phenyl phosphoni t e		$\text{C}_{10}\text{H}_{15}\text{O}_2\text{P}$	1638-86-4	198.199			235; 62 ¹	1.032 ¹⁶		



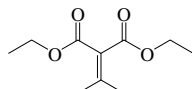
Di et hyl mi nodi acet at e



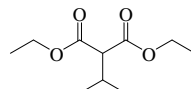
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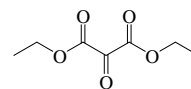
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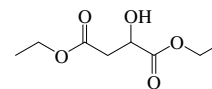
Di et hyl sopropyl i denemal onat e



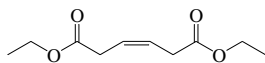
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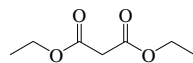
Di et hyl et omal onat e



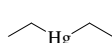
Di et hyl hal at e



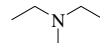
Di et hyl hal eat e



Di et hyl hal onat e



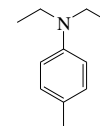
Di et hyl hercury



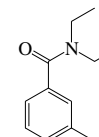
Di et hyl met hyl ami ne



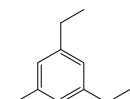
N,N-Di et hyl -2-met hyl ani li ne



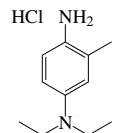
N,N-Di et hyl -4-met hyl ani li ne



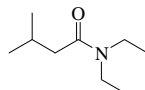
N,N-Di et hyl -3-met hyl benzami de



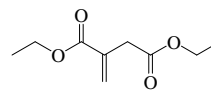
1,3-Di et hyl -5-met hyl benzene



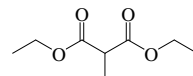
N,N-Di et hyl -2-met hyl -1,4-benzenedi ami nohydrochl ori de



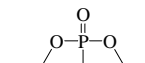
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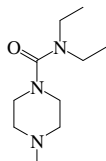
Di et hyl met hyl enesu ci nat e



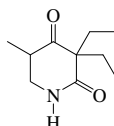
Di et hyl met hyl mal onat e



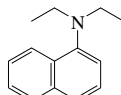
Di et hyl met hyl fosphonat e



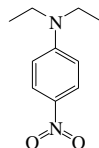
N,N-Di et hyl -4-met hyl -1-pi perazi ne carboxami de



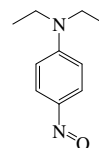
3,3-Di et hyl -5-met hyl -2,4-pi peri di ne



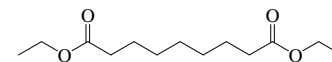
N,N-Di et hyl -1-napht hal enami ne



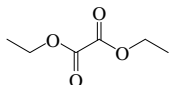
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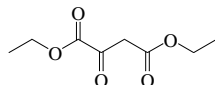
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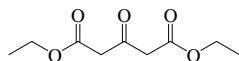
Di et hyl tonanedi oat e



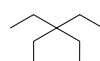
Di et hyl oxal at e



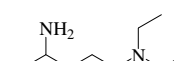
Di et hyl xobut anedi oat e



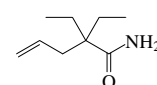
Di et hyl oxo-1,5-pent anedi oat e



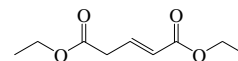
3,3-Di et hyl pent ane



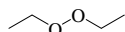
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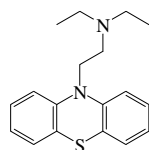
2,2-Di et hyl -4-pent enami de



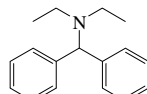
Di et hyl 2-pent enedi oat e



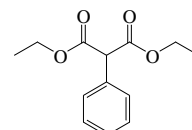
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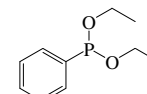
N,N-Di et hyl -10-phenot hi azi ne-10-et hanami ne



N,N-Di et hyl -1,1-phenyl benzenemet hanami en

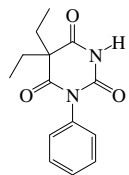


Di et hyl phenyl mal onat e

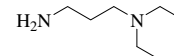
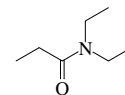
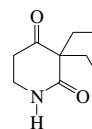
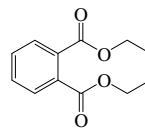
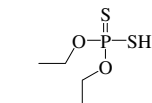
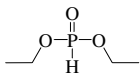
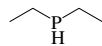


Di et hyl phenyl fosphoni t e

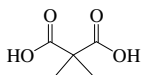
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3507	5,5-Di et hyl-1-phenyl-2,4,6-(1 <i>H</i> ,3 <i>H</i> ,5 <i>H</i>)-pyri mi di net ri one	Phenet harbi t al	$_{14}\text{H}_{16}\text{N}_2\text{O}_3$	357-67-5	260.288		178				vs Et OH
3508	Di et hyl phosphi ne		$_{4}\text{H}_4\text{P}$	627-49-6	90.104			85	0.786 ²⁰		
3509	Di et hyl phosphonate		$_{4}\text{H}_4\text{O}_3\text{P}$	762-04-9	138.102			54 ⁶			s ct c
3510	<i>O,O</i> -Di et hyl phosphorodi t hi onat e		$_{4}\text{H}_4\text{O}_2\text{PS}_2$	298-06-6	186.233						s H ₂ O
3511	Di et hyl pht hal at e		$_{12}\text{H}_{14}\text{O}_4$	84-66-2	222.237	li q	-40.5	295	1.232 ²	1.5000 ²¹	i H ₂ O; msc Et OH, et h; s ace, bz, ct c
3512	3,3-Di et hyl-2,4-pi peri di nedi one	Pi peri di one	$_{6}\text{H}_{10}\text{NO}_2$	77-03-2	169.221	nd (w)	104				vs H ₂ O, Et OH, chl, MeOH
3513	<i>N,N</i> -Di et hyl propanami de		$_{7}\text{H}_9\text{NO}$	1114-51-8	129.200			191	0.8972 ²⁰	1.4425 ²⁰	vs Et OH
3514	<i>N,N</i> -Di et hyl-1,3-propanedi ami ne		$_{7}\text{H}_9\text{CN}_2$	104-78-9	130.231			168.5	0.822 ²⁰	1.443 ²⁰	
3515	Di et hyl propanedi oi c aci d	Di et hyl mal oni c aci d	$_{7}\text{H}_7\text{O}_4$	510-20-3	160.168	pr (w,bz)	127 dec				vs H ₂ O, Et OH, et h; sl bz, chl
3516	2,2-Di et hyl-1,3-propanedi ol		$_{7}\text{H}_8\text{O}_2$	115-76-4	132.201		61.5	240.5	1.050 ²⁰	1.4574 ²⁵	vs H ₂ O, Et OH, et h; s chl
3517	Di et hyl 2-propyl mal onat e		$_{10}\text{H}_{16}\text{O}_4$	2163-48-6	202.248			221; 114 ²²	0.989 ²⁰	1.4197 ²⁰	sl H ₂ O; vs Et OH, et h
3518	<i>N,N</i> -Di et hyl-3-pyri di ncarboxami de	Ni ket hami de	$_{10}\text{H}_{14}\text{NO}_2$	59-26-7	178.230	ye sol i d or vi sc li q	25	dec 280; 175 ²⁵	1.060 ²⁵	1.525 ²⁰	sl DMSO
3519	<i>N,N</i> -Di et hyl-4-pyri di ncarboxami de	Isoni cot i ni c aci d di et hyl ami de	$_{10}\text{H}_{14}\text{N}_2\text{O}$	530-40-5	178.230			119 ¹		1.525 ²⁰	vs H ₂ O, ace, et h, Et OH
3520	3,3-Di et hyl-2,4-(1 <i>H</i> ,3 <i>H</i>)-pyri di nedi one	Pyri t hyl di one	$_{6}\text{H}_{10}\text{NO}_2$	77-04-3	167.205		90.7				
3521	Di et hyl sebacat e		$_{14}\text{H}_{26}\text{O}_4$	110-40-7	258.354		2.5	305; 188 ¹⁹	0.9646 ²⁰	1.4306 ²⁰	sl H ₂ O, ct c; s Et OH, ace; i bz
3522	Di et hyl seleni de		$_{4}\text{H}_4\text{Se}$	627-53-2	137.08	pa ye	55	108	1.2300 ²⁰	1.4768 ²⁰	
3523	Di et hyl si l ane		$_{4}\text{H}_4\text{Si}$	542-91-6	88.224	li q	-134.3	57	0.6848	1.3921 ²⁰	i H ₂ O
3524	<i>t rans</i> Di et hyl st i l best rol		$_{18}\text{H}_{30}\text{O}_2$	56-53-1	268.351	pl (bz)	170.5				vs et h, Et OH, chl
3525	<i>t rans</i> Di et hyl st i l best rol di propanoat e	Cl i nest rol	$_{24}\text{H}_{38}\text{O}_4$	130-80-3	380.477	pr (MeOH)	104				vs bz, et h, Et OH
3526	<i>t rans</i> Di et hyl st i l best rol monomet hyl mest i l bol et her		$_{19}\text{H}_{32}\text{O}_2$	18839-90-2	282.377	nd (bz-pet h)	117.5	190 ³			vs ace, et h, Et OH
3527	Di et hyl succi nat e	Et hyl succi nat e	$_{6}\text{H}_{14}\text{O}_6$	123-25-1	174.195	li q	-21	217.7	1.040 ²²	1.4201 ²⁰	i H ₂ O; msc Et OH, et h; s ace, chl
3528	Di et hyl sul f at e		$_{4}\text{H}_6\text{OS}$	64-67-5	154.185	oi l	-24	208	1.17 ²	1.3989 ²⁰	i H ₂ O; msc Et OH, et h
3529	Di et hyl sul fide		$_{4}\text{H}_6\text{S}$	352-93-2	90.187	li q	-103.91	92.1	0.836 ²²	1.4430 ²⁰	sl H ₂ O, ct c; s Et OH, et h
3530	Di et hyl sul fit e	Et hyl sul fit e	$_{4}\text{H}_6\text{OS}$	623-81-4	138.185			158; 51 ¹³	1.1 ²⁰	1.4310 ²⁰	s Et OH, et h
3531	Di et hyl sul f one	Et hyl sul f one	$_{4}\text{H}_6\text{O}_2\text{S}$	597-35-3	122.186	ort h pl	73.5	248	1.357 ²		s H ₂ O, et h; vs bz; i pet h
3532	Di et hyl sul f oxi de		$_{4}\text{H}_6\text{O}_3\text{S}$	70-29-1	106.186	syr	14	104 ²⁵ ; 90 ¹⁵	1.0092 ²²		vs H ₂ O, et h, Et OH
3533	Di et hyl <i>DL</i> -t art rat e		$_{8}\text{H}_{14}\text{O}_6$	57968-71-5	206.193		18.7	281; 158 ¹⁴	1.2046 ²⁰	1.4438 ²⁰	sl H ₂ O; msc Et OH, et h; s ace, ct c
3534	Di et hyl t ell uri de		$_{4}\text{H}_6\text{Te}$	627-54-3	185.72	red-ye		137.5	1.599 ¹⁵	1.5182 ¹⁵	vs Et OH
3535	Di et hyl t erepht hal at e		$_{12}\text{H}_{10}\text{O}_4$	636-09-9	222.237	mcl pr (al, pet h)	44	302	1.0989		i H ₂ O; vs Et OH, et h
3536	Di et hyl t hi odi propi onat e		$_{10}\text{H}_{16}\text{O}_5\text{S}$	673-79-0	234.313			174 ¹⁵ ; 121 ²	1.1034 ²⁰	1.4655 ²⁰	
3537	<i>N,N</i> -Di et hyl t hi ourea		$_{6}\text{H}_8\text{N}_2\text{S}$	105-55-5	132.227		78	dec			s H ₂ O, Et OH; vs et h; sl ct c
3538	<i>N,N</i> -Di et hyl-1,1,1- <i>t ri</i> met hyl si lanami ne	(Di et hyl ami no) <i>t ri</i> met hyl si l ane	$_{7}\text{H}_{19}\text{NSi}$	996-50-9	145.319			126.3	0.7627 ²⁰	1.4112 ²⁰	
3539	Di et hyl t ri sul fide		$_{4}\text{H}_6\text{S}_3$	3600-24-6	154.317		-72.6	85 ²⁶	1.1082 ²⁰	1.5689 ¹³	
3540	<i>N,N</i> -Di et hyl urea		$_{2}\text{H}_{12}\text{N}_2\text{O}$	634-95-7	116.161	pl, nd (et h)	75	95 ⁰²			vs H ₂ O, Et OH, bz, li g; s et h
3541	<i>N,N</i> -Di et hyl urea		$_{3}\text{H}_{12}\text{N}_2\text{O}$	623-76-7	116.161	t ab (li g), hyg nd (al)	112.5	263	1.0415 ²⁵	1.4616 ⁴⁰	vs H ₂ O, Et OH, et h
3542	Di et hyl vi nyl phosphonate		$_{6}\text{H}_{10}\text{O}_3\text{P}$	682-30-4	164.139			110 ²	1.068 ²⁵	1.4290 ²⁰	
3543	Di et hyl zi nc	Zi nc di et hyl	$_{4}\text{H}_6\text{Zn}$	557-20-0	123.531	col li q	-28	118; 80 ²	1.2065 ²⁰	1.4936 ²⁰	dec H ₂ O; msc et h, pet h, bz
3544	Di f enoconazol e		$_{19}\text{H}_{17}\text{Cl}_2\text{N}_3\text{O}_3$	119446-68-3	406.262		76	220 ⁰⁰³			
3545	Di f enoquat met hyl sul f at e	<i>H</i> -Pylazol i um, 1,2-di met hyl-3,5-di phenyl-, met hyl sul f at e	$_{18}\text{H}_{20}\text{N}_2\text{O}_4\text{S}$	43222-48-6	360.428		157				



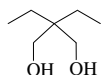
5,5-Di et hyl -1-phenyl -2,4,6-trimethyl-3,5,6-triazin-2-one



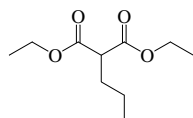
Di et hylphosphi ne Di et hylphosponat e 0,0-Di et hylphosphoroditi onat e Di et hylht halat e 3,3-Di et hyl -2,4-pi peri di nedion/N,N-Di et hylpropanami de /N,N-Di et hyl -1,3-propanedi ami ne



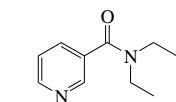
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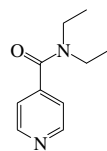
2,2-Di et hyl -1,3-propanedi ol



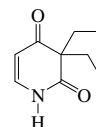
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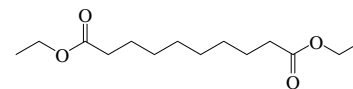
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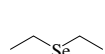
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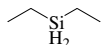
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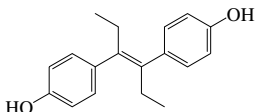
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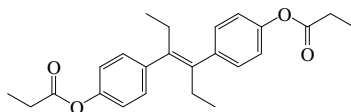
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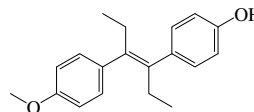
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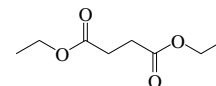
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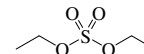
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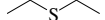
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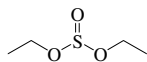
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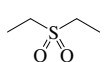
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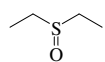
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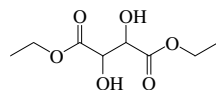
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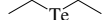
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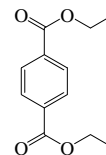
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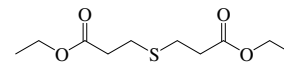
Di et hylDL-t art rat e



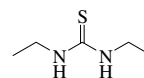
Di et hyltel l uri de



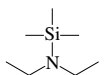
Di et hylterept halat e



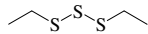
Di et hylthi odi propi onat e



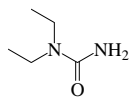
N,N-Di et hylthi ourea



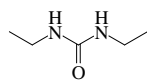
N,N-Di et hyl -1,1,1-tri met hylsil anami ne



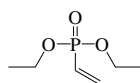
Di et hyltri sul f i de



N,N-Di et hyl urea



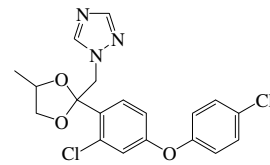
N,N-Di et hyl urea



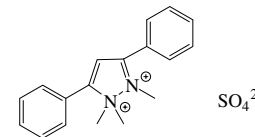
Di et hylvi nylphosponat e



Di et hylzinc



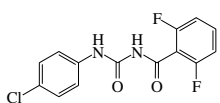
Di f enoconazol e



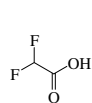
Di f enzoquat ethylsul f at e



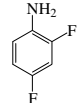
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3546	Di flubenzuron	<i>N</i> -[[[4-Chlorophenyl]amino]carbonyl]-2,6-difluorobenzamide	C ₁₄ H ₉ ClF ₂ N ₂ O ₂	35367-38-5	310.683		239				
3547	Di fluoroacetimid		$\text{C}_2\text{H}_2\text{F}_2\text{O}_2$	381-73-7	96.033	liquid	-1	133	1.526	1.3470 ²⁰	
3548	2,4-Difluoroaniline		$\text{C}_6\text{H}_4\text{F}_2\text{N}$	367-25-9	129.108	liquid	-7.5	170	1.268	1.5063 ²⁰	
3549	<i>o</i> -Difluorobenzene	1,2-Difluorobenzene	$\text{C}_6\text{H}_4\text{F}_2$	367-11-3	114.093	liquid	-47.1	94	1.1599	1.4451 ¹⁸	in H ₂ O; soluble in acetone, benzene, chloroform
3550	<i>m</i> -Difluorobenzene	1,3-Difluorobenzene	$\text{C}_6\text{H}_4\text{F}_2$	372-18-9	114.093	liquid	-69.12	82.6	1.1572	1.4374 ²⁰	in H ₂ O; soluble in acetone, benzene
3551	<i>p</i> -Difluorobenzene	1,4-Difluorobenzene	$\text{C}_6\text{H}_4\text{F}_2$	540-36-3	114.093	liquid	-23.55	89	1.1704	1.4422 ²⁰	in H ₂ O; soluble in acetone, benzene, chloroform, carbon tetrachloride
3552	4,4'-Difluoro-1,1'-biphenyl	4,4'-Difluorodiphenyl	$\text{C}_{12}\text{H}_8\text{F}_2$	398-23-2	190.189	monoclinic (all) / liquid (w)	94.5	254.5			in H ₂ O; soluble in EtOH, benzene, chloroform; soluble in ether, acetone
3553	1,1-Difluorocyclohexane		$\text{C}_6\text{H}_{10}\text{F}_2$	371-90-4	120.140	liquid		99.5			
3554	3,3-Difluorocyclopropene		$\text{C}_3\text{H}_2\text{F}_2$	56830-75-2	76.045	liquid		34			
3555	Difluorodimethylsilane		$\text{C}_2\text{H}_6\text{F}_2\text{Si}$	353-66-2	96.152	colorless gas	-87.5	2.5			
3556	1,5-Difluoro-2,4-dinitrobenzene		$\text{C}_6\text{H}_3\text{F}_2\text{N}_2\text{O}_4$	327-92-4	204.088		75.5	132 ²			soluble in EtOH
3557	Difluorodiphenylsilane		$\text{C}_{12}\text{H}_{10}\text{F}_2\text{Si}$	312-40-3	220.290			246; 157 ⁰	1.145 ¹⁷	1.5221 ²⁵	
3558	1,1-Difluoroethane	Ethylidene difluoride	$\text{C}_2\text{H}_4\text{F}_2$	75-37-6	66.050	colorless gas	-117	-24.05	0.896 ²⁵ (p>1 at m)	1.3011 ⁻⁷²	
3559	1,2-Difluoroethane	Ethylene difluoride	$\text{C}_2\text{H}_4\text{F}_2$	624-72-6	66.050	volatile liquid		26			soluble in benzene, ether, chloroform
3560	1,1-Difluoroethene	Vinylidene difluoride	$\text{C}_2\text{H}_2\text{F}_2$	75-38-7	64.034	colorless gas	-144	-85.7			soluble in ether, EtOH
3561	<i>cis</i> -1,2-Difluoroethene	<i>cis</i> -1,2-Difluoroethene	$\text{C}_2\text{H}_2\text{F}_2$	1630-77-9	64.034	colorless gas		-26			
3562	<i>trans</i> -1,2-Difluoroethene	<i>trans</i> -1,2-Difluoroethene	$\text{C}_2\text{H}_2\text{F}_2$	1630-78-0	64.034	colorless gas		-53.1			
3563	Difluoromethane	Methane difluoride	$\text{C}_1\text{H}_2\text{F}_2$	75-10-5	52.024	colorless gas	-136.8 (tp)	-51.6	1.2139 ²		in H ₂ O; soluble in EtOH
3564	2-(Difluoromethoxy)-1,1,1-trifluoroethane	Difluoromethyl 2,2,2-trifluoroethyl ether	C ₃ H ₂ F ₅ O	1885-48-9	150.047	colorless liquid		29			
3565	Difluoromethyl borane		$\text{C}_1\text{B}_1\text{F}_2$	373-64-8	63.843	gas		-78.5 ²⁸⁷			reacts with H ₂ O
3566	2,4-Difluoro-1-nitrobenzene		$\text{C}_6\text{H}_3\text{F}_2\text{NO}_2$	446-35-5	159.091		9.8	207	1.4571 ¹⁴	1.5149 ¹⁴	soluble in chloroform
3567	2,2-Difluoropropane		$\text{C}_3\text{H}_6\text{F}_2$	420-45-1	80.077	colorless gas	-104.8	-0.4	0.9205 ⁹ (p>1 at m)	1.2904 ²⁰	
3568	1,3-Difluoro-2-propanol		$\text{C}_3\text{H}_6\text{F}_2\text{O}$	453-13-4	96.076			127; 55 ³⁴	1.24 ²⁵	1.3725 ²⁰	
3569	Di- <i>n</i> -butyl ether		$\text{C}_{10}\text{H}_{20}\text{O}$	492-94-4	190.153	crystalline (all), crystalline (bz)	166.3				soluble in H ₂ O; soluble in EtOH, ether, benzene, chloroform
3570	Di- <i>n</i> -butyl ether	α -Furane dioxide	$\text{C}_{10}\text{H}_{18}\text{N}_2\text{O}_4$	522-27-0	220.182		167				soluble in EtOH, ether, benzene, liquid nitrogen
3571	1,5-Di- <i>n</i> -butyl-1,4-pentadiene-3-one		C ₁₃ H ₂₀ O ₃	886-77-1	214.216	hygroscopic (petroleum) / crystalline (lig)	60.5	181 ⁴			soluble in ether, EtOH, chloroform
3572	Difurfuryl sulfide	Furfuryl sulfide	$\text{C}_{10}\text{H}_{10}\text{O}_3\text{S}_2$	4437-20-1	226.315		10	167 ¹³ , 112 ^{0.5}			soluble in EtOH
3573	Difurfuryl ether	Furfuryl ether	$\text{C}_{10}\text{H}_{10}\text{O}_3$	4437-22-3	178.184			101 ²	1.1405 ²⁰	1.5088 ²⁰	in H ₂ O
3574	Diglytine		$\text{C}_{56}\text{H}_{92}\text{O}_{29}$	11024-24-1	1229.312		237.5				
3575	Diglytine		$\text{C}_{23}\text{H}_{36}\text{O}_4$	143-62-4	374.514		253				soluble in EtOH; soluble in MeOH
3576	Diglytine		$\text{C}_{41}\text{H}_{64}\text{O}_{13}$	71-63-6	764.939	prismatic (all)	255.5				soluble in EtOH; soluble in ether, chloroform, MeOH, pyridine
3577	Diglytine		$\text{C}_6\text{H}_{12}\text{O}_4$	527-52-6	148.157	crystalline (MeOH+ether)	112				soluble in H ₂ O, acetone; soluble in pyridine, AcOEt
3578	Diglycidyl ether	Bis(2,3-epoxypropyl) ether	$\text{C}_8\text{H}_{16}\text{O}_3$	2238-07-5	130.141			260	1.1195 ²⁰		
3579	Diglycol acetate	2,2'-Oxydiacetate	$\text{C}_4\text{H}_8\text{O}_3$	110-99-6	134.088	monoclinic (w+1)	148	dec			soluble in H ₂ O, ether, EtOH
3580	Digoxigenin		$\text{C}_{28}\text{H}_{34}\text{O}_5$	1672-46-4	390.513	prismatic (AcOEt)	222				soluble in EtOH, MeOH; soluble in chloroform
3581	Digoxin		$\text{C}_{41}\text{H}_{64}\text{O}_{14}$	20830-75-5	780.939	triclinic (diethyl ether, pyridine)	249 dec				soluble in EtOH
3582	Diheptylamine	<i>N</i> -Heptyl-1-heptanamine	$\text{C}_{14}\text{H}_{31}\text{N}$	2470-68-0	213.403	liquid	31.5	271; 135 ⁹	0.7956 ²¹		soluble in H ₂ O; soluble in EtOH; soluble in ether
3583	Diheptyl ether	Heptyl ether	$\text{C}_{14}\text{H}_{30}\text{O}$	629-64-1	214.387			258.5	0.8008 ²⁰	1.4275 ²⁰	soluble in ether, EtOH



Di fluorubenzuron



Di fluoracetate



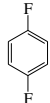
2,4-Di fluorani li



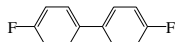
Di fluorobenzenep-Di



Di fluorobenzenep-Di



Di fluorobenzene



4,4-Di fluoro-1,1'-bi phenyl



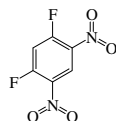
Di fluorocyclohexane



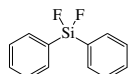
3-Di fluorocyclopropene



Di fluorodimethylsilane



Di fluoro-2,4-di nitrobenzene



Di fluorodiphenylsilane



1,1-Di fluoroethane



1,2-Di fluoroethane



1,1-Di fluoroethene



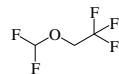
1,2-Di fluoroethene



1,1,1,2-Tetrafluoroethane



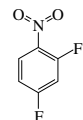
Difluoromethane



1,1,1,2-Tetrafluoroethoxy



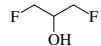
Difluoroborane



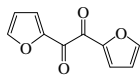
2,4-Di fluoronitrobenzene



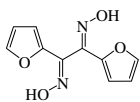
Di fluoropropane



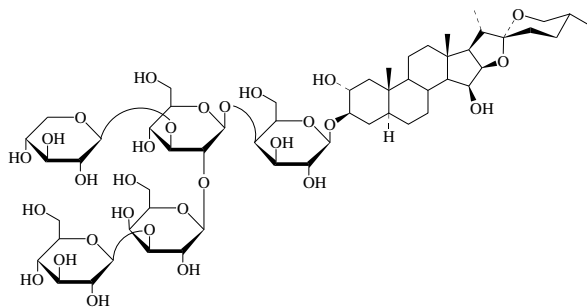
1,3-Di fluoropropanol



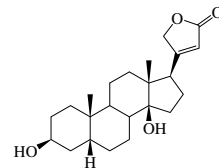
2,2-Di fluorouracil



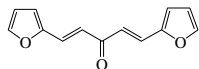
2,2-Di fluorouracil



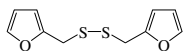
Digoxin



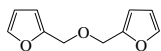
Digoxigenin



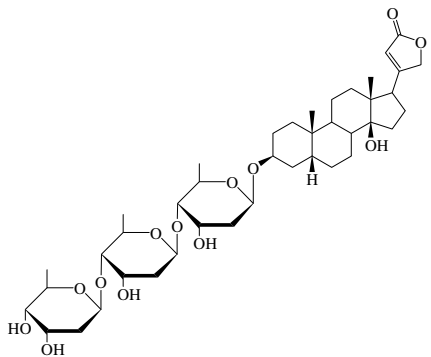
1,5-Di-2-furanyl-1,4-pentadien-3-one



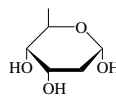
Di furfuryl sulfide



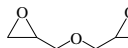
Di furfuryl ether



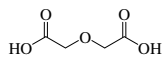
Digoxin



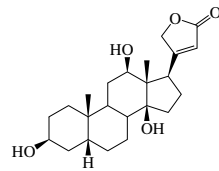
Diglucose



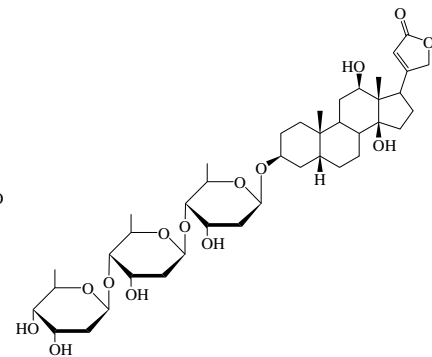
Diglycerol ether



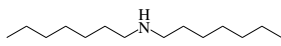
Diglycolic acid



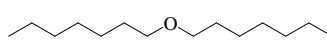
Digoxigenin



Digoxin

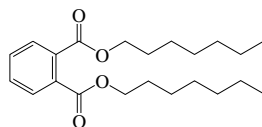


Diheptylamine

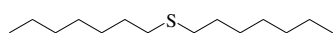


Diheptyl ether

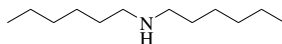
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3584	Di heptyl pht halat e		$C_{22}H_{44}O_4$	3648-21-3	362.503			360			
3585	Di heptyl sul fide	Heptyl sul fide	$C_{14}H_{30}S$	629-65-2	230.453		70	298	0.8416 ²⁰	1.4606 ²⁰	i H ₂ O; s et h
3586	Di hexyl ami ne	N-Hexyl -1-hexanami ne	$C_{12}H_{27}N$	143-16-8	185.349	li q	-13.1	236; 75	0.7889 ²⁰	1.4339 ²⁰	s Et OH, et h
3587	Di hexyl et her	Hexyl et her	$C_{12}H_{26}O$	112-58-3	186.333			226	0.7936 ²⁰	1.4204 ²⁰	i H ₂ O; s et h; sl ct c
3588	Di hexyl hexanedi oat e		$C_{18}H_{34}O_4$	110-33-8	314.461	li q	-9	348; 182.5	0.941 ²⁰		
3589	Di hexyl pht halat e		$C_{20}H_{40}O_4$	84-75-3	334.450			210 ⁵			
3590	Di hexyl sul fide	Hexyl sul fide	$C_{12}H_{26}S$	6294-31-1	202.399			230; 136 ²⁰	0.8411 ²⁰	1.4586 ²⁰	
3591	15,16-Di hydroafilat oxo ni G	Afilat oxo ni G	$C_{17}H_{14}O_7$	7241-98-7	330.289		239.3				
3592	9,10-Di hydroant hracene		$C_{12}H_{12}$	613-31-0	180.245	t ab or pr	111	305	1.218 ⁰		i H ₂ O; s Et OH, et h, bz, chl
3593	6,15-Di hydro-5,9,14,18-ant hrazi net et rone	Indant hrene	$C_{26}H_{14}N_2O_4$	81-77-6	442.422	bl nd	485 dec				i H ₂ O, Et OH, et h, ace, bz; s PhNq di l alk
3594	1,2-Di hydrobenz[<i>j</i>]aceant hryl ene	Cholant hrene	$C_{20}H_{16}$	479-23-2	254.325	pa ye lf (bz-al)	174				i ₂ OH; s Et OH, bz, HOAc, li g, t ol
3595	9,10-Di hydro-9,10[1',2']-benzenoant hracene	Tri pt ycene	$C_{14}H_{14}$	477-75-8	254.325	cry (cyhex)	256				
3596	1,3-Di hydro- <i>2H</i> -benzi mi dazol e-2-thi one	2-Benzi mi dazol et hi ol	C_7H_8S	583-39-1	150.201	pl (di l al or NH ₃)	298				vs Et OH
3597	1,3-Di hydro- <i>2H</i> -benzi mi dazol -2-one		$C_7H_8N_2O$	615-16-7	134.135	lf (w or al)	318 dec				sl ₂ OH, et h, bz; s ace; vs Et OH
3598	2,3-Di hydro-1,4-benzodi oxo ni		$C_8H_8O_2$	493-09-4	136.149			212; 103 ⁶	1.180 ²⁰	1.5485 ²⁰	
3599	2,3-Di hydrobenzof uran	Coumaran	C_9H_8O	496-16-2	120.149	li q	-21.5	188.5	1.058 ⁸	1.5497 ²⁰	vs et h, Et OH, chl
3600	3,4-Di hydro- <i>7H</i> -2-benzopyran	Isochroman	$C_9H_{10}O$	493-05-0	134.174		4	110 ²⁵ , 90 ¹²	1.067 ²⁵	1.5444 ²⁰	
3601	3,4-Di hydro- <i>2H</i> -1-benzopyran		$C_9H_{10}O$	493-08-3	134.174		4.8	215; 98 ¹⁸	1.072 ²⁰	1.5444 ²⁰	s H ₂ O; msc os
3602	3,4-Di hydro- <i>2H</i> -1-benzopyran-2-one		$C_9H_8O_2$	119-84-6	148.159	lf	25	272	1.169 ⁹	1.5563 ²⁰	i H ₂ O; sl Et OH, et h, ct c; s chl
3603	2,3-Di hydro- <i>4H</i> -1-benzopyran-4-one	4-Chromanone	$C_9H_8O_2$	491-37-2	148.159		36.5	160 ⁵⁰ , 127 ¹³	1.1291 ¹⁰⁰	1.5750	s Et OH; vs et h, ace, bz, chl; sl ct c
3604	6,7-Di hydrobenz[<i>b</i>]ti hi ophen- <i>4H</i> -one	4,5,6,7-Tet rahydro-4-benzot hi ophenone	C_8H_8OS	13414-95-4	152.214						sl chl
3605	2,3-Di hydro- <i>4H</i> -1-benzot hi opyran-4-one		C_8H_8OS	3528-17-4	164.224		29	154 ¹²	1.2487 ¹⁴	1.6395 ²⁰	
3606	4,5-Di hydro-2-benzyl - <i>H</i> -i mi dazol e	Tolazol i ne	$C_{10}H_{12}N_2$	59-98-3	160.215	cry (pet h)	67				
3607	7,8-Di hydrobi opt eri n		$C_8H_{14}N_2O_3$	6779-87-9	239.231	hyg nd (w)					s H ₂ O
3608	Di hydrocodei ne		$C_8H_{13}NO_3$	125-28-0	301.381	cry (aq, MeOH)	112.5	248 ¹⁵			
3609	16,17-Di hydro-1 <i>H</i> -cycl opent enophenant hrene	1,2-Cycl opent enophenant hrene	$C_{14}H_{14}$	482-66-6	218.293	nd (al, pet r)	135.5				i ₂ OH; s Et OH, pet h
3610	10,11-Di hydro- <i>5H</i> -di benz[<i>b,f</i>]azepi ne		$C_{13}H_{13}N$	494-19-9	195.260						s chl
3611	10,11-Di hydro- <i>5H</i> -di benz[<i>a,d</i>]cycl ohept en-5-one		$C_{15}H_{12}O$	1210-35-1	208.255		30	203 ⁷	1.1635 ²⁰	1.6324 ²⁰	
3612	2,5-Di hydro-2,5-di met hoxyl uran		$C_8H_8O_3$	332-77-4	130.141			161	1.073 ²⁵	1.4339 ²⁰	
3613	3,4-Di hydro-6,7-di met hoxyl - <i>1H</i> -i soqui nol i none	Corydal di ne	$C_8H_{13}NO_3$	493-49-2	207.226	mcl pr (w, al)	175				vs H ₂ O, bz, et h, Et OH
3614	1,2-Di hydro-1,5-di met hyl -2-phenyl - <i>Ant</i> i pyri ne-3 <i>H</i> -pyrazol -3-one	Ant i pyri ne	$C_{12}H_{12}N_2O$	60-80-0	188.225	lf or sc (et h, bz)	114	319			vs ₂ OH, Et OH
3615	2,3-Di hydro-1,4-di oxo ni		$C_8H_8O_2$	543-75-9	86.090			94.1	1.0836 ²⁰	1.4372 ²⁰	s ct c
3616	9,10-Di hydro-9,10-di oxo-2-ant hracenicarboxyl i c aci d		$C_{15}H_8O_4$	117-78-2	252.223	ye nd (HOAc)	291	sub			sl Et OH, HOAc; i et h, bz; s ace
3617	9,10-Di hydro-9,10-di oxo-1,5-ant hracenedi sulf oni c aci d		$C_{14}H_8O_6S_2$	117-14-6	368.339	ye nd (HCl +4w) pl (di l HOAc)	310 dec				vs H ₂ O, Et OH, HOAc
3618	9,10-Di hydro-9,10-di oxo-2,6-ant hracenedi sulf oni c aci d		$C_{14}H_8O_6S_2$	84-50-4	368.339						vs H ₂ O; s Et OH; i et h, bz



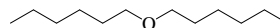
Di heptyl sebacate



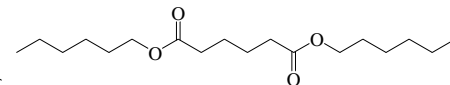
Di heptyl sulfide



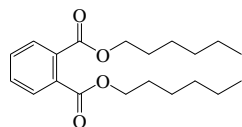
Di hexylamine



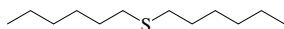
Di hexyl ether



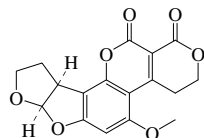
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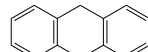
Di heptyl sebacate



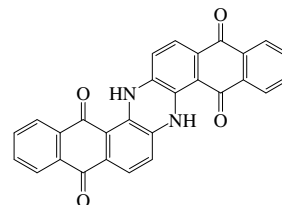
Di hexyl sulfide



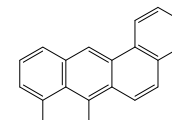
15,16-Di hydroflavone



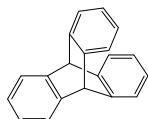
9,10-Di hydroanthracene



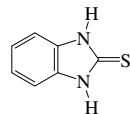
6,15-Di hydro-5,9,14,18-antihrazinetone



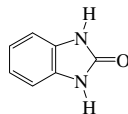
1,2-Di hydrobenz[j]aceanthrylene



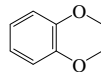
9,10-Di hydro-9,10[1',2']-benzoanthracene



1,3-Di hydro-2H-benzimidazole-2-thione



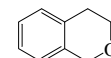
1,3-Di hydro-2H-benzimidazole-2-one



2,3-Di hydro-1,4-benzodioxin



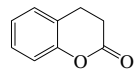
2,3-Di hydrobenzofuran



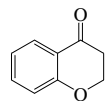
3,4-Di hydro-7H-benzopyran



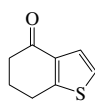
3,4-Di hydro-2H-benzopyran



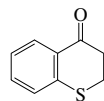
3,4-Di hydro-2H-benzopyran-2-one



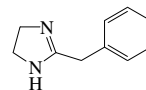
2,3-Di hydro-4H-benzopyran-4-one



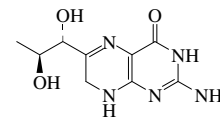
6,7-Di hydrobenzofuran



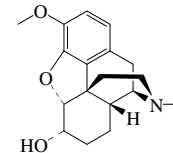
2,3-Di hydro-4H-benzopyran-4-one



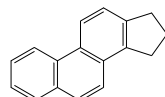
4,5-Di hydro-2-benzyl-1H-imidazole



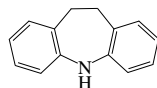
7,8-Di hydropteridine



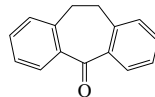
Dihydrocodeine



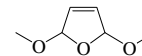
16,17-Di hydro-1H-cyclopenta[a]phenanthrene



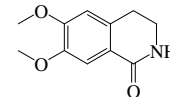
10,11-Di hydro-9H-benz[b,f]azepine



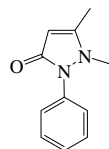
10,11-Di hydro-9H-benzo[a,d]cyclohepten-5-one



2,5-Di hydro-2,5-dimethoxyfuran



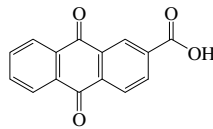
3,4-Di hydro-6,7-dimethoxy-1H-isoquinoline



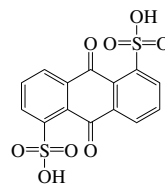
1,2-Di hydro-1,5-dimethyl-2-phenyl-3H-pyrazol-3-one



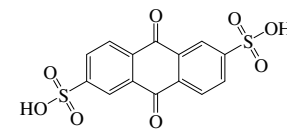
2,3-Di hydro-1,4-dioxin



9,10-Di hydro-9,10-dioxo-2-anthracene-9-carboxylic acid

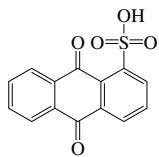


9,10-Di hydro-9,10-dioxo-1,5-anthracenedisulfonic acid

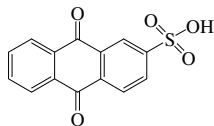


9,10-Di hydro-9,10-dioxo-2,6-anthracenedisulfonic acid

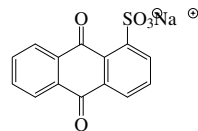
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3619	9,10-Di hydro-9,10-di oxo-1-ant hracenesulf oni c aci d		C ₁₄ H ₈ O ₂ S	82-49-5	288.276	lf (HOAc) ye lf (conc HCl, +3w)	216.0				vs H ₂ O, HOAc; s Et OH
3620	9,10-Di hydro-9,10-di oxo-2-ant hracenesulf oni c aci d		C ₁₄ H ₈ O ₂ S	84-48-0	288.276	ye lf (+3w)					vs H ₂ O; s Et OH; i et h
3621	9,10-Di hydro-9,10-di oxo-1-ant hracenesulf oni c aci d, sodi um salt	Sodi um ant hraqui none-1-sulf onat e	C ₁₄ H ₇ NaO ₂ S	128-56-3	310.258	ye lf (w)					sl H ₂ O
3622	9,10-Di hydro-9,10-di oxo-2-ant hracenesulf oni c aci d, sodi um salt		C ₁₄ H ₇ NaO ₂ S	131-08-8	310.258						sl DMSO
3623	7,8-Di hydrof oli c aci d		C ₁₉ H ₁₇ N ₇ O ₆	4033-27-6	443.413	ye cry					
3624	2,3-Di hydrof uran		C ₄ H ₆ O	1191-99-7	70.090			54.5	0.927 ²⁵	1.4239 ²⁰	
3625	2,5-Di hydrof uran		C ₄ H ₆ O	1708-29-8	70.090					1.4311 ²⁰	
3626	2,3-Di hydro-3-hydroxy-1-met hyl -1-indol e-5,6-di one	Adrenochrome	C ₈ H ₈ NO ₃	54-06-8	179.172		125 dec				vs H ₂ O, Et OH; i et h, bz
3627	2,3-Di hydro-1H-inden-5-ami ne		C ₈ H ₉ N	24425-40-9	133.190	nd (pet h)	37.5	248; 131 ⁵			sl H ₂ O, chl; s et h, ace, bz
3628	2,3-Di hydro-1H-inden-1-ol		C ₈ H ₉ O	6351-10-6	134.174	pl (pet h)	54.8	220; 128 ⁸			vs bz, Et OH, chl
3629	2,3-Di hydro-1H-inden-5-ol		C ₈ H ₉ O	1470-94-6	134.174		58	253			sl H ₂ O, pet h; vs Et OH, et h; s sul f
3630	2,3-Di hydro-1H-inden-1-one		C ₈ H ₆ O	83-33-0	132.159	t a, nd (w + 3)	42	243; 129 ²	1.0943 ⁴⁰	1.561 ²⁵	sl H ₂ O; vs Et OH, et h, ace, chl
3631	1,3-Di hydro-2H-inden-2-one	2-Indanone	C ₈ H ₆ O	615-13-4	132.159	nd (al, et h)	59	dec 218	1.071 ⁸	1.538 ⁶⁷	i H ₂ O; vs Et OH, et h, ace, chl
3632	1a,6a-Di hydro-1H-indeno[1,2-b]oxi rene		C ₉ H ₈ O	768-22-9	132.159		24.5	113 ²⁰ , 98 ⁶	1.1255 ²⁴		s chl
3633	2,3-Di hydro-1H-indol e		C ₈ H ₇ N	496-15-1	119.164			229	1.069 ²⁰	1.5923 ²⁰	sl H ₂ O; s et h, ace, bz
3634	1,3-Di hydro-2H-indol -2-one		C ₈ H ₇ NO	59-48-3	133.148	nd (w)	128	227 ²³ , 195 ¹⁷			s H ₂ O, Et OH, et h
3635	2,3-Di hydro-1H-indol -1-one		C ₈ H ₇ NO	480-91-1	133.148	nd (w)	151	338; 103 ¹⁸			vs et h, Et OH, chl
3636	Di hydro-1,4-dithiol e	6,8-Di mercapt ooct anoi c aci d	C ₈ H ₁₆ O ₂ S ₂	462-20-4	208.342	ye li q		145 ⁷			
3637	3,4-Di hydro-6-met hoxy-1(2H)-naphthal enone	6-Met hoxy-1,2-diol e	C ₁₂ H ₁₂ O ₂	1078-19-9	176.212	cry (MeOH, li g)	78	171 ⁴			
3638	3,4-Di hydro-2-met hoxy-2H-pyran		C ₆ H ₁₀ O ₂	4454-05-1	114.142	li q		128	1.006	1.442 ²⁰	
3639	1,2-Di hydro-3-met hyl benzol e	3-Met hyl chol ant hrene	C ₁₀ H ₁₆	56-49-5	268.352	ye nd (bz)	180	280 ⁸⁰	1.28 ²⁰		i H ₂ O
3640	2,3-Di hydro-2-met hyl benzof uran		C ₁₀ H ₁₀ O	1746-11-8	134.174			197.5	1.061 ²⁵	1.5308	
3641	Di hydro-3-met hyl ene-2,5-f urandi one		C ₅ H ₈ O ₃	2170-03-8	112.084	ort h bi pym pr (et h, chl)	69	139 ³⁰ , 114 ¹⁸			sl et h; vs chl
3642	Di hydro-3-met hyl ene-2(3H)-f uranone	α-Met hyl ene but yrol act one	C ₅ H ₆ O ₂	547-65-9	98.101			85 ¹⁰	1.1206 ²⁰	1.4650 ²⁰	s H ₂ O, et h, ace, bz; sl ct c; vs Et OH
3643	Di hydro-3-met hyl -2,5-f urandi one		C ₅ H ₆ O ₂	4100-80-5	114.100		34	239	1.22 ²⁵		
3644	Di hydro-3-met hyl -2(3H)-f uranone	2-Met hyl -but yrol act one	C ₅ H ₈ O ₂	1679-47-6	100.117	li q		200; 79 ⁹	1.0570 ²⁰	1.4325 ²⁰	
3645	Di hydro-4-met hyl -2(3H)-f uranone	3-Met hyl -but yrol act one	C ₅ H ₈ O ₂	1679-49-8	100.117	li q		78	1.058 ²⁰	1.4339 ²⁰	
3646	Di hydro-5-met hyl -2(3H)-f uranone, (±)-γ-Val erol act one	(±)-γ-Val erol act one	C ₅ H ₈ O ₂	57129-69-8	100.117	li q	-31	206	1.055 ⁴	1.4328 ²⁰	msc H ₂ O; s Et OH, ace; sl ct c
3647	4,5-Di hydro-2-met hyl -1H-imidazol e	Lysi di ne	C ₄ H ₆ N ₂	534-26-9	84.120	hyg	107	196.5			vs H ₂ O, Et OH; i et h; s chl
3648	1,3-Di hydro-1-met hyl -2H-imidazol e-2-thi one	Met hi mazol e	C ₄ H ₆ N ₂ S	60-56-0	114.169	lf (al)	146	dec 280			vs H ₂ O; s Et OH, chl; sl et h, bz, li g
3649	2,3-Di hydro-1-met hyl -1H-imidene		C ₆ H ₁₂	767-58-8	132.202			190.6	0.938 ²⁵	1.5266 ²⁰	i H ₂ O
3650	3,4-Di hydro-2-met hyl -1(2H)-naphthal enone		C ₁₁ H ₁₂ O	1590-08-5	160.212		15	136 ¹⁶	1.057 ²⁵	1.5535 ²⁰	
3651	4-(4,5-Di hydro-3-met hyl -5-oxo-1H-pyrazol -1-yl)benzenesulf oni c aci d		C ₁₀ H ₁₀ N ₂ O ₄ S	89-36-1	254.262	nd (w+1)	≈300 dec				
3652	1,2-Di hydro-5-met hyl -2-phenyl -1H-pyrazol -3-one	5-Hydroxy-3-met hyl -1-phenyl pyrazol e	C ₁₀ H ₁₀ N ₂ O	19735-89-8	174.198		128	287 ¹⁰⁵ , 191 ¹⁷	1.2600 ²⁰	1.637	s H ₂ O, Et OH; sl bz; i pet h



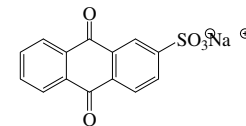
9,10-Di hydro-9,10-di oxo-1-ant hracenesul f oxii d



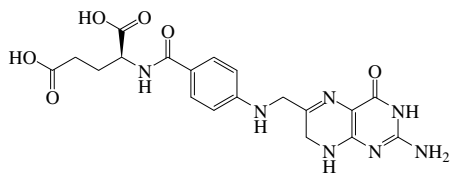
9,10-Di hydro-9,10-di oxo-2-ant hracenesul f oxii d



9,10-Di hydro-9,10-di oxo-1-ant hracenesul f oxii d sodi umsalt



9,10-Di hydro-9,10-di oxo-2-ant hracenesul f oxii d sodi umsalt



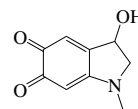
7,8-Di hydrof ol aei d



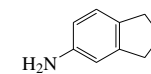
2,3-Di hydrof uran



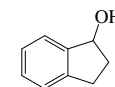
2,5-Di hydrof uran



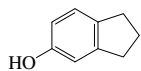
2,3-Di hydro-3-hydroxy-1-met hyl #i ndol e-5,6-di one



2,3-Di hydro-#i nden-5-ami ne



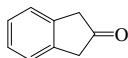
2,3-Di hydro-#i nden-1-ol



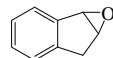
2,3-Di hydro-#i nden-5-ol



2,3-Di hydro-#i nden-1-one



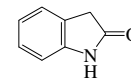
1,3-Di hydro-#i nden-2-one



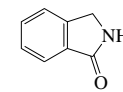
1a,6a-Di hydro-#i ndeno[1,2-b]oxi rene



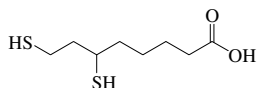
2,3-Di hydro-#i ndol e



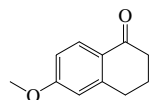
1,3-Di hydro-#i ndol -2-one



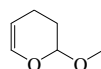
2,3-Di hydro-#i ndol -1-one



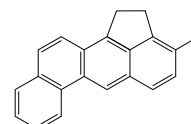
Di hydro-#i ndol -2,3-pi aci d



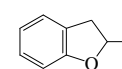
3,4-Di hydro-6-met hoxi-1(2)-napt hal enone



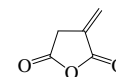
3,4-Di hydro-2-met hoxi-#i pyran



1,2-Di hydro-3-met hyl benz[j] jaceant hyl ene



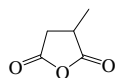
2,3-Di hydro-2-met hyl benzof uran



Di hydro-3-met hyl ene-2,5-f urandi



Di hydro-3-met hyl ene-2(3)-f uranone



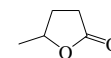
Di hydro-3-met hyl -2,5-f urandi one



Di hydro-3-met hyl -2(3)-f uranone



Di hydro-4-met hyl -2(3)-f uranone



Di hydro-5-met hyl -2(3)-f uranone(±)



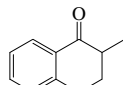
4,5-Di hydro-2-met hyl #i mi dazol



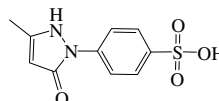
1,3-Di hydro-1-met hyl #i mi dazol e-2-t hi one



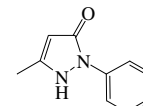
2,3-Di hydro-1-met hyl #i ndene



3,4-Di hydro-2-met hyl -1(2)-napt hal enone

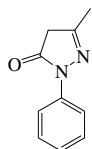


4-(4,5-Di hydro-3-met hyl -5-oxo#i pyrazol -1-yl)benzenesul f onaei d



1,2-Di hydro-5-met hyl -2-phenyl#i pyrazol -3-one

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3653	2,4-Di hydro-5-met hyl-2-phenyl- <i>H</i> B pyrazol-3-one		C ₁₀ H ₁₀ N ₂ O	89-25-8	174.198	mcl pr (w)	127	287 ⁰⁵ , 191 ¹⁷		1.637	
3654	3,6-Di hydro-4-met hyl- <i>H</i> 2-pyran		C ₆ H ₁₀ O	16302-35-5	98.142			117.5	0.912 ²⁵	1.4495 ²⁰	
3655	4,5-Di hydro-2-met hyl t hi azol e		C ₄ H ₆ NS	2346-00-1	101.171	li q	-101	145	1.067 ⁷	1.5200 ²⁰	
3656	1,2-Di hydronapht hal ene		C ₁₀ H ₁₀	447-53-0	130.186	li q	-8	206.5	0.997 ⁴	1.5814 ²⁰	
3657	1,4-Di hydronapht hal ene	Δ-2-Di ali n	C ₁₀ H ₁₀	612-17-9	130.186	pl	25	211.5	0.9928 ³	1.5577 ²⁰	
3658	3,4-Di hydro-2(<i>H</i>)-napht hal enone		C ₆ H ₁₀ O	530-93-8	146.185		18	237	1.1055 ²⁷	1.5598 ²⁰	i H ₂ O; s et h, bz
3659	1,2-Di hydro-5-ni t roacenapht hyl ene		C ₁₂ H ₁₂ NO ₂	602-87-9	199.205		103				s H ₂ O, Et OH, et h, li g
3660	1,6-Di hydro-6-oxo-3-pyri di ncarboxyl i c aci d		C ₆ H ₆ NO ₃	5006-66-6	139.109	nd(w)	310 dec	sub			sl H ₂ O, t f a; i Et OH, et h, bz, chl
3661	Di hydro-5-pent yl-2(<i>H</i>)-f uranone	4-Hydroxynonanoi c aci d lact one	C ₉ H ₁₆ O ₂	104-61-0	156.222	oi l		13 ⁴			
3662	9,10-Di hydrophenant hrene		C ₁₂ H ₁₂	776-35-2	180.245	nd (MeOH)	34.5	168 ¹⁵	1.0757 ⁴⁰	1.6415 ²⁰	s chl
3663	2,3-Di hydro-2-phenyl- <i>H</i> -1-benzopyran-4-one		C ₁₅ H ₁₂ O ₂	487-26-3	224.255	nd (li g)	76				i ₂ H ₂ O; s ace, bz; sl ct c
3664	4,5-Di hydro-2-(phenyl met hyl)- <i>H</i> i mi dazol e, monohydrochl ori de		C ₁₀ H ₁₃ ClN ₂	59-97-2	196.676			174			
3665	4,5-Di hydro-5-phenyl-2-oxazol ami ne	Ami norex	C ₉ H ₁₀ N ₂ O	2207-50-3	162.187	cry (bz)	137				
3666	1,4-Di hydro-1-phenyl- <i>H</i> -t et razol e-5-t hi one	1-Phenyl-5-mercapt o- <i>H</i> -t et razol e	C ₈ H ₉ N ₂ S	86-93-1	178.215		145				
3667	Di hydro-5-propyl-2(<i>H</i>)-f uranone	γ-Propyl-γ-but yrol act one	C ₈ H ₁₂ O ₂	105-21-5	128.169			84 ⁵		1.4385 ²⁵	
3668	2,3-Di hydro-6-propyl-2-t hi oxo- <i>H</i> 1-pyri mi di none	Propyl t hi ouraci l	C ₇ H ₉ N ₃ O ₂	51-52-5	170.231	w pow (w)	219				sl H ₂ O, chl, DMSO, Et OH; i et h, bz
3669	1,7-Di hydro- <i>H</i> 7-pyri ne-6-t hi one	6-Mercapt opyri ne	C ₅ H ₆ N ₂ S	50-44-2	152.178	ye pr (w, + l w)	313 dec				i H ₂ O; s al k
3670	3,4-Di hydro- <i>H</i> 2-pyran		C ₆ H ₈ O	110-87-2	84.117			86	0.921 ¹⁹	1.4402 ¹⁹	s H ₂ O, Et OH; sl chl
3671	3,6-Di hydro- <i>H</i> 2-pyran		C ₆ H ₈ O	3174-74-1	84.117	li q		95	0.9 ⁴		
3672	Di hydro- <i>H</i> 2-pyran-2,6(<i>H</i> 3 <i>H</i>)-di one		C ₆ H ₆ O ₃	108-55-4	114.100		56.3	158 ¹⁵	1.4110 ²⁰		
3673	4,5-Di hydro- <i>H</i> 1-pyrazol e	2-Pyrazol i ne	C ₄ H ₆ N ₂	109-98-8	70.093			144	1.0200 ¹⁷	1.4796 ¹⁷	vs H ₂ O, et h, Et OH
3674	1,2-Di hydro-3,6-pyri dazi nedi one	Mal ei c hydrazi de	C ₄ H ₄ N ₂ O ₂	123-33-1	112.087	cry (w)	307				sl H ₂ O, Et OH, t f a
3675	Di hydro-2,4(<i>H</i> 3 <i>H</i>)-pyri mi di nedi one	5,6-Di hydrouraci l	C ₄ H ₆ N ₂ O ₂	504-07-4	114.103	nd (w)	275.5				vs H ₂ O; s Et OH, chl, MeOH
3676	2,5-Di hydro- <i>H</i> 1-pyrrol e	3-Pyrrol i ne	C ₄ H ₇ N	109-96-6	69.106			90.5	0.9097 ²⁰	1.4664 ²⁰	vs H ₂ O, ace, et h, Et OH
3677	3,4-Di hydro-2(<i>H</i>)-qui nol i none	Hydrocarbost yri l	C ₈ H ₈ NO	553-03-7	147.173	pr (al, et h)	163.5	20 ⁴			vs et h, Et OH
3678	1,4-Di hydro-2,3-qui noxal i nedi one	2,3-Qui noxal i nedi ol	C ₈ H ₈ N ₂ O ₂	15804-19-0	162.146	nd (w)	410				vs H ₂ O; sl Et OH, et h; s bz, DMSO, HOAc
3679	Di hydrot achyst erol		C ₂₆ H ₄₆ O	67-96-9	398.664	cry (MeOH)	131				i H ₂ O; s os
3680	Di hydrot ehai ne		C ₁₉ H ₂₃ NO ₃	561-25-1	313.391		162.5				i H ₂ O; s Et OH, bz, AcOEt
3681	4,5-Di hydro-2-t hi azol ami ne		C ₄ H ₆ N ₂ S	1779-81-3	102.158	nd or lf (bz)	85.3	dec			vs H ₂ O, Et OH, bz, chl
3682	2,3-Di hydrot hi ophene		C ₈ H ₆ S	1120-59-8	86.156			112.1			
3683	2,5-Di hydrot hi ophene		C ₈ H ₆ S	1708-32-3	86.156			122.4			
3684	2,5-Di hydrot hi ophene 1,1-di oxo-	3-Sul f ol ene	C ₄ H ₄ O ₂ S	77-79-2	118.155		64.5				s chl
3685	Di hydro-2(<i>H</i>)-t hi ophenone		C ₈ H ₆ O ₂	1003-10-7	102.155			111 ⁵² , 39 ¹	1.18 ²⁵	1.5230 ²⁰	
3686	Di hydro-2-t hi oxo-4,6(<i>H</i> 5 <i>H</i>)-pyri mi di nedi one	2-Thi obarbi t uri c aci d	C ₄ H ₄ N ₂ O ₂ S	504-17-6	144.152	pl (w)	235 dec				sl H ₂ O; s Et OH, di l al k, di l HCl
3687	2,3-Di hydro-2-t hi oxo- <i>H</i> 1-pyri mi di none	2-Thi ouraci l	C ₄ H ₆ N ₂ O ₂ S	141-90-2	128.152	pr (w, al)	>340 dec				sl H ₂ O, Et OH, DMSO; s anh HF
3688	1,2-Di hydro- <i>H</i> 1,2,4-t ri azol e-3-t hi one		C ₂ H ₃ N ₃ S	3179-31-5	101.130		222.5				s DMSO
3689	(1,3-Di hydro-1,3,3-t ri met hyl-2 i ndol-2-yl i dene)acet al dehyde		C ₁₃ H ₁₃ NO	84-83-3	201.264						s chl



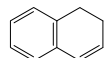
2,4-Di hydro-5-met hyl -2-phenyl-1H-pyrazol -3-one



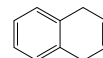
3,6-Di hydro-4-met hyl -2H-pyran



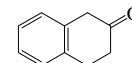
4,5-Di hydro-2-met hyl t hi azole



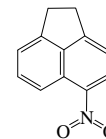
1,2-Di hydronapht hal ene



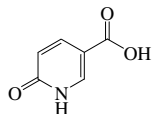
1,4-Di hydronapht hal ene



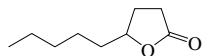
3,4-Di hydro-2(1H)-napht hal enone



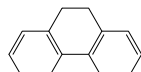
1,2-Di hydro-5-ni t roacenapht hyl ene



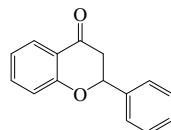
1,6-Di hydro-6-oxo-3-pyri di necarboxylic acid



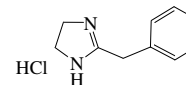
Di hydro-5-pent yl -2(1H)-f uranone



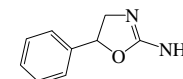
9,10-Di hydrophenant hrene



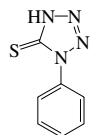
2,3-Di hydro-2-phenyl -1H-benzopyran-4-one



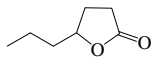
4,5-Di hydro-2-(phenyl met hyl)-1H-im idazol monohydrochl ori de



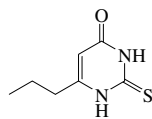
4,5-Di hydro-5-phenyl -2-oxazol ami ne



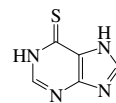
1,4-Di hydro-1-phenyl -5H-t et razol e-5-t hi one



Di hydro-5-propyl -2(1H)-f uranone



2,3-Di hydro-6-propyl -2-t hi oxo-4H-pyri mi di none



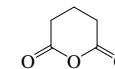
1,7-Di hydro-6H-puri ne-6-t hi one



3,4-Di hydro-2H-pyran



3,6-Di hydro-2H-pyran

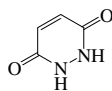


Di hydro-2H-pyran-2,6(3H)-di one

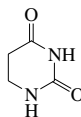
3-197



4,5-Di hydro-1H-pyrazol e



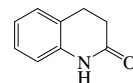
1,2-Di hydro-3,6-pyri dazi ned i



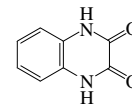
Di hydro-2,4(1H,3H)-pyri mi di ned i one



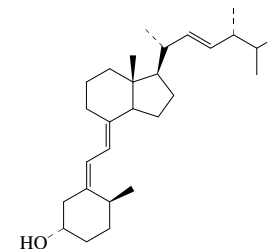
2,5-Di hydro-1H-pyrrol e



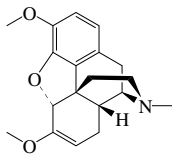
3,4-Di hydro-2(1H)-qui nol i none



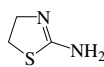
1,4-Di hydro-2,3-qui noxal i ned i one



Di hydrot actyst erol



Di hydrot hebai ne



4,5-Di hydro-2-t hi azol ami ne



2,3-Di hydrot hi ophene



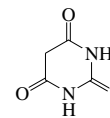
2,5-Di hydrot hi ophene



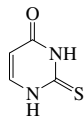
2,5-Di hydrot hi opherlet -di ox i d



Di hydro-2(3H)-t hi ophenone



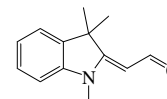
Di hydro-2-t hi oxo-4,6(5H)-pyri mi di ned i one



2,3-Di hydro-2-t hi oxo-4H-pyri mi di none

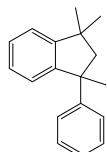


1,2-Di hydro-3H-1,2,4-t ri azol e-3-t hi one

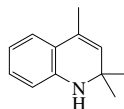


(1,3-Di hydro-1,3,3-t ri met hyl -2ndol -2-yl i dene)acet al dehyde

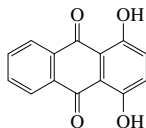
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3690	2,3-Di hydro-1,1,3-t ri met hyl -3-phenyl -1 <i>H</i> -i ndene		C ₁₈ H ₂₀	3910-35-8	236.352	t cl pr (al)	52.5	308.5	1.0009	1.5681 ²⁰	i H ₂ O; s Et OH, bz, MeOH
3691	1,2-Di hydro-2,2,4-t ri met hyl qui nol i ne		C ₁₂ H ₁₅ O	147-47-7	173.254		26.5	260; 132 ¹³			
3692	1,4-Di hydroxy-9,10-ant hracenedi one	Qui ni zari n	C ₁₄ H ₈ O ₄	81-64-1	240.212	ye red lf (et h) dk red nd	200				s H ₂ O, Et OH, et h, bz, KOH, sul f
3693	1,5-Di hydroxy-9,10-ant hracenedi one	Ant hrarufin	C ₁₄ H ₈ O ₄	117-12-4	240.212	pa ye pl (gl HOAc)	280	sub			i H ₂ O; sl Et OH, et h, ace, C ₅ Ss bz
3694	1,8-Di hydroxy-9,10-ant hracenedi one	Dant hron	C ₁₄ H ₈ O ₄	117-10-2	240.212	red or red-ye nd or lf (al)	193	sub			i H ₂ O; sl Et OH, et h; s ace, HOAc, al k
3695	2,6-Di hydroxy-9,10-ant hracenedi one		C ₁₄ H ₈ O ₄	84-60-6	240.212	ye nd (al)	360 dec				sl H ₂ O, Et OH; i et h, bz, chl; s al k
3696	2,7-Di hydroxy-9,10-ant hracenedi one		C ₁₄ H ₈ O ₄	572-93-0	240.212	ye nd (+1w, di l al) nd (sub)	353.8	sub			i H ₂ O; s Et OH; sl et h, bz, chl
3697	2,2'-Di hydroxyazobenzene		C ₁₂ H ₁₀ N ₂ O ₂	2050-14-8	214.219	gol d-ye lf (bz, nd (al)	173	140 ^{0.001}			i H ₂ O; sl Et OH, bz; vs et h; s con al k
3698	2,3-Di hydroxybenzal dehyde		C ₇ H ₆ O ₃	24677-78-9	138.121	ye nd	108	235; 120 ¹⁶			vs ace, Et OH, HOAc
3699	2,4-Di hydroxybenzal dehyde	β-Resorcy l al dehyde	C ₇ H ₆ O ₃	95-01-2	138.121	nd (et h-l i g)	135	226			s H ₂ O, HOAc; vs Et OH, et h, chl; sl bz
3700	2,5-Di hydroxybenzal dehyde		C ₇ H ₆ O ₃	1194-98-5	138.121	ye nd (bz)	100.0				vs H ₂ O, Et OH, chl
3701	3,4-Di hydroxybenzal dehyde	Prot ocat e chual dehyde	C ₇ H ₆ O ₃	139-85-5	138.121	lf (w, t o)	153 dec				s H ₂ O; vs Et OH, et h
3702	<i>N</i> ,2-Di hydroxybenzami de	Sal i cyl hydroxami c aci d	C ₇ H ₇ NO ₃	89-73-6	153.136	nd (HOAc)	168	sub			sl H ₂ O, DMSO; vs Et OH, et h; s HOAc
3703	2,5-Di hydroxybenzeneacet i c aci d	Homogent i si c aci d	C ₈ H ₆ O ₄ C	451-13-8	168.148	pr (w+1), lf (al - chl)	153				vs H ₂ O, Et OH, et h; i bz, chl
3704	2,3-Di hydroxybenzoi c aci d		C ₇ H ₆ O ₄	303-38-8	154.121	pr or nd (w+1)	205.5		1.542 ²⁰		s H ₂ O, Et OH, et h; sl ace
3705	2,4-Di hydroxybenzoi c aci d	β-Resorcy l i c aci d	C ₇ H ₆ O ₄	89-86-1	154.121	cry (+w)	226 dec				s H ₂ O, Et OH, et h, bz; i C ₅ S
3706	2,5-Di hydroxybenzoi c aci d	Gent i si c aci d	C ₇ H ₆ O ₄ C	490-79-9	154.121	nd or pr (w)	199.5				vs H ₂ O, Et OH, et h; s ace; i bz, chl, CS ₂
3707	2,6-Di hydroxybenzoi c aci d		C ₇ H ₆ O ₄	303-07-1	154.121	nd (+w)	167 dec				s H ₂ O, Et OH, et h; i chl; sl t f a
3708	3,4-Di hydroxybenzoi c aci d	Prot ocat e chui c aci d	C ₇ H ₆ O ₄ C	99-50-3	154.121	mcl nd (w+1)	201 dec		1.524 ^f		sl H ₂ O; vs Et OH; s et h; i bz
3709	3,5-Di hydroxybenzoi c aci d		C ₇ H ₆ O ₄	99-10-5	154.121	pr or nd	239				sl H ₂ O, ace; vs Et OH, et h
3710	2,2'-Di hydroxybenzophenone	Bi s(2-hydroxyphenyl) ket one	C ₁₂ H ₁₀ O ₃	835-11-0	214.216		59.5	333			i H ₂ O; s Et OH, et h, chl
3711	4,4'-Di hydroxybenzophenone	Bi s(4-hydroxyphenyl) ket one	C ₁₂ H ₁₀ O ₃	611-99-4	214.216	nd (l i g), cry (w)	210		1.133 ¹		sl H ₂ O; s Et OH, et h, ace; i bz, C ₅ S
3712	6,7-Di hydroxy-2 <i>H</i> -1-benzopyran-2-one	Escul et i n	C ₉ H ₆ O ₄	305-01-1	178.142	nd (w), pr (HOAc) lf (sub)	276	sub			sl H ₂ O, et h; s Et OH, ace, chl, AcOEt
3713	7,8-Di hydroxy-2 <i>H</i> -1-benzopyran-2-one	Daphnet i n	C ₉ H ₆ O ₄	486-35-1	178.142	ye nd (di l al)	262	sub			s H ₂ O, Et OH; sl et h, bz, chl, C ₅ S
3714	2,4-Di hydroxybut anoi c aci d		C ₄ H ₆ O ₄	1518-62-3	120.105	l i q		96			
3715	3,6-Di hydroxychol an-24-oi c aci d, (3α,5β,6α)	Hydoeoxchol i c aci d	C ₂₁ H ₄₀ O ₄	83-49-8	392.573	cry (AcOEt)	198.5				sl H ₂ O, et h, ace, bz; s Et OH, HOAc
3716	3,7-Di hydroxychol an-24-oi c aci d, (3α,5β,7β)	Ursodi ol	C ₂₁ H ₄₀ O ₄	128-13-2	392.573	pl (al)	203				vs Et OH; sl et h
3717	3,7-Di hydroxychol an-24-oi c aci d, (3α,5β,7α)	Chenodi ol	C ₂₁ H ₄₀ O ₄	474-25-9	392.573	nd (Et OAc+hep)	119				i H ₂ O, bz; vs Et OH, ace; s et h, HOAc
3718	1,25-Di hydroxychol ecal ci f erol	Cal ci t ri ol	C ₂₇ H ₄₄ O ₄	32222-06-3	416.636	wh cry pow	115				sl Et OH, MeOH, t hf, i AcOEt
3719	2,5-Di hydroxy-2,5-cycl ohexadi ene-1,4-di one		C ₆ H ₄ O ₄	615-94-1	140.094	dk ye nd	211				sl H ₂ O, ace, DMSO; s Et OH, HOAc; i et h
3720	2,3-Di hydroxy-2-cycl opent en-1-one	Reduct i c aci d	C ₅ H ₆ O ₃	80-72-8	114.100		212				s H ₂ O, Et OH; sl et h, ace, AcOEt; i bz



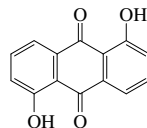
2,3-Di hydro-1,1,3-tri met hyl-3-phenyl-Indene



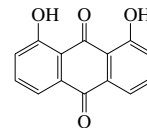
1,2-Di hydro-2,2,4-tri met hyl qui nol i ne



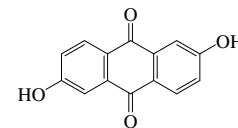
1,4-Di hydroxy-9,10-ant hracenedi one



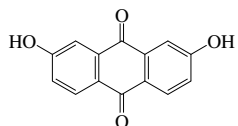
1,5-Di hydroxy-9,10-ant hracenedi one



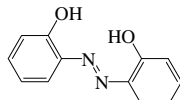
1,8-Di hydroxy-9,10-ant hracenedi one



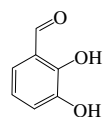
2,6-Di hydroxy-9,10-ant hracenedi one



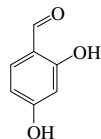
2,7-Di hydroxy-9,10-ant hracenedi one



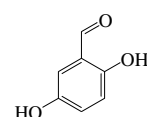
2,2'-Di hydroxyazobenzene



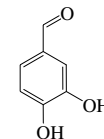
2,3-Di hydroxybenzaldehyde



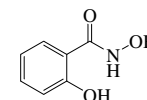
2,4-Di hydroxybenzaldehyde



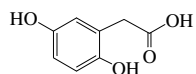
2,5-Di hydroxybenzaldehyde



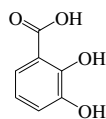
3,4-Di hydroxybenzaldehyde



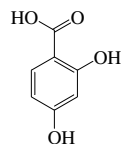
N,2-Di hydroxybenzami de



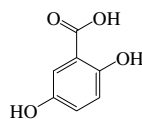
2,5-Di hydroxybenzeneacetic acid



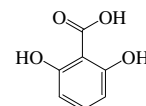
2,3-Di hydroxybenzoic acid



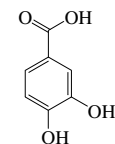
2,4-Di hydroxybenzoic acid



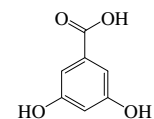
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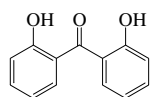
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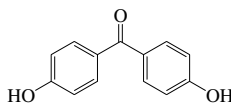
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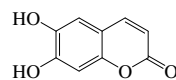
3,5-Di hydroxybenzoic acid



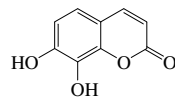
2,2'-Di hydroxybenzophenone



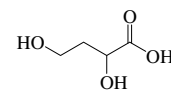
4,4'-Di hydroxybenzophenone



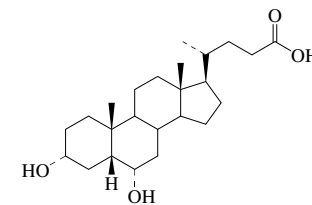
6,7-Di hydroxy-2H-1-benzopyran-2-one



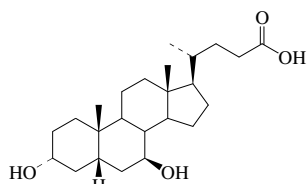
7,8-Di hydroxy-2H-1-benzopyran-2-one



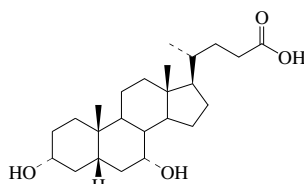
2,4-Di hydroxybutanoic acid



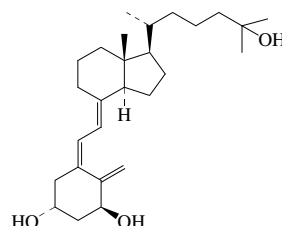
3,6-Di hydroxycholestan-24-oic acid (3 α ,5 β ,6 α)



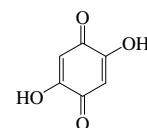
3,7-Di hydroxycholestan-24-oic acid (3 α ,5 β ,7 β)



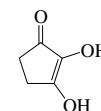
3,7-Di hydroxycholestan-24-oic acid (3 α ,5 β ,7 α)



1,25-Di hydroxycholecalciferol

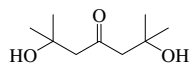


2,5-Di hydroxy-2,5-cyclohexadiene-1,4-dione

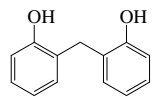


2,3-Di hydroxy-2-cyclopenten-1-one

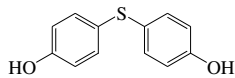
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3721	2,6-Di hydroxy-2,6-di met hyl-4-hept anone	Di (2-hydroxy-2-met hyl propyl) ket one	C ₉ H ₁₆ O ₃	3682-91-5	174.237	pal e ye cry					
3722	2,2'-Di hydroxydi phenyl met hane	2,2'-Met hyl enebi sphenol	C ₁₃ H ₁₂ O ₂	2467-02-9	200.233		118.3	363	1.280 ²⁵		
3723	4,4'-Di hydroxydi phenyl sul fide	4,4'-Thi obi sphenol	C ₁₂ H ₈ O ₂ S	2664-63-3	218.271	mcl pr or lf (al)	151				sl; Et OH, et h, C ₆ S ₆
3724	1,8-Di hydroxy-3-(hydroxymet hyl)-9,10-ant hracenedi one	Al oe-emodol	C ₉ H ₁₀ O ₅	481-72-1	270.237	oran ye nd (t o, al)	223.5	sub			vs bz, et h, Et OH
3725	2,3-Di hydroxymal ei c aci d	Di hydroxymal ei c aci d	C ₄ H ₄ O ₄	526-84-1	148.071	pl (w+2)	155 dec				sl H ₂ O, et h, MeOH; s Et OH
3726	α,4-Di hydroxy-3-met hox benzeneacet i c aci d	Vani l mandel i c aci d	C ₉ H ₈ O ₅	55-10-7	198.172	sc (bz-et h)	132 dec				vs H ₂ O, ace, et h
3727	7,8-Di hydroxy-6-met hox y-β-1-benzopyran-2-one	Fraxet i n	C ₁₆ H ₈ O ₅	574-84-5	208.168	pl (di l al)	231				vs Et OH
3728	5,7-Di hydroxy-3-(4-met hox yphenyl)-4H-1-benzopyran-4-one		C ₁₆ H ₁₂ O ₅	491-80-5	284.263		214.8				
3729	(2,6-Di hydroxy-4-met hox yphenyl) phenyl met hanone	Cot oi n	C ₁₇ H ₁₂ O ₄	479-21-0	244.243	ye pr (chl) lf or nd (w)	130.5				vs ace, bz, et h, Et OH
3730	1,7-Di hydroxy-3-met hox y-β-xant hen-9-one	Gen t i si n	C ₁₆ H ₁₀ O ₅	437-50-3	258.226	ye ort h	266.5				i H ₂ O; vs Et OH; i ace; s py
3731	1,8-Di hydroxy-3-met hyl-9,10-ant hracenedi one	Chrysophani c aci d	C ₉ H ₁₀ O ₄	481-74-3	254.238	ye hex or mcl nd (sub)	196	sub	0.92 ²⁵		vs bz, HOAc
3732	2,4-Di hydroxy-6-met hyl benzo i c aci do-Orsel l i ni c aci d		C ₈ H ₆ O ₄	480-64-8	168.148	nd (di l HOAc, +1w)	176 dec				s Et OH, et h
3733	5,7-Di hydroxy-4-met hyl-β-1-benzopyran-2-one		C ₁₆ H ₈ O ₄	2107-76-8	192.169	nd (al), lf (HOAc)	283				sl H ₂ O, et h, bz, chl; vs Et OH, al k
3734	6,7-Di hydroxy-4-met hyl-β-1-benzopyran-2-one		C ₁₆ H ₈ O ₄	529-84-0	192.169	ye nd (di l al)	275				s H ₂ O, Et OH, HOAc
3735	5,8-Di hydroxy-1,4-napt hal enedi one		C ₁₀ H ₆ O ₄	475-38-7	190.153	dk red mcl pr (bz) red-br nd (al)	232	sub			sl H ₂ O, Et OH, et h; s HOAc
3736	4,5-Di hydroxy-2,7-napt hal enedi sul f oni c aci d	Chromot ropi c aci d	C ₁₀ H ₆ O ₃ S ₂	148-25-4	320.296	nd or lf (w+2)					s H ₂ O, al k; i Et OH, et h
3737	5,6-Di hydroxynapt hol[2,3-f]qui nol i ne-7,12-di one	Al i zari n Bl ue	C ₁₇ H ₁₄ N ₂ O ₄	568-02-5	291.258	br-vi ol nd (bz)	269				vs bz, gl HOAc
3738	1,2-Di hydroxy-3-ni t ro-9,10-ant hracenedi one	Al i zari n Orange	C ₁₅ H ₁₀ N ₂ O ₆	568-93-4	285.209	oran nd or pl (HOAc)	244 dec	sub			sl H ₂ O; s Et OH, bz, chl, sul f, HOAc
3739	9,10-Di hydroxyoct adecenedi oi c aci d (R*,R*)-(±)	Phl oi oni c aci d	C ₁₈ H ₃₄ O ₆	23843-52-9	346.459	cry (al)	126				
3740	9,10-Di hydroxyoct adecanoi c aci d	9,10-Di hydroxyst eari c aci d	C ₁₈ H ₃₆ O ₄	120-87-6	316.477		90				i H ₂ O; sl Et OH, et h
3741	5,7-Di hydroxy-2-phenyl-β-1-benzopyran-4-one	Chrysi n	C ₁₅ H ₁₀ O ₄	480-40-0	254.238	lt ye pr (MeOH)	285.5				i H ₂ O; s Et OH, ace; sl et h, bz, C ₆ S ₆
3742	1-(2,4-Di hydroxyphenyl)et hanone	Resacet ophenone	C ₈ H ₈ O ₃	89-84-9	152.148	nd or lf	146		1.18 ¹		i H ₂ O, chl; s Et OH, py; sl et h, bz
3743	(2,4-Di hydroxyphenyl) phenyl met hanone	Benzoresorci nol	C ₈ H ₁₀ O ₃	131-56-6	214.216	nd (w)	144				i H ₂ O; s Et OH; vs et h; sl bz, chl
3744	3-(3,4-Di hydroxyphenyl)-2-propeni c aci d	Caf f ei c aci d	C ₉ H ₈ O ₄	331-39-5	180.158	ye pr, pl (w)	225 dec				vs Et OH
3745	Di hydroxyphenyl st i bi ne ox i de	Benzenest i boni c aci d	C ₆ H ₄ O ₃ S ₂	535-46-6	248.878	nd (HOAc)	139				
3746	17,21-Di hydroxypregna-1,4-diene-3,11,20-tri one	Predni sone	C ₂₁ H ₂₆ O ₅	53-03-2	358.428		234 dec				
3747	17,21-Di hydroxypregna-4-ene-3,20-di one	11-Deoxy-17-hydrocort i cost erone	C ₂₁ H ₃₀ O ₄	152-58-9	346.461		215				vs ace, Et OH, chl



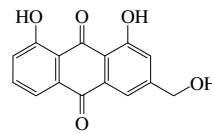
2,6-Di hydroxy-2,6-di met hyl -4-hept anone



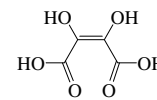
2,2'-Di hydroxydi phenyl met hane



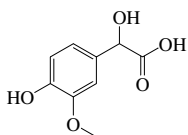
4,4'-Di hydroxydi phenyl sul f i d e



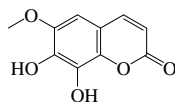
1,8-Di hydroxy-3-(hydroxymet hyl)-9,10-ant hracenedi one



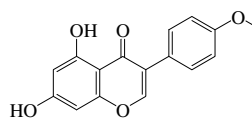
2,3-Di hydroxymal ei aci d



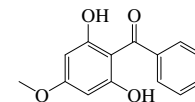
α ,4-Di hydroxy-3-met hoxybenzeneacet aci d



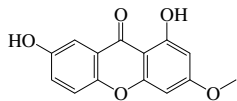
7,8-Di hydroxy-6-met hoxy-#1-benzopyran-2-one



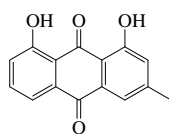
5,7-Di hydroxy-3-(4-met hoxyphenyl)#1-benzopyran-4-one



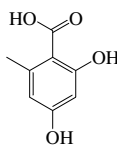
(2,6-Di hydroxy-4-met hoxyphenyl)phenyl met hanone



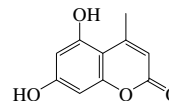
1,7-Di hydroxy-3-met hoxy-#9-xant hen-9-one



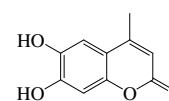
1,8-Di hydroxy-3-met hyl -9,10-ant hracenedi one



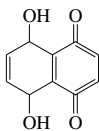
2,4-Di hydroxy-6-met hyl benzoaci d



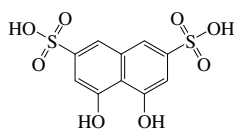
5,7-Di hydroxy-4-met hyl #21-benzopyran-2-one



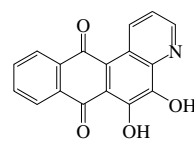
6,7-Di hydroxy-4-met hyl #21-benzopyran-2-one



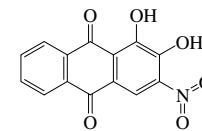
5,8-Di hydroxy-1,4-napht halenedi one



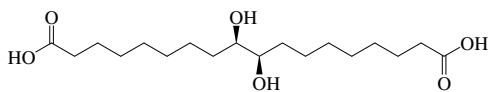
4,5-Di hydroxy-2,7-napht halenedi sul f aci d



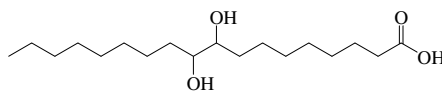
5,6-Di hydroxynapht ho[2,3-f]qui nol i ne-7,12-di one



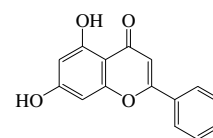
1,2-Di hydroxy-3-ni t ro-9,10-ant hracenedi one



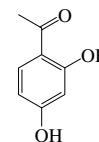
9,10-Di hydroxyoct adecenedi aci d,(R^* , R^*)(\pm)



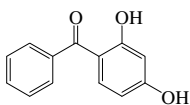
9,10-Di hydroxyoct adecanoi aci d



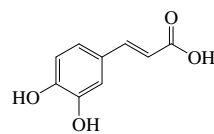
5,7-Di hydroxy-2-phenyl -#1-benzopyran-4-one



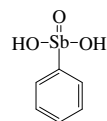
1-(2,4-Di hydroxyphenyl)et hanone



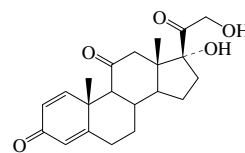
(2,4-Di hydroxyphenyl)phenyl met hanone



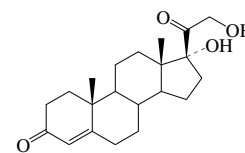
3-(3,4-Di hydroxyphenyl)-2-propenoaci d



Di hydroxyphenyl st i biomè de

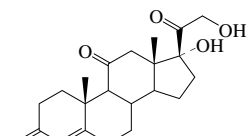


17,21-Di hydroxypregna-1,4-di ene-3,11,20-tri one

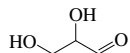


17,21-Di hydroxypregna-4-ene-3,20-di one

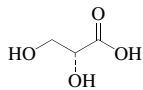
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3748	17,21-Di hydroxypropen-4-ene-3,11,20-trione	Cortisonone	C ₂₇ H ₄₂ O ₅	53-06-5	360.444		222				sl H ₂ O, et h, bz, chl; s Et OH, ace
3749	2,3-Di hydroxypropanal, (±)		C ₃ H ₆ O ₃	56-82-6	90.078	nd or pr (40% MeOH)	145	145 ^{0,8}	1.453 ¹⁸		s H ₂ O; sl Et OH, et h; i bz, pet h, li g
3750	2,3-Di hydroxypropanoic acid	Glyceric acid	C ₃ H ₆ O ₄	6000-40-4	106.078	thick gum		dec			
3751	1,3-Di hydroxy-2-propanone	Dihydroxyacetone	C ₃ H ₆ O ₃	96-26-4	90.078		90				s H ₂ O, Et OH, et h, ace; i li g
3752	2,3-Di hydroxypropyl decanoate	Decanoic acid glycerol monoester	C ₁₃ H ₂₆ O ₄	2277-23-8	246.343	pr (pet h)	53				
3753	2,3-Di hydroxypropyl octanoate	Octanoic acid glycerol monoester	C ₁₁ H ₂₂ O ₄	26402-26-6	218.291	cry (pet h)	40				
3754	4,8-Di hydroxy-2-quinolinecarboxylic acid	Quinoline-2,8-diol	C ₈ H ₈ N ₂ O ₄	59-00-7	205.168	yellow crystals (w)	289				i H ₂ O; s Et OH, dil HCl; sl et h, bz
3755	Dihydroxyacetone		C ₃ H ₆ O ₃	76-30-2	182.086		114.5				
3756	3,4-Di hydroxy-5-[(3,4,5-trihydroxybenzoyloxy)benzoyl]benzoic acid	Digallonic acid	C ₁₄ H ₁₀ O ₉	536-08-3	322.224	nf (dilal + 1w)	269 dec				vs ace, Et OH
3757	2-(3,6-Di hydroxy-9H-xanthene-9-yl)benzoic acid	Fluorescein	C ₂₀ H ₁₄ O ₅	518-44-5	334.322	colorless nd (et h), pl (bz)	126				i H ₂ O; s Et OH, et h, ace, bz, HOAc
3758	Diacetyl		C ₄ H ₈ O ₂	624-74-8	277.830	orthoid (li g)	81.5	exp			vs ace, bz, et h, Et OH
3759	2,4-Diiodoaniline		C ₆ H ₄ I ₂ N	533-70-0	344.920	brnd or orth cry (al)	95.5		2.748 ²⁵		vs ace, bz, et h, Et OH
3760	<i>o</i> -Diiodobenzene	1,2-Diiodobenzene	C ₆ H ₄ I ₂	615-42-9	329.905	pl or pr (li g)	27	287; 100	2.54 ²⁰	1.7179 ²⁰	i H ₂ O; sl Et OH
3761	<i>m</i> -Diiodobenzene	1,3-Diiodobenzene	C ₆ H ₄ I ₂	626-00-6	329.905	orthoid or pr (et h-al)	40.4	285	2.47 ²⁵		i H ₂ O; vs et h, Et OH, chl
3762	<i>p</i> -Diiodobenzene	1,4-Diiodobenzene	C ₆ H ₄ I ₂	624-38-4	329.905	orthoid (al)	131.5	285			i H ₂ O; s Et OH; vs et h; sl chl
3763	1,4-Diiodobutane		C ₄ H ₈ I ₂	628-21-7	309.916		5.8	125 ¹⁵ dec	2.3494 ²⁵	1.6184 ²⁵	i H ₂ O; sl ct c; s os
3764	1,2-Diiodoethane		C ₂ H ₄ I ₂	624-73-7	281.862	yellow pr or orthoid (et h)	83	200	3.325 ²⁰	1.871 ²⁰	sl H ₂ O; s Et OH, et h, ace, chl
3765	<i>cis</i> -1,2-Diiodoethane	<i>cis</i> -1,2-Diiodoethane	C ₂ H ₄ I ₂	590-26-1	279.846		-14	72.5 ¹⁶	3.0625 ²⁰		i H ₂ O; s et h, chl
3766	4,4'-Diiododifluorescein		C ₂₀ H ₁₀ I ₂ O ₅	38577-97-8	584.099	orange-red pow					sl H ₂ O; s al k, Et OH
3767	1,6-Diiodohexane	Hexamethylene diiodide	C ₆ H ₁₂ I ₂	629-09-4	337.968	nd	9.5	163 ¹⁷ , 141 ¹⁰	2.0342 ²⁵	1.5837 ²⁵	i H ₂ O; vs Et OH, et h
3768	Diodoethane	Methylene diiodide	C ₂ H ₄ I ₂	75-11-6	267.836	yellow nd or lf	6.1	182	3.321 ¹⁹	1.7411 ²⁰	sl H ₂ O, ct c; s Et OH, et h, bz, chl
3769	2,6-Diiodo-4-nitrophenol	Dinitrophenol	C ₆ H ₃ I ₂ NO ₃	305-85-1	390.902	light yellow crystals (gl HOAc)	157				vs Et OH
3770	1,5-Diiodopentane	Pentamethylene diiodide	C ₅ H ₁₀ I ₂	628-77-3	323.942		9	149 ²⁰ , 101 ³	2.1692 ²⁵	1.5987 ²⁵	i H ₂ O; s et h, chl
3771	1,2-Diiodopropane		C ₃ H ₆ I ₂	598-29-8	295.889				2.490 ¹⁸		vs et h, Et OH
3772	1,3-Diiodopropane	Trimethylene diiodide	C ₃ H ₆ I ₂	627-31-6	295.889		-20	dec 227; 110 ¹⁹	2.5612 ²⁵	1.6391 ²⁵	i H ₂ O; s et h, ct c, chl
3773	5,7-Diiodo-8-quinoline	Quinoline	C ₈ H ₇ I ₂ NO	83-73-8	396.951	yellow (HOAc, xyl)	210				sl H ₂ O, bz, chl, et h; vs Et OH; s al k
3774	3,5-Diiodotyrosine		C ₉ H ₉ I ₂ NO ₃	300-39-0	432.981	yellow (w, 70% al)	213				sl H ₂ O; i Et OH, et h, bz
3775	Dibutyl adipate		C ₁₄ H ₂₆ O ₄	141-04-8	258.354			293; 187 ¹⁵	0.9543 ¹⁹	1.4301 ²⁰	
3776	Dibutylaluminum chloride		C ₈ H ₁₈ AlCl	1779-25-5	176.664	hygroscopic liq	-40	152	0.905	1.4506 ²⁰	s et h, hx
3777	Dibutylaluminum hydride		C ₈ H ₁₉ Al	1191-15-7	142.219	liq		140.85 ^{0,5}			s cyclohex, et h, bz, tolu
3778	Dibutylamine	2-Methyl-2-methylpropyl-1-propanamine	C ₈ H ₁₉ N	110-96-3	129.244	liq	-73.5	139.6		1.409 ¹⁹	sl H ₂ O, ct c; s Et OH, et h, ace, bz
3779	Dibutyl carbonate		C ₈ H ₁₆ O ₃	539-92-4	174.237			190	0.9138 ²⁰	1.4072 ²⁰	i H ₂ O; msc Et OH, et h
3780	Dibutyl ether	1,1'-Oxybis[2-methylpropane]	C ₈ H ₁₈ O	628-55-7	130.228			122.6	0.761 ¹⁵		i H ₂ O; msc Et OH, et h
3781	Dibutylphthalate		C ₁₈ H ₂₀ O ₄	84-69-5	278.344			296.5; 159 ⁴	1.0490 ¹⁵		s ct c
3782	Dibutyl sulfide		C ₈ H ₁₈ S	592-65-4	146.294	liq	-105.5	171	0.836 ¹⁹		



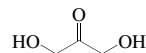
17,21-Di hydroxypregn-4-ene-3,11,20-trione



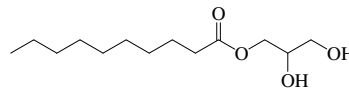
2,3-Di hydroxypropanal (±)



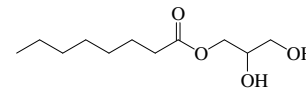
2,3-Di hydroxypropanoic acid (R)



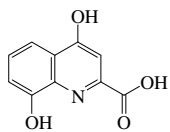
1,3-Di hydroxy-2-propanone



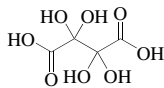
2,3-Di hydroxypropyldecanoate



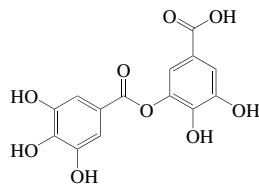
2,3-Di hydroxypropyl octanoate



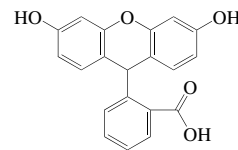
4,8-Di hydroxy-2-quinolinecarboxylic acid



Di hydroxytartaric acid



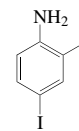
3,4-Di hydroxy-5-((3,4,5-trihydroxybenzoyl)oxy)benzoic acid



2-(3,6-Di hydroxy-9H-xanthhen-9-yl)benzoic acid



Di iodoacetylene

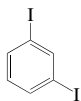


2,4-Di iodoaniline

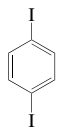


o-Di iodobenzene

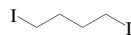
3-203



m-Di iodobenzene



p-Di iodobenzene



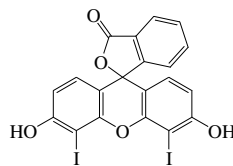
1,4-Di iodoethane



1,2-Di iodoethane



cis-1,2-Di iodoethene



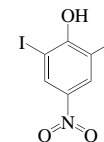
4,4'-Di iodo-6-fluorescein



1,6-Di iodoethane



Di iodomethane



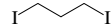
2,6-Di iodo-4-nitrophenol



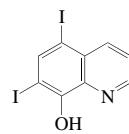
1,5-Di iodopentane



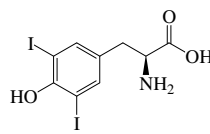
1,2-Di iodopropane



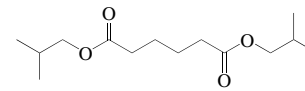
1,3-Di iodopropane



5,7-Di iodo-8-quinolineol



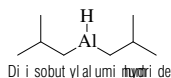
3,5-Di iodo-L-tyrosine



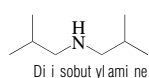
Di isobutyl adipate



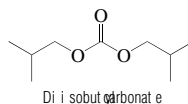
Di isobutyl aluminum chloride



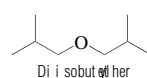
Di isobutyl aluminum hydride



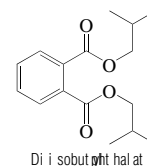
Di isobutylamine



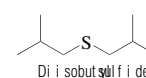
Di isobutyl carbonate



Di isobutyl ether

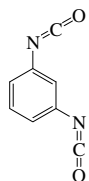


Di isobutyl phthalate

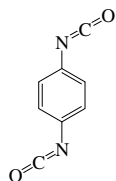


Di isobutyl sulfide

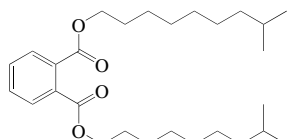
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3783	1,3-Di i socyanat obenzene		$\text{C}_6\text{H}_4\text{N}_2\text{O}_2$	123-61-5	160.130	cry	51	103 ⁸			
3784	1,4-Di i socyanat obenzene		$\text{C}_6\text{H}_4\text{N}_2\text{O}_2$	104-49-4	160.130	cry	95	117 ¹⁴			
3785	Di i sodexyl pht hal at e	Bi s(8-met hyl nonyl)pht hal at e	$\text{C}_{28}\text{H}_{46}\text{O}_4$	26761-40-0	446.663	li q	-50	258	0.966 ²⁰		i H ₂ O; s os
3786	Di i sononyl pht hal at e	Bi s(7-met hyl oct yl)pht hal at e	$\text{C}_{26}\text{H}_{42}\text{O}_4$	28553-12-0	418.609	col li q					i H ₂ O; s ace, MeOH; bz, et h
3787	Di i sooct yl adi pat e		$\text{C}_{22}\text{H}_{38}\text{O}_4$	1330-86-5	370.566			210 ⁴			
3788	Di i sooct yl pht hal at e		$\text{C}_{24}\text{H}_{40}\text{O}_4$	27554-26-3	390.557			370			
3789	Di i sopenl yl ami ne	3-Met hyl sopenl yl -1-but anami ne	$\text{C}_{10}\text{H}_{19}\text{N}$	544-00-3	157.297	li q	-44	188	0.767 ²	1.4235 ²⁰	i H ₂ O; s Et OH; msc et h
3790	Di i sopenl yl et her	Di i soamyl et her	$\text{C}_{10}\text{H}_{22}\text{O}$	544-01-4	158.281			172.5	0.7777 ²⁰	1.4085 ²⁰	i H ₂ O; vs ace, Et OH, chl
3791	Di i sopenl yl pht hal at e	Di i soamyl pht hal at e	$\text{C}_{18}\text{H}_{26}\text{O}_4$	605-50-5	306.397			dec 334	1.0209 ¹⁶	1.4871 ²⁰	vs Et OH
3792	Di i sopenl yl sul fide		$\text{C}_{10}\text{H}_{16}\text{S}$	544-02-5	174.347	li q	-74.6	211	0.832 ³	1.4520 ²⁰	i H ₂ O; msc Et OH; vs et h
3793	Di i sopropanol ami ne	1,1'-Imi nobi s-2-propanol	$\text{C}_6\text{H}_{12}\text{N}_2\text{O}_2$	110-97-4	133.189	cry	44.5	250; 151 ²³	0.989 ²⁰		s H ₂ O, Et OH; sl et h
3794	Di i sopropyl adi pat e		$\text{C}_{12}\text{H}_{22}\text{O}_4$	6938-94-9	230.301		-0.6	120 ^{6,5}	0.9569 ²⁰	1.4247 ²⁰	vs ace, et h, Et OH
3795	Di i sopropyl ami ne	<i>N</i> -Isopropyl -2-propanami ne	$\text{C}_6\text{H}_{13}\text{N}$	108-18-9	101.190	li q	-61	83.9	0.715 ³	1.3924 ²⁰	vs ace, bz, et h, Et OH
3796	2,6-Di i sopropyl ani li ne		$\text{C}_{12}\text{H}_{19}\text{N}$	24544-04-5	177.286	li q	-45	257	0.9 ⁴	1.5332 ²⁰	
3797	1,2-Di i sopropyl benzene		$\text{C}_{12}\text{H}_{18}$	577-55-9	162.271	li q	-57	204	0.870 ⁴	1.4960 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, ct c
3798	1,3-Di i sopropyl benzene		$\text{C}_{12}\text{H}_{18}$	99-62-7	162.271	li q	-63.1	203.2	0.855 ⁹	1.4883 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, ct c
3799	1,4-Di i sopropyl benzene		$\text{C}_{12}\text{H}_{18}$	100-18-5	162.271	li q	-17	210.3	0.856 ⁸	1.4898 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, ct c
3800	<i>p</i> -Di i sopropyl benzene hydroperoxi de		$\text{C}_{12}\text{H}_{18}\text{O}_2$	98-49-7	194.270	waxy cry	30.1	123 ¹	0.9932 ²⁰		i H ₂ O
3801	<i>M,M</i> -Di i sopropyl -2-benzot hi azol esul f enami de		$\text{C}_{13}\text{H}_{18}\text{N}_2\text{S}_2$	95-29-4	266.425		59.0				
3802	<i>M,N</i> -Di i sopropyl carbodi i mi de		$\text{C}_7\text{H}_{12}\text{O}_2$	693-13-0	126.199			147	0.806 ²⁵	1.4320 ²⁰	
3803	Di i sopropyl di sul fide		$\text{C}_6\text{H}_8\text{S}_2$	4253-89-8	150.305	li q	-69	177	0.943 ⁹	1.4916 ²⁰	
3804	<i>M,M</i> -Di i sopropyl et hanol ami ne	<i>M,M</i> -Di i sopropyl -2-ami noet hanol	$\text{C}_8\text{H}_{17}\text{NO}$	96-80-0	145.243			190	0.826 ²⁵	1.4417 ²⁰	
3805	Di i sopropyl et her	Isopropyl et her	$\text{C}_3\text{H}_8\text{O}$	108-20-3	102.174	li q	-85.4	68.4	0.719 ²	1.3658 ²⁵	sl H ₂ O; msc Et OH, et h; s ace, ct c
3806	Di i sopropyl met hyl phosphonat e		$\text{C}_7\text{H}_{13}\text{O}_3\text{P}$	1445-75-6	180.182			66 ³		1.4120 ¹⁶	
3807	2,6-Di i sopropyl naph hal ene		$\text{C}_{16}\text{H}_{20}$	24157-81-1	212.330	cry (MeOH)	70				
3808	Di i sopropyl oxalat e		$\text{C}_8\text{H}_{14}\text{O}_4$	615-81-6	174.195			190	1.002 ²⁰	1.4100 ²⁰	vs et h, Et OH
3809	Di i sopropyl phosphonat e		$\text{C}_6\text{H}_{11}\text{O}_3\text{P}$	1809-20-7	166.155			97 ⁴⁰ , 76 ¹⁰	0.9970 ¹⁸		
3810	<i>O,O</i> -Di i sopropyl phosphorodi t hi oat e		$\text{C}_8\text{H}_{15}\text{O}_4\text{PS}_2$	107-56-2	214.286	li q		7 ¹	1.09 ²⁰		s Et OH, bz, ace, ct c, chl
3811	Di i sopropyl pht hal at e	1,2-Benzenedi carboxyl i c aci d, di i sopropyl est er	$\text{C}_{14}\text{H}_{18}\text{O}_4$	605-45-8	250.291			130 ¹²	1.0615 ¹⁵	1.4900 ²⁰	
3812	Di i sopropyl sul fide		$\text{C}_6\text{H}_8\text{S}$	625-80-9	118.240	li q	-78.1	120.0	0.814 ²	1.4438 ²⁰	i H ₂ O; s Et OH, et h
3813	Di i sopropyl t art rat e, (±)		$\text{C}_{10}\text{H}_{16}\text{O}_6$	58167-01-4	234.246		34	275; 154 ¹²	1.1166 ²⁰		vs ace, et h, Et OH
3814	Di i sopropyl t hi operoxydi carbonat e	Di i sopropyl di xant hogen	$\text{C}_8\text{H}_{14}\text{O}_2\text{S}_4$	105-65-7	270.456		52				s chl
3815	1,4-Di i sot hi ocyanat obenzene	Bi t oscanat e	$\text{C}_6\text{H}_4\text{N}_2\text{S}_2$	4044-65-9	192.261	nd (ace, HOAc)	132				
3816	Di ket ene		$\text{C}_4\text{H}_4\text{O}_2$	674-82-8	84.074	li q	-6.5	126.1	1.087 ⁷	1.4379 ²⁰	
3817	Di i act i c aci d	2,2'-Oxybi spropanoi c aci d	$\text{C}_{10}\text{H}_{18}\text{O}_6$	19201-34-4	162.140	ort h	112.5				vs H ₂ O, et h
3818	Di met ili ne		$\text{C}_2\text{H}_2\text{N}_2\text{O}_3$	1165-48-6	323.386		109.5				s chl
3819	Di met ox	Tet ramet hyl phosphorodi ami di c fluori de	$\text{C}_4\text{H}_{12}\text{F}_2\text{N}_2\text{OP}$	115-26-4	154.122	li q		8 ⁶	1.1151 ²⁰	1.4267 ²⁰	vs H ₂ O, bz, et h
3820	Di memorf an	3,17-Di met hyl morphi narin, (α,14 α)-	$\text{C}_{18}\text{H}_{25}\text{N}$	36309-01-0	255.399	ye oi l	92	138 ³			
3821	2,3-Di mercapt obut anedi oi c aci d		$\text{C}_4\text{H}_8\text{O}_2\text{S}_2$	2418-14-6	182.219	wh cry (MeOH)	193				
3822	1,4-Di mercapt o-2,3-but anedi ol		$\text{C}_4\text{H}_8\text{O}_2\text{S}_2$	7634-42-6	154.251		42.5				s chl
3823	2,2'-Di mercapt odi et hyl et her	2-Mercapt oet hyl et her	$\text{C}_4\text{H}_{10}\text{O}_2\text{S}_2$	2150-02-9	138.251	li q	-80	217; 6 ⁴	1.114 ²⁰		
3824	2,3-Di mercapt o-1-propanol	Di mercaprol	$\text{C}_3\text{H}_8\text{O}_2\text{S}_2$	59-52-9	124.225			83 ^{0,8}	1.2463 ²⁰	1.5749 ²⁰	s Et OH, et h, oi l s; sl chl



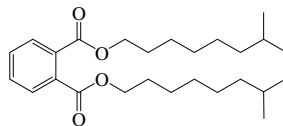
1,3-Di i socyanat obzene



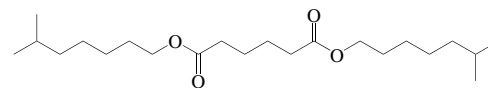
1,4-Di i socyanat obzene



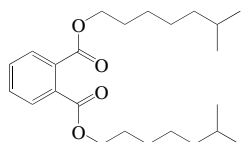
Di i sodecylht halat e



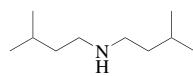
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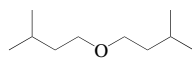
Di i sooctyl di pat e



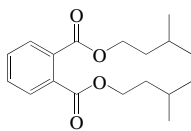
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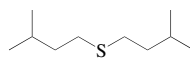
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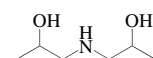
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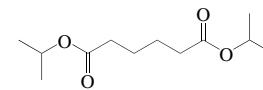
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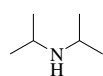
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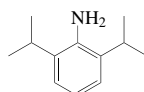
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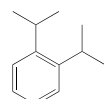
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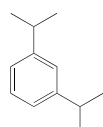
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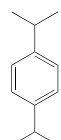
2,6-Di i sopropylani li ne



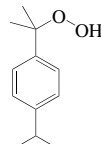
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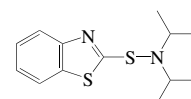
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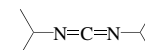
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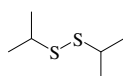
p-Di i sopropyl benzetyl hydroperoxi de



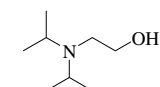
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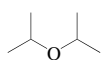
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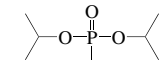
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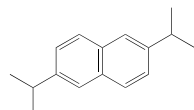
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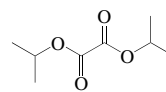
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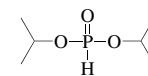
Di i sopropyl et hyl fosphonat e



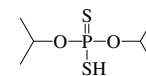
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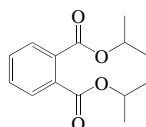
Di i sopropyl oxalat e



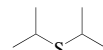
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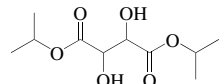
O,O-Di i sopropyl fosforoditi hi oz



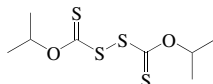
Di i sopropylht halat e



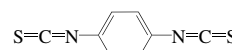
Di i sopropyl sulfi c



Di i sopropyl tart (t)



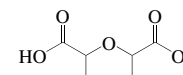
Di i sopropyl thi peroxydi carbonat



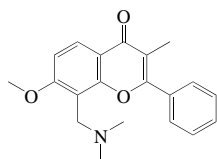
1,4-Di i sot hi ocyanat obzene



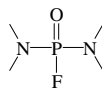
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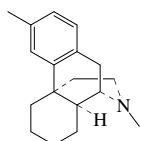
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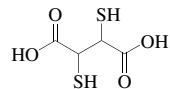
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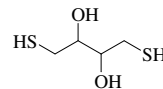
Di mef ox



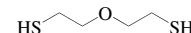
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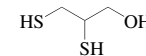
2,3-Di mercapt obut anedi aci d



1,4-Di mercapt o-2,3-but anedi ol

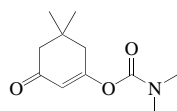


2,2'-Di mercapt odi et ylht her

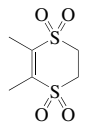


2,3-Di mercapt o-1-propanol

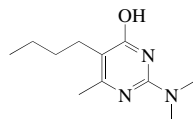
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3825	Di met an		C ₁₁ H ₁₇ NO ₃	122-15-6	211.258	cry	46	175 ¹¹			s H ₂ O, cyhex; vs Et OH, et h, ace
3826	Di met hi pi n	2,3-Di hydro-5,6-di met hyl -1,4-di t hi i n, 1,1,4,4-t et raaxi de	C ₆ H ₁₀ O ₄ S ₂	55290-64-7	210.271		165				
3827	Di met hi ri mol	5-But yl -2-(di met hyl ami no)-6-met hyl pyri mi di n-4-one	C ₁₁ H ₁₉ N ₃ O	5221-53-4	209.288	nd	102				sl H ₂ O; vs chl, xyl; s Et OH, ace
3828	Di met hi soqui n	2-[(3-But yl -1-i soqui nol i nyl)oxy]N,N-di met hyl et hanami ne	C ₁₇ H ₂₄ N ₂ O	86-80-6	272.385		146	156 ³		1.5486 ²⁰	s H ₂ O, Et OH
3829	Di met hoxane	2,6-Di met hyl -1,3-di oxan-4-ol acet al	C ₈ H ₁₆ O ₃	828-00-2	174.195	li q		88	1.0655 ²⁰	1.4310 ²⁰	msc H ₂ O; s os
3830	2',5'-Di met hoxacet ophenone		C ₁₂ H ₁₂ O ₃	1201-38-3	180.200	cry	21	156 ¹⁴	1.139	1.5441 ²⁰	
3831	1,2-Di met hoxi-4-al yl benzene		C ₁₄ H ₁₄ O ₂	93-15-2	178.228	li q	-2.0	254.7	1.0396	1.5340 ²⁰	i H ₂ O; s Et OH, et h
3832	4,7-Di met hoxi-5-al yl -1,3-benzodi oxole	Api ole	C ₈ H ₁₄ O ₄	523-80-8	222.237	nd	29.5	294; 179 ³⁵	1.015 ²⁰	1.5360 ²⁰	vs ace, bz, Et OH, li g
3833	2,4-Di met hoxyani li ne		C ₈ H ₈ NO ₂	2735-04-8	153.179	pl (li g)	33.5	262.0			sl H ₂ O, chl; s Et OH, et h, bz, li g
3834	2,5-Di met hoxyani li ne		C ₈ H ₈ NO ₂	102-56-7	153.179		82.5	270			s H ₂ O, Et OH, chl, li g
3835	3,4-Di met hoxyani li ne		C ₈ H ₈ NO ₂	6315-89-5	153.179	lf (et h)	87.5	159			s et h, chl
3836	2,4-Di met hoxbenzal dehyde		C ₉ H ₁₀ O ₃	613-45-6	166.173	nd (al or li g)	72	290; 165			i H ₂ O; s Et OH, et h, bz; sl chl
3837	2,5-Di met hoxbenzal dehyde		C ₉ H ₁₀ O ₃	93-02-7	166.173		52	270; 146 ¹⁰			sl H ₂ O; s Et OH, et h
3838	3,4-Di met hoxbenzal dehyde	Verat ral dehyde	C ₉ H ₁₀ O ₃	120-14-9	166.173	nd (et h, li g, t o)	43	281; 155			sl H ₂ O, chl; vs Et OH, et h
3839	3,5-Di met hoxbenzal dehyde		C ₉ H ₁₀ O ₃	7311-34-4	166.173		46.3	151 ¹⁶			sl H ₂ O, pet h; s Et OH, bz
3840	1,2-Di met hoxbenzene	Verat role	C ₈ H ₈ O ₂	91-16-7	138.164		22.5	206	1.0810 ²⁵	1.5827 ²¹	sl H ₂ O; s Et OH, et h, ct c
3841	1,3-Di met hoxbenzene		C ₈ H ₁₀ O ₂	151-10-0	138.164	li q	-52	217.5	1.052 ⁴	1.5231 ²⁰	sl H ₂ O; s Et OH, et h, bz, ct c, sul f
3842	1,4-Di met hoxbenzene		C ₈ H ₁₀ O ₂	150-78-7	138.164	lf (w)	59	212.6	1.037 ⁵		sl H ₂ O; s Et OH, chl; vs et h, bz
3843	3,4-Di met hoxbenzeneacet i c aci d		C ₁₀ H ₁₂ O ₄	93-40-3	196.200	cry (bz-pet h) nd (w+1)	98				s H ₂ O, chl; vs Et OH, et h
3844	3,4-Di met hoxbenzeneet hanami ne		C ₁₀ H ₁₅ NO ₂	120-20-7	181.232			164 ¹⁴		1.5464 ²⁰	s ct c
3845	3,4-Di met hoxbenzenemet hanami ne		C ₉ H ₉ NO ₂	5763-61-1	167.205			156 ¹² , 120 ³	1.143 ²⁵		s chl
3846	3,4-Di met hoxbenzenemet hanol		C ₉ H ₉ O ₃	93-03-8	168.189	vi sc oi l		298; 172	1.178 ¹⁷	1.555 ¹⁷	s H ₂ O, Et OH
3847	3,3'-Di met hoxbenzi di ne	Di ani si di ne	C ₁₄ H ₁₆ NO ₂	119-90-4	244.289	lf or nd (w)	137				i H ₂ O; s Et OH, et h, ace, bz, chl
3848	3,3'-Di met hoxbenzi di ne-4,4'-di i socyanat e		C ₁₆ H ₁₂ N ₂ O ₄	91-93-0	296.277	cry	112				
3849	2,4-Di met hoxbenzoi c aci d		C ₉ H ₈ O ₄	91-52-1	182.173			108.5			sl H ₂ O; s Et OH, et h, chl, HOAc
3850	2,6-Di met hoxbenzoi c aci d		C ₉ H ₈ O ₄	1466-76-8	182.173			186 dec			
3851	3,4-Di met hoxbenzoi c aci d	Verat ri c aci d	C ₉ H ₁₀ O ₄	93-07-2	182.173	nd (w or HOAc) ort h (sub)	181	sub			i H ₂ O; vs Et OH, et h; sl chl
3852	3,5-Di met hoxbenzoi c aci d		C ₉ H ₈ O ₄	1132-21-4	182.173	nd (w), pr (al)	185.5	sub			vs et h, Et OH
3853	4,4'-Di met hoxbenzoi n	p-Ani soi n	C ₁₆ H ₁₆ O ₄	119-52-8	272.296	pr (di l al)	114.0				sl H ₂ O, chl, Et OH, et h; s ace
3854	5,7-Di met hoxi- 2 -1-benzopyran-2-one	Li met ti n	C ₁₁ H ₁₀ O ₄	487-06-9	206.195	pr or nd (al)	149	dec 200			sl H ₂ O; vs Et OH, ace, chl; i et h, li g
3855	4,4'-Di met hoxi-1,1'-bi phenyl		C ₁₄ H ₁₄ O ₂	2132-80-1	214.260	lf (bz)	175	sub			i H ₂ O, pet h; vs Et OH, bz, chl; sl et h
3856	Di met hoxylborane		BH ₂ BO ₂	4542-61-4	73.887	vol li q or gas	-130.6	25.9			dec 10
3857	4,4-Di met hoxi-2-but anone		C ₈ H ₁₂ O ₃	5436-21-5	132.157			50 ⁵			s ct c
3858	2,6-Di met hoxi-2,5-cycl hexadi ene-1,4-di one	2,6-Di met hoxp-qui none	C ₈ H ₈ O ₄	530-55-2	168.148	ye mcl pr (HOAc)	256	sub			sl H ₂ O, Et OH, et h; s t f a; vs al k, HOAc
3859	Di met hoxidi met hyl si lane		C ₄ H ₁₂ O ₂ Si	1112-39-6	120.223			82	0.864 ⁰	1.3708 ²⁰	dec H ₂ O
3860	Di met hoxidi phenyl si lane		C ₁₆ H ₁₆ O ₂ Si	6843-66-9	244.362			286; 161 ⁵	1.0771 ²⁰	1.5447 ²⁰	
3861	1,1-Di met hoxidodecane	Laural dehyde, di met hyl acet al	C ₁₄ H ₃₀ O ₂	14620-52-1	230.387			133 ⁵		1.4310 ²⁵	vs et h, Et OH
3862	2,2-Di met hoxet hanami ne		C ₄ H ₉ NO ₂	22483-09-6	105.136		-78	137 ⁹⁵	0.966 ²⁵	1.4170 ²⁰	



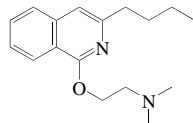
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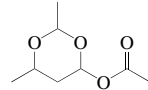
Di met hi pi n



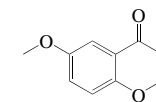
Di met hi ri mol



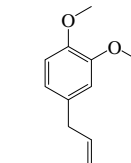
Di met hi soqui n



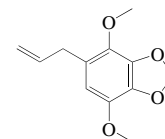
Di met hoxane



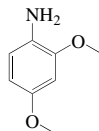
2',5'-Di met hoxacet ophenone



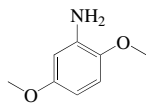
1,2-Di met hoxi-4-al lyl benzene



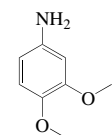
4,7-Di met hoxi-5-al lyl-1,3-benzodi oxole



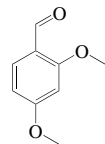
2,4-Di met hoxiani li ne



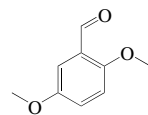
2,5-Di met hoxiani li ne



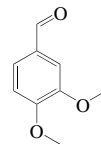
3,4-Di met hoxiani li ne



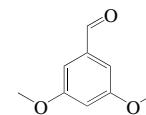
2,4-Di met hoxibenzal dehyde



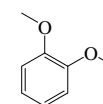
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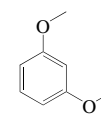
3,4-Di met hoxibenzal dehyde



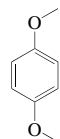
3,5-Di met hoxibenzal dehyde



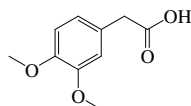
1,2-Di met hoxibenzene



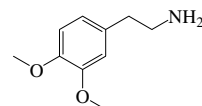
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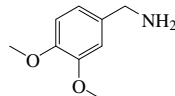
1,4-Di met hoxibenzene



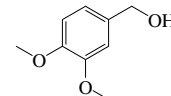
3,4-Di met hoxibenzeneacet aci d



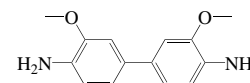
3,4-Di met hoxibenzeneet hanami ne



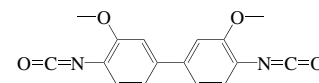
3,4-Di met hoxibenzenemet hanami ne



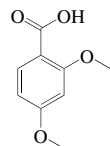
3,4-Di met hoxibenzenemet hanol



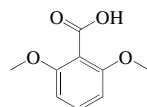
3,3'-Di met hoxibenzi di ne



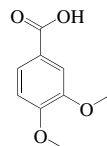
3,3'-Di met hoxibenzi di ne-4,4'-di i socyanat e



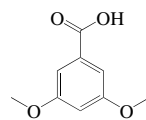
2,4-Di met hoxibenzoiaci d



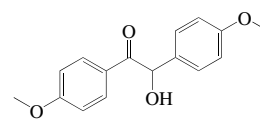
2,6-Di met hoxibenzoiaci d



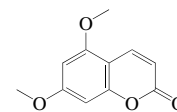
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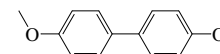
3,5-Di met hoxibenzoiaci d



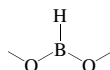
4,4'-Di met hoxibenzo i n



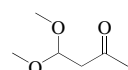
5,7-Di met hoxi-#1-benzopyran-2-one



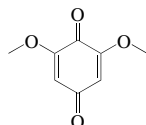
4,4'-Di met hoxi-1,1'-bi phenyl



Di met hoxborane



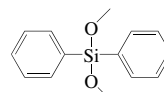
4,4-Di met hoxi-2-but anone



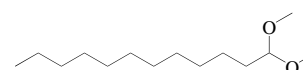
2,6-Di met hoxi-2,5-cycl ohexadi ene-1,4-di one



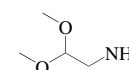
Di met hoxidi met hyl si l ane



Di met hoxidi phenyl si l ane

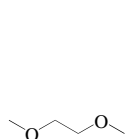


1,1-Di met hoxidodecane

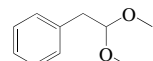


2,2-Di met hoxet hanami ne

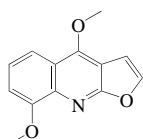
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3863	1,2-Di met hoxyet hane	Et hyl ene glycol di met hyl et her	$\text{C}_4\text{H}_{10}\text{O}_2$	110-71-4	90.121	liq	-69.20	84.50	0.8637 ⁷	1.3770 ²⁵	s H ₂ O, Et OH, et h, ace, bz, chl, ct c
3864	(2,2-Di met hoxyet hyl)benzene		$\text{C}_{10}\text{H}_{14}\text{O}_2$	101-48-4	166.217			193.5			
3865	4,8-Di met hoxyl uro[2,3-b]qui nol i ne	Fagari ne	$\text{C}_{13}\text{H}_{11}\text{NO}_3$	524-15-2	229.231	pr (al)	142				sl H ₂ O, pet h; s Et OH, et h, bz, chl
3866	1,1-Di met hoxylhexadecane	Pal mi t al dehyde, di met hyl acet al	$\text{C}_{18}\text{H}_{36}\text{O}_2$	2791-29-9	286.494		10	144 ²	0.8542 ²⁰	1.4382 ²⁵	vs ace, et h, Et OH
3867	2,4-Di met hoxyl-6-hydroxyacet ophenone	Xant hoxyl i n	$\text{C}_{10}\text{H}_{12}\text{O}_4$	90-24-4	196.200	cry (al)	82	185 ²⁰			vs et h, Et OH
3868	5,6-Di met hoxyl-1-i ndanone		$\text{C}_{12}\text{H}_{12}\text{O}_3$	2107-69-9	192.211			119.5			sl ct c
3869	6,7-Di met hoxyl-1(9)-i sobenzof uranone	Meconi n	$\text{C}_{10}\text{H}_{10}\text{O}_4$	569-31-3	194.184	wh nd (w)	102.5				sl H ₂ O; s Et OH, et h, ace, bz, HOAc, chl
3870	Di met hoxymet hane	Met hyl al	$\text{C}_3\text{H}_8\text{O}_2$	109-87-5	76.095	liq	-105.1	42	0.8599 ⁹	1.3513 ²⁰	s H ₂ O; vs ace, bz, et h, Et OH
3871	1,2-Di met hoxyl-4-met hyl benzene		$\text{C}_8\text{H}_{10}\text{O}_2$	494-99-5	152.190	pr (et h)	24	220	1.0509 ⁵	1.5257 ²⁵	i H ₂ O; sl ct c; vs os
3872	1,3-Di met hoxyl-5-met hyl benzene		$\text{C}_8\text{H}_{10}\text{O}_2$	4179-19-5	152.190			244	1.0478 ¹⁵	1.5234 ²⁰	vs bz, et h, Et OH
3873	1,4-Di met hoxyl-2-met hyl benzene		$\text{C}_8\text{H}_{10}\text{O}_2$	24599-58-4	152.190		21	214.0			
3874	N-(Di met hoxymet hyl)di met hyl ami ne	Di met hyl f ormami de di met hyl	$\text{C}_6\text{H}_{10}\text{N}_2\text{O}_2$	4637-24-5	119.163			104	0.897 ²⁵	1.3972 ²⁰	
3875	2,2-Di met hoxyl-4-met hyl et hanami ne		$\text{C}_8\text{H}_{10}\text{N}_2\text{O}_2$	122-07-6	119.163			140	0.928 ²⁵	1.4115 ²⁰	
3876	Di met hoxymet hyl phenyl si lane		$\text{C}_9\text{H}_{10}\text{O}_2\text{Si}$	3027-21-2	182.292			129 ⁹			1.4795 ²⁰
3877	1,2-Di met hoxyl-4-ni t robenzene		$\text{C}_8\text{H}_8\text{NO}_4$	709-09-1	183.162	ye nd (al-w)	98	230 ⁵	1.1888 ¹³³		i H ₂ O; vs Et OH, et h; s chl; sl i g
3878	1,4-Di met hoxyl-2-ni t robenzene		$\text{C}_8\text{H}_8\text{NO}_4$	89-39-4	183.162	gol d-ye nd (di l al)	72.5		1.1666 ¹³²		i H ₂ O; s Et OH, bz, chl, sul f
3879	2,6-Di met hoxylphenol		$\text{C}_6\text{H}_8\text{O}_3$	91-10-1	154.163	mcl pr (w)	56.5	261			vs et h, Et OH
3880	3,5-Di met hoxylphenol		$\text{C}_6\text{H}_8\text{O}_3$	500-99-2	154.163		37	199 ³⁵ , 170 ¹⁰			s et h, bz; sl i g
3881	1-(3,4-Di met hoxylphenyl)et hanone		$\text{C}_{10}\text{H}_{12}\text{O}_3$	1131-62-0	180.200	pr (di l al)	51	287			vs H ₂ O, bz, Et OH, chl
3882	1,1-Di met hoxylpropane		$\text{C}_3\text{H}_8\text{O}_2$	4744-10-9	104.148			86	0.8648 ²⁰		
3883	2,2-Di met hoxylpropane		$\text{C}_3\text{H}_8\text{O}_2$	77-76-9	104.148	liq	-47	83	0.847 ⁷	1.3780 ²⁰	
3884	3,3-Di met hoxyl-1-propene		$\text{C}_3\text{H}_6\text{O}_2$	6044-68-4	102.132			88	0.862 ²⁵	1.3954 ²⁰	
3885	1,2-Di met hoxyl-4-(1-propenyl)benzene		$\text{C}_{11}\text{H}_{14}\text{O}_2$	93-16-3	178.228		18	270.5	1.0521 ²⁰	1.5616 ²⁰	
3886	4,5-Di met hoxyl-6-(2-propenyl)-1,3-benzodi oxole	Api ole (Di l l)	$\text{C}_{12}\text{H}_{14}\text{O}_4$	484-31-1	222.237	oi l	29.5	285	1.1598 ⁸	1.5305 ¹⁷	
3887	1,2-Di met hoxyl-4-vi nyl benzene		$\text{C}_{10}\text{H}_{12}\text{O}_2$	6380-23-0	164.201					1.5711 ²⁰	s chl
3888	Di met hyl acet al		$\text{C}_4\text{H}_8\text{O}_2$	534-15-6	90.121	liq	-113.2	64.5	0.8509 ⁹	1.3668 ²⁰	s H ₂ O, Et OH, et h, ct c, chl; vs ace
3889	N,N-Di met hyl acet ami de	N,N-Di met hyl et hanami de	$\text{C}_4\text{H}_{10}\text{NO}$	127-19-5	87.120	liq	-18.59	165	0.9372 ⁸	1.4341 ²⁵	msc H ₂ O, Et OH, et h, ace, bz, chl
3890	2,7-Di met hyl-3,6-acri di ned i ami ne, Acri di ne Yel l ow monohydrochl ori de		$\text{C}_{15}\text{H}_{16}\text{Cl}_2\text{N}_2$	135-49-9	273.761	red cry pow					s hot H ₂ O, Et OH
3891	Di met hyl adi pat e		$\text{C}_8\text{H}_{10}\text{O}_4$	627-93-0	174.195	cry	10.3	115 ¹³	1.0600 ²⁰	1.4283 ²⁰	i H ₂ O; s Et OH, et h, ct c, HOAc
3892	3,3-Di met hyl al l yl di phosphat e	3-Met hyl -2-but enyl pyrophosphat e	$\text{C}_{12}\text{O}_7\text{F}_2$	358-72-5	246.092	cry (MeOH)					
3893	Di met hyl ami ne	N-Met hyl met hanami ne	$\text{C}_2\text{H}_6\text{N}$	124-40-3	45.084	col gas	-92.18	6.88	0.6804 ⁴	1.350 ¹⁷	vs H ₂ O; s Et OH, et h
3894	Di met hyl ami ne hydrochl ori de	N-Met hyl met hanami ne hydrochl ori de	$\text{C}_2\text{H}_8\text{ClN}$	506-59-2	81.545	ort h nd (al)	171				vs H ₂ O, Et OH, chl
3895	(Di met hyl ami no)acet oni t ri le		$\text{C}_4\text{H}_8\text{N}_2\text{C}$	926-64-7	84.120			137.5	0.8649 ²⁰	1.4095 ²⁰	vs H ₂ O, Et OH
3896	4-(Di met hyl ami no)acet ophenone	4-Acet yl-N,N-di met hyl ani li ne	$\text{C}_{10}\text{H}_{12}\text{NO}$	2124-31-4	163.216	nd (w, pet h)	105.5				vs H ₂ O, et h, i g; sl chl
3897	10-[(Di met hyl ami no)acet yl H]O phenot hi azi ne	Ahi st an	$\text{C}_8\text{H}_{16}\text{N}_2\text{OS}$	518-61-6	284.375	cry	144.5				
3898	p-(Di met hyl ami no)azobenzene		$\text{C}_{14}\text{H}_{15}\text{N}_3$	60-11-7	225.289	ye lf (al)	117	dec			i H ₂ O; vs Et OH, py; s et h; sl chl, i g
3899	2,3-Di met hyl-4-ami noazobenzene	oFol yl azo-o-t ol ui di ne	$\text{C}_{14}\text{H}_{15}\text{N}_3$	97-56-3	225.289	ye lf (al)	102				vs et h, Et OH
3900	4-(Di met hyl ami no)benzal dehyde	Ehrl i ch's reagent	$\text{C}_8\text{H}_{11}\text{NO}$	100-10-7	149.189	lf (w)	74.5	176	1.0254 ¹⁰⁰		sl H ₂ O, chl; s Et OH, et h, ace, bz
3901	p-(Di met hyl ami no)benzal rhodani ne		$\text{C}_{12}\text{H}_{12}\text{N}_2\text{OS}_2$	536-17-4	264.365	dp red nd (xyl)	270 dec				i H ₂ O; sl Et OH, bz; vs et h, ct c; s ace



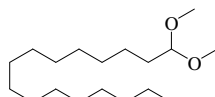
1,2-Di met hoxyet hane



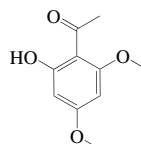
(2,2-Di met hoxyet hyl)benzene



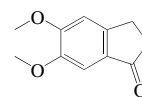
4,8-Di met hoxyf uro[2,3-b]qui nol i ne



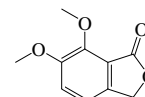
1,1-Di met hoxylhexadecane



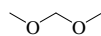
2,4-Di met hoxi-6-hydroxyacet ophenone



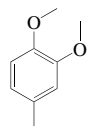
5,6-Di met hoxi-1-i ndanone



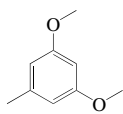
6,7-Di met hoxi-1(9)-i sobenzof uranone



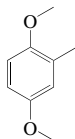
Di met hoxymet hane



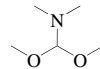
1,2-Di met hoxi-4-met hyl benzene



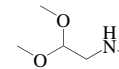
1,3-Di met hoxi-5-met hyl benzene



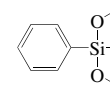
1,4-Di met hoxi-2-met hyl benzene



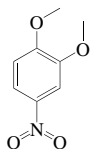
N-(Di met hoxymet hyl)di met hyl ami ne



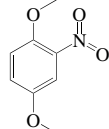
2,2-Di met hoxi-N-met hyl et hanami ne



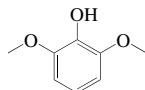
Di met hoxymet hyl phenyl si l ane



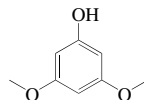
1,2-Di met hoxi-4-ni t robenzene



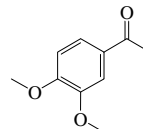
1,4-Di met hoxi-2-ni t robenzene



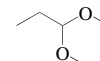
2,6-Di met hoxyphenol



3,5-Di met hoxyphenol



1-(3,4-Di met hoxyphenyl)et hanone



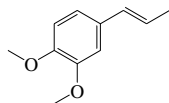
1,1-Di met hoxypropane



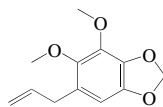
2,2-Di met hoxypropane



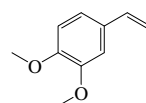
3,3-Di met hoxi-1-propene



1,2-Di met hoxi-4-(1-propenyl)benzene



4,5-Di met hoxi-6-(2-propenyl)-1,3-benzodi oxole



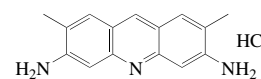
1,2-Di met hoxi-4-vi nyl benzene



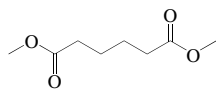
Di met hylacet :



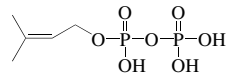
N,N-Di met hylacet ami de



2,7-Di met hyl -3,6-acri di nedi ami nohydrochl ori de



Di met hyl di pat e



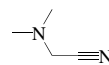
3,3-Di met hyl al kyl phosphat e



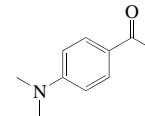
Di met hyl ami ne



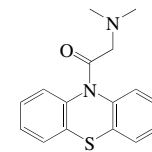
Di met hyl ami hydrochl ori de



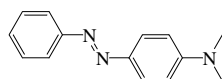
(Di met hyl ami no)acet oni t ri le



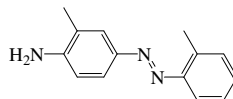
4-(Di met hyl ami no)acet ophenone



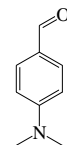
10-(Di met hyl ami no)acet yl 10H-thiopi re



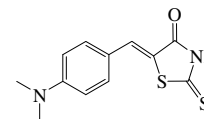
p-(Di met hyl ami no)azobenzene



2,3-Di met hyl -4-ami noazobenzene

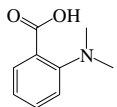


4-(Di met hyl ami no)benzaldehyde

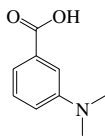


p-(Di met hyl ami no)benzaldehyde

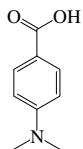
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3902	2-(Di met hyl ami no)benzoi c aci d		₉ H ₁₁ NO ₂	610-16-2	165.189	pr, nd (et h)	72	sub			vs H ₂ O, et h, Et OH
3903	3-(Di met hyl ami no)benzoi c aci d		₉ H ₁₁ NO ₂	99-64-9	165.189	nd (w)	152.5				sl H ₂ O, chl ; s Et OH, et h
3904	4-(Di met hyl ami no)benzoi c aci d		₉ H ₁₁ NO ₂	619-84-1	165.189	nd (al)	242.5				s Et OH; sl et h
3905	4,4'-Di met hyl ami nobenzophenoni mi de	Bri lli ant Oi l Yel low	₁₇ H ₂₁ N ₃	492-80-8	267.369	ye or col pl (al)	136				i ₂ B; s Et OH; sl et h
3906	(Di met hyl ami no)di met hyl borane		₄ H ₁₂ BN	1113-30-0	84.956	li q	-92	65			vs et h, ace
3907	6-(Di met hyl ami no)-4,4-di phenyl-3-hept anone		C ₂₁ H ₂₇ NO	76-99-3	309.445		99.5				vs Et OH
3908	6-(Di met hyl ami no)-4,4-di phenyl-3-Normet hadone hexanone		C ₂₀ H ₂₅ NO	467-85-6	295.419	oi ly li q		165			
3909	2-(Di met hyl ami no)et hyl acryl at e		₇ H ₁₃ NO ₂	2439-35-2	143.184		<-60	95 ⁵⁰	0.938 ²⁰		
3910	3-[2-(Di met hyl ami no)et hyl-1-ndol-5-ol	Bu f et oni ne	₁₆ H ₁₆ N ₂ O	487-93-4	204.267	pr (Et OAc)	146.5	320 ¹			vs et h, Et OH
3911	2-(Di met hyl ami no)et hyl met hacryl at e		₈ H ₁₅ NO ₂	2867-47-2	157.211			63 ⁶			
3912	4-[2-(Di met hyl ami no)et hyl]phenol	Hordeni ne	₁₀ H ₉ NO	539-15-1	165.232	ort h pr (al), nd (w)	117.5	173 ¹¹			vs et h, Et OH, chl
3913	N-[2-(Di met hyl ami no)et hyl]-N'-tri met hyl-1,2-et hanedi ami ne		C ₉ H ₂₃ N ₃	3030-47-5	173.299			84 ¹²		1.4413 ²⁵	
3914	5-(Di met hyl ami no)-1-naphth al enesul f onyl chl ori de	Dansyl chl ori de	₁₂ H ₁₂ Cl NO ₂ S	605-65-2	269.747		70				
3915	3-(Di met hyl ami no)phenol		₈ H ₉ Cl NO	99-07-0	137.179	nd (li g)	86	266.5		1.589 ⁵	i H ₂ O; s Et OH, et h, ace, bz, C ₆ H ₆
3916	4-(Di met hyl ami no)phenol		₈ H ₉ Cl NO	619-60-3	137.179		77	165 ³⁰			sl H ₂ O; s Et OH, et h
3917	[4-(Di met hyl ami no)phenyl]phenyl met hanone	4-(Di met hyl ami no)benzophenone	₁₅ H ₁₅ NO	530-44-9	225.286	ye lf (al) nd (pet h)	92.5				i H ₂ O; sl Et OH; vs et h; s chl , pet h
3918	3-(Di met hyl ami no)-1-phenyl-1-propanone, hydrochl ori de		C ₁₁ H ₁₆ Cl NO	879-72-1	213.704			153.5			
3919	3-[4-(Di met hyl ami no)phenyl]-2-propenal	4-(Di met hyl ami no)ci nnamal dehyde	₁₁ H ₉ Cl NO	6203-18-5	175.227			139.5			
3920	3-(Di met hyl ami no)propaneni tri le		₅ H ₁₀ Cl ₃	1738-25-6	98.146			173	0.8705 ²⁰		
3921	2-(Di met hyl ami no)-1-propanol		₅ H ₁₀ Cl NO	15521-18-3	103.163			150.3	0.8820 ²⁶		s H ₂ O
3922	3-(Di met hyl ami no)-1-propanol		₅ H ₁₀ Cl NO	3179-63-3	103.163			163.5	0.872 ²⁵	1.4360 ²⁰	s ct c
3923	1-(Di met hyl ami no)-2-propanol		₅ H ₁₀ Cl NO	108-16-7	103.163			124.5	0.837 ²⁵	1.4193 ²⁰	s ct c
3924	3-(Di met hyl ami no)-1-propyne	N,N-Di met hyl-2-propargyl ami ne	₅ H ₈ Cl N	7223-38-3	83.132			80	0.7792 ²⁰	1.4195 ²⁰	
3925	2-Di met hyl ami nopuri ne	N,N-Di met hyl- <i>H</i> -puri n-6-ami ne	₈ H ₈ N ₅	938-55-6	163.180			263			
3926	2-(<i>p</i> -Di met hyl ami nost yryl) benzot hi azol e		C ₁₇ H ₁₆ N ₂ S	1628-58-6	280.387	ye nd (MeOH)		207 dec			
3927	2,3-Di met hyl ani li ne	2,3-Xyl i di ne	₈ H ₁₁ NC	87-59-2	121.180		<-15	221.5	0.9931 ²⁰	1.5684 ²⁰	sl H ₂ O; vs Et OH, et h; s ct c
3928	2,4-Di met hyl ani li ne	2,4-Xyl i di ne	₈ H ₁₁ NC	95-68-1	121.180	li q	-14.3	214	0.972 ²⁸	1.5569 ²⁰	sl H ₂ O, ct c; s Et OH, et h, bz
3929	2,5-Di met hyl ani li ne	2,5-Xyl i di ne	₈ H ₁₁ NC	95-78-3	121.180	ye lf (li g)	15.5	214	0.9790	1.5591 ²¹	sl H ₂ O; s et h, ct c
3930	2,6-Di met hyl ani li ne	2,6-Xyl i di ne	₈ H ₁₁ NC	87-62-7	121.180		11.2	215	0.9842 ²⁰	1.5610 ²⁰	vs et h, Et OH
3931	3,4-Di met hyl ani li ne	3,4-Xyl i di ne	₈ H ₁₁ NC	95-64-7	121.180	pl or pr (li g)	51	228	1.07 ⁶		sl H ₂ O, chl ; s et h; vs li g
3932	3,5-Di met hyl ani li ne	3,5-Xyl i di ne	₈ H ₁₁ NC	108-69-0	121.180		9.8	220.5	0.9706 ²⁰	1.5581 ²⁰	sl H ₂ O; s et h, ct c
3933	N,2-Di met hyl ani li ne		₈ H ₉ Cl N	611-21-2	121.180			207.5	0.9709 ²⁰	1.5649 ²⁰	i H ₂ O; msc Et OH, et h; s ace
3934	N,3-Di met hyl ani li ne		₈ H ₉ Cl N	696-44-6	121.180			206.5	0.9660 ²⁰	1.5557 ²⁵	i H ₂ O; msc Et OH, et h; s ace
3935	N,4-Di met hyl ani li ne		₈ H ₉ Cl N	623-08-5	121.180			210	0.9348 ⁵⁵	1.5568 ²⁰	i H ₂ O; msc Et OH, et h; s ace
3936	N,N-Di met hyl ani li ne		₈ H ₉ Cl N	121-69-7	121.180	pa ye	2.42	194.15	0.9557 ²⁰	1.5582 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz; vs chl
3937	N,N-Di met hyl ani li ne hydrochl ori de		₈ H ₁₂ Cl N	5882-44-0	157.641	hyg pl (w, bz)	90		1.1156 ⁹		vs H ₂ O, Et OH, chl
3938	2,6-Di met hyl ani sol e		₈ H ₉ Cl ₂ O	1004-66-6	136.190			182.5	0.9619 ¹⁴	1.5053 ¹⁴	i H ₂ O; s Et OH, et h, bz, ct c



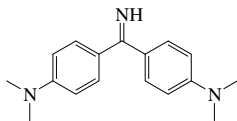
2-(Di met hyl ami no)benzoic acid



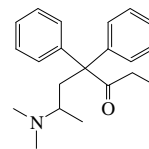
3-(Di met hyl ami no)benzoic acid



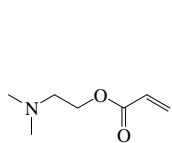
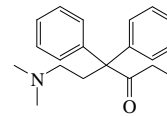
4-(Di met hyl ami no)benzoic acid



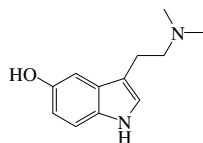
4,4'-Di met hyl ami no benzophenoni mi de (Di met hyl ami no)di met hyl borane



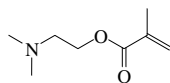
6-(Di met hyl ami no)-4,4-di phenyl -3-hept anone 6-(Di met hyl ami no)-4,4-di phenyl -3-hexanone



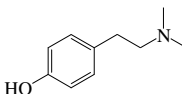
2-(Di met hyl ami no)et hyl acrylate



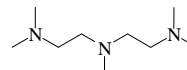
3-[2-(Di met hyl ami no)et hyl]-Indol -5-ol



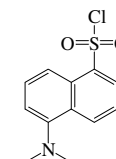
2-(Di met hyl ami no)et hyl acrylate



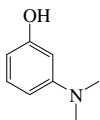
4-[2-(Di met hyl ami no)et hyl]phenol



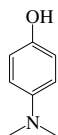
N,N'-bi (2-(Di met hyl ami no)et hyl)-1,2-et hane di ami ne 5-(Di met hyl ami no)-1-naphthalenesulfonamide



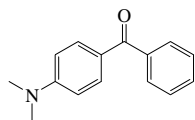
3-211



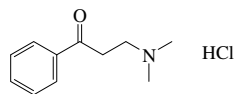
3-(Di met hyl ami no)phenol



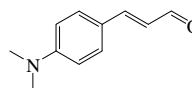
4-(Di met hyl ami no)phenol



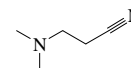
[4-(Di met hyl ami no)phenyl]phenyl met hanone



3-(Di met hyl ami no)-1-phenyl -1-propanone hydrochl ori de



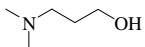
3-[4-(Di met hyl ami no)phenyl]-2-propenal



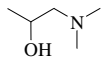
3-(Di met hyl ami no)propaneni t ri le



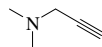
1-(Di met hyl ami no)-1-propanol



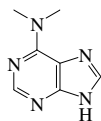
3-(Di met hyl ami no)-1-propanol



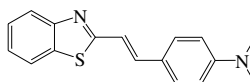
1-(Di met hyl ami no)-2-propanol



3-(Di met hyl ami no)-1-propyne



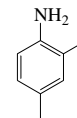
2-Di met hyl ami no puri ne



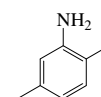
2-(p-Di met hyl ami no styryl)benzot hi azole



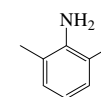
2,3-Di met hyl ani li ne



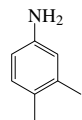
2,4-Di met hyl ani li ne



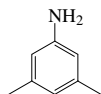
2,5-Di met hyl ani li ne



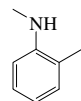
2,6-Di met hyl ani li ne



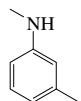
3,4-Di met hyl ani li ne



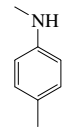
3,5-Di met hyl ani li ne



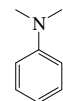
N,N-Di met hyl ani li ne



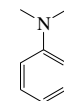
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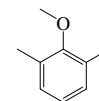
N,N-Di met hyl ani li ne



N,N-Di met hyl ani li ne

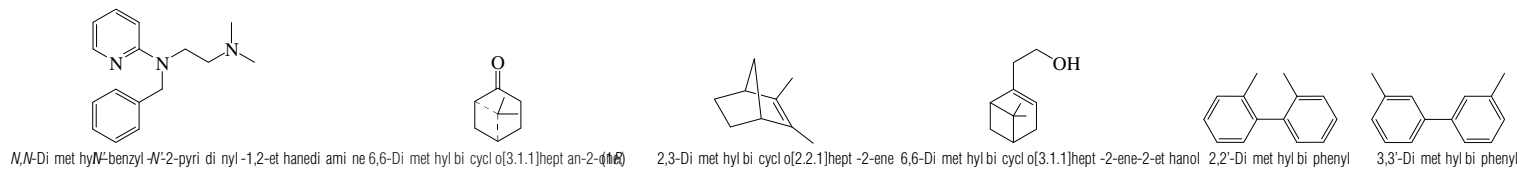
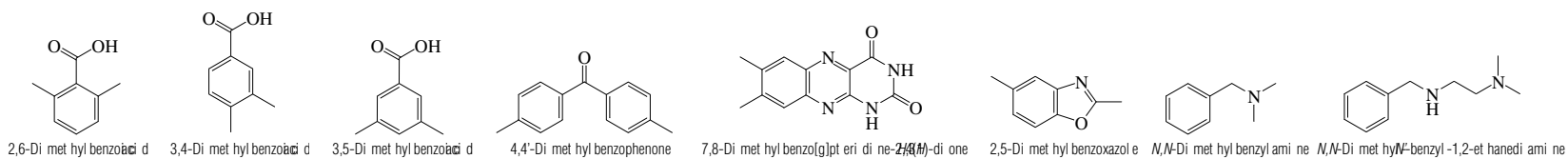
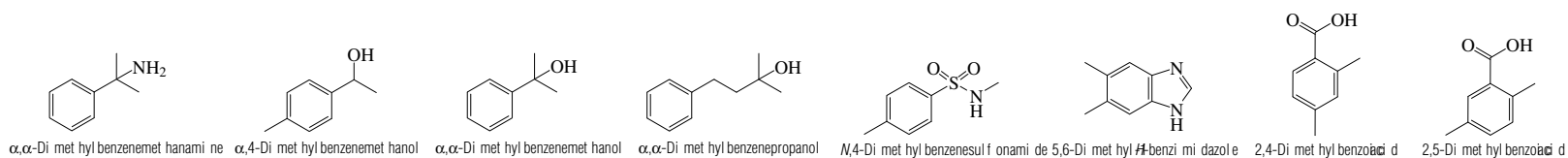
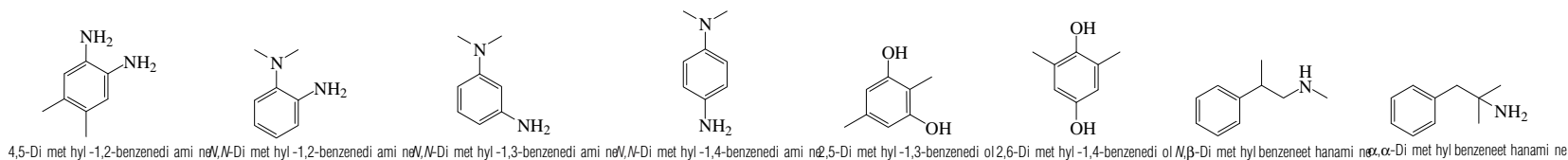
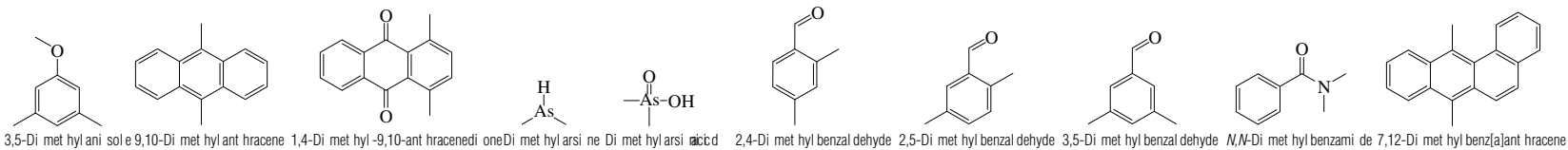


N,N-Di met hyl ani li ne hydrochl ori de

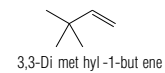
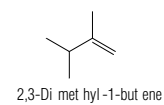
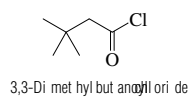
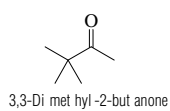
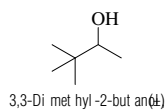
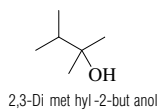
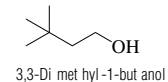
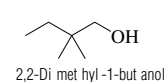
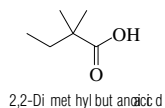
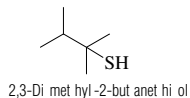
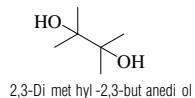
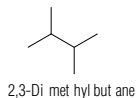
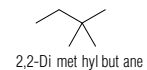
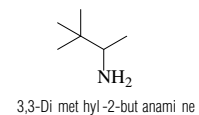
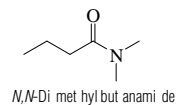
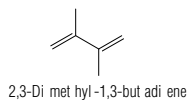
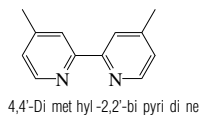
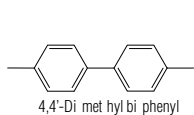


2,6-Di met hyl ani so le

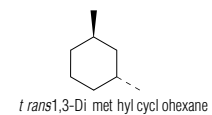
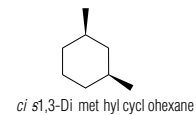
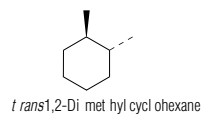
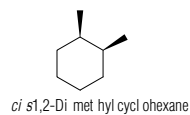
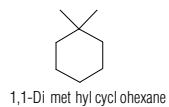
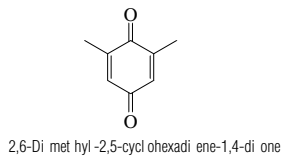
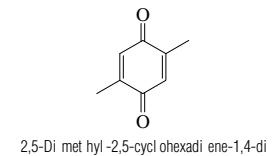
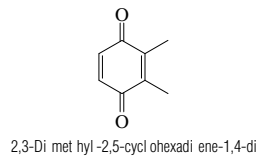
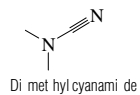
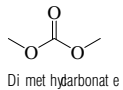
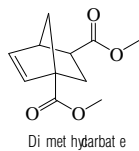
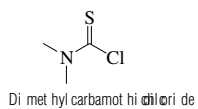
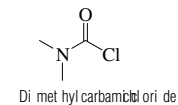
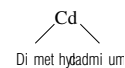
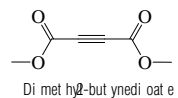
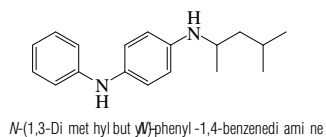
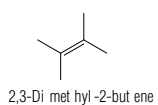
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3939	3,5-Di met hyl ani sol e		₉ H ₁₀ O	874-63-5	136.190			194; 89 ¹⁵	0.9627 ¹⁵	1.5110 ²⁰	i H ₂ O; s Et OH, et h, bz, C ₈ sl ct c
3940	9,10-Di met hyl ant hracene		₁₆ H ₁₄	781-43-1	206.282		183.6	360.0			i H ₂ O
3941	1,4-Di met hyl -9,10-ant hracenedi one		₁₆ H ₁₂ O ₂	1519-36-4	236.265	ye nd (al, sub)	140.5	sub			i H ₂ O; sl Et OH; s bz, xyl, HOAc
3942	Di met hyl arsi ne		₂ H ₂ As	593-57-7	105.999	li q, i gn i n ai r	-136.1	36	1.208		vs ace, bz, et h, Et OH
3943	Di met hyl arsi ni c aci d	Cacodyl i c aci d	₂ H ₇ AsO ₂	75-60-5	137.998		195	>200			vs H ₂ O; s Et OH; i et h
3944	2,4-Di met hyl benzal dehyde		₈ H ₈ O	15764-16-6	134.174	li q	-9	218			s Et OH; s et h, ace, bz; sl chl
3945	2,5-Di met hyl benzal dehyde	Isoxyl al dehyde	₈ H ₈ O	5779-94-2	134.174			220	0.9500 ²⁰		vs Et OH; s et h, ace, bz, ct c
3946	3,5-Di met hyl benzal dehyde		₈ H ₈ O	5779-95-3	134.174		9	221			vs ace, bz, et h, Et OH
3947	N,N-Di met hyl benzami de		₈ H ₈ NO	611-74-5	149.189		44.8	272.0			
3948	7,12-Di met hyl benz[ajant hracene	9,10-Di met hyl -1,2-benzant hracene	₂₀ H ₁₆ C	57-97-6	256.341	pa ye pl (al, HOAc)	122.5				vs ace, bz
3949	4,5-Di met hyl -1,2-benzenedi ami ne		₈ H ₈ N ₂	3171-45-7	136.194		128				
3950	N,N-Di met hyl -1,2-benzenedi ami ne		₈ H ₈ N ₂	2836-03-5	136.194	oi l		218; 98	0.995 ²²		sl H ₂ O; vs Et OH, et h, ace, bz
3951	N,N-Di met hyl -1,3-benzenedi ami ne		₈ H ₈ N ₂	2836-04-6	136.194		<-20	270; 138 ¹⁰	0.995 ²⁵		sl H ₂ O; vs Et OH, et h
3952	N,N-Di met hyl -1,4-benzenedi ami ne	Di met hyl enylenedi ami ne	₈ H ₈ N ₂	99-98-9	136.194	nd (bz)	53	263	1.036 ²⁰		s H ₂ O, chl; vs Et OH, et h, bz; sl li g
3953	2,5-Di met hyl -1,3-benzenedi ol		₈ H ₈ O ₂	488-87-9	138.164	nd (bz), pr (w)	163	278.5			s H ₂ O, Et OH, et h
3954	2,6-Di met hyl -1,4-benzenedi ol		₈ H ₈ O ₂	654-42-2	138.164	nd (xyl), cry (w)	152.3				vs et h, Et OH
3955	Mβ-Di met hyl benzenet hanami ne	Phenyl propyl met hyl ami ne	₁₀ H ₁₃ N	93-88-9	149.233			207.5	0.915 ²⁵		vs bz, et h, Et OH
3956	α,α-Di met hyl benzenet hanami ne	Phent ermi ne	₁₀ H ₁₃ N	122-09-8	149.233	oi ly li q		205; 100			
3957	α,α-Di met hyl benzenemet hanami ne		₉ H ₉ N	585-32-0	135.206			196.5	0.9423 ²⁰	1.5181 ²⁵	
3958	α,4-Di met hyl benzenemet hanol	1-(4-Met hyl phenyl) et hanol	₉ H ₁₂ O	536-50-5	136.190			219	0.9668 ²⁵	1.5246 ²⁰	i H ₂ O; vs Et OH, et h
3959	α,α-Di met hyl benzenemet hanol	α-Cumyl al cohol	₉ H ₁₂ O	617-94-7	136.190	pr	36	202	0.9735 ²⁰	1.5325 ²⁰	i H ₂ O; s Et OH, et h, bz, HOAc
3960	α,α-Di met hyl benzenepropanol	Benzyl et but anol	₉ H ₁₂ O	103-05-9	164.244	nd	24.5	121 ¹³	0.9626 ²¹	1.5077 ²¹	i H ₂ O; vs Et OH, et h, ace, bz
3961	N,4-Di met hyl benzenesul f onami de		₈ H ₈ NO ₂ S	640-61-9	185.244	pl (di l al)	78.5		1.340		vs et h, Et OH
3962	5,6-Di met hyl #benzi mi dazol e	Di medazol e	₈ H ₈ N ₂	582-60-5	146.188	cry (et h)	205.5	sub			s H ₂ O; Et OH, et h, chl, DMSO
3963	2,4-Di met hyl benzoi c aci d		₈ H ₆ O ₂	611-01-8	150.174	mcl or t cl nd (w)	90	268			sl H ₂ O; s Et OH, ace, bz, chl, HOAc, t ol
3964	2,5-Di met hyl benzoi c aci d		₈ H ₆ O ₂	610-72-0	150.174	nd (al)	132	sub	1.069 ³¹		i H ₂ O; s Et OH, et h, ace, bz
3965	2,6-Di met hyl benzoi c aci d		₈ H ₆ O ₂	632-46-2	150.174	nd (li g)	116	274.5; 155			sl H ₂ O, li g; s Et OH, et h
3966	3,4-Di met hyl benzoi c aci d		₈ H ₆ O ₂	619-04-5	150.174	pr (al)	167.3				i H ₂ O; s Et OH, et h, bz
3967	3,5-Di met hyl benzoi c aci d	Mesi t yl eni c aci d	₈ H ₁₀ O ₂ C	499-06-9	150.174	nd (w, al)	171.1	sub			sl H ₂ O; vs Et OH, et h
3968	4,4'-Di met hyl benzophenone	Bi s(4-met hyl phenyl) ket one	₁₅ H ₁₄ O	611-97-2	210.271	ort h (al)	96.5	334			vs ace, bz, et h, Et OH
3969	7,8-Di met hyl benzo[g]pt eri di ne-2,4(1H,3H)-di one	Lumi chrome	₆ H ₁₀ N ₄ O ₂	1086-80-2	242.233	ye cry (chl)	300				sl H ₂ O, Et OH, chl
3970	2,5-Di met hyl benzoxazol e		₈ H ₆ NO	5676-58-4	147.173			218.5	1.0880 ¹⁸	1.5412 ²⁰	s ct c
3971	N,N-Di met hyl benzyl ami ne	Di met hyl benzyl ami ne	₉ H ₁₃ N	103-83-3	135.206			181	0.915 ⁰	1.5011 ²⁰	sl H ₂ O; msc Et OH, et h
3972	N,N-Di met hyl benzyl -1,2-et hanedi ami ne	N-Benzyl -N,N'-di met hyl -1,2-et hanedi ami ne	₁₁ H ₁₈ N ₂	103-55-9	178.274			145 ³⁰ , 123 ¹¹	0.9343 ²⁰	1.5089 ²⁰	
3973	N,N-Di met hyl benzyl -N'-2-pyri di nyl -1,2-et hanedi ami ne	Tri pel ennam i ne	₁₆ H ₂₁ N ₃	91-81-6	255.358	ye oi l		140 ¹		1.576 ²⁵	mi sc H ₂ O
3974	6,6-Di met hyl bi cycl o[3.1.1]hept an-2-one, (1R)		₈ H ₁₄ O	38651-65-9	138.206	li q	-1	209	0.980 ⁷	1.4787 ²⁰	vs et h, Et OH
3975	2,3-Di met hyl bi cycl o[2.2.1]hept -2-ene	2,3-Di met hyl -2-norbornene	₉ H ₁₄ C	529-16-8	122.207			140.5	0.8698 ¹⁷	1.4688 ¹⁷	s et h, ace, bz
3976	6,6-Di met hyl bi cycl o[3.1.1]hept -2-ene-2-et hanol		₁₁ H ₁₈ O	128-50-7	166.260			235; 110 ¹⁰	0.973 ²⁵	1.4930 ²⁰	s chl
3977	2,2'-Di met hyl bi phenyl		₁₄ H ₁₀	605-39-0	182.261	cry (al)	19.5	256	0.9906 ⁰	1.5752 ²⁰	i H ₂ O; vs Et OH, et h, bz; s ace
3978	3,3'-Di met hyl bi phenyl		₁₄ H ₁₀	612-75-9	182.261		9	280	0.9995 ²⁰	1.5946 ²⁰	i H ₂ O; vs Et OH, et h, bz; s ace



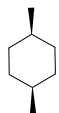
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
3979	4,4'-Di met hyl bi phenyl		$_{14}H_{14}$	613-33-2	182.261	mcl pr (et h)	125	295	0.917 ²¹		i H ₂ O; sl Et OH; s et h, ace, bz, CS ₂
3980	4,4'-Di met hyl -2,2'-bi pyri di ne		$_{12}H_{12}N_2$	1134-35-6	184.236		171.5				s chl
3981	2,3-Di met hyl -1,3-but adi ene	Di i sopropenyl	$_{6}H_{10}C$	513-81-5	82.143	li q	-76	68.8	0.722 2	1.4394 ²⁰	s ct c
3982	N,N-Di met hyl but anami de		$_{6}HCNO$	760-79-2	115.173	li q	-40	186; 125 ⁰	0.9064 ²⁵	1.4391 ²⁵	vs ace, bz, et h, Et OH
3983	3,3-Di met hyl -2-but anami ne		$_{6}HCN$	3850-30-4	101.190	li q	-20	102	0.766 8	1.4105 ²⁵	vs H ₂ O
3984	2,2-Di met hyl but ane	Neohexane	$_{6}C_4$	75-83-2	86.175	li q	-98.8	49.73	0.644 4	1.3688 ²⁰	i H ₂ O; s Et OH, et h; vs ace, bz, pet h, ct c
3985	2,3-Di met hyl but ane		$_{6}C_4$	79-29-8	86.175	li q	-128.10	57.93	0.661 6	1.3750 ²⁰	i H ₂ O; s Et OH, et h; vs ace, bz, pet h, ct c
3986	2,3-Di met hyl -2,3-but anedi ol	Pi nacol	$_{6}H_{14}O_2$	76-09-5	118.174	nd (al, et h)	43.32	174.4			sl H ₂ O, CS ₂ ; vs Et OH, et h
3987	2,3-Di met hyl -2-but anet hi ol		$_{6}H_{14}S$	1639-01-6	118.240	li q		126.1			
3988	2,2-Di met hyl but anoi c aci d		$_{6}H_{14}O_2$	595-37-9	116.158	li q	-14	186	0.927 6	1.4145 ²⁰	sl H ₂ O; s Et OH, et h
3989	2,2-Di met hyl -1-but anol		$_{6}HC_4O$	1185-33-7	102.174		<-15	136.5	0.8283 ²⁰	1.4208 ²⁰	sl H ₂ O; s Et OH, et h
3990	3,3-Di met hyl -1-but anol		$_{6}HC_4O$	624-95-3	102.174	li q	-60	143	0.84 4	1.4323 ¹⁵	sl H ₂ O; s Et OH, et h, ace
3991	2,3-Di met hyl -2-but anol		$_{6}HC_4O$	594-60-5	102.174	li q	-14	118.4	0.823 6	1.4176 ²⁰	s H ₂ O; msc Et OH, et h
3992	3,3-Di met hyl -2-but anol, (±)		$_{6}HC_4O$	20281-91-8	102.174		5.6	120.4	0.8122 ²⁵	1.4148 ²⁰	sl H ₂ O; vs Et OH, et h
3993	3,3-Di met hyl -2-but anone	Pi nacol one	$_{6}H_{14}O$	75-97-8	100.158	li q	-52.5	106.1	0.722 9	1.3952 ²⁰	sl H ₂ O; s Et OH, et h, ace, ct c
3994	3,3-Di met hyl but anoyl chl ori de		$_{6}H_{14}ClO$	7065-46-5	134.603			130; 68 ⁰⁰	0.969 ²⁰	1.4210 ²⁰	vs et h
3995	2,3-Di met hyl -1-but ene		$_{6}C_4$	563-78-0	84.159	li q	-157.3	55.6	0.680 3	1.3995 ²⁰	i H ₂ O; s Et OH, et h, ace, ct c, CS ₂
3996	3,3-Di met hyl -1-but ene		$_{6}C_4$	558-37-2	84.159	li q	-115.2	41.2	0.652 9	1.3763 ²⁰	i H ₂ O; s Et OH, et h, ct c, chl
3997	2,3-Di met hyl -2-but ene		$_{6}C_4$	563-79-1	84.159	li q	-74.19	73.3	0.708 0	1.4122 ²⁰	i H ₂ O; s Et OH, et h, ace, chl
3998	N-(1,3-Di met hyl but yl)-phenyl-1,4-benzenedi ami ne		$C_{18}H_{24}N_2$	793-24-8	268.397		46	164 ¹			
3999	3,3-Di met hyl -1-but yne	<i>t</i> erBut yl acet yl ene	$_{6}C_{10}$	917-92-0	82.143	li q	-78.2	37.7	0.662 3	1.3736 ²⁰	
4000	Di met hyl 2-but ynedi oat e		$_{6}H_8O_4$	762-42-5	142.110			dec 197; 98 ²⁰	1.1564 ²⁰	1.4434 ²⁰	s Et OH, et h, ct c
4001	Di met hyl cadmi um		$_{2}HCd$	506-82-1	142.480		-4.5	105.5 (exp 150)	1.9846 ¹⁸	1.5488	s pet h
4002	Di met hyl carbam i chl ori de	Di met hyl carbamoyl chl ori de	$_{3}H_6ClNO$	79-44-7	107.539	li q	-33	167	1.16 8	1.4540 ²⁰	
4003	Di met hyl carbamot hi oi c chl ori de		$_{3}H_6CCNS$	16420-13-6	123.605	pr	42.5	98 ⁰			vs et h; s chl, pet h
4004	Di met hyl carbat e		$_{11}H_{14}O_4$	39589-98-5	210.227	cry	38	137 ^{12.5}	1.164 ²¹	1.4852 ²⁰	i H ₂ O
4005	Di met hyl carbonat e	Met hyl carbonat e	$_{3}H_6C_3$	616-38-6	90.078		0.5	90.5	1.0636 ²⁵	1.3687 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
4006	Di met hyl cyanami de		$_{3}HCN_2$	1467-79-4	70.093			163.5		1.4089 ¹⁹	vs ace, et h, Et OH
4007	2,3-Di met hyl -2,5-cycl ohexadi ene-1,4-di one		$C_8H_{10}O_2$	526-86-3	136.149	ye nd	55	sub			sl H ₂ O; s Et OH, et h, chl
4008	2,5-Di met hyl -2,5-cycl ohexadi ene-1,4-di one		$C_8H_{10}O_2$	137-18-8	136.149	ye nd (al)	126.0				sl H ₂ O, Et OH; s et h, bz, chl
4009	2,6-Di met hyl -2,5-cycl ohexadi ene-1,4-di one		$C_8H_{10}O_2$	527-61-7	136.149	ye nd	72.5	sub	1.0479 ²⁸		s chl
4010	1,1-Di met hyl cycl ohexane		$_{8}C_{16}$	590-66-9	112.213	li q	-33.3	119.6	0.780 9	1.4290 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; msc ct c
4011	<i>ci s</i> 1,2-Di met hyl cycl ohexane		$_{8}C_{16}$	2207-01-4	112.213	li q	-49.8	129.8	0.796 3	1.4360 ²⁰	i H ₂ O; s Et OH, bz, ct c; msc et h, ace
4012	<i>t rans</i> 1,2-Di met hyl cycl ohexane		$_{8}C_{16}$	6876-23-9	112.213	li q	-88.15	123.5	0.776 0	1.4270 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz; vs li g
4013	<i>ci s</i> 1,3-Di met hyl cycl ohexane		$_{8}C_{16}$	638-04-0	112.213	li q	-75.53	120.1	0.766 0	1.4229 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
4014	<i>t rans</i> 1,3-Di met hyl cycl ohexane		$_{8}C_{16}$	2207-03-6	112.213	li q	-90.07	124.5	0.79	1.4284 ²⁵	



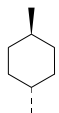
3-215



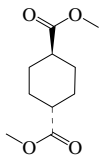
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4015	<i>ci s</i> 1,4-Di met hyl cycl ohexane		C_8H_{16}	624-29-3	112.213	li q	-87.39	124.4	0.7829	1.4230 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
4016	<i>t rans</i> 1,4-Di met hyl cycl ohexane		C_8H_{16}	2207-04-7	112.213	li q	-36.93	119.4	0.77	1.4185 ²⁵	i H ₂ O
4017	Di met hyl <i>rans</i> 1,4-cycl ohexanedi carboxyl at e		$\text{C}_{10}\text{H}_{16}\text{O}_4$	3399-22-2	200.232	ndl (et h)	71				s et h
4018	5,5-Di met hyl -1,3-cycl ohexanedi one	5,5-Di met hyl di hydroresorci nol	$\text{C}_8\text{H}_{12}\text{O}_2$	126-81-8	140.180	nd (w)	150 dec				sl H ₂ O, et h; s ace, ct c; vs chl, HOAc
4019	<i>N,α</i> -Di met hyl cycl ohexaneet hanami ne	Propyl hexedri ne	$\text{C}_{10}\text{H}_{20}\text{N}$	101-40-6	155.281			205; 82 ¹⁰	0.8501 ²⁰	1.4600 ²⁰	vs Et OH
4020	3,3-Di met hyl cycl ohexanol		$\text{C}_8\text{H}_{16}\text{O}$	767-12-4	128.212		11.5	185; 99.5 ²⁵	0.9128 ¹⁴	1.4606 ¹⁵	
4021	2,2-Di met hyl cycl ohexanone		$\text{C}_8\text{H}_{14}\text{O}$	1193-47-1	126.196	li q	-20.5	172	0.9149	1.4486 ²⁰	
4022	2,6-Di met hyl cycl ohexanone		$\text{C}_8\text{H}_{14}\text{O}$	2816-57-1	126.196			175	0.925 ²⁵	1.4460 ²⁰	
4023	3,3-Di met hyl cycl ohexanone		$\text{C}_8\text{H}_{14}\text{O}$	2979-19-3	126.196			180; 72 ²⁵	0.909 ¹⁵	1.4482 ¹⁷	
4024	4,4-Di met hyl cycl ohexanone		$\text{C}_8\text{H}_{14}\text{O}$	4255-62-3	126.196		39	73 ¹⁴	0.932 ²⁰	1.4537 ²⁴	
4025	1,2-Di met hyl cycl ohexene		C_8H_{14}	1674-10-8	110.197	li q	-84.1	138	0.8229	1.4620 ²⁰	
4026	1,3-Di met hyl cycl ohexene		C_8H_{14}	2808-76-6	110.197			127	0.799 ²⁵	1.449 ²⁰	
4027	3,5-Di met hyl -2-cycl ohexen-1-one		$\text{C}_8\text{H}_{12}\text{O}$	1123-09-7	124.180			208.5	0.9400 ²⁰	1.4812 ²⁰	s Et OH, et h
4028	1,1-Di met hyl cycl opent ane		C_7H_{14}	1638-26-2	98.186	li q	-69.8	87.5	0.7499	1.4136 ²⁰	
4029	<i>ci s</i> 1,2-Di met hyl cycl opent ane		C_7H_{14}	1192-18-3	98.186	li q	-54	99.5	0.7689	1.4222 ²⁰	
4030	<i>t rans</i> 1,2-Di met hyl cycl opent ane		C_7H_{14}	822-50-4	98.186	li q	-117.6	91.9	0.7468	1.4120 ²⁰	
4031	<i>ci s</i> 1,3-Di met hyl cycl opent ane		C_7H_{14}	2532-58-3	98.186	li q	-133.7	90.8	0.7402	1.4089 ²⁰	
4032	<i>t rans</i> 1,3-Di met hyl cycl opent ane		C_7H_{14}	1759-58-6	98.186	li q	-134	91.7	0.7443	1.4107 ²⁰	
4033	<i>N,α</i> -Di met hyl cycl opent aneet hanami ne	Cycl opent ami ne	$\text{C}_9\text{H}_{19}\text{N}$	102-45-4	141.254			171		1.4500 ²⁰	
4034	1,2-Di met hyl cycl opent ene		C_7H_{12}	765-47-9	96.170	li q	-90.4	105.8	0.7926	1.4448 ²⁰	
4035	1,5-Di met hyl cycl opent ene		C_7H_{12}	16491-15-9	96.170	li q	-118	99	0.789	1.4331 ²⁰	
4036	1,1-Di met hyl cycl opropane		C_6H_{10}	1630-94-0	70.133	vol li q or gas	-109	20.6	0.6604	1.3668 ²⁰	i H ₂ O; s Et OH; vs et h, sul f
4037	<i>ci s</i> 1,2-Di met hyl cycl opropane		C_6H_{10}	930-18-7	70.133	li q	-140.9	37.0	0.6889	1.3829 ²⁰	i H ₂ O; s Et OH; vs et h; sl ct c
4038	<i>t rans</i> 1,2-Di met hyl cycl opropane		C_6H_{10}	2402-06-4	70.133	vol li q or gas	-149.6	28.2	0.6648	1.3713 ²⁰	vs et h, Et OH
4039	Di met hyl decyl ami ne	<i>N,N</i> -Di met hyl -1-decanami ne	$\text{C}_{12}\text{H}_{27}\text{N}$	1120-24-7	185.349			234.5			
4040	Di met hyl di acet oxy si l ane	Bi s(acet yl oxy)di met hyl si l ane	$\text{C}_8\text{H}_{12}\text{O}_4\text{Si}$	2182-66-3	176.243	li q	-12.5	165	1.0540	1.4030 ²⁰	
4041	<i>t rans</i> Di met hyl di azene	Azomet hane	$\text{C}_2\text{H}_2\text{N}_2$	4143-41-3	58.082	gas	-78	1.5	0.743 ⁰	1.4199 ¹⁹	vs ace, Et OH, et h; s ct c, hp
4042	2,2-Di met hyl -1,3-di oxane-4,6-di one	Mel drum's aci d	$\text{C}_8\text{H}_{10}\text{O}_4$	2033-24-1	144.126		94				
4043	<i>ci s</i> 3,6-Di met hyl -1,4-di oxane-2,5-di one		$\text{C}_8\text{H}_{10}\text{O}_4$	4511-42-6	144.126	ort h (et h)	96.8	150			
4044	2,2-Di met hyl -1,3-di oxol ane-4-met hanol	Isopropyl i dene glycerol	$\text{C}_8\text{H}_{12}\text{O}_3$	100-79-8	132.157			82 ¹⁰	1.064 ²⁰	1.4383 ²⁰	
4045	Di met hyl di phenoxy si l ane		$\text{C}_{14}\text{H}_{16}\text{O}_2\text{Si}$	3440-02-6	244.362		-23	131	1.0599 ²⁵	1.5330 ²⁰	
4046	2,3-Di met hyl -2,3-di phenyl but ane	Di cumene	$\text{C}_{18}\text{H}_{20}$	1889-67-4	238.368	cry (MeOH)	119.5				
4047	3,3'-Di met hyl di phenyl met hane 4,4'-di i socyanat e		$\text{C}_{17}\text{H}_{14}\text{N}_2\text{O}_2$	139-25-3	278.305						s chl
4048	2,9-Di met hyl -4,7-di phenyl -1,10-phenant hrol i ne		$\text{C}_{26}\text{H}_{20}\text{N}_2$	4733-39-5	360.450		280 dec				
4049	Di met hyl di phenyl si l ane		$\text{C}_{14}\text{H}_{16}\text{Si}$	778-24-5	212.363			277; 173 ⁵	0.9867 ²⁰	1.5644 ²⁰	
4050	<i>N,N'</i> -Di met hyl <i>N,N'</i> -di phenyl urea		$\text{C}_8\text{H}_{16}\text{N}_2\text{O}$	611-92-7	240.300	pl (al)	122	350			vs H ₂ O, Et OH, ace; sl et h, bz, C ₆ S
4051	Di met hyl di sul fide	Met hyl di sul fide	$\text{C}_2\text{H}_6\text{S}_2$	624-92-0	94.199	li q	-84.67	109.74	1.0629	1.5289 ²⁰	i H ₂ O; msc Et OH, et h
4052	<i>O,O</i> -Di met hyl di t hi ophospat e	<i>O,O</i> -Di met hyl phosphorodi t hi onat e	$\text{C}_2\text{H}_4\text{O}_2\text{P}_2\text{S}_2$	756-80-9	158.180	li q		56	1.29 ²⁰		
4053	<i>N,N</i> -Di met hyl dodecyl ami ne oxi de		$\text{C}_{14}\text{H}_{30}\text{NO}$	1643-20-5	229.402	hyg nd (t ol)	130.5				



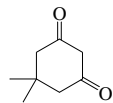
ci s1,4-Di met hyl cycl ohexane



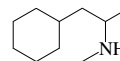
t rans1,4-Di met hyl cycl ohexane



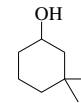
Di met hyl *trans*1,4-cycl ohexanedi carboxylat e



5,5-Di met hyl -1,3-cycl ohexanedi one



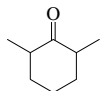
N,N-Di met hyl cycl ohexaneet hanami n



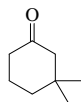
3,3-Di met hyl cycl ohexanol



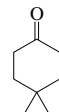
2,2-Di met hyl cycl ohexanone



2,6-Di met hyl cycl ohexanone



3,3-Di met hyl cycl ohexanone



4,4-Di met hyl cycl ohexanone



1,2-Di met hyl cycl ohexene



1,3-Di met hyl cycl ohexene



3,5-Di met hyl -2-cycl ohexen-1-one



1,1-Di met hyl cycl opent ane



ci s1,2-Di met hyl cycl opent ane



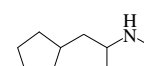
t rans1,2-Di met hyl cycl opent ane



ci s1,3-Di met hyl cycl opent ane



t rans1,3-Di met hyl cycl opent ane



N,N-Di met hyl cycl opent aneet hanami n



1,2-Di met hyl cycl opent ene



1,5-Di met hyl cycl opent ene



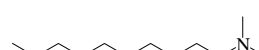
1,1-Di met hyl cycl opropa



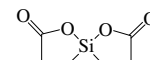
ci s1,2-Di met hyl cycl opropane



t rans1,2-Di met hyl cycl opropai



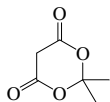
Di met hyl decyl ami ne



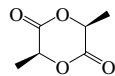
Di met hyl di acet oxysi l ane



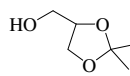
t ransDi met hyl di azene



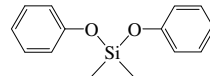
2,2-Di met hyl -1,3-di oxane-4,6-di one



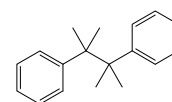
ci s3,6-Di met hyl -1,4-di oxane-2,5-di one



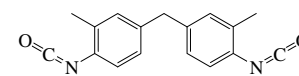
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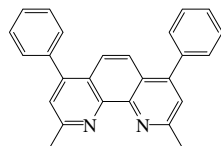
Di met hyl di phenoxy si l ane



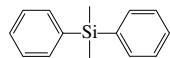
2,3-Di met hyl -2,3-di phenyl but ane



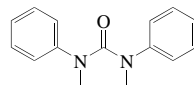
3,3'-Di met hyl di phenyl met hyl di i socyanat e



2,9-Di met hyl -4,7-di phenyl -1,10-phenant hroli i ne



Di met hyl di phenyl si l ane



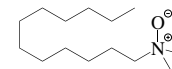
N,N'-Di met hyl *N,N'*-di phenyl urea



Di met hyl di sul fi de



O,O-Di met hyl di thi ophospat e

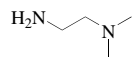
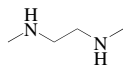
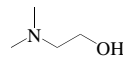


N,N-Di met hyl dodecyl ami ne

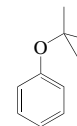
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4054	1,2-Di met hyl enecycl ohexane		$\text{C}_{12}\text{H}_{22}$	2819-48-9	108.181			127; 60 ⁹⁰	0.8361 ²⁰	1.4718 ²⁵	i H ₂ O; s Et OH, et h, bz, chl; vs ace
4055	<i>N,N</i> -Di met hyl -1,2-et hanedi ami ne		$\text{C}_{12}\text{H}_{22}\text{O}_2$	108-00-9	88.151			104	0.803 ²⁵	1.4260 ²⁰	
4056	<i>N,N'</i> -Di met hyl -1,2-et hanedi ami ne		$\text{C}_{12}\text{H}_{22}\text{O}_2$	110-70-3	88.151			120	0.828 ¹⁵		s Et OH, et h, di l HCl
4057	<i>N,N</i> -Di met hyl et hanol ami ne	Deanol	$\text{C}_{11}\text{H}_{20}\text{NO}$	108-01-0	89.136	li q	-59	134	0.886 ⁶	1.4300 ²⁰	msc H ₂ O, Et OH, et h; s chl
4058	Di met hyl et her	Met hyl et her	$\text{C}_6\text{H}_6\text{O}$	115-10-6	46.068	col gas	-141.5	-24.8			s H ₂ O, Et OH, et h, ace, chl; sl bz
4059	(1,1-Di met hyl et hoxy)benzene		$\text{C}_{10}\text{H}_{14}\text{O}$	6669-13-2	150.217	li q	-24	185.5	0.921 ⁴		
4060	[(1,1-Di met hyl et hoxy)met hyl]oxi rane		$\text{C}_{11}\text{H}_{16}\text{O}_2$	7665-72-7	130.185	li q	-70	152	0.89 ⁸		
4061	<i>N,N</i> -Di met hyl f ormami de	DMF	$\text{C}_3\text{H}_7\text{NO}$	68-12-2	73.094	li q	-60.48	153	0.944 ⁵	1.4305 ²⁰	msc H ₂ O, Et OH, et h, ace, bz; sl li g
4062	Di met hyl f umarat e		$\text{C}_6\text{H}_{10}\text{O}_4$	624-49-7	144.126		103.5	193	1.37 ²⁰	1.4062 ¹¹	i H ₂ O; s ace, chl
4063	2,5-Di met hyl f uran		$\text{C}_6\text{H}_6\text{O}$	625-86-5	96.127	li q	-62.8	93	0.888 ³	1.4363 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, HOAc, chl
4064	3,4-Di met hyl -2,5-f urandi one		$\text{C}_8\text{H}_{10}\text{O}_3$	766-39-2	126.110	pl or lf (di l al)	96	223	1.1 ⁰⁷		sl H ₂ O; vs Et OH, et h, bz, chl
4065	Di met hyl germani um sul fide		$\text{C}_2\text{H}_2\text{GeS}$	16090-49-6	134.77	col cry	54.5	302			
4066	Di met hyl gl ut arat e		$\text{C}_7\text{H}_{12}\text{O}_4$	1119-40-0	160.168	li q	-42.5	214; 109	1.0876 ²⁰	1.4242 ²⁰	vs Et OH, et h; s chl
4067	<i>N,N</i> -Di met hyl glyci ne		$\text{C}_2\text{H}_4\text{N}_2\text{O}_2$	1118-68-9	103.120	hyg nd (PrOH)	185.5				vs H ₂ O, MeOH; s Et OH, et h, ace
4068	Di met hyl gl yoxi me		$\text{C}_4\text{H}_6\text{N}_2\text{O}_2$	95-45-4	116.119	nd (t o or di l al)	245.5	sub 234			i OH; vs Et OH, et h; sl bz, t ol
4069	2,6-Di met hyl -1,5-hept adi ene		C_7H_{12}	6709-39-3	124.223	li q	-70	143	0.764 ⁸		
4070	2,2-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	1071-26-7	128.255	li q	-113	132.7	0.710 ⁵	1.4016 ²⁰	i H ₂ O; s et h, ct c; vs ace, chl; msc bz
4071	2,3-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	3074-71-3	128.255	li q	-116	140.5	0.726 ⁰	1.4088 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, chl
4072	2,4-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	2213-23-2	128.255			132.9	0.7115 ²⁵	1.4034 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, chl, pet h
4073	2,5-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	2216-30-0	128.255			136	0.719 ²⁰	1.4033 ²⁰	vs ace, bz, et h, Et OH
4074	2,6-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	1072-05-5	128.255	li q	-102.9	135.2	0.708 ⁹	1.4011 ²⁰	sl chl
4075	3,3-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	4032-86-4	128.255			137.3	0.7254 ²⁰	1.4087 ²⁰	i H ₂ O; msc Et OH; s et h; vs ace, bz
4076	3,4-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	922-28-1	128.255			140.6	0.7314 ²⁰	1.4108 ²⁰	i H ₂ O; s et h, ct c; vs ace, chl; msc bz
4077	3,5-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	926-82-9	128.255			136	0.7225 ²⁰	1.4083 ²⁰	i H ₂ O; s et h, ct c; vs ace, chl; msc bz
4078	4,4-Di met hyl hept ane		$\text{C}_{10}\text{H}_{20}$	1068-19-5	128.255			135.2	0.7221 ²⁰	1.4076 ²⁰	i H ₂ O; s et h, ct c; vs ace, chl; msc bz
4079	Di met hyl hept anedi oat e	Di met hyl pi mel at e	$\text{C}_{10}\text{H}_{16}\text{O}_4$	1732-08-7	188.221		-21	120 ¹⁰ ; 80 ¹	1.0625 ²⁰	1.4309 ²⁰	sl H ₂ O; s Et OH, et h, bz
4080	2,6-Di met hyl -2-hept anol		$\text{C}_7\text{H}_{14}\text{O}$	13254-34-7	144.254			173	0.8186 ²⁰	1.4242 ²⁰	
4081	2,6-Di met hyl -4-hept anol	Di i sobut yl carbi nol	$\text{C}_{10}\text{H}_{20}\text{O}$	108-82-7	144.254			174.5	0.8114 ²⁰	1.4242 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
4082	3,5-Di met hyl -4-hept anol		$\text{C}_7\text{H}_{14}\text{O}$	19549-79-2	144.254			186	0.836 ¹⁸	1.4283 ²⁰	sl H ₂ O
4083	2,6-Di met hyl -4-hept anone	Di i sobut yl ket one	$\text{C}_{10}\text{H}_{18}\text{O}$	108-83-8	142.238	li q	-41.5	169.4	0.806 ²	1.412 ²¹	i H ₂ O; msc Et OH, et h; s ct c
4084	2,6-Di met hyl -5-hept enal		$\text{C}_{10}\text{H}_{16}\text{O}$	106-72-9	140.222	oi l		120 ⁰			
4085	<i>N</i> ,6-Di met hyl -5-hept en-2-ami ne	Isomet hept ene	$\text{C}_{10}\text{H}_{19}\text{N}$	503-01-5	141.254			177			vs et h, Et OH
4086	2,5-Di met hyl -1,5-hexadi ene		C_8H_{14}	627-58-7	110.197	li q	-75.6	114.3	0.74 ⁹	1.43995 ²¹	i H ₂ O; s ace, chl
4087	2,5-Di met hyl -2,4-hexadi ene		C_8H_{14}	764-13-6	110.197		14	134.5	0.7577 ²⁵	1.4785 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
4088	2,2-Di met hyl hexane		C_8H_{18}	590-73-8	114.229	li q	-121.1	106.86	0.695 ³	1.3935 ²⁰	vs ace, bz, et h, Et OH
4089	2,3-Di met hyl hexane		C_8H_{18}	584-94-1	114.229			115.62	0.6912 ²⁵	1.4011 ²⁰	vs ace, bz, Et OH, li g
4090	2,4-Di met hyl hexane		C_8H_{18}	589-43-5	114.229			109.5	0.6962 ²⁵	1.3929 ²⁵	
4091	2,5-Di met hyl hexane		C_8H_{18}	592-13-2	114.229	li q	-91	109.12	0.690 ⁴	1.3925 ²⁰	i H ₂ O; msc Et OH, ace, bz; s et h
4092	3,3-Di met hyl hexane		C_8H_{18}	563-16-6	114.229	li q	-126.1	111.97	0.710 ⁰	1.4001 ²⁰	i H ₂ O; msc Et OH; vs et h, ace, bz
4093	3,4-Di met hyl hexane		C_8H_{18}	583-48-2	114.229			117.73	0.7151 ²⁵	1.4041 ²⁰	i H ₂ O; s et h; msc Et OH, ace, bz



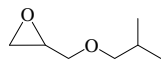
1,2-Di met hyl enecycl ohexane


N,N-Di met hyl -1,2-et hanedi ami ne

N,N'-Di met hyl -1,2-et hanedi ami ne

N,N-Di met hyl et hanol ami ne

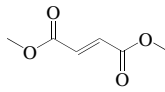

Di met hyl et her



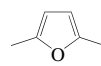
(1,1-Di met hyl et hoxy)benzene



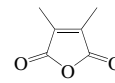
[(1,1-Di met hyl et hoxy)met hyl]oxi rane


N,N-Di met hyl f ormami de


Di met hyl umarat e



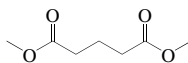
2,5-Di met hyl f uran



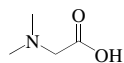
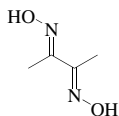
3,4-Di met hyl -2,5-f urandi one



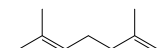
Di met hyl germani umsul f i de



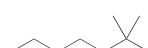
Di met hyl ut arat e


N,N-Di met hyl gli cyi ne


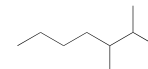
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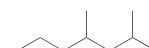
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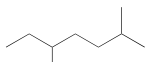
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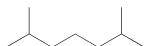
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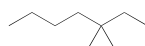
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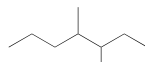
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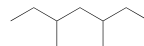
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3,3-Di met hyl hept ane



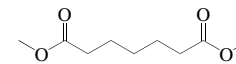
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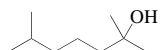
3,5-Di met hyl hept ane



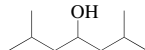
4,4-Di met hyl hept ane



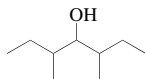
Di met hyl sept anedi oat e



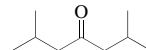
2,6-Di met hyl -2-hept anol



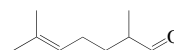
2,6-Di met hyl -4-hept anol



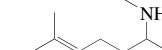
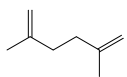
3,5-Di met hyl -4-hept anol



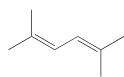
2,6-Di met hyl -4-hept ano



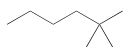
2,6-Di met hyl -5-hept enal


N-(6-Di met hyl -5-hept en-2-ami ne)


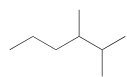
2,5-Di met hyl -1,5-hexadi ene



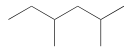
2,5-Di met hyl -2,4-hexadi ene



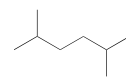
2,2-Di met hyl hexane



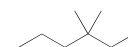
2,3-Di met hyl hexane



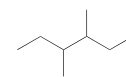
2,4-Di met hyl hexane



2,5-Di met hyl hexane

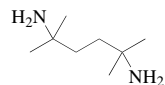


3,3-Di met hyl hexane

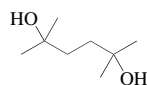


3,4-Di met hyl hexane

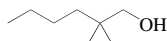
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4094	2,5-Di met hyl -2,5-hexanedi ami ne		$\text{C}_8\text{H}_{16}\text{N}_2$	23578-35-0	144.258			184; 63 ^a	0.8485 ¹⁵	1.4459 ²⁰	
4095	2,5-Di met hyl -2,5-hexanedi ol	1,1,4,4-Tet ramet hyl -1,4-but anedi ol	$\text{C}_8\text{H}_{16}\text{O}_2$	110-03-2	146.228	pr (AcOEt) fl (pet h)	88.50	214	0.898 ²⁰		s H ₂ O; vs Et OH, bz, chl
4096	2,2-Di met hyl -1-hexanol		$\text{C}_8\text{H}_{16}\text{O}$	2370-13-0	130.228			95 ²⁹			
4097	2,3-Di met hyl -1-hexene		C_8H_{16}	16746-86-4	112.213			110.5	0.7172 ²⁵	1.4113 ²⁰	
4098	5,5-Di met hyl -1-hexene		C_8H_{16}	7116-86-1	112.213			104	0.705 ²⁵	1.4049 ²⁰	
4099	2,3-Di met hyl -2-hexene		C_8H_{16}	7145-20-2	112.213	li q	-115.1	121.8	0.7366	1.4268 ²⁰	
4100	2,5-Di met hyl -2-hexene		C_8H_{16}	3404-78-2	112.213			112.2	0.7182 ²⁰	1.4140 ²⁰	
4101	<i>ci s</i> 2,2-Di met hyl -3-hexene		C_8H_{16}	690-92-6	112.213	li q	-137.4	105.5	0.7086	1.4099 ²⁰	
4102	<i>t rans</i> 2,2-Di met hyl -3-hexene		C_8H_{16}	690-93-7	112.213			100.8	0.6995 ²⁵	1.4063 ²⁰	
4103	3,5-Di met hyl -1-hexen-3-ol		$\text{C}_8\text{H}_{16}\text{O}$	3329-48-4	128.212			146.5	0.8382 ²⁰	1.4342 ²⁰	
4104	1-(1,5-Di met hyl -4-hexenyl)-4-met hyl benzene	α -Curcumene	$\text{C}_{15}\text{H}_{22}$	644-30-4	202.336			140 ¹⁹	0.8805 ²⁰	1.4989 ²⁰	i H ₂ O; s bz
4105	2,5-Di met hyl -3-hexyne-2,5-di ol		$\text{C}_8\text{H}_{10}\text{O}_2$	142-30-3	142.196			95	0.947 ²⁰		s H ₂ O, chl; vs Et OH, et h, ace, bz
4106	1,1-Di met hyl hydrazi ne		$\text{C}_2\text{H}_4\text{N}_2$	57-14-7	60.098	li q, fumes i n ai r	-57.20	63.9	0.791	1.4075 ²²	vs H ₂ O, Et OH, et h, MeOH
4107	1,2-Di met hyl hydrazi ne		$\text{C}_2\text{H}_4\text{N}_2$	540-73-8	60.098	fumes (ai r)	-8.9	81	0.827 ⁴	1.4209 ²⁰	msc H ₂ O, Et OH, et h
4108	1,2-Di met hyl hydrazi ne di hydrochl ori de		$\text{C}_2\text{H}_6\text{Cl}_2\text{N}_2$	306-37-6	133.019	pr (w)	170 dec				vs H ₂ O, Et OH
4109	Di met hyl hydrogen phosphat e	Di met hyl phosphat e	$\text{H}_2\text{O}_3\text{P}$	813-78-5	126.048			dec 174	1.3225 ²⁰	1.408 ²⁵	vs H ₂ O, ace, Et OH
4110	Di met hyl hydrogen phosphi t e		$\text{H}_2\text{O}_3\text{P}$	868-85-9	110.049			170.5	1.2002 ²⁰	1.4036 ²⁰	s Et OH, py; sl ct c
4111	1,2-Di met hyl #-i mi dazol e		$\text{C}_2\text{H}_2\text{N}_2$	1739-84-0	96.131			206	1.0051 ¹¹		vs H ₂ O, et h, Et OH
4112	2,4-Di met hyl #-i mi dazol e		$\text{C}_2\text{H}_2\text{N}_2$	930-62-1	96.131			92	267		
4113	5,5-Di met hyl -2,4-i mi dazol i di nedi one		$\text{C}_5\text{H}_8\text{N}_2\text{O}_2$	77-71-4	128.130	pr (di l al)	178	sub			vs H ₂ O, Et OH, et h, ace, bz, chl; s DMSO
4114	1,1-Di met hyl i ndan		$\text{C}_{11}\text{H}_{14}$	4912-92-9	146.229			191	0.919 ²⁰	1.5135 ²⁵	
4115	1,3-Di met hyl #-i ndol e		$\text{C}_8\text{H}_{11}\text{N}$	875-30-9	145.201	nd	142	258.5			s et h
4116	2,3-Di met hyl #-i ndol e		$\text{C}_8\text{H}_{11}\text{N}$	91-55-4	145.201		107.5	287			
4117	<i>N,N</i> -Di met hyl #-i ndol e-3-et hanami ne	<i>N,N</i> -Di met hyl t ryp t ami ne	$\text{C}_{12}\text{H}_{16}\text{N}_2$	61-50-7	188.268		46				
4118	<i>N,N</i> -Di met hyl #-i ndol e-3-met hanami ne	Grami ne	$\text{C}_7\text{H}_{14}\text{N}_2$	87-52-5	174.242	nd or pl (ace)	138.5				i H ₂ O; s Et OH, et h, chl; i pet h
4119	Di met hyl i sopht hal at e		$\text{C}_{10}\text{H}_{16}\text{O}_4$	1459-93-4	194.184	nd(di l al)	67.5	282	1.194	1.5168 ²⁰	sl H ₂ O
4120	1,4-Di met hyl -7-i sopropyl azul ene	Guai azul ene	$\text{C}_{15}\text{H}_{16}$	489-84-9	198.304	bl-vi ol pl (al)	31.5	167	0.973 ²⁰		s Et OH, et h, AcOEt
4121	1,6-Di met hyl -4-i sopropyl naph t hal ene	Cadal ene	$\text{C}_{15}\text{H}_{16}$	483-78-3	198.304			294; 149 ¹⁰	0.9667 ²⁵	1.5785 ²⁵	vs oi l s
4122	2,4-Di met hyl -3-i sopropyl pent ane		$\text{C}_{10}\text{H}_{16}$	13475-79-1	142.282	li q	-81.7	157.1	0.754 ⁵	1.4246 ²⁰	
4123	3,5-Di met hyl i soxazol e		$\text{C}_5\text{H}_6\text{N}_2\text{O}$	300-87-8	97.116			143	0.99 ²⁵	1.4421 ²⁰	
4124	Di met hyl magnesi um	Magnesi um di met hyl	$\text{C}_2\text{H}_4\text{Mg}$	2999-74-8	54.374	sol i d	220 dec	subl			
4125	Di met hyl mal eat e	Met hyl but enedi oat e	$\text{C}_4\text{H}_6\text{O}_4$	624-48-6	144.126	li q	-19	202	1.160 ⁶	1.4416 ²⁰	sl H ₂ O, li g; s et h, ct c
4126	Di met hyl mal onat e	Met hyl mal onat e	$\text{C}_5\text{H}_8\text{O}_6$	108-59-8	132.116	li q	-61.9	181.4	1.52 ⁸	1.4135 ²⁰	sl H ₂ O; msc Et OH; vs ace, bz; s chl
4127	Di met hyl mal oni c aci d	Di met hyl propanedi oc aci d	$\text{C}_3\text{H}_4\text{O}_4$	595-46-0	132.116	pr (bz/pet h)	192.5	subl			s hot H ₂ O
4128	Di met hyl mercury		$\text{C}_2\text{H}_2\text{Hg}$	593-74-8	230.66			93	3.17 ²⁵	1.5452 ²⁰	i H ₂ O; vs Et OH, et h
4129	Di met hyl <i>s</i> 2-met hyl -2-but enedi oat e	Di met hyl ci t raconat e	$\text{C}_7\text{H}_{10}\text{O}_4$	617-54-9	158.152			210.5	1.1153 ²⁰	1.4473 ²⁰	vs ace, et h, Et OH
4130	Di met hyl met hyl enesucci nat e		$\text{C}_7\text{H}_{10}\text{O}_4$	617-52-7	158.152	hyg mcl (MeOH)	38	208	1.1241 ¹⁸	1.4457 ²⁰	s Et OH, et h, MeOH; vs ace
4131	Di met hyl met hyl mal onat e		$\text{C}_6\text{H}_{10}\text{O}_4$	609-02-9	146.141			174	1.0977 ²⁰	1.4128 ²⁰	vs ace, et h, Et OH, chl
4132	Di met hyl met hyl phosphonat e		$\text{C}_3\text{H}_4\text{O}_3\text{P}$	756-79-6	124.075			181; 79.5 ²⁰	1.1684 ²⁰	1.4099 ³⁰	s H ₂ O, Et OH, et h



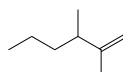
2,5-Di met hyl -2,5-hexanedi ami ne



2,5-Di met hyl -2,5-hexanedi ol



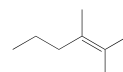
2,2-Di met hyl -1-hexanol



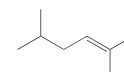
2,3-Di met hyl -1-hexene



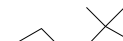
5,5-Di met hyl -1-hexene



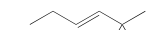
2,3-Di met hyl -2-hexene



2,5-Di met hyl -2-hexene



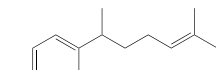
cis 2,2-Di met hyl -3-hexene



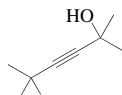
trans 2,2-Di met hyl -3-hexene



3,5-Di met hyl -1-hexen-3-ol



1-(1,5-Di met hyl -4-hexenyl)-4-met hyl benzene



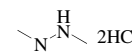
2,5-Di met hyl -3-hexyne-2,5-di ol



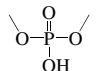
1,1-Di met hyl hidrazi ne



1,2-Di met hyl hidrazi ne



1,2-Di met hyl hidrazi dihydrochl ori de



Di met hyl hydrogen phosphat e



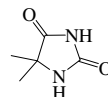
Di met hyl hydrogen phosphi t e



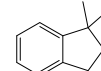
1,2-Di met hyl #i mi dazol e



2,4-Di met hyl #i mi dazol e



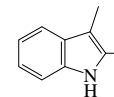
5,5-Di met hyl -2,4-i mi dazol i di ned i one



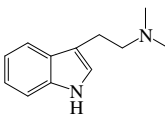
1,1-Di met hyl i ndan



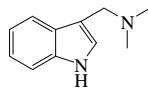
1,3-Di met hyl #i ndol e



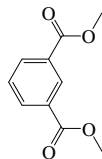
2,3-Di met hyl #i ndol e



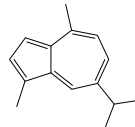
N,N-Di met hyl #i ndol e-3-et hanami ne



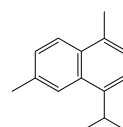
N,N-Di met hyl #i ndol e-3-met hanami



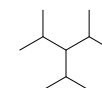
Di met hyl sopht hal at e



1,4-Di met hyl -7-i sopropyl azul



1,6-Di met hyl -4-i sopropyl napt hal ene



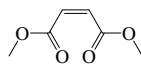
2,4-Di met hyl -3-i sopropyl pent



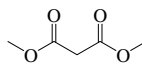
3,5-Di met hyl i soxaz



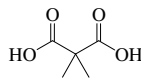
Di met hyl magnesi um



Di met hyl mal eat e



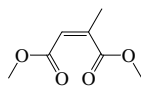
Di met hyl mal onat e



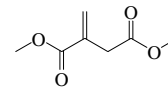
Di met hyl mal onat e d



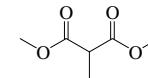
Di met hyl mercur y



Di met hyl 2-met hyl -2-but enedi oat e



Di met hyl et hyl enesucci nal

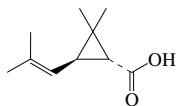


Di met hyl et hyl mal onat e

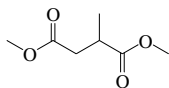


Di met hyl et hyl phosphonat e

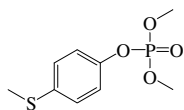
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4133	<i>t rans</i> 2,2-Di met hyl -3-(2-met hyl -1-propenyl)cycl opropanecarboxyl i c aci d		C ₁₀ H ₁₆ O ₂	4638-92-0	168.233	pr	20.0	245			vs et h, Et OH, chl
4134	Di met hyl 2-met hyl succi nat e		C ₇ H ₁₂ O ₄	1604-11-1	160.168			196	1.076 ²⁵	1.4200 ²⁰	
4135	Di met hyl p-(met hyl t hi o)phenyl phosphat e		C ₉ H ₁₃ O ₄ PS	3254-63-5	248.235	li q			1.273		sl H ₂ O; s ace, Et OH, di ox, ct c, xyl
4136	2,6-Di met hyl morphol i ne		C ₆ H ₁₀ NO	141-91-3	115.173	li q	-88	146.6	0.932 ⁹	1.4460 ²⁰	msc H ₂ O, Et OH, bz, li g; s ace; sl chl
4137	Di met hyl morphol i nophosphorami dat e	Di met hyl 4-morphol i nyl phosphonat e	C ₆ H ₁₁ NO ₃ P	597-25-1	195.153	li q		96			
4138	1,2-Di met hyl napht hal ene		C ₁₂ H ₁₂	573-98-8	156.223		0.8	266.5	1.0179 ²⁰	1.6166 ²⁰	i H ₂ O; s et h, bz
4139	1,3-Di met hyl napht hal ene		C ₁₂ H ₁₂	575-41-7	156.223	li q	-6	263	1.014 ⁴	1.6140 ²⁰	i H ₂ O; s et h, bz
4140	1,4-Di met hyl napht hal ene		C ₁₂ H ₁₂	571-58-4	156.223		7.6	268	1.0166 ²⁰	1.6127 ²⁰	i H ₂ O; vs Et OH; msc et h, ace, bz, ct c
4141	1,5-Di met hyl napht hal ene		C ₁₂ H ₁₂	571-61-9	156.223		82	265			i H ₂ O; vs bz, et h
4142	1,6-Di met hyl napht hal ene		C ₁₂ H ₁₂	575-43-9	156.223	li q	-16.9	264	1.002 ⁴	1.6166 ²⁰	i H ₂ O; s et h, bz
4143	1,7-Di met hyl napht hal ene		C ₁₂ H ₁₂	575-37-1	156.223	li q	-13.9	263	1.011 ⁵	1.6083 ²⁰	i H ₂ O; s et h, bz
4144	1,8-Di met hyl napht hal ene		C ₁₂ H ₁₂	569-41-5	156.223		65	270	1.003 ²⁰		i H ₂ O; s et h, bz
4145	2,3-Di met hyl napht hal ene	Guaj en	C ₁₂ H ₁₂	581-40-8	156.223	lf (al)	105	268	1.003	1.5060 ²⁰	i H ₂ O; vs bz, et h
4146	2,6-Di met hyl napht hal ene		C ₁₂ H ₁₂	581-42-0	156.223		112	262	1.003 ²⁰		i H ₂ O
4147	2,7-Di met hyl napht hal ene		C ₁₂ H ₁₂	582-16-1	156.223		97	265	1.003 ²⁰		
4148	<i>N,N</i> -Di met hyl -1-napht hyl ami ne		C ₁₂ H ₁₇ N	86-56-6	171.238	vi ol flr cry		250; 14 ⁹	1.0423 ²⁰	1.624 ¹⁵	i H ₂ O; s Et OH, et h, ct c
4149	<i>N,N</i> -Di met hyl -2-napht hyl ami ne		C ₁₂ H ₁₇ N	2436-85-3	171.238	dk red nd	52.5	305	1.0279 ⁶⁰	1.6443 ⁵³	i H ₂ O; s Et OH, et h
4150	<i>N,N</i> -Di met hyl -2-ni t roani li ne		C ₈ H ₁₀ NO ₂	610-17-3	166.177	ye-oran	-20	146 ²⁰	1.1794 ²⁰	1.6102 ²⁰	s H ₂ O, et h; vs Et OH, chl
4151	<i>N,N</i> -Di met hyl -3-ni t roani li ne		C ₈ H ₁₀ NO ₂	619-31-8	166.177	red mcl pr (et h)	60.5	282.5	1.31 ³		i H ₂ O; s Et OH, et h
4152	<i>N,N</i> -Di met hyl -4-ni t roani li ne		C ₈ H ₁₀ NO ₂	100-23-2	166.177	ye nd (al)	164.5				i H ₂ O; s Et OH, et h, HOAc
4153	1,2-Di met hyl -3-ni t robenzene		C ₈ H ₁₀ NO ₂	83-41-0	151.163	nd (al)	15	240	1.140 ²⁰	1.5441 ²⁰	i H ₂ O; s Et OH, ct c
4154	1,2-Di met hyl -4-ni t robenzene	4-Ni t roxy l ene	C ₈ H ₁₀ NO ₂	99-51-4	151.163	ye pr (al)	30.5	251; 143 ¹	1.112 ¹⁵	1.5202 ²⁰	i H ₂ O; msc Et OH
4155	1,3-Di met hyl -2-ni t robenzene		C ₈ H ₁₀ NO ₂	81-20-9	151.163		15	226	1.112 ¹⁵	1.5202 ²⁰	i H ₂ O; vs Et OH; s ct c
4156	1,3-Di met hyl -5-ni t robenzene		C ₈ H ₁₀ NO ₂	99-12-7	151.163	nd (al)	75	274			i H ₂ O; vs Et OH, et h
4157	1,4-Di met hyl -2-ni t robenzene		C ₈ H ₁₀ NO ₂	89-58-7	151.163	pa ye li q	-25	240.5	1.13 ²	1.5413 ²⁰	i H ₂ O; s Et OH
4158	2,4-Di met hyl -1-ni t robenzene		C ₈ H ₁₀ NO ₂	89-87-2	151.163		9	247; 122 ¹⁸	1.135 ¹⁵	1.5473 ²⁵	i H ₂ O; s et h, ace, bz, chl
4159	1,2-Di met hyl -5-ni t robenzene	Di met ri dazol e	C ₈ H ₁₀ NO ₂	551-92-8	141.129	nd (w)	138.5				vs et h, Et OH
4160	<i>N,N</i> -Di met hyl -4-[2-(4-ni t rophenyl)et heny l]ani li ne		C ₁₆ H ₁₆ N ₂ O ₂	4584-57-0	268.310		258.3				
4161	<i>N,N</i> -Di met hyl -4-ni t robenzene sul f onami de	p-Tol yl sul f onyl met hyl ni t rosam i de	C ₈ H ₁₀ NO ₃ S	80-11-5	214.241	cry	60				i H ₂ O; vs Et OH, et h
4162	Di met hyl nonanedi oat e	Met hyl azel at e	C ₁₁ H ₂₀ O ₄	1732-10-1	216.275		-0.8	156 ²⁰	1.0082 ²⁰	1.4367 ²⁰	i H ₂ O; s Et OH, ace, bz, ct c
4163	6,6-Di met hyl -2-norpi nene-2-carboxal dehyde	Myrt enal	C ₆ H ₁₄ O	564-94-3	150.217	unst ab oi l		99			
4164	<i>ci s</i> 3,7-Di met hyl -2,6-oct adi enal		C ₁₀ H ₁₆ O	106-26-3	152.233			120 ²⁰	0.8869 ²⁰	1.4869 ²⁰	i H ₂ O; msc Et OH, et h
4165	<i>t rans</i> 3,7-Di met hyl -2,6-oct adi enal		C ₁₀ H ₁₆ O	141-27-5	152.233			229	0.8888 ²⁰	1.4898 ²⁰	i H ₂ O; msc Et OH, et h
4166	3,7-Di met hyl -1,6-oct adi ene	Ci t ronel l ene	C ₁₀ H ₁₈	2436-90-0	138.250				0.7601 ²⁰	1.4362 ²⁰	
4167	3,7-Di met hyl -2,6-oct adi enoi c aci d	Gerani c aci d	C ₁₀ H ₁₆ O ₂	459-80-3	168.233	oi l					
4168	<i>ci s</i> 3,7-Di met hyl -2,6-oct adi en-1-ol	Nerol	C ₁₀ H ₁₈ O	106-25-2	154.249		<-15	225; 125 ²⁵	0.8756 ²⁰	1.4746 ²⁰	vs Et OH
4169	<i>ci s</i> 3,7-Di met hyl -2,6-oct adi en-1-ol acet at e		C ₁₂ H ₂₀ O ₂	141-12-8	196.286			134 ²⁵ , 93 ³	0.905 ¹⁵	1.452 ²⁰	



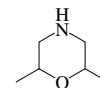
trans-2,2-Di met hyl -3-(2-met hyl -1-propenyl)cycl opropanecarboxy- ci



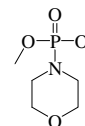
Di met hyl -2-met hyl succi nat e



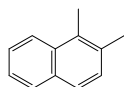
Di met hyl -(met hyl t hi o)phenyl phosphat e



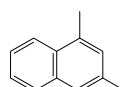
2,6-Di met hyl morphol i ne



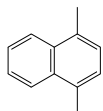
Di met hyl morphol i nophosphorami dat e



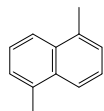
1,2-Di met hyl naphth hal ene



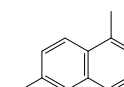
1,3-Di met hyl naphth hal ene



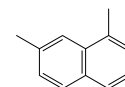
1,4-Di met hyl naphth hal ene



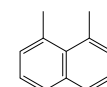
1,5-Di met hyl naphth hal ene



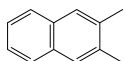
1,6-Di met hyl naphth hal ene



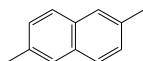
1,7-Di met hyl naphth hal ene



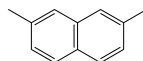
1,8-Di met hyl naphth hal ene



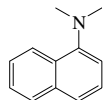
2,3-Di met hyl naphth hal ene



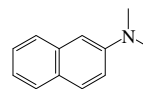
2,6-Di met hyl naphth hal ene



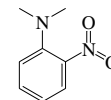
2,7-Di met hyl naphth hal ene



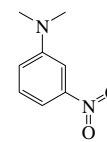
N,N-Di met hyl -1-naphth hyl ami ne



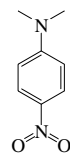
N,N-Di met hyl -2-naphth hyl ami ne



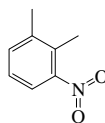
N,N-Di met hyl -2-ni troani li ne



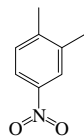
N,N-Di met hyl -3-ni troani li ne



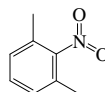
N,N-Di met hyl -4-ni troani li ne



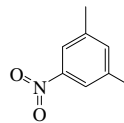
1,2-Di met hyl -3-ni trobenzene



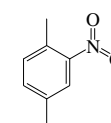
1,2-Di met hyl -4-ni trobenz



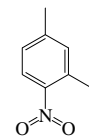
1,3-Di met hyl -2-ni trobenz



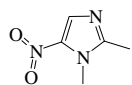
1,3-Di met hyl -5-ni trobenzene



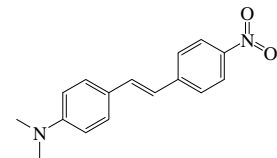
1,4-Di met hyl -2-ni trobenzene



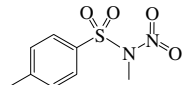
2,4-Di met hyl -1-ni trobenz



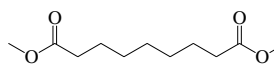
1,2-Di met hyl -5-ni tro-*imidazol*



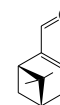
N,N-Di met hyl -4-[2-(4-ni trophenyl)et heny] ani li ne



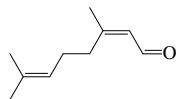
N,N-Di met hyl -ni trosobenzenesul f onami de



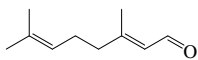
Di met hyl nonandi oat e



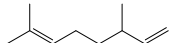
6,6-Di met hyl -2-norpi nene-2-carboxal dehy



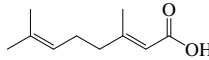
*ci s*3,7-Di met hyl -2,6-oct adi enal



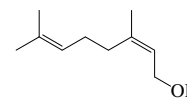
*tr ans*3,7-Di met hyl -2,6-oct adi enal



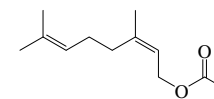
3,7-Di met hyl -1,6-oct adi ene



3,7-Di met hyl -2,6-oct adi enoi cid

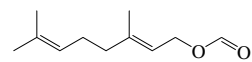
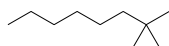


*ci s*3,7-Di met hyl -2,6-oct adi en-1-ol

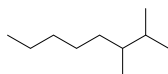


*ci s*3,7-Di met hyl -2,6-oct adi en-1-yl acetat e

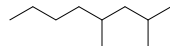
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4170	<i>t rans</i> 3,7-Di met hyl -2,6-oct adi en-1-ol format e		C ₁₁ H ₁₈ O ₂	105-86-2	182.260			dec 229; 113 ²⁵	0.9086 ²⁵	1.4659 ²⁰	i H ₂ O; vs Et OH; s et h, ace
4171	2,2-Di met hyl oct ane		C ₁₀ H ₂₂	15869-87-1	142.282			155	0.7208 ²⁵	1.4082 ²⁰	
4172	2,3-Di met hyl oct ane		C ₁₀ H ₂₂	7146-60-3	142.282			164.3	0.7377 ²⁰	1.4146 ²⁰	
4173	2,4-Di met hyl oct ane		C ₁₀ H ₂₂	4032-94-4	142.282			156	0.7226 ²⁵	1.4091 ²⁰	
4174	2,5-Di met hyl oct ane		C ₁₀ H ₂₂	15869-89-3	142.282			158.5	0.7264 ²⁵	1.4112 ²⁰	
4175	2,6-Di met hyl oct ane		C ₁₀ H ₂₂	2051-30-1	142.282			160.4	0.7313 ²⁰	1.4097 ²⁰	
4176	2,7-Di met hyl oct ane		C ₁₀ H ₂₂	1072-16-8	142.282	li q	-54.9	159.9	0.7202	1.4086 ²⁰	s et h, HOAc
4177	3,4-Di met hyl oct ane		C ₁₀ H ₂₂	15869-92-8	142.282			163.4	0.7410 ²⁵	1.4182 ²⁰	
4178	3,6-Di met hyl oct ane		C ₁₀ H ₂₂	15869-94-0	142.282			160.8	0.7324 ²⁵	1.4139 ²⁰	
4179	Di met hyl oct anedi oat e	Di met hyl suberat e	C ₁₀ H ₁₈ O ₂	1732-09-8	202.248	li q	-1.6	268	1.0217 ⁹	1.4341 ²⁰	i H ₂ O; s Et OH, et h, ace; sl ct c
4180	3,7-Di met hyl -1,7-oct anedi ol		C ₁₀ H ₁₈ O ₂	107-74-4	174.281			265	0.937 ²⁰	1.4599 ²⁰	sl bz, t ol
4181	2,2-Di met hyl oct anoi c aci d		C ₁₀ H ₁₆ O ₂	29662-90-6	172.265			140 ¹³			
4182	2,2-Di met hyl -1-oct anol		C ₁₀ H ₂₂ O	2370-14-1	158.281	li q		97	0.84		
4183	3,7-Di met hyl -1-oct anol		C ₁₀ H ₂₂ O	106-21-8	158.281			212.5	0.832 ²⁵	1.438 ²⁵	s et h
4184	2,6-Di met hyl -2-oct anol	Tet rahyromyrcenol	C ₁₀ H ₂₀ O	18479-57-7	158.281			80.5 ¹⁰	0.8023 ²⁵	1.4220 ²⁵	
4185	3,6-Di met hyl -3-oct anol		C ₁₀ H ₂₂ O	151-19-9	158.281	li q	-67.5	202.2	0.8347 ⁹	1.4370 ²⁰	
4186	3,7-Di met hyl -3-oct anol		C ₁₀ H ₂₂ O	78-69-3	158.281			205.1	0.826 ²⁵	1.433 ²⁵	
4187	<i>ci s</i> 3,7-Di met hyl -1,3,6-oct at ri ene	<i>ci s</i> β-Oci mene	C ₁₀ H ₁₆	3338-55-4	136.234				0.799 ²⁰		
4188	<i>t rans</i> 3,7-Di met hyl -1,3,6-oct at ri ene	<i>t rans</i> β-Oci mene	C ₁₀ H ₁₆	3779-61-1	136.234				0.799 ²⁰		
4189	3,7-Di met hyl -1,3,7-oct at ri ene	α-Oci mene	C ₁₀ H ₁₆	502-99-8	136.234			dec 177	0.8000 ²⁰	1.4862 ²⁰	i H ₂ O; s Et OH, et h, chl, HOAc
4190	<i>ci s ci s</i> 2,6-Di met hyl -2,4,6-oct at ri ene	<i>ci s sal i</i> eOci mene	C ₁₀ H ₁₆	17202-20-9	136.234	li q					
4191	<i>t rans t rans</i> 2,6-Di met hyl -2,4,6-oct at ri ene	<i>t rans sal i</i> eOci mene	C ₁₀ H ₁₆	3016-19-1	136.234	li q	-35.4	188; 99 ⁹	0.8118 ²⁰	1.5446 ²⁰	
4192	3,7-Di met hyl -6-oct enal	Ci t ronell al	C ₁₀ H ₁₈ O	106-23-0	154.249	nd or ort h cry		207.5	0.853 ⁹	1.4473 ²⁰	sl H ₂ O; s Et OH
4193	3,7-Di met hyl -1-oct ene		C ₁₀ H ₂₀	4984-01-4	140.266	col li q		154	0.7396	1.4212 ²⁰	
4194	3,7-Di met hyl -6-oct enoi c aci d	Ci t ronell i c aci d	C ₁₀ H ₁₈ O ₂	502-47-6	170.249			257; 157 ²³	0.9234 ²¹		
4195	3,7-Di met hyl -6-oct en-1-ol	Ci t ronell ol, (+)	C ₁₀ H ₂₀ O	1117-61-9	156.265	oi l		224; 108 ⁹	0.8550 ²⁰	1.4565 ²⁰	sl H ₂ O; msc Et OH, et h
4196	3,7-Di met hyl -6-oct en-1-ol	Ci t ronell ol, (-)	C ₁₀ H ₂₀ O	7540-51-4	156.265	oi l		224; 108 ⁹	0.859 ¹⁸	1.4576 ¹⁸	vs et h, Et OH
4197	3,7-Di met hyl -7-oct en-1-ol	Rhodi nol	C ₁₀ H ₂₀ O	6812-78-8	156.265			114 ¹²	0.8549 ²⁰	1.4556 ²⁰	vs et h, Et OH
4198	3,7-Di met hyl -6-oct en-3-ol		C ₁₀ H ₂₀ O	18479-51-1	156.265			94 ¹⁴	0.8695 ¹⁵	1.4569 ¹⁵	
4199	3,7-Di met hyl -6-oct en-1-ol, acet at e	Ci t ronell ol acet at e	C ₁₂ H ₂₂ O ₂	150-84-5	198.302			115 ¹⁰			
4200	Di met hyl ol di hydroxyet hyl eneurea	4,5-Di hydroxy-1,3-bi s(hydroxymet hyl)-2-i mi dazol i di none	C ₅ H ₁₀ N ₂ O ₅	1854-26-8	178.143	hyg cry					
4201	Di met hyl oxal at e		C ₂ H ₂ O ₄	553-90-2	118.089	mcl t ab	54.8	163.5	1.171 ⁹	1.379 ⁸²	sl H ₂ O; s Et OH, et h, ace, chl
4202	5,5-Di met hyl -2,4-oxazol i di nedi one	Di met hadi one	C ₅ H ₈ N ₂ O ₂	695-53-4	129.115		76.5				
4203	3,3-Di met hyl oxet ane		C ₅ H ₁₀ O	6921-35-3	86.132			80.6	0.834 ²⁵	1.3965 ²⁰	
4204	3,3-Di met hyl -2-oxet anone		C ₅ H ₈ O ₂	1955-45-9	100.117			58 ¹⁵			
4205	2,2-Di met hyl oxir ane	2-Met hyl -1,2-epoxypropane	C ₃ H ₆ O	558-30-5	72.106			52	0.8112 ²⁰	1.3712 ²²	s Et OH, et h
4206	<i>ci s</i> 2,3-Di met hyl oxir ane		C ₃ H ₆ O	1758-33-4	72.106	li q	-80	60	0.8226 ⁹	1.3802 ²⁰	vs et h, ace, bz
4207	<i>t rans</i> 2,3-Di met hyl oxir ane		C ₃ H ₆ O	6189-41-9	72.106	li q	-85	56.5	0.801 ⁹	1.3736 ²⁰	vs et h, ace, bz
4208	3,3-Di met hyl -2-oxobut anoi c aci d		C ₆ H ₁₀ O ₃	815-17-8	130.141		90.5	189; 80 ¹⁵			sl H ₂ O; s et h, bz, chl, C ₂ S
4209	<i>N</i> -(1,1-Di met hyl -3-oxobut yl)-2-propenam i de	Di acet one acryl ami de	C ₉ H ₁₆ N ₂ O ₂	2873-97-4	169.221						s chl
4210	Di met hyl 3-oxo-1,5-pent anedi oat e	Di met hyl 1,3-acet onedi carboxyl at e	C ₇ H ₁₀ O ₃	1830-54-2	174.151			150 ²⁵ ; 77 ⁰⁶	1.185 ²⁵	1.4434 ²⁰	


trans-3,7-Di met hyl -2,6-oct adi en-1-**o**lmat e


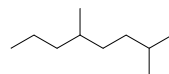
2,2-Di met hyl oct ane



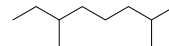
2,3-Di met hyl oct ane



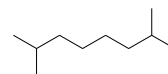
2,4-Di met hyl oct ane



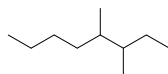
2,5-Di met hyl oct ane



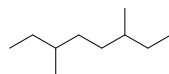
2,6-Di met hyl oct ane



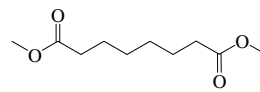
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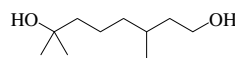
3,4-Di met hyl oct ane



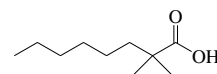
3,6-Di met hyl oct ane



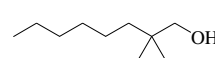
Di met hyl oct anedi oat e



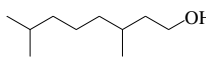
3,7-Di met hyl -1,7-oct anedi ol



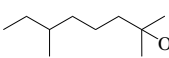
2,2-Di met hyl oct anoi cãc d



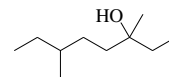
2,2-Di met hyl -1-oct anol



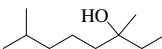
3,7-Di met hyl -1-oct anol



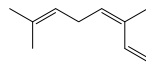
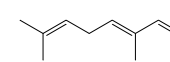
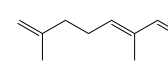
2,6-Di met hyl -2-oct anol



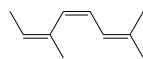
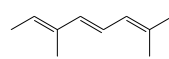
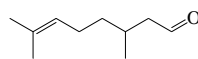
3,6-Di met hyl -3-oct anol



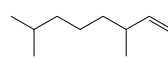
3,7-Di met hyl -3-oct anol


ci s-3,7-Di met hyl -1,3,6-oct at ri ene

trans-3,7-Di met hyl -1,3,6-oct at ri ene


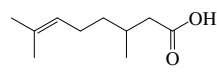
3,7-Di met hyl -1,3,7-oct at ri ene


ci s-2,6-Di met hyl -2,4,6-oct at ri ene

trans-2,6-Di met hyl -2,4,6-oct at ri ene


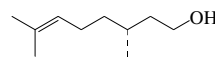
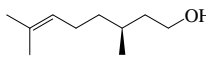
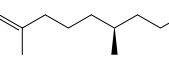
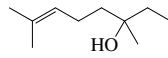
3,7-Di met hyl -6-oct enal



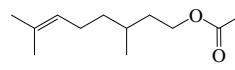
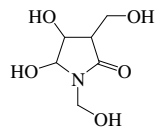
3,7-Di met hyl -1-oct ene



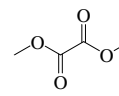
3,7-Di met hyl -6-oct enoi cãc d


 3,7-Di met hyl -6-oct en-1-**o**l

 3,7-Di met hyl -6-oct en-1-**(S)**

 3,7-Di met hyl -7-oct en-1-**(S)**


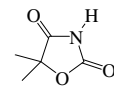
3,7-Di met hyl -6-oct en-3-ol


 3,7-Di met hyl -6-oct en-1-**ac**et at e


Di met hyl ol di hydroxyet hyl ene



Di met hyl al at e



5,5-Di met hyl -2,4-oxazol i di ned i one



3,3-Di met hyl oxet ane

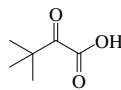


3,3-Di met hyl -2-oxet ane

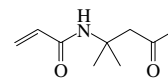
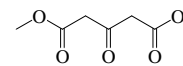


2,2-Di met hyl ox i rane


ci s-2,3-Di met hyl ox i rane

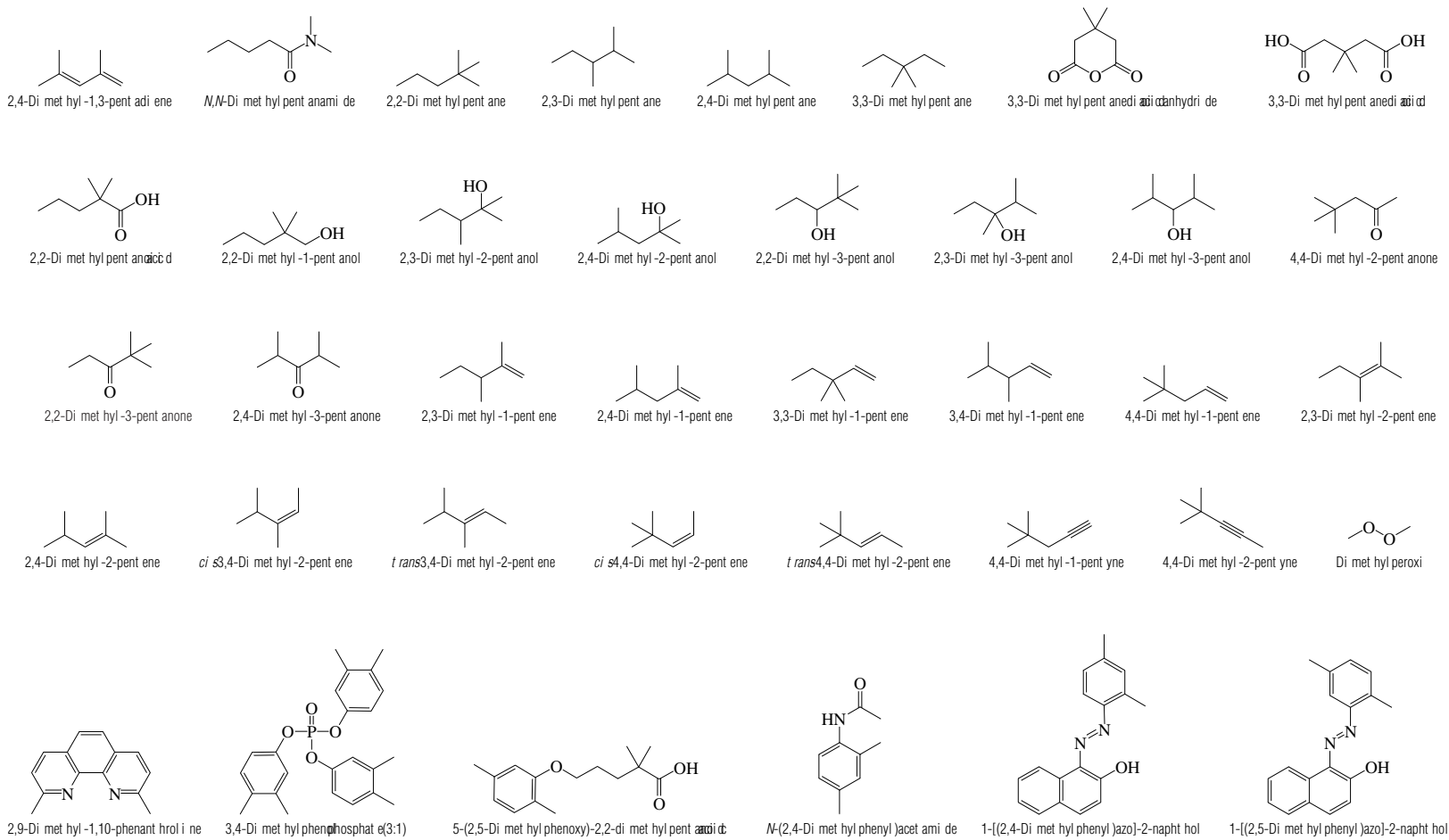
trans-2,3-Di met hyl ox i rane


3,3-Di met hyl -2-oxobut anoi cãc d

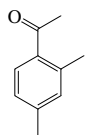

N-(1,1-Di met hyl -3-oxobut yl)-2-propenam i de


Di met hyl 3-oxo-1,5-pent anedi oat e

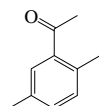
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4211	2,4-Di met hyl -1,3-pent adi ene		C_6H_{12}	1000-86-8	96.170	li q	-114	93.2	0.734 3	1.4390 ²³	
4212	<i>N,N</i> -Di met hyl pent anami de		$\text{C}_6\text{H}_{11}\text{NO}$	6225-06-5	129.200		-51	141 ¹⁰⁰	0.8962 ²⁵	1.4419 ²⁵	vs H ₂ O, et h, Et OH
4213	2,2-Di met hyl pent ane		C_6H_{16}	590-35-2	100.202	li q	-123.7	79.2	0.673 9	1.3822 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, hp, chl
4214	2,3-Di met hyl pent ane		C_6H_{16}	565-59-3	100.202			89.78	0.6908 ²⁵	1.3894 ²⁵	i H ₂ O; s Et OH, et h; msc ace, bz, chl
4215	2,4-Di met hyl pent ane		C_6H_{16}	108-08-7	100.202	li q	-119.2	80.49	0.672 7	1.3815 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, chl, hp
4216	3,3-Di met hyl pent ane		C_6H_{16}	562-49-2	100.202	li q	-134.4	86.06	0.693 6	1.3909 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, hp, chl
4217	3,3-Di met hyl pent anedi oi c aci d anhydri de	Di hydro-4,4-di met hyl-2,6(3 <i>H</i>)-di one	$\text{C}_7\text{H}_{10}\text{O}_3$	4160-82-1	142.152		125.8	181 ²⁵ , 156 ²⁰			
4218	3,3-Di met hyl pent anedi oi c aci d		$\text{C}_7\text{H}_{12}\text{O}_4$	4839-46-7	160.168	mcl pl, nd (bz)	103.5	126 ¹⁵ , 89 ²	1.4278 ²⁰		vs H ₂ O, Et OH, et h; sl bz; i li g
4219	2,2-Di met hyl pent anoi c aci d		$\text{C}_6\text{H}_{10}\text{O}_2$	1185-39-3	130.185	li q		98	0.9189 ²⁰		
4220	2,2-Di met hyl -1-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	2370-12-9	116.201						s chl
4221	2,3-Di met hyl -2-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	4911-70-0	116.201				0.804 ²⁰		sl H ₂ O
4222	2,4-Di met hyl -2-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	625-06-9	116.201		<-20	133.1	0.8103 ²⁰	1.4172 ²⁰	sl H ₂ O; s Et OH, et h, ct c
4223	2,2-Di met hyl -3-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	3970-62-5	116.201	li q	-2.5	135	0.825 3	1.4223 ²⁰	i H ₂ O; s Et OH, et h
4224	2,3-Di met hyl -3-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	595-41-5	116.201		<-30	139.7	0.833 ²⁰	1.4287 ²⁰	sl H ₂ O, bz; s Et OH, et h
4225	2,4-Di met hyl -3-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	600-36-2	116.201		<-70	138.7	0.8288 ²⁰	1.4250 ²⁰	sl H ₂ O; s Et OH, et h
4226	4,4-Di met hyl -2-pent anone		$\text{C}_6\text{H}_{12}\text{O}$	590-50-1	114.185	li q	-64	126	0.80 9	1.4036 ²⁰	
4227	2,2-Di met hyl -3-pent anone		$\text{C}_6\text{H}_{12}\text{O}$	564-04-5	114.185	li q	-45	125.6	0.812 5	1.4065 ²⁰	sl H ₂ O; s Et OH, et h, ace, chl
4228	2,4-Di met hyl -3-pent anone	Di i sopropyl ket one	$\text{C}_6\text{H}_{12}\text{O}$	565-80-0	114.185	li q	-69	125.4	0.810 8	1.3999 ²⁰	sl H ₂ O; msc Et OH, et h; s bz; sl ct c
4229	2,3-Di met hyl -1-pent ene		C_6H_{12}	3404-72-6	98.186	li q	-134.3	84.3	0.705 4	1.4033 ²⁰	i H ₂ O; msc Et OH, et h; vs di l sul f
4230	2,4-Di met hyl -1-pent ene		C_6H_{12}	2213-32-3	98.186	li q	-124.1	81.6	0.694 3	1.3986 ²⁰	i H ₂ O; msc Et OH, et h; s bz, ct c, chl
4231	3,3-Di met hyl -1-pent ene		C_6H_{12}	3404-73-7	98.186	li q	-134.3	77.5	0.697 4	1.3984 ²⁰	i H ₂ O; msc Et OH, et h; s bz, chl
4232	3,4-Di met hyl -1-pent ene		C_6H_{12}	7385-78-6	98.186			80.8	0.6934 ²⁵	1.3992 ²⁰	
4233	4,4-Di met hyl -1-pent ene		C_6H_{12}	762-62-9	98.186	li q	-136.6	72.5	0.682 7	1.3818 ²⁰	i H ₂ O; msc Et OH, et h; s bz, ct c, chl
4234	2,3-Di met hyl -2-pent ene		C_6H_{12}	10574-37-5	98.186	li q	-118.3	97.5	0.727 7	1.4208 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
4235	2,4-Di met hyl -2-pent ene		C_6H_{12}	625-65-0	98.186	li q	-127.7	83.4	0.695 4	1.4040 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
4236	<i>ci s</i> 3,4-Di met hyl -2-pent ene		C_6H_{12}	4914-91-4	98.186	li q	-113.4	89.3	0.709 2	1.4104 ²⁰	
4237	<i>t rans</i> 3,4-Di met hyl -2-pent ene		C_6H_{12}	4914-92-5	98.186	li q	-124.2	91.5	0.712 4	1.4128 ²⁰	
4238	<i>ci s</i> 4,4-Di met hyl -2-pent ene		C_6H_{12}	762-63-0	98.186	li q	-135.4	80.4	0.695 4	1.4026 ²⁰	
4239	<i>t rans</i> 4,4-Di met hyl -2-pent ene		C_6H_{12}	690-08-4	98.186	li q	-115.2	76.7	0.688 9	1.3982 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
4240	4,4-Di met hyl -1-pent yne		C_6H_{10}	13361-63-2	96.170	li q	-75.7	76.1	0.714 2	1.3983 ²⁰	vs bz, et h, chl
4241	4,4-Di met hyl -2-pent yne		C_6H_{10}	999-78-0	96.170	li q	-82.4	83	0.717 6	1.4071 ²⁰	i H ₂ O; s et h, bz, chl; sl ct c
4242	Di met hyl peroxi de		$\text{C}_2\text{H}_6\text{O}_2$	690-02-8	62.068	vol li q or gas	-100	14	0.867 7	1.3503 ⁰	sl Et OH, et h; s t ol, HOAc
4243	2,9-Di met hyl -1,10-phenant hrol i ne	Neocuproi ne	$\text{C}_{14}\text{H}_{18}\text{N}_2$	484-11-7	208.258	cry, 1/2w (w, li g)	159.5				
4244	3,4-Di met hyl phenol phosphat e (3:1)		$\text{C}_{24}\text{H}_{27}\text{O}_4\text{P}$	3862-11-1	410.442		72	261 ⁷			i H ₂ O; sl Et OH, chl, hx; s bz
4245	5-(2,5-Di met hyl phenoxy)-2,2-di met hyl pent anoi c aci d	Gemfibrozil	$\text{C}_{21}\text{H}_{28}\text{O}_3$	25812-30-0	250.334	cry	62	159 ^{0,02}			
4246	<i>N</i> -(2,4-Di met hyl phenyl)acet ami de		$\text{C}_{10}\text{H}_{15}\text{NO}$	2050-43-3	163.216	nd (al)	129.3	170 ⁰			vs Et OH, chl
4247	1-[(2,4-Di met hyl phenyl)jazo]-2-napt hol	1-(2,4-Xyl yl azo)-2-napt hol	$\text{C}_{16}\text{H}_{19}\text{N}_2\text{O}$	3118-97-6	276.332	red nd (al)	166				vs et h, Et OH
4248	1-[(2,5-Di met hyl phenyl)jazo]-2-napt hol	1-(2,5-Xyl yl azo)-2-napt hol	$\text{C}_{16}\text{H}_{19}\text{N}_2\text{O}$	85-82-5	276.332	nd (al)	153				



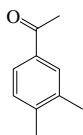
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4249	1-(2,4-Di met hyl phenyl)et hanone	2,4-Di met hyl acet ophenone	₁₀ H ₁₂ O	89-74-7	148.201			228	1.0121 ¹⁵	1.5340 ²⁰	vs et h, Et OH
4250	1-(2,5-Di met hyl phenyl)et hanone	2,5-Di met hyl acet ophenone	₁₀ H ₁₂ O	2142-73-6	148.201	li q	-18.1	232.5	0.9969	1.5291 ²⁰	i H ₂ O; vs Et OH, et h, bz, C ₆ S
4251	1-(3,4-Di met hyl phenyl)et hanone	3,4-Di met hyl acet ophenone	₁₀ H ₁₂ O	3637-01-2	148.201	li q	-1.5	246.5	1.0090	1.5413 ¹⁵	i H ₂ O; vs Et OH, et h, bz; s ct c, HOAc
4252	4,4-Di met hyl -1-phenyl -1-pent en-3-one		C ₁₃ H ₁₆ O	538-44-3	188.265		43	154 ²⁵	0.9508 ⁴⁶	1.5523 ²⁵	
4253	2,2-Di met hyl -1-phenyl -1-propanone		₇ H ₁₄ O	938-16-9	162.228			220	0.963 ²⁶	1.5086 ¹⁹	s ace
4254	3,5-Di met hyl -1-phenyl- <i>N</i> -pyrazol e		C ₇ H ₁₂ N ₂	1131-16-4	172.226			272; 145 ^{12,5}	1.0566 ²⁰	1.5738 ¹⁹	vs et h, Et OH, chl
4255	4,4-Di met hyl -1-phenyl -3-pyrazol i di none	4,4-Di met hyl pheni done	₁₁ H ₁₄ N ₂ O	2654-58-2	190.241		176				
4256	<i>N,N</i> -Di met hyl-phenyl -2-pyri di nepropanami ne	Pheni rami ne	₈ H ₂₀ N ₂	86-21-5	240.343			181 ¹³ , 135 ^{0,5}	1.0081 ²⁵	1.5519 ²⁵	vs bz, et h, Et OH, chl
4257	1,3-Di met hyl -3-phenyl -2,5-pyrrol i di nedi one	Met hsuxi mi de	₁₂ H ₁₃ NO ₂	77-41-8	203.237		52.5	121 ^{0,1}			
4258	Di met hyl phenyl si l ane		₈ H ₈ Si	766-77-8	136.267			156.5	0.889 ⁴⁹	1.4995 ²⁰	i H ₂ O
4259	<i>N,N</i> -Di met hyl- <i>N</i> -phenyl urea	Fenuron	C ₈ H ₁₂ N ₂ O	101-42-8	164.203	cry (hx)	132				
4260	Di met hyl phosphi ne		₂ H ₂ P	676-59-5	62.051	vol li q or gas		25			i ₂ 0t s Et OH, et h
4261	Di met hyl phosphi ni c aci d		₂ H ₂ O ₂ P	3283-12-3	94.050	cry (bz)	92	377			vs H ₂ O, Et OH, et h; s bz
4262	<i>O,O</i> -Di met hyl phosphorochl ori dot hi oat e	Di met hyl chl orot hi ophosphat e	₂ H ₆ O ₂ PS	2524-03-0	160.560	hyg li q		68	1.322	1.4820 ²⁰	
4263	Di met hyl pht halat e		₁₀ H ₆ O ₄	131-11-3	194.184	pa ye	5.5	283.7	1.1905 ²⁰	1.5138 ²⁰	i H ₂ O; msc Et OH, et h; s bz; sl ct c
4264	1,4-Di met hyl pi perazi ne		₆ H ₈ N ₂	106-58-1	114.188	li q	-0.59	131	0.8600	1.4474 ²⁰	vs H ₂ O, Et OH, et h
4265	<i>cis</i> -2,5-Di met hyl pi perazi ne		₆ H ₈ N ₂	6284-84-0	114.188	ort h bi pym nd or pr (chl)	114	162		1.4720 ²⁰	vs H ₂ O, Et OH, chl; sl et h, bz
4266	1,2-Di met hyl pi peri di ne, (<i>±</i>)		₇ H ₁₀ N	2512-81-4	113.201			127.5	0.824 ¹⁵	1.4395 ²⁰	vs H ₂ O, et h, Et OH
4267	2,6-Di met hyl pi peri di ne		₇ H ₁₀ N	504-03-0	113.201			127	0.8158 ²⁵	1.4377 ²⁰	msc H ₂ O, Et OH, et h; sl ct c; s aci d
4268	3,5-Di met hyl pi peri di ne	3,5-Lupet i di ne	₇ H ₁₀ N	35794-11-7	113.201			144	0.853 ²⁵	1.4454 ²⁰	
4269	2,2-Di met hyl propanal	Pi val dehyde	₅ H ₈ O	630-19-3	86.132		6	77.5	0.7923 ¹⁷	1.3791 ²⁰	s Et OH, et h
4270	2,2-Di met hyl propanami de		₅ H ₈ NO	754-10-9	101.147						s t f a
4271	<i>N,N</i> -Di met hyl propanami de		₅ H ₈ NO	758-96-3	101.147	li q	-45	175	0.9269		
4272	<i>N,N</i> -Di met hyl -1-propanami ne	Di met hyl propyl ami ne	₅ H ₁₀ NC	926-63-6	87.164			66	0.7152 ²⁰	1.3860 ²⁰	vs bz, et h, Et OH
4273	<i>N,N</i> -Di met hyl -1,3-propanedi ami ne		₅ H ₁₀ N ₂	109-55-7	102.178			132	0.8272 ²⁰		
4274	2,2-Di met hyl -1,3-propanedi ol	Neopent yl glycol	₅ H ₁₂ O ₂	126-30-7	104.148	nd (bz)	129.13	208			s H ₂ O, bz, chl; vs Et OH, et h
4275	2,2-Di met hyl propaneni t ri le	<i>tert</i> But yl cyani de	₄ H ₈ N	630-18-2	83.132		15	106.1	0.7586 ²⁵	1.3774 ²⁰	
4276	2,2-Di met hyl -1-propanet hi ol	Neopent yl mercapt an	₅ H ₁₂ SC	1679-08-9	104.214	li q		103.7			
4277	2,2-Di met hyl propanoi c aci d	Tri met hyl acet i c aci d	₅ H ₁₀ O ₂ C	75-98-9	102.132	nd	35	164	0.905 ⁵⁰	1.3931 ³⁰	sl H ₂ O; vs Et OH, et h
4278	2,2-Di met hyl -1-propanol	Neopent yl al cohol	₅ H ₁₀ O	75-84-3	88.148		52.5	113.5	0.812 ²⁰		sl H ₂ O; vs Et OH, et h; s ct c
4279	2,2-Di met hyl propanoyl chl ori de	Pi val i c aci d chl ori de	₅ H ₈ Cl OC	3282-30-2	120.577			107	1.003 ³⁰	1.4139 ²⁰	vs et h
4280	<i>N,N</i> -Di met hyl -2-propanami de	<i>M,M</i> -Di met hyl acryl ami de	₅ H ₈ NO	2680-03-7	99.131	li q		8 ⁴	0.962 ²⁵	1.4730 ²⁰	
4281	2,2-Di met hyl propyl ami ne	2,2-Di met hyl -1-propanami ne	₅ H ₁₀ NC	5813-64-9	87.164			82	0.745 ²⁰	1.4023 ²⁰	vs et h
4282	(1,1-Di met hyl propyl)benzene		₁₇ H ₁₆	2049-95-8	148.245			192.4	0.8748 ²⁰	1.4958 ²⁰	
4283	(2,2-Di met hyl propyl)benzene		₁₇ H ₁₆	1007-26-7	148.245			185	0.8581 ¹⁸	1.4884 ¹⁸	
4284	4-(1,1-Di met hyl propyl) cycl ohexanone		C ₁₁ H ₂₀ O	16587-71-6	168.276		96	125 ¹⁶ , 109 ¹¹	0.920 ²⁵	1.4677 ²⁰	
4285	1,1-Di met hyl propyl 3-met hyl but anoat e	<i>tert</i> Pen t yl i sopent anoat e	₁₀ H ₂₀ O ₂	542-37-0	172.265			173.5	0.8729 ⁰		vs Et OH
4286	2-(1,1-Di met hyl propyl)phenol		₁₁ H ₁₆ O	3279-27-4	164.244						sl ct c



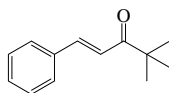
1-(2,4-Di met hyl phenyl)et hanone



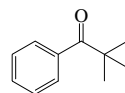
1-(2,5-Di met hyl phenyl)et hanone



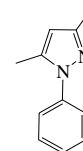
1-(3,4-Di met hyl phenyl)et hanone



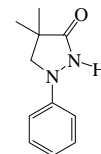
4,4-Di met hyl -1-phenyl -1-pent en-3-one



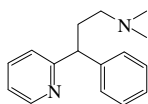
2,2-Di met hyl -1-phenyl -1-propanone



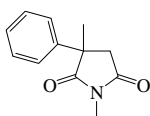
3,5-Di met hyl -1-phenyl#pyrazol e



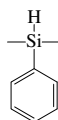
4,4-Di met hyl -1-phenyl -3-pyrazol i di none



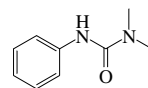
N,N-Di met hyl-phenyl -2-pyri di nepropanami ne



1,3-Di met hyl -3-phenyl -2,5-pyrrol i di ned i one



Di met hyl phenyl si l ane



N,N-Di met hyl-phenyl urea



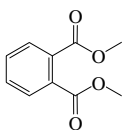
Di met hyl phosphi ne



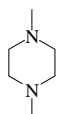
Di met hyl phosphi aci d



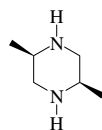
O,O-Di met hylphosphorochl ori dot hi oat e



Di met hylht hal at e



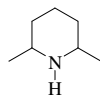
1,4-Di met hyl pi perazi ne



ci s 2,5-Di met hyl pi perazi ne



1,2-Di met hyl pi peri d(i)ne



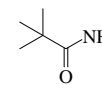
2,6-Di met hyl pi peri di ne



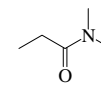
3,5-Di met hyl pi peri di ne



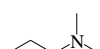
2,2-Di met hyl propanal



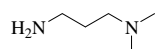
2,2-Di met hyl propanami de



N,N-Di met hyl propanami de



N,N-Di met hyl -1-propanami ne



N,N-Di met hyl -1,3-propanedi ami ne



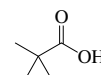
2,2-Di met hyl -1,3-propanedi ol



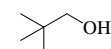
2,2-Di met hyl propaneni t ri le



2,2-Di met hyl -1-propanet hi ol



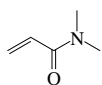
2,2-Di met hyl propanoici d



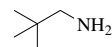
2,2-Di met hyl -1-propanol



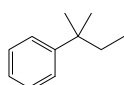
2,2-Di met hyl propanochl ori de



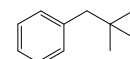
N,N-Di met hyl -2-propenami de



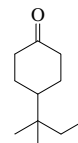
2,2-Di met hyl propyl ami ne



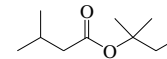
(1,1-Di met hyl propyl)benzene



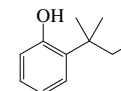
(2,2-Di met hyl propyl)benzene



4-(1,1-Di met hyl propyl)cycl ohexanc

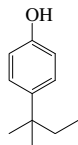


1,1-Di met hyl propyl met hyl but anoat e

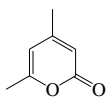


2-(1,1-Di met hyl propyl)phenol

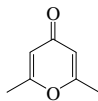
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4287	4-(1,1-Di met hyl propyl)phenol	<i>p</i> -t er#Pent yl phenol	C ₁₆ H ₁₈ O	80-46-6	164.244		95	262.5			
4288	4,6-Di met hyl #2-pyran-2-one		C ₇ H ₆ O ₂	675-09-2	124.138	lf (et h)	51.5	245			vs H ₂ O, Et OH, et h, Et OH
4289	2,6-Di met hyl #4-pyran-4-one		C ₇ H ₆ O ₂	1004-36-0	124.138	pl, nd (sub)	132	251; 140 ⁵	0.9953 ¹³⁷		s H ₂ O, Et OH, et h, ace
4290	2,3-Di met hyl pyrazi ne		C ₄ H ₄ N ₂	5910-89-4	108.141			156	1.0281 ¹⁰		s H ₂ O, Et OH, et h
4291	2,5-Di met hyl pyrazi ne		C ₄ H ₄ N ₂	123-32-0	108.141		15	155	0.9887 ²⁰	1.4980 ²⁰	msc H ₂ O, Et OH, et h; s ace, chl
4292	2,6-Di met hyl pyrazi ne		C ₄ H ₄ N ₂	108-50-9	108.141	pr	47.5	155.6	0.9647 ⁵⁰		s H ₂ O, Et OH, et h; sl ct c
4293	1,3-Di met hyl #4-pyrazol e		C ₆ H ₈ N ₂	694-48-4	96.131			137	0.9561 ¹⁷	1.4734 ¹⁵	vs H ₂ O
4294	3,5-Di met hyl #4-pyrazol e		C ₆ H ₈ N ₂	67-51-6	96.131	cry (pet h, al)	107.5	218	0.883 ⁹		s H ₂ O, ace; vs Et OH, et h, bz, MeOH
4295	2,7-Di met hyl pyrene		C ₁₄ H ₁₄	15679-24-0	230.304		230				
4296	4,6-Di met hyl -2-pyri di nami ne		C ₇ H ₈ O ₂	5407-87-4	122.167		61	235			
4297	<i>N,N</i> -Di met hyl -2-pyri di nami ne		C ₇ H ₈ O ₂	5683-33-0	122.167		182	196	1.0149 ¹⁴	1.5663 ²⁰	s Et OH, et h, bz
4298	<i>N,N</i> -Di met hyl -4-pyri di nami ne		C ₇ H ₈ O ₂	1122-58-3	122.167	pl (et h)	114				vs H ₂ O, Et OH, bz, chl; s et h
4299	2,3-Di met hyl pyri di ne	2,3-Lut i di ne	C ₇ H ₈ N ₂	583-61-9	107.153			161.12	0.9319 ²⁵	1.5057 ²⁰	s H ₂ O, Et OH, et h
4300	2,4-Di met hyl pyri di ne	2,4-Lut i di ne	C ₇ H ₈ N ₂	108-47-4	107.153	li q	-64	158.38	0.930 ⁹	1.5010 ²⁰	vs H ₂ O, Et OH, et h; s ace
4301	2,5-Di met hyl pyri di ne	2,5-Lut i di ne	C ₇ H ₈ N ₂	589-93-5	107.153	li q	-16	156.98	0.929 ⁷	1.5006 ²⁰	sl H ₂ O; vs Et OH; msc et h; s ace
4302	2,6-Di met hyl pyri di ne	2,6-Lut i di ne	C ₇ H ₈ N ₂	108-48-5	107.153	li q	-6.1	144.01	0.922 ⁶	1.4953 ²⁰	msc H ₂ O; sl Et OH; s et h, ace, chl
4303	3,4-Di met hyl pyri di ne	3,4-Lut i di ne	C ₇ H ₈ N ₂	583-58-4	107.153	li q	-11	179.10	0.928 ⁷	1.5096 ²⁰	sl H ₂ O, ct c; s Et OH, et h, ace, chl
4304	3,5-Di met hyl pyri di ne	3,5-Lut i di ne	C ₇ H ₈ N ₂	591-22-0	107.153	li q	-6.6	171.84	0.941 ⁹	1.5061 ²⁰	s H ₂ O, Et OH, et h, ace; sl ct c
4305	2,6-Di met hyl pyri di ne-1-oxi de		C ₇ H ₈ NO	1073-23-0	123.152	hyg	35	133 ²²	1.073 ²⁵	1.5706 ²⁰	
4306	4,6-Di met hyl -2-pyri mi di nami ne		C ₈ H ₁₀ N ₂	767-15-7	123.155		153.5				s H ₂ O, Et OH, ace, bz; i et h; vs chl
4307	2,6-Di met hyl -4-pyri mi di nami ne	Kyanmet hi n	C ₈ H ₁₀ N ₂	461-98-3	123.155	nd (al), pl (bz)	183	sub			sl H ₂ O, Et OH, bz, chl
4308	4,6-Di met hyl pyri mi di ne		C ₈ H ₁₀ N ₂	1558-17-4	108.141		25	159		1.4880 ²⁰	vs H ₂ O
4309	1,3-Di met hyl -2,4,4,4-(1,3,4)-pyri mi di nedi one		C ₆ H ₈ N ₂ O ₂	874-14-6	140.140		123.5				sl Et OH; s et h, chl
4310	2,4-Di met hyl pyrrol e		C ₄ H ₆ N	625-82-1	95.142	pa bl flr cry		168	0.9236 ¹⁰	1.5048 ²⁰	sl H ₂ O; vs Et OH, et h, bz; s chl
4311	2,5-Di met hyl pyrrol e		C ₄ H ₆ N	625-84-3	95.142		6.5	171; 51 ⁸	0.9353 ²⁰	1.5036 ²⁰	i H ₂ O; vs Et OH, et h
4312	1,2-Di met hyl pyrrol i di ne		C ₄ H ₆ N	765-48-0	99.174	oi l		99	0.79 ⁹		s H ₂ O
4313	2,4-Di met hyl qui nol i ne	4-Met hyl qui nal di ne	C ₁₁ H ₁₁ N	1198-37-4	157.212	ort h pr (et h)		265	1.061 ⁴	1.6075 ²⁰	sl H ₂ O, chl; vs Et OH, et h
4314	2,6-Di met hyl qui nol i ne		C ₁₁ H ₁₁ N	877-43-0	157.212	ort h pr (et h)	60	266.5			sl H ₂ O, Et OH, et h, chl; vs bz
4315	2,7-Di met hyl qui nol i ne	<i>m</i> -Tol uqui nal di ne	C ₁₁ H ₁₁ N	93-37-8	157.212		61	264.5			sl H ₂ O; s Et OH, et h, chl
4316	2,3-Di met hyl qui noxal i ne		C ₁₀ H ₁₀ N ₂	2379-55-7	158.199	nd (w+3, ace)	106				s Et OH, et h, ace, bz, chl; aci d
4317	Di met hyl sebacat e		C ₁₈ H ₃₄ O ₄	106-79-6	230.301	lo pr	38	175 ¹⁰ , 144 ⁵	0.9882 ²⁸	1.4355 ²⁸	i H ₂ O; s Et OH, et h, ace, ct c
4318	Di met hyl seleni de	Met hyl seleni de	C ₂ H ₆ Se	593-79-3	109.03			57	1.4077 ¹⁵		vs et h, Et OH, chl
4319	Di met hyl silane	2-Silapropane	C ₃ H ₈ Si	1111-74-6	60.171	col gas	-150	-20	0.68 ⁰		
4320	Di met hyl st earyl ami ne	Dymant hi ne	C ₂₀ H ₄₃ N	124-28-7	297.562		22.9				
4321	Di met hyl succi nat e		C ₆ H ₈ O ₄	106-65-0	146.141		19	196.4	1.1198 ²⁰	1.4197 ²⁰	sl H ₂ O, ct c; s Et OH, ace; vs et h
4322	Di met hyl sulf amoyl chl ori de	Di met hyl ami nosulfonyl chl ori de	C ₆ H ₈ ClNO ₂ S	13360-57-1	143.593			80 ¹⁶			
4323	Di met hyl sulf at e		C ₂ H ₄ O ₄ S	77-78-1	126.132		-27	dec 188; 76 ¹⁵	1.3322 ²⁰	1.3874 ²⁰	s H ₂ O, et h, bz, ct c; msc Et OH; i CS ₂
4324	Di met hyl sulfide		C ₂ H ₆ S	75-18-3	62.134	li q	-98.24	37.33	0.848 ³	1.4438 ²⁰	sl H ₂ O; s Et OH, et h
4325	Di met hyl sulfite		C ₂ H ₄ O ₃ S	616-42-2	110.132			126	1.2129 ²⁰	1.4083 ²⁰	s H ₂ O, Et OH, et h
4326	2,4-Di met hyl sulf olane		C ₆ H ₁₀ O ₂ S	1003-78-7	148.223	li q	-1.5	281	1.136 ²	1.4732 ²⁰	vs li g
4327	Di met hyl sulfone		C ₂ H ₄ O ₂ S	67-71-0	94.133	pr	108.9	238	1.1700 ¹⁰	1.4226	s H ₂ O, Et OH, bz
4328	Di met hyl sulf oxide	DMSO	C ₂ H ₆ OS	67-68-5	78.133		17.89	189	1.1010 ²⁵	1.4793 ²⁰	s H ₂ O, Et OH, et h, ace, ct c, AcOEt



4-(1,1-Di met hyl propyl) phenol



4,6-Di met hyl #pyran-2-one



2,6-Di met hyl #pyran-4-one



2,3-Di met hyl pyrazi ne



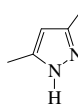
2,5-Di met hyl pyrazi ne



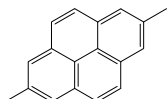
2,6-Di met hyl pyrazi ne



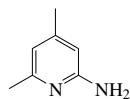
1,3-Di met hyl #pyrazol e



3,5-Di met hyl #pyrazol e



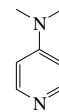
2,7-Di met hyl pyrene



4,6-Di met hyl -2-pyri di nami ne



N,N-Di met hyl -2-pyri di nami ne



N,N-Di met hyl -4-pyri di nami ne



2,3-Di met hyl pyri di ne



2,4-Di met hyl pyri di ne



2,5-Di met hyl pyri di ne



2,6-Di met hyl pyri di ne



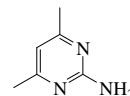
3,4-Di met hyl pyri di ne



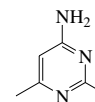
3,5-Di met hyl pyri di ne



2,6-Di met hyl pyri di ne-1-oxi de



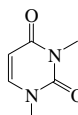
4,6-Di met hyl -2-pyri mi di nami ne



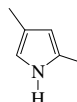
2,6-Di met hyl -4-pyri mi di nami ne



4,6-Di met hyl pyri mi c



1,3-Di met hyl -2,4(1H)-pyri mi di nedi one



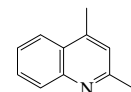
2,4-Di met hyl pyrrol e



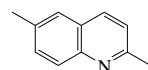
2,5-Di met hyl pyrro



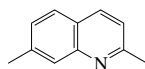
1,2-Di met hyl pyrrol i di ne



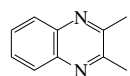
2,4-Di met hyl qui nol



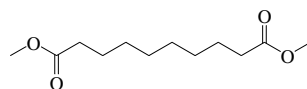
2,6-Di met hyl qui nol i ne



2,7-Di met hyl qui nol i



2,3-Di met hyl qui noxal i ne



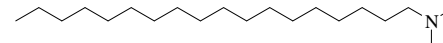
Di met hyl sebacat e



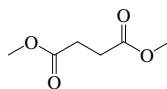
Di met hyl sel eni di



Di met hyl si l ane



Di met hyl st earyl ami ne



Di met hyl succi nat e



Di met hyl sul f amoyl ori de



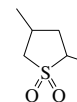
Di met hyl sul f ate



Di met hyl sul f i de



Di met hyl sul f i t e



2,4-Di met hyl sul fol ane

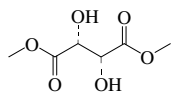


Di met hyl sul f one



Di met hyl sul f oxi de

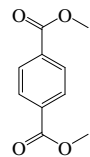
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4329	Di met hyl-t art rat e	Di met hyl 2,3-di hydroxybut anedi c [R-(R*,R*)]-	C ₄ H ₁₀ O ₆	608-68-4	178.139	(i) cry (bz) (i) cry (w)	50(f orm a); 61(f orm b)	280	1.306 ⁴⁵		vs H ₂ O, ace, et h, Et OH
4330	Di met hyl t el luri de		C ₂ H ₆ O	593-80-6	157.67	pa ye		94			vs Et OH
4331	Di met hyl t erepht hal at e		C ₁₀ H ₁₆ O ₄	120-61-6	194.184		141	288	1.075 ¹⁴¹		sl H ₂ O, Et OH, MeOH; s et h, chl
4332	Di met hyl t et rachl orot erepht hal at e		C ₁₀ H ₆ CClO ₄	1861-32-1	331.965		155				
4333	2,7-Di met hyl t hi achromi ne-8-et hanol		C ₁₂ H ₁₄ O ₄ S	92-35-3	262.330	ye pr (chl)	228.8	sub			s H ₂ O, MeOH; sl Et OH, et h, ace, chl
4334	2,5-Di met hyl -1,3,4-t hi adi azol e		C ₄ H ₆ N ₂ S	27464-82-0	114.169		65	202.5			sl H ₂ O, Et OH, et h
4335	2,7-Di met hyl t hi ant hrene	Mesul phen	C ₁₄ H ₁₀ CS ₂	135-58-0	244.375	nd (HOAc,al)	123	184			vs ace, et h, pet h, chl
4336	2,4-Di met hyl t hi azol e		C ₂ H ₄ N ₂ S	541-58-2	113.182			146; 71 ⁵⁰	1.0562 ¹⁵	1.5091 ²⁰	sl H ₂ O; s Et OH, et h, chl
4337	4,5-Di met hyl t hi azol e		C ₂ H ₄ N ₂ S	3581-91-7	113.182			83.5	158	1.0699 ²⁰	vs et h, Et OH
4338	N,N-Di met hyl t hi oacet ami de		C ₄ H ₈ N ₂ S	631-67-4	103.186		74.5				
4339	Di met hyl t hi odi propi onat e		C ₈ H ₁₄ O ₂ S	4131-74-2	206.260			162 ¹⁸ , 148 ¹⁸	1.1559 ²⁰	1.4740 ²⁰	
4340	2,3-Di met hyl t hi ophene		C ₆ H ₆ CS	632-16-6	112.193	li q	-49	141.6	1.0024 ⁹	1.5192 ²⁰	i H ₂ O; vs Et OH, et h; s bz
4341	2,4-Di met hyl t hi ophene		C ₆ H ₆ CS	638-00-6	112.193			140.7	0.9938 ²⁰	1.5104 ²⁰	i H ₂ O; s Et OH, et h, bz
4342	2,5-Di met hyl t hi ophene		C ₆ H ₆ CS	638-02-8	112.193	li q	-62.6	136.5	0.985 ⁹	1.5129 ²⁰	i H ₂ O; s Et OH, et h, bz
4343	3,4-Di met hyl t hi ophene		C ₆ H ₆ CS	632-15-5	112.193			145	0.993 ²⁵	1.5206 ²⁰	i H ₂ O; s Et OH; vs et h
4344	N,N-Di met hyl t hi ourea		C ₃ H ₆ N ₂ S	6972-05-0	104.174	cry (w)	161.5				
4345	N,N'-Di met hyl t hi ourea		C ₃ H ₆ N ₂ S	534-13-4	104.174	hyg pl	62				vs H ₂ O, Et OH, ace; sl et h, bz; i cS
4346	2,6-Di met hyl -4-t ri decyl morphol i ne	Tri demorph	C ₁₉ H ₃₉ N	24602-86-6	297.519			141 ^{1,3}	0.86		
4347	N,N-Di met hyl N-[3-(t ri fluoromet hyl) Fl uomet uron phenyl] urea		C ₆ H ₁₁ F ₃ N ₃ O	2164-17-2	232.201		164				vs ace, Et OH
4348	Di met hyl t ri sulfide		C ₂ H ₆ S ₃	3658-80-8	126.264			41 ⁵			
4349	6,10-Di met hyl -3,5,9-undecat ri en-2- Pseudoi onone one		C ₆ H ₂₀ O	141-10-6	192.297	pa ye oi l		144	0.8984 ²⁰	1.5335 ²⁰	s Et OH, et h, chl, MeOH
4350	N,N-Di met hyl urea		C ₂ H ₆ N ₂ O	598-94-7	88.108	mcl pr (al, chl)	182.1		1.255 ⁵		s H ₂ O; sl Et OH, t f a; i et h
4351	N,N'-Di met hyl urea		C ₂ H ₆ N ₂ O	96-31-1	88.108	ort h bi pym (chl -et h)	106.6	269	1.142 ²⁵		vs H ₂ O, Et OH; i et h; sl chl
4352	Di met hyl zi nc		C ₂ H ₂ Zn	544-97-8	95.478	li q, i gn i n ai r	-43.0	46	1.386		s et h; msc pet h
4353	Di met i lan		C ₁₀ H ₁₆ N ₄ O ₃	644-64-4	240.259	col sol i d	69	205			s H ₂ O, chl, Et OH, ace, xyl
4354	Di morphol ami ne		C ₂ H ₃₈ N ₄ O ₄	119-48-2	398.541	cry (pet h)	41.5	229 ⁴			vs H ₂ O
4355	N,N'-Di -2-napht hyl -1,4-benzenedi ami ne		C ₂₆ H ₂₀ N ₂	93-46-9	360.450		235				i Et OH, et h, bz
4356	Di -2-napht hyl di sulfide		C ₂₀ H ₁₄ S ₂	5586-15-2	318.455	nd	139.5		1.144 ¹⁴⁵	1.4555 ²⁰	i H ₂ O; vs Et OH, et h; i li g
4357	N,N'-Di -1-napht hyl urea		C ₂ H ₁₆ N ₂ O	607-56-7	312.364	nd (py, HOAc)	296	sub			vs py
4358	Di ni conazol e		C ₁₇ H ₁₇ Cl ₂ N ₃ O	83657-24-3	326.221	cry	149				s H ₂ O, ace, MeOH, xyl
4359	Di ni t rami ne		C ₁₁ H ₁₃ F ₃ N ₄ O ₄	29091-05-2	322.241		98				
4360	2,3-Di ni t roani li ne		C ₆ H ₈ N ₂ O ₄	602-03-9	183.122		128		1.646 ⁵⁰		i H ₂ O; s Et OH; sl et h
4361	2,4-Di ni t roani li ne		C ₆ H ₈ N ₂ O ₄	97-02-9	183.122	ye nd (ace) grn ye t ab (al)	180.0	56.7	1.615 ¹⁴		i H ₂ O; sl Et OH, ace, HCl
4362	2,5-Di ni t roani li ne		C ₆ H ₈ N ₂ O ₄	619-18-1	183.122	oran nd (al)	138.0				vs Et OH
4363	2,6-Di ni t roani li ne		C ₆ H ₈ N ₂ O ₄	606-22-4	183.122	gol d lf (HOAc) ye nd (al)	141.5				i H ₂ O, li g; sl Et OH; s et h, bz
4364	3,5-Di ni t roani li ne		C ₆ H ₈ N ₂ O ₄	618-87-1	183.122	ye nd (di l al)	163		1.604		i H ₂ O; s Et OH, et h; sl ace, bz
4365	1,5-Di ni t ro-9,10-ant hracenedi one		C ₁₄ H ₈ N ₂ O ₆	82-35-9	298.207	pa ye nd (xyl)	385	sub			i H ₂ O; sl Et OH, et h, bz; vs PhNO
4366	1,8-Di ni t ro-9,10-ant hracenedi one		C ₁₄ H ₈ N ₂ O ₆	129-39-5	298.207		312				



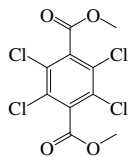
Di met hyl-t art rat e



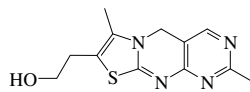
Di met hyltel luri de



Di met hylterept halat e



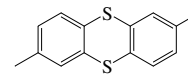
Di met hyltet racht orot erept halat e



2,7-Di met hylt hi achromi ne-8-et hanol



2,5-Di met hyl-1,3,4-t hi adi azole



2,7-Di met hylt hi ant hrene



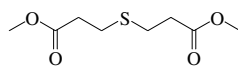
2,4-Di met hylt hi azole



4,5-Di met hylt hi azole



N,N-Di met hylt hi oacet ami de



Di met hylt hi odi propi onat e



2,3-Di met hylt hi ophene



2,4-Di met hylt hi ophene



2,5-Di met hylt hi ophene



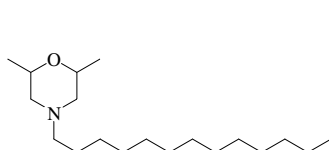
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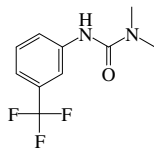
N,N-Di met hylt hi ourea



N,N'-Di met hylt hi ourea



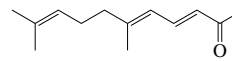
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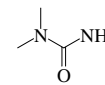
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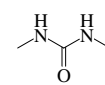
Di met hylt ri sulf i de



6,10-Di met hyl-3,5,9-undecat ri en-2-one



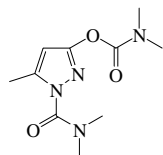
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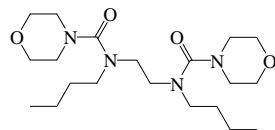
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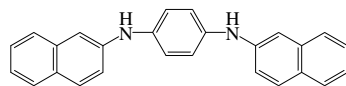
Di met hylz nc



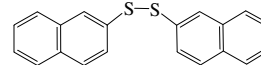
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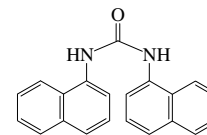
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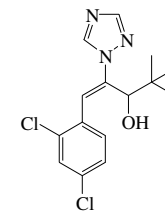
N,N'-2-napht hyl-1,4-benzenedi ami ne



Di-2-napht hylt ri sulf i de



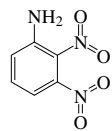
N,N'-1-napht hylurea



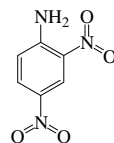
Di ni conazol e



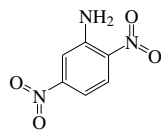
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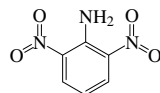
2,3-Di ni t roani li ne



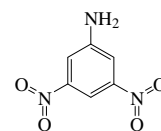
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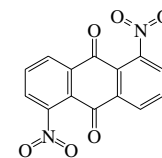
2,5-Di ni t roani li ne



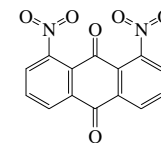
2,6-Di ni t roani li ne



3,5-Di ni t roani li ne

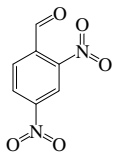


1,5-Di ni t ro-9,10-ant hracenedi one

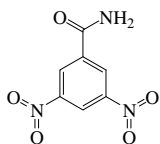


1,8-Di ni t ro-9,10-ant hracenedi one

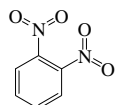
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4367	2,4-Di ni t robenzal dehyde		$\text{C}_8\text{H}_7\text{NO}_2$	528-75-6	196.117	pa ye pr (al), pl (bz)	72	200 ¹⁵			sl H_2O , chl, l i g; s Et OH, et h, bz
4368	3,5-Di ni t robenzami de	Ni t romi de	$\text{C}_6\text{H}_7\text{NO}_2$	121-81-3	211.132	lf (w)	184				vs H_2O
4369	1,2-Di ni t robenzene	<i>o</i> -Di ni t robenzene	$\text{C}_6\text{H}_4\text{N}_2\text{O}_4$	528-29-0	168.107	nd (bz), pl (al)	116.5	318; 194 ⁹	1.3119 ¹²⁰	1.565 ¹⁷	i H_2O ; s Et OH, bz, chl, AcOEt; sl DMSO
4370	1,3-Di ni t robenzene	<i>m</i> -Di ni t robenzene	$\text{C}_6\text{H}_4\text{N}_2\text{O}_4$	99-65-0	168.107	ort h pl (al)	90.3	291; 167 ⁹	1.5751 ¹⁸		sl H_2O ; vs Et OH, ace, py; s et h, t ol
4371	1,4-Di ni t robenzene	<i>p</i> -Di ni t robenzene	$\text{C}_6\text{H}_4\text{N}_2\text{O}_4$	100-25-4	168.107	nd (al)	173.5	297; 183 ⁴	1.625 ¹⁸		i H_2O ; sl Et OH, chl; s ace, bz, t ol
4372	2,4-Di ni t ro-1,3-benzenedi ol	2,4-Di ni t roresorci nol	$\text{C}_6\text{H}_4\text{N}_2\text{O}_6$	519-44-8	200.105	ye lf (al)	147.5				sl H_2O , Et OH
4373	2,4-Di ni t robenzenesul f enyl chl ori de		$\text{C}_6\text{H}_4\text{CClNO}_2\text{S}$	528-76-7	234.617	ye pr (bz-pet h)	99				vs bz, chl, HOAc; sl pet h
4374	2,4-Di ni t robenzenesul f oni c aci d		$\text{C}_6\text{H}_4\text{NCO}_2\text{S}$	89-02-1	248.170	nd (w+3)	108				vs H_2O , Et OH; sl et h; i bz, pet h
4375	2,4-Di ni t robenzoi c aci d		$\text{C}_6\text{H}_4\text{N}_2\text{O}_6$	610-30-0	212.116	nd (w)	183		1.672 ²⁰		sl H_2O , Et OH, bz
4376	3,4-Di ni t robenzoi c aci d		$\text{C}_6\text{H}_4\text{N}_2\text{O}_6$	528-45-0	212.116	cry (di l al)	166				sl H_2O ; vs Et OH, et h
4377	3,5-Di ni t robenzoi c aci d		$\text{C}_6\text{H}_4\text{N}_2\text{O}_6$	99-34-3	212.116	mcl pr (al)	205				sl H_2O ; vs Et OH, HOAc
4378	3,5-Di ni t robenzoyl chl ori de		$\text{C}_7\text{H}_5\text{ClNO}_2$	99-33-2	230.562	ye nd (bz)	74	196 ¹²			s et h, chl
4379	2,2'-Di ni t ro-1,1'-bi phenyl		$\text{C}_{12}\text{H}_9\text{N}_2\text{O}_4$	2436-96-6	244.203	ye mcl pr or nd (al)	126	305	1.45 ²⁵		i H_2O ; vs Et OH; s et h, bz; sl ace, l i g
4380	4,4'-Di ni t ro-1,1'-bi phenyl		$\text{C}_{12}\text{H}_9\text{N}_2\text{O}_4$	1528-74-1	244.203	nd (al)	242.3				i H_2O ; sl Et OH; s bz, HOAc
4381	1,4-Di ni t robut ane		$\text{C}_4\text{H}_9\text{N}_2\text{O}_4$	4286-49-1	148.118	pl (al)	33.5	176 ³			i H_2O ; sl Et OH; s et h, bz, MeOH
4382	4,4'-Di ni t rodi phenyl ami ne	4-Ni t ro-4'eni t rophenyl)ani li ne	$\text{C}_{12}\text{H}_9\text{N}_2\text{O}_4$	1821-27-8	259.217	ye nd(al)	217.5				i H_2O , t ol; sl Et OH, bz; s ace, HOAc
4383	4,4'-Di ni t rodi phenyl et her	Bi s(4-ni t rophenyl) et her	$\text{C}_{12}\text{H}_9\text{N}_2\text{O}_6$	101-63-3	260.202		146.0				i H_2O ; sl Et OH, et h; s bz, HOAc
4384	4,4'-Di ni t rodi phenyl sul fide	Bi s(4-ni t rophenyl) sul fide	$\text{C}_{12}\text{H}_9\text{N}_2\text{O}_6\text{S}$	1223-31-0	276.268	oran pl (HOAc)	160.5				i H_2O ; sl Et OH; s con sul f
4385	1,1-Di ni t roet hane		$\text{C}_2\text{H}_3\text{N}_2\text{O}_4$	600-40-8	120.064	ye mcl (bz, MeOH)		185.5	1.349 ²⁴		sl H_2O ; s Et OH, et h
4386	1,2-Di ni t roet hane		$\text{C}_2\text{H}_3\text{N}_2\text{O}_4$	7570-26-5	120.064		39.5	95 ⁵	1.4597 ²⁰	1.4468 ²⁰	vs et h, Et OH
4387	Di ni t romet hane		$\text{C}_2\text{H}_3\text{N}_2\text{O}_4$	625-76-3	106.038	ye nd	<-15	exp 100			i H_2O ; s Et OH, et h
4388	1,3-Di ni t ronapht hal ene		$\text{C}_{10}\text{H}_7\text{N}_2\text{O}_4$	606-37-1	218.166	ye nd (bz, py-w)	148	sub			i H_2O ; s Et OH, ace
4389	1,5-Di ni t ronapht hal ene		$\text{C}_{10}\text{H}_7\text{N}_2\text{O}_4$	605-71-0	218.166	hex nd (ace, HOAc)	219	sub	1.5860 ²⁰		i H_2O ; sl Et OH, ace; s bz, py; vs et h
4390	1,8-Di ni t ronapht hal ene		$\text{C}_{10}\text{H}_7\text{N}_2\text{O}_4$	602-38-0	218.166	ye ort h pl (chl)	173	dec 445			i H_2O ; sl Et OH, bz; s ace, chl, py
4391	2,4-Di ni t ro-1-napht hol		$\text{C}_{10}\text{H}_7\text{N}_2\text{O}_5$	605-69-6	234.165	ye nd (al, chl)	138.8				
4392	2,3-Di ni t rophenol		$\text{C}_6\text{H}_4\text{N}_2\text{O}_5$	66-56-8	184.106	ye nd (w)	144.5		1.681 ²⁰		sl H_2O , DMSO; vs Et OH, et h; s bz
4393	2,4-Di ni t rophenol		$\text{C}_6\text{H}_4\text{N}_2\text{O}_5$	51-28-5	184.106	paye pl or lf (w)	114.8	sub	1.683 ³		sl H_2O ; s Et OH, et h, ace, bz, t ol, chl, py
4394	2,5-Di ni t rophenol		$\text{C}_6\text{H}_4\text{N}_2\text{O}_5$	329-71-5	184.106	ye mcl pr or nd (w, l i g)	108				vs bz, et h
4395	2,6-Di ni t rophenol		$\text{C}_6\text{H}_4\text{N}_2\text{O}_5$	573-56-8	184.106	paye ort h nd or lf (di l al)	63.5				i H_2O ; vs Et OH, et h; s bz, chl; sl ct c
4396	3,4-Di ni t rophenol		$\text{C}_6\text{H}_4\text{N}_2\text{O}_5$	577-71-9	184.106	t cl nd (w)	134		1.672 ²⁵		vs bz, et h, Et OH
4397	2,4-Di ni t rophenol, acet ate		$\text{C}_8\text{H}_7\text{N}_2\text{O}_6$	4232-27-3	226.143	cry (MeOH)	72.5				
4398	4-[(2,4-Di ni t rophenyl)ami no]phenol		$\text{C}_{12}\text{H}_9\text{N}_3\text{O}_5$	119-15-3	275.216	red lf	195.5				s al k
4399	2,4-Di ni t ro-1,1'-bi phenyl ami li ne		$\text{C}_{12}\text{H}_9\text{N}_3\text{O}_4$	961-68-2	259.217	ye red nd (al)	157.8				i H_2O ; s Et OH, ace; sl et h, bz, DMSO
4400	2,4-Di ni t rophenyl di met hyl carbamodi t hi oat e		$\text{C}_9\text{H}_9\text{N}_3\text{O}_6\text{S}_2$	89-37-2	287.315		152.5		1.54 ²⁰		i H_2O ; s Et OH, ace, bz
4401	(2,4-Di ni t rophenyl)hydrazi ne		$\text{C}_6\text{H}_7\text{N}_4\text{O}_4$	119-26-6	198.137	bl sh-red (al)	194				i H_2O ; s Et OH; sl et h, bz, chl, DMSO



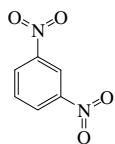
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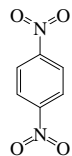
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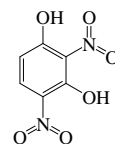
1,2-Di ni t robenzene



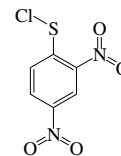
1,3-Di ni t robenzene



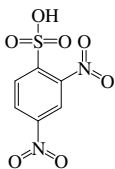
1,4-Di ni t robenzene



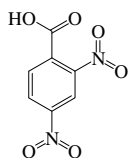
2,4-Di ni t ro-1,3-benzenedi ol



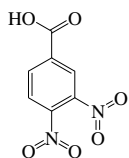
2,4-Di ni t robenzenesul f athyloxi de



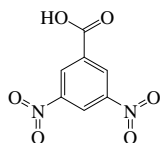
2,4-Di ni t robenzenesul f amidi ad



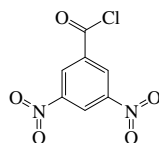
2,4-Di ni t robenzoi cãci d



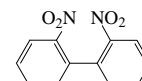
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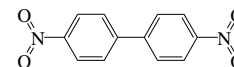
3,5-Di ni t robenzoi cãci d



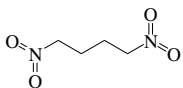
3,5-Di ni t robenzoyl chl ori de



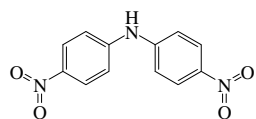
2,2'-Di ni t ro-1,1'-bi phenyl



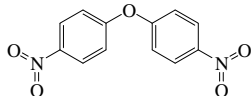
4,4'-Di ni t ro-1,1'-bi phenyl



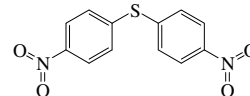
1,4-Di ni t robut ane



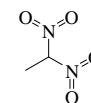
4,4'-Di ni t rodi phenyl ami ne



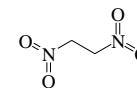
4,4'-Di ni t rodi phenyl ether



4,4'-Di ni t rodi phenyl f i de



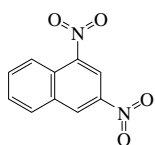
1,1-Di ni t roet hane



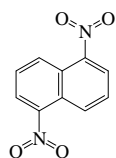
1,2-Di ni t roet hane



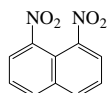
Di ni t romet hane



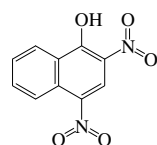
1,3-Di ni t ronapht hal ene



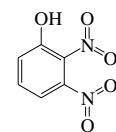
1,5-Di ni t ronapht hal ene



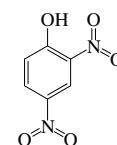
1,8-Di ni t ronapht hal ene



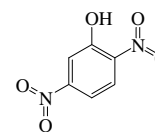
2,4-Di ni t ro-1-napht hol



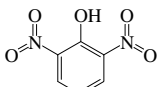
2,3-Di ni t rophenol



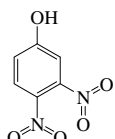
2,4-Di ni t rophenol



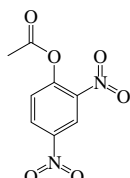
2,5-Di ni t rophenol



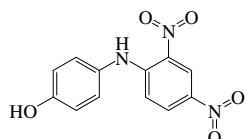
2,6-Di ni t rophenol



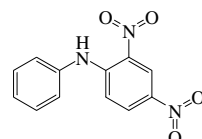
3,4-Di ni t rophenol



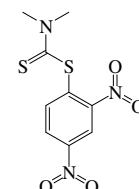
2,4-Di ni t rophenyl acet ate



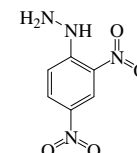
4-[(2,4-Di ni t rophenyl) ami no]phenol



2,4-Di ni t ro-N-phenyl ami ni ne

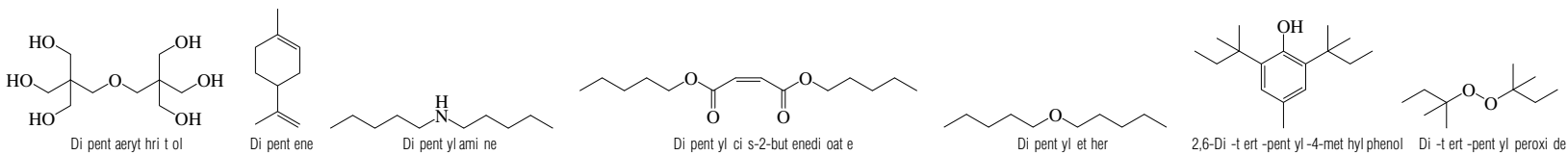
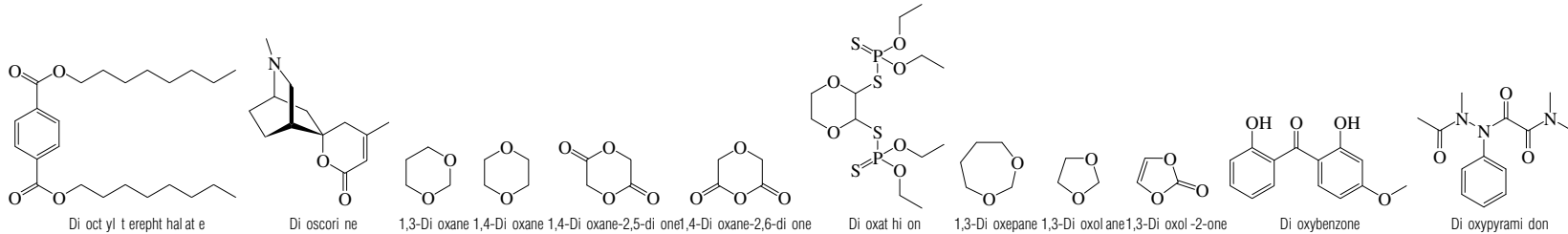
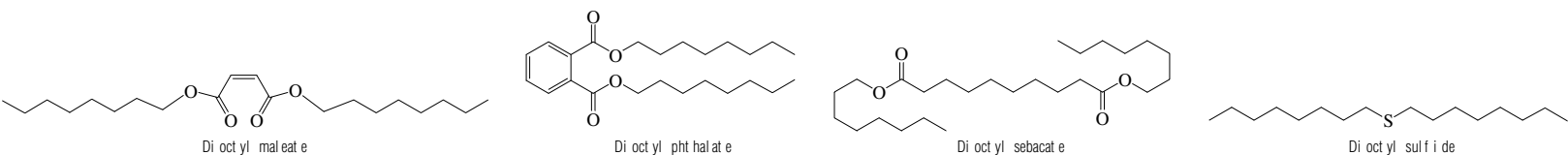
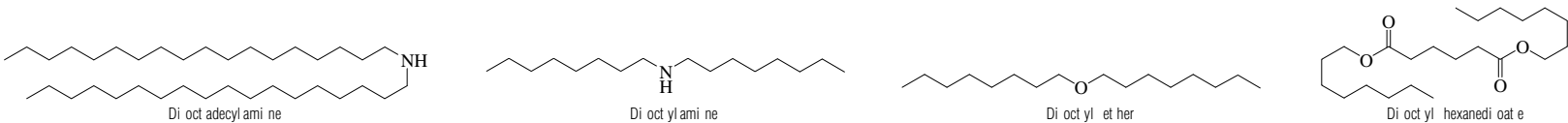
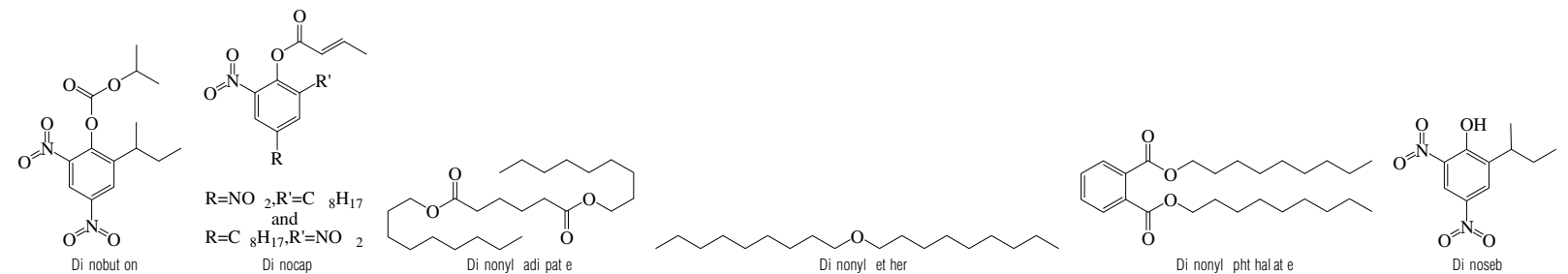
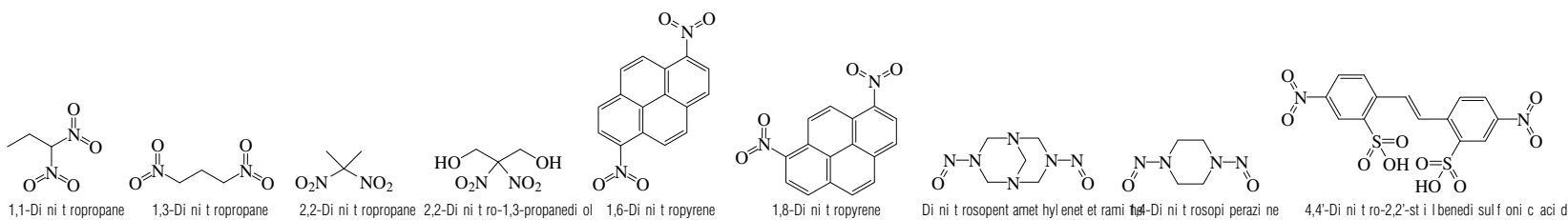


2,4-Di ni t rophenyl met hyl carbamodi t hi oate e

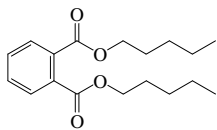


(2,4-Di ni t rophenyl)hydrazi ne

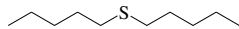
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4402	1,1-Di nitropropane		$\text{C}_3\text{H}_5\text{N}_2\text{O}_4$	601-76-3	134.091	liq	-42	184	1.261 ⁶	1.4339 ²⁰	s al k
4403	1,3-Di nitropropane		$\text{C}_3\text{H}_5\text{N}_2\text{O}_4$	6125-21-9	134.091		-21.4	103 ¹	1.353 ²⁶	1.4654 ²⁰	i H ₂ O; s et h
4404	2,2-Di nitropropane		$\text{C}_3\text{H}_5\text{N}_2\text{O}_4$	595-49-3	134.091		53	185.5	1.30 ²⁵		sl H ₂ O
4405	2,2-Di nitro-1,3-propanediol		$\text{C}_3\text{H}_7\text{N}_2\text{O}_6$	2736-80-3	166.089	wh pl (bz)	142				
4406	1,6-Di nitropyrene		$\text{C}_{16}\text{H}_9\text{N}_2\text{O}_4$	42397-64-8	292.246		>300				
4407	1,8-Di nitropyrene		$\text{C}_{16}\text{H}_9\text{N}_2\text{O}_4$	42397-65-9	292.246		300				
4408	Di nitroisopentylamine		$\text{C}_5\text{H}_{10}\text{N}_2\text{O}_2$	101-25-7	186.172	cry (MeOH)	207				
4409	1,4-Di nitroperazine		$\text{C}_4\text{H}_8\text{N}_4\text{O}_2$	140-79-4	144.133	pa ye pl (w)	159.0				vs Et OH
4410	4,4'-Di nitro-2,2'-stilbene disulfide		$\text{C}_{14}\text{H}_{10}\text{N}_2\text{O}_{10}\text{S}_2$	128-42-7	430.366	cry (AcOH)	266				
4411	Diobutone	Dessin	$\text{C}_8\text{H}_{18}\text{N}_2\text{O}_7$	973-21-7	326.302	ye cry (Et OH)	60				
4412	Diocap		$\text{C}_{16}\text{H}_{24}\text{N}_2\text{O}_6$	6119-92-2	364.393			136 ⁰¹			
4413	Di nonyl adipate		$\text{C}_{24}\text{H}_{46}\text{O}_4$	151-32-6	398.620			205 ¹			
4414	Di nonyl ether		$\text{C}_{18}\text{H}_{38}\text{O}$	2456-27-1	270.494	liq		318	0.81	1.435 ⁶	
4415	Di nonyl phthalate		$\text{C}_{26}\text{H}_{42}\text{O}_4$	84-76-4	418.609			413			
4416	Di noseb	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	$\text{C}_{10}\text{H}_{12}\text{N}_2\text{O}_5$	88-85-7	240.212		40		1.265 ⁴⁵		
4417	Di octadecylamine	Distearylamine	$\text{C}_{36}\text{H}_{74}\text{N}_2$	112-99-2	521.988		72.9	268 ²			vs chl
4418	Di octylamine	N-Octyl-1-octanamine	$\text{C}_{16}\text{H}_{33}\text{N}$	1120-48-5	241.456	nd	35.5	297.5	0.7963 ²⁶	1.4415 ²⁶	vs et h, Et OH
4419	Di octyl ether		$\text{C}_{16}\text{H}_{34}\text{O}$	629-82-3	242.440	liq	-7.6	283	0.806 ³	1.4327 ²⁰	sl H ₂ O; s Et OH, et h, ct c
4420	Di octyl hexanedioate		$\text{C}_{22}\text{H}_{42}\text{O}_4$	123-79-5	370.566		9.6	191 ²	0.922 ²⁵		
4421	Di octyl maleate		$\text{C}_{20}\text{H}_{36}\text{O}_4$	2915-53-9	340.498	liq		242 ⁰²	0.94 ²⁰	1.4539 ²⁰	
4422	Di octyl phthalate		$\text{C}_{24}\text{H}_{40}\text{O}_4$	117-84-0	390.557		25	220 ⁴			
4423	Di octyl sebacate	Di octyl decanedioate	$\text{C}_{26}\text{H}_{50}\text{O}_4$	2432-87-3	426.673		18	218 ⁰⁵	0.9074 ²⁵		s ct c
4424	Di octyl sulfide	Octyl sulfide	$\text{C}_{16}\text{H}_{34}\text{S}$	2690-08-6	258.506			202 ²⁹ , 180 ¹⁰	0.842 ²⁵	1.4610 ²⁰	
4425	Di octyl terephthalate		$\text{C}_{24}\text{H}_{40}\text{O}_4$	4654-26-6	390.557	cry		425	1.21 ⁶²		
4426	Di osorine		$\text{C}_7\text{H}_{13}\text{NO}_2$	3329-91-7	221.296	grn-ye pr (et h)	34				s H ₂ O, ace, chl, Et OH; sl et h, bz
4427	1,3-Dioxane	1,3-Dioxacyclohexane	$\text{C}_4\text{H}_8\text{O}_2$	505-22-6	88.106	liq	-45	106.1	1.028 ⁶	1.4165 ²⁰	msc H ₂ O, Et OH, et h, ace, bz
4428	1,4-Dioxane	1,4-Dioxacyclohexane	$\text{C}_4\text{H}_8\text{O}_2$	123-91-1	88.106		11.85	101.5	1.0337 ²⁰	1.4224 ²⁰	msc H ₂ O, Et OH, et h, ace, bz; s ct c
4429	1,4-Dioxane-2,5-dione		$\text{C}_4\text{H}_4\text{O}_4$	502-97-6	116.073	lf (al, al-chl)	85.4				vs ace
4430	1,4-Dioxane-2,6-dione	Diglycollic anhydride	$\text{C}_4\text{H}_4\text{O}_4$	4480-83-5	116.073	cry (bz)	92.5	240.5; 120 ¹²			
4431	Di oxathion		$\text{C}_{12}\text{H}_{26}\text{O}_6\text{P}_2\text{S}_4$	78-34-2	456.538		-20		1.257 ²⁶		
4432	1,3-Dioxepane		$\text{C}_5\text{H}_{10}\text{O}_2$	505-65-7	102.132						s chl
4433	1,3-Dioxolane	1,3-Dioxacyclopentane	$\text{C}_3\text{H}_6\text{O}_2$	646-06-0	74.079	liq	-97.22	78	1.06 ⁹	1.3974 ²⁰	msc H ₂ O; s Et OH, et h, ace
4434	1,3-Dioxol-2-one		$\text{C}_3\text{H}_4\text{O}_3$	872-36-6	86.046	liq	22	162; 7 ³	1.35 ²⁵		
4435	Di oxybenzone	(2-Hydroxy-4-methoxyphenyl)(2-hydroxyphenyl)methanone	$\text{C}_{14}\text{H}_{12}\text{O}_4$	131-53-3	244.243			172 ¹			
4436	Di oxypyramidone		$\text{C}_7\text{H}_{17}\text{N}_3\text{O}_3$	519-65-3	263.292	pr	105.5	197 ²			s H ₂ O, Et OH
4437	Di pentacetyritol		$\text{C}_{10}\text{H}_{22}\text{O}_7$	126-58-9	254.278	cry (w)	221		1.366 ¹⁵		s hot H ₂ O
4438	Di pentene	p-Menthadiene	$\text{C}_{10}\text{H}_{16}$	7705-14-8	136.234	liq	-95.5	178	0.840 ²	1.4727 ²⁰	
4439	Di pentylamine	Diamylamine	$\text{C}_{10}\text{H}_{23}\text{N}$	2050-92-2	157.297			202.5	0.777 ¹²⁰	1.4272 ²⁰	sl H ₂ O; vs Et OH; msc et h; s ace
4440	Di pentylsulfide	Di pentyl maleate	$\text{C}_{14}\text{H}_{28}\text{S}$	10099-71-5	256.339	liq	16 ⁹		0.974 ²⁰		
4441	Di pentyl ether	Amyl ether	$\text{C}_{10}\text{H}_{22}\text{O}$	693-65-2	158.281	liq	-69	190	0.783 ³	1.4119 ²⁰	i H ₂ O; msc Et OH, et h; s chl
4442	2,6-Diisopentyl-4-methylphenol	2,6-Bis(1,1-dimethylpropyl)-4-methylphenol	$\text{C}_{17}\text{H}_{28}\text{O}$	56103-67-4	248.403			283	0.931 ²⁵	1.4950 ²⁰	
4443	Diisopentyl peroxide		$\text{C}_{10}\text{H}_{22}\text{O}_2$	10508-09-5	174.281		-55	58 ¹⁴ , 38 ⁹	0.808 ²⁰	1.4095 ²⁰	



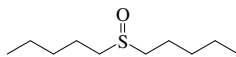
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4444	Di pent yl pht halat e		$_{18}C_{26}O_4$	131-18-0	306.397			205 ¹¹			s ct c, C ₅
4445	Di pent yl sul fide		$_{16}C_{22}S$	872-10-6	174.347		-51.3	86 ^{3,7}	0.8407 ²⁰	1.4561 ²⁰	i H ₂ O; s et h
4446	Di pent yl sulf oxi de		$_{16}C_{22}OS$	1986-90-9	190.346		58	120 ¹			
4447	Di phenami d	Benzeneacet ami de, <i>N</i> -di met hyl-phenyl -	$C_{16}H_{17}NO$	957-51-7	239.312		135		1.17 ^{23,3}		
4448	Di pheni dol	1,1-Di phenyl-4-pi peri di nyl-1-but anol	$C_{24}H_{30}O$	972-02-1	309.445	nd (pet h)	104.5				
4449	Di phenol i c aci d		$_{17}C_{13}O_4$	126-00-1	286.323	cry (w)	171.5				vs H ₂ O, ace, Et OH
4450	1,2-Di phenoxyet hane	Et hyl ene glycol di phenyl et her	$_{14}H_{14}O_2$	104-66-5	214.260	lf (al)	98	182			i H ₂ O; sl Et OH; s et h, chl
4451	<i>N,N</i> -Di phenyl acet ami de		$_{14}C_{13}NO$	519-87-9	211.259	wh cry pow	103	sub			sl H ₂ O, et h, chl; s Et OH
4452	Di phenyl acet yl ene		$_{14}C_{10}$	501-65-5	178.229	mcl pr or pl (al)	62.5	300	0.9657 ²⁰		i H ₂ O; sl Et OH, chl; vs et h
4453	2-(Di phenyl acet yl)-1,3(2 <i>H</i>)-di one	Di phenadi one	$_{14}C_{16}O_3$	82-66-6	340.371	pa ye mcl (al)	146.5			1.670	vs ace, HOAc
4454	Di phenyl ami ne	<i>N</i> -Phenyl benzenami ne	C_7H_9N	122-39-4	169.222	mcl lf (di l al)	53.2	302	1.458		i H ₂ O; vs Et OH, ace; s et h; sl chl
4455	Di phenyl ami ne-2,2'-di carboxyl i c aci d		$_{14}H_{10}O_4$	579-92-0	257.242	ye cry (al)	296 dec				
4456	Di phenyl ami ne-4-sul f oni c aci d, sodi um salt	Sodi um di phenyl ami ne-4-sul f onat e sodi um salt	$_{12}H_{10}ONaO_3S$	6152-67-6	271.267	ye cry					
4457	9,10-Di phenyl ant hracene		$_{20}C_{18}$	1499-10-1	330.421		246.5				
4458	Di phenyl arsi nous chl ori de	Chl orodi phenyl arsi ne	$_{12}H_{10}AsCl$	712-48-1	264.582	ort h pl (pet h)	44	337	1.4820	1.6332 ⁵⁶	vs ace, bz, et h, Et OH
4459	<i>N,N'</i> -Di phenyl-1,4-benzenedi ami ne	<i>N,N'</i> -Di phenyl- <i>p</i> -phenylenedi ami ne	$_{18}H_{16}N_2$	74-31-7	260.333		150	222 ^{0,5}			sl Et OH, et h, bz, chl; i aci d
4460	α,α -Di phenyl benzeneet hanol		$_{26}C_{18}O$	4428-13-1	274.356	nd(bz-i g) pr (pet h)	89.5	222 ¹¹			i H ₂ O; vs Et OH; sl et h, chl, pet h
4461	α,α -Di phenyl benzenemet hanet hi ol	Tri phenyl met hyl mercapt an	$_{19}H_{16}SC$	3695-77-0	276.395		105.8				
4462	<i>N,N'</i> -Di phenyl-[1,1'-bi phenyl]-4,4'-di ami ne	<i>N,N'</i> -Di phenyl benzi di ne di ami ne	$_{24}C_{20}N_2$	531-91-9	336.429	lf or pl	247				i H ₂ O; sl Et OH, et h, bz; vs t ol, HOAc
4463	<i>t rans</i> 1,4-Di phenyl-1,3-but adi ene		$C_{16}H_{14}$	538-81-8	206.282	lf (al, HOAc)	154.3	352			vs bz, et h, Et OH, pet h
4464	1,4-Di phenyl-1,3-but adi yne	Di phenyl di acet yl ene	$_{16}H_{10}C$	886-66-8	202.250		86.5				
4465	1,1-Di phenyl but ane		$_{16}H_{18}$	719-79-9	210.314		27	287	0.9928 ²⁰	1.5664 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
4466	1,2-Di phenyl but ane		$_{16}H_{18}$	5223-59-6	210.314			291; 152 ¹¹	0.9673 ²⁰	1.5554 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
4467	1,4-Di phenyl but ane		$_{16}H_{18}$	1083-56-3	210.314		52.5	317	0.9880 ²⁰		i H ₂ O; s Et OH, et h, chl
4468	1,3-Di phenyl-1-but ene		$_{16}H_{16}$	7614-93-9	208.298		47.5	311	0.9996 ²⁰	1.590 ¹⁵	
4469	<i>t rans</i> 1,4-Di phenyl-2-but ene-1,4-di one		$C_{16}H_{12}O_2$	959-28-4	236.265	ye nd (al, bz)	111				sl Et OH; s bz, HOAc; vs chl; i li g
4470	1,3-Di phenyl-2-but en-1-one	Dyprone	$_{16}H_{14}O$	495-45-4	222.281			342.5	1.1080 ¹⁵	1.6343 ²⁰	vs et h, Et OH
4471	Di phenyl carbami c chl ori de		$_{13}C_{10}ClNO$	83-01-2	231.677	lf (al)	84.5				
4472	Di phenyl carbazone		$C_8H_{12}N_4O$	538-62-5	240.260	oran oran nd (bz) pr (al)	157 dec				i H ₂ O; vs Et OH, bz, chl
4473	<i>N,N'</i> -Di phenyl carbodi mi de		$_{13}C_6N_2$	622-16-2	194.231		169	331; 175 ²⁰			sl H ₂ O, Et OH, et h; s bz
4474	Di phenyl carbonat e	Phenyl carbonat e	$_{13}C_{10}O_3$	102-09-0	214.216	nd (al, bz)	83	306	1.1215 ⁷		i H ₂ O; s Et OH, et h, ct c, HOAc
4475	2,2'-Di phenyl carboni c di hydrazid e	<i>sym</i> -Di phenyl carbazi de	$_{16}H_{14}N_4O$	140-22-7	242.276	cry (al + 1) cry (HOAc)	170	dec			sl H ₂ O, et h; s Et OH, ace, bz
4476	Di phenyl chl orophosphonat e		$_{16}C_{10}ClO_3P$	2524-64-3	268.632			314 ^{27,2}	1.296 ²⁵	1.5500 ²⁰	s t f a
4477	Di phenyl di sel eni de	Phenyl di sel eni de	$_{12}H_{10}Se_2$	1666-13-3	312.13	ye nd	63.5	202 ¹¹	1.557 ⁸⁰	1.743 ²⁰	s Et OH, et h, xyl, MeOH
4478	Di phenyl di sul fide	Phenyl di sul fide	$_{12}H_8S_2$	882-33-7	218.337	nd(al) or ort h	62	310	1.35 ⁸		i H ₂ O; s Et OH, et h, bz, C ₅
4479	1,1-Di phenyl et hane		$_{16}H_{14}$	612-00-0	182.261	li q	-17.9	272.6	0.9997 ⁷	1.5756 ²⁰	i H ₂ O; msc Et OH, et h; s bz
4480	1,2-Di phenyl et hane	Di benzyl	$_{14}C_{14}$	103-29-7	182.261	mcl pr (MeOH)	52.5	284	0.9780 ⁹	1.5476 ⁶⁰	i H ₂ O; s Et OH, et h, C ₅
4481	<i>N,N'</i> -Di phenyl et hanedi ami de		$_{14}C_{12}N_2O_2$	620-81-5	240.257	lf (bz)	254	>360			vs bz



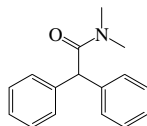
Di-pentyl phthalate



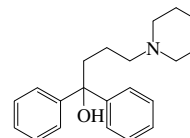
Di-pentyl sulfide



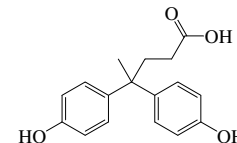
Di-pentyl sulfoxide



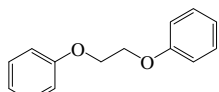
Diphenylamine



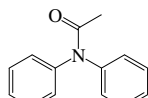
Diphenol



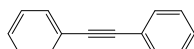
Diphenolacetate



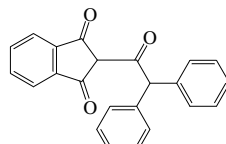
1,2-Diphenylethane



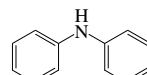
N,N-Diphenylacetamide



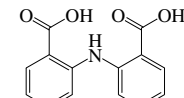
Diphenylacetylene



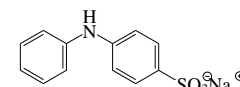
2-(Diphenylacetyl)indene-1,3-dione



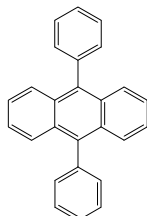
Diphenylamine



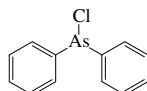
Diphenylamine-2,2'-dicarboxylic acid



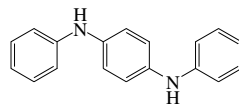
Diphenylamine-4-sulfonate sodium salt



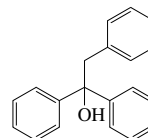
9,10-Diphenylanthracene



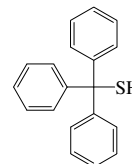
Diphenylarsine dichloride



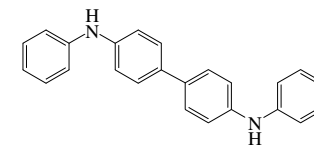
N,N'-Diphenyl-1,4-benzenediamine



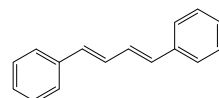
alpha,alpha-Diphenylbenzenethanol



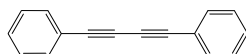
alpha,alpha-Diphenylbenzenethiol



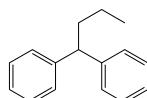
N,N'-Diphenyl-[1,1'-bi(phenyl)]-4,4'-diamine



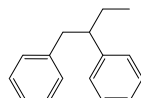
trans-1,4-Diphenyl-1,3-butadiene



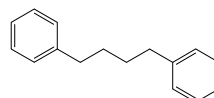
1,4-Diphenyl-1,3-butadiyne



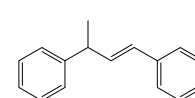
1,1-Diphenylbutane



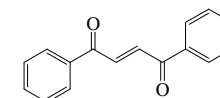
1,2-Diphenylbutane



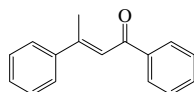
1,4-Diphenylbutane



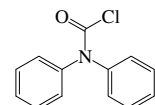
1,3-Diphenyl-1-butene



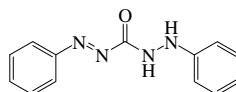
trans-1,4-Diphenyl-2-butene-1,4-dione



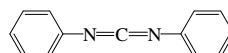
1,3-Diphenyl-2-buten-1-one



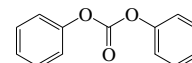
Diphenylcarbamoyl chloride



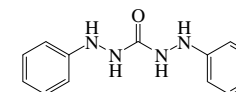
Diphenylcarbazone



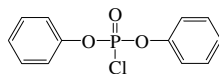
N,N'-Diphenylcarbodiimide



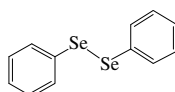
Diphenylcarbonate



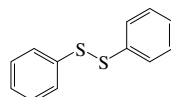
2,2'-Diphenylcarbonyl dihydrazide



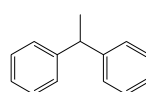
Diphenylchlorophosphate



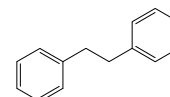
Diphenylselenide



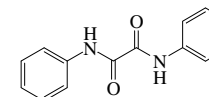
Diphenylsulfide



1,1-Diphenylethane

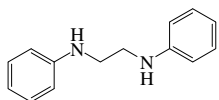


1,2-Diphenylethane

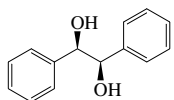


N,N'-Diphenylethanediimine

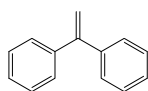
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4482	<i>N,N'</i> -Di phenyl-1,2-ethanediamine	1,2-Dianiline	$C_{14}H_{16}N_2$	150-61-8	212.290	crystal	74	229, 178 ²			in H ₂ O; soluble in EtOH, ether; slightly in water
4483	1,2-Diphenyl-1,2-ethanediamine (<i>R,R'</i>)- (±)		$C_{14}H_{14}O_2$	655-48-1	214.260	solid (wax), tab (ether)	122.5	>300			in H ₂ O, lig; vs EtOH, ether; soluble in acetone
4484	1,1-Diphenylethane		$C_{12}H_{12}$	530-48-3	180.245		8.2	277	1.0232 ²⁰	1.6085 ²⁰	in H ₂ O; soluble in ether, chloroform
4485	Diphenyl ether		$C_{10}H_{10}O$	101-84-8	170.206		26.87	258.0	1.0661 ³⁰	1.5787 ²⁵	in H ₂ O; soluble in EtOH, ether, benzene, HOAc; slightly in chloroform
4486	Diphenyl 2-ethylhexyl phosphat e		$C_{20}H_{37}O_4P$	1241-94-7	362.399			232 ⁵	1.090 ²⁵	1.510 ²⁵	
4487	<i>N,N</i> -Diphenylformamide		$C_{13}H_{11}NO$	607-00-1	197.232	orthorhombic	73.5	337.5; 189			in H ₂ O; soluble in EtOH, ether, benzene; slightly in chloroform
4488	2,5-Diphenylfuran		$C_{12}H_{12}O$	955-83-9	220.265	solid or liquid (dilat)	91	344			soluble in EtOH, ether; soluble in acetone, benzene
4489	<i>N,N'</i> -Diphenylguanidine	1,3-Diphenylguanidine	$C_{13}H_{13}N_3$	102-06-7	211.262	solid (solid, tab)	150	dec 170	1.193		slightly in H ₂ O; soluble in EtOH, chloroform, toluene; vs ether
4490	1,6-Diphenyl-1,3,5-hexatriene		$C_{16}H_{16}$	1720-32-7	232.320	liquid (acetone)	202.3				in benzene, EtOH, ether, HOAc; soluble in acetone; slightly in benzene, chloroform
4491	1,1-Diphenylhydrazine		$C_{12}H_{12}N_2$	530-50-7	184.236	tab (lig)	50.5	220	1.190 ¹⁶		vs benzene, ether, EtOH, chloroform
4492	1,2-Diphenylhydrazine	Hydrazobenzene	$C_{12}H_{12}N_2$	122-66-7	184.236	tab (al-ether)	131		1.158		vs EtOH; soluble in benzene, DMSO; in HOAc
4493	5,5-Diphenyl-4-imidazole none	Doxenitoin	$C_{15}H_{14}N_2O$	3254-93-1	238.284	pl (MeOH)	183				
4494	Diphenyl isophthalate		$C_{20}H_{16}O_4$	744-45-6	318.323		138				soluble in chloroform
4495	Diphenyl ketone	Diphenyl ethanone	$C_{14}H_{10}O$	525-06-4	194.228	red-yellow liq		267.5	1.1107 ⁷	1.615 ¹⁴	
4496	Diphenyl maleate		$C_{16}H_{12}O_4$	7242-17-3	268.264	pl (lig)	73	226			vs acetone, benzene, ether, EtOH
4497	Diphenylmercury	Mercuriodiphenylbenzene	$C_{12}H_{10}Hg$	587-85-9	354.80			204 ¹⁰	2.318 ²⁵		in H ₂ O; soluble in EtOH, ether; soluble in benzene, chloroform
4498	Diphenylmethane		$C_{12}H_{12}$	101-81-5	168.234	pr solid	25.4	265.0	1.001 ²⁶	1.5753 ²⁰	in H ₂ O; soluble in EtOH, ether, chloroform
4499	4,4'-Diphenylmethane diisocyanate	Methylenediphenyl diisocyanate	$C_{16}H_{10}N_2O_2$	101-68-8	250.252		37	196 ⁵	1.197 ⁷⁰	1.5906 ⁵⁰	soluble in acetone, benzene, PhNO ₂
4500	Diphenylmethane thione		$C_{12}H_{10}S$	1450-31-3	198.283		53.5	174 ¹⁴			slightly in EtOH, ether, petroleum ether; vs benzene, chloroform
4501	<i>N,N'</i> -Diphenylmethanediimine		$C_{13}H_{12}N_2$	622-15-1	196.247	solid (al)	142	>250			slightly in H ₂ O; petroleum ether; soluble in EtOH, acetone, benzene; vs ether
4502	Diphenylmethanol	Benzhydrol	$C_{13}H_{12}O$	91-01-0	184.233	solid (lig)	69	298; 180 ⁷			slightly in H ₂ O; vs EtOH, ether, chloroform, benzene; soluble in HOAc
4503	2-(Diphenylmethoxy)- <i>N,N'</i> -diphenylethanamine	Diphenhydramine	$C_{21}H_{21}NO$	58-73-1	255.355	oil		165			
4504	Diphenylmethane diisophthalate		$C_{18}H_{13}O_3P$	7526-26-3	248.214		35	205 ¹³	1.2051 ²⁰		in H ₂ O
4505	2-(Diphenylmethoxy)-1-piperidine	Diphenylmethoxy piperidine	$C_{20}H_{25}NO$	13862-07-2	295.419		106.5	180 ¹¹			
4506	2,5-Diphenyloxazole		$C_{11}H_{11}NO$	92-71-7	221.254	solid (lig)	74	360	1.094 ⁷⁰	1.6231 ¹⁰⁰	in H ₂ O; vs EtOH, ether; slightly in chloroform
4507	1,5-Diphenyl-1,4-pentadiene-3-one	Diphenylacetone	$C_{17}H_{15}O$	538-58-9	234.292	pl or liq (acetone, AcOEt)	113 dec	dec			in H ₂ O; soluble in EtOH, ether; soluble in acetone, chloroform
4508	4,7-Diphenyl-1,10-phenanthroline		$C_{24}H_{16}N_2$	1662-01-7	332.397			220 dec			
4509	Diphenylphosphinoyl chloride	Chlorodiphenylphosphine	$C_{12}H_{10}ClP$	1079-66-9	220.634	hygroscopic liq		320; 174	1.229	1.6360 ²⁰	
4510	Diphenyl phosphonate		$C_{11}H_{11}O_3P$	4712-55-4	234.187		12	218 ²⁶	1.223 ²⁵	1.5575 ²⁰	
4511	Diphenylphthalate	Phthalate	$C_{20}H_{16}O_4$	84-62-8	318.323	pr (al, liq)	73	293			in H ₂ O; soluble in EtOH, ether, chloroform
4512	α,α -Diphenyl-2-piperidine	Piperadrol	$C_{18}H_{21}NO$	467-60-7	267.366	crystal (hex)	97.5				
4513	1,3-Diphenylpropane		$C_{15}H_{16}$	1081-75-0	196.288	liquid	6	300; 123 ⁷	1.007 ²⁰	1.5760 ²⁰	
4514	2,2-Diphenylpropane		$C_{16}H_{16}$	778-22-3	196.288		29	282.5	0.9980 ²⁰		
4515	1,3-Diphenyl-1,3-propanediol	Diphenylacetone	$C_{15}H_{14}O_2$	120-46-7	224.255		70.5				soluble in EtOH, ether, chloroform, dilute NaOH
4516	1,3-Diphenyl-1-propanone	Phenylacetone	$C_{14}H_{14}O$	1083-30-3	210.271	liquid (EtOH)	72.5	360			
4517	1,1-Diphenyl-2-propanone	1,1-Diphenylacetone	$C_{15}H_{14}O$	781-35-1	210.271		46	307; 174 ¹⁰		1.5361 ¹⁶	soluble in EtOH, ether, benzene, chloroform, lig
4518	1,3-Diphenyl-2-propanone	Diphenylacetone	$C_{15}H_{14}O$	102-04-5	210.271	crystal (al, petroleum ether)	35	331	1.195		in H ₂ O; soluble in EtOH, ether, petroleum ether
4519	3,3-Diphenyl-2-propanal	β -Phenylcinnamaldehyde	$C_{17}H_{14}O$	1210-39-5	208.255	paraffin (lig)	44.8	209			
4520	1,1-Diphenyl-1-propene		$C_{14}H_{14}$	778-66-5	194.272		52	280; 149 ¹¹	1.0250 ²⁰	1.5880 ²⁰	in H ₂ O; soluble in EtOH, benzene



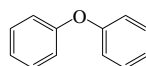
N,N'-Di phenyl-1,2-ethanediamine



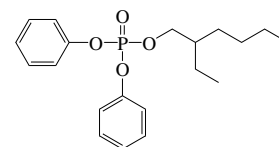
1,2-Di phenyl-1,2-ethanediol (*rac*, *RS*)-(±)



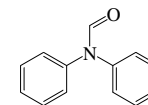
1,1-Di phenyl ethene



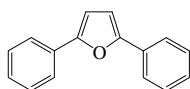
Diphenyl ether



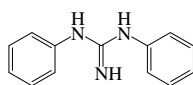
Di phenyl-2-ethyl hexyl phosphat e



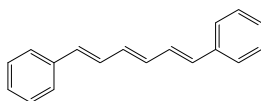
N,N-Di phenyl formamide



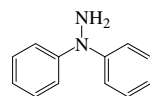
2,5-Di phenyl furan



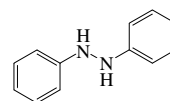
N,N'-Di phenyl guanidine



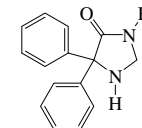
1,6-Di phenyl-1,3,5-hexatriene



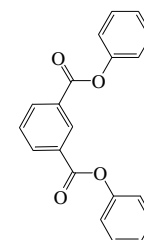
1,1-Di phenyl hydrazine



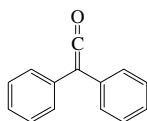
1,2-Di phenyl hydrazine



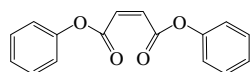
5,5-Di phenyl-4-imidazolidinone



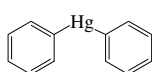
Di phenyl succinate



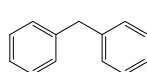
Di phenyl ketone



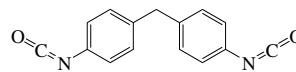
Di phenyl malonate



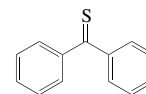
Di phenyl mercury



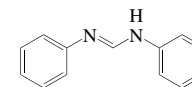
Di phenyl methane



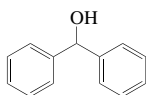
4,4'-Di phenyl methylene dicyanide



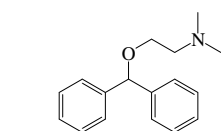
Di phenyl metanesulfonyl sulfide



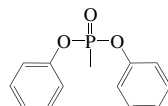
N,N'-Di phenyl methanimine



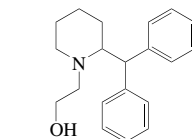
Di phenyl methanol



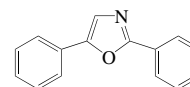
2-(Di phenyl methoxy)-*N,N*-dimethyl ethylamine



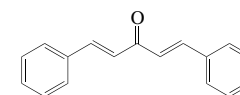
Di phenyl methyl phosphonate



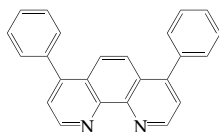
2-(Di phenyl methyl)-1-piperidine ethanol



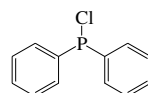
2,5-Di phenyl oxazole



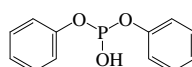
1,5-Di phenyl-1,4-pentadien-3-one



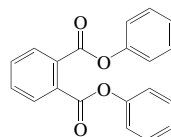
4,7-Di phenyl-1,10-phenanthroline



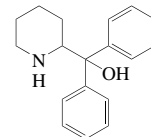
Di phenyl phosphorochloridate



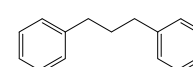
Di phenyl phosphonate



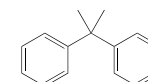
Di phenyl phthalate



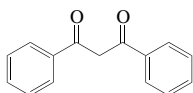
α,α -Di phenyl-2-piperidine ethanol



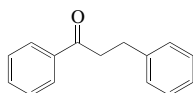
1,3-Di phenyl propane



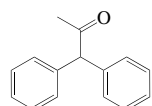
2,2-Di phenyl propane



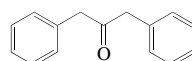
1,3-Di phenyl-1,3-propanedione



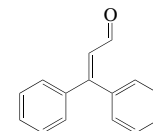
1,3-Di phenyl-1-propanone



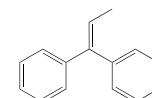
1,1-Di phenyl-2-propanone



1,3-Di phenyl-2-propanone

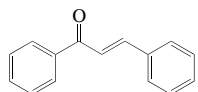


3,3-Di phenyl-2-propenal

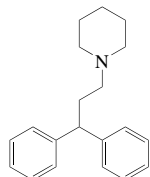


1,1-Di phenyl-1-propene

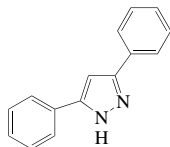
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4521	<i>trans</i> -1,3-Di phenyl-2-propen-1-one	Chalcone	$\text{C}_{15}\text{H}_{12}\text{O}$	614-47-1	208.255	pa ye lf , pr, nd (pet h)	59	dec 346	1.0712 ²²		i H ₂ O; sl Et OH; s et h, bz, chl, CS
4522	1-(3,3-Di phenylpropyl)pi peridi ne	Fenpi prane	$\text{C}_{20}\text{H}_{24}\text{N}$	3540-95-2	279.420		41.5	215 ⁸			
4523	3,5-Di phenyl- <i>H</i> -pyrazole		$\text{C}_{10}\text{H}_{12}\text{N}_2$	1145-01-3	220.269	cry (al)	200				
4524	1,4-Di phenyl-3,5-pyrazoli di nedi one	Phenopyrazone	$\text{C}_{15}\text{H}_{10}\text{N}_2\text{O}_2$	3426-01-5	252.268	cry (Et OAc, Di ox)	233.5				
4525	Di phenyl seleni de		$\text{C}_{12}\text{H}_{10}\text{Se}$	1132-39-4	233.17	ye nd (bz)	1.3	301.5	1.351 ²⁰	1.5500 ²⁰	i H ₂ O; msc Et OH, et h; s bz, xyl
4526	Di phenyl silane		$\text{C}_{12}\text{H}_{12}\text{Si}$	775-12-2	184.309			134 ¹ , 96 ¹³	0.9969 ²⁰	1.5800 ²⁰	s ct c, CS ₂
4527	Di phenyl silanedi ol		$\text{C}_{12}\text{H}_{16}\text{O}_2\text{Si}$	947-42-2	216.308						sl DMSO
4528	Di phenyl succi nate		$\text{C}_{16}\text{H}_{14}\text{O}_4$	621-14-7	270.280	lf (al)	121	330; 222 ¹⁵			i H ₂ O; s Et OH, et h, ace, bz
4529	Di phenyl sul fide	Phenyl sul fide	$\text{C}_{12}\text{H}_{10}\text{S}$	139-66-2	186.272	li q	-25.9	296	1.113 ⁶	1.6334 ²⁰	i H ₂ O; s Et OH, ct c; msc et h, bz, CS ₂
4530	Di phenyl sulf one		$\text{C}_{12}\text{H}_{10}\text{O}_2\text{S}$	127-63-9	218.271	mcl pr(bz) pl (al)	128.5	379	1.252 ²⁰		i H ₂ O; s Et OH, et h, bz
4531	Di phenyl sulf ox i de		$\text{C}_{12}\text{H}_{10}\text{OS}$	945-51-7	202.271	pr(li g)	71.2	34 ⁶			vs Et OH, et h, bz, HOAc; sl chl; i pet h
4532	<i>N,N'</i> -Di phenyl thi ourea	<i>sym</i> -Di phenyl thi ourea	$\text{C}_{16}\text{H}_{12}\text{N}_2\text{S}$	102-08-9	228.312		154.5		1.32 ²⁵		sl H ₂ O; vs Et OH, et h, chl, oi l s
4533	1,3-Di phenyl-1- <i>tr</i> -iazene	Di azoami nobenzene	$\text{C}_{12}\text{H}_{10}\text{N}_3$	136-35-6	197.235	ye lf or pr (al)	98				i ₂ OH vs Et OH, et h, bz, py
4534	<i>N,N</i> -Di phenyl urea		$\text{C}_8\text{H}_{12}\text{N}_2\text{O}$	603-54-3	212.246	t ab (al)	189	dec	1.27 ⁶		sl H ₂ O; s Et OH, et h, chl
4535	<i>N,N'</i> -Di phenyl urea	Carbani li de	$\text{C}_{13}\text{H}_{12}\text{N}_2\text{O}$	102-07-8	212.246	ort h pr (al)	239	260 dec	1.23 ⁶		sl H ₂ O, Et OH; s et h, py, HOAc; i bz
4536	Di phosgene	Carbonochlori di c aci d, tri chl oromet hyl est er	$\text{C}_2\text{Cl}_4\text{O}_2$	503-38-8	197.832	li q	-57	128	1.652 ⁹	1.4566 ²²	vs et h, Et OH
4537	1,2-Di pi peridi noi et hane		$\text{C}_{12}\text{H}_{10}\text{N}_2$	1932-04-3	196.332	li q	-0.5	265	0.916 ⁶	1.4853 ²⁵	
4538	1,1'-Di pi peridi nomi et hane	1,1'-Met hyl enedi pi peridi ne	$\text{C}_{11}\text{H}_{12}\text{N}_2\text{C}$	880-09-1	182.306			230; 122 ¹⁵	0.9269 ²⁰	1.4820 ²⁰	
4539	1,3-Di-4-pi peridi yl propane	4,4'-Tri met hyl enedi pi peridi ne	$\text{C}_{13}\text{H}_{26}\text{N}_2\text{C}$	16898-52-5	210.358		67.1	329			vs H ₂ O
4540	Di pl oi ci n		$\text{C}_{16}\text{H}_{10}\text{Cl}_4\text{O}_5$	527-93-5	424.059		232				
4541	Di-2-propenoyl di et hyl enegly col		$\text{C}_{10}\text{H}_{16}\text{O}_5$	4074-88-8	214.215			200	1.1110 ²⁵	1.4595 ²⁵	
4542	Di-2-propenoyl-2,2-di met hyl-1,3-propanedi ol	2-Propenoi c aci d, 2,2-di met hyl-1,3-propanedi yl est er	$\text{C}_{11}\text{H}_{16}\text{O}_4$	2223-82-7	212.243					1.4542 ²⁵	
4543	Di-2-propenoyl-1,6-hexanedi ol	2-Propenoi c aci d, 1,6-hexanedi yl	$\text{C}_{12}\text{H}_{18}\text{O}_4$	13048-33-4	226.269				1.010 ²⁵		
4544	Di propet ry n	6-(Et hyl t h NO <i>N</i> -di i sopropyl-1,3,5- <i>C</i> ₁₁ H ₂₁ N ₅ S tri azi ne-2,4-di ami ne	$\text{C}_{11}\text{H}_{21}\text{N}_5\text{S}$	4147-51-7	255.384		105				
4545	1,2-Di propoxyet hane		$\text{C}_8\text{H}_{18}\text{O}_2$	18854-56-3	146.228	li q		163.2 dec	0.831 ²	1.4013 ²⁵	
4546	Di propoxymet hane	Formal dehyde, di propyl acet al	$\text{C}_7\text{H}_{14}\text{O}_2$	505-84-0	132.201	li q	-97.3	140.5	0.834 ⁵	1.3939 ¹⁹	vs ace, bz, et h, Et OH
4547	<i>N,N</i> -Di propyl acet ami de		$\text{C}_8\text{H}_{17}\text{NO}$	1116-24-1	143.227			209.5	0.8992 ¹⁷	1.4419 ¹⁷	vs Et OH
4548	Di propyl adi pat e		$\text{C}_{12}\text{H}_{22}\text{O}_4$	106-19-4	230.301		-15.7	151 ¹¹	0.9790 ²⁰	1.4314 ²⁰	vs et h, Et OH, chl
4549	Di propyl ami ne	<i>N</i> -Propyl-1-propanami ne	$\text{C}_8\text{H}_{15}\text{N}$	142-84-7	101.190	li q	-63	109.3	0.740 ⁶	1.4050 ²⁰	s H ₂ O, Et OH; msc et h; vs ace, bz
4550	4-[(Di propyl ami no)sulf onyl]benzoi d	Probeneci d	$\text{C}_9\text{H}_{13}\text{NO}_4\text{S}$	57-66-9	285.360		195				
4551	<i>N,N</i> -Di propyl ani li ne		$\text{C}_{12}\text{H}_{19}\text{N}$	2217-07-4	177.286	ye lf		242	0.910 ⁴	1.5271 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; sl ct c
4552	Di propyl carbamat hi oi c aci d hyl est er	EPTC	$\text{C}_9\text{H}_{15}\text{NOS}$	759-94-4	189.318			127 ²⁰	0.9546 ³⁰		
4553	Di propyl carbonat e		$\text{C}_8\text{H}_{14}\text{O}_3$	623-96-1	146.184			168	0.9435 ²⁰	1.4008 ²⁰	sl H ₂ O; msc Et OH, et h
4554	Di propyl di sul fide		$\text{C}_6\text{H}_6\text{S}_2$	629-19-6	150.305	li q	-85.6	195.8	0.9599	1.4981 ²⁰	
4555	Di propyl ene glycol		$\text{C}_8\text{H}_{16}\text{O}_3$	25265-71-8	134.173			230.5	1.0206 ²⁰		msc H ₂ O; s Et OH
4556	Di propyl ene glycol di benzoat e		$\text{C}_{20}\text{H}_{22}\text{O}_5$	27138-31-4	342.386			197 ¹			



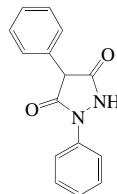
trans-1,3-Di phenyl -2-propen-1-one



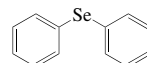
1-(3,3-Di phenyl propyl)pi peri di ne



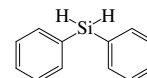
3,5-Di phenyl -*H*-pyrazole



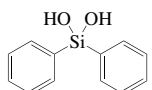
1,4-Di phenyl -3,5-pyrazol i di nedi one



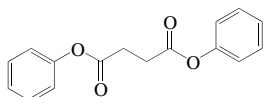
Di phenylsel eni de



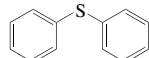
Di phenylsi lani e



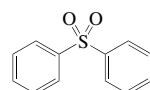
Di phenyl si lani di ol



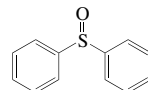
Di phenylsucci nat e



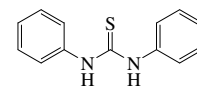
Di phenylsul f i de



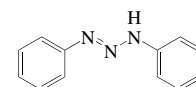
Di phenylsul f one



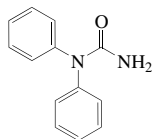
Di phenylsul f oxi de



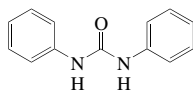
N,N-Di phenyl t hi urea



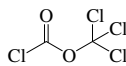
1,3-Di phenyl -1,1-ti azene



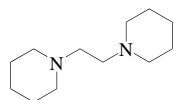
N,N-Di phenyl urea



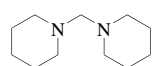
N,N'-Di phenyl urea



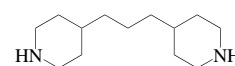
Di phosgene



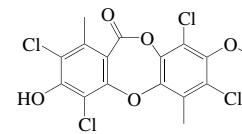
1,2-Di pi peri di noet hane



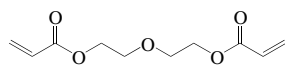
1,1'-Di pi peri di noet hane



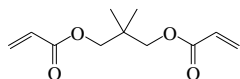
1,3-Di -4-pi peri dy l propane



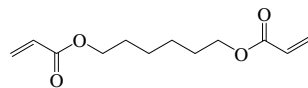
Di pl oi ci n



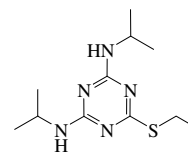
Di -2-propenoyl di et hyl eneg l ycol



Di -2-propenoyl -2,2-di met hyl -1,3-propanec



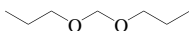
Di -2-propenoyl -1,6-hexanedi ol



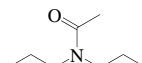
Di propet ryn



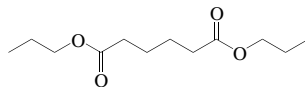
1,2-Di propoxyet hane



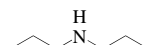
Di propoxymet hane



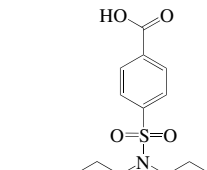
N,N-Di propyl acet ami de



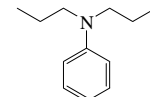
Di propylidi pat e



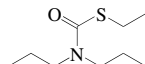
Di propylami ne



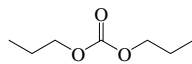
4-[(Di propyl ami no)sul f onyl]benzoi c



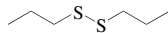
N,N-Di propyl ani li ne



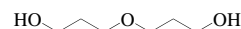
Di propyl carbamot hi aci d,S-et hylest er



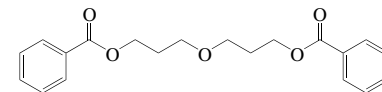
Di propylcarbonat e



Di propyl di sul f i de

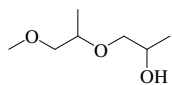


Di propyl eneg l ycol

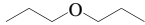


Di propyl eneg l ycol di benzoat e

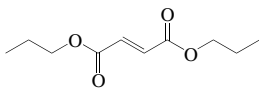
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4557	Di propyl ene glycol monomet hyl et her	1-(2-Met hoxyl sopropoxy)-2-propanol	C ₇ H ₁₆ O ₃	34590-94-8	148.200	li q	-80	188.3	0.95	1.4190	
4558	Di propyl et her	Propyl et her	C ₆ H ₁₄ O	111-43-3	102.174	li q	-114.8	90.08	0.7466	1.3809 ²⁰	sl H ₂ O; vs et h, Et OH
4559	Di propyl fumarat e		C ₁₀ H ₁₆ O ₄	14595-35-8	200.232			110 ⁵	1.0129 ²⁰	1.4435 ²⁰	s Et OH, et h
4560	Di propyl mal eat e		C ₁₀ H ₁₆ O ₄	2432-63-5	200.232			126 ¹²	1.0245 ²⁰	1.4434 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
4561	Di propyl oxalat e		C ₈ H ₁₄ O ₄	615-98-5	174.195	li q	-44.3	211	1.0188	1.4158 ²⁰	sl H ₂ O; msc Et OH; s et h
4562	5,5-Di propyl -2,4-oxazol i di nedi one		C ₉ H ₁₈ N ₂ O ₃	512-12-9	185.220		42.5	149 ³			
4563	Di propyl succi nat e		C ₁₀ H ₁₈ O ₄	925-15-5	202.248	li q	-5.9	250.8	1.0020	1.4250 ²⁰	vs ace, bz, et h
4564	Di propyl sulf at e		C ₆ H ₁₄ O ₄ S	598-05-0	182.238			120 ²⁰	1.1064 ²⁰	1.4135 ²⁰	vs pet h
4565	Di propyl sul fide		C ₆ H ₁₄ S	111-47-7	118.240	li q	-102.5	142.9	0.814	1.4487 ²⁰	i H ₂ O; s Et OH, et h
4566	Di propyl sulf one		C ₆ H ₁₄ O ₂ S	598-03-8	150.239	cry	29.5		1.0278 ⁵⁰	1.4456 ³⁰	sl H ₂ O; s Et OH, et h
4567	Di propyl sulf oxi de		C ₆ H ₁₄ O ₃ S	4253-91-2	134.239	nd	22.5	80 ²	0.9654 ²⁰	1.4663 ²⁰	vs et h, Et OH
4568	Di pyri damol e		C ₂₀ H ₄₀ N ₈ O ₄	58-32-2	504.627		163				
4569	Di -2-pyri di nyl di sul fide	Di pyri t hi one	C ₁₀ H ₁₆ O ₂ S ₂	3696-28-4	252.313	cry (MeOH)	205				
4570	2,2'-Di pyrrol yl met hane		C ₈ H ₁₀ N ₂	21211-65-4	146.188	lf or nd (al)	73	164			vs bz, et h, Et OH
4571	Di quat		C ₂ H ₁₂ N ₂	2764-72-9	184.236	Cat i on					
4572	Di quat di bromi de		C ₂ H ₁₂ Br ₂ N ₂	85-00-7	344.044		337		1.24 ²⁰		
4573	Di sodi um calci um EDTA	Edet at e calci um di sodi um	C ₁₀ H ₁₂ CaN ₂ Na ₂ O ₈	62-33-9	374.268	pow					s H ₂ O
4574	Di sodi um hydrogen ci t rat e	Sodi um aci d ci t rat e	C ₈ H ₈ Na ₂ O ₇	144-33-2	236.088	wh pow (w)	149 dec				vs H ₂ O
4575	Di sperse Bl ue No. 1	1,4,5,8-Tet raami no-9,10-ant hra cenedi one	C ₁₄ H ₁₂ N ₄ O ₂	2475-45-8	268.271	red-br nd	331				
4576	Di st earyl t hi odi propi onat e	Di oct adecyl t hi obi spropanoat e	C ₄₂ H ₈₂ O ₄ S	693-36-7	683.163	cry	61				
4577	Di sul firam		C ₆ H ₁₀ N ₂ S ₄	97-77-8	296.539		71.5	117 ¹⁷			i H ₂ O; s Et OH; sl et h; vs chl
4578	Di sul f ot on		C ₈ H ₆ O ₂ PS ₃	298-04-4	274.405		-25	108 ^{0.01} , 128 ¹	1.144 ²⁰		
4579	1,2-Di t hi ane		C ₄ H ₆ S ₂	505-20-4	120.237	nd	32.5	80 ¹⁴ , 60 ⁵		1.5981 ²⁵	s et h, bz, chl
4580	1,3-Di t hi ane		C ₄ H ₆ S ₂	505-23-7	120.237		54	89 ¹⁴		1.5981 ²⁵	vs bz, et h, chl
4581	1,4-Di t hi ane		C ₄ H ₆ S ₂	505-29-3	120.237	mcl pr	112.3	199.5			sl H ₂ O; s Et OH, et h, ct c, CS HOAc
4582	Di t hi anone		C ₄ H ₆ N ₂ O ₂ S ₂	3347-22-6	296.324	nd (ace)	220				
4583	Di t hi azani ne i odi de		C ₂₃ H ₃₀ N ₂ S ₂	514-73-8	518.476	grn nd (MeOH)	248 dec				i H ₂ O
4584	2,2'-Di t hi obi sbenzi c aci d	Di phenyl di sul fide-2,2'-di carboxyl aci d	C ₁₄ H ₁₀ O ₄ S ₂	119-80-2	306.357		289.5				i H ₂ O; s Et OH, et h
4585	3,3'-Di t hi obi spropanoi c aci d		C ₆ H ₁₀ O ₄ S ₂	1119-62-6	210.271		158				
4586	3,3'-Di t hi obi sval i ne		C ₆ H ₁₀ N ₂ O ₄ S ₂	20902-45-8	296.407		204.5				
4587	2,5-Di t hi obi urea	1,2-Hydrazi nedi carbot hi oami de	C ₂ H ₄ N ₄ S	142-46-1	150.226	nd (w)	214				
4588	4,4'-Di t hi odi morphol i ne		C ₈ H ₁₀ N ₂ O ₂ S ₂	103-34-4	236.355		124.5				s chl
4589	1,2-Di t hi ol ane		C ₃ H ₆ S ₂	557-22-2	106.210		77	90 ²⁷			
4590	1,3-Di t hi ol ane	1,3-Di t hi acyl opent ane	C ₃ H ₆ S ₂ C	4829-04-3	106.210	li q	-50	175	1.259	1.5975 ¹⁵	s Et OH, et h, xyl
4591	1,3-Di t hi ol ane-2-t hi one		C ₃ H ₄ S ₃	822-38-8	136.259		35	307			
4592	Di t hi opyr		C ₁₆ H ₁₆ F ₃ N ₂ O ₂ S ₂	97886-45-8	401.416		65				
4593	Di t hi zone		C ₁₂ H ₁₂ N ₄ S	60-10-6	256.326	bl-bl k (chl -al)	167 dec				i H ₂ O; sl Et OH, et h; s chl, al k
4594	Di p-t ol yl)carbodi i mi de		C ₁₃ H ₁₆ N ₂	726-42-1	222.285		58.5	221 ²⁰	1.1500 ²⁰		
4595	1,2-Di p-t ol yl)et hane	1,2-Bis(p-t ol yl)et hane	C ₁₈ H ₁₈	538-39-6	210.314	lf (al)	85	176			i H ₂ O; sl Et OH; s bz, pet h
4596	N,N'-Di p-t ol yl)guani di ne		C ₁₅ H ₁₇ N ₃	97-39-2	239.316	cry (di l al)	179		1.10		sl H ₂ O, t f a, Et OH; vs et h; s chl
4597	Di t ri decyl pht hal at e		C ₃₄ H ₆₈ O ₄	119-06-2	530.823	li q		285 ⁵	0.952 ²⁵		



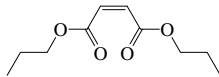
Di propyl enyl colmonomet hylet her



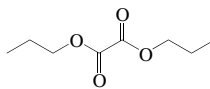
Di propylet her



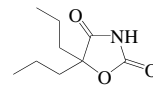
Di propylf umarat e



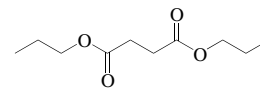
Di propymal eat e



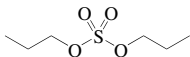
Di propylxalat e



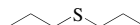
5,5-Di propyl-2,4-oxazol i di nedi one



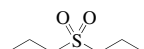
Di propylsuccinat e



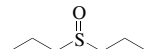
Di propylsulfat e



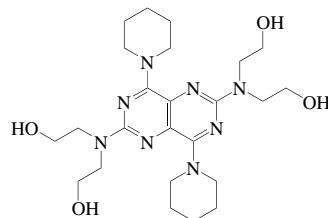
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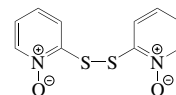
Di propylsulfo ne



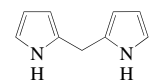
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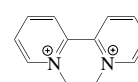
Di pyr i damole



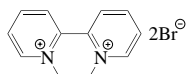
Di-2-pyri di rojl sulf i di N-oxi de



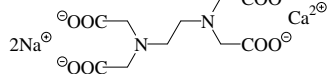
2,2'-Di pyrrolil met hane



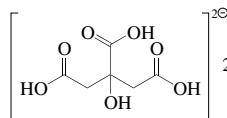
Di quat



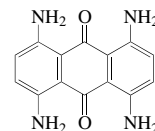
Di quatli bromi de



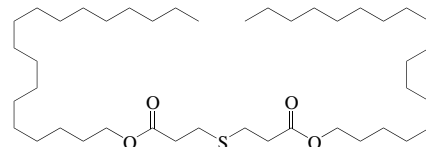
Di sodi umalci unEDTA



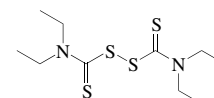
Di sodi urhydrogen ci t rat e



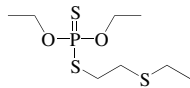
Di sperstBlueNo. 1



Di st earylhi odi propi onat e



Di sulf i ram



Di sulf of on



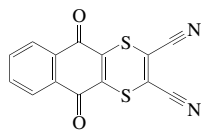
1,2-Di thi ane



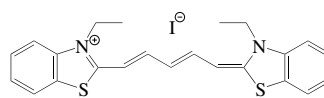
1,3-Di thi ane



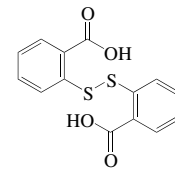
1,4-Di thi a



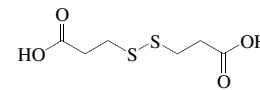
Di thi anone



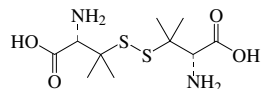
Di thi azaniinedi de



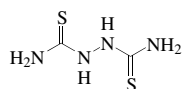
2,2-Di thi obi sbenzoi di



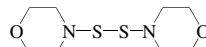
3,3'-Di thi obi spropanoi di



3,3'-Di thi obi dval i ne



2,5-Di thi obi urea



4,4'-Di thi odi morpholi ne



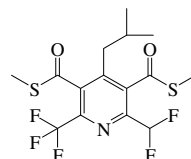
1,2-Di thi olane



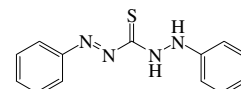
1,3-Di thi olane



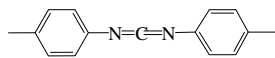
1,3-Di thi olane-2-thi one



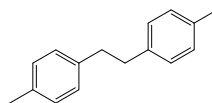
Di thi opyr



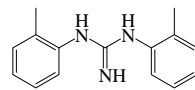
Di thi zone



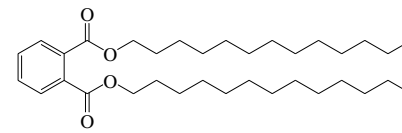
Di (p-t olil)carbodi i mi de



1,2-Di (p-t olil)et hane

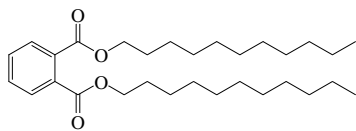


N,N-Di (p-t olil)guani di ne

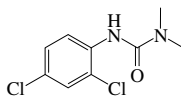


Di tri decyl halat e

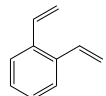
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4598	Di undecyl pht hal at e		$\text{C}_{30}\text{H}_{60}\text{O}_4$	3648-20-2	474.716	cry (Et OH)	35.5				
4599	Di uron		$\text{C}_8\text{H}_{10}\text{Cl}_2\text{N}_2\text{O}$	330-54-1	233.093		158				
4600	<i>o</i> -Di vi nyl benzene	1,2-Di vi nyl benzene	C_{10}H_8	91-14-5	130.186			82 ¹⁴	0.9325 ²²	1.5767 ²⁰	s ace, bz
4601	<i>m</i> -Di vi nyl benzene	1,3-Di vi nyl benzene	C_{10}H_8	108-57-6	130.186		-52.3	121 ⁷⁶ , 52 ³	0.9294 ²⁰	1.5760 ²⁰	s ace, bz
4602	<i>p</i> -Di vi nyl benzene	1,4-Di vi nyl benzene	C_{10}H_8	105-06-6	130.186		31	95 ¹⁸ , 340 ²	0.913 ⁴⁰	1.5835 ²⁵	s ace, bz
4603	<i>ci s</i> 1,2-Di vi nyl cycl obut ane		C_8H_{12}	16177-46-1	108.181			38 ³⁸	0.8010 ²⁰	1.4563 ²⁰	
4604	<i>t rans</i> 1,2-Di vi nyl cycl obut ane		C_8H_{12}	6553-48-6	108.181			112.5	0.7817 ²⁰	1.4451 ²⁰	
4605	Di vi nyl et her		$\text{C}_4\text{H}_8\text{O}$	109-93-3	70.090	vol li q or gas	-100.6	28.3	0.77 ³	1.3989 ²⁰	i H ₂ O; msc Et OH, et h, ace, chl
4606	Di vi nyl sul fide	Vi nyl sul fide	$\text{C}_4\text{H}_6\text{S}$	627-51-0	86.156		20	84	0.9174 ¹⁵		sl H ₂ O; s ace; msc Et OH, et h
4607	Di vi nyl sul f one	Vi nyl sul f one	$\text{C}_4\text{H}_6\text{O}_2\text{S}$	77-77-0	118.155	li q	-26	234.5	1.17 ⁷	1.4765 ²⁰	
4608	1,3-Di vi nyl -1,1,3,3-t et ramet hyl di si l oxane		$\text{C}_8\text{H}_{16}\text{OSi}_2$	2627-95-4	186.399	li q	-99.7	39	0.81 ⁴	1.4123 ²⁰	
4609	Dj enkol i c aci d		$\text{C}_7\text{H}_6\text{N}_2\text{O}_2\text{S}_2$	498-59-9	254.327	nd(w)	≈325 dec				
4610	DMPA		$\text{C}_{10}\text{H}_{14}\text{Cl}_2\text{N}_2\text{O}_2\text{P}$ S	299-85-4	314.169	sol i d	51.4	150			sl H ₂ O; vs bz, ct c, ace
4611	Docosane		$\text{C}_{22}\text{H}_{46}$	629-97-0	310.600	pl (t o), cry (et h)	43.6	368.6	0.7944	1.4455 ²⁰	i H ₂ O; s Et OH, chl; vs et h
4612	Docosanoi c aci d	Beheni c aci d	$\text{C}_{22}\text{H}_{42}\text{O}_2$	112-85-6	340.583	nd	81.5	306 ⁸⁰	0.8223 ³⁰	1.4270 ¹⁰⁰	sl H ₂ O, Et OH, et h
4613	1-Docosanol		$\text{C}_{22}\text{H}_{46}\text{O}$	661-19-8	326.599	cry (ace, chl)	72.5	180 ²²			sl H ₂ O, et h; vs Et OH, MeOH; s chl
4614	13-Docosenami de	Erucami de	$\text{C}_{22}\text{H}_{43}\text{NO}$	112-84-5	337.582	cry	94				
4615	1-Docosene		$\text{C}_{22}\text{H}_{44}$	1599-67-3	308.584		38	367	0.794 ²⁵		
4616	<i>ci s</i> 13-Docosanoi c aci d	Eruci c aci d	$\text{C}_{22}\text{H}_{42}\text{O}_2$	112-86-7	338.567	nd (al)	34.7	265 ⁵	0.860 ⁵⁵	1.4758 ²⁰	i H ₂ O; s Et OH, ct c; vs et h, MeOH
4617	<i>t rans</i> 13-Docosanoi c aci d	Brassi di c aci d	$\text{C}_{22}\text{H}_{42}\text{O}_2$	506-33-2	338.567	pl (al)	61.9	282 ⁹ , 256 ¹⁰	0.8585 ⁵⁷	1.4347 ¹⁰⁰	
4618	5,7-Dodecadi yne	Di but yl but adi yne	$\text{C}_{12}\text{H}_{18}$	1120-29-2	162.271			103 ⁸			
4619	Dodecamet hyl cycl ohexasi l oxane		$\text{C}_{12}\text{H}_{36}\text{O}_6\text{Si}_6$	540-97-6	444.923	li q	-1.5	245	0.967 ²	1.4015 ²⁰	i H ₂ O
4620	Dodecamet hyl pent asi l oxane		$\text{C}_{12}\text{H}_{36}\text{O}_5\text{Si}_5$	141-63-9	384.840	li q	-80	232; 10 ⁹	0.8755 ²⁰	1.3925 ²⁰	s ct c, CS
4621	Dodecanal	Laural dehyde	$\text{C}_{12}\text{H}_{24}\text{O}$	112-54-9	184.318	lf	44.5	185 ⁰ , 100 ^{2,5}	0.8352 ¹⁵	1.435 ²²	i H ₂ O; sl Et OH; s et h
4622	Dodecanami de		$\text{C}_{12}\text{H}_{25}\text{NO}$	1120-16-7	199.333	nd	110	199 ¹²		1.4287 ¹¹⁰	i H ₂ O; s Et OH, ace, ct c; sl et h, bz
4623	Dodecane		$\text{C}_{12}\text{H}_{26}$	112-40-3	170.334	li q	-9.57	216.32	0.749 ⁵	1.4210 ²⁰	i H ₂ O; vs Et OH, et h, ace, ct c, chl
4624	1,12-Dodecanedi ami ne		$\text{C}_{12}\text{H}_{28}\text{N}_2$	2783-17-7	200.363		67.38	135 ⁵			
4625	Dodecanedi oi c aci d		$\text{C}_{12}\text{H}_{22}\text{O}_4$	693-23-2	230.301		128	222 ²⁵	1.15 ²⁵		s t f a
4626	1,12-Dodecanedi ol		$\text{C}_{12}\text{H}_{26}\text{O}_2$	5675-51-4	202.333	cry (bz, di l al)	81.3	189			s t f a
4627	Dodecaneni t ri le	Lauroni t ri le	$\text{C}_{12}\text{H}_{23}\text{N}$	2437-25-4	181.318		4	277; 198 ¹⁰⁰	0.8240 ²⁰	1.4361 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, chl
4628	1-Dodecanet hi ol		$\text{C}_{12}\text{H}_{26}\text{O}$	112-55-0	202.399	li q	-6.7	277; 14 ⁹	0.844 ²⁰	1.4589 ²⁰	i H ₂ O; s Et OH, et h, chl
4629	Dodecanoi c aci d	Lauri c aci d	$\text{C}_{12}\text{H}_{24}\text{O}_2$	143-07-7	200.318	nd (al)	43.8	91.4	0.8679 ⁹	1.4183 ⁸²	i H ₂ O; vs Et OH, et h; s ace; msc bz
4630	Dodecanoi c anhydri de		$\text{C}_{12}\text{H}_{46}\text{O}_3$	645-66-9	382.620	lf (al, et h)	41.8		0.8533	1.4292 ⁷⁰	vs Et OH
4631	1-Dodecanol	Lauryl al cohoh	$\text{C}_{12}\text{H}_{26}\text{O}$	112-53-8	186.333	lf (di l al)	23.9	260	0.8309		i H ₂ O; s Et OH, et h; sl bz
4632	2-Dodecanol		$\text{C}_{12}\text{H}_{26}\text{O}$	10203-28-8	186.333		19	252	0.8286 ²⁰	1.4400 ²⁰	
4633	2-Dodecanone	Decyl met hyl ket one	$\text{C}_{12}\text{H}_{24}\text{O}$	6175-49-1	184.318		21	246.5	0.8198 ²⁰	1.4330 ²⁰	i H ₂ O; s Et OH, et h, ace; sl ct c
4634	Dodecanoyl chl ori de		$\text{C}_{12}\text{H}_{23}\text{Cl O}$	112-16-3	218.763		-17	145 ⁸	0.9169 ²⁵	1.4458 ²⁰	vs et h
4635	1-Dodecene		$\text{C}_{12}\text{H}_{24}$	112-41-4	168.319	li q	-35.2	213.8	0.758 ⁴	1.4300 ²⁰	i H ₂ O; s Et OH, et h, ace, ct c, pet h
4636	<i>t rans</i> 2-Dodecenedi oi c aci d	Traumat i c aci d	$\text{C}_{12}\text{H}_{20}\text{O}_4$	6402-36-4	228.285	cry (al, ace)	165.5				vs et h, Et OH, chl
4637	2-Dodecenyl succi ni c anhydri de		$\text{C}_{16}\text{H}_{26}\text{O}_3$	19780-11-1	266.375	hyg cry	42	181 ⁵			
4638	Dodecyl acet at e		$\text{C}_{14}\text{H}_{28}\text{O}_2$	112-66-3	228.371		0.7	265; 180 ⁴⁰	0.8652 ²²	1.4439 ²⁰	
4639	Dodecyl acryl at e	Lauryl 2-propenoat e	$\text{C}_{16}\text{H}_{28}\text{O}_2$	2156-97-0	240.382		4	120 ^{0,5}	0.8727 ²⁰		
4640	Dodecyl ami ne	1-Dodecanami ne	$\text{C}_{12}\text{H}_{27}\text{N}$	124-22-1	185.349		28.3	259	0.8015 ²⁰	1.4421 ²⁰	sl H ₂ O; msc Et OH, et h, bz, chl



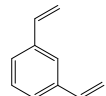
Diundecylphthalate



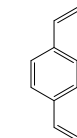
Diuron



o-Divinylnylbenzene



m-Divinylnylbenzene



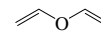
p-Divinylnylbenzene



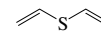
cis-1,2-Divinylcyclobutane



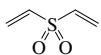
trans-1,2-Divinylcyclobutane



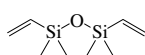
Divinyl ether



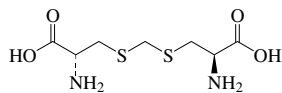
Divinyl sulfide



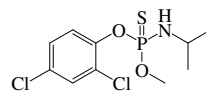
Divinyl sulfone



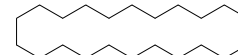
1,3-Divinyl-1,1,3,3-tetraethylsiloxane



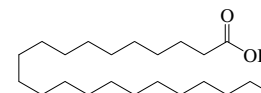
Djenkolic acid



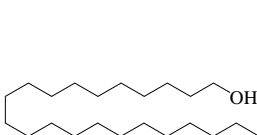
DMPA



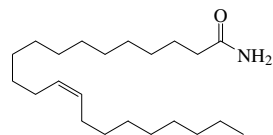
Docosane



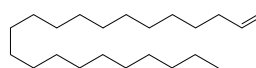
Docosanoic acid



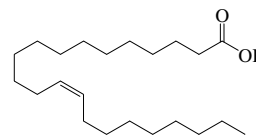
1-Docosanol



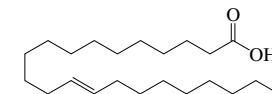
13-Docosenamide



1-Docosene



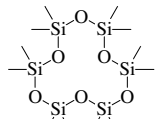
cis-13-Docosenoic acid



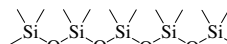
trans-13-Docosenoic acid



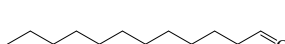
5,7-Dodecadiyne



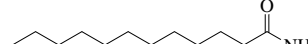
Dodecamethylcyclohexasiloxane



Dodecamethylpentasiloxane



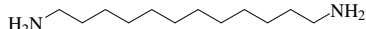
Dodecanal



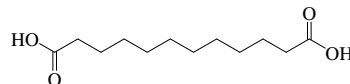
Dodecanamide



Dodecane



1,12-Dodecanediamine



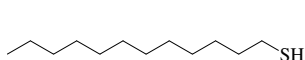
Dodecanedioic acid



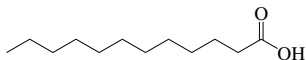
1,12-Dodecanediol



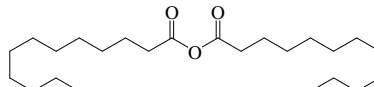
Dodecanenitrile



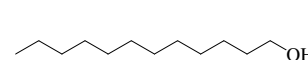
1-Dodecanethiol



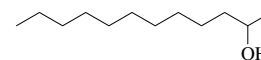
Dodecanoic acid



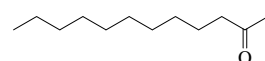
Dodecanoincanehydride



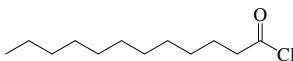
1-Dodecanol



2-Dodecanol



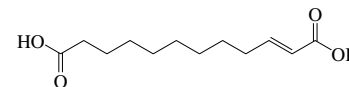
2-Dodecanone



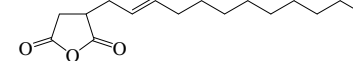
Dodecanoyl chloride



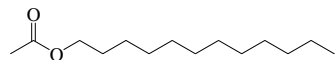
1-Dodecene



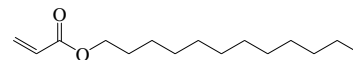
trans-2-Dodecenedioic acid



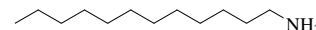
2-Dodecenylnicotinamide



Dodecyl acetate

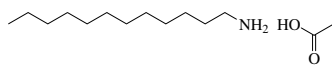


Dodecyl acrylate

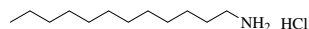


Dodecylamine

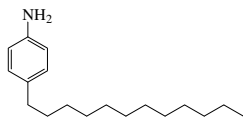
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4641	Dodecylami ne, acet at e	1-Dodecanami ne, acet at e	$C_{14}H_{29}NO_2$	2016-56-0	245.402		69.5				vs H ₂ O, Et OH
4642	Dodecylami ne hydrochl ori de	Lauryl ami ne hydrochl ori de	$C_{12}H_{25}ClN$	929-73-7	221.810		186				vs H ₂ O, Et OH
4643	4-Dodecyl ani li ne		$C_{18}H_{31}N$	104-42-7	261.446		41.5	211 ¹⁰			
4644	Dodecyl benzene	Lauryl benzene	$C_{18}H_{30}$	123-01-3	246.431		3	328	0.8551 ²⁰	1.4824 ²⁰	i H ₂ O
4645	4-Dodecyl benzenesul f oni c aci d		$C_{18}H_{30}O_2S$	121-65-3	326.494			>205			
4646	Dodecyl cycl ohexane		$C_{18}H_{36}$	1795-17-1	252.479		12.5	331	0.8223 ²⁰	1.4559 ²⁰	
4647	Dodecyl mercapt acet at e		$C_{14}H_{28}O_2S$	3746-39-2	260.436		1.5	171 ³			
4648	Dodecyl met hacryl at e		$C_{18}H_{30}O_2$	142-90-5	254.408			142 ⁴	0.866 ²⁰		
4649	Dodecyl oxo rane	1,2-Epoxyt et radecane	$C_{14}H_{28}O$	3234-28-4	212.371	oi l		95 ⁴	0.845	1.4408 ²⁰	
4650	2-(Dodecyl oxy)et hanol		$C_{14}H_{30}O_2$	4536-30-5	230.387			143 ^{0.5}			
4651	4-Dodecyl oxy-2-hydroxybenzophenone		$C_{25}H_{34}O_3$	2985-59-3	382.536		43.5				
4652	4-Dodecyl phenol		$C_{18}H_{30}O$	104-43-8	262.430	nd (bz)	66	175 ²			
4653	1-Dodecyl pi peri di ne		$C_{17}H_{35}N$	5917-47-5	253.467	pa ye		161 ⁵ , 115 ^{0.6}	0.8378 ²⁰	1.4588 ²⁰	
4654	Dodecyl sul f at e	Lauryl sul f at e	$C_{12}H_{25}SO_2$	151-41-7	266.397	cry					s H ₂ O
4655	Dodecyl t et raet hyl ene glycol monoet her	3,6,9,12-Tet raoxyt et racosan-1-ol	$C_{26}H_{42}O_5$	5274-68-0	362.544			247 ¹⁰			
4656	Dodecyl 3,4,5-t ri hydroxybenzoat e		$C_{19}H_{30}O_5$	1166-52-5	338.438			96.5			s ace
4657	Dodecyl t ri met hyl ammoni um chl ori de		$C_{12}H_{25}ClN$	112-00-5	263.891			246 dec			vs H ₂ O, ace, Et OH, chl
4658	1-Dodecyne	Decyl acet yl ene	$C_{12}H_{22}$	765-03-7	166.303	li q	-19	215	0.7788	1.4340 ²⁰	
4659	6-Dodecyne		$C_{12}H_{22}$	6975-99-1	166.303			210; 100 ¹⁴	0.785 ²⁰	1.4442 ²⁰	vs ace, et h, Et OH
4660	Dodi ne	Dodecyl guani di ne, monoacet at e	$C_{13}H_{27}N_3O_2$	2439-10-3	287.442			136			
4661	Dopami ne	4(2-Ami noet hyl)-1,2-benzenedi ol	$C_8H_{11}NO_2$	51-61-6	153.179	pr					
4662	Dot hi epi n		$C_{19}H_{21}NS$	113-53-1	295.442		56	172 ^{0.05}			
4663	Dot ri acont ane	Bi cet yl	$C_{32}H_{66}$	544-85-4	450.866	pl (bz,chl ,HOAc, et h)	69.4	467	0.8124 ²⁰	1.4550 ²⁰	i H ₂ O; sl Et OH, chl ; s et h, ct c; vs bz
4664	Doxepi n		$C_{19}H_{21}NO$	1668-19-5	279.376	oi ly li q		195, 265 ^{0.2}			
4665	Doxorubi ci n	Adri amyci n	$C_{27}H_{39}NO_{11}$	23214-92-8	543.519	cry	230				
4666	Doxorubi ci n hydrochl ori de	Adri amyci n hydrochl ori de	$C_{27}H_{39}ClNO_{11}$	25316-40-9	579.980	oran-red nd	204 dec				s H ₂ O, MeOH; i ace, bz, chl , et h, pet h
4667	Doxyl ami ne		$C_{12}H_{22}N_2O$	469-21-6	270.369	li q		139 ⁶			
4668	Dri meni n		$C_{12}H_{22}O_2$	2326-89-8	234.335	cry	133	110 ^{0.1}			i H ₂ O
4669	Dromost anol one propanoat e	2-Met hyl -17-(1-oxoproxy) androst an-3-one, (2 α ,5 α ,17 β)	$C_{23}H_{36}O_3$	521-12-0	360.530			128			
4670	Droperi dol	Dehydrobenzperi dol	$C_{22}H_{22}FN_3O_2$	548-73-2	379.427	cry (w)	146 (hyd)				i H ₂ O; sl Et OH, et h, bz; s chl , DMF
4671	Dydrogest erone		$C_{19}H_{28}O_2$	152-62-5	312.446	cry (ace/hx)	170				
4672	Dyphyl i i ne		$C_{14}H_{14}N_4O_4$	479-18-5	254.243			161.5			
4673	Ecgoni di ne		$C_{13}H_{13}NO_2$	484-93-5	167.205	cry (MeOH) (MeOH-et h)	228 dec				vs H ₂ O
4674	Ecgoni ne		$C_{13}H_{13}NO_3$	481-37-8	185.220	mcl pr	205				vs H ₂ O, Et OH
4675	Echi mi di ne		$C_{20}H_{31}NO_7$	520-68-3	397.463	gl ass					
4676	Echi nochrome A	2-Et hyl -3,5,6,7,8-pent ahydroxy-1,4-napht hal enedi one	$C_{17}H_{10}O_7$	517-82-8	266.203	red nd (Di ox-w)	220 dec	sub 120			sl H ₂ O; s Et OH, ace; vs et h, bz
4677	Echi t ami ne		$C_{13}H_{30}N_2O_5$	6871-44-9	402.483			206			s H ₂ O, Et OH, et h, chl , con sul f ; i pet h
4678	Edrophoni um chl ori de		$C_{16}H_{16}ClNO$	116-38-1	201.693	cry	162				vs H ₂ O; s Et OH; i et h, chl



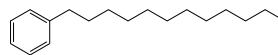
Dodecylami ne, acet at e



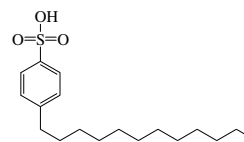
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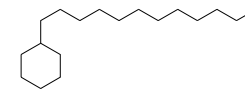
4-Dodecyl ani li ne



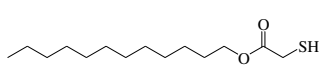
Dodecyl benzene



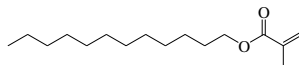
4-Dodecyl benzenesul f oniaci d



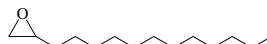
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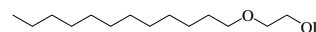
Dodecyl mercapt oacet at e



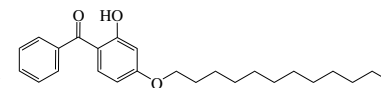
Dodecyl met hacryl at e



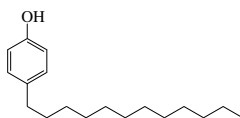
Dodecyl oxi rane



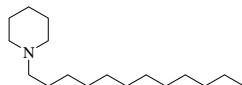
2-(Dodecyl oxy)et hanol



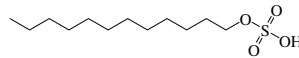
4-Dodecyl oxy-2-hydroxybenzophenone



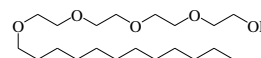
4-Dodecyl phenol



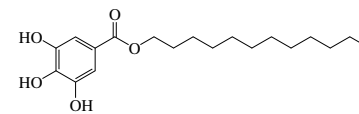
1-Dodecyl pi peri di ne



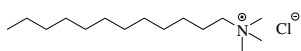
Dodecyl sul f at e



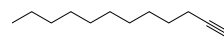
Dodecyl t et raet hyl gly col monoet her



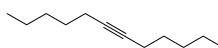
Dodecyl 3,4,5-t ri hydroxybenzoat e



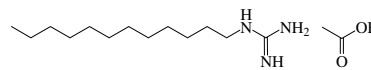
Dodecyl t ri met hyl amoni um chlo ri de



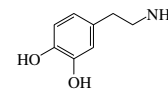
1-Dodecyne



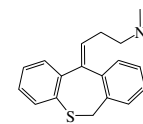
6-Dodecyne



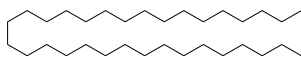
Dodi ne



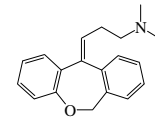
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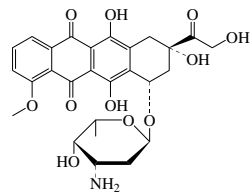
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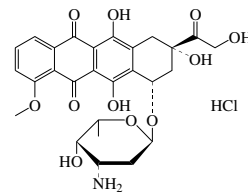
Dot ri acont ane



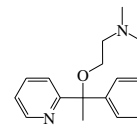
Doxepi n



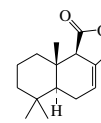
Doxorubi ci n



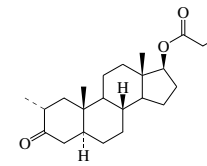
Doxorubi ci hydrochlo ri de



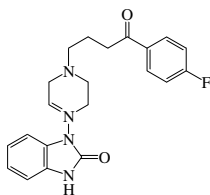
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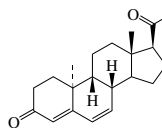
Dri meni n



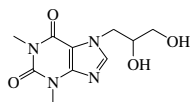
Dromost anol onproprioat e



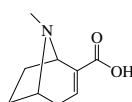
Droperi dol



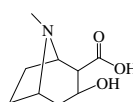
Dydrogest rone



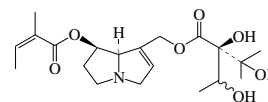
Dyphylli ne



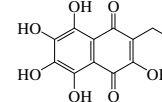
Ecgoni di ne



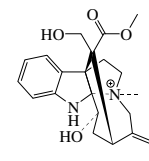
Ecgoni ne



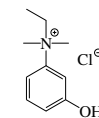
Echi mi di ne



Echi nochrome A

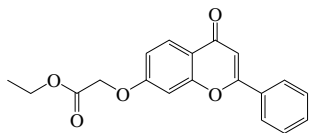


Echi t ami ne

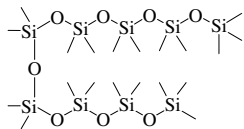


Edrophi oni umchlo ri de

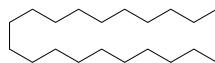
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4679	Efloxat e	Et hyl [(4-oxo-2-phenyl-1-benzopyran-7-yl)oxy]acet at e	C ₁₉ H ₁₆ O ₅	119-41-5	324.327		123.7				s chl
4680	Ei cosamet hyl nonasi l oxane		$\text{C}_{20}\text{H}_{40}\text{O}_8\text{Si}_9$	2652-13-3	681.455			307.5; 198 ¹⁶	0.9173 ²⁰	1.3980 ²⁰	vs bz
4681	Ei cosane	icosane	C ₂₀ H ₄₂	112-95-8	282.547	lf (al)	36.6	343	0.7886	1.4425 ²⁰	i H ₂ O; s et h, pet h, bz; sl chl; vs ace
4682	Ei cosanedi oi c aci d	1,18-Oct adecanedi carboxyl i c aci d	C ₂₀ H ₃₈ O ₂	2424-92-2	342.514	cry (bz,al)	125.5	233 ³			s et h
4683	Ei cosanoi c aci d	Arachi di c aci d	C ₂₀ H ₄₀ O ₂	506-30-9	312.531	pl (al)	76.5	dec 328; 204 ¹	0.8240 ¹⁰⁰	1.425 ¹⁰⁰	i H ₂ O; sl Et OH; vs et h; s bz, chl
4684	1-Ei cosanol	Arachi c alcohol	C ₂₀ H ₄₂ O	629-96-9	298.546	wax (al), cry (chl)	65.4	356; 222 ³	0.8405 ²⁰	1.4350 ²⁰	i H ₂ O; sl Et OH, chl; vs ace; s bz, pet h
4685	5,8,11,14-Ei cosat et raenoi c aci d, (al) Arachi doni c aci d ci §	Arachi doni c aci d	C ₂₀ H ₃₂ O ₂	506-32-1	304.467		-49.5	163 ¹	0.9082 ²⁰	1.4824 ²⁰	i H ₂ O; vs ace, et h, Et OH, pet h
4686	1-Ei cosene		C ₂₀ H ₄₀	3452-07-1	280.532		28.5	341; 151 ²	0.7882 ²⁰	1.4440 ³⁰	i H ₂ O; s bz, pet h
4687	ci s-9-Ei cosenoi c aci d		C ₂₀ H ₃₈ O ₂	29204-02-2	310.515		24.5	220 ⁶	0.8882 ²⁵		
4688	t rans-9-Ei cosenoi c aci d		C ₂₀ H ₃₈ O ₂	506-31-0	310.515		54				
4689	11-Ei cosenoi c aci d		C ₂₀ H ₃₈ O ₂	2462-94-4	310.515		24	267 ¹⁵	0.8826 ²⁵		vs Et OH, MeOH
4690	El ai di c aci d	t rans-9-Oct adecenoi c aci d	C ₁₈ H ₃₄ O ₂	112-79-8	282.462	pl (al)	45	288 ⁸⁰ , 234 ¹⁵	0.8734 ⁴⁵	1.4499 ⁴⁵	i H ₂ O; s Et OH, et h, bz, chl
4691	El ai omyci n		C ₁₇ H ₂₆ N ₂ O ₃	23315-05-1	258.356	ye oi l				1.479 ⁸	sl H ₂ O; s os
4692	1,3-El emadi en-11-ol	Elemol	C ₁₆ H ₂₆ O	639-99-6	222.366	cry (al)	52.5	142 ²	0.9345 ¹⁸	1.4980 ¹⁸	
4693	β-El emene		C ₁₅ H ₂₄	33880-83-0	204.352			120 ¹⁶ , 104 ¹¹	0.8749 ²⁰	1.4935 ²⁰	
4694	Embel i n	2,5-Di hydroxy-3-undecyl-2,5-cycl ohexadi ene-1,4-di one	C ₁₇ H ₂₆ O ₄	550-24-3	294.386	oran pl (al)	142.5				vs bz, et h, Et OH
4695	Emet i ne	6',7',10,11-Tet ramet hoxymet an	C ₂₉ H ₄₀ N ₂ O ₄	483-18-1	480.639	amor pow	74				i H ₂ O; s Et OH, et h, ace; sl bz, chl
4696	Emyl camat e	3-Met hyl-3-pent anol, carbamat e	C ₇ H ₁₃ N ₂ O ₂	78-28-4	145.200	nd	57	35 ¹			sl H ₂ O; vs bz, et h, Et OH
4697	Enal lyl propymal		C ₁₁ H ₁₅ N ₂ O ₃	1861-21-8	224.256	cry (w, di l al)	56.5	177			vs bz, et h, Et OH, chl
4698	Endosul f an		C ₈ H ₆ Cl ₂ O ₂ S	115-29-7	406.925		106	106 ^{0.7}	1.745 ²⁰		
4699	Endosul f an sul f at e		C ₈ H ₆ Cl ₂ O ₂ S	1031-07-8	422.925	cry (cyhex)	181				
4700	Endot hal l di sodi um		C ₈ H ₆ Cl ₂ Na ₂ O ₅	145-73-3	232.142		144		1.431 ²⁰		
4701	Endri n		C ₁₂ H ₈ Cl ₆ O	72-20-8	380.909	cry	dec 245				vs ace, bz, xyl; s ct c, hx
4702	Enflurane		C ₃ H ₂ Cl F ₅ O	13838-16-9	184.492	li q		56.5	1.512 ⁴	1.3025 ²⁰	vs os
4703	Ephedri ne, (±)	α-[1-(Met hyl ami no) et hyl]benzenemet hanol (R [*] , S [*])-(±)-	C ₁₀ H ₁₅ NO	90-81-3	165.232	nd (et h, pet h)	76.5	138	1.1220 ²⁰		s H ₂ O, Et OH, et h, bz, chl
4704	α-Ephedri ne	α-[1-(Met hyl ami no) et hyl]benzenemet hanol S† (R [*] , S [*])-	C ₁₀ H ₁₅ NO	321-98-2	165.232	pl (w)	40	225			s H ₂ O, Et OH, et h, bz, chl
4705	l-Ephedri ne	α-[1-(Met hyl ami no) et hyl]benzenemet hanol R† (R [*] , S [*])-	C ₁₀ H ₁₅ NO	299-42-3	165.232	pl (w + 1)	40	225	1.0085 ²		s H ₂ O, Et OH, et h, bz, chl
4706	Ephedri ne hydrochl ori de	2-(Met hyl ami no)-1-phenyl-1-propanol, hydrochl ori de	C ₁₀ H ₁₅ Cl NO	50-98-6	201.693	ort h nd	219		1.020 ⁸		
4707	Epi chl orohydr i n	(Chl oromet hyl)oxi rane	C ₃ H ₆ Cl O	13403-37-7	92.524	li q	-26	118; 62 ²	1.1812 ²⁰	1.4358 ²⁵	sl H ₂ O; msc Et OH, et h; s bz, ct c
4708	Epi nephri ne	D-Adrenal i ne	C ₁₁ H ₁₃ NO ₃	51-43-4	183.204	br (i n ai r)	211.5				sl H ₂ O; i Et OH; s HOAc, aci d
4709	Epi qui ni di ne		C ₂₀ H ₂₄ N ₂ O ₂	572-59-8	324.417	cry (AcOEt) lf (et h)	113				vs Et OH; s et h
4710	1,2-Epoxybut ane	Et hyl oxi rane	C ₄ H ₆ O	106-88-7	72.106	li q	-150	63.4	0.829 ⁷	1.3851 ²⁰	vs Et OH, ace; msc et h
4711	1,2-Epoxy-4-(epoxyet hyl)cycl ohexane	4-Vi nyl-1-cycl ohexene di oxi de	C ₈ H ₁₂ O ₂	106-87-6	140.180		<-55	227	1.0966 ²⁰	1.4787 ²⁰	vs H ₂ O
4712	1,2-Epoxyhexadecane	Tet radecyl oxi rane	C ₁₆ H ₃₂ O	7320-37-8	240.424	hyg cry or li q	24.1	178	0.846	1.2240	



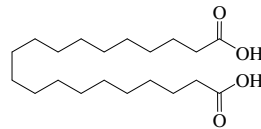
Ef I oxat e



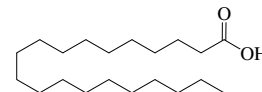
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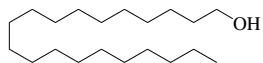
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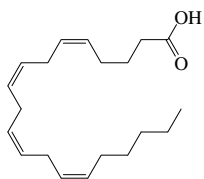
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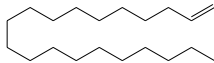
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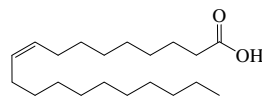
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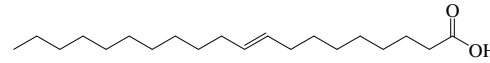
5,8,11,14-Ei cosat et raenoaci d(al l ei)



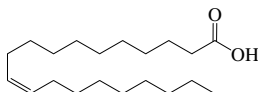
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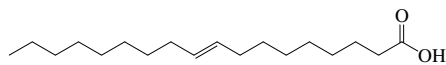
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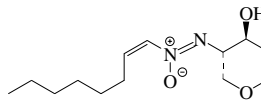
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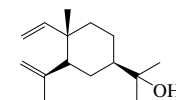
11-Ei cosenoi aci d



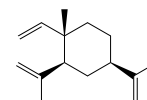
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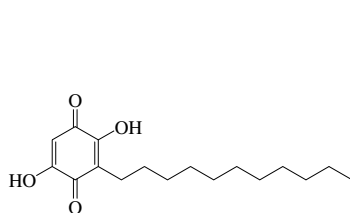
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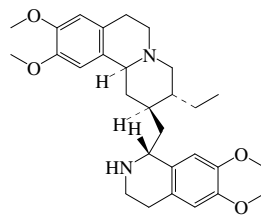
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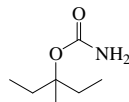
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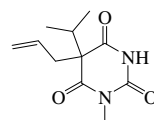
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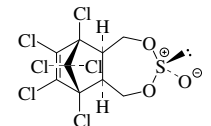
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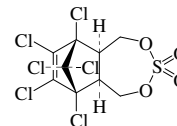
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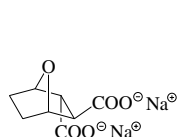
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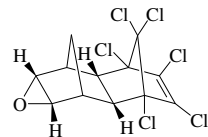
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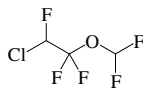
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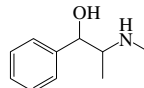
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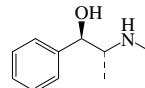
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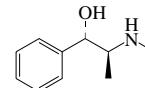
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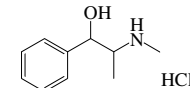
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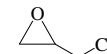
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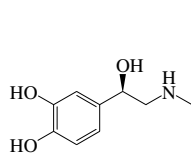
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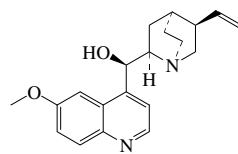
Ephedri nehydrochl ori de



Epi chl orohydri



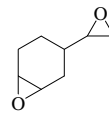
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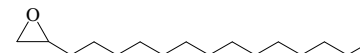
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1,2-Epoxybut ane

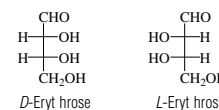
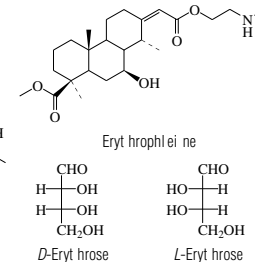
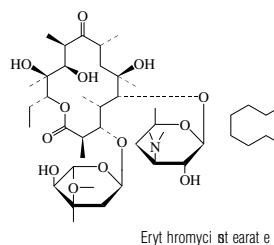
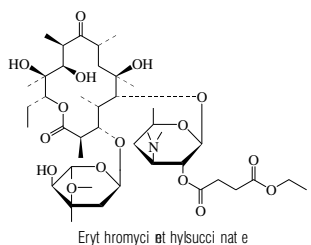
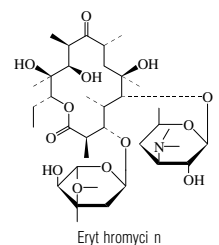
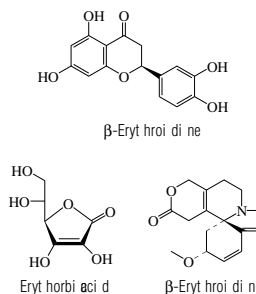
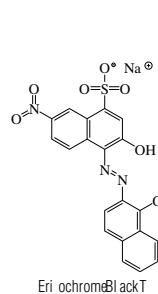
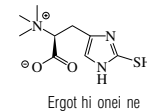
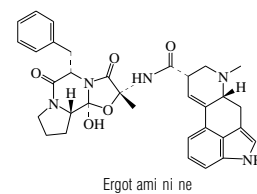
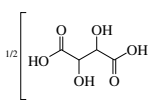
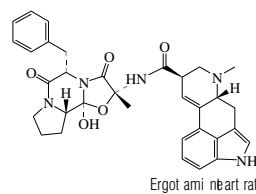
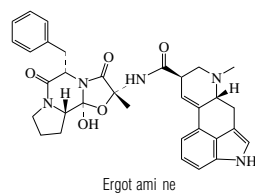
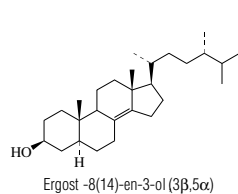
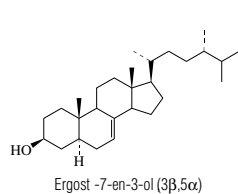
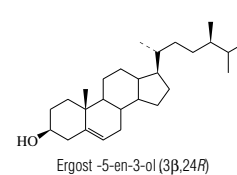
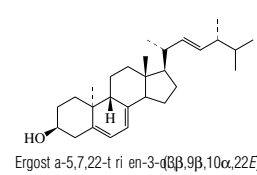
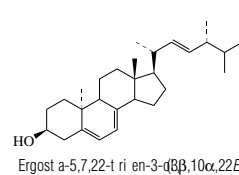
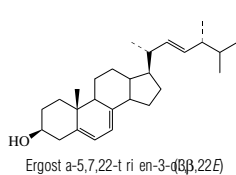
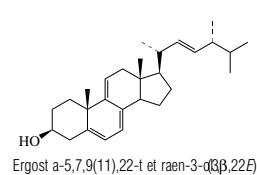
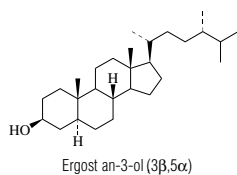
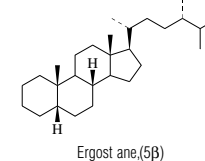
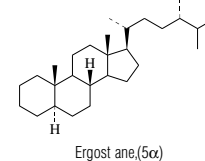
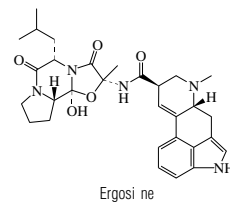
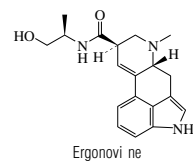
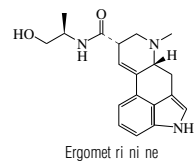
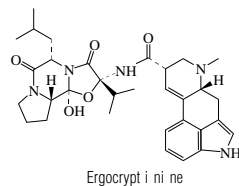
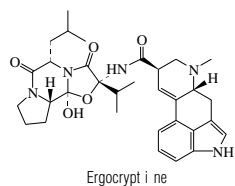
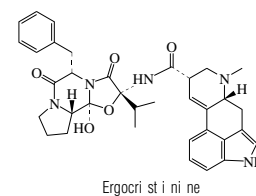
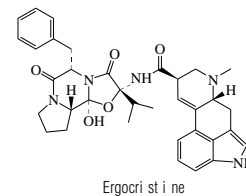
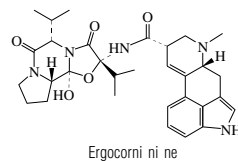
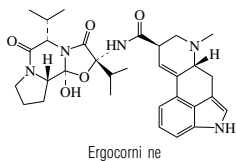
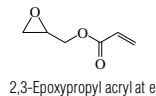
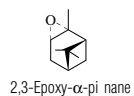
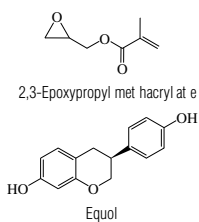
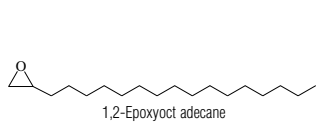


1,2-Epoxy-4-(epoxyet hyl)cycl ohexane

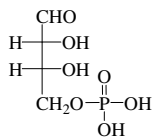


1,2-Epoxyhexadecane

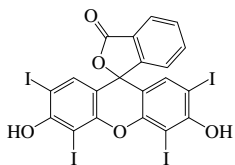
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4713	1,2-Epoxyoctadecane	Hexadecyl oxirane	C ₁₈ H ₃₆ O	7390-81-0	268.478	hyg cry	26.1	137 ^{0.5}			
4714	2,3-Epoxy- α -pinane		C ₁₀ H ₁₆ O	1686-14-2	152.233			85 ²⁴			
4715	2,3-Epoxypropyl acrylate	Glycidyl acrylate	C ₉ H ₈ O ₃	106-90-1	128.126			53 ¹⁰	1.1109 ²⁰	1.4490 ²⁰	vs bz
4716	2,3-Epoxypropyl methacrylate	Glycidol methacrylate	C ₁₁ H ₁₀ O ₃	106-91-2	142.152			189; 75 ¹⁰	1.042 ²⁰	1.448 ²⁵	vs bz, et h, Et OH
4717	Equol		C ₁₄ H ₁₄ O ₃	531-95-3	230.259	cry (aq, al)	189.5				
4718	Ergocornine		C ₃₁ H ₃₉ N ₅ O ₅	564-36-3	561.673	cry (MeOH)	183 dec				i H ₂ O; s Et OH, ace, bz, chl, AcOEt
4719	Ergocorninine		C ₃₁ H ₃₉ N ₅ O ₅	564-37-4	561.673	l o pr (al)	228 dec				vs ace, bz, Et OH, chl
4720	Ergocristinine		C ₃₁ H ₃₉ N ₅ O ₅	511-08-0	609.716	ort h (bz)	175 dec				i H ₂ O; s Et OH, ace, chl
4721	Ergocristinine		C ₃₁ H ₃₉ N ₅ O ₅	511-07-9	609.716	pr (al)	237 dec				i H ₂ O; sl Et OH, ace, chl
4722	Ergocryptinine		C ₃₁ H ₄₁ N ₅ O ₅	511-09-1	575.699	pr (al)	213 dec				i H ₂ O; s Et OH, chl
4723	Ergocryptinine		C ₃₁ H ₄₁ N ₅ O ₅	511-10-4	587.710	l o pr (al)	245 dec				vs ace, chl
4724	Ergometrinine		C ₁₉ H ₂₃ N ₃ O ₂	479-00-5	325.405	pr (ace)	196 dec				vs chl
4725	Ergonovine	Ergometrine	C ₁₉ H ₂₃ N ₃ O ₂	60-79-7	325.405	pl or nd	162 dec				s H ₂ O, ace; vs Et OH; sl chl
4726	Ergosine		C ₃₀ H ₃₇ N ₅ O ₅	561-94-4	547.646	pr (MeOH, AcOEt)	228 dec				s ace, chl; sl MeOH
4727	Ergostane, (5 α)		C ₂₈ H ₅₀	511-20-6	386.697	l f or pl (ace, et h- MeOH)	85				vs ace, et h, chl
4728	Ergostane, (3 β)	Coproergostane	C ₂₈ H ₅₀	511-21-7	386.697	nd (ace)	64				vs et h, chl
4729	Ergostan-3-ol, (3 β ,5 α)	Ergostanol	C ₂₈ H ₅₀ O	6538-02-9	402.696	nd (MeOH-et h)	144.5				i H ₂ O; s et h, chl
4730	Ergostan-5,7,9(11),22-tetraene-3-ol, (3 β ,22E)	Dehydroergosterol	C ₂₈ H ₄₂ O	516-85-8	394.632	l f (al) nd (et h)	146	230 ^{0.5}			vs ace, bz, et h, Et OH
4731	Ergostan-5,7,22-triene-3-ol, (3 β ,22E)	Ergosterol	C ₂₈ H ₄₄ O	57-87-4	396.648	pl (+w, al) nd (et h)	170	250 ^{0.01}			i H ₂ O; sl Et OH, et h, pet h; s bz, chl
4732	Ergostan-5,7,22-triene-3-ol, (3 β ,10 α ,22E)	Pyrocalciferol	C ₂₈ H ₄₄ O	128-27-8	396.648	nd (MeOH)	94				i H ₂ O; s Et OH, chl, MeOH
4733	Ergostan-5,7,22-triene-3-ol, (3 β ,9 β ,10 α ,22E)	Lumisterol	C ₂₈ H ₄₄ O	474-69-1	396.648	nd (ace-MeOH)	118				i H ₂ O; s Et OH, HOAc; vs et h, ace, chl
4734	Ergostan-5-en-3-ol, (3 β ,24H)	Campesterol	C ₂₈ H ₄₆ O	474-62-4	400.680	cry (ace)	157.5				
4735	Ergostan-7-en-3-ol, (3 β ,5 α)	γ -Ergosterol	C ₂₈ H ₄₆ O	516-78-9	400.680	nd (MeOH) cry (PrOH)	146				s et h
4736	Ergostan-8(14)-en-3-ol, (3 β ,5 α)	α -Ergosterol	C ₂₈ H ₄₆ O	632-32-6	400.680	l f or nd (MeOH)	131				sl Et OH; s et h, bz, chl
4737	Ergotamine		C ₃₁ H ₃₅ N ₅ O ₅	113-15-5	601.821	nd (al), pr (bz)	213 dec				vs bz, et h, chl
4738	Ergotamine tartrate (2:1)	Gynergen	C ₃₅ H ₃₉ N ₅ O ₈	379-79-3	656.706		192 dec				
4739	Ergotaminine		C ₃₁ H ₃₅ N ₅ O ₅	639-81-6	581.662	ort h pl (MeOH)	252 dec				i H ₂ O; sl Et OH, ace, bz; s chl; vs py
4740	Ergothioneine		C ₁₃ H ₁₅ N ₃ O ₂ S	497-30-3	229.299	nd or l f (dil Et OH)	290 dec				vs H ₂ O; sl Et OH, ace; i et h, bz, chl
4741	Eriochrome Black T		C ₁₂ H ₁₂ N ₂ NaO ₇ S	1787-61-7	461.380	br-blk pow					s H ₂ O, Et OH, MeOH
4742	Eriodictyol		C ₁₅ H ₁₂ O ₆	552-58-9	288.252	pl or nd (Et OH)	267 dec				vs Et OH, HOAc
4743	Erythorbic acid	3',4',5',7-Tetrahydroxyflavanone (Isoascorbic acid)	C ₁₅ H ₁₂ O ₆	89-65-6	176.124	gran cry	168				s H ₂ O, py; sl ace
4744	β -Erythroidine		C ₁₉ H ₁₉ NO ₃	466-81-9	273.327	cry (al)	99.5				s H ₂ O, et h, chl; vs Et OH, bz
4745	Erythromycin	Propionine	C ₃₇ H ₆₇ NO ₁₃	114-07-8	733.927	cry (w)	191				vs ace, et h, Et OH, chl
4746	Erythromycin ethylsuccinate		C ₄₃ H ₇₃ NO ₁₆	1264-62-6	862.053	cry (ace aq)	222				
4747	Erythromycin stearate		C ₅₅ H ₁₀₃ NO ₁₅	643-22-1	1018.405	cry	92				i H ₂ O; sl Et OH, et h, chl
4748	Erythrophenine	Norcassamine	C ₂₄ H ₃₉ NO ₅	36150-73-9	421.571	gl ass	115				s H ₂ O, Et OH
4749	D-Erythrose		C ₄ H ₈ O ₄	583-50-6	120.105	syr					s H ₂ O; vs Et OH
4750	L-Erythrose		C ₄ H ₈ O ₄	533-49-3	120.105	syr					vs H ₂ O, Et OH



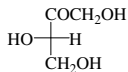
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4751	D-Eryt hrose 4-phosphat e	2,3-Di hydroxy-4-(phosphonoxy) but anal	C ₆ H ₁₀ O ₇ P	585-18-2	200.084	st ab i n aq sol n only					s H ₂ O
4752	Eryt hrosi ne		C ₆ H ₈ O ₅	15905-32-5	835.893	br pow (Na sal t)					s H ₂ O; vs et h, Et OH
4753	L-Eryt hrul ose		C ₆ H ₈ O ₄	533-50-6	120.105	syr	dec	dec			vs H ₂ O, Et OH
4754	Esaprazol e	N-Cycl ohexyl -1-pi perazi neacet ami de	C ₁₅ H ₁₉ N ₃ O	64204-55-3	225.330		112	190 ^{0.5}			
4755	Escul i n	6β-D-Gl ucopyranosyl oxy)-7-hydroxy-2H-1-benzopyran-2-one	C ₁₅ H ₁₆ O ₉	531-75-9	340.283	pr (w+2)	205				sl H ₂ O, Et OH, et h; s chl , py, HOAc
4756	Eseri ne sul f at e	Physost i gmi ne sul f at e	C ₃₀ H ₄₄ N ₆ O ₆ S	64-47-1	648.770	hyg cry (ace-et h)	141				vs ace, Et OH
4757	Est ra-1,3,5(10)-t ri ene-3,17-di ol, (17α)	α-Est radi ol	C ₁₈ H ₂₄ O ₂	57-91-0	272.383	nd (+1/2 w) (80% al)	221.5				i H ₂ O; s Et OH, ace; sl et h, bz
4758	Est ra-1,3,5(10)-t ri ene-3,17-di ol (17β)	β-Est radi ol	C ₁₈ H ₂₄ O ₂	50-28-2	272.383	pr (80% al),	178.5				vs ace, Et OH, Di ox
4759	Est ra-1,3,5(10)-t ri ene-3,17-di ol, (8α,17β)	Isoest radi ol	C ₁₈ H ₂₄ O ₂	517-04-4	272.383	cry (di l MeOH-chl)	181				s Et OH, di ox
4760	Est ra-1,3,5(10)-t ri ene-3,17-di ol 3-benzoat e, (17β)	Est radi ol benzoat e	C ₂₅ H ₂₀ O ₃	50-50-0	376.488		196				
4761	Est ra-1,3,5(10)-t ri ene-3,16,17-t ri ol, Est ri ol (16α,17β)	Est ri ol	C ₁₈ H ₂₄ O ₃	50-27-1	288.382	lf (al), mcl (di l288 dec al)			1.27 ²⁵		s Et OH; sl et h, bz, t f a; vs py
4762	Est ra-1,3,5(10)-t ri ene-3,16,17-t ri ol, 16-Epi est ri ol (16β,17β)	16-Epi est ri ol	C ₁₈ H ₂₄ O ₃	547-81-9	288.382	cry (MeOH-bz)	290				
4763	Est rone		C ₁₈ H ₂₂ O ₂	53-16-7	270.367	mcl , ort h (al)	260.2		1.23 ⁶		i H ₂ O; sl Et OH, et h, bz; s ace, di ox
4764	Et hacryni c aci d		C ₁₂ H ₁₂ Cl ₂ O ₄	58-54-8	303.138		122.5				
4765	Et hal flural i n		C ₁₄ H ₁₄ F ₃ N ₃ O ₄	55283-68-6	333.263		57	dec 256			
4766	Et hambut ol		C ₁₀ H ₂₄ N ₂ O ₂	74-55-5	204.310	cry	89				sl H ₂ O; s bz, chl
4767	Et hane		C ₂ H ₆	74-84-0	30.069	col gas	-182.79	-88.6	0.5446 ⁸⁹		i H ₂ O; vs bz
4768	Et hanearoni c aci d		C ₂ H ₇ AsO ₃	507-32-4	153.997	nd (al), ort h nd (w)	99.5	210 ¹²			vs H ₂ O, Et OH
4769	Et hanedi al di oxi me		C ₂ H ₄ O ₂	557-30-2	88.065	ort h pl (w)	178 dec	sub			vs H ₂ O, Et OH, et h
4770	1,2-Et hanedi ami ne	Et hyl enedi ami ne	C ₂ H ₈ N ₂	107-15-3	60.098		11.14	117	0.8979 ²⁰	1.4565 ²⁰	vs H ₂ O; msc Et OH; i et h, bz; s ct c
4771	1,2-Et hanedi ami ne, di hydrochl ori de	Et hyl enedi ami ne di hydrochl ori de	C ₂ H ₁₀ Cl ₂ N ₂	333-18-6	133.019					1.633	vs H ₂ O
4772	1,2-Et hanedi ol	Et hyl ene glycol	C ₂ H ₆ O ₂	107-21-1	62.068	li q	-12.69	197.3	1.113 ⁹	1.4318 ²⁰	msc H ₂ O, Et OH, ace; s et h, chl ; sl bz
4773	1,2-Et hanedi ol, bi s(4-met hyl benzenesul f onat e)		C ₁₆ H ₁₈ O ₆ S ₂	6315-52-2	370.440	cry (bz)	128				
4774	1,1-Et hanedi ol, di acet at e	Et hyl i dene di acet at e	C ₆ H ₁₀ O ₄	542-10-9	146.141		18.9	169	1.070 ²⁵	1.3985 ²⁵	vs et h, Et OH
4775	1,2-Et hanedi ol, di acet at e	Et hyl ene glycol di acet at e	C ₆ H ₁₀ O ₄	111-55-7	146.141	li q	-31	190	1.104 ⁹	1.4159 ²⁰	vs H ₂ O; msc Et OH, et h, ace, bz, CS ₂
4776	1,2-Et hanedi ol, di acryl at e	Et hyl ene glycol di acryl at e	C ₈ H ₁₀ O ₄	2274-11-5	170.163	li q		55 ⁹	1.0935 ²⁵		
4777	1,2-Et hanedi ol, di benzoat e	Et hyl ene glycol di benzoat e	C ₁₆ H ₁₄ O ₄	94-49-5	270.280	ort h pr (et h)	73.5	dec 360			i H ₂ O; s et h, chl
4778	1,2-Et hanedi ol, di dodecanoat e	Et hyl ene glycol di dodecanoat e	C ₂₆ H ₅₀ O ₄	624-04-4	426.673	pl (al)	56.6	188 ⁹			vs et h, Et OH
4779	1,2-Et hanedi ol, di f ormat e	Et hyl ene glycol di f ormat e	C ₄ H ₆ O ₄	629-15-2	118.089			174	1.193 ⁰	1.3580	sl H ₂ O; s Et OH, et h
4780	1,2-Et hanedi ol, di hexadecanoat e	Et hyl ene glycol di pal mi t at e	C ₃₄ H ₆₆ O ₄	624-03-3	538.886	lf or nd (al-chl)	72		0.859 ⁴		i H ₂ O, Et OH; s et h; vs ace
4781	1,2-Et hanedi ol, di met hacryl at e	Et hyl ene glycol di met hacryl at e	C ₁₀ H ₁₄ O ₄	97-90-5	198.216	li q	-40	260	1.05 ⁹	1.4532 ²⁵	vs bz, Et OH, li g
4782	1,2-Et hanedi ol, di ni t rat e	Et hyl ene glycol di ni t rat e	C ₂ H ₄ N ₂ O ₆	628-96-6	152.062	ye li q	-22.3	198.5	1.491 ⁸		vs et h, Et OH
4783	1,2-Et hanedi ol, di st earat e	Et hyl ene glycol di st earat e	C ₃₈ H ₇₄ O ₄	627-83-8	594.993	lf	79	24 ⁹	0.8581 ⁷⁸		i H ₂ O, Et OH; vs et h, ace
4784	1,2-Et hanedi ol, di t et radecanoat e	Et hyl ene glycol di t et radecanoat e	C ₂₈ H ₅₀ O ₄	627-84-9	482.780	cry (et h, ace)	65	208 ⁹	0.8600 ⁸⁰		i H ₂ O, Et OH; s et h; vs ace, bz, ct c



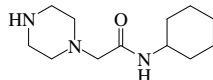
D-Erytrose-4-phosphate



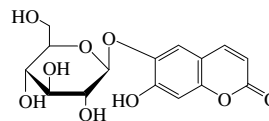
Erythrosine



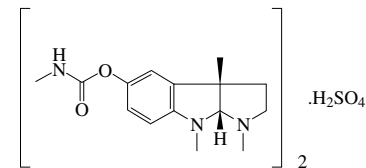
L-Erythrose



Esomeprazole



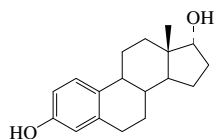
Esculin



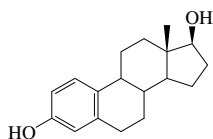
Eserin sulfate

$\cdot H_2SO_4$

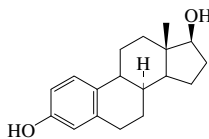
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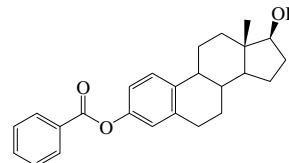
Est-1,3,5(10)-triene-3,17-diol (17 α)



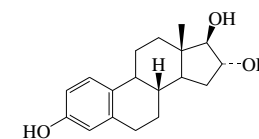
Est-1,3,5(10)-triene-3,17-diol (17 β)



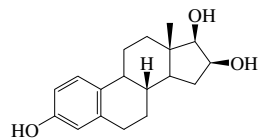
Est-1,3,5(10)-triene-3,17-diol (16 α ,17 β)



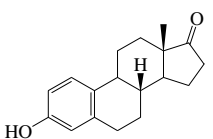
Est-1,3,5(10)-triene-3,17-di(3-benzoate), (17 β)



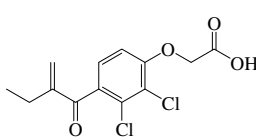
Est-1,3,5(10)-triene-3,16,17-triol (16 α ,17 β)



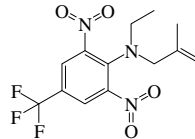
Est-1,3,5(10)-triene-3,16,17-triol (16 β ,17 β)



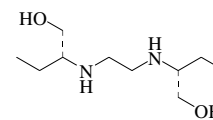
Estrone



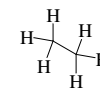
Et-hacrynic acid



Et-halofuralin



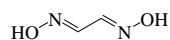
Et-hambol



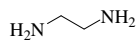
Et-hane



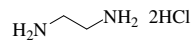
Et-hanearsonic acid



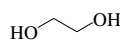
Et-hanedialdimine



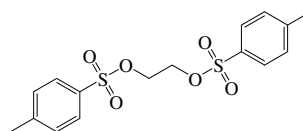
1,2-Et-hanediamine



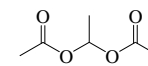
1,2-Et-hanediamine hydrochloride



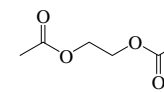
1,2-Et-hanediol



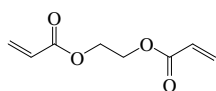
1,2-Et-hanedibis(4-methylbenzenesulfonate)



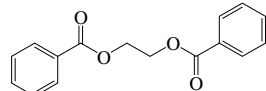
1,1-Et-hanediacetate



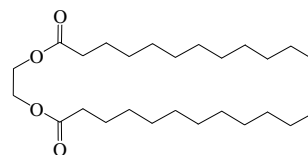
1,2-Et-hanediacetate



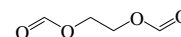
1,2-Et-hanediacrylate



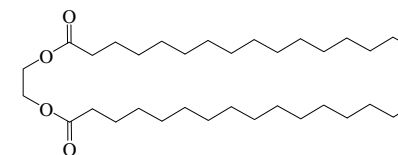
1,2-Et-hanedibenzate



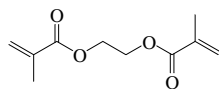
1,2-Et-hanedidodecanoate



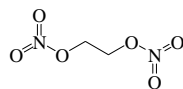
1,2-Et-hanediformate



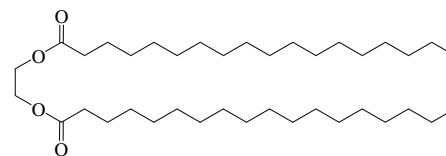
1,2-Et-hanedihexadecanoate



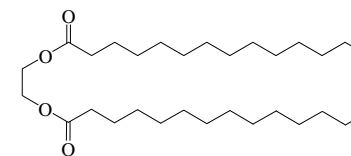
1,2-Et-hanedimethacrylate



1,2-Et-hanedinitrate

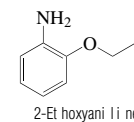
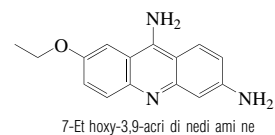
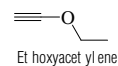
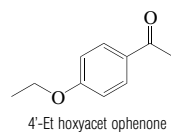
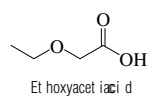
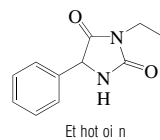
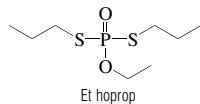
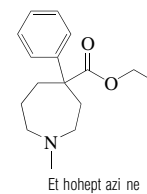
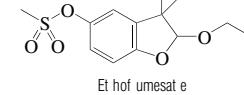
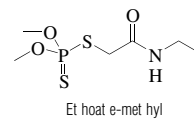
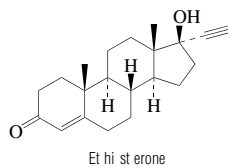
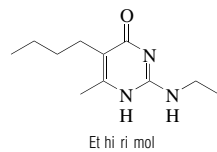
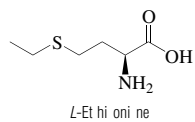
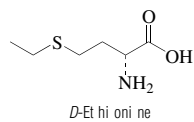
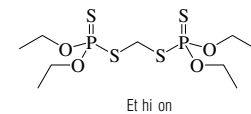
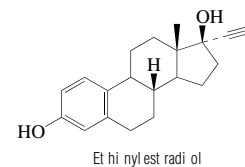
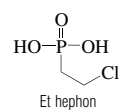
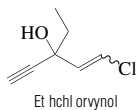
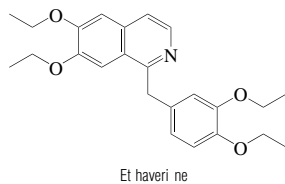
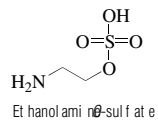
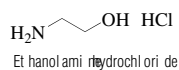
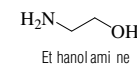
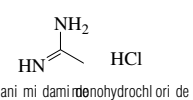
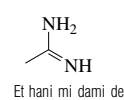
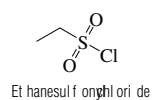
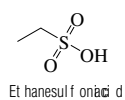
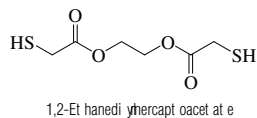
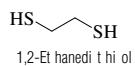
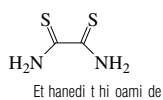
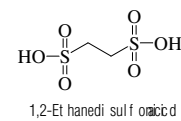
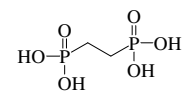
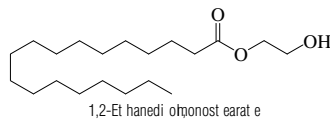
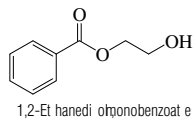
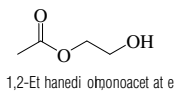
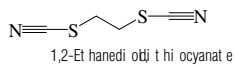


1,2-Et-hanedistearate

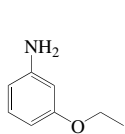


1,2-Et-haneditetradecanoate

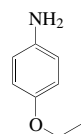
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4785	1,2-Et hanedi ol, di t hi ocyanat e	Et hyl ene glycol di t hi ocyanat e	$\text{C}_4\text{H}_8\text{N}_2\text{S}_2$	629-17-4	144.218	ort h pl or nd (w)	90	dec	1.4200 ⁹		sl H_2O , bz; s Et OH, et h; vs ace
4786	1,2-Et hanedi ol, monoacet at e	Et hyl ene glycol monoacet at e	$\text{C}_4\text{H}_8\text{O}_3$	542-59-6	104.105			188	1.108 ¹⁵		msc H_2O , Et OH, et h
4787	1,2-Et hanedi ol, monobenzoat e	Et hyl ene glycol monobenzoat e	$\text{C}_{10}\text{H}_{10}\text{O}_3$	94-33-7	166.173		45	150 ¹⁰	1.1101 ³⁰		vs Et OH
4788	1,2-Et hanedi ol, monost earat e	Et hyl ene glycol monost earat e	$\text{C}_{20}\text{H}_{40}\text{O}_6$	111-60-4	328.530	cry (pet h)	60.5	190	0.8780 ⁶⁰	1.4310 ⁶⁰	sl Et OH; s et h
4789	1,2-Et hanedi ol, monosul fit e	Et hyl ene glycol monosul fit e	$\text{C}_2\text{H}_4\text{O}_3\text{S}$	3741-38-6	108.116	li q	-11	173	1.4402 ⁹	1.4463 ²⁰	vs H_2O , Et OH, et h, ace, bz, AcOEt ; sl chl
4790	1,2-Et hanedi phosphoni c aci d	1,2-Di phosphonoet hane	$\text{C}_2\text{H}_6\text{O}_6\text{P}_2$	6145-31-9	190.029	nd (Et OH/et h)	223				
4791	1,2-Et hanedi sul f oni c aci d	Et hyl ene di sul f oni c aci d	$\text{C}_2\text{H}_4\text{O}_6\text{S}_2$	110-04-3	190.195			173			vs di ox
4792	Et hanedi t hi oami de	Rubeani c aci d	$\text{C}_2\text{H}_4\text{N}_2\text{O}_2$	79-40-3	120.196	red cry	170 dec				sl H_2O , Et OH; s con sul f
4793	1,2-Et hanedi t hi ol	Et hyl ene di mercapt an	$\text{C}_2\text{H}_4\text{S}_2$	540-63-6	94.199	li q	-41.2	146.1	1.234 ⁹	1.5590 ²⁰	i H_2O ; s Et OH, et h, ace, bz; vs al k
4794	1,2-Et hanedi yl mercapt oacet at e		$\text{C}_2\text{H}_4\text{O}_2\text{S}_2$	123-81-9	210.271			138 ^{1,5}			
4795	Et hanesul f oni c aci d	Et hyl sul f oni c aci d	$\text{C}_2\text{H}_4\text{O}_2\text{S}$	594-45-6	110.132	hyg	-17	123 ¹	1.3341 ²⁵	1.4335 ²⁰	vs H_2O , Et OH
4796	Et hanesul f onyl chl ori de		$\text{C}_2\text{H}_3\text{ClO}_2\text{S}$	594-44-5	128.578	pa ye		174	1.357 ²²	1.4531 ²⁰	vs et h; s CS_2
4797	Et hanet hi ol	Et hyl mercapt an	$\text{C}_2\text{H}_6\text{S}$	75-08-1	62.134	li q	-147.88	35.0	0.831 ⁵	1.4310 ²⁰	sl H_2O ; s Et OH, et h, ace, di l al k
4798	Et hani mi dami de		$\text{C}_2\text{H}_4\text{N}_2$	143-37-3	58.082		-35				sl H_2O ; s Et OH, aci d
4799	Et hani mi dami de monohydrochl ori de	Acet ami di ne hydrochl ori de	$\text{C}_2\text{H}_7\text{ClN}_2$	124-42-5	94.543	nd or pr (al) hyg lo pr (al)	177.5				vs H_2O , Et OH
4800	Et hanol	Et hyl al cohoh	$\text{C}_2\text{H}_6\text{O}$	64-17-5	46.068	li q	-114.14	78.29	0.789 ⁹	1.3611 ²⁰	msc H_2O , Et OH, et h, ace, chl ; s bz
4801	Et hanol ami ne	Glyci nol	$\text{C}_2\text{H}_5\text{NO}$	141-43-5	61.083		10.5	171	1.0180 ²⁰	1.4541 ²⁰	msc H_2O , Et OH; sl et h, li g, bz; s chl
4802	Et hanol ami ne hydrochl ori de	2-Ami noet hanol hydrochl ori de	$\text{C}_2\text{H}_6\text{ClNO}$	2002-24-6	97.544	hyg cry (Et OH)	85				
4803	Et hanol ami ne sul f at e	2-Ami noet hyl sul f at e	$\text{C}_2\text{H}_5\text{NO}_2\text{S}$	926-39-6	141.147		230 dec				s H_2O ; i Et OH
4804	Et haveri ne	1-[(3,4-Di et hoxypheyl)met hyl]-6,7-di et hoxi soqui nol i ne	$\text{C}_{24}\text{H}_{29}\text{NO}_4$	486-47-5	395.492		100				i H_2O ; s Et OH; sl et h, chl
4805	Et hchl orvynol	1-Chl oro-3-et hyl -1-pent en-4-yn-ol	$\text{C}_7\text{H}_{12}\text{ClO}$	113-18-8	144.598	li q		181; 30	1.07 ²⁵	1.474 ²⁵	i H_2O ; s os
4806	Et hephon	Phosphoni c aci d, (2-chl oroet hyl)-	$\text{C}_2\text{H}_4\text{ClO}_3\text{P}$	16672-87-0	144.494		74		1.2		
4807	Et hi nyl est radi ol	19-Norpregna-1,3,5(10)-tri en-20-C ₂₀ H ₂₄ O ₂ yne-3,17-di ol, (1 α)-		57-63-6	296.404						sl chl
4808	Et hi on		$\text{C}_{12}\text{H}_{22}\text{O}_4\text{P}_2\text{S}_4$	563-12-2	384.476		-13	165 ^{0,3}	1.22 ²⁰		
4809	D-Et hi oni ne	3-Et hyl homocyst eiyl)e, (	$\text{C}_6\text{H}_{13}\text{NO}_2\text{S}$	535-32-0	163.238	cry (H_2O)	278 dec				
4810	L-Et hi oni ne	3-Et hyl homocyst eiyl)e, (	$\text{C}_6\text{H}_{13}\text{NO}_2\text{S}$	13073-35-3	163.238	cry (H_2O)	273 dec				
4811	Et hi ri mol	4H-Pyri mi di none, 5-but yl -2-(et hyl ami no)-6-met hyl -	$\text{C}_{11}\text{H}_{19}\text{N}_3\text{O}$	23947-60-6	209.288		160		1.21 ²⁵		
4812	Et hi st erone		$\text{C}_{27}\text{H}_{46}\text{O}_2$	434-03-7	312.446		272				
4813	Et hoat e-met hyl		$\text{C}_6\text{H}_8\text{NO}_4\text{PS}_2$	116-01-8	243.284	cry (t ol /hp)	67				
4814	Et hof umesat e		$\text{C}_8\text{H}_{16}\text{O}_5\text{S}$	26225-79-6	286.344		71		1.14		
4815	Et hohept azi ne	4-Carbet hoxymet hyl -4-phenyl azacycl ohept ane	$\text{C}_{16}\text{H}_{23}\text{NO}_2$	77-15-6	261.360	li q		134	1.038 ²⁶	1.5210 ²⁶	
4816	Et hoprop	Phosphorodi t hi oi c aci d, di propyl est er	$\text{C}_6\text{H}_{16}\text{O}_2\text{P}_2\text{S}_2$	13194-48-4	242.340			88 ^{0,2}	1.094 ²⁰		
4817	Et hot oi n		$\text{C}_4\text{H}_8\text{N}_2\text{O}_2$	86-35-1	204.225	pr (w)	94				s hot H_2O ; vs Et OH, bz, et h
4818	Et hoxycet i c aci d		$\text{C}_2\text{H}_4\text{O}_3$	627-03-2	104.105			206.5	1.1021 ²⁰	1.4194 ²⁰	vs H_2O , Et OH, et h; s chl
4819	4-Et hoxycet ophenone		$\text{C}_8\text{H}_{12}\text{O}_2$	1676-63-7	164.201	pl (et h)	39	268			vs et h, Et OH
4820	Et hoxycet yl ene		$\text{C}_2\text{H}_4\text{O}$	927-80-0	70.090			50	0.8000 ²⁰	1.3796 ²⁰	
4821	7-Et hoxi-3,9-aci di nedi ami ne	Et hacri di ne	$\text{C}_{15}\text{H}_{15}\text{NO}$	442-16-0	253.299	ye nd	226				
4822	2-Et hoxyani li ne	α -Phenet i di ne	$\text{C}_8\text{H}_9\text{NO}$	94-70-2	137.179		<-21	232.5		1.5560 ²⁰	sl H_2O , ct c; s Et OH, et h



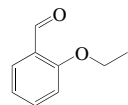
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4823	3-Et hoxyani li ne	<i>m</i> -Phenet i di ne	$\text{C}_8\text{H}_9\text{NO}$	621-33-0	137.179			248			vs et h, Et OH
4824	4-Et hoxyani li ne	<i>p</i> -Phenet i di ne	$\text{C}_8\text{H}_9\text{NO}$	156-43-4	137.179		1.2	254	1.0652 ¹⁶	1.5528 ²⁰	sl H ₂ O; s Et OH, et h, chl
4825	2-Et hoxybenzal dehyde		$\text{C}_9\text{H}_{10}\text{O}_2$	613-69-4	150.174		21	248			msc Et OH, et h; sl chl
4826	4-Et hoxybenzal dehyde		$\text{C}_9\text{H}_{10}\text{O}_2$	10031-82-0	150.174		13.5	249	1.08 ²¹		vs Et OH, et h, bz
4827	2-Et hoxybenzami de	Et henzami de	$\text{C}_9\text{H}_9\text{NO}_2$	938-73-8	165.189	nd (w, al)	133				sl H ₂ O, chl; vs Et OH, et h
4828	Et hoxybenzene	Phenet ol e	$\text{C}_8\text{H}_{10}\text{O}$	103-73-1	122.164	li q	-29.43	169.81	0.965 ⁷	1.5076 ²⁰	i H ₂ O; s Et OH, et h, ct c
4829	4-Et hoxy-1,2-benzenedi ami ne		$\text{C}_8\text{H}_{12}\text{N}_2\text{O}$	1197-37-1	152.193		71.5	295			vs H ₂ O; s Et OH, et h, chl
4830	2-Et hoxybenzoi c aci d		$\text{C}_8\text{H}_7\text{NO}_3$	134-11-2	166.173		20.7	211 ³⁹			sl H ₂ O, Et OH, ct c
4831	4-Et hoxybenzoi c aci d		$\text{C}_8\text{H}_7\text{NO}_3$	619-86-3	166.173	nd (w)	198.5				sl H ₂ O, t f a; s Et OH, et h, bz
4832	6-Et hoxy-2-benzot hi azol esul f onami de	Et hoxzol ami de	$\text{C}_9\text{H}_{10}\text{N}_2\text{O}_3\text{S}_2$	452-35-7	258.316		189				
4833	3-Et hoxy- <i>N,N</i> -di et hyl ani li ne		$\text{C}_{12}\text{H}_{17}\text{NO}$	1864-92-2	193.285			286; 97 ^{0.6}		1.5325 ²⁵	s Et OH, bz, HOAc
4834	2-Et hoxy-3,4-di hydro- <i>B</i> -pyran		$\text{C}_7\text{H}_{12}\text{O}_2$	103-75-3	128.169			132; 42 ¹⁶	0.9658 ²⁵	1.4394 ²⁰	
4835	6-Et hoxy-1,2-di hydro-2,2,4-t ri met hyl qui nol i ne	Et hoxyqui n	$\text{C}_7\text{H}_{13}\text{NO}$	91-53-2	217.307			124 ²	1.026 ²⁵	1.569 ²⁵	
4836	Et hoxydi met hyl si l ane	Di met hyl et hoxy si l ane	$\text{C}_8\text{H}_{17}\text{OSiC}$	14857-34-2	104.223	li q		54	0.76		
4837	2-Et hoxy-1,2-di phenyl et hanone		$\text{C}_{16}\text{H}_{15}\text{O}_2$	574-09-4	240.297	nd (li g)	62	19 ⁴	1.1016 ¹⁷	1.5727 ¹⁷	vs bz, et h, Et OH, li g
4838	2-Et hoxyet hanami ne		$\text{C}_8\text{H}_{11}\text{NO}$	110-76-9	89.136			107	0.8512 ²⁰	1.4101 ²⁰	msc H ₂ O, Et OH, et h; s ace, bz; sl chl
4839	2-Et hoxyet hanol	Et hyl ene glycol monoet hyl et her	$\text{C}_8\text{H}_{16}\text{O}_2$	110-80-5	90.121	li q	-70	135	0.925 ³	1.4054 ²⁵	vs H ₂ O, ace, et h, Et OH
4840	2-(2-Et hoxyet hoxy)et hyl 2-propenoate	Di et hyl ene glycol et hyl et her acrylate	$\text{C}_{10}\text{H}_{16}\text{O}_4$	7328-17-8	188.221				1.13 ²⁵		
4841	2-Et hoxyet hyl acet at e	Et hyl ene glycol monoet hyl et her acet at e	$\text{C}_8\text{H}_{12}\text{O}_3$	111-15-9	132.157	li q	-61.7	156.4	0.974 ⁰	1.4054 ²⁰	vs H ₂ O, ace, et h, Et OH
4842	2-Et hoxyet hyl acryl at e	Et hyl ene glycol monoet hyl et her acryl at e	$\text{C}_8\text{H}_{12}\text{O}_3$	106-74-1	144.168	li q	-47	174	0.98 ³	1.4274 ²⁰	
4843	3-Et hoxy-2-hydroxybenzal dehyde		$\text{C}_9\text{H}_{10}\text{O}_3$	492-88-6	166.173		65.3	264			
4844	3-Et hoxy-4-hydroxybenzal dehyde	Et hyl vani lli n	$\text{C}_9\text{H}_{10}\text{O}_3$	121-32-4	166.173		77.5	285			sl H ₂ O; s Et OH, et h, bz, chl
4845	4-Et hoxy-3-met hoxybenzal dehyde		$\text{C}_9\text{H}_{12}\text{O}_3$	120-25-2	180.200	mcl pr	64.5	168 ³			sl H ₂ O; s Et OH, et h, bz, chl, HOAc
4846	1-Et hoxy-2-met hoxyet hane		$\text{C}_8\text{H}_{12}\text{O}_2$	5137-45-1	104.148	li q		103.5	0.846 ⁰	1.3843 ²⁵	
4847	1-Et hoxy-3-met hyl benzene		$\text{C}_8\text{H}_{12}\text{O}$	621-32-9	136.190			192	0.949 ²⁰	1.513 ²⁰	i H ₂ O; s Et OH, et h
4848	1-Et hoxy-4-met hyl benzene		$\text{C}_8\text{H}_{12}\text{O}$	622-60-6	136.190			188.5	0.9509 ¹⁸	1.5058 ¹⁸	i H ₂ O; s Et OH, et h; sl ct c
4849	2-Et hoxy-2-met hyl but ane	Et hyl propyl et her	$\text{C}_8\text{H}_{16}\text{O}$	919-94-8	116.201			102	0.751 ¹⁸		vs et h, Et OH
4850	(Et hoxyet hyl ene)propanedi ni t ri le		$\text{C}_8\text{H}_{13}\text{NO}$	123-06-8	122.124		66	160 ¹²			s Et OH, et h; sl chl
4851	(Et hoxyet hyl)oxi rane	2,3-Epoxypropyl et hyl et her	$\text{C}_8\text{H}_{16}\text{O}_2$	4016-11-9	102.132			128	0.9700 ²⁰	1.4320 ²⁰	s H ₂ O, Et OH, et h; sl ct c
4852	1-Et hoxy naph t hal ene		$\text{C}_9\text{H}_{12}\text{O}$	5328-01-8	172.222	nd	5.5	280.5	1.060 ²⁰	1.5953 ²⁵	i H ₂ O; vs Et OH, et h
4853	2-Et hoxy naph t hal ene		$\text{C}_9\text{H}_{12}\text{O}$	93-18-5	172.222	pl (al)	37.5	282	1.064 ⁰	1.5975 ³⁶	i H ₂ O; s Et OH, et h, t ol, li g, CS
4854	5-Et hoxy-5-ni t roani li ne	5-Ni t rophenet i di ne	$\text{C}_8\text{H}_7\text{NO}_3$	136-79-8	182.176	ye nd (di l al)	96.5	205			vs et h, Et OH
4855	1-Et hoxy-2-ni t robenzene		$\text{C}_8\text{H}_7\text{NO}_3$	610-67-3	167.162	br ye	1.1	267	1.1903 ¹⁵	1.5425 ²⁰	vs et h, Et OH
4856	1-Et hoxy-4-ni t robenzene		$\text{C}_8\text{H}_7\text{NO}_3$	100-29-8	167.162	pr (di l al, et h)	60	283	1.11 ⁷⁶		sl H ₂ O, Et OH; vs et h; msc ace, bz; s pet h
4857	<i>N</i> -(4-Et hoxy-3-ni t rophenyl)acet ami de		$\text{C}_{10}\text{H}_{13}\text{N}_2\text{O}_4$	1777-84-0	224.213	nd (di l al)	124.0				vs ace, bz, Et OH
4858	2-Et hoxyphenol	Cat echol monoet hyl et her	$\text{C}_8\text{H}_9\text{O}_2$	94-71-3	138.164		29	217	1.0903 ²⁵		sl H ₂ O, ct c; msc Et OH, et h
4859	3-Et hoxyphenol	Resorci nol monoet hyl et her	$\text{C}_8\text{H}_9\text{O}_2$	621-34-1	138.164			246; 131 ¹⁰	1.105 ¹⁵		i H ₂ O; s Et OH, et h, bz; sl chl
4860	4-Et hoxyphenol	Hydroqui none monoet hyl et her	$\text{C}_8\text{H}_9\text{O}_2$	622-62-8	138.164	pr or lf (w)	66.5	246.5			sl H ₂ O; vs Et OH, et h; s chl
4861	<i>N</i> -(2-Et hoxyphenyl)acet ami de		$\text{C}_{10}\text{H}_{13}\text{NO}_2$	581-08-8	179.216	lf (di l al)	79	>240			sl H ₂ O; vs Et OH, et h, chl
4862	<i>N</i> -(4-Et hoxyphenyl)acet ami de	Phenacet i n	$\text{C}_{10}\text{H}_{13}\text{NO}_2$	62-44-2	179.216	mcl pr	137.5			1.571	sl H ₂ O, et h, bz; s Et OH, ace; vs py
4863	<i>N</i> -(4-Et hoxyphenyl)-2-hydroxypropanami de	<i>p</i> -Lact ophenet i de	$\text{C}_9\text{H}_{13}\text{NO}_3$	539-08-2	209.242		118				s H ₂ O; vs Et OH; sl et h, bz, chl, pet h



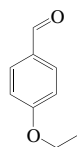
3-Et hoxyani li ne



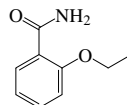
4-Et hoxyani li ne



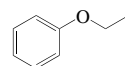
2-Et hoxybenzaldehyde



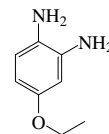
4-Et hoxybenzaldehyde



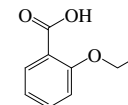
2-Et hoxybenzami de



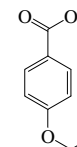
Et hoxybenzene



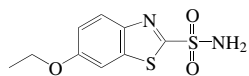
4-Et hoxy-1,2-benzenedi ami ne



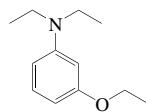
2-Et hoxybenzoi aci d



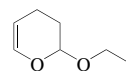
4-Et hoxybenzoi aci d



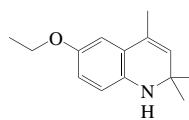
6-Et hoxy-2-benzot hi azol esulf onami de



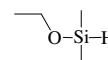
3-Et hoxy-N,N-di et hyl ani li ne



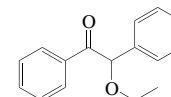
2-Et hoxy-3,4-di hydro-2H-pyran



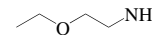
6-Et hoxy-1,2-di hydro-2,2,4-tri met hyl qui nol i ne



Et hoxydi met hyl si l ane

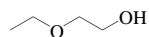


2-Et hoxy-1,2-di phenyl et hanone

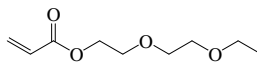


2-Et hoxet hanami ne

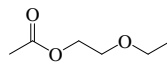
3-259



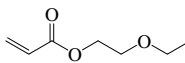
2-Et hoxet hanol



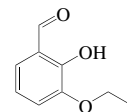
2-(2-Et hoxet hoxy)et hyl-propenoat e



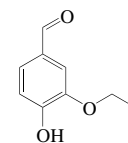
2-Et hoxet hyl acet at e



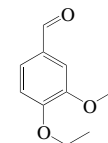
2-Et hoxet hyl acryl at e



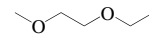
3-Et hoxy-2-hydroxybenzaldehyde



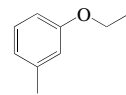
3-Et hoxy-4-hydroxybenzaldehyde



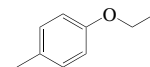
4-Et hoxy-3-met hoxybenzaldehyde



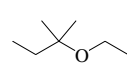
1-Et hoxy-2-met hoxet hane



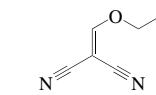
1-Et hoxy-3-met hyl benzer



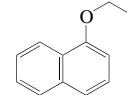
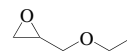
1-Et hoxy-4-met hyl benzer



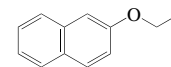
2-Et hoxy-2-met hyl but ane



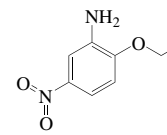
(Et hoxymet hyl ene)propanedi ni t ri l d(Et hoxymet hyl)oxi rane



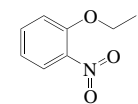
1-Et hoxynapht hal ene



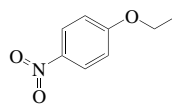
2-Et hoxynapht hal ene



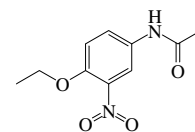
2-Et hoxy-5-ni t roani li ne



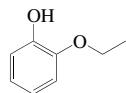
1-Et hoxy-2-ni t robenzene



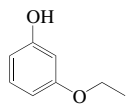
1-Et hoxy-4-ni t robenzene



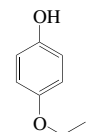
N-(4-Et hoxy-3-ni t rophenyl)acet ami de



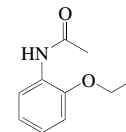
2-Et hoxyphenol



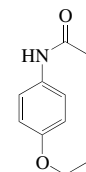
3-Et hoxyphenol



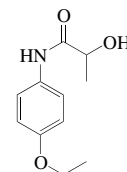
4-Et hoxyphenol



N-(2-Et hoxyphenyl)acet ami de

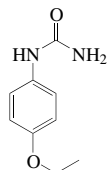


N-(4-Et hoxyphenyl)acet ami de



N-(4-Et hoxyphenyl)-2-hydroxypropanami de

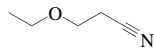
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4864	(4-Et hoxypheyl)urea	Dulci n	$\text{C}_9\text{H}_{12}\text{N}_2\text{O}_2$	150-69-6	180.203	lf (di l al), pl (w)	173.5	dec			s; Et OH; vs AcOEt
4865	3-Et hoxypropanal		$\text{C}_7\text{H}_{10}\text{O}_2$	2806-85-1	102.132			135.2	0.9165 ²⁰		
4866	3-Et hoxypropaneni tri le		$\text{C}_7\text{H}_{10}\text{NO}$	2141-62-0	99.131			171	0.9285 ¹⁵	1.4068 ²⁰	vs et h, Et OH
4867	8-Et hoxi-5-qui nol i nesul f oni c aci d	Act i noqui nol	$\text{C}_{11}\text{H}_{11}\text{NO}_5$	15301-40-3	253.275	br nd (w)	286 dec				s al k
4868	Et hoxyt ri met hyl si l ane		$\text{C}_7\text{H}_9\text{OSi}$	1825-62-3	118.250			76	0.7573 ⁹	1.3741 ²⁰	i H ₂ O; s Et OH, et h, ace
4869	Et hoxyt ri phenyl si l ane		$\text{C}_{20}\text{H}_{19}\text{OSi}$	1516-80-9	304.458		65	344			s chl
4870	N-Et hyl acet ami de		$\text{C}_4\text{H}_9\text{NO}$	625-50-3	87.120			205; 104 ¹⁸	0.942 ⁴	1.4338 ²⁰	msc H ₂ O, Et OH; s chl, HOAc
4871	Et hyl acet at e		$\text{C}_2\text{H}_4\text{O}_2$	141-78-6	88.106	li q	-83.8	77.11	0.9009 ⁹	1.3723 ²⁰	s H ₂ O; msc Et OH, et h; vs ace, bz
4872	Et hyl acet oacet at e		$\text{C}_6\text{H}_{10}\text{O}_3$	141-97-9	130.141	li q	-45	180.8	1.0368 ⁸	1.4171 ²⁰	s H ₂ O; msc Et OH, et h; s bz, chl
4873	4-Et hyl acet ophenone		$\text{C}_{10}\text{H}_{12}\text{O}$	937-30-4	148.201			114 ¹¹			
4874	Et hyl 2-acet yl hexanoat e		$\text{C}_{16}\text{H}_{24}\text{O}_2$	1540-29-0	186.248			221.5	0.9523 ²⁰	1.4301 ²⁰	vs ace, et h
4875	Et hyl 2-acet yl -3-met hyl but anoat e		$\text{C}_{11}\text{H}_{18}\text{O}_2$	1522-46-9	172.221			201; 97 ²⁰	0.9648 ¹⁸	1.4256 ¹⁸	i H ₂ O; msc Et OH, et h
4876	Et hyl 2-acet yl pent anoat e		$\text{C}_9\text{H}_{16}\text{O}_2$	1540-28-9	172.221			224; 90 ¹⁵	0.9661 ²⁰	1.4255 ²⁰	vs et h, Et OH
4877	Et hyl 2-acet yl -4-pent enoat e	Et hyl 2-yl acet oacet at e	$\text{C}_9\text{H}_{14}\text{O}_2$	610-89-9	170.205			208	0.9898 ²⁰	1.4388 ¹⁸	msc Et OH, et h, bz
4878	Et hyl acryl at e	Et hyl propenoat e	$\text{C}_3\text{H}_4\text{O}_2$	140-88-5	100.117	li q	-71.2	99.4	0.9234 ⁴	1.4068 ²⁰	sl H ₂ O, DMSO; msc Et OH, et h; s chl
4879	Et hyl ami ne	Et hanami ne	$\text{C}_2\text{H}_7\text{N}$	75-04-7	45.084	vol li q or gas	-80.5	16.5	0.677 (p>1 at m)	1.3663 ²⁰	msc H ₂ O, Et OH, et h
4880	Et hyl ami ne hydrochl ori de	Et hanami ne hydrochl ori de	$\text{C}_2\text{H}_9\text{ClN}$	557-66-4	81.545	mcl pl (al)	109.5		1.2160 ⁸		vs H ₂ O, Et OH
4881	Et hyl 2-ami noacet at e	Gl yci ne, et hyl est er	$\text{C}_2\text{H}_5\text{NO}_2$	459-73-4	103.120			149; 58 ¹⁸	1.0275 ¹⁰	1.4242 ¹⁰	msc H ₂ O, Et OH, et h, ace, bz; vs li g
4882	Et hyl 2-ami nobenzoat e		$\text{C}_7\text{H}_7\text{NO}_2$	87-25-2	165.189			268	1.1174 ²⁰	1.5646 ²⁰	vs et h, Et OH
4883	Et hyl 3-ami nobenzoat e		$\text{C}_7\text{H}_7\text{NO}_2$	582-33-2	165.189			294; 160 ⁵	1.171 ²⁰	1.5600 ²²	sl H ₂ O; vs Et OH, et h; s ct c
4884	Et hyl 4-ami nobenzoat e	Et hyl ami nobenzoat e	$\text{C}_7\text{H}_7\text{NO}_2$	94-09-7	165.189	nd (w), ort h (et h)	92	310			i H ₂ O; vs Et OH, et h; s chl, aci d
4885	Et hyl (ami nocarbonyl)carbamat e		$\text{C}_4\text{H}_9\text{N}_2\text{O}_3$	626-36-8	132.118	nd (w, bz)	196.5	dec			i H ₂ O, et h; sl Et OH, bz, t f a
4886	2-(Et hyl ami no)et hanol		$\text{C}_7\text{H}_{15}\text{NO}$	110-73-6	89.136			169.5	0.914 ²⁰	1.444 ²⁰	vs H ₂ O, Et OH, et h; s chl
4887	2-Et hyl ani li ne		$\text{C}_8\text{H}_{17}\text{N}$	578-54-1	121.180	li q	-43	209.5	0.988 ³	1.5584 ²²	sl H ₂ O, chl; vs Et OH, et h
4888	3-Et hyl ani li ne		$\text{C}_8\text{H}_{17}\text{N}$	587-02-0	121.180	li q	-64	214; 94	0.9896 ²⁵		vs et h, Et OH
4889	4-Et hyl ani li ne		$\text{C}_8\text{H}_{17}\text{N}$	589-16-2	121.180	li q	-2.4	217.5	0.9679 ⁹	1.5554 ²⁰	sl H ₂ O, ct c; vs Et OH, et h
4890	N-Et hyl ani li ne		$\text{C}_8\text{H}_{17}\text{N}$	103-69-5	121.180	li q	-63.5	203.0	0.9625 ⁹	1.5559 ²⁰	i H ₂ O; msc Et OH, et h; vs ace, bz; s ct c
4891	2-Et hyl -9,10-ant hracenedi one		$\text{C}_{16}\text{H}_{12}\text{O}_2$	84-51-5	236.265		108.8				
4892	4-Et hyl benzal dehyde		$\text{C}_{10}\text{H}_{10}\text{O}$	4748-78-1	134.174			221	0.9790 ²⁰		
4893	N-Et hyl benzami de		$\text{C}_8\text{H}_{11}\text{NO}$	614-17-5	149.189	nd (w)	70.5				
4894	Et hyl benzene	Phenyl et hane	C_6H_6	100-41-4	106.165	li q	-94.96	136.19	0.8626 ⁶	1.4959 ²⁰	i H ₂ O; msc Et OH, et h; sl chl
4895	α -Et hyl benzeneacet ami de	α -Phenyl but yrami de	$\text{C}_{11}\text{H}_{13}\text{NO}$	90-26-6	163.216	cry	86	185 ¹⁶			s H ₂ O, ct c; sl ace
4896	α -Et hyl benzeneacet i c aci d		$\text{C}_{10}\text{H}_8\text{O}_2$	90-27-7	164.201	pl (et h)	47.5	271			s et h, bz, ct c
4897	α -Et hyl benzeneacet oni tri le		$\text{C}_{10}\text{H}_8\text{N}$	769-68-6	145.201			241	0.977 ¹⁴		i H ₂ O; s Et OH, et h, bz
4898	4-Et hyl -1,3-benzenedi ol		$\text{C}_8\text{H}_{10}\text{O}_2$	2896-60-8	138.164	pr (chl, bz)	98.5	160 ⁴ , 131 ¹⁵			sl H ₂ O, Et OH, et h
4899	α -Et hyl benzenemet hanol	α -Et hyl benzyl al cohol	$\text{C}_8\text{H}_{10}\text{O}$	93-54-9	136.190			219	0.9915 ²⁵	1.5169 ²³	vs bz, et h, Et OH, MeOH
4900	Et hyl benzenesul f onat e		$\text{C}_8\text{H}_9\text{O}_3\text{S}$	515-46-8	186.228			156 ¹⁵	1.2167 ²⁰	1.5081 ²⁰	sl H ₂ O; s Et OH; vs et h, chl
4901	4-Et hyl benzenesul f oni c aci d		$\text{C}_8\text{H}_9\text{O}_3\text{S}$	98-69-1	186.228				1.23		
4902	2-Et hyl -4-benzi mi dazol e		$\text{C}_{10}\text{H}_{10}\text{N}_2$	1848-84-6	146.188		176.5				sl chl
4903	Et hyl benzoat e		$\text{C}_8\text{H}_8\text{O}_2$	93-89-0	150.174	li q	-34	212	1.0415 ⁵	1.5007 ²⁰	i H ₂ O; s Et OH, ace, bz; msc et h; sl ct c
4904	Et hyl 1,3-benzodi oxol e-5-carboxyl at e		$\text{C}_{10}\text{H}_8\text{O}_4$	6951-08-2	194.184	pr	18.5	285.5; 135 ⁶			vs et h, Et OH, pet h



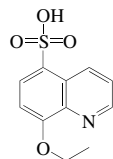
(4-Et hoxýphenyl) urea



3-Et hoxýpropanal



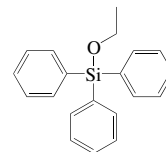
3-Et hoxýpropanenitril e



8-Et hoxý-5-qui nol i nesulf onát e



Et hoxýt ri met hýl sí l ane



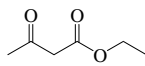
Et hoxýt ri phenýl sí l ane



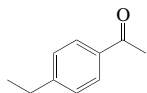
N-Et hýl acet amí de



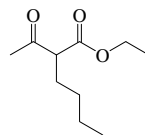
Et hýlacet át e



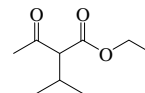
Et hýlacet oacet át e



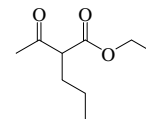
4-Et hýl acet ophenone



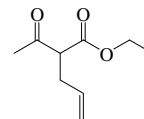
Et hýl2-acet ýl hexanoát e



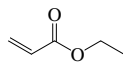
Et hýl2-acet ýl -3-met hýl but anoát e



Et hýl2-acet ýl pent anoát e



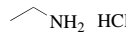
Et hýl2-acet ýl -4-pent enoát e



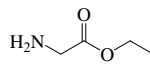
Et hýlacryl át e



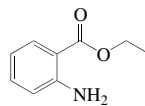
Et hýl amí ne



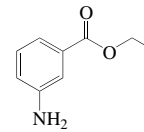
Et hýl amí rýdrochl orí de



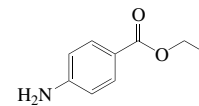
Et hýl2-amí noacet át e



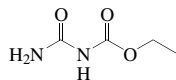
Et hýl2-amí nobenzoát e



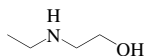
Et hýl3-amí nobenzoát e



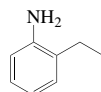
Et hýl4-amí nobenzoát e



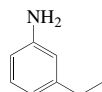
Et hýl(amí nocarbonyl) carbamat e



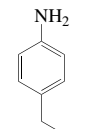
2-(Et hýl amí no) et hanol



2-Et hýl aní lí ne



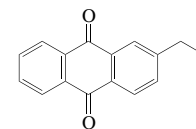
3-Et hýl aní lí ne



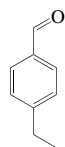
4-Et hýl aní lí ne



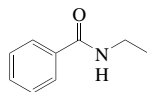
N-Et hýl aní lí ne



2-Et hýl -9,10-ant hracenedí one



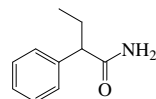
4-Et hýl benzaldehyd



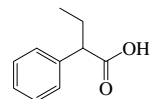
N-Et hýl benzamí de



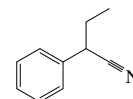
Et hýl benzene



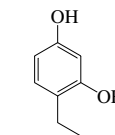
α-Et hýl benzeneacet amí de



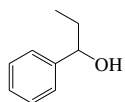
α-Et hýl benzeneacet át e



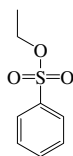
α-Et hýl benzeneacet oní trí l



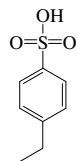
4-Et hýl -1,3-benzenedí ol



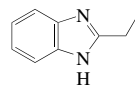
α-Et hýl benzeneet hanol



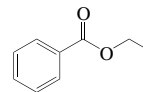
Et hýlbenzenesulf onát e



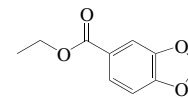
4-Et hýl benzenesulf onát e



2-Et hýl -H-benzi mí dazol e

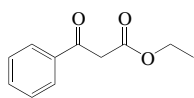


Et hýlbenzoát e

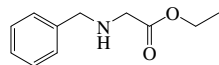


Et hýl1,3-benzodí oxol e-5-carboxýl át e

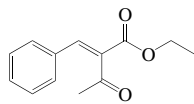
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4905	Et hyl benzoyl acet at e		₁₁ H ₁₂ O ₃	94-02-0	192.211		<0	dec 267; 167 ²⁰	1.1202 ¹⁵	1.5317 ¹⁵	sl H ₂ O; s Et OH, et h
4906	Et hyl <i>N</i> -benzyl glyci nat e		₁₇ H ₁₅ NO ₂	6436-90-4	193.243			177 ⁵⁰		1.5041 ²⁰	vs Et OH, et h, bz
4907	Et hyl 2-benzyl i deneacet oacet at e		₁₃ H ₁₀ O ₃	620-80-4	218.248	ort h pl (di l al)	60.5	296; 180			i H ₂ O; sl Et OH, et h, bz; vs chl
4908	Et hyl bromoacet at e		₄ H ₅ BrO ₂	105-36-2	167.002			168.5	1.5032 ²⁰	1.4489 ²⁰	i H ₂ O; msc Et OH, et h; s ace; sl ct c
4909	Et hyl 4-bromoacet oacet at e		₆ H ₇ BrO ₃	13176-46-0	209.037			115 ¹⁴ , 110 ¹⁰	1.5278 ¹⁸	1.5281 ²⁰	vs et h, Et OH
4910	Et hyl 4-bromobenzoat e		₈ H ₇ BrO ₂	5798-75-4	229.070	li q	-18	263; 125 ⁹	1.4332 ¹⁷	1.5438 ¹⁷	sl H ₂ O; s Et OH, et h, ace, bz
4911	Et hyl 2-bromobut anoat e		₆ H ₉ BrO ₂	533-68-6	195.054			177; 43 ⁵	1.3273 ²⁰	1.4475 ²⁰	i H ₂ O; msc Et OH, et h; s chl
4912	Et hyl 4-bromobut anoat e		₆ H ₉ BrO ₂	2969-81-5	195.054			192; 82 ¹⁰	1.3540 ²⁰	1.4559 ²⁰	
4913	Et hyl <i>t rans</i> 4-bromo-2-but enoat e		₈ H ₉ BrO ₂	37746-78-4	193.038			100 ¹⁴	1.402 ¹⁶	1.4925 ²⁰	vs Et OH
4914	Et hyl 6-bromohexanoat e	Et hyl 6-bromocaproat e	₈ H ₁₃ BrO ₂	25542-62-5	223.108	cry (pet h)	33	128 ¹	1.238 ²³	1.4566 ²¹	
4915	Et hyl 2-bromo-3-met hyl but anoat e		₇ H ₉ BrO ₂	609-12-1	209.081			186	1.2760 ²⁰	1.4496 ²⁰	vs et h, Et OH
4916	Et hyl 2-bromo-2-met hyl propanoat e		₆ H ₉ BrO ₂	600-00-0	195.054			163	1.3263 ²⁰	1.4446 ²⁰	i H ₂ O; s Et OH; msc et h
4917	Et hyl 3-bromo-2-oxopropanoat e	Et hyl 3-bromopyruvat e	₅ H ₇ BrO ₃	70-23-5	195.012			87 ⁹			
4918	Et hyl 2-bromopent anoat e		₇ H ₉ BrO ₂	615-83-8	209.081			191	1.226 ¹⁸	1.4496 ²⁰	i H ₂ O; s Et OH, et h
4919	Et hyl 5-bromopent anoat e		₇ H ₉ BrO ₂	14660-52-7	209.081			129 ³⁵ , 107 ²⁰	1.3085 ²⁰	1.4543 ²⁰	sl ct c
4920	Et hyl 2-bromopropanoat e	Et hyl-bromopropi onat e	₆ H ₉ BrO ₂	535-11-5	181.028			dec 160; 71 ²⁶	1.4135 ²⁰	1.4490 ²⁰	i H ₂ O; msc Et OH, et h; s chl
4921	Et hyl 3-bromopropanoat e		₆ H ₉ BrO ₂	539-74-2	181.028			179; 65 ¹⁵	1.4123 ¹⁸	1.4516 ²⁰	s Et OH, et h, ace; sl ct c
4922	2-Et hyl but anal	Di et hyl acet al dehyde	₆ H ₁₂ O	97-96-1	100.158			118 ¹⁶⁰	0.8110 ²⁰	1.4025 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
4923	Et hyl but anoat e		₆ H ₁₂ O ₂	105-54-4	116.158	li q	-98	121.3	0.873 ⁹	1.3898 ²⁵	sl H ₂ O, ct c; s Et OH, et h
4924	2-Et hyl but anoi c aci d	Di et hyl acet i c aci d	₆ H ₁₂ O ₂ C	88-09-5	116.158	li q	-31.8	194	0.923 ⁹	1.4132 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
4925	2-Et hyl but anoi caci d, t ri et hyl eneglycol di est er		C ₁₈ H ₃₄ O ₆	95-08-9	346.459			181 ^{3,5}			
4926	2-Et hyl -1-but anol		₆ H ₁₄ O	97-95-0	102.174		<-15	147	0.8326 ²⁰	1.4220 ²⁰	sl H ₂ O; s Et OH, et h, chl
4927	2-Et hyl but anoyl chl ori de		₆ H ₁₁ ClO	2736-40-5	134.603			140	0.9825 ²⁰	1.4234 ²⁰	vs et h
4928	2-Et hyl -1-but ene		₆ H ₁₂	760-21-4	84.159	li q	-131.5	64.7	0.689 ⁴	1.3969 ²⁰	i H ₂ O; s et h, ace, bz, chl
4929	Et hyl <i>ci s</i> -2-but enoat e	Et hyl i socrot onat e	₆ H ₁₀ O ₂	6776-19-8	114.142			136	0.9182 ²⁰	1.4242 ²⁰	vs ace, et h, Et OH
4930	Et hyl <i>t rans</i> -2-but enoat e	Et hyl crot onat e	₆ H ₁₀ O ₂	623-70-1	114.142			138	0.9175 ²⁰	1.4243 ²⁰	i H ₂ O; s Et OH, et h
4931	Et hyl 3-but enoat e		₆ H ₁₀ O ₂	1617-18-1	114.142			119	0.9122 ²⁰	1.4105 ²⁰	s Et OH
4932	2-Et hyl but yl acet at e		₈ H ₁₆ O ₂	10031-87-5	144.212		<-100	162.5	0.8790 ²⁰	1.4109 ²⁰	i H ₂ O; s Et OH, et h, ct c
4933	2-Et hyl but yl acryl at e		₈ H ₁₄ O ₂	3953-10-4	156.222	li q		80			
4934	2-Et hyl but yl ami ne	2-Et hyl -1-but anami ne	₆ H ₁₃ NC	617-79-8	101.190	li q	125				
4935	Et hyl <i>N</i> -but yl carbamat e		₈ H ₁₅ NO ₂	591-62-8	145.200	li q	-22	202; 100 ⁹	0.9434 ²⁶	1.4278 ²⁶	
4936	Et hyl 2-but ynoat e		₆ H ₁₀ O ₂	4341-76-8	112.127			163	0.9641 ²⁰	1.4372 ²⁰	
4937	Et hyl carbamat e	Uret hane	₃ H ₆ NO ₂	51-79-6	89.094	pr (bz, t o)	49	185	0.9862 ¹	1.4144 ⁵¹	vs H ₂ O, Et OH, et h, bz, chl, py; sl li g
4938	9-Et hyl - <i>H</i> -carbazol -3-ami ne		C ₉ H ₁₄ N ₂	132-32-1	210.274		99				
4939	9-Et hyl - <i>H</i> -carbazol e		C ₉ H ₁₃ N	86-28-2	195.260	nd (al)	68	190 ⁰	1.059 ⁸⁰	1.6394 ⁸⁰	i H ₂ O; vs Et OH, et h
4940	Et hyl chl oroacet at e		₄ H ₅ ClO ₂	105-39-5	122.551	li q	-21	144.3	1.158 ⁹	1.4215 ²⁰	i H ₂ O; msc Et OH, et h, ace; s bz
4941	Et hyl 4-chl oroacet oacet at e		₆ H ₇ ClO ₃	638-07-3	164.586		-8	dec 220; 115 ¹⁴	1.218 ²⁵	1.4520 ²⁰	
4942	Et hyl 4-chl orobenzoat e		₇ H ₅ ClO ₂	7335-27-5	184.619			237.5	1.1873 ¹⁴		vs Et OH
4943	Et hyl 4-chl orobut anoat e		₆ H ₇ ClO ₂	3153-36-4	150.603			184	1.0756 ²⁰	1.4311 ²⁰	vs ace, et h, Et OH
4944	Et hyl chl orofluoroacet at e		₄ H ₄ ClFO ₂	401-56-9	140.541			129	1.225 ²⁰	1.3927 ²⁰	
4945	Et hyl chl orof ormat e		₃ H ₃ ClO ₂	541-41-3	108.524	li q	-80.6	95	1.135 ²	1.3974 ²⁰	vs bz, et h, chl



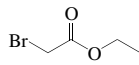
Et hylbenzoyl acet at e



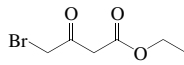
Et hylN-benzyl glyci nat e



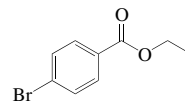
Et hyl2-benzyl i deneacet oacet at e



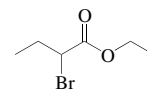
Et hylbromoacet at e



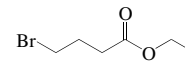
Et hyl4-bromoacet oacet at e



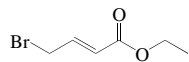
Et hyl4-bromobenzoat e



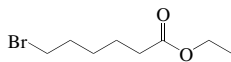
Et hyl2-bromobut anoat e



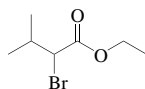
Et hyl4-bromobut anoat e



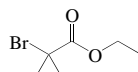
Et hyl4-bromo-2-but enoat e



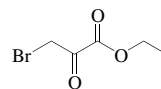
Et hyl6-bromohexanoat e



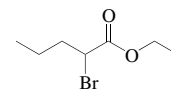
Et hyl2-bromo-3-met hyl but anoat e



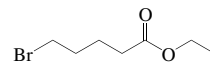
Et hyl2-bromo-2-met hyl propanoat e



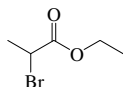
Et hyl3-bromo-2-oxopropanoat e



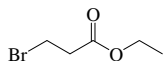
Et hyl2-bromopent anoat e



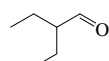
Et hyl5-bromopent anoat e



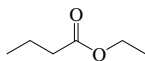
Et hyl2-bromopropanoat e



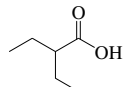
Et hyl3-bromopropanoat e



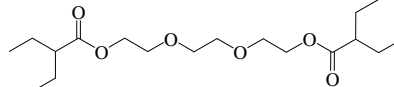
2-Et hyl but anal



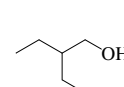
Et hylbut anoat e



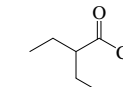
2-Et hyl but anoici d



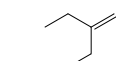
2-Et hyl but anoici d j ri et hyl enegly dylolest er



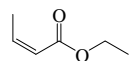
2-Et hyl -1-but anol



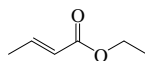
2-Et hyl but anoyl chl ori de



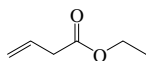
2-Et hyl -1-but ene



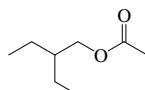
Et hylci s2-but enoat e



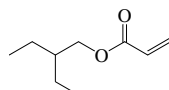
Et hylt rans2-but enoat e



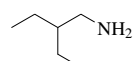
Et hyl3-but enoat e



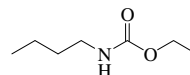
2-Et hyl but yl acet at e



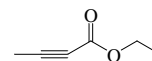
2-Et hyl but yl acryl at e



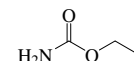
2-Et hyl but yl ami ne



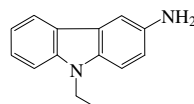
Et hylN-but yl carbamat e



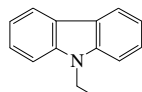
Et hyl2-but ynoat e



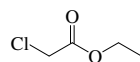
Et hylcarbamat e



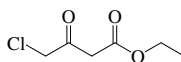
9-Et hyl -9H-carbazol -3-ami ne



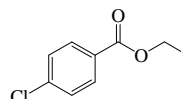
9-Et hyl -9H-carbazol e



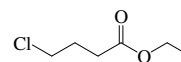
Et hylchl oroacet at e



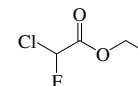
Et hyl4-chl oroacet oacet at e



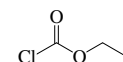
Et hyl4-chl orobenzoat e



Et hyl4-chl orobut anoat e

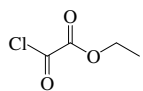


Et hylchl orof l uoroacet e

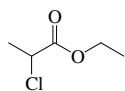


Et hylchl orof ormat e

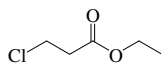
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4946	Et hyl 2-chloro-2-oxoacetate	Et hyl oxalyl chloride	$\text{C}_2\text{H}_2\text{Cl}_2\text{O}_2$	4755-77-5	136.534	hyg		137	1.2226 ²⁰		vs bz, et h
4947	Et hyl 2-chloropropanoate	Et hyl chloropropionate	$\text{C}_3\text{H}_5\text{ClO}_2$	535-13-7	136.577			147	1.0793 ²⁰	1.4178 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
4948	Et hyl 3-chloropropanoate		$\text{C}_3\text{H}_5\text{ClO}_2$	623-71-2	136.577			162	1.1086 ²⁰	1.4254 ²⁰	sl H ₂ O; msc Et OH, et h
4949	Et hyl chlorosulfinate		$\text{C}_2\text{H}_2\text{ClO}_2\text{S}$	6378-11-6	128.578			52.5 ⁴⁴ , 32 ¹⁶	1.2837 ²⁰	1.4550 ²⁵	vs et h
4950	Et hyl chlorosulfonate		$\text{C}_2\text{H}_2\text{ClO}_3\text{S}$	625-01-4	144.577			152.5; 93 ¹⁰⁰	1.3502 ²⁵	1.416 ²⁰	vs et h, chl, li g
4951	S-Et hyl chlorothioformate		$\text{C}_2\text{H}_2\text{OS}$	2941-64-2	124.589	li q		136	1.195	1.4820 ²⁰	
4952	Et hyl trans-2-phenylpropanoate	Et hyl trans-3-phenyl-2-propenoate	$\text{C}_9\text{H}_{10}\text{O}_2$	4192-77-2	176.212		10	271.5	1.0491 ²⁰	1.5598 ²⁰	i H ₂ O; vs Et OH, et h, ace; s bz, ct c
4953	Et hyl cyanate		$\text{C}_2\text{H}_3\text{NO}$	627-48-5	71.078			dec 162; 30 ¹²	0.89 ²⁰	1.3788 ²⁵	vs et h, Et OH
4954	Et hyl cyanoacetate		$\text{C}_3\text{H}_3\text{NO}_2$	105-56-6	113.116	li q	-22.5	205	1.0654 ⁴	1.4175 ²⁰	s H ₂ O; vs et h, Et OH
4955	Et hyl 2-cyanoacrylate	Et hyl 2-cyano-2-propenoate	$\text{C}_5\text{H}_7\text{NO}_2$	7085-85-0	125.126	li q		55			
4956	Et hyl 2-cyano-3,3-diphenyl-2-propenoate	Et ocrolene	$\text{C}_{19}\text{H}_{15}\text{NO}_2$	5232-99-5	277.318		110.5	195 ³			
4957	Et hyl 2-cyano-3-ethoxyacrylate		$\text{C}_7\text{H}_9\text{NO}_3$	94-05-3	169.178		52	190.5			
4958	Et hyl cyanofornate		$\text{C}_2\text{H}_2\text{NO}_2$	623-49-4	99.089			115.5	1.003 ²⁵	1.3820 ²⁰	i H ₂ O; s Et OH, et h, ct c
4959	Et hyl 2-cyano-2-phenylacetate		$\text{C}_{11}\text{H}_{11}\text{NO}_2$	4553-07-5	189.211	oi l		dec 275; 165 ²⁰	1.091 ²⁰	1.5012 ²⁵	vs ace, bz, et h, Et OH
4960	Et hyl 2-cyano-3-phenyl-2-propenoate	Et hyl 2-benzylidene-2-cyanoacetate	$\text{C}_{12}\text{H}_{11}\text{NO}_2$	2025-40-3	201.221	(i)nd(al)(i)oi l	51	198	1.1076 ²⁵	1.5033	vs ace, chl
4961	Et hyl cyclobutane		C_4H_8	4806-61-5	84.159	li q	-142.9	70.8	0.7284 ⁴	1.4020 ²⁰	i H ₂ O; msc Et OH, et h; s ace, bz, pet h
4962	Et hyl cyclohexane		C_6H_{12}	1678-91-7	112.213	li q	-111.3	131.9	0.7880 ⁴	1.4330 ²⁰	i H ₂ O; s Et OH, ace, bz; vs li g; msc ct c
4963	Et hyl cyclohexanecarboxylate		$\text{C}_7\text{H}_{12}\text{O}_2$	3289-28-9	156.222			196	0.9362 ²⁰	1.4501 ¹⁵	vs ace, et h, Et OH, chl
4964	1-Et hyl cyclohexene		C_8H_{14}	1453-24-3	110.197	li q	-109.9	137	0.8176 ⁴	1.4567 ²⁰	
4965	Et hyl 3-cyclohexene-1-carboxylate		$\text{C}_9\text{H}_{16}\text{O}_2$	15111-56-5	154.206			194.5	0.9688 ²⁰	1.4578 ²⁰	
4966	Et hyl cyclohexylacetate		$\text{C}_{10}\text{H}_{18}\text{O}_2$	5452-75-5	170.249			211	0.9537 ¹⁴	1.451 ¹⁴	
4967	Et hyl cyclopentane		C_5H_{10}	1640-89-7	98.186	li q	-138.4	103.5	0.7665 ⁴	1.4198 ²⁰	i H ₂ O; msc Et OH, et h, ace; s bz, t ol
4968	Et hyl 2-cyclopentanone-1-carboxylate		$\text{C}_7\text{H}_{10}\text{O}_3$	611-10-9	156.179			221; 110 ¹⁶	1.0781 ²¹	1.4519 ²⁰	s et h, bz
4969	1-Et hyl cyclopentene		C_6H_{10}	2146-38-5	96.170	li q	-118.5	106.3	0.7936 ⁴	1.4412 ²⁰	
4970	Et hyl cyclopropane		C_3H_6	1191-96-4	70.133	li q	-149.2	35.9	0.6790 ⁴	1.3786 ²⁰	
4971	Et hyl cyclopropanecarboxylate		$\text{C}_4\text{H}_6\text{O}_2$	4606-07-9	114.142			134	0.9608 ¹⁵	1.4190 ²⁰	
4972	Et hyl decanoate	Et hyl caprate	$\text{C}_{12}\text{H}_{24}\text{O}_2$	110-38-3	200.318	li q	-20	241.5	0.8650 ⁴	1.4256 ²⁰	i H ₂ O; vs et h, Et OH, chl
4973	Et hyl diazoacetate	Di azoacetate ester	$\text{C}_2\text{H}_2\text{N}_2\text{O}_2$	623-73-4	114.103	ye ort h cry	-22	dec 140	1.0852 ⁸	1.4605 ²⁰	sl H ₂ O; msc Et OH, et h, bz, li g
4974	Et hyl dibromoacetate		$\text{C}_2\text{H}_2\text{Br}_2\text{O}_2$	617-33-4	245.898			194	1.8991 ²⁰	1.5017 ¹³	i H ₂ O; msc Et OH, et h
4975	Et hyl 2,3-dibromobutanoate		$\text{C}_4\text{H}_6\text{Br}_2\text{O}_2$	609-11-0	273.950	nd	58.5	113 ³⁰	1.6800 ²⁰		sl H ₂ O, ct c; s Et OH, et h
4976	Et hyl 2,4-dibromobutanoate		$\text{C}_4\text{H}_6\text{Br}_2\text{O}_2$	36847-51-5	273.950			149 ³²	1.6987 ²⁰	1.4960 ²⁰	i H ₂ O; s Et OH, et h
4977	Et hyl 2,3-dibromopropanoate		$\text{C}_3\text{H}_4\text{Br}_2\text{O}_2$	3674-13-3	259.925			214.5	1.7966 ²⁰	1.5007 ²⁰	s Et OH, et h
4978	Et hyl 3,6-dithiabutyl-1-naphthalenesulfonate	Et hyl dibunate	$\text{C}_{20}\text{H}_{20}\text{O}_2\text{S}$	5560-69-0	348.499						s chl
4979	Et hyl dichloroacetate		$\text{C}_2\text{H}_2\text{Cl}_2\text{O}_2$	535-15-9	156.996			155; 56 ¹⁰	1.2827 ²⁰	1.4386 ²⁰	sl H ₂ O; msc Et OH, et h; s ace, chl
4980	Et hyl dichloroarsine	Di chloroethylarsine	$\text{C}_2\text{H}_2\text{AsCl}_2$	598-14-1	174.889			155.3; 74 ⁵⁰	1.66 ²⁰		s H ₂ O; mi sc Et OH, bz
4981	Et hyl dichloroacetamide		$\text{C}_2\text{H}_2\text{Cl}_2\text{NO}_2$	13698-16-3	157.984			66 ¹⁸ , 55 ¹⁵	1.304 ³⁰	1.4595 ²⁰	
4982	Et hyl 2,3-dichloropropanoate		$\text{C}_3\text{H}_2\text{Cl}_2\text{O}_2$	6628-21-3	171.022			183.5	1.2401 ²⁰	1.4482 ²⁰	vs et h, Et OH
4983	Et hyl diethoxyacetate		$\text{C}_6\text{H}_{14}\text{O}_4$	6065-82-3	176.211			199	0.985 ²⁵	1.4100 ²⁰	
4984	Et hyl diethylmalonate		$\text{C}_{11}\text{H}_{20}\text{O}_4$	77-25-8	216.275			230	0.9643 ³⁰	1.4240 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
4985	Et hyl difluoroacetate		$\text{C}_2\text{H}_2\text{F}_2\text{O}_2$	454-31-9	124.087			100	1.1765 ²⁰		i H ₂ O
4986	Et hyl difluoroarsine		$\text{C}_2\text{H}_2\text{AsF}_2$	430-40-0	141.980	li q, fumes in air	-38.7	94.3	1.708		



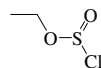
Et hyl2-chl oro-2-oxoacet at e



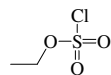
Et hyl2-chl oropropanoat e



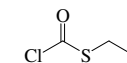
Et hyl3-chl oropropanoat e



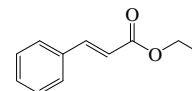
Et hylchl orosul f i nat e



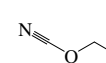
Et hylchl orosul f onat e



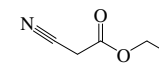
S-Et hylchl orot hi of ormat e



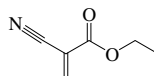
Et hylt ransci nnamat e



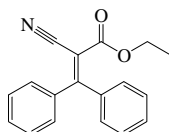
Et hylcyanat e



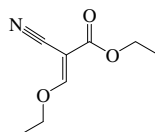
Et hylcyanoacet at e



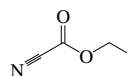
Et hyl2-cyanoacryl at e



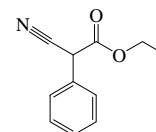
Et hyl2-cyano-3,3-di phenyl -2-propenoat e



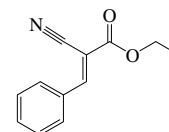
Et hyl2-cyano-3-et hoxyacryl at e



Et hylcyanof ormat e



Et hyl2-cyano-2-phenyl acet at e



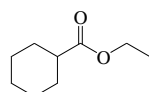
Et hyl2-cyano-3-phenyl -2-propenoat e



Et hyl cycl obut ane



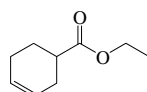
Et hyl cycl ohexane



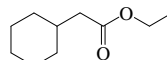
Et hylcycl ohexanecarboxyl at e



1-Et hyl cycl ohexene



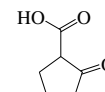
Et hyl3-cycl ohexene-1-carboxyl at e



Et hylcycl ohexyl acet at e



Et hyl cycl opent ane



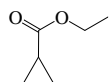
Et hyl2-cycl opent anone-1-carboxyl at e



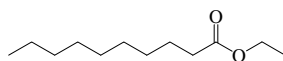
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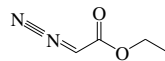
Et hyl cycl opropane



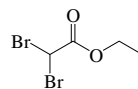
Et hylcycl opropanecarboxyl at e



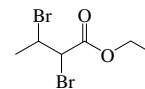
Et hyldecanoat e



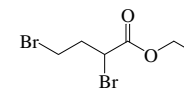
Et hyl di azoacet at e



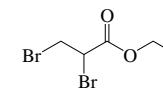
Et hyl di bromoacet at e



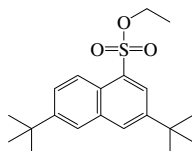
Et hyl2,3-di bromobut anoat e



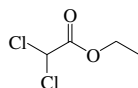
Et hyl2,4-di bromobut anoat e



Et hyl2,3-di bromopropanoat e



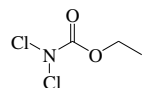
Et hyl3,6-di (t erbut yl)-1-napht hal enesul f onat e



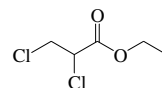
Et hyl di chl oroacet at e



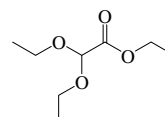
Et hyl di chl oroarsi ne



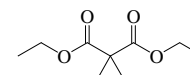
Et hyl di chl oro carbamat e



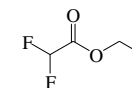
Et hyl2,3-di chl oropropanoat e



Et hyl di et hoxyacet at e



Et hyl di et hyl mal onat e

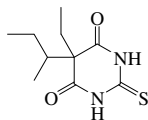


Et hyl di f luoroacet at e

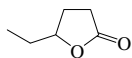


Et hyl di f luoroarsi ne

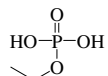
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
4987	5-Et hyl di hydro- <i>Sec</i> -but yl -2-(1 hi oxo-Thi obut arbari t al 4,6(1 <i>H</i> ,5 <i>H</i>)-pyri mi di nedi one		$_{10}C_{16}N_2O_2S$	2095-57-0	228.311		169				
4988	5-Et hyl di hydro-2(3- <i>f</i> uranone		$CH_{10}O_2$	695-06-7	114.142	li q	-18	215.5	1.026 ⁹	1.4495 ²⁰	vs H ₂ O, Et OH
4989	Et hyl di hydrogen phosphat e		$_{3}H_5O_4P$	1623-14-9	126.048	hyg cry		dec	1.430 ²⁵	1.427	vs H ₂ O, ace, et h, Et OH
4990	5-Et hyl di hydro-5-phenyl -4,6(1 <i>H</i> ,5 <i>H</i>)-pyri mi di nedi one	Pri mi done	$CH_{14}N_2O_2$	125-33-7	218.251		281.5				
4991	Et hyl 2,4-di hydroxy-6-met hyl benzoat e		$C_{10}H_{12}O_4$	2524-37-0	196.200	lf (HOAc), pr (al)	132	sub			vs et h, Et OH
4992	<i>O</i> -Et hyl S-[2-(di i sopropyl ami no) et hyl] met hyl phosphonot hi oat e	VX Nerve agent	$C_7H_{25}NO_2PS$	50782-69-9	267.369	very t oxi c li q					
4993	Et hyl di met hyl ami ne	<i>N,N</i> -Di met hyl et hanami ne	$_{4}HCN$	598-56-1	73.137	li q	-140	36.5	0.67 ⁹	1.3705 ²⁵	
4994	Et hyl 4-(di met hyl ami no)benzoat e		$_{11}H_9NO_2$	10287-53-3	193.243		66.5	190 ¹⁴	1.0099 ¹⁰⁰		
4995	1-Et hyl -2,4-di met hyl benzene		$_{10}C_{14}$	874-41-9	134.218	li q	-62.9	188.4	0.876 ⁹	1.5038 ²⁰	vs ace, bz, et h, Et OH
4996	1-Et hyl -3,5-di met hyl benzene		$_{10}C_{14}$	934-74-7	134.218	li q	-84.3	183.6	0.860 ⁸	1.4981 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; s pet h, ct c
4997	2-Et hyl -1,3-di met hyl benzene		$_{10}C_{14}$	2870-04-4	134.218	li q	-16.2	190	0.886 ⁴	1.5107 ²⁰	
4998	2-Et hyl -1,4-di met hyl benzene		$_{10}C_{14}$	1758-88-9	134.218	li q	-53.7	186.9	0.873 ²	1.5043 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; s pet h, ct c
4999	3-Et hyl -1,2-di met hyl benzene		$_{10}C_{14}$	933-98-2	134.218	li q	-49.5	194	0.888 ⁴	1.5117 ²⁰	
5000	4-Et hyl -1,2-di met hyl benzene		$_{10}C_{14}$	934-80-5	134.218	li q	-66.9	189.5	0.870 ⁶	1.5031 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; s pet h, ct c
5001	<i>N'</i> -Et hyl <i>N,N</i> -di met hyl -1,2-et hanedi ami ne		$C_6H_{16}N_2$	123-83-1	116.204			134.5	0.738 ²⁵	1.4222 ²⁰	
5002	Et hyl 4,4-di met hyl -3-oxopent anoat e	Et hyl pi val oyl acet at e	$_{9}H_{16}O_3$	17094-34-7	172.221	li q		8 ³	0.97 ¹⁸		
5003	3-Et hyl -2,2-di met hyl pent ane		$_{9}H_{16}$	16747-32-3	128.255	li q	-99.3	133.8	0.743 ⁸	1.4123 ²⁰	
5004	3-Et hyl -2,3-di met hyl pent ane		$_{9}H_{16}$	16747-33-4	128.255			144.7	0.7508 ²⁵	1.4221 ²⁰	
5005	3-Et hyl -2,4-di met hyl pent ane		$_{9}H_{16}$	1068-87-7	128.255	li q	-122.4	136.7	0.736 ⁹	1.4131 ²⁰	
5006	Et hyl 2,2-di met hyl propanoat e	Et hyl 2,2-di met hyl propi onat e	$_{7}H_{14}O_2$	3938-95-2	130.185	li q	-89.5	118.4	0.85 ⁶	1.3906 ²⁰	s Et OH, et h
5007	3-Et hyl -2,5-di met hyl pyrazi ne		$_{8}H_{12}N_2$	13360-65-1	136.194			180.5	0.9657 ²⁴	1.5014 ²⁴	sl H ₂ O, Et OH, et h
5008	3-Et hyl -2,4-di met hyl pyrrol e		$C_6H_{13}N$	517-22-6	123.196	pr	0	199; 96 ¹⁶	0.913 ²⁰	1.4961 ²⁰	sl H ₂ O; s Et OH, et h, bz, chl
5009	Et hyl 3,5-di met hyl pyrrol e-2-carboxyl at e		$C_8H_{13}NO_2$	2199-44-2	167.205	cry (al)	125	135 ^{9,5}			s Et OH, ace
5010	Et hyl 2,4-di met hyl pyrrol e-3-carboxyl at e		$C_8H_{13}NO_2$	2199-51-1	167.205	cry (et h-li g, pet h)	78.5	291			vs et h, Et OH
5011	Et hyl 2,5-di met hyl pyrrol e-3-carboxyl at e		$C_8H_{13}NO_2$	2199-52-2	167.205	ort h (al)	117.5	291; 13 ⁶			vs Et OH
5012	Et hyl 4,5-di met hyl pyrrol e-3-carboxyl at e		$C_8H_{13}NO_2$	2199-53-3	167.205	cry (di l al)	111.3				vs et h, Et OH, chl
5013	Et hyl 2,4-di oxopent anoat e		$_{7}H_{12}O_4$	615-79-2	158.152		18	214	1.1251 ²⁰	1.4757 ¹⁷	vs et h, Et OH
5014	<i>O</i> -Et hyl di t hi ocarbonat e	Xant hogeni c aci d	$_{3}H_6O_5S_2$	151-01-9	122.209	unst ab li q	-53	25			
5015	Et hyl ene	Et hene	$_{2}H_4$	74-85-1	28.053	col gas	-169.15	-103.77	0.5678 ¹⁰⁴	1.363 ⁻¹⁰⁰	i H ₂ O; sl Et OH, bz, ace; s et h
5016	Et hyl enebi sdi t hi ocarbami c aci d		$_{4}H_8N_2S_4$	111-54-6	212.380	unst ab li q					
5017	Et hyl ene carbonat e	Vi nyl ene carbonat e	$_{3}H_4O_3$	96-49-1	88.062	mcl pl (al)	36.4	248	1.321 ⁴	1.4148 ⁵⁰	msc H ₂ O, Et OH, et h, bz, chl, AcOEt
5018	Et hyl enedi ami net et raacet i c aci d	EDTA	$_{10}H_{16}NO_8$	60-00-4	292.242	cry (w)	245 dec				
5019	Et hyl enedi ami net et raacet i c aci d, EDTA di sodi um di sodi um salt , di hydrat e		$_{18}H_{18}N_2Na_2O_{10}$	6381-92-6	372.237		242 dec				
5020	<i>N,N</i> -Et hyl ene di st earyl ami de	<i>N,N</i> -Di oct adecanyl et hanedi ami ne	$_{38}H_{74}N_2O_2$	110-30-5	593.022	cry (Et OH)	149				



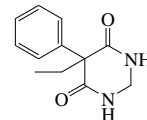
5-Et hyl di hydro-5-sec-but yl -2-thi oxo-4,5,6,7-pyri mi di nedi one



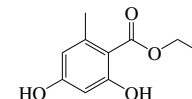
5-Et hyl di hydro-2-ethyl uranone



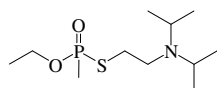
Et hyl di hydrogenphospat e



5-Et hyl di hydro-5-phenyl -4,5,6,7-pyri mi di nedi one



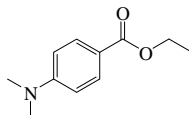
Et hyl 2,4-di hydroxy-6-met hyl benzoat e



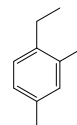
O-Et hyl S-[2-(di isopropyl ami no)et hyl] hyl phosphonot hi oat e



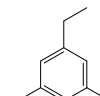
Et hyl di met hyl ami ne



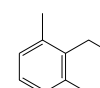
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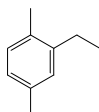
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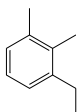
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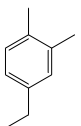
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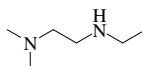
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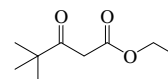
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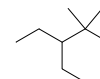
4-Et hyl -1,2-di met hyl benzene



N-Et hyl N,N-di met hyl -1,2-et hanedi ami ne



Et hyl 4,4-di met hyl -3-oxopent oat e



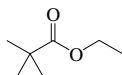
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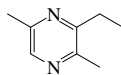
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3-Et hyl -2,4-di met hyl pent ane



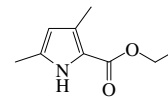
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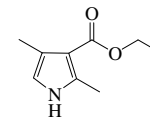
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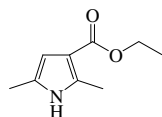
3-Et hyl -2,4-di met hyl pyrrol e



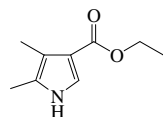
Et hyl 3,5-di met hyl pyrrol e-2-carboxyl at e



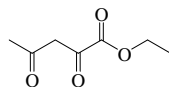
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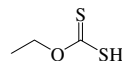
Et hyl 2,5-di met hyl pyrrol e-3-carboxyl at e



Et hyl 4,5-di met hyl pyrrol e-3-carboxyl at e



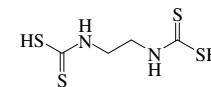
Et hyl 2,4-di oxopent oat e



O-Et hyl di t hi ocarbonat e



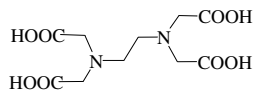
Et hyl ene



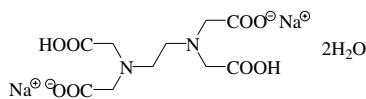
Et hyl enedi s di t hi ocarbonat e



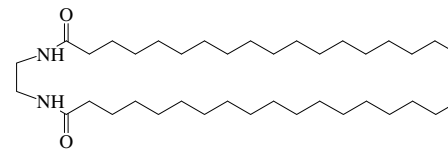
Et hyl enecarbonat e



Et hyl enedi ami net et raacetat id e

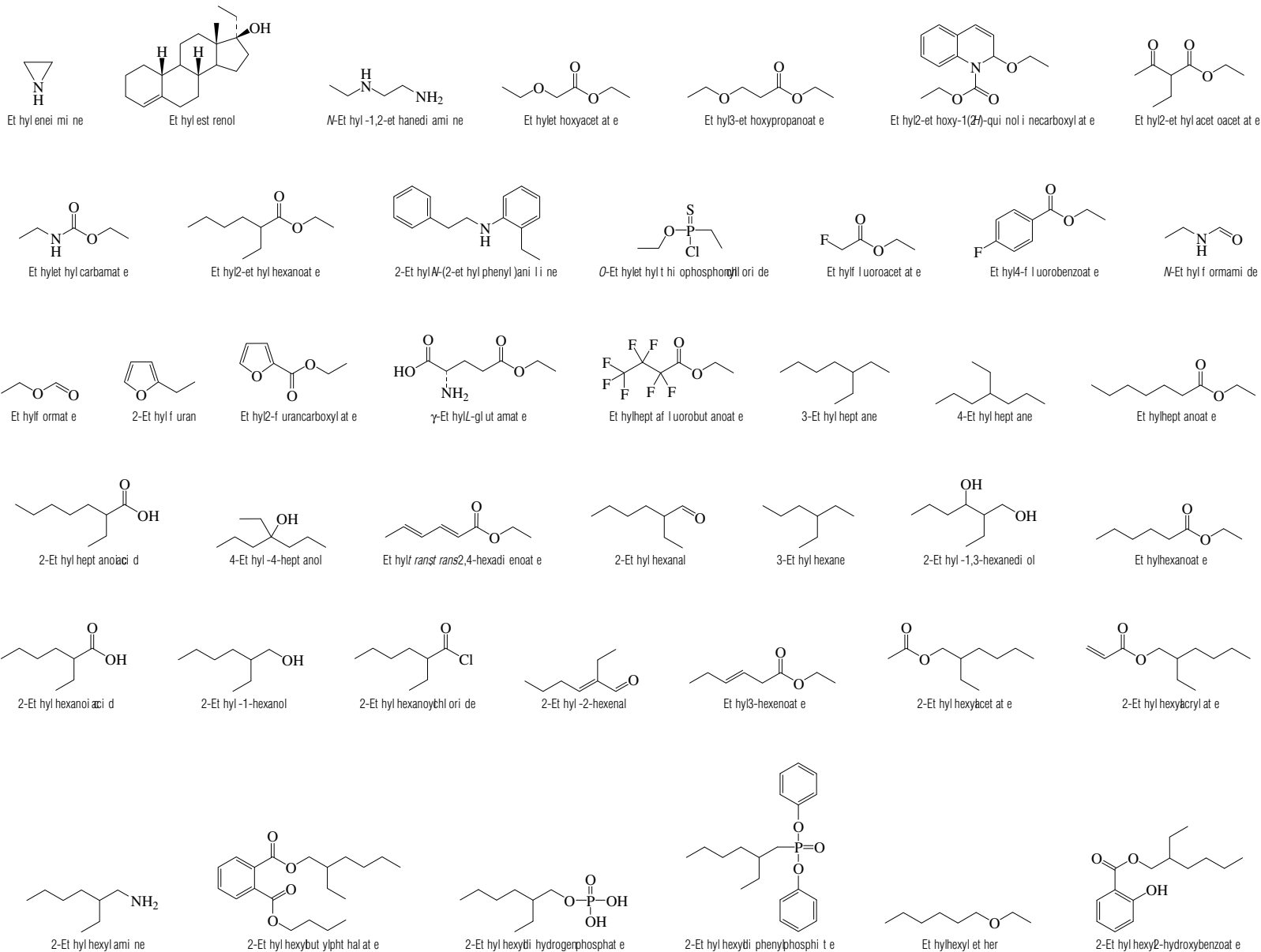


Et hyl enedi ami net et raacetat id di sodi ural t di hydrat e

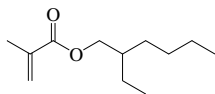


N,N'-Et hyl enedi st earyl ami de

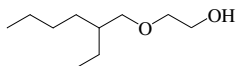
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5021	Et hyl enei mi ne	Azi ri di ne	$\text{C}_2\text{H}_5\text{NC}$	151-56-4	43.068	li q	-77.9	56	0.832 ²		msc H ₂ O; s Et OH; vs et h; sl chl
5022	Et hyl est renol		$\text{C}_{20}\text{H}_{32}\text{O}$	965-90-2	288.467	cry	77				
5023	<i>N</i> -Et hyl -1,2-et hanedi ami ne		$\text{C}_4\text{H}_9\text{CN}_2$	110-72-5	88.151			129	0.837 ²⁵	1.4385 ²⁰	
5024	Et hyl et hoxycet at e		$\text{C}_6\text{H}_{12}\text{O}_3$	817-95-8	132.157			158	0.9702 ²⁰	1.4039 ²⁰	s Et OH, et h, ace
5025	Et hyl 3-et hoxiproanoat e		$\text{C}_7\text{H}_{14}\text{O}_3$	763-69-9	146.184			166; 48 ⁵	0.9490 ²⁰	1.4065 ²⁰	
5026	Et hyl 2-et hoxi-1(2)-qui nol i necarboxyl at e	EEDQ	$\text{C}_{14}\text{H}_{17}\text{NO}_3$	16357-59-8	247.290		56.5	126 ^{0.1}			s chl
5027	Et hyl 2-et hyl acet oacet at e		$\text{C}_8\text{H}_{16}\text{O}_3$	607-97-6	158.195			198.0; 80 ¹⁰	0.9847 ¹⁶	1.4214 ²⁵	msc Et OH, et h
5028	Et hyl et hyl carbamat e		$\text{C}_7\text{H}_{11}\text{NO}_2$	623-78-9	117.147			176	0.9813 ²⁰	1.4215 ²⁰	vs H ₂ O, et h, Et OH
5029	Et hyl 2-et hyl hexanoat e	Et hyl 2-et hyl caproat e	$\text{C}_{10}\text{H}_{20}\text{O}_2$	2983-37-1	172.265			90 ²⁸	0.8586 ²⁵	1.4123 ²⁵	
5030	2-Et hyl <i>N</i> -(2-et hyl phenyl) ani li ne		$\text{C}_{16}\text{H}_{19}\text{N}$	64653-59-4	225.329		29	336 ⁶⁰³ , 173 ¹⁰		1.5550 ²⁵	i H ₂ O; vs Et OH, et h; sl chl; s aci d
5031	<i>O</i> -Et hyl et hyl t hi ophosphonyl chl ori de		$\text{C}_4\text{H}_{10}\text{O}_2\text{OPS}$	1497-68-3	172.613	li q		35	1.15 ²⁰		
5032	Et hyl fluoroacet at e		$\text{C}_2\text{H}_4\text{FO}_2$	459-72-3	106.096			120	1.0912 ²⁰	1.3755 ²⁰	vs H ₂ O
5033	Et hyl 4-fluorobenzoat e		$\text{C}_8\text{H}_7\text{FO}_2$	451-46-7	168.164	mcl pr (w)	26	210	1.146 ²⁵	1.4864 ²⁰	vs et h, Et OH
5034	<i>N</i> -Et hyl f ormati de		$\text{C}_7\text{H}_{13}\text{NO}$	627-45-2	73.094			198	0.9552 ²⁰	1.4320 ²⁰	msc H ₂ O, Et OH, et h
5035	Et hyl f ormat e		$\text{C}_2\text{H}_4\text{O}_2$	109-94-4	74.079	li q	-79.6	54.4	0.920 ⁸	1.3609 ²⁰	s H ₂ O; msc Et OH, et h; vs ace; sl ct c
5036	2-Et hyl f uran		$\text{C}_6\text{H}_{10}\text{O}$	3208-16-0	96.127			92.5	0.9018 ²⁰	1.4403 ²⁰	s Et OH, et h, ace, bz
5037	Et hyl 2-f urancarboxyl at e	Et hyl 2-f uranoat e	$\text{C}_7\text{H}_{12}\text{O}_3$	614-99-3	140.137	lf or pr	34.5	196.8	1.1174	1.4797 ²¹	i H ₂ O; msc Et OH, et h, ace; s bz sl H ₂ O
5038	γ -Et hyl L-gl ut amat e		$\text{C}_8\text{H}_{15}\text{NO}_4$	1119-33-1	175.183			191		1.4255 ²⁷	
5039	Et hyl hept affluorobot anoat e		$\text{C}_8\text{H}_7\text{F}_7\text{O}_2$	356-27-4	242.092			95	1.394 ²⁰	1.3011 ²⁰	sl H ₂ O; s et h, ace
5040	3-Et hyl hept ane		$\text{C}_{10}\text{H}_{20}$	15869-80-4	128.255	li q	-114.9	143.0	0.722 ⁵	1.4093 ²⁰	
5041	4-Et hyl hept ane		$\text{C}_{10}\text{H}_{20}$	2216-32-2	128.255			141.2	0.7241 ²⁵	1.4096 ²⁰	i H ₂ O; s et h; msc Et OH, ace, bz
5042	Et hyl hept anoat e	Et hyl oenanat e	$\text{C}_8\text{H}_{16}\text{O}_2$	106-30-9	158.238	li q	-66.1	187	0.8817 ⁹	1.4100 ²⁰	sl H ₂ O, ct c; s Et OH, et h
5043	2-Et hyl hept anoi c aci d		$\text{C}_8\text{H}_{16}\text{O}_2$	3274-29-1	158.238	li q		158		1.4255 ²⁷	
5044	4-Et hyl -4-hept anol		$\text{C}_8\text{H}_{18}\text{O}$	597-90-0	144.254			182	0.8350 ²⁰	1.4332 ²⁰	vs et h, Et OH
5045	Et hyl t rans t rans 2,4-hexadi enoat e	Et hyl sorbat e	$\text{C}_8\text{H}_{14}\text{O}_2$	2396-84-1	140.180			195.5	0.9506 ²⁰	1.4951 ²⁰	vs et h, Et OH, chl
5046	2-Et hyl hexanal		$\text{C}_8\text{H}_{16}\text{O}$	123-05-7	128.212		<-100	163	0.8540 ²⁰	1.4142 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
5047	3-Et hyl hexane		C_9H_{18}	619-99-8	114.229			118.6	0.7136 ²⁰	1.4018 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, chl; s ct c
5048	2-Et hyl -1,3-hexanedi ol	Et hohexadi ol	$\text{C}_8\text{H}_{18}\text{O}_2$	94-96-2	146.228	li q	-40	244	0.932 ⁵	1.4497 ²⁰	sl H ₂ O; s Et OH, et h
5049	Et hyl hexanoat e		$\text{C}_8\text{H}_{16}\text{O}_2$	123-66-0	144.212	li q	-67	167	0.877 ⁹	1.4073 ²⁰	sl H ₂ O; vs et h, Et OH
5050	2-Et hyl hexanoi c aci d		$\text{C}_8\text{H}_{16}\text{O}_2$	149-57-5	144.212			228; 120 ¹³	0.9031 ²⁵	1.4241 ²⁰	s H ₂ O, et h, ct c; sl Et OH
5051	2-Et hyl -1-hexanol		$\text{C}_8\text{H}_{18}\text{O}$	104-76-7	130.228	li q	-70	184.6	0.8319	1.4300 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl
5052	2-Et hyl hexanoyl chl ori de		$\text{C}_8\text{H}_{15}\text{ClO}$	760-67-8	162.657			101 ⁴⁰ , 67 ¹¹	0.939 ²⁵	1.4335 ²⁰	
5053	2-Et hyl -2-hexenal		$\text{C}_8\text{H}_{14}\text{O}$	645-62-5	126.196			175	0.8554 ²⁰		
5054	Et hyl 3-hexenoat e	Et hyl hydrosorbat e	$\text{C}_8\text{H}_{14}\text{O}_2$	2396-83-0	142.196			166.5	0.8957 ²⁰	1.4255 ²⁰	
5055	2-Et hyl hexyl acet at e		$\text{C}_{10}\text{H}_{20}\text{O}_2$	103-09-3	172.265	li q	-80	199	0.871 ⁸	1.4204 ²⁰	i H ₂ O; s Et OH, et h
5056	2-Et hyl hexyl acryl at e		$\text{C}_{11}\text{H}_{20}\text{O}_2$	103-11-7	184.276		-90	125 ⁶⁰	0.880 ²⁵	1.4332 ²⁵	
5057	2-Et hyl hexylami ne	2-Et hyl -1-hexanami ne	$\text{C}_{10}\text{H}_{21}\text{N}$	104-75-6	129.244			169.2			sl H ₂ O
5058	2-Et hyl hexyl but yl pht hal at e	But yl 2-et hyl hexyl pht hal at e	$\text{C}_{20}\text{H}_{39}\text{O}_4$	85-69-8	334.450	col li q					sl θ
5059	2-Et hyl hexyl di hydrogen phosphat e	Mono(2-et hyl hexyl) phosphat e	$\text{C}_8\text{H}_{19}\text{O}_4\text{P}$	1070-03-7	210.208	li q					s H ₂ O, bz
5060	2-Et hyl hexyl di phenyl phosphi t e	Forst ab	$\text{C}_{20}\text{H}_{29}\text{O}_3\text{P}$	15647-08-2	346.400			152 ^{0.15}	1.054 ²⁰	1.5207 ²⁷	
5061	Et hyl hexyl et her	1-Et hoxihexane	$\text{C}_8\text{H}_{18}\text{O}$	5756-43-4	130.228			143	0.7722 ²⁰	1.4008 ²⁰	vs et h, Et OH
5062	2-Et hyl hexyl 2-hydroxybenzoat e	Oct i sal at e	$\text{C}_{15}\text{H}_{21}\text{O}_3$	118-60-5	250.334	li q		190	1.01		



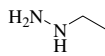
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5063	2-Et hyl hexyl met hacryl at e		$\text{C}_{12}\text{H}_{22}\text{O}_2$	688-84-6	198.302			120 ¹⁸ , 110 ¹⁴	0.880 ²⁵	1.436 ²⁵	
5064	2-[(2-Et hyl hexyl)oxy]et hanol	Et hyl ene gl ycol mono(2-et hyl hexyl) et her	$\text{C}_{10}\text{H}_{22}\text{O}_2$	1559-35-9	174.281			227.7			
5065	Et hyl hidrazi ne		$\text{C}_2\text{H}_8\text{N}_2$	624-80-6	60.098			101			vs H ₂ O, ace, et h, Et OH
5066	Et hyl hidrazi necarboxyl at e	Et hyl carbazat e	$\text{C}_3\text{H}_6\text{N}_2\text{O}_2$	4114-31-2	104.108	cry	46	dec 198; 93 ⁹			s Et OH, et h; sl chl
5067	Et hyl hydrogen adi pat e		$\text{C}_8\text{H}_{14}\text{O}_4$	626-86-8	174.195	hyg cry (et h, pet h)	29	285	0.9796 ²⁰	1.4311 ²⁰	s Et OH, et h, pet h
5068	Et hyl hydrogen f umarat e		$\text{C}_6\text{H}_{10}\text{O}_4$	2459-05-4	144.126		70	147 ¹⁶	1.1109 ⁹⁷		s Et OH, ace; sl chl
5069	Et hyl hydrogen succi nat e	But anedi oi c aci d, monoet hyl est et	$\text{C}_{11}\text{H}_{20}\text{O}_4$	1070-34-4	146.141	pr or nd	8	172 ⁴² , 119 ³	1.1466 ²⁰	1.4327 ²⁰	vs H ₂ O, et h, Et OH
5070	Et hyl hidroperoxi de	Et hyl hydrogen peroxi de	$\text{C}_2\text{H}_4\text{O}_2$	3031-74-1	62.068	li q	-100	95	0.933 ²	1.3800 ²⁰	vs H ₂ O, bz, et h, Et OH
5071	Et hyl hidroxyacet at e		$\text{C}_2\text{H}_4\text{O}_3$	623-50-7	104.105			160	1.0826 ²³	1.4180 ²⁰	vs et h, Et OH
5072	Et hyl 3-hidroxybenzoat e		$\text{C}_9\text{H}_{10}\text{O}_3$	7781-98-8	166.173	pl (bz)	74		1.0680 ³¹		sl H ₂ O, chl; s Et OH, et h
5073	Et hyl 4-hidroxybenzoat e	Et hyl paraben	$\text{C}_8\text{H}_8\text{O}_3$	120-47-8	166.173	cry (di l al)	117	297.5			sl ₂ chl, t f a; vs Et OH, et h; i ₂ C ₅
5074	Et hyl 3-hidroxybut anoat e, (±)		$\text{C}_8\text{H}_{12}\text{O}_3$	35608-64-1	132.157			185; 76 ¹⁵	1.017 ²⁰	1.4182 ²⁰	s H ₂ O, Et OH; sl ct c
5075	Et hyl 2-hidroxy-3-but enoat e		$\text{C}_8\text{H}_{10}\text{O}_3$	91890-87-8	130.141			dec 173; 68 ¹⁵	1.0470 ¹⁵	1.436 ¹³	vs H ₂ O, et h, Et OH
5076	α-Et hyl -1-hidroxyccyl ohexaneacet i c Cycl obut yrol aci d		$\text{C}_{18}\text{H}_{34}\text{O}_3$	512-16-3	186.248	cry (et h-pet h)	81.5	164	1.0010 ¹⁸	1.4680 ¹⁸	vs ace, et h, Et OH, chl
5077	N-Et hyl N-hidroxyet hanami ne	N,N-Di et hyl hidroxyyl ami ne	$\text{C}_4\text{H}_{10}\text{N}_2\text{O}$	3710-84-7	89.136		10	133	0.8669 ²⁰	1.4195 ²⁰	
5078	2-Et hyl -3-hidroxyhexanal		$\text{C}_{11}\text{H}_{20}\text{O}_2$	496-03-7	144.212			138 ⁵⁰ , 101 ⁹			
5079	Et hyl 4-hidroxy-3-met hoxybenzoat e		$\text{C}_{10}\text{H}_{12}\text{O}_4$	617-05-0	196.200	nd (di l al)	44	292			i ₂ chl vs Et OH, et h; s chl
5080	Et hyl ci s12-hidroxy-9-oct adecenoat e, (A)	Et hyl ri ci nol eat e	$\text{C}_{20}\text{H}_{38}\text{O}_3$	55066-53-0	326.514			258 ¹³	0.9180 ²⁰	1.4618 ²²	
5081	Et hyl i denecycl ohexane		C_8H_{14}	1003-64-1	110.197			136	0.822 ²⁵	1.4618 ²⁰	
5082	5-Et hyl i dene-2-norbornene	5-Et hyl i denebi cycl o[2.2.1]hept -2-egl	$\text{C}_{12}\text{H}_{20}$	16219-75-3	120.191	li q		146	0.893	1.490 ⁹	
5083	1-Et hyl -H-i mi dazol e		$\text{C}_2\text{H}_8\text{N}_2$	7098-07-9	96.131			208	0.999 ²⁵		msc H ₂ O
5084	Et hyl i odoacet at e		$\text{C}_2\text{H}_3\text{O}_2$	623-48-3	214.002	oi l		179	1.817 ³	1.5079 ¹³	s Et OH, et h
5085	Et hyl i sobut yl carbamat e	Isobut yl uret hane	$\text{C}_7\text{H}_{15}\text{NO}_2$	539-89-9	145.200		<-65	110 ³⁰	0.9432 ²⁰	1.4288 ²⁰	vs et h, Et OH
5086	Et hyl i socyanat e		$\text{C}_2\text{H}_3\text{NO}$	109-90-0	71.078			60	0.9031 ²⁰	1.3808 ²⁰	i H ₂ O; msc Et OH, et h
5087	Et hyl i socyani de		$\text{C}_2\text{H}_3\text{N}$	624-79-3	55.079		<-66	79	0.7402 ²⁰	1.3622 ²⁰	vs H ₂ O; msc Et OH, et h; s ace
5088	N-Et hyl -H-i soi ndol e-1,3(2)-di one		$\text{C}_9\text{H}_{13}\text{NO}_2$	5022-29-7	175.184	nd (al)	79	285.5			s Et OH, et h
5089	Et hyl i sopent yl et her		$\text{C}_7\text{H}_{14}\text{O}$	628-04-6	116.201			112.5	0.7688 ²¹		vs et h, Et OH
5090	Et hyl i sopropyl ami ne	N-Et hyl -2-propanami ne	$\text{C}_6\text{H}_{13}\text{N}$	19961-27-4	87.164			69.6		1.3872 ²⁵	
5091	1-Et hyl -2-i sopropyl benzene		$\text{C}_{11}\text{H}_{16}$	18970-44-0	148.245			193	0.888 ²⁰	1.508 ²⁰	vs ace, bz, et h, Et OH
5092	Et hyl i sopropyl et her		$\text{C}_6\text{H}_{12}\text{O}$	625-54-7	88.148			54.1	0.720 ²⁵	1.3698 ²⁵	s H ₂ O, ace, chl; msc Et OH, et h
5093	N-Et hyl N-i sopropyl -2-propanami ne		$\text{C}_8\text{H}_{15}\text{N}$	7087-68-5	129.244			126.5	0.742 ²⁵	1.4138 ²⁰	s ct c
5094	Et hyl i sopropyl sul fide		$\text{C}_6\text{H}_{12}\text{S}$	5145-99-3	104.214	li q	-122.2	107.5	0.824 ⁶		
5095	Et hyl i sot hi ocyanat e		$\text{C}_2\text{H}_3\text{NS}$	542-85-8	87.144	li q	-5.9	131.5	0.999 ⁹	1.5130 ²⁰	i H ₂ O; msc Et OH, et h
5096	Et hyl i act at e	Et hyl 2-hidroxypropi onat e	$\text{C}_3\text{H}_6\text{O}_3$	2676-33-7	118.131	li q	-26	154.5	1.032 ⁹	1.4124 ²⁰	vs H ₂ O, et h, Et OH
5097	Et hyl laurat e		$\text{C}_{18}\text{H}_{36}\text{O}_2$	106-33-2	228.371	li q	-10	271; 15 ⁴	0.8618 ²⁰	1.4311 ²⁰	i H ₂ O; vs Et OH; msc et h; sl ct c
5098	Et hyl i levul i nat e		$\text{C}_5\text{H}_8\text{O}_3$	539-88-8	144.168			205.8	1.0111 ²⁰	1.4229 ²⁰	vs H ₂ O, Et OH
5099	Et hyl mercapt oacet at e		$\text{C}_2\text{H}_4\text{O}_2\text{S}$	623-51-8	120.171			157	1.0964 ¹⁵	1.4582 ²⁰	s Et OH, et h; sl ct c
5100	Et hyl met hacryl at e		$\text{C}_6\text{H}_8\text{O}_2$	97-63-2	114.142			117	0.9135 ²⁰	1.4147 ²⁰	sl H ₂ O, chl; msc Et OH, et h
5101	Et hyl met hanesulf onat e		$\text{C}_3\text{H}_6\text{O}_2\text{S}$	62-50-0	124.159			86 ¹⁰			
5102	1-Et hyl -4-met hoxybenzene		$\text{C}_{12}\text{H}_{16}\text{O}$	1515-95-3	136.190			198	0.9624 ¹⁵	1.5120 ²⁰	vs bz, et h
5103	α-Et hyl -4-met hoxybenzenemet hanol		$\text{C}_{10}\text{H}_{14}\text{O}_2$	5349-60-0	166.217			143 ²⁰		1.5277 ²⁰	s ct c



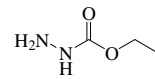
2-Et hyl hexymet hacryl at e



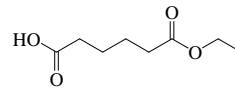
2-[(2-Et hyl hexyl)oxy]et hanol



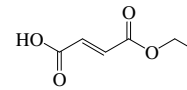
Et hyl hydrazi ne



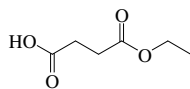
Et hylhydrazi necarboxyl at e



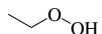
Et hylhydrogen adi pat e



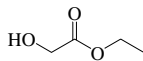
Et hylhydrogen f umarat e



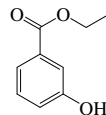
Et hylhydrogen succi nat e



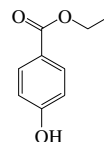
Et hylhydroperoxi de



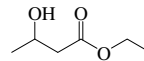
Et hylhydroxyacet at e



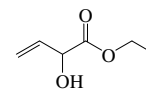
Et hy3-hydroxybenzoat e



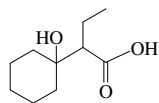
Et hy4-hydroxybenzoat e



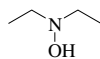
Et hyl3-hydroxybut anoat e(±)



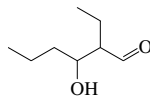
Et hyl2-hydroxy-3-but enoat e



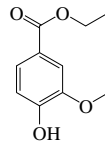
α-Et hyl-1-hydroxycycl ohexaneacet ärid



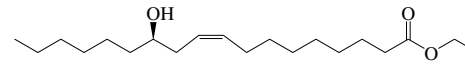
N-Et hylN-hydroxyet hanami ne



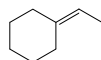
2-Et hyl-3-hydroxyhexanal



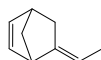
Et hyl4-hydroxy-3-met hoxybenzoat e



Et hylci s12-hydroxy-9-oct adecenoat e(f)



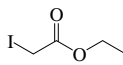
Et hyl i denecycl ohexane



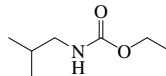
5-Et hyl i dene-2-norbomene



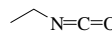
1-Et hyl-4-i mi dazol



Et hyl i odoacet at e



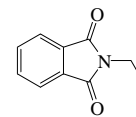
Et hyl i sobut yl carbamat e



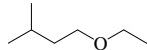
Et hyl i socyanat e



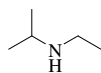
Et hyl i socyani de



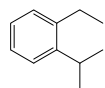
N-Et hyl-4-i soi ndole-1,3-di one



Et hyl i sopent ylt her



Et hyl i sopropyl ami ne



1-Et hyl-2-i sopropyl benzene



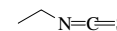
Et hyl i sopropyl et her



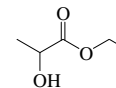
N-Et hylN-i sopropyl-2-propanami r



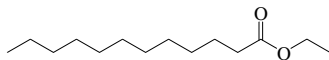
Et hyl i sopropylsul f i c



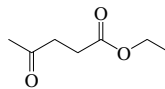
Et hyl i sot hi ocyanat e



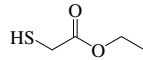
Et hyl lact at e



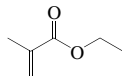
Et hyl aurat e



Et hyl evul i nat e



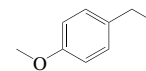
Et hylmercapt oacet at e



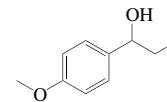
Et hylmet hacryl at e



Et hylmet hanesul f onat e

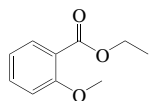


1-Et hyl-4-met hoxybenzene

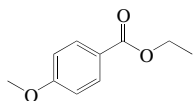


α-Et hyl-4-met hoxybenzenemet hanol

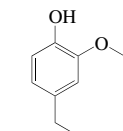
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5104	Et hyl 2-met hoxibenzoat e		₁₀ B ₁₂ O ₃	7335-26-4	180.200			261	1.1124 ²⁰	1.5224 ²⁰	vs et h, Et OH
5105	Et hyl 4-met hoxibenzoat e		₁₀ B ₁₂ O ₃	94-30-4	180.200		7.5	269.5	1.1038 ²⁰	1.5254 ²⁰	i H ₂ O; s Et OH, et h
5106	4-Et hyl -2-met hoxiphenol		₉ B ₁₂ O ₂	2785-89-9	152.190	li q	-7	236.5	1.0937 [†]		
5107	Et hyl (4-met hoxiphenyl)acet at e		₁₁ H ₁₄ O ₃	14062-18-1	194.227			139 ⁷⁰	1.0972 ⁵	1.5075 ²⁰	
5108	Et hyl 2-met hylacet oacet at e		₇ H ₁₂ O ₃	609-14-3	144.168			187	0.9941 ²⁰	1.4185 ²⁰	sl H ₂ O; s Et OH, et h; vs ace
5109	N-Et hyl -2-met hyl al lyl ami ne	N-Et hyl -2-met hyl -2-propen-1-ami ne	₈ H ₁₂ N	18328-90-0	99.174	li q		104.7	0.753	1.4227 [†]	msc H ₂ O
5110	5-Et hyl -5-(2-met hyl al lyl)-2-t hi obarbi t uri c aci d	Met hal l at al	₁₀ B ₁₄ N ₂ O ₂ S	115-56-0	226.295		160.5				
5111	Et hyl met hyl ami ne	N-Met hyl et hanami ne	₃ H ₇ N	624-78-2	59.110			36.7			vs H ₂ O, ace, et h, Et OH
5112	Et hyl met hyl ami ne hydrochl ori de	N-Met hyl et hanami ne hydrochl ori de	₃ H ₇ ClN	624-60-2	95.571	pl (al-et h)	128		1.0877 [†]		vs H ₂ O, Et OH; i et h; s chl
5113	2-Et hyl -6-met hyl ani li ne		₉ H ₁₇ N	24549-06-2	135.206	li q	-33	231	0.966 [†]	1.5525 ²⁰	
5114	N-Et hyl -2-met hyl ani li ne		₉ H ₁₇ N	94-68-8	135.206		<-15	216	0.9482 ⁵	1.5456 ²⁰	s Et OH, et h
5115	N-Et hyl -3-met hyl ani li ne		₉ H ₁₇ N	102-27-2	135.206			221	0.9263 ¹⁵	1.5451 ²⁰	s Et OH, et h
5116	N-Et hyl -4-met hyl ani li ne	N-Et hyl -4-t ol ui di ne	₉ H ₁₇ N	622-57-1	135.206			217	0.9391 ¹⁶		s Et OH, et h
5117	N-Et hyl N-met hyl ani li ne		₉ H ₁₇ N	613-97-8	135.206			204	0.922 ⁵⁵		i H ₂ O; msc Et OH, et h; s ct c
5118	N-Et hyl α-met hyl benzeneet hanami ne	N-Et hyl amphet ami ne	₁₁ B ₁₇ N	457-87-4	163.260			105 ¹⁴		1.4986 ²⁵	
5119	N-Et hyl -4-met hyl benzenesul f onami de		₉ H ₁₃ NO ₂ S	80-39-7	199.270		64				s Et OH
5120	1-Et hyl -2-met hyl N-benzi mi dazol e		₁₀ H ₁₂ N ₂	5805-76-5	160.215		51	296	1.073 ²⁵		
5121	Et hyl 2-met hyl benzoat e		₁₀ B ₁₂ O ₂	87-24-1	164.201		<-10	227; 113 ¹⁸	1.0325 ²¹	1.507 ²²	i H ₂ O; msc Et OH, et h
5122	Et hyl 4-met hyl benzoat e		₁₀ B ₁₂ O ₂	94-08-6	164.201			232	1.0269 ¹⁸	1.5089 ¹⁸	i H ₂ O; msc Et OH, et h
5123	Et hyl 3-met hyl but anoat e	Et hyl i soval erat e	₇ H ₁₄ O ₂	108-64-5	130.185	li q	-99.3	135.0	0.865 [†]	1.3962 ²⁰	sl H ₂ O; vs Et OH, et h
5124	2-Et hyl -2-met hyl but anoi c aci d		₇ H ₁₄ O ₂	19889-37-3	130.185		<-20	207		1.4250 ²⁰	vs Et OH
5125	2-Et hyl -3-met hyl -1-but ene		₇ H ₁₄	7357-93-9	98.186			89	0.7150 ²⁰	1.410 ²⁰	i H ₂ O; s et h, ace, bz, chl
5126	Et hyl t rans-2-met hyl -2-but enoat e		₇ H ₁₂ O ₂	5837-78-5	128.169			156	0.9200 ²⁰	1.4340 ²⁰	
5127	Et hyl 3-met hyl -2-but enoat e		₇ H ₁₂ O ₂	638-10-8	128.169			153.5	0.9199 ²¹	1.4345 ²⁰	
5128	5-Et hyl -5-(1-met hyl but yl)-2,4,6-(1 <i>H</i> ,3 <i>H</i> ,5 <i>H</i>)-pyri mi di net ri one		C ₁₁ H ₁₈ N ₂ O ₃	76-74-4	226.272		130				sl H ₂ O; s Et OH, et h
5129	Et hyl N-met hyl carbamat e		₈ B ₁₂ NO ₂	105-40-8	103.120			170	1.0115 ²⁰	1.4183 ²⁰	vs H ₂ O, Et OH
5130	Et hyl met hyl carbonat e		₄ H ₆ O ₃	623-53-0	104.105	li q	-14	107.5	1.012 [†]	1.3778 ²⁰	vs et h, Et OH
5131	t rans-1-Et hyl -4-met hyl cycl ohexane		₈ H ₁₆	6236-88-0	126.239	li q	-80.8	149	0.779 [†]	1.4304 ²⁰	
5132	1-Et hyl -1-met hyl cycl opent ane		₈ H ₁₆	16747-50-5	112.213	li q	-143.8	121.6	0.7767 [†]	1.4272 ²⁰	vs ace, bz, et h, Et OH
5133	ci s-1-Et hyl -2-met hyl cycl opent ane		₈ H ₁₆	930-89-2	112.213	li q	-106	128	0.7852 [†]	1.4293 ²⁰	
5134	t rans-1-Et hyl -2-met hyl cycl opent ane		₈ H ₁₆	930-90-5	112.213	li q	-105.9	121.2	0.764 [†]	1.4219 ²⁰	
5135	ci s-1-Et hyl -3-met hyl cycl opent ane		₈ H ₁₆	2613-66-3	112.213			121	0.7724 ²⁰	1.4203 ²⁰	vs ace, bz, et h, Et OH
5136	t rans-1-Et hyl -3-met hyl cycl opent ane		₈ H ₁₆	2613-65-2	112.213	li q	-108	121	0.761 [†]	1.4186 ²⁰	
5137	1-Et hyl -1-met hyl cycl propane		₆ H ₁₂	53778-43-1	84.159	li q	-130.2	56.8	0.696 [†]	1.3887 ²⁰	
5138	2-Et hyl -2-met hyl -1,3-di oxol ane		₆ H ₁₀ O ₂	126-39-6	116.158			118	0.9360 ²⁰		
5139	Et hyl met hyl et her		₃ H ₆ O	540-67-0	60.095	col gas	-113	7.4	0.7257 [†]	1.3420 ⁴	s H ₂ O, ace, chl; msc Et OH, et h
5140	3-Et hyl -2-met hyl hexane		₉ B ₂₀	16789-46-1	128.255			138	0.7310 ²⁰	1.4106 ²⁰	
5141	3-Et hyl -3-met hyl hexane		₉ B ₂₀	3074-76-8	128.255			140.6	0.7371 ²⁵	1.4140 ²⁰	
5142	3-Et hyl -4-met hyl hexane	2,3-Di et hyl pent ane	₉ H ₂₀ C	3074-77-9	128.255			140	0.7420 ²⁰	1.4134 ²⁰	
5143	4-Et hyl -2-met hyl hexane		₉ B ₂₀	3074-75-7	128.255			133.8	0.7195 ²⁵	1.4063 ²⁰	
5144	Et hyl 4-met hyl hexanoat e	Et hyl 4-met hyl caproat e	₉ H ₁₈ O ₂	1561-10-0	158.238			180	0.8708 ²⁰	1.4051 ²⁰	
5145	Et hyl 4-met hyl -3-oxopent anoat e		₈ H ₁₄ O ₃	7152-15-0	158.195	li q	-9	173	0.9 [†]	1.250 ²⁰	
5146	3-Et hyl -2-met hyl pent ane		₈ H ₁₈	609-26-7	114.229	li q	-114.9	115.66	0.719 [†]	1.4040 ²⁰	i H ₂ O; s et h; msc Et OH, ace, bz
5147	3-Et hyl -3-met hyl pent ane		₈ H ₁₈	1067-08-9	114.229	li q	-90.9	118.27	0.7274 [†]	1.4078 ²⁰	i H ₂ O; s et h; msc Et OH, ace, bz



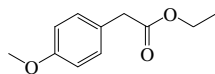
Et hyl 2-met hoxybenzoat e



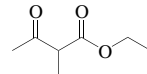
Et hyl 4-met hoxybenzoat e



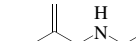
4-Et hyl -2-met hoxyphenol



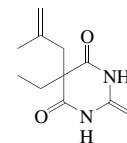
Et hyl (4-met hoxyphenyl) acetat e



Et hyl 2-met hyl acet oacetat e



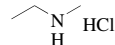
N-Et hyl -2-met hyl al lyl ami ne



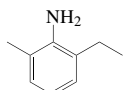
5-Et hyl -5-(2-met hyl al lyl) -2-t hi obarbidiu d c



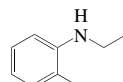
Et hyl met hyl ami ne



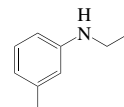
Et hyl met hyl ami hyl drochl ori de



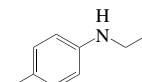
2-Et hyl -6-met hyl ani li ne



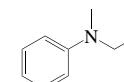
N-Et hyl -2-met hyl ani li ne



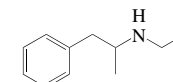
N-Et hyl -3-met hyl ani li ne



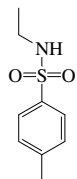
N-Et hyl -4-met hyl ani li ne



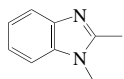
N-Et hyl N-met hyl ani li ne



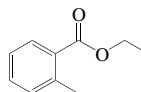
N-Et hyl N-met hyl benzeneet hanami n



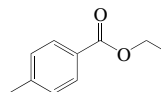
N-Et hyl -4-met hyl benzenesul f onami de



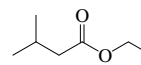
1-Et hyl -2-met hyl imbenzi mi dazol e



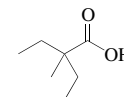
Et hyl 2-met hyl benzoat e



Et hyl 4-met hyl benzoat e



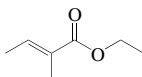
Et hyl 3-met hyl but anoat e



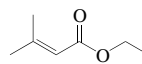
2-Et hyl -2-met hyl but anoi d c



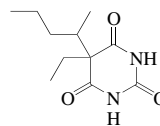
2-Et hyl -3-met hyl -1-but ene



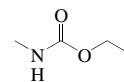
Et hyl 2-met hyl -2-but enoat e



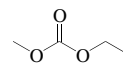
Et hyl 3-met hyl -2-but enoat e



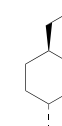
5-Et hyl -5-(1-met hyl but yl) -2,4,6-(3H,5H) -pyri mi di net ri



Et hyl N-met hyl carbat e



Et hyl met hyl carbonat e



t rans 1-Et hyl -4-met hyl cycl ohexane



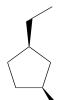
1-Et hyl -1-met hyl cycl opent ane



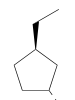
ci s 1-Et hyl -2-met hyl cycl opent .



t rans 1-Et hyl -2-met hyl cycl opent .



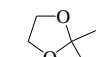
ci s 1-Et hyl -3-met hyl cycl opent .



t rans 1-Et hyl -3-met hyl cycl opent ane



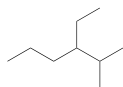
1-Et hyl -1-met hyl cycl opropane



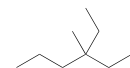
2-Et hyl -2-met hyl -1,3-di oxol ane



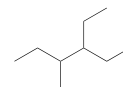
Et hyl met hyl et her



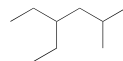
3-Et hyl -2-met hyl hexane



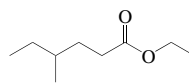
3-Et hyl -3-met hyl hexane



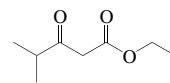
3-Et hyl -4-met hyl hexane



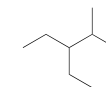
4-Et hyl -2-met hyl hexane



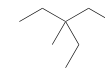
Et hyl 4-met hyl hexanoat e



Et hyl 4-met hyl -3-oxopent anoat e

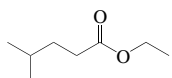


3-Et hyl -2-met hyl pent ane



3-Et hyl -3-met hyl pent ane

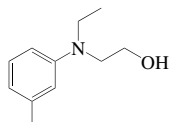
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5148	Et hyl 4-met hyl pent anoat e		₈ H ₁₆ O ₂	25415-67-2	144.212			163; 52 ¹⁰	0.8705 ²⁰	1.4050 ²⁰	
5149	3-Et hyl -2-met hyl -1-pent ene		₈ H ₁₆	19780-66-6	112.213	li q	-112.9	109.5	0.726 ²	1.4140 ²⁰	
5150	2-(Et hyl (3-met hyl phenyl) ami nol)et hanol		C ₁₁ H ₁₇ NO	91-88-3	179.259			118 ¹⁵		1.5540 ²⁰	s ct c
5151	Et hyl 3-met hyl -3-phenyl oxo ranecarboxyl at e	Et hyl 3-met hyl -3-phenyl gl yci dat e	₁₂ H ₁₉ O ₃	77-83-8	206.237			273.5	1.044 ²⁰	1.5182 ²⁰	
5152	4-Et hyl -4-met hyl -2,6-pi peri di nedi one	Bemegri de	₈ H ₁₃ NO ₂	64-65-3	155.195	pl (w, ace-et h)	126.5	sub 100			s chl
5153	Et hyl 2-met hyl propanoat e	Et hyl i sobut anoat e	₆ H ₁₂ O ₂	97-62-1	116.158	li q	-88.2	110.1	0.868 ⁸	1.3869 ¹⁸	sl H ₂ O, ct c; msc Et OH, et h; s ace
5154	2-Et hyl -5-met hyl pyrazi ne		₇ H ₁₀ N ₂	13360-64-0	122.167	li q		7 ⁹			
5155	3-Et hyl -4-met hyl pyri di ne	3-Et hyl -4-pi col i ne	₈ H ₁₁ N C	529-21-5	121.180			198	0.9286 ¹⁷		sl H ₂ O; s Et OH, et h, chl; vs ace
5156	4-Et hyl -2-met hyl pyri di ne	4-Et hyl -2-pi col i ne	₈ H ₁₁ N C	536-88-9	121.180			179	0.9130 ²⁵		vs ace, bz, et h, Et OH
5157	3-Et hyl -3-met hyl -2,5-pyrrol i di nedi one	Et hosuxi mi de	₇ H ₉ NO ₂	77-67-8	141.168	cry (ace-et h)	64.5				vs H ₂ O
5158	Et hyl met hyl sul fide		₃ H ₆ S	624-89-5	76.161	li q	-105.93	66.7	0.842 ²	1.4404 ²⁰	i H ₂ O; msc Et OH; s et h, chl
5159	N-Et hyl morphol i ne		₆ H ₁₃ NO	100-74-3	115.173			138.5	0.8996 ²⁰	1.4400 ²⁰	msc H ₂ O, Et OH, et h; s ace, bz
5160	Et hyl myri st at e		₁₈ H ₃₂ O ₂	124-06-1	256.424		12.3	295	0.8573 ²⁵	1.4362 ²⁰	i H ₂ O; s Et OH, ct c, li g; sl et h
5161	N-Et hyl -1-napht hal enami ne		₁₂ H ₁₃ N	118-44-5	171.238			305; 191 ¹⁶	1.0652 ¹⁵	1.6477 ¹⁵	vs et h, Et OH
5162	1-Et hyl napht hal ene		₁₂ H ₁₂	1127-76-0	156.223	li q	-13.9	258.6	1.008 ²	1.6062 ²⁰	i H ₂ O; msc Et OH, et h
5163	2-Et hyl napht hal ene		₁₂ H ₁₂	939-27-5	156.223	li q	-7.4	258	0.992 ²	1.5999 ²⁰	i H ₂ O; msc Et OH, et h; sl chl
5164	Et hyl 1-napht hyl acet at e		₁₄ H ₁₄ O ₂	2122-70-5	214.260	oi l	88.5	22 ² , 118 ¹³			s Et OH, et h
5165	Et hyl ni t rat e		₂ H ₅ NO ₃	625-58-1	91.066	li q	-94.6	87.2	1.108 ⁴	1.3852 ²⁰	s H ₂ O; msc Et OH, et h
5166	Et hyl ni t ri t e		₂ H ₂ NO ₂	109-95-5	75.067	ye vol li q or gas		18	0.899	1.3418 ¹⁰	msc Et OH, et h
5167	Et hyl ni t roacet at e		₄ H ₇ NO ₄	626-35-7	133.104			106 ²⁵ , 83 ⁶	1.1953 ²⁰	1.4250 ²⁰	sl H ₂ O; msc Et OH; vs et h; s di l alk
5168	1-Et hyl -2-ni t robenzene		₈ H ₈ NO ₂	612-22-6	151.163	li q	-12.3	232.5	1.120 ⁷	1.5356 ²⁰	i H ₂ O; vs Et OH, et h; s ace; sl ct c
5169	1-Et hyl -4-ni t robenzene		₈ H ₈ NO ₂	100-12-9	151.163	li q	-12.3	245.5	1.119 ²	1.5455 ²⁰	i H ₂ O; vs Et OH, et h; s ace; sl ct c
5170	Et hyl 3-ni t robenzoat e		₉ H ₉ NO ₄	618-98-4	195.172		47	297			i H ₂ O; vs Et OH, et h
5171	Et hyl 4-ni t robenzoat e		₉ H ₉ NO ₄	99-77-4	195.172		57	186.3; 153 ⁸			i H ₂ O; s Et OH, et h
5172	Et hyl p-ni t rophenyl benzenet hi ophosphat e		C ₁₄ H ₁₄ NO ₄ PS	2104-64-5	323.304		36		1.27 ²⁵	1.5978 ³⁰	vs bz, et h, Et OH
5173	2-Et hyl -2-ni t ro-1,3-propanedi ol		₅ H ₁₀ NO ₄	597-09-1	149.146	nd (w)	57.5	dec			vs H ₂ O, et h, Et OH
5174	Et hyl 2-ni t ropropanoat e		₅ H ₁₀ NO ₄	2531-80-8	147.130			190.5		1.4210 ²⁰	vs bz, et h, Et OH
5175	N-Et hyl N-ni t rosurea	N-Ni t ro N-et hyl urea	₆ H ₁₂ N ₂ O ₂	759-73-9	117.107		100 dec				s chl
5176	Et hyl nonanoat e		₁₀ H ₂₂ O ₂	123-29-5	186.292	li q	-36.7	227.0	0.865 ⁷	1.4220 ²⁰	i H ₂ O; s Et OH, et h, ace, ct c
5177	5-Et hyl -2-norbornene		₉ H ₁₄	15403-89-1	122.207	li q		143.6	0.86	1.463 ⁸	
5178	Et hyl ci sci s9,12-oct adecadi enoat e	Et hyl li nol eat e	₂₀ H ₃₆ O ₂	544-35-4	308.499	ye or col		272 ⁸⁰ , 212 ¹²	0.8865 ²⁰		vs et h, Et OH
5179	Et hyl ci sci s9,12,15-oct adecadi ri enoat e	Et hyl li nol enat e	₂₀ H ₃₄ O ₂	1191-41-9	306.483			218 ¹⁵	0.8919 ²⁰	1.4694 ²⁰	vs et h, Et OH
5180	Et hyl f rans9-oct adecenoat e		₂₀ H ₃₆ O ₂	6114-18-7	310.515		5.8	218 ¹⁵	0.8664 ²⁵	1.4480 ²⁵	vs et h, Et OH
5181	3-Et hyl oct ane		₁₀ H ₂₂	5881-17-4	142.282			166.5	0.7359 ²⁵	1.4156 ²⁰	
5182	4-Et hyl oct ane		₁₀ H ₂₂	15869-86-0	142.282			163.7	0.7343 ²⁵	1.4151 ²⁰	
5183	Et hyl oct anoat e		₁₀ H ₂₀ O ₂	106-32-1	172.265	li q	-43.1	208.5	0.868 ⁸	1.4178 ²⁰	i H ₂ O; vs Et OH, et h; sl ct c
5184	Et hyl 1-oct yl sul fide	1-(Et hyl t hi o)oct ane	₁₀ H ₂₂ S	3698-94-0	174.347	li q		109			
5185	Et hyl ol eat e	Et hyl s9-oct adecenoat e	₂₀ H ₃₈ O ₂	111-62-6	310.515			216 ¹⁵ , 207 ¹³	0.8720 ²⁰	1.4515 ²⁰	vs et h, Et OH
5186	Et hyl 5-oxohexanoat e		₆ H ₁₂ O ₃	13984-57-1	158.195			221.5	0.989 ²⁵	1.4277 ²⁰	
5187	Et hyl 3-oxopent anoat e		₇ H ₁₂ O ₃	4949-44-4	144.168			191	1.0120 ²⁰	1.4230 ²⁰	vs bz, et h, Et OH
5188	Et hyl 2-oxo-2-phenyl acet at e	Et hyl phenyl gl yoxyl at e	₁₀ H ₁₀ O ₃	1603-79-8	178.184			256.5	1.1222 ²⁵	1.5190 ²⁵	



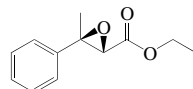
Et hyl4-met hyl pent anoat e



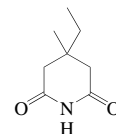
3-Et hyl -2-met hyl -1-pent ene



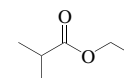
2-[Et hyl (3-met hyl phenyl)jami no]et hanol



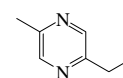
Et hyl3-met hyl -3-phenyl oxi ranecarboxyl at e



4-Et hyl -4-met hyl -2,6-pi peri di nedi one



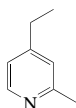
Et hyl2-met hyl propanoat e



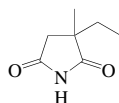
2-Et hyl -5-met hyl pyrazi ne



3-Et hyl -4-met hyl pyri di ne



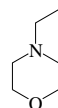
4-Et hyl -2-met hyl pyri di ne



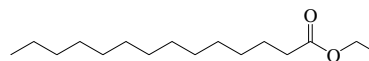
3-Et hyl -3-met hyl -2,5-pyrrol i di nedi one



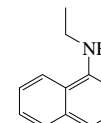
Et hylmet hylsul f i de



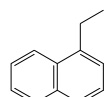
N-Et hyl morphol i ne



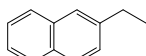
Et hylmyri st at e



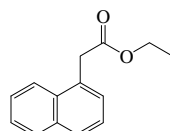
N-Et hyl -1-napht hal enami ne



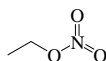
1-Et hyl napht hal ene



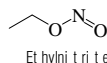
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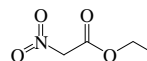
Et hyl1-napht hyl acet at e



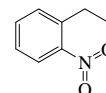
Et hylni t rat e



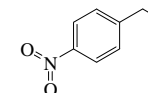
Et hylni t ri t e



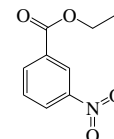
Et hylni t roacet at e



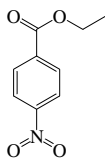
1-Et hyl -2-ni t robenzene



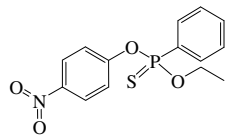
1-Et hyl -4-ni t robenzene



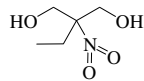
Et hyl3-ni t robenzoat e



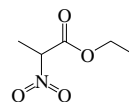
Et hyl4-ni t robenzoat e



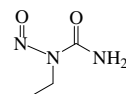
Et hylp-ni t rophenylbenzenet hi ophospat



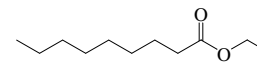
2-Et hyl -2-ni t ro-1,3-propanedi ol



Et hyl2-ni t ropropanoat e



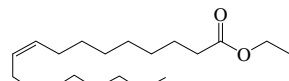
N-Et hylN-ni t rosoure:



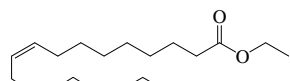
Et hylnonanoat e



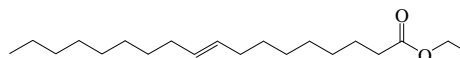
5-Et hyl -2-norbome



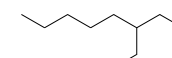
Et hylci sci s9,12-oct adecadi enoat e



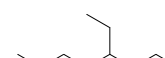
Et hylci sci s9,12,15-oct adecatri enoat e



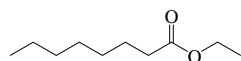
Et hylt rans9-oct adecenoat e



3-Et hyl oct ane



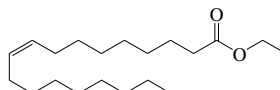
4-Et hyl oct ane



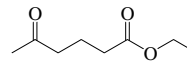
Et hyl oct anoat e



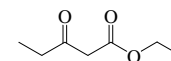
Et hyl1-oct ylsul f i de



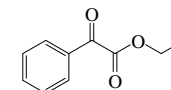
Et hylol eat e



Et hyl5-oxohexanoat e

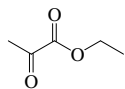


Et hyl3-oxopent anoat e

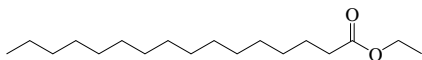


Et hyl2-oxo-2-phenyl acet at e

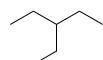
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5189	Et hyl 2-oxopropanoat e	Et hyl pyruvat e	$\text{C}_3\text{H}_5\text{O}_3$	617-35-6	116.116	li q	-50	155	1.0596	1.4052 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
5190	Et hyl pal mi t at e		$\text{C}_{18}\text{H}_{36}\text{O}_2$	628-97-7	284.478	nd	24	191 ¹⁰	0.8577 ²⁵	1.4347 ³⁴	i H ₂ O; s Et OH, et h, ace, bz, chl
5191	3-Et hyl pent ane		$\text{C}_{16}\text{H}_{34}$	617-78-7	100.202	li q	-118.55	93.5	0.6982	1.3934 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, hp, chl
5192	3-Et hyl -2,4-pent anedi one		$\text{C}_6\text{H}_{10}\text{O}_2$	1540-34-7	128.169			178.5	0.9531 ¹⁹	1.4408 ¹⁹	vs et h, Et OH, chl
5193	Et hyl pent anoat e	Et hyl val erat e	$\text{C}_5\text{H}_{10}\text{O}_2$	539-82-2	130.185	li q	-91.2	146.1	0.8770	1.4120 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
5194	3-Et hyl -3-pent anol		$\text{C}_{16}\text{H}_{34}\text{O}$	597-49-9	116.201	li q	-12.5	142	0.8407	1.4294 ²⁰	sl H ₂ O; s Et OH, et h
5195	2-Et hyl -1-pent ene		$\text{C}_{14}\text{H}_{28}$	3404-71-5	98.186			94	0.7079 ²⁰	1.405 ²⁰	vs bz, et h, Et OH
5196	3-Et hyl -1-pent ene		$\text{C}_{14}\text{H}_{28}$	4038-04-4	98.186	li q	-127.5	84.1	0.6917	1.3982 ²⁰	
5197	3-Et hyl -2-pent ene		$\text{C}_{14}\text{H}_{28}$	816-79-5	98.186			96	0.7204 ²⁰	1.4148 ²⁰	i H ₂ O; s Et OH, et h, bz, chl
5198	Et hyl pent yl et her		$\text{C}_6\text{H}_{12}\text{O}$	17952-11-3	116.201			117.6	0.7622 ²⁰	1.3927 ²⁰	vs et h, Et OH
5199	Et hyl 2-pent ynoat e		$\text{C}_6\text{H}_{10}\text{O}_2$	55314-57-3	126.153			67 ¹⁸	0.962 ²⁵		
5200	2-Et hyl phenol		$\text{C}_{10}\text{H}_{10}\text{O}$	90-00-6	122.164		18	204.5	1.0146 ²⁵	1.5367 ²⁰	vs ace, bz, et h, Et OH
5201	3-Et hyl phenol		$\text{C}_{10}\text{H}_{10}\text{O}$	620-17-7	122.164	li q	-4	218.4	1.0283		sl H ₂ O, chl; vs Et OH, et h
5202	4-Et hyl phenol		$\text{C}_{10}\text{H}_{10}\text{O}$	123-07-9	122.164	nd	45.0	217.9		1.5239 ²⁵	sl H ₂ O, chl; vs Et OH, et h, bz; s ace
5203	Et hyl phenoxyacet at e		$\text{C}_{10}\text{H}_{12}\text{O}_3$	2555-49-9	180.200			247; 110 ³	1.0958 ³⁰	1.5080 ²⁰	
5204	N-Et hyl N-phenyl acet ami de		$\text{C}_{13}\text{H}_{15}\text{NO}$	529-65-7	163.216		55	260	0.9938 ⁵⁰		s H ₂ O, et h, ct c
5205	Et hyl phenyl acet at e	Benzeneacet i c aci d, et hyl est er	$\text{C}_{10}\text{H}_{12}\text{O}_2$	101-97-3	164.201	li q	-29.4	227	1.0333	1.4980 ²⁰	vs et h, Et OH
5206	2-(Et hyl phenyl ami no)et hanol		$\text{C}_{10}\text{H}_{15}\text{NO}$	92-50-2	165.232						s chl
5207	Et hyl phenyl carbamat e	Phenyl uret hane	$\text{C}_9\text{H}_9\text{NO}_2$	101-99-5	165.189	wh nd (w) pl (di l al)	53	dec 237	1.1064 ³⁰	1.5376 ³⁰	i H ₂ O; vs Et OH, et h; s bz; sl ct c
5208	Et hyl N-phenyl f ormi mi dat e		$\text{C}_9\text{H}_9\text{NO}$	6780-49-0	149.189			214; 87 ¹⁰	1.0051 ²⁰	1.5279 ²⁰	s et h, bz
5209	Et hyl N-phenyl gl yci nat e		$\text{C}_{13}\text{H}_{13}\text{NO}_2$	2216-92-4	179.216	lf (di l al)	58	273.5			vs et h, Et OH
5210	1-(4-Et hyl phenyl)-2-phenyl et hane		$\text{C}_{18}\text{H}_{22}$	7439-15-8	210.314	cry		294	1.028 ⁵⁰		
5211	Et hyl 3-phenyl propanoat e		$\text{C}_{11}\text{H}_{14}\text{O}_2$	2021-28-5	178.228			247.2	1.0147 ²⁰	1.4954 ²⁰	vs et h, Et OH
5212	Et hyl 3-phenyl propynoat e	Et hyl phenyl acet yl enecarboxyl at e	$\text{C}_{11}\text{H}_{10}\text{O}_2$	2216-94-6	174.196			265; 128 ¹⁶	1.055 ²⁵	1.5520 ²⁰	s et h
5213	Et hyl phenyl sul f one		$\text{C}_8\text{H}_8\text{O}_2\text{S}$	599-70-2	170.229	lf (di l al)	42	160	1.1410 ²⁰		vs bz, et h, Et OH, chl
5214	Et hyl phosphoni c aci d		$\text{C}_3\text{H}_7\text{O}_2\text{P}$	6779-09-5	110.049	hyg pl or nd	61.5	335			vs H ₂ O, et h, Et OH
5215	Et hyl phosphorodi chl ori dat e	Et hyl phosphori c aci d di chl ori de	$\text{C}_2\text{H}_5\text{Cl}_2\text{O}_2\text{P}$	1498-51-7	162.940			62 ¹⁰		1.4338 ²⁰	
5216	5-Et hyl -2-pi col i ne		$\text{C}_8\text{H}_9\text{N}$	104-90-5	121.180			178.3	0.9202 ²⁰	1.4971 ²⁰	sl H ₂ O; s Et OH, et h, bz; vs ace
5217	Et hyl 1-pi perazi necarboxyl at e	1-Carbet hoxypi perazi ne	$\text{C}_{14}\text{H}_{19}\text{NO}_2$	120-43-4	158.198			237		1.4760 ²⁵	vs H ₂ O, et h, Et OH
5218	1-Et hyl pi peri di ne		$\text{C}_8\text{H}_{15}\text{N}$	766-09-6	113.201			130.8	0.8237 ²⁰	1.4480 ²⁰	
5219	Et hyl 4-pi peri di necarboxyl at e		$\text{C}_{15}\text{H}_{21}\text{NO}_2$	1126-09-6	157.211	col oi l		100		1.4591 ²⁰	vs H ₂ O, bz, et h, Et OH
5220	Et hyl 1-pi peri di nepropanoat e		$\text{C}_{10}\text{H}_{13}\text{NO}_2$	19653-33-9	185.264			217; 139 ⁵⁰	0.9627 ²⁵	1.4525 ²⁵	vs H ₂ O
5221	1-Et hyl -3-pi peri di nol		$\text{C}_9\text{H}_{11}\text{NO}$	13444-24-1	129.200			94 ¹⁵		1.4777 ¹⁴	
5222	N-Et hyl -1-propanami ne		$\text{C}_8\text{H}_{13}\text{N}$	20193-20-8	87.164			81	0.7204 ¹⁷	1.3858 ²⁵	sl H ₂ O; vs ace, Et OH
5223	Et hyl propanedi oi c aci d		$\text{C}_3\text{H}_7\text{O}_4$	601-75-2	132.116	pr (w+1)	114	180 ⁰⁵			vs H ₂ O; s Et OH, et h, bz; i ace; sl t f a
5224	Et hyl propanoat e	Et hyl propi onat e	$\text{C}_3\text{H}_7\text{O}_2$	105-37-3	102.132	li q	-73.9	99.1	0.8843	1.3839 ²⁰	sl H ₂ O, ct c; msc Et OH, et h; s ace
5225	Et hyl propyl et her		$\text{C}_6\text{H}_{12}\text{O}$	628-32-0	88.148	li q	-127.5	63.21	0.7386	1.3695 ²⁰	vs et h, Et OH, HOAc
5226	2-(1-Et hyl propyl)pyri di ne		$\text{C}_{10}\text{H}_{15}\text{N}$	7399-50-0	149.233			195.4	0.8981 ²⁰	1.4850 ²⁵	
5227	4-(1-Et hyl propyl)pyri di ne		$\text{C}_{10}\text{H}_{15}\text{N}$	35182-51-5	149.233		125.5	217; 80 ¹²	0.9085 ²⁵	1.40905 ²⁵	
5228	Et hyl propyl sul fide		$\text{C}_6\text{H}_{12}\text{S}$	4110-50-3	104.214	li q	-117	118.6	0.8370	1.4462 ²⁰	s Et OH
5229	Et hyl 2-propynoat e	(Et hoxycarbonyl)acet yl ene	$\text{C}_3\text{H}_4\text{O}_2$	623-47-2	98.101			120	0.9645 ¹⁶	1.4105 ²⁰	i H ₂ O; vs Et OH, et h, chl
5230	2-Et hyl pyrazi ne		$\text{C}_8\text{H}_{12}\text{N}_2$	13925-00-3	108.141			112 ²⁰⁰			
5231	2-Et hyl pyri di ne		$\text{C}_7\text{H}_9\text{N}$	100-71-0	107.153	li q	-63.1	148.6	0.9502	1.4964 ²⁰	s H ₂ O; msc Et OH; vs et h, ace; sl ct c



Et hyl2-oxoproanoat e



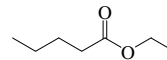
Et hylpal mi t at e



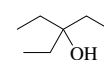
3-Et hyl pent ane



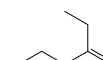
3-Et hyl -2,4-pent anedi one



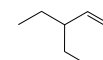
Et hylpent anoat e



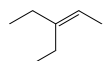
3-Et hyl -3-pent anol



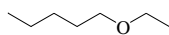
2-Et hyl -1-pent ene



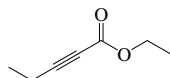
3-Et hyl -1-pent ene



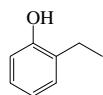
3-Et hyl -2-pent ene



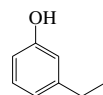
Et hylpent ylet her



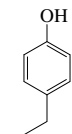
Et hyl2-pent ynoat e



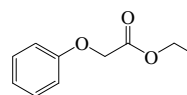
2-Et hyl phenol



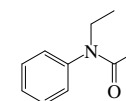
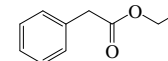
3-Et hyl phenol



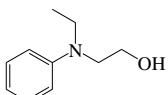
4-Et hyl phenol



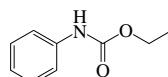
Et hylphenoxyacet at e


N-Et hyl*N*-phenyl acet ami de


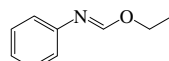
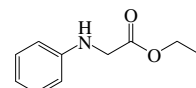
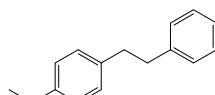
Et hylphenyl acet at e



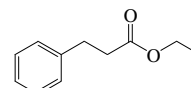
2-(Et hyl phenyl ami no)et hanol



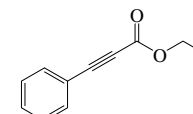
Et hylphenyl carbat at e


 Et hyl*N*-phenyl f ormi mi dat e

 Et hyl*N*-phenyl glyci nat e


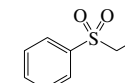
1-(4-Et hyl phenyl)-2-phenyl et hane



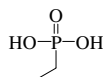
Et hyl3-phenyl propanoat e



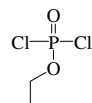
Et hyl3-phenyl propynoat e



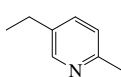
Et hylphenyl sul f one



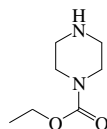
Et hyl phosphoni aci d



Et hylphosphordi chl ori dat e



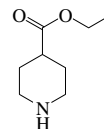
5-Et hyl -2-pi coli ne



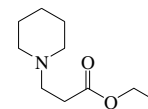
Et hyl1-pi perazi necarboxyl at e



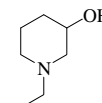
1-Et hyl pi peri di ne



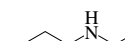
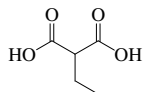
Et hyl4-pi peri di necarboxyl at e



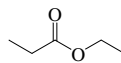
Et hyl1-pi peri di neproanoat e



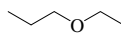
1-Et hyl -3-pi peri di nol


N-Et hyl -1-propanami ne


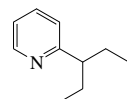
Et hyl propanedi oaci d



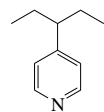
Et hylproanoat e



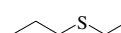
Et hylpropyl et her



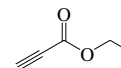
2-(1-Et hyl propyl)pyri di ne



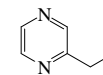
4-(1-Et hyl propyl)pyri di ne



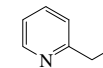
Et hylpropyl sul f i de



Et hyl2-propynoat e

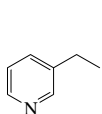


2-Et hyl pyrazi ne

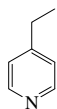


2-Et hyl pyri di ne

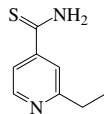
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5232	3-Et hyl pyri di ne		$\text{C}_{10}\text{H}_{13}\text{N}$	536-78-7	107.153	li q	-76.9	165	0.9539	1.5021 ²⁰	s H ₂ O, Et OH, et h; vs ace; sl ct c
5233	4-Et hyl pyri di ne		$\text{C}_{10}\text{H}_{13}\text{N}$	536-75-4	107.153	li q	-90.5	168.3	0.9417 ⁹	1.5009 ²⁰	s H ₂ O, Et OH, et h; vs ace; sl ct c
5234	2-Et hyl -4-pyri di ncarbort hi oami de	Et hi onami de	$\text{C}_{10}\text{H}_{13}\text{N}_2\text{S}$	536-33-4	166.243		163				
5235	Et hyl 2-pyri di ncarbonyl at e	Et hyl 2-pi col i nat e	$\text{C}_8\text{H}_9\text{NO}_2$	2524-52-9	151.163	ye cry i n ai r	1	243	1.1194	1.5104 ²⁰	vs H ₂ O, et h, Et OH
5236	Et hyl 3-pyri di ncarbonyl at e	Et hyl ni cot i nat e	$\text{C}_8\text{H}_9\text{NO}_2$	614-18-6	151.163		8.5	224	1.1070 ²⁰	1.5024 ²⁰	vs H ₂ O, Et OH, et h, bz; sl ct c
5237	Et hyl 4-pyri di ncarbonyl at e		$\text{C}_8\text{H}_9\text{NO}_2$	1570-45-2	151.163		23	219.5	1.0091 ¹⁵	1.5017 ²⁰	sl H ₂ O; s Et OH, bz; vs et h, chl
5238	N-Et hyl pyri di ni um bromi de		$\text{C}_8\text{H}_{10}\text{BrN}$	1906-79-2	188.065	cry (al)	111.5				s H ₂ O, Et OH; i et h
5239	1-Et hyl -H-pyrrol e		$\text{C}_4\text{H}_7\text{N}$	617-92-5	95.142			129.5	0.9009 ²⁰	1.4841 ²⁰	vs Et OH
5240	1-Et hyl -H-pyrrol e-2,5-di one	N-Et hyl mal ei mi de	$\text{C}_6\text{H}_9\text{NO}_2$	128-53-0	125.126	cry (bz)	45.5				sl H ₂ O; vs Et OH, et h; s chl
5241	1-Et hyl -2-pyrrol i di nemet hanami ne		$\text{C}_7\text{H}_{10}\text{O}_2$	26116-12-1	128.215			59 ¹⁶ , 40 ¹⁰	0.887 ²⁵	1.4665 ²⁰	
5242	Et hyl Red	2-(4-Di et hyl ami nophenyl azo)benzoate	$\text{C}_{20}\text{H}_{19}\text{N}_3\text{O}_2$	76058-33-8	297.352		135				
5243	Et hyl sali c yl at e		$\text{C}_9\text{H}_9\text{O}_3$	118-61-6	166.173		45	150 ¹⁰	1.1326 ²⁰	1.5296 ²⁰	i H ₂ O; msc Et OH; vs et h; s ct c
5244	Et hyl si li cat e		$\text{C}_8\text{H}_{10}\text{OSi}$	78-10-4	208.329	li q	-82.5	168.8	0.9320	1.3928 ²⁰	dec H ₂ O
5245	Et hyl st earat e	Et hyl oct adecanoat e	$\text{C}_{20}\text{H}_{40}\text{O}_2$	111-61-5	312.531		33	199 ¹⁰	1.057 ²⁰	1.4349 ⁴⁰	i H ₂ O; s Et OH, et h, chl; vs ace
5246	2-Et hyl st yrene		$\text{C}_{12}\text{H}_{12}$	7564-63-8	132.202	li q	-75.5	187.3; 6 ⁸	0.9017 ²⁵	1.5380 ²⁰	
5247	3-Et hyl st yrene		$\text{C}_{12}\text{H}_{12}$	7525-62-4	132.202	li q	-101	190.0	0.894 ⁵	1.5351 ²⁰	
5248	4-Et hyl st yrene		$\text{C}_{12}\text{H}_{12}$	3454-07-7	132.202	li q	-49.7	192.3; 8 ⁸	0.8884 ²⁵	1.5376 ²⁰	
5249	Et hyl sul f at e		$\text{C}_2\text{H}_5\text{O}_2\text{S}$	540-82-9	126.132			dec 280	1.3657 ²⁰	1.4105 ²⁰	vs H ₂ O
5250	2-(Et hyl sul f onyl)et hanol	Et hyl sul f onyl et hyl al cohoh	$\text{C}_4\text{H}_{10}\text{O}_2\text{S}$	513-12-2	138.185						sl chl
5251	2-Et hyl -5-(3-sul f ophenyl) i soxazol i ni um hydroxi de, i nner salt	Woodward's Reagent K	$\text{C}_7\text{H}_{11}\text{NO}_2\text{S}$	4156-16-5	253.275		dec 207				
5252	Et hyl t art rat e	Et hyl t art rat e, aci d	$\text{C}_{10}\text{H}_{10}\text{O}_6$	608-89-9	178.139		90				vs H ₂ O, Et OH
5253	2-Et hyl et rahydrof uran		$\text{C}_6\text{H}_{12}\text{O}$	1003-30-1	100.158			109	0.8570 ¹⁹	1.4147 ¹⁹	vs ace, bz, et h, Et OH
5254	5-Et hyl -1,3,4-t hi adi azol -2-ami ne		$\text{C}_8\text{H}_{10}\text{N}_2\text{S}$	14068-53-2	129.184		200.8				
5255	S-Et hyl t hi oacet at e		$\text{C}_4\text{H}_8\text{OS}$	625-60-5	104.171			116.4	0.9792 ²⁰	1.4583 ²¹	i H ₂ O; vs Et OH, et h
5256	(Et hyl t hi o)acet i c aci d		$\text{C}_4\text{H}_8\text{O}_2\text{S}$	627-04-3	120.171		-8.5	164 ⁸³ , 109 ⁵	1.1497 ²⁰		vs H ₂ O, Et OH, et h
5257	(Et hyl t hi o)benzene	Thi ophenet ol e	$\text{C}_8\text{H}_8\text{S}$	622-38-8	138.230			205	1.0211 ²⁰	1.5670 ²⁰	s Et OH
5258	Et hyl t hi ocyanat e		$\text{C}_3\text{H}_5\text{NS}$	542-90-5	87.144	li q	-85.5	146	1.007 ⁹	1.4684 ¹⁵	i H ₂ O; msc Et OH, et h; s chl
5259	2-(Et hyl t hi o)et hanol		$\text{C}_4\text{H}_{10}\text{OS}$	110-77-0	106.186	li q	-100	184	1.016 ⁶	1.4867 ²⁰	sl H ₂ O; s Et OH; vs ace
5260	1-(Et hyl t hi o)-4-met hyl benzene		$\text{C}_9\text{H}_{10}\text{S}$	622-63-9	152.256			220	0.9996 ²⁰	1.555 ²⁰	
5261	2-Et hyl t hi ophene		$\text{C}_8\text{H}_8\text{S}$	872-55-9	112.193			134	0.9930 ²⁰	1.5122 ²⁰	i H ₂ O; vs Et OH, et h
5262	Et hyl t hi ophene-2-carboxyl at e		$\text{C}_9\text{H}_8\text{O}_2\text{S}$	2810-04-0	156.203			218	1.1623 ¹⁶	1.5248 ²⁰	s Et OH, ace; sl ct c
5263	3-Et hyl -2-t hi oxo-4-t hi azol i di none	3-Et hyl rhodani ne	$\text{C}_8\text{H}_{11}\text{NOS}$	7648-01-3	161.246		35.5				
5264	2-Et hyl ol uene		C_8H_{12}	611-14-3	120.191	li q	-79.83	165.2	0.8807 ⁹	1.5046 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
5265	3-Et hyl ol uene		C_8H_{12}	620-14-4	120.191	li q	-95.6	161.3	0.864 ⁵	1.4966 ²⁰	i H ₂ O; vs Et OH, et h; msc ace, bz
5266	4-Et hyl ol uene		C_8H_{12}	622-96-8	120.191	li q	-62.35	162	0.8614 ⁹	1.4959 ²⁰	i H ₂ O; vs Et OH, et h; msc ace, bz
5267	Et hyl p-t ol uenesul f onat e		$\text{C}_9\text{H}_9\text{O}_2\text{S}$	80-40-0	200.254		34.5	173 ¹⁵	1.166 ⁴⁶		i H ₂ O; s Et OH, et h, AcOEt; sl ct c
5268	Et hyl t ri chl oroacet at e		$\text{C}_2\text{HCl}_3\text{O}_2$	515-84-4	191.441			167.5	1.3836 ²⁰	1.4505 ²⁰	i H ₂ O; s Et OH, et h, bz; sl chl
5269	Et hyl t ri fluoroacet at e		$\text{C}_2\text{HF}_3\text{O}_2$	383-63-1	142.077			61	1.194 ²⁰	1.308 ²⁰	
5270	Et hyl 4,4,4-t ri fluoroacet at e		$\text{C}_4\text{H}_7\text{FO}_2$	372-31-6	184.113	li q	-39.1	132	1.258 ⁶	1.3783 ¹⁵	s Et OH, et h
5271	Et hyl t ri fluoromet hanesul f onat e		$\text{C}_2\text{HF}_3\text{FO}_2\text{S}$	425-75-2	178.130			115	1.3740 ⁹		s et h
5272	Et hyl 3,4,5-t ri hydroxybenzoat e		$\text{C}_7\text{H}_6\text{O}_5$	831-61-8	198.172	mcl pr (w+2 l/ 2) nd (chl)	163.0				sl H ₂ O, chl; s Et OH, et h, AcOEt
5273	Et hyl t ri met hoxysi l ane		$\text{C}_3\text{H}_8\text{O}_3\text{Si}$	5314-55-6	150.249			124.3	0.9488 ⁹	1.3838 ²⁰	vs Et OH



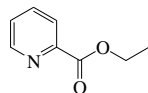
3-Et hyl pyri di r



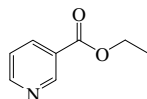
4-Et hyl pyri di ne



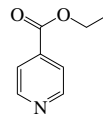
2-Et hyl-4-pyri di necarbot hi oami de



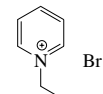
Et hyl2-pyri di necarboxyl at e



Et hyl3-pyri di necarboxyl at e



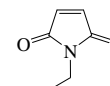
Et hyl4-pyri di necarboxyl at e



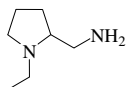
N-Et hyl pyri di ni bromi de



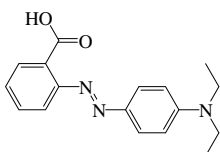
1-Et hyl-*H*-pyrrol e



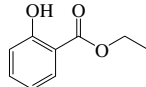
1-Et hyl-*H*-pyrrol e-2,5-di one



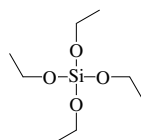
1-Et hyl-2-pyrrol i di nemet hanami ne



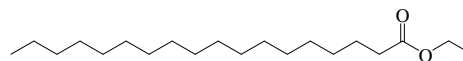
Et hylRed



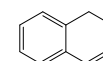
Et hylsal i cyl at e



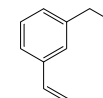
Et hylsi li cat e



Et hylst ear at e

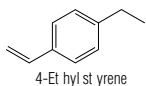


2-Et hyl st yrene

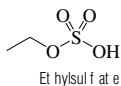


3-Et hyl st yrene

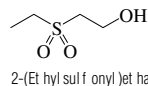
3-279



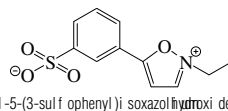
4-Et hyl st yrene



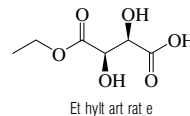
Et hylsul f at e



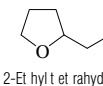
2-(Et hyl sul f onyl)et hanol



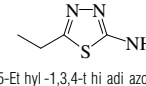
2-Et hyl-5-(3-sul f ophenyl) i soxazol ihydroxi de j nnesal t



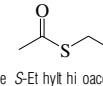
Et hylt art rat e



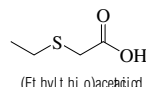
2-Et hyl t et rahydrof uran



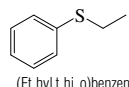
5-Et hyl-1,3,4-t hi adi azol-2-ami ne



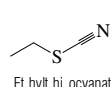
S-Et hylt hi oacet at e



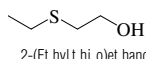
(Et hyl t hi o)acet iat d



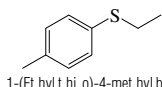
(Et hyl t hi o)benzene



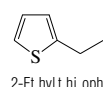
Et hylt hi ocyanat



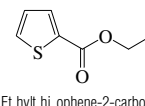
2-(Et hyl t hi o)et hanol



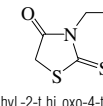
1-(Et hyl t hi o)-4-met hyl benzene



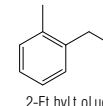
2-Et hyl t hi ophene



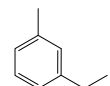
Et hylt hi ophene-2-carboxyl at e



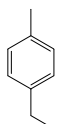
3-Et hyl-2-t hi oxo-4-t hi azol i d



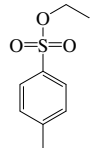
2-Et hylt hi uene



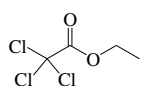
3-Et hyl t hi uene



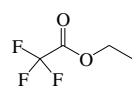
4-Et hyl t hi uene



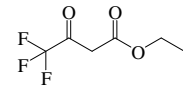
Et hylp-t ol uenesul f onat e



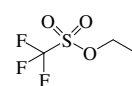
Et hylt ri chl oroacet at e



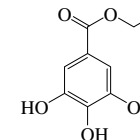
Et hylt ri f luoroacet at e



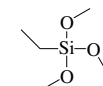
Et hyl4,4,4-t ri f luoroacet oacet at e



Et hylt ri f luoromet hanesul f onat e

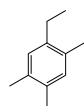


Et hyl3,4,5-t ri hydroxybenzoat e



Et hylt ri met hoxysi l ane

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5274	1-Et hyl -2,4,5-t ri met hyl benzene		$_{11}H_{16}$	17851-27-3	148.245	li q	-13.5	213	0.888 ⁹	1.5075 ²⁰	vs ace, bz, et h, Et OH
5275	2-Et hyl -1,3,5-t ri met hyl benzene		$_{11}H_{16}$	3982-67-0	148.245	li q	-15.5	212.4	0.888 ⁹	1.5074 ²⁰	vs ace, bz, et h, Et OH
5276	Et hyl t ri met hyl lead	Et hyl t ri met hyl pl umbane	$_{3}H_{14}Pb$ C	1762-26-1	281.4	col li q		27 ⁵	1.88 ²⁰		
5277	3-Et hyl -2,4,5-t ri met hyl pyrrol e		$_{9}H_{10}N$	520-69-4	137.222	lf (et h)	66.5	214; 110			
5278	4-Et hyl -2,6,7-t ri oxa-1-phosphabi cycl o[2.2.2]oct ane	Tri met hyl ol propane phosphi t e	$_{6}H_{10}O_3P$	824-11-3	162.123		53.7				s chl
5279	Et hyl undecanoat e	Et hyl undecyl at e	$_{13}H_{26}O_2$	627-90-7	214.344		-15	131 ¹⁴	0.8633 ²⁰	1.4285 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
5280	Et hyl 10-undecenoat e		$_{13}H_{24}O_2$	692-86-4	212.329	li q	-38	264.5	0.8827 ⁹	1.4449 ²⁵	i H ₂ O; s Et OH, et h, HOAc; sl ct c
5281	N-Et hyl urea		$_{6}H_{12}N_2O$	625-52-5	88.108	nd (bz, al-et h)	92.5	dec	1.2130 ⁹		vs H ₂ O, Et OH, bz; s et h; i GS
5282	Et hyl vi nyl et her		$_{4}H_6O$	109-92-2	72.106	li q	-115.8	35.5	0.7589 ⁹	1.3767 ²⁰	sl H ₂ O, ct c; s Et OH; msc et h
5283	Et hyl Vi ol et		$_{31}H_{42}ClN_5$	2390-59-2	492.138	gray-vi ol cry					s H ₂ O, Et OH
5284	α-Et hynyl benzenemet hanol	1-Phenyl propargyl al cohoh	$_{9}H_{10}O$	4187-87-5	132.159	pr	22	114 ¹²	1.0655 ²⁰	1.5508 ²⁰	
5285	α-Et hynyl benzenemet hanol carbat e	Carfimat e	$_{10}H_{13}NO_2$	3567-38-2	175.184	cry (al)	86.5				
5286	1-Et hynyl cycl ohexanam i ne		$_{8}H_{13}N$	30389-18-5	123.196			65 ²⁰	0.913 ²⁵	1.4817 ²⁰	
5287	1-Et hynyl cycl ohexanol		$_{8}H_{16}O$	78-27-3	124.180	cry (pet h)	31.5	174	0.9873 ⁹	1.4822 ²⁰	i H ₂ O; s Et OH, bz, pet h; sl chl
5288	1-Et hynyl cycl ohexanol , carbat e	Et hi namat e	$_{8}H_{15}NO_2$	126-52-3	167.205	nd	97	120 ³		1.4441 ²¹	sl H ₂ O; vs Et OH; s hx
5289	1-Et hynyl cycl opent anol		$_{7}H_{10}O$	17356-19-3	110.153		27	157.5	0.962 ²⁵	1.4751 ²⁰	
5290	α-Et hynyl α-met hyl benzenemet hanol		$_{10}H_{10}O$	127-66-2	146.185		52.3	217.5; 102 ¹²	1.0314 ²⁰		
5291	Et hynyl si lane	Si lyl acet yl ene	$_{2}H_4Si$	1066-27-9	56.139	col gas		-22.5			
5292	Et i oporphyr i n		$_{30}H_{38}N_4$	448-71-5	478.671			362			
5293	Et of yl i ne		$_{3}H_6N_2O_3$	519-37-9	224.216			158			vs H ₂ O; s Et OH; sl et h, bz
5294	Et ogluci d	Oxi rane, 2,2'-(2,5,8,11-t et raoxidodecane-1,12-di yl)bi s-	$_{12}H_{22}O_6$	1954-28-5	262.299	col li q	-13	196	1.1312 ²⁰	1.4622 ²⁰	
5295	Et oposi de		$_{39}H_{32}O_{13}$	33419-42-0	588.556	cry (MeOH)	≈243				s MeOH
5296	Et ri mf os		$_{16}H_{17}N_2O_4PS$	38260-54-7	292.291		-1.7		1.195 ²⁰		
5297	Eucal ypt ol	Ci neol e	$_{16}H_{18}O$	470-82-6	154.249		0.8	176.4	0.9267 ²⁰	1.4586 ²⁰	i H ₂ O; s Et OH, et h, chl; sl ct c
5298	Eupari n	1-[6-Hydroxy-2-(1-met hyl vi nyl)-5-benzof uranyl]et hanone	$_{13}H_{12}O_3$	532-48-9	216.232		121.5				s et h, bz, chl; sl NaOH
5299	Evan's Bl ue		$_{24}H_{24}Na_6O_{14}S_4$	314-13-6	960.806						s H ₂ O, Et OH, aci d
5300	Evodi ami ne		$_{19}H_{17}N_3O$	518-17-2	303.357	ye lf (al)	28				
5301	Famot i di ne		$_{16}H_{15}N_5O_2S_3$	76824-35-6	337.446	cry	163				i Et OH, chl; vs DMF; s HOAc; sl MeOH
5302	Famphur		$_{10}H_{16}NO_5PS_2$	52-85-7	325.342		53				
5303	α-Farnesene		$_{15}H_{24}$	502-61-4	204.352			130 ¹²	0.8410 ²⁰	1.4836 ²⁰	i H ₂ O; s et h, ace; msc pet h, li g
5304	β-Farnesene		$_{15}H_{24}$	18794-84-8	204.352			121 ⁹	0.8363 ²⁰	1.4899 ²⁰	vs ace, et h, chl
5305	Farnesi c aci d		$_{15}H_{24}O_2$	7548-13-2	236.351	oi l		20 ⁴			
5306	2- <i>ci</i> β- <i>t rans</i> Farnesol		$_{15}H_{26}O$	3790-71-4	222.366	oi l		156, 120 ^{0,3}	0.8908 ²⁰	1.4877 ²⁰	vs ace, et h, Et OH
5307	2- <i>t rans</i> β- <i>t rans</i> Farnesol		$_{15}H_{26}O$	106-28-5	222.366	oi l		160, 137 ³	0.888 ²⁰	1.4877 ²⁰	i H ₂ O; vs Et OH; s et h, ace
5308	Farnesol acet at e		$_{16}H_{28}O_2$	29548-30-9	264.403			168 ¹⁰			
5309	Fenadi azol e	2-(1,2,4-Oxadi azol -2-yl)phenol	$_{6}H_8N_2O_4$	1008-65-7	194.145	cry	112	180 ^{0,1}			
5310	Fenami phos		$_{9}H_{12}NO_3PS$	22224-92-6	303.358		49		1.15 ²⁰		
5311	Fenari mol		$_{12}H_{12}Cl_2N_2O$	60168-88-9	331.195			118			
5312	Fenbuconazol e		$_{20}H_{19}ClN_4$	114369-43-6	350.845			125			
5313	Fenbut at i n oxi de	Di st annoxane, hexaki s(2-met hyl phenyl propyl)-	$_{26}H_{76}OSn_2$	13356-08-6	1052.680			138			



1-Et-2,4,5-trimethylbenzene



2-Et-1,3,5-trimethylbenzene



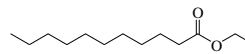
EtHyl



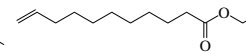
EtHyl-2,4,5-trimethylpyrrole



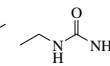
EtHyl-2,6,7-trioxaphosphabicyclo[2.2.2]octane



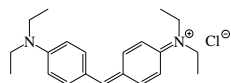
Ethylundecanoate



Ethyl-10-undecenoate



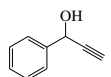
N-Ethylurea



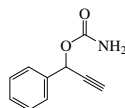
EtHylVIolet



EtHylNylHer



α -EtHynylbenzenemetanol



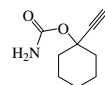
α -EtHynylbenzenemetanocarbamate



1-EtHynylcyclohexanamine



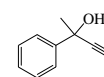
n-EtHynylcyclohexanol



1-EtHynylcyclohexanocarbamate



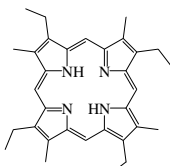
1-EtHynylcyclopentanol



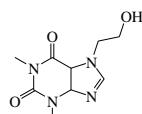
α -EtHynylbenzenemetanol



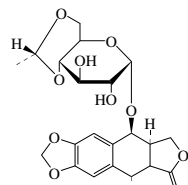
EtHynylsilane



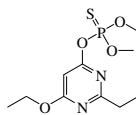
Etioophyrin



Etolliene



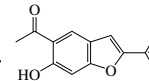
Etoposide



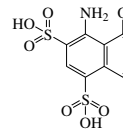
Ettrimfos



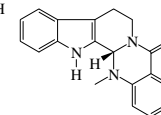
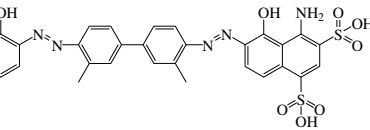
Eucalyptol



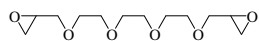
Euparin



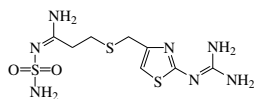
Evan's Blue



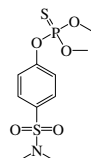
Evodiamine



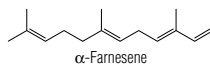
Etoglucid



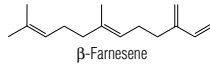
Famotidine



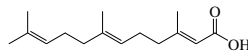
Famphur



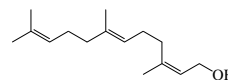
α -Farnesene



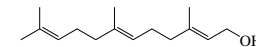
β -Farnesene



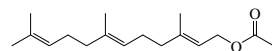
Farnesic acid



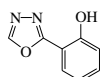
2-cis,6-trans-Farnesol



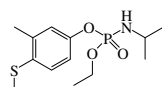
2-trans,6-trans-Farnesol



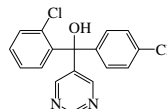
Farnesol acetate



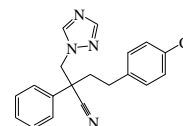
Fenadiazole



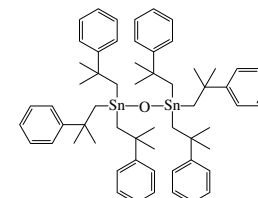
Fenami phosphite



Fenarimol

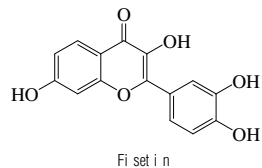
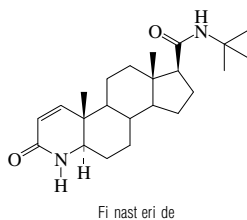
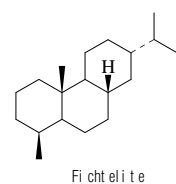
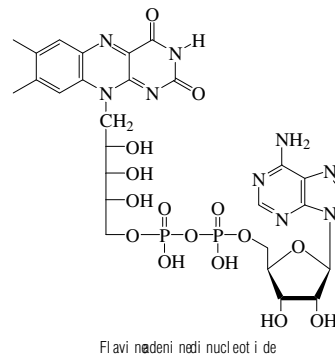
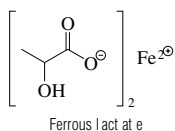
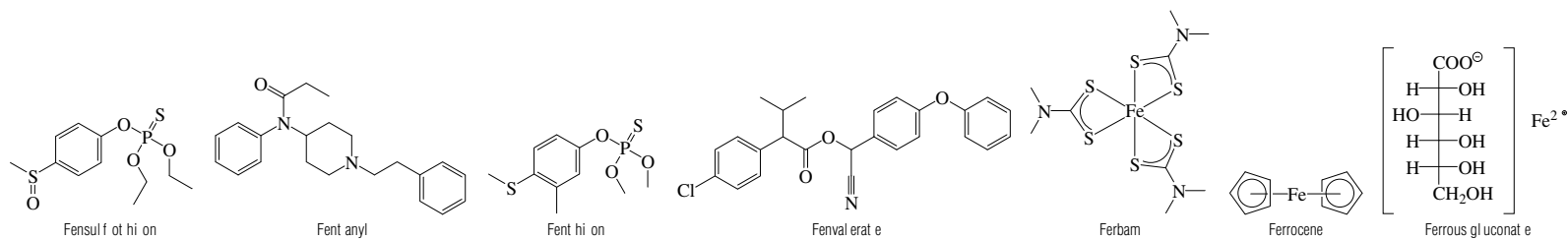
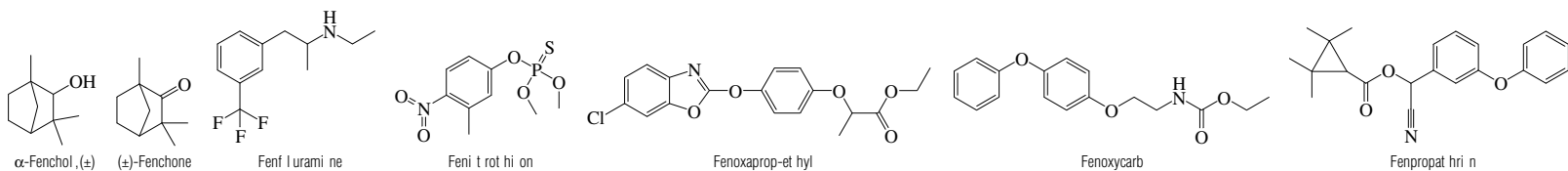


Fenbuconazole

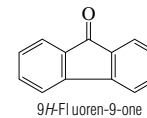
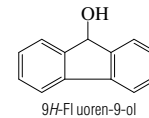
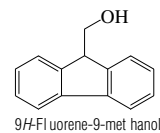
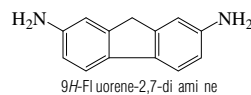
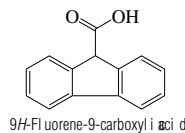
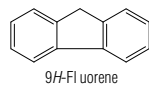
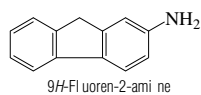
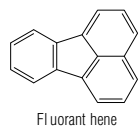
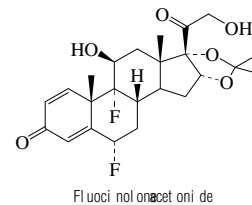
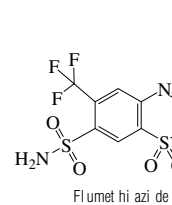
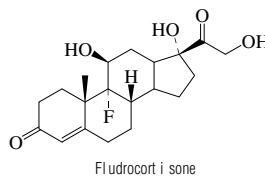
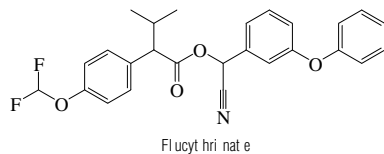
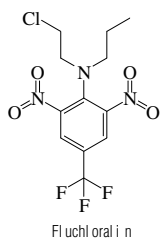
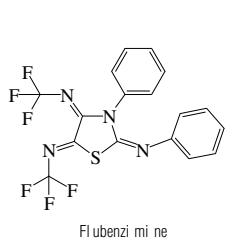
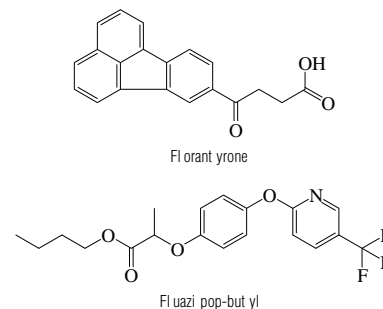


Fenbutaxide

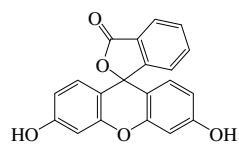
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5314	α-Fenchol, (±)	1,3,3-Tri met hyl bi cycl o[2.2.1]hept an-2-ol, <i>endo</i> -(±)	C ₁₀ H ₁₆ O	36386-49-9	154.249		39	199.5	0.9420 ⁴⁰		vs et h, Et OH
5315	(±)-Fenchone		C ₁₀ H ₁₆ O	18492-37-0	152.233	oil y li q	6.1	193.5	0.9492	1.4702 ²⁰	i H ₂ O; vs Et OH; s et h, ace
5316	Fenflurami ne		C ₁₆ H ₁₅ F ₃ N	458-24-2	231.257	cry (AcOEt)		110 ²			
5317	Feni t rot hi on		C ₉ H ₉ NO ₃ PS	122-14-5	277.234			118 ^{0.05} , 164 ¹	1.3227 ²⁵		
5318	Fenoxaprop-et hyl		C ₁₆ H ₁₆ ClNO ₃	82110-72-3	361.777		85	200 ^{0.001}			sl H ₂ O, hx; s et h; vs ace, t ol
5319	Fenoxycarb	Et hyl 2-(4-phenoxyphenoxy) et hyl carbamat e	C ₁₇ H ₁₉ NO ₄	79127-80-3	301.338		53				
5320	Fenpropat hri n		C ₁₁ H ₂₃ NO ₃	64257-84-7	349.423		47		1.15 ²⁵		
5321	Fensulf ot hi on		C ₁₁ H ₁₇ O ₄ PS ₂	115-90-2	308.354			140 ^{0.01}	1.202 ²⁰		
5322	Fent anyl		C ₁₂ H ₂₃ N ₂ O	437-38-7	336.469		87.5				
5323	Fent hi on		C ₁₁ H ₁₅ O ₃ PS ₂	55-38-9	278.328		7.5	87 ^{0.01}	1.246 ²⁰		
5324	Fenval erat e		C ₁₂ H ₂₂ ClNO ₃	51630-58-1	419.901			dec	1.15 ²⁵		
5325	Ferbam	Iron, t ri s(di met hyl carbamodi t hi oate), (OC-6-11)-	C ₁₀ H ₁₈ FeN ₃ S ₆	14484-64-1	416.494		180 dec				
5326	Ferrocene	Di cycl opent adi enyl i ron	C ₁₀ H ₆ Fe	102-54-5	186.031		172.5	249			i H ₂ O
5327	Ferrous gluconat e		C ₁₂ H ₂₂ FeO ₁₄	299-29-6	446.140	ye-gray pow (w)					s H ₂ O; i Et OH
5328	Ferrous lact at e		C ₁₀ H ₁₀ FeO ₆	5905-52-2	233.984	grn-wh pow (hyd)					s H ₂ O; i Et OH
5329	Ficht eli t e	18-Norabi et ane	C ₁₉ H ₃₄	2221-95-6	262.473	cry	46	236 ⁴³	0.9380 ²²	1.5052 ²⁰	
5330	Finast eri de	Proscar	C ₂₈ H ₃₈ N ₂ O ₂	98319-26-7	372.544	wh cry	252				sl H ₂ O; s chl, Et OH, MeOH, DMSO
5331	Fiset i n		C ₁₉ H ₁₀ O ₆	528-48-3	286.236	lt ye nd (di l al, 330 + 1 w)					i H ₂ O; s Et OH, ace; sl et h, bz, pet h
5332	Flavi ne adeni ne di nucleot i de	FAD	C ₂₇ H ₃₉ O ₉ N ₅ P ₂	146-14-5	785.550	ye cry (w)					
5333	Florant yrone		C ₁₀ H ₁₄ O ₃	519-95-9	302.323	ye cry (HOAc)	208				s Et OH, MeOH
5334	Fluazi pop-but yl		C ₁₉ H ₂₉ F ₃ NO ₄	79241-46-6	383.362	pal e ye li q	5				
5335	Flubenzi mi ne		C ₁₀ H ₁₀ F ₆ N ₂ S	37893-02-0	416.343	ye cry	119				sl H ₂ O
5336	Fluchl oral i n		C ₁₃ H ₁₃ ClF ₃ N ₃ O ₄	33245-39-5	355.697		42				
5337	Flucyt hri nat e	Cyt hri n	C ₁₃ H ₁₃ F ₂ NO ₄	70124-77-5	451.463			108 ^{0.35}	1.189 ²²		
5338	Fludrocort i sone		C ₂₁ H ₂₉ FO ₅	127-31-1	380.450	cry (Et OH)	261 dec				
5339	Flumet hi azi de	Tri fluoromet hyl t hi azi de	C ₈ H ₆ F ₃ N ₂ O ₄ S ₂	148-56-1	329.277	cry	306				sl H ₂ O; i bz, t ol; s MeOH, Et OH, DMF
5340	Fluocinol one acet oni de		C ₂₄ H ₃₀ F ₂ O ₆	67-73-2	452.488	cry (ace/hx)	266 dec				
5341	Fluorant hene	1,2-(1,8-Napht hyl ene)benzene	C ₁₆ H ₁₀	206-44-0	202.250	pa ye nd or pl (al)	110.19	384	1.252 ⁰		i H ₂ O; s Et OH, et h, bz, chl, CS
5342	9 <i>H</i> -Fluorene-2-ami ne		C ₉ H ₁₁ N	153-78-6	181.233	pl or nd (di l al)	130.3				i ₂ H s Et OH, et h, ct c, CS
5343	9 <i>H</i> -Fluorene	2,2'-Met hyl enebi phenyl	C ₁₃ H ₁₀	86-73-7	166.218	lf (al)	114.77	295	1.203		i H ₂ O; sl Et OH; s et h, ace, bz, CS
5344	9 <i>H</i> -Fluorene-9-carboxyl i c aci d		C ₁₄ H ₁₀ O ₂	1989-33-9	210.228		226				
5345	9 <i>H</i> -Fluorene-2,7-di ami ne	2,7-Di ami nofluorene	C ₁₃ H ₁₂ N ₂	525-64-4	196.247	nd (w), pr (bz), pl (et h)	166				i H ₂ O; s Et OH, chl
5346	9 <i>H</i> -Fluorene-9-met hanol		C ₁₄ H ₁₂ O	24324-17-2	196.244		105.0				
5347	9 <i>H</i> -Fluorene-9-ol		C ₁₃ H ₁₀ O	1689-64-1	182.217	hex nd (w, pet h)	156.0				sl H ₂ O, pet h, Et OH; s et h, ace; vs bz
5348	9 <i>H</i> -Fluorene-9-one		C ₁₃ H ₈ O	486-25-9	180.202	ye ort h bi pym (al, bz-pet h)	84	341.5	1.1300 ⁹⁹	1.6309 ⁹⁹	i H ₂ O; s Et OH, ace, bz; vs t ol; sl ct c



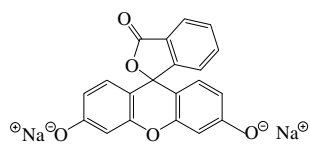
Flavinadenine nucleotide



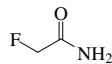
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5349	Fluorescein		C ₂₀ H ₁₂ O ₅	2321-07-5	332.306	red orth h pr	315 dec				sl H ₂ O, Et OH, et h; vs ace; s py, MeOH
5350	Fluorescein sodium	Cl Acid Yellow 73	²⁰ C ₂₀ H ₉ Na ₂ O ₅	518-47-8	376.270	ye pow					s H ₂ O, Et OH, glycerol, di l aci d
5351	2-Fluoroacetamide	Fluoroacetimidamide	₂ H ₄ FN ₂ O	640-19-7	77.057		108	sub			s H ₂ O, ace; sl chl
5352	Fluoroacetimidamide	Fluoroacetimidamide	₂ H ₃ FO ₂	144-49-0	78.042	nd	35.2	168	1.3693 ³⁰		s H ₂ O, Et OH
5353	Fluoroacetyl chloride		₂ H ₂ ClFO	359-06-8	96.487	li q		72; 29 ⁶			
5354	Fluoroacetylene	Fluoroethyne	₂ H ₂ F	2713-09-9	44.027	gas	-196	-105 exp			
5355	2-Fluoroaniline		₆ H ₆ FN	348-54-9	111.117	pa ye li q	-34.6	175; 55 ⁸	1.1513 ²¹	1.5421 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
5356	3-Fluoroaniline		₆ H ₆ FN	372-19-0	111.117			188	1.1561 ¹⁹	1.5436 ²⁰	sl H ₂ O, chl; s Et OH, et h
5357	4-Fluoroaniline		₆ H ₆ FN	371-40-4	111.117	pa ye li q	-0.8	182; 85 ⁸	1.1725 ²⁰	1.5195 ²⁰	sl H ₂ O, ct c; s Et OH, et h
5358	2-Fluorobenzaldehyde		CH ₅ FO	446-52-6	124.112	li q	-44.5	175	1.177 ⁸	1.5234 ²⁰	
5359	3-Fluorobenzaldehyde		CH ₅ FO	456-48-4	124.112			173	1.1725 ²⁵	1.5206 ²⁰	
5360	4-Fluorobenzaldehyde		CH ₅ FO	459-57-4	124.112	li q	-10	181.5	1.181 ¹⁰		
5361	Fluorobenzene		C ₆ H ₅ F	462-06-6	96.102	li q	-42.18	84.73	1.0225 ⁹	1.4684 ³⁰	sl H ₂ O; vs bz, et h, Et OH, li g
5362	4-Fluorobenzeneacetimidamide		₈ H ₈ ClFO ₂	405-50-5	154.139	cry (chl)	86	164 ⁴			
5363	2-Fluorobenzeneacetimidamide		₈ H ₈ FN	326-62-5	135.139			232; 102 ¹⁰	1.059 ²⁵	1.5009 ²⁰	
5364	4-Fluorobenzeneacetimidamide		₈ H ₈ FN	459-22-3	135.139		86.0	228; 119 ¹⁸	1.1390 ²⁰	1.5002 ²⁰	
5365	4-Fluorobenzeneacetimidamide		₈ H ₈ FN	140-75-0	125.144			183		1.5139 ²⁰	
5366	4-Fluorobenzeneacetimidamide		₈ H ₇ FO	459-56-3	126.128			23		1.5080 ²⁰	
5367	4-Fluorobenzeneacetimidamide		₈ H ₇ ClFO ₂ S	349-88-2	194.611	pl or nd	30	106 ⁶			vs bz, et h, chl
5368	2-Fluorobenzonitrile		₇ H ₅ FO ₂	445-29-4	140.112	nd (a)	126.5		1.460 ²⁵		sl H ₂ O; vs Et OH, et h; i bz; s chl
5369	3-Fluorobenzonitrile		₇ H ₅ FO ₂	455-38-9	140.112	lf (w)	124		1.474 ⁴		sl H ₂ O; s et h
5370	4-Fluorobenzonitrile		₇ H ₅ FO ₂	456-22-4	140.112	pr (w), mcl pr (w)	185		1.479 ²⁵		sl H ₂ O, ace; s Et OH, et h
5371	2-Fluorobenzonitrile		₇ H ₄ FN	394-47-8	121.112			93 ²²			
5372	4-Fluorobenzonitrile		₇ H ₄ FN	1194-02-1	121.112	nd (pet h)	34.8	188.8	1.107 ⁶	1.4925 ⁵⁵	sl chl; s pet h
5373	2-Fluorobenzoyl chloride		₇ H ₅ ClFO	393-52-2	158.557		2.0	91 ⁵	1.328 ²⁵	1.5365 ²⁰	
5374	3-Fluorobenzoyl chloride		₇ H ₅ ClFO	1711-07-5	158.557	li q	-30	189	1.304 ⁴	1.5285 ²⁰	
5375	4-Fluorobenzoyl chloride		₇ H ₅ ClFO	403-43-0	158.557		9	82 ²⁰	1.342 ²⁵	1.5296 ²⁰	
5376	2-Fluoro-1,1'-bi-phenyl		CH ₉ F	321-60-8	172.197		73.5	248	1.2452 ²⁵		s Et OH, et h, chl, pet h; sl li g
5377	4-Fluoro-1,1'-bi-phenyl		CH ₉ F	324-74-3	172.197	pr	74.2	253	1.247 ²⁵		sl Et OH; s et h, gl HOAc
5378	1-Fluorobutane	Butyl fluoride	₄ H ₉ F	2366-52-1	76.112	li q	-134	32.5	0.778 ⁹	1.3396 ²⁰	vs Et OH
5379	2-Fluorobutane	sec-Butyl fluoride	₄ H ₉ F	359-01-3	76.112	vol li q or gas	-121.4	25.1	0.755 ⁹		
5380	Fluorocyclohexane	Cyclohexyl fluoride	₆ H ₁₁ F	372-46-3	102.149		13	101	0.9279 ²⁰	1.4146 ²⁰	i H ₂ O; s py
5381	1-Fluorocyclohexane		CH ₉ F	694-51-9	100.133			96.5		1.4441 ²⁵	
5382	5-Fluorocytosine	4-Amino-5-fluoro-2-hydroxypyrimidine	C ₄ H ₄ FN ₃ O	2022-85-7	129.092	wh cry	296 dec				
5383	1-Fluorodecane	Decyl fluoride	CH ₂₁ F	334-56-5	160.272	li q	-35	186.2	0.819 ⁴	1.4085	vs et h
5384	Fluorodifen	2-Nitro-1-(4-nitrophenoxy)-4-(trifluoromethyl)benzene	C ₁₃ H ₇ F ₃ N ₂ O ₅	15457-05-3	328.200		94				
5385	1-Fluoro-2,4-dinitrobenzene		₆ H ₃ FN ₂ O ₄	70-34-8	186.097		25.8	296	1.4718 ⁵⁴	1.5690 ²⁰	s Et OH; sl chl
5386	Fluoroethane	Ethyl fluoride	₂ H ₅ F	353-36-6	48.059	col gas	-143.2	-37.7	0.7182 ²⁰ (p>1 at m)	1.2656 ²⁰	sl H ₂ O; vs Et OH, et h
5387	2-Fluoroethanol	Ethylene fluorohydrin	₂ H ₄ FO	371-62-0	64.058	li q	-26.4	103.5	1.104 ⁰	1.3647 ¹⁸	msc H ₂ O, Et OH, et h; vs ace; sl chl
5388	Fluoroethene	Vinyl fluoride	₂ H ₃ F	75-02-5	46.043	col gas	-160.5	-72			i H ₂ O; s Et OH, ace
5389	1-Fluoroheptane		CH ₁₅ F	661-11-0	118.192	li q	-73	117.9	0.806 ²	1.3854 ²⁰	i H ₂ O; s et h, ace, bz; vs pet h



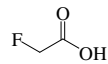
Fluorescei n



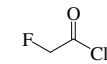
Fluorescei n sodi um



2-Fluoroacet ami de



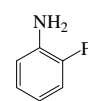
Fluoroacet i aci d



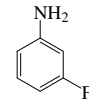
Fluoroacet ylchl ori de



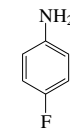
Fluoroacet ylene



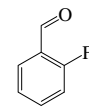
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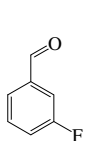
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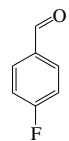
4-Fluoroani li ne



2-Fluorobenzal dehyde



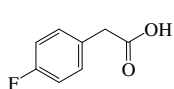
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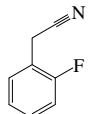
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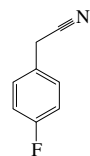
Fluorobenzene



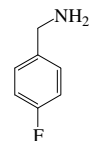
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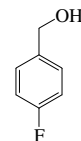
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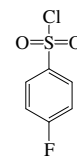
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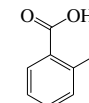
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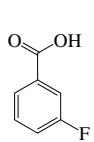
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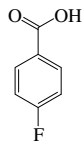
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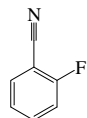
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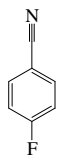
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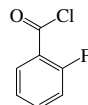
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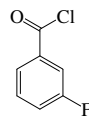
2-Fluorobenzoni t ri le



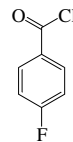
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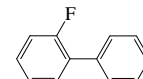
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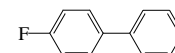
3-Fluorobenzoylchl ori d



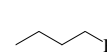
4-Fluorobenzoylchl ori de



2-Fluoro-1,1'-bi phenyl



4-Fluoro-1,1'-bi phenyl



1-Fluorobut ane



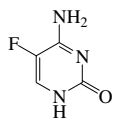
2-Fluorobut ane



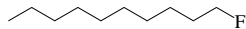
Fluorocycl ohexane



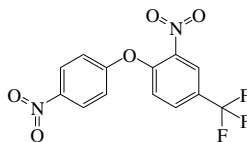
1-Fluorocycl ohexene



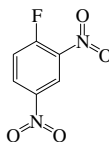
5-Fluorocyt osi ne



1-Fluorodecane



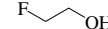
Fluorodi fen



1-Fluoro-2,4-di ni t robenzene



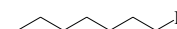
Fluoroet hane



2-Fluoroet hanol

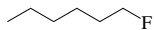


Fluoroet hene



1-Fluorohept ane

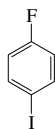
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5390	1-Fluorohexane	Hexyl fluori de	C ₆ H ₁₃ F	373-14-8	104.165	li q	-103	91.5	0.7999	1.3738 ²⁰	s et h, bz
5391	1-Fluoro-2-iodobenzene		C ₆ H ₄ FI	348-52-7	221.998	li q	-41.5	188.6		1.591 ¹⁹	s ace, bz, chl
5392	1-Fluoro-4-iodobenzene		C ₆ H ₄ FI	352-34-1	221.998	li q	-27	183	1.952 ⁹	1.5270 ²²	i H ₂ O; s Et OH, et h, ace
5393	1-Fluoro-3-iodobenzene		C ₆ H ₄ FI	404-72-8	153.177			227	1.27 ²⁵	1.6186 ²⁰	
5394	1-Fluoro-4-iodobenzene		C ₆ H ₄ FI	1544-68-9	153.177		27	228			
5395	Fluoromet hane	Met hyl fluori de	CF ₄	593-53-3	34.033	col gas	-141.8	-78.4	0.557 ²⁵ (p>1 at m)	1.1674 ²⁵	sl H ₂ O, bz, chl; vs Et OH, et h
5396	1-Fluoro-2-methoxybenzene		C ₇ H ₇ FO	321-28-8	126.128	li q	-39	154.5	1.548 ⁹	1.4969 ¹⁷	i H ₂ O; s et h, ct c
5397	1-Fluoro-3-methoxybenzene		C ₇ H ₇ FO	456-49-5	126.128	li q	-35	159; 5 ¹¹	1.104 ²⁵	1.4876 ²⁰	
5398	1-Fluoro-4-methoxybenzene		C ₇ H ₇ FO	459-60-9	126.128	li q	-45	157	1.178 ¹¹	1.4886 ¹⁸	s et h
5399	4-Fluoro-2-methylaniline		C ₇ H ₇ FN	452-71-1	125.144		14.2	94 ¹⁶	1.1263 ¹⁸	1.5363 ¹⁸	s et h, ace, bz, ct c
5400	(Fluoromet hyl)benzene		C ₆ H ₅ F	350-50-5	110.129	li q	-35	140; 4 ¹⁰	1.0228 ²⁵	1.4892 ²⁵	s ct c
5401	2-Fluoro-4-methyl-1-nitrobenzene	3-Fluoro-4-nitrobenzene	C ₇ H ₆ FNO ₂	446-34-4	155.127	nd (al)	53.2	97 ⁸	1.4380 ²⁵		
5402	2-Fluoro-2-methylpropane	<i>t</i> -Butyl fluori de	C ₄ H ₉ F	353-61-7	76.112	col gas		12.1			
5403	1-Fluoronaphthalene		C ₁₀ H ₇ F	321-38-0	146.161	li q	-9	215; 8 ⁰	1.1322 ²⁰	1.5939 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, HOAc
5404	2-Fluoronaphthalene		C ₁₀ H ₇ F	323-09-1	146.161	nd (al)	61	212; 90 ⁶			i H ₂ O; s Et OH, et h, bz, chl, HOAc
5405	1-Fluoro-2-nitrobenzene	<i>o</i> -Fluoronitrobenzene	C ₆ H ₄ FNO ₂	1493-27-2	141.100	ye li q	-6	dec 215	1.328 ⁵	1.5489 ¹⁷	vs et h, Et OH
5406	1-Fluoro-3-nitrobenzene	<i>m</i> -Fluoronitrobenzene	C ₆ H ₄ FNO ₂	402-67-5	141.100	ye cry	41	199; 86 ¹⁹	1.3254 ¹⁹	1.5262 ¹⁵	i H ₂ O; s Et OH, et h; sl bz
5407	1-Fluoro-4-nitrobenzene	<i>p</i> -Fluoronitrobenzene	C ₆ H ₄ FNO ₂	350-46-9	141.100	ye nd	21	205	1.3300 ²⁰	1.5316 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
5408	1-Fluorooctane	Octyl fluori de	C ₈ H ₁₇ F	463-11-6	132.219	li q	-64	142.3	0.811 ⁶	1.3946 ²⁰	
5409	1-Fluoropentane	Pentyl fluori de	C ₅ H ₁₁ F	592-50-7	90.139	li q	-120	62.8	0.790 ⁷	1.3591 ²⁻	vs et h, Et OH
5410	2-Fluorophenol		C ₆ H ₅ FO	367-12-4	112.101		16.1	151.5	1.120 ²⁵	1.5144 ²⁰	s H ₂ O
5411	3-Fluorophenol		C ₆ H ₅ FO	372-20-3	112.101		13.7	178	1.238 ²⁵	1.5140 ²⁰	
5412	4-Fluorophenol		C ₆ H ₅ FO	371-41-5	112.101		48	185.5	1.1889 ⁵⁶		sl H ₂ O; s ace, pet h
5413	2-Fluoro-1-phenylethanone		C ₈ H ₇ FO	450-95-3	138.139	pl	29	90 ²	1.152 ²⁰	1.5200 ²⁰	
5414	1-(4-Fluorophenyl)ethanone		C ₈ H ₇ FO	403-42-9	138.139	li q	-45	196	1.138 ²	1.5081 ²⁵	i H ₂ O; s bz, chl
5415	1-Fluoropropane	Propyl fluori de	C ₃ H ₇ F	460-13-9	62.086	col gas	-159	-2.5	0.7596 ¹⁹ (p>1 at m)	1.3115 ²⁰	sl H ₂ O; vs Et OH, et h
5416	2-Fluoropropane	Isopropyl fluori de	C ₃ H ₇ F	420-26-8	62.086	gas		-9.4			sl H ₂ O
5417	1-Fluoro-2-propanone	Fluoroacetone	C ₃ H ₅ FO	430-51-3	76.069			77	1.0288 ²⁰	1.3700 ²⁰	
5418	<i>cis</i> -1-Fluoropropene		C ₃ H ₅ F	19184-10-2	60.070	col gas		≈-20			
5419	<i>trans</i> -1-Fluoropropene		C ₃ H ₅ F	20327-65-5	60.070	col gas	≈-20				
5420	2-Fluoropropene		C ₃ H ₅ F	1184-60-7	60.070	col gas		-24			
5421	3-Fluoropropene		C ₃ H ₅ F	818-92-8	60.070	col gas		-3			sl H ₂ O; vs Et OH, et h; s chl
5422	2-Fluoropyridine		C ₅ H ₄ FN	372-48-5	97.091			125	1.1280 ²⁰	1.4574 ²⁰	
5423	3-Fluoropyridine		C ₅ H ₄ FN	372-47-4	97.091	li q		107	1.130	1.472 ¹⁰	
5424	2-Fluorotoluene		C ₇ H ₇ F	95-52-3	110.129	li q	-62	115	1.004 ¹¹	1.4704 ²⁰	i H ₂ O; vs Et OH, et h
5425	3-Fluorotoluene		C ₇ H ₇ F	352-70-5	110.129	li q	-87	115	0.997 ⁴	1.4691 ²⁰	i H ₂ O; vs Et OH, et h
5426	4-Fluorotoluene		C ₇ H ₇ F	352-32-9	110.129	li q	-56	116.6	0.997 ⁵	1.4699 ²⁰	i H ₂ O; vs Et OH, et h
5427	1-Fluoro-2-(trichloromethyl)benzene		C ₇ H ₄ Cl ₃ F	488-98-2	213.464			95 ¹² ; 75 ⁵	1.453 ²⁵	1.5432 ²⁰	
5428	1-Fluoro-2-(trifluoromethyl)benzene		C ₇ H ₄ F ₃	392-85-8	164.101			114.5	1.293 ²⁵	1.4040 ²⁵	
5429	1-Fluoro-3-(trifluoromethyl)benzene		C ₇ H ₄ F ₃	401-80-9	164.101	li q	-81.5	101.5	1.302 ¹¹		
5430	1-Fluoro-4-(trifluoromethyl)benzene		C ₇ H ₄ F ₃	402-44-8	164.101	li q	-41.7	103.5	1.29 ³	1.4025 ²⁰	
5431	Fluorotrimethylsilane		C ₃ H ₉ FSi	420-56-4	92.187	vol li q or gas		16.4			
5432	5-Fluorouracil	5-Fluoro-2,4(1 <i>H</i>)-Pyrimidinone	C ₄ H ₃ FN ₂ O ₂	51-21-8	130.077	cry (w, MeOH-et h)	283	sub 190			



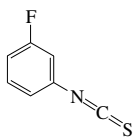
1-Fluorohexane



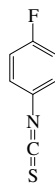
1-Fluoro-2-iodobenzene



1-Fluoro-4-iodobenzene



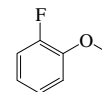
1-Fluoro-3-isothiocyanatobenzene



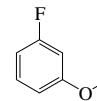
1-Fluoro-4-isothiocyanatobenzene



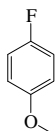
Fluoromethane



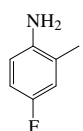
1-Fluoro-2-methoxybenzene



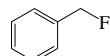
1-Fluoro-3-methoxybenzene



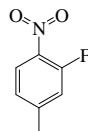
1-Fluoro-4-methoxybenzene



4-Fluoro-2-methylaniline



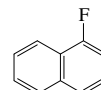
(Fluoromethyl)benzene



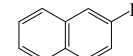
2-Fluoro-4-methyl-1-nitrobenzene



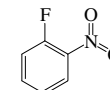
2-Fluoro-2-methylpropane



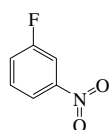
1-Fluoronaphthalene



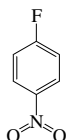
2-Fluoronaphthalene



1-Fluoro-2-nitrobenzene



1-Fluoro-3-nitrobenzene



1-Fluoro-4-nitrobenzene



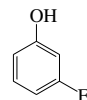
1-Fluorooctane



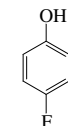
1-Fluoropentane



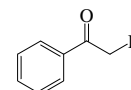
2-Fluorophenol



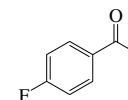
3-Fluorophenol



4-Fluorophenol



2-Fluoro-1-phenylethanone



1-(4-Fluorophenyl)ethanone



1-Fluoropropane



2-Fluoropropane



1-Fluoro-2-propanone

*cis*-1-Fluoropropene*trans*-1-Fluoropropene

2-Fluoropropene



3-Fluoropropene



2-Fluoropyridine



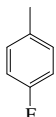
3-Fluoropyridine



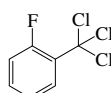
2-Fluorotoluene



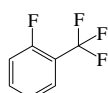
3-Fluorotoluene



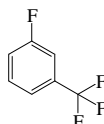
4-Fluorotoluene



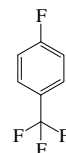
1-Fluoro-2-(trichloromethyl)benzene



1-Fluoro-2-(difluoromethyl)benzene



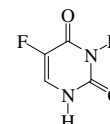
1-Fluoro-3-(difluoromethyl)benzene



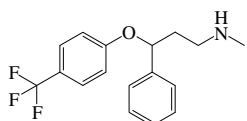
1-Fluoro-4-(difluoromethyl)benzene



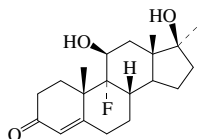
Fluorotrimethylsilane



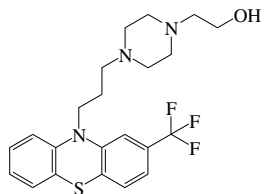
5-Fluorouracil



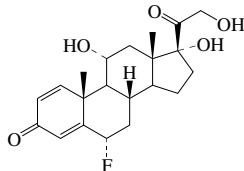
Flouxetine



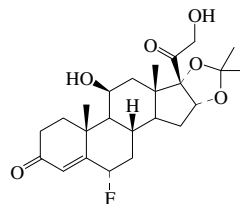
Fluoxymesterone



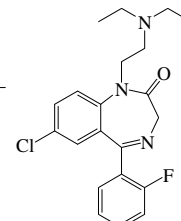
Fluphenazine



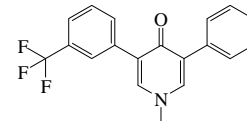
Fluprednisolone



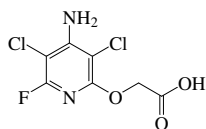
Flurandrenolide



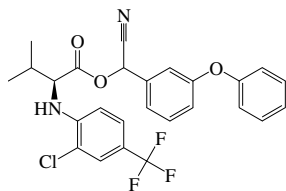
Flurazepam



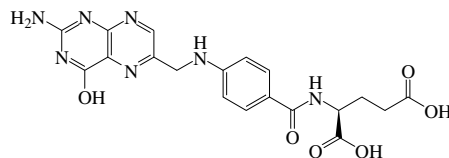
Fluridone



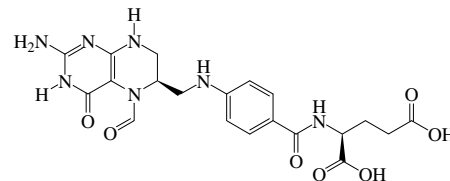
Fluroxypyr



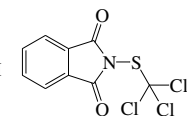
Fluvalinate



Folic acid

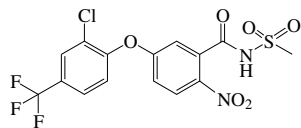


Folinic acid

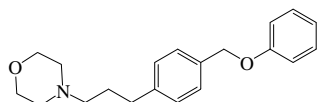


Folate

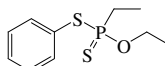
3-289



Fomesafen



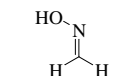
Fomocaine



Fosfosal



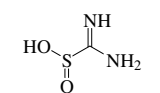
Formaldehyde



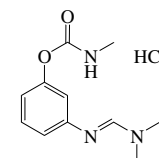
Formaldehydeoxime



Formamide



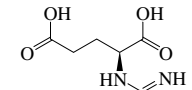
Formamidine



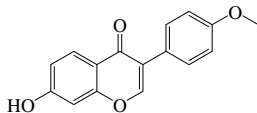
Formetanidazole hydrochloride



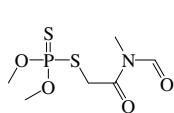
Formic acid



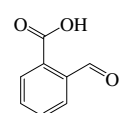
N-Formylglycyl-L-glutamic acid



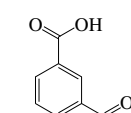
Formononetin



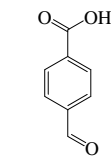
Formothion



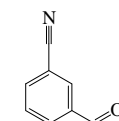
2-Formylbenzoic acid



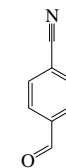
3-Formylbenzoic acid



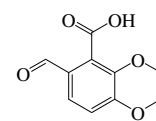
4-Formylbenzoic acid



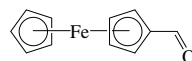
3-Formylbenzotrile



4-Formylbenzotrile



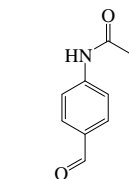
6-Formyl-2,3-dimethoxybenzoic acid



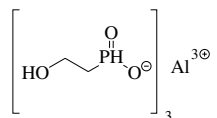
Formyl ferrocene



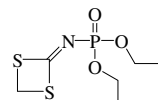
Formyl fluoride



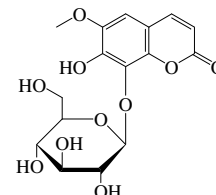
N-(4-Formylphenyl)acetamide



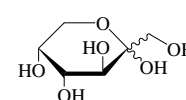
Fosetyl-Al



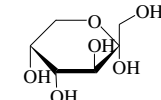
Fosthetan



Fraxin

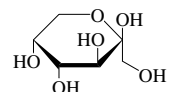


DL-Fructose

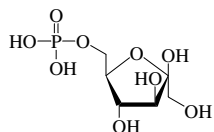


L-Fructose

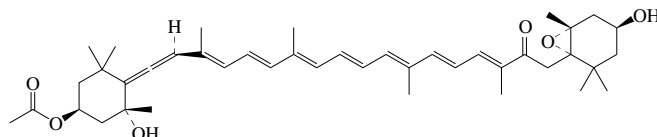
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility	
5471	β-D-Fructose	β-Levulose	C ₆ H ₁₂ O ₆	53188-23-1	180.155	pr or nd (w) ort h pr (al)	103 dec		1.60 ²⁰		vs H ₂ O, ace; s Et OH, MeOH, py	
5472	D-Fructose 6-phosphate	Hexose monophosphate	C ₆ H ₁₃ O ₉ P	643-13-0	260.135						vs H ₂ O	
5473	Fucosantinnin		C ₆ H ₁₀ O ₆	3351-86-8	658.905	red pl (et h) hex pl (di l al)	168				vs et h, Et OH	
5474	Fulminic acid	Carbonyl oxide	CHNO	506-85-4	43.025			unst able in pure form			s et h	
5475	Fulvene		C ₆ H ₆	497-20-1	78.112			7 ⁵⁶	0.8241 ²⁰	1.4920 ²⁰	i H ₂ O; s bz, chl	
5476	Fumaric acid	trans-2-Butenedioic acid	C ₄ H ₄ O ₄	110-17-8	116.073	nd, mcl pr or lf (w)	287 dec	sub 165	1.635 ²⁰		sl H ₂ O, et h, ace; s Et OH, con sulf	
5477	Fumigatinin	3-Hydroxy-2-methoxy-5-methyl-2,5,6-trihydroxy-1,4-dioxane	C ₈ H ₁₄ O ₄	484-89-9	168.148	br nd or pl (pet h)	116				vs ace, bz, et h, Et OH	
5478	Furan	Oxacyclopentadiene	C ₄ H ₄ O	110-00-9	68.074	li q	-85.61	31.5	0.951 ⁴	1.4214 ²⁰	sl H ₂ O, chl; vs Et OH, et h; s ace, bz	
5479	2-Furanacetamide		C ₆ H ₈ O ₃	2745-26-8	126.110	lf (pet h)	68.5	102			s H ₂ O, bz, MeOH, pet h	
5480	2-Furancarboxamide		C ₅ H ₆ NO	617-90-3	93.084			147	1.0822 ²⁰	1.4798 ²⁰	s Et OH, et h	
5481	2-Furancarboxyl chloride		C ₅ H ₄ ClO ₂	527-69-5	130.530	li q	-1.0	173	1.32 ⁴	1.5310 ²⁰	i H ₂ O; s et h, chl; sl ct c	
5482	3-Furancarboxaldehyde		C ₅ H ₄ O ₂	498-60-2	96.085			145; 71 ⁴³	1.110 ²⁰	1.4945 ²⁰		
5483	2-Furancarboxylic acid	2-Furoic acid	C ₅ H ₄ O ₃	88-14-2	112.084	mcl nd or lf (w)	133.5	231			s H ₂ O, Et OH; vs et h; sl ace	
5484	3-Furancarboxylic acid		C ₅ H ₄ O ₃	488-93-7	112.084	nd (w)	122.5	sub 105			sl H ₂ O; s Et OH, AcOEt; vs et h	
5485	2,5-Furandicarboxylic acid	Dehydromucic acid	C ₆ H ₄ O ₅	3238-40-2	156.093	nd (w), lf (al)	342	sub	1.740 ⁰		sl H ₂ O, Et OH	
5486	2-Furanmethanamine	Furfurylamine	C ₅ H ₈ NO	617-89-0	97.116			145.5	1.0995 ²⁰	1.4908 ²⁰	msc H ₂ O, Et OH; s et h, chl	
5487	2-Furanmethanediol diacetate		C ₈ H ₁₀ O ₅	613-75-2	198.172	nd or pl (et h- pet h)	53.3	220			vs bz, et h, Et OH	
5488	2-Furanmethanethiol		C ₄ H ₆ OS	98-02-2	114.166			157	1.1319 ²⁰	1.5329 ²⁰	i H ₂ O; sl chl	
5489	2-Furanmethanethanediol diacetate		C ₈ H ₁₀ O ₅	623-17-6	140.137			179	1.1175 ²⁰	1.4327 ²⁰	i H ₂ O; s Et OH, et h	
5490	4-(2-Furanyl)-2-butanone		C ₈ H ₁₀ O ₂	699-17-2	138.164	oi l		203	1.036 ⁴	1.4696 ¹⁷		
5491	4-(2-Furanyl)-3-buten-2-one		C ₈ H ₈ O ₂	623-15-4	136.149		39.5	dec 229; 113 ¹⁰	1.0496 ⁵⁷	1.5788 ⁴⁵	i H ₂ O; vs Et OH, et h, chl; s pet h	
5492	1-(2-Furanyl)ethanone		C ₈ H ₈ O ₂	1192-62-7	110.111	cry (li g)	33	175	1.099 ⁰	1.5017 ²⁰	i H ₂ O; s Et OH, et h	
5493	2-Furanylmethanepentanoate	Furfuryl valerate	C ₁₀ H ₁₄ O ₃	36701-01-6	182.216			228; 82 ¹	1.0284 ²⁰		vs et h, Et OH	
5494	3-(2-Furanyl)-1-phenyl-2-propen-1-one		C ₁₃ H ₁₀ O ₂	717-21-5	198.217		47	317	1.1140 ²⁰		s Et OH, et h	
5495	1-(2-Furanyl)-1-propanone		C ₈ H ₈ O ₂	3194-15-8	124.138	cry	28	88 ¹⁴	1.0626 ²⁸	1.4922 ²⁵	s et h; sl ct c	
5496	1-(2-Furanyl)-2-propanone	2-Furfurylmethanone	C ₈ H ₈ O ₂	6975-60-6	124.138		29	179.5	1.104 ²⁰	1.5035 ²⁰		
5497	3-(2-Furanyl)-2-propenal		C ₈ H ₆ O ₂	623-30-3	122.122		54	135 ¹⁴			i H ₂ O; msc Et OH; s et h; sl chl	
5498	3-(2-Furanyl)-2-propenethanethiol	2-Furanacryloethanethiol	C ₇ H ₈ NO	7187-01-1	119.121		38	96			1.5824 ²⁵	vs t ol
5499	3-(2-Furanyl)-2-propenoic acid	2-Furanacrylic acid	C ₇ H ₆ O ₃	539-47-9	138.121	nd (w)	141	286			vs et h, Et OH	
5500	Furazolidone	3-[[5-(nitro-2-furanyl)methylene]amino]-2-oxazolidinone	C ₈ H ₈ N ₂ O ₃	67-45-8	225.159		255					
5501	Furetidine		C ₈ H ₁₃ N ₂ O ₄	2385-81-1	361.476		28	210 ¹⁵			1.5219 ²⁰	
5502	Furfural	2-Furaldehyde	C ₅ H ₄ O ₂	98-01-1	96.085	li q	-38.1	161.7	1.159 ⁴	1.5261 ²⁰	s H ₂ O, bz, chl; vs Et OH, ace; msc et h	
5503	Furfuryl alcohol	2-Furanmethanol	C ₅ H ₆ O ₂	98-00-0	98.101	col-ye li q	-14.6	171	1.1296	1.4869 ²⁰	msc H ₂ O; vs Et OH, et h; s chl	
5504	Furfuryl propanoate	2-Furanmethanol, propanoate	C ₈ H ₁₀ O ₃	623-19-8	154.163			195	1.1085 ²⁰		sl H ₂ O; s Et OH, ace; msc et h	
5505	Furoin	1,2-Di-2-furanyl-2-hydroxyethanone	C ₁₀ H ₁₀ O ₄	552-86-3	192.169	nd (al)	138.5				sl H ₂ O, Et OH, chl; s et h, MeOH	
5506	Furonazide		C ₆ H ₁₁ N ₃ O ₂	3460-67-1	229.234		202.3					
5507	Furosemide		C ₁₂ H ₁₁ ClN ₂ O ₅ S	54-31-9	330.743		204 dec					
5508	Fursultiamine		C ₁₇ H ₂₆ N ₄ O ₃ S ₂	804-30-8	398.543	col pr	132 dec		1.29		sl H ₂ O	



β -D-Fructose



D-Fructose 6-phosphate



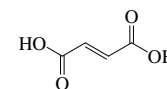
Fucoxanthin



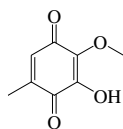
Fulminic acid



Fulvene



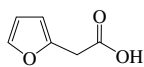
Fumaric acid



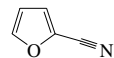
Fumigatin



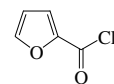
Furan



2-Furanacetic acid



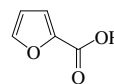
2-Furan carbonitrile



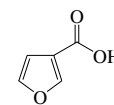
2-Furancarboxyl chloride



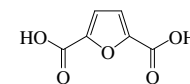
3-Furancarboxaldehyde



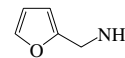
2-Furancarboxylic acid



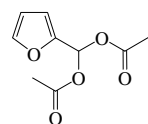
3-Furancarboxylic acid



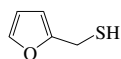
2,5-Furandicarboxylic acid



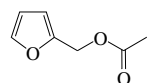
2-Furanmethanamine



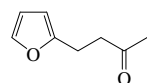
2-Furanmethanediyl acetate



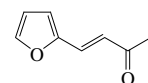
2-Furanmethanethiol



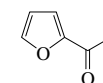
2-Furanmethanacetate



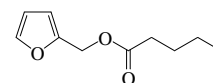
4-(2-Furyl)-2-butanone



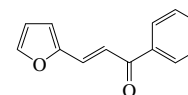
4-(2-Furyl)-3-buten-2-one



1-(2-Furyl)ethanone

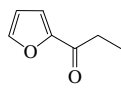


2-Furylmethyl propanoate

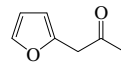


3-(2-Furyl)-1-phenyl-2-propen-1-one

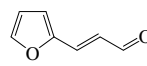
3-291



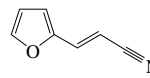
1-(2-Furyl)-1-propanone



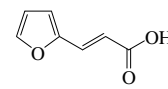
1-(2-Furyl)-2-propanone



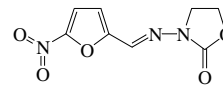
3-(2-Furyl)-2-propenal



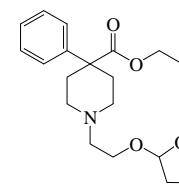
3-(2-Furyl)-2-propenenitrile



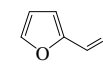
3-(2-Furyl)-2-propenoic acid



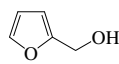
Furazolidone



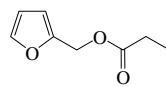
Furetidine



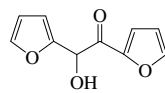
Furfural



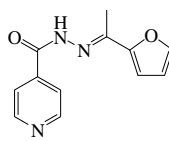
Furfuryl alcohol



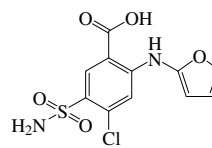
Furfurylpropanoate



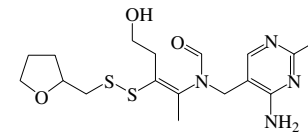
Furoin



Furonazide

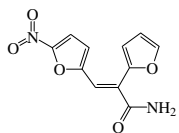


Furosemide

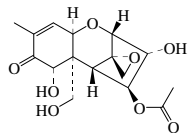


Fursultamizone

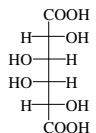
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5509	Furyl f urami de f	2-(2-Furanyl)-3-(5-nitro-2-furanyl)-2-propenamide	C ₁₁ H ₈ N ₂ O ₅	18819-45-9	248.192	cry	154				
5510	Fusarenon X		C ₁₇ H ₂₂ O ₈	23255-69-8	354.352	cry	182				
5511	Galactaric acid	Mucic acid	C ₆ H ₈ O ₆	526-99-8	210.138	pr (w)	255 dec				
5512	Galactitol	Dulcose	C ₆ H ₁₂ O ₆	608-66-2	182.171	cry (dil MeOH)	189.5	277	1.47 ²⁰		s H ₂ O; sl Et OH, py; i et h, bz
5513	D-Galactonic acid lactone		C ₆ H ₁₀ O ₆	2782-07-2	178.139	nd (w+1), nd (al)	112				vs H ₂ O
5514	α-D-Galactopyranose		C ₆ H ₁₂ O ₆	3646-73-9	180.155		167				
5515	4-O-β-D-Galactopyranosyl-D-gluconic acid	Lactobionic acid	C ₁₂ H ₂₂ O ₁₂	96-82-2	358.296	syr					vs H ₂ O; sl Et OH, MeOH, HOAc; i et h
5516	D-Galactose		C ₆ H ₁₂ O ₆	59-23-4	180.155	pl or pr (al) pr or nd (w+1)	170				vs H ₂ O; sl Et OH; i et h, bz; s py
5517	D-Galacturonic acid		C ₆ H ₈ O ₇	685-73-4	194.139	nd (w)	166 (β)				s H ₂ O, Et OH; i et h
5518	Galanthamine	Lycoremine	C ₁₇ H ₂₁ N ₃ O ₃	357-70-0	287.354	cry (bz)	126.5				vs ace, Et OH, chl
5519	Galipine	2-[2-(3,4-Dimethoxyphenyl)ethyl]-2,6-nitrophenol	C ₂₀ H ₂₁ N ₃ O ₃	525-68-8	323.386	pr (al, et h) nd (pet h)	115.5				vs ace, bz, et h, Et OH
5520	Galamine triethylide		C ₃₀ H ₆₀ N ₃ O ₃	65-29-2	891.528		147.5				vs H ₂ O, Et OH; sl et h, ace, bz, chl
5521	Galienin		C ₂₀ H ₁₂ O ₅	2103-64-2	332.306	br-red pow (+1.5w) red (anh)	>300				vs ace, Et OH
5522	Ganciclovir		C ₉ H ₁₃ N ₅ O ₄	82410-32-0	255.231	cry (MeOH)	250 dec				
5523	Gardol		C ₁₅ H ₂₈ NNaO ₃	137-16-6	293.378						sl H ₂ O
5524	Gelsemine		C ₈ H ₂₂ N ₂ O ₂	509-15-9	322.401	cry (ace)	178				vs ace, bz, et h, Et OH
5525	Gelsemine, monohydrochloride		C ₂₀ H ₂₃ ClN ₂ O ₂	35306-33-3	358.862		326				s H ₂ O; sl Et OH
5526	Genistein	5,7-Dihydroxy-3-(4-hydroxyphenyl)-4H-1-benzopyran-4-one	C ₁₅ H ₁₀ O ₅	446-72-0	270.237	nd(et h), pr(di l al)	301 dec				
5527	β-Gentiobiose	β-D-Glucopyranosyl-D-glucose	C ₁₇ H ₂₂ O ₁₁	554-91-6	342.296	cry (Et OH)	192				s hot H ₂ O, hot MeOH
5528	Geraniol		C ₁₅ H ₁₈ O	106-24-1	154.249		<-15	230	0.8894 ²⁰	1.4766 ²⁰	i H ₂ O; s Et OH, et h, ace, chl
5529	Geranyl 2-methylpropanoate		C ₁₄ H ₂₄ O ₂	2345-26-8	224.340			136 ¹³	0.8997 ¹⁵	1.4576 ²⁰	
5530	Geranyl acetate		C ₁₄ H ₂₀ O ₂	16409-44-2	196.286			115 ¹²	0.9163 ¹⁵	1.4624 ²⁰	
5531	Germine		C ₇ H ₁₃ NO ₈	508-65-6	509.632	pr or cry (MeOH)	220				s bz, MeOH, alk, acid
5532	Gibberellin acid		C ₁₉ H ₂₂ O ₆	77-06-5	346.374	cry (Et OAc)	234				vs ace, Et OH, MeOH
5533	Gitoxigenin		C ₂₃ H ₃₄ O ₅	545-26-6	390.513	pr (AcOEt) pr (+w, dil al)	234				i H ₂ O; sl et h; s chl
5534	Gitoxin		C ₄ H ₆ O ₁₄	4562-36-1	780.939	pr (chl-MeOH)	285 dec				
5535	α-Glucosamine		C ₆ H ₁₂ NO ₄	475-81-0	355.429	pl, pr (et h, AcOEt)	120				vs ace, Et OH, chl
5536	D-Glucuronic acid	D-Tetrahydroxypyridonic acid	C ₆ H ₈ O ₈	87-73-0	210.138	nd (45% al)	125.5				vs H ₂ O, Et OH; sl et h, chl
5537	D-Glucitol	Sorbitol	C ₆ H ₁₄ O ₆	50-70-4	182.171	nd (w)	111	295 ^{3,5}	1.489 ²⁰	1.3330 ²⁰	vs H ₂ O, ace
5538	D-Glucitol, hexaacetate	Sorbitol hexaacetate	C ₁₈ H ₂₆ O ₁₄	7208-47-1	434.392	pr (w)	100.8		1.30 ²⁰		sl H ₂ O, et h; vs Et OH; s chl, AcOEt
5539	D-Glucuronic acid		C ₆ H ₁₂ O ₇	526-95-4	196.155	nd (al-et h)	131				s H ₂ O; sl Et OH; i et h, bz
5540	β-D-Glucopyranose		C ₆ H ₁₂ O ₆	492-61-5	180.155	cry (hot Et OH)	149				
5541	6-O-α-D-Glucopyranosyl-D-fructose	Palatinose	C ₁₂ H ₂₂ O ₁₁	13718-94-0	342.296						s H ₂ O
5542	2-(β-D-Glucopyranosyloxy)benzaldehyde	Helicin	C ₁₅ H ₁₆ O ₇	618-65-5	284.262	nd (w)	175				vs H ₂ O, Et OH
5543	7-(β-D-Glucopyranosyloxy)-2H-1-benzopyran-2-one	Skinmin	C ₁₉ H ₁₆ O ₈	93-39-0	324.283	cry (w+1)	220				s H ₂ O, Et OH; i et h, chl



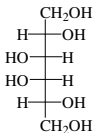
Furyl f urami d(ƒƒ)



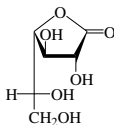
Fusarenon X



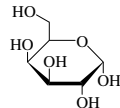
Gal act ari æci d



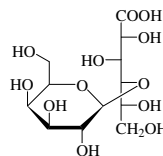
Gal act i t ol



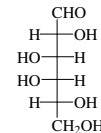
D-Gal act oni æci dy-l act one



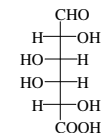
α-D-Gal act opyranos



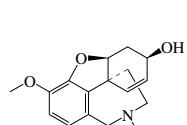
4-O-β-D-Gal act opyranosyl D-gl uconi æci d



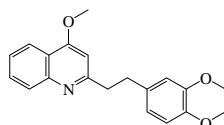
D-Gal act ose



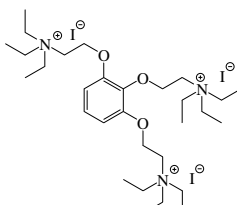
D-Gal act uroni æci d



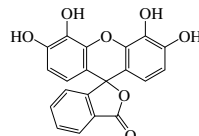
Gal ant hami ne



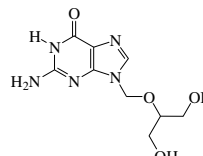
Gal i pi ne



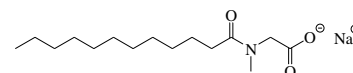
Gal lami reri ethi odi de



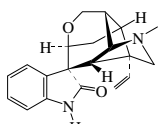
Gal lei n



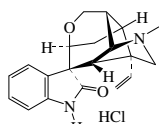
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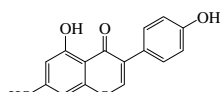
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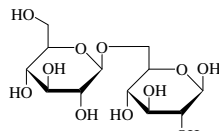
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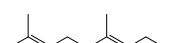
Gel semi ne monohydrochl ori de



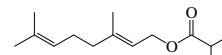
Geni st ei n



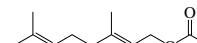
β-Gent i obi ose



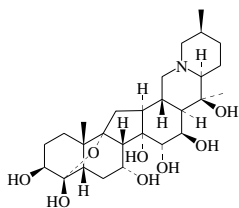
*trans*Gerani ol



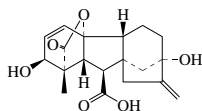
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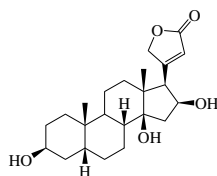
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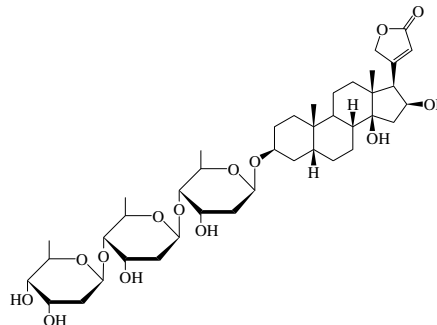
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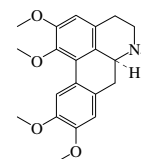
Gi bberel l iaci d



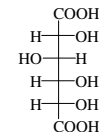
Gi t oxi geni n



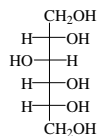
Gi t oxi n



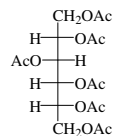
D-Gl auci ne



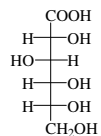
D-Gl uconi æci d



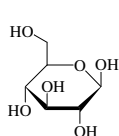
D-Gl uci t ol



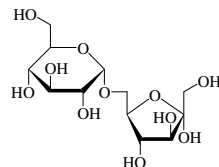
D-Gl uci t dl æxacet at e



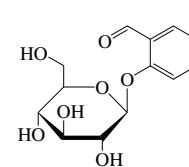
D-Gl uconi æci d



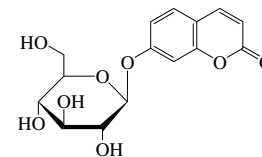
β-D-Gl ucopyranose



6-O-α-D-Gl ucopyranosyl D- fruct ose



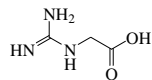
2-(β-D-Gl ucopyranosyl oxy) benzal dehyde



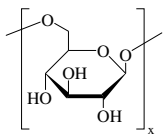
7-(β-D-Gl ucopyranosyl oxy)-2H-1-benzopyran-2-one

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5544	2-(β-D-Glucopyranosyl oxy)-2-methylpropanetriole	Linamarin	C ₈ H ₁₇ NO ₆	554-35-8	247.245	nd (w, al)	145				vs ace
5545	1-[4-(β-D-Glucopyranosyl oxy)phenyl]ethanone	Picein	C ₁₈ H ₁₈ O ₇	530-14-3	298.289	nd (w+1), nd (MeOH)	195.5				sl H ₂ O; s Et OH, et h, HOAc; i chl
5546	α-D-Glucose		C ₆ H ₁₂ O ₆	26655-34-5	180.155		146 dec		1.5620 ¹⁸		vs H ₂ O; sl Et OH; i ace, AcOEt; s py
5547	α-D-Glucose pentaacetate		C ₃₀ H ₄₂ O ₁₁	604-68-2	390.339	pl or nd (al)	113.3	sub			sl H ₂ O, Et OH, CS ₂ ; s et h, chl, HOAc
5548	β-D-Glucose pentaacetate		C ₃₀ H ₄₂ O ₁₁	604-69-3	390.339	nd (al)	134	sub	1.2740 ¹⁹		i H ₂ O; sl Et OH, pet h, et h; s bz; msc chl
5549	α-D-Glucose 1-phosphate		C ₆ H ₁₃ O ₉ P	59-56-3	260.135						vs H ₂ O
5550	D-Glucuronic acid		C ₆ H ₁₀ O ₇	6556-12-3	194.139	nd (al)	165				vs H ₂ O, Et OH
5551	D-Glucuronic acid lactone	D-Glucuronolactone	C ₆ H ₈ O ₆	32449-92-6	176.124	mcl pl (w) cry (al)	177.5		1.76 ²⁰		s H ₂ O; sl Et OH, DMSO, MeOH; i bz
5552	DL-Glutamic acid		C ₅ H ₉ NO ₄	617-65-2	147.130	ort h (al, w)	199 dec		1.460 ¹⁹		sl H ₂ O, et h; i Et OH, CS ₂ ; i g
5553	D-Glutamic acid		C ₅ H ₉ NO ₄	6893-26-1	147.130	lf (w)	213 dec		1.53 ¹⁹		sl H ₂ O; i Et OH, et h, ace, bz, HOAc, MeOH
5554	L-Glutamic acid	S(2-Aminopentanedioic acid)	C ₅ H ₉ NO ₄	56-86-0	147.130	ort h (di l al)	160 dec	sub 175	1.53 ¹⁸		sl H ₂ O
5555	L-Glutamic acid, hydrochloride		C ₅ H ₉ ClNO ₄	138-15-8	183.591	ort h pl (w)	214 dec				vs H ₂ O, Et OH
5556	L-Glutamine	2-Aminoglutaric acid	C ₅ H ₁₁ N ₂ O ₃	56-85-9	146.144	nd (w, di l al)	185 dec				s H ₂ O; i Et OH, et h, bz, MeOH
5557	Glutaric acid	Pentanedioic acid	C ₅ H ₈ O ₄	110-94-1	132.116	nd (bz)	97.8	dec 303	1.429 ¹⁵	1.4188 ¹⁰⁶	vs H ₂ O, Et OH, et h; i bz; s chl, i g
5558	Glutathione	L-γ-Glutamyl-L-cysteinylglycine	C ₁₀ H ₁₇ N ₃ O ₆ S	70-18-8	307.323	cry (50% al)	195				vs H ₂ O; i Et OH, et h; s DMF
5559	Glutathione disulfide	L-γ-Glutamyl-L-cysteinylglycine disulfide	C ₂₀ H ₃₂ N ₆ O ₁₂ S ₂	27025-41-8	612.631	cry (Et OH aq)	179				
5560	Glutimide		C ₅ H ₇ NO ₂	77-21-4	217.264	cry (et h)	84				i H ₂ O; s Et OH; vs et h, ace
5561	Glycerol	1,2,3-Propanetriol	C ₃ H ₈ O ₃	56-81-5	92.094	syr, ort h pl	18.1	290	1.261 ¹⁹	1.4746 ²⁰	msc H ₂ O, Et OH; sl et h; i bz, ct c, chl
5562	Glycerol 1-acetate	1,2,3-Propanetriol 1-acetate, (±)	C ₅ H ₁₀ O ₄	93713-40-7	134.131			158 ¹⁶⁵ , 130 ³	1.2060 ²⁰	1.4157 ²⁰	s H ₂ O, Et OH; sl et h; i bz
5563	Glycerol 1-butanoate		C ₇ H ₁₄ O ₄	557-25-5	162.184			280; 117 ¹⁰	1.129 ¹⁸	1.4531 ²⁰	vs H ₂ O, Et OH
5564	Glycerol 1,3-dinitrate	1,2,3-Propanetriol, 1,3-dinitrate	C ₉ H ₁₄ N ₂ O ₇	623-87-0	182.089	pr (w), cry (et h)	26	148 ⁵ , 116 ^{0.6}	1.523 ²⁰	1.4715 ²⁰	vs H ₂ O, et h, Et OH
5565	Glycerol 1,3-di-9-octadecanoate, cis,cis		C ₃₈ H ₇₂ O ₅	2465-32-9	620.986	cry (et h/Et OH)	50.1				
5566	Glycerol 1-oleate	1-Monoolein	C ₂₁ H ₄₀ O ₄	111-03-5	356.541	pl (al)	35	239	0.9420 ²⁰	1.4626 ²⁰	i H ₂ O; s Et OH, et h, chl
5567	L-Glycerol 1-phosphate	α-Glycerophosphoric acid	C ₃ H ₈ O ₆ P	5746-57-6	172.073	syr		dec			dec H ₂ O
5568	Glycerol tridecanoate	Decanoic acid diglycerol triester	C ₃₃ H ₆₂ O ₆	621-71-6	554.841	cry (pet h)	32				
5569	Glycerol trielaidate	Trielaidin	C ₅₇ H ₁₀₄ O ₆	537-39-3	885.432						vs bz, et h, chl
5570	Glycerol trilaurate	Trilaurin	C ₃₉ H ₇₄ O ₆	538-24-9	639.001	nd (al)			0.8986 ⁵	1.4404 ⁶⁰	i H ₂ O; s Et OH, et h, pet h; vs ace, bz
5571	Glycerol tri-3-methylbutanoate	Triisovalerin	C ₁₈ H ₃₂ O ₆	620-63-3	344.443			332.5	0.9984 ²⁰	1.4354 ²⁰	vs et h, Et OH
5572	Glycerol trioleate	Triolein	C ₅₇ H ₁₀₄ O ₆	122-32-7	885.432	col-ye oil	-4	237	0.915 ¹⁵	1.4676 ¹⁵	i H ₂ O; sl Et OH; vs et h; s chl, pet h
5573	Glycerol tripalmitate	Tripalmitin	C ₅₁ H ₉₈ O ₆	555-44-2	807.320	nd (et h)	66.5	315	0.8752 ²⁰	1.4381 ⁸⁰	i H ₂ O; sl Et OH; vs et h; s bz, chl
5574	Glycerol tristearate	Tristearin	C ₅₇ H ₁₁₀ O ₆	555-43-1	891.479				0.8559 ³⁰	1.4395 ³⁰	i H ₂ O, Et OH; sl bz, ct c; s ace, chl
5575	Glycerol triretadecanoate	Trimyristin	C ₄₅ H ₈₆ O ₆	555-45-3	723.161	wh-ye solid	58.5	311	0.884 ¹⁸	1.4428 ⁶⁰	i H ₂ O; sl Et OH, i g; s et h, ace, bz
5576	Glycerone phosphate	1-Hydroxy-3-(phosphonoxy)-2-propanone	C ₃ H ₇ O ₆ P	57-04-5	170.058						dec H ₂ O
5577	Glycine	Aminoacetic acid	C ₂ H ₃ NO ₂	56-40-6	75.067	mcl or tr gr pr (di l al)	290 dec		1.161 ²⁰		vs H ₂ O; i Et OH, et h; sl ace, py
5578	Glycine, ethylester, hydrochloride	Ethylaminoacetate hydrochloride	C ₄ H ₁₀ ClNO ₂	623-33-6	139.581		144				vs H ₂ O, Et OH
5579	Glycine, hydrochloride		C ₂ H ₄ ClNO ₂	6000-43-7	111.528	hyg ort h nd (w)	200.5				vs H ₂ O
5580	Glycocholic acid		C ₂₆ H ₄₃ NO ₆	475-31-0	465.622	nd (w)	166.5				sl H ₂ O, et h; vs Et OH

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5581	Glucosamine		C ₆ H ₁₃ N ₃ O ₂	352-97-6	117.107	pl or nd (w)	282				sl H ₂ O, Et OH, et h
5582	Glucogen		(C ₆ H ₁₀ O ₅) _x	9005-79-2	162.140	wh pow					vs H ₂ O; i Et OH, et h
5583	Glucosyl aldehyde		C ₆ H ₁₂ O ₂	141-46-8	60.052	pl	97		1.366 ⁰⁰	1.4772 ¹⁹	s chl
5584	Glucosyl chloride		C ₆ H ₁₁ ClO ₃	79-14-1	76.051	ort h nd (w) lf (et h)	79.5	100			s H ₂ O, Et OH, et h
5585	N-Glucosylneuraminic acid	N-(Hydroxyacetyl)neuraminic acid	C ₁₁ H ₁₉ N ₃ O ₁₀	1113-83-3	325.270		186				
5586	Glucopyrrolate		C ₈ H ₁₂ BrNO ₃	596-51-0	398.334		192.5				
5587	Glucosylamine	N-Alanylglucosine	C ₈ H ₁₆ N ₂ O ₃	1188-01-8	146.144		237 dec				s H ₂ O; i Et OH, et h
5588	L-Glucyl asparagine		C ₈ H ₁₄ N ₂ O ₄	1999-33-3	189.169	nd (Et OH aq)	216				s H ₂ O; sl Et OH
5589	N-Glucylglucosine	2-(Aminoacetamidyl)glucosine	C ₁₂ H ₂₁ N ₃ O ₅	556-50-3	132.118		215 dec				s H ₂ O
5590	N-(N-Glucylglucosyl)glucosine		C ₁₈ H ₃₁ N ₅ O ₈	556-33-2	189.169	nd (di l al)	246 dec				s H ₂ O; i Et OH, et h
5591	N-Glucyl-L-leucine		C ₁₀ H ₁₉ N ₂ O ₃	869-19-2	188.224	pl (di l al) pl (di 256 dec al)					vs H ₂ O; i Et OH
5592	N-Glucyl-L-phenylalanine		C ₁₁ H ₁₇ N ₂ O ₃	3321-03-7	222.240		266				s H ₂ O
5593	N-Glucylserine (DL)		C ₈ H ₁₆ N ₂ O ₄	687-38-7	162.144		198 dec				
5594	Glucosylglycoside		C ₁₂ H ₂₂ O ₁₆	1405-86-3	822.931	pl or pr (HOAc)	220 dec				vs H ₂ O, Et OH; i et h
5595	Glucosylidene	M-limic acid, 2-heptadecyl-4,5-dihydro-, monoacetate	C ₂₂ H ₄₄ N ₂ O ₂	556-22-9	368.596				1.035 ²⁰		
5596	Glucose		C ₆ H ₁₂ O ₆	107-22-2	58.036	ye pr	15	50.4	1.14 ²⁰	1.3826 ²⁰	vs H ₂ O; s Et OH, et h
5597	Glucose bis(2-hydroxyethyl)	2,2'-Benzoxazolone	C ₁₄ H ₁₆ N ₂ O ₂	1149-16-2	240.257		202				s DMSO
5598	Glucosyl chloride		C ₆ H ₁₁ ClO ₃	298-12-4	74.035	ort h pr (w+1/2)	98				vs H ₂ O; sl Et OH, et h, bz
5599	Glucosylphosphate	Glucosyl-N-(phosphonomethyl)-	C ₇ H ₁₃ NO ₅ P	1071-83-6	169.074		230 dec				
5600	Glucosylphosphate isopropylamine salt		C ₁₁ H ₁₉ N ₂ O ₅ P	38641-94-0	228.183	cry					vs H ₂ O
5601	Glucosylphosphate	Glucosyl-N,N-bis(phosphonomethyl)-	C ₈ H ₁₅ N ₂ O ₅ P ₂	2439-99-8	263.080	wh cry					s H ₂ O
5602	Grayanotoxin I		C ₂₇ H ₃₆ O ₇	4720-09-6	412.517	cry (AcOEt / C ₆ H ₁₂)	268				
5603	Griseofulvin, (+)		C ₁₇ H ₁₇ ClO ₆	126-07-8	352.766	oct or ort h cry (bz)	220				i H ₂ O; sl Et OH, et h, ace, bz, AcOEt, chl
5604	Guaiacol		C ₈ H ₈ O	489-86-1	222.366	t rg pr (al)	91	dec 288; 165 ¹⁷	0.9074 ¹⁰⁰	1.4716 ¹⁰⁰	i H ₂ O; s Et OH, et h
5605	Guanabenz		C ₈ H ₈ Cl ₂ N ₄	5051-62-7	231.083	wh sol i d	228 dec				
5606	Guanadrel sulfate (2:1)		C ₁₀ H ₁₀ N ₆ O ₈ S	22195-34-2	524.632	cry (MeOH/ Et OH)	214				
5607	Guanethidine		C ₁₀ H ₁₆ N ₄	55-65-2	198.309	wh cry (MeOH)	226				
5608	Guanidine	Aminonitroguanidine	C ₄ H ₅ N ₃	113-00-8	59.071	cry	50				vs H ₂ O, Et OH
5609	Guanidine monohydrochloride		C ₄ H ₇ N ₃	50-01-1	95.532	ort h bi pym (al)	182.3		1.35 ⁴		vs H ₂ O, Et OH
5610	Guanidine mononitrate		C ₄ H ₅ N ₃ O ₃	506-93-4	122.084	lf (w)	217	dec			vs H ₂ O, Et OH
5611	Guanidine sulfate (2:1)		C ₈ H ₁₀ N ₆ O ₄ S	594-14-9	216.219		292 dec				
5612	2-Guanidinoethanesulfonamide	Taurocyamine	C ₃ H ₇ N ₃ O ₂ S	543-18-0	167.186	cry (Et OH, ace)	227				
5613	3-Guanidinoethanesulfonamide	N-Amino-β-alanine	C ₃ H ₇ N ₃ O ₂	353-09-3	131.133	cry (Et OH)	210				
5614	Guanine		C ₄ H ₅ N ₅ O	73-40-5	151.127	nd or pl (aq NH ₃)	360 dec	sub			i H ₂ O, HOAc; sl Et OH, et h; s al k, aci d
5615	Guanosine	2-Amino-1,9-dihydro-9H-purin-6-one	C ₁₀ H ₁₃ N ₅ O ₅	118-00-3	283.241	nd (w)	239 dec				sl H ₂ O; i Et OH, et h; vs HOAc
5616	Guanosine 5'-diphosphate	Guanosine 5'-(trihydrogen diphosphate)	C ₁₀ H ₁₅ N ₅ O ₁₁ P ₂	146-91-8	443.201	amorp sol i d					
5617	Guanosine 5'-monophosphate	5'-Guanylic acid	C ₁₀ H ₁₄ N ₅ O ₆ P	85-32-5	363.221	hyg cry	190 dec				sl H ₂ O



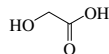
Glycocyami ne



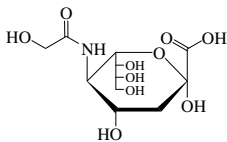
Glycogen



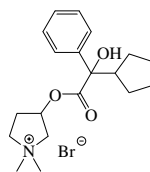
Glycolaldehyde



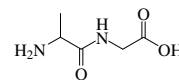
Glycolic acid



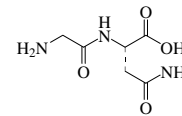
N-Glycyl-L-neurami acid



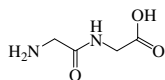
Glycopyrrrolate



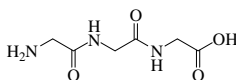
Glycyl-L-alani ne



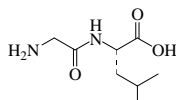
L-Glycyl-asparagi ne



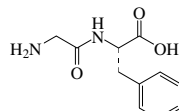
N-Glycylglyci ne



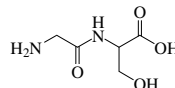
N-(*N*-Glycylglycyl)glyci ne



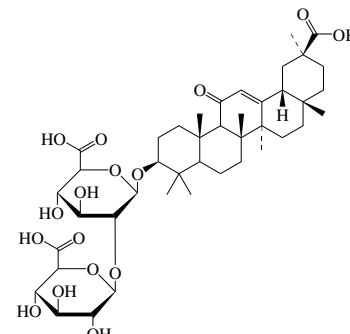
N-Glycyl-*L*-leuci ne



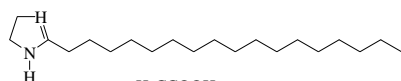
N-Glycyl-*L*-phenylalani ne



N-Glycylseri ne(*DL*)



Glycyrrhi zi acid

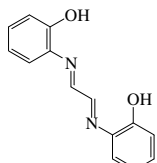


H₃CCOOH

Glydi n



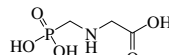
Glyoxal



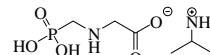
Glyoxalbi s(2-hydroxyani l)



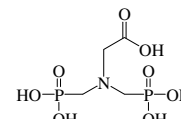
Glyoxyli acid



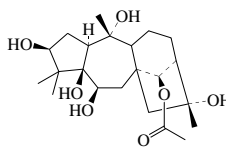
Glyphosate



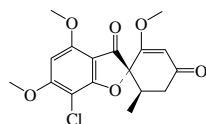
Glyphosate isopropylami salt



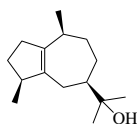
Glyphosi ne



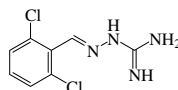
Grayanot oxi n



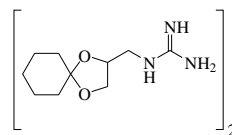
Gri seof ul vi(n)



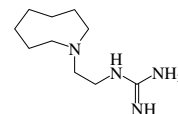
Guai ol



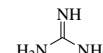
Guanabenz



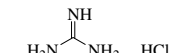
Guanadrel sulfat (2:1)



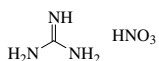
Guaneti hi di ne



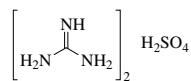
Gua ni di ne



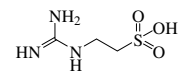
Gua ni di monohydrochl ori de



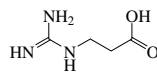
Gua ni di mononi t rat e



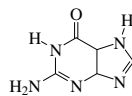
Gua ni di sulfat (2:1)



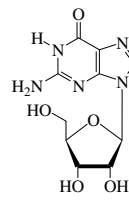
2-Gua ni di noet hanesulf onati d



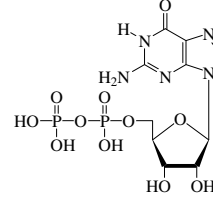
3-Gua ni di nopropanoi d



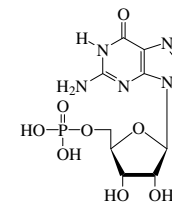
Gua ni ne



Gua nosi ne

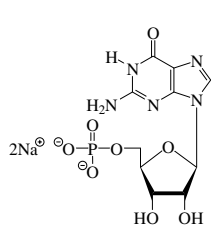


Gua nosi ne5'-di phosphat e

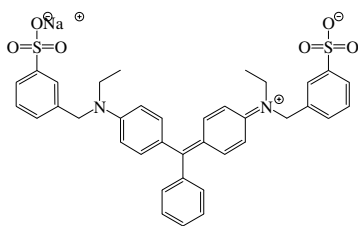


Gua nosi ne5'-monophosphat e

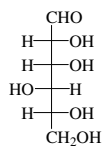
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5618	Guanosine 5'-monophosphate, disodium salt	5'-Guanylidene di sodium salt	$C_{10}H_{16}N_5Na_2O_9P$	5550-12-9	407.185		195 dec				sl H ₂ O
5619	Guinea Green B	C.I. Acid Green 3	$C_{13}H_{12}N_2NaO_6S_2$	4680-78-8	690.803	dk grn pow					s H ₂ O; sl Et OH
5620	D-Gulose		$C_6H_{12}O_6$	4205-23-6	180.155	syr		dec			vs H ₂ O
5621	L-Gulose		$C_6H_{12}O_6$	6027-89-0	180.155	syr		dec			vs H ₂ O
5622	Haloperidol		$C_{17}H_{19}ClFNO_2$	52-86-8	375.865		151.5				
5623	Harmaline	4,9-Dihydro-7-methoxy-1-methyl-3H-pyridolo[3,4-b]indole	$C_{13}H_{14}N_2O$	304-21-2	214.262	tab (MeOH) orth pr (al)	230				sl H ₂ O, Et OH, et h; s chl, py
5624	Harman	1-Methyl-9H-pyridolo[3,4-b]indole	$C_{12}H_{10}N_2$	486-84-0	182.220	bl flr orth cry (hp)	236.5				
5625	Harmine	7-Methoxy-1-methyl-9H-pyridolo[3,4-b]indole	$C_{13}H_{12}N_2O$	442-51-3	212.246	orth (al), pr (MeOH)	273	sub			sl H ₂ O, chl, Et OH, et h; s py
5626	HC Blue No. 1		$C_7H_{17}N_3O_4$	2784-94-3	255.271	blk cry	100				
5627	HC Blue No. 2		$C_{12}H_{19}N_3O_5$	33229-34-4	285.296	dk bl-blk cry	110				
5628	Hectane		$C_{10}H_{22}$	6703-98-6	140.467		117				
5629	Hederagenin		$C_{30}H_{48}O_4$	465-99-6	472.700	pr (al)	333				
5630	Helenaïn		$C_{18}O_4$	6754-13-8	262.302	cry (Et OH)	226				sl H ₂ O; s Et OH, chl
5631	Helminthosporal		$C_{18}H_{22}O_2$	723-61-5	234.335		58	117 ^{0.015}			
5632	Helvetic acid		$C_{33}H_{44}O_8$	29400-42-8	568.697	nd (di l HOAc)	212 dec				sl H ₂ O, Et OH; s et h, ace, bz, di ox
5633	Hematine		$C_{12}H_{12}O_6$	475-25-2	300.262	red-br cry	250 dec				i H ₂ O, et h, bz, chl; sl Et OH, HOAc
5634	Hematin		$C_{34}H_{33}FeN_4O_5$	15489-90-4	633.495	br pow (py)	>200				i H ₂ O, et h; s Et OH, al k; sl py, HOAc
5635	Hematoporphyrin		$C_{38}H_{38}N_4O_6$	14459-29-1	598.689	deep red cry	172.5				i H ₂ O; s Et OH; sl et h, chl
5636	Hematoxilin		$C_{14}H_{14}O_6$	517-28-2	302.278	ye cry	140				sl H ₂ O, et h; s al k, Et OH
5637	Hemin		$C_{34}H_{32}ClFeN_4O_4$	16009-13-5	651.941	long blades (gl HOAc)	>300				
5638	Heneicosane		$C_{21}H_{44}$	629-94-7	296.574	cry (w)	40.01	356.5	0.7919 ²⁰	1.4441 ²⁰	i H ₂ O; sl Et OH; s pet h
5639	Heptanoic acid	Unteri acid	$C_7H_{14}O_2$	630-04-6	436.840	lf (AcOEt)	67.9	458	0.781	1.4278 ⁹⁰	sl Et OH, et h, bz, chl; s pet h
5640	Heptachlor		$C_7H_5Cl_7$	76-44-8	373.318	wh cry	95.5		1.57 ⁹		vs bz, et h, Et OH, li g
5641	Heptachlor epoxide		$C_7H_5Cl_7O$	1024-57-3	389.317		160				
5642	2,2',3,3',4,4',6-Heptachlorobiphenyl		$C_{12}H_3Cl_7$	52663-71-5	395.323	cry	117.5				i H ₂ O
5643	1,1,1,2,3,3,3-Heptachloropropane		C_3HCl_7	3849-33-0	285.211		11	249	1.7921 ³⁴	1.5427 ²¹	vs chl
5644	Heptanoic acid		$C_7H_{14}O_2$	7719-93-9	983.876		107	647			
5645	Heptacosane		$C_{27}H_{56}$	593-49-7	380.734	cry (al, bz) lf (AcOEt)	59.23	442	0.7796 ⁶⁰	1.4345 ⁶⁵	i H ₂ O, Et OH; sl et h
5646	Heptadecanal	Margaric aldehyde	$C_{17}H_{34}O$	629-90-3	254.451	nd (pet h), cry (al)	36	204 ²⁶			vs bz, et h
5647	1-Heptadecanamine		$C_{17}H_{37}N$	4200-95-7	255.483		49	336	0.8510 ²⁰	1.4510 ²⁰	i H ₂ O; s Et OH, et h
5648	Heptadecane		$C_{17}H_{36}$	629-78-7	240.468	hex lf	22.0	302.0	0.7780	1.4369 ²⁰	i H ₂ O; sl Et OH, ct c; s et h
5649	Heptadecanetriole		$C_{17}H_{30}O_3$	5399-02-0	251.451	cry (al)	34	349	0.8315 ⁵⁰	1.4467 ⁵⁰	i H ₂ O; sl Et OH, chl; vs et h
5650	Heptadecanoic acid	Margaric acid	$C_{17}H_{34}O_2$	506-12-7	270.451	pl (pet h)	61.3	227 ⁶⁰	0.8532 ⁶⁰	1.4342 ⁶⁰	i H ₂ O; sl Et OH; s et h, ace, bz, chl
5651	1-Heptadecanol	Margarol alcohol	$C_{17}H_{36}O$	1454-85-9	256.467	lf (al), cry (ace)	53.9	324	0.8475		i H ₂ O; s Et OH, et h
5652	2-Heptadecanone	Pentadecyl methyl ketone	$C_{17}H_{34}O$	2922-51-2	254.451	pl (di l al)	48	320	0.8049		i H ₂ O; sl Et OH; s ace, pet h; vs bz, et h
5653	9-Heptadecanone		$C_{17}H_{34}O$	540-08-9	254.451	pl (MeOH)	53	251.5; 142 ^{1.5}	0.8140 ⁴⁸		sl Et OH; s MeOH
5654	1-Heptadecene	Hexahydroaplaxene	$C_{17}H_{34}$	6765-39-5	238.452		11.5	300	0.7852 ²⁰	1.4432 ²⁰	i H ₂ O; vs et h; s bz; msc li g



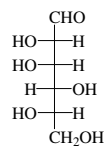
Guanosine 5'-monophosphate sodium salt



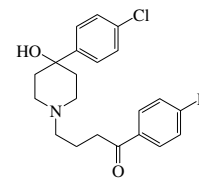
Guineazulene B



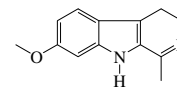
D-Gulose



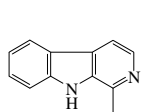
L-Gulose



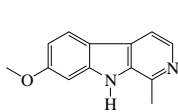
Haloperidol



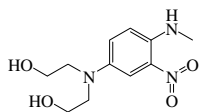
Harmaline



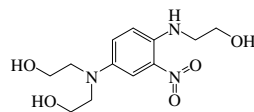
Harman



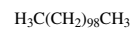
Harmine



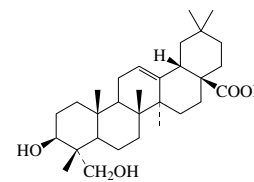
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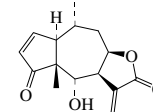
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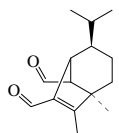
Hectane



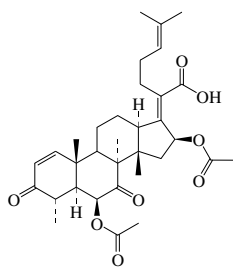
Hederagenin



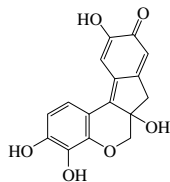
Helenaline



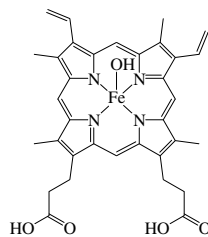
Helminthosporal



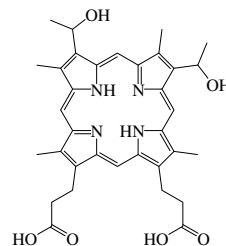
Helvolic acid



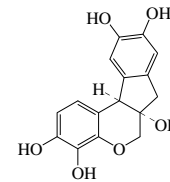
Hematein



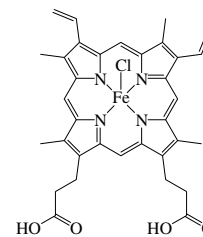
Hematin



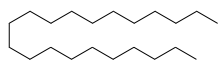
Hematoporphyrin



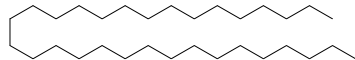
Hematopyllin



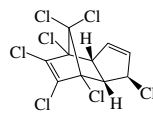
Hemin



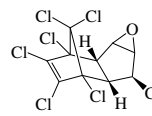
Heptacosane



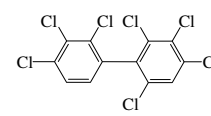
Heptriacontane



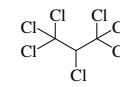
Heptachlor



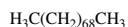
Heptachloroepoxide



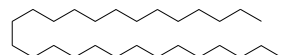
2,2',3,3',4,4',6-Heptachlorobiphenyl



1,1,1,2,3,3,3-Heptachloropropane



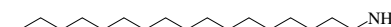
Heptacosane



Heptacosane



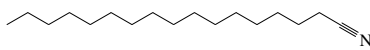
Heptadecanal



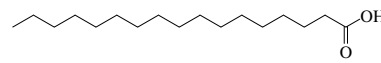
1-Heptadecanamine



Heptadecane



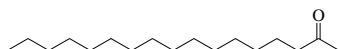
Heptadecanenitrile



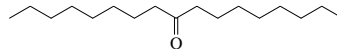
Heptadecanoic acid



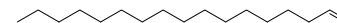
1-Heptadecanol



2-Heptadecanone

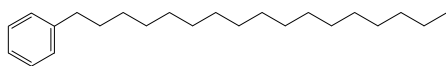


9-Heptadecanone

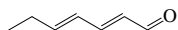


1-Heptadecene

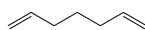
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5655	Hept adecyl benzene	1-Phenyl hept adecane	$\text{C}_{27}\text{H}_{40}$	14752-75-1	316.564		32	397	0.8546 ²⁰	1.4810 ²⁰	
5656	<i>trans</i> -2,4-Hept adi enal		$\text{C}_{10}\text{H}_{16}\text{O}$	4313-03-5	110.153			84.5	0.881 ²⁵	1.5315 ²⁰	
5657	1,6-Hept adi ene		C_7H_{12}	3070-53-9	96.170	li q		90			
5658	1,6-Hept adi yne		C_7H_8	2396-63-6	92.139	li q	-85	112	0.8164 ⁴	1.451 ¹⁷	i H ₂ O; s bz, HOAc
5659	Hept afluorobot anoi c aci d		$\text{C}_7\text{HF}_7\text{O}_2$	375-22-4	214.039	li q	-17.5	121	1.654 ⁹	1.295 ²⁵	s H ₂ O, et h, t ol; i pet h
5660	Hept afluorobot anoi c anhydri de		$\text{C}_7\text{F}_6\text{O}_3$	336-59-4	410.062	li q	-43	106.5	1.665 ⁹	1.285 ²⁰	
5661	2,2,3,3,4,4,4-Hept afluoro-1-but anol		$\text{C}_4\text{H}_3\text{F}_7\text{O}$	375-01-9	200.055			95	1.600 ²⁰	1.294 ²⁰	s Et OH, ace
5662	Hept afluorobot anoyl chl ori de		$\text{C}_7\text{OCF}_7\text{O}$	375-16-6	232.484			38.5	1.55 ²⁰	1.288 ²⁰	
5663	6,6,7,7,8,8,8-Hept afluoro-2,2-di met hyl -3,5-oct anedi one		$\text{C}_{10}\text{H}_{11}\text{F}_7\text{O}_2$	17587-22-3	296.182		38	46 ⁵	1.273 ²⁵	1.3766 ²⁰	
5664	Hept afluoro-2-i odopropane	Perfluoroi sopropyl i odi de	$\text{C}_3\text{F}_7\text{IO}$	677-69-0	295.925			38	1.3298 ²⁰		
5665	1,1,1,2,3,3,3-Hept afluoropropane	Ref ri gerant 227ea	C_3HF_7	431-89-0	170.029	col gas	-131	-16.4			
5666	2,2,4,4,6,8,8-Hept amet hyl nonane		$\text{C}_{14}\text{H}_{34}$	4390-04-9	226.441			246.3			
5667	1,1,1,3,5,5,5-Hept amet hyl t ri si loxane		$\text{C}_7\text{H}_{12}\text{OSi}_3$	1873-88-7	222.506			142	0.8194 ²⁰	1.3818 ²⁰	
5668	Hept anal	Hept al dehyde	$\text{C}_7\text{H}_{14}\text{O}$	111-71-7	114.185	li q	-43.4	152.8	0.8132 ²	1.4113 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
5669	Hept anal oxi me	Enant hal doxi me	$\text{C}_7\text{H}_{14}\text{NO}$	629-31-2	129.200	pl (al)	57.5	195	0.8583 ⁹	1.4210 ²⁰	sl H ₂ O; s Et OH, et h
5670	2-Hept anami ne	Tuami nohept ane	$\text{C}_7\text{H}_{15}\text{N}$	123-82-0	115.217			142	0.7665 ¹⁹	1.4199 ¹⁹	sl H ₂ O, chl; s Et OH, et h, pet h
5671	4-Hept anami ne		$\text{C}_7\text{H}_{15}\text{N}$	16751-59-0	115.217			139.5	0.767 ²⁰	1.4172 ²⁰	
5672	Hept ane		C_7H_{16}	142-82-5	100.202	li q	-90.55	98.4	0.6795 ⁵	1.3855 ²⁵	i H ₂ O; vs Et OH; msc et h, bz, chl; s ct c
5673	1,7-Hept anedi ami ne		$\text{C}_7\text{H}_{15}\text{N}_2$	646-19-5	130.231		25.32	224			s Et OH, et h, ace
5674	Hept anedi ni t ri le		$\text{C}_7\text{H}_{10}\text{N}_2$	646-20-8	122.167		-31.4	155 ¹⁴	0.949 ¹⁸	1.4472 ²⁰	i H ₂ O; msc Et OH, et h, chl
5675	Hept anedi oi c aci d	Pi mel i c aci d	$\text{C}_7\text{H}_{12}\text{O}_2$	111-16-0	160.168	pr (w)	106	272 ¹⁰⁰ , 212 ¹⁰	1.329 ¹⁵		s H ₂ O, Et OH, et h; i bz
5676	1,7-Hept anedi ol		$\text{C}_7\text{H}_{16}\text{O}_2$	629-30-1	132.201		22.5	262	0.9569 ²⁵	1.4520 ²⁵	vs et h, Et OH
5677	2,3-Hept anedi one	Acet yl valeryl	$\text{C}_7\text{H}_{12}\text{O}_2$	96-04-8	128.169			144; 46 ¹³	0.919 ¹⁸	1.4150 ¹⁸	
5678	3,5-Hept anedi one	Di propi onyl met hane	$\text{C}_7\text{H}_{12}\text{O}_2$	7424-54-6	128.169			175; 79 ³⁰	0.945 ²⁰		
5679	Hept anedi oyl di chl ori de		$\text{C}_7\text{H}_{10}\text{Cl}_2\text{O}_2$	142-79-0	197.059			137 ¹⁵			
5680	Hept aneni t ri le		$\text{C}_7\text{H}_9\text{N}$	629-08-3	111.185	li q	-64	183; 7 ⁹	0.8106 ²⁰	1.4104 ³⁰	i H ₂ O; s et h, ace, bz, HOAc
5681	1-Hept anet hi ol	Hept yl mercapt an	$\text{C}_7\text{H}_{14}\text{S}$	1639-09-4	132.267	li q	-43	176.9	0.8427 ⁹	1.4521 ²⁰	i H ₂ O; msc Et OH, et h; s chl
5682	2,4,6-Hept anet ri one		$\text{C}_7\text{H}_{10}\text{O}_3$	626-53-9	142.152	lf	49	12 ⁹	1.0599 ⁴⁰	1.4930 ²⁰	vs H ₂ O, et h, Et OH
5683	Hept anoi c aci d	Enant hi c aci d	$\text{C}_7\text{H}_{12}\text{O}_2$	111-14-8	130.185	li q	-7.17	222.2	0.9124 ⁴	1.4170 ²⁰	sl H ₂ O, ct c; s Et OH, et h, ace
5684	Hept anoi c anhydri de		$\text{C}_7\text{H}_{12}\text{O}_3$	626-27-7	242.354	li q	-12.4	269.5	0.9324 ⁴	1.4335 ¹⁵	i H ₂ O; s Et OH, et h
5685	1-Hept anol	Hept yl al cohol	$\text{C}_7\text{H}_{16}\text{O}$	111-70-6	116.201	li q	-33.2	176.45	0.8219 ⁹	1.4249 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
5686	2-Hept anol, (±)		$\text{C}_7\text{H}_{16}\text{O}$	52390-72-4	116.201			159	0.8167 ²⁰	1.4210 ²⁰	sl H ₂ O, ct c; s Et OH, et h
5687	3-Hept anol, (±)		$\text{C}_7\text{H}_{16}\text{O}$	26549-25-7	116.201	li q	-70	157; 6 ⁸	0.8227 ²⁰	1.4201 ²⁰	sl H ₂ O, ct c; s Et OH, et h
5688	4-Hept anol	Di propyl carbi nol	$\text{C}_7\text{H}_{16}\text{O}$	589-55-9	116.201	li q	-41.2	156	0.8183 ⁹	1.4205 ²⁰	sl H ₂ O; s Et OH, et h
5689	2-Hept anone	Met hyl pent yl ket one	$\text{C}_7\text{H}_{14}\text{O}$	110-43-0	114.185	li q	-35	151.05	0.8114 ⁹	1.4088 ²⁰	vs H ₂ O; s Et OH, et h
5690	3-Hept anone	Et hyl but yl ket one	$\text{C}_7\text{H}_{14}\text{O}$	106-35-4	114.185	li q	-39	147	0.8183 ⁹	1.4057 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
5691	4-Hept anone	Di propyl ket one	$\text{C}_7\text{H}_{14}\text{O}$	123-19-3	114.185	li q	-33	144	0.8174 ⁹	1.4069 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
5692	Hept anoyl chl ori de		$\text{C}_7\text{H}_{13}\text{ClO}$	2528-61-2	148.630	li q	-83.8	125.2	0.9590 ⁹	1.4345 ¹⁸	s et h; sl ct c; vs li g
5693	2-Hept enal	But yl acrol ei n	$\text{C}_7\text{H}_{12}\text{O}$	2463-63-0	112.169			166	0.864 ¹⁷	1.4468 ¹⁷	
5694	1-Hept ene		C_7H_{14}	592-76-7	98.186	li q	-118.9	93.64	0.697 ⁹	1.3998 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
5695	<i>cis</i> -2-Hept ene		C_7H_{14}	6443-92-1	98.186			98.4	0.708 ²⁰	1.406 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl; sl ct c



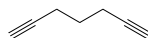
Heptadecyl benzene



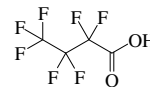
trans-2,4-Heptadienal



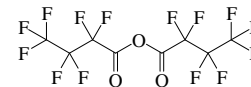
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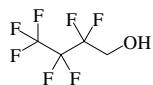
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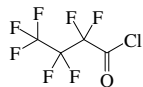
Heptafluorobutanoic acid



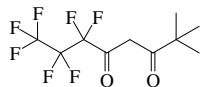
Heptafluorobutanoic anhydride



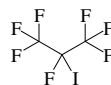
2,2,3,3,4,4,4-Heptafluoro-1-butanol



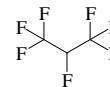
Heptafluorobutanoic acid chloride



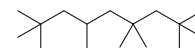
6,6,7,7,8,8,8-Heptafluoro-2,2-dimethyl-3,5-octanedione



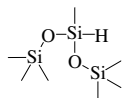
Heptafluoro-2-iodopropane



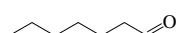
1,1,1,2,3,3,3-Heptafluoropropane



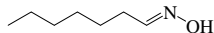
2,2,4,4,6,8,8-Heptamethylnonane



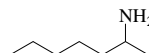
1,1,1,3,5,5,5-Heptamethyltrisiloxane



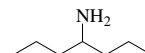
Heptanal



Heptanaldoxime



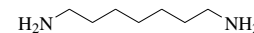
2-Heptanamine



4-Heptanamine



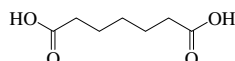
Heptane



1,7-Heptanediamine



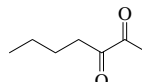
Heptanedinitrile



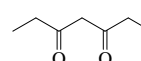
Heptanedioic acid



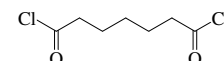
1,7-Heptanediol



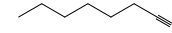
2,3-Heptanedione



3,5-Heptanedione



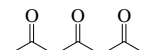
Heptafluorobutanoic acid chloride



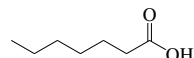
Heptanenitrile



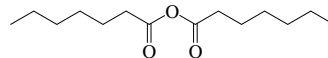
1-Heptanethiol



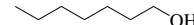
2,4,6-Heptanetrione



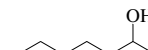
Heptanoic acid



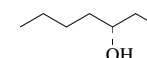
Heptanoic anhydride



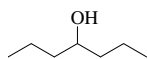
1-Heptanol



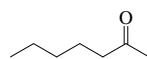
2-Heptanol (±)



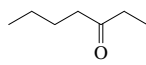
3-Heptanol (S)



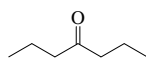
4-Heptanol



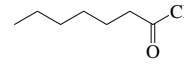
2-Heptanone



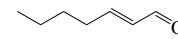
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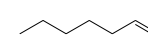
4-Heptanone



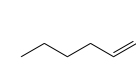
Heptanoyl chloride



2-Heptenal

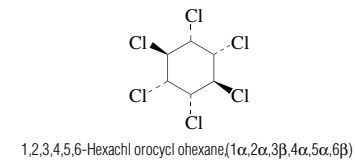
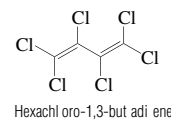
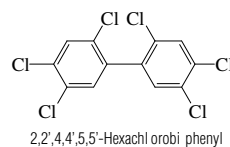
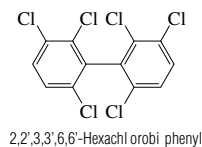
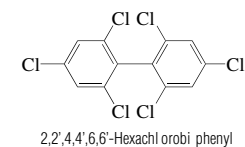
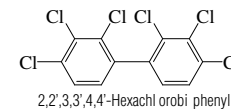
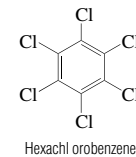
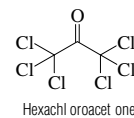
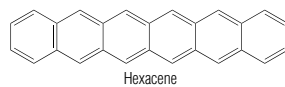
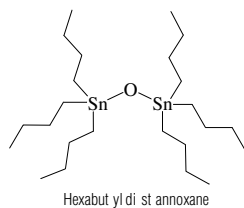
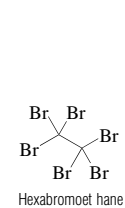
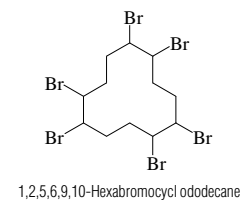
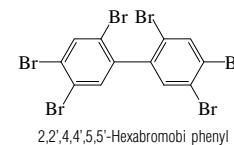
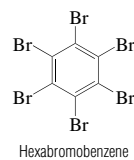
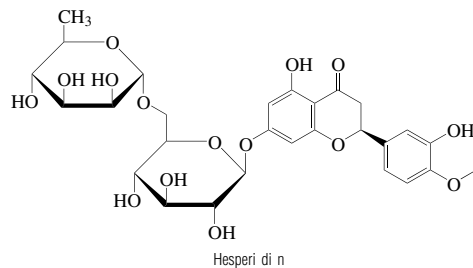
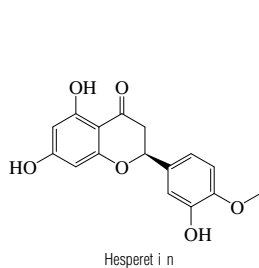
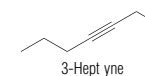
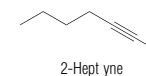
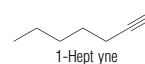
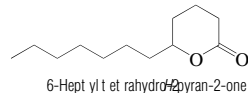
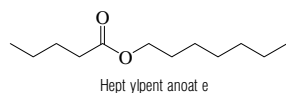
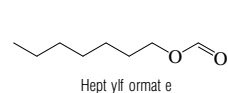
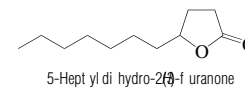
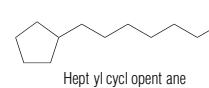
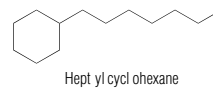
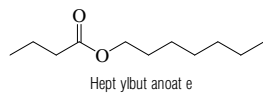
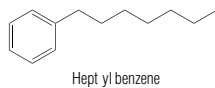
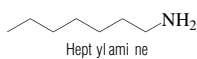
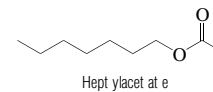
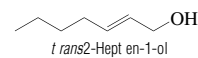
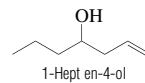
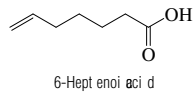
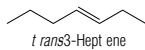
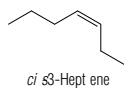
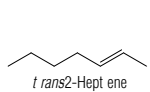


1-Heptene

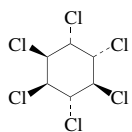


cis-2-Heptene

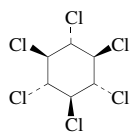
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5696	<i>trans</i> -2-Heptene		C ₇ H ₁₄	14686-13-6	98.186	liq	-109.5	98	0.7012	1.4045 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, pet h, chl
5697	<i>cis</i> -3-Heptene		C ₇ H ₁₄	7642-10-6	98.186	liq	-136.6	95.8	0.7030	1.4059 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, pet h, chl
5698	<i>trans</i> -3-Heptene		C ₇ H ₁₄	14686-14-7	98.186	liq	-136.6	95.7	0.6987	1.4043 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl; sl ct c
5699	6-Heptenoic acid		C ₇ H ₁₂ O ₂	1119-60-4	128.169	liq	-6.5	226	0.9519	1.4404 ¹⁴	
5700	1-Hepten-4-ol		C ₇ H ₁₄ O	3521-91-3	114.185			152.1	0.8384 ²²	1.4347 ²⁰	
5701	<i>trans</i> -2-Hepten-1-ol		C ₇ H ₁₄ O	33467-76-4	114.185			178; 75 ¹⁰	0.8516 ²⁰	1.4460 ²⁰	s Et OH, ace
5702	Heptyl acetate		C ₉ H ₁₈ O ₂	112-06-1	158.238	liq	-50.2	193	0.8750	1.4150 ²⁰	i H ₂ O; s Et OH, et h, ct c
5703	Heptylamine	1-Heptanamine	C ₇ H ₁₅ N	111-68-2	115.217	liq	-18	156	0.7754	1.4251 ²⁰	sl H ₂ O, chl; msc Et OH, et h
5704	Heptylbenzene		C ₉ H ₂₀	1078-71-3	176.298	liq	-48	240; 109	0.8567 ²⁰	1.4865 ²⁰	i H ₂ O; s bz, chl
5705	Heptylbutanoate		C ₁₁ H ₂₂ O ₂	5870-93-9	186.292	liq	-57.5	225.8	0.8637	1.4231 ²⁰	vs Et OH
5706	Heptylcyclohexane		C ₁₃ H ₂₆	5617-41-4	182.345	liq	-30	244	0.8109	1.4484 ²⁰	
5707	Heptylcyclopentane		C ₁₂ H ₂₄	5617-42-5	168.319	liq	-53	224	0.8010	1.4421 ²⁰	vs ace, bz, et h, Et OH
5708	5-Heptyldihydro-2(1H)-furanone	4-Hydroxyundecanoic acid lactone	C ₁₁ H ₂₀ O ₂	104-67-6	184.276			286	0.9494 ²⁰	1.4512 ²⁰	vs Et OH
5709	Heptylformate		C ₈ H ₁₆ O ₂	112-23-2	144.212			178.1	0.8784 ²⁰	1.4140 ²⁰	i H ₂ O; msc Et OH, et h
5710	Heptylpentanoate		C ₁₂ H ₂₄ O ₂	5451-80-9	200.318	liq	-46.4	245.2	0.8623	1.4254 ¹⁵	vs ace, et h, Et OH
5711	6-Heptyltetrahydro-2H-pyran-2-one	5-Dodecanolide	C ₁₂ H ₂₂ O ₂	713-95-1	198.302	liq	-12	101 ⁰³			
5712	1-Heptyne		C ₇ H ₁₂	628-71-7	96.170	liq	-81	99.7	0.7320	1.4087 ²⁰	sl H ₂ O; msc Et OH, et h; s bz, chl, pet h
5713	2-Heptyne	1-Methyl-2-butylacetylene	C ₇ H ₁₀	1119-65-9	96.170			112	0.744 ²⁵	1.4230 ²⁰	i H ₂ O; msc Et OH, et h; s bz, chl, pet h
5714	3-Heptyne	1-Ethyl-2-propylacetylene	C ₇ H ₁₀	2586-89-2	96.170	liq	-130.5	107.2	0.7330	1.4189 ²⁰	i H ₂ O; msc Et OH, et h; s bz, chl, pet h
5715	Hesperetin		C ₁₆ H ₁₄ O ₆	520-33-2	302.278	pl (dilal + 1/2 w)	227.5	sub 205			vs et h, Et OH
5716	Hesperidin		C ₂₈ H ₃₄ O ₁₅	520-26-3	610.561	whnd (dil MeOH, HOAc)	262				vs py, Et OH, HOAc
5717	Hexabromobenzene		C ₆ Br ₆	87-82-1	551.488	mclnd (bz)	327				i H ₂ O; sl Et OH, et h; s bz, chl
5718	2,2',4,4',5,5'-Hexabromobiphenyl		C ₁₂ H ₆ Br ₆	59080-40-9	627.584	cry (ct c)	160				
5719	1,2,5,6,9,10-Hexabromocyclododecane		C ₁₂ H ₁₈ Br ₆	3194-55-6	641.695	cry	167				
5720	Hexabromoethane		C ₂ Br ₆	594-73-0	503.445	orthpr (bz)		dec 200	3.823 ⁰	1.863	sl Et OH, et h, CS
5721	Hexabutyl distannoxane	Bis(tributyltin)oxide	C ₂₄ H ₅₄ OSn ₂	56-35-9	596.105		45	180 ²			
5722	Hexacene		C ₂₆ H ₁₆	258-31-1	328.405	dkbl-grncry (sub)	380	sub			i H ₂ O, Et OH
5723	Hexachloroacetone		CCl ₆ O	116-16-5	264.749	liq	-1.0	203	1.7434	1.5112 ²⁰	sl H ₂ O; s ace
5724	Hexachlorobenzene	Perchlorobenzene	CCl ₆	118-74-1	284.782	nd (sub)	228.83	325	2.044 ²³	1.5691 ²³	i H ₂ O; sl Et OH; s et h, chl; vs bz
5725	2,2',3,3',4,4'-Hexachlorobiphenyl		C ₁₂ H ₄ Cl ₆	38380-07-3	360.878	cry	151				i H ₂ O
5726	2,2',4,4',6,6'-Hexachlorobiphenyl		C ₁₂ H ₄ Cl ₆	33979-03-2	360.878	cry	112.5				i H ₂ O
5727	2,2',3,3',6,6'-Hexachlorobiphenyl		C ₁₂ H ₄ Cl ₆	38411-22-2	360.878	cry (hx)	114.2				i H ₂ O
5728	2,2',4,4',5,5'-Hexachlorobiphenyl		C ₁₂ H ₄ Cl ₆	35065-27-1	360.878	cry	103.5				
5729	Hexachloro-1,3-butadiene		C ₄ Cl ₆	87-68-3	260.761	liq	-21	215	1.550	1.5542 ²⁰	i H ₂ O; s Et OH, et h
5730	1,2,3,4,5,6-Hexachlorocyclohexane, (1 α ,2 α ,3 β ,4 α ,5 α ,6 β)	Lindane	C ₆ Cl ₆	58-89-9	290.830	nd (al)	112.5	323.4			vs ace, bz



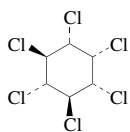
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5731	1,2,3,4,5,6-Hexachl orocycl ohexane, (1α,2α,3β,4α,5β,6β)	α-Hexachl orocycl ohexane	C ₆ H ₆ Cl ₆	319-84-6	290.830	cry	158				
5732	1,2,3,4,5,6-Hexachl orocycl ohexane, (1α,2β,3α,4β,5α,6β)	β-Hexachl orocycl ohexane	C ₆ H ₆ Cl ₆	319-85-7	290.830	cry (bz, al, xyl)		60 ⁵⁰	1.89 ¹⁹		i H ₂ O; sl Et OH, bz, chl, HOAc
5733	1,2,3,4,5,6-Hexachl orocycl ohexane, (1α,2α,3α,4β,5α,6β)	δ-Li ndane	C ₆ H ₆ Cl ₆	319-86-8	290.830	pl	141.5	60 ³⁶			
5734	Hexachl oro-1,3-cycl opent adi ene	Perchl orocycl opent adi ene	C ₅ Cl ₆ C	77-47-4	272.772	ye grm li q	-9	239, 48 ⁶	1.7019 ²⁵	1.5658 ²⁰	
5735	1,2,3,6,7,8-Hexachl orodi benzog- di ox i n		C ₁₂ H ₂ Cl ₆ O ₂	57653-85-7	390.861	cry	285				
5736	1,2,3,7,8,9-Hexachl orodi benzog- di ox i n		C ₁₂ H ₂ Cl ₆ O ₂	19408-74-3	390.861	cry	243				
5737	Hexachl oroet hane	Perchl oroet hane	C ₂ Cl ₆	67-72-1	236.739	ort h (al -et h)	186.8 t p	184.7 sp	2.091		i H ₂ O; vs Et OH, et h; s bz; sl li q HF
5738	Hexachl orophene		C ₃ H ₆ Cl ₆ O ₂	70-30-4	406.904	nd (bz)	166.5				i H ₂ O; s Et OH, et h, ace, chl, di l al k
5739	Hexachl oropropene		C ₆ Cl ₆	1888-71-7	248.750	li q	-72.9	209.5	1.763 ²	1.5091 ²⁰	i H ₂ O; s ct c, chl
5740	Hexacont ane		C ₆₀ H ₁₂₂	7667-80-3	843.611		99.3				
5741	Hexacosane		C ₂₆ H ₅₄	630-01-3	366.707	mcl, t cl or ort h (bz) cry (et h)	56.1	412.2	0.7783 ⁶⁰	1.4357 ⁶⁰	vs bz, li g, chl
5742	Hexacosanoi c aci d	Ceroti c aci d	C ₂₆ H ₅₀ O ₂	506-46-7	396.690		88.5		0.8198 ¹⁰⁰	1.4301 ¹⁰⁰	i H ₂ O; vs Et OH, et h
5743	1-Hexacosanol		C ₂₆ H ₅₄ O	506-52-5	382.706	ort h pl (di l al)	80	305 ⁵ ec			i H ₂ O; s Et OH, et h
5744	Hexadecamethyl hept asi loxane		C ₁₆ H ₄₈ O ₆ Si ₇	541-01-5	533.147	li q	-78	270	0.901 ²	1.3965 ²⁰	vs bz, li g
5745	Hexadecanal		C ₁₆ H ₃₂ O	629-80-1	240.424	pl (et h), nd (pet h)	35	200 ²⁹			i H ₂ O; s Et OH, et h, ace, bz
5746	Hexadecanami de		C ₁₆ H ₃₃ NO	629-54-9	255.439	lf	107	238	1.0000 ²⁰		i H ₂ O; sl Et OH, bz, ace, et h
5747	Hexadecane	Cet ane	C ₁₆ H ₃₄	544-76-3	226.441	lf (HOAc)	18.12	286.86	0.770 ⁹	1.4329 ²⁵	i H ₂ O; sl Et OH; msc et h; s ct c
5748	Hexadecanedioi c aci d		C ₁₆ H ₃₀ O ₄	505-54-4	286.407	pl (al)	126.6				vs ace, Et OH
5749	Hexadecanetri ri le		C ₁₆ H ₃₁ N	629-79-8	237.424	hex	31	333	0.8303 ²⁰	1.4450 ²⁰	i H ₂ O; vs Et OH, et h, ace, bz, chl
5750	1-Hexadecanethi ol	Cet yl mercapt an	C ₁₆ H ₃₃ S	2917-26-2	258.506	cry (li g)	19	125 ⁵			i H ₂ O; sl Et OH, ct c; s et h
5751	Hexadecanoi c aci d	Pal mi ti c aci d	C ₁₆ H ₃₂ O ₂	57-10-3	256.424	nd (al)	62.5	351.5	0.852 ^{7,2}	1.43345 ⁶⁰	i H ₂ O; s Et OH, ace, bz; msc et h; vs chl
5752	Hexadecanoi c anhydri de		C ₁₆ H ₃₂ O ₃	623-65-4	494.832	lf (pet h)	64		0.838 ⁸	1.4364 ⁶⁸	vs et h
5753	1-Hexadecanol	Cet yl al coh ol	C ₁₆ H ₃₄ O	36653-82-4	242.440	fl (AcOEt)	49.2	312	0.818 ⁷⁰	1.4283 ⁷⁹	i H ₂ O; sl Et OH; vs et h, bz, chl; s ace
5754	3-Hexadecanone		C ₁₆ H ₃₂ O	18787-64-9	240.424	lf (pet h)	43	184 140 ²			s chl
5755	Hexadecanoyl chl ori de		C ₁₆ H ₃₁ ClO	112-67-4	274.869		12	199 ⁹⁰	0.9016 ²⁵	1.4514 ²⁰	vs et h
5756	1-Hexadecene	1-Cet ene	C ₁₆ H ₃₂	629-73-2	224.425	lf	2.1	284.9	0.781 ⁴	1.4412 ²⁰	i H ₂ O; s Et OH, et h, ct c, pet h
5757	ci s9-Hexadeceno i c aci d	Pal mi t olei c aci d	C ₁₆ H ₃₀ O ₂	373-49-9	254.408		0.5	182 ¹			
5758	Hexadecyl acet at e		C ₁₆ H ₃₂ O ₂	629-70-9	284.478		-18.5	222 ²⁰⁵	0.8574 ²⁵	1.4438 ²⁰	i H ₂ O; sl Et OH; s ct c
5759	Hexadecyl ami ne	1-Hexadecanami ne	C ₁₆ H ₃₃ N	143-27-1	241.456	lf	46.8	322.5	0.812 ⁹	1.4496 ²⁰	i H ₂ O; vs Et OH, et h, bz; s ace
5760	Hexadecyl benzene		C ₂₂ H ₃₈	1459-09-2	302.537		27	385	0.8547 ²⁰	1.4813 ²⁰	i H ₂ O; sl Et OH; vs et h, bz, C ₆ S
5761	Hexadecyl di met hyl ami ne	<i>N,N</i> -Di met hyl -1-hexadecanami ne	C ₁₈ H ₃₉ N	112-69-6	269.510			330.0			
5762	Hexadecyl hexadecanoat e	Cet yl pal mi t at e	C ₃₂ H ₆₄ O ₂	540-10-3	480.849	mcl lf	54		0.989	1.4398 ⁷⁰	vs et h, Et OH
5763	Hexadecyl 3-hydroxy-2-naphthal enecarboxyl at e	Hexadecyl 3-hydroxy-2-naphthoat e	C ₂₄ H ₄₀ O ₃	531-84-0	412.605	grn-wh fl	72.5				vs bz, HOAc
5764	Hexadecyl 2-hydroxypropanoat e	Cet yl lact at e	C ₁₈ H ₃₆ O ₃	35274-05-6	314.503	wax	41	219 ¹⁰ , 170 ¹		1.4410 ⁴⁰	
5765	Hexadecyl 2-met hyl -2-propenoat e		C ₁₈ H ₃₆ O ₂	2495-27-4	310.515		24	183 ²	0.87 ²⁰		
5766	3-(Hexadecyl oxy)-1,2-propanedi ol, (S)	Chi myl al coh ol	C ₁₈ H ₄₀ O ₃	506-03-6	316.519	lf (hx)	64	120 ⁰⁵			vs ace, pet h, chl
5767	1-Hexadecyl pyri di ni um bromi de		C ₁₇ H ₃₅ BrN	140-72-7	384.438		61				



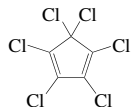
1,2,3,4,5,6-Hexachlorocyclohexane,
(1 α ,2 α ,3 β ,4 α ,5 β ,6 β)



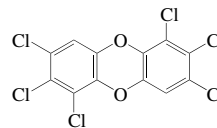
1,2,3,4,5,6-Hexachlorocyclohexane,
(1 α ,2 β ,3 α ,4 β ,5 α ,6 β)



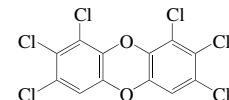
1,2,3,4,5,6-Hexachlorocyclohexane,
(1 α ,2 α ,3 α ,4 β ,5 α ,6 β)



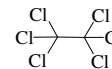
Hexachloro-1,3-cyclopentadiene



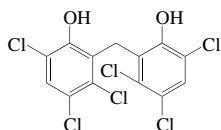
1,2,3,6,7,8-Hexachlorodibenzodioxin



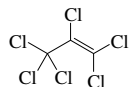
1,2,3,7,8,9-Hexachlorodibenzodioxin



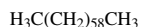
Hexachloroethane



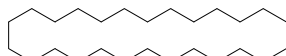
Hexachlorophene



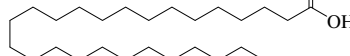
Hexachloropropene



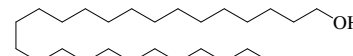
Hexacosane



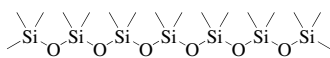
Hexacosane



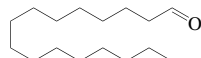
Hexacosanoic acid



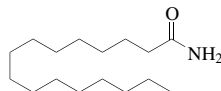
1-Hexacosanol



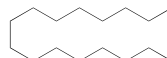
Hexadecamethylheptasiloxane



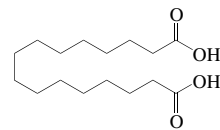
Hexadecanal



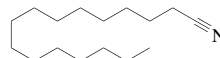
Hexadecanamide



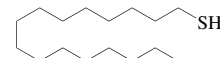
Hexadecane



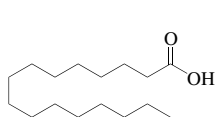
Hexadecanedioic acid



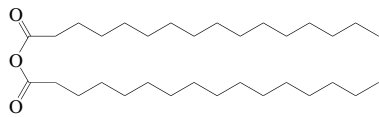
Hexadecanenitrile



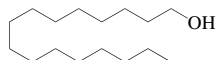
1-Hexadecanethiol



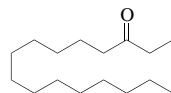
Hexadecanoic acid



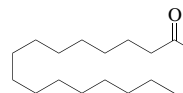
Hexadecanoic anhydride



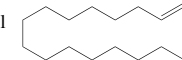
1-Hexadecanol



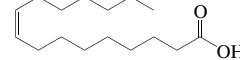
3-Hexadecanone



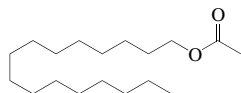
Hexadecanoyl chloride



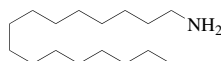
1-Hexadecene



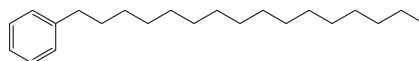
cis-9-Hexadecenoic acid



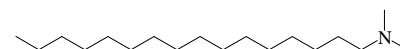
Hexadecyl acetate



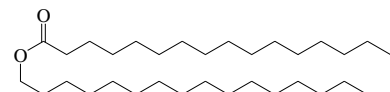
Hexadecylamine



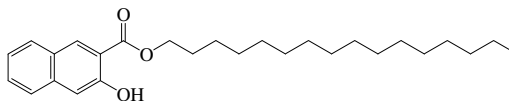
Hexadecylbenzene



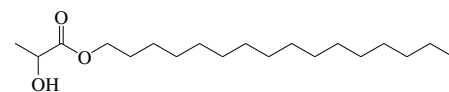
Hexadecyl dimethylamine



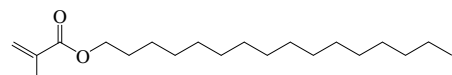
Hexadecyl hexadecanoate



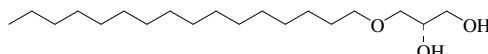
Hexadecyl 3-hydroxy-2-naphthalenecarboxylate



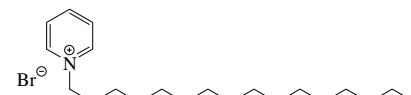
Hexadecyl 2-hydroxypropanoate



Hexadecyl 2-methyl-2-propenoate

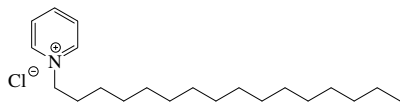


3-(Hexadecyloxy)-1,2-propanediol

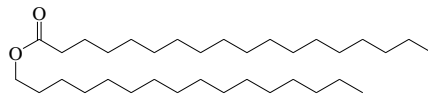


1-Hexadecylpyridinium bromide

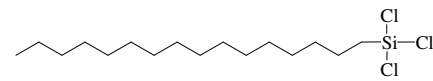
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5768	1-Hexadecyl pyr di ni um chl ori de	Cet yl pyr di ni um chl ori de	$_{21}H_{38}ClNC$	123-03-5	339.987	wh pow	80				vs H ₂ O, chl
5769	Hexadecyl st earat e	Cet yl st earat e	$_{34}H_{68}O_2$	1190-63-2	508.903	lf or pl (et h, HOAc)	57			1.4410 ⁷⁰	vs ace, et h, chl
5770	Hexadecyl t ri chl orosi l ane		$_{16}H_{33}Cl_3Si$	5894-60-0	359.878			269			
5771	Hexadecyl vi nyl et her	1-(Et henyl oxy)hexadecane	$_{18}H_{36}O$	822-28-6	268.478		16	160 ²	0.821 ²⁷	1.4444 ²⁵	
5772	1-Hexadecyne		$C_{16}H_{30}$	629-74-3	222.409		15	284	0.7965 ²⁰	1.4440 ²⁰	vs bz
5773	<i>t rans</i> 2,4-Hexadi enal	Sorbi nal dehyde	$_{10}H_{16}O$	142-83-6	96.127	li q	-16.5	174, 7 ⁸	0.898 ²⁰	1.5384 ²⁰	
5774	1,2-Hexadi ene	Propyl al l ene	$_{6}H_{10}$	592-44-9	82.143			76	0.7149 ²⁰	1.4282 ²⁰	vs et h, chl
5775	<i>ci s</i> 1,3-Hexadi ene		$_{6}H_{10}$	14596-92-0	82.143			73.1	0.7033 ²⁵	1.4379 ²⁰	
5776	<i>t rans</i> 1,3-Hexadi ene		$_{6}H_{10}$	20237-34-7	82.143	li q	-102.4	73.2	0.699 ⁵	1.4406 ²⁰	
5777	<i>ci s</i> 1,4-Hexadi ene		$_{6}H_{10}$	7318-67-4	82.143			66.3	0.695 ²⁵	1.4049 ²⁰	vs et h
5778	<i>t rans</i> 1,4-Hexadi ene		$_{6}H_{10}$	7319-00-8	82.143	li q	-138.7	65.0	0.69 ⁵	1.4104 ²⁰	
5779	1,5-Hexadi ene	Bi al l yl	$_{6}H_{10}$	592-42-7	82.143	li q	-140.7	59.4	0.687 ⁸	1.4042 ²⁰	i H ₂ O; s Et OH, et h, bz, chl; sl ct c
5780	<i>ci s,ci -2,4</i> -Hexadi ene		$_{6}H_{10}$	6108-61-8	82.143	li q		85	0.729 ⁸	1.4606 ²⁰	i H ₂ O; s Et OH, et h, chl
5781	<i>t rans,ci -2,4</i> -Hexadi ene		$_{6}H_{10}$	5194-50-3	82.143	li q	-96.1	83.5	0.718 ⁵	1.4560 ²⁰	i H ₂ O; s Et OH, et h, chl
5782	<i>t rans,t rans</i> 2,4-Hexadi ene		$_{6}H_{10}$	5194-51-4	82.143	li q	-44.9	82.2	0.710 ⁹	1.4510 ²⁰	i H ₂ O; s Et OH, et h, chl
5783	2,4-Hexadi enoi c aci d	Sorbi c aci d	$_{6}H_8O_2$	110-44-1	112.127	nd (di l al) nd (w)	134.5	dec 228; 153 ⁵⁰	1.204 ¹⁹		s H ₂ O, Et OH, chl; vs et h
5784	2,4-Hexadi en-1-ol	Sorbi c al coh ol	$_{6}H_{10}O$	111-28-4	98.142	nd	30.5	76 ¹²	0.8967 ²³	1.4981 ²⁰	i H ₂ O; s Et OH, et h
5785	<i>t rans</i> 2,4-Hexadi enoyl chl ori de		$_{8}H_8ClO$	2614-88-2	130.572			82 ²	1.0666 ¹⁹	1.5545 ²⁰	vs ace
5786	1,5-Hexadi en-3-yne	Di vi nyl acet yl ene	$_{6}H_6C$	821-08-9	78.112	li q	-88	85	0.785 ⁹	1.5035 ²⁰	i H ₂ O; s bz
5787	1,5-Hexadi yne	Bi propargyl	$_{6}H_6$	628-16-0	78.112	li q	-6	86	0.804 ⁹	1.4380 ²³	i H ₂ O; s Et OH, et h, ace, bz
5788	2,4-Hexadi yne	Di met hyl di acet yl ene	$_{6}H_6C$	2809-69-0	78.112	pr (sub)	67.8	129.5			vs Et OH, et h
5789	Hexaet hyl benzene		$_{16}H_{30}$	604-88-6	246.431	mcl pr (al or bz)	129	298	0.8305 ³⁰	1.4736 ¹³⁰	i H ₂ O; s Et OH, sul f; vs et h, bz
5790	Hexaet hyl di si l oxane		$_{12}H_{20}OSi_2$	994-49-0	246.536			233; 129 ³⁰	0.8457 ²⁰	1.4340 ²⁰	
5791	Hexaet hyl t et raphosphat e	Et hyl t et raphosphat e	$_{12}H_{30}O_4P_4$	757-58-4	506.253	hyg	-40	dec 150	1.2917 ²⁷	1.4273 ²⁷	vs ace, bz, Et OH
5792	Hexafluoreni um bromi de		$_{38}H_{12}Br_2N_2$	317-52-2	662.539	cry (PrOH)	188				
5793	Hexafluoroacet yl acet one		$_{6}H_2F_6O_2$	1522-22-1	208.059			54.15	1.485 ²⁰	1.3333 ²⁰	
5794	Hexafluorobenzene	Perfluorobenzene	C_6F_6	392-56-3	186.054		5.03	80.26	1.6184 ²⁰	1.3777 ²⁰	
5795	1,1,2,3,4,4-Hexafluoro-1,3-but adi ene		F_6	685-63-2	162.033	col gas	-132	6	1.553 ²⁰	1.378 ²⁰	
5796	1,1,1,4,4,4-Hexafluoro-2-but yne		CF_6	692-50-2	162.033	col gas	-117.4	-24.6			s Et OH, et h, ace, ct c, HOAc
5797	Hexafluorocycl obut ene		CF_6	697-11-0	162.033	col gas	-60	5.5	1.602 ²⁰	1.298 ²⁰	
5798	Hexafluoroet hane	Perfluoroet hane	F_6	76-16-4	138.011	col gas	-100.05	-78.1	1.590 ⁷⁸		i H ₂ O; sl Et OH, et h
5799	1,1,1,2,3,3-Hexafluoropropane	Ref ri gerant 236ea	$_{3}H_2F_6$	431-63-0	152.038	col gas		6.1	1.502 ⁸		
5800	1,1,1,3,3,3-Hexafluoropropane	Ref ri gerant 236fa	$_{3}H_2F_6$	690-39-1	152.038	col gas	-93.6	-1.0	1.434 ³		
5801	1,1,1,3,3,3-Hexafluoro-2-propanol		$C_3H_2F_6O$	920-66-1	168.037	li q	-2.0	59	1.4600		
5802	Hexahydro-1 <i>H</i> -azepi ne	Hexamet hyl eni mi ne	$_{6}H_8CN$	111-49-9	99.174			138	0.8643 ²²	1.4631 ²⁰	s H ₂ O; vs Et OH, et h
5803	Hexahydro-1 <i>H</i> -1,4-di azepi ne		$_{8}H_{12}N_2$	505-66-8	100.162	hyg	40.5	169			
5804	1,5a,6,9,9a,9b-Hexahydro-4a(4 <i>H</i>)-di benzof urancarboxal dehyde		$C_{13}H_{16}O_2$	126-15-8	204.265	li q	-80	307	1.1 ⁸	1.5254 ²⁰	i H ₂ O
5805	<i>ci s</i> 1,2,3,5,6,8a-Hexahydro-4,7-di met hyl -1-i sopropyl napht hal ene, (1 <i>S</i>)		$C_{15}H_{24}$	483-76-1	204.352			125 ¹²	0.9160 ¹⁵	1.5089 ¹⁵	
5806	1,2,4a,5,8,8a-Hexahydro-4,7-di met hyl -1-i sopropyl napht hal ene, [1 <i>S</i> -(1 <i>α</i> ,4 <i>α</i> β,8 <i>αα</i>)]		$C_{15}H_{24}$	523-47-7	204.352			274; 136 ¹¹	0.9230 ²⁰	1.5059 ²⁰	vs et h, li q
5807	Hexahydro-1,3-i sobenzof urandi one	Hexahydropt hal i c anhydri de	$_{8}H_{10}O_2$	85-42-7	154.163		32	145 ¹⁸			



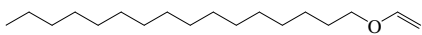
1-Hexadecylpyridinium chloride



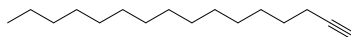
Hexadecyl stearate



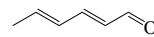
Hexadecyl trichlorosilane



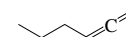
Hexadecyl vinyl ether



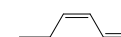
1-Hexadecyne



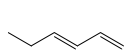
trans,trans-2,4-Hexadienal



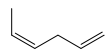
1,2-Hexadiene



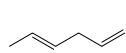
cis-1,3-Hexadiene



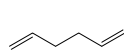
trans-1,3-Hexadiene



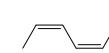
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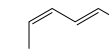
trans-1,4-Hexadiene



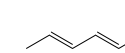
1,5-Hexadiene



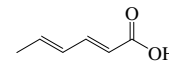
cis,ci-2,4-Hexadiene



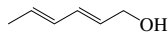
trans,ci-2,4-Hexadiene



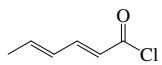
trans,trans-2,4-Hexadiene



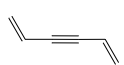
2,4-Hexadienoic acid



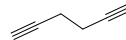
2,4-Hexadien-1-ol



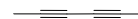
trans,trans-2,4-Hexadienoyl chloride



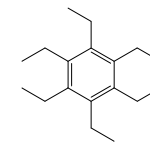
1,5-Hexadien-3-yne



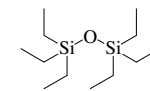
1,5-Hexadiyne



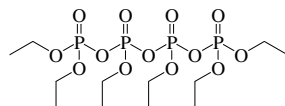
2,4-Hexadiyne



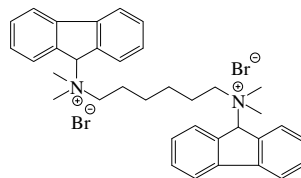
Hexaethylbenzene



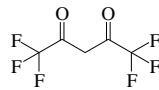
Hexaethylcyclodisiloxane



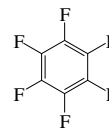
Hexaethyltetraphosphate



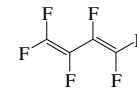
Hexafluoroantimony bromide



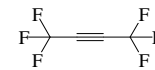
Hexafluoroacetone



Hexafluorobenzene



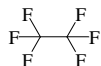
1,1,2,3,4,4-Hexafluoro-1,3-butadiene



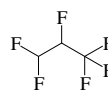
1,1,1,4,4,4-Hexafluoro-2-butyne



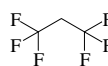
Hexafluorocyclobutene



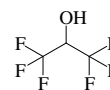
Hexafluoroethane



1,1,1,2,3,3-Hexafluoropropane



1,1,1,3,3,3-Hexafluoropropane



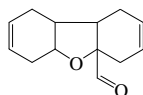
1,1,1,3,3,3-Hexafluoro-2-propanol



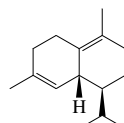
Hexahydro-1H-azepine



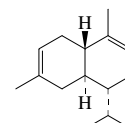
Hexahydro-1H-1,4-diazepine



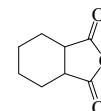
1,5a,6,9,9a,9b-Hexahydro-4a(4H)-di-benzofurancarboxaldehyde



cis-1,2,3,5,6,8a-Hexahydro-4,7-di-methyl-1-i-sopropyl-naphthalene



1,2,4a,5,8,8a-Hexahydro-4,7-di-methyl-1-i-sopropyl-naphthalene



Hexahydro-1,3-i-benzofuranone

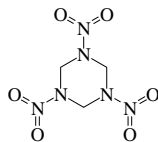
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5808	Hexahydro-1-met hyl -#-1,4-di azepi ne		C ₆ H ₁₄ N ₂	4318-37-0	114.188			154	0.9111 ²⁰	1.4769 ²⁰	
5809	2,3,4,6,7,8-Hexahydropyrrol o[1,2-ajpyri mi di ne		C ₇ H ₁₂ N ₂	3001-72-7	124.183			96 ⁷ , 81 ²	1.005 ²⁵	1.5190 ²⁰	
5810	Hexahydro-1,3,5-t ri ni t ro-1,3,5-t ri azi ne	Cycl oni t e	C ₆ H ₆ N ₆ O ₆	121-82-4	222.116	ort h cry (ace)	205.5		1.82 ⁹		i H ₂ O, Et OH, bz; sl et h, MeOH; s ace, HOAc
5811	Hexahydro-1,3,5-t ri phenyl -1,3,5-t ri azi ne		C ₂₁ H ₂₁ N ₃	91-78-1	315.412		144	185; 60 ²⁹			i H ₂ O; sl Et OH; s et h, ace, bz, t ol
5812	1,2,3,5,6,7-Hexahydroxy-9,10-ant hracenedi one	Rufigal ol	C ₁₄ H ₆ O ₈	82-12-2	304.209	red rhom, red-ye nd (sub)		sub			i H ₂ O; sl Et OH, et h; s ace, al k
5813	Hexamet hyl benzene	Mel li t ene	C ₁₂ H ₆	87-85-4	162.271	ort h pr or nd (al)	165.5	263.4	1.0630 ²⁵		i H ₂ O; s Et OH, et h, ace, bz, HOAc, chl
5814	2,2,4,4,6,6-Hexamet hyl cycl ot ri si l azane		C ₆ H ₂₁ N ₃ Si ₃	1009-93-4	219.508	li q	-10	188	0.919 ⁶	1.448 ²⁰	
5815	Hexamet hyl cycl ot ri si l oxane	Di met hyl si l oxane cycl i c t ri me	C ₆ H ₁₆ O ₂ Si ₃	541-05-9	222.462		64.5	134	1.1200 ²⁰		i H ₂ O
5816	Hexamet hyl di si l ane		C ₆ H ₆ Si ₂	1450-14-2	146.378		13.5	113.5	0.724 ⁷²	1.4229 ²⁰	i H ₂ O; s et h, ace, bz; dec al k
5817	Hexamet hyl di si l at hi ane		C ₆ H ₁₆ Si ₂	3385-94-2	178.443			162.5	0.851 ²⁰		
5818	Hexamet hyl di si l azane		C ₆ H ₆ NSi ₂	999-97-3	161.393			125	0.7741 ²⁵	1.4090 ²⁰	
5819	Hexamet hyl di si l oxane		C ₆ H ₆ O ₂ Si ₂	107-46-0	162.377	li q	-66	99	0.763 ⁸	1.3774 ²⁰	i H ₂ O
5820	Hexamet hyl enedi ami ne carbat e	(6-Ami nohexyl)carbami c aci d	C ₇ H ₁₆ N ₂ O ₂	143-06-6	160.214	cry	150				
5821	Hexamet hyl ene di i socyanat e		C ₆ H ₁₀ N ₂ O ₂	822-06-0	168.193			122 ¹⁰ , 94 ¹	1.0528 ²⁰	1.4585 ²⁰	
5822	Hexamet hyl enet et rami ne	Met henami ne	C ₆ H ₁₂ N ₄	100-97-0	140.186	ort h (al)	>250	sub	1.33f		vs H ₂ O; s Et OH, ace, chl ; sl et h, bz
5823	Hexamet hyl ol met ami ne		C ₆ H ₁₂ N ₂ O	531-18-0	306.275		137				vs H ₂ O
5824	Hexamet hyl phosphori c t ri ami de	Tri s(di met hyl ami no)phosphi ne	C ₆ H ₁₂ N ₆ O ₃ PC	680-31-9	179.200			232.5	1.03 ²⁰	1.4579 ²⁰	s Et OH, et h
5825	Hexamet hyl phosphorous t ri ami de	Tri s(di met hyl ami no)phosphi ne	C ₆ H ₁₆ N ₃ PC	1608-26-0	163.201						s chl
5826	2,6,10,15,19,23-Hexamet hyl t racosane	Squal ane	C ₃₀ H ₆₂	111-01-3	422.813	li q	-38	350	0.811 ⁵	1.4530 ¹⁵	i H ₂ O; sl Et OH, ace; s et h, chl ; msc bz
5827	Hexanal	Caproal dehyde	C ₆ H ₁₂ O	66-25-1	100.158	li q	-56	131	0.833 ⁵	1.4039 ²⁰	sl H ₂ O; vs Et OH, et h; s ace, bz
5828	Hexanami de		C ₆ H ₁₃ NO	628-02-4	115.173	cry (ace)	101	255	0.999 ²⁰	1.4200 ¹¹⁰	vs bz, et h, Et OH, chl
5829	Hexane		C ₆ H ₁₄	110-54-3	86.175	li q	-95.35	68.73	0.660 ⁶	1.3727 ²⁵	i H ₂ O; vs Et OH; s et h, chl
5830	Hexanedi al		C ₆ H ₁₀ O ₂	1072-21-5	114.142		-8	93 ⁹	1.003 ¹⁹	1.4350 ²⁰	vs bz, et h, Et OH
5831	Hexanedi ami de		C ₆ H ₁₂ N ₂ O ₂	628-94-4	144.171	pl	220				vs Et OH
5832	1,6-Hexanedi ami ne	Hexamet hyl enedi ami ne	C ₆ H ₁₂ N ₂	124-09-4	116.204	ort h bi pym pl	39.13	205			vs Et OH, bz
5833	Hexanedi oi c aci d, di hydrazi de		C ₆ H ₁₀ N ₂ O ₂	1071-93-8	174.201		181.8				
5834	1,2-Hexanedi ol		C ₆ H ₁₄ O ₂	6920-22-5	118.174		45	224; 87 ^{1.5}		1.4431 ²⁰	
5835	1,6-Hexanedi ol	Hexamet hyl ene glycol	C ₆ H ₁₄ O ₂	629-11-8	118.174		41.5	208		1.4579 ²⁵	s H ₂ O, Et OH, ace; sl et h; i bz
5836	2,5-Hexanedi ol	Di i sopropanol	C ₆ H ₁₄ O ₂	2935-44-6	118.174	cry (et h)	43	218; 86	0.9610 ²⁰	1.4475 ²⁰	s H ₂ O, Et OH, et h; sl ct c
5837	1,6-Hexanedi ol di met hacryl at e	Hexamet hyl ene met hacryl at e	C ₁₄ H ₂₂ O ₆	6606-59-3	254.323				0.998 ²⁵		
5838	2,3-Hexanedi one	Acet yl but yryl	C ₆ H ₁₀ O ₂	3848-24-6	114.142			128	0.934 ¹⁹		
5839	2,4-Hexanedi one	Propi onyl acet one	C ₆ H ₁₀ O ₂	3002-24-2	114.142	oi l		160	0.95 ⁹	1.4516 ²⁰	
5840	2,5-Hexanedi one	Acet onyl acet one	C ₆ H ₁₀ O ₂	110-13-4	114.142	li q	-5.5	194	0.737 ⁹	1.4232 ²⁰	vs H ₂ O, bz, et h, Et OH
5841	3,4-Hexanedi one	Bi propi onyl	C ₆ H ₁₀ O ₂	4437-51-8	114.142	li q	-10	130	0.94f	1.4130 ²¹	
5842	Hexanedi oyl di chl ori de		C ₆ H ₁₀ Cl ₂ O ₂	111-50-2	183.033			126 ¹²			sl chl
5843	1,6-Hexanedi t hi ol		C ₆ H ₁₄ S ₂	1191-43-1	150.305	li q	-21	237; 118	0.9886 ²⁵	1.5110 ²⁰	
5844	Hexaneni t ri le	Caproni t ri le	C ₆ H ₁₁ NC	628-73-9	97.158	li q	-80.3	163.65	0.805 ⁴	1.4068 ²⁰	i H ₂ O; s Et OH, et h; sl chl
5845	1-Hexanet hi ol	Hexyl mercapt an	C ₆ H ₁₃ S	111-31-9	118.240	li q	-81	152.7	0.842 ⁴	1.4496 ²⁰	i H ₂ O; vs Et OH, et h
5846	2-Hexanet hi ol		C ₆ H ₁₄ S	1679-06-7	118.240	li q	-147	142	0.834 ⁵	1.4451 ²⁰	i H ₂ O; s Et OH, et h, bz



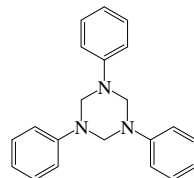
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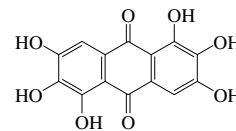
2,3,4,6,7,8-Hexahydropyrrol o[1,2-a]pyri mi di ne



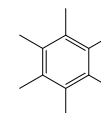
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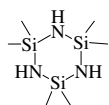
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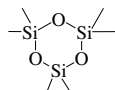
1,2,3,5,6,7-Hexahydroxy-9,10-ant hracenedi one



Hexamet hyl benzene



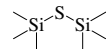
2,2,4,4,6,6-Hexamet hyl cycl ot ri si l azane



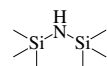
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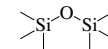
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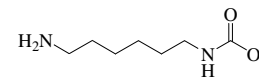
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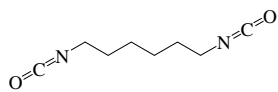
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Hexamet hyl di si l oxane



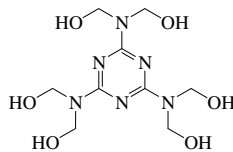
Hexamet hyl enedi ami carbamat e



Hexamet hyl enedi i socyanat e



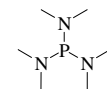
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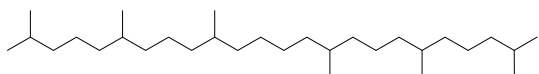
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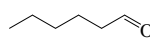
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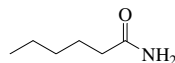
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2,6,10,15,19,23-Hexamet hyl t et racosane



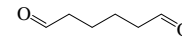
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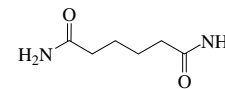
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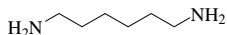
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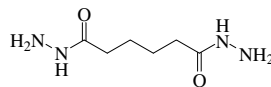
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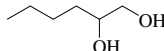
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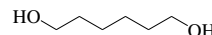
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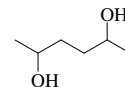
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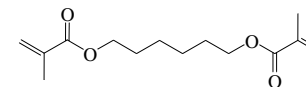
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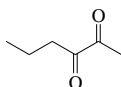
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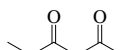
2,5-Hexanedi ol



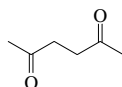
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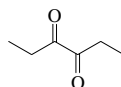
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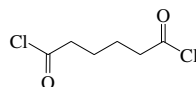
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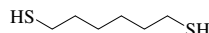
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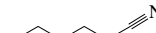
3,4-Hexanedi one



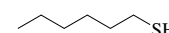
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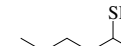
1,6-Hexanedi t hi ol



Hexaneni t ri l e

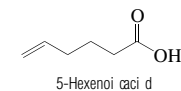
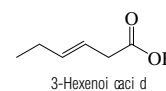
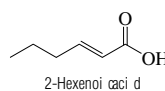
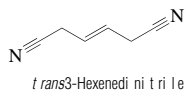
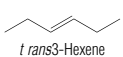
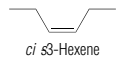
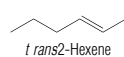
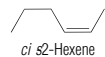
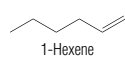
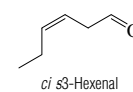
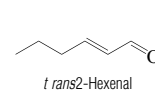
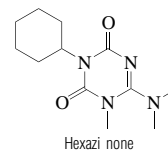
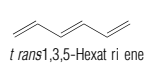
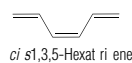
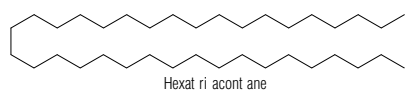
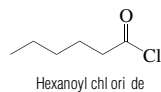
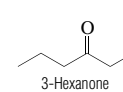
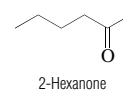
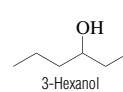
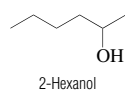
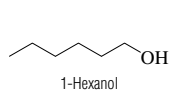
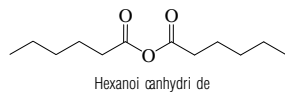
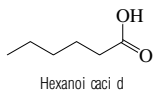
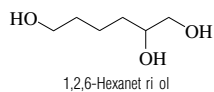


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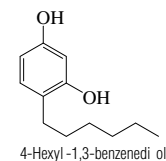
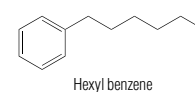
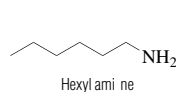
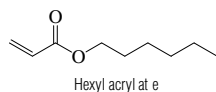
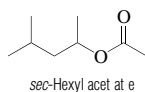
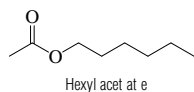
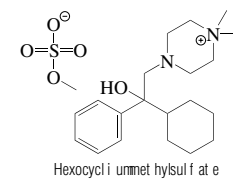
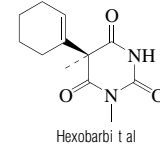
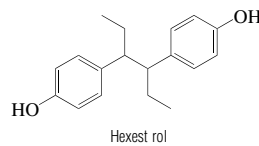
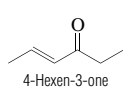
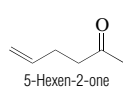
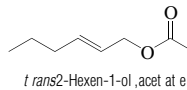
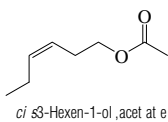
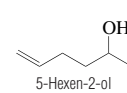
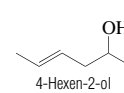
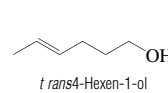
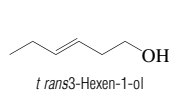
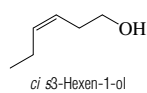
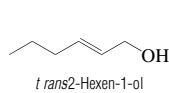
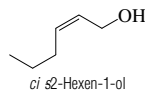
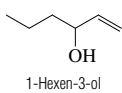


2-Hexanet hi ol

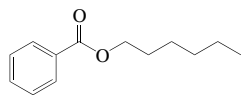
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5847	1,2,6-Hexanetriol	1,2,6-Trihydroxyhexane	C ₆ H ₁₄ O ₃	106-69-4	134.173			170 ³ , 161 ¹	1.1049 ²⁰	1.58 ²⁰	
5848	Hexanoincaci d	Caproicacaci d	C ₆ H ₁₂ O ₂	142-62-1	116.158	liq	-3	205.2	0.921 ²	1.4163 ²⁰	sl H ₂ O; s Et OH, et h, chl
5849	Hexanoinc anhydride		C ₁₂ H ₂₂ O ₃	2051-49-2	214.301		-41	dec 255	0.9240 ¹⁵	1.4297 ²⁰	vs et h, Et OH
5850	1-Hexanol	Caproylalcohol	C ₆ H ₁₄ O	111-27-3	102.174	liq	-47.4	157.6	0.813 ⁶	1.4178 ²⁰	sl H ₂ O; s Et OH, ace, chl; msc et h, bz
5851	2-Hexanol		C ₆ H ₁₄ O	20281-86-1	102.174			140	0.8159 ²⁰	1.4144 ²⁰	sl H ₂ O, ct c; s Et OH, et h
5852	3-Hexanol		C ₆ H ₁₄ O	17015-11-1	102.174			135	0.8182 ²⁰	1.4167 ²⁰	sl H ₂ O; s Et OH, ace; msc et h
5853	2-Hexanone	Butyl methyl ketone	C ₆ H ₁₂ O	591-78-6	100.158	liq	-55.5	127.6	0.811 ³	1.4007 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
5854	3-Hexanone	Ethyl propyl ketone	C ₆ H ₁₂ O	589-38-8	100.158	liq	-55.4	123.5	0.811 ⁸	1.4004 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
5855	Hexanoylchloride	Caproylchloride	C ₆ H ₁₃ ClO	142-61-0	134.603	liq	-87	153	0.977 ⁸	1.4264 ²⁰	s et h, ace
5856	Hexatriacetone		C ₆ H ₁₄	630-06-8	506.973		75.8	298.4 ³	0.7803 ⁸⁰	1.4397 ⁸⁰	
5857	<i>ci s</i> 1,3,5-Hexatriene		C ₆ H ₁₀	2612-46-6	80.128	liq	-12	78	0.717 ⁵	1.4577 ²⁰	i H ₂ O; s Et OH, ace, chl, pet h
5858	<i>t rans</i> 1,3,5-Hexatriene		C ₆ H ₁₀	821-07-8	80.128	liq	-12	78.5	0.736 ⁹	1.5135 ²⁰	i H ₂ O; s Et OH, ace, chl, pet h
5859	Hexazone		C ₆ H ₂₀ N ₄ O ₂	51235-04-2	252.313		99	dec	1.25		
5860	<i>t rans</i> 2-Hexenal		C ₆ H ₁₀ O	6728-26-3	98.142			146.5; 50 ²⁰	0.8491 ²⁰	1.4480 ²⁰	
5861	<i>ci s</i> 3-Hexenal		C ₆ H ₁₀ O	6789-80-6	98.142			121	0.8533 ²²	1.4300 ²¹	
5862	1-Hexene		C ₆ H ₁₂	592-41-6	84.159	liq	-139.76	63.48	0.668 ⁵	1.3852 ²⁵	i H ₂ O; vs bz, et h, Et OH, pet h
5863	<i>ci s</i> 2-Hexene		C ₆ H ₁₂	7688-21-3	84.159	liq	-141.11	68.8	0.682 ⁴	1.3979 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, li g
5864	<i>t rans</i> 2-Hexene		C ₆ H ₁₂	4050-45-7	84.159	liq	-133	67.9	0.673 ³	1.3936 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, li g
5865	<i>ci s</i> 3-Hexene		C ₆ H ₁₂	7642-09-3	84.159	liq	-137.8	66.4	0.677 ⁸	1.3947 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, li g
5866	<i>t rans</i> 3-Hexene		C ₆ H ₁₂	13269-52-8	84.159	liq	-115.4	67.1	0.677 ²	1.3943 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, li g
5867	<i>t rans</i> 3-Hexenedinitrile	<i>t rans</i> 1,4-Dicyano-2-butene	C ₆ H ₈ N ₂	1119-85-3	106.125	cry	76				
5868	2-Hexenoincaci d		C ₆ H ₁₀ O ₂	1191-04-4	114.142	nd (w, al)	36.5	216.5	0.965 ²⁰	1.4460 ⁴⁰	vs et h
5869	3-Hexenoincaci d	Hydrosorbicacaci d	C ₆ H ₁₀ O ₂	4219-24-3	114.142		12	208	0.9640 ²³	1.4935 ²⁰	
5870	5-Hexenoincaci d		C ₆ H ₁₀ O ₂	1577-22-6	114.142	liq	-37	203	0.961 ⁹	1.4343 ²⁰	vs et h, Et OH
5871	1-Hexen-3-ol		C ₆ H ₁₂ O	4798-44-1	100.158			134	0.834 ²²	1.4297 ¹⁸	sl H ₂ O; vs ace, et h, Et OH
5872	<i>ci s</i> 2-Hexen-1-ol		C ₆ H ₁₂ O	928-94-9	100.158			157	0.8472 ²⁰	1.4397 ²⁰	s H ₂ O; vs Et OH; s et h, ace; sl ct c
5873	<i>t rans</i> 2-Hexen-1-ol		C ₆ H ₁₂ O	928-95-0	100.158			157	0.8490 ¹⁶	1.4340 ²⁰	
5874	<i>ci s</i> 3-Hexen-1-ol		C ₆ H ₁₂ O	928-96-1	100.158			156.5	0.8478 ²²	1.4380 ²⁰	s H ₂ O; vs Et OH, et h
5875	<i>t rans</i> 3-Hexen-1-ol		C ₆ H ₁₂ O	928-97-2	100.158			154.5		1.4374 ²⁰	
5876	<i>t rans</i> 4-Hexen-1-ol		C ₆ H ₁₂ O	928-92-7	100.158			159	0.8513 ²⁰	1.4402 ²⁰	
5877	4-Hexen-2-ol		C ₆ H ₁₂ O	52387-50-5	100.158			137.5	0.8405 ¹⁸	1.4392 ²⁰	sl H ₂ O
5878	5-Hexen-2-ol		C ₆ H ₁₂ O	626-94-8	100.158			139	0.842 ¹⁶		sl H ₂ O
5879	<i>ci s</i> 3-Hexen-1-ol, acetate		C ₆ H ₁₄ O ₂	3681-71-8	142.196	liq		6 ⁸			
5880	<i>t rans</i> 2-Hexen-1-ol, acetate		C ₆ H ₁₄ O ₂	2497-18-9	142.196	liq		166; 6 ⁸	0.898	1.4270 ²⁰	
5881	5-Hexen-2-one		C ₆ H ₁₀ O	109-49-9	98.142			129.5	0.833 ²⁷	1.4178 ²⁷	
5882	4-Hexen-3-one		C ₆ H ₁₀ O	2497-21-4	98.142			138.5	0.8559 ²⁰	1.4388 ²⁰	s Et OH, et h; vs ace
5883	Hexestrol		C ₆ H ₂₂ O ₂	84-16-2	270.367	nd (bz)	186.5				vs ace, et h, Et OH
5884	Hexobarbital		C ₆ H ₁₀ N ₂ O ₃	56-29-1	236.266		146.5				
5885	Hexocyclium methylsulfate		C ₂₁ H ₃₀ N ₂ O ₆ S	115-63-9	428.586	cry	205				sl chl; i et h
5886	Hexylacetate		C ₆ H ₁₆ O ₂	142-92-7	144.212	liq	-80.9	171.5	0.877 ⁹	1.4092 ²⁰	i H ₂ O; vs et h, Et OH
5887	sec-Hexylacetate		C ₆ H ₁₆ O ₂	108-84-9	144.212			147.5	0.8805 ²⁵	1.3980 ²⁰	sl H ₂ O; vs et h, Et OH
5888	Hexylacrylate		C ₆ H ₁₆ O ₂	2499-95-8	156.222		-45	40 ¹	0.878 ²⁰		
5889	Hexylamine	1-Hexanamine	C ₆ H ₁₅ N	111-26-2	101.190	liq	-22.9	132.8	0.766 ⁹	1.4180 ²⁰	sl H ₂ O; msc Et OH, et h; s chl
5890	Hexylbenzene		C ₁₂ H ₁₈	1077-16-3	162.271	liq	-61	226.1	0.857 ⁵	1.4864 ²⁰	i H ₂ O; msc et h; s bz, pet h
5891	4-Hexyl-1,3-benzenediol	4-Hexylresorcinol	C ₁₂ H ₁₈ O ₂	136-77-6	194.270	nd (bz)	68	334			vs ace, et h, Et OH, chl



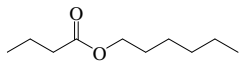
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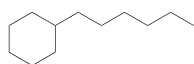
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5892	Hexyl benzoate		C ₆ H ₁₈ O ₂	6789-88-4	206.281			272; 139 ⁸	0.9793 ²⁰		i H ₂ O; s Et OH, ace
5893	Hexyl butanoate		C ₁₀ H ₂₀ O ₂	2639-63-6	172.265	liq	-78	208	0.8652 ⁸	1.4160 ¹⁵	i H ₂ O; s Et OH; sl chl
5894	Hexyl cyclohexane		C ₁₂ H ₂₄	4292-75-5	168.319	liq	-43	224	0.8076 ⁸	1.4462 ²⁰	
5895	Hexyl cyclopentane		C ₁₁ H ₂₂	4457-00-5	154.293	liq	-73	203	0.7965 ⁸	1.4392 ²⁰	vs ace, bz, et h, Et OH
5896	2-Hexyl decanoic acid		C ₁₈ H ₃₂ O ₂	25354-97-6	256.424	visc oil		148 ⁸		1.4432 ²⁴	
5897	Hexyl formate		C ₈ H ₁₆ O ₂	629-33-4	130.185	liq	-62.6	155.5	0.8813 ⁸	1.4071 ²⁰	i H ₂ O; msc Et OH, et h
5898	Hexyl hexanoate	Hexyl caproate	C ₁₂ H ₂₄ O ₂	6378-65-0	200.318	liq	-55	246	0.865 ⁸	1.4264 ¹⁵	vs ace, bz, et h, Et OH
5899	Hexyl isocyanate		C ₆ H ₁₃ NO	2525-62-4	127.184			447			
5900	Hexyl methacrylate		C ₁₄ H ₁₈ O ₂	142-09-6	170.249			162; 86 ¹⁷	0.880 ²⁵	1.429 ²⁵	vs ace, bz, et h, Et OH
5901	Hexyl methylether		C ₈ H ₁₈ O	4747-07-3	116.201			126.1			
5902	1-Hexyl naphthalene		C ₁₈ H ₂₀	2876-53-1	212.330	liq	-18	322	0.9566 ⁸	1.5647 ²⁰	
5903	Hexyl octanoate		C ₁₄ H ₂₈ O ₂	1117-55-1	228.371	liq	-30.6	277.4	0.8603 ⁸	1.4323 ²⁵	i H ₂ O; s Et OH, et h, ace
5904	4-(Hexyloxy)benzoic acid		C ₁₈ H ₁₈ O ₃	1142-39-8	222.280	cry	106				
5905	2-(Hexyloxy)ethanol	Et hyl ene glycol monohexyl ether	C ₁₄ H ₃₀ O ₂	112-25-4	146.228	liq	-45.1	208	0.887 ⁸	1.4291 ²⁰	sl H ₂ O; vs Et OH, et h
5906	Hexyl pentanoate		C ₁₃ H ₂₆ O ₂	1117-59-5	186.292	liq	-63.1	226.3	0.8635 ⁸	1.4228 ¹⁵	vs ace, et h, Et OH
5907	4-Hexyl phenol		C ₁₂ H ₁₈ O	2446-69-7	178.270			148 ⁹			
5908	1-Hexyl propanoate		C ₁₁ H ₂₀ O ₂	2445-76-3	158.238	liq	-57.5	190	0.869 ⁸	1.4162 ¹⁵	i H ₂ O; s Et OH, et h, ace, AcOEt
5909	1-Hexyl-1,2,3,4-tetrahydronaphthalene		C ₁₆ H ₂₄	66325-11-9	216.362	liq		305	0.9176 ⁸	1.5127 ²⁵	
5910	1-Hexyne	Butyl acetylene	C ₈ H ₁₀	693-02-7	82.143	liq	-131.9	71.3	0.7155 ⁸	1.3989 ²⁰	i H ₂ O; s Et OH, et h, bz, chl; sl ct c
5911	2-Hexyne	1-Methyl-2-propyl acetylene	C ₈ H ₁₀	764-35-2	82.143	liq	-89.6	84.5	0.7315 ⁸	1.4138 ²⁰	i H ₂ O; msc Et OH, et h; s bz, chl, pet h
5912	3-Hexyne	Diethyl acetylene	C ₈ H ₁₀	928-49-4	82.143	liq	-103	81	0.723 ⁸	1.4115 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, pet h
5913	3-Hexyne-2,5-diol		C ₁₀ H ₁₈ O ₂	3031-66-1	114.142			121 ¹⁵	1.0180 ²⁰	1.4691 ²⁰	
5914	3-Hexyn-1-ol	3-Hexynol	C ₈ H ₁₄ O	1002-28-4	98.142			162; 65 ¹²	0.8982 ²⁰	1.4530 ²⁰	
5915	1-Hexyn-3-ol		C ₈ H ₁₄ O	105-31-7	98.142	liq	-80	142	0.870 ⁸	1.4340 ²⁵	s ct c
5916	5-Hexyn-2-one		C ₈ H ₁₂ O	2550-28-9	96.127			149	0.9065 ²⁰	1.4366 ²⁰	
5917	Hexamethylenimine		C ₆ H ₁₂ N ₂	51-45-6	111.145	wh nd (chl)	83	209 ⁸			s H ₂ O, Et OH, chl; sl et h
5918	L-Histidine	Glyoxal in-5-alanine	C ₆ H ₉ N ₃ O ₂	71-00-1	155.154	nd or pl (di l al)	287 dec				s ₂ B; sl Et OH; i et h, ace, bz, chl
5919	L-Histidine, monohydrochloride		C ₆ H ₉ ClN ₃ O ₂	645-35-2	191.615		245 dec				s H ₂ O
5920	Homatropine		C ₁₁ H ₂₁ NO ₃	87-00-3	275.343	pr (al, et h)	99.5				sl H ₂ O, bz; s Et OH, et h, ace, chl
5921	Homatropine hydrobromide	Tropanol mandelate	C ₁₆ H ₂₂ BrNO ₃	51-56-9	356.255	orth pym or pl (w)	217 dec				vs H ₂ O, Et OH
5922	Homochlorocyclizine		C ₁₈ H ₂₃ ClN ₂	848-53-3	314.852	oil		177 ⁸			
5923	DL-Homocysteine	DL-2-Amino-4-mercaptobutanoic acid	C ₄ H ₉ NO ₂ S	454-29-5	135.185		272 dec				s H ₂ O; i et h, bz
5924	L-Homocysteine	L-2-Amino-4-mercaptobutanoic acid	C ₄ H ₉ NO ₂ S	6027-13-0	135.185	pl at el et s	232				
5925	Homocystine		C ₈ H ₁₆ N ₂ O ₄ S ₂	870-93-9	268.354		264				sl H ₂ O; i et h, bz
5926	L-Homoserine	2-Amino-4-hydroxybutanoic acid	C ₄ H ₉ NO ₃	672-15-1	119.119	pr (90% al)	203 dec				vs H ₂ O; sl Et OH; i et h, bz
5927	Humulene		C ₁₅ H ₂₄	6753-98-6	204.352			123 ¹⁰	0.8905 ²⁰	1.5038 ²⁰	
5928	Humulone		C ₂₁ H ₃₀ O ₅	26472-41-3	362.460	ye cry (et h)	66.5				sl H ₂ O; s Et OH, et h, ace, bz, al k
5929	Hydralazine	1-Hydrazinophthalazine	C ₈ H ₁₀ N ₄	86-54-4	160.177	ye cry (MeOH)	172				s acid
5930	Hydramet hyl non		C ₉ H ₂₄ F ₆ N ₄	67485-29-4	494.476		190				
5931	Hydrastine		C ₁₇ H ₂₁ NO ₆	118-08-1	383.395	ye pr (al)	132				i H ₂ O; s ace, bz
5932	Hydrastinine		C ₁₇ H ₁₃ NO ₃	6592-85-4	207.226	nd (li g), cry (et h)	116.5				s H ₂ O; vs Et OH, et h, chl
5933	Hydrazinecarbohydrazide	Thiosemicarbazide	C ₃ N ₃ SH	79-19-6	91.136	lond (w)	183				vs H ₂ O, Et OH



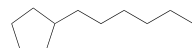
Hexyl benzoate



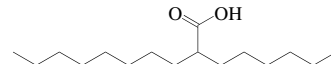
Hexyl butanoate



Hexyl cyclohexane



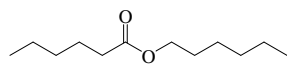
Hexyl cyclopentane



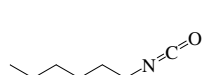
2-Hexyl decanoic acid



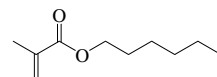
Hexyl formate



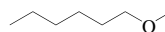
Hexyl hexanoate



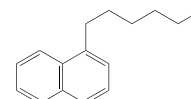
Hexyl isocyanate



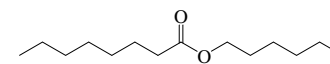
Hexyl methacrylate



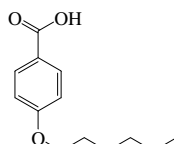
Hexyl methyl ether



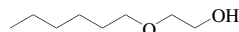
1-Hexyl naphthalene



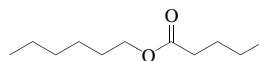
Hexyl octanoate



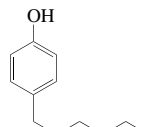
4-(Hexyloxy)benzoic acid



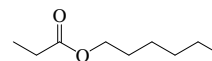
2-(Hexyloxy)ethanol



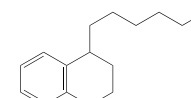
Hexyl pentanoate



4-Hexyl phenol



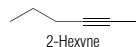
1-Hexyl propanoate



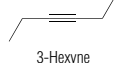
1-Hexyl-1,2,3,4-tetrahydronaphthalene



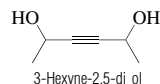
1-Hexyne



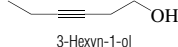
2-Hexyne



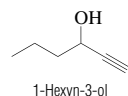
3-Hexyne



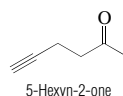
3-Hexyne-2,5-diol



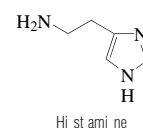
3-Hexyn-1-ol



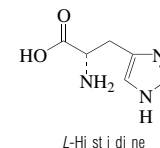
1-Hexyn-3-ol



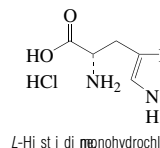
5-Hexyn-2-one



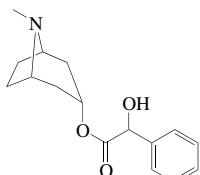
Histamine



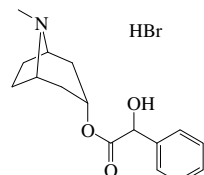
L-Histidine



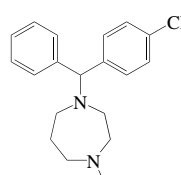
L-Histidine monohydrochloride



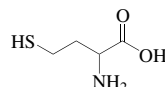
Homatropine



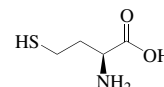
Homatropine hydrobromide



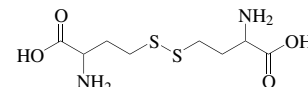
Homocyclizine



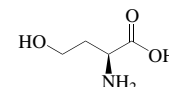
DL-Homocysteine



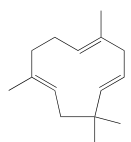
L-Homocysteine



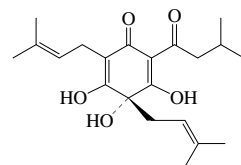
Homocystine



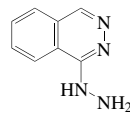
L-Homoserine



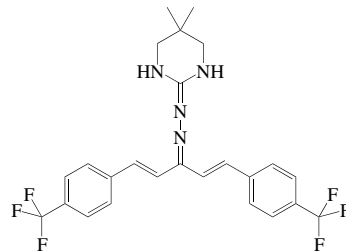
Humulene



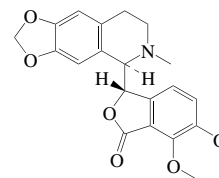
Humulone



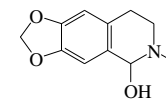
Hydralazine



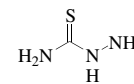
Hydramethylnon



Hydrastine



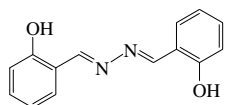
Hydrastinine



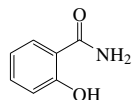
Hydrazinecarbohydrazide

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5934	Hydrazi necarboxal dehyde		C ₆ H ₇ N ₃ O	624-84-0	60.055	ye lf or nd (al)	54				vs bz, et h, Et OH, chl
5935	Hydrazi necarboxami de		C ₆ H ₇ N ₃ O	57-56-7	75.070	pr (al)	96		1.484 ⁶		vs H ₂ O; s Et OH; i et h, bz, chl
5936	Hydrazi necarboxi mi dami de	Ami noguani di ne	C ₆ H ₇ N ₃ O	79-17-4	74.086	cry	dec				vs H ₂ O, Et OH
5937	1,2-Hydrazi nedi carboxal dehyde		C ₆ H ₇ N ₃ O ₂	628-36-4	88.065	pr (al)	161.0				vs H ₂ O; sl Et OH, DMSO; i et h
5938	1,2-Hydrazi nedi carboxami de		C ₆ H ₇ N ₃ O ₂	110-21-4	118.095	pl (w)	258		1.604 ⁷		
5939	4-Hydrazi nobenzenesul f oni c aci d	Phenyl hydrazi ne-4-sul f oni c aci d	C ₆ H ₇ N ₃ O ₂ S	98-71-5	188.204	nd, lf (w)	286				sl H ₂ O, Et OH
5940	4-Hydrazi nobenzi c aci d		C ₆ H ₇ N ₃ O ₂	619-67-0	152.151	ye nd or pl (w)	221 dec				sl H ₂ O; i et h
5941	2-Hydrazi noet hanol		C ₆ H ₇ N ₃ O	109-84-2	76.097	li q	-70	219; 120 ⁵	1.119 ²⁵		vs H ₂ O, Et OH, MeOH
5942	Hydri ndant i n		C ₆ H ₁₀ O ₆	5103-42-4	322.268	pr (ace)	250 dec				
5943	Hydrochl orot hi azi de		C ₆ H ₁₀ Cl ₂ N ₂ O ₂ S ₂	58-93-5	297.740		274				
5944	Hydroci nchoni di ne		C ₆ H ₁₂ N ₂ O	485-64-3	296.406	lf (al)	229				vs Et OH
5945	Hydroci nchoni ne		C ₆ H ₁₂ N ₂ O	485-65-4	296.406	pr	268.5				s H ₂ O; sl Et OH; i et h
5946	Hydrocodone		C ₁₈ H ₂₁ N ₃ O ₃	125-29-1	299.365		198				i H ₂ O; s Et OH
5947	Hydrocort i sone		C ₂₁ H ₃₀ O ₅	50-23-7	362.460	pl (al or i - PrOH)	220				sl H ₂ O; s Et OH, di ox, HOAc
5948	Hydrocort i sone 21-acet at e	Cort i sol acet at e	C ₂₃ H ₃₂ O ₆	50-03-3	404.496		223 dec		1.289 ²⁰		
5949	Hydrocot arni ne		C ₇ H ₁₅ N ₃ O	550-10-7	221.252		56				i H ₂ O; s Et OH, et h, ace, bz, chl
5950	Hydroflumet hi azi de		C ₈ H ₉ F ₃ N ₃ O ₄ S ₂	135-09-1	331.293		270.5				
5951	Hydrof urami de		C ₇ H ₁₂ N ₂ O ₃	494-47-3	268.267	nd (al)	117				i H ₂ O; vs Et OH, et h
5952	Hydrogen cyani de	Hydrocyani c aci d	CHN	74-90-8	27.026	vol li q or gas	-13.29	26	0.6876	1.2614 ²⁰	msc H ₂ O, Et OH, et h
5953	Hydrohydrat i ni ne		C ₇ H ₁₃ N ₃ O ₂	494-55-3	191.227	nd (li g), cry (pet h)	66	303			vs ace, bz, et h, Et OH
5954	Hydromorphone	7,8-Di hydromorphi n-6-one	C ₁₇ H ₁₉ NO ₃	466-99-9	285.338	cry (Et OH)	266.5				
5955	Hydroprene		C ₁₇ H ₃₀ O ₂	41096-46-2	266.419			174 ¹⁹	0.8955 ²⁰		
5956	Hydroqui ni di ne		C ₂₀ H ₂₆ N ₂ O ₂	1435-55-8	326.432	nd (al)	168.5				s Et OH, et h, ace, chl
5957	Hydroqui ni ne		C ₂₀ H ₂₆ N ₂ O ₂	522-66-7	326.432	nd (et h, chl)	172.5				vs ace, et h, Et OH, chl
5958	p-Hydroqui none	1,4-Benzenedi ol	C ₆ H ₆ O ₂	123-31-9	110.111	mcl pr (sub) nd(w) pr (MeOH)	172.4	285	1.330 ²⁰	1.632 ²⁵	s H ₂ O, et h; vs Et OH, ace; i bz
5959	Hydroxocobal ami n	Vi t ami n B-12a	C ₆₂ H ₈₉ CoN ₁₃ O ₁₄ P	13422-51-0	1346.355	red cry (ace aq)	200 dec				s H ₂ O, Et OH; i ace, et h, bz
5960	Hydroxyacet oni t ri le	Glyconi t ri le	C ₂ H ₃ NOC	107-16-4	57.051		<-72	dec 183; 119 ²⁴		1.4117 ¹⁹	vs H ₂ O, Et OH, et h; i bz, chl
5961	(Hydroxyacet yl)benzene		C ₇ H ₆ O ₂	582-24-1	136.149	hex pl (al), pl (w or di l al)	90	125 ¹² , 56 ¹	1.0963 ⁹⁹		s H ₂ O, Et OH, et h, chl; sl li g
5962	17-Hydroxyandrost an-3-one, (5α,17β)	St anol one	C ₁₉ H ₃₀ O ₂	521-18-6	290.440		181	sub 135			
5963	3-Hydroxyandrost an-17-one, (3α,5α)	Androst erone	C ₁₉ H ₃₀ O ₂	53-41-8	290.440	lf or nd (al, ace)	185				sl H ₂ O, chl; s Et OH, et h, ace, bz
5964	3-Hydroxyandrost an-17-one, (β,5α)	Epi androst erone	C ₁₉ H ₃₀ O ₂	481-29-8	290.440	cry (bz-pet h, ace)	178				
5965	17-Hydroxyandrost -4-en-3-one, (17β)	Test ost erone	C ₁₉ H ₂₈ O ₂	58-22-0	288.424	nd (di l ace)	155				i H ₂ O; s Et OH, et h, ace
5966	1-Hydroxy-9,10-ant hracenedi one		C ₁₄ H ₈ O ₃	129-43-1	224.212	red-oran nd (al)	193.8	sub			i H ₂ O; s Et OH, et h, bz; sl li q NH ₃
5967	2-Hydroxy-9,10-ant hracenedi one		C ₁₄ H ₈ O ₃	605-32-3	224.212	ye pl or nd (al or HOAc)	306	sub			i H ₂ O; s Et OH, et h, aq NH ₃ KOH
5968	3-Hydroxybenzal dehyde	3-Formyl phenol	C ₇ H ₆ O ₂	100-83-4	122.122	nd (w)	108	240	1.1179 ¹³⁰		sl H ₂ O; s Et OH, et h, ace, bz; i li g
5969	4-Hydroxybenzal dehyde	4-Formyl phenol	C ₇ H ₆ O ₂	123-08-0	122.122	nd (w)	117		1.129 ¹³⁰	1.5705 ¹³⁰	sl H ₂ O, ace; vs Et OH, et h; s bz

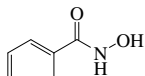
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
5970	2-Hydroxybenzaldehyde, ((2-hydroxyphenyl)methyl)hydrazone		C ₁₄ H ₁₂ N ₂ O ₂	959-36-4	240.257		214				i H ₂ O; s Et OH, chl; vs bz, al k
5971	2-Hydroxybenzamide	Salicylamide	C ₇ H ₇ NO ₂	65-45-2	137.137		142	181.5 ¹⁴	1.175 ¹⁴⁰		sl H ₂ O, et h, DMSO; s Et OH
5972	N-Hydroxybenzamide		C ₇ H ₇ NO ₂	495-18-1	137.137	orth tall, lf (et h)	131 exp				s OH et OH; sl et h, bz
5973	α-Hydroxybenzeneacetide	DL-Mandelic acid	C ₈ H ₈ O ₃	611-72-3	152.148	orth pl	119		1.289 ⁰		s H ₂ O, et h, Et OH, i -PrOH
5974	2-Hydroxybenzeneacetide		C ₈ H ₈ O ₃	614-75-5	152.148		148	240			sl H ₂ O, chl; s et h
5975	3-Hydroxybenzeneacetide		C ₈ H ₈ O ₃	621-37-4	152.148	nd (bz-li g)	132	190			vs H ₂ O, Et OH, et h; s bz, sl i g
5976	4-Hydroxybenzeneacetide		C ₈ H ₈ O ₃	156-38-7	152.148	nd (w)	152	sub			sl H ₂ O; vs Et OH, et h
5977	α-Hydroxybenzeneacetone triole	Mandelonitrile	C ₈ H ₇ NOC	532-28-5	133.148	ye oily li q	-10		1.12		i OH vs chl, et h, Et OH
5978	2-Hydroxybenzenecarboxylic acid	Dithiosalicylic acid	C ₇ H ₆ OS ₂	527-89-9	170.252	oran-ye nd	49				vs bz, et h, Et OH
5979	4-Hydroxy-1,3-benzenedicarboxylic acid	4-Hydroxyisophthalic acid	C ₈ H ₆ O ₅	636-46-4	182.131	nd(w), lf (di l al)	310				j OH chl; vs Et OH, et h; s HOAc
5980	5-Hydroxy-1,3-benzenedicarboxylic acid		C ₈ H ₆ O ₅	618-83-7	182.131	nd(w+2) cr(aq-al)		sub			vs bz, et h, Et OH
5981	4-Hydroxy-1,3-benzenedisulfonic acid	Phenol disulfonic acid	C ₆ H ₄ O ₇ S ₂	96-77-5	254.238	nd (w)	>100 dec				vs H ₂ O, Et OH
5982	4-Hydroxybenzenethanol		C ₇ H ₁₀ O ₂	501-94-0	138.164		91.8	310.0			
5983	2-Hydroxybenzenethanol	Salicyl alcohol	C ₇ H ₈ O ₂	90-01-7	124.138	lf (bz), nd or pl (w, et h)	87	sub	1.1613 ²⁵		s H ₂ O, Et OH, et h, bz; vs chl
5984	3-Hydroxybenzenethanol	3-Hydroxybenzyl alcohol	C ₈ H ₁₀ O ₂	620-24-6	124.138	nd (bz), cry (CCl ₄)	73	dec 300	1.161 ²⁵		vs H ₂ O, Et OH, et h; sl chl
5985	4-Hydroxybenzenethanol	4-Hydroxybenzyl alcohol	C ₈ H ₁₀ O ₂	623-05-2	124.138	pr or nd (w)	124.5	252			vs H ₂ O, Et OH, bz, chl; s et h; sl DMSO
5986	4-Hydroxybenzenepropanoic acid	p-Hydroxyhydrocinnamic acid	C ₉ H ₁₀ O ₃	501-97-3	166.173		130.8	209 ¹⁴			s H ₂ O, Et OH, et h, bz; i CS
5987	α-Hydroxybenzenepropanoic acid	(±)-3-Phenyl lactic acid	C ₉ H ₁₀ O ₃	828-01-3	166.173	cry (chl, bz), pr (w)	98	149 ¹⁵			vs H ₂ O, ace, et h, Et OH
5988	3-Hydroxybenzenesulfonic acid	m-Phenol sulfonic acid	C ₆ H ₄ O ₃ S	585-38-6	174.175	nd (w+2)					
5989	4-Hydroxybenzenesulfonic acid	p-Phenol sulfonic acid	C ₆ H ₄ O ₃ S	98-67-9	174.175	nd					vs H ₂ O, Et OH
5990	2-Hydroxybenzoic acid	Salicylic acid	C ₇ H ₆ O ₃	69-72-7	138.121	nd (w), mcl pr (al)	159.0	211 ²⁰	1.443 ²⁰	1.565	sl H ₂ O, bz, chl, ct c; vs Et OH, et h, ace
5991	3-Hydroxybenzoic acid		C ₇ H ₆ O ₃	99-06-9	138.121	nd (w) pl, pr (al)	202.5		1.485 ²⁵		sl H ₂ O; s Et OH, et h, ace; i bz
5992	4-Hydroxybenzoic acid		C ₇ H ₆ O ₃	99-96-7	138.121	pr or pl (w, al) cry (ace)	214.5		1.46 ²⁵		sl H ₂ O, bz; vs Et OH; s et h, ace
5993	2-Hydroxybenzoic acid, hydrate		C ₇ H ₆ N ₂ O ₂	936-02-7	152.151		148				vs bz, Et OH
5994	2-Hydroxybenzotriole		C ₇ H ₇ NO	611-20-1	119.121		98	149 ¹⁴	1.1052 ¹⁰⁰	1.5372 ¹⁰⁰	sl H ₂ O; vs Et OH, et h, bz, chl
5995	3-Hydroxybenzotriole		C ₇ H ₇ NO	873-62-1	119.121	pr (al, et h) lf (w)	82.8				vs Et OH, et h, bz, chl
5996	4-Hydroxybenzotriole		C ₇ H ₇ NO	767-00-0	119.121	lf (w)	113	148			sl H ₂ O, DMSO; vs Et OH, et h, chl
5997	4-Hydroxybenzophenone	4-Hydroxyphenyl phenyl ketone	C ₁₃ H ₁₀ O ₂	1137-42-4	198.217	nd (al), pr (di l al)	135		1.133 ¹⁷²		sl H ₂ O; vs Et OH, et h, HOAc
5998	4-Hydroxy-2H-1-benzopyran-2-one		C ₉ H ₆ O ₃	1076-38-6	162.142	nd (w)	213.5				s H ₂ O, Et OH, et h; sl DMSO
5999	7-Hydroxy-2H-1-benzopyran-2-one	Umbelliferone	C ₉ H ₆ O ₃	93-35-6	162.142	nd (w)	230.5	sub			vs Et OH, HOAc, chl
6000	1-Hydroxy-1H-benzotriazole		C ₇ H ₆ N ₂ O	2592-95-2	135.123		157.8				
6001	2-Hydroxybenzoyl chloride		C ₇ H ₅ ClO ₂	1441-87-8	156.567		19	92 ¹⁵	1.3112 ²⁰	1.5812 ²⁰	vs et h
6002	4-(2-Hydroxybenzoyl)morpholine	4-Salicylmorpholine	C ₁₁ H ₁₂ N ₂ O ₃	3202-84-4	204.202						s DMSO
6003	2-Hydroxybiphenyl	[1,1'-Bi phenyl]-2-ol	C ₁₂ H ₁₀ O	90-43-7	170.206		57.5	286	1.213 ²⁵		i H ₂ O; s Et OH, ace, bz; vs et h, py
6004	3-Hydroxybiphenyl	[1,1'-Bi phenyl]-3-ol	C ₁₂ H ₁₀ O	580-51-8	170.206		78	>300			sl H ₂ O; vs Et OH, et h, bz, py; s chl



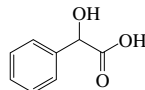
2-Hydroxybenzaldehyde, [(2-hydroxyphenyl)met hylene]hydrazone



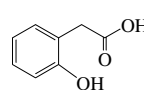
2-Hydroxybenzamide



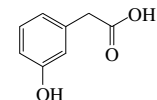
N-Hydroxybenzamide



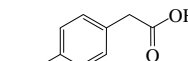
α -Hydroxybenzoic acid



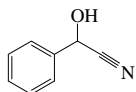
2-Hydroxybenzoic acid



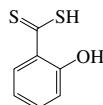
3-Hydroxybenzoic acid



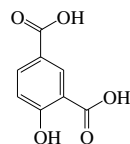
4-Hydroxybenzoic acid



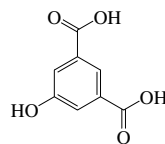
α -Hydroxybenzotriole



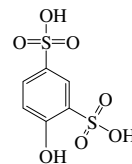
2-Hydroxybenzenecarbonylthioic acid



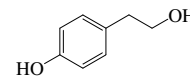
4-Hydroxy-1,3-benzenedicarboxylic acid



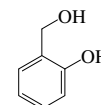
5-Hydroxy-1,3-benzenedicarboxylic acid



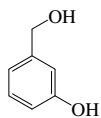
4-Hydroxy-1,3-benzenedisulfonic acid



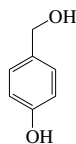
4-Hydroxybenzenemethanol



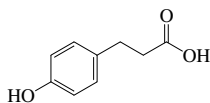
2-Hydroxybenzenemethanol



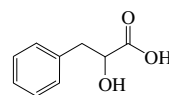
3-Hydroxybenzenemethanol



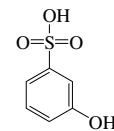
4-Hydroxybenzenemethanol



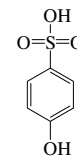
4-Hydroxybenzenepropanoic acid



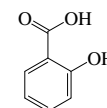
α -Hydroxybenzenepropanoic acid



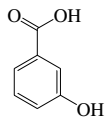
3-Hydroxybenzenesulfonic acid



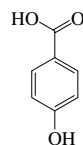
4-Hydroxybenzenesulfonic acid



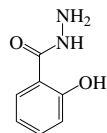
2-Hydroxybenzoic acid



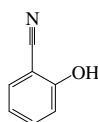
3-Hydroxybenzoic acid



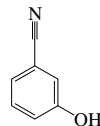
4-Hydroxybenzoic acid



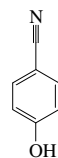
2-Hydroxybenzohydrazide



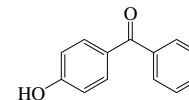
2-Hydroxybenzotriole



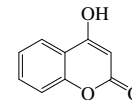
3-Hydroxybenzotriole



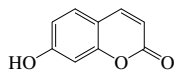
4-Hydroxybenzotriole



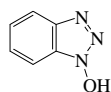
4-Hydroxybenzophenone



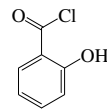
4-Hydroxy-2H-1-benzopyran-2-one



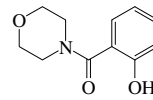
7-Hydroxy-2H-1-benzopyran-2-one



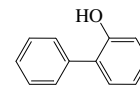
1-Hydroxy-1H-benzotriazole



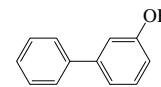
2-Hydroxybenzoyl chloride



4-(2-Hydroxybenzoyl)morpholine

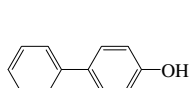


2-Hydroxybiphenyl

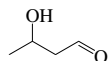


3-Hydroxybiphenyl

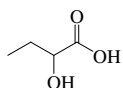
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6005	4-Hydroxybi phenyl	[1,1'-Bi phenyl]-4-ol	$_{12}C_{10}O$	92-69-3	170.206		166	305			sl H ₂ O, DMSO; vs Et OH, et h, chl, py
6006	3-Hydroxybut anal	Al dol	$_{4}C_4O_2$	107-89-1	88.106			83 ²⁰	1.103 ²⁰	1.4238 ²⁰	msc H ₂ O, Et OH; s et h; vs ace
6007	2-Hydroxybut anoi c aci d, (±)		$_{4}C_4O_3$	600-15-7	104.105		44.2	dec 260; 140 ¹⁴	1.125 ²⁰		s H ₂ O, Et OH, et h
6008	3-Hydroxybut anoi c aci d, (±)		$_{4}C_4O_3$	625-71-8	104.105		49	130 ¹² , 94 ⁰¹		1.4424 ²⁰	vs H ₂ O, Et OH, et h; i bz
6009	4-Hydroxybut anoi c aci d		$_{4}C_4O_3$	591-81-1	104.105		<-17	dec 180			
6010	1-Hydroxy-2-but anone		CH_4O_2	5077-67-8	88.106			160; 78 ⁶⁰	1.0272 ²⁰	1.4189 ²⁰	vs H ₂ O, Et OH, et h
6011	3-Hydroxy-2-but anone, (±)	Acet oi n	$_{4}C_4O_2$	52217-02-4	88.106		15	148	1.0044 ²⁰	1.4171 ²⁰	msc H ₂ O; sl Et OH, et h; s ace, chl; i li g
6012	4-Hydroxy-2-but anone		CH_4O_2	590-90-9	88.106			182; 90 ¹¹	1.0233 ²⁰	1.4585 ¹⁴	msc H ₂ O, Et OH, et h; vs ace
6013	2-Hydroxy-3-but eneni t ri le		$_{4}H_4NO$	5809-59-6	83.089	li q		94			
6014	4-Hydroxybut yrami de		$_{4}H_4NO_2$	927-60-6	103.120		52				
6015	3-Hydroxycamphor	3-Hydroxy-1,7,7-t ri met hyl bi cycl o[2.2.1]hept an-2-one	$C_{10}H_{16}O_2$	10373-81-6	168.233	nd (bz-pet h)	205.5				vs et h, Et OH, chl
6016	3-Hydroxychol an-24-oi c aci d, (3α,5β)	Li t chohol i c aci d	$_{24}C_{24}O_3$	434-13-9	376.573	hex l f (al) pr (di l 186 al)					i H ₂ O, li g; s Et OH, chl, HOAc; sl et h
6017	Hydroxycodei none		$C_9H_{19}NO_4$	508-54-3	313.349		275 dec				
6018	2-Hydroxycycl odecanone	Sebacoi n	$C_{10}H_{18}O_2$	96-00-4	170.249	cry (pet h)	38.5	138 ⁴			
6019	2-Hydroxy-2,4,6-cycl ohept at ri en-1-one		$C_7H_6O_2$	533-75-5	122.122	nd	50.8	sub 40			s H ₂ O, et h, ace
6020	1-Hydroxycycl ohexanecarboni t ri le		$_{7}H_7NO$	931-97-5	125.168		35	132 ²⁰	1.0172 ²⁰	1.4693 ²⁰	vs H ₂ O, et h
6021	2-Hydroxycycl ohexanone		$C_6H_{10}O_2$	533-60-8	114.142	nd (al)				1.4785 ²¹	vs H ₂ O, Et OH; i et h, bz, pet h
6022	1-(1-Hydroxycycl ohexyl) et hanone		$_{14}H_{14}O_2$	1123-27-9	142.196			125.5; 91 ¹¹	1.0248 ²⁵	1.4670 ²⁵	vs et h, Et OH
6023	4-Hydroxydecanoi c aci d-lact one	5-Hexyl di hydro-2H-f uranone	$C_{10}H_{18}O_2$	706-14-9	170.249	li q		281			
6024	2-Hydroxy-3,5-di i odobenzo i c aci d	3,5-Di i odosal i cyl i c aci d	$_{7}H_4I_2O_3$	133-91-5	389.914	nd (al)	235.5				sl H ₂ O; vs Et OH, et h; i bz, chl
6025	4-Hydroxy-3,5-di i odobenzo i c aci d		$_{7}H_4O_3$	618-76-8	389.914		237	dec 260			i H ₂ O; vs Et OH, et h; sl bz, chl, li g
6026	4-Hydroxy-3,5-di i odobenzo ni t ri le		$_{7}H_3INO$	1689-83-4	370.914		201 dec				
6027	4-Hydroxy-3,5-di i odα-phenyl benzenepropanoi c aci d	lodoal phi oni c aci d	$_{15}C_{12}H_2O_3$	577-91-3	494.063		164				i H ₂ O; s Et OH, et h; sl bz, chl
6028	2-Hydroxy-4,6-di met hoxybenzal dehyde		$C_9H_{10}O_4$	708-76-9	182.173		70	193 ²⁵ , 165 ¹⁰			i H ₂ O; vs Et OH, et h, bz, chl, HOAc
6029	4-Hydroxy-3,5-di met hoxybenzal dehyde	Syri ngal dehyde	$_{10}H_{10}O_4$	134-96-3	182.173	br nd (li g)	113	192			sl H ₂ O, li g; vs Et OH, et h, bz, chl
6030	4-Hydroxy-3,5-di met hoxybenzo i c aci d		$C_9H_{10}O_5$	530-57-4	198.172	nd (w)	204.5				sl H ₂ O; vs Et OH
6031	7-Hydroxy-3,7-di met hyl oct anal		$_{10}C_{10}O_2$	107-75-5	172.265			103 ³	0.9220 ²⁰	1.4494 ²⁰	sl H ₂ O; s Et OH, ace
6032	3-Hydroxy-2,2-di met hyl propanal	Hydroxy pi val dehyde	$_{5}H_8O_2$	597-31-9	102.132	nd (w)	89.5	173; 68 ¹⁴			
6033	2-Hydroxy-3,5-di ni t robenzo i c aci d		$_{7}H_4O_7$	609-99-4	228.116	ye nd or pl (+1w)	182				s H ₂ O, Et OH, et h, bz
6034	11-Hydroxy-9,15-di oxoprost a-5,13-di en-1-oi c aci d, Z (1α,13E)	15-Oxo-prost agl andi n E2	$_{29}C_{30}O_5$	26441-05-4	350.449	cry					
6035	1-Hydroxy-1,1-di phosphonet hane	Et i droni c aci d	$_{2}H_2OP_2$	2809-21-4	206.028	cry (w)	105				s H ₂ O, Et OH, MeOH
6036	3-Hydroxyest ra-1,3,5,7,9-pent aen-17-one	Equi l eni n	$_{18}H_{18}O_2$	517-09-9	266.335		258.5	sub 170			sl Et OH, ace, chl
6037	3-Hydroxyest ra-1,3,5(10),7-t et raen-17-one	Equi li n	$_{18}H_{20}O_2$	474-86-2	268.351	pl (AcOEt)	239	sub 170			sl H ₂ O; s Et OH, ace, di ox, AcOEt
6038	2-Hydroxyet hyl acryl at e	2-Hydroxyet hyl 2-propenoat e	$_{5}H_8O_3$	818-61-1	116.116	li q		191; 94	1.011 ²³		



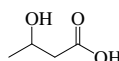
4-Hydroxybiphenyl



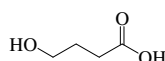
3-Hydroxybutanal



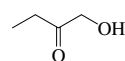
2-Hydroxybutanoic acid(±)



3-Hydroxybutanoic acid(±)



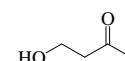
4-Hydroxybutanoic acid



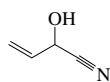
1-Hydroxy-2-butanone



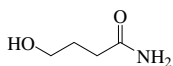
3-Hydroxy-2-butanone(±)



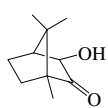
4-Hydroxy-2-butanone



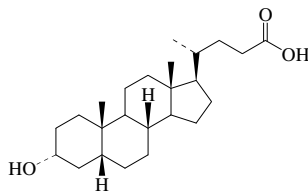
2-Hydroxy-3-butenitrile



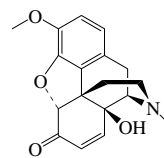
4-Hydroxybutanamide



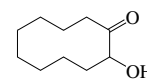
3-Hydroxycamphor



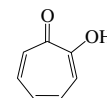
3-Hydroxycholestan-24-oic acid(3 α ,5 β)



Hydroxycodone

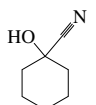


2-Hydroxycyclodecanone

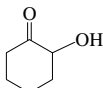


2-Hydroxy-2,4,6-cycloheptatrien-1-one

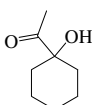
3-319



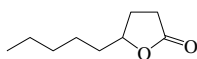
1-Hydroxycyclohexanecarbonitrile



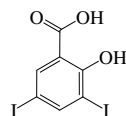
2-Hydroxycyclohexanone



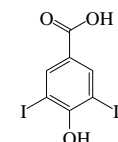
1-(1-Hydroxycyclohexyl)ethanone



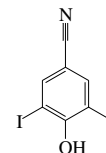
4-Hydroxydecanoic acid



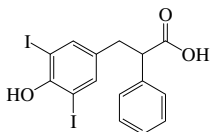
2-Hydroxy-3,5-diiodobenzoic acid



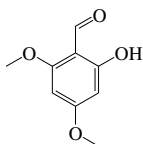
4-Hydroxy-3,5-diiodobenzoic acid



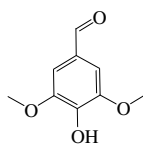
4-Hydroxy-3,5-diiodobenzonitrile



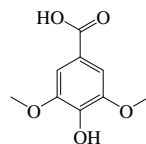
4-Hydroxy-3,5-diiodophenyl benzenepropanoic acid



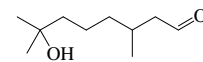
2-Hydroxy-4,6-dimethoxybenzaldehyde



4-Hydroxy-3,5-dimethoxybenzaldehyde



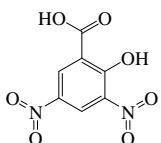
4-Hydroxy-3,5-dimethoxybenzoic acid



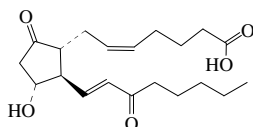
7-Hydroxy-3,7-dimethyloctanal



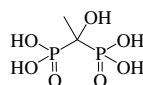
3-Hydroxy-2,2-dimethylpropanal



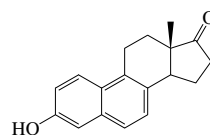
2-Hydroxy-3,5-dinitrobenzoic acid



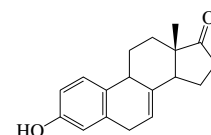
11-Hydroxy-9,15-dioxoprostanoic acid(5Z,11 α ,13E)



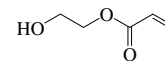
1-Hydroxy-1,1-diphosphonohane



3-Hydroxyestra-1,3,5,7,9-pentaen-17-one

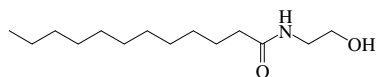


3-Hydroxyestra-1,3,5(10),7-tetraen-17-one

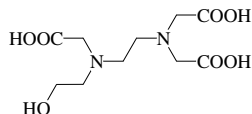


2-Hydroxyethyl acrylate

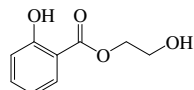
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6039	<i>N</i> -(2-Hydroxyethyl)dodecanamide		$C_{18}H_{35}NO_2$	142-78-9	243.386		88.5				
6040	<i>N</i> -(2-Hydroxyethyl)ethylenediamine		$C_{10}H_{18}N_2O_2$	150-39-0	278.259	cry	165 dec				
6041	2-Hydroxyethyl 2-hydroxybenzoate	Glycol salicylate	$C_9H_{10}O_4$	87-28-5	182.173		37	173 ¹⁵	1.2526 ¹⁵		sl H ₂ O; vs Et OH, et h, bz, chl
6042	2-Hydroxyethyl methacrylate	Ethylene glycol monomethacrylate	$C_6H_{10}O_2$	868-77-9	130.141			103 ¹³ , 67 ³	1.079 ²⁰	1.4515 ²⁰	
6043	<i>N</i> -(2-Hydroxyethyl)phthalimide		$C_{10}H_{10}NO_3$	3891-07-4	191.183	nd (al), lf (w)	130.3				sl H ₂ O
6044	1-(2-Hydroxyethyl)-2-pyrrolidone		$C_6H_{10}NO_2$	3445-11-2	129.157		20	295	1.1435 ²⁰		
6045	4-Hydroxy-4 <i>H</i> -furo[3,2- <i>c</i>]pyran-2(6 <i>H</i>)-one	Patulin	C_6O_4	149-29-1	154.121	pl or pr (et h, chl)	111				s H ₂ O, Et OH, et h, ace, bz; i pet h
6046	16-Hydroxyhexadecanoic acid	16-Hydroxypalmitic acid	$C_{16}H_{32}O_2$	506-13-8	272.423		96.5				i H ₂ O; s Et OH, ace; sl et h, bz
6047	2-Hydroxyhexanoic acid		$C_6H_{12}O_3$	6064-63-7	132.157	pr (et h)	60				vs H ₂ O
6048	6-Hydroxyhexanoic acid		$C_6H_{12}O_3$	1191-25-9	132.157	liq					
6049	3-Hydroxy-2-(hydroxymethyl)-2-methylpropanoic acid	Dimethylolpropionic acid	$C_5H_{10}O_4$	4767-03-7	134.131		190				
6050	5-Hydroxy-2-(hydroxymethyl)-4-pyranone	Kojic acid	C_6O_4	501-30-4	142.110	pr nd (ace)	153.5				sl H ₂ O, bz; s Et OH, et h, ace, DMSO
6051	8-Hydroxy-7-iodo-5-quinoline sulfonic acid	Ferron	$C_8H_6INO_4S$	547-91-1	351.118	ye pr, lf (al)	260 dec				sl H ₂ O, Et OH; i et h, bz, chl; s con sul f
6052	2-Hydroxy-1 <i>H</i> -imidazole-3 <i>H</i> -dione		$C_3H_3NO_3$	524-38-9	163.131		232				s DMSO
6053	2-Hydroxy-4-isopropyl-2,4,6-cycloheptatrien-1-one		$C_{10}H_{12}O_2$	499-44-5	164.201	pa ye (pet h)	51.5	137 ⁰	1.0606 ⁶⁵		sl H ₂ O, bz, li g; s ct c
6054	Hydroxylamine		$C_1H_2N_2O_2$	15358-48-2	264.364	cry (ace)	169.5				vs H ₂ O, Et OH, chl
6055	<i>N</i> -Hydroxymethanamine	<i>N</i> -Methylhydroxylamine	CH_3NO	593-77-1	47.057	hyg nd	87.5	62.5 ¹⁵	1.0003 ²⁰	1.4164 ²⁰	vs H ₂ O, Et OH
6056	2-Hydroxy-3-methoxybenzaldehyde		$C_8H_8O_3$	148-53-8	152.148	li ye lf, grn nd (w, li g)	44.5	265.5			sl H ₂ O, li g; vs Et OH, et h, ct c
6057	2-Hydroxy-4-methoxybenzaldehyde		$C_8H_8O_3$	673-22-3	152.148	nd (w), cry (al)	42.0				s Et OH, et h, bz, li g
6058	2-Hydroxy-5-methoxybenzaldehyde		$C_8H_8O_3$	672-13-9	152.148	ye li q (w)	4	247.5			vs et h, Et OH
6059	3-Hydroxy-4-methoxybenzaldehyde		$C_8H_8O_3$	621-59-0	152.148		114	179 ¹⁵	1.196 ²⁵		sl H ₂ O; s Et OH, et h, bz, HOAc; vs chl
6060	4-Hydroxy-3-methoxybenzaldehyde	Vanillin	$C_8H_8O_3$	121-33-5	152.148	t et r (w, li g)	81.5	285	1.056		sl H ₂ O; vs Et OH, et h, ace; s bz, li g
6061	4-Hydroxy-3-methoxybenzoic acid	Homovanillic acid	$C_9H_8O_4$	306-08-1	182.173		143.5				
6062	4-Hydroxy-3-methoxybenzenemethanol		$C_9H_{10}O_3$	498-00-0	154.163	pr (w), nd (bz)	115	dec			s H ₂ O, Et OH, et h, bz
6063	4-Hydroxy-3-methoxybenzenepropanol		$C_{10}H_{14}O_3$	2305-13-7	182.216		65	197 ¹⁵		1.5545 ²⁵	vs et h, Et OH
6064	2-Hydroxy-5-methoxybenzoic acid		$C_8H_8O_4$	2612-02-4	168.148		142				
6065	4-Hydroxy-3-methoxybenzoic acid	Vanillic acid	$C_8H_8O_4$	121-34-6	168.148	wh nd	211.5	sub			sl H ₂ O; vs Et OH; s et h, DMSO
6066	7-Hydroxy-6-methoxy-2 <i>H</i> -1-benzopyran-2-one	Scopolamine	$C_{17}H_{21}O_4$	92-61-5	192.169	nd or pr (al)	204				sl H ₂ O, Et OH; s chl; i bz, GS
6067	4-(4-Hydroxy-3-methoxyphenyl)-2-butanone	Zingerone	$C_{11}H_{14}O_3$	122-48-5	194.227	cry (ace, et h)	40.5	187 ⁴			vs et h
6068	1-(2-Hydroxy-4-methoxyphenyl)ethanone		$C_9H_{10}O_3$	552-41-0	166.173	nd (al)	52.5	158 ⁰	1.3102 ⁸¹	1.5452 ⁸¹	vs bz, et h, Et OH, chl
6069	1-(4-Hydroxy-3-methoxyphenyl)ethanone	Apocynin	$C_9H_{10}O_3$	498-02-2	166.173	pr (w)	115	297; 234 ¹⁵			sl H ₂ O; s Et OH, ace, bz; vs et h, chl
6070	(2-Hydroxy-4-methoxyphenyl)phenylmethanone	Oxybenzone	$C_{14}H_{12}O_3$	131-57-7	228.243		65.5				s ct c



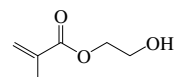
N-(2-Hydroxyethyl)dodecanami d e



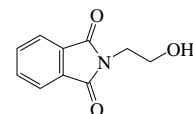
N-(2-Hydroxyethyl)et hyl enedi ami net ri a c e t i d c



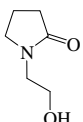
2-Hydroxyet hyl 2-hydroxybenzoat e



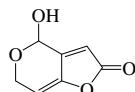
2-Hydroxyet hyl met hacryl at e



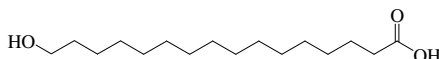
N-(2-Hydroxyethyl)ph t hal i mi d e



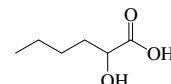
1-(2-Hydroxyet hyl)-2-pyrrol i di none



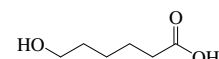
4-Hydroxy-4*H*-1 uro[3,2-*c*]pyran-2(1*H*)-one



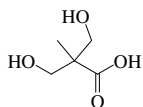
16-Hydroxyhexadecanoi a c i d



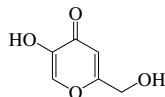
2-Hydroxyhexanoi a c i d



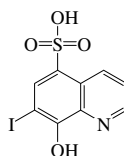
6-Hydroxyhexanoi a c i d



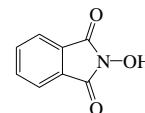
3-Hydroxy-2-(hydroxymet hyl)-2-met hyl propano a c i d



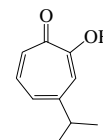
5-Hydroxy-2-(hydroxymet hyl)-4*H*-pyran-4-one



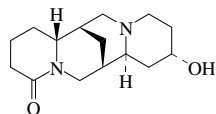
8-Hydroxy-7-i odo-5-qui nol i nesul f a c i d



2-Hydroxy-1*H*-i so i ndol e-1,3*d*-i one



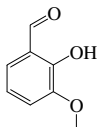
2-Hydroxy-4-i sopropyl-2,4,6-cycl ohept at ri en-1-one



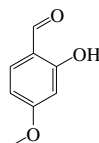
Hydroxyl upani ne



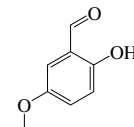
M-Hydroxymet hanami ne



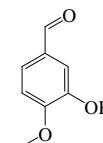
2-Hydroxy-3-met hoxybenzal dehyde



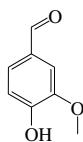
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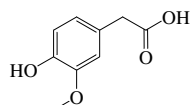
2-Hydroxy-5-met hoxybenzal dehyde



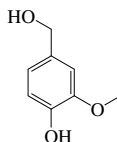
3-Hydroxy-4-met hoxybenzal dehyde



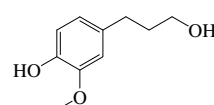
4-Hydroxy-3-met hoxybenzal dehyde



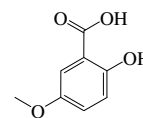
4-Hydroxy-3-met hoxybenzoic a c i d



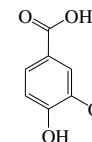
4-Hydroxy-3-met hoxybenzenet hanol



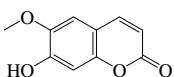
4-Hydroxy-3-met hoxybenzenepropanol



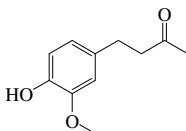
2-Hydroxy-5-met hoxybenzo i a c i d



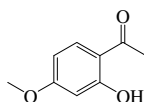
4-Hydroxy-3-met hoxybenzo i a c i d



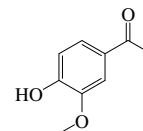
7-Hydroxy-6-met hoxy-2*H*-1-benzopyran-2-one



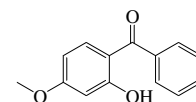
4-(4-Hydroxy-3-met hoxyphenyl)-2-but anone



1-(2-Hydroxy-4-met hoxyphenyl)et hanone

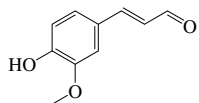


1-(4-Hydroxy-3-met hoxyphenyl)et hanone

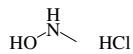


(2-Hydroxy-4-met hoxyphenyl)phenyl met hanone

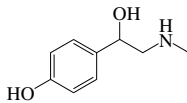
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6071	3-(4-Hydroxy-3-methoxyphenyl)-2-propenal		C ₁₀ H ₁₀ O ₃	458-36-6	178.184	cry (bz)	84		1.1562 ¹⁰²		vs bz, et h, Et OH
6072	N-Hydroxymethylamine hydrochloride	d ¹ -Methylhydroxylamine hydrochloride	CH ₅ ClNO	4229-44-1	83.518		83.5				
6073	4-Hydroxy- α -(methyl)benzenemethanol	Synephrine	C ₉ H ₁₃ NO ₂	94-07-5	167.205		184.5				
6074	17-Hydroxy-17-methylandrostan-3-one, (5 α ,17 β)	Mestranolone	C ₂₀ H ₃₂ O ₂	521-11-9	304.467		192.5				sl AcOEt
6075	N-Hydroxy-4-methylamine		CH ₅ NO	623-10-9	123.152	lf (bz)	96	dec 117			vs et h, Et OH, chl
6076	2-Hydroxy-5-methylbenzaldehyde		C ₉ H ₈ O ₂	613-84-3	136.149	pl (aq, al)	56	217.5	1.0913 ⁹	1.547 ⁹⁹	vs et h, Et OH, chl
6077	α -(Hydroxymethyl)benzeneacetamide, (\pm)	Tropidamide	C ₉ H ₁₀ O ₃	552-63-6	166.173	nd, pl (al, bz, w)	118	dec			vs H ₂ O, et h, Et OH
6078	α -Hydroxy- α -methylbenzeneacetamide, (\pm)	Atrolamide	C ₉ H ₉ O ₃	4607-38-9	166.173	nd, pl (liq)	94				vs ace, bz
6079	2-Hydroxy-5-methyl-1,3-benzenediol		C ₉ H ₁₂ O ₃	91-04-3	168.189		130.5				
6080	2-(Hydroxymethyl)-1,4-benzenediol	Gentisylalcohol	C ₇ H ₈ O ₃	495-08-9	140.137	nd (chl)	100	sub 75			vs H ₂ O, Et OH, chl
6081	2-Hydroxy-5-methylbenzoic acid	p-Cresotic acid	C ₉ H ₈ O ₃	89-56-5	152.148		151				sl H ₂ O; s Et OH, et h, bz, chl; i C ₅
6082	2-Hydroxy-3-methylbenzoic acid	o-Cresotic acid	C ₉ H ₈ O ₃	83-40-9	152.148		165.5				sl H ₂ O; s Et OH, et h, bz, chl
6083	2-Hydroxy-4-methylbenzoic acid	m-Cresotic acid	C ₉ H ₈ O ₃	50-85-1	152.148	cry, lf	177				sl H ₂ O; s Et OH, bz, chl; vs et h
6084	7-Hydroxy-4-methyl-2H-1-benzopyran-2-one	Hymecromone	C ₁₀ H ₈ O ₃	90-33-5	176.169	nd (al)	194.5				sl H ₂ O, et h, chl; s Et OH, al, k, HOAc
6085	3-Hydroxy-3-methylbutanoic acid		C ₇ H ₁₂ O ₃	625-08-1	118.131		<-32	162 ¹²	0.9384 ²⁰	1.5081 ²⁰	vs H ₂ O, et h, Et OH
6086	3-Hydroxy-3-methyl-2-butanone		C ₆ H ₁₀ O ₂	115-22-0	102.132			140	0.9526 ²⁰		s chl
6087	2-Hydroxy-3-methyl-2-cyclohexanone		C ₈ H ₁₄ O ₂	80-71-7	112.127		104.8				
6088	5-(Hydroxymethyl)-2-furancarboxaldehyde	5-(Hydroxymethyl)-2-furaldehyde	C ₆ H ₆ O ₃	67-47-0	126.110	nd (et h-pet h)	31.5	115	1.2062 ²⁵	1.5627 ¹⁸	s H ₂ O, Et OH, bz, chl; sl et h, ct c
6089	2-Hydroxy-6-methyl-3-isopropylbenzoic acid	α -Thymotic acid	C ₁₁ H ₁₄ O ₃	548-51-6	194.227	nd (w, bz, liq)	127	sub			vs bz, et h, Et OH
6090	2-Hydroxy-3-methyl-6-isopropyl-2-cyclohexanone	Diisphenol	C ₁₀ H ₁₆ O ₂	490-03-9	168.233		83	109 ¹⁰			
6091	2-(Hydroxymethyl)-2-methyl-1,3-propanediol		C ₅ H ₁₂ O ₃	77-85-0	120.147	wh pow or nd (al)	204	136 ¹⁵			misc H ₂ O, Et OH; i et h, bz, vs HOAc
6092	2-Hydroxy-3-methyl-1,4-naphthalenediol	Phthalicol	C ₁₀ H ₈ O ₃	483-55-6	188.180	ye pr (et h-pet h)	173.5	sub			vs ace, et h
6093	5-Hydroxy-2-methyl-1,4-naphthalenediol	Plumbagin	C ₁₀ H ₈ O ₃	481-42-5	188.180	gol d pr or orange nd (di l al)	78.5	sub			vs ace, bz, et h, Et OH
6094	2-(Hydroxymethyl)-2-nitro-1,3-propanediol	Tris(hydroxymethyl)nitromethane	C ₄ H ₉ NO ₅	126-11-4	151.118	nd or pr	165	dec			vs H ₂ O, et h, Et OH
6095	2-Hydroxy-4-methylpentanoic acid, (S)	L-Leucic acid	C ₇ H ₁₂ O ₃	13748-90-8	132.157	ort h (et h)	81.5				vs H ₂ O, et h, Et OH
6096	1-(2-Hydroxy-4-methylphenyl)ethanone		C ₉ H ₁₀ O ₂	6921-64-8	150.174		21	245	1.1012 ¹⁰	1.5527 ¹³	
6097	1-(2-Hydroxy-5-methylphenyl)ethanone		C ₉ H ₁₀ O ₂	1450-72-2	150.174	pr (liq)	50	210; 120	1.0797 ⁵³		vs bz, et h, Et OH, chl
6098	2-(Hydroxymethyl)phenyl- β -D-glucopyranoside	Salicin	C ₁₃ H ₁₆ O ₇	138-52-3	286.278	ort h nd or lf (w)	207	dec 240	1.434		vs H ₂ O, Et OH, HOAc
6099	1-(2-Hydroxy-5-methylphenyl)-1-propanone		C ₁₀ H ₁₂ O ₂	938-45-4	164.201		1.0	129 ^{16,5}	1.0841 ¹⁴	1.549 ¹³	s chl



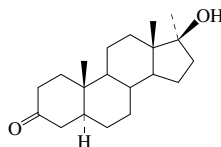
3-(4-Hydroxy-3-methoxyphenyl)-2-propenal



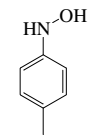
N-Hydroxymethylamine hydrochloride



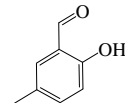
4-Hydroxy-α-(methylamino)methylbenzenemethanol



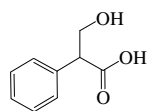
17-Hydroxy-17-methylandrostan-3-one



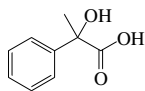
N-Hydroxy-4-methylaniline



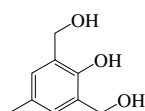
2-Hydroxy-5-methylbenzaldehyde



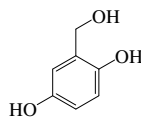
α-(Hydroxymethyl)benzeneacetic acid



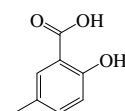
α-Hydroxy-α-methylbenzeneacetic acid



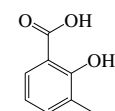
2-Hydroxy-5-methyl-1,3-benzenediol



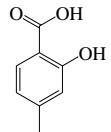
2-(Hydroxymethyl)-1,4-benzenediol



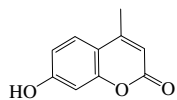
2-Hydroxy-5-methylbenzoic acid



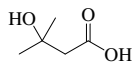
2-Hydroxy-3-methylbenzoic acid



2-Hydroxy-4-methylbenzoic acid



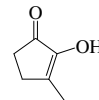
7-Hydroxy-4-methyl-2H-1-benzopyran-2-one



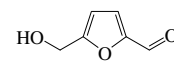
3-Hydroxy-3-methylbutanoic acid



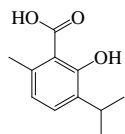
3-Hydroxy-3-methyl-2-butanone



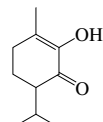
2-Hydroxy-3-methyl-2-cyclopenten-1-one



5-(Hydroxymethyl)-2-furancarboxaldehyde



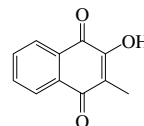
2-Hydroxy-6-methyl-3-isopropylbenzoic acid



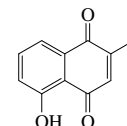
2-Hydroxy-3-methyl-6-isopropyl-2-cyclohexen-1-one



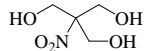
2-(Hydroxymethyl)-2-methyl-1,3-propanediol



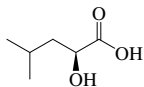
2-Hydroxy-3-methyl-1,4-naphthalenedione



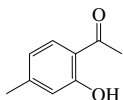
5-Hydroxy-2-methyl-1,4-naphthalenedione



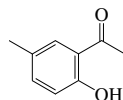
2-(Hydroxymethyl)-2-nitro-1,3-propanediol



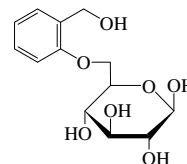
2-Hydroxy-4-methylpentanoic acid



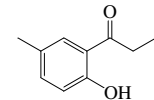
1-(2-Hydroxy-4-methylphenyl)ethanone



1-(2-Hydroxy-5-methylphenyl)ethanone

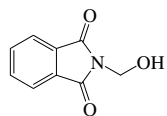


2-(Hydroxymethyl)phenyl-β-D-glucopyranoside

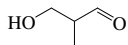


1-(2-Hydroxy-5-methylphenyl)-1-propanone

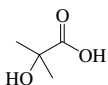
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6100	<i>N</i> -(Hydroxymethyl)phthalimide		$C_8H_7NO_3$	118-29-6	177.157	lf, pr (t o)	141.5				i H ₂ O; et h, ct c; sl Et OH, bz; s t ol
6101	3-Hydroxy-2-methylpropanal		$C_4H_8O_2$	38433-80-6	88.106	oi l					
6102	2-Hydroxy-2-methylpropanoic acid		$C_4H_8O_3$	594-61-6	104.105	hyg pr (et h) nd (bz)	82.5	212			vs H ₂ O, Et OH, et h; sl bz
6103	3-Hydroxy-2-methylpropanoic acid		$C_4H_8O_3$	2068-83-9	104.105	oi l					
6104	<i>N</i> -(Hydroxymethyl)-2-propenamide	<i>N</i> -(Hydroxymethyl)acrylamide	$C_4H_7NO_2$	924-42-5	101.105	cry	76				
6105	4-Hydroxy-6-methyl-2-pyran-2-one	Triacetin lactone	$C_8H_{14}O_3$	675-10-5	126.110			189 dec			
6106	3-Hydroxy-2-methyl-4-pyridone	Maltol	$C_5H_7NO_3$	118-71-8	126.110	mcl pr (chl)	161.5	sub 93			sl H ₂ O, et h, bz; vs chl; s alk; pet h
6107	5-Hydroxy-6-methyl-3,4-pyridinedimethanol	Pyridoxin	$C_8H_{11}NO_3$	65-23-6	169.178	nd (HOAc)	160	140 ^{0.0001}			
6108	4-Hydroxy-1-methyl-2-quinoline	4-Hydroxymethylcarbazole	$C_{10}H_9NO_2$	1677-46-9	175.184			265			sl DMSO
6109	2-Hydroxy-4-(methylthio)butanoic acid	Metionine hydroxy analog	$C_5H_{10}O_3S$	583-91-5	150.196	oi l					
6110	3-Hydroxy- α -methyl-L-tyrosine	Metihyl dopa	$C_{10}H_{13}NO_4$	555-30-6	211.215	cry (MeOH)	300 dec				
6111	(Hydroxymethyl)urea		$CH_4N_2O_2$	1000-82-4	90.081	pr (al)	111				vs H ₂ O; s Et OH, MeOH, HOAc; i et h
6112	2-Hydroxy-1-naphthalenecarboxaldehyde		$C_{11}H_8O_2$	708-06-5	172.181	pr (al), nd (AcOEt)	83	192 ²⁷			i H ₂ O; s Et OH, et h, aq alk, sul f, pet h
6113	2-Hydroxy-1-naphthalenecarboxylic acid	2-Hydroxy-1-naphthoic acid	$C_{10}H_8O_3$	2283-08-1	188.180			157.3			sl H ₂ O; vs Et OH; s et h, ace, bz, li g, chl
6114	1-Hydroxy-2-naphthalenecarboxylic acid	1-Hydroxy-2-naphthoic acid	$C_{10}H_8O_3$	86-48-6	188.180	cry (al) nd (al, et h, bz)	195				sl H ₂ O; vs Et OH, et h; s bz
6115	3-Hydroxy-2-naphthalenecarboxylic acid	3-Hydroxy-2-naphthoic acid	$C_{10}H_8O_3$	92-70-6	188.180	nd (di l al) ye lf (di l al)	222.5				sl H ₂ O; vs Et OH, et h; s bz, chl, t ol
6116	2-Hydroxy-1,4-naphthalenedione	Lawsone	$C_{10}H_6O_3$	83-72-7	174.153	ye pr (HOAc)	195 dec				vs Et OH; i et h, bz, chl; s HOAc
6117	5-Hydroxy-1,4-naphthalenedione	Juglone	$C_{10}H_6O_3$	481-39-0	174.153	ye nd (bz) pet h	155	sub			i H ₂ O; s Et OH, et h, bz; vs chl; sl li g
6118	7-Hydroxy-1,3-naphthalenedisulfonic acid	2-Naphthol-6,8-disulfonic acid	$C_{10}H_6O_7S_2$	118-32-1	304.297						s H ₂ O
6119	3-Hydroxy-2,7-naphthalenedisulfonic acid	2-Naphthol-3,6-disulfonic acid	$C_{10}H_6O_7S_2$	148-75-4	304.297	hyg nd	dec				vs H ₂ O, Et OH
6120	6-Hydroxy-2-naphthalenepropanoic acid	Allenolic acid	$C_{13}H_{12}O_3$	553-39-9	216.232	cry (di l MeOH)	180.5				vs py, Et OH, MeOH
6121	4-Hydroxy-1-naphthalenesulfonic acid	1-Naphthol-4-sulfonic acid	$C_{10}H_8O_3S$	84-87-7	224.234	t ab or pl (w)	170 dec				vs H ₂ O; i et h
6122	7-Hydroxy-1-naphthalenesulfonic acid	Crocein acid	$C_{10}H_8O_3S$	132-57-0	224.234						s H ₂ O
6123	1-Hydroxy-2-naphthalenesulfonic acid	1-Naphthol-2-sulfonic acid	$C_{10}H_8O_3S$	567-18-0	224.234	pl (w)	>250				sl H ₂ O, di l HCl; s Et OH; i et h
6124	6-Hydroxy-2-naphthalenesulfonic acid	2-Naphthol-6-sulfonic acid	$C_{10}H_8O_3S$	93-01-6	224.234	lf, cry (w+1)	125				vs H ₂ O, Et OH; i et h; s HOAc
6125	Hydroxynaphthol blue, tri sodium salt		$C_{20}H_{14}O_2Na_3O_{11}S_3$	63451-35-4	623.495	dk red cry					
6126	<i>N</i> -(2-Hydroxy-1-naphthyl)acetamide		$C_{12}H_{11}NO_2$	117-93-1	201.221	lf (w, di l al)	235 dec	sub			vs ace, bz, et h, Et OH
6127	1-(1-Hydroxy-2-naphthyl)ethanone		$C_{12}H_{10}O_2$	711-79-5	186.206	pr (bz, li g) grn-ye nd (al)	101	dec 325			vs bz, HOAc
6128	2-Hydroxy-3-nitrobenzaldehyde		$C_7H_5NO_4$	5274-70-4	167.120	nd (HOAc)	109.5				vs bz, Et OH
6129	2-Hydroxy-5-nitrobenzaldehyde		$C_7H_5NO_4$	97-51-8	167.120	cry (di l HOAc)	127.0				s ace
6130	2-Hydroxy-3-nitrobenzoic acid	3-Nitrosalicylic acid	$C_7H_5NO_5$	85-38-1	183.119	ye nd (HOAc, w+1)	148				sl H ₂ O; vs Et OH, et h; s ace, bz, chl



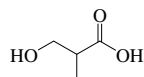
N-(Hydroxymethyl)phthalimide



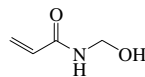
3-Hydroxy-2-methylpropanal



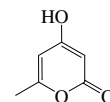
2-Hydroxy-2-methylpropanoic acid



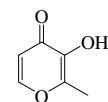
3-Hydroxy-2-methylpropanoic acid



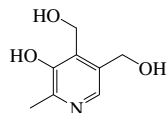
N-(Hydroxymethyl)-2-propenamide



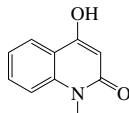
4-Hydroxy-6-methyl-2H-pyran-2-one



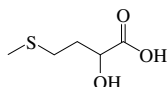
3-Hydroxy-2-methyl-4H-pyran-4-one



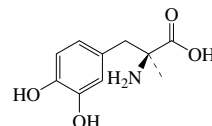
5-Hydroxy-6-methyl-3,4-pyridinedimethanol



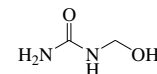
4-Hydroxy-1-methyl-2-quinoline



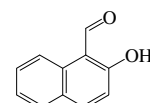
2-Hydroxy-4-(methylthio)butanoic acid



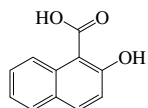
3-Hydroxy- α -methyl-L-tyrosine



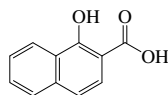
(Hydroxymethyl)urea



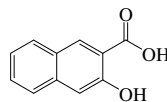
2-Hydroxy-1-naphthalenecarboxaldehyde



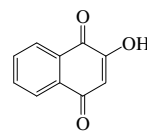
2-Hydroxy-1-naphthalenecarboxylic acid



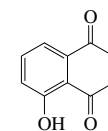
1-Hydroxy-2-naphthalenecarboxylic acid



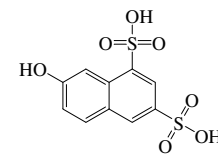
3-Hydroxy-2-naphthalenecarboxylic acid



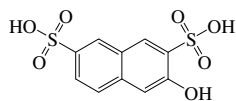
2-Hydroxy-1,4-naphthenedione



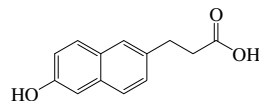
5-Hydroxy-1,4-naphthenedione



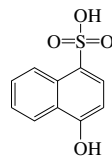
7-Hydroxy-1,3-naphthenedisulfonic acid



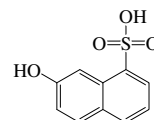
3-Hydroxy-2,7-naphthenedisulfonic acid



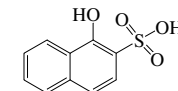
6-Hydroxy-2-naphthenepropanoic acid



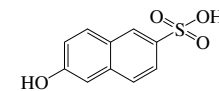
4-Hydroxy-1-naphthenesulfonic acid



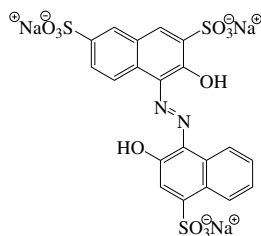
7-Hydroxy-1-naphthenesulfonic acid



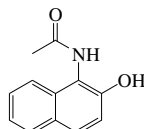
1-Hydroxy-2-naphthenesulfonic acid



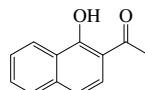
6-Hydroxy-2-naphthenesulfonic acid



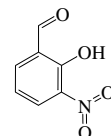
Hydroxynaphtholbue,tri sodium salt



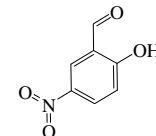
N-(2-Hydroxy-1-naphthyl)acetamide



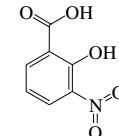
1-(1-Hydroxy-2-naphthyl)ethanone



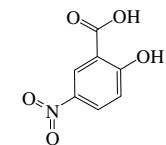
2-Hydroxy-3-nitrobenzaldehyde



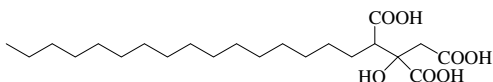
2-Hydroxy-5-nitrobenzaldehyde



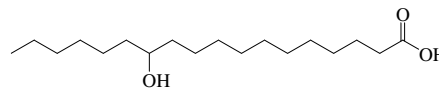
2-Hydroxy-3-nitrobenzoic acid



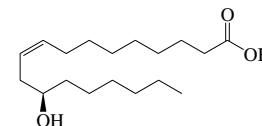
2-Hydroxy-5-nitrobenzoic acid



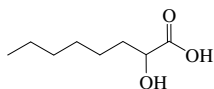
2-Hydroxy-1,2,3-nonadecanetricarboxylic acid



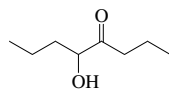
12-Hydroxyoctadecanoic acid



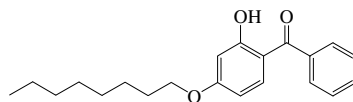
cis-12-Hydroxy-9-octadecenoic acid (R)



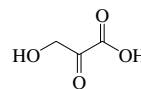
2-Hydroxyoctanoic acid



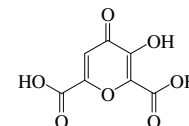
5-Hydroxy-4-octanone



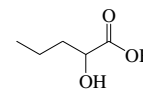
[2-(4-(octyloxy)phenyl)phenyl]methanone



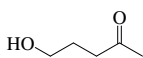
3-Hydroxy-2-oxopropanoic acid



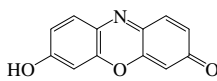
3-Hydroxy-4-oxo-4H-pyran-2,6-dicarboxylic acid



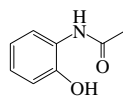
2-Hydroxypentanoic acid



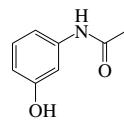
5-Hydroxy-2-pentanone



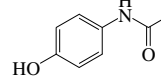
7-Hydroxy-3H-phoxazin-3-one



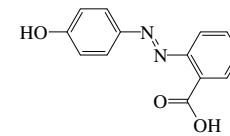
N-(2-Hydroxyphenyl)acetamide



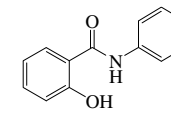
N-(3-Hydroxyphenyl)acetamide



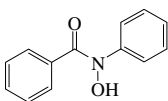
N-(4-Hydroxyphenyl)acetamide



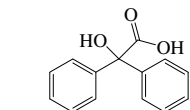
2-[(4-Hydroxyphenyl)azo]benzoic acid



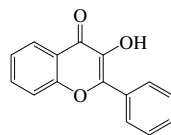
2-Hydroxy-N-phenylbenzamide



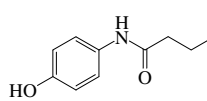
N-Hydroxy-N-phenylbenzamide



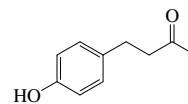
alpha-Hydroxy-alpha-phenylbenzeneacetate



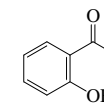
3-Hydroxy-2-phenyl-4H-1-benzopyran-4-one



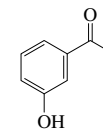
N-(4-Hydroxyphenyl)butanamide



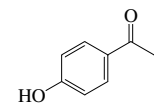
4-(4-Hydroxyphenyl)-2-butanone



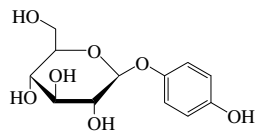
1-(2-Hydroxyphenyl)ethanone



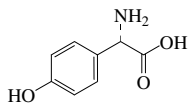
1-(3-Hydroxyphenyl)ethanone



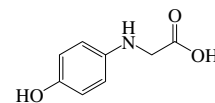
1-(4-Hydroxyphenyl)ethanone



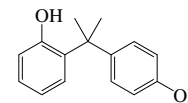
4-Hydroxyphenyl-beta-D-glucopyranoside



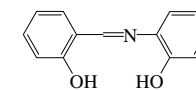
2-(4-Hydroxyphenyl)-D-glucosamine



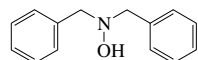
N-(4-Hydroxyphenyl)glycine



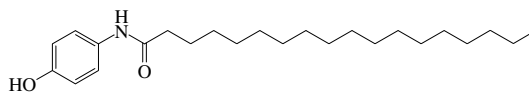
2-(2-Hydroxyphenyl)-2-(4-hydroxyphenyl)propane



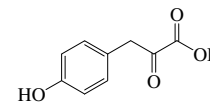
2-[[2-(2-Hydroxyphenyl)imino]methyl]phenol



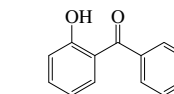
N-Hydroxy-N-(phenylmethyl)benzenemethanamine



N-(4-Hydroxyphenyl)octadecanamide

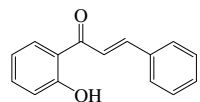


3-(4-Hydroxyphenyl)-2-oxopropanoic acid

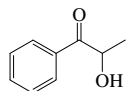


(2-Hydroxyphenyl)phenylmethanone

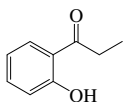
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6165	1-(2-Hydroxyphenyl)-3-phenyl-2-propen-1-one	2'-Hydroxychalcone	C ₁₅ H ₁₂ O ₂	1214-47-7	224.255		90				
6166	2-Hydroxy-1-phenyl-1-propanone		C ₉ H ₁₀ O ₂	5650-40-8	150.174	ye oi l		251	1.1085	1.536 ²³	
6167	1-(2-Hydroxyphenyl)-1-propanone		C ₉ H ₁₀ O ₂	610-99-1	150.174			150 ⁸⁰ , 115 ¹⁵		1.5501 ²⁰	sl H ₂ O; s Et OH, et h, ct c, al k
6168	1-(4-Hydroxyphenyl)-1-propanone	Paroxypropione	C ₉ H ₁₀ O ₂	70-70-2	150.174	wh nd or pl (w)	149				sl H ₂ O, ace; s Et OH, et h, al k
6169	3-(4-Hydroxyphenyl)-2-propenol c acid	p-Coumaric acid	C ₉ H ₈ O ₃	7400-08-0	164.158	nd	211.5				vs et h, Et OH
6170	3-Hydroxy-2-phenyl-4-quinolinecarboxylic acid	Oxycinchonine	C ₁₆ H ₁₁ NO ₃	485-89-2	265.263	ye pr (al)	206 dec				vs bz, Et OH, HOAc
6171	N-Hydroxypropanolamine	1-Piperidine	C ₆ H ₁₁ NO	4801-58-5	101.147	hyg	39.3	110 ⁵⁵			
6172	3-Hydroxypregnan-20-one, (3α,5α)	Allopregnan-20-one	C ₂₁ H ₃₄ O ₂	516-54-1	318.494	cry (al)	177				
6173	3-Hydroxypregnan-20-one, (3β,5α)	Allopregnan-20-one	C ₂₁ H ₃₄ O ₂	516-55-2	318.494		189.5				
6174	17-Hydroxypregn-4-ene-3,20-dione	17α-Hydroxyprogesterone	C ₂₁ H ₃₀ O ₃	68-96-2	330.461						sl chl
6175	21-Hydroxypregn-4-ene-3,20-dione	Deoxycorticosterone	C ₂₁ H ₃₀ O ₃	64-85-7	330.461	pl (et h)	141.5				sl H ₂ O, et h; vs Et OH, ace; s chl
6176	21-Hydroxypregn-4-ene-3,11,20-trione	11-Dehydrocorticosterone	C ₂₁ H ₂₈ O ₄	72-23-1	344.445	pr (ace-w, al, ace-et h)	183.5				i H ₂ O; s Et OH, ace, bz
6177	cis-4-Hydroxy-L-proline		C ₅ H ₉ NO ₂	618-27-9	131.130	nd (w+1)	239.5				vs H ₂ O
6178	trans-4-Hydroxy-L-proline		C ₅ H ₉ NO ₂	51-35-4	131.130	lf (di l al) pr (w)	274				vs H ₂ O, sl Et OH
6179	3-Hydroxypropanal	Hydracrolein	C ₃ H ₄ O ₂	2134-29-4	74.079			90 ¹⁸ , 38 ^{0.2}			vs ace, et h, Et OH
6180	Hydroxypropanediol c acid	Tartaric acid	C ₄ H ₄ O ₆	80-69-3	120.061	pr (w+1)	157	sub			s H ₂ O, Et OH; sl et h
6181	2-Hydroxypropanenitrile	Acetaldehyde cyanohydrin	C ₃ H ₅ NO	78-97-7	71.078	li q	-40	183	0.987 ⁷	1.4058 ¹⁸	msc H ₂ O, Et OH; s et h, chl; i CS pet h
6182	3-Hydroxypropanenitrile	Hydracrylonitrile	C ₃ H ₃ NO	109-78-4	71.078	li q	-46	221	1.040 ⁴	1.4248 ²⁰	msc H ₂ O, Et OH; sl et h; s chl; i CS
6183	3-Hydroxypropanoic acid	Hydracrylic acid	C ₃ H ₄ O ₃	503-66-2	90.078	syd		dec		1.4489 ²⁰	vs H ₂ O; s Et OH; msc et h
6184	1-Hydroxy-2-propanone	Acetone alcohol	C ₃ H ₆ O ₂	116-09-6	74.079	hyg li q	-17	145.5	1.080 ⁵	1.4295 ²⁰	vs H ₂ O, Et OH, et h
6185	4-(3-Hydroxy-1-propenyl)-2-methoxyphenol	Coniferyl alcohol	C ₁₀ H ₁₂ O ₃	458-35-5	180.200	pr (et h-l i g)	74	164			i H ₂ O; s Et OH, al k; vs et h
6186	2-Hydroxypropyl acrylate		C ₇ H ₁₀ O ₃	999-61-1	130.141	li q		70			
6187	(2-Hydroxypropyl)trimethylammonium chloride		C ₆ H ₁₆ ClNO	2382-43-6	153.650	pr (Bu OH)	165	dec			vs H ₂ O, Et OH
6188	3-Hydroxy-1H-pyridin-2-one		C ₅ H ₅ NO ₂	16867-04-2	111.100		245 dec				
6189	1-Hydroxy-2,5-pyrrolidinedione	N-Hydroxysuccinimide	C ₄ H ₅ NO ₃	6066-82-6	115.088	hyg	96.3				sl DMSO
6190	4-Hydroxy-2-quinolinecarboxylic acid	Kynurenic acid	C ₁₀ H ₇ NO ₃	492-27-3	189.168	ye nd (+w, di l al)	282.5				sl H ₂ O; s Et OH; i et h; vs al k
6191	8-Hydroxy-5-quinolinesulfonic acid		C ₉ H ₇ NO ₂ S	84-88-8	225.222	ye lf, nd (+1w) (di l HCl)	322.5				sl H ₂ O
6192	4-Hydroxy-2-quinoline	2,4-Quinolinediol	C ₉ H ₇ NO ₂	86-95-3	161.158			360 dec			sl Et OH, PhN ₃ , gl HOAc
6193	3-Hydroxyspirostan-12-one, (3β,5α,25R)	Hecogenin	C ₂₇ H ₄₂ O ₄	467-55-0	430.620	pl (et h)	266.5				vs ace, et h, Et OH
6194	4-Hydroxystyrene	4-Vinylphenol	C ₈ H ₈ O	2628-17-3	120.149			73.5			
6195	2-Hydroxy-5-sulfobenzoin c acid	5-Sulfosalicylic acid	C ₇ H ₆ O ₆ S	97-05-2	218.184	hyg nd	120				vs H ₂ O; vs Et OH, et h
6196	2-Hydroxy-5-sulfobenzoin c acid dihydrate	5-Sulfosalicylic acid dihydrate	C ₇ H ₁₀ O ₈ S	5965-83-3	254.214	wh cry (w)					vs H ₂ O; vs Et OH, et h
6197	4-Hydroxy-2,2,6,6-tetramethylpiperidine	2,2,6,6-Tetramethylpiperidine	C ₉ H ₁₈ O	2403-88-5	157.253		130	213.5			
6198	5-Hydroxytryptamine	3-(2-Aminoethyl)indol-5-ol	C ₁₀ H ₁₂ NO	50-67-9	176.214						s H ₂ O
6199	5-Hydroxy-DL-tryptophan		C ₁₁ H ₁₂ N ₂ O ₃	114-03-4	220.224	rod or nd (al)	300 dec				
6200	Hydroxyurea		CH ₄ N ₂ O ₂	127-07-1	76.055	nd (al)	141	dec			vs H ₂ O



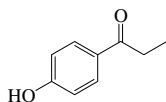
1-(2-Hydroxyphenyl)-3-phenyl-2-propen-1-one



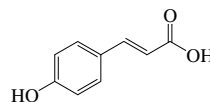
2-Hydroxy-1-phenyl-1-propanone



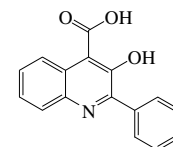
1-(2-Hydroxyphenyl)-1-propanone



1-(4-Hydroxyphenyl)-1-propanone



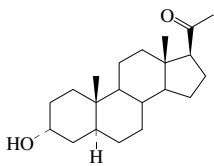
3-(4-Hydroxyphenyl)-2-propenoic acid



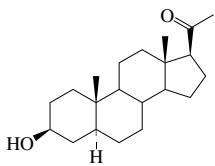
3-Hydroxy-2-phenyl-4-quinolinecarboxylic acid



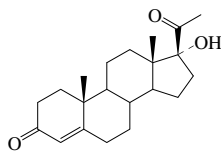
N-Hydroxypiperidine



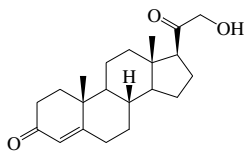
3-Hydroxypregnan-20-one, (3 α ,5 α)



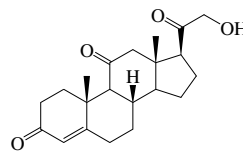
3-Hydroxypregnan-20-one, (3 β ,5 α)



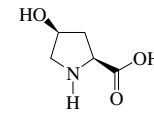
17-Hydroxypregn-4-ene-3,20-dione



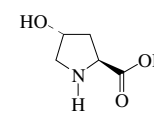
21-Hydroxypregn-4-ene-3,20-dione



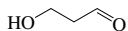
21-Hydroxypregn-4-ene-3,11,20-trione



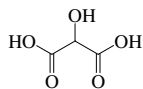
cis-4-Hydroxy-L-proline



trans-4-Hydroxy-L-proline



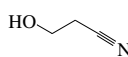
3-Hydroxypropanal



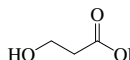
Hydroxypropanedioic acid



2-Hydroxypropanenitrile



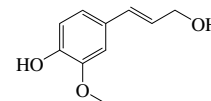
3-Hydroxypropanenitrile



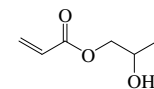
3-Hydroxypropanoic acid



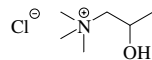
1-Hydroxy-2-propanone



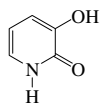
4-(3-Hydroxy-1-propenyl)-2-methoxyphenol



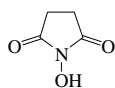
2-Hydroxypropyl acrylate



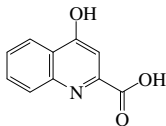
(2-Hydroxypropyl)trimethylammonium chloride



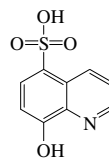
3-Hydroxy-1H-pyridin-2-one



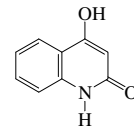
1-Hydroxy-2,5-pyrrolidinedione



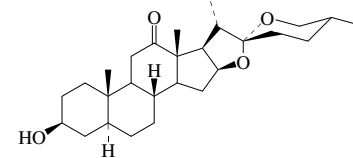
4-Hydroxy-2-quinolinecarboxylic acid



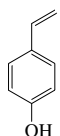
8-Hydroxy-5-quinoline-sulfonic acid



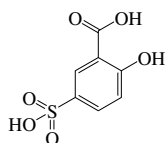
4-Hydroxy-2-quinolineone



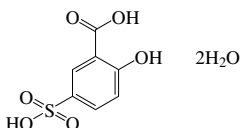
3-Hydroxyspirost-12-one, (3 β ,5 α ,25 β)



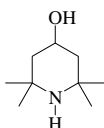
4-Hydroxystyrene



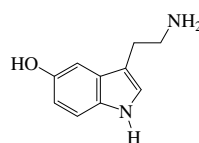
2-Hydroxy-5-sulfobenzoic acid



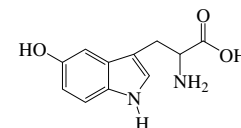
2-Hydroxy-5-sulfobenzoic acid dihydrate



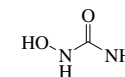
4-Hydroxy-2,2,6,6-tetramethylpiperidine



5-Hydroxytryptamine

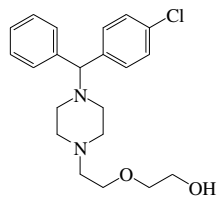


5-Hydroxy-DL-tryptophan

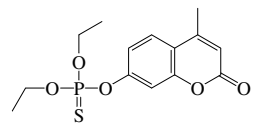


Hydroxyurea

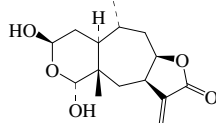
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6201	Hydroxyzine		C ₇ H ₂₇ ClN ₂ O ₂	68-88-2	374.904	oil		220 ^o			
6202	Hymecromone O,O-diethyl phosphorothioate		C ₁₄ H ₁₇ O ₃ PS	299-45-6	328.321	nd	38	210 ^{1.0} dec	1.260 ³⁸	1.5685 ³⁷	vs H ₂ O; sl pet h
6203	Hymenoxone		C ₁₅ H ₂₂ O ₃	57377-32-9	282.333	cry					
6204	Hyoscyamine		C ₁₇ H ₂₃ NO ₃	101-31-5	289.370	t et r nd (di l al)	108.5				sl OH et h, bz; vs Et OH, chl
6205	Hypoglycin A		C ₇ H ₁₁ N ₂ O ₂	156-56-9	141.168	ye pl (Me aq)	282				
6206	Hypoxanthine		C ₇ H ₁₁ N ₄ O	68-94-0	136.112	oct nd (w)	150 dec				sl H ₂ O; s al k, di l aci d
6207	Ibuprofen	2-(4-Isobutylphenyl)propanoic acid	C ₁₃ H ₁₉ O ₂	15687-27-1	206.281	col cry	76				sl H ₂ O; s os
6208	Icosylamine	1-Eicosanamine	C ₂₀ H ₄₃ N	10525-37-8	297.562			372.4			
6209	D-Idose		C ₆ H ₁₂ O ₆	5978-95-0	180.155	syr					vs H ₂ O
6210	L-Idose		C ₆ H ₁₂ O ₆	5934-56-5	180.155	syr					vs H ₂ O
6211	Imazalil		C ₇ H ₁₁ Cl ₃ N ₃ O	35554-44-0	297.179		50	dec	1.243 ²³		
6212	Imazapyr		C ₁₃ H ₁₅ N ₃ O ₃	81334-34-1	261.276		171				
6213	Imazaquin		C ₇ H ₁₇ N ₃ O ₃	81335-37-7	311.335		221				
6214	Imazetapyr		C ₆ H ₁₃ N ₃ O ₃	81335-77-5	289.330		173				
6215	Imidazole	1,3-Diazole	C ₄ H ₅ N ₃	288-32-4	68.077	mcl pr (bz)	89.5	257	1.0303 ⁹¹	1.4801 ¹⁰¹	vs H ₂ O, Et OH; s et h, ace, py; sl bz
6216	1 <i>H</i> -Imidazole-4,5-dicarboxylic acid		C ₆ H ₄ N ₂ O ₄	570-22-9	156.097	pr	290 dec		1.749 ²⁵		sl H ₂ O, py; i Et OH, et h, bz
6217	1 <i>H</i> -Imidazole-4-ethylamine, dihydrochloride		C ₅ H ₁₁ Cl ₂ N ₃	56-92-8	184.066	pl (et h-HOAc), pr (w)	251.3		1.43 ²⁰		vs H ₂ O, MeOH
6218	2,4-Imidazole dione	Hydantoin	C ₃ H ₄ N ₂ O ₂	461-72-3	100.076	nd (MeOH), lf (w)	220				s H ₂ O, Et OH, al k; sl et h; i pet h
6219	2-Imidazole dione	Ethylenethiourea	C ₃ H ₆ N ₂ SC	96-45-7	102.158	nd (al), pr (al)	203				vs H ₂ O; s Et OH; i et h, bz, chl; sl DMSO
6220	Imidazole dione	Parabanic acid	C ₃ H ₂ N ₂ O ₃	120-89-8	114.059	mcl nd (w)	244 dec	sub 100			s H ₂ O; vs Et OH
6221	2-Imidazole dione	Ethylenurea	C ₃ H ₆ N ₂ O	120-93-4	86.092		131				vs H ₂ O, Et OH; sl et h, chl
6222	Imidazole dione	Bisuret	C ₄ H ₆ N ₄ O ₂	108-19-0	103.080	pl (al), nd (w+1)	190 dec				sl H ₂ O; vs Et OH; i et h
6223	3,3'-Imidazole dione	Bis(2-cyanoethyl)amine	C ₆ H ₈ N ₄	111-94-4	123.155		-6	162 ⁵	1.0165 ²⁰		
6224	Imidazole dione		C ₄ H ₆ N ₂ O ₄	142-73-4	133.104	ort h pr	247.5				sl H ₂ O; i Et OH, et h
6225	Imidazole dione	2,2'-Imidazole dione	C ₄ H ₆ N ₄	628-87-5	95.103		78				s H ₂ O, Et OH; sl et h, bz, chl
6226	Imidazole dione		C ₇ H ₂₄ N ₂	50-49-7	280.407			160 ⁹¹			
6227	Imidazole dione	Tofranil	C ₁₉ H ₂₃ ClN ₂	113-52-0	316.868		174.5				vs H ₂ O; s Et OH; sl ace
6228	Imperatorin		C ₆ H ₁₁ O ₄	482-44-0	270.280	cry (al)	102				sl H ₂ O; s Et OH, et h, bz, pet h; vs chl
6229	Indaconitin		C ₁₇ H ₁₇ NO ₁₀	4491-19-4	629.738	cry	202 dec				vs et h, Et OH, chl
6230	Indalone	Butoxyronoxyl	C ₁₈ H ₁₉ O ₄	532-34-3	226.269	ye-red li q		263	1.057 ⁷	1.475 ²⁵	i H ₂ O; vs Et OH, et h, chl
6231	Indan		C ₉ H ₁₀	496-11-7	118.175	li q	-51.38	177.97	0.963 ⁹	1.5378 ²⁰	i H ₂ O; msc Et OH, et h; sl chl
6232	1-Indanamine	1-Aminindane	C ₉ H ₁₁ N	34698-41-4	133.190			221; 96 ³	1.038 ¹⁵	1.5613 ²⁰	sl H ₂ O; s et h, ace, bz
6233	1 <i>H</i> -Indazole	1 <i>H</i> -Benzopyrazole	C ₇ H ₆ N ₂	271-44-3	118.136	nd (al, w)	148	269			s H ₂ O, Et OH, et h
6234	1 <i>H</i> -Indazole-3-ol	1,2-Dihydro-3 <i>H</i> -indazole-3-one	C ₇ H ₇ N ₂ O	7364-25-2	134.135	nd or lf (MeOH), pl or nd (al)	252.5				sl H ₂ O, et h; s MeOH, Et OH
6235	Indene	Indonaphthene	C ₉ H ₈	95-13-6	116.160	li q	-1.5	182	0.996 ⁶	1.5768 ²⁰	i H ₂ O; msc Et OH, et h; s ace, bz, py; sl chl
6236	1 <i>H</i> -Indene-1,3(2 <i>H</i>)-dione		C ₉ H ₆ O ₂	606-23-5	146.143	nd (et h, li g)	131 dec		1.37		sl H ₂ O, ct c; vs Et OH; s et h, bz, al k
6237	1 <i>H</i> -Indene-1,2,3-trione monohydrate	Nihydriin	C ₉ H ₆ O ₄	485-47-2	178.142	pa ye pr (w, al)	242 dec				vs H ₂ O; s Et OH, al k; sl et h
6238	Indeno[1,2,3- <i>cd</i>]pyrene	1,10-(1,2-Phenylene)pyrene	C ₂₂ H ₁₂	193-39-5	276.330	ye cry (cy)	162				
6239	Indigo		C ₁₆ H ₁₀ N ₂ O ₂	482-89-3	262.262	dk bl pow	390 dec	sub 300			



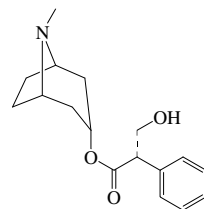
Hydroxyzine



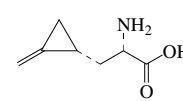
Hymecromone 0,0-diethylphosphorothioate



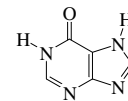
Hymenoxone



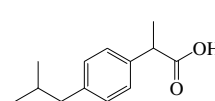
Hyoscyamine



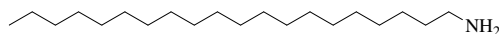
Hypoglycin A



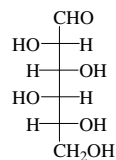
Hypoxanthine



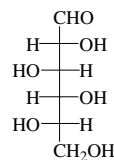
Ibuprofen



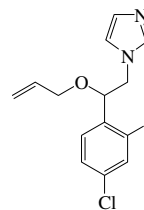
Icosylamine



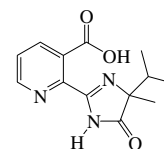
D-Idose



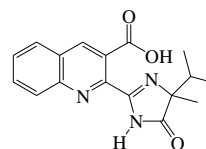
L-Idose



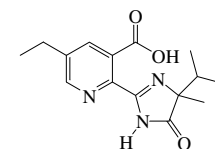
Imazalil



Imazapyr



Imazaquin

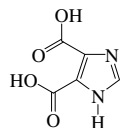


Imazetapyr

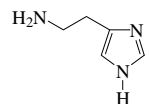
3-331



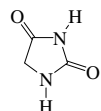
Imidazole



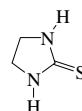
1H-Imidazole-4,5-dicarboxylic acid



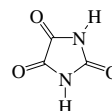
1H-Imidazole-4-ethylamine hydrochloride



2,4-Imidazole dione



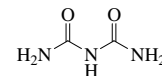
2-Imidazole dione



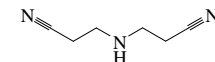
Imidazole



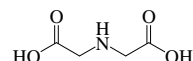
Imidazole



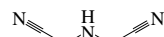
Imidazole



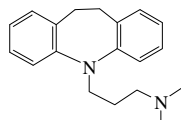
3,3'-Imidazole bispropane



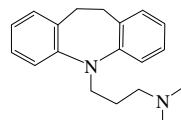
Imidazole



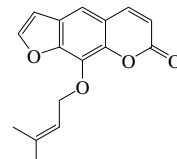
Imidazole



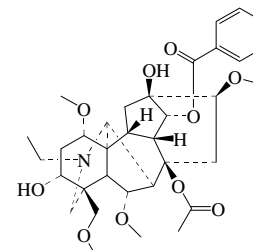
Imipramine



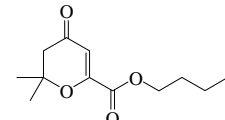
Imipramine hydrochloride



Imperatorin



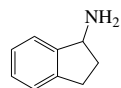
Indaconitine



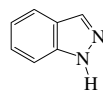
Indalone



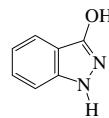
Indan



1-Indanamine



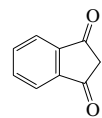
1H-Indazole



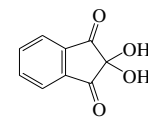
1H-Indazole-3-ol



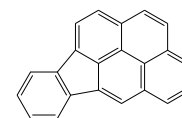
Indene



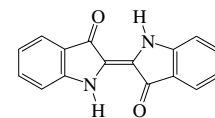
1H-Indene-1,3(2H)-dione



1H-Indene-1,2,3-trione monohydrate

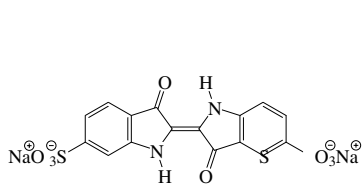


Indeno[1,2,3-cd]pyrene

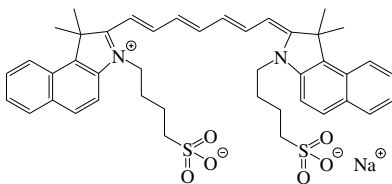


Indigo

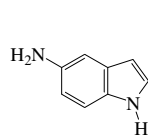
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6240	5,5'-Indi godi sulfoni c aci d, di sodi indi go Carmi ne salt		C ₁₆ H ₈ N ₂ Na ₂ O ₈ S ₂	860-22-0	466.353	dk-bl pow					sl H ₂ O, Et OH; i os
6241	Indocyani ne green		C ₄₃ H ₄₇ N ₂ NaO ₆ S ₂	3599-32-4	774.962	grn pow	244 dec				
6242	1 <i>H</i> -Indol-5-ami ne		C ₈ H ₇ N ₂	5192-03-0	132.163		132				
6243	1 <i>H</i> -Indole	2,3-Benzopyrrol e	C ₈ H ₇ N	120-72-9	117.149	lf (w, pet h) cry (et h)	52.5	253.6	1.22 ²⁵		s H ₂ O, bz; vs Et OH, et h, t ol; sl ct c
6244	1 <i>H</i> -Indole-3-acet i c aci d	Indol eacet i c aci d	₁₀ H ₉ NO ₂	87-51-4	175.184	lf (bz), pl (chl)	168.5				i ₂ OH vs Et OH; s et h, ace, bz; sl chl
6245	1 <i>H</i> -Indole-3-acet oni t ri l e		₁₀ H ₉ N ₂	771-51-7	156.184		36	160 ⁰²			
6246	1 <i>H</i> -Indole-3-but anoi c aci d	Indol ebut yri c aci d	₁₂ H ₁₃ NO ₂	133-32-4	203.237		124.5				vs bz; s DMSO; i pet h
6247	1 <i>H</i> -Indole-3-carboxal dehyde		C ₈ H ₇ NO	487-89-8	145.158		197.8				
6248	1 <i>H</i> -Indole-2,3-di one	Isat i n	₈ H ₆ NO ₂	91-56-5	147.132	oran mcl pr	203 dec				s H ₂ O, ace, bz; vs Et OH; sl et h
6249	1 <i>H</i> -Indole-2,3-di one, 3-t hi osemi carbazone	Isat i n, 3-t hi osemi carbazone	₉ H ₈ NO ₂ S	487-16-1	220.251		283				
6250	1 <i>H</i> -Indole-3-et hanami ne, monohydrochl ori de	Trypt ami ne hydrochl ori de	₁₀ H ₁₃ Cl N ₂	343-94-2	196.676	nd (al -bz or l i g)	255				vs ace, Et OH
6251	1 <i>H</i> -Indole-3-et hanol	Trypt ophol	₁₀ H ₁₁ NO	526-55-6	161.200	pr (bz-pet h)	59	174			vs ace, et h, Et OH, chl
6252	1 <i>H</i> -Indole-3-act i c aci d (α)	α-Hydroxy-1 <i>H</i> -indole-3-propanoi c aci d	C ₁₁ H ₁₁ NO ₃	7417-65-4	205.210	cry (pet h)	100				
6253	1 <i>H</i> -Indole-3-propanoi c aci d		₁₁ H ₁₁ NO ₂	830-96-6	189.211		134.5				sl H ₂ O, DMSO; vs Et OH, et h, ace, bz
6254	Indol i zi ne		₈ H ₇ N	274-40-8	117.149	pl	75	205			i H ₂ O; s Et OH
6255	1 <i>H</i> -Indole-3-ol, acet at e		₁₀ H ₉ NO ₂	608-08-2	175.184		129				
6256	1-(1 <i>H</i> -Indol-3-yl)et hanone		C ₉ H ₉ NO	703-80-0	159.184	nd (bz)	192.3	144 ¹⁰			vs Et OH
6257	1-(1 <i>H</i> -Indol-3-yl)-2-propanone	3-Indol yl acet one	₁₁ H ₁₁ NO	1201-26-9	173.211	br ort h (bz), nd (aq MeOH)	116				
6258	3-(1 <i>H</i> -Indol-3-yl)-2-propenoi c aci d	3-Indol yl acryl i c aci d	₁₁ H ₉ NO ₂	1204-06-4	187.195		185 dec				
6259	Indomet haci n		C ₉ H ₁₆ Cl NO ₄	53-86-1	357.788		155 (f orm a); 162 (f orm b)				
6260	Inosi ne	Hypoxant hi ne ri boside	₁₀ H ₁₂ N ₄ O ₅	58-63-9	268.226	pl (w + 2), nd (80% al)	218 dec				sl H ₂ O; vs Et OH
6261	Inosi ne 5'-monophosphat e	5'-Inosi ni c aci d	₁₀ H ₁₂ N ₄ O ₆ P	131-99-7	348.206	vi scl i q or gl ass					vs ₂ OH sl Et OH, et h
6262	<i>myo</i> -Inosi tol	(1,2α,3α,4β,5α,6β)-Cycl ohexanehexol	C ₆ H ₁₂ O ₆	87-89-8	180.155	cry (w)	225		1.752		s H ₂ O
6263	locet ami c aci d		₁₂ H ₁₃ N ₃ O ₃	16034-77-8	613.955	wh-ye pow	225				i H ₂ O; sl Et OH, bz, et h, ace
6264	lodi pami de		C ₁₄ H ₁₄ N ₂ O ₆	606-17-7	1139.761		307 dec				i H ₂ O, bz; sl Et OH, et h, ace
6265	2-Iodoacet ami de		C ₂ H ₃ INO	144-48-9	184.963		93.0				s H ₂ O; sl t f a
6266	Iodoacet i c aci d		₂ H ₃ IO ₂	64-69-7	185.948		82.5				s H ₂ O, Et OH, pet h; sl et h, chl
6267	Iodoacet one		C ₂ H ₃ IO	3019-04-3	183.975			62 ¹²	2.17 ¹⁵		s Et OH
6268	Iodoacet oni t ri l e		₂ H ₃ ON	624-75-9	166.948			185	2.307 ²⁵	1.5744 ²⁰	
6269	Iodoacet yl ene		CHI	14545-08-5	151.933			32			
6270	2-Iodoani l i ne		₈ H ₉ IN	615-43-0	219.023	nd (di l al)	60.5				sl ₂ OH vs Et OH, et h, ace
6271	3-Iodoani l i ne		₈ H ₉ IN	626-01-7	219.023	lf	33	145		1.6811 ²⁰	i H ₂ O; s Et OH, chl
6272	4-Iodoani l i ne		₈ H ₉ IN	540-37-4	219.023	nd (w)	67.5				sl H ₂ O, pet h; s Et OH, et h
6273	2-Iodobenzal dehyde		C ₇ H ₅ IO	26260-02-6	232.018		37	129 ¹⁴			sl H ₂ O; s ace
6274	4-Iodobenzal dehyde		C ₇ H ₅ IO	15164-44-0	232.018		77.5	265			sl H ₂ O; s Et OH, bz



5,5'-Indi godi sulf oaciddi sodi ur salt



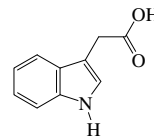
Indocyani negreen



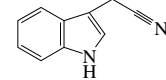
1H-Indol-5-ami ne



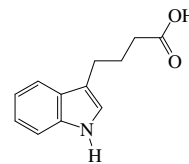
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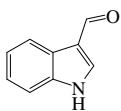
1H-Indol e-3-acet i acidi



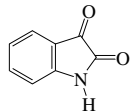
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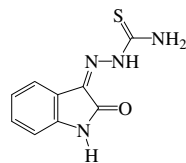
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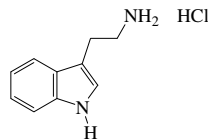
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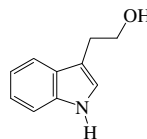
1H-Indol e-2,3-di one



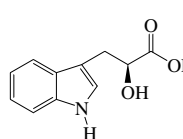
1H-Indol e-2,3-di one-3-t hi osemi carbazone



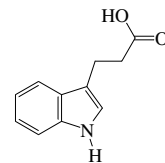
1H-Indol e-3-et hanami ne xonhydrochl ori de



1H-Indol e-3-et hanol



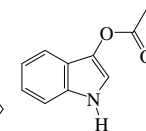
1H-Indol e-3-lact iaci d,(S)



1H-Indol e-3-propanoi acidi

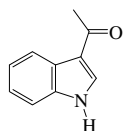


Indi zi ne

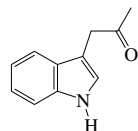


1H-Indol-3-ol,acet at e

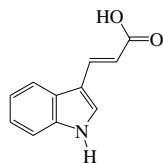
3-333



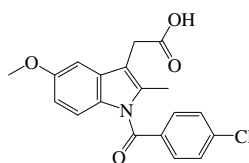
1-(1H-Indol-3-yl)et hanon



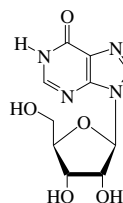
1-(1H-Indol-3-yl)-2-propanone



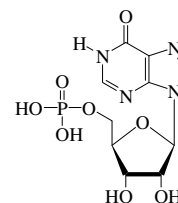
3-(1H-Indol-3-yl)-2-propenoi acidi



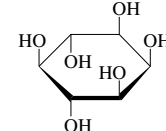
Indomet haci n



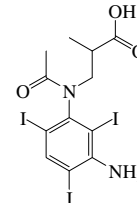
Inosi ne



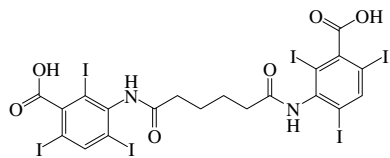
Inosi ne5'-monophosphat e



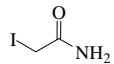
myo-Inosi t ol



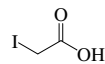
Iocet ami acidi



Iodi pami de



2-Iodoacet ami de



Iodoacet i acidi



Iodoacet one



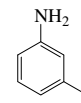
Iodoacet oni tri le



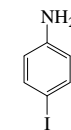
Iodoacet yl ene



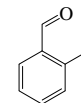
2-Iodoani li ne



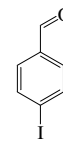
3-Iodoani li ne



4-Iodoani li ne

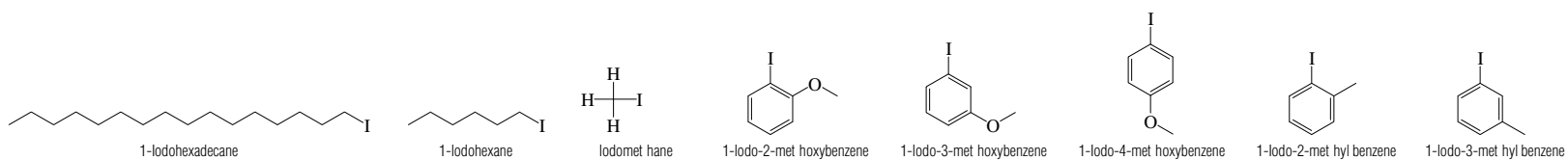
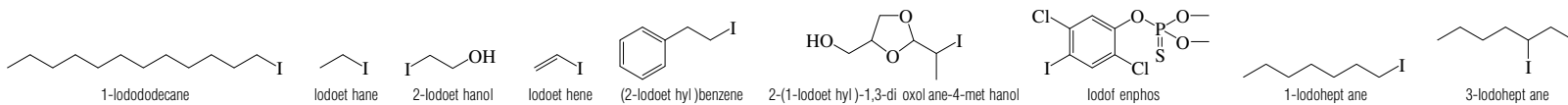
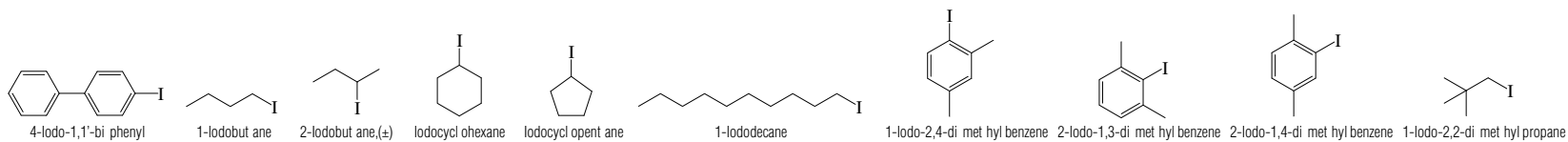
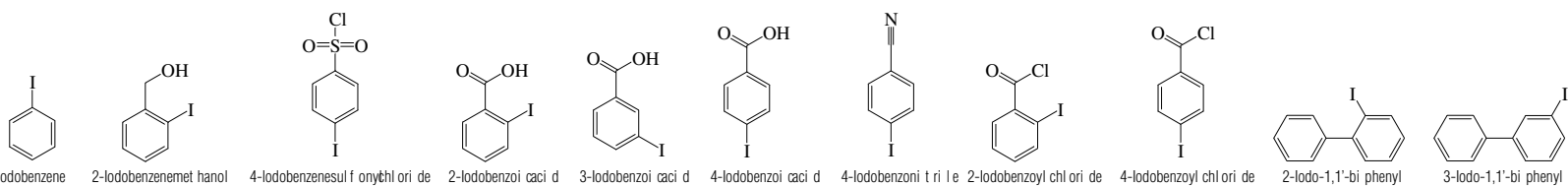


2-Iodobenzal dehyde

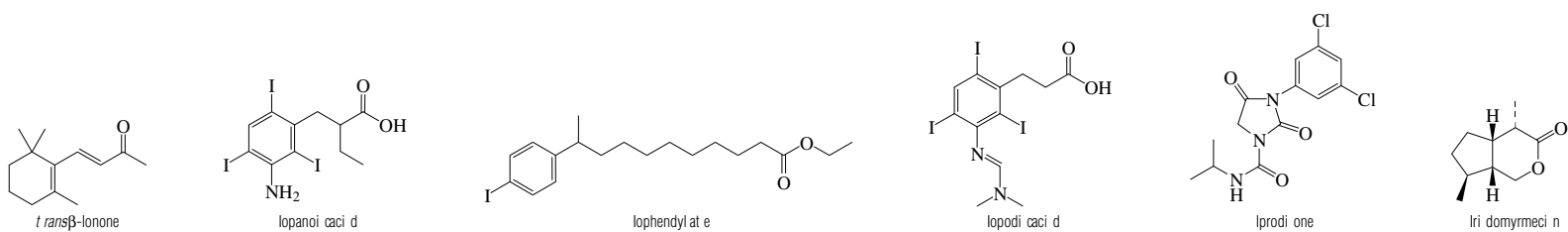
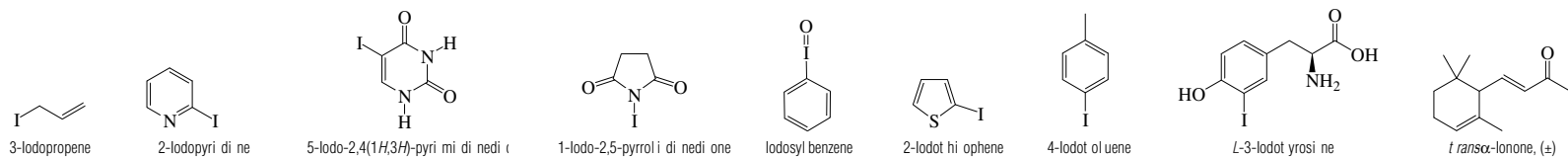
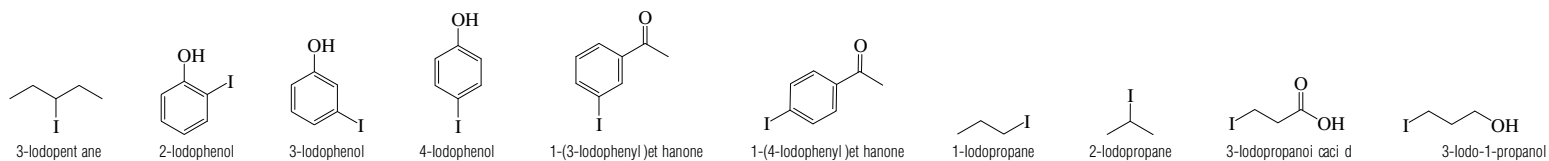
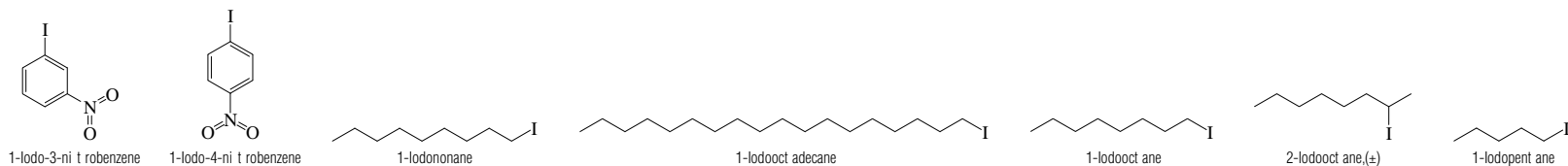
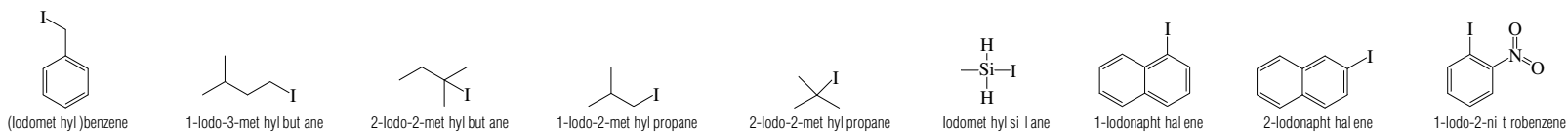


4-Iodobenzal dehyde

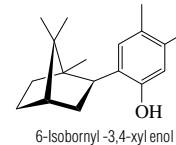
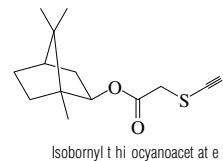
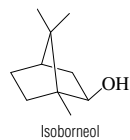
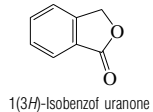
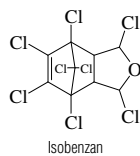
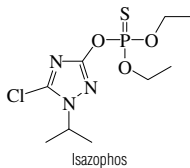
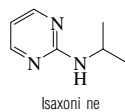
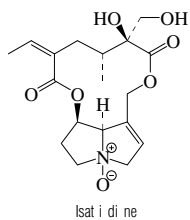
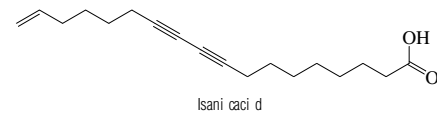
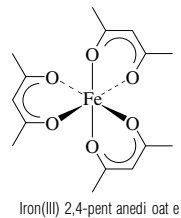
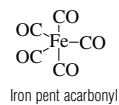
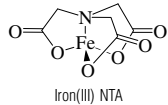
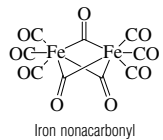
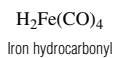
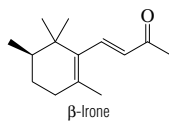
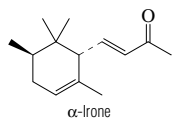
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6275	Iodobenzene		C ₆ H ₅ I	591-50-4	204.008	liq	-31.3	188.4	1.8308	1.6200 ²⁰	i H ₂ O; s Et OH; msc et h, ace, bz, ct c
6276	2-Iodobenzenemetanol		C ₇ H ₇ IO	5159-41-1	234.034		92	148 ³²		1.6349 ²⁰	
6277	4-Iodobenzenesulfonyl chloride	Pi psyl chl ori de	C ₆ H ₄ ClIO ₂ S	98-61-3	302.517		85				
6278	2-Iodobenzoyl chloride		C ₇ H ₅ IO ₂	88-67-5	248.018	nd (w)	163	exp 233	2.25 ²⁵		sl H ₂ O, ace; vs Et OH, et h
6279	3-Iodobenzoyl chloride		C ₇ H ₅ IO ₂	618-51-9	248.018	mcl pr (ace)	188.3	sub			sl H ₂ O, et h; vs Et OH
6280	4-Iodobenzoyl chloride		C ₇ H ₅ IO ₂	619-58-9	248.018	mcl pr (di l al) f 270 (sub)		sub	2.184 ²⁰		i H ₂ O; sl Et OH; s et h, DMSO
6281	4-Iodobenzonitrile		C ₇ H ₄ ClIN	3058-39-7	229.018		127.5				
6282	2-Iodobenzoyl chloride		C ₇ H ₅ ClIO	609-67-6	266.463		38.3	159 ⁷ , 135 ¹⁹			
6283	4-Iodobenzoyl chloride		C ₇ H ₅ ClIO	1711-02-0	266.463		65.5	164 ²			
6284	2-Iodo-1,1'-bi phenyl		C ₁₂ H ₉ I	2113-51-1	280.103			190 ³⁶ , 169 ¹⁷	1.5511 ²⁵	1.6620 ²⁰	i H ₂ O; s Et OH, et h, bz, HOAc
6285	3-Iodo-1,1'-bi phenyl		C ₁₂ H ₉ I	20442-79-9	280.103		26.5	188 ¹⁶	1.5967 ²⁵		
6286	4-Iodo-1,1'-bi phenyl		C ₁₂ H ₉ I	1591-31-7	280.103	nd (al, HOAc)	113.5	320; 183 ¹			i H ₂ O; s Et OH, et h, bz, HOAc
6287	1-Iodobutane	But yl i odi de	C ₄ H ₉ I	542-69-8	184.018	liq	-103	130.5	1.6154	1.5001 ²⁰	i H ₂ O; msc Et OH, et h; vs chl
6288	2-Iodobutane, (±)	(±)-sec-But yl i odi de	C ₄ H ₉ I	52152-71-3	184.018	liq	-104.2	120.1	1.5920	1.4991 ²⁰	i H ₂ O; msc Et OH, et h; vs chl
6289	Iodocycl hexane	Cycl ohexyl i odi de	C ₆ H ₁₁ I	626-62-0	210.055			dec 180; 81 ²⁰	1.6244 ²⁰	1.5477 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
6290	Iodocyclopentane	Cycl opent yl i odi de	C ₅ H ₉ I	1556-18-9	196.029			166.5	1.7096 ²⁰	1.5447 ²⁰	i H ₂ O; s et h, bz; sl ct c
6291	1-Iododecane		C ₁₀ H ₂₁ I	2050-77-3	268.178	liq	-16.3	263.7; 132	1.2546 ²⁰	1.4858 ²⁰	i H ₂ O; s Et OH, et h, ct c
6292	1-Iodo-2,4-di met hyl benzene		C ₈ H ₉ I	4214-28-2	232.061			dec 231; 111 ¹⁴	1.6282 ¹⁵	1.6008 ¹⁶	i H ₂ O; s ace, bz
6293	2-Iodo-1,3-di met hyl benzene		C ₈ H ₉ I	608-28-6	232.061	oi l	11.2	229.5	1.6158	1.6035 ²⁰	i H ₂ O; s ace, bz
6294	2-Iodo-1,4-di met hyl benzene		C ₈ H ₉ I	1122-42-5	232.061			dec 227	1.6168 ¹⁷	1.5992 ¹⁷	i H ₂ O; s ace, bz
6295	1-Iodo-2,2-di met hyl propane		C ₆ H ₁₁ I	15501-33-4	198.045			dec 128	1.4940 ²⁰	1.4890 ²⁰	i H ₂ O; s Et OH, et h
6296	1-Iodododecane	Lauryl i odi de	C ₁₁ H ₂₃ I	4292-19-7	296.231		0.3	298.2	1.1999 ²⁰	1.4840 ²⁰	i H ₂ O; s Et OH, MeOH; msc et h, ace, ct c
6297	Iodoethane	Et hyl i odi de	C ₂ H ₅ I	75-03-6	155.965	liq	-111.1	72.3	1.9357	1.5133 ²⁰	sl H ₂ O; msc Et OH; s et h, chl
6298	2-Iodoethanol		C ₂ H ₅ IO	624-76-0	171.964			dec 176	2.1967 ²⁰	1.5713 ²⁰	vs H ₂ O, et h, Et OH
6299	Iodoethane	Vi nyl i odi de	C ₂ H ₃ I	593-66-8	153.949			56	2.037 ²⁰	1.5385 ²⁰	vs et h, Et OH
6300	(2-Iodoethyl)benzene		C ₈ H ₉ I	17376-04-4	232.061	liq		122	1.603	1.6010 ²⁰	
6301	2-(1-Iodoethyl)-1,3-di oxolane-4-metanol	lodi nat ed glycerol	C ₆ H ₁₁ IO ₃	5634-39-9	258.053	pal e ye li q			1.797	1.547	s et h, chl, t hf, AcOEt
6302	Iodofenophos		C ₁₀ H ₇ Cl ₂ IO ₃ PS	18181-70-9	412.997	wh cry	76				i H ₂ O; s ace, xyl; sl Et OH
6303	1-Iodoheptane		C ₇ H ₁₅ I	4282-40-0	226.098	liq	-48.2	204.0	1.3794	1.4904 ²⁰	i H ₂ O; s Et OH, et h, ace, chl; sl ct c
6304	3-Iodoheptane		C ₇ H ₁₅ I	31294-92-5	226.098			89 ³⁰	1.3676 ²⁰		
6305	1-Iodohexadecane		C ₁₆ H ₃₃ I	544-77-4	352.337	pa ye li q	24.7	357; 212	1.1213 ²⁵	1.4797 ²⁰	i H ₂ O; sl Et OH; s et h, ace; msc bz; vs chl
6306	1-Iodohexane	Hexyl i odi de	C ₆ H ₁₃ I	638-45-9	212.071	liq	-74.2	181.3	1.4397	1.4928 ²⁰	i H ₂ O
6307	Iodometane	Met hyl i odi de	CH ₃ I	74-88-4	141.939	liq	-66.4	42.43	2.2789	1.5308 ²⁰	sl H ₂ O; s ace, bz, chl; msc Et OH, et h
6308	1-Iodo-2-met hoxybenzene	o-Iodoani sol e	C ₇ H ₇ IO	529-28-2	234.034			241; 91 ²	1.8 ²⁰		vs Et OH, et h, ace, bz, chl, li g
6309	1-Iodo-3-met hoxybenzene	m-Iodoani sol e	C ₇ H ₇ IO	766-85-8	234.034			244.5	1.9650 ²⁰		vs Et OH, et h
6310	1-Iodo-4-met hoxybenzene	p-Iodoani sol e	C ₇ H ₇ IO	696-62-8	234.034	lf (al), nd (MeOH)	53	238; 138 ²⁵			s Et OH, et h, chl
6311	1-Iodo-2-met hyl benzene		C ₇ H ₇ I	615-37-2	218.035			211.5	1.713 ²⁰	1.6079 ²⁰	i H ₂ O; msc Et OH, et h
6312	1-Iodo-3-met hyl benzene		C ₇ H ₇ I	625-95-6	218.035	liq	-27.2	213	1.705	1.6053 ²⁰	i H ₂ O; msc Et OH, et h



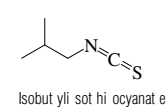
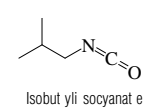
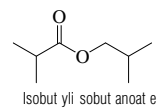
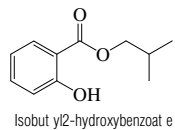
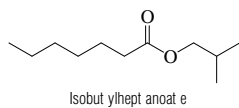
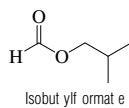
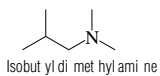
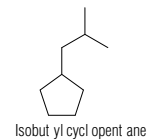
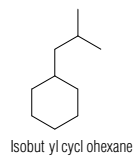
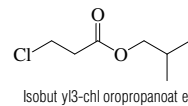
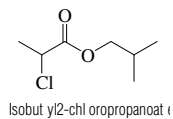
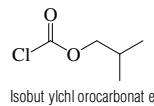
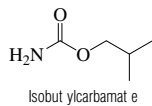
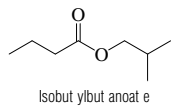
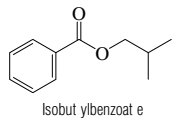
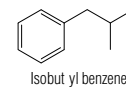
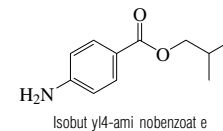
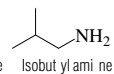
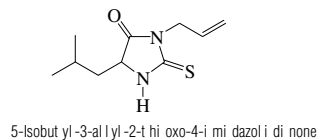
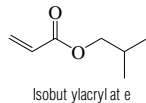
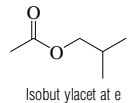
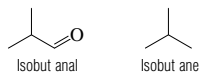
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6313	(Iodomet hyl)benzene		C ₆ H ₅ I	620-05-3	218.035	col or ye nd (MeOH)	24.5	93 ¹⁰	1.7335 ²⁵	1.6334 ²⁵	vs bz, et h, Et OH
6314	1-Iodo-3-met hyl but ane	Isopent yl i odi de	C ₄ H ₉ I	541-28-6	198.045			147	1.5118 ²⁰	1.4939 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
6315	2-Iodo-2-met hyl but ane		C ₄ H ₉ I	594-38-7	198.045			124.5	1.4937 ²⁰	1.4981 ²⁰	i H ₂ O; msc Et OH, et h
6316	1-Iodo-2-met hyl propane	Isobut yl i odi de	C ₃ H ₇ I	513-38-2	184.018			121.1	1.6035 ²⁰	1.4959 ²⁰	
6317	2-Iodo-2-met hyl propane	<i>tert</i> But yl i odi de	C ₃ H ₇ I	558-17-8	184.018	li q	-38.2	100.1	1.57 ⁹	1.4918 ²⁰	msc Et OH, et h
6318	Iodometh hyl silane		CSi	18089-64-0	172.041	col li q	-109.5	71.8			
6319	1-Iodonaphthalene		C ₁₀ H ₇ I	90-14-2	254.067		2.1	302	1.7399 ²⁰	1.7026 ²⁰	i H ₂ O; msc Et OH, et h, bz, C ₆ H ₆
6320	2-Iodonaphthalene		C ₁₀ H ₇ I	612-55-5	254.067	lf (di l al)	54.5	308	1.63 ⁹	1.6662 ⁹⁹	i H ₂ O; vs Et OH, et h, HOAc
6321	1-Iodo-2-nitrobenzene		C ₆ H ₄ INO ₂	609-73-4	249.006	ye ort h nd (al)	54	290; 162 ⁹	1.9186 ⁷⁵		i H ₂ O; s Et OH, et h
6322	1-Iodo-3-nitrobenzene		C ₆ H ₄ INO ₂	645-00-1	249.006	mcl pr	38.5	280	1.9477 ⁹		i H ₂ O; s Et OH, et h
6323	1-Iodo-4-nitrobenzene		C ₆ H ₄ INO ₂	636-98-6	249.006	ye nd (al)	174.7	288	1.8090 ⁸⁵		i H ₂ O; s Et OH, HOAc; sl DMSO
6324	1-Iodononane		C ₉ H ₁₉ I	4282-42-2	254.151	col li q	-20	245.0	1.2836	1.4848 ²⁵	
6325	1-Iodooctadecane		C ₁₈ H ₃₇ I	629-93-6	380.391	lf (li g), nd (ace, 34.0 al-ace)		383	1.0994 ²⁰	1.4810 ²⁰	i H ₂ O; sl Et OH, et h
6326	1-Iodooctane		C ₈ H ₁₇ I	629-27-6	240.125	li q	-45.7	225.1	1.329 ⁹	1.4885 ²⁰	s Et OH, et h
6327	2-Iodooctane, (±)	2-Oct yl i odi de, (±)	C ₈ H ₁₇ I	36049-78-2	240.125			210; 95 ¹⁶	1.3251 ²⁰	1.4896 ²⁰	i H ₂ O; s Et OH, et h, li g
6328	1-Iodopentane	Pent yl i odi de	C ₅ H ₁₁ I	628-17-1	198.045	li q	-85.6	157.0	1.516 ⁹	1.4959 ²⁰	s chl
6329	3-Iodopentane		C ₅ H ₁₁ I	1809-05-8	198.045			145.5	1.5176 ²⁰	1.4974 ²⁰	vs ace, bz, et h
6330	2-Iodophenol		C ₆ H ₄ IO	533-58-4	220.007	nd	43	186 ¹⁶⁰ , 91 ²	1.8757 ⁸⁰		s H ₂ O; vs Et OH, et h, C ₆ H ₆
6331	3-Iodophenol		C ₆ H ₄ IO	626-02-8	220.007	nd (li g)	118	186 ⁹			sl H ₂ O; s Et OH, et h
6332	4-Iodophenol		C ₆ H ₄ IO	540-38-5	220.007	nd (w or sub)	93.5	139 ⁵ dec	1.8573 ¹¹²		sl H ₂ O; vs Et OH, et h
6333	1-(3-Iodophenyl)ethanone	3-Iodoacetophenone	C ₈ H ₇ IO	14452-30-3	246.045			129 ⁸ , 117 ⁴		1.622 ²⁰	s bz
6334	1-(4-Iodophenyl)ethanone	4-Iodoacetophenone	C ₈ H ₇ IO	13329-40-3	246.045		86	153 ¹⁸			s Et OH, bz, C ₆ H ₆ , HOAc; sl li g, et h
6335	1-Iodopropane	Propyl i odi de	C ₃ H ₇ I	107-08-4	169.992	li q	-101.3	102.5	1.748 ⁹	1.5058 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
6336	2-Iodopropane	Isopropyl i odi de	C ₃ H ₇ I	75-30-9	169.992	li q	-90	89.5	1.704 ²	1.5028 ²⁰	sl H ₂ O; msc Et OH, et h, bz, chl
6337	3-Iodopropanoic acid		C ₃ H ₅ IO ₂	141-76-4	199.975	lf (w)	85				sl H ₂ O, chl; vs Et OH; s et h, ace
6338	3-Iodo-1-propanol		C ₃ H ₇ IO	627-32-7	185.991	vi sc oi l		226; 1 ¹⁵	1.9976 ²⁰	1.5585 ²⁰	
6339	3-Iodopropene	Allyl i odi de	C ₃ H ₅ I	556-56-9	167.976	ye li q	-99.3	103	1.84 ⁸	1.5540 ²¹	i H ₂ O; s Et OH, et h, chl
6340	2-Iodopyridine		C ₅ H ₄ IN	5029-67-4	204.997			100 ¹⁵ , 93 ¹³	1.928 ²⁵	1.6366 ²⁰	s Et OH, et h, ace, bz
6341	5-Iodo-2,4-(1 <i>H</i> ,3 <i>H</i>)-pyridine	5-Iodouracil	C ₄ H ₃ INO ₂	696-07-1	237.983		275 dec				
6342	1-Iodo-2,5-pyrrolidinedione	<i>N</i> -Iodosuccinimide	C ₄ H ₃ INO ₂	516-12-1	224.985	cry (ace)	200.5		2.245 ²⁵		vs H ₂ O; s Et OH, ace; sl et h, DMSO
6343	Iodosylbenzene		C ₆ H ₅ IO	536-80-1	220.007	ye pow	210 exp				s H ₂ O, Et OH; i et h, ace, bz, pet h
6344	2-Iodotoluene		C ₇ H ₇ IS	3437-95-4	210.036	li q	-40	181	2.059 ⁵	1.6465 ²⁵	vs Et OH, et h; sl chl
6345	4-Iodotoluene		C ₇ H ₇ I	624-31-7	218.035	lf (al)	36.5	211	1.67 ⁸		i H ₂ O; s Et OH, et h, C ₆ H ₆ sl chl
6346	<i>L</i> -3-Iodotyrosine		C ₉ H ₉ INO ₃	70-78-0	307.084	cry (w)	205 dec				
6347	<i>trans</i> -Iionone, (±)		C ₁₃ H ₂₀ O	30685-95-1	192.297			146 ²⁸	0.9298 ²¹	1.5041 ²⁰	vs ace, et h, Et OH
6348	<i>trans</i> -Iionone		C ₁₃ H ₂₀ O	79-77-6	192.297			124 ¹⁰ , 73 ^{0.1}	0.945 ²⁰	1.5198 ²⁰	sl H ₂ O; msc Et OH, et h; s chl
6349	Iopanoic acid		C ₉ H ₁₇ NO ₂	96-83-3	570.932	wh sol i d	156				i ₂ B; s di l alk, Et OH
6350	Iophendylate	Et hyl 10-(4-i odophenyl)undecanoate	C ₁₉ H ₂₅ NO ₂	99-79-6	416.336	vi sc li q		197	1.25 ²⁰	1.525 ²⁵	sl H ₂ O; s Et OH, bz, chl
6351	Iopodic acid	Ipodate	C ₈ H ₁₃ N ₂ O ₃	5587-89-3	597.956	cry	168				i H ₂ O; vs Et OH, MeOH, chl, ace
6352	Iprodone		C ₉ H ₁₃ Cl ₂ N ₃ O ₃	36734-19-7	330.166		136				
6353	Iridomyrmecin	Hexahydro-4,7-di met hyl cycl opent a[c]pyran-2(1 <i>H</i>)-one	C ₁₀ H ₁₆ O ₂	485-43-8	168.233	pr	61	106 ^{1.5}		1.4607 ⁶⁵	sl H ₂ O; s et h



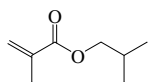
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6354	α-Irone	4-(2,5,6,6-Tetramethyl-2-cyclohexen-1-yl)-3-but-en-2-one	C ₁₄ H ₂₂ O	79-69-6	206.324			90 ^{0.4}	0.9362 ²⁰	1.5002 ²⁰	
6355	β-Irone	4-(2,5,6,6-Tetramethyl-1-cyclohexen-1-yl)-3-but-en-2-one	C ₁₄ H ₂₂ O	79-70-9	206.324			125 ¹¹	0.9434 ²¹	1.5162 ²⁵	sl H ₂ O; vs Et OH, et h, bz, chl
6356	Iron hydrocarbonyl	Hydrogen tetracarboxylate(II)	H ₄ FeO ₄	17440-90-3	169.902	col liq; unst ab	-70	dec			s al k
6357	Iron nonacarbonyl	Diron nonacarbonyl	Fe ₉ O ₉	15321-51-4	363.781	oran-ye cry	100 dec		2.85		
6358	Iron(III) NTA	Nitrioltriacetateiron(III)	H ₆ FeNO ₆	16448-54-7	243.960	solid					s H ₂ O
6359	Iron pentacarbonyl		FeO ₅	13463-40-6	195.896	col to ye oi lyl i q	-20	103	2.5	1.453 ²²	i H ₂ O; sl Et OH; s bz, ace, ct c
6360	Iron(III) 2,4-pentanedioate	Ferric acetate	H ₁₂ FeO ₆	14024-18-1	353.169		179		5.24		
6361	Isanacide	17-Octadecene-9,11-dienoic acid	H ₁₈ O ₂	506-25-2	274.398	cry	39.5		0.9309 ⁴⁵	1.49148 ⁵⁰	s ace, Et OH, i -PrOH; sl pet h
6362	Isatin	Retrorsin	C ₁₀ H ₇ NO ₂	15503-86-3	367.395	cry	145				
6363	Isaxoniine	N-Isopropyl-2-pyridimidine	H ₁₁ N ₃	4214-72-6	137.182		28	93 ¹²			
6364	Isazophos		C ₉ H ₁₇ ClN ₃ O ₃ PS	67329-04-8	313.741			170; 100 ^{0.001}	1.22 ²⁰		
6365	Isobenzan		C ₇ H ₈ Cl ₂ O	297-78-9	411.751	cry (hp)	121				s et h, bz, xyl, tol
6366	1(3 <i>H</i>)-Isobenzofuranone		C ₈ H ₆ O ₂	87-41-2	134.133	nd or pl (w)	75	290	1.163 ⁶⁹	1.536 ⁹⁹	s H ₂ O; vs Et OH, et h; sl chl
6367	Isoborneol	1,7,7-Triethylbicyclo[2.2.1]heptan-2-ol, exo-(±)	C ₁₀ H ₁₈ O	24393-70-2	154.249	t ab (pet h)	212	sub	1.10		i H ₂ O; vs Et OH, et h, chl; sl bz
6368	Isobornyl thiocyanate		C ₁₃ H ₂₃ NO ₂ S	115-31-1	253.361	ye oi lyl i q		95	1.1465 ²⁵	1.512 ²⁵	i H ₂ O; vs Et OH, bz, chl, pet h
6369	6-Isobornyl-3,4-xylene	Xi bornol	C ₁₈ H ₂₆ O	13741-18-9	258.398	cry	95	167 ³	1.0240 ²⁰	1.5382 ²⁰	
6370	Isobutanal	2-Methyl-1-propanal	C ₄ H ₈ O	78-84-2	72.106	liq	-65.9	64.5	0.789 ⁹	1.3730 ²⁰	s H ₂ O, et h, ace, chl; sl ct c
6371	Isobutane	2-Methylpropane	C ₄ H ₁₀	75-28-5	58.122	col gas	-159.4	-11.73	0.5510 ⁹⁵ (p>1 at m)	1.3518 ⁻²⁵	sl H ₂ O; s Et OH, et h, chl
6372	Isobutene		C ₄ H ₈	115-11-7	56.107	col gas	-140.7	-6.9	0.589 ⁹⁵ (p>1 at m)	1.3926 ⁻²⁵	i H ₂ O; vs Et OH, et h; s bz, sul f
6373	Isobutyl acetate		C ₆ H ₁₂ O ₂	110-19-0	116.158	liq	-98.8	116.5	0.871 ²	1.3902 ²⁰	sl H ₂ O, ct c; msc Et OH, et h; s ace
6374	Isobutyl acrylate		C ₇ H ₁₂ O ₂	106-63-8	128.169	liq	-61	132	0.889 ⁶	1.4150 ²⁰	sl H ₂ O; s Et OH, et h, MeOH
6375	5-Isobutyl-3-allyl-2-thioxo-4-imidazole	Albutin	C ₁₀ H ₁₆ N ₂ OS	830-89-7	212.311		210.5				
6376	Isobutylamine	2-Methyl-1-propanamine	C ₄ H ₁₁ N	78-81-9	73.137	liq	-86.7	67.75	0.72 ⁴	1.3988 ¹⁹	
6377	Isobutyl 4-aminobenzoate	Isobutylamine benzoate	C ₁₁ H ₁₅ NO ₂	94-14-4	193.243		64.5				
6378	Isobutylbenzene		C ₁₀ H ₁₄	538-93-2	134.218	liq	-51.4	172.79	0.853 ²	1.4866 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
6379	Isobutyl benzoate		C ₁₁ H ₁₄ O ₂	120-50-3	178.228			242	0.9990 ²⁰		i H ₂ O; msc Et OH, et h; s ace, chl
6380	Isobutyl butanoate		C ₈ H ₁₆ O ₂	539-90-2	144.212			156.9	0.8364 ¹⁸	1.4032 ²⁰	sl H ₂ O; msc Et OH, et h
6381	Isobutyl carbamate		C ₆ H ₁₁ NO ₂	543-28-2	117.147	lf	67	207		1.409 ⁶	vs et h, Et OH
6382	Isobutyl chloroacetate		C ₆ H ₁₁ ClO ₂	543-27-1	136.577			128.8	1.0426 ¹⁸	1.4071 ¹⁸	s Et OH, bz, chl; msc et h
6383	Isobutyl 2-chloropropanoate		C ₇ H ₁₃ ClO ₂	114489-96-2	164.630			176	1.0312 ²⁰	1.4247 ²⁰	
6384	Isobutyl 3-chloropropanoate		C ₇ H ₁₃ ClO ₂	62108-68-3	164.630			191.3	1.0323 ²⁰	1.4295 ²⁰	vs et h, Et OH
6385	Isobutyl cyclohexane		C ₁₀ H ₂₀	1678-98-4	140.266	liq	-95	171.3	0.795 ²	1.4386 ²⁰	i H ₂ O; s Et OH, ace, chl; vs et h, bz
6386	Isobutyl cyclopentane		C ₉ H ₁₈	3788-32-7	126.239	liq	-115.2	148	0.776 ⁹	1.4298 ²⁰	
6387	Isobutyl dimethylamine	N,N,2-Triethyl-1-propanamine	C ₈ H ₁₉ N	7239-24-9	101.190			80.5	0.7097 ²⁰	1.3907 ²⁰	vs H ₂ O
6388	Isobutyl formate		C ₅ H ₁₀ O ₂	542-55-2	102.132	liq	-95.8	98.2	0.877 ⁶	1.3857 ²⁰	sl H ₂ O, chl; msc Et OH, et h; vs ace
6389	Isobutyl heptanoate	Isobutyl enanthate	C ₁₁ H ₂₂ O ₂	7779-80-8	186.292			208	0.8593 ²⁰		vs ace, bz, et h, Et OH
6390	Isobutyl 2-hydroxybenzoate	Isobutyl salicylate	C ₁₁ H ₁₄ O ₃	87-19-4	194.227		5.9	261	1.0639 ²⁰	1.5087 ²⁰	i H ₂ O; s Et OH, et h, ct c
6391	Isobutyl isobutanoate		C ₈ H ₁₆ O ₂	97-85-8	144.212	liq	-80.7	148.6	0.854 ²	1.3999 ²⁰	sl H ₂ O, ct c; s Et OH, ace; msc et h
6392	Isobutyl isocyanate		C ₅ H ₈ NO	1873-29-6	99.131			106			
6393	Isobutyl isothiocyanate	1-Isothiocyano-2-methylpropane	C ₄ H ₈ NS	591-82-2	115.197			160	0.9631 ¹⁴	1.5005 ¹⁴	



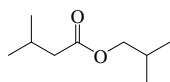
3-339



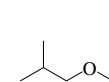
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6394	Isobutyl met hacrylat e		$\text{C}_8\text{H}_{14}\text{O}_2$	97-86-9	142.196			155	0.8858 ²⁰	1.4199 ²⁰	i H ₂ O; msc Et OH, et h
6395	Isobutyl 3-met hyl but anoat e	Isobutyl i soval erat e	$\text{C}_{10}\text{H}_{18}\text{O}_2$	589-59-3	158.238			168.5	0.853 ²⁰	1.4057 ²⁰	i H ₂ O; msc Et OH, et h; vs ace; s chl
6396	Isobutyl met hyl et her		$\text{C}_8\text{H}_{16}\text{O}$	625-44-5	88.148			58.6	0.7311 ²⁰		vs et h, Et OH
6397	Isobutyl ni t rat e		$\text{C}_4\text{H}_8\text{NO}_3$	543-29-3	119.119			123.4	1.0152 ²⁰	1.4028 ²⁰	
6398	Isobutyl ni t ri t e		$\text{C}_4\text{H}_8\text{NO}_2$	542-56-3	103.120	col li q		67	0.8699	1.3715 ²²	sl H ₂ O; s Et OH, et h
6399	Isobutyl pent anoat e		$\text{C}_{10}\text{H}_{18}\text{O}_2$	10588-10-0	158.238			179	0.8625 ²⁵	1.4046 ²⁰	i H ₂ O; msc Et OH; s et h, ace
6400	Isobutyl phenyl acet at e		$\text{C}_{12}\text{H}_{16}\text{O}_2$	102-13-6	192.254			247	0.999 ¹⁸		i H ₂ O; s Et OH, et h
6401	Isobutyl propanoat e	Isobutyl propi onat e	$\text{C}_7\text{H}_{14}\text{O}_2$	540-42-1	130.185	li q	-71.4	137	0.888	1.3973 ²⁰	sl H ₂ O; vs Et OH, et h; s ace, bz, chl, ct c
6402	Isobutyl st earat e		$\text{C}_{20}\text{H}_{40}\text{O}_2$	646-13-9	340.583	wax	28.9	223 ¹⁵	0.8498 ²⁰		vs et h
6403	Isobutyl t hi ocyanat e		$\text{C}_4\text{H}_8\text{NS}$	591-84-4	115.197	li q	-59	175.4			vs et h, Et OH
6404	Isobutyl t ri chl oroacet at e		$\text{C}_8\text{H}_9\text{Cl}_3\text{O}_2$	33560-15-5	219.493			188	1.2636 ²⁰	1.4483 ²⁰	vs bz, et h, Et OH
6405	Isobutyl vi nyl et her		$\text{C}_8\text{H}_{16}\text{O}$	109-53-5	100.158	li q	-112	83	0.764 ⁵	1.3966 ²⁰	sl H ₂ O; vs Et OH, ace, bz; msc et h
6406	Isoci t ri c aci d		$\text{C}_6\text{H}_{10}\text{O}_7$	320-77-4	192.124	ye syr	105				
6407	Isocorybul bi ne		$\text{C}_9\text{H}_{15}\text{NO}_4$	22672-74-8	355.429	lf (al)	187.5		1.045		i H ₂ O; s Et OH, chl, aci d
6408	Isocorydi ne		$\text{C}_{10}\text{H}_{17}\text{NO}_4$	475-67-2	341.402	pl	185				vs chl
6409	2-Isocyanat o-1,3-di met hyl benzene	2,6-Di met hyl phenyl i socyanat e	$\text{C}_8\text{H}_9\text{NOC}$	28556-81-2	147.173	li q		109			
6410	1-Isocyanat o-2-met hoxybenzene		$\text{C}_8\text{H}_9\text{NO}_2$	700-87-8	149.148			94 ¹⁷			
6411	1-Isocyanat o-3-met hoxybenzene		$\text{C}_8\text{H}_9\text{NO}_2$	18908-07-1	149.148			102 ¹⁵			
6412	1-Isocyanat o-2-met hyl benzene	2-Tol yl i socyanat e	$\text{C}_8\text{H}_9\text{NO}$	614-68-6	133.148			185		1.5282 ²⁰	i H ₂ O; s et h
6413	1-Isocyanat o-3-met hyl benzene	3-Tol yl i socyanat e	$\text{C}_8\text{H}_9\text{NO}$	621-29-4	133.148			196.5	1.0330 ²⁰		vs bz, et h
6414	1-Isocyanat o-4-met hyl benzene	4-Tol yl i socyanat e	$\text{C}_8\text{H}_9\text{NO}$	622-58-2	133.148			187			vs bz, et h
6415	2-Isocyanat o-2-met hyl propane	<i>tert</i> But yl i socyanat e	$\text{C}_4\text{H}_9\text{NO}$	1609-86-5	99.131		85.5		0.8670 ⁷	1.4061 ²⁰	
6416	1-Isocyanat onapht hal ene	1-Napht hyl i socyanat e	$\text{C}_{11}\text{H}_9\text{NO}$	86-84-0	169.180			269	1.1774 ²⁰		s et h, bz
6417	1-Isocyanat o-2-ni t robenzene	2-Ni t rophenyl i socyanat e	$\text{C}_7\text{H}_7\text{NOC}$	3320-86-3	164.118	wh nd (pet h)	41	137 ⁹			vs bz, et h, chl
6418	1-Isocyanat o-3-ni t robenzene	3-Ni t rophenyl i socyanat e	$\text{C}_7\text{H}_7\text{NOC}$	3320-87-4	164.118	wh lf (li g)	51	190			vs bz, et h, chl
6419	1-Isocyanat o-4-ni t robenzene	4-Ni t rophenyl i socyanat e	$\text{C}_7\text{H}_7\text{NOC}$	100-28-7	164.118	pa ye nd	57	162 ²⁰ , 137 ¹¹			vs bz, et h, chl
6420	2-Isocyanat opropane	Isopropyl i socyanat e	$\text{C}_4\text{H}_9\text{NO}$	1795-48-8	85.105			74.5	0.866 ²⁵	1.3825 ²⁰	
6421	1-Isocyanat o-3-(t ri fluoromet hyl) benzene	3-(Tri fluoromet hyl)phenyl i socyanat e	$\text{C}_8\text{H}_6\text{F}_3\text{NO}$	329-01-1	187.119			54 ¹¹	1.3455 ²⁰	1.4690 ²⁰	
6422	Isocyanobenzene	Phenyl i socyani de	$\text{C}_6\text{H}_5\text{N}$	931-54-4	103.122	unst ab li q		80	0.98 ¹⁵		
6423	Isocyanomet hane	Met hyl i socyani de	$\text{C}_2\text{H}_5\text{N}$	593-75-9	41.052		-45	exp 59.6	0.756 ⁴		
6424	(Isocyanomet hyl)benzene	Benzyl i socyani de	$\text{C}_8\text{H}_9\text{N}$	10340-91-7	117.149			dec 199; 93 ⁵⁵	0.972 ¹⁵	1.5193 ²⁰	
6425	2-Isocyanopropane	Isopropyl i socyani de	$\text{C}_4\text{H}_9\text{N}$	598-45-8	69.106			87	0.7596 ²⁵		i H ₂ O; msc Et OH, et h
6426	Isodecyl acryl at e		$\text{C}_{12}\text{H}_{24}\text{O}_2$	1330-61-6	212.329		-100	158 ⁵⁰	0.885 ²⁰	1.4416 ²⁰	
6427	Isodecyl di phenyl phosphat e		$\text{C}_{26}\text{H}_{31}\text{O}_4\text{P}$	29761-21-5	390.452			249 ¹⁰ dec			
6428	Isodecyl met hacryl at e		$\text{C}_{18}\text{H}_{36}\text{O}_2$	29964-84-9	226.355			126 ¹⁰	0.876 ²⁰		
6429	8-Isost rone		$\text{C}_{10}\text{H}_{18}\text{O}_2$	517-06-6	270.367	pr (MeOH)	254				vs et h, Di ox
6430	Isoeugenol		$\text{C}_{10}\text{H}_{12}\text{O}_2$	97-54-1	164.201			266	1.080 ²⁵	1.5739 ¹⁹	vs et h, Et OH
6431	Isofenphos		$\text{C}_6\text{H}_9\text{NO}_4\text{PS}$	25311-71-1	345.395		<-12	120 ^{0.01}	1.134 ²⁰		
6432	Isoflurophat e		$\text{C}_8\text{H}_9\text{FO}_3\text{P}$	55-91-4	184.145			62 ⁹	1.055 ²⁵	1.3830 ²⁵	sl H ₂ O, li g; s et h; vs oi ls
6433	1 <i>H</i> -Isoi ndole-1,3(2 <i>H</i>)-di one	Pht hal i mi de	$\text{C}_8\text{H}_9\text{NO}_2$	85-41-6	147.132	nd (w), pr (HOAc) lf (sub)	238				vs bz
6434	Isolan		$\text{C}_{10}\text{H}_{17}\text{N}_3\text{O}_2$	119-38-0	211.261	col li q		118	1.07 ²⁰		msc H ₂ O; s Et OH, xyl



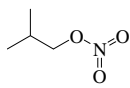
Isobut ylmet hacryl at e



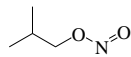
Isobut yl3-met hyl but anoat e



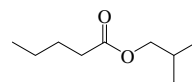
Isobut ylmet hylet her



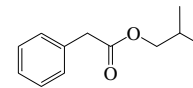
Isobut ylini t rat e



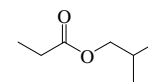
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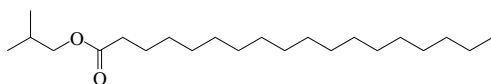
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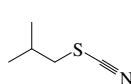
Isobut ylphenyl acet at e



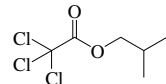
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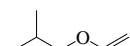
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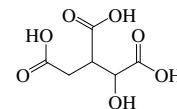
Isobut ylt hi ocyanat e



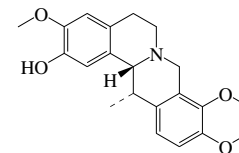
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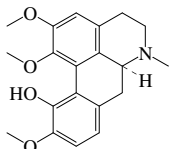
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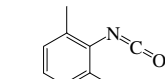
Isoci t riaci d



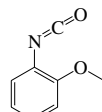
Isocorybul bi ne



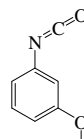
Isocorydi ne



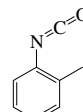
2-Isocyanat o-1,3-di met hyl benzene



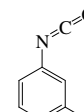
1-Isocyanat o-2-met hoxybenzene



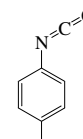
1-Isocyanat o-3-met hoxybenzene



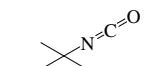
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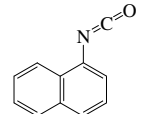
1-Isocyanat o-3-met hyl benzene



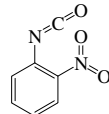
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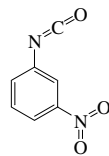
2-Isocyanat o-2-met hyl propane



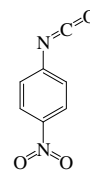
1-Isocyanat onapht hal ene



1-Isocyanat o-2-ni t robenzene



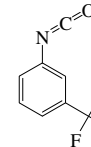
1-Isocyanat o-3-ni t robenzene



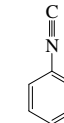
1-Isocyanat o-4-ni t robenzene



2-Isocyanat opropane



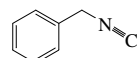
1-Isocyanat o-3-(t ri f luoromet hyl)benzene



Isocyanobenzene



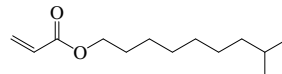
Isocyanomet hane



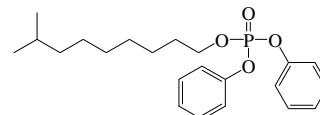
(Isocyanomet hyl)benzene



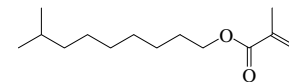
2-Isocyanopropane



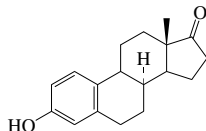
Isodecyl acryl at e



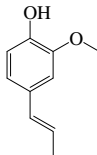
Isodecyl di phenylphospat e



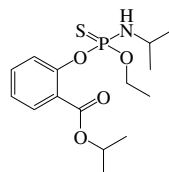
Isodecyl met hacryl at e



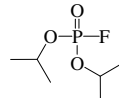
8-Isoeu rone



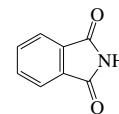
Isoeu genol



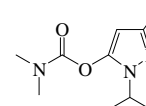
Isof enphos



Isol urophat e

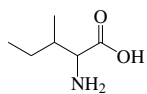


1*H*-Isi ndole-1,3(2*H*)-di one

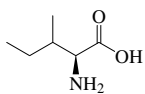


Isolan

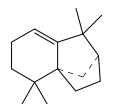
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6435	<i>DL</i> -Isolucine		$C_6H_{13}NO_2$	443-79-8	131.173		292 dec				
6436	<i>L</i> -Isolucine	2-Amino-3-methylpentanoic acid	$C_6H_{13}NO_2$	73-32-5	131.173		284 dec				s H ₂ O; i Et OH
6437	Isolongifolene		$C_{24}H_{44}$	1135-66-6	204.352	liq		82 ⁴			
6438	Isolysergic acid		$C_{16}H_{16}N_2O_2$	478-95-5	268.310	cry (w+2)	218 dec				sl H ₂ O, Et OH; s py
6439	α -Isomaltose	6 β - α -D-Glucopyranosyl-D-glucose	$C_{12}H_{22}O_{11}$	499-40-1	342.296		120				
6440	Isoniazid	4-Pyridinecarboxylic acid hydrazide	$C_6H_7N_3O$	54-85-3	137.139	cry (al)	171.4				vs H ₂ O, Et OH
6441	Isopentane	2-Methylbutane	C_5H_{12}	78-78-4	72.149	volatile liq or gas	-159.77	27.88	0.620 ⁴	1.3537 ²⁰	i H ₂ O; msc Et OH, et h
6442	Isopentyl acetate		$C_7H_{14}O_2$	123-92-2	130.185	liq	-78.5	142.5	0.876 ⁶	1.4000 ²⁰	sl H ₂ O; msc Et OH, et h; s ace, chl
6443	Isopentyl benzene		C_9H_{16}	2049-94-7	148.245			195	0.856 ²⁰	1.4867 ¹⁰	i H ₂ O; s Et OH, et h; vs bz
6444	Isopentyl butanoate		$C_{11}H_{20}O_2$	106-27-4	158.238			179	0.865 ¹⁹	1.4110 ²⁰	i H ₂ O; vs Et OH, et h
6445	Isopentyl formate		$C_6H_{12}O_2$	110-45-2	116.158	liq	-93.5	123.5	0.877 ⁷	1.3967 ²⁰	sl H ₂ O, ct c; s Et OH; msc et h
6446	Isopentyl hexanoate	Isopentyl caproate	$C_{11}H_{20}O_2$	2198-61-0	186.292			225.5	0.861 ²⁰		i H ₂ O; s Et OH, et h
6447	Isopentyl α -hydroxybenzoate	Isopentyl mandelate	$C_{13}H_{18}O_3$	5421-04-5	222.280	oil y liq		172			
6448	Isopentyl isopentanoate	Isoamyl isovalerate	$C_{10}H_{20}O_2$	659-70-1	172.265			190.4	0.8583 ¹⁹	1.4130 ¹⁹	
6449	Isopentyl lactate		$C_7H_{12}O_3$	19329-89-6	160.211			202.4	0.9589 ²⁵	1.4240 ²⁵	vs et h, Et OH
6450	Isopentyl 2-methylpropanoate	Isopentyl isobutyrate	$C_8H_{16}O_2$	2050-01-3	158.238			168.5	0.8627 ²⁰		sl H ₂ O; s Et OH, et h, ace
6451	Isopentyl nitrite	Isoamyl nitrite	$C_5H_{11}NO$	110-46-3	117.147			99.2	0.8828 ²⁰	1.3918 ²⁰	sl H ₂ O; msc Et OH, et h
6452	Isopentyl pentanoate		$C_{10}H_{20}O_2$	2050-09-1	172.265			193			
6453	Isopentyl propanoate		$C_7H_{14}O_2$	105-68-0	144.212			160.2	0.8697 ²⁰	1.4069 ²⁰	vs et h, Et OH
6454	Isopentyl salicylate		$C_{12}H_{16}O_3$	87-20-7	208.253			278; 151 ¹⁵	1.0535 ²⁰	1.5080 ²⁰	i H ₂ O; vs Et OH; s et h, chl; sl ct c
6455	Isopentyl tricloroacetate		$C_7H_7Cl_3O_2$	57392-55-9	233.520			217	1.2314 ²⁰	1.4521 ²⁰	vs et h, Et OH
6456	Isophorone	3,5,5-Triethyl-2-cyclohexen-1-one	$C_{14}H_{26}O$	78-59-1	138.206	liq	-8.1	215.2	0.9255 ⁵	1.4766 ¹⁸	
6457	Isophorone diisocyanate		$C_{18}H_{30}N_2O_2$	4098-71-9	222.283		60	217 ¹⁰⁰	1.062 ²⁰		
6458	Isophthalic acid	1,3-Benzenedicarboxylic acid	$C_8H_6O_4$	121-91-5	166.132	nd (w, al)	347	sub			sl H ₂ O; s Et OH, HOAc; i et h, bz, li g
6459	Isoplosine		$C_{18}H_{18}N_2O_3$	491-88-3	286.325	pl (al), pr (w, dil)	187				vs Et OH
6460	Isopropalin	Benzenamine, 4-(1-methyl-2-(4-nitrophenyl)ethyl)-2,6-	$C_{15}H_{23}N_3O_4$	33820-53-0	309.362	red-orange liq					i H ₂ O; s os
6461	Isopropamide		$C_3H_7N_2O$	71-81-8	480.424	cry or pow	190				s H ₂ O, Et OH, MeOH; i chl
6462	Isopropenyl acetate		$C_6H_{10}O_2$	108-22-5	100.117	liq	-92.9	94	0.909 ⁹	1.4033 ²⁰	sl H ₂ O; s Et OH, chl, ace; vs et h
6463	Isopropenyl benzene	α -Methylstyrene	C_9H_{10}	98-83-9	118.175	liq	-23.2	165.4	0.910 ⁶	1.5386 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, ct c
6464	<i>p</i> -Isopropenyl isopropyl benzene		$C_{16}H_{22}$	2388-14-9	160.255	liq	-30.6	220.8	0.893 ⁶	1.5238 ²⁰	vs ace, bz, et h, Et OH
6465	<i>p</i> -Isopropenylstyrene		$C_{14}H_{18}$	16262-48-9	144.213	liq		242	0.93	1.568 ⁴	
6466	4-Isopropoxydiphenylamine	4-Isopropoxy-N-phenylaniline	$C_{17}H_{17}NO$	101-73-5	227.302		83				
6467	2-Isopropoxyethanol		$C_7H_{14}O_2$	109-59-1	104.148			145	0.9030 ²⁰	1.4095 ²⁰	msc H ₂ O, Et OH, et h; s ace
6468	3-Isopropoxypropanetriole	1-Cyano-2-isopropoxyethane	$C_7H_{13}NO$	110-47-4	113.157			65 ¹⁰			s chl
6469	Isopropyl acetate		$C_7H_{14}O_2$	108-21-4	102.132	liq	-73.4	88.6	0.871 ⁸	1.3773 ²⁰	s H ₂ O, Et OH, ace, chl; msc et h
6470	Isopropyl acrylate	Isopropyl 2-propenoate	$C_9H_{16}O_2$	689-12-3	114.142	liq		5 ¹³			
6471	Isopropylamine	2-Propanamine	C_3H_7N	75-31-0	59.110	liq	-95.13	31.76	0.689 ⁴	1.3742 ²⁰	msc H ₂ O, Et OH, et h; vs ace; s bz, chl
6472	Isopropylamine hydrochloride	2-Propanamine hydrochloride	C_3H_7ClN	15572-56-2	95.571		164				s DMSO
6473	2-(Isopropylamino)ethanol		$C_7H_{13}NO$	109-56-8	103.163		128.5	173	0.8970 ²⁰	1.4395 ²⁰	msc H ₂ O, Et OH, et h
6474	2-Isopropylaniline		C_9H_9N	643-28-7	135.206			221; 95 ¹³	0.9760 ¹²		i H ₂ O; s et h, bz, ct c
6475	4-Isopropylaniline	Cumidine	C_9H_9N	99-88-7	135.206			225	0.953 ²⁰		
6476	<i>N</i> -Isopropylaniline		C_9H_9N	768-52-5	135.206			203	0.9526 ²⁵	1.5380 ²⁰	s Et OH, et h, ace, bz



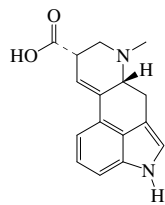
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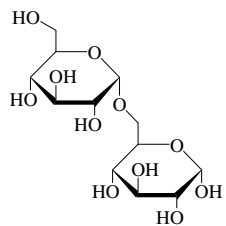
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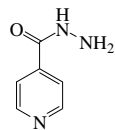
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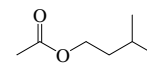
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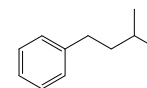
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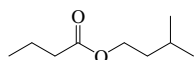
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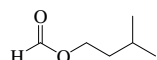
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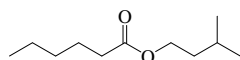
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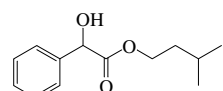
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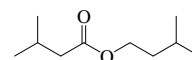
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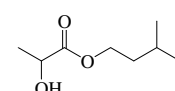
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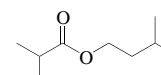
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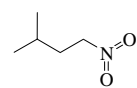
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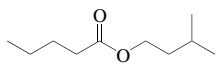
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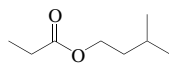
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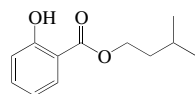
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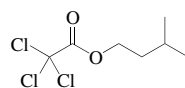
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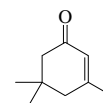
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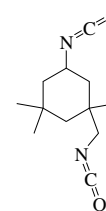
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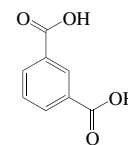
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Isophorone

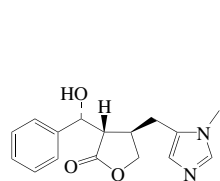


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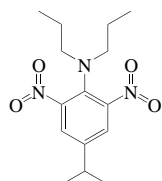


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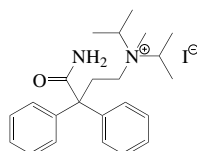
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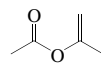
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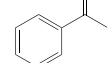
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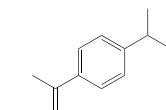
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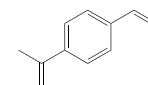
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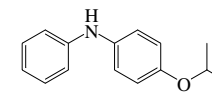
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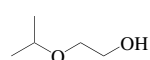
p-Isopropenyl i sopropyl benzen



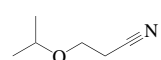
p-Isopropenyl st yrene



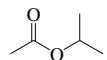
4-Isopropoxydi phenyl ami ne



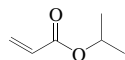
2-Isopropoxyet hanol



3-Isopropoxypropaneni t ri l e



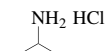
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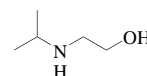
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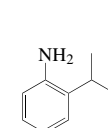
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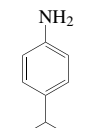
Isopropyl ami n hydrochl ori de



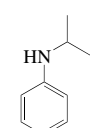
2-(Isopropyl ami no)et hanol



2-Isopropyl ani li ne

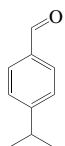


4-Isopropyl ani li ne



N-Isopropyl ani li ne

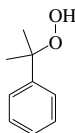
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	<i>n</i> _D	Solubility
6477	4-Isopropyl benzaldehyde	Cuminaldehyde	$C_{10}H_{12}O$	122-03-2	148.201			235.5	0.9755 ²⁰	1.5301 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
6478	Isopropyl benzene	Cumene	C_9H_{12}	98-82-8	120.191	liq	-96.02	152.41	0.8640	1.4915 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
6479	Isopropyl benzene hydroperoxide	Cumene hydroperoxide	$C_9H_{12}O_2$	80-15-9	152.190	liq		153; 84	1.03 ²⁰		
6480	4-Isopropyl benzenemethanol	Cuminalcohol	$C_{10}H_{14}O$	536-60-7	150.217		28	249	0.9818 ²⁰	1.5210 ²⁰	i H ₂ O; msc Et OH, et h; vs bz
6481	α -Isopropyl benzenemethanol	1-Phenyl-2-methylpropyl alcohol	$C_{10}H_{14}O$	611-69-8	150.217			223	0.9869 ¹⁴	1.5193 ¹⁴	i H ₂ O; s Et OH, ace
6482	Isopropyl benzoate		$C_{10}H_{12}O_2$	939-48-0	164.201			216	1.0163 ¹⁵	1.4890 ²⁰	i H ₂ O; s Et OH, et h, ace
6483	4-Isopropyl benzoic acid	Cumic acid	$C_{10}H_{12}O_2$	536-66-3	164.201	tbl pl (al)	117.5	sub	1.182		sl H ₂ O; vs Et OH, et h; s pet h
6484	Isopropyl butanoate		$C_{11}H_{14}O_2$	638-11-9	130.185			130.5	0.8588 ²⁰	1.3936 ²⁰	i H ₂ O; s Et OH
6485	Isopropyl carbamate		$C_8H_{12}NO_2$	1746-77-6	103.120	nd	93	183	0.9951 ⁶⁸		
6486	Isopropyl chloroacetate		$C_8H_{13}ClO_2$	105-48-6	136.577			150.5	1.0888 ²⁰	1.4382 ²⁰	vs et h
6487	Isopropyl chloroformate		$C_7H_9ClO_2$	108-23-6	122.551			105		1.4013 ²⁰	vs et h
6488	Isopropyl 2-chloropropanoate		$C_9H_{11}ClO_2$	40058-87-5	150.603			151.5	1.0315 ²⁰	1.4149 ²⁰	i H ₂ O; s Et OH, et h
6489	Isopropyl cyclohexane		C_8H_{18}	696-29-7	126.239	liq	-89.4	154.8	0.8029	1.4410 ²⁰	i H ₂ O; vs Et OH, et h; msc ace, bz
6490	4-Isopropyl cyclohexanone		$C_{10}H_{18}O$	5432-85-9	140.222			214; 139 ¹⁰⁰	0.9099 ³⁰	1.4552 ²⁵	
6491	Isopropyl cyclopentane		C_8H_{16}	3875-51-2	112.213	liq	-111.4	126.5	0.7769	1.4258 ²⁰	i H ₂ O; msc Et OH, ace, ct c; s et h, bz
6492	Isopropyl cyclopropane		C_6H_{12}	3638-35-5	84.159	liq	-112.9	58.3	0.6938	1.3865 ²⁰	
6493	Isopropyl (2,4-dichlorophenoxy)acetate		$C_{11}H_{12}Cl_2O_3$	94-11-1	263.117		5	140 ¹	1.26 ²⁵	1.5209 ²⁵	
6494	<i>M</i> -Isopropyl-4,4-diphenylcyclohexanamine	Pramipexifen	$C_{27}H_{27}N$	14334-40-8	293.446		70	165 ⁰⁵			
6495	Isopropyl dodecanoate	Isopropyl laurate	$C_{19}H_{38}O_2$	10233-13-3	242.398			196 ⁶⁰ ; 105 ⁰⁸	0.8536 ²⁰	1.4280 ²⁵	vs et h, Et OH
6496	Isopropyl formate		$C_6H_8O_2$	625-55-8	88.106			68.2	0.8728 ²⁰	1.3678 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace; s chl
6497	Isopropyl 2-fulancarboxylate	Isopropyl 2-fulanoate	$C_8H_{10}O_3$	6270-34-4	154.163			198.5	1.0655 ²⁴	1.4682 ²⁴	i H ₂ O; s Et OH, et h, ace, bz
6498	Isopropyl glycidyl ether	(1-Methyl ethoxy)methyl oxirane	$C_8H_{14}O_2$	4016-14-2	116.158			137	0.9186 ²⁰		s H ₂ O, ace, Et OH
6499	4-Isopropyl heptane		$C_{10}H_{22}$	52896-87-4	142.282			158.9	0.7354 ²⁵	1.4153 ²⁰	
6500	Isopropyl hydrazine		$C_8H_{16}N_2$	2257-52-5	74.124	liq		107			s H ₂ O, bz, Et OH; sl et h
6501	Isopropyl 2-hydroxybenzoate	Isopropyl salicylate	$C_{10}H_{12}O_3$	607-85-2	180.200			238	1.0729 ²⁰	1.5065 ²⁰	i H ₂ O; msc Et OH, et h
6502	Isopropyl isobutanoate	Isopropyl isobutyrate	$C_9H_{18}O_2$	617-50-5	130.185			120.7	0.8471 ²¹		i H ₂ O; s Et OH, et h, ace
6503	Isopropyl lactate		$C_8H_{14}O_3$	617-51-6	132.157			167	0.9980 ²⁰	1.4082 ²⁵	vs H ₂ O, bz, et h, Et OH
6504	Isopropyl methacrylate	Isopropyl 2-methyl-2-propenoate	$C_{10}H_{18}O_2$	4655-34-9	128.169			125	0.8847 ²⁰	1.4122 ²⁰	vs ace, bz, et h, Et OH
6505	Isopropyl methanesulfonylate		$C_8H_{16}O_3S$	926-06-7	138.185			82 ⁶			
6506	Isopropyl methanamine	Methylisopropylamine	$C_8H_{17}N$	4747-21-1	73.137			50.4			
6507	1-Isopropyl-2-methylbenzene	<i>o</i> -Cymene	$C_{10}H_{14}$	527-84-4	134.218	liq	-71.5	178.1	0.8766	1.5006 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
6508	1-Isopropyl-3-methylbenzene	<i>m</i> -Cymene	$C_{10}H_{14}$	535-77-3	134.218	liq	-63.7	175.1	0.8610	1.4930 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
6509	1-Isopropyl-4-methylbenzene	<i>p</i> -Cymene	$C_{10}H_{14}$	99-87-6	134.218	liq	-67.94	177.1	0.8579	1.4909 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
6510	Isopropyl 3-methylbutanoate		$C_{11}H_{20}O_2$	32665-23-9	144.212			142; 70 ⁵⁵	0.8538 ¹⁷	1.3960 ²⁰	vs ace, et h, Et OH
6511	5-Isopropyl-2-methyl-1,3-cyclohexadiene, (E)		$C_{10}H_{16}$	4221-98-1	136.234			173	0.8421 ²⁰	1.4772 ¹⁹	
6512	5-Isopropyl-3-methyl-2-cyclohexen-1-one, (±)	Homocamfin	$C_{10}H_{16}O$	535-86-4	152.233	pa ye		244; 121 ¹⁵	0.9340 ²¹	1.4865 ²¹	vs ace, Et OH
6513	6-Isopropyl-3-methyl-2-cyclohexen-1-one, (±)	(±)-Piperitone	$C_{10}H_{16}O$	6091-52-7	152.233	liq	-19	232.5	0.9339 ¹	1.4845 ²⁰	vs ace, Et OH



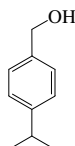
4-Isopropyl benzaldehyde



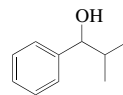
Isopropyl benzene



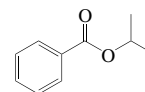
Isopropyl benzene hydroperoxide



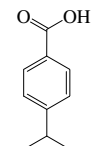
4-Isopropyl benzenemethanol



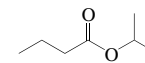
α-Isopropyl benzenemethanol



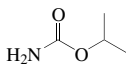
Isopropyl benzoate



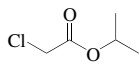
4-Isopropyl benzoic acid



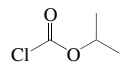
Isopropyl butanoate



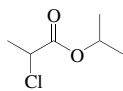
Isopropyl carbamate



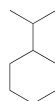
Isopropyl chloroacetate



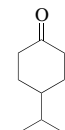
Isopropyl chloroformate



Isopropyl 2-chloropropanoate



Isopropyl cyclohexane



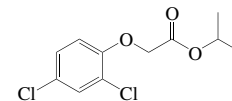
4-Isopropyl cyclohexanone



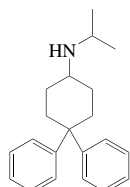
Isopropyl cyclopentane



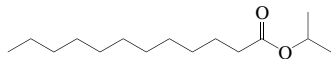
Isopropyl cyclopropane



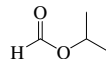
Isopropyl (2,4-dichlorophenoxy)acetate



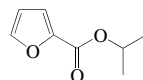
N-Isopropyl-4,4-diphenylcyclohexanamine



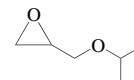
Isopropyl dodecanoate



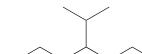
Isopropyl formate



Isopropyl 2-furancarboxylate



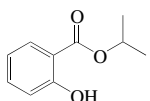
Isopropyl glycidyl ether



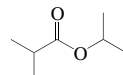
4-Isopropyl heptane



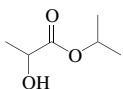
Isopropylhydrazine



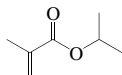
Isopropyl 2-hydroxybenzoate



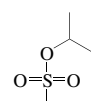
Isopropyl isobutanoate



Isopropyl lactate



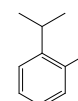
Isopropyl methacrylate



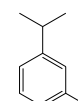
Isopropyl methanesulfonate



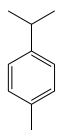
Isopropyl methylamine



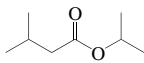
1-Isopropyl-2-methylbenzene



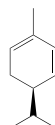
1-Isopropyl-3-methylbenzene



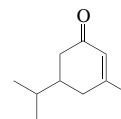
1-Isopropyl-4-methylbenzene



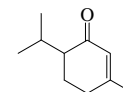
Isopropyl 3-methylbutanoate



5-Isopropyl-2-methyl-1,3-cyclohexadiene



5-Isopropyl-3-methyl-2-cyclohexen-1-one

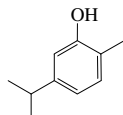


6-Isopropyl-3-methyl-2-cyclohexen-1-one

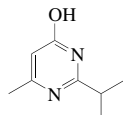
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6514	Isopropyl met hyl et her	2-Met hoxopropane	$\text{C}_6\text{H}_{14}\text{O}$	598-53-8	74.121			30.77	0.7237 ¹⁵	1.3576 ²⁰	sl H ₂ O; msc Et OH, et h
6515	5-Isopropyl-2-met hyl phenol	Carvacrol	$\text{C}_{10}\text{H}_{14}\text{O}$	499-75-2	150.217	nd	1	237.7	0.9772 ²⁰	1.5230 ²⁰	sl H ₂ O; s Et OH, et h, ct c; vs ace
6516	2-Isopropyl-6-met hyl-4-pyri mi di nol		$\text{C}_8\text{H}_{14}\text{O}_2$	2814-20-2	152.193	cry	173				
6517	Isopropyl met hyl sul fide		$\text{C}_8\text{H}_{16}\text{S}$	1551-21-9	90.187	li q	-101.5	84.8	0.829 ⁹	1.4932 ²⁰	s Et OH, et h, ace
6518	1-Isopropyl naphthalene		$\text{C}_{14}\text{H}_{14}$	6158-45-8	170.250	li q	-16	268	0.995 ⁶	1.5952 ²⁰	
6519	2-Isopropyl naphthalene		$\text{C}_{14}\text{H}_{14}$	2027-17-0	170.250		14.5	268.2	0.9753 ²⁰	1.5848 ²⁰	i H ₂ O; vs Et OH, et h; s bz
6520	Isopropyl nitrate		$\text{C}_3\text{H}_7\text{NO}_3$	1712-64-7	105.093			100	1.034 ¹⁹	1.3912 ¹⁶	s Et OH, et h
6521	Isopropyl nitrite		$\text{C}_3\text{H}_7\text{NO}_2$	541-42-4	89.094	pa ye oi l		40	0.868 ⁴		i H ₂ O; s Et OH, et h
6522	1-Isopropyl-4-nitrobenzene		$\text{C}_9\text{H}_{11}\text{NO}_2$	1817-47-6	165.189	pa ye oi l		122	1.084 ²⁰	1.5367 ²⁰	i H ₂ O; s ace, bz, li g
6523	<i>N</i> -Isopropyl- <i>N</i> -nitroso-2-propanamine		$\text{C}_6\text{H}_{14}\text{N}_2\text{O}$	601-77-4	130.187	cry (et h,w)	48	194.5	0.9422 ⁹		sl H ₂ O; s Et OH, et h, bz
6524	Isopropyl 3-oxobutanoate	Isopropyl acetate	$\text{C}_7\text{H}_{14}\text{O}_3$	542-08-5	144.168	li q	-27.3	186	0.983 ⁵	1.4173 ²⁰	vs et h, Et OH, li g
6525	Isopropyl palmitate	Isopropyl hexadecanoate	$\text{C}_{19}\text{H}_{38}\text{O}_2$	142-91-6	298.504		13.5	160 ²	0.8404 ³⁸	1.4364 ²⁵	vs ace, bz, et h, Et OH
6526	Isopropyl pentanoate		$\text{C}_{10}\text{H}_{18}\text{O}_2$	18362-97-5	144.212				0.8579 ²⁰	1.4061 ²⁰	i H ₂ O; s Et OH, et h, ace
6527	2-Isopropylphenol		$\text{C}_9\text{H}_{10}\text{O}$	88-69-7	136.190		15.5	213.5	1.012 ²⁰	1.5315 ²⁰	sl H ₂ O; s Et OH, et h, bz, ct c
6528	3-Isopropylphenol		$\text{C}_9\text{H}_{10}\text{O}$	618-45-1	136.190		26	228		1.5261 ²⁰	vs et h
6529	4-Isopropylphenol		$\text{C}_9\text{H}_{10}\text{O}$	99-89-8	136.190	nd (pet h)	62.3	230; 110 ⁹	0.990 ²⁰	1.5228 ²⁰	sl H ₂ O; s Et OH, chl
6530	<i>N</i> -Isopropyl- <i>N</i> -phenyl-1,4-benzenediamine		$\text{C}_{13}\text{H}_{18}\text{N}_2$	101-72-4	226.317		72.5	148 ²			
6531	Isopropyl phenylcarbamate	Propham	$\text{C}_9\text{H}_{13}\text{NO}_2$	122-42-9	179.216	wh nd (al)	90		1.09 ⁹	1.4989 ⁹¹	vs bz, Et OH
6532	1-(4-Isopropylphenyl)ethanone		$\text{C}_{14}\text{H}_{18}\text{O}$	645-13-6	162.228			254	0.9753 ¹⁵	1.5235 ²⁰	
6533	Isopropyl propanoate		$\text{C}_7\text{H}_{14}\text{O}_2$	637-78-5	116.158			109.5	0.8660 ²⁰	1.3872 ²⁰	sl H ₂ O; msc Et OH, et h
6534	<i>N</i> -Isopropyl-2-propanamine		$\text{C}_7\text{H}_{15}\text{NO}$	2210-25-5	113.157		64.5	110 ¹⁵			
6535	Isopropylpropylamine	<i>N</i> -Propyl-2-propanamine	$\text{C}_9\text{H}_{19}\text{N}$	21968-17-2	101.190			96.9			
6536	Isopropyl propyl sulfide		$\text{C}_9\text{H}_{18}\text{S}$	5008-73-1	118.240			132.1	0.8269 ²⁰		
6537	4-Isopropylpyridine		$\text{C}_9\text{H}_{11}\text{N}$	696-30-0	121.180	li q	-54.9	178	0.938 ²	1.4962 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace
6538	Isopropyl 3-pyridinecarboxylate	Isopropyl nicotinate	$\text{C}_{11}\text{H}_{13}\text{NO}_2$	553-60-6	165.189			126 ³⁰ , 92.5 ⁵	1.0624 ²⁰	1.4926 ²⁰	
6539	Isopropyl silicate	Tetra(isopropoxy)silane	$\text{C}_{12}\text{H}_{26}\text{O}_4\text{Si}$	1992-48-9	264.434			184	0.877 ⁹		s ct c, C ₅
6540	Isopropyl stearate		$\text{C}_{24}\text{H}_{46}\text{O}_2$	112-10-7	326.557		28	207 ⁶	0.8403 ³⁸		vs ace, et h, Et OH, chl
6541	4-Isopropylstyrene		$\text{C}_{14}\text{H}_{14}$	2055-40-5	146.229	li q	-44.7	204.1	0.885 ⁹	1.5289 ²⁰	vs ace, bz, et h, Et OH
6542	Isopropyl tetradecanoate	Isopropyl myristate	$\text{C}_{17}\text{H}_{34}\text{O}_2$	110-27-0	270.451			193 ²⁰ , 140 ²	0.8532 ²⁰	1.4325 ²⁵	i H ₂ O; s Et OH, et h, chl; vs ace, bz
6543	(Isopropylthio)benzene		$\text{C}_9\text{H}_{12}\text{S}$	3019-20-3	152.256			208	0.9852 ²⁰	1.5464 ²⁰	
6544	Isopropyl trichloroacetate		$\text{C}_9\text{H}_{11}\text{Cl}_3\text{O}_2$	3974-99-0	205.468			175; 66 ¹⁵	1.2911 ²⁵	1.4428 ²⁰	vs bz, et h, Et OH
6545	Isopropyl urea		$\text{C}_6\text{H}_{10}\text{N}_2\text{O}$	691-60-1	102.134	nd		103 ^{0.1}			s H ₂ O, Et OH, chl, ace; sl et h
6546	Isopropyl vinyl ether	2-(Ethenoxy)propane	$\text{C}_5\text{H}_{10}\text{O}$	926-65-8	86.132	li q	-140	55.5	0.753 ⁴	1.3840 ²⁰	vs ace, bz, et h, Et OH
6547	Isoprotrenol	4-[1-Hydroxy-2-(isopropylamino)ethyl]-1,2-benzenediol	$\text{C}_{11}\text{H}_{17}\text{NO}_3$	7683-59-2	211.258		170.5				
6548	Isosoralen		$\text{C}_{11}\text{H}_{16}\text{O}_3$	523-50-2	186.164		139				
6549	1-Isoquinoline		$\text{C}_8\text{H}_7\text{N}$	1532-84-9	144.173	pl (w)	123	16 ⁴			sl H ₂ O, et h; vs Et OH
6550	3-Isoquinoline		$\text{C}_8\text{H}_7\text{N}$	25475-67-6	144.173		178.5				
6551	Isoquinoline	Benzo[c]pyridine	$\text{C}_9\text{H}_7\text{N}$	119-65-3	129.159	hyg pl	26.47	243.22	1.091 ⁹⁰	1.6148 ²⁰	i H ₂ O; vs Et OH, chl; msc et h, bz
6552	7-Isoquinoline		$\text{C}_8\text{H}_7\text{NO}$	7651-83-4	145.158		230				sl H ₂ O, et h; s Et OH
6553	Isosorbide		$\text{C}_8\text{H}_{16}\text{O}_4$	652-67-5	146.141		63	170 ²			
6554	Isosorbide dinitrate	1,4:3,6-Di anhydroglucitol	$\text{C}_8\text{H}_{10}\text{N}_2\text{O}_6$	87-33-2	236.136	col cry	52				vs Et OH, et h, ace
6555	Isosystoxin	Demeton-S	$\text{C}_{13}\text{H}_{19}\text{O}_3\text{PS}_2$	126-75-0	258.339	li q		133	1.132 ²¹		s H ₂ O



Isopropyl met hylet her



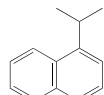
5-Isopropyl -2-met hyl phenol



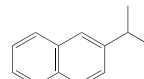
2-Isopropyl -6-met hyl -4-pyri mi di nol



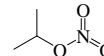
Isopropyl met hylsul f i de



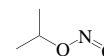
1-Isopropyl naph t hal ene



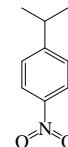
2-Isopropyl naph t hal ene



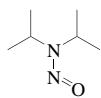
Isopropyl ni t rat e



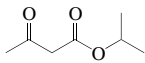
Isopropyl ni t ri t e



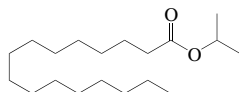
1-Isopropyl -4-ni t robenzene



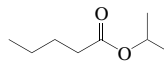
N-Isopropyl -*N*-ni t roso-2-propanami ne



Isopropyl 3-oxobut anoat e



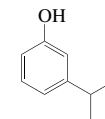
Isopropyl pal mi t at e



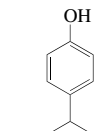
Isopropyl pent anoat e



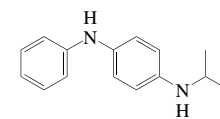
2-Isopropyl phenol



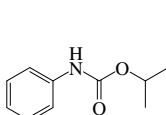
3-Isopropyl phenol



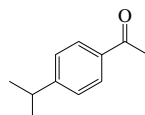
4-Isopropyl phenol



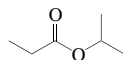
N-Isopropyl -*N*'-phenyl -1,4-benzenedi ami ne



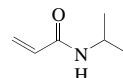
Isopropyl phenyl carbamat e



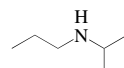
1-(4-Isopropyl phenyl)et hanone



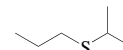
Isopropyl propanoat e



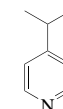
N-Isopropyl -2-propenami de



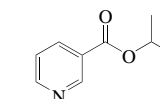
Isopropyl propyl ami ne



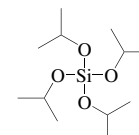
Isopropyl propyl sul f i de



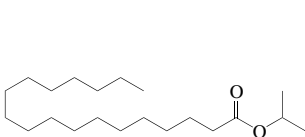
4-Isopropyl pyri di ne



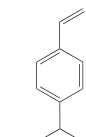
Isopropyl 3-pyri di ncarboxyl at e



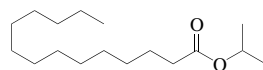
Isopropyl si li cat e



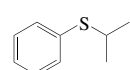
Isopropyl st earat e



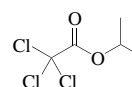
4-Isopropyl st yrene



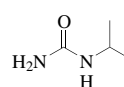
Isopropyl t et radecanoat e



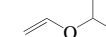
(Isopropyl t hi o)benzene



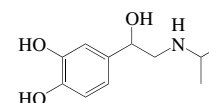
Isopropyl t ri chl oroacet at e



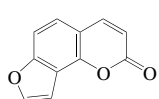
Isopropyl urea



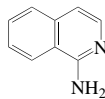
Isopropyl vi nylet her



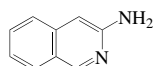
Isoprot erenol



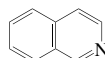
Isopsoralen



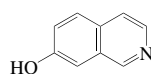
1-Isoqui nol i nami ne



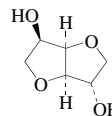
3-Isoqui nol i nami ne



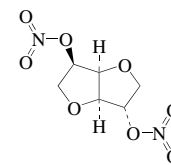
Isoqui nol i ne



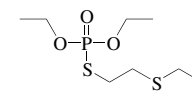
7-Isoqui nol i nol



Isosorbi de

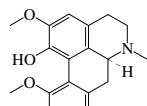


Isosorbi dedi ni t rat e

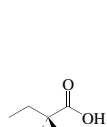
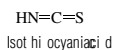


Isosyst ox

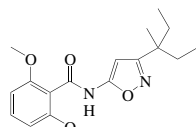
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6556	Isot hebai ne		C ₉ H ₂₁ NO ₃	568-21-8	311.375	ort h cry (al)	203.5				s ₂ θ; msc Et OH, chl; sl et h; s MeOH
6557	Isot hi ocyani c aci d		CHNS	3129-90-6	59.091	unst ab gas					
6558	L-Isoval i ne	2-Ami no-2-met hyl but yri c aci d	C ₅ H ₁₁ NO ₂	595-40-4	117.147	nd (w)	≈300				s Et OH; sl et h
6559	Isoxaben		C ₁₈ H ₂₄ N ₂ O ₄	82558-50-7	332.395	wh cry	173				s Et OAc, MeCN, MeOH
6560	Isoxazol e	1-Oxa-2-azacycl opent adi ene	C ₃ H ₃ NO	288-14-2	69.062			95	1.078 ²⁰	1.4298 ¹⁷	s H ₂ O
6561	Isoxsupri ne		C ₉ H ₁₃ NO ₃	395-28-8	301.381	cry	103.0				
6562	Jacobi ne		C ₈ H ₂₅ NO ₆	6870-67-3	351.395	pl (Et OH)	228				
6563	Javani ci n		C ₈ H ₁₄ O ₆	476-45-9	290.268	red cry (al)	208 dec				s al k
6564	Jervi ne		C ₇ H ₃₉ NO ₃	469-59-0	425.604		243 dec				i H ₂ O; s Et OH, ace, chl; sl et h
6565	Kaempf erol		C ₆ H ₁₀ O ₆	520-18-3	286.236	ye nd (al, + 1 w)	277				sl H ₂ O, chl; vs Et OH, et h, ace; i bz
6566	Kai ni c aci d		C ₇ H ₁₅ NO ₄	487-79-6	213.231	cry (Et OH aq)	253 dec				s H ₂ O; i Et OH
6567	Kanamyci n A		C ₈ H ₃₆ N ₄ O ₁₁	59-01-8	484.499	cry (Et OH)					
6568	Kepone	Chl ordecone	C ₁₀ Cl ₁₀ O	143-50-0	490.636		350 dec		1.61 ²⁵		
6569	Ket ami ne	2-(2-Chl orophenyl)-2-(met hyl ami nyl)cycl ohexanone, (±)	C ₁₀ H ₁₆ ClNO	6740-88-1	237.725	cry (et h-pent ane)	92.5				
6570	Ket ene		CH ₂ O	463-51-4	42.036	col gas	-151	-49.8			sl et h, ace
6571	Khel l i n	4,9-Di met hoxy-7-met hyl-5-f uro[3,2-g][1]benzopyran-5-one	C ₁₄ H ₁₂ O ₅	82-02-0	260.242	et h, al	154 dec	190 ⁶⁵			i H ₂ O; s Et OH, ace; sl et h, chl
6572	L-Kynureni ne	Benzenebut anoi c aci d, 2-di ami no-γ-oxo-	C ₁₀ H ₁₂ N ₂ O ₃	343-65-7	208.213	lf (+1/2w)	191 dec				sl ₂ θ
6573	Labet al ol		C ₉ H ₂₄ N ₂ O ₃	36894-69-6	328.405	cry (MeOH)	164				
6574	DL-Lact i c aci d	2-Hydroxypropanoi c aci d, (±)	C ₃ H ₆ O ₃	598-82-3	90.078	ye cry	16.8	122 ¹⁵	1.2060 ²¹	1.4392 ²⁰	vs H ₂ O, Et OH; sl et h
6575	D-Lact i c aci d	D-2-Hydroxypropanoi c aci d	C ₃ H ₆ O ₃	10326-41-7	90.078	pl (chl)	53	103			vs H ₂ O, Et OH
6576	L-Lact i c aci d	L-2-Hydroxypropanoi c aci d	C ₃ H ₆ O ₃	79-33-4	90.078	hyg pr (et h)	25.5				vs H ₂ O, Et OH
6577	Lact of en		C ₇ H ₁₅ ClF ₅ NO ₇	77501-63-4	461.773	ye pow (bz)	93				
6578	δ-Lact one-D-gl uconi c aci d	δ-D-Gl uconol act one	C ₆ H ₁₀ O ₆	90-80-2	178.139	nd (al)					
6579	α-Lact ose		C ₁₂ H ₂₂ O ₁₁	14641-93-1	342.296	wh pow	222.8				vs H ₂ O; sl Et OH; i et h, chl
6580	β-D-Lact ose		C ₁₂ H ₂₂ O ₁₁	5965-66-2	342.296		254		1.59 ²⁰		vs H ₂ O; sl Et OH; i et h, chl
6581	α-Lact ose monohydrat e		C ₁₂ H ₂₄ O ₁₂	5989-81-1	360.312	mcl (w)	201 dec		1.547 ²⁰		vs H ₂ O; i Et OH, et h, chl, MeOH
6582	Lact ul ose	4β-D-Gal act opranosylD-f ruct ose	C ₁₂ H ₂₂ O ₁₁	4618-18-2	342.296	hx pl (MeOH)	169				vs H ₂ O
6583	Lami nari bi ose	α-β-D-Gl ucopyranosyl D-glucose	C ₁₂ H ₂₂ O ₁₁	34980-39-7	342.296		205				
6584	Lanost a-8,24-di en-3-ol, (β)	Lanost erol	C ₃₀ H ₅₀ O	79-63-0	426.717	nd (et h), cry (MeOH-ace)	140.5				vs et h, Et OH, chl
6585	Lant adene A	Rehmanni c aci d	C ₃₈ H ₅₂ O ₅	467-81-2	552.785	cry (MeOH)	297				
6586	Lant adene B		C ₃₈ H ₅₂ O ₅	467-82-3	552.785	cry (Et OH)	302				
6587	L-Lant hi oni ne	L-Cyst ei neS-(2-ami no-2-carboxy et hyl)-, (R)-	C ₆ H ₁₂ N ₂ O ₄ S	922-55-4	208.235	hex pl	294 dec				sl H ₂ O
6588	Lapachol	2-Hydroxy-3-(3-met hyl-2-but enyl)-1,4-napht halenedi one	C ₁₅ H ₁₄ O ₃	84-79-7	242.270	ye pr (et h, bz) pl (al)	139.5				i H ₂ O; s Et OH, et h, bz, chl; vs HOAc
6589	Lappaconi t i ne		C ₃₆ H ₄₄ N ₂ O ₈	32854-75-4	584.699	hex pl (al)	217.5				i H ₂ O; sl Et OH, et h; s bz, chl
6590	Lasi ocarpi ne		C ₇ H ₁₃ NO ₇	303-34-4	411.490	col pl (pet h)	95.5				sl ₂ θ; s Et OH, bz, et h
6591	Laudani di ne		C ₇ H ₂₅ NO ₄	301-21-3	343.418	hex pr (al)	184.5				vs H ₂ O, bz
6592	Laudani ne		C ₇ H ₂₅ NO ₄	85-64-3	343.418	ye wh pr (di l al, al-chl)	167		1.26 ²⁰		sl H ₂ O, Et OH, et h; s bz, chl
6593	Laudansi ne		C ₇ H ₂₇ NO ₄	2688-77-9	357.444	nd (pet h), pr (al)	89				vs ace, et h, Et OH, chl



Isot hebai ne



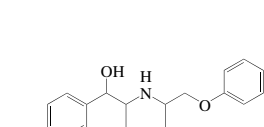
L-Isovali ne



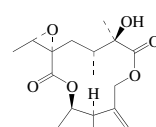
Isoxaben



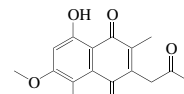
Isoxazol e



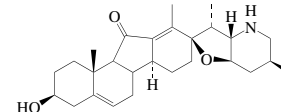
Isoxsupri ne



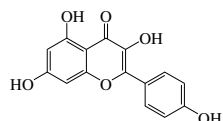
Jacobi ne



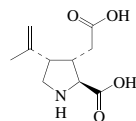
Javani ci n



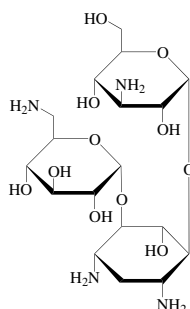
Jervi ne



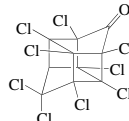
Kaempferol



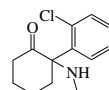
Kai ni aci d



Kanamyci nA



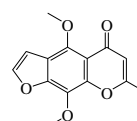
Kepone



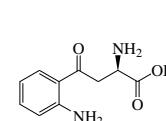
Ket ami ne



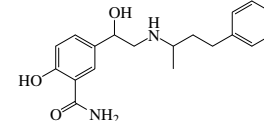
Ket ene



Kheli i n



L-Kynureni ne



Labet al ol

3-349



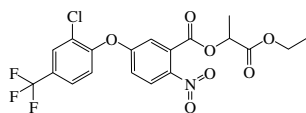
DL-Lact i aci d



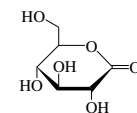
D-Lact i aci d



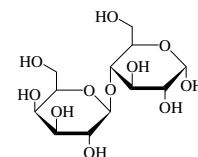
L-Lact i aci d



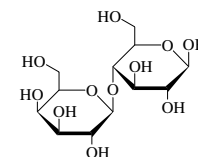
Lact of en



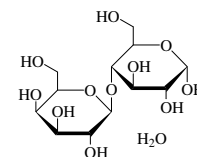
δ -Lact one-D-gluconi aci d



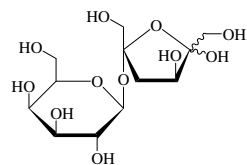
α -Lact ose



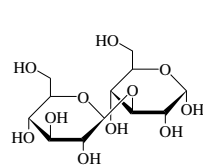
β -Lact ose



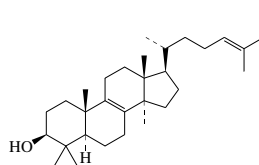
α -Lact osemonohydrat e



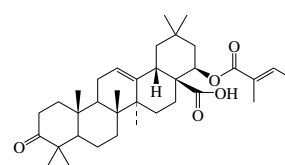
Lact ul ose



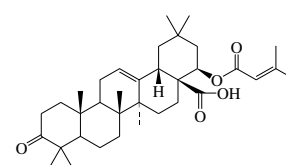
Lami nari bi ose



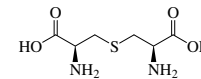
Lanost a-8,24-di en-3-ol(3B)



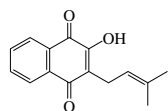
Lant adeneA



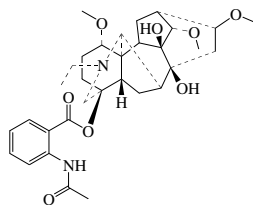
Lant adeneB



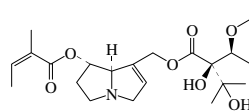
L-Lant hi oni ne



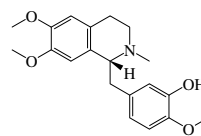
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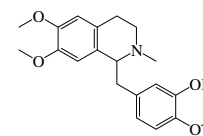
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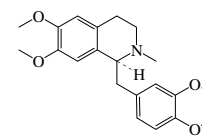
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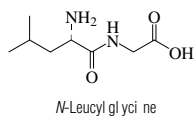
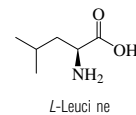
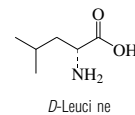
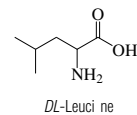
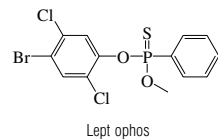
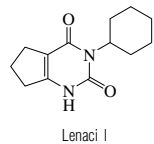
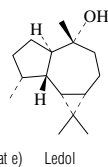
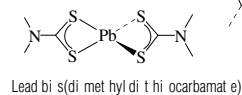
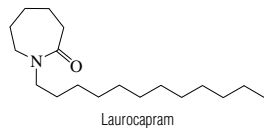
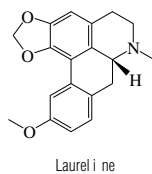


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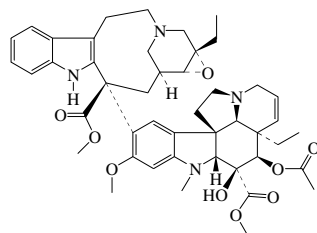
Laudanosi ne

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6594	Laureline		C ₉ H ₁₉ NO ₃	81-38-9	309.359	tab (al) cubes (pet h)	114				i H ₂ O; s Et OH, et h, di l aci d, con sul f
6595	Laurocapram	1-Dodecyl hexahydro-2 <i>H</i> -azepi n-2-one	C ₁₈ H ₃₅ NO	59227-89-3	281.477	col li q	-7	160	0.91	1.4701	i H ₂ O
6596	Lead bis (di met hyl di t hi ocarbamate)		C ₆ H ₁₂ N ₂ P ₂ S ₄	19010-66-3	447.6	pal e ye nd	258				
6597	Ledol		C ₁₅ H ₂₅ O	577-27-5	222.366	nd (al)	105	292	0.9078 ⁰⁰	1.4667 ¹¹⁰	vs ace, et h, Et OH
6598	Lenacil		C ₈ H ₁₈ N ₂ O ₂	2164-08-1	234.294		290		1.32 ²⁵		vs py
6599	Leptophos		C ₃ H ₁₀ BrCl ₂ O ₂ P ₂ S	21609-90-5	412.066	t an waxy sol i d	71		1.53		i H ₂ O; vs bz; s ace, 2-PrOH, xyl
6600	<i>DL</i> -Leucine		C ₆ H ₁₃ NO ₂	328-39-2	131.173	lf (w)	293	sub	1.293		s H ₂ O; sl Et OH; i et h
6601	<i>D</i> -Leucine		C ₆ H ₁₃ NO ₂	328-38-1	131.173	pl (al)	293	sub			sl H ₂ O
6602	<i>L</i> -Leucine	2-Amino-4-methylpentanoic acid	C ₆ H ₁₃ NO ₂	61-90-5	131.173	hex pl (di l al)	293	sub	1.293		sl H ₂ O; i Et OH, et h
6603	<i>N</i> -Leucylglycine		C ₁₁ H ₁₉ N ₂ O ₃	686-50-0	188.224		248 dec				s H ₂ O; sl Et OH, et h; i ace, bz, chl
6604	Leuproline		C ₉ H ₁₈ N ₂ O ₁₂	53714-56-0	1209.398	fluf f y sol i d					
6605	Leuroisine		C ₁₆ H ₂₅ N ₄ O ₉	23360-92-1	808.959	cry	203				
6606	Levallophan	17-Allylmorphinan-3-ol	C ₁₈ H ₂₅ NO	152-02-3	283.408	cry (Et OH aq)	181				
6607	Levodopa	<i>L</i> -3,4-Dihydroxyphenylalanine	C ₉ H ₉ NO ₄	59-92-7	197.188	pl (di l al) pr or nd (w+SO ₂)	277 dec				s H ₂ O; i Et OH, et h, ace, bz; s al k, MeOH
6608	Levomiscacid		C ₂₀ H ₃₁ O ₂	79-54-9	302.451	ort h cry	150				
6609	Levorphanol	17-Methylmorphinan-3-ol	C ₁₇ H ₂₃ NO	77-07-6	257.371	cry	198				
6610	<i>α</i> -Limonene	<i>p</i> -Menthane-1,8-diene, (R)	C ₁₀ H ₁₆	5989-27-5	136.234	oi l	-74.0	178	0.8414 ⁹	1.4730 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
6611	<i>β</i> -Limonene	<i>p</i> -Menthane-1,8-diene, (S)	C ₁₀ H ₁₆	5989-54-8	136.234	oi l		178; 64.4 ⁸	0.843 ²⁰	1.4746 ²⁰	i H ₂ O; vs et h, Et OH
6612	Linalol	3,7-Dimethyl-1,6-octadiene-3-ol, (±)	C ₁₀ H ₁₈ O	22564-99-4	154.249			198; 86 ¹³	0.870 ¹⁵	1.4627	
6613	Linalyl acetate	3,7-Dimethyl-1,6-octadiene-3-yl acetate	C ₁₂ H ₂₀ O ₂	115-95-7	196.286	li q		220; 44 ²	0.895 ²⁰	1.4460 ²⁰	i H ₂ O; mi sc Et OH, et h
6614	Lincosamine		C ₁₈ H ₃₄ N ₂ O ₆ S	154-21-2	406.537	amor sol i d					sl H ₂ O; s Et OH, ace, chl
6615	Linalyl acetate	<i>ci s, ci s, 9, 12</i> -Octadecadienoic acid	C ₁₈ H ₃₂ O ₂	60-33-3	280.446		-7	229 ¹⁶	0.9022 ²⁰	1.4699 ²⁰	vs ace, bz, et h, Et OH
6616	Linalyl acetate	<i>ci s, ci s, 9, 12, 15</i> -Octadecatrienoic acid	C ₁₈ H ₃₀ O ₂	463-40-1	278.430		-11	231 ¹⁷ , 129 ^{0.05}	0.9164 ²⁰	1.4800 ²⁰	i H ₂ O; s Et OH, et h; sl bz
6617	Lisuride	<i>N</i> -(3,4-Dichlorophenyl)- <i>N</i> -methylurea	C ₉ H ₁₀ Cl ₂ N ₂ O ₂	330-55-2	249.093		93				
6618	Lisuride		C ₉ H ₁₂ N ₂ O ₄	6893-02-3	650.974	cry	236 dec				i H ₂ O, Et OH; s di l al k
6619	Lisuride	1,2-Dithiolane-3-pentanamide	C ₈ H ₁₅ NOS ₂	940-69-2	205.341	cry	128				
6620	<i>α</i> -Lipoic acid	1,2-Dithiolane-3-pentanone	C ₈ H ₁₄ O ₂ S ₂	1077-28-7	206.326	ye pl (cy)	60	87 ²⁵			i H ₂ O
6621	Lisuride		C ₂₁ H ₃₅ N ₃ O ₇	83915-83-7	441.519	wh cry pow	159				i Et OH, chl, ace; sl MeOH
6622	Lithium oxalate		C ₂ L ₂ O ₄	30903-87-8	101.901		dec		2.121 ¹⁷		s H ₂ O; i Et OH, et h
6623	Lobeline		C ₈ H ₁₃ NO ₂	552-72-7	339.471	sc (al, et h)	150				i H ₂ O; s Et OH; sl et h; vs ace, bz, py
6624	Lobeline		C ₈ H ₁₃ NO ₂	579-21-5	335.440	nd (et h, pet h)	99				vs ace, bz, Et OH, chl
6625	Lobeline		C ₈ H ₁₇ NO ₂	90-69-7	337.455	nd (al, bz)	130.5				sl H ₂ O; s Et OH, et h, bz, chl; vs ace
6626	Loflucarban		C ₁₃ H ₁₉ Cl ₂ FN ₂ S	790-69-2	315.192		163.5				
6627	Longifolene	Kuromat suene	C ₁₅ H ₂₄	475-20-7	204.352			258; 126 ¹⁵	0.9319 ¹⁸	1.5040 ²⁰	i H ₂ O; s bz
6628	Loratadine	Clarithin	C ₂₂ H ₂₇ ClN ₂ O ₂	79794-75-5	382.883	cry (MeCN)	132				
6629	Lovastatin	Mevacor	C ₂₄ H ₃₆ O ₅	75330-75-5	404.540	wh cry (ace aq)	174				i H ₂ O; vs chl; s DMF; sl ace, Et OH
6630	Lovozal		C ₁₇ H ₁₇ Cl ₂ F ₂ N ₂ O ₂	14255-88-0	375.130	ye cry	103				s ace, di ox
6631	Loxapine		C ₁₆ H ₁₈ ClN ₂ O	1977-10-2	327.808	ye cry (pet h)	109.5				
6632	Loxoprofen	<i>α</i> -Methyl-4-[(2-oxocyclopropyl)methyl]benzeneacetate	C ₁₅ H ₁₈ O ₃	68767-14-6	246.302	col oi l	110	192			

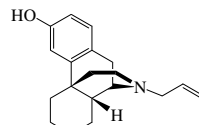


H-5-oxoPro-His-Trp-Ser-Tyr-D-Leu-Leu-Arg-Pro-NHEt

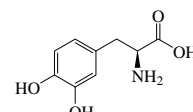
Leuproline



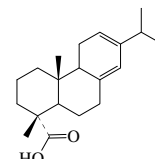
Leurosin



Levallophan

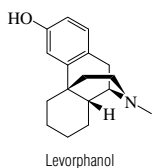


Levodopa

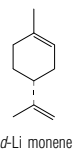


Levopimaric acid

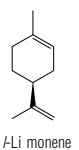
3-351



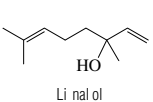
Levorphanol



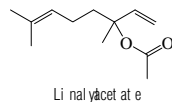
d-Limonene



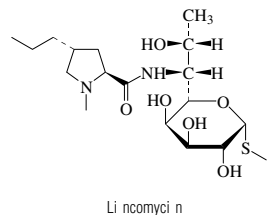
l-Limonene



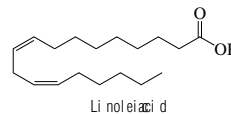
Linalol



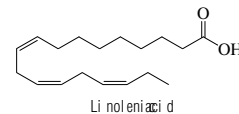
Linalylacetate



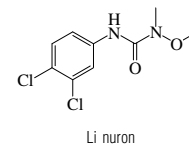
Lincosamine



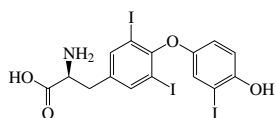
Linoleic acid



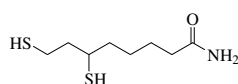
Linolenic acid



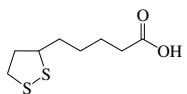
Lincocin



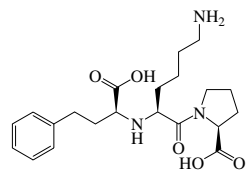
Lithyronine



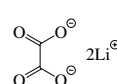
Lipamide



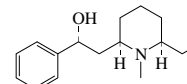
alpha-Lipoic acid



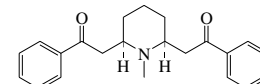
Lisinopril



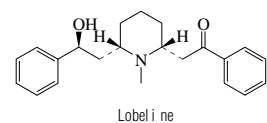
Lithium oxalate



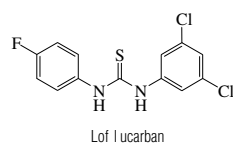
Lobeline



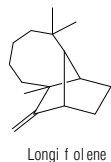
Lobelanine



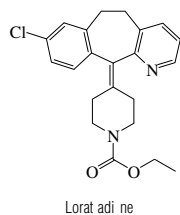
Lobeline



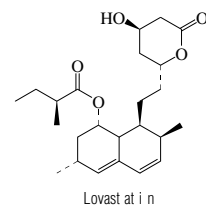
Lofexidine



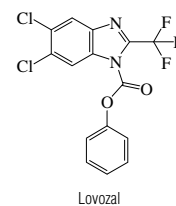
Longifolene



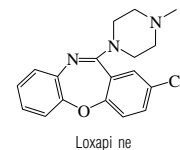
Lorazepam



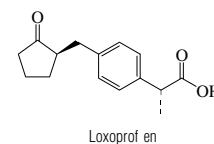
Lovastatin



Lovoxal

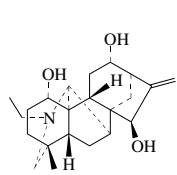


Loxapine

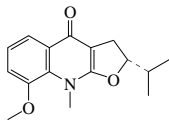


Loxoprofen

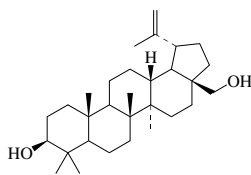
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6633	Luci culi ne	Napel i ne	$_{22}C_{25}NO_3$	5008-52-6	361.518	cry (+1w, ace)	149	165 ^{0.02}			vs Et OH
6634	Lunacri ne		$_{26}H_{19}NO_3$	82-40-6	273.327						s chl
6635	Lup-20(29)-ene-3,28-di ol, (β)	Bet uli n	$_{38}H_{50}O_2$	473-98-3	442.717	nd (al +1)	250	sub 240			i H ₂ O; sl Et OH, bz; s et h, AcOEt, li g
6636	Lup-20(29)-en-3-ol, (β)	Lupeol	$_{38}H_{50}O$	545-47-1	426.717	nd (al, ace)	216		0.945 ⁷¹⁸	1.4910 ²¹⁸	i H ₂ O; vs Et OH, et h, ace, bz, chl
6637	Lupul on		$_{26}H_{38}O_4$	468-28-0	414.578	pr (MeOH)	93				i H ₂ O; s Et OH, pet h, hx
6638	Lut eoli n		$_{19}H_{10}O_6$	491-70-3	286.236	ye nd (di l al, + 1 w)	329 dec				sl H ₂ O; s Et OH, et h, al k, con sul f
6639	Lut eoskyri n	8,8'-Di hydroxyrugul osi n	$_{30}H_{22}O_{12}$	21884-44-6	574.489	ye nd (Et OH)	278 dec				
6640	Lycodi ne		$_{26}H_{22}N_2$	20316-18-1	242.359	ort h pr	99	190 ⁰			s H ₂ O, chl, et h, Et OH; i pet h
6641	Lycomarasmine		$_{21}H_{14}N_2O_7$	7611-43-0	277.231			228 dec			
6642	Lycori ne		$_{26}H_{17}NO_4$	476-28-8	287.311	pr (al, py)	280	sub			i H ₂ O; sl Et OH, et h, chl
6643	Lysergami de		$_{26}H_{17}N_3O$	478-94-4	267.325	cry (MeOH), pr (aq, ace)	137.5				sl Et OH, ace, os
6644	Lysergi c aci d		$_{26}H_{15}N_2O_2$	82-58-6	268.310	li f or hex sc (w)	240 dec				sl H ₂ O, et h, bz; s Et OH, py
6645	Lysergi de		$_{26}H_{25}N_2O$	50-37-3	323.432		82				
6646	<i>DL</i> -Lysi ne	2,6-Di ami nohexanoi c aci d, (±)	$_{6}H_{10}N_2O_2$	70-54-2	146.187		224				sl H ₂ O
6647	<i>D</i> -Lysi ne	2,6-Di ami nohexanoi c aci d, ()	$_{6}H_{10}N_2O_2$	923-27-3	146.187		218 dec				s H ₂ O
6648	<i>L</i> -Lysi ne	2,6-Di ami nohexanoi c aci d, ()	$_{6}H_{10}N_2O_2$	56-87-1	146.187	nd (w, di l al)	224 dec				s H ₂ O; i Et OH, et h, ace, bz
6649	<i>L</i> -Lysi ne, hydrochl ori de		$_{6}H_{15}ClN_2O_2$	10098-89-2	182.648		263 dec				
6650	<i>D</i> -Lyxose		$_{6}H_{10}O_5$	1114-34-7	150.130		108		1.545 ²⁰		
6651	<i>L</i> -Lyxose		$_{6}H_{10}O_5$	1949-78-6	150.130		110				
6652	Macl uri n	(3,4-Di hydroxyphenyl)(2,4,6-tri hydroxyphenyl)met hanone	$_{13}H_{10}O_6$	519-34-6	262.214	ye nd (al)	222.5				vs et h, Et OH
6653	Magent a base	Rosani li ne	$_{20}H_{19}N_3$	3248-93-9	301.385	br-red cry	186 dec				
6654	Magent a l	Rosani li ne hydrochl ori de	$_{20}H_{20}ClN_3$	632-99-5	337.846	grn cry	200 dec				sl H ₂ O, Et OH; i et h
6655	Magnesi um st earat e	Magnesi um oct adecanoat e	$_{36}H_{70}MgO_4$	557-04-0	591.244	wh pow	132				i H ₂ O; reac aci d
6656	Malachi te Green		$_{28}H_{25}ClN_5$	569-64-2	364.911	grn cry					vs H ₂ O, Et OH, MeOH
6657	Malaoxon	(Di met hoxyposphi nyl t hi o) but anedi oi c aci d	$_{10}H_{19}O_7PS$	1634-78-2	314.293	li q		132 ¹			
6658	Malat hi on		$_{19}H_{19}O_6PS_2$	121-75-5	330.358	ye-br li q	1.4	156 ¹ dec	1.2076 ²⁰	1.4960 ²⁰	sl H ₂ O; s Et OH, et h, bz
6659	Mal ei c aci d	<i>ci s</i> -2-But enedi oi c aci d	$_{4}H_6O_4$	110-16-7	116.073	mcl pr (w)	139		1.590 ⁰		vs H ₂ O, Et OH, ace; s et h; i bz, chl
6660	Mal ei c anhydry de		$_{4}H_4O_3$	108-31-6	98.057	nd (chl, et h)	52.56	202	1.31 ⁴		s H ₂ O; s et h, ace, chl; sl li g
6661	Mal eoni t ri le	<i>ci s</i> -2-But enedi ni t ri le	$_{4}H_4O_2$	928-53-0	78.072	pr (Et OH)	31.5	11 ¹⁰			
6662	Mal i c aci d	Hydroxybut anedi oi c aci d	$_{4}H_6O_5$	617-48-1	134.088		132		1.601 ²⁰		s H ₂ O; vs et h, Et OH, MeOH
6663	Mal onal dehyde	1,3-Propanedi al	$_{3}H_4O_2$	542-78-9	72.063	hyg nd	73				
6664	Mal oni c aci d		$_{3}H_4O_4$	141-82-2	104.062	t cl (al)	135 dec	sub	1.619		vs H ₂ O, py; s Et OH, et h; i bz
6665	Mal ononi t ri le		$_{3}H_2N_2$	109-77-3	66.061		32	218.5	1.1910 ²⁰	1.4146 ³⁴	s H ₂ O, ace, bz, chl; vs Et OH, et h
6666	Mal t opent aose		$_{39}H_{52}O_{26}$	34620-76-3	828.718	cry (w)	78 (hyd)				
6667	α -Malt ose		$_{32}H_{54}O_{31}$	4482-75-1	342.296	nd (al)	162.5		1.546 ⁰		vs H ₂ O
6668	6- <i>O</i> - α -Malt osyl β -cycl odext ri n		$_{42}H_{70}O_{45}$	104723-60-6	1459.266	cry (MeOH)					
6669	Mal t ot et raose		$_{24}H_{42}O_{21}$	34612-38-9	666.577	amorp soli d	170 dec				
6670	Mal vi di n chl ori de		$_{17}H_{15}ClO_7$	643-84-5	366.750		>300				sl H ₂ O; s Et OH, MeOH
6671	Mandel i c aci d	α -Hydroxybenzeneacet i c aci d	$_{8}H_8O_3$	90-64-2	152.148	ort h pl	119		1.289 ⁰		s H ₂ O, et h, Et OH, i -PrOH
6672	Mandel oni t ri le gl ucosi de		$_{14}H_{16}O_6$	138-53-4	295.288	wh nd or pl (al)	122				vs H ₂ O, Et OH



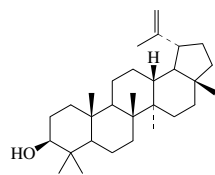
Luciculin



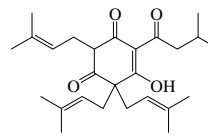
Lunacrine



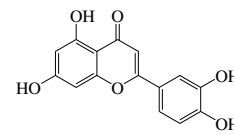
Lup-20(29)-ene-3,28-diol (3β)



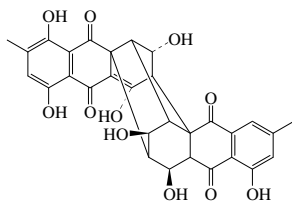
Lup-20(29)-en-3-ol (3β)



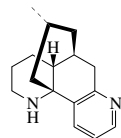
Lupulone



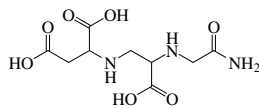
Lutecolone



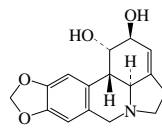
Luteosyringone



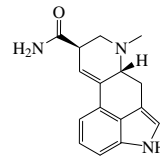
Lycodine



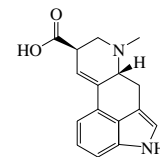
Lycomarasmin



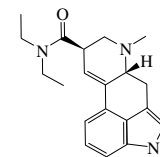
Lycorine



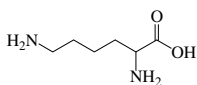
Lysergamide



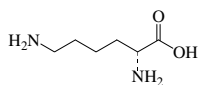
Lysergic acid



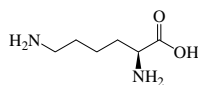
Lysergine



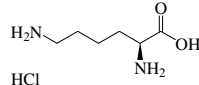
DL-Lysine



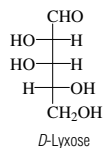
D-Lysine



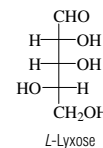
L-Lysine



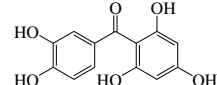
L-Lysine hydrochloride



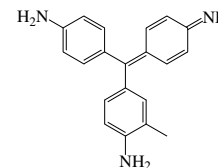
D-Lyxose



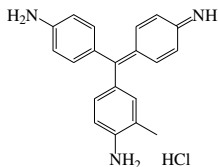
L-Lyxose



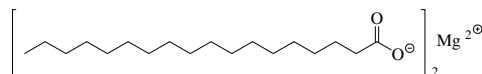
Maclurone



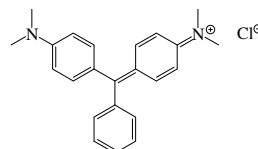
Magenta base



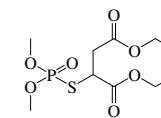
Magenta



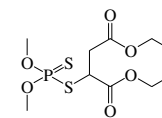
Magnesium stearate



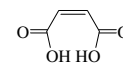
Malachite green



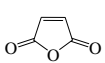
Malaoxon



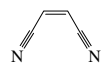
Malathion



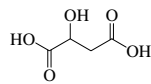
Maleic acid



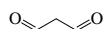
Maleic anhydride



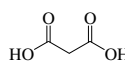
Maleonitrile



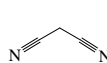
Malic acid



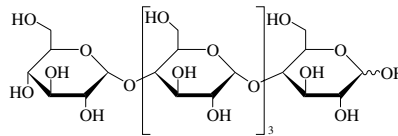
Malonaldehyde



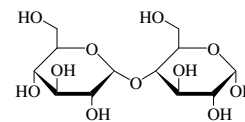
Malonic acid



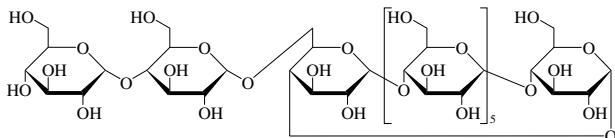
Malonitrile



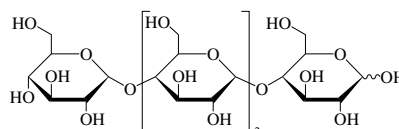
Maltopentose



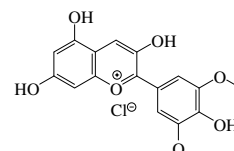
α-Maltose



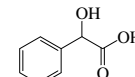
6-O-α-Maltosyl-β-cyclodextrin



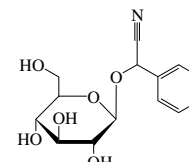
Maltotetraose



Maltiviolin

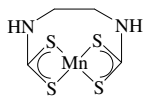


Mandelic acid

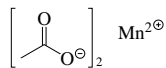


Mandelonitrile

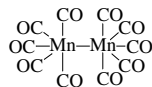
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6673	Maneb	Manganese, [[1,2-et hanedi yl bi s(carbamodi t hi oat o)](2-)-]-	C ₄ H ₆ MnN ₂ S ₄	12427-38-2	265.302		dec 200				
6674	Manganese(II) acetate		CH ₄ O ₄ Mn	638-38-0	173.027	red cry (w)	210				s H ₂ O, MeOH, HOAc; i ace
6675	Manganese carbonyl	Di manganese decacarbonyl	C ₁₀ Mn ₂ O ₁₀	10170-69-1	389.977	ye mcl cry	154		1.75		i H ₂ O; s os
6676	Manganese cycl opent adi enyl t ri carbonyl		C ₆ H ₆ MnO ₃	12079-65-1	204.062	pal e ye cry	77.0	subl			s os
6677	Manganese 2-met hyl cycl opent adi enyl t ri carbonyl		C ₉ H ₈ MnO ₃	12108-13-3	218.088	ye li q	1.5	233; 10 ²	1.388 ²⁰		i H ₂ O; mi sc bz
6678	D-Manni t ol	Cordycepi c aci d	C ₆ H ₁₀ O ₆	69-65-8	182.171	ort h nd or pr (w)	168	295 ^{3,5}	1.489 ²⁰	1.3330	vs H ₂ O; sl Et OH, py; i et h
6679	D-Manni t ol hexani t rat e		C ₆ H ₁₀ O ₆	15825-70-4	452.157	nd (al)	107	exp	1.8 ⁰		vs bz, et h, Et OH
6680	D-Mannose	Semi nose	CH ₁₂ O ₆	3458-28-4	180.155	nd or ort h pr (al)	132 dec		1.539 ²⁰		vs H ₂ O; sl Et OH, MeOH; i et h, bz
6681	L-Mannose		C ₆ H ₁₂ O ₆	10030-80-5	180.155	cry (al)	132				vs H ₂ O
6682	Mat ri di n-15-one	Mat ri ne	C ₁₅ H ₂₆ N ₂ O	519-02-8	248.364	α-nd or pl; β-ort h pr,		223 ⁶		1.5286 ²⁵	s H ₂ O, et h, ace; vs Et OH, bz; sl pet h
6683	Mazi ndol		C ₆ H ₁₃ Cl N ₂ O	22232-71-9	284.739	cry (ace/hx)	198				i H ₂ O; s Et OH
6684	Mebendazol e		C ₁₆ H ₁₃ N ₃ O ₃	31431-39-7	295.292	cry (HOAc/MeOH)	288.5				i H ₂ O, Et OH, et h, chl
6685	Mebhydroli ne		C ₉ H ₂₀ N ₂	524-81-2	276.375	cry	95	211 ¹			i H ₂ O; sl et h; vs Et OH, ace, MeOH
6686	Mecarbam		C ₁₀ H ₂₀ N ₂ PS ₂	2595-54-2	329.374	ye oi l		144 ^{0,2}	1.223 ²⁰		sl H ₂ O
6687	Mecl i zi ne		C ₂₇ H ₂₇ Cl N ₂	569-65-3	390.948			230			s CS ₂
6688	Medroxyprogesterone		C ₂₂ H ₃₂ O ₃	520-85-4	344.487		214.5				vs chl
6689	Met enami c aci d	2-[(2,3-Di met hyl phenyl) ami no]benzoi c aci d	C ₁₅ H ₁₅ NO ₂	61-68-7	241.286	hyg cry	230 dec				s al k; sl et h, chl
6690	Mefloqui ne		C ₇ H ₁₆ F ₆ N ₂ O	53230-10-7	378.311	cry (MeOH aq)	178.2				
6691	Meflui di de		C ₇ H ₁₃ F ₃ N ₂ O ₃ S	53780-34-0	310.292		184				
6692	Mel ezi t ose		C ₁₂ H ₂₂ O ₁₆	597-12-6	504.437	cry (w+2)	153		1.5565 ²⁵		vs H ₂ O
6693	α-D-Mel i bi ose	β-α-D-Gal act opyranosyl D-glucose	C ₁₂ H ₂₂ O ₁₁	585-99-9	342.296						vs H ₂ O; sl Et OH; dec aci d
6694	Mel i nami de	N-(1-Phenyl et hyl)-9,12-oct adecadi eneami de, [Z]-	C ₂₆ H ₄₁ NO	14417-88-0	383.610	oi l	<4	20 ²⁷		1.5050 ²³	
6695	Mel phal an	L-Phenyl al ani ne, 4-[bi s(2-chl oroet hyl) ami no]-	C ₁₃ H ₁₈ Cl ₂ N ₂ O ₂	148-82-3	305.200	nd	183 dec				i H ₂ O; s Et OH
6696	Menaqui none 7	Vi t ami n (36)	C ₄₆ H ₆₄ O ₂	2124-57-4	648.999	cry	54				
6697	Menazon		C ₈ H ₁₂ N ₂ O ₂ PS ₂	78-57-9	281.296	cry (MeOH)	160				sl H ₂ O; s t hf
6698	p-Ment hane hydroperoxi de	1-Met hyl -1-(4-met hyl cycl ohexyl) et hyl hydroperoxi de	C ₁₀ H ₂₀ O ₂	80-47-7	172.265			259	0.92		
6699	p-Ment h-8-en-2-one	2-Met hyl -5-(1-met hyl et henyl) cycl ohexanone	C ₁₀ H ₁₈ O	7764-50-3	152.233			223.0			
6700	Ment hol 3-met hyl but anoat e	Ment hol , i soval erat e	C ₁₅ H ₂₆ O	16409-46-4	240.382			129 ⁹	0.908 ¹⁵	1.4486 ²⁰	i H ₂ O; s Et OH, ace
6701	Meperi di ne	Pet hi di ne	C ₁₃ H ₁₆ NO ₂	57-42-1	247.334		30	155 ⁵			
6702	Mephenytoi n		C ₇ H ₁₄ N ₂ O ₂	50-12-4	218.251		136				
6703	Mephobarbi tal		C ₁₁ H ₁₄ N ₂ O ₃	115-38-8	246.261	wh cry (w)	176				sl H ₂ O, et h, chl; vs Et OH
6704	Mephosol an		C ₁₁ H ₁₆ NO ₂ PS ₂	950-10-7	269.322	ye li q		120 ^{0,1}		1.5354 ²⁶	s ace, Et OH, bz
6705	Mepi quat chl ori de	Pi peri di ni um, 1,1-di met hyl -, chl ori de	C ₁₁ H ₁₆ N ₂	24307-26-4	149.662		223				
6706	Mepi vacai ne	N-(2,6-Di met hyl phenyl)-1-met hyl -2-C ₁₅ H ₂₂ N ₂ O pi peri di ncarboxami de	C ₂₆ H ₃₈ N ₂ O	96-88-8	246.348	cry (et h)	150.5				s CS ₂



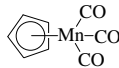
Maneb



Manganese(II) acetate



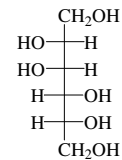
Manganese carbonyl



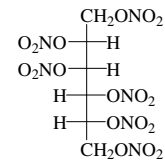
Manganese cyclopentadienyl carbonyl



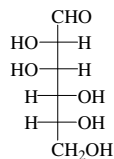
Manganese 2-methylcyclopentadienyl carbonyl



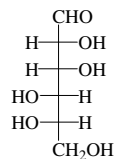
D-Mannitol



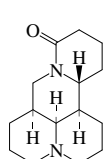
D-Mannitol dioxane derivative



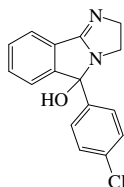
D-Mannose



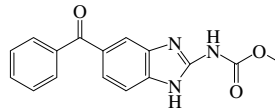
L-Mannose



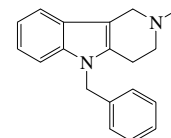
Matrine



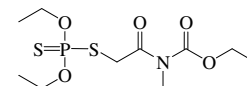
Maziadol



Mebendazole

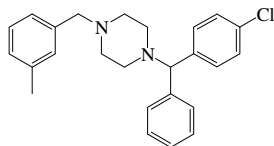


Mefhydroline

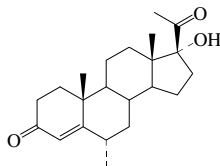


Mecarbam

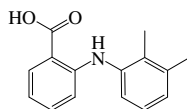
3-355



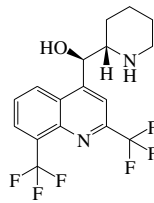
Meclizine



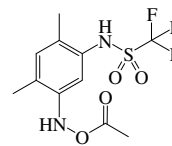
Medroxyprogesterone



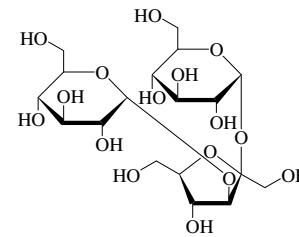
Mefenamic acid



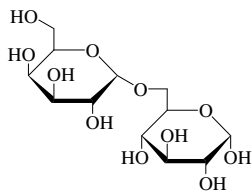
Mefloquine



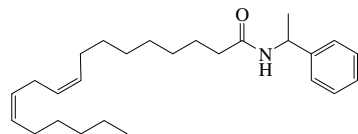
Mefluidide



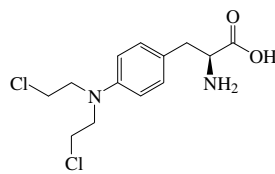
Melezitose



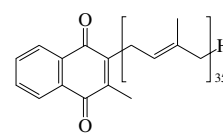
alpha-D-Melibiose



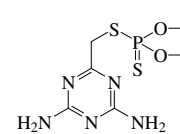
Melinamide



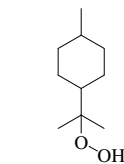
Mefphalan



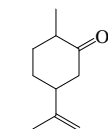
Menaquinone



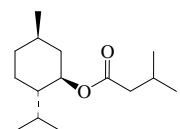
Menazon



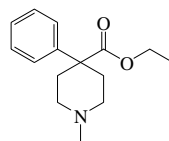
p-Menthanehydroperoxide



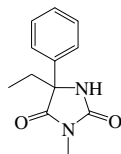
p-Menth-1,8-dien-2-one



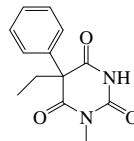
Menthol 3-methylbutanoate



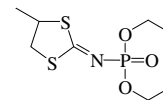
Meperidine



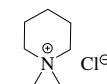
Mephentoin



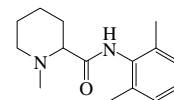
Mephobarbital



Mepfosolan

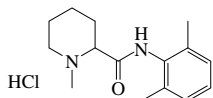


Mepi quaternary

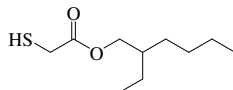


Mepivacaine

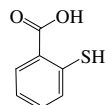
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6707	Mepi vacai ne monohydrochl ori de	Carbocai ne hydrochl ori de	$_{15}H_{23}Cl N_2O$	1722-62-9	282.809	cry	263				s H ₂ O
6708	Mercapt oacet i c aci d, 2-et hyl hexyl ester		$C_{10}H_{20}O_2S$	7659-86-1	204.330			133.5	0.97 ²⁰		
6709	2-Mercapt obenzo i c aci d	<i>o</i> -Thi osal i c yl i c aci d	$_{7}H_6O_2S$	147-93-3	154.187	l f or nd (al, w, HOAc)	168.5	sub			s H ₂ O, Et OH, et h; sl DMSO, li g
6710	Mercapt obenzt hi azyl et her	2,2-Di t hi obi s(benzot hi azol e)	$_{14}H_8N_2S_2$	120-78-5	332.487	ye nd	180		1.50		i H ₂ O; sl Et OH, bz, ct c, ace
6711	2-Mercapt oet hanol		$_{4}H_8OS$	60-24-2	78.133			158; 55 ¹³	1.1143 ²⁰	1.4996 ²⁰	s H ₂ O, Et OH, et h, bz
6712	2-Mercapt o-2-met hyl propanoi c aci d		$_{4}H_8O_2S$	4695-31-2	120.171		47	101 ¹⁵			vs H ₂ O
6713	2-Mercapt o- <i>N</i> -2-napht hyl acet ami de	Thi onal i de	$_{17}H_{17}ONOS$	93-42-5	217.286		111.5				i H ₂ O; vs Et OH, os
6714	2-Mercapt ophenol		$_{6}H_6OS$	1121-24-0	126.176	oi l	5.5	217; 89	1.2371 ⁰		vs bz, et h, Et OH
6715	4-Mercapt ophenol		$_{6}H_6OS$	637-89-8	126.176	cry	29.5	167 ⁴⁵ , 135 ¹¹	1.1285 ²⁵	1.5101 ²⁵	s H ₂ O, Et OH, al k, con sul f
6716	3-Mercapt o-1,2-propanedi ol	Thi oglycerol	$_{3}H_6O_2S$	96-27-5	108.160	vi sc		100	1.2455 ²⁰	1.5268 ²⁰	sl H ₂ O, et h, bz, chl; msc Et OH; vs ace
6717	3-Mercapt opropanoi c aci d		$_{3}H_6O_2S$	107-96-0	106.144	amor	18	111 ¹⁵ , 86 ³	1.218 ²¹	1.494 ²⁰	s H ₂ O, Et OH, et h, ct c
6718	3-Mercapt o- <i>D</i> -val i ne	Peni ci l lami ne	$_{5}H_9NO_2S$	52-67-5	149.212			198.5			
6719	Mercury(II) benzoat e	Mercuri c benzoat e	$_{6}H_6HgO_4$	583-15-3	442.81	cry pow (w)	≈125				i Et OH
6720	Mercury(II) oleat e	Mercuri c oleat e	$_{36}H_{66}HgO_4$	1191-80-6	763.35	ye-br sol i d					i $_{2}B$; sl Et OH, et h
6721	Mercury(II) phenyl acet at e	Phenylmercuri c acet at e	$_{6}H_6HgO_2$	62-38-4	336.74			153			i H ₂ O; s chl
6722	Merphos	Phosphorot ri t hi os ac id , t ri but yl ester	$C_{12}H_{27}PS_3$	150-50-5	298.511			100	137 ^{0,7} , 176 ¹⁵	1.02 ²⁰	
6723	Mesi t yl oxide	Isobut enyl met hyl ket one	$_{6}H_{10}O$	141-79-7	98.142	li q	-59	130	0.865 ³	1.4440 ²⁰	s H ₂ O, ace; msc Et OH, et h
6724	Mesori dazi ne		$_{24}H_{26}N_2OS_2$	5588-33-0	386.573	oi l					
6725	Mest ranol		$C_{16}H_{26}O_2$	72-33-3	310.430	cry	151				i H ₂ O; s di ox, et h, Et OH, chl
6726	[2.2]Met acyl ophane	Tri cycl o[9.3.1.1]hexadeca-1(15),4,6,8(16),11,13-hexaene	$C_{16}H_{16}$	2319-97-3	208.298	ort h pr	132.5	290			sl Et OH; s bz, et h
6727	Met al axyl		$_{19}H_{21}NO_4$	57837-19-1	279.333			71			
6728	Met al dehyde	Met acet al dehyde (pol ymer)	$_{2}H_2O$	37273-91-9		t et r nd or pr (al)	246	sub 115			i_2O ace; sl Et OH, et h, bz, chl
6729	Met ani l Yel l ow		$_{18}H_{14}N_3NaO_3S$	587-98-4	375.377	br-ye pow					vs H ₂ O, Et OH; s bz, et h; sl ace
6730	Met arami nol	2-Ami no-1-(3-hydroxyphenyl)-1-propanol, (1 <i>R</i> ,2 <i>S</i>)	$C_9H_{13}NO_2$	54-49-9	167.205	hyg cry (HCl)					s H ₂ O
6731	Met axal one		$C_6H_{15}NO_3$	1665-48-1	221.252	cry (AcOEt)	122	223 ⁵			
6732	Met hachol i ne chl ori de		$_{8}H_6Cl NO_2$	62-51-1	195.688	hyg cry	172				vs H ₂ O, Et OH, chl
6733	Met hacryl i c aci d	2-Met hyl propenoi c aci d	$_{4}H_6O_2$	79-41-4	86.090	pr	16	162.5	1.0153 ²⁰	1.4314 ²⁰	s H ₂ O, chl; msc Et OH, et h
6734	Met hacryl i ne		$_{28}H_{22}N_2O_8$	914-00-1	442.418	cry	205 dec				
6735	Met hadone hydrochl ori de	6-(Di met hyl ami no)-4,4-di phenyl hept anone hydrochl ori de	$_{27}H_{28}Cl NO$	1095-90-5	345.906	pl (al-et h)	235				vs $_{2}B$, Et OH
6736	Met hal l enest ri l		$_{18}H_{22}O_3$	517-18-0	286.366	cry (MeOH aq)	139				s et h
6737	Met hami dophos	Phosphorami dot hi oi c acid , di met hyl ester	$C_2H_8NO_2PS$	10265-92-6	141.130		46		1.31 ²⁰		
6738	Met hamphet ami ne		$_{10}H_{15}N$	537-46-2	149.233			212			
6739	Met hamphet ami ne hydrochl ori de	<i>N</i> , α -Di met hyl benzeenet hanami ne, hydrochl ori de, (<i>S</i> -)	$C_{10}H_{16}Cl N$	51-57-0	185.694			173.8			vs H ₂ O, Et OH, chl
6740	Met handrost enol one		$_{28}H_{36}O_2$	72-63-9	300.435		166				
6741	Met hane		CH_4	74-82-8	16.043	col gas	-182.47	-161.48	0.4228 ¹⁶²		sl H ₂ O, ace; s Et OH, et h, bz, t ol, MeOH
6742	Met haneanson i c aci d		$C_6H_6O_3$	124-58-3	139.971		160.5				s H ₂ O, Et OH
6743	Met hanedi sul f oni c aci d	Met hi oni c aci d	$_{4}O_3S_2CH$	503-40-2	176.169		98				i H ₂ O; s HNO ₃
6744	Met hanesul f oni c aci d	Met hyl sul f oni c aci d	$_{4}O_3SCH$	75-75-2	96.106		20	167 ¹⁰	1.4812 ¹⁸	1.4317 ¹⁸	s H ₂ O



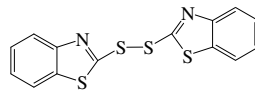
Mepi vacai nemonohydrochlori de



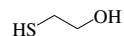
Mercapt oacet iaci d2-et hyl hexyest er



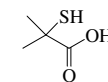
2-Mercapt obenzoi aci d



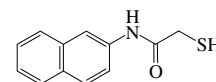
Mercapt obenzti hyl azyli her



2-Mercapt oet hanol



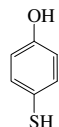
2-Mercapt o-2-met hyl propanoaci d



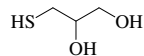
2-Mercapt o-N-2-napht hyl acet ami de



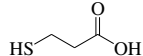
2-Mercapt ophenol



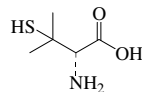
4-Mercapt ophenol



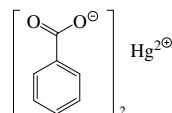
3-Mercapt o-1,2-propanedi ol



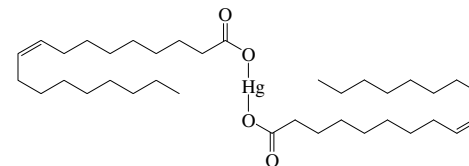
3-Mercapt opropanoi aci d



3-Mercapt o-D-vali ne

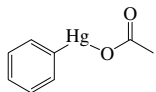


Mercury(II) benzoate

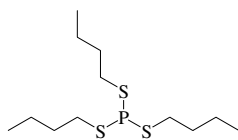


Mercury(II) oleate

3-357



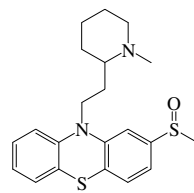
Mercury(II) phenyl acetate



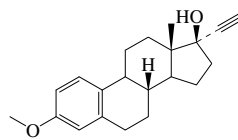
Merphos



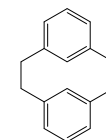
Mesi tyxi de



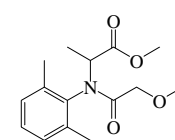
Mesori dazi ne



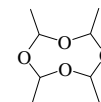
Mest ranol



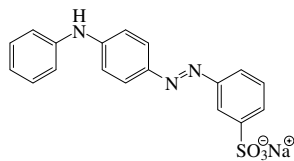
[2.2]Metacyclopentane



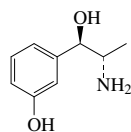
Met al axyl



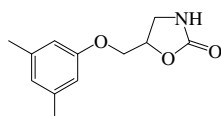
Met aldehyde



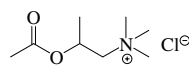
Met ani Yel low



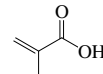
Met arami nol



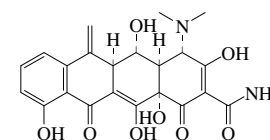
Met axal one



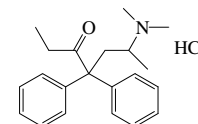
Met hacholi nethl ori de



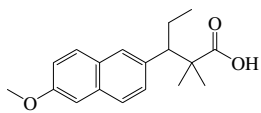
Met hacryli aci d



Met hacryli ne



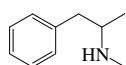
Met hadonehydrochlori de



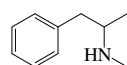
Met hal lenest ri l



Met hami dophos

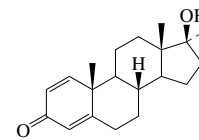


Met hamphet ami ne



Met hamphet ami hydrochlori de

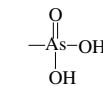
HCl



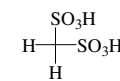
Met handrost enol one



Met hane



Met hanearsoni aci d



Met hanedi sulf onaci d



Met hanesulf onaci d

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6745	Met hanesul f onyl chl ori de		₃ CH ₂ S	124-63-0	114.552			162; 55 ¹¹	1.4805 ¹⁸	1.4573 ²⁰	i H ₂ O; s Et OH, et h
6746	Met hanesul f onyl fluori de		₃ CF ₂ S	558-25-8	98.097			123.5			
6747	Met hanet hi ol	Met hyl mercapt an	₄ SCH	74-93-1	48.108	col gas	-123	5.9	0.8665 ⁵⁰		sl H ₂ O, chl; vs Et OH, et h
6748	Met hani mi dami de	Formami di ne	₄ NCH	463-52-5	44.056	pr	81	dec			vs H ₂ O, Et OH
6749	Met hani mi dami de, monoacet at e	Formami di ne acet at e	₃ H ₃ N ₂ O ₂	3473-63-0	104.108		161.5				vs H ₂ O
6750	Met hanol	Met hyl alcohol	₁ CH	67-56-1	32.042	liq	-97.53	64.6	0.7914 ⁴	1.3288 ²⁰	msc H ₂ O, Et OH, et h, ace; vs bz; s chl
6751	Met hant hel i ne bromi de		₂₁ HC ₂₅ BrNO ₃	53-46-3	420.340	cry (i -PrOH)	174.5				s H ₂ O, Et OH, chl; i et h
6752	Met hapyri l ene		₁₈ H ₁₉ N ₃ S	91-80-5	261.386			174 ³		1.5915 ²⁰	
6753	Met harbi t al	5,5-Di et hyl -1-met hyl -2,4,6-(1 <i>H</i> ,3 <i>H</i> ,5 <i>H</i>)-pyri mi di net ri one	₃ C ₈ H ₁₁ N ₂ O ₃	50-11-3	198.218	nd	150.5				s H ₂ O; sl chl
6754	Met hazol ami de		₈ CH ₈ N ₄ O ₃ S ₂	554-57-4	236.273	cry (w)	213 dec				
6755	Met hazol e		₇ CH ₆ Cl ₂ N ₂ O ₃	20354-26-1	261.061		123		1.24 ²⁵		
6756	Met henami ne al lyl i odi de	Al lyl hexamet hyl enet et rami ne i odi de	₁₁ CH ₁₈ N ₄ C	36895-62-2	308.162	cry	148 dec				vs H ₂ O; i chl, et h
6757	Met hest rol		₂₀ CH ₂₆ O ₂	130-73-4	298.419	cry (di l HOAc)	145				
6758	Met hi dat hi on		₆ HC ₈ N ₂ O ₂ PS ₃	950-37-8	302.330		39				
6759	Met hi ocarb	Phenol, 3,5-di met hyl -4-(met hyl t hC ₆ H ₁₃ NO ₂ S, met hyl carbat e	₁₁ CH ₁₃ N ₂ O ₂ S	2032-65-7	225.308		120				
6760	L-Met hi oni ne		₈ CH ₁₁ NO ₂ S	63-68-3	149.212	hex pl (di l al)	281 dec				s Et OH, et h, ace, bz, pet h; sl HOAc
6761	Met hocarbamol	Guai f enesi n-1-carbat e	₁₁ H ₉ NO ₅	532-03-6	241.241	cry (bz)	93				s Et OH
6762	Met homyl		₇ CH ₁₀ N ₂ O ₂ S	16752-77-5	162.210		78		1.2946 ²⁴		
6763	Met hoprene		₆ C ₉ H ₁₂ O ₃	40596-69-8	310.471			100 ^{0.05}	0.926 ²⁰		
6764	Met hoprot ryne		₇ CH ₂₁ N ₅ OS	841-06-5	271.383	cry	69				sl H ₂ O; s os
6765	Met hot rext e		₂₈ CH ₂₂ N ₆ O ₅	59-05-2	454.440	ye cry (w)	190 dec				
6766	Met hoxami ne hydrochl ori de		₁₁ H ₁₆ ClNO ₃	61-16-5	247.719	cry	214				vs H ₂ O; i et h, bz, chl
6767	Met hoxsal en	9-Met hoxo- <i>H</i> -f uro[3,2- <i>g</i>][1]benzopyran-7-one	₁₂ H ₈ O ₄	298-81-7	216.190	pr (di l al) nd (pet h)	148				sl H ₂ O, et h, ace, pet h; vs Et OH
6768	Met hoxycet al dehyde		₆ CH ₆ O ₂	10312-83-1	74.079			92	1.005 ²⁵	1.3950 ²⁰	vs H ₂ O, ace, et h, Et OH
6769	Met hoxycet i c aci d		₃ HC ₃ O ₃	625-45-6	90.078	hyg		203.5	1.1768 ²⁰	1.4168 ²⁰	s H ₂ O, Et OH, et h
6770	Met hoxycet oni t ri le		₃ H ₂ NO	1738-36-9	71.078			119	0.9492 ²⁰	1.3831 ²⁰	sl H ₂ O; s Et OH, et h, ace, chl, al k, aci d
6771	Met hoxycet yl chl ori de		₃ HC ₃ ClO ₂	38870-89-2	108.524			112.5	1.1871 ²⁰	1.4199 ²⁰	s et h, ace, ct c; vs chl
6772	2-Met hoxyani l i ne	<i>o</i> -Ani si di ne	₇ HC ₇ NO	90-04-0	123.152		6.2	224	1.0923 ²⁰	1.5715 ¹⁰	sl H ₂ O; s Et OH, et h, ace, bz
6773	3-Met hoxyani l i ne	<i>m</i> -Ani si di ne	₇ HC ₇ NO	536-90-3	123.152	liq	-1	251	1.09 ⁶	1.5794 ²⁰	sl H ₂ O, ct c; s Et OH, et h, ace, bz
6774	4-Met hoxyani l i ne	<i>p</i> -Ani si di ne	₇ HC ₇ NO	104-94-9	123.152	ort h pl	57.2	243	1.07 ⁴	1.5559 ⁶⁰	s H ₂ O, ace, bz; vs Et OH, et h
6775	2-Met hoxyani l i ne hydrochl ori de	<i>o</i> -Ani si di ne hydrochl ori de	₇ H ₇ ClNO	134-29-2	159.613	nd	225				
6776	1-Met hoxo-9,10-ant hracenedi one		₁₄ CH ₁₀ O ₃	82-39-3	238.238		170.3				sl Et OH; vs bz, chl
6777	2-Met hoxbenzal dehyde		₇ CH ₆ O ₂	135-02-4	136.149	pr	37.5	243.5	1.1326 ²⁰	1.5600 ²⁰	i H ₂ O; s Et OH, bz, ct c; vs et h, ace, chl
6778	3-Met hoxbenzal dehyde		₇ CH ₆ O ₂	591-31-1	136.149			231	1.1187 ²⁰	1.5530 ²⁰	i H ₂ O; s Et OH, bz; vs et h, ace, chl
6779	4-Met hoxbenzal dehyde	<i>p</i> -Ani sal dehyde	₇ CH ₆ O ₂	123-11-5	136.149		0	248; 134 ¹²	1.119 ¹⁵	1.5730 ²⁰	i H ₂ O; msc Et OH, et h; vs ace, chl; s bz
6780	4-Met hoxbenzami de		₁₁ CH ₁₂ NO ₂	3424-93-9	151.163	nd or t ab (w)	166.5	295			vs H ₂ O, Et OH
6781	4-Met hoxbenzeneacet al dehyde		₉ CH ₁₀ O ₂	5703-26-4	150.174			255.5	1.096 ²⁰	1.5359 ²⁰	
6782	2-Met hoxbenzeneacet i c aci d		₉ HC ₉ O ₃	93-25-4	166.173	nd (w)	124	100 ²			s H ₂ O; vs Et OH, et h, ace, bz, chl
6783	4-Met hoxbenzeneacet i c aci d		₉ HC ₉ O ₃	104-01-8	166.173	pl (w)	87	138 ⁸			i H ₂ O; vs Et OH; s et h, bz; sl chl, liq



Met hanesulf onghl ori de



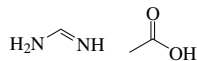
Met hanesulf onfll uori de



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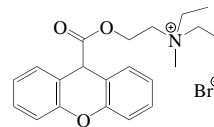
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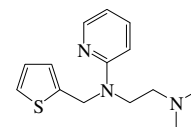
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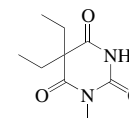
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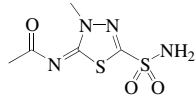
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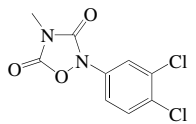
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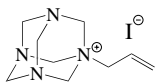
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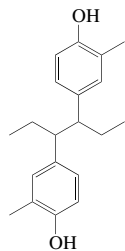
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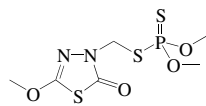
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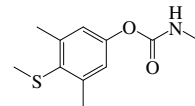
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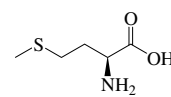
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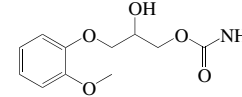
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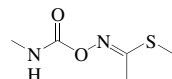
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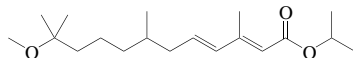
L-Met hi oni ne



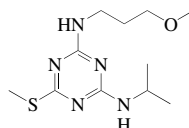
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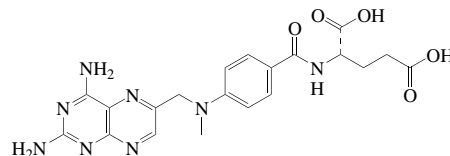
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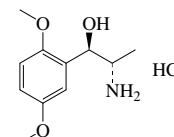
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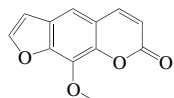
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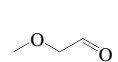
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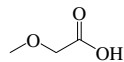
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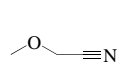
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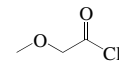
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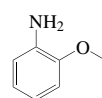
Met hoxacet iaci d



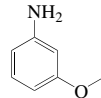
Met hoxacet oni t r



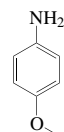
Met hoxacet yhl ori de



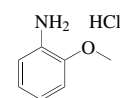
2-Met hoxyani l i ne



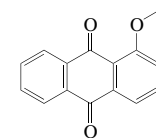
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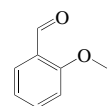
4-Met hoxyani l i



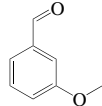
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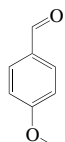
1-Met hoxy-9,10-ant hracenedi one



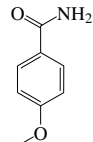
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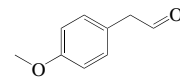
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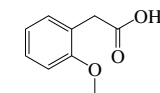
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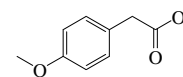
4-Met hoxybenzami de



4-Met hoxybenzeneacet al dehyde

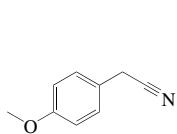


2-Met hoxybenzeneacet iaci d

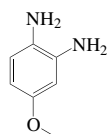


4-Met hoxybenzeneacet iaci d

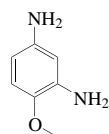
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6784	4-Met hoxylbenzeneacetoni tri le		$\text{C}_9\text{H}_{10}\text{O}$	104-47-2	147.173			286.5	1.0845 ²⁰	1.5309 ²⁰	s Et OH, et h, chl
6785	4-Met hoxyl-1,2-benzenedi ami ne	4-Met hoxylphenylenedi ami ne	$\text{C}_9\text{H}_9\text{N}_2\text{O}$	102-51-2	138.166	grn pl	51	200 ¹ , 168 ¹¹			vs et h
6786	4-Met hoxyl-1,3-benzenedi ami ne	4-Met hoxylphenylenedi ami ne	$\text{C}_9\text{H}_9\text{N}_2\text{O}$	615-05-4	138.166	nd (et h)	67.5				s Et OH, et h; sl DMSO
6787	2-Met hoxyl-1,4-benzenedi ami ne	2,5-Di ami noani sole	$\text{C}_9\text{H}_9\text{N}_2\text{O}$	5307-02-8	138.166	cry	107				
6788	3-Met hoxyl-1,2-benzenedi ol		$\text{C}_9\text{H}_9\text{O}_3$	934-00-9	140.137	nd	42.8	163 ^{4b} , 129 ¹⁰			s chl
6789	4-Met hoxylbenzeneet hanami ne		$\text{C}_9\text{H}_{13}\text{NO}$	55-81-2	151.205			139 ²⁰		1.5379 ²⁰	
6790	4-Met hoxylbenzeneet hanol		$\text{C}_9\text{H}_{12}\text{O}_2$	702-23-8	152.190		29	335			
6791	2-Met hoxylbenzenemet hanami ne		$\text{C}_9\text{H}_{11}\text{NO}$	6850-57-3	137.179			228	1.051 ²⁵	1.5475 ²⁰	
6792	4-Met hoxylbenzenemet hanami ne		$\text{C}_9\text{H}_{11}\text{NO}$	2393-23-9	137.179			236.5	1.050 ¹⁵	1.5462 ²⁰	sl H ₂ O, Et OH, et h
6793	2-Met hoxylbenzenemet hanol		$\text{C}_9\text{H}_{10}\text{O}_2$	612-16-8	138.164			249	1.0386 ²⁵	1.5455 ²⁰	i H ₂ O; s Et OH; msc et h
6794	3-Met hoxylbenzenemet hanol		$\text{C}_9\text{H}_{10}\text{O}_2$	6971-51-3	138.164		30	252	1.112 ²⁵	1.5440 ²⁰	
6795	4-Met hoxylbenzenemet hanol	Ani se alcohol	$\text{C}_9\text{H}_9\text{O}_2$	105-13-5	138.164	nd	25	259.1	1.109 ²⁶	1.5420 ²⁵	s H ₂ O, ct c; vs Et OH, et h
6796	4-Met hoxylbenzenesulfonyl chl ori de		$\text{C}_9\text{H}_9\text{ClO}_2\text{S}$	98-68-0	206.647	nd or pr (bz)	42.5	103 ²⁵			s Et OH, et h, bz
6797	3-Met hoxylbenzenet hi ol		$\text{C}_9\text{H}_9\text{OS}$	15570-12-4	140.203			224.5; 114 ²⁰		1.5874 ²⁰	s chl
6798	4-Met hoxylbenzenet hi ol		$\text{C}_9\text{H}_9\text{OS}$	696-63-9	140.203			228	1.1313 ²⁵	1.5801 ²⁵	s Et OH, et h, bz; sl chl
6799	2-Met hoxylbenzoi c aci d		$\text{C}_8\text{H}_7\text{O}_3$	579-75-9	152.148	pl (w)	101	200			sl H ₂ O; vs Et OH, et h, chl; s bz, ct c
6800	3-Met hoxylbenzoi c aci d		$\text{C}_8\text{H}_7\text{O}_3$	586-38-9	152.148	nd (w)	107	170 ¹⁰			sl H ₂ O, ct c; s Et OH, et h, bz; vs chl
6801	4-Met hoxylbenzoi c aci d	p-Ani si c aci d	$\text{C}_8\text{H}_7\text{O}_3$	100-09-4	152.148			276.5			i H ₂ O; vs Et OH, MeOH, et h; s chl
6802	2-Met hoxylbenzoni tri le		$\text{C}_8\text{H}_7\text{NO}$	6609-56-9	133.148		24.5	255.5	1.1063 ²⁰		s Et OH; vs et h
6803	3-Met hoxylbenzoni tri le		$\text{C}_8\text{H}_7\text{NO}$	1527-89-5	133.148			140 ³⁴ , 111 ¹³	1.089 ²⁵	1.5402 ²⁰	
6804	4-Met hoxylbenzoni tri le		$\text{C}_8\text{H}_7\text{NO}$	874-90-8	133.148	nd (w) lf (al)	61.5	256.5			i ₂ OH vs Et OH, et h; s bz
6805	7-Met hoxyl-2H-1-benzopyran-2-one		$\text{C}_{10}\text{H}_9\text{O}_3$	531-59-9	176.169	lf (w, MeOH)	118.3				sl H ₂ O; s Et OH, et h, con sul f, alk
6806	6-Met hoxyl-2-benzot hi azol ami ne		$\text{C}_8\text{H}_7\text{N}_2\text{OS}$	1747-60-0	180.227		166				
6807	2-(4-Met hoxylbenzoyl)benzoi c aci d	α -(p-Ani soy l)benzoi c aci d	$\text{C}_{15}\text{H}_{12}\text{O}_4$	1151-15-1	256.254	lf (w), cry (al, t o)	146				vs et h, Et OH, t ol
6808	2-Met hoxylbenzoyl chl ori de		$\text{C}_8\text{H}_7\text{ClO}_2$	21615-34-9	170.594			254			
6809	4-Met hoxylbenzoyl chl ori de	p-Ani soy l chl ori de	$\text{C}_8\text{H}_7\text{ClO}_2$	100-07-2	170.594	nd	24.5	262.5	1.261 ²⁰	1.580 ²⁰	s et h, ace; vs bz; sl ct c
6810	4-Met hoxylbenzyl acet at e		$\text{C}_{10}\text{H}_{12}\text{O}_3$	104-21-2	180.200		84	270; 150 ²³	1.105 ²⁵		s ct c
6811	2-Met hoxyl-1,1'-bi phenyl		$\text{C}_{12}\text{H}_{10}$	86-26-0	184.233	pr (pet h)	29	274	1.0233 ⁹	1.5641 ⁹⁹	i H ₂ O; s Et OH, pet h; sl ct c
6812	4-Met hoxyl-1,1'-bi phenyl		$\text{C}_{12}\text{H}_{10}$	613-37-6	184.233	pl (al)	90	157 ⁹	1.0278 ¹⁰⁰	1.5744 ¹⁰⁰	i H ₂ O; s Et OH, et h
6813	1-Met hoxyl-1,3-but adi ene		$\text{C}_5\text{H}_8\text{O}$	3036-66-6	84.117			91.5	0.8296 ²⁰	1.4594 ²⁰	s H ₂ O, Et OH
6814	2-Met hoxyl-1,3-but adi ene		$\text{C}_5\text{H}_8\text{O}$	3588-30-5	84.117			75	0.8272 ²⁰	1.4442 ²⁰	vs ace, bz, et h, Et OH
6815	3-Met hoxyl-1-but anol		$\text{C}_6\text{H}_{12}\text{O}_2$	2517-43-3	104.148			157	0.923 ²³	1.4148 ²⁵	vs Et OH, ace; s et h; sl chl
6816	1-Met hoxyl-1-but en-3-yne		$\text{C}_6\text{H}_8\text{O}$	2798-73-4	82.101			dec 123; 39 ²³	0.906 ²⁰	1.4818 ²⁰	i H ₂ O; s chl
6817	Met hoxylchl or		$\text{C}_6\text{H}_5\text{Cl}_3\text{O}_2$	72-43-5	345.648	cry (di l al)	87		1.44		i H ₂ O; s Et OH, ct c; vs et h, bz
6818	Met hoxycycl ohexane		$\text{C}_7\text{H}_{14}\text{O}$	931-56-6	114.185	li q	-74.4	133	0.875 ⁹	1.4355 ²⁰	vs et h, Et OH
6819	1-Met hoxyl-2,4-di ni t robenzene		$\text{C}_6\text{H}_3\text{N}_2\text{O}_5$	119-27-7	198.133	nd (al or w)	94.5	206 ²	1.3364 ¹³¹	1.546 ¹⁵	sl H ₂ O; s Et OH, et h, ace, bz; vs py
6820	1-Met hoxyl-3,5-di ni t robenzene	3,5-Di ni t roani sole	$\text{C}_6\text{H}_3\text{N}_2\text{O}_5$	5327-44-6	198.133	nd (al)	105.3		1.558 ²		vs ace, bz, MeOH
6821	2-Met hoxyl-1,2-di phenyl et hanone		$\text{C}_{15}\text{H}_{14}\text{O}_2$	3524-62-7	226.271	nd (li g)	49.5	188	1.1278 ¹⁴		vs bz, et h, Et OH
6822	2-Met hoxyl et hanol	Et hyl ene glycol monomet hyl et her	$\text{C}_3\text{H}_6\text{O}_2$	109-86-4	76.095	li q	-85.1	124.1	0.964 ⁷	1.4024 ²⁰	msc H ₂ O, et h, bz; vs Et OH; s ace; sl chl
6823	(2-Met hoxyl et hoxyl) et hene		$\text{C}_8\text{H}_{10}\text{O}_2$	1663-35-0	102.132			107			
6824	2-[2-(2-Met hoxyl et hoxyl) et hoxyl] et hanol	Tri et hyl ene glycol monomet hyl et her	$\text{C}_7\text{H}_{16}\text{O}_4$	112-35-6	164.200			246			



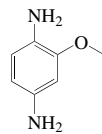
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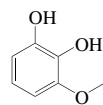
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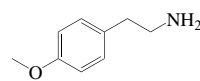
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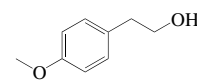
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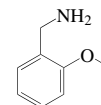
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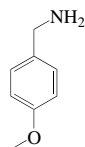
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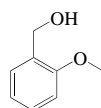
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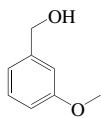
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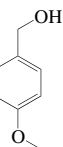
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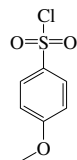
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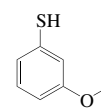
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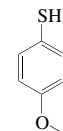
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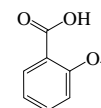
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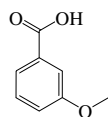
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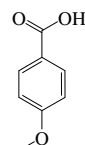
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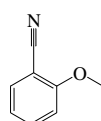
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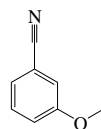
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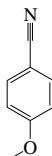
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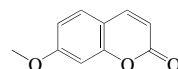
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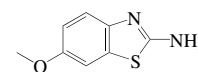
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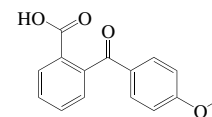
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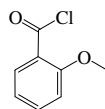
7-Met hoxy-2H-1-benzopyran-2-one



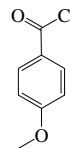
6-Met hoxy-2-benzot hi azolami ne



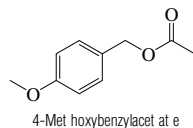
2-(4-Met hoxybenzoyl)benzoi aci d



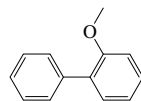
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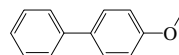
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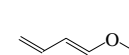
4-Met hoxybenzylacet at e



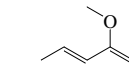
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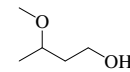
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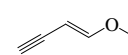
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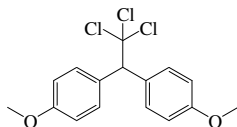
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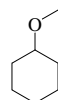
3-Met hoxy-1-but anol



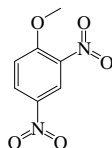
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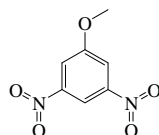
Met hoxychl or



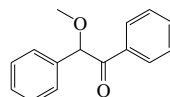
Met hoxycycl ohexane



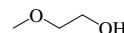
1-Met hoxy-2,4-di ni t robenzene



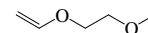
1-Met hoxy-3,5-di ni t robenzene



2-Met hoxy-1,2-di phenyl et hanone



2-Met hoxyet hanol

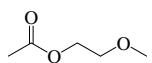


(2-Met hoxyet hoxy)et hene

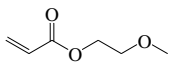


2-[2-(2-Met hoxyet hoxy)et hoxy]et hanol

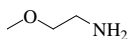
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6825	2-Met hoxyet hyl acet at e	Et hyl ene glycol monomet hyl acet at e	C ₆ H ₁₀ O ₃	110-49-6	118.131	li q	-70	143	1.0074 ⁴	1.4002 ²⁰	s H ₂ O, Et OH, et h; sl ct c
6826	2-Met hoxyet hyl acryl at e	2-Met hoxyet hyl 2-propenoat e	C ₉ H ₁₀ O ₂	3121-61-7	130.141			67 ¹⁶ , 56 ¹²	1.012 ²⁰		
6827	2-Met hoxyet hyl ami ne	1-Ami no-2-met hoxyet hane	C ₃ H ₉ NO	109-85-3	75.109			95			vs H ₂ O, Et OH; sl chl
6828	Met hoxyet hyl mercuri c acet at e		C ₅ H ₈ HgO ₃	151-38-2	318.72	nd (pet h)	42				
6829	2-(2-Met hoxyet hyl)pyri di ne	Met yri di ne	C ₈ H ₁₁ NO	114-91-0	137.179			203; 96 ¹⁷	0.988 ²⁰	1.4975 ²⁰	vs H ₂ O, Et OH
6830	2-Met hoxyf uran		C ₈ H ₁₀ O ₂	25414-22-6	98.101			110.5	1.0646 ²⁵	1.4468 ²⁵	
6831	4-Met hoxyf uro[2,3-b]qui nol i ne	Di ct amni ne	C ₁₂ H ₁₃ NO ₂	484-29-7	199.205	pr (al)	133.5				sl H ₂ O; vs Et OH; s et h, chl, AcOEt
6832	12-Met hoxyi bogami ne	lbogai ne	C ₂₀ H ₂₆ N ₂ O	83-74-9	310.432			148			s chl
6833	5-Met hoxi- <i>W</i> -i ndol e-3-et hanami ne	5-Met hoxyt rypt ami ne	C ₁₁ H ₁₄ N ₂ O	608-07-1	190.241	cry (al)	121.5				
6834	<i>N</i> -(2-(5-Met hoxi- <i>W</i> -i ndol -3-yl) et hyl)acet ami de	Mel at oni n	C ₁₆ H ₁₆ N ₂ O ₂	73-31-4	232.278	pa ye lf (bz)	117				
6835	3-Met hoxyi sopropyl ami ne	1-Met hoxi-2-propanami ne	C ₄ H ₉ NO	37143-54-7	89.136			97		1.4031 ²⁵	
6836	4-Met hoxi- <i>N</i> -(4-met hoxi phenyl) ani li ne	4,4'-Di met hoxidi phenyl ami ne	C ₁₄ H ₉ NO ₂	101-70-2	229.275	lf (Et OH)	103				
6837	<i>N</i> -Met hoxymet hyl ami ne	<i>N</i> -Met hoxymet hanami ne	C ₈ H ₉ NO	1117-97-1	61.083	li q		42.4			
6838	2-Met hoxi-5-met hyl ani li ne	5-Met hoxi- <i>W</i> -i ndol e-3-et hanami ne	C ₈ H ₉ NO	120-71-8	137.179		53	235			sl H ₂ O, chl; s Et OH, et h, bz, pet h
6839	4-Met hoxi-2-met hyl ani li ne		C ₈ H ₉ NO	102-50-1	137.179	cry (li g)	29.5	248.5	1.065 ⁵	1.5647 ²⁰	vs Et OH
6840	4-Met hoxi- α -met hyl benzenemet hanol		C ₉ H ₁₁ O ₂	3319-15-1	152.190			dec 310; 140 ¹⁷	1.0794 ²⁰	1.5310 ²⁵	s ct c
6841	2-Met hoxi-2-met hyl but ane	Met hyl pent yl et her	C ₈ H ₁₄ O	994-05-8	102.174			86.1	0.7660 ²⁵	1.3862 ²⁵	sl H ₂ O; vs et h, Et OH
6842	2-(Met hoxymet hyl) i uran		C ₆ H ₈ O ₂	13679-46-4	112.127			132	1.0163 ²⁰	1.4570 ²⁰	i H ₂ O; s Et OH; vs et h
6843	2-(Met hoxymet hyl)-5-ni t rof uran		C ₆ H ₇ NO ₄	586-84-5	157.125			104 ³	1.281 ²⁰	1.5325 ²⁰	vs Et OH
6844	(Met hoxymet hyl)oxi rane		C ₄ H ₇ O ₂	930-37-0	88.106			113	0.9890 ²⁰	1.4320 ²⁰	vs H ₂ O, ace, et h, Et OH
6845	3-Met hoxi-5-met hyl -4-oxo-2,5-hexadi enoi c aci d	Peni ci lli c aci d	C ₈ H ₁₀ O ₄	90-65-3	170.163	ort h or hexpl (+ 1w)	83				s H ₂ O, ace; vs Et OH, et h, bz; sl pet h
6846	4-Met hoxi-4-met hyl -2-pent anone	Pent oxone	C ₇ H ₁₂ O ₂	107-70-0	130.185			160	0.8980 ²⁵	1.418 ²⁰	
6847	2-Met hoxi-4-met hyl phenol	Creosol	C ₈ H ₁₀ O ₂	93-51-6	138.164	pr	5.5	221	1.098 ²⁰	1.5353 ²⁵	vs et h, Et OH
6848	1-Met hoxynapht hal ene		C ₉ H ₁₀ O	2216-69-5	158.196		<-10	269	1.0963 ¹⁴	1.6940 ²⁵	i H ₂ O; s Et OH, et h, bz, chl; vs CS
6849	2-Met hoxynapht hal ene		C ₉ H ₁₀ O	93-04-9	158.196	lf (et h), pl (pet h)	73.5	274			vs bz, et h, chl
6850	2-Met hoxi-1,4-napht hal enedi one		C ₁₀ H ₈ O ₃	2348-82-5	188.180			183.0			
6851	4-Met hoxi-1-napht hol		C ₁₀ H ₁₀ O ₂	84-85-5	174.196			129.8			
6852	2-Met hoxi-4-ni t roani li ne		C ₇ H ₉ N ₂ O ₃	97-52-9	168.150			141.0			s DMSO
6853	2-Met hoxi-5-ni t roani li ne	5-Ni t ro- <i>W</i> -i ndol e-3-et hanami ne	C ₈ H ₉ N ₂ O ₃	99-59-2	168.150			118	1.2068 ¹⁵		s H ₂ O, et h; vs Et OH, ace, bz; sl i l g
6854	4-Met hoxi-2-ni t roani li ne		C ₇ H ₉ N ₂ O ₃	96-96-8	168.150	dk red pr (w or al)	129				vs H ₂ O, ace, et h, Et OH
6855	2-Met hoxi phenol	Guai acol	C ₇ H ₈ O ₂	90-05-1	124.138	hex pr	32	205	1.1287 ²¹	1.5429 ²⁰	sl H ₂ O; s Et OH, et h, ct c, chl
6856	3-Met hoxi phenol		C ₇ H ₈ O ₂	150-19-6	124.138		<-17	114 ⁵	1.131 ²⁵	1.5510 ²⁰	sl H ₂ O, chl; msc Et OH, et h
6857	4-Met hoxi phenol		C ₇ H ₈ O ₂	150-76-5	124.138	pl	57	243			s H ₂ O, bz, ct c; vs Et OH, et h
6858	2-Met hoxi phenol benzoat e	Guai acol benzoat e	C ₁₄ H ₁₂ O ₃	531-37-3	228.243			57.5			vs et h, chl
6859	2-Met hoxi phenol carbonat e (2:1)	Guai acol carbonat e	C ₁₃ H ₁₀ O ₅	553-17-3	274.269	cry (al)	89				i H ₂ O; sl Et OH; s et h; vs chl
6860	2-Met hoxi phenol fosphat e (3:1)	Guai acol fosphat e	C ₂₁ H ₁₈ O ₇ P	563-03-1	416.362			91	277 ³		vs ace, t ol, chl
6861	5-[(2-Met hoxi phenoxy)met hyl]-2-oxazol i di none	Mephenoxal one	C ₁₁ H ₁₃ NO ₄	70-07-5	223.226			144			
6862	3-(2-Met hoxi phenoxy)-1,2-propanedi ol	Guai f enesi n	C ₁₆ H ₁₈ O ₄	93-14-1	198.216	ort h pr (et h, et h-pet h)	78.5	215 ¹⁹ , 127 ^{0.2}			s H ₂ O, bz, chl; vs Et OH; i pet h



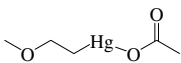
2-Met hoxyet hÿacet at e



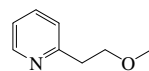
2-Met hoxyet hÿacryl at e



2-Met hoxyet hÿyl ami ne



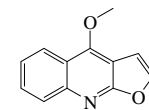
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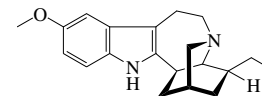
2-(2-Met hoxyet hÿyl)pyri di ne



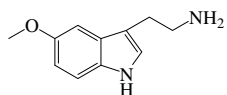
2-Met hoxÿf uran



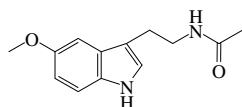
4-Met hoxÿÿ uro[2,3-b]qui nol i ne



12-Met hoxÿÿ bogami ne



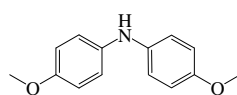
5-Met hoxÿ-*H*-i ndol e-3-et hanami ne



N-[2-(5-Met hoxÿ-*H*-i ndol -3-ÿl)et hÿl]acet ami de



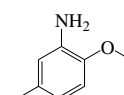
3-Met hoxÿÿ sopropÿl ami ne



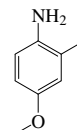
4-Met hoxÿ-*N*-(4-met hoxÿÿÿÿÿ)ani li ne



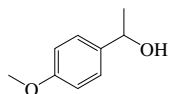
N-Met hoxÿmet hÿyl ami ne



2-Met hoxÿ-5-met hÿyl ani li ne



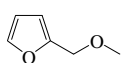
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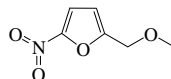
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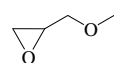
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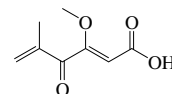
2-(Met hoxÿmet hÿl)ÿ uran



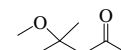
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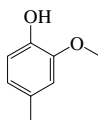
(Met hoxÿmet hÿl)oxi rane



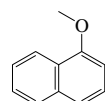
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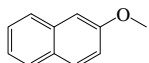
4-Met hoxÿ-4-met hÿl -2-pent anone



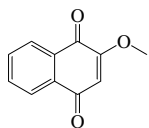
2-Met hoxÿ-4-met hÿÿÿÿÿ



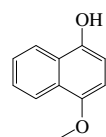
1-Met hoxÿnaph t hal ene



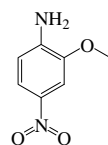
2-Met hoxÿnaph t hal ene



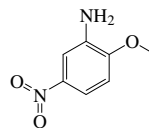
2-Met hoxÿ-1,4-naph t hal enedi o



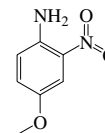
4-Met hoxÿ-1-naph t hc



2-Met hoxÿ-4-ni t roani li ne



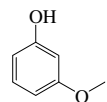
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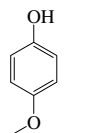
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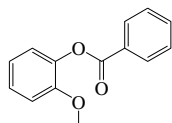
2-Met hoxÿÿÿÿÿ



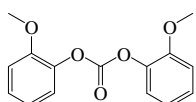
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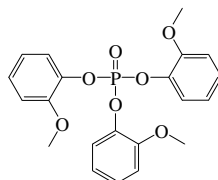
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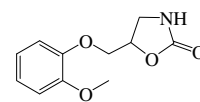
2-Met hoxÿÿÿÿÿbenzoat e



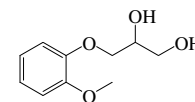
2-Met hoxÿÿÿÿÿcarbonat e(2:1)



2-Met hoxÿÿÿÿÿphosphat e(3:1)

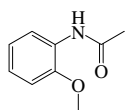


5-[(2-Met hoxÿÿÿÿÿ)met hÿl]-2-oxazol i di none

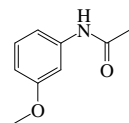


3-(2-Met hoxÿÿÿÿÿ)-1,2-propanedi ol

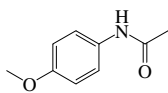
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	<i>n_D</i>	Solubility
6863	<i>N</i> -(2-Met hoxyphe nyl)acet ami de	<i>o</i> -Acet ani si di ne	$\text{C}_9\text{H}_9\text{NO}_2$	93-26-5	165.189	nd (w)	87.5	304			vs H ₂ O, Et OH; s et h, ace, HOAc
6864	<i>N</i> -(3-Met hoxyphe nyl)acet ami de	<i>m</i> -Acet ani si di ne	$\text{C}_9\text{H}_9\text{NO}_2$	588-16-9	165.189	nd or pl (w)	81				vs H ₂ O, Et OH; s et h, ace
6865	<i>N</i> -(4-Met hoxyphe nyl)acet ami de	<i>p</i> -Acet ani si di ne	$\text{C}_9\text{H}_9\text{NO}_2$	51-66-1	165.189	pl (w)	131				vs ace, Et OH, chl
6866	2-Met hoxyphe nyl acet at e	2-Acet oxyani sol e	$\text{C}_9\text{H}_9\text{O}_3$	613-70-7	166.173		31.5	123 ¹³	1.1285 ²⁵	1.5101 ²⁵	i H ₂ O; s Et OH, et h
6867	4-(4-Met hoxyphe nyl)-3-but en-2-one		$\text{C}_{11}\text{H}_{12}\text{O}_2$	943-88-4	176.212	lf (al, et h, HOAc)	74.0	187.5 ¹⁹			i H ₂ O; vs Et OH, et h; s bz, HOAc, sul f
6868	2-Met hoxyphe nyl et hanone		$\text{C}_9\text{H}_{10}\text{O}_2$	4079-52-1	150.174	ye li q	8	245; 125 ⁹	1.0897 ²⁰	1.5393 ²⁰	s Et OH, ace
6869	1-(3-Met hoxyphe nyl)et hanone		$\text{C}_9\text{H}_{10}\text{O}_2$	586-37-8	150.174		95.5	240	1.0343 ¹⁹	1.5410 ²⁰	s H ₂ O, Et OH, ace, ct c
6870	2-(4-Met hoxyphe nyl)- <i>H</i> -i ndene-1,3(2 <i>H</i>)-di one	Ani si ndi one	$\text{C}_{16}\text{H}_{12}\text{O}_3$	117-37-3	252.264	pa ye cry (HOAc, al)	156.5				
6871	4-Met hoxyphe nyl i socyanat e		$\text{C}_9\text{H}_9\text{NO}_2$	5416-93-3	149.148			110 ¹⁰			
6872	2-Met hoxyphe nyl i sot hi ocyanat e	1-Isot hi ocyanat o-2-met hoxyphe nyl	$\text{C}_9\text{H}_9\text{NO}_2$	3288-04-8	165.213			264; 131 ¹¹	1.1878 ²⁰	1.6458 ²⁰	
6873	<i>N</i> -(4-Met hoxyphe nyl)-3-oxobut anami de		$\text{C}_{11}\text{H}_{13}\text{NO}_3$	5437-98-9	207.226		117.3				s Et OH, chl; sl et h
6874	2-Met hoxyphe nyl pent anoat e	Guai acol val erat e	$\text{C}_{12}\text{H}_{16}\text{O}_3$	531-39-5	208.253			265	1.05 ²⁵		vs bz, et h, Et OH
6875	(4-Met hoxyphe nyl)pheni yl di azene		$\text{C}_6\text{H}_5\text{N}_2\text{O}$	2396-60-3	212.246	oran-red pl, lf (al, pet h)	56	340	1.12 ²⁵		i H ₂ O; s Et OH, et h, ace
6876	<i>N</i> -(<i>p</i> -Met hoxyphe nyl)pheny lenedi ami ne	<i>N</i> -(4-Met hoxyphe nyl)-1,4-benzenedi ami ne	$\text{C}_{13}\text{H}_{14}\text{N}_2\text{O}$	101-64-4	214.262	nd	102	238 ¹²			sl H ₂ O, pet h; vs bz, et h, Et OH
6877	<i>N</i> -(4-Met hoxyphe nyl)pheny lenedi ami ne hydrochl ori de		$\text{C}_{13}\text{H}_{15}\text{ClN}_2\text{O}$	3566-44-7	250.723	cry	245 dec				
6878	(4-Met hoxyphe nyl)pheni yl met hanone		$\text{C}_{10}\text{H}_{12}\text{O}_2$	611-94-9	212.244	pr (et h)	61.5	355; 168 ²			i H ₂ O; vs Et OH, et h; s ace, bz, HOAc
6879	3-(4-Met hoxyphe nyl)-1-pheny l-2-propen-1-one		$\text{C}_{16}\text{H}_{14}\text{O}_2$	959-33-1	238.281	ye nd (al)	79	187 ⁹			i H ₂ O; vs Et OH; s et h, ct c, chl, HOAc
6880	1-(4-Met hoxyphe nyl)-1-propanone	Et hyl 4-met hoxyphe nyl ket one	$\text{C}_{10}\text{H}_{12}\text{O}_2$	121-97-1	164.201		25.5	266	1.0798 ¹⁶		s ct c
6881	1-(4-Met hoxyphe nyl)-2-propanone	Ani syl met hyl ket one	$\text{C}_{10}\text{H}_{12}\text{O}_2$	122-84-9	164.201		<-15	268	1.0694 ¹⁷	1.5253 ²⁰	vs et h, Et OH
6882	<i>t rans</i> 3-(4-Met hoxyphe nyl)-2-propenoi c aci d	<i>t rans</i> 4-Met hoxyci nna mi c aci d	$\text{C}_{10}\text{H}_{10}\text{O}_3$	943-89-5	178.184		173.5				sl H ₂ O, Et OH, bz, DMSO; s ct c, HOAc
6883	<i>t rans</i> 1-Met hoxyphe nyl-4-(2-pheny lvi nyl)benzene		$\text{C}_{15}\text{H}_{14}\text{O}$	1694-19-5	210.271		136.5	142.5 ¹⁵			i H ₂ O; vs Et OH, et h, ace, bz; s pet h
6884	1-Met hoxyphe nyl-2-propadi ene	Met hoxyl l ene	$\text{C}_4\text{H}_6\text{O}$	13169-00-1	70.090	oi l		51.5			
6885	3-Met hoxyphe nyl-1-propanami ne		$\text{C}_9\text{H}_{11}\text{NO}$	5332-73-0	89.136			117.5	0.8727 ²⁰	1.4391 ²⁰	s H ₂ O, ace, bz, ct c, chl, MeOH
6886	3-Met hoxyphe nyl-2-propanedi ol	Glycerol 3-met hyl et her	$\text{C}_9\text{H}_{17}\text{O}_3$	623-39-2	106.120	hyg li q		220	1.114 ⁴	1.442 ²⁵	vs H ₂ O, Et OH, ace; s et h
6887	3-Met hoxyphe nyl-1-propaneni t ri le		$\text{C}_9\text{H}_{10}\text{O}$	110-67-8	85.105			163	0.9379 ²⁰	1.4043 ²⁰	s Et OH, et h, chl
6888	2-Met hoxyphe nyl-1-propanol		$\text{C}_9\text{H}_{10}\text{O}_2$	1589-47-5	90.121			130	0.938 ²⁰	1.4070 ²⁰	
6889	1-Met hoxyphe nyl-2-propanone	Met hoxycet one	$\text{C}_6\text{H}_8\text{O}_2$	5878-19-3	88.106			116	0.957 ²⁵	1.3970 ²⁰	
6890	2-Met hoxyphe nyl-1-propene		$\text{C}_7\text{H}_8\text{O}$	116-11-0	72.106			38	0.7372 ²⁰		
6891	3-Met hoxyphe nyl-1-propene		$\text{C}_7\text{H}_8\text{O}$	627-40-7	72.106			44	0.77 ¹¹	1.3778 ²⁰	i H ₂ O; msc Et OH, et h; s ace
6892	<i>t rans</i> 1-Met hoxyphe nyl-4-(1-propenyl)benzene	Anet hol e	$\text{C}_{10}\text{H}_{12}\text{O}$	4180-23-8	148.201	col oi ly li q	22.5	235; 78 ¹	0.9882 ²⁰	1.5615 ²⁰	sl H ₂ O; msc Et OH, et h; s ace; vs bz
6893	1-Met hoxyphe nyl-4-(2-propenyl)benzene	Est ragol e	$\text{C}_{10}\text{H}_{12}\text{O}$	140-67-0	148.201			215.5	0.965 ²⁵	1.5195 ²⁰	vs Et OH, chl
6894	<i>ci s</i> 2-Met hoxyphe nyl-4-(1-propenyl)phenol		$\text{C}_{10}\text{H}_{12}\text{O}_2$	5912-86-7	164.201			134 ¹³	1.0837 ²⁰	1.5726 ²⁰	sl H ₂ O; s Et OH, et h
6895	<i>t rans</i> 2-Met hoxyphe nyl-4-(1-propenyl)phenol		$\text{C}_{10}\text{H}_{12}\text{O}_2$	5932-68-3	164.201		33.5	141 ¹³	1.0852 ²⁰	1.5784 ²⁰	sl H ₂ O; s Et OH, et h, chl
6896	1-Met hoxyphe nyl-4-propyl benzene		$\text{C}_{10}\text{H}_{14}\text{O}$	104-45-0	150.217			211.5	0.9472 ²⁰	1.5045 ²⁰	sl H ₂ O; s Et OH, ace, bz, chl; vs et h
6897	2-Met hoxyphe nyl-4-propyl phenol		$\text{C}_{10}\text{H}_{14}\text{O}_2$	2785-87-7	166.217			121 ¹⁰			
6898	3-Met hoxyphe nyl-1-propyne		$\text{C}_7\text{H}_8\text{O}$	627-41-8	70.090			63	0.83 ¹²	1.5035 ²⁰	vs et h, Et OH



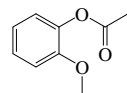
N-(2-Met hoxifyphenyl) acet ami de



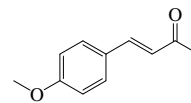
N-(3-Met hoxifyphenyl) acet ami de



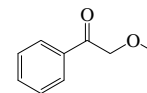
N-(4-Met hoxifyphenyl) acet ami de



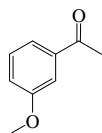
2-Met hoxifyphenylacet ate



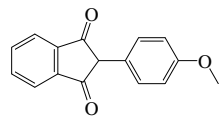
4-(4-Met hoxifyphenyl)-3-but en-2-one



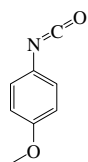
2-Met hoxi-1-phenyl et hanone



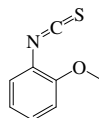
1-(3-Met hoxifyphenyl) et hanone



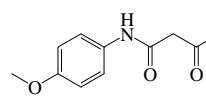
2-(4-Met hoxifyphenyl)-#-i ndene-1,3(2#)-di one



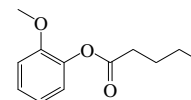
4-Met hoxifyphenyli socyanat e



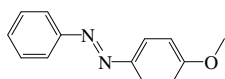
2-Met hoxifyphenyli sot hi ocyanat e



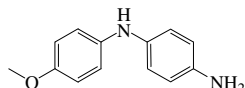
N-(4-Met hoxifyphenyl)-3-oxobut anami de



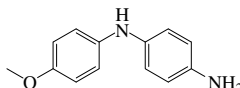
2-Met hoxifyphenylpent anoat e



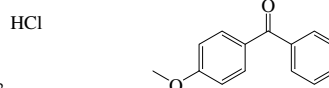
(4-Met hoxifyphenyl) phenyl di azene



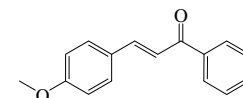
N-(p-Met hoxifyphenyl) #-phenyl enedi ami ne



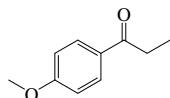
N-(4-Met hoxifyphenyl) #-phenyl enedi ami rhydrolori de



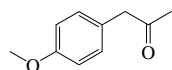
(4-Met hoxifyphenyl) phenyl met hanone



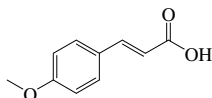
3-(4-Met hoxifyphenyl)-1-phenyl-2-propen-1-one



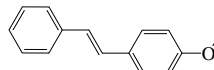
1-(4-Met hoxifyphenyl)-1-propanone



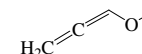
1-(4-Met hoxifyphenyl)-2-propanone



t rans3-(4-Met hoxifyphenyl)-2-propenoi aci d



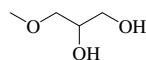
t rans1-Met hoxi-4-(2-phenyl vi nyl) benzene



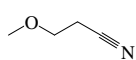
1-Met hoxi-1,2-propadi ene



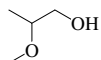
3-Met hoxi-1-propanami ne



3-Met hoxi-1,2-propanedi c



3-Met hoxipropaneni t ri



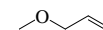
2-Met hoxi-1-propanol



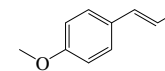
1-Met hoxi-2-propanone



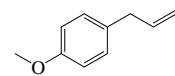
2-Met hoxi-1-propene



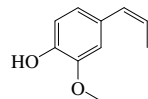
3-Met hoxi-1-propene



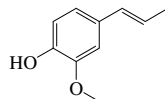
t rans1-Met hoxi-4-(1-propenyl) benzeni



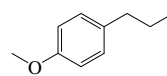
1-Met hoxi-4-(2-propenyl) benzene



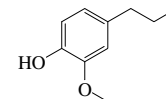
ci s2-Met hoxi-4-(1-propenyl) phenol



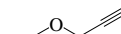
t rans2-Met hoxi-4-(1-propenyl) phenol



1-Met hoxi-4-propyl benzene

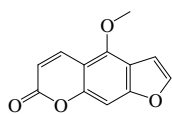


2-Met hoxi-4-propyl phenol

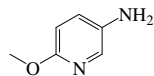


3-Met hoxi-1-propyne

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6899	5-Met hoxyporsoral en	Bergapt ene	$\text{C}_{10}\text{H}_8\text{O}_4$	484-20-8	216.190	nd (Et OH)	188				i H ₂ O; sl Et OH, bz, chl
6900	6-Met hoxy-3-pyri di nami ne		$\text{C}_8\text{H}_8\text{N}_2\text{O}$	6628-77-9	124.140		30	125 ¹⁰ , 87 ¹		1.5745 ²⁰	
6901	2-Met hoxypyri di ne		$\text{C}_8\text{H}_8\text{NO}$	1628-89-3	109.126			142.5	1.0457 ²⁰	1.5042 ²⁰	
6902	3-Met hoxypyri di ne		$\text{C}_8\text{H}_8\text{NO}$	7295-76-3	109.126	li q		178.5; 65 ⁵	1.083	1.5180 ²⁰	
6903	4-Met hoxypyri di ne		$\text{C}_8\text{H}_8\text{NO}$	620-08-6	109.126			192; 95 ⁴⁵			msc H ₂ O
6904	6-Met hoxyqui nol i ne		$\text{C}_{10}\text{H}_8\text{NO}$	5263-87-6	159.184	hyg lf	26.5	306; 153 ⁸	1.152 ²⁰		s Et OH, et h, chl, di l HCl
6905	6-Met hoxy-4-qui nol i necarboxyli c aci d	Qui ni ni c aci d	$\text{C}_{11}\text{H}_8\text{NO}_3$	86-68-0	203.194	pa ye pr (di l al)	285 dec	sub			sl ₂ H ₂ O, et h, bz, t f a; i chl; s Et OH
6906	2-Met hoxy-1,3,5-t ri ni t robenzene	Met hyl pi crat e	$\text{C}_7\text{H}_5\text{N}_3\text{O}_7$	606-35-9	243.131	nd (di l MeOH)	69		1.494 ⁷		i H ₂ O; vs Et OH, chl, bz; s et h
6907	(2-Met hoxyvi nyl)benzene		$\text{C}_{10}\text{H}_{10}\text{O}$	4747-15-3	134.174				211.5	0.9894 ²³	1.5620 ²⁴
6908	Met hscopol ami ne bromi de	Scopol ami ne met hobromi de	$\text{C}_{18}\text{H}_{24}\text{BrNO}_4$	155-41-9	398.293	cry (Et OH)	215 dec				s H ₂ O; sl Et OH
6909	Met hyl abi et at e		$\text{C}_{21}\text{H}_{22}\text{O}_2$	127-25-3	316.478	pa ye lf (li q)		225	1.049 ²⁰	1.5344	i H ₂ O; s Et OH, HOAc
6910	N-Met hyl acet ami de		$\text{C}_9\text{H}_9\text{NO}$	79-16-3	73.094		28	205	0.9371 ²⁵	1.4301 ²⁰	vs ace, bz, et h, Et OH
6911	4-Met hyl acet ani li de		$\text{C}_9\text{H}_9\text{NO}$	103-89-9	149.189	mcl cry or nd (di l al)	152	307	1.2120 ¹⁵		vs et h, Et OH
6912	Met hyl acet at e		$\text{C}_4\text{H}_6\text{O}_2$	79-20-9	74.079	li q	-98.25	56.87	0.934 ²	1.3614 ²⁰	vs H ₂ O, et h, Et OH
6913	Met hyl acet oacet at e		$\text{C}_5\text{H}_8\text{O}_3$	105-45-3	116.116		27.5	171.7	1.0762 ²⁰	1.4184 ²⁰	vs H ₂ O; msc Et OH, et h; s ct c
6914	4-Met hyl acet ophenone		$\text{C}_{11}\text{H}_{12}\text{O}$	122-00-9	134.174	nd	28	226; 93.5 ⁷	1.0051 ²⁰	1.5335 ²⁰	vs bz, et h, Et OH, chl
6915	Met hyl 2-(acet yl oxy)benzoat e	Met hyl acet yl sal i c yl at e	$\text{C}_{10}\text{H}_8\text{O}_4$	580-02-9	194.184	pl (pet h)	51.5	135			vs et h, Et OH, chl
6916	Met hyl acryl at e	Met hyl propenoat e	$\text{C}_4\text{H}_6\text{O}_2$	96-33-3	86.090	li q	<-75	80.7	0.953 ⁵	1.4040 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz, chl
6917	2-Met hyl acryl oni t ri le	2-Met hyl propeneni t ri le	$\text{C}_4\text{H}_5\text{N}$	126-98-7	67.090	li q	-35.8	90.3	0.800 ⁷	1.4003 ²⁰	sl H ₂ O, chl; msc Et OH, et h, ace, t ol
6918	2-Met hyl al ani ne	α -Ari noi sobut yri c aci d	$\text{C}_4\text{H}_9\text{NO}_2$	62-57-7	103.120	mcl pr	335	sub 280			vs H ₂ O; sl Et OH; i et h
6919	5-Met hyl -3-al lyl -2,4-oxazol i di nedi one	Al oxi done	$\text{C}_7\text{H}_7\text{NO}_3$	526-35-2	155.151			138 ³⁵ , 86 ^{0.5}		1.4688 ²⁵	
6920	Met hyl ami ne	Met hanami ne	$\text{C}_2\text{H}_7\text{N}$	74-89-5	31.058	col gas	-93.5	-6.32	0.656 ⁶⁵ (p>1 at m)		vs H ₂ O; s Et OH, ace, bz; msc et h
6921	Met hyl ami ne hydrochl ori de	Met hanami ne hydrochl ori de	$\text{C}_2\text{H}_8\text{NCl}$	593-51-1	67.519	hyg t et r t ab (al)	227.5	227			s H ₂ O, Et OH; i chl, ace
6922	1-(Met hyl ami no)-9,10-ant hracenedi one		$\text{C}_{15}\text{H}_{11}\text{NO}_2$	82-38-2	237.254	ye-red nd	171.0				s Et OH, bz, chl, HOAc
6923	Met hyl 2-ami nobenzoat e	Met hyl ant hrani l at e	$\text{C}_8\text{H}_9\text{NO}_2$	134-20-3	151.163		24.5	256	1.1682 ¹⁰	1.5810	sl H ₂ O; vs Et OH, et h
6924	Met hyl 3-ami nobenzoat e		$\text{C}_8\text{H}_9\text{NO}_2$	4518-10-9	151.163		39	152 ¹¹	1.232 ²⁰		vs Et OH, et h, bz, chl; s li g; sl pet h
6925	Met hyl 4-ami nobenzoat e		$\text{C}_8\text{H}_9\text{NO}_2$	619-45-4	151.163	lf or nd (aq MeOH)	113.0				s chl
6926	2-(Met hyl ami no)benzoi c aci d		$\text{C}_8\text{H}_7\text{NO}_2$	119-68-6	151.163	pl (al or li g)	180.5	80 ¹			sl H ₂ O; vs Et OH, et h, bz, chl
6927	3-(Met hyl ami no)benzoi c aci d		$\text{C}_8\text{H}_7\text{NO}_2$	51524-84-6	151.163	pl (pet h)	127				vs ace, bz, Et OH, chl
6928	4-(Met hyl ami no)benzoi c aci d		$\text{C}_8\text{H}_7\text{NO}_2$	10541-83-0	151.163	nd (bz, w, di l al)	168				s H ₂ O, bz, AcOEt; vs Et OH, et h; sl t f a
6929	Met hyl 3-ami no-2-but enoat e		$\text{C}_8\text{H}_9\text{NO}_2$	14205-39-1	115.131						s chl
6930	N-((Met hyl ami no)carbonyl)acet ami de		$\text{C}_4\text{H}_8\text{N}_2\text{O}_2$	623-59-6	116.119	t cl (w, al), pr (w)	180.5	dec			s H ₂ O, chl; sl Et OH, et h
6931	2-(Met hyl ami no)-2-deoxy- β -L-ucopyranose	N-Met hyl α -L-gl ucosami ne	$\text{C}_7\text{H}_{13}\text{NO}_3$	42852-95-9	193.198	gl ass					s MeOH
6932	2-(Met hyl ami no)et hanesul f oni c aci d	N-Met hyl t auri ne	$\text{C}_7\text{H}_9\text{NO}_3\text{S}$	107-68-6	139.173		241.5				vs H ₂ O; i Et OH, et h
6933	4-[2-(Met hyl ami no)et hyl]-1,2-benzenedi ol	Deoxyepi nephri ne	$\text{C}_{13}\text{H}_{19}\text{NO}_2$	501-15-5	167.205		188.5				
6934	Met hyl 3-ami no-4-hydroxybenzoat e	Ort hocai ne	$\text{C}_8\text{H}_9\text{NO}_3$	536-25-4	167.162	nd (bz or HOAc)	143				i H ₂ O; vs Et OH; s et h, al k; sl bz



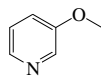
5-Met hoxypsoral en



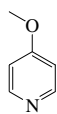
6-Met hoxi-3-pyri di nami ne



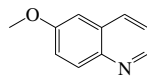
2-Met hoxypyri di ne



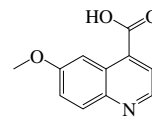
3-Met hoxypyri di ne



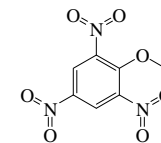
4-Met hoxypyri di ne



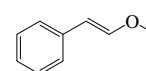
6-Met hoxiqui nol i ne



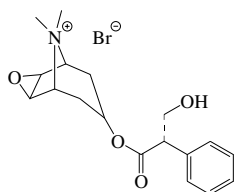
6-Met hoxi-4-qui nol i necarboxyãicid



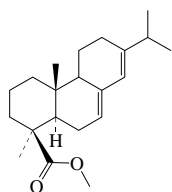
2-Met hoxi-1,3,5-t ri ni t robenzene



(2-Met hoxivi nyl)benzene



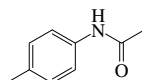
Met hscopol ami bromi de



Met hylabi et at e



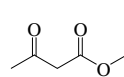
N-Met hylacet ami de



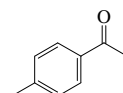
4-Met hylacet ani li de



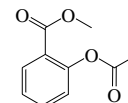
Met hylacet at e



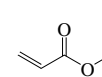
Met hylacet oacet at e



4-Met hylacet ophenone



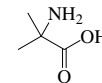
Met hyl2-(acet yl oxy)benzoat e



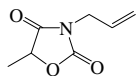
Met hylacryl at e



2-Met hylacryl oni t ri l



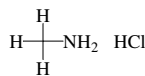
1,2-Met hyl al ani ne



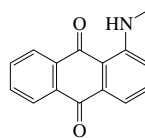
5-Met hyl-3-ãl l yl-2,4-oxazol i di ned



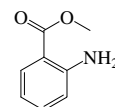
Met hyl ami ne



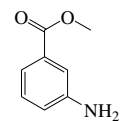
Met hyl ami ni hydrochl ori di



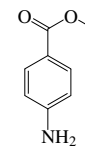
1-(Met hyl ami no)-9,10-ant hracenedi



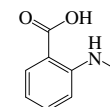
Met hyl2-ami nobenzoat e



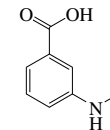
Met hyl3-ami nobenzoat e



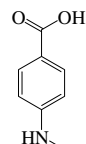
Met hyl4-ami nobenzoat e



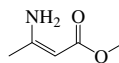
2-(Met hyl ami no)benzoãci d



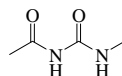
3-(Met hyl ami no)benzoãci d



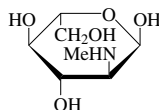
4-(Met hyl ami no)benzoãci c



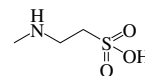
Met hyl3-ami no-2-but enoat e



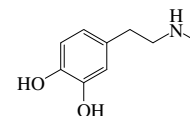
N-[(Met hyl ami no)carbonyl]acet ami de



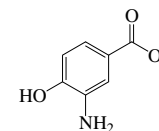
2-(Met hyl ami no)-2-deoxy-L-gl ucopyranos



2-(Met hyl ami no)et hanesul f ami d

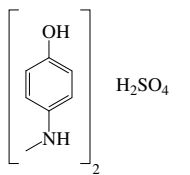


4-[2-(Met hyl ami no)et hyl]-1,2-benzenedi ol



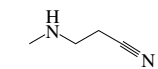
Met hyl3-ami no-4-hydroxybenzoat e

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6935	4-(Met hyl ami no)phenol sulf a te		$_{14}H_{13}N_2O_6S$	1936-57-8	344.383	cry	260 dec				sl Et OH; i et h
6936	3-(Met hyl ami no)propaneni t ri le		$_{10}H_{17}N$	693-05-0	84.120			102 ⁴⁹ , 74 ¹⁶	0.8992 ²⁰	1.4320 ²⁰	s H ₂ O, ace, bz, chl, MeOH
6937	4-[2-(Met hyl ami no)propyl]phenol	Pholedri ne	$_{10}H_{13}NO$	370-14-9	165.232	cry (MeOH)	161				vs et h, Et OH
6938	2-Met hyl ani li ne	<i>o</i> -Tol ui di ne	$_{7}H_9N$	95-53-4	107.153	li q	-14.41	200.3	0.998 4	1.5725 ²⁰	sl H ₂ O; msc Et OH, et h, ct c
6939	3-Met hyl ani li ne	<i>m</i> -Tol ui di ne	$_{7}H_9N$	108-44-1	107.153	li q	-31.3	203.3	0.988 9	1.5681 ²⁰	vs ace, bz, et h, Et OH
6940	4-Met hyl ani li ne	<i>p</i> -Tol ui di ne	$_{7}H_9N$	106-49-0	107.153	lf (w+1)	43.6	200.4	0.961 9	1.5534 ⁴⁵	sl H ₂ O; vs Et OH, py; s et h, ace, ct c
6941	<i>N</i> -Met hyl ani li ne		$_{7}H_9N$	100-61-8	107.153	li q	-57	196.2	0.989 4	1.5684 ²⁰	i H ₂ O; s Et OH, et h, ct c, chl
6942	2-Met hyl ani li ne, hydrochl ori de	<i>o</i> -Tol ui di ne, hydrochl ori de	$_{7}H_8ClN$	636-21-5	143.614	mcl pr (w)	215				vs H ₂ O, Et OH
6943	4-Met hyl ani li ne, hydrochl ori de		$_{7}H_8ClN$	540-23-8	143.614	mcl nd (et h- HOAc)	244.5	258	1.1930 ¹⁸		vs H ₂ O, Et OH, HOAc
6944	2-Met hyl ani sol e		$_{8}H_{10}O$	578-58-5	122.164	li q	-34.1	171	0.98 5	1.5161 ²⁰	i H ₂ O; s Et OH, et h, ace, ct c
6945	3-Met hyl ani sol e		$_{8}H_{10}O$	100-84-5	122.164	li q	-47	175.5	0.96 9	1.5130 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; sl ct c
6946	4-Met hyl ani sol e		$_{8}H_{10}O$	104-93-8	122.164	li q	-32	175.5	0.96 9	1.5112 ²⁰	i H ₂ O; s Et OH, et h, chl
6947	1-Met hyl ant hracene		$_{12}H_{12}$	610-48-0	192.256	bl nd (MeOH) lf (al)	85.5	199.5	1.0471 ⁹⁹	1.6802 ⁹⁹	i H ₂ O; s Et OH, et h, bz, chl, sul f
6948	2-Met hyl ant hracene		$_{12}H_{12}$	613-12-7	192.256	grn bl flr lf (sub)	209	sub	1.80 ⁰		i H ₂ O, ace; sl Et OH, et h; s bz, C ₆ S
6949	9-Met hyl ant hracene		$_{12}H_{12}$	779-02-2	192.256	ye nd (di l al) pr (bz, al)	81.5	196 ¹²	1.065 ⁹⁹	1.6959 ⁹⁹	s Et OH, et h, ace, bz, chl
6950	2-Met hyl -9,10-ant hracenedi one	2-Met hyl ant hraqui none	$_{15}H_{16}O_2$	84-54-8	222.239	ye nd (al, HOAc)	177	sub			vs bz, Et OH, HOAc
6951	Met hyl arsi ne		$_{7}As$	593-52-2	91.973	col gas	-143	2			vs ace, et h, Et OH
6952	9-Met hyl -9-azabi cycl o[3.3.1]nonan- 3-one	Pseudopel let i eri ne	$_{9}H_9NO$	552-70-5	153.221	ort h pr (pet h)	54	246	1.00 ⁴⁰	1.4760 ¹⁰⁰	vs H ₂ O, et h, Et OH
6953	8-Met hyl -8-azabi cycl o[3.2.1]oct ane	Tropane	$_{8}H_8N$	529-17-9	125.212			166	0.9251 ¹⁵		
6954	8-Met hyl -8-azabi cycl o[3.2.1]oct an-3- one		$_{8}H_7NO$	532-24-1	139.195		43	227; 113 ²⁵	1.9872 ¹⁰⁰	1.4598 ¹⁰⁰	s Et OH, et h, ace, bz, pet h; sl chl
6955	Met hyl azi de		$_{2}H_2$	624-90-8	57.055			exp 20.5	0.869 ¹⁵		
6956	Met hyl azoxymet hanol acet at e		$_{4}H_6O_3$	592-62-1	132.118			191; 490 ⁴⁵			
6957	2-Met hyl benzal dehyde	<i>o</i> -Tol ual dehyde	$_{8}H_8O$	529-20-4	120.149			200; 94 ¹⁰	1.0328 ²⁰	1.5462 ²⁰	sl H ₂ O, ct c; s Et OH, et h, bz; vs ace
6958	3-Met hyl benzal dehyde	<i>m</i> -Tol ual dehyde	$_{8}H_8O$	620-23-5	120.149			199	1.0189 ²¹	1.5413 ²¹	sl H ₂ O; msc Et OH, et h; vs ace; s bz, chl
6959	4-Met hyl benzal dehyde	<i>p</i> -Tol ual dehyde	$_{8}H_8O$	104-87-0	120.149			204; 106 ¹⁰	1.0194 ¹⁷	1.5454 ²⁰	sl H ₂ O; msc Et OH, et h, ace; vs chl
6960	2-Met hyl benzami de	<i>o</i> -Tol uami de	$_{7}H_7NO$	527-85-5	135.163		147				sl H ₂ O, et h, t f a, bz; vs Et OH
6961	4-Met hyl benzami de	<i>p</i> -Tol uami de	$_{7}H_7NO$	619-55-6	135.163		162.5				sl H ₂ O, bz, chl; vs Et OH, et h; s t f a
6962	<i>N</i> -Met hyl benzami de		$_{7}H_7NO$	613-93-4	135.163		82	291; 167 ¹²			s Et OH, ace
6963	7-Met hyl benz[a]ant hracene		$_{14}H_{14}$	2541-69-7	242.314	ye pl (al)	141				i H ₂ O; s Et OH, et h, ace, ct c, HOAc, CS ₂
6964	8-Met hyl benz[a]ant hracene		$_{14}H_{14}$	2381-31-9	242.314	pl (bz-al), nd (bz-li g)	156.5	272 ³ , 160 ³¹	1.2310 ⁰		i H ₂ O; s Et OH, et h, bz, xyl
6965	9-Met hyl benz[a]ant hracene		$_{14}H_{14}$	2381-16-0	242.314	nd (al)	152.5				i H ₂ O; s Et OH, et h, ct c, chl, C ₆ S xyl
6966	10-Met hyl benz[a]ant hracene		$_{14}H_{14}$	2381-15-9	242.314		184				i H ₂ O; s Et OH, HOAc
6967	12-Met hyl benz[a]ant hracene		$_{14}H_{14}$	2422-79-9	242.314	pl (al)	150.5				i H ₂ O; s Et OH, C ₆ S, HOAc
6968	2-Met hyl benzeneacet al dehyde		$_{9}H_{10}O$	10166-08-2	134.174			221; 92 ¹⁰	1.0241 ¹⁰		vs et h, Et OH, chl
6969	4-Met hyl benzeneacet al dehyde		$_{9}H_{10}O$	104-09-6	134.174		40	221.5	1.0052 ²⁰	1.5255 ²⁰	vs et h, Et OH, chl
6970	α -Met hyl benzeneacet al dehyde		$_{9}H_{10}O$	93-53-8	134.174			203.5	1.0089 ²⁰	1.5176 ²⁰	vs Et OH
6971	2-Met hyl benzeneacet i c aci d		$_{9}H_8O_2$	644-36-0	150.174	nd (w)	89				s H ₂ O, chl

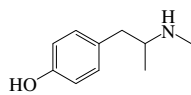


4-(Met hyl ami no)phensulf f at e

H₂SO₄



3-(Met hyl ami no)propaneni t



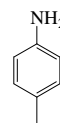
4-[2-(Met hyl ami no)propyl]phenol



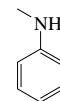
2-Met hyl ani li ne



3-Met hyl ani li ne



4-Met hyl ani li ne

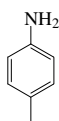


N-Met hyl ani li ne



2-Met hyl ani li hydrochl ori de

HCl



4-Met hyl ani li hydrochl ori de

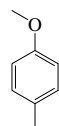
HCl



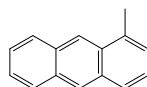
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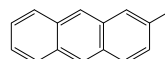
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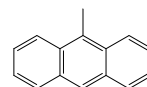
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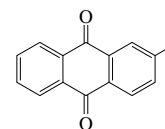
1-Met hyl ant hracene



2-Met hyl ant hracene



9-Met hyl ant hracene

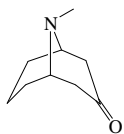


2-Met hyl -9,10-ant hracenedi one

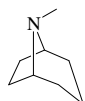
3-369



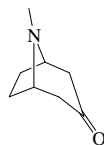
Met hyl arsi ne



9-Met hyl -9-azabi cycl o[3.3.1]nonan-3-one



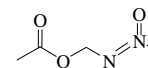
8-Met hyl -8-azabi cycl o[3.2.1]oct ane



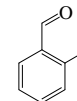
8-Met hyl -8-azabi cycl o[3.2.1]oct an-3-one



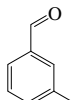
Met hyl azi de



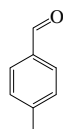
Met hyl azoxymet hanacet at e



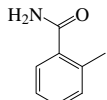
2-Met hyl benzal dehyde



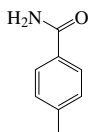
3-Met hyl benzal dehyd



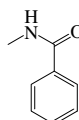
4-Met hyl benzal dehyd



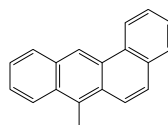
2-Met hyl benzami de



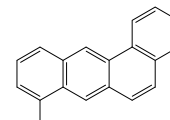
4-Met hyl benzami de



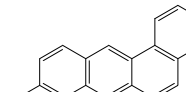
N-Met hyl benzami c



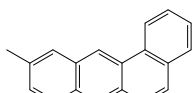
7-Met hyl benz[a]ant hracene



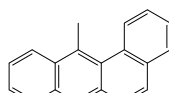
8-Met hyl benz[a]ant hracene



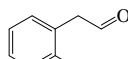
9-Met hyl benz[a]ant hracene



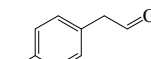
10-Met hyl benz[a]ant hracene



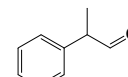
12-Met hyl benz[a]ant hracene



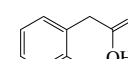
2-Met hyl benzeneacet al dehyde



4-Met hyl benzeneacet al dehyde

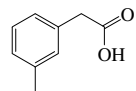


α-Met hyl benzeneacet al dehyd

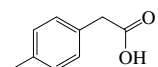


2-Met hyl benzeneacet aci d

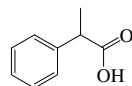
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
6972	3-Met hyl benzeneacet i c aci d		₉ H ₉ O ₂	621-36-3	150.174	nd (w)	62	121 ²⁶			s H ₂ O, chl
6973	4-Met hyl benzeneacet i c aci d		₉ H ₉ O ₂	622-47-9	150.174	nd or pl (al, w)	93	265			vs bz, et h, Et OH
6974	α-Met hyl benzeneacet i c aci d, (±)		₉ H ₉ O ₂	2328-24-7	150.174		<-20	263	1.1 ⁰	1.5237 ²⁰	
6975	4-Met hyl benzeneacet oni t ri l e		₉ H ₉ NC	2947-61-7	131.174		18	242.5	0.992 ²⁵	1.5190 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
6976	α-Met hyl benzeneacet oni t ri l e		₉ H ₉ NC	1823-91-2	131.174			231	0.9854 ²⁰	1.5095 ²⁵	vs et h, Et OH
6977	3-Met hyl -1,2-benzenedi ami ne	Tol uene-2,3-di ami ne	₇ H ₁₀ O ₂	2687-25-4	122.167		63.5	255			vs ace, bz, Et OH
6978	4-Met hyl -1,2-benzenedi ami ne	Tol uene-3,4-di ami ne	₇ H ₁₀ O ₂	496-72-0	122.167	pl (li g)	89.5	265			vs J ₀ ; s li g
6979	2-Met hyl -1,3-benzenedi ami ne	Tol uene-2,6-di ami ne	₇ H ₁₀ O ₂	823-40-5	122.167	pr (bz, w)	106				s H ₂ O, Et OH, bz
6980	2-Met hyl -1,4-benzenedi ami ne	Tol uene-2,5-di ami ne	₇ H ₁₀ O ₂	95-70-5	122.167	pl (bz)	64	273.5			s H ₂ O, Et OH, et h; sl bz, HOAc
6981	3-Met hyl -1,2-benzenedi ol		₇ H ₈ O ₂	488-17-5	124.138	lf (bz)	68	248			s J ₀ , Et OH, bz, chl
6982	4-Met hyl -1,2-benzenedi ol		₇ H ₈ O ₂	452-86-8	124.138	lf (bz-li g), pr (bz)	65	258	1.1287 ⁷⁴	1.5425 ⁷⁴	s H ₂ O, Et OH, et h, ace, chl; sl li g
6983	2-Met hyl -1,3-benzenedi ol		₇ H ₈ O ₂	608-25-3	124.138	pr (bz)	120	265			vs H ₂ O, bz, et h, Et OH
6984	4-Met hyl -1,3-benzenedi ol		₇ H ₈ O ₂	496-73-1	124.138	cry (bz-pet h)	105	270			s H ₂ O, Et OH, et h; sl bz, pet h
6985	5-Met hyl -1,3-benzenedi ol	Orci nol	₇ H ₈ O ₂	504-15-4	124.138	pr(w+1), lf (chl)	107	287	1.290		s H ₂ O, Et OH, et h, bz; sl li g, pet h
6986	2-Met hyl -1,4-benzenedi ol		₇ H ₈ O ₂	95-71-6	124.138		125	283; 163 ¹¹			vs H ₂ O, Et OH, et h; s ace; sl bz, li g
6987	4-Met hyl -1,2-benzenedi t hi ol	Tol uene-3,4-di t hi ol	₇ H ₈ S ₂ C	496-74-2	156.269		29				s chl
6988	β-Met hyl benzeneet hanami ne		₈ H ₉ N	582-22-9	135.206			210	0.9433 ⁴	1.5255 ²⁰	vs bz, et h, Et OH
6989	N-Met hyl benzeneet hanami ne		₈ H ₉ N	589-08-2	135.206			206	0.93 ²⁵	1.5162 ²⁰	
6990	2-Met hyl benzeneet hanol		₈ H ₁₀ O	19819-98-8	136.190		1.0	243.5	1.016 ²⁵	1.5355 ²⁰	
6991	4-Met hyl benzeneet hanol		₈ H ₁₀ O	699-02-5	136.190			244.5; 94 ⁶	1.0028 ²⁰	1.5267 ²⁰	
6992	2-Met hyl benzenemet hanami ne		₈ H ₉ N	89-93-0	121.180	li q	-30	206; 8 [¶]	0.9766 ¹⁹	1.5436 ¹⁹	
6993	3-Met hyl benzenemet hanami ne		₈ H ₉ N	100-81-2	121.180			203.5	0.966 ²⁵	1.5360 ²⁰	
6994	4-Met hyl benzenemet hanami ne		₈ H ₉ N	104-84-7	121.180		12.5	195	0.952 ²⁰	1.5340 ²⁰	
6995	N-Met hyl benzenemet hanami ne		₈ H ₉ N	103-67-3	121.180			180.5	0.9442 ¹⁵		vs H ₂ O
6996	α-Met hyl benzenemet hanol	1-Phenyl et hanol	₈ H ₁₀ O	98-85-1	122.164		20	205	1.013 ²⁵	1.5265 ²⁰	i H ₂ O; vs Et OH, et h
6997	2-Met hyl benzenemet hanol	α-Tol yl al cohol	₈ H ₁₀ O	89-95-2	122.164	nd (pet h-et h)	38	224; 11 [¶]	1.023 ⁴⁰		vs et h, Et OH, chl
6998	3-Met hyl benzenemet hanol	m-Tol yl al cohol	₈ H ₁₀ O	587-03-1	122.164		<-20	215.5	0.9157 ¹⁷		sl H ₂ O; vs Et OH, et h; s chl
6999	4-Met hyl benzenemet hanol	p-Tol yl al cohol	₈ H ₁₀ O	589-18-4	122.164	nd (li g)	61.5	217	0.97 [¶]		vs et h, Et OH
7000	α-Met hyl benzenemet hanol, acet a e		₁₀ H ₁₂ O ₂	93-92-5	164.201	oi l		109			
7001	4-Met hyl benzenepropanal		₁₀ H ₁₂ O	5406-12-2	148.201			223	0.999 ¹⁴	1.525 ¹⁴	
7002	α-Met hyl benzenepropanami ne	1-Met hyl -3-phenyl propyl ami ne	₁₀ H ₁₃ N	22374-89-6	149.233		143	223; 101 ¹⁴	0.9289 ¹⁵	1.5152 ²⁰	vs Et OH
7003	β-Met hyl benzenepropanoi c aci d, (±)		₁₀ H ₁₂ O ₂	772-17-8	164.201		46.5	168 ¹⁴	1.0701 ²⁰	1.5155 ²⁰	sl H ₂ O; s pet h
7004	α-Met hyl benzenepropanol		₁₀ H ₁₄ O	2344-70-9	150.217			239; 123 ¹⁵	0.9899 ¹⁶	1.517 ¹⁶	
7005	4-Met hyl benzenesul fini c aci d	p-Tol uenesul fini c aci d	₇ H ₆ O ₂ S	536-57-2	156.203	ort h pl or nd (w)	86.5				s H ₂ O; vs Et OH, et h; sl bz
7006	4-Met hyl benzenesul finyl chl ori de		₇ H ₆ Cl OS	10439-23-3	174.648	nd	57	113 ⁵			vs chl
7007	2-Met hyl benzenesul f onami de		₇ H ₆ NO ₂ S	88-19-7	171.217	oct cry (al), pr (w)	158.7	214 ¹⁰			sl H ₂ O, et h, DMSO; s Et OH
7008	4-Met hyl benzenesul f onami de	p-Tol uenesul f onami de	₇ H ₆ NO ₂ S	70-55-3	171.217	mcl pl (w+2)	138	214 [¶]			sl H ₂ O, et h; s Et OH
7009	Met hyl benzenesul f onat e		₇ H ₆ O ₂ S	80-18-2	172.202		4.5	150 ¹⁵	1.2730 ¹⁷	1.5151 ²⁰	sl H ₂ O; vs Et OH, et h, chl
7010	2-Met hyl benzenesul f oni c aci d		₇ H ₆ O ₂ S	88-20-0	172.202	hyg pl (w+2)	67.5	128.8 ⁵			sl H ₂ O; s Et OH; i et h
7011	2-Met hyl benzenesul f onyl chl ori de	α-Tol uenesul f onyl chl ori de	₇ H ₆ Cl OS	133-59-5	190.648		10.2	154 ³⁶	1.3383 ²⁰	1.5565 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
7012	2-Met hyl benzenet hi ol		₇ H ₆ S	137-06-4	124.204		15	195	1.041 ²⁰	1.570 ²⁰	i H ₂ O; s Et OH; vs et h
7013	3-Met hyl benzenet hi ol		₇ H ₆ S	108-40-7	124.204	li q	-20	195	1.04 [¶]	1.572 ²⁰	i H ₂ O; s Et OH; msc et h
7014	4-Met hyl benzenet hi ol		₇ H ₆ S	106-45-6	124.204		43	195	1.0220 ⁵¹		i H ₂ O; s Et OH, chl; vs et h



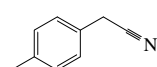
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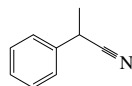
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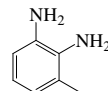
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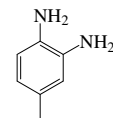
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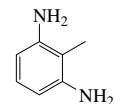
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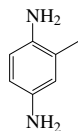
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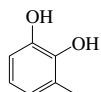
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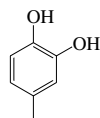
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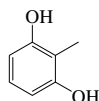
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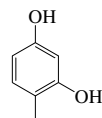
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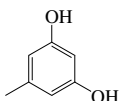
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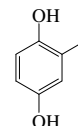
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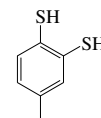
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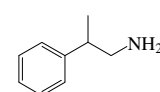
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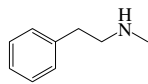
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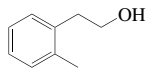
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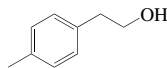
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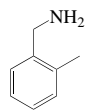
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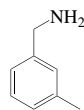
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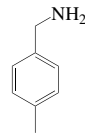
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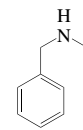
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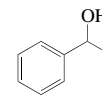
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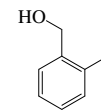
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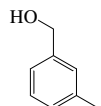
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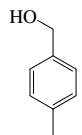
α -Met hyl benzenet hanol



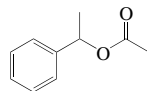
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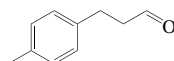
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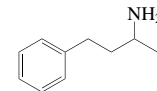
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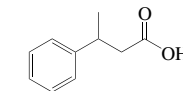
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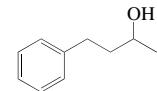
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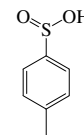
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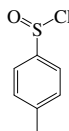
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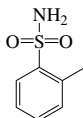
α -Met hyl benzenepropanol



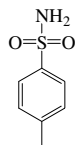
4-Met hyl benzenesul f i aci d



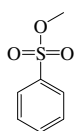
4-Met hyl benzenesul f i chl ori de



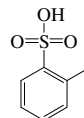
2-Met hyl benzenesul f onami de



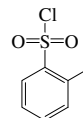
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Met hylbenzenesul f onat e



2-Met hyl benzenesul f onaci d



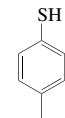
2-Met hyl benzenesul f onchl ori de



2-Met hyl benzenet hi ol



3-Met hyl benzenet hi ol

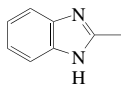


4-Met hyl benzenet hi ol

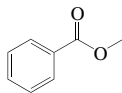
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7015	1-Met hyl - <i>H</i> -benzimidazole		$\text{C}_8\text{H}_8\text{N}_2$	1632-83-3	132.163	nd (pet h), pl (al)	66	286	1.1254 ²⁰	1.6013 ⁷	s pet h
7016	2-Met hyl - <i>H</i> -benzimidazole		$\text{C}_8\text{H}_8\text{N}_2$	615-15-6	132.163	pr or nd (w)	177.8				s H ₂ O; sl Et OH, et h; i bz
7017	Met hyl benzoate		$\text{C}_9\text{H}_8\text{O}_2$	93-58-3	136.149	li q	-12.4	199	1.0837 ⁷	1.5164 ²⁰	i H ₂ O; s Et OH, ct c, MeOH; msc et h
7018	Met hyl 1,3-benzodioxole-5-carboxylate		$\text{C}_9\text{H}_8\text{O}_4$	326-56-7	180.158	nd or lf (pet h)	53	dec 273			vs et h, Et OH
7019	2-Met hyl benzofuran		$\text{C}_9\text{H}_8\text{O}$	4265-25-2	132.159			197.5	1.0540 ²⁰	1.5495 ²²	vs et h, Et OH
7020	2-Met hyl benzotriazole	<i>o</i> -Tolunitriazole	$\text{C}_7\text{H}_6\text{N}_4$	529-19-1	117.149	li q	-13.5	205	0.9959 ⁵	1.5279 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
7021	3-Met hyl benzotriazole	<i>m</i> -Tolunitriazole	$\text{C}_7\text{H}_6\text{N}_4$	620-22-4	117.149	li q	-23	213	1.0316 ⁶	1.5252 ²⁰	i H ₂ O; msc Et OH, et h; sl ct c
7022	4-Met hyl benzotriazole	<i>p</i> -Tolunitriazole	$\text{C}_7\text{H}_6\text{N}_4$	104-85-8	117.149		29.5	217.0	0.9762 ²⁰		i H ₂ O; vs Et OH, et h; sl ct c
7023	6-Met hyl - <i>2H</i> -1-benzopyran-2-one		$\text{C}_{10}\text{H}_8\text{O}_2$	92-48-8	160.170		76.5	304; 174 ¹⁴			vs Et OH, et h, bz; sl chl, pet h
7024	7-Met hyl - <i>2H</i> -1-benzopyran-2-one	7-Met hyl coumarin	$\text{C}_{10}\text{H}_8\text{O}_2$	2445-83-2	160.170	nd, (pl) (aq al)	128	171.5 ¹			sl H ₂ O; vs Et OH, HOAc; s et h
7025	3-Met hyl - <i>H</i> -1-benzopyran-4-one	Tri cromyl	$\text{C}_{10}\text{H}_8\text{O}_2$	85-90-5	160.170						s chl
7026	6-Met hyl -2-benzothiazolamine		$\text{C}_7\text{H}_8\text{N}_2\text{S}$	2536-91-6	164.228	nd (w) pr (dil al)	142				sl H ₂ O; s Et OH
7027	2-Met hyl benzothiazole		$\text{C}_7\text{H}_6\text{N}_2\text{S}$	120-75-2	149.214		14	238	1.1763 ¹⁹	1.6092 ¹⁹	i H ₂ O; s Et OH, chl
7028	3-Met hyl -2(<i>B</i>)-benzothiazolamine		$\text{C}_7\text{H}_8\text{N}_2\text{S}_2$	2254-94-6	181.279	nd (al), pr (HOAc)	90	335			i H ₂ O; sl Et OH, et h; vs bz, chl
7029	4-(6-Met hyl -2-benzothiazolyl)aniline		$\text{C}_{14}\text{H}_{12}\text{N}_2\text{S}$	92-36-4	240.323		194.8	434			sl Et OH, et h, bz, HOAc
7030	1-Met hyl - <i>H</i> -benzotriazole		$\text{C}_7\text{H}_7\text{N}_3$	13351-73-0	133.151	pl (bz-li g)	64.5	270.5			vs bz, Et OH, HOAc
7031	1-Met hyl - <i>2H</i> -3,1-benzoxazine-2,4(1 <i>H</i>)-dione		$\text{C}_9\text{H}_7\text{NO}_3$	10328-92-4	177.157		180				
7032	2-Met hyl benzoxazole		$\text{C}_7\text{H}_7\text{NO}$	95-21-6	133.148		9.5	200.5	1.1211 ²⁰	1.5497 ²⁰	i H ₂ O; vs Et OH; msc et h
7033	Met hyl benzoylacetate		$\text{C}_{10}\text{H}_{10}\text{O}_3$	614-27-7	178.184	pa ye		dec 265; 151 ¹²	1.158 ²⁹	1.537 ²⁰	vs ace, et h, Et OH
7034	Met hyl 2-benzoylbenzoate		$\text{C}_{15}\text{H}_{12}\text{O}_3$	606-28-0	240.254	pl or mcl pr (dil al)	52	351	1.1903 ¹⁹	1.591 ²⁰	i H ₂ O; vs Et OH, et h; s sul f
7035	2-(4-Met hyl benzoyl)benzoic acid	<i>p</i> -Toluylobenzoic acid	$\text{C}_{15}\text{H}_{12}\text{O}_3$	85-55-2	240.254		146				sl H ₂ O, DMSO; vs Et OH, et h, ace, bz
7036	2-Met hyl benzoylchloride		$\text{C}_7\text{H}_5\text{ClO}$	933-88-0	154.594			213.5		1.5549 ²⁰	vs et h, Et OH
7037	3-Met hyl benzoylchloride		$\text{C}_7\text{H}_5\text{ClO}$	1711-06-4	154.594	li q	-23	219.5	1.0265 ⁵	1.505 ²²	vs et h, Et OH
7038	4-Met hyl benzoylchloride		$\text{C}_7\text{H}_5\text{ClO}$	874-60-2	154.594	li q	-1.5	226	1.1686 ⁶	1.5547 ²⁰	s ct c
7039	Met hyl benzoylsalicylate	2-(Benzoyloxy)benzoic acid, ester	$\text{C}_{14}\text{H}_{12}\text{O}_4$	610-60-6	256.254	cry	85	385			i H ₂ O; s bz, chl, et h, Et OH
7040	α -Met hyl benzylamine, (\pm)	1-Amino-1-phenylethane	$\text{C}_9\text{H}_{11}\text{N}$	618-36-0	121.180		32	187	0.9395 ¹⁵	1.5238 ²⁵	s H ₂ O, chl; msc Et OH, et h
7041	1-Met hyl -2-benzylbenzene		$\text{C}_{14}\text{H}_{14}$	713-36-0	182.261		6.6	280.5	1.0020 ²⁰	1.5763 ²⁰	
7042	1-Met hyl -4-benzylbenzene		$\text{C}_{14}\text{H}_{14}$	620-83-7	182.261	li q	-30	286	0.9976 ⁶	1.5712 ²⁰	vs et h, bz, Et OH, chl
7043	α -Met hyl benzylformate		$\text{C}_9\text{H}_{10}\text{O}_2$	7775-38-4	150.174	li q					
7044	1-Met hyl -2-benzyl-4(<i>H</i>)-quinazolinone	Glycosine	$\text{C}_8\text{H}_{14}\text{N}_2\text{O}$	6873-15-0	250.294		161.5				
7045	1-Met hyl bicyclo[3.1.0]hexane		C_6H_{12}	4625-24-5	96.170			93.1			
7046	2-Met hyl biphenyl		$\text{C}_{12}\text{H}_{10}$	643-58-3	168.234	li q	-0.2	255.3	1.0113 ⁹	1.5914 ²⁰	i H ₂ O; s Et OH, et h
7047	3-Met hyl biphenyl		$\text{C}_{12}\text{H}_{10}$	643-93-6	168.234		2.3	272.7	1.0182 ¹⁷	1.5972 ²⁰	i H ₂ O; s Et OH, et h, ct c
7048	4-Met hyl biphenyl		$\text{C}_{12}\text{H}_{10}$	644-08-6	168.234	pl (li g, MeOH)	49.5	267.5	1.015 ⁵		i H ₂ O; s Et OH, et h; sl ct c
7049	4-Met hyl <i>N,N</i> -bis(4-met hyl phenyl)aniline		$\text{C}_{21}\text{H}_{21}\text{N}$	1159-53-1	287.399	cry (HOAc)	117				vs ace, bz, et h, chl
7050	Met hyl bromoacetate		$\text{C}_3\text{H}_5\text{BrO}_2$	96-32-2	152.975			132	1.6350 ²⁰	1.4520 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
7051	Met hyl 2-bromobenzoate		$\text{C}_8\text{H}_7\text{BrO}_2$	610-94-6	215.045			244			i H ₂ O; s Et OH



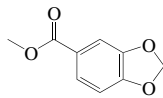
1-Met hyl -*H*-benzi mi dazol e



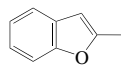
2-Met hyl -*H*-benzi mi dazol e



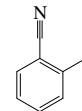
Met hyl benzoat e



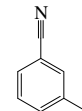
Met hyl 1,3-benzod i oxol e-5-carboxyl at e



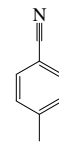
2-Met hyl benzof uran



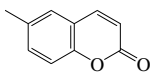
2-Met hyl benzoni t ri l e



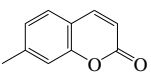
3-Met hyl benzoni t ri l e



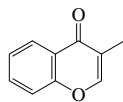
4-Met hyl benzoni t ri l e



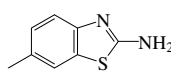
6-Met hyl -*H*-1-benzopyran-2-one



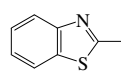
7-Met hyl -*H*-1-benzopyran-2-one



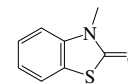
3-Met hyl -*H*-1-benzopyran-4-one



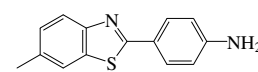
6-Met hyl -2-benzot hi azol ami ne



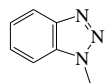
2-Met hyl benzot hi azol e



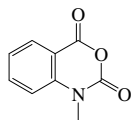
3-Met hyl -2(*B*)-benzot hi azol et hi one



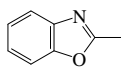
4-(6-Met hyl -2-benzot hi azol yl)ani li ne



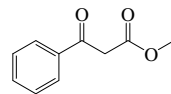
1-Met hyl -*H*-benzot ri azol e



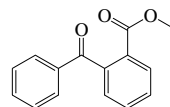
1-Met hyl -*H*-3,1-benzoxazi ne-2,4(*H*)-di one



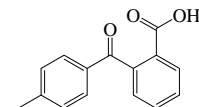
2-Met hyl benzoxazol e



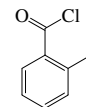
Met hyl benzoyl acet at e



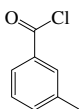
Met hyl 2-benzoyl benzoat e



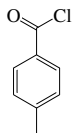
2-(4-Met hyl benzoyl)benzoiaci d



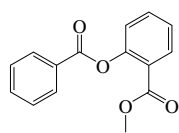
2-Met hyl benzoyl chl ori de



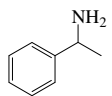
3-Met hyl benzoyl chl ori de



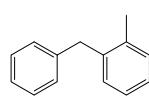
4-Met hyl benzoyl chl ori de



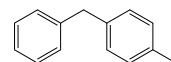
Met hyl benzoyl sal i cyl at e



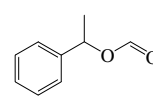
α -Met hyl benzyl ami ri e)



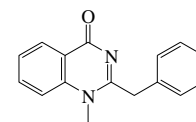
1-Met hyl -2-benzyl benzen



1-Met hyl -4-benzyl benzene



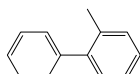
α -Met hyl benzyl ormat e



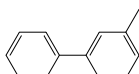
1-Met hyl -2-benzyl -4(*H*)-qui nazol i none



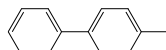
1-Met hyl bi cycl o[3,1,0]hexane



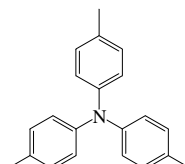
2-Met hyl bi phenyl



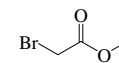
3-Met hyl bi phenyl



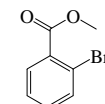
4-Met hyl bi phenyl



4-Met hyl *N,N*-bi s(4-met hyl phenyl)ani l i

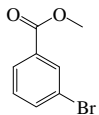


Met hyl bromoacet at e

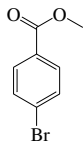


Met hyl 2-bromobenzoat e

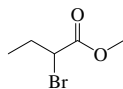
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7052	Met hyl 3-bromobenzoat e		$\text{C}_7\text{H}_5\text{BrO}_2$	618-89-3	215.045	pl	32	125 ⁵			sl H ₂ O; s Et OH, et h
7053	Met hyl 4-bromobenzoat e		$\text{C}_7\text{H}_5\text{BrO}_2$	619-42-1	215.045	lf (di l al), nd (et h)	81		1.689 ²⁵		s Et OH, et h, ace, pet h; vs bz, chl
7054	Met hyl 2-bromobut anoaat e		$\text{C}_4\text{H}_7\text{BrO}_2$	3196-15-4	181.028			168	1.4528 ²⁰	1.4029 ²⁵	vs Et OH
7055	Met hyl 4-bromobut anoaat e		$\text{C}_4\text{H}_7\text{BrO}_2$	4897-84-1	181.028			186.5	1.4 ²⁵	1.4567 ²⁵	vs Et OH
7056	Met hyl 4-bromo-2-but enoaat e		$\text{C}_4\text{H}_7\text{BrO}_2$	1117-71-1	179.013			84 ¹²	1.490 ¹⁹	1.498 ¹⁹	
7057	Met hyl 5-bromopent anoaat e		$\text{C}_5\text{H}_9\text{BrO}_2$	5454-83-1	195.054	li q		10 ⁴	1.363	1.4630 ²⁰	
7058	Met hyl 3-bromopropanoaat e		$\text{C}_3\text{H}_5\text{BrO}_2$	3395-91-3	167.002			105 ⁶⁰ , 62 ¹²	1.4123 ¹⁸	1.4542 ²⁰	s Et OH, et h, ace
7059	3-Met hyl -1,2-but adi ene		C_4H_6	598-25-4	68.118	li q	-113.6	40.83	0.680 ⁶	1.4203 ²⁰	vs ace, bz, et h, Et OH
7060	2-Met hyl -1,3-but adi ene	Isoprene	C_5H_8	78-79-5	68.118	li q	-145.9	34.0	0.67 ⁹	1.4219 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz
7061	3-Met hyl but anal	Isoval eral dehyde	$\text{C}_5\text{H}_8\text{O}$	590-86-3	86.132	li q	-51	92.5	0.797 ⁷	1.3902 ²⁰	sl H ₂ O; s Et OH, et h
7062	3-Met hyl but anami de	Isoval erami de	$\text{C}_5\text{H}_9\text{NO}$	541-46-8	101.147	mcl lf (al)	137	226			s ₂ θ, Et OH, et h; vs pet h
7063	3-Met hyl -1-but anami ne	Isopent yl ami ne	$\text{C}_5\text{H}_{11}\text{N}$	107-85-7	87.164			96	0.7505 ²⁰	1.4083 ²⁰	msc H ₂ O, Et OH, et h; s ace, chl
7064	2-Met hyl -2-but anami ne		$\text{C}_5\text{H}_{11}\text{N}$	594-39-8	87.164	li q	-105	77	0.73 ⁴	1.3954 ²⁵	vs H ₂ O, ace, et h, Et OH
7065	3-Met hyl -2-but anami ne		$\text{C}_5\text{H}_{11}\text{N}$	598-74-3	87.164	li q	-50	85.5	0.757 ⁴	1.4096 ¹⁸	vs H ₂ O; s Et OH
7066	3-Met hyl -1,3-but anedi ol		$\text{C}_5\text{H}_{10}\text{O}_2$	2568-33-4	104.148			202.5	0.9448 ²⁰	1.4452 ²⁰	s H ₂ O, Et OH
7067	2-Met hyl but aneni t ri le		$\text{C}_5\text{H}_{10}\text{O}$	18936-17-9	83.132			125	0.7913 ¹⁵	1.3933 ²⁰	vs et h, Et OH
7068	3-Met hyl but aneni t ri le	Isobut yl cyani de	$\text{C}_5\text{H}_9\text{N}$	625-28-5	83.132	li q	-101	127.5	0.791 ⁴	1.3927 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace
7069	2-Met hyl -1-but anet hi ol, (+)		$\text{C}_5\text{H}_{10}\text{S}$	20089-07-0	104.214	li q		119.1	0.842 ⁰	1.4440 ²⁰	
7070	3-Met hyl -1-but anet hi ol	Isopent yl mercapt an	$\text{C}_5\text{H}_{10}\text{S}$	541-31-1	104.214	li q		116	0.835 ⁰	1.4412 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
7071	2-Met hyl -2-but anet hi ol		$\text{C}_5\text{H}_{10}\text{S}$	1679-09-0	104.214	li q		99.1	0.812 ⁰	1.4385 ²⁰	
7072	3-Met hyl -2-but anet hi ol		$\text{C}_5\text{H}_{10}\text{S}$	2084-18-6	104.214	li q	-127.1	109.8			
7073	Met hyl but anoaat e		$\text{C}_4\text{H}_8\text{O}_2$	623-42-7	102.132	li q	-85.8	102.8	0.898 ⁴	1.3878 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
7074	2-Met hyl but anoi c aci d	(±)-2-Met hyl but yri c aci d	$\text{C}_5\text{H}_{10}\text{O}_2$	600-07-7	102.132		<-80	177	0.934 ²⁰	1.4051 ²⁰	sl H ₂ O; msc Et OH, et h; s chl
7075	3-Met hyl but anoi c aci d	Isoval eri c aci d	$\text{C}_5\text{H}_{10}\text{O}_2$	503-74-2	102.132	li q	-29.3	176.5	0.93 ⁴	1.4033 ²⁰	s H ₂ O; msc Et OH, et h, chl
7076	3-Met hyl but anoi c anhydi de		$\text{C}_5\text{H}_8\text{O}_3$	1468-39-9	186.248			215	0.9327 ²⁰	1.4043 ²⁰	vs et h
7077	2-Met hyl -1-but anol, (±)		$\text{C}_4\text{H}_9\text{O}$	34713-94-5	88.148			127.5	0.8152 ²⁵	1.4092 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace
7078	3-Met hyl -1-but anol	Isopent yl al cohol	$\text{C}_5\text{H}_{11}\text{O}$	123-51-3	88.148	li q	-117.2	131.1	0.810 ⁴	1.4053 ²⁰	sl H ₂ O; vs ace, et h, Et OH
7079	2-Met hyl -2-but anol	<i>tert</i> Pent yl al cohol	$\text{C}_5\text{H}_{11}\text{O}$	75-85-4	88.148	li q	-9.1	102.4	0.809 ⁶	1.4052 ²⁰	s H ₂ O, bz, chl; msc Et OH, et h; vs ace
7080	3-Met hyl -2-but anol, (±)		$\text{C}_5\text{H}_{11}\text{O}$	70116-68-6	88.148			112.9	0.8180 ²⁰	1.4089 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace; s bz, ct c
7081	2-Met hyl -1-but anol acet at e		$\text{C}_5\text{H}_{10}\text{O}_2$	624-41-9	130.185			140	0.8740 ²⁰	1.4040 ²⁰	vs ace, et h, Et OH
7082	3-Met hyl -2-but anone	Met hyl i sopropyl ket one	$\text{C}_5\text{H}_{10}\text{O}$	563-80-4	86.132	li q	-93.1	94.33	0.805 ⁴	1.3880 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace; s ct c
7083	2-Met hyl but anoyl chl ori de, (±)		$\text{C}_4\text{H}_7\text{ClO}$	57526-28-0	120.577			116	0.991 ²⁰	1.4170 ²⁰	
7084	3-Met hyl but anoyl chl ori de	Isovaleryl chl ori de	$\text{C}_5\text{H}_9\text{ClO}$	108-12-3	120.577			114	0.984 ⁴⁰	1.4149 ²⁰	s et h
7085	<i>trans</i> -2-Met hyl -2-but enal	Ti gli c al dehyde	$\text{C}_5\text{H}_8\text{O}$	497-03-0	84.117	li q		117, 6 ⁴⁹	0.8710 ²⁰	1.4475 ²⁰	sl H ₂ O; vs Et OH
7086	3-Met hyl -2-but enal	Seneci al dehyde	$\text{C}_5\text{H}_8\text{O}$	107-86-8	84.117			134	0.8722 ²⁰	1.4528 ²⁰	s H ₂ O, Et OH, et h
7087	2-Met hyl -1-but ene		C_4H_8	563-46-2	70.133	li q	-137.53	31.2	0.650 ⁴	1.3778 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
7088	3-Met hyl -1-but ene		C_4H_8	563-45-1	70.133	vol li q or gas	-168.43	20.1	0.62 ¹³	1.3643 ²⁰	i H ₂ O; msc Et OH, et h; s bz
7089	2-Met hyl -2-but ene		C_4H_8	513-35-9	70.133	li q	-133.72	38.56	0.662 ³	1.3874 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c; vs li q
7090	<i>cis</i> -2-Met hyl -2-but enedi oi c aci d	Ci t raconi c aci d	$\text{C}_5\text{H}_8\text{O}_4$	498-23-7	130.100	nd (et h-l i g) t cl 93.5 pr (et h-bz)			1.617 ²⁵		vs H ₂ O; sl et h, chl; i bz, CS
7091	3-Met hyl -2-but eneni t ri le		$\text{C}_5\text{H}_9\text{N}$	4786-24-7	81.117	li q		141			
7092	Met hyl <i>ci</i> s-2-but enoaat e	Met hyl i socrot onaat e	$\text{C}_5\text{H}_8\text{O}_2$	4358-59-2	100.117			118		1.4175 ²⁰	



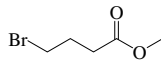
Met hyl3-bromobenzoat e



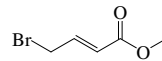
Met hyl4-bromobenzoat e



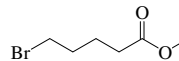
Met hyl2-bromobut anoat e



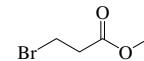
Met hyl4-bromobut anoat e



Met hyl4-bromo-2-but enoat e



Met hyl5-bromopent anoat e



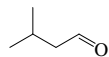
Met hyl3-bromopropanoat e



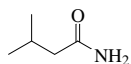
3-Met hyl-1,2-but adi ene



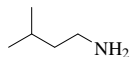
2-Met hyl-1,3-but adi ene



3-Met hyl but anal



3-Met hyl but anami de



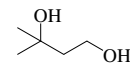
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2-Met hyl-2-but anami ne



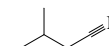
3-Met hyl-2-but anami ne



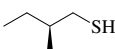
3-Met hyl-1,3-but anedi ol



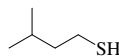
2-Met hyl but aneni t ri le



3-Met hyl but aneni t ri le



2-Met hyl-1-but anet hi (e),



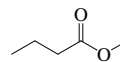
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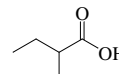
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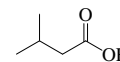
3-Met hyl-2-but anet hi ol



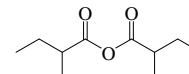
Met hylbut anoat e



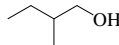
2-Met hyl but anoici d



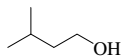
3-Met hyl but anoici d



3-Met hyl but anoiahydri de



2-Met hyl-1-but anol(±)



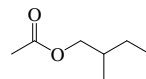
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2-Met hyl-2-but anol



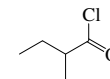
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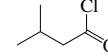
2-Met hyl-1-but anoat e



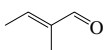
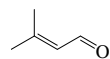
3-Met hyl-2-but anone



2-Met hyl but anohl ori de(±)



3-Met hyl but anohl ori de


t rans-2-Met hyl-2-but enal


3-Met hyl-2-but enal



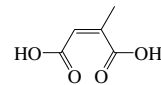
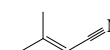
2-Met hyl-1-but ene



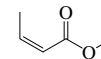
3-Met hyl-1-but ene



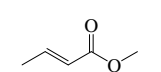
2-Met hyl-2-but ene


c i s-2-Met hyl-2-but enedi aci d


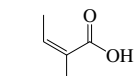
3-Met hyl-2-but eneni t ri le


 Met hyl*c i s*-2-but enoat e

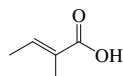
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7093	Met hyl <i>rans</i> 2-but enoat e	Met hyl crot onat e	$\text{C}_6\text{H}_{10}\text{O}_2$	623-43-8	100.117	l i q	-42	121	0.9444 ⁴	1.4242 ²⁰	i H ₂ O; vs Et OH, et h
7094	<i>ci s</i> 2-Met hyl -2-but enoi c aci d	Angel i c aci d	$\text{C}_6\text{H}_8\text{O}_2$	565-63-9	100.117	mcl pr or nd	45.5	185	0.9834 ⁹	1.4434 ⁴⁷	sl H ₂ O; s Et OH; vs et h
7095	<i>t rans</i> 2-Met hyl -2-but enoi c aci d	Ti gli c aci d	$\text{C}_6\text{H}_8\text{O}_2$	80-59-1	100.117	t ab (w)	64.5	198.5	0.9641 ⁶	1.4330 ⁷⁶	s H ₂ O; vs Et OH, et h
7096	3-Met hyl -2-but enoi c aci d		$\text{C}_7\text{H}_{12}\text{O}_2$	541-47-9	100.117		69.5	197	1.0062 ²⁴		
7097	3-Met hyl -2-but en-1-ol		$\text{C}_7\text{H}_{14}\text{O}$	556-82-1	86.132			140	0.848 ²⁵	1.4412 ²⁰	
7098	3-Met hyl -3-but en-1-ol		$\text{C}_7\text{H}_{14}\text{O}$	763-32-6	86.132			129.9			
7099	2-Met hyl -3-but en-2-ol		$\text{C}_7\text{H}_{14}\text{O}$	115-18-4	86.132	l i q	-28	97	0.82 ²		
7100	3-Met hyl -3-but en-2-ol		$\text{C}_7\text{H}_{14}\text{O}$	10473-14-0	86.132			114	0.8531 ¹⁷	1.4288 ¹⁷	
7101	3-Met hyl -3-but en-2-one	Isopropenyl met hyl ket one	$\text{C}_7\text{H}_{12}\text{O}$	814-78-8	84.117	l i q	-54	98	0.8527 ⁷	1.4220 ²⁰	vs Et OH
7102	3-Met hyl -2-but enoyl chl ori de		$\text{C}_7\text{H}_{11}\text{ClO}$	3350-78-5	118.562			146	1.065 ²⁵	1.4770 ²⁰	
7103	(3-Met hyl -2-but enyl)guanidi ne	Gal egi ne	$\text{C}_7\text{H}_{13}\text{N}_3$	543-83-9	127.187	hyg		dec			vs H ₂ O, Et OH
7104	2-Met hyl -1-but en-3-yne	Isopropenyl acet yl ene	C_7H_{10}	78-80-8	66.102	l i q	-113	32	0.680 ⁴	1.4140 ²⁰	s chl
7105	[(3-Met hyl but oxy)met hyl]benzene		$\text{C}_{10}\text{H}_{18}\text{O}$	122-73-6	178.270			236; 118 ¹⁹	0.909 ²⁰	1.4792 ²⁰	vs et h, Et OH
7106	1-[2-(3-Met hyl but oxy)-2-phenyl et hyl]pyrrolidi ne	Ami xet ri ne	$\text{C}_{17}\text{H}_{27}\text{NO}$	24622-72-8	261.402			121 ²		1.4978 ²²	
7107	2-Met hyl but yl acryl at e		$\text{C}_8\text{H}_{14}\text{O}_2$	44914-03-6	142.196			160; 45 ¹⁰	0.8936 ²⁰	1.4240 ²⁰	vs et h, Et OH
7108	3-Met hyl but yl benzoat e	Isopent yl benzoat e	$\text{C}_{12}\text{H}_{16}\text{O}_2$	94-46-2	192.254			261	0.993 ¹⁵		vs Et OH
7109	3-Met hyl but yl 2-chl oropropanoat e		$\text{C}_8\text{H}_{15}\text{ClO}_2$	62108-69-4	178.657			208	1.0050 ²⁰	1.4289 ²⁰	
7110	3-Met hyl but yl 3-chl oropropanoat e		$\text{C}_8\text{H}_{15}\text{ClO}_2$	62108-70-7	178.657			208; 87 ¹²	1.0171 ²⁰	1.4343 ²⁰	vs et h, Et OH
7111	Met hyl <i>er</i> but yl et her	<i>t er</i> But yl met hyl et her	$\text{C}_7\text{H}_{14}\text{O}$	1634-04-4	88.148	l i q	-108.6	55.0	0.735 ³	1.3664 ²⁵	s H ₂ O; vs Et OH, et h
7112	3-Met hyl but yl ni t rat e	Isopent yl ni t rat e	$\text{C}_7\text{H}_{11}\text{NO}_2$	543-87-3	133.146			148	0.996 ²²	1.4122 ²¹	
7113	2-Met hyl -3-but yn-2-ami ne		$\text{C}_7\text{H}_{11}\text{N}$	2978-58-7	83.132		18	79.5	0.79 ²⁵	1.4235 ²⁰	
7114	3-Met hyl -1-but yne		C_7H_{10}	598-23-2	68.118	vol l i q or gas	-89.7	26.3	0.666 ⁰	1.3723 ²⁰	i H ₂ O; msc Et OH, et h
7115	2-Met hyl -3-but yn-2-ol	1,1-Di met hyl propargyl al cohol	$\text{C}_7\text{H}_{10}\text{O}$	115-19-5	84.117		1.5	104	0.8618 ²⁰	1.4207 ²⁰	
7116	Met hyl carbamat e		$\text{C}_6\text{H}_9\text{NO}_2$	598-55-0	75.067	nd	54	177	1.1361 ⁵⁶	1.4125 ⁵⁶	vs H ₂ O; vs Et OH, et h
7117	3-Met hyl - β -carbazol e		$\text{C}_9\text{H}_{11}\text{N}$	4630-20-0	181.233	pl (HOAc)	208.5	365			vs bz, et h
7118	9-Met hyl - β -carbazol e		$\text{C}_9\text{H}_{11}\text{N}$	1484-12-4	181.233	nd, l f (al)	89.34	343.64; 195 ¹²			vs et h
7119	Met hyl chl oroacet at e		$\text{C}_2\text{H}_3\text{ClO}_2$	96-34-4	108.524	l i q	-32.1	129.5	1.23 ⁶	1.4218 ²⁰	vs ace, bz, et h, Et OH
7120	Met hyl 2-chl oroacryl at e		$\text{C}_3\text{H}_3\text{ClO}_2$	80-63-7	120.535			52 ⁵¹	1.189 ²⁰	1.4420 ²⁰	vs et h
7121	Met hyl 2-chl orobenzoat e		$\text{C}_8\text{H}_7\text{ClO}_2$	610-96-8	170.594			234			s Et OH
7122	Met hyl 3-chl orobenzoat e		$\text{C}_8\text{H}_7\text{ClO}_2$	2905-65-9	170.594		21	229			
7123	Met hyl 4-chl orobenzoat e		$\text{C}_8\text{H}_7\text{ClO}_2$	1126-46-1	170.594	nd or mcl pr	43.5		1.38 ²⁰		vs Et OH
7124	Met hyl 4-chl orobut anoat e		$\text{C}_8\text{H}_{15}\text{ClO}_2$	3153-37-5	136.577			174; 55 ⁴	1.1293 ²⁰	1.4321 ²⁰	i H ₂ O; vs Et OH, et h; s ace
7125	Met hyl chl oro carbonat e		$\text{C}_2\text{H}_3\text{ClO}_3$	79-22-1	94.497			70.5	1.2231 ²⁰	1.3868 ²⁰	msc Et OH, et h; s bz, ct c, chl
7126	Met hyl 5-chl oro-2-hydroxybenzoat e		$\text{C}_7\text{H}_5\text{ClO}_3$	4068-78-4	186.593	nd (al)	50	dec 249; 120 ¹²			vs Et OH
7127	Met hyl 5-chl oro-2-ni t robenzoat e		$\text{C}_7\text{H}_4\text{ClNO}_4$	51282-49-6	215.592	pl (MeOH)	48.5		1.453 ⁶		vs MeOH
7128	Met hyl chl oro oxoacet at e		$\text{C}_3\text{H}_3\text{ClO}_3$	5781-53-3	122.507			119	1.3316 ²⁰	1.4189 ²⁰	
7129	Met hyl 2-chl oropropanoat e		$\text{C}_5\text{H}_9\text{ClO}_2$	17639-93-9	122.551			132.5	1.0750 ²⁵		
7130	3-Met hyl chrysene		$\text{C}_{16}\text{H}_{14}$	3351-31-3	242.314	l f (bz-pet h)	173.3				vs Et OH
7131	5-Met hyl chrysene		$\text{C}_{16}\text{H}_{14}$	3697-24-3	242.314		118.3				i H ₂ O
7132	6-Met hyl chrysene		$\text{C}_{16}\text{H}_{14}$	1705-85-7	242.314		161				
7133	Met hyl <i>rans</i> ci nnamat e	Met hyl <i>rans</i> 3-phenyl -2-propenoat e	$\text{C}_{10}\text{H}_{10}\text{O}_2$	1754-62-7	162.185	cry (pet h, di l al)	36.5	261.9	1.04 ²	1.5766 ²²	i H ₂ O; vs Et OH, et h; s ace, bz; sl chl
7134	<i>t rans</i> - α Met hyl ci nnami c aci d		$\text{C}_{10}\text{H}_8\text{O}_2$	2373-76-4	162.185	cry (Et OH)	175				



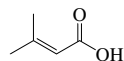
Met hyl *rans*2-but enoa t e



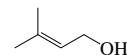
*ci s*2-Met hyl -2-but enoa i c i d



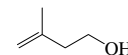
*t rans*2-Met hyl -2-but enoa i c i d



3-Met hyl -2-but enoa i c i d



3-Met hyl -2-but en-1-ol



3-Met hyl -3-but en-1-ol



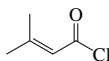
2-Met hyl -3-but en-2-ol



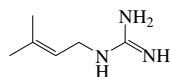
3-Met hyl -3-but en-2-ol



3-Met hyl -3-but en-2-one



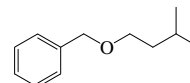
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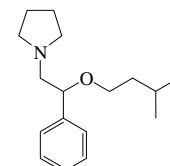
(3-Met hyl -2-but enyl)guani di ne



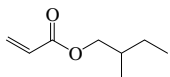
2-Met hyl -1-but en-3-yne



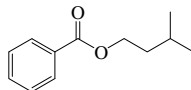
[(3-Met hyl but oxy)met hyl]benzene



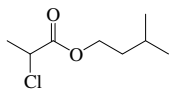
1-[2-(3-Met hyl but oxy)-2-phenyl et hyl]pyrr ol i di ne



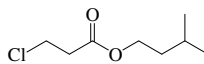
2-Met hyl but y l acryl at e



3-Met hyl but y l enzoa t e



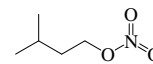
3-Met hyl but y l chl oro propanoa t e



3-Met hyl but y l chl oro propanoa t e



Met hyl t erbut y l et her



3-Met hyl but y l i t rat e



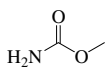
2-Met hyl -3-but yn-2-ami ne



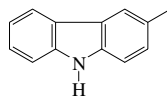
3-Met hyl -1-but yne



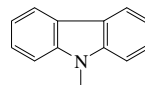
2-Met hyl -3-but yn-2-ol



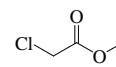
Met hyl carbama t e



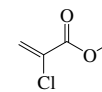
3-Met hyl -9H-carbazol e



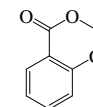
9-Met hyl -9H-carbazol e



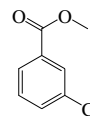
Met hyl chl oroacet at e



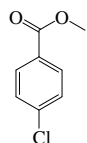
Met hyl 2-chl oroacryl at e



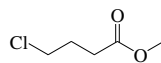
Met hyl 2-chl oroenzoa t e



Met hyl 3-chl oroenzoa t e



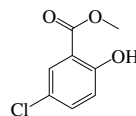
Met hyl 4-chl oroenzoa t e



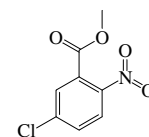
Met hyl 4-chl orobut enoa t e



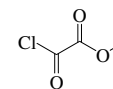
Met hyl chl oroacet at e



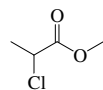
Met hyl 5-chl oro-2-hydroxyenzoa t e



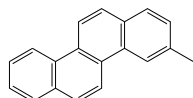
Met hyl 5-chl oro-2-ni t roenzoa t e



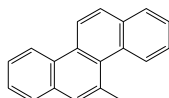
Met hyl chl oroacet at e



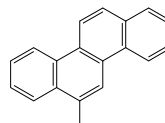
Met hyl 2-chl oro propanoa t e



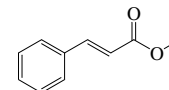
3-Met hyl chryse ne



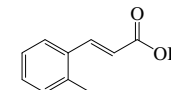
5-Met hyl chryse ne



6-Met hyl chryse ne

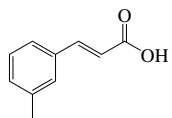


Met hyl *rans* ci nnama t e

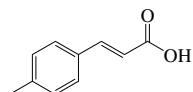


t rans-eMet hyl ci nna i c i d

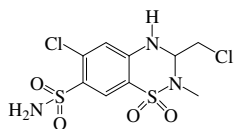
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7135	<i>t rans-m</i> Met hyl ci n nami c aci d		₁₀ H ₁₀ O ₂	3029-79-6	162.185	cry (w)	115				
7136	<i>t rans-p</i> Met hyl ci n nami c aci d		₁₀ H ₁₀ O ₂	1866-39-3	162.185		198.5				
7137	Met hyl chl ol hi azi de		₉ H ₉ Cl ₃ N ₃ O ₂ S ₂	135-07-9	360.237	cry (Et OH aq)	225				i H ₂ O, bz, chl ; sl MeOH; vs ace, py
7138	Met hyl cyanat e		₃ H ₃ NO	1768-34-9	57.051	unst ab gas	-30	exp			
7139	Met hyl cyanoacet at e		₃ H ₃ NO ₂	105-34-0	99.089	li q	-22.5	200.5	1.1225	1.4176 ²⁰	vs et h, Et OH
7140	Met hyl 2-cyanoacryl at e	Mecryl at e	₅ H ₅ NO ₂	137-05-3	111.100			47 ²	1.1012 ²⁰	1.4430	
7141	Met hyl cycl obut ane		₄ H ₄	598-61-8	70.133	li q	-161.5	36.3	0.6884	1.3866 ²⁰	i H ₂ O; msc Et OH, et h; s ace, bz, pet h
7142	Met hyl cycl obut anecarboxyl at e		₆ H ₆ O ₂	765-85-5	114.142			135.5			
7143	2-Met hyl -1,3-cycl ohexadi ene	4,5-Di hydrot ol uene	₇ H ₇ C	1489-57-2	94.154			107.5	0.8260 ¹⁸	1.4662 ¹⁸	
7144	2-Met hyl -2,5-cycl ohexadi ene-1,4-di one		C ₇ H ₆ O ₂	553-97-9	122.122	ye pl or nd	69	sub	1.08 ²		sl H ₂ O; s Et OH, et h
7145	Met hyl cycl ohexane		₆ H ₁₄	108-87-2	98.186	li q	-126.6	100.93	0.7694	1.4231 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, li g
7146	Met hyl cycl ohexanecarboxyl at e		₈ H ₈ O ₂	4630-82-4	142.196			183	0.9954 ¹⁵	1.4433 ²⁰	i H ₂ O; s Et OH, et h, ace, chl
7147	α -Met hyl cycl ohexanemet hanol		₈ H ₁₆ O	1193-81-3	128.212			189	0.928 ²⁵	1.4656 ²⁰	vs Et OH, et h; sl ct c
7148	4-Met hyl cycl ohexanemet hanol		₈ H ₁₆ O	34885-03-5	128.212			75 ^{2,5}	0.9074 ²⁰	1.4617 ²⁰	
7149	1-Met hyl cycl ohexanol		₈ H ₁₆ O	590-67-0	114.185		25	155; 70 ²⁵	0.9194 ²⁰	1.4595 ²⁰	i H ₂ O; s Et OH, bz, chl
7150	<i>ci s</i> 2-Met hyl cycl ohexanol		₈ H ₁₆ O	615-38-3	114.185		7	165	0.9360 ²⁰	1.4640 ²⁰	vs Et OH
7151	<i>t rans</i> 2-Met hyl cycl ohexanol , (±)		₈ H ₁₆ O	615-39-4	114.185	li q	-2.0	167.5	0.9247 ²⁰	1.4616 ²⁰	vs et h, Et OH
7152	<i>ci s</i> 3-Met hyl cycl ohexanol , (±)		₈ H ₁₆ O	5454-79-5	114.185	li q	-5.5	168; 9 ⁴	0.9155 ²⁰	1.4752 ²⁰	vs et h, Et OH
7153	<i>t rans</i> 3-Met hyl cycl ohexanol , (±)		₈ H ₁₆ O	7443-55-2	114.185	li q	-0.5	167; 8 ⁴	0.9214 ³⁰	1.4580 ²⁰	vs et h, Et OH
7154	<i>ci s</i> 4-Met hyl cycl ohexanol		₈ H ₁₆ O	7731-28-4	114.185	li q	-9.2	173	0.917 ⁹	1.4614 ²⁰	vs et h, Et OH
7155	<i>t rans</i> 4-Met hyl cycl ohexanol		₈ H ₁₆ O	7731-29-5	114.185			174	0.9118 ²¹	1.4561 ²⁰	sl H ₂ O; msc Et OH; s et h
7156	2-Met hyl cycl ohexanone, (±)		₈ H ₁₂ O	24965-84-2	112.169	li q	-13.9	165	0.925 ⁹	1.4483 ²⁵	i H ₂ O; s Et OH, et h
7157	3-Met hyl cycl ohexanone, (±)		₈ H ₁₂ O	625-96-7	112.169	li q	-73.5	169; 6 ⁵	0.9136 ²⁰	1.4456 ²⁰	i H ₂ O; s Et OH, et h
7158	4-Met hyl cycl ohexanone		₈ H ₁₂ O	589-92-4	112.169	li q	-40.6	170	0.913 ⁸	1.4451 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
7159	1-Met hyl cycl ohexene		₈ H ₁₂	591-49-1	96.170	li q	-120.4	110.3	0.810 ²	1.4503 ²⁰	i H ₂ O; s et h, bz, ct c
7160	3-Met hyl cycl ohexene, (±)		₈ H ₁₂	56688-75-6	96.170	li q	-115.5	104	0.799 ⁹	1.4414 ²⁰	vs bz, et h, chl , pet h
7161	4-Met hyl cycl ohexene		₈ H ₁₂	591-47-9	96.170	li q	-115.5	102.7	0.799 ⁴	1.4414 ²⁰	i H ₂ O; s Et OH, et h
7162	Met hyl 3-cycl ohexene-1-carboxyl at e		₈ H ₁₂ O ₂	6493-77-2	140.180			182; 80 ²⁰	1.0130 ²⁰	1.4610 ²⁰	
7163	2-Met hyl -2-cycl ohexen-1-one		₈ H ₁₀ O	1121-18-2	110.153			178.5	0.966 ²⁰	1.4833 ²⁰	s bz
7164	3-Met hyl -2-cycl ohexen-1-one		₈ H ₁₀ O	1193-18-6	110.153	li q	-21	201	0.969 ³	1.49475 ²⁰	msc H ₂ O; s bz
7165	3-Met hyl cycl opent adecanone	Muscone	₁₃ H ₃₀ O	541-91-3	238.408	oi ly li q		329; 1 ⁹⁰	0.9221 ¹⁷	1.4802 ¹⁷	vs ace, et h, Et OH
7166	1-Met hyl -1,3-cycl opent adi ene		₆ H ₆	96-39-9	80.128	li q		73	0.8 ⁴	1.4512 ²⁰	
7167	Met hyl cycl opent ane		₆ H ₁₂	96-37-7	84.159	li q	-142.42	71.8	0.748 ⁶	1.4097 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, li g, ct c
7168	1-Met hyl cycl opent anol		₆ H ₁₂ O	1462-03-9	100.158	nd	36	136; 53 ³⁰	0.9044 ²³	1.4429 ²³	
7169	<i>ci s</i> 2-Met hyl cycl opent anol		₆ H ₁₂ O	25144-05-2	100.158			148.5	0.9379 ¹⁶	1.4504 ¹⁶	
7170	2-Met hyl cycl opent anone		₆ H ₁₀ O	1120-72-5	98.142	li q	-75	139.5	0.913 ⁹	1.4364 ²⁰	s H ₂ O; vs Et OH, et h, ace
7171	3-Met hyl cycl opent anone, (±)		₆ H ₁₀ O	6195-92-2	98.142	li q	-58.4	144	0.91 ³	1.4329 ²⁰	s H ₂ O; vs Et OH, et h, ace, HOAc
7172	1-Met hyl cycl opent ene		₆ H ₁₀	693-89-0	82.143	li q	-126.5	75.5	0.774 ⁸	1.4322 ²⁰	
7173	3-Met hyl cycl opent ene		₆ H ₁₀	1120-62-3	82.143			64.9	0.7572 ²⁵	1.4216 ²⁰	
7174	4-Met hyl cycl opent ene		₆ H ₁₀	1759-81-5	82.143	li q	-160.8	65.7	0.763 ⁴	1.4209 ²⁰	
7175	2-Met hyl -2-cycl opent en-1-one		₆ H ₈ O	1120-73-6	96.127			157	0.9808 ¹⁶	1.4762 ¹⁵	
7176	3-Met hyl -2-cycl opent en-1-one		₆ H ₈ O	2758-18-1	96.127			157.5	0.9712 ²⁰	1.4714 ²⁰	



trans-*m*-Methyl cinnamic acid



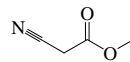
trans-*p*-Methyl cinnamic acid



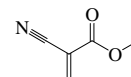
Met hyl chl oti hi azi de



Met hylcyanat e



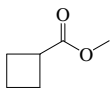
Met hylcyanoacet at e



Met hyl2-cyanoacryl at e



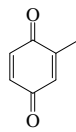
Met hyl cycl obut ane



Met hylcycl obut anecarboxyl at e



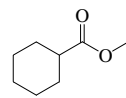
2-Met hyl -1,3-cycl ohexadi ene



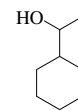
2-Met hyl -2,5-cycl ohexadi ene-1,4-di one



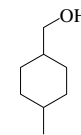
Met hyl cycl ohexane



Met hylcycl ohexanecarboxyl at e



α-Met hyl cycl ohexanemet hanol



4-Met hyl cycl ohexanemet hanol



1-Met hyl cycl ohexanol



*ci s*2-Met hyl cycl ohexanol



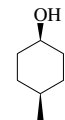
*t rans*2-Met hyl cycl ohexano(±)



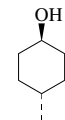
*ci s*3-Met hyl cycl ohexano(±)



*t rans*3-Met hyl cycl ohexano(±)



*ci s*4-Met hyl cycl ohexanol



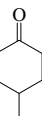
*t rans*4-Met hyl cycl ohexanol



2-Met hyl cycl ohexanon(±)



3-Met hyl cycl ohexanon(±)



4-Met hyl cycl ohexanone



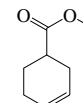
1-Met hyl cycl ohexene



3-Met hyl cycl ohexen(±)



4-Met hyl cycl ohexene



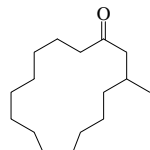
Met hyl3-cycl ohexene-1-carboxyl at e



2-Met hyl -2-cycl ohexen-1-one



3-Met hyl -2-cycl ohexen-1-one



3-Met hyl cycl opent adecanone



1-Met hyl -1,3-cycl opent adi ene



Met hyl cycl opent ane



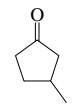
1-Met hyl cycl opent anol



*ci s*2-Met hyl cycl opent anol



2-Met hyl cycl opent anone



3-Met hyl cycl opent anon(±)



1-Met hyl cycl opent ene



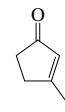
3-Met hyl cycl opent ene



4-Met hyl cycl opent ene



2-Met hyl -2-cycl opent en-1-one



3-Met hyl -2-cycl opent en-1-one

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7177	Met hyl cycl opropane		C ₃ H ₆	594-11-6	56.107	col gas	-177.6	0.7	0.6912 ²⁰		vs et h, Et OH
7178	Met hyl cycl opropanecarboxyl at e		C ₄ H ₆ O ₂	2868-37-3	100.117			114.9	0.9848 ²⁰	1.4144 ¹⁹	s ace, chl
7179	α-Met hyl cycl opropanemet hanol		C ₄ H ₈ O	765-42-4	86.132	li q	-32.1	123.5	0.8805	1.4316 ²⁰	
7180	Met hyl L-cyst ei ne hydrochl ori de		C ₄ H ₉ ClNO ₂ S	18598-63-5	171.646	cry (MeOH)	140.5				
7181	Met hyl rans2,ci s4-decadi enoat e		C ₁₀ H ₁₈ O ₂	4493-42-9	182.260			71 ^{0.15}	0.9128 ²²	1.4874 ²²	
7182	Met hyl rans2,t rans4-decadi enoat e		C ₁₀ H ₁₈ O ₂	7328-33-8	182.260			87 ¹³ , 70 ^{0.2}	0.9082 ²²	1.4918 ²²	
7183	2-Met hyl decane		C ₁₀ H ₂₂	6975-98-0	156.309	li q	-48.9	189.3	0.7368	1.4154 ²⁰	
7184	3-Met hyl decane		C ₁₀ H ₂₂	13151-34-3	156.309	li q	-92.9	188.1	0.7422	1.4177 ²⁰	
7185	4-Met hyl decane		C ₁₀ H ₂₂	2847-72-5	156.309	li q	-77.5	187		1.4352	
7186	Met hyl decanoat e		C ₁₀ H ₂₀ O ₂	110-42-9	186.292	li q	-18	224	0.8730	1.4259 ²⁰	i H ₂ O; vs Et OH, et h; sl ct c; msc chl
7187	Met hyl demet on		C ₁₀ H ₁₆ O ₃ PS ₂	8022-00-2	230.285	ye li q		89 ¹⁵ , 118 ¹	1.20 ²⁰	1.5063 ²⁰	i H ₂ O; s os
7188	Met hyl di borane(6)		C ₂ B ₂	23777-55-1	41.697	unst ab gas					s et h
7189	Met hyl 2,3-di bromopropanoat e		C ₃ H ₄ Br ₂ O ₂	1729-67-5	245.898			206	1.9333 ²⁰	1.5127 ²⁰	s Et OH
7190	Met hyl di chl oroacet at e		C ₂ H ₂ Cl ₂ O ₂	116-54-1	142.969	li q	-51.9	142.9	1.3774	1.4429 ²⁰	i H ₂ O; s Et OH, ct c
7191	Met hyl 2,5-di chl orobenzoat e		C ₈ H ₆ Cl ₂ O ₂	2905-69-3	205.039	cry	38				
7192	Met hyl (2,4-di chl orophenoxy)acet at e	2,4-D met hyl est er	C ₈ H ₆ Cl ₂ O ₃	1928-38-7	235.064		119	141 ¹⁸			
7193	Met hyl (3,4-di chl orophenyl) carbat e	Swep	C ₈ H ₇ Cl ₂ NO ₂	1918-18-9	220.054	nd	114				
7194	Met hyl 2,3-di chl oropropanoat e		C ₃ HCl ₂ O ₂	3674-09-7	156.996			92 ⁵⁰ , 63 ¹⁰	1.3282 ²⁰		vs ace, et h, Et OH
7195	Met hyl di fluororsi ne		C ₂ F ₂	420-24-6	127.954	li q, f umes i n ai r	-29.7	76.5	1.924		
7196	Met hyl di fluorophosphi ne	(Di fluoro)met hyl fosphi ne	F ₂ P ₂ H	753-59-3	84.006	gas	-110	-28			
7197	Met hyl 2,4-di hydroxybenzoat e		C ₆ H ₄ O ₄	2150-47-2	168.148			116.5			sl Et OH, ace
7198	Met hyl 3,5-di hydroxybenzoat e		C ₆ H ₄ O ₄	2150-44-9	168.148			165			
7199	Met hyl 3,4-di met hoxybenzoat e		C ₁₀ H ₁₂ O ₄	2150-38-1	196.200	nd (di l al)	60.8	283			vs bz, et h, Et OH
7200	Met hyl di met hoxysi lane		C ₃ H ₈ O ₂ Si	16881-77-9	106.196			61			
7201	3-Met hyl -4'-(di met hyl ami no) azobenzene		C ₁₅ H ₁₇ N ₃	55-80-1	239.316	oran cry	122				
7202	2-Met hyl N,N-di met hyl ani li ne	N,N-Di met hyl t ol ui di ne	C ₉ H ₁₃ N	609-72-3	135.206	li q	-60	194.1	0.9286	1.5152 ²⁰	vs et h, Et OH
7203	3-Met hyl N,N-di met hyl ani li ne	N,N-Di met hyl t ol ui di ne	C ₉ H ₁₃ N	121-72-2	135.206			212	0.9410 ²⁰	1.5492 ²⁰	msc Et OH, et h
7204	4-Met hyl N,N-di met hyl ani li ne	N,N-Di met hyl t ol ui di ne	C ₉ H ₁₃ N	99-97-8	135.206			211	0.9366 ²⁰	1.5366 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
7205	Met hyl 2,2-di met hyl propanoat e	Met hyl 2,2-di met hyl propi onat e	C ₅ H ₁₂ O ₂	598-98-1	116.158			101.1	0.891 ⁰	1.3905 ²⁰	vs et h, Et OH
7206	Met hyl di met hyl t hi oborane	Di met hyl (met hyl t hi o)borane	C ₃ H ₈ BS ₂ C	19163-05-4	87.979	li q	-84	71			vs ace, et h
7207	2-Met hyl -3,5-di ni t robenzami de	Di ni t ol mi de	C ₇ H ₅ N ₂ O ₂	148-01-6	225.159	cry	181				
7208	1-Met hyl -2,3-di ni t robenzene	2,3-Di ni t rot ol uene	C ₇ H ₅ N ₂ O ₂	602-01-7	182.134		63				i H ₂ O; s Et OH, et h; sl chl
7209	1-Met hyl -2,4-di ni t robenzene	2,4-Di ni t rot ol uene	C ₇ H ₅ N ₂ O ₂	121-14-2	182.134	ye nd or mcl pr (CS ₂)	70.5	dec 300	1.3208 ⁷¹	1.442	i H ₂ O; s Et OH, et h, chl , bz; vs ace, py
7210	1-Met hyl -3,5-di ni t robenzene	3,5-Di ni t rot ol uene	C ₇ H ₅ N ₂ O ₂	618-85-9	182.134	ye ort h nd (HOAc)	93	sub	1.2772 ¹¹¹		sl H ₂ O; s Et OH, et h, bz, chl , CS
7211	2-Met hyl -1,3-di ni t robenzene	2,6-Di ni t rot ol uene	C ₇ H ₅ N ₂ O ₂	606-20-2	182.134	ort h nd (al)	66.0	285	1.2833 ¹	1.479	s Et OH, chl
7212	2-Met hyl -1,4-di ni t robenzene	2,5-Di ni t rot ol uene	C ₇ H ₅ N ₂ O ₂	619-15-8	182.134	nd (al)	52.5		1.282 ¹¹¹		s Et OH, bz; vs CS
7213	4-Met hyl -1,2-di ni t robenzene	3,4-Di ni t rot ol uene	C ₇ H ₅ N ₂ O ₂	610-39-9	182.134	ye nd (CS ₂)	59.0		1.2594 ¹¹¹		i H ₂ O; s Et OH, CS; sl chl
7214	2-Met hyl -4,6-di ni t rophenol	4,6-Di ni t roresol	C ₆ H ₃ N ₂ O ₅	534-52-1	198.133	ye pr or nd (al)	86.5				sl H ₂ O, pet h; s Et OH, et h, ace, chl
7215	4-Met hyl -2,6-di ni t rophenol	2,6-Di ni t roresol	C ₆ H ₃ N ₂ O ₅	609-93-8	198.133	ye nd (et h, pet h)	85				i H ₂ O; s Et OH, et h, bz
7216	Met hyl di oct yl ami ne	N-Met hyl A-oct yl -1-oct anami ne	C ₁₇ H ₃₇ N	4455-26-9	255.483		-30.1	158 ¹⁰		1.4424 ²⁰	
7217	4-Met hyl -1,3-di oxane		C ₈ H ₁₆ O ₂	1120-97-4	102.132	li q	-44.5	114	0.9758	1.4159 ²⁰	sl H ₂ O; vs os



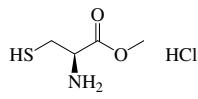
Met hyl cycl opropane



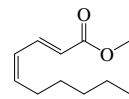
Met hyl cycl opropanecarboxyl at e



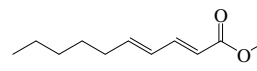
α -Met hyl cycl opropanemet hanol



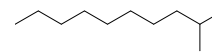
Met hyl L-cyst ei nhydrochl ori de HCl



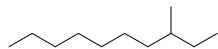
Met hyl *rans*2, *ci s*4-decadi enoat e



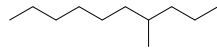
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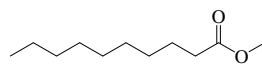
2-Met hyl decane



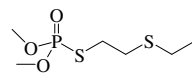
3-Met hyl decane



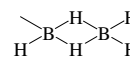
4-Met hyl decane



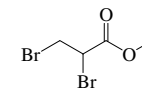
Met hyl decanoat e



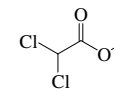
Met hyl demet on



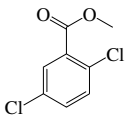
Met hyl di borane(6)



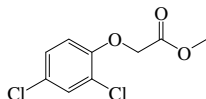
Met hyl 2,3-di bromoproanoat e



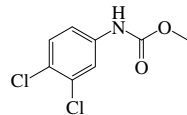
Met hyl di chl oroacet at e



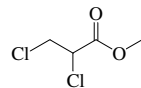
Met hyl 2,5-di chl orobenzoat e



Met hyl (2,4-di chl orophenoxy)acet at e



Met hyl (3,4-di chl orophenyl) carbamat e



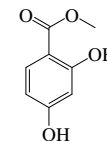
Met hyl 2,3-di chl oroproanoat e



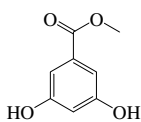
Met hyl di fl uoroarsi ne



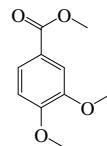
Met hyl di fl uorophosphi ne



Met hyl 2,4-di hydroxybenzoat e



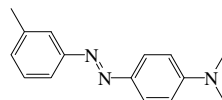
Met hyl 3,5-di hydroxybenzoat e



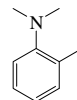
Met hyl 3,4-di met hoxybenzoat e



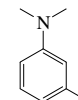
Met hyl di met hoxysi l ane



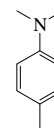
3-Met hyl -4'-(di met hyl ami no)azobenzene



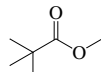
2-Met hyl *N,N*-di met hyl ani li ne



3-Met hyl *N,N*-di met hyl ani li ne



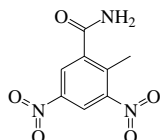
4-Met hyl *N,N*-di met hyl ani li ne



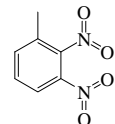
Met hyl 2,2-di met hyl propanoat e



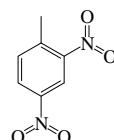
Met hyl di met hyl t hi obor



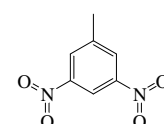
2-Met hyl -3,5-di ni t robenzami de



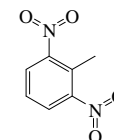
1-Met hyl -2,3-di ni t robenz



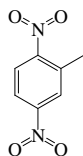
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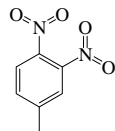
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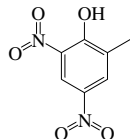
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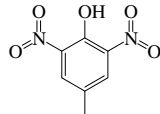
2-Met hyl -1,4-di ni t robenzene



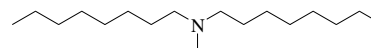
4-Met hyl -1,2-di ni t robenzene



2-Met hyl -4,6-di ni t rophenol



4-Met hyl -2,6-di ni t rophenol

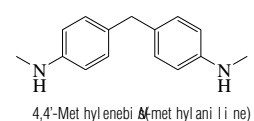
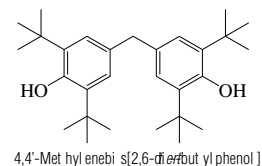
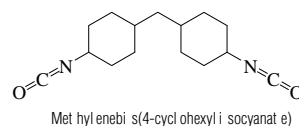
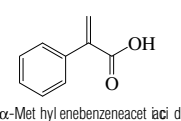
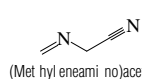
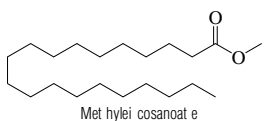
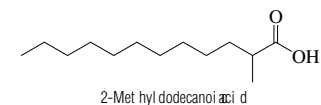
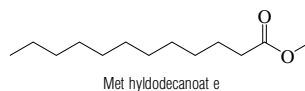
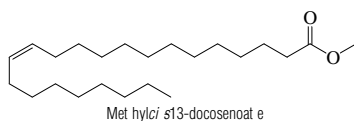
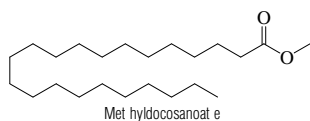
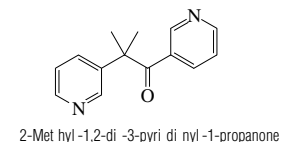
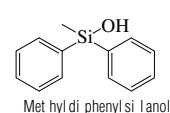
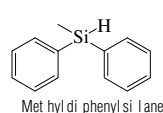
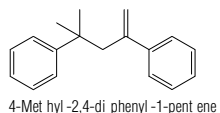
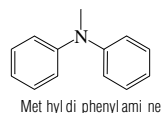
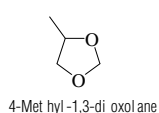
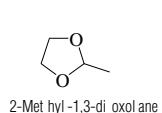


Met hyl di oct yl ami ne

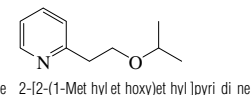
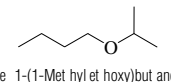
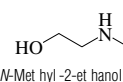
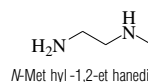
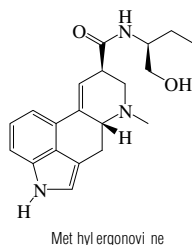
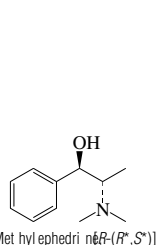
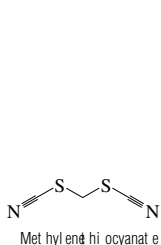
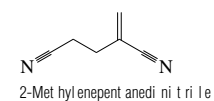
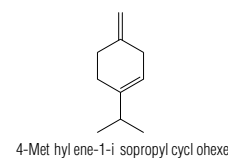
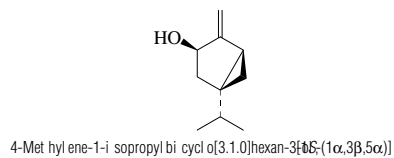
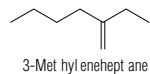
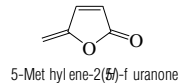
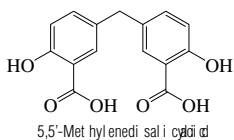
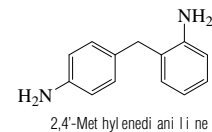
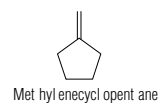
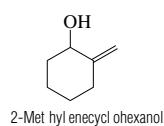
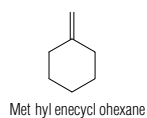
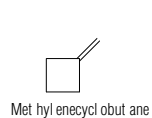
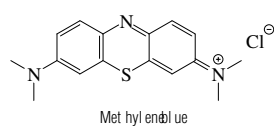


4-Met hyl -1,3-di oxane

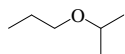
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7218	2-Met hyl -1,3-di oxol ane		₄ C ₆ O ₂	497-26-7	88.106			81.5	0.9811 ²⁰	1.4035 ¹⁷	vs H ₂ O; msc Et OH, et h
7219	4-Met hyl -1,3-di oxol ane		₄ C ₆ O ₂	1072-47-5	88.106	li q		85	0.99	1.3980 ²⁰	
7220	Met hyl di phenyl ami ne	<i>N</i> -Met hyl <i>N</i> -phenyl benzenami ne	₆ H ₁₃ N	552-82-9	183.249	li q	-7.5	293.5	1.0476	1.6193 ²⁰	i H ₂ O; sl Et OH, MeOH; s ct c
7221	4-Met hyl -2,4-di phenyl -1-pent ene		₁₈ C ₂₀	6362-80-7	236.352	li q		177, 102 ²²	0.99 ²⁵		
7222	Met hyl di phenyl si l ane		₁₃ C ₄ Si	776-76-1	198.336			93.5	0.996 ²⁰	1.5694 ²⁰	s ct c
7223	Met hyl di phenyl si l anol		₁₃ C ₄ O _{Si}	778-25-6	214.335		167	184 ⁴ , 148 ³	1.0840 ²⁵		s ct c, C ₆ S ₆
7224	2-Met hyl -1,2-di -3-pyri di nyl -1-propanone	Met yrapone	₆ H ₁₄ N ₂ O	54-36-4	226.273		50.5				
7225	Met hyl docosanoat e	Met hyl behenat e	₂₃ H ₄₆ O ₂	929-77-1	354.610	nd (ace)	54			1.4339 ⁶⁰	vs et h, Et OH
7226	Met hylci s13-docosenoat e		₂₃ H ₄₄ O ₂	1120-34-9	352.594		-1.2	220 ⁵			
7227	Met hyl dodecanoat e	Met hyl laurat e	₁₃ H ₂₆ O ₂	111-82-0	214.344		5.2	267	0.8702 ²⁰	1.4319 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; s chl, ct c
7228	2-Met hyl dodecano i c aci d		₁₃ H ₂₄ O ₂	2874-74-0	214.344	pl	22	153	0.890 ¹⁸		
7229	Met hyl ei cosanoat e	Met hyl arachi dat e	₂₁ H ₄₂ O ₂	1120-28-1	326.557	lf (MeOH)	54.5	219		1.4317 ⁶⁰	vs bz, et h, Et OH, chl
7230	(Met hyl eneami no)acet on i t ri le		₃ H ₄ NC	109-82-0	68.077		129				
7231	α-Met hyl enebenzeneacet i c aci d	At ropi c aci d	₉ H ₁₀ O ₂	492-38-6	148.159	lf (al), nd (w)	106.5	dec 267			sl ₂ B; s Et OH, et h, bz, chl, C ₆ S ₆
7232	Met hyl enebi s(4-cycl ohexyl i socyanat e)		₁₅ H ₂₂ N ₂ O ₂	5124-30-1	262.348	li q			1.066	1.4970	
7233	4,4'-Met hyl enebi s[2,6-di- <i>tert</i> -but yl phenol]	Bi s(3,5-di- <i>tert</i> -but yl -4-hydroxyphenyl)met hane	₂₉ H ₄₄ O ₂	118-82-1	424.658		154	289 ⁴⁰ , 250 ¹⁰			
7234	4,4'-Met hyl enebi s[met hyl ani li ne]	<i>N,N'</i> -Di met hyl -4,4'-di ami nodi phenyl met hane	₁₅ H ₁₈ N ₂	1807-55-2	226.317						s ct c, C ₆ S ₆
7235	Met hyl ene bl ue		₆ H ₁₆ Cl ₂ N ₂ S	61-73-4	319.852	dk grn cry or pow (chl -et h)					s H ₂ O, Et OH, chl; i et h; sl py
7236	Met hyl enecycl obut ane		₂ H ₈	1120-56-5	68.118	li q	-134.7	42.2	0.7409	1.4210 ²⁰	
7237	Met hyl enecycl ohexane		₆ H ₁₂	1192-37-6	96.170	li q	-106.7	102.5	0.8074	1.4523 ²⁰	i H ₂ O; s et h, bz, chl
7238	2-Met hyl enecycl ohexanol		₇ H ₁₂ O	4065-80-9	112.169			83 ¹³	0.955 ²⁰	1.4843 ²⁰	
7239	Met hyl enecycl opent ane		₆ H ₁₀	1528-30-9	82.143			75.5	0.7787 ²⁰	1.4355 ²⁰	s bz, chl
7240	Met hyl enecycl opropene		₃ H ₄	4095-06-1	52.075	sol i d st ab at -196					
7241	2,4'-Met hyl enedi ani li ne	2,4'-Di ami nodi phenyl met hane	₁₃ H ₁₄ N ₂ C	1208-52-2	198.263	lf (bz)	88.5	222			
7242	5,5'-Met hyl enedi sal i c yl i c aci d		₁₅ H ₁₂ O ₆	122-25-8	288.252	nd (bz)	243.5				vs ace, et h, Et OH
7243	5-Met hyl ene-2(<i>tert</i> -f) uranone	Prot oanemoni n	₅ H ₈ O ₂	108-28-1	96.085	pa ye oi l		79			sl H ₂ O; s chl
7244	3-Met hyl enehept ane		₈ H ₁₆	1632-16-2	112.213			120	0.7270 ²⁰	1.4157 ²⁰	i H ₂ O; vs et h, bz, pet h
7245	4-Met hyl ene-1-i sopropyl bi cycl o[3.1.0]hexan-3-ol, [1 <i>S</i> -(1α,3β,5α)]	4(10)-Thuj ene-3-ol	₆ H ₁₆ O	471-16-9	152.233			208	0.9488 ¹⁹	1.4871 ²⁵	s et h
7246	4-Met hyl ene-1-i sopropyl cycl ohexene		₁₀ H ₁₆	99-84-3	136.234			173.5	0.838 ²²	1.4754 ²²	
7247	2-Met hyl enepent anedi ni t ri le	2,4-Di cyano-1-but ene	₆ H ₁₀ N ₂ C	1572-52-7	106.125			103 ⁵		1.4561 ²⁰	s chl
7248	Met hyl ene t hi ocyanat e	Di t hi ocyanat omet hane	₃ H ₄ N ₂ S	6317-18-6	130.191	sol i d	102				
7249	2-Met hyl ene-1,3,3-t ri met hyl i ndol i ne	Fi scher's base	₁₂ H ₁₃ NC	118-12-7	173.254			244			sl H ₂ O; s Et OH, et h, bz, chl
7250	<i>N</i> -Met hyl ephedri ne[<i>R</i> [*] , <i>S</i> [*]]	(1 <i>R</i> ,2 <i>S</i>)- <i>N</i> -Met hyl ephedri ne	₁₀ H ₁₇ NO	552-79-4	179.259	nd or pl (al, et h)	87.5				i ₂ B; s Et OH, et h, MeOH
7251	Met hyl ergonovi ne	Met hyl ergomet ri ne	₂₀ H ₂₈ N ₃ O ₂	113-42-8	339.432	pr (MeOH, ace)	172				i H ₂ O; s Et OH, ace
7252	<i>N</i> -Met hyl -1,2-et hanedi ami ne		₃ H ₆ N ₂	109-81-9	74.124			115	0.841 ²⁵	1.4395 ²⁰	
7253	<i>N</i> -Met hyl -2-et hanol ami ne		₃ H ₆ NO	109-83-1	75.109			158	0.937 ²⁰	1.4385 ²⁰	msc H ₂ O, Et OH, et h
7254	1-(1-Met hyl et hoxyl)but ane	But yl i sopropyl et her	₇ H ₁₆ O	1860-27-1	116.201			108	0.7594 ¹⁵	1.3870 ¹⁵	i H ₂ O; s Et OH, et h, ace, con sul f
7255	2-[2-(1-Met hyl et hoxyl)et hyl]pyri di ne		₁₀ H ₁₄ NO	70715-19-4	165.232			133 ⁵⁰	0.9502 ²⁵	1.4820 ²⁵	vs H ₂ O



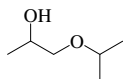
3-383



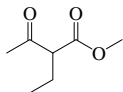
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7256	1-(1-Met hyl et hoxo)propane		$\text{C}_4\text{H}_{10}\text{O}$	627-08-7	102.174			83	0.7370 ²⁰	1.376 ²¹	sl H_2O ; vs Et OH; s et h, ace
7257	1-(1-Met hyl et hoxo)-2-propanol	1-Isopropoxy-2-propanol	$\text{C}_6\text{H}_{14}\text{O}_2$	3944-36-3	118.174			137.5	0.879 ²⁰	1.4070 ²⁰	
7258	Met hyl 2-et hyl acet oacet at e		$\text{C}_7\text{H}_{14}\text{O}_3$	51756-08-2	144.168			182	0.995 ¹⁴		vs ace, et h, Et OH
7259	5-(1-Met hyl et hyl i dene)-1,3-cycl opent adi ene		C_8H_{10}	2175-91-9	106.165		1.4	155; 49 ¹¹	0.881 ²⁰	1.5474 ²⁰	
7260	1-Met hyl - β -fluorene		$\text{C}_{14}\text{H}_{12}$	1730-37-6	180.245		87				
7261	9-Met hyl - β -fluorene		$\text{C}_{14}\text{H}_{12}$	2523-37-7	180.245	pr	46.5	155 ¹⁵	1.0263 ⁶⁵	1.610 ⁶⁵	i H_2O ; s Et OH, et h, ace, bz, chl
7262	Met hyl fluorosul f onat e		$\text{C}_6\text{H}_5\text{S}$	421-20-5	114.096	col li q	-95	93	1.412	1.332 ⁶	
7263	N-Met hyl f ormami de		$\text{C}_7\text{H}_9\text{NO}$	123-39-7	59.067	li q	-3.8	199.51	1.01 ⁹	1.4319 ²⁰	vs H_2O , ace, Et OH
7264	Met hyl f ormat e		$\text{C}_4\text{H}_6\text{O}_2$	107-31-3	60.052	li q	-99	31.7	0.971 ⁹	1.3419 ²⁰	vs H_2O ; msc Et OH; s et h, chl, MeOH
7265	Met hyl 4-f ormyl benzoat e		$\text{C}_9\text{H}_8\text{O}_3$	1571-08-0	164.158	nd (w)	63	265			
7266	2-Met hyl f uran		$\text{C}_6\text{H}_6\text{O}$	534-22-5	82.101	li q	-91.3	64.7	0.913 ²	1.4342 ²⁰	sl H_2O , ct c; s Et OH, et h
7267	3-Met hyl f uran		$\text{C}_6\text{H}_6\text{O}$	930-27-8	82.101			65.5	0.923 ¹⁸	1.4330 ¹⁹	i H_2O ; s Et OH, et h
7268	5-Met hyl -2-f urancarboxal dehyde		$\text{C}_8\text{H}_8\text{O}_2$	620-02-0	110.111			187; 89 ²⁶	1.1072 ¹⁸	1.5264 ²⁰	s H_2O ; vs Et OH; msc et h; sl ct c
7269	Met hyl 2-f urancarboxyl at e	Met hyl 2-f uranoat e	$\text{C}_8\text{H}_8\text{O}_2$	611-13-2	126.110			181.3	1.1786 ²¹	1.4866 ²⁰	i H_2O ; s Et OH, et h, bz, chl
7270	3-Met hyl -2,5-f urandi one		$\text{C}_8\text{H}_8\text{O}_3$	616-02-4	112.084		7.5	213.5	1.2469 ¹⁸	1.4710 ²¹	vs ace, et h, Et OH
7271	N-Met hyl -2-f uranmet hanami ne		$\text{C}_8\text{H}_{10}\text{NO}$	4753-75-7	111.141			149	0.989 ²⁵	1.4729 ²⁰	
7272	5-Met hyl -2-f uranmet hanol		$\text{C}_8\text{H}_{10}\text{O}_2$	3857-25-8	112.127			dec 195; 81 ²³	1.0769 ²⁰	1.4853 ²⁰	vs et h, Et OH
7273	α -Met hyl -2-f uranmet hanol		$\text{C}_8\text{H}_{10}\text{O}_2$	4208-64-4	112.127			162.5	1.0739 ²⁵	1.4827 ¹⁵	
7274	5-Met hyl -2(β)-f uranone		$\text{C}_8\text{H}_8\text{O}_2$	591-12-8	98.101	nd	18	56 ¹²	1.084 ²⁰	1.4476 ²⁰	s H_2O , Et OH, et h, CS_2 sl ct c
7275	5-Met hyl -2(β)-f uranone		$\text{C}_8\text{H}_8\text{O}_2$	591-11-7	98.101		<-17	209; 98 ¹⁵	1.0810 ²⁰	1.4454 ²⁰	msc H_2O ; s Et OH, et h
7276	Met hyl germane		$\text{C}_2\text{H}_6\text{Ge}$	1449-65-6	90.70	col gas	-158	-23			
7277	Met hyl β -D-gl ucopyranosi de		$\text{C}_6\text{H}_{14}\text{O}_6$	709-50-2	194.182		109				s H_2O
7278	Met hyl α -D-gl ucopyranosi de	α -Met hyl gl ucosi de	$\text{C}_6\text{H}_{14}\text{O}_6$	97-30-3	194.182	ort h nd (al)	168	200 ²	1.46 ³⁰		vs H_2O
7279	3-Met hyl gl ut ari c aci d	3-Met hyl pent anedi oi c aci d	$\text{C}_8\text{H}_{16}\text{O}_4$	626-51-7	146.141		87	166 ⁵			s H_2O , Et OH, et h; sl bz, chl; i li g
7280	Met hyl Green		$\text{C}_6\text{H}_5\text{BrClN}_3$	14855-76-6	516.944	grn pow (al)					vs H_2O
7281	Met hyl hept adecanoat e		$\text{C}_{18}\text{H}_{36}\text{O}_2$	1731-92-6	284.478	pl (al)	30	188; 152 ⁰⁵			i H_2O ; s Et OH, ace, ct c; vs et h, bz
7282	Met hyl hept affluorobot anoat e		$\text{C}_7\text{H}_7\text{F}_7\text{O}_2$	356-24-1	228.066	li q	-86	80	1.48 ⁹	1.295 ²⁰	sl H_2O ; s et h, ace
7283	6-Met hyl -2-hept anami ne, (\pm)	Oct odri ne	$\text{C}_8\text{H}_{17}\text{N}$	5984-58-7	129.244	vi sc li q		155	0.767	1.4209 ²⁰	
7284	N-Met hyl -2-hept anami ne		$\text{C}_8\text{H}_{17}\text{N}$	540-43-2	129.244			155			
7285	2-Met hyl hept ane		C_8H_{18}	592-27-8	114.229	li q	-109.02	117.66	0.698 ⁹	1.3949 ²⁰	i H_2O ; msc Et OH, ace, bz; s et h, ct c
7286	3-Met hyl hept ane		C_8H_{18}	589-81-1	114.229	col li q	-120.48	118.9	0.701 ⁷	1.3961 ²⁵	i H_2O ; s Et OH, et h; msc ace, bz, chl
7287	4-Met hyl hept ane		C_8H_{18}	589-53-7	114.229	li q	-121.0	117.72	0.704 ⁶	1.3979 ²⁰	i H_2O ; s et h; msc Et OH, ace, bz
7288	Met hyl hept anoat e		$\text{C}_8\text{H}_{16}\text{O}_2$	106-73-0	144.212	li q	-56	174	0.881 ⁵	1.4152 ²⁰	sl H_2O , ct c, ace; s Et OH, et h
7289	2-Met hyl -1-hept anol, (\pm)		$\text{C}_8\text{H}_{18}\text{O}$	111675-77-5	130.228	col li q	-112	175.6	0.8022	1.424 ²⁰	
7290	3-Met hyl -1-hept anol		$\text{C}_8\text{H}_{18}\text{O}$	1070-32-2	130.228	li q	-90	186; 10 ⁹	0.824 ²⁴	1.4295 ²⁵	
7291	4-Met hyl -1-hept anol		$\text{C}_8\text{H}_{18}\text{O}$	817-91-4	130.228			188	0.8065 ²⁵	1.4253 ²⁵	vs Et OH
7292	5-Met hyl -1-hept anol, (\pm)		$\text{C}_8\text{H}_{18}\text{O}$	111767-95-4	130.228	col li q	-104	186.6	0.815 ³	1.4272 ²⁵	
7293	6-Met hyl -1-hept anol	Isocyt yl al colol	$\text{C}_8\text{H}_{18}\text{O}$	1653-40-3	130.228	li q	-106	188; 95.8 ⁹	0.8176 ²⁵	1.4251 ²⁵	i H_2O ; s Et OH, et h
7294	2-Met hyl -2-hept anol		$\text{C}_8\text{H}_{18}\text{O}$	625-25-2	130.228	li q	-50.4	156	0.814 ²	1.4250 ²⁰	i H_2O ; s Et OH, et h
7295	3-Met hyl -2-hept anol		$\text{C}_8\text{H}_{18}\text{O}$	31367-46-1	130.228			166.1	0.8177 ²⁵	1.4199 ²⁵	i H_2O ; s Et OH, et h, ct c
7296	4-Met hyl -2-hept anol		$\text{C}_8\text{H}_{18}\text{O}$	56298-90-9	130.228	col li q	-102	171.6	0.802 ⁷	1.424 ²⁰	



1-(1-Met hyl et hoxyl)propane



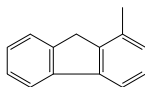
1-(1-Met hyl et hoxyl)-2-propanol



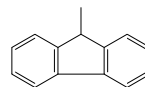
Met hyl2-et hyl acet oacet at e



5-(1-Met hyl et hyl i dene)-1,3-cycl opent adi ene



1-Met hyl -8-f luorene



9-Met hyl -8-f luorene



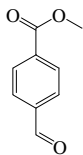
Met hyl f luorosul f onat e



N-Met hyl f ormami de



Met hyl f ormat e



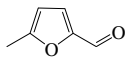
Met hyl4-f ormyl benzoat e



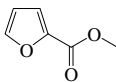
2-Met hyl f uran



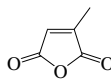
3-Met hyl f uran



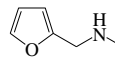
5-Met hyl -2-f urancarboxyl dehyde



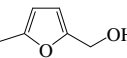
Met hyl2-f urancarboxyl at e



3-Met hyl -2,5-f urandi one



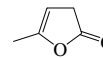
N-Met hyl -2-f uranmet hanami ne



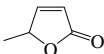
5-Met hyl -2-f uranmet hanol



α-Met hyl -2-f uranmet hanol



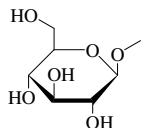
5-Met hyl -2(5H)-f uranone



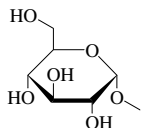
5-Met hyl -2(5H)-f uranone



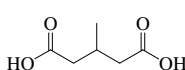
Met hyl germane



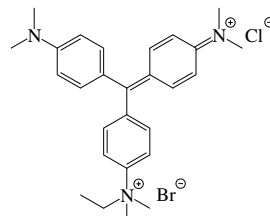
Met hylβ-D-gl ucopyranosi de



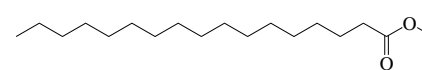
Met hylα-D-gl ucopyranosi de



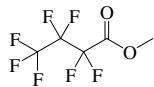
3-Met hyl gl ut arāi d



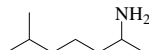
Met hylGreen



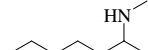
Met hylhept adecanoat e



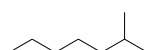
Met hylhept af luorobut onat e



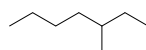
6-Met hyl -2-hept anami ne (ta)



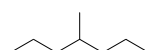
N-Met hyl -2-hept anami ne



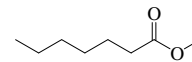
2-Met hyl hept ane



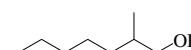
3-Met hyl hept ane



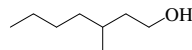
4-Met hyl hept ane



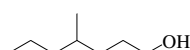
Met hylhept onat e



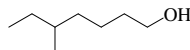
2-Met hyl -1-hept anol(±)



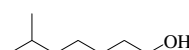
3-Met hyl -1-hept anol



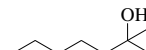
4-Met hyl -1-hept anol



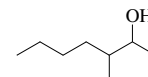
5-Met hyl -1-hept anol(±)



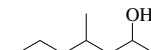
6-Met hyl -1-hept anol



2-Met hyl -2-hept anol

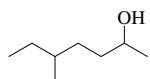


3-Met hyl -2-hept anol

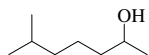


4-Met hyl -2-hept anol

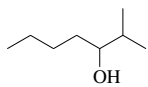
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7297	5-Met hyl -2-hept anol		$\text{C}_{18}\text{H}_{38}\text{O}$	54630-50-1	130.228	li q	-61	170	0.8174		
7298	6-Met hyl -2-hept anol		$\text{C}_{18}\text{H}_{38}\text{O}$	4730-22-7	130.228	li q	-105	174	0.8218	1.4238 ¹⁰	
7299	2-Met hyl -3-hept anol , (±)		$\text{C}_{18}\text{H}_{38}\text{O}$	100296-26-2	130.228	li q	-85	167.5	0.8235	1.4265 ²⁰	sl H ₂ O; s Et OH, et h, ct c
7300	3-Met hyl -3-hept anol	2-Et hyl -2-hexanol	$\text{C}_{18}\text{H}_{38}\text{O}$	5582-82-1	130.228	li q	-83	163	0.8282	1.4279 ²⁰	i H ₂ O; s Et OH, et h, ct c
7301	4-Met hyl -3-hept anol		$\text{C}_{18}\text{H}_{38}\text{O}$	14979-39-6	130.228	li q	-123	170	0.827	1.4300 ²⁰	
7302	5-Met hyl -3-hept anol		$\text{C}_{18}\text{H}_{38}\text{O}$	18720-65-5	130.228	li q	-91.2	172	0.8425	1.433 ²⁴	
7303	6-Met hyl -3-hept anol , (±)		$\text{C}_{18}\text{H}_{38}\text{O}$	100295-85-0	130.228	col li q	-61	169	0.8220	1.4254 ²⁰	
7304	2-Met hyl -4-hept anol		$\text{C}_{18}\text{H}_{38}\text{O}$	21570-35-4	130.228	li q	-81	164	0.8207	1.4203	vs et h, Et OH
7305	3-Met hyl -4-hept anol		$\text{C}_{18}\text{H}_{38}\text{O}$	1838-73-9	130.228	li q		164.7	0.8329	1.4211 ²⁵	sl H ₂ O; s Et OH, et h, ct c
7306	4-Met hyl -4-hept anol		$\text{C}_{18}\text{H}_{38}\text{O}$	598-01-6	130.228	li q	-82	161	0.8248	1.4258 ²⁰	i H ₂ O; s Et OH, et h, ct c
7307	6-Met hyl -2-hept anol acet at e		$\text{C}_{20}\text{H}_{40}\text{O}_2$	67952-57-2	172.265			187	0.8474 ²⁰	1.413 ²⁰	vs Et OH
7308	6-Met hyl -2-hept anone		$\text{C}_{16}\text{H}_{32}\text{O}$	928-68-7	128.212			167	0.8151 ²⁰	1.4162 ²⁰	sl H ₂ O; vs Et OH, et h; msc ace, bz, chl
7309	5-Met hyl -3-hept anone		$\text{C}_{16}\text{H}_{32}\text{O}$	541-85-5	128.212	li q		161			
7310	6-Met hyl -3-hept anone		$\text{C}_{16}\text{H}_{32}\text{O}$	624-42-0	128.212			164	0.8304 ²⁰	1.4209 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
7311	2-Met hyl -4-hept anone	Isobut yl propyl ket one	$\text{C}_{16}\text{H}_{32}\text{O}$	626-33-5	128.212			154	0.813 ²²		i H ₂ O; s Et OH, et h
7312	2-Met hyl -1-hept ene		$\text{C}_{16}\text{H}_{32}$	15870-10-7	112.213	li q	-90	119.3	0.7104	1.4123 ²⁰	
7313	6-Met hyl -1-hept ene		$\text{C}_{16}\text{H}_{32}$	5026-76-6	112.213			113.2	0.7079 ²⁵	1.4070 ²⁰	
7314	2-Met hyl -2-hept ene		$\text{C}_{16}\text{H}_{32}$	627-97-4	112.213			122.6	0.7200 ²⁵	1.4170 ²⁰	i H ₂ O; s et h, bz, ct c, chl
7315	ci s3-Met hyl -2-hept ene		$\text{C}_{16}\text{H}_{32}$	22768-19-0	112.213			122	0.725 ²⁵	1.419 ²⁰	
7316	6-Met hyl -5-hept en-2-ol		$\text{C}_{16}\text{H}_{32}\text{O}$	1569-60-4	128.212			175	0.8545 ²⁰	1.4505 ²⁰	
7317	3-Met hyl -5-hept en-2-one		$\text{C}_{14}\text{H}_{28}\text{O}$	38552-72-6	126.196			63 ²⁰	0.8463 ¹⁵	1.4345 ¹⁸	
7318	6-Met hyl -5-hept en-2-one		$\text{C}_{14}\text{H}_{28}\text{O}$	110-93-0	126.196		173.5		0.8546 ¹⁵	1.4445 ²⁰	vs et h, Et OH
7319	2-Met hyl hept yl acet at e, (±)		$\text{C}_{20}\text{H}_{40}\text{O}_2$	74112-36-0	172.265			195	0.8626 ¹⁴	1.4146 ²⁰	vs et h, Et OH
7320	2-Met hyl -1,5-hexadi ene		$\text{C}_{12}\text{H}_{22}$	4049-81-4	96.170	li q	-128.8	88.1	0.7153	1.4183 ²⁰	
7321	Met hyl rans rans2,4-hexadi enoat e	Met hyl sorbat e	$\text{C}_{12}\text{H}_{22}\text{O}_2$	689-89-4	126.153	lf	15	180; 70	0.9777 ²⁰	1.5025 ²²	i H ₂ O; s Et OH, et h
7322	2-Met hyl hexanal		$\text{C}_{14}\text{H}_{28}\text{O}$	925-54-2	114.185	li q		141; 132			
7323	3-Met hyl hexanal	3-Met hyl caproal dehyde	$\text{C}_{14}\text{H}_{28}\text{O}$	19269-28-4	114.185			143	0.8203 ²⁰	1.4122 ²⁰	i H ₂ O; s Et OH, et h
7324	3-Met hyl -1-hexanami ne		$\text{C}_{17}\text{H}_{31}\text{N}$	65530-93-0	115.217			149; 67 ⁴⁵	0.772 ²⁶	1.4249 ²⁵	
7325	4-Met hyl -2-hexanami ne		$\text{C}_{17}\text{H}_{31}\text{N}$	105-41-9	115.217			132.5	0.7655 ²⁰	1.4150 ²⁵	sl H ₂ O; vs Et OH, et h, chl , di l aci d
7326	2-Met hyl hexane		$\text{C}_{16}\text{H}_{34}$	591-76-4	100.202	li q	-118.2	90.04	0.6787	1.3848 ²⁰	i H ₂ O; s Et OH; msc et h, ace, bz, li g, chl
7327	3-Met hyl hexane		$\text{C}_{16}\text{H}_{34}$	78918-91-9	100.202	li q	-119.4	92	0.687	1.3854 ²⁵	i H ₂ O; s Et OH; msc et h, ace, bz, li g, chl
7328	5-Met hyl -2,3-hexanedi one	2-Met hyl hexa-4,5-di one	$\text{C}_{12}\text{H}_{22}\text{O}_2$	13706-86-0	128.169			138	0.908 ²²	1.4119 ²⁰	
7329	Met hyl hexanoat e	Met hyl caproat e	$\text{C}_{12}\text{H}_{22}\text{O}_2$	106-70-7	130.185	li q	-71	149.5	0.8846	1.4049 ²⁰	i H ₂ O; vs Et OH, et h; s ace, bz, ct c
7330	2-Met hyl hexanoi c aci d		$\text{C}_{12}\text{H}_{22}\text{O}_2$	4536-23-6	130.185			215.5	0.918 ²⁰	1.4193 ²⁰	vs ace, bz, et h, Et OH
7331	2-Met hyl -1-hexanol , (±)		$\text{C}_{16}\text{H}_{34}\text{O}$	111768-04-8	116.201			164; 71 ¹⁵	0.826 ²⁰	1.4226 ²⁰	vs et h, Et OH
7332	5-Met hyl -1-hexanol		$\text{C}_{16}\text{H}_{34}\text{O}$	627-98-5	116.201			169; 54 ¹⁵	0.8192 ²⁴	1.4175 ²⁰	vs et h, Et OH
7333	2-Met hyl -2-hexanol		$\text{C}_{16}\text{H}_{34}\text{O}$	625-23-0	116.201			143	0.8119 ²⁰	1.4175 ²⁰	sl H ₂ O; msc Et OH, et h
7334	3-Met hyl -2-hexanol		$\text{C}_{16}\text{H}_{34}\text{O}$	2313-65-7	116.201			151; 80 ⁵²	0.8220 ²⁵	1.4198 ¹⁸	i H ₂ O; vs Et OH, et h; s ace
7335	5-Met hyl -2-hexanol		$\text{C}_{16}\text{H}_{34}\text{O}$	627-59-8	116.201			151; 78 ²⁸	0.814 ²⁰	1.4180 ²⁰	sl H ₂ O; s Et OH, et h
7336	3-Met hyl -3-hexanol		$\text{C}_{16}\text{H}_{34}\text{O}$	597-96-6	116.201			143	0.8233 ²⁰	1.4231 ²⁰	sl H ₂ O; s Et OH, et h, ct c
7337	5-Met hyl -2-hexanone	Met hyl i sopent yl ket one	$\text{C}_{14}\text{H}_{28}\text{O}$	110-12-3	114.185			144	0.888 ²⁰	1.4062 ²⁰	sl H ₂ O; msc Et OH; vs ace, bz; s ct c
7338	2-Met hyl -3-hexanone	Propyl i sopropyl ket one	$\text{C}_{14}\text{H}_{28}\text{O}$	7379-12-6	114.185			135	0.8091 ²⁰	1.4042 ²⁰	s Et OH, et h, chl ; vs ace
7339	5-Met hyl -2-hexanone oxi me		$\text{C}_{15}\text{H}_{30}\text{NO}$	624-44-2	129.200			195.5	0.8881 ²⁰	1.4448 ²⁰	sl chl



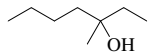
5-Methyl-2-heptanol



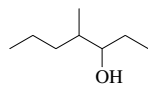
6-Methyl-2-heptanol



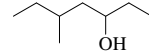
2-Methyl-3-heptanol(±)



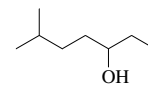
3-Methyl-3-heptanol



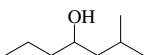
4-Methyl-3-heptanol(±)



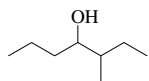
5-Methyl-3-heptanol



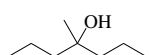
6-Methyl-3-heptanol(±)



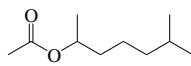
2-Methyl-4-heptanol



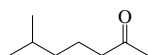
3-Methyl-4-heptanol



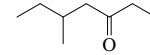
4-Methyl-4-heptanol



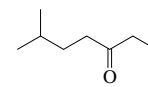
6-Methyl-2-heptanoate



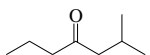
6-Methyl-2-heptanone



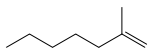
5-Methyl-3-heptanone



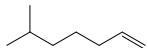
6-Methyl-3-heptanone



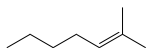
2-Methyl-4-heptanone



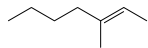
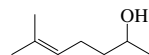
2-Methyl-1-heptene



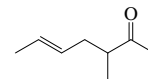
6-Methyl-1-heptene



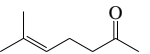
2-Methyl-2-heptene


cis-3-Methyl-2-heptene


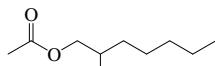
6-Methyl-5-hepten-2-ol



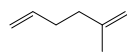
3-Methyl-5-hepten-2-one



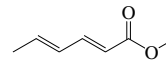
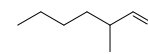
6-Methyl-5-hepten-2-one



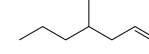
2-Methylheptanoate(±)



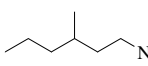
2-Methyl-1,5-hexadiene


 Methyl *trans*-2,4-hexadienoate


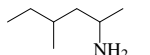
2-Methylhexanal



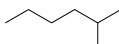
3-Methylhexanal



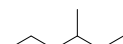
3-Methyl-1-hexanamine



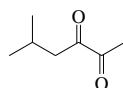
4-Methyl-2-hexanamine



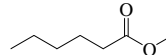
2-Methylhexane



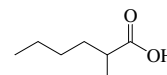
3-Methylhexane



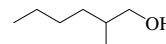
5-Methyl-2,3-hexanedione



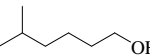
Methylhexanoate



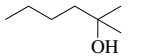
2-Methylhexanoic acid



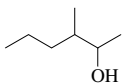
2-Methyl-1-hexanol(±)



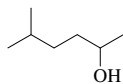
5-Methyl-1-hexanol



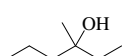
2-Methyl-2-hexanol



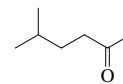
3-Methyl-2-hexanol



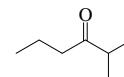
5-Methyl-2-hexanol



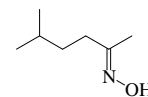
3-Methyl-3-hexanol



5-Methyl-2-hexanone

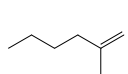


2-Methyl-3-hexanone

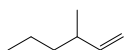


5-Methyl-2-hexanone oxime

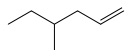
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7340	2-Met hyl -1-hexene		C ₈ H ₁₄	6094-02-6	98.186	li q	-102.8	92	0.7008	1.4035 ²⁰	
7341	3-Met hyl -1-hexene		C ₈ H ₁₄	3404-61-3	98.186			83.9	0.6871 ²⁵	1.3965 ²⁰	
7342	4-Met hyl -1-hexene		C ₈ H ₁₄	3769-23-1	98.186	li q	-141.5	86.7	0.6942	1.4000 ²⁰	
7343	5-Met hyl -1-hexene		C ₈ H ₁₄	3524-73-0	98.186			85.3	0.6877 ²⁵	1.3967 ²⁰	
7344	2-Met hyl -2-hexene		C ₈ H ₁₄	2738-19-4	98.186	li q	-130.4	95.4	0.7038	1.4106 ²⁰	
7345	ci s3-Met hyl -2-hexene		C ₈ H ₁₄	10574-36-4	98.186	li q	-118.5	95.6	0.712	1.4126 ²⁰	
7346	ci s4-Met hyl -2-hexene		C ₈ H ₁₄	3683-19-0	98.186			86.3	0.6952 ²⁵	1.4026 ²⁰	
7347	t rans4-Met hyl -2-hexene		C ₈ H ₁₄	3683-22-5	98.186	li q	-125.7	87.6	0.6925	1.4025 ²⁰	
7348	ci s5-Met hyl -2-hexene		C ₈ H ₁₄	13151-17-2	98.186			89.5	0.697 ²⁵	1.404 ²⁰	
7349	t rans5-Met hyl -2-hexene		C ₈ H ₁₄	7385-82-2	98.186	li q	-124.3	88.1	0.6883	1.4006 ²⁰	
7350	ci s2-Met hyl -3-hexene		C ₈ H ₁₄	15840-60-5	98.186			86	0.690 ²⁵	1.401 ²⁰	
7351	t rans2-Met hyl -3-hexene		C ₈ H ₁₄	692-24-0	98.186	li q	-141.6	85.9	0.6853	1.4001 ²⁰	
7352	ci s3-Met hyl -3-hexene		C ₈ H ₁₄	4914-89-0	98.186			95.4	0.7079 ²⁵	1.4126 ²⁰	
7353	t rans3-Met hyl -3-hexene		C ₈ H ₁₄	3899-36-3	98.186			93.5	0.7050 ²⁵	1.4109 ²⁰	
7354	Met hyl 3-hexenoat e		C ₈ H ₁₂ O ₂	2396-78-3	128.169			67 ³⁴	0.9132 ²⁵	1.4240 ²³	
7355	5-Met hyl -3-hexen-2-one	2-Oxo-5-met hyl hex-3-ene	C ₈ H ₁₂ O	5166-53-0	112.169			77 ³⁰ , 65 ¹³	0.8549 ²⁸	1.4395 ²²	
7356	5-Met hyl -5-hexen-2-one		C ₈ H ₁₂ O	3240-09-3	112.169			150	0.8460 ²⁰	1.4348 ²⁰	vs ace, et h, Et OH
7357	5-Met hyl -1-hexyne		C ₈ H ₁₂	2203-80-7	96.170	li q	-125	92	0.7274	1.4059 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, pet h
7358	5-Met hyl -2-hexyne		C ₈ H ₁₂	53566-37-3	96.170	li q	-92.9	102.5	0.7378	1.4176 ²⁰	i H ₂ O; s et h, ace, bz, chl, pet h
7359	2-Met hyl -3-hexyne		C ₈ H ₁₂	36566-80-0	96.170	li q	-116.7	95.2	0.7263	1.4120 ²⁰	vs bz, et h, chl, pet h
7360	Met hyl 2-hexynoat e		C ₈ H ₁₀ O ₂	18937-79-6	126.153			80 ²³	0.9648 ²⁵		
7361	L-1-Met hyl hi st i di ne		C ₈ H ₁₁ O ₂	332-80-9	169.181	pl (DMF aq)	249				
7362	L-3-Met hyl hi st i di ne		C ₈ H ₁₁ O ₂	368-16-1	169.181		250				
7363	Met hyl hydrazi ne		C ₂ N ₂	60-34-4	46.072	li q	-52.36	87.5		1.4325	s H ₂ O, et h, ct c; msc Et OH; i li g
7364	Met hyl hydrazi necarboxyl at e	Met hyl carbat e	C ₂ H ₃ N ₂ O ₂	6294-89-9	90.081		73	108 ¹²			s H ₂ O, Et OH; sl bz; i pet h
7365	Met hyl hydrogen succi nat e	Monomet hyl succi nat e	C ₆ H ₇ O ₂	3878-55-5	132.116		58	151 ²⁰ , 122 ⁴			s H ₂ O
7366	Met hyl hydroperoxi de	Met hyl hydrogen peroxi de	C ₄ H ₈ O ₂	3031-73-0	48.042	li q	-72	86; 39	1.9967 ¹⁵	1.3641 ¹⁵	vs H ₂ O, bz, et h, Et OH
7367	Met hyl hydroxyacet at e		C ₃ H ₆ O ₃	96-35-5	90.078			149; 52 ¹⁷	1.1677 ¹⁵		s H ₂ O; msc Et OH, et h
7368	Met hyl 3-hydroxybenzoat e		C ₇ H ₆ O ₃	19438-10-9	152.148	nd (bz-pet h)	73	281; 178 ⁷	1.1528 ¹⁰⁰		s Et OH, bz, pet h; sl chl
7369	Met hyl 4-hydroxybenzoat e	Met hyl paraben	C ₈ H ₈ O ₃	99-76-3	152.148	nd (di l al)	131	dec 275			sl Et OH; vs Et OH, et h, ace; s t f a
7370	Met hyl α-hydroxydi phenyl acet at e	Met hyl di phenyl glycol at e	C ₁₅ H ₁₄ O ₂	76-89-1	242.270	mcl or t cl cry (al)	75.8	187 ¹³			vs et h, Et OH
7371	O-Met hyl hydroxyl ami ne	Met hoxiami ne	C ₅ H ₁₁ O	67-62-9	47.057			49			
7372	O-Met hyl hydroxyl ami ne hydrochl ori de	Met hoxiami ne hydrochl ori de	C ₅ H ₁₁ NO	593-56-6	83.518	pr	150.0				vs H ₂ O, Et OH
7373	Met hyl 4-hydroxy-3-met hoxibenzoat e		C ₉ H ₈ O ₄	3943-74-6	182.173	nd (di l al)	64	286			s Et OH, pet h; sl chl
7374	Met hyl 2-hydroxy-3-met hyl benzoat e		C ₉ H ₈ O ₃	23287-26-5	166.173		29	235	1.1683 ²⁵	1.5354 ¹⁶	
7375	Met hyl 2-hydroxy-5-met hyl benzoat e		C ₉ H ₈ O ₃	22717-57-3	166.173	li q	-1	244.5	1.1673	1.5351 ¹⁵	
7376	Met hyl 2-hydroxy-2-met hyl propanoat e	Met hyl 2-met hyl act at e	C ₅ H ₁₀ O ₃	2110-78-3	118.131			137		1.4056 ²⁰	vs H ₂ O, Et OH
7377	Met hyl 3-hydroxy-2-naphthal enecarboxyl at e	Met hyl 3-hydroxy-2-naphthoat e	C ₁₇ H ₁₀ O ₃	883-99-8	202.205	pa ye ort h nd (di l MeOH)	75.5	206			i H ₂ O; s Et OH
7378	Met hyl α-hydroxyphenyl acet at e, (±)	(±)-Met hyl mandel at e	C ₉ H ₁₀ O ₃	4358-87-6	166.173	pl (bz-li g)	58	dec 250; 144 ²⁰	1.1756 ²⁰		vs Et OH, chl
7379	1-Met hyl i mi dazol		C ₄ H ₆ N ₂	616-47-7	82.104	li q	-6	195.5	1.0325	1.4970 ²⁰	vs H ₂ O, ace, et h, Et OH
7380	2-Met hyl -H-i mi dazol e		C ₄ H ₆ N ₂	693-98-1	82.104		144	267			vs H ₂ O, Et OH



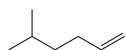
2-Met hyl -1-hexene



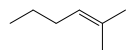
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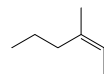
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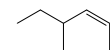
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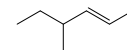
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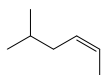
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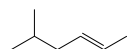
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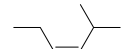
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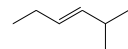
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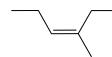
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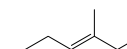
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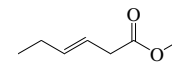
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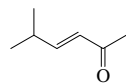
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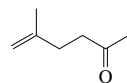
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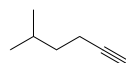
Met hyl3-hexenoat e



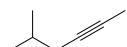
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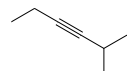
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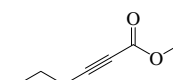
5-Met hyl -1-hexyne



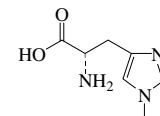
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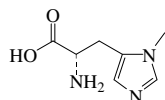
2-Met hyl -3-hexyne



Met hyl2-hexynoat e



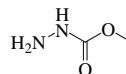
L-1-Met hyl hi st i di ne



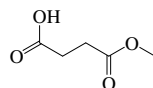
L-3-Met hyl hi st i di ne



Met hyl hydrazi ne



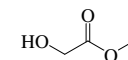
Met hyl hydrazi ne carboxyl at e



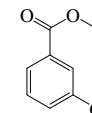
Met hyl hydrogen succi nat e



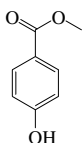
Met hyl hydroperoxi de



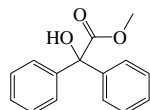
Met hyl hydroxyacet at e



Met hyl3-hydroxybenzoat e



Met hyl4-hydroxybenzoat e



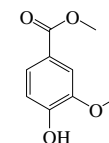
Met hyl- hydroxydi phenyl acet at e



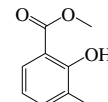
O-Met hyl hydroxyl ami ne



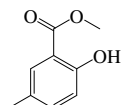
O-Met hyl hydroxyl ami ne hydrochl ori de



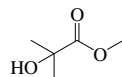
Met hyl4-hydroxy-3-met hoxybenzoat e



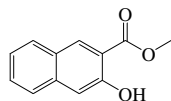
Met hyl2-hydroxy-3-met hyl benzoat e



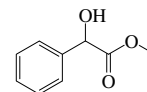
Met hyl2-hydroxy-5-met hyl benzoat e



Met hyl2-hydroxy-2-met hyl propanoat e



Met hyl3-hydroxy-2-napt hal enicarboxyl at e



Met hyl- hydroxyphenyl acet at e

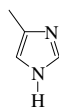


1-Met hyl i mi dazol

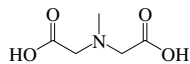


2-Met hyl -H-i mi dazol e

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7381	4-Met hyl -#i mi dazole		₄ B ₂ N ₂	822-36-6	82.104		56	263	1.0416 ¹⁴	1.5037 ¹⁴	vs H ₂ O, Et OH
7382	<i>N</i> -Met hyl i mi nodi acet i c aci d	<i>N</i> -(Carboxymet hyl) <i>N</i> -met hyl gl yci ne	₄ B ₂ NO ₄	4408-64-4	147.130	cry (w)	226				s H ₂ O; i Et OH, et h
7383	1-Met hyl -#i ndene		C ₉ H ₁₀	767-59-9	130.186			199; 82 ¹⁵	0.970 ²⁵	1.5616 ²⁰	
7384	2-Met hyl -#i ndene		C ₉ H ₁₀	2177-47-1	130.186		80	208	0.974 ²⁵	1.5652 ²⁰	i H ₂ O; s et h, ace, bz
7385	3-Met hyl -#i ndene		C ₉ H ₁₀	767-60-2	130.186			198	0.972 ²⁵	1.5621 ²⁰	i H ₂ O; s et h, ace, bz
7386	1-Met hyl -#i ndole		C ₈ H ₇ N	603-76-9	131.174			237	1.0707 ²⁵		i H ₂ O; s Et OH, et h, bz
7387	2-Met hyl -#i ndole		C ₈ H ₇ N	95-20-5	131.174	pl (di l al) nd or lf (w)	61	272	1.07 ²⁰		sl H ₂ O; vs Et OH, et h; s ace, bz
7388	3-Met hyl -#i ndole	Skat ole	₈ B ₃ N	83-34-1	131.174	lf (li g)	97.5	266			s Et OH, et h, ace, bz, chl
7389	5-Met hyl -#i ndole		C ₈ H ₇ N	614-96-0	131.174		60	267	1.0202 ⁷⁸		s H ₂ O, Et OH, et h, bz, li g
7390	7-Met hyl -#i ndole		C ₈ H ₇ N	933-67-5	131.174		85	266	1.0202 ¹⁰⁰		
7391	Met hyl 2-i odobenzoat e		₈ H ₆ ClO ₂	610-97-9	262.045			280; 146 ¹⁶		1.6052 ²⁰	s Et OH
7392	Met hyl 3-i odobenzoat e		₈ H ₆ ClO ₂	618-91-7	262.045	nd (di l al)	54.5	277; 150			i H ₂ O, li g; s Et OH; vs et h, ace
7393	Met hyl 4-i odobenzoat e		₈ H ₆ ClO ₂	619-44-3	262.045	nd (et h-al)	114.8	sub	2.0200		s Et OH, et h
7394	5-Met hyl -1,3-i sobenzof urandi one		₈ H ₆ O ₃	19438-61-0	162.142		93.0	295			
7395	Met hyl i sobut anoat e		₈ H ₈ O ₂	547-63-7	102.132	li q	-84.7	92.5	0.8906	1.3840 ²⁰	sl H ₂ O; msc Et OH, et h; s ace, ct c
7396	Met hyl i socyanat e		₈ H ₆ NO	624-83-9	57.051	li q	-45	39.5	0.9230	1.3419 ¹⁸	vs H ₂ O
7397	2-Met hyl -#i soi ndole-1,3- di di one		C ₈ H ₇ NO ₂	550-44-7	161.158	nd (al), lf (sub)	134	286			i ₂ Et sl Et OH
7398	Met hyl i sopent anoat e	Met hyl i soval erat e	₈ H ₁₂ O ₂	556-24-1	116.158			116.5	0.8808 ²⁰	1.3927 ²⁰	i H ₂ O; vs Et OH, et h, ace
7399	6-Met hyl- <i>N</i> -i sopent yl -2-hept anami ne	Oct amyl ami ne	₁₃ H ₂₉ N	502-59-0	199.376			100 ⁷			
7400	2-Met hyl -5-i sopropyl ani li ne		₁₀ H ₁₉ N	2051-53-8	149.233	li q	-16	241	0.9942	1.5387 ²⁰	s ct c, C ₅
7401	α -Met hyl -4-i sopropyl benzenepropanal	3- <i>p</i> -Cumenyl -2-met hyl propi onal dehyde	C ₁₃ H ₁₈ O	103-95-7	190.281			270; 135 ⁹⁹	0.9459 ²⁰	1.5068 ²⁰	vs bz, et h, Et OH
7402	2-Met hyl -5-i sopropyl bi cycl o[3.1.0]hex-2-ene		C ₁₀ H ₁₆	2867-05-2	136.234			151	0.8301 ²⁰	1.4515 ²⁰	
7403	2-Met hyl -5-i sopropyl -2,5-cycl ohexadi ene-1,4-di one		C ₁₀ H ₁₂ O ₂	490-91-5	164.201		45.5	232			s chl
7404	<i>ci s</i> -1-Met hyl -4-i sopropyl cycl ohexane		₁₀ B ₂₀	6069-98-3	140.266	li q	-89.9	172	0.8039	1.4431 ²⁰	i H ₂ O; vs Et OH, et h; s bz, pet h
7405	<i>t rans</i> -1-Met hyl -4-i sopropyl cycl ohexane	<i>t rans</i> - <i>p</i> Ment hane	C ₁₀ H ₂₀	1678-82-6	140.266	oi l	-86.3	170.6	0.7926	1.4366 ²⁰	vs bz, et h, Et OH, li g
7406	1-Met hyl -4-i sopropyl cycl ohexanol		₁₀ H ₂₀ O	21129-27-1	156.265			208.5	0.90 ²⁰	1.4619 ²⁰	
7407	5-Met hyl -2-i sopropyl cycl ohexanol , (+)-Ment hol [1 <i>S</i> -(1 α ,2 β ,5 α)]-		C ₁₀ H ₂₀ O	15356-60-2	156.265		39	103 ⁹			vs ace, bz, et h, Et OH
7408	5-Met hyl -2-i sopropyl cycl ohexanol , (-)-Ment hol [1 <i>R</i> -(1 α ,2 β ,5 α)]-		C ₁₀ H ₂₀ O	2216-51-5	156.265	nd (MeOH)	43	216	0.903 ¹⁵	1.460 ²²	sl H ₂ O; vs Et OH, et h, ace, bz; s pet h
7409	5-Met hyl -2-i sopropyl cycl ohexanol , (+)-Neoment hol [1 <i>S</i> -(1 α ,2 α ,5 β)]-		C ₁₀ H ₂₀ O	2216-52-6	156.265	oi l	-22	211.7	0.897	1.4600 ²⁰	vs ace, Et OH
7410	5-Met hyl -2-i sopropyl cycl ohexanol , (+)-Isoment hol [1 <i>S</i> -(1 α ,2 β ,5 β)]-		C ₁₀ H ₂₀ O	23283-97-8	156.265	nd(di l al)	82.5	218			vs et h, Et OH
7411	5-Met hyl -2-i sopropyl cycl ohexanol acet at e, [1 <i>R</i> -(1 α ,2 α ,5 β)]		C ₁₂ H ₂₂ O ₂	2623-23-6	198.302			222; 109 ¹⁰	0.9244 ²⁰	1.4469 ²⁰	
7412	<i>ci s</i> -5-Met hyl -2-i sopropyl cycl ohexanone	Ment hone	C ₁₀ H ₁₈ O	491-07-6	154.249			205; 89 ¹⁵	0.8995 ²⁰	1.4527 ²⁰	
7413	<i>t rans</i> -5-Met hyl -2-i sopropyl cycl ohexanone, (Δ)	<i>t</i> -Ment hone	C ₁₀ H ₁₈ O	14073-97-3	154.249	li q	-6	207	0.8954	1.4505 ²⁰	sl H ₂ O; msc Et OH, et h, bz, C ₅ s ace
7414	1-Met hyl -4-i sopropyl cycl ohexene		₁₀ B ₁₈	5502-88-5	138.250			174.5	0.8457 ¹⁵	1.4735 ²⁰	



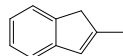
4-Met hyl -#-i mi dazole



N-Met hyl i mi nodi acatii d



1-Met hyl -#-i ndene



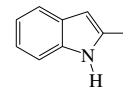
2-Met hyl -#-i ndene



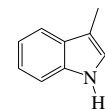
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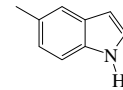
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2-Met hyl -#-i ndole



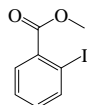
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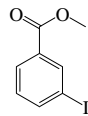
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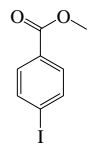
7-Met hyl -#-i ndole



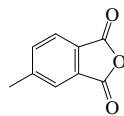
Met hyl 2-i odobenzoat e



Met hyl 3-i odobenzoat e



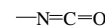
Met hyl 4-i odobenzoat e



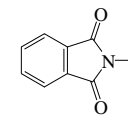
5-Met hyl -1,3-i sobenzof urandi one



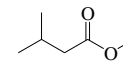
Met hyl i sobut anoat e



Met hyl i socyanat e

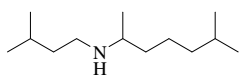


2-Met hyl -#-i soi ndole-1,3-d-ione

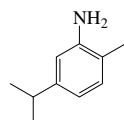


Met hyl i sopent anoat e

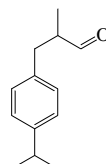
3-391



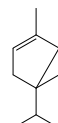
6-Met hyl -#-i sopent yl -2-hept anami ne



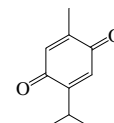
2-Met hyl -5-i sopropyl ani li ne



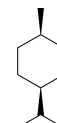
α -Met hyl -4-i sopropyl benzenepropanal



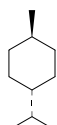
2-Met hyl -5-i sopropyl bi cycl o[3.1.0]hex-2-ene



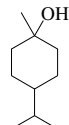
2-Met hyl -5-i sopropyl -2,5-cycl ohexadi ene-1,4-di one



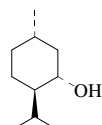
ci s 1-Met hyl -4-i sopropyl cycl ohexane



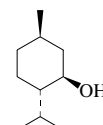
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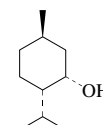
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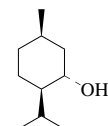
5-Met hyl -2-i sopropyl cycl ohexan[1*S*-(1 α ,2 β ,5 α)]-



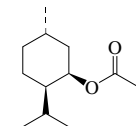
5-Met hyl -2-i sopropyl cycl ohexan[1*R*-(1 α ,2 β ,5 α)]-



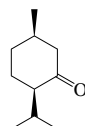
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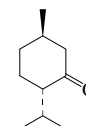
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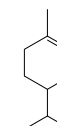
5-Met hyl -2-i sopropyl cycl ohexan[1*R*-(1 α ,2 α ,5 β)]-



ci s 5-Met hyl -2-i sopropyl cycl ohexanone

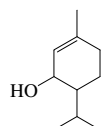


t rans 5-Met hyl -2-i sopropyl cycl ohexanone[2*S*]

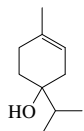


1-Met hyl -4-i sopropyl cycl ohexene

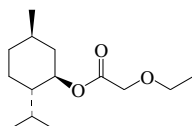
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7415	3-Met hyl -6-i sopropyl -2-cycl ohexen-1-ol		C ₁₀ H ₁₈ O	491-04-3	154.249			97 ^{15.5}	0.911 ²⁵	1.4729 ²⁵	
7416	4-Met hyl -1-i sopropyl -3-cycl ohexen-1-ol		C ₁₀ H ₁₈ O	562-74-3	154.249			209	0.926 ²⁰	1.4785 ¹⁹	
7417	5-Met hyl -2-i sopropyl cycl ohexyl et hoxycet at e, (4,2β,5α)		C ₁₄ H ₂₆ O ₃	579-94-2	242.354			155 ²⁰ , 144 ¹⁴	0.9545 ²⁰		vs et h, Et OH, chl
7418	1-Met hyl -4-i sopropyl -2-ni t robenzene		C ₁₀ H ₉ NO ₂	943-15-7	179.216			126 ¹⁰	1.0744 ²⁰	1.5301 ²⁰	vs et h, Et OH
7419	1-Met hyl -4-i sopropyl -7-oxabi cycl o[2.2.1]hept ane		C ₁₀ H ₁₈ O	470-67-7	154.249		1	173.5	0.8997 ²⁰	1.4562 ²⁰	sl H ₂ O; msc Et OH, et h; s bz, l i g
7420	1-Met hyl -7-i sopropyl phenant hrene	Ret ene	C ₁₈ H ₁₈	483-65-8	234.336			101	1.035 ²⁵		i H ₂ O; s Et OH, et h, bz, C ₆ S HOAc
7421	4-Met hyl -2-i sopropyl phenol		C ₁₀ H ₁₄ O	4427-56-9	150.217	nd (HOAc)	36.5	228.5	0.9910 ²⁰	1.5275 ²⁰	sl H ₂ O; s Et OH, bz, chl
7422	5-Met hyl -2-i sopropyl phenyl acet at e	Thymol, acet at e	C ₁₂ H ₁₆ O ₂	528-79-0	192.254			245	1.009 ⁹		vs bz, et h, Et OH, chl
7423	1-Met hyl i soqui nol i ne	Isoqui nal di ne	C ₁₀ H ₁₅ NC	1721-93-3	143.185		10	248	1.0777 ²⁰	1.6095 ²⁰	sl H ₂ O; s et h, ace, bz
7424	3-Met hyl i soqui nol i ne		C ₁₀ H ₁₅ N	1125-80-0	143.185	cry (et h)	68	249			sl H ₂ O, chl; s et h, ace
7425	Met hyl i sot hi ocyanat e		C ₂ H ₃ NS	556-61-6	73.117		36	119	1.0691 ³⁷	1.5258	sl H ₂ O; msc Et OH; vs et h
7426	5-Met hyl -3-i soxazol ami ne		C ₄ H ₅ N ₃ O	1072-67-9	98.103		62				
7427	4-Met hyl i soxazol e		C ₄ H ₅ NO	6454-84-8	83.089	l i q		127			
7428	5-Met hyl i soxazol e		C ₄ H ₅ NO	5765-44-6	83.089			122	1.023 ²⁰	1.4386 ²⁰	s DMSO
7429	Met hyl l act at e, (±)	Met hyl 2-hydroxypropanoat e, (±)	C ₃ H ₆ O ₃	2155-30-8	104.105	oi l		144.8	1.092 ⁸	1.4141 ²⁰	vs H ₂ O, Et OH, et h, Et OH
7430	Met hyl l i nol eat e		C ₁₀ H ₁₆ O ₃	112-63-0	294.472		-35	215 ²⁰	0.8886 ¹⁰	1.4638 ²⁰	vs et h, Et OH
7431	Met hyl l i nol enat e		C ₁₀ H ₁₆ O ₂	301-00-8	292.456		-45.5	207 ¹⁴ , 182 ³	0.895 ²⁵	1.4709 ²⁰	
7432	Met hyl magnesi um bromi de	Bromomet hyl magnesi um	C ₃ B ₂ H ₇	75-16-1	119.244						s et h, t hf; i hx, bz
7433	Met hyl magnesi um chl ori de	Chl oromet hyl magnesi um	C ₃ Cl ₂ H ₇	676-58-4	74.793	st ab i n t hf sol n					i pet h, bz
7434	Met hyl mal oni c aci d		C ₄ H ₄ O ₄	516-05-2	118.089	nd (bz-AcOEt)	135 dec pr (et h-bz)		1.455 ²⁰		vs H ₂ O, Et OH, et h; sl bz, t f a; s AcOEt
7435	Met hyl mercapt oacet at e		C ₃ H ₆ O ₂ S	2365-48-2	106.144			42 ¹⁰		1.4657 ²⁰	vs et h, Et OH
7436	Met hyl 3-mercapt opropanoat e		C ₄ H ₈ O ₂ S	2935-90-2	120.171			54 ¹⁴	1.085 ²⁵	1.4640 ²⁰	
7437	Met hyl mercuri c di cyanami de	1-Cyano-3-(met hyl mercuri o) guani di ne	C ₃ H ₃ HgN ₄	502-39-6	298.70		157				
7438	Met hyl met hacryl at e		C ₃ H ₄ O ₂	80-62-6	100.117	l i q	-47.55	100.5	0.937 ⁷	1.4142 ²⁰	sl H ₂ O; msc Et OH, et h, ace; s chl
7439	Met hyl met hanesul f onat e		C ₂ H ₄ O ₃ S	66-27-3	110.132		20	202.5	1.2943 ²⁰	1.4138 ²⁰	
7440	Met hyl met hoxycet at e		C ₄ H ₈ O ₃	6290-49-9	104.105			131	1.0511 ²⁰	1.3962 ²⁰	sl H ₂ O; vs Et OH, et h, ace
7441	Met hyl 2-met hoxybenzoat e		C ₈ H ₈ O ₃	606-45-1	166.173			246.5	1.1571 ¹⁹	1.534 ¹⁹	i H ₂ O; s Et OH
7442	Met hyl 3-met hoxybenzoat e		C ₈ H ₈ O ₃	5368-81-0	166.173			248	1.1310 ²⁰	1.5224 ²⁰	i H ₂ O; s Et OH
7443	Met hyl 4-met hoxybenzoat e		C ₈ H ₈ O ₃	121-98-2	166.173	l f (al or et h)	49	244			i OHs Et OH, et h, chl
7444	Met hyl 3-met hoxy-2-(met hyl ami no) Damasceni ne benzoat e		C ₁₀ H ₁₃ NO ₃	483-64-7	195.215	pr (al)	28	271; 147 ⁹			vs bz, et h, Et OH, l i g
7445	Met hyl 3-met hoxypropanoat e		C ₆ H ₁₀ O ₃	3852-09-3	118.131			142.8	1.0139 ¹⁵	1.4030 ²⁰	
7446	Met hyl 2-met hyl acet oacet at e		C ₈ H ₁₄ O ₃	17094-21-2	130.141			177.4	1.0217 ²⁵	1.416 ²⁴	vs et h, Et OH
7447	Met hyl 2-(met hyl ami no)benzoat e		C ₈ H ₉ NO ₂	85-91-6	165.189	cry (pet h)	19	255	1.120 ⁵	1.5839 ¹⁵	i H ₂ O; s Et OH, et h
7448	Met hyl 2-met hyl benzoat e		C ₈ H ₉ O ₂	89-71-4	150.174		<-50	215	1.068 ²⁰		i H ₂ O; msc Et OH, et h
7449	Met hyl 3-met hyl benzoat e		C ₈ H ₉ O ₂	99-36-5	150.174			221	1.061 ²⁰		i H ₂ O; s Et OH; sl ct c
7450	Met hyl 4-met hyl benzoat e		C ₈ H ₉ O ₂	99-75-2	150.174	cry (aq MeOH, pet h)	33.2	220			i H ₂ O; vs Et OH, et h
7451	Met hyl 2-met hyl -2-but enoat e, (		C ₈ H ₁₀ O ₂	6622-76-0	114.142			139	0.9349 ¹²	1.4370 ²⁰	
7452	Met hyl 3-met hyl -2-but enoat e		C ₈ H ₁₀ O ₂	924-50-5	114.142		114	136.5	0.9337 ²⁰	1.432 ²⁰	
7453	3-Met hyl -4-met hyl enehexane		C ₈ H ₁₆	3404-67-9	112.213			112.5	0.725 ²⁵	1.4142 ²⁰	



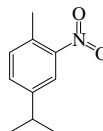
3-Met hyl -6-i sopropyl -2-cycl ohexen-1-ol



4-Met hyl -1-i sopropyl -3-cycl ohexen-1-ol



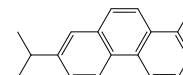
5-Met hyl -2-i sopropyl cycl ohexylhoxyacet at (α,2β,5α)



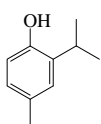
1-Met hyl -4-i sopropyl -2-ni t robenzene



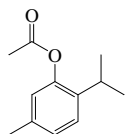
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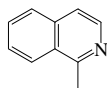
1-Met hyl -7-i sopropyl phenant hrene



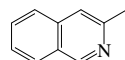
4-Met hyl -2-i sopropyl phenol



5-Met hyl -2-i sopropyl phenylacet at e



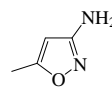
1-Met hyl i soqui nol i ne



3-Met hyl i soqui nol i ne



Met hyl i sot hi ocyanat e



5-Met hyl -3-i soxazol ami ne



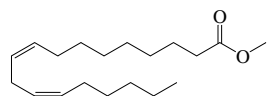
4-Met hyl i soxazol e



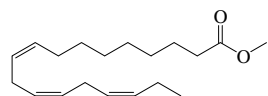
5-Met hyl i soxazol e



Met hyl lact at (±)



Met hyl i nol eat e



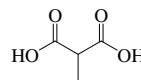
Met hyl i nol eat e



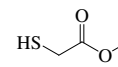
Met hyl magnesi umbromi de



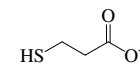
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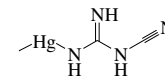
Met hyl mal oniaci d



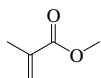
Met hyl mercapt oacet at e



Met hyl3-mercapt opropanoat e



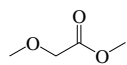
Met hyl mercuri di cyanami de



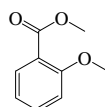
Met hylmet hacryl at e



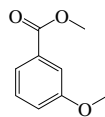
Met hylmet hanesul f onat e



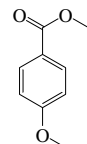
Met hylmet hoxyacet at e



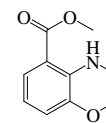
Met hyl2-met hoxybenzoat e



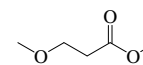
Met hyl3-met hoxybenzoat



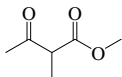
Met hyl4-met hoxybenzoat e



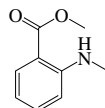
Met hyl3-met hoxy-2-(met hyl ami no)benzoat e



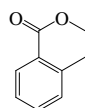
Met hyl3-met hoxypropanoat e



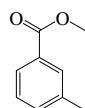
Met hyl2-met hyl acet oacet at e



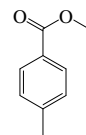
Met hyl2-(met hyl ami no)benzoat e



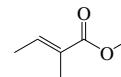
Met hyl2-met hyl benzoat e



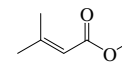
Met hyl3-met hyl benzoat e



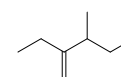
Met hyl4-met hyl benzoat e



Met hyl2-met hyl -2-but enoat (±)

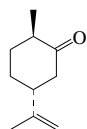


Met hyl3-met hyl -2-but enoat e

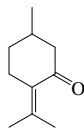


3-Met hyl -4-met hyl enehexane

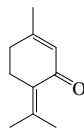
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7454	2-Met hyl -5-(1-met hyl et henyl) cycl ohexanone, (2 <i>P</i> - <i>t</i> ranž)		C ₁₀ H ₁₆ O	5524-05-0	152.233			221.5	0.928 ¹⁹	1.4724	vs ace, et h
7455	5-Met hyl -2-(1-met hyl et hyl i dene) cycl ohexanone		C ₁₀ H ₁₆ O	15932-80-6	152.233			93 ¹⁰	0.9367 ²⁰	1.4869 ²⁰	
7456	3-Met hyl -6-(1-met hyl et hyl i dene)-2-Pi peri t enone cycl ohexen-1-one		C ₁₀ H ₁₄ O	491-09-8	150.217			120 ¹⁴	0.9774 ²⁰	1.5294 ²⁰	vs Et OH, et h
7457	1-Met hyl -4-(5-met hyl -1-met hyl ene- 4-hexenyl) cycl ohexene, (S)		C ₁₅ H ₂₄	495-61-4	204.352			129 ¹⁰	0.8673 ²⁰	1.4880 ²⁰	
7458	<i>N</i> -Met hyl <i>N</i> -(2-met hyl phenyl) acet ami de		C ₁₀ H ₁₃ NO	573-26-2	163.216		55.5	260			s Et OH, chl
7459	4-Met hyl <i>N</i> -(4-met hyl phenyl) ani li ne		C ₁₄ H ₁₅ N	620-93-9	197.276	nd (pet h)	79.8	330.5			vs et h, pet h
7460	2-Met hyl -3-(2-met hyl phenyl)-4-β qui nazol i none	Met haqual one	C ₆ H ₁₄ N ₂ O	72-44-6	250.294		120				vs et h, Et OH, chl
7461	Met hyl 3-(met hyl t hi o)propanoat e sul fide	2-Met hoxycarbonyl et hyl met hyl	C ₅ H ₁₀ O ₂ S	13532-18-8	134.197			75 ¹³ , 69 ¹¹	1.077 ²⁵	1.4650 ²⁰	
7462	1-Met hyl -4-(1-met hyl vi nyl)benzene		C ₁₀ H ₁₂	1195-32-0	132.202	li q	-20	185.3	0.893 ⁶	1.5283 ²³	
7463	1-Met hyl -4-(1-met hyl vi nyl) cycl ohexanol	β-Terpi neol	C ₆ H ₁₆ O	138-87-4	154.249	nd	32.5	210; 90 ¹⁰	0.917 ²⁰	1.4747 ²⁰	
7464	5-Met hyl -2-(1-met hyl vi nyl) cycl ohexanol, [β-(1α,2β,5α)]		C ₁₀ H ₁₈ O	89-79-2	154.249		78	93 ¹⁴	0.911 ²⁰	1.4723 ²⁰	sl H ₂ O; s Et OH, et h
7465	5-Met hyl -2-(1-met hyl vi nyl) cycl ohexanol acet at e, β (1α,2β,5α)]		C ₁₂ H ₂₀ O ₂	57576-09-7	196.286		85	113 ⁸	0.925 ²⁵	1.4566 ²⁰	
7466	<i>t</i> rans-5-Met hyl -2-(1-met hyl vi nyl) cycl ohexanone		C ₁₀ H ₁₆ O	29606-79-9	152.233			100 ¹⁸	0.9198 ²⁰	1.4675 ²⁰	
7467	2-Met hyl -5-(1-met hyl vi nyl)-2- cycl ohexen-1-ol		C ₁₀ H ₁₆ O	99-48-9	152.233			228	0.9484 ²⁵	1.4942 ²⁵	
7468	4-Met hyl morphol i ne		C ₄ H ₉ NO	109-02-4	101.147	li q	-64.40	116	0.905 ⁹	1.4332 ²⁰	s H ₂ O, Et OH, et h
7469	α-Met hyl -4-morphol i neet hanol		C ₇ H ₁₃ NO ₂	2109-66-2	145.200			121 ¹⁸ , 93 ¹³	1.0174 ²⁰	1.4638 ²⁰	vs H ₂ O, ace, bz, Et OH
7470	1-Met hyl napt hal ene		C ₁₀ H ₁₀	90-12-0	142.197	li q	-30.43	244.7	1.020 ²	1.6170 ²⁰	i H ₂ O; vs Et OH, et h; s bz
7471	2-Met hyl napt hal ene		C ₁₀ H ₁₀	91-57-6	142.197	mcl (al)	34.6	241.1	1.0058 ⁹	1.6015 ⁴⁰	i H ₂ O; vs Et OH, et h; s bz, chl
7472	Met hyl 1-napt hal enecarboxyl at e	Met hyl 1-napt hoat e	C ₁₂ H ₁₀ O ₂	2459-24-7	186.206		59.5	168 ²⁰ , 101 ^{0.04}	1.1290 ²⁰	1.6086 ²⁰	vs bz, Et OH
7473	Met hyl 2-napt hal enecarboxyl at e	Met hyl 2-napt hoat e	C ₁₂ H ₁₀ O ₂	2459-25-8	186.206	lf (MeOH)	77	290			vs bz, et h, Et OH, chl
7474	2-Met hyl -1,4-napt hal enedi ol di acet at e	Menadi ol di acet at e	C ₁₅ H ₁₄ O ₄	573-20-6	258.270	pr (al)	113				vs Et OH
7475	2-Met hyl -1,4-napt hal enedi one	Menadi one	C ₁₁ H ₁₀ O ₂	58-27-5	172.181	ye nd (al, pet h)	107				i H ₂ O; sl Et OH, HOAc; s et h, bz, chl
7476	Met hyl -1-napt hyl ami ne	<i>N</i> -Met hyl -1-napt hal enami ne	C ₁₁ H ₁₇ N	2216-68-4	157.212	oi l	174	294.5		1.672 ²	vs et h, Et OH
7477	Met hyl ni t rat e		C ₃ O ₃	598-58-3	77.040	exp gas	-83.0	exp 64.6	1.2075 ²⁰	1.3748 ²⁰	sl H ₂ O; s Et OH, et h
7478	Met hyl ni t ri t e		C ₃ N ₃	624-91-9	61.041	ye gas	-16	-12	0.991 ¹⁵		s Et OH, et h
7479	Met hyl ni t roacet at e		C ₃ H ₅ NO ₂	2483-57-0	119.077			107 ²⁸	1.320 ⁰		
7480	2-Met hyl -3-ni t roani li ne		C ₇ H ₉ NO ₂	603-83-8	152.151	ye ort h nd (w), ye lf (al)	92	305	1.3780 ¹⁵		sl H ₂ O; s Et OH, et h, bz, chl
7481	2-Met hyl -4-ni t roani li ne		C ₇ H ₉ NO ₂	99-52-5	152.151		133.5		1.1586 ¹⁴⁰		sl H ₂ O, DMSO; s Et OH, bz, HOAc
7482	2-Met hyl -5-ni t roani li ne		C ₇ H ₉ NO ₂	99-55-8	152.151		105.5				sl H ₂ O; s Et OH, et h, ace, bz, chl
7483	2-Met hyl -6-ni t roani li ne		C ₇ H ₉ NO ₂	570-24-1	152.151		96		1.1900 ¹⁰⁰		sl H ₂ O; s Et OH, et h, bz, chl
7484	4-Met hyl -2-ni t roani li ne		C ₇ H ₉ NO ₂	89-62-3	152.151		116.3		1.161 ²¹		sl H ₂ O; s Et OH, chl
7485	4-Met hyl -3-ni t roani li ne		C ₇ H ₉ NO ₂	119-32-4	152.151		79.8				sl H ₂ O, CS ₂ ; s Et OH, et h, bz



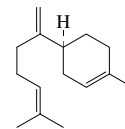
2-Met hyl-5-(1-met hyl et heryl)cycl ohexanone (trans)



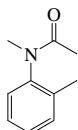
5-Met hyl-2-(1-met hyl et hyl i dene)cycl ohexanone



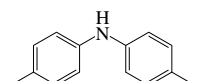
3-Met hyl-6-(1-met hyl et hyl i dene)-2-cycl ohexen-1-one



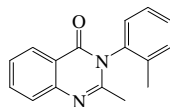
1-Met hyl-4-(5-met hyl-1-met hyl ene-4-hexenyl)cycl ohexane



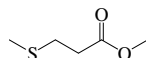
N-Met hyl N-(2-met hyl phenyl)acet ami de



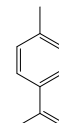
4-Met hyl N-(4-met hyl phenyl)ani li ne



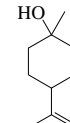
2-Met hyl-3-(2-met hyl phenyl)-4-qui nazol i none



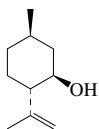
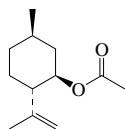
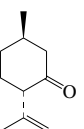
Met hyl 3-(met hyl t hi o)propanoat e



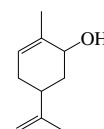
1-Met hyl-4-(1-met hyl vi nyl)benzene



1-Met hyl-4-(1-met hyl vi nyl)cycl ohexanol

5-Met hyl-2-(1-met hyl vi nyl)cycl ohexanol (1 α ,2 β ,5 α)5-Met hyl-2-(1-met hyl vi nyl)cycl ohexanone (1 α ,2 β ,5 α)

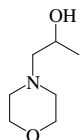
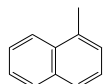
trans 5-Met hyl-2-(1-met hyl vi nyl)cycl ohexanone



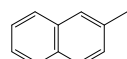
2-Met hyl-5-(1-met hyl vi nyl)-2-cycl ohexen-1-ol



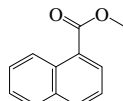
4-Met hyl morphol i ne

 α -Met hyl-4-morphol i neet hanol

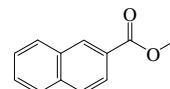
1-Met hyl napt hal ene



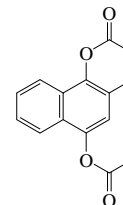
2-Met hyl napt hal ene



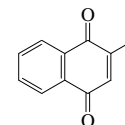
Met hyl 1-napt hal enecarboxyl at e



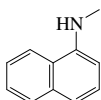
Met hyl 2-napt hal enecarboxyl at e



2-Met hyl-1,4-napt hal enediolacet at



2-Met hyl-1,4-napt hal enedi one



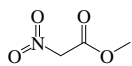
Met hyl-1-napt hyl ami ne



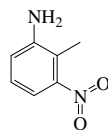
Met hyl ni t rat e



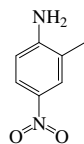
Met hyl ni t ri t e



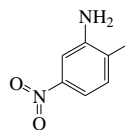
Met hyl ni t roacet at e



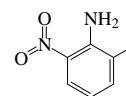
2-Met hyl-3-ni t roani li ne



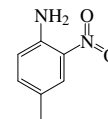
2-Met hyl-4-ni t roani li ne



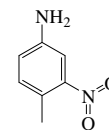
2-Met hyl-5-ni t roani li ne



2-Met hyl-6-ni t roani li ne

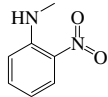


4-Met hyl-2-ni t roani li ne

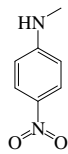


4-Met hyl-3-ni t roani li ne

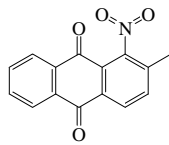
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7486	<i>N</i> -Met hyl -2-ni t roani li ne		$\text{C}_7\text{H}_9\text{NO}_2$	612-28-2	152.151	red or oran nd (pet h)	38	158 ¹⁸			sl H_2O , li g; s Et OH, et h, ace, bz
7487	<i>N</i> -Met hyl -4-ni t roani li ne		$\text{C}_7\text{H}_9\text{NO}_2$	100-15-2	152.151	br-ye pr (al) cry (et h)	152	dec	1.201 ¹⁵⁵		i H_2O ; s Et OH, bz, chl; sl et h, li g
7488	2-Met hyl -1-ni t ro-9,10-ant hracenedi one		$\text{C}_{15}\text{H}_9\text{NO}_4$	129-15-7	267.237	pa ye nd (HOAc)	273.0				i H_2O , Et OH; sl et h, bz, chl; s PhNO_2
7489	2-Met hyl -5-ni t robenzenesul f oni c aci d		$\text{C}_7\text{H}_7\text{NO}_5\text{S}$	121-03-9	217.200		135.8				vs H_2O , Et OH, et h, chl
7490	Met hyl 2-ni t robenzoat e		$\text{C}_8\text{H}_7\text{NO}_4$	606-27-9	181.147	li q	-13	275	1.285 ⁵⁹		i H_2O ; s Et OH, et h, bz, chl; i li g
7491	Met hyl 3-ni t robenzoat e		$\text{C}_8\text{H}_7\text{NO}_4$	618-95-1	181.147		78	279 ⁶⁰			i H_2O ; sl Et OH, et h, MeOH
7492	Met hyl 4-ni t robenzoat e		$\text{C}_8\text{H}_7\text{NO}_4$	619-50-1	181.147		96				i H_2O ; s Et OH, et h, chl
7493	2-Met hyl -4-ni t ro β -ni mi dazol e		$\text{C}_8\text{H}_8\text{N}_2\text{O}_2$	696-23-1	127.102		253				
7494	<i>N</i> -Met hyl <i>N</i> -ni t romet hanami ne		$\text{C}_7\text{H}_9\text{N}_3\text{O}_2$	4164-28-7	90.081	nd(et h)	58	187	1.109 ⁰⁷	1.446 ²⁷²	vs H_2O , ace, et h, Et OH
7495	2-Met hyl -1-ni t ronapht hal ene		$\text{C}_{11}\text{H}_9\text{NO}_2$	881-03-8	187.195	ye pr or nd (al)	81.5	188 ⁹⁰			i H_2O ; s Et OH; vs ace
7496	<i>N</i> -Met hyl <i>N</i> '-ni t ro β -ni t rosoquani di ne		$\text{C}_2\text{H}_2\text{N}_2\text{O}_3$	70-25-7	147.093						s DMSO
7497	3-Met hyl -4-ni t rophenol		$\text{C}_9\text{H}_9\text{NO}_3$	2581-34-2	153.136	nd or pr (w)	129				sl H_2O ; s Et OH, et h, bz, chl
7498	4-Met hyl -2-ni t rophenol		$\text{C}_9\text{H}_9\text{NO}_3$	119-33-5	153.136	ye nd (al, w)	36.5	125 ²	1.2399 ²⁰	1.5744 ⁴⁰	vs ace, bz, et h, Et OH
7499	1-Met hyl -2-(4-ni t rophenoxy)benzene	2-Met hyl phenyl 4-ni t rophenyl et her	$\text{C}_{11}\text{H}_{11}\text{NO}_3$	2444-29-3	229.231	ye cry (pet h)		220 ⁷			vs bz, et h, Et OH
7500	2-Met hyl -2-ni t ro-1,3-propanedi ol		$\text{C}_8\text{H}_{11}\text{NO}_4$	77-49-6	135.119	mcl	150.1	dec			vs H_2O , Et OH; sl DMSO
7501	2-Met hyl -2-ni t ro-1-propanol		$\text{C}_8\text{H}_9\text{NO}_3$	76-39-1	119.119	nd or pl (MeOH)	89.5	94 ¹⁰			sl H_2O ; vs Et OH, et h; s chl
7502	3-Met hyl -4-ni t roqui nol <i>N</i> -ni t roxi de		$\text{C}_9\text{H}_9\text{N}_2\text{O}_3$	14073-00-8	204.182	cry (MeOH)	179				
7503	<i>N</i> -Met hyl <i>N</i> -ni t rosoani li ne		$\text{C}_7\text{H}_9\text{N}_2\text{O}$	614-00-6	136.151	ye cry	14.7	dec 225; 121 ¹³	1.1240 ²⁰	1.5769 ²⁰	i H_2O ; s Et OH, et h
7504	<i>N</i> -met hyl <i>N</i> -ni t rosourea	<i>N</i> -Ni t ro β -met hyl urea	$\text{CH}_3\text{N}_3\text{O}_2$	684-93-5	103.080	col or ye pl (et h)	123 dec				sl H_2O , Et OH, et h
7505	Met hyl nonadecanoat e		$\text{C}_{29}\text{H}_{58}\text{O}_2$	1731-94-8	312.531		41.3	190 ⁴			
7506	2-Met hyl nonane		$\text{C}_{10}\text{H}_{22}$	871-83-0	142.282	li q	-74.6	167.1	0.728 ⁹	1.4099 ²⁰	i H_2O ; s et h, bz, chl
7507	3-Met hyl nonane		$\text{C}_{10}\text{H}_{22}$	5911-04-6	142.282	li q	-84.8	167.9	0.735 ⁴	1.4125 ²⁰	vs bz, et h, chl
7508	4-Met hyl nonane		$\text{C}_{10}\text{H}_{22}$	17301-94-9	142.282	li q	-99	165.7	0.732 ⁹	1.4123 ²⁰	vs bz, et h, chl
7509	5-Met hyl nonane		$\text{C}_{10}\text{H}_{22}$	15869-85-9	142.282	li q	-87.7	165.1	0.732 ⁶	1.4116 ²⁰	i H_2O ; s et h, bz, chl
7510	Met hyl nonanoat e		$\text{C}_{10}\text{H}_{20}\text{O}_2$	1731-84-6	172.265			213.5	0.8799 ¹⁵	1.4214 ²⁰	i H_2O ; s Et OH, et h; sl ct c
7511	8-Met hyl -1-nonanol		$\text{C}_{10}\text{H}_{22}\text{O}$	55505-26-5	158.281			108 ¹⁰			
7512	2-Met hyl -1-nonene		$\text{C}_{10}\text{H}_{20}$	2980-71-4	140.266	li q	-64.2	168.4	0.741 ²	1.4241 ²⁰	
7513	2-Met hyl -2-norbornene	2-Met hyl bi cycl o[2.2.1]hept -2-ene	C_8H_{14}	694-92-8	108.181	li q		122			
7514	Met hyl <i>rans</i> -9-oct adecenoat e		$\text{C}_{18}\text{H}_{36}\text{O}_2$	1937-62-8	296.488		13.5	218 ²⁴	0.8730 ²⁰	1.4513 ²⁰	vs et h, Et OH
7515	2-Met hyl oct ane		$\text{C}_{10}\text{H}_{22}$	3221-61-2	128.255	li q	-80.3	143.2	0.709 ⁵	1.4031 ²⁰	i H_2O ; s Et OH, et h; sl ct c; vs pet h
7516	3-Met hyl oct ane		$\text{C}_{10}\text{H}_{22}$	2216-33-3	128.255	li q	-107.6	144.2	0.71 ⁷	1.4040 ²⁵	
7517	4-Met hyl oct ane		$\text{C}_{10}\text{H}_{22}$	2216-34-4	128.255	li q	-113.3	142.4	0.71 ⁶	1.4039 ²⁵	i H_2O
7518	Met hyl oct anoat e	Met hyl caprylat e	$\text{C}_{18}\text{H}_{36}\text{O}_2$	111-11-5	158.238	li q	-40	192.9	0.877 ⁵	1.4170 ²⁰	i H_2O ; vs Et OH, et h; sl ct c
7519	2-Met hyl oct anoi c aci d		$\text{C}_{10}\text{H}_{18}\text{O}_2$	3004-93-1	158.238			138 ¹⁴ , 88 ⁴		1.4281 ²⁵	
7520	2-Met hyl -2-oct anol		$\text{C}_{10}\text{H}_{20}\text{O}$	628-44-4	144.254			178	0.8210 ²⁰	1.4280 ²⁰	i H_2O ; s Et OH, et h
7521	3-Met hyl -3-oct anol		$\text{C}_{10}\text{H}_{20}\text{O}$	5340-36-3	144.254			83 ¹⁸ , 36 ³	0.8108 ²⁵	1.4257 ²⁵	
7522	5-Met hyl -2-oct anone		$\text{C}_{10}\text{H}_{18}\text{O}$	58654-67-4	142.238			101 ⁵⁰			
7523	2-Met hyl -1-oct ene		$\text{C}_{10}\text{H}_{18}$	4588-18-5	126.239	li q	-77.8	144.8	0.734 ³	1.4184 ²⁰	
7524	7-Met hyl -1-oct ene		$\text{C}_{10}\text{H}_{18}$	13151-06-9	126.239	li q		138.9			
7525	Met hyl oct yl ami ne	<i>N</i> -Met hyl -1-oct anami ne	$\text{C}_{11}\text{H}_{23}\text{N}$	2439-54-5	143.270			68 ⁵			



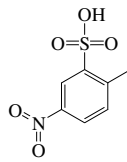
N-Met hyl-2-ni t roani li ne



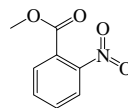
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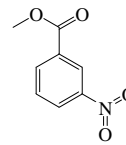
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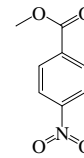
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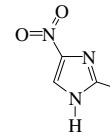
Met hyl2-ni t robenzoat e



Met hyl3-ni t robenzoat e



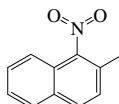
Met hyl4-ni t robenzoat e



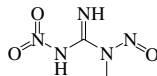
2-Met hyl-4-ni t rōHl mi dazol e



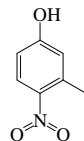
N-Met hylA- ni t romet hanami ne



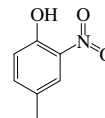
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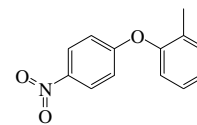
N-Met hylA'-ni t rōA-ni t rosoguani di ne



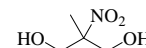
3-Met hyl-4-ni t rophenol



4-Met hyl-2-ni t rophenol



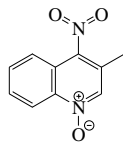
1-Met hyl-2-(4-ni t rophenoxy)benzene



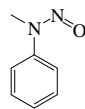
2-Met hyl-2-ni t ro-1,3-propanedi ol



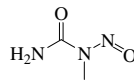
2-Met hyl-2-ni t ro-1-propanol



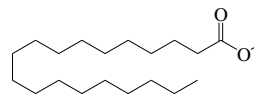
3-Met hyl-4-ni t roqui nolA- ni d e



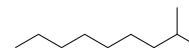
N-Met hylA- ni t rosoani li ne



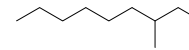
N-met hylA- ni t rosurea



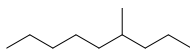
Met hylnonadecanoat e



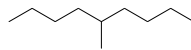
2-Met hyl nonane



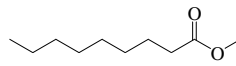
3-Met hyl nonane



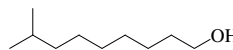
4-Met hyl nonane



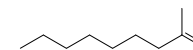
5-Met hyl nonane



Met hylnonanoat e



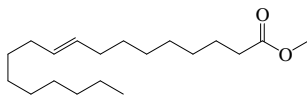
8-Met hyl-1-nonanol



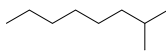
2-Met hyl-1-nonene



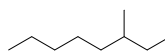
2-Met hyl-2-norborneni



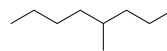
Met hyl stear9-oct adecenoat e



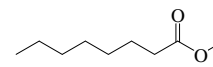
2-Met hyl oct ane



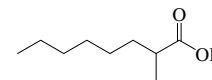
3-Met hyl oct ane



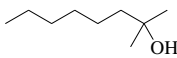
4-Met hyl oct ane



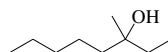
Met hyl oct anoat e



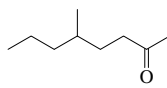
2-Met hyl oct anoāci d



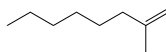
2-Met hyl-2-oct anol



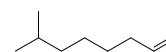
3-Met hyl-3-oct anol



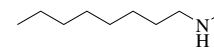
5-Met hyl-2-oct anone



2-Met hyl-1-oct ene

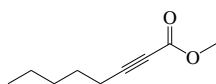


7-Met hyl-1-oct ene

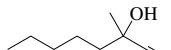


Met hyl oct yl ami ne

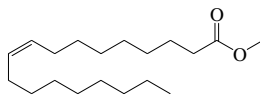
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7526	Met hyl 2-oct ynoat e		$\text{C}_8\text{H}_{14}\text{O}_2$	111-12-6	154.206			217; 107 ²⁰	0.926 ²⁰	1.4464 ²⁰	
7527	3-Met hyl -1-oct yn-3-ol		$\text{C}_8\text{H}_{16}\text{O}$	23580-51-0	140.222			174; 75 ¹⁰	0.8547 ²⁰	1.443 ¹⁰	
7528	Met hyl ol eat e		$\text{C}_8\text{H}_{16}\text{O}_2$	112-62-9	296.488		-19.9	218.5 ²⁰	0.8739 ²⁰	1.4522 ²⁰	i H ₂ O; msc Et OH, et h; s chl
7529	Met hyl Orange	Sodi urp- di met hyl ami noazobenzenesul fonat e	$\text{C}_{14}\text{H}_{14}\text{N}_3\text{NaO}_3\text{S}$	547-58-0	327.334	oran, ye pl or sc (w)	dec				sl H ₂ O, Et OH, py; i et h
7530	2-Met hyl oxazol e		$\text{C}_4\text{H}_8\text{N}_2\text{O}$	23012-10-4	83.089	li q		87.5			
7531	4-Met hyl oxazol e		$\text{C}_4\text{H}_8\text{N}_2\text{O}$	693-93-6	83.089			88	1.015 ²⁵	1.4317 ²⁰	
7532	5-Met hyl oxazol e		$\text{C}_4\text{H}_8\text{N}_2\text{O}$	66333-88-8	83.089	li q		88			
7533	2-Met hyl -2-oxazol i ne		$\text{C}_4\text{H}_6\text{N}_2\text{O}$	1120-64-5	85.105			111	1.005 ²⁵	1.4340 ²⁰	
7534	2-Met hyl oxet ane		$\text{C}_4\text{H}_8\text{O}$	2167-39-7	72.106	hyg		59	0.841 ²⁵	1.3885 ²⁰	
7535	4-Met hyl -2-oxet anone	3-Hydroxybut yri c aci d lact one	$\text{C}_4\text{H}_6\text{O}_3$	3068-88-0	86.090			86 ⁵⁰ , 57 ⁹	1.0555 ²⁰		
7536	Met hyl oxir ane	1,2-Propyl ene ox i de	$\text{C}_3\text{H}_6\text{O}$	16033-71-9	58.079	li q	-111.9	35	0.859	1.3660 ²⁰	vs H ₂ O, Et OH, et h; s chl
7537	3-Met hyl -2-oxobut anoi c aci d		$\text{C}_4\text{H}_6\text{O}_3$	759-05-7	116.116		31.5	170.5	0.9968 ²⁰	1.3850 ¹⁶	s H ₂ O, Et OH, et h
7538	<i>N</i> -Met hyl <i>N</i> -(1-oxododecyl)gl yci ne	<i>N</i> -Dodecanoyl sarcosi ne	$\text{C}_{13}\text{H}_{29}\text{NO}_3$	97-78-9	271.396		44.5				s chl
7539	Met hyl 4-oxopent anoat e	Met hyl levul i nat e	$\text{C}_5\text{H}_{10}\text{O}_3$	624-45-3	130.141			196	1.0511 ²⁰	1.4233 ²⁰	sl H ₂ O; s Et OH, ace, bz, ct c; msc et h
7540	4-Met hyl -2-oxopent anoi c aci d		$\text{C}_5\text{H}_8\text{O}_3$	816-66-0	130.141	li q	10	84			
7541	Met hyl 2-oxopropanoat e	Met hyl pyruvat e	$\text{C}_3\text{H}_4\text{O}_3$	600-22-6	102.089			135.5	1.154 ⁰	1.4046 ²⁵	sl H ₂ O; s ace; msc Et OH, et h
7542	Met hyl pal mi t at e	Met hyl hexadecanoat e	$\text{C}_{17}\text{H}_{34}\text{O}_2$	112-39-0	270.451		30	417; 148 ²	0.8247 ⁷⁵		i H ₂ O; vs Et OH, ace, bz; s et h
7543	Met hyl parat hi on		$\text{C}_8\text{H}_{16}\text{N}_2\text{O}_2\text{PS}$	298-00-0	263.208	cry	38		1.358 ²⁰	1.5367 ²⁵	i H ₂ O; s os
7544	Met hyl pent achl orophenyl sul fide	<i>S</i> -Met hyl pent achl orobenzenet hi ol	$\text{C}_5\text{H}_3\text{Cl}_5\text{S}$	1825-19-0	296.429	cry (Et OH)	95.5				
7545	Met hyl pent adecanoat e		$\text{C}_{15}\text{H}_{30}\text{O}_2$	7132-64-1	256.424	nd (di l al)	18.5	153.5	0.861 ⁸	1.4390 ²⁵	s Et OH, et h
7546	<i>ci s</i> -2-Met hyl -1,3-pent adi ene		C_5H_{10}	1501-60-6	82.143	li q	-117.6	75.8	0.714 ⁴	1.446 ²⁰	
7547	3-Met hyl -1,3-pent adi ene		C_5H_{10}	4549-74-0	82.143			77	0.730 ²⁵	1.452 ²⁰	
7548	4-Met hyl -1,3-pent adi ene	1,1-Di met hyl -1,3-but adi ene	C_5H_{10}	926-56-7	82.143			76.5	0.7181 ²⁰	1.4532 ²⁰	
7549	Met hyl pent affluoroet hyl et her	1-Met hoxyperfluoroet hane	$\text{C}_5\text{H}_3\text{F}_5\text{O}$	22410-44-2	150.047	col gas		5.59			
7550	Met hyl pent affluoropropanoat e		$\text{C}_5\text{H}_3\text{F}_5\text{O}_2$	378-75-6	178.058			59.5	1.390 ²⁵	1.2869 ²⁵	
7551	2-Met hyl pent anal	2-Met hyl val eral dehyde	$\text{C}_5\text{H}_{10}\text{O}$	123-15-9	100.158			117			s H ₂ O; s et h, ace; sl ct c
7552	2-Met hyl pent ane	Isohexane	C_6H_{14}	107-83-5	86.175	li q	-153.6	60.26	0.65 ⁸	1.3715 ²⁰	i H ₂ O; s Et OH, et h; msc ace, bz, chl
7553	3-Met hyl pent ane		C_6H_{14}	96-14-0	86.175	li q	-162.90	63.27	0.659 ⁸	1.3765 ²⁰	i H ₂ O; s Et OH, ct c; msc et h, ace, bz, hp
7554	2-Met hyl pent anedi ni t ri le	2-Met hyl gl ut aroni t ri le	$\text{C}_6\text{H}_{10}\text{N}_2$	4553-62-2	108.141	li q	-45	270; 134 ⁴	0.950	1.4340 ²⁰	s H ₂ O
7555	2-Met hyl -2,4-pent anedi ol	Hexyl ene gl ycol	$\text{C}_6\text{H}_{14}\text{O}_2$	107-41-5	118.174	li q	-50	197.1	0.92 ³	1.4276 ²⁰	s H ₂ O, Et OH, et h; sl ct c
7556	4-Met hyl pent aneni t ri le	Isopent yl cyani de	$\text{C}_6\text{H}_{11}\text{NC}$	542-54-1	97.158	li q	-51	156.5	0.803 ⁰	1.4059 ²⁰	i H ₂ O; s Et OH; msc et h; sl ct c
7557	2-Met hyl -2-pent anet hi ol		$\text{C}_6\text{H}_{14}\text{O}_2$	1633-97-2	118.240	li q		125.0; 3 ⁸			
7558	Met hyl pent anoat e	Met hyl val erat e	$\text{C}_6\text{H}_{12}\text{O}_2$	624-24-8	116.158			127.4	0.8947 ²⁰	1.4003 ²⁰	sl H ₂ O, ct c; msc Et OH, et h; s ace
7559	2-Met hyl pent anoi c aci d, (±)		$\text{C}_6\text{H}_{10}\text{O}_2$	22160-39-0	116.158			195.6	0.9230 ²⁰	1.413 ²⁰	s H ₂ O, Et OH, et h; sl ct c
7560	3-Met hyl pent anoi c aci d, (±)		$\text{C}_6\text{H}_{10}\text{O}_2$	22160-40-3	116.158	li q	-41.6	197.5	0.926 ²	1.4159 ²⁰	vs et h, Et OH
7561	4-Met hyl pent anoi c aci d		$\text{C}_6\text{H}_{10}\text{O}_2$	646-07-1	116.158	li q	-33	200.5	0.922 ⁵	1.4144 ²⁰	sl H ₂ O; s Et OH, et h, chl
7562	2-Met hyl -1-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	105-30-6	102.174			149	0.8263 ²⁰	1.4182 ²⁰	sl H ₂ O; s Et OH, et h, ace, ct c
7563	3-Met hyl -1-pent anol, (±)		$\text{C}_6\text{H}_{14}\text{O}$	20281-83-8	102.174			153	0.8242 ²⁰	1.4112 ²³	i H ₂ O; s Et OH, et h
7564	4-Met hyl -1-pent anol	Isohexyl al cohol	$\text{C}_6\text{H}_{14}\text{O}$	626-89-1	102.174			151.9	0.8131 ²⁰	1.4134 ²⁵	i H ₂ O; s Et OH, et h
7565	2-Met hyl -2-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	590-36-3	102.174	li q	-103	121.1	0.835 ⁰	1.4100 ²⁰	sl H ₂ O; s Et OH, et h
7566	3-Met hyl -2-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	565-60-6	102.174			134.3	0.8307 ²⁰	1.4182 ²⁰	sl H ₂ O; s Et OH, et h
7567	4-Met hyl -2-pent anol		$\text{C}_6\text{H}_{14}\text{O}$	108-11-2	102.174	li q	-90	131.6	0.807 ⁹	1.4100 ²⁰	sl H ₂ O, ct c; s Et OH, et h



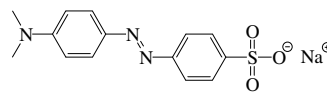
Met hyl2-oct ynoat e



3-Met hyl -1-oct yn-3-ol



Met hyl ol eat e



Met hyl Orange



2-Met hyl oxazol e



4-Met hyl oxazol e



5-Met hyl oxazol e



2-Met hyl -2-oxazol i ne



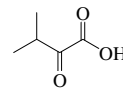
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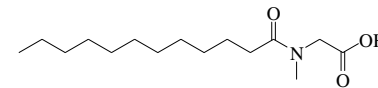
4-Met hyl -2-oxet anone



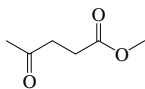
Met hyl oxi rane



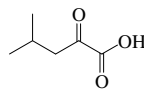
3-Met hyl -2-oxobut anoici d



N-Met hyl N-(1-oxododecyl)gl yci ne



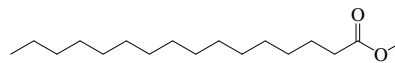
Met hyl 4-oxopent anoat e



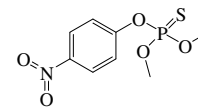
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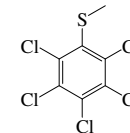
Met hyl 2-oxopropanoat e



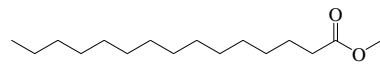
Met hyl pal mi t at e



Met hyl parat hi on



Met hyl pent achl oropheny sul f i de



Met hyl pent adecanoat e



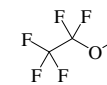
ci s 2-Met hyl -1,3-pent adi e



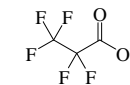
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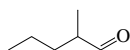
4-Met hyl -1,3-pent adi ene



Met hyl pent af luoroet hyl ther



Met hyl pent af luoropropanoat e



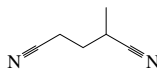
2-Met hyl pent anal



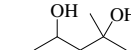
2-Met hyl pent ane



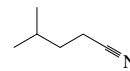
3-Met hyl pent ane



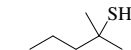
2-Met hyl pent anedi ni t ri le



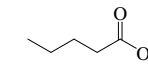
2-Met hyl -2,4-pent anedi ol



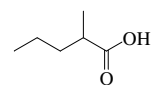
4-Met hyl pent aneni t ri le



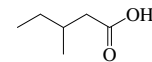
2-Met hyl -2-pent anet hi ol



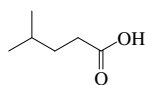
Met hyl pent anoat e



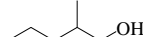
2-Met hyl pent anoici d(±)



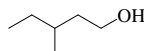
3-Met hyl pent anoici d(±)



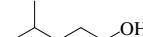
4-Met hyl pent anoici d



2-Met hyl -1-pent anol



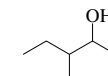
3-Met hyl -1-pent anol(±)



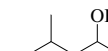
4-Met hyl -1-pent anol



2-Met hyl -2-pent anol

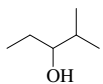


3-Met hyl -2-pent anol

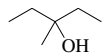


4-Met hyl -2-pent anol

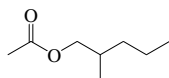
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7568	2-Met hyl -3-pent anol		$\text{C}_8\text{H}_{18}\text{O}$	565-67-3	102.174			126.5	0.8243 ²⁰	1.4175 ²⁰	sl H_2O ; msc Et OH, et h
7569	3-Met hyl -3-pent anol		$\text{C}_8\text{H}_{18}\text{O}$	77-74-7	102.174	li q	-23.6	122.4	0.8206	1.4186 ²⁰	sl H_2O , ct c; msc Et OH, et h
7570	2-Met hyl -1-pent anol acet at e		$\text{C}_9\text{H}_{18}\text{O}_2$	7789-99-3	144.212			163	0.870 ²⁵		vs et h, Et OH
7571	3-Met hyl -2-pent anone, (±)	(±)sec-But yl met hyl ket one	$\text{C}_8\text{H}_{16}\text{O}$	55156-16-6	100.158			117.5	0.8130 ²⁰	1.4002 ²⁰	sl H_2O ; msc Et OH, et h; s chl
7572	4-Met hyl -2-pent anone	Isobut yl met hyl ket one	$\text{C}_8\text{H}_{16}\text{O}$	108-10-1	100.158	li q	-84	116.5	0.7965	1.3962 ²⁰	sl H_2O ; msc Et OH, et h, ace, bz; s chl
7573	2-Met hyl -3-pent anone	Et hyl i sopropyl ket one	$\text{C}_8\text{H}_{16}\text{O}$	565-69-5	100.158			113.5	0.814 ¹⁸	1.3975 ²⁰	sl H_2O ; vs Et OH, bz; msc et h, ace; s chl
7574	4-Met hyl pent anoyl chl ori de		$\text{C}_9\text{H}_{17}\text{ClO}$	38136-29-7	134.603			143	0.9725 ²⁰		
7575	2-Met hyl -2-pent enal		$\text{C}_8\text{H}_{16}\text{O}$	623-36-9	98.142			136.5	0.8581 ²⁰	1.4488 ²⁰	i H_2O ; s Et OH, et h, bz, MeOH
7576	2-Met hyl -1-pent ene		C_8H_{16}	763-29-1	84.159	li q	-135.7	62.1	0.6799	1.3920 ²⁰	i H_2O ; s Et OH, bz, chl; sl ct c
7577	3-Met hyl -1-pent ene		C_8H_{16}	760-20-3	84.159	li q	-153	54.2	0.6675	1.3841 ²⁰	i H_2O ; s Et OH, bz, chl, pet h
7578	4-Met hyl -1-pent ene		C_8H_{16}	691-37-2	84.159	li q	-153.6	53.9	0.6642	1.3828 ²⁰	i H_2O ; s Et OH, bz, chl, pet h
7579	2-Met hyl -2-pent ene		C_8H_{16}	625-27-4	84.159	li q	-135	67.3	0.6863	1.4004 ²⁰	i H_2O ; s Et OH, bz, ct c, chl
7580	3-Met hyl <i>trans</i> -2-pent ene		C_8H_{16}	922-62-3	84.159	li q	-134.8	67.7	0.6806	1.4016 ²⁰	i H_2O ; s Et OH, bz, chl, pet h
7581	3-Met hyl <i>trans</i> -2-pent ene		C_8H_{16}	616-12-6	84.159	li q	-138.5	70.4	0.6930	1.4045 ²⁰	i H_2O ; s Et OH, bz, ct c, chl, pet h
7582	4-Met hyl <i>trans</i> -2-pent ene		C_8H_{16}	691-38-3	84.159	li q	-134.8	56.3	0.6690	1.3800 ²⁰	i H_2O ; s Et OH, bz, chl, pet h
7583	4-Met hyl <i>trans</i> -2-pent ene		C_8H_{16}	674-76-0	84.159	li q	-140.8	58.6	0.6680	1.3889 ²⁰	i H_2O ; s Et OH, bz, chl; sl ct c
7584	<i>trans</i> -2-Met hyl -2-pent enoi c aci d		$\text{C}_9\text{H}_{16}\text{O}_2$	16957-70-3	114.142	pr	24.4	214; 112 ¹²	0.9751 ²⁰	1.4513 ²⁰	sl H_2O ; s et h, chl, C S_2
7585	4-Met hyl -2-pent enoi c aci d	4,4-Di met hyl -2-but enoi c aci d	$\text{C}_8\text{H}_{16}\text{O}_2$	10321-71-8	114.142		35	217	0.9529 ²¹	1.4489 ²¹	vs ace, et h, Et OH
7586	2-Met hyl -3-pent enoi c aci d		$\text{C}_9\text{H}_{16}\text{O}_2$	37674-63-8	114.142			199	0.966 ¹⁵	1.4402 ²⁵	
7587	4-Met hyl -3-pent en-2-ol		$\text{C}_8\text{H}_{16}\text{O}$	4325-82-0	100.158			134	0.840 ¹⁵	1.9377 ¹⁵	
7588	3-Met hyl -2-pent en-4-one		$\text{C}_8\text{H}_{16}\text{O}$	565-62-8	98.142			138		1.4508 ²⁰	
7589	4-Met hyl -4-pent en-2-one		$\text{C}_8\text{H}_{16}\text{O}$	3744-02-3	98.142	li q	-72.6	124.2	0.841 ⁹		
7590	<i>cis</i> -3-Met hyl -2-(2-pent enyl)-2-cycl opent en-1-one	Jasnone	$\text{C}_{11}\text{H}_{16}\text{O}$	488-10-8	164.244	ye oi l		258; 13 ⁴	0.9437 ²²	1.4979 ²²	sl H_2O ; s Et OH, et h, ct c, li g
7591	3-(4-Met hyl -3-pent enyl) f uran		$\text{C}_{10}\text{H}_{18}\text{O}$	539-52-6	150.217			185.5	0.9017 ²⁰	1.4705 ²¹	
7592	3-Met hyl -3-pent en-1-yne		C_8H_8	1574-33-0	80.128			66.5	0.739 ²⁰	1.4332 ²⁰	s et h, bz
7593	3-Met hyl -2-pent yl -2-cycl opent en-1-one		$\text{C}_{11}\text{H}_{18}\text{O}$	1128-08-1	166.260			143 ²² , 116 ¹²	0.9165 ¹⁸	1.4767 ²⁰	
7594	Met hyl pent yl et her		$\text{C}_9\text{H}_{18}\text{O}$	628-80-8	102.174			99	0.759 ²²	1.3862 ²²	vs ace, et h, Et OH
7595	5-Met hyl -2-pent yl phenol	6-Pentylresorol	$\text{C}_{12}\text{H}_{18}\text{O}$	1300-94-3	178.270		24	138 ¹⁵			vs ace, et h, Et OH
7596	Met hyl pent yl sul fide		$\text{C}_9\text{H}_{18}\text{S}$	1741-83-9	118.240	li q	-94	145.1	0.843 ⁹	1.4506 ²⁰	s Et OH, et h, ace, bz, chl
7597	Met hyl <i>tert</i> -pent yl sul fide	2-Met hyl -2-(met hyl t hi o)but ane	$\text{C}_9\text{H}_{18}\text{S}$	13286-92-5	118.240	li q		150	0.84	1.457 ⁹	
7598	4-Met hyl -1-pent yne		C_8H_{10}	7154-75-8	82.143	li q	-104.6	61.2	0.700 ⁹	1.3936 ²⁰	i H_2O ; s bz, chl
7599	4-Met hyl -2-pent yne		C_8H_{10}	21020-27-9	82.143	li q	-110.3	73.1	0.711 ²	1.4057 ²⁰	vs bz, chl
7600	3-Met hyl -1-pent yn-3-ol	Meparf ynol	$\text{C}_8\text{H}_{10}\text{O}$	77-75-8	98.142		30.5	120.5	0.8688 ²⁰	1.4310 ²⁰	
7601	Met hyl perfluorooct anoi c aci d		$\text{C}_8\text{F}_{15}\text{O}_2$	376-27-2	428.095			158	1.684 ²⁰	1.304 ²⁷	
7602	1-Met hyl phenant hrene		$\text{C}_{12}\text{H}_{12}$	832-69-9	192.256	lf, pl (di l al)	123	354			C_6H_6 ; Et OH
7603	3-Met hyl phenant hrene		$\text{C}_{12}\text{H}_{12}$	832-71-3	192.256	pr or nd (al)	65	350; 145 ⁵			i H_2O ; s Et OH, ace; sl chl
7604	4-Met hyl phenant hrene		$\text{C}_{12}\text{H}_{12}$	832-64-4	192.256	pl (90% al)	53.5	177 ⁹			i H_2O ; s Et OH, ct c
7605	Met hyl pheni dat e		$\text{C}_8\text{H}_{13}\text{NO}_2$	113-45-1	233.307			136 ¹⁶			i H_2O , pet h; s chl, Et OH, et h, AcOEt
7606	10-Met hyl -10 ϕ -phenot hi azi ne		$\text{C}_{11}\text{H}_{11}\text{NS}$	1207-72-3	213.298		101				
7607	10-Met hyl -10 ϕ -phenot hi azi ne-2-acet i c aci d	Met i azi ni c aci d	$\text{C}_{13}\text{H}_{13}\text{NO}_2$	13993-65-2	271.335		144				s chl
7608	Met hyl phenoxyacet at e		$\text{C}_{10}\text{H}_{10}\text{O}_3$	2065-23-8	166.173			245	1.1493 ²⁰	1.5155 ²⁰	vs et h, Et OH



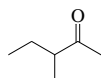
2-Methyl-3-pentanol



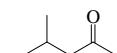
3-Methyl-3-pentanol



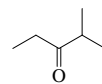
2-Methyl-1-pentyl acetate



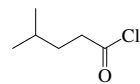
3-Methyl-2-pentanone



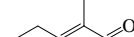
4-Methyl-2-pentanone



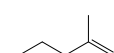
2-Methyl-3-pentanone



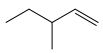
4-Methylpentanoyl chloride



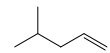
2-Methyl-2-pentenal



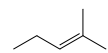
2-Methyl-1-pentene



3-Methyl-1-pentene



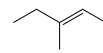
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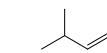
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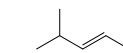
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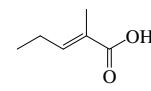
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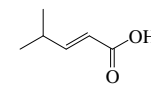
4-Methyl-2-pentene



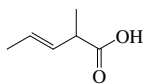
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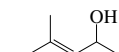
trans-2-Methyl-2-pentenoic acid



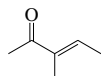
4-Methyl-2-pentenoic acid



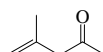
2-Methyl-3-pentenoic acid



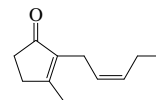
4-Methyl-3-pentanol



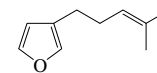
3-Methyl-2-pentene



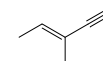
4-Methyl-4-pentanol



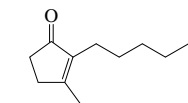
cis-3-Methyl-2-(2-pentenyl)-2-cyclopentanol



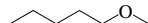
3-(4-Methyl-3-pentenyl)furan



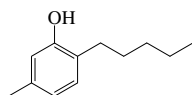
3-Methyl-3-pentyn-1-yn-3-ol



3-Methyl-2-pentyl-2-cyclopentanol



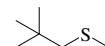
Methylpentyl ether



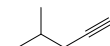
5-Methyl-2-pentylphenol



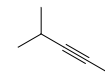
Methylpentyl sulfide



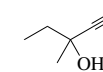
Methyl-2-pentyl sulfide



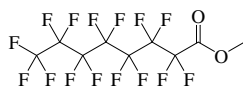
4-Methyl-1-pentyne



4-Methyl-2-pentyne



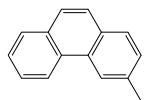
3-Methyl-1-pentyn-3-ol



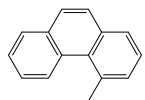
Methylperfluorooctanoate



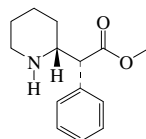
1-Methylphenanthrene



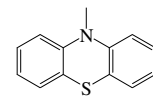
3-Methylphenanthrene



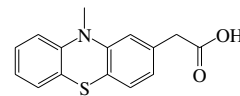
4-Methylphenanthrene



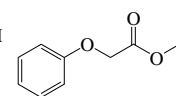
Methylphenidate



10-Methyl-10H-phenothiazine

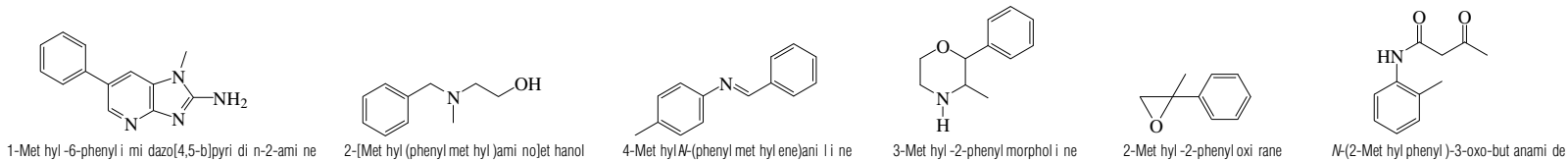
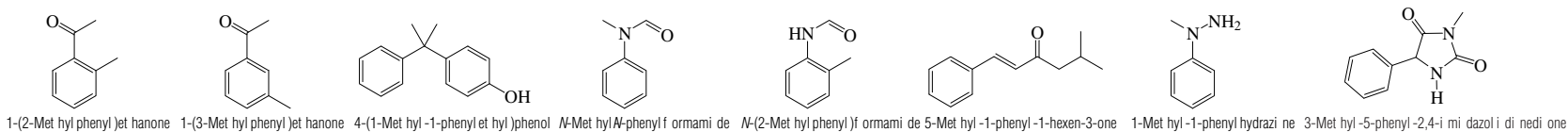
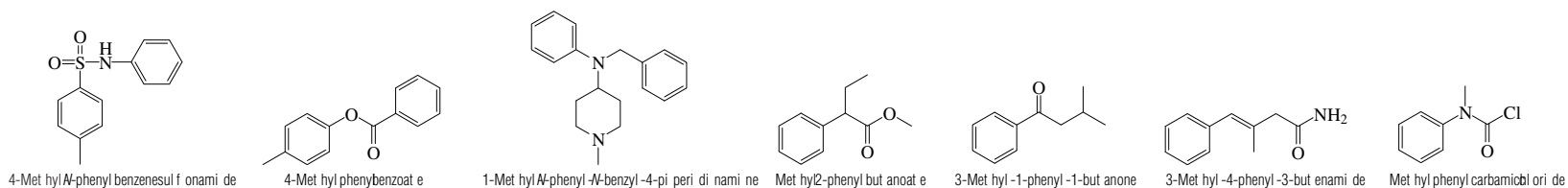
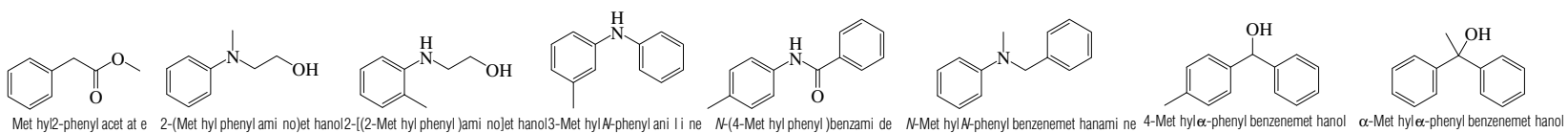
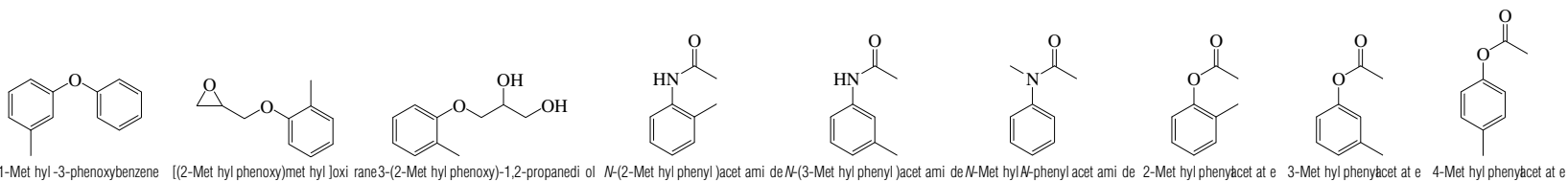


10-Methyl-10H-phenothiazine-2-acetic acid

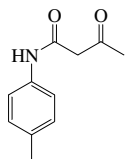


Methylphenoxacetate

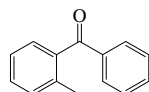
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7609	1-Met hyl -3-phenoxybenzene		C ₉ H ₁₂ O	3586-14-9	184.233			272	1.051 ²⁵	1.5727 ²⁰	
7610	[(2-Met hyl phenoxy)met hyl]oxi rane		C ₁₀ H ₁₂ O ₂	2210-79-9	164.201			123 ²	1.0884 ²⁰		
7611	3-(2-Met hyl phenoxy)-1,2-propanedi ol	Mephenesi n	C ₉ H ₁₄ O ₃	59-47-2	182.216		70 dec				sl H ₂ O, et h; s Et OH
7612	<i>N</i> -(2-Met hyl phenyl)acet ami de		C ₉ H ₉ NO	120-66-1	149.189	nd (al)	110	296	1.168 ⁵		sl H ₂ O, bz; s Et OH, et h, ace, HOAc
7613	<i>N</i> -(3-Met hyl phenyl)acet ami de		C ₉ H ₉ NO	537-92-8	149.189	nd (w)	65.5	303	1.141 ¹⁵		sl H ₂ O; vs Et OH, et h; s chl
7614	<i>N</i> -Met hyl <i>N</i> -phenyl acet ami de	<i>N</i> -Met hyl acet ani li de	C ₉ H ₉ NO	579-10-2	149.189	nd (et h), pr (al)	103	256	1.0036 ⁵	1.576	s H ₂ O, Et OH, et h, chl, li g
7615	2-Met hyl phenyl acet at e	<i>o</i> -Cresyl acet at e	C ₉ H ₁₀ O ₂	533-18-6	150.174			208	1.0533 ¹⁵	1.5002 ²⁰	vs et h, Et OH
7616	3-Met hyl phenyl acet at e	<i>m</i> -Cresyl acet at e	C ₉ H ₁₀ O ₂	122-46-3	150.174		12	212	1.043 ²⁰	1.4978 ²⁰	vs bz, et h, Et OH
7617	4-Met hyl phenyl acet at e	<i>p</i> -Cresyl acet at e	C ₉ H ₁₀ O ₂	140-39-6	150.174			212.5	1.0512 ¹⁷	1.5163 ²²	sl H ₂ O, ct c; s Et OH, et h, chl
7618	Met hyl 2-phenyl acet at e		C ₉ H ₉ O ₂	101-41-7	150.174			216.5	1.0622 ¹⁶	1.5075 ²⁰	i H ₂ O; msc Et OH, et h; s ace, ct c
7619	2-(Met hyl phenyl ami no)et hanol		C ₉ H ₉ NO	93-90-3	151.205			218 ¹¹⁰ , 150 ¹⁴	1.0143 ⁹		s H ₂ O; vs Et OH, et h, ace, bz
7620	2-[(2-Met hyl phenyl)ami no]et hanol		C ₉ H ₉ NO	136-80-1	151.205			285.5	1.0794 ²⁰	1.5675 ²⁰	vs et h, Et OH
7621	3-Met hyl <i>N</i> -phenyl ani li ne		C ₉ H ₁₃ N	1205-64-7	183.249		30	316; 183 ¹⁷		1.6350 ²⁰	vs bz, et h, Et OH
7622	<i>N</i> -(4-Met hyl phenyl)benzami de		C ₁₄ H ₁₃ NO	582-78-5	211.259	ort h nd (al)	158		1.20 ²		vs et h, Et OH
7623	<i>N</i> -Met hyl <i>N</i> -phenyl benzenemet hanami ne		C ₁₄ H ₁₃ N	614-30-2	197.276						s ct c
7624	4-Met hyl α -phenyl benzenemet hanol		C ₉ H ₁₄ O	1517-63-1	198.260		52				
7625	α -Met hyl α -phenyl benzenemet hanol		C ₉ H ₁₄ O	599-67-7	198.260			285; 190 ¹²	1.1059 ¹⁵		
7626	4-Met hyl <i>N</i> -phenyl benzenesul f onami de		C ₁₃ H ₁₃ NO ₂ S	68-34-8	247.313	(α) t cl, (β) mcl pr (al, bz)	103.5				i H ₂ O; vs Et OH; s bz, HOAc
7627	4-Met hyl phenyl benzoat e		C ₉ H ₁₂ O ₂	614-34-6	212.244	pl (et h-al)	71.5	316			vs et h, Et OH
7628	1-Met hyl <i>N</i> -phenyl <i>N</i> -benzyl -4-pi peri di nami ne	Bami pi ne	C ₉ H ₂₄ N ₂	4945-47-5	280.407	cry (MeOH)	115				
7629	Met hyl 2-phenyl but anoat e		C ₁₁ H ₁₄ O ₂	2294-71-5	178.228	nd (di l al)	77.5	228			vs et h, Et OH
7630	3-Met hyl -1-phenyl -1-but anone		C ₁₁ H ₁₄ O	582-62-7	162.228			236.5	0.9701 ¹⁶	1.5139 ¹⁵	i H ₂ O; msc Et OH, et h; vs ace
7631	3-Met hyl -4-phenyl -3-but enami de	β -Benzal but yrami de	C ₉ H ₁₃ NO	7236-47-7	175.227		133				
7632	Met hyl phenyl carbami c chl ori de		C ₈ H ₉ ClNO	4285-42-1	169.609	pl (al)	88.5	280			vs et h, Et OH
7633	1-(2-Met hyl phenyl)et hanone		C ₉ H ₁₀ O	577-16-2	134.174			214	1.026 ²⁰	1.5276 ²⁰	
7634	1-(3-Met hyl phenyl)et hanone		C ₉ H ₁₀ O	585-74-0	134.174			220	1.0165 ⁹	1.533 ¹⁵	s Et OH, et h, ace; sl ct c
7635	4-(1-Met hyl -1-phenyl et hyl)phenol		C ₁₅ H ₁₆ O	599-64-4	212.287	pr (pet h)	74.5	335			
7636	<i>N</i> -Met hyl <i>N</i> -phenyl f ormami de		C ₈ H ₉ NO	93-61-8	135.163		14.5	243	1.0948 ²⁰	1.5589 ²⁰	sl H ₂ O, ct c; s Et OH, ace
7637	<i>N</i> -(2-Met hyl phenyl) f ormami de		C ₈ H ₉ NO	94-69-9	135.163	lf (al)	62	288	1.086		s H ₂ O; vs Et OH
7638	5-Met hyl -1-phenyl -1-hexen-3-one		C ₁₃ H ₁₈ O	2892-18-4	188.265	cry	43	154 ²⁵	0.9509 ⁴⁶	1.5523 ²⁵	sl H ₂ O; s Et OH, bz, chl
7639	1-Met hyl -1-phenyl hydrazi ne		C ₇ H ₁₀ N ₂	618-40-6	122.167			228; 131 ³⁵	1.0404 ²⁰	1.5691 ²⁰	sl H ₂ O; msc Et OH, et h, bz, chl
7640	3-Met hyl -5-phenyl -2,4-i mi dazol i di nedi one	3-Met hyl -5-phenyl hydant oi n	C ₁₀ H ₁₀ N ₂ O ₂	6846-11-3	190.198			164.5			s chl
7641	1-Met hyl -6-phenyl i mi dazo[4,5-b]pyri di n-2-ami ne	PhIP	C ₁₃ H ₁₂ N ₄	105650-23-5	224.261	sol i d	327				
7642	2-[Met hyl (phenyl met hyl) ami no]et hanol		C ₁₀ H ₁₅ NO	101-98-4	165.232			134 ¹⁴			
7643	4-Met hyl <i>N</i> -(phenyl met hyl ene)ani li ne		C ₁₄ H ₁₇ N	2272-45-9	195.260	ye cry	35	318; 178 ¹¹			vs ace
7644	3-Met hyl -2-phenyl morfol i ne	Phenmet razi ne	C ₁₁ H ₁₃ NO	134-49-6	177.243			139 ¹² , 104 ¹			
7645	2-Met hyl -2-phenyl oxi rane		C ₉ H ₁₀ O	2085-88-3	134.174			84 ¹⁷	1.0228 ²⁰	1.5232 ²⁰	
7646	<i>N</i> -(2-Met hyl phenyl)-3-oxo-but anami de		C ₁₁ H ₁₃ NO ₂	93-68-5	191.227	pr (AcOEt)	107.5				vs bz, Et OH



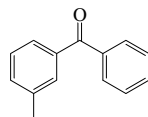
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7647	<i>N</i> -(4-Met hyl phenyl)-3-oxobutanami de		C ₁₁ H ₁₃ NO ₂	2415-85-2	191.227	pr (AcOEt)	95				sl H ₂ O, li q; s Et OH, bz
7648	(2-Met hyl phenyl)phenyl met hanone		C₁₄H₁₂O	131-58-8	196.244		<-18	308; 128 ¹²	1.1098 ²⁰		i H ₂ O; vs Et OH
7649	(3-Met hyl phenyl)phenyl met hanone		C₁₄H₁₂O	643-65-2	196.244	oi l	2	317; 170	1.095 ²⁰		i H ₂ O; s Et OH, et h, bz, chl, HOAc
7650	(4-Met hyl phenyl)phenyl met hanone		C₁₄H₁₂O	134-84-9	196.244	mcl pr	59.5	228 ⁹	0.9926 ⁹		i H ₂ O; sl Et OH, li q; s et h, bz, chl
7651	Met hyl 3-phenyl propanoate	Met hyl di hydroci nmat e	C₁₀H₁₂O₂	103-25-3	164.201			238.5; 91 ⁴	1.0455 ²⁵		i H ₂ O; s Et OH, et h, bz, AcOEt
7652	1-(4-Met hyl phenyl)-1-propanone		C₉H₁₂O	5337-93-9	148.201		7.2	236	0.9926 ²⁰	1.5278 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, C ₆ S ₆
7653	2-Met hyl -1-phenyl -1-propanone		C₉H₁₂O	611-70-1	148.201	li q	-0.7	220	0.9863	1.5172 ²⁰	vs et h, Et OH
7654	2-Met hyl -3-phenyl -2-propanal		C₉H₁₀O	101-39-3	146.185			248; 150 ¹⁰⁰	1.0407 ¹⁷	1.6057 ¹⁷	
7655	Met hyl 3-phenyl -2-propynoate		C₉H₈O₂	4891-38-7	160.170		26	158 ⁴⁸ , 132 ¹⁶	1.0830 ²⁵	1.5618 ²⁵	
7656	3-Met hyl -1-phenyl - <i>H</i> -pyrazol -5-ami ne		C ₁₀ H ₁₁ N ₃	1131-18-6	173.214		116	333			s H ₂ O, Et OH, chl; sl bz
7657	2-Met hyl -5-phenyl pyri di ne		C₁₂H₁₁N	3256-88-0	169.222			189 ⁵⁰	1.0590 ²⁵	1.6055 ²⁵	
7658	5-Met hyl -5-phenyl -2,4,6-(<i>M</i> ,3 <i>H</i> ,5 <i>H</i>)-pyri mi di net ri one	Phenyl met hyl barbi t uri c aci d pyri mi di net ri one	C₁₁H₉N₂O₃	76-94-8	218.208	cry	220				i H ₂ O; s Et OH, et h, al k
7659	1-Met hyl -3-phenyl -2,5-pyrrol i di nedi one	Phensuxi mi de	C₉H₁₁NO₂	86-34-0	189.211	cry (hot al)	72				vs Et OH, MeOH
7660	Met hyl phenyl si l ane		C₇H₉Si	766-08-5	122.240			140	0.889 ⁹	1.5058 ²⁰	
7661	Met hyl phenyl sul f one		C₇H₇O₂S	3112-85-4	156.203		88				i H ₂ O; s Et OH, bz, chl; sl ct c
7662	1-Met hyl -4-(phenyl t hi o)benzene		C₁₃H₉S	3699-01-2	200.299		15.7	317	1.0986 ²⁵	1.6225 ²⁵	i H ₂ O; s ace, bz
7663	(2-Met hyl phenyl)t hi ourea	<i>o</i> -Tolyl t hi ourea	C₈H₁₀N₂S	614-78-8	166.243	nd (di l al, w)	162				vs H ₂ O, Et OH; sl et h
7664	<i>N</i> -Met hyl <i>N'</i> -phenyl t hi ourea		C₈H₁₀N₂S	2724-69-8	166.243	t a, pl	112.5				vs Et OH
7665	Met hyl phosphat e	Met hyl di hydrogen phosphat e	C₅O₃P	812-00-0	112.022	oi l					
7666	Met hyl phosphi ne		CH₃	593-54-4	48.025	col gas		-16			vs et h
7667	Met hyl phosphoni c aci d		CH₃P	993-13-5	96.023	hyg pl	108.5	dec			vs H ₂ O, Et OH, et h; i bz, pet h
7668	Met hyl phosphoni c di fluori de		C₃F₃OP	676-99-3	100.005	li q		98; 22	1.3314 ²⁰		
7669	Met hyl phosphonofluori d c aci d, i sopropyl est er	Sari n	CH₁₀FO₂P	107-44-8	140.093	li q	-57	147	1.10		dec H ₂ O
7670	Met hyl phosphorodi chl ori di t e	Met hyl di chl orophosphi t e	C₃Cl₂OPCH	3279-26-3	132.914	hyg li q	-91	93	1.406	1.4740	
7671	1-Met hyl pi perazi ne		C₄H₈N₂	109-01-3	100.162			138		1.4378 ²⁰	vs H ₂ O, et h, Et OH
7672	2-Met hyl pi perazi ne		C₄H₈N₂	109-07-9	100.162	hyg lf (al)	62	153			vs H ₂ O; s Et OH, et h, bz, chl
7673	1-Met hyl pi peri di ne		C₆H₈N	626-67-5	99.174	li q	-102.7	107	0.8159	1.4355 ²⁰	vs H ₂ O; msc Et OH, et h; s ct c
7674	2-Met hyl pi peri di ne, (±)		C₆H₈N	3000-79-1	99.174	li q	-2.5	118	0.8436	1.4459 ²⁰	vs H ₂ O; s Et OH, et h; sl chl; i di KOH
7675	3-Met hyl pi peri di ne, (±)		C₆H₈N	53152-98-0	99.174	li q	-24	125.5	0.8446	1.4470 ²⁰	vs H ₂ O; sl chl
7676	4-Met hyl pi peri di ne		C₆H₈N	626-58-4	99.174			130	0.8674 ²⁵	1.4458 ²⁰	vs H ₂ O; sl chl
7677	1-Met hyl -3-pi peri di nol		C₆H₉NO	3554-74-3	115.173			93 ²⁶ , 77 ¹¹	0.9635 ¹⁶	1.4735 ²⁰	
7678	1-Met hyl -4-pi peri di nol		C₆H₉NO	106-52-5	115.173		29	200		1.4775 ²⁰	
7679	1-Met hyl -2-pi peri di none		C₆H₉NO	931-20-4	113.157			221; 105 ¹²	1.0263 ²⁵	1.4820 ²⁰	
7680	1-Met hyl -4-pi peri di none		C₆H₉NO	1445-73-4	113.157			85 ⁴⁵ , 57 ¹¹	0.971 ²⁵	1.4580 ²⁵	
7681	Met hyl predni sol one		C₂₁H₃₀O₅	83-43-2	374.470	cry	232				
7682	2-Met hyl propanami de		C₄H₉NO	563-83-7	87.120		129.0	217	1.013 ²⁰		s chl
7683	<i>N</i> -Met hyl propanami de		C₄H₉NO	1187-58-2	87.120	li q	-30.9	148	0.9305	1.4345 ²⁵	
7684	2-Met hyl -1,2-propanedi ami ne		C₄H₁₁N₂	811-93-8	88.151			123	0.841 ²⁵	1.4410 ²⁰	s ct c
7685	2-Met hyl -1,2-propanedi ol		C₄H₉O₂	558-43-0	90.121			176	1.0024 ²⁰	1.4350 ²⁰	vs H ₂ O, et h, Et OH
7686	2-Met hyl -1,3-propanedi ol		C₄H₉O₂	2163-42-0	90.121	li q	-91	211.6; 124	1.015 ²⁰	1.4450 ²⁰	
7687	2-Met hyl propaneni t ri l e	Isobut yroni t ri l e	C₄H₇N C	78-82-0	69.106	li q	-71.5	103.9	0.7704	1.3720 ²⁰	sl H ₂ O; vs Et OH, et h, ace, chl



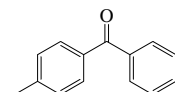
N-(4-Methylphenyl)-3-oxobutanamide



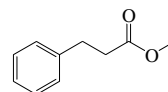
(2-Methylphenyl)phenylmethanone



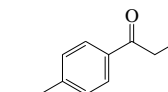
(3-Methylphenyl)phenylmethanone



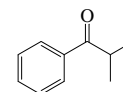
(4-Methylphenyl)phenylmethanone



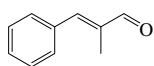
Methyl 3-phenylpropanoate



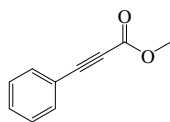
1-(4-Methylphenyl)-1-propanone



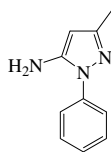
2-Methyl-1-phenyl-1-propanone



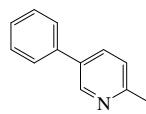
2-Methyl-3-phenyl-2-propenal



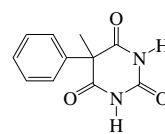
Methyl 3-phenyl-2-propynoate



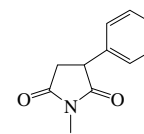
3-Methyl-1-phenyl-1H-pyrazol-5-amine



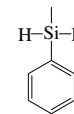
2-Methyl-5-phenylpyridine



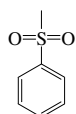
5-Methyl-5-phenyl-2,4,6-trimethyl-1,2,4-pyrimidin-3(1H)-one



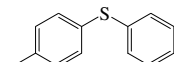
1-Methyl-3-phenyl-2,5-pyrrolidinedione



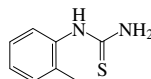
Methylphenylsilane



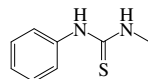
Methylphenylsulfone



1-Methyl-4-(phenylthio)benzene



(2-Methylphenyl)thiourea



N-Methyl-*N'*-phenylthiourea



Methylphosphonic acid



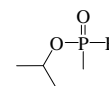
Methylphosphine



Methylphosphonic acid diisopropylester



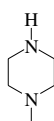
Methylphosphonic acid difluoride



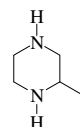
Methylphosphonic acid diisopropylester



Dichloromethylphosphorodichloridate



1-Methylpiperazine



2-Methylpiperazine



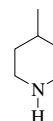
1-Methylpiperidine



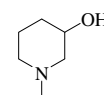
2-Methylpiperidine



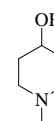
3-Methylpiperidine



4-Methylpiperidine



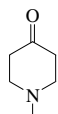
1-Methyl-3-piperidol



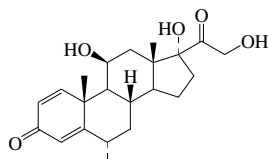
1-Methyl-4-piperidol



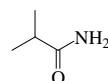
1-Methyl-2-piperidinone



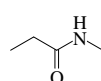
1-Methyl-4-piperidone



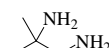
Methylprednisolone



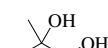
2-Methylpropanamide



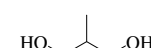
N-Methylpropanamide



2-Methyl-1,2-propanediamine



2-Methyl-1,2-propanediol



2-Methyl-1,3-propanediol



2-Methylpropanenitrile

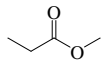
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7688	2-Met hyl-1-propanet hi ol	Isobut yl mercapt an	$\text{C}_4\text{H}_{10}\text{S}$	513-44-0	90.187		<-70	88.5	0.8357 ²⁰	1.4387 ²⁰	sl H_2O ; vs Et OH, et h, ace; s ct c
7689	2-Met hyl-2-propanet hi ol	<i>t</i> erBut yl mercapt an	$\text{C}_4\text{H}_{10}\text{S}$	75-66-1	90.187	li q	-0.5	64.2	0.7943	1.4232 ²⁰	i H_2O ; s ct c, hp
7690	Met hyl propanoat e	Met hyl propi onat e	$\text{C}_3\text{H}_6\text{O}_2$	554-12-1	88.106	li q	-87.5	79.8	0.9150	1.3775 ²⁰	sl H_2O ; msc Et OH, et h; s ace, ct c
7691	2-Met hyl propanoi c aci d	Isobut yri c aci d	$\text{C}_4\text{H}_8\text{O}_2$	79-31-2	88.106	li q	-46	154.45	0.9687	1.3930 ²⁰	vs H_2O ; msc Et OH, et h; sl ct c
7692	2-Met hyl propanoi c anhydri de	Isobut ryi c anhydri de	$\text{C}_4\text{H}_6\text{O}_3$	97-72-3	158.195	li q	-53.5	183; 89	0.9535 ²⁰	1.4061 ¹⁹	msc et h; s chl
7693	2-Met hyl-1-propanol	Isobut yl al cohol	$\text{C}_4\text{H}_8\text{O}$	78-83-1	74.121	li q	-101.9	107.89	0.8010	1.3955 ²⁰	s H_2O , Et OH, et h, ace, ct c
7694	2-Met hyl-2-propanol	<i>t</i> erBut yl al cohol	$\text{C}_4\text{H}_{10}\text{O}$	75-65-0	74.121		25.69	82.4	0.7887 ²⁰	1.3878 ²⁰	msc H_2O , Et OH, et h; s chl
7695	2-Met hyl propanoyl chl ori de	Isobut yri c aci d chl ori de	$\text{C}_4\text{H}_7\text{ClO}$	79-30-1	106.551	li q	-90	92		1.4079	s et h
7696	2-Met hyl propenal	Met hacrol ei n	$\text{C}_4\text{H}_6\text{O}$	78-85-3	70.090			68.4	0.840 ²⁵	1.4144 ²⁰	msc H_2O , Et OH, et h
7697	2-Met hyl-2-propenami de		$\text{C}_4\text{H}_7\text{NO}$	79-39-0	85.105	cry (bz)	110.5				sl et h, chl; s Et OH, C_6H_6
7698	<i>N</i> -Met hyl-2-propen-1-ami ne		$\text{C}_4\text{H}_7\text{N}$	627-37-2	71.121			64		1.4065 ²⁰	vs H_2O , ace, et h, Et OH
7699	2-Met hyl-2-propene-1,1-di ol di acet at e	Met hacrol ei n di acet at e	$\text{C}_8\text{H}_{16}\text{O}_4$	10476-95-6	172.179			191		1.4241 ²⁰	
7700	2-Met hyl-1-propene, <i>t</i> et ramer		C_3H_6	15220-85-6	224.425	li q	-98	244; 109	0.7944 ²⁰	1.4482 ²⁰	
7701	2-Met hyl-2-propenoi c anhydri de	Met hacryli c aci d anhydri de	$\text{C}_3\text{H}_4\text{O}_2$	760-93-0	154.163			89 ⁵		1.4540 ²⁰	msc Et OH, et h
7702	2-Met hyl-2-propenol	Met hal yl al cohol	$\text{C}_3\text{H}_6\text{O}$	513-42-8	72.106			114.5	0.8515 ²⁰	1.4255 ²⁰	vs H_2O ; msc Et OH, et h
7703	2-Met hyl-2-propenoyl chl ori de	Met hacryli c aci d chl ori de	$\text{C}_3\text{H}_5\text{ClO}$	920-46-7	104.535	li q	-60	96	1.0871	1.4435 ²⁰	s et h, ace, chl
7704	<i>ci s</i> (1-Met hyl-1-propenyl)benzene		C_9H_{12}	767-99-7	132.202			194.7; 177 ⁵⁰⁰	0.9191 ²⁵	1.5402 ²⁵	i H_2O ; s bz, chl
7705	<i>trans</i> (1-Met hyl-1-propenyl)benzene		C_9H_{12}	768-00-3	132.202	li q	-23.5	194.7	0.9138	1.5425 ²⁰	i H_2O ; s bz, chl
7706	(2-Met hyl-1-propenyl)benzene		C_9H_{12}	768-49-0	132.202	li q	-48.0	183; 99	0.900 ²⁰	1.5388 ²⁰	
7707	4-(2-Met hyl propenyl)morphol i ne	1-Morphol i noi sobut ene	$\text{C}_8\text{H}_{13}\text{NO}$	2403-55-6	141.211		120	89 ²⁰		1.4663 ²⁰	
7708	2-(2-Met hyl propoxy)et hanol		$\text{C}_8\text{H}_{16}\text{O}_2$	4439-24-1	118.174			160	0.8900 ²⁰	1.4143 ²⁰	
7709	Met hyl propyl ami ne	<i>N</i> -Met hyl-1-propanami ne	$\text{C}_4\text{H}_{11}\text{N}$	627-35-0	73.137			63	0.7204 ¹⁷		
7710	1-Met hyl-2-propyl benzene		C_9H_{14}	1074-17-5	134.218	li q	-60.3	185	0.8697	1.4996 ²⁰	
7711	1-Met hyl-3-propyl benzene		C_9H_{14}	1074-43-7	134.218	li q	-82.5	182	0.8569	1.4935 ²⁰	
7712	1-Met hyl-4-propyl benzene		C_9H_{14}	1074-55-1	134.218	li q	-63.6	183.4	0.8544	1.4922 ²⁰	i H_2O ; s Et OH, et h
7713	<i>ci s</i> 1-Met hyl-2-propyl cycl opent ane		C_8H_{16}	932-43-4	126.239	li q	-104	152.6	0.7887	1.4343 ²⁰	
7714	<i>trans</i> 1-Met hyl-2-propyl cycl opent ane		C_8H_{16}	932-44-5	126.239	li q	-123	146.4	0.7735	1.4274 ²⁰	
7715	Met hyl propyl di sul fide		$\text{C}_4\text{H}_8\text{S}_2$	2179-60-4	122.252	li q		70	0.980	1.5080 ²⁰	
7716	Met hyl propyl et her	1-Met hoxypropane	$\text{C}_4\text{H}_{10}\text{O}$	557-17-5	74.121			39.1	0.7356 ¹³	1.3579 ²⁵	s H_2O , ace; msc Et OH, et h
7717	1-Met hyl-2-propyl pi peri di O_9 , (Met hyl con i ne		$\text{C}_8\text{H}_{15}\text{N}$	35305-13-6	141.254			174	0.8326 ²²	1.4538 ¹²	vs ace, Et OH
7718	2-Met hyl-2-propyl-1,3-propanedi ol		$\text{C}_6\text{H}_{12}\text{O}_2$	78-26-2	132.201	cry (hx)	62.5	234; 121 ¹⁰			s H_2O , hx; sl chl
7719	2-Met hyl-2-propyl-1,3-propanedi ol di carbamat e	Meprobamat e	$\text{C}_8\text{H}_{15}\text{N}_2\text{O}_4$	57-53-4	218.250	cry (w)	105				vs bz, et h, Et OH
7720	Met hyl propyl sul fide		$\text{C}_6\text{H}_{12}\text{S}$	3877-15-4	90.187	li q	-113	95.6	0.8424	1.4442 ²⁰	s H_2O , Et OH, et h, ace
7721	<i>N</i> -Met hyl-2-propyn-1-ami ne		$\text{C}_4\text{H}_7\text{N}$	35161-71-8	69.106			83	0.819 ²⁵	1.4332 ²⁰	
7722	<i>N</i> -Met hyl-2-propynyl benzenemet hanami ne	Pargyl i ne	$\text{C}_9\text{H}_{13}\text{N}$	555-57-7	159.228			96 ¹¹	0.944 ²⁵	1.5213 ²⁰	
7723	3-Met hyl pyrazi nami ne	2-Ami no-3-met hyl pyrazi ne	$\text{C}_5\text{H}_7\text{N}_2$	19838-08-5	109.130	nd (hx/AcOEt)	174				
7724	2-Met hyl pyrazi ne		$\text{C}_5\text{H}_7\text{N}_2$	109-08-0	94.115	li q	-29	137	1.039	1.5042 ²⁰	msc H_2O , Et OH, et h; s ace; sl ct c
7725	1-Met hyl- <i>H</i> -pyrazol e		$\text{C}_4\text{H}_5\text{N}_2$	930-36-9	82.104			127	0.9929 ¹³	1.4787 ¹³	
7726	3-Met hyl- <i>H</i> -pyrazol e		$\text{C}_4\text{H}_5\text{N}_2$	1453-58-3	82.104		36.5	204; 108 ²⁵	1.0203 ¹⁶	1.4915 ²⁰	msc H_2O , Et OH, et h
7727	4-Met hyl- <i>H</i> -pyrazol e	Fomepi zol e	$\text{C}_4\text{H}_5\text{N}_2$	7554-65-6	82.104			206; 95 ¹³	1.015 ²⁰		
7728	3-Met hyl-2-pyrazol i n-5-one		$\text{C}_6\text{H}_7\text{N}_2\text{O}$	108-26-9	98.103		215				vs H_2O ; sl Et OH
7729	1-Met hyl pyrene		$\text{C}_{10}\text{H}_{12}$	2381-21-7	216.277		71.3	410			



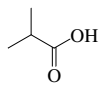
2-Methyl-1-propanethiol



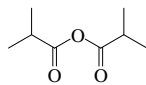
2-Methyl-2-propanethiol



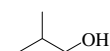
Methyl propanoate



2-Methylpropanoic acid



2-Methylpropanoic anhydride



2-Methyl-1-propanol



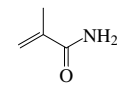
2-Methyl-2-propanol



2-Methylpropanoyl chloride



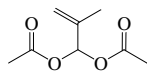
2-Methylpropenal



2-Methyl-2-propenamine



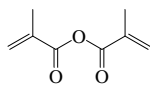
N-Methyl-2-propen-1-amine



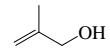
2-Methyl-2-propene-1,1-diacetate



2-Methyl-1-propene



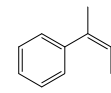
2-Methyl-2-propenoic anhydride



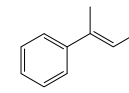
2-Methyl-2-propenol



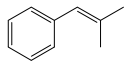
2-Methyl-2-propenoyl chloride



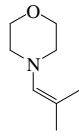
cis-1-Methyl-1-propenylbenzene



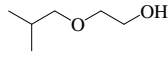
trans-1-Methyl-1-propenylbenzene



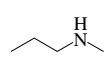
(2-Methyl-1-propenyl)benzene



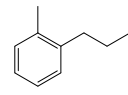
4-(2-Methylpropenyl)morpholine



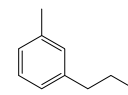
2-(2-Methylpropoxy)ethanol



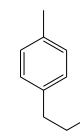
Methylpropylamine



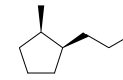
1-Methyl-2-propylbenzene



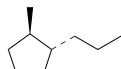
1-Methyl-3-propylbenzene



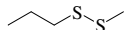
1-Methyl-4-propylbenzene



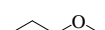
cis-1-Methyl-2-propylcyclopentane



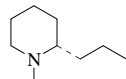
trans-1-Methyl-2-propylcyclopentane



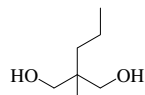
Methylpropyl disulfide



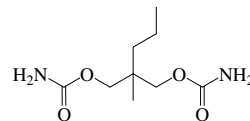
Methylpropyl ether



1-Methyl-2-propylpiperidine



2-Methyl-2-propyl-1,3-propanediol



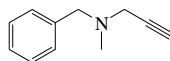
2-Methyl-2-propyl-1,3-propanediol carbamate



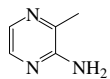
Methylpropyl sulfide



N-Methyl-2-propyn-1-amine



N-Methyl-2-propynylbenzenemethanamine



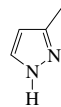
3-Methylpyrazinamine



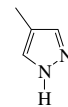
2-Methylpyrazine



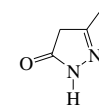
1-Methyl-1H-pyrazole



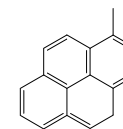
3-Methyl-1H-pyrazole



4-Methyl-1H-pyrazole

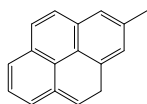


3-Methyl-2-pyrazolin-5-one



1-Methylpyrene

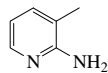
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7730	2-Met hyl pyrene		C ₁₇ H ₁₂	3442-78-2	216.277	fl (Et OH)	143	409.8			
7731	3-Met hyl pyri dazi ne	3-Met hyl -1,2-di azi ne	C ₇ H ₆ NC	1632-76-4	94.115		184	214	1.0450 ²⁶	1.5145 ²⁰	
7732	3-Met hyl -2-pyri di nami ne	2-Ami no-3-pi coli ne	C ₈ H ₈ N ₂ C	1603-40-3	108.141	hyg	33.5	222; 95 ⁸			vs H ₂ O; s Et OH, et h, ace, bz, ct c; sl li g
7733	4-Met hyl -2-pyri di nami ne	2-Ami no-4-pi coli ne	C ₈ H ₈ N ₂ C	695-34-1	108.141	lf or pl (li g)	100	116			vs H ₂ O; s Et OH, et h, ace, bz; i li g; sl chl
7734	5-Met hyl -2-pyri di nami ne		C ₈ H ₈ O ₂	1603-41-4	108.141		76.5	227			
7735	6-Met hyl -2-pyri di nami ne	2-Ami no-6-pi coli ne	C ₈ H ₈ N ₂ C	1824-81-3	108.141	hyg (li g)	41	208.5			vs H ₂ O; s Et OH, et h, ace, bz, li g
7736	N-Met hyl -2-pyri di nami ne		C ₈ H ₈ O ₂	4597-87-9	108.141		15	200.5	1.048 ²⁹		s H ₂ O, bz; vs Et OH, et h, HOAc
7737	N-Met hyl -4-pyri di nami ne		C ₈ H ₈ O ₂	1121-58-0	108.141	pl (et h)	118.8				vs H ₂ O, ace, et h, Et OH
7738	2-Met hyl pyri di ne	2-Pi coli ne	C ₇ H ₇ NC	109-06-8	93.127	li q	-66.68	129.38	0.944 ³	1.4957 ²⁰	vs H ₂ O, ace; msc Et OH, et h; s ct c
7739	3-Met hyl pyri di ne	3-Pi coli ne	C ₇ H ₇ NC	108-99-6	93.127	li q	-18.14	144.14	0.956 ⁶	1.5040 ²⁰	msc H ₂ O, Et OH, et h; vs ace; s ct c
7740	4-Met hyl pyri di ne	4-Pi coli ne	C ₇ H ₇ NC	108-89-4	93.127		3.67	145.36	0.9548 ²⁰	1.5037 ²⁰	msc H ₂ O, Et OH, et h; s ace, ct c
7741	6-Met hyl -2-pyri di necarboxyl dehyde		C ₇ H ₇ NO	1122-72-1	121.137		32	77 ¹²			
7742	Met hyl 3-pyri di necarboxyl at e	Met hyl ni cot i nat e	C ₇ H ₇ NO ₂ C	93-60-7	137.137	cry	42.5	204			s H ₂ O, Et OH, bz
7743	Met hyl 4-pyri di necarboxyl at e	Met hyl i soni cot i nat e	C ₇ H ₇ NO ₂ C	2459-09-8	137.137		16.1	208	1.1599 ²⁰	1.5135 ²⁰	sl H ₂ O, ct c; s Et OH, et h, bz
7744	2-Met hyl pyri di ne-1-oxi de		C ₇ H ₇ NO	931-19-1	109.126		49	260			
7745	3-Met hyl pyri di ne-1-oxi de		C ₇ H ₇ NO	1003-73-2	109.126		39	148 ¹⁵			s chl
7746	4-Met hyl pyri di ne-1-oxi de		C ₇ H ₇ NO	1003-67-4	109.126		185.8				
7747	1-Met hyl -2(1H)-pyri di none		C ₇ H ₇ NO	694-85-9	109.126	nd	31	250	1.1120 ²⁰		msc H ₂ O; sl pet h, li g
7748	1-(6-Met hyl -3-pyri di nyl)et hanone		C ₈ H ₁₀ O	36357-38-7	135.163		17.6	144 ⁵⁰	1.0168 ²⁵	1.5302 ²⁵	vs H ₂ O
7749	4-Met hyl -2-pyri mi di nami ne		C ₇ H ₇ NC ₃	108-52-1	109.130	pl (w), nd (sub)	160.3	sub			s H ₂ O, Et OH; sl chl
7750	2-Met hyl pyri mi di ne	2-Met hyl -1,3-di azi ne	C ₇ H ₆ N ₂ C	5053-43-0	94.115	li q	-4	138			msc H ₂ O
7751	4-Met hyl pyri mi di ne	4-Met hyl -1,3-di azi ne	C ₇ H ₆ N ₂ C	3438-46-8	94.115		32	142	1.030 ¹⁶	1.500 ²⁰	msc H ₂ O
7752	5-Met hyl pyri mi di ne	5-Met hyl -1,3-di azi ne	C ₇ H ₆ N ₂ C	2036-41-1	94.115		30.5	153			vs H ₂ O
7753	6-Met hyl -2,4(1H,3H)-pyri mi di nedi one	6-Met hyl uraci l	C ₇ H ₆ N ₂ O ₂	626-48-2	126.114	oct pr or nd (w, al)	275 dec				s H ₂ O, Et OH; sl et h, t f a; vs NH
7754	1-Met hyl pyrrol e		C ₄ H ₇ N	96-54-8	81.117	li q	-56.32	112.81	0.914 ⁵	1.4875 ²⁰	i H ₂ O; msc Et OH, et h
7755	2-Met hyl pyrrol e		C ₄ H ₇ N	636-41-9	81.117	li q	-35.6	147.6	0.944 ⁶	1.5035 ¹⁶	i H ₂ O; msc Et OH, et h
7756	3-Met hyl pyrrol e		C ₄ H ₇ N	616-43-3	81.117	li q	-48.4	142.9; 4 ⁵		1.4970 ²⁰	msc Et OH, et h
7757	N-Met hyl pyrrol i di ne		C ₅ H ₉ N	120-94-5	85.148			81	0.8188 ²⁰	1.4247 ²⁰	vs H ₂ O, et h
7758	1-Met hyl -2,5-pyrrol i di nedi one		C ₄ H ₅ NO ₂	1121-07-9	113.116	nd (et h- pet h, al, ace)	71	234			s H ₂ O, Et OH; vs et h
7759	N-Met hyl -2-pyrrol i di net hi one		C ₅ H ₉ NS	10441-57-3	115.197	oi l		100 ⁸			
7760	5-Met hyl -2-pyrrol i di none		C ₅ H ₉ NO	108-27-0	99.131		43	248	1.0458 ²⁰		
7761	1-(1-Met hyl -2-pyrrol i di nyl)-2-propanone, (R)	Hygri ne	C ₇ H ₁₃ NO	496-49-1	141.211			76.5 ¹¹		1.4555 ²⁰	vs Et OH, chl
7762	3-(1-Met hyl -2-pyrrol i di nyl)pyri di ne, (±)		C ₁₀ H ₁₄ N ₂	22083-74-5	162.231			244	1.0082 ²⁰	1.5289 ²⁰	msc H ₂ O; vs Et OH, et h, chl; s li g
7763	N-Met hyl -2-pyrrol i done		C ₆ H ₉ NO	872-50-4	99.131	li q	-23.09	202	1.023 ⁶	1.4684 ²⁰	vs H ₂ O; s et h, ace, chl
7764	1-(1-Met hyl -1H-pyrrol -2-yl)et hanone		C ₆ H ₉ NO	932-16-1	123.152			201 ²⁶² , 93 ²²	1.0445 ¹⁵	1.5403 ¹⁵	s Et OH, bz, chl
7765	6-Met hyl -8-qui noli nami ne	8-Ami no-6-met hyl qui noli ne	C ₁₀ H ₁₀ N ₂ C	68420-93-9	158.199	nd	73	sub			vs ace, bz, et h, Et OH
7766	2-Met hyl qui noli ne	Qui nai di ne	C ₁₀ H ₁₃ NC	91-63-4	143.185	col oi ly li q	-0.8	246.5	1.06	1.6116 ²⁰	sl H ₂ O; s Et OH, et h, ace, ct c, chl
7767	3-Met hyl qui noli ne		C ₁₀ H ₁₃ N	612-58-8	143.185	pr	16.5	259.8	1.0673 ²⁰	1.6171 ²⁰	vs ace, et h, Et OH
7768	4-Met hyl qui noli ne	Lepi di ne	C ₁₀ H ₁₃ N	491-35-0	143.185	col oi ly li q	9.5	262	1.083	1.6200 ²⁰	sl H ₂ O; s Et OH, et h, ace; i al k
7769	5-Met hyl qui noli ne		C ₁₀ H ₁₃ N	7661-55-4	143.185	col cry	19	262.7	1.083 ²⁰	1.6219 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
7770	6-Met hyl qui noli ne		C ₁₀ H ₁₃ N	91-62-3	143.185	col oi ly li q	-22	258.6	1.0654	1.6157 ²⁰	sl H ₂ O; s Et OH, et h, ace



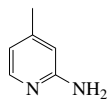
2-Met hyl pyrene



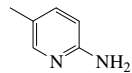
3-Met hyl pyri dazi



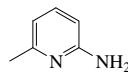
3-Met hyl -2-pyri di nami ne



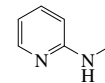
4-Met hyl -2-pyri di nami ne



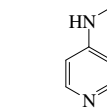
5-Met hyl -2-pyri di nami ne



6-Met hyl -2-pyri di nami ne



N-Met hyl -2-pyri di nami



N-Met hyl -4-pyri di nami ne



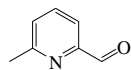
2-Met hyl pyri di



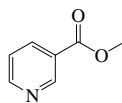
3-Met hyl pyri di ne



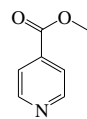
4-Met hyl pyri di ne



6-Met hyl -2-pyri di necarboxyl aldehido



Met hyl 3-pyri di necarboxyl ate



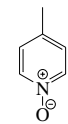
Met hyl 4-pyri di necarboxyl ate



2-Met hyl pyri di ne-1-ossi de



3-Met hyl pyri di ne-1-ossi de

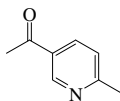


4-Met hyl pyri di ne-1-ossi de

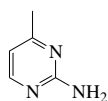
3-409



1-Met hyl -2(*H*)-pyri di none



1-(6-Met hyl -3-pyri di nyl)et hanone



4-Met hyl -2-pyri mi di nami ne



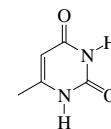
2-Met hyl pyri mi di ne



4-Met hyl pyri mi di ne



5-Met hyl pyri mi di ne



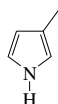
6-Met hyl -2,4(*H*,3*H*)-pyri mi di nedi one



1-Met hyl pyrrol e



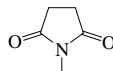
2-Met hyl pyrrol e



3-Met hyl pyrrol e



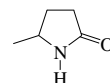
N-Met hyl pyrrol i di ne



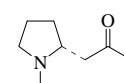
1-Met hyl -2,5-pyrrol i di nedi one



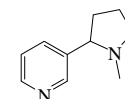
N-Met hyl -2-pyrrol i di net hi one



5-Met hyl -2-pyrrol i di none



1-(1-Met hyl -2-pyrrol i di nyl)-2-propano(*n*)o



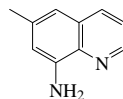
3-(1-Met hyl -2-pyrrol i di nyl)pyri di ne



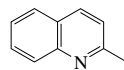
N-Met hyl -2-pyrrol i di none



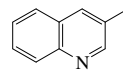
1-(1-Met hyl -*H*-pyrrol -2-yl)et hanone



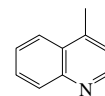
6-Met hyl -8-qui nol i nami ne



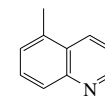
2-Met hyl qui nol i ne



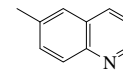
3-Met hyl qui nol i ne



4-Met hyl qui nol i ne

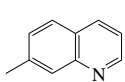


5-Met hyl qui nol i ne

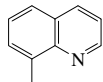


6-Met hyl qui nol i ne

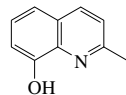
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7771	7-Met hyl qui nol i ne	<i>m</i> -Tol uqui nol i ne	$\text{C}_9\text{H}_9\text{N}$	612-60-2	143.185	ye cry	39	257.6	1.0609 ²⁰	1.6150 ²⁰	sl H ₂ O; s Et OH, et h, ace
7772	8-Met hyl qui nol i ne		$\text{C}_9\text{H}_9\text{N}$	611-32-5	143.185	col li q	-80	247.5	1.0719	1.6164 ²⁰	sl H ₂ O; s ace; msc Et OH, et h
7773	2-Met hyl -8-qui nol i nol		$\text{C}_9\text{H}_9\text{NO}$	826-81-3	159.184		73.8	267			i H ₂ O; s Et OH, et h, bz, ct c
7774	1-Met hyl -2(H)-qui nol i none		$\text{C}_9\text{H}_9\text{NO}$	606-43-9	159.184	nd (li g)	74	325			sl H ₂ O; s Et OH, et h, ace; vs bz
7775	1-Met hyl -4(H)-qui nol i none	Echi nopsi ne	$\text{C}_9\text{H}_9\text{NO}$	83-54-5	159.184	α -nd (bz); β -cry (al)					s H ₂ O; vs Et OH, bz, chl; sl et h
7776	2-Met hyl qui noxal i ne		$\text{C}_9\text{H}_9\text{N}_2$	7251-61-8	144.173	ye cry	180.5	244			msc H ₂ O, et h, ace, bz; vs Et OH; s ct c
7777	Met hyl Red	Benzoil c aci d, 2-[[4-(di met hyl ami n)phenyl]azo]-	$\text{C}_{10}\text{H}_{15}\text{N}_3\text{O}_2$	493-52-7	269.299	vi ol or red pr (t o, bz)	183				sl H ₂ O, li g; s Et OH; vs ace, bz, chl
7778	Met hyl β - <i>D</i> -ri bof uranosi de		$\text{C}_{10}\text{H}_{12}\text{O}_5$	7473-45-2	164.156		80				
7779	Met hyl sal i cyl at e	Met hyl 2-hydroxybenzoat e	$\text{C}_8\text{H}_8\text{O}_2$	119-36-8	152.148	li q	-8	222.9	1.187	1.535 ²⁰	sl H ₂ O; vs et h, Et OH, chl
7780	Met hyl si l ane		C_8H_8	992-94-9	46.145	col gas	-156.5	-57.5			
7781	Met hyl si l yl et her		$\text{C}_8\text{H}_8\text{O}$	2171-96-2	62.144	col gas	-98.5	-21; -87			
7782	Met hyl st annane		$\text{C}_8\text{H}_8\text{Sn}$	1631-78-3	136.769	col gas					dec H ₂ O
7783	Met hyl st earat e		$\text{C}_8\text{H}_{16}\text{O}_2$	112-61-8	298.504		39.1	443; 215 ¹⁵	0.8498 ⁴⁰	1.4367 ⁴⁰	vs et h, chl
7784	2-Met hyl st yrene		C_8H_8	611-15-4	118.175	li q	-68.5	169.8	0.9077	1.5437 ²⁰	i H ₂ O; s bz, chl
7785	3-Met hyl st yrene		C_8H_8	100-80-1	118.175	li q	-86.3	164	0.9076	1.5411 ²⁰	i H ₂ O; s Et OH, et h, bz
7786	4-Met hyl st yrene		C_8H_8	622-97-9	118.175	li q	-34.1	172.8	0.9173	1.5420	i H ₂ O; s bz
7787	Met hyl succi ni c aci d		$\text{C}_8\text{H}_8\text{O}_4$	636-60-2	132.116	pr	115	dec	1.4200 ⁰	1.4303	vs H ₂ O, Et OH, MeOH; s et h; sl chl
7788	Met hyl sul f at e		$\text{C}_8\text{H}_8\text{S}$	75-93-4	112.106		<-30	dec 135			vs H ₂ O, et h, Et OH
7789	(Met hyl sul finyl)benzene		$\text{C}_8\text{H}_8\text{OS}$	1193-82-4	140.203		32.0	263.5; 140 ¹³		1.5885 ²⁰	
7790	1-(Met hyl sul finyl)decane	Decyl met hyl sul f oxi de	$\text{C}_{11}\text{H}_{24}\text{OS}$	3079-28-5	204.373	cry	52.5				
7791	3-Met hyl sul f ol ane		$\text{C}_8\text{H}_8\text{O}_2\text{S}$	872-93-5	134.197		1	276	1.188 ²⁵	1.4772 ²⁰	
7792	(Met hyl sul f onyl)et hene		$\text{C}_8\text{H}_8\text{O}_2\text{S}$	3680-02-2	106.144			122 ²⁴	1.2117 ²⁰	1.4636 ²⁰	s et h, ace
7793	Met hyl t erephthal at e	Met hyl 1,4-benzenedi carboxyl at e	$\text{C}_8\text{H}_6\text{O}_4$	1679-64-7	180.158	nd (w)	222	subl = 230			
7794	17-Met hyl t est ost erone	17-Hydroxy-17-met hyl androst -4- e	$\text{C}_{26}\text{H}_{42}\text{O}_2$	58-18-4	302.451		163.5				vs et h, Et OH
7795	Met hyl t et radecanoat e		$\text{C}_{15}\text{H}_{30}\text{O}_2$	124-10-7	242.398		19	295; 155 ⁷	0.8671 ²⁰	1.425 ¹⁵	i H ₂ O; msc Et OH, et h, ace, bz, chl, ct c
7796	5- <i>N</i> -Met hyl -5,6,7,8-t et rahydrof oli c aci d		$\text{C}_{20}\text{H}_{25}\text{N}_7\text{O}_6$	134-35-0	459.456	cry (w)					
7797	2-Met hyl t et rahydrof uran		$\text{C}_8\text{H}_8\text{O}$	96-47-9	86.132			78	0.8552 ²⁰	1.4059 ²¹	s H ₂ O; vs Et OH, et h, ace, bz; sl ct c
7798	<i>N</i> -Met hyl <i>N</i> ,2,4,6-t et rani t roani li ne	Tet ryl	$\text{C}_7\text{H}_9\text{N}_3\text{O}_6$	479-45-8	287.144	ye pr (al)	131.5	exp 180	1.57 ⁰		i H ₂ O; sl Et OH, et h, chl; s ace, bz, py
7799	4-Met hyl -2-t hi azol ami ne	2-Ami no-4-met hyl t hi azol e	$\text{C}_7\text{H}_9\text{N}_3\text{S}$	1603-91-4	114.169		45.5	125 ²⁰ , 70 ^{0,4}			vs H ₂ O, Et OH, et h
7800	2-Met hyl t hi azol e		$\text{C}_7\text{H}_7\text{NS}$	3581-87-1	99.155			128		1.510	msc H ₂ O; s Et OH, ace
7801	4-Met hyl t hi azol e		$\text{C}_7\text{H}_7\text{NS}$	693-95-8	99.155			133.3	1.112 ²⁵		s H ₂ O, Et OH, et h
7802	4-Met hyl -5-t hi azol eet hanol		$\text{C}_7\text{H}_9\text{NOS}$	137-00-8	143.206	col t o pa ye		135	1.196 ²⁴		vs H ₂ O; s Et OH, et h, bz, chl
7803	4-Met hyl -2(M)-t hi azol et hi one		$\text{C}_7\text{H}_7\text{NOS}_2$	5685-06-3	131.220	ye cry (di l al)	89.3	188			vs Et OH
7804	Met hyl t hi i rane		$\text{C}_7\text{H}_7\text{S}$	1072-43-1	74.145	li q	-91	72.5	0.947	1.472 ²⁰	s chl
7805	(Met hyl t hi o)acet i c aci d		$\text{C}_7\text{H}_7\text{O}_2\text{S}$	2444-37-3	106.144		13.0	130 ²⁷	1.221 ²⁰	1.495 ²⁰	
7806	2-(Met hyl t hi o)ani li ne		$\text{C}_7\text{H}_7\text{NS}$	2987-53-3	139.218			234	1.111 ²⁵	1.6239 ²⁰	
7807	4-(Met hyl t hi o)ani li ne		$\text{C}_7\text{H}_7\text{NS}$	104-96-1	139.218			272.5	1.1379 ²⁰	1.6395 ²⁰	s Et OH, et h, ace, bz
7808	(Met hyl t hi o)benzene	Met hyl phenyl sul fide	$\text{C}_7\text{H}_7\text{S}$	100-68-5	124.204			193	1.0579 ²⁰	1.5868 ²⁰	i H ₂ O; s Et OH; vs ace
7809	2-(Met hyl t hi o)benzot hi azol e		$\text{C}_7\text{H}_7\text{NS}_2$	615-22-5	181.279	pr (di l al)	52	174			s Et OH, chl
7810	Met hyl t hi ocyanat e		$\text{C}_7\text{H}_7\text{ONS}$	556-64-9	73.117	col li q	-2.5	132.9	1.0678	1.4669 ²⁵	sl H ₂ O; msc Et OH, et h; s ct c



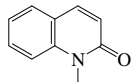
7-Met hyl qui nol i ne



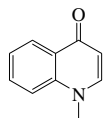
8-Met hyl qui nol i ne



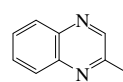
2-Met hyl -8-qui nol i nol



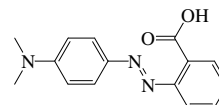
1-Met hyl -2(1#)-qui nol i none



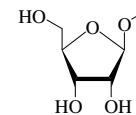
1-Met hyl -4(1#)-qui nol i none



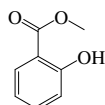
2-Met hyl qui noxal i ne



Met hylRed



Met hyl- β -D-ri bof uransi de



Met hylsal i cyl at e



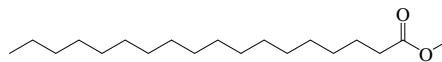
Met hyl si l ane



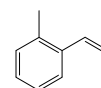
Met hyl si lyèt her



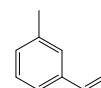
Met hyl st annane



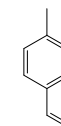
Met hyl st earat e



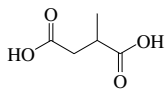
2-Met hyl st yrene



3-Met hyl st yrene



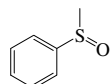
4-Met hyl st yrene



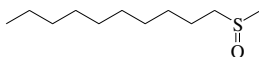
Met hyl succi niãci d



Met hylsul f at e



(Met hyl sul f i nyl) benzene



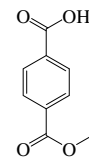
1-(Met hyl sul f i nyl) decane



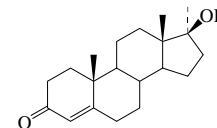
3-Met hylsul f ol ane



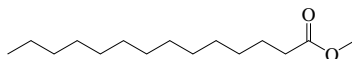
(Met hyl sul f onyl) et hene



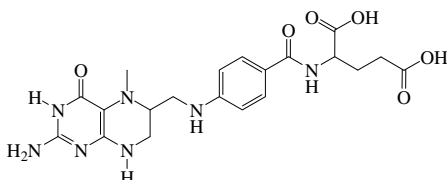
Met hyl t ereph thal at e



17-Met hyl t est ost erone



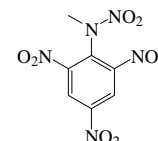
Met hyl t et radecanoat e



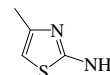
5-*N*-Met hyl -5,6,7,8-t et rahydrof olaci d



2-Met hyl t et rahydrof uran



N-Met hyl A,2,4,6-t et rani t roani li ne



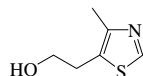
4-Met hyl -2-t hi azol ami ne



2-Met hyl t hi azol e



4-Met hyl t hi azol e



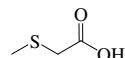
4-Met hyl -5-t hi azol eet hanol



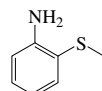
4-Met hyl -2(1#)-t hi azol et hi one



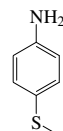
Met hyl t hi i rane



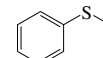
(Met hyl t hi o) acetèici d



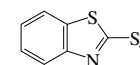
2-(Met hyl t hi o) ani li ne



4-(Met hyl t hi o) ani li ne



(Met hyl t hi o) benzene

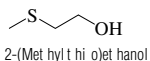


2-(Met hyl t hi o) benzot hi azol e

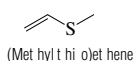


Met hyl t hi ocyanat e

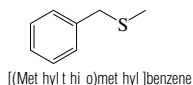
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7811	2-(Met hyl t hi o)et hanol		$\text{C}_4\text{H}_{10}\text{OS}$	5271-38-5	92.160			70 ²⁰	1.063 ²⁰	1.4861 ³⁰	vs H ₂ O, et h, Et OH
7812	(Met hyl t hi o)et hene		$\text{C}_4\text{H}_8\text{S}$	1822-74-8	74.145			69.5	0.9026 ²⁰	1.4837 ²⁰	s et h, ace, chl
7813	[(Met hyl t hi o)met hyl]benzene		$\text{C}_8\text{H}_{10}\text{S}$	766-92-7	138.230	li q	-30	210; 120	1.0274 ²⁰	1.5620 ²⁰	
7814	4-(Met hyl t hi o)-2-oxobutanoi c aci d		$\text{C}_4\text{H}_6\text{O}_2\text{S}$	583-92-6	148.181	oi l					
7815	2-Met hyl t hi ophene		$\text{C}_8\text{H}_8\text{S}$	554-14-3	98.167	li q	-63.4	112.6	1.0199	1.5203 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, hp, ct c
7816	3-Met hyl t hi ophene		$\text{C}_8\text{H}_8\text{S}$	616-44-4	98.167	li q	-69	115.5	1.0210	1.5204 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; vs chl
7817	5-Met hyl -2-t hi ophenecarboxaldehyde		$\text{C}_8\text{H}_8\text{O}_2\text{S}$	13679-70-4	126.176			114 ²⁵		1.5825 ²⁰	s chl
7818	4-(Met hyl t hi o)phenol		$\text{C}_7\text{H}_8\text{OS}$	1073-72-9	140.203		84	154 ²⁰ , 113 ⁶			
7819	3-(Met hyl t hi o)propanal		$\text{C}_5\text{H}_{10}\text{OS}$	3268-49-3	104.171			62 ¹¹			
7820	3-(Met hyl t hi o)propanoi c aci d	S-Met hyl propi ot het i n	$\text{C}_4\text{H}_8\text{O}_2\text{S}$	646-01-5	120.171	ye oi l or fl (hx)	21	130			
7821	3-(Met hyl t hi o)-1-propene		$\text{C}_4\text{H}_6\text{S}$	10152-76-8	88.172			92	0.8767 ²⁰	1.4714 ²⁰	
7822	N-Met hyl t hi osemi carbazi de	N-Met hyl hydrazi necarbot hi oami de	$\text{C}_2\text{H}_4\text{N}_2\text{S}$	6610-29-3	105.162		136.5				s H ₂ O, Et OH, DMSO; i et h, bz, li g
7823	Met hyl t hi ouraci l		$\text{C}_4\text{H}_6\text{N}_2\text{OS}$	56-04-2	142.179		330 dec	sub			i H ₂ O; sl Et OH, et h, MeOH, bz
7824	Met hyl t hi ourea		$\text{C}_2\text{H}_4\text{N}_2\text{S}$	598-52-7	90.147	pr (Et OH)	121				vs H ₂ O, Et OH; sl et h; s ace
7825	1-Met hyl t hymi ne	1,5-Di met hyl -2,4,6-tri-pyri mi di nedi one	$\text{C}_8\text{H}_{10}\text{N}_2\text{O}_2$	4160-72-9	140.140	nd (w)	295				s H ₂ O
7826	Met hyl t hymol bl ue, sodi um salt		$\text{C}_{37}\text{H}_{40}\text{N}_2\text{O}_{13}\text{Na}_4\text{S}$	1945-77-3	844.743	bl-vi ol cry					s H ₂ O
7827	Met hyl 4-t ol uenesul f onat e		$\text{C}_8\text{H}_9\text{O}_2\text{S}$	80-48-8	186.228		28.5	292; 186 ²²	1.2087 ⁴⁰		i H ₂ O; vs Et OH, bz; s et h, ct c; sl li g
7828	Met hyl t ri acet oxyli ane	Met hyl si lanet ri ol, t ri acet at e	$\text{C}_{12}\text{H}_{20}\text{O}_3\text{Si}$	4253-34-3	220.252		40.5	111 ⁷	1.1750 ²⁰	1.4083 ²⁰	
7829	6-Met hyl -1,2,4-t ri azi ne-5,6-di one	6-Azat hymi ne	$\text{C}_6\text{H}_8\text{N}_2\text{O}_2$	932-53-6	127.102	cry (w)	211				s H ₂ O, Et OH, ace
7830	5-Met hyl -[1,2,4]t ri azol o[1,5-a]pyri mi di n-7-ol		$\text{C}_6\text{H}_8\text{N}_4\text{O}$	2503-56-2	150.138			>245			
7831	Met hyl t ri chl oroacet at e		$\text{C}_2\text{H}_2\text{Cl}_3\text{O}_2$	598-99-2	177.414	li q	-17.5	153.8	1.4874	1.4572 ²⁰	i H ₂ O; vs Et OH, et h; s ct c
7832	Met hyl t ri chl orosi lane		$\text{C}_3\text{Cl}_3\text{Si}$	75-79-6	149.480	li q	-90	65.6	1.279	1.4106 ²⁰	dec H ₂ O, Et OH
7833	Met hyl t ri decanoat e		$\text{C}_{34}\text{H}_{68}\text{O}_2$	1731-88-0	228.371		6.5	92 ¹		1.4405 ²⁰	msc Et OH; s ct c
7834	Met hyl t ri et hyl lead	Tri et hyl met hyl pl umbane	$\text{C}_7\text{H}_{18}\text{PbC}$	1762-28-3	309.4	col li q		70	1.71 ²⁰		
7835	Met hyl t ri fluoroacet at e		$\text{C}_2\text{H}_2\text{F}_6\text{O}_2$	431-47-0	128.050			43.0	1.28 ²⁰		
7836	Met hyl t ri fluoromet hyl et her		$\text{C}_2\text{H}_2\text{F}_6\text{O}$	421-14-7	100.039	col gas	-149	-23.66			
7837	Met hyl 3,4,5-t ri hydroxybenzoat e		$\text{C}_7\text{H}_6\text{O}_5$	99-24-1	184.147	mcl pr (MeOH)	202				sl H ₂ O; vs Et OH, MeOH
7838	Met hyl 3,4,5-t ri met hoxybenzoat e		$\text{C}_{11}\text{H}_{14}\text{O}_5$	1916-07-0	226.226		83	274.5			
7839	Met hyl t ri phenoxyli ane		$\text{C}_{19}\text{H}_{16}\text{O}_3\text{Si}$	3439-97-2	322.430			269 ³⁰ , 179 ²	1.135 ²⁰	1.5599 ²⁰	
7840	Met hyl t ri thi on		$\text{C}_3\text{H}_6\text{Cl}_3\text{OPS}_3$	953-17-3	314.812	ye li q	-18				sl H ₂ O; mi sc os
7841	N-Met hyl L-t rypt ophan	L-Abr i ne	$\text{C}_9\text{H}_{14}\text{N}_2\text{O}_2$	526-31-8	218.251	pr (w)	295 dec				sl H ₂ O, MeOH; i et h; s al k
7842	N-Met hyl L-t yrosi ne	Suri nami ne	$\text{C}_{10}\text{H}_{13}\text{NO}_3$	537-49-5	195.215	nd	293				
7843	α -Met hyl β -L-t yrosi ne, met hyl est er, hydrochl ori de		$\text{C}_{11}\text{H}_{16}\text{ClNO}_3$	7361-31-1	245.703		190 dec				s H ₂ O
7844	2-Met hyl undecanal		$\text{C}_{12}\text{H}_{24}\text{O}$	110-41-8	184.318			119 ¹⁵ , 114 ¹⁰	0.832 ¹⁵	1.4321 ²⁰	sl H ₂ O; s Et OH, et h
7845	2-Met hyl undecane		$\text{C}_{12}\text{H}_{26}$	7045-71-8	170.334	li q	-45.6	210.2		1.4199	
7846	3-Met hyl undecane		$\text{C}_{12}\text{H}_{26}$	1002-43-3	170.334	col li q	-58.0	211.2	0.7485	1.4208 ²⁵	
7847	Met hyl undecanoat e		$\text{C}_{12}\text{H}_{24}\text{O}_2$	1731-86-8	200.318			123 ¹⁰			
7848	2-Met hyl -1-undecanol		$\text{C}_{12}\text{H}_{26}\text{O}$	10522-26-6	186.333			129 ¹²	0.8300 ¹⁵	1.4382 ²⁰	vs et h, Et OH
7849	Met hyl 10-undecanoat e		$\text{C}_{12}\text{H}_{22}\text{O}_2$	111-81-9	198.302	li q	-27.5	248	0.889	1.4393 ²⁰	i H ₂ O; s Et OH, et h, HOAc; sl ct c
7850	N-Met hyl urea		$\text{C}_2\text{H}_4\text{N}_2\text{O}$	598-50-5	74.081	ort h pr (w, al)	104.9	dec	1.2040		vs H ₂ O, Et OH; i et h, bz; s CS ₂ li g



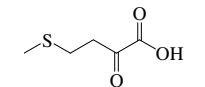
2-(Met hyl t hi o)et hanol



(Met hyl t hi o)et hene



[(Met hyl t hi o)met hyl]benzene



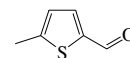
4-(Met hyl t hi o)-2-oxobut anoi c acid



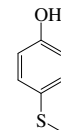
2-Met hyl t hi ophene



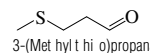
3-Met hyl t hi ophene



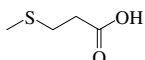
5-Met hyl -2-t hi ophene carboxal dehyde



4-(Met hyl t hi o)phenol



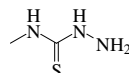
3-(Met hyl t hi o)propanal



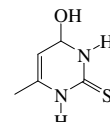
3-(Met hyl t hi o)propanoi c acid



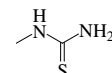
3-(Met hyl t hi o)-1-propene



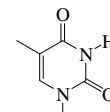
N-Met hyl t hi osemi carba zi de



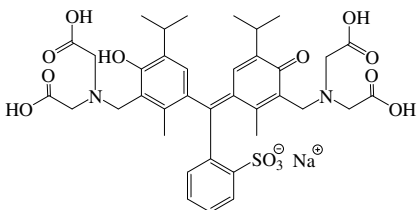
Met hyl t hi ouraci l



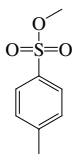
Met hyl t hi urea



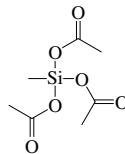
1-Met hyl t hymi ne



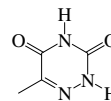
Met hyl t hymi ne, sodi um salt



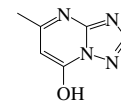
Met hyl 4-t ol uenesul f onat e



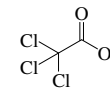
Met hyl t ri acet oxy si lane



6-Met hyl -1,2,4-t ri azi ne-3,5-di one



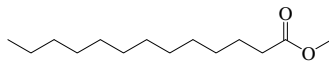
5-Met hyl -[1,2,4]t ri azol o[1,5-a]pyri mi di n-7-ol



Met hyl t ri chl oroacet at e



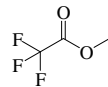
Met hyl t ri chl orosi l



Met hyl t ri decanoat e



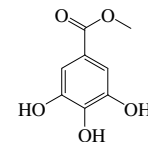
Met hyl t ri et hyl l



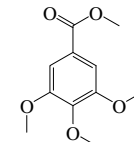
Met hyl t ri fl uoroacet at e



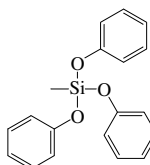
Met hyl t ri fl uoromet hyl er



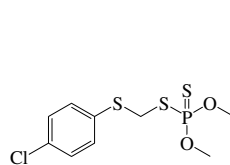
Met hyl 3,4,5-t ri hydroxybenzoat e



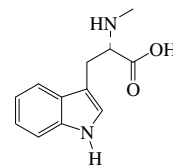
Met hyl 3,4,5-t ri met hoxybenzoat e



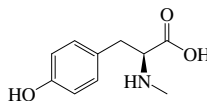
Met hyl t ri phenoxy si l



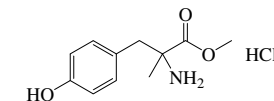
Met hyl t ri t hi on



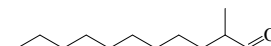
N-Met hyl L-t rypt ophan



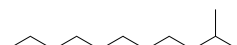
N-Met hyl L-t yrosi ne



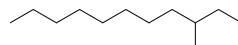
α-Met hyl DL-t yrosi ne, met hyl est er, hydrochl ori de



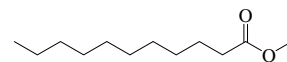
2-Met hyl undecanal



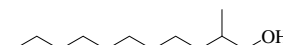
2-Met hyl undecane



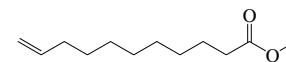
3-Met hyl undecane



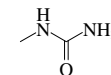
Met hyl undecanoat e



2-Met hyl -1-undecanol

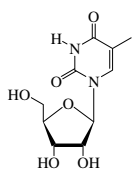


Met hyl 10-undecenoat e

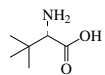


N-Met hyl urea

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7851	5-Met hyl uri di ne	Thymi ne ri bosu de	$_{10}H_{14}O_2$	1463-10-1	258.227	cry (Et OH)	184				
7852	3-Met hyl E-val i ne	<i>L</i> -t erfl euci ne	$C_8H_{13}NO_2$	20859-02-3	131.173		248 dec				
7853	2-(1-Met hyl vi nyl)ani li ne		$_{9}H_{11}N$	52562-19-3	133.190			115 ²⁰ , 95 ¹³	0.977 ²⁵	1.5722 ²⁰	
7854	1-Met hyl -4-vi nyl cycl ohexene		$_{9}C_4$	17699-86-4	122.207	li q		152	0.85	1.470 ⁴	
7855	4-(1-Met hyl vi nyl)-1-cycl ohexene-1-carboxal dehyde, (<i>R</i>)	<i>d</i> -Peri l l al dehyde	$_{10}H_{14}O$	5503-12-8	150.217	oi l		238; 99	0.953 ²⁰	1.5058 ²⁰	s ct c
7856	4-(1-Met hyl vi nyl)-1-cycl ohexene-1-carboxal dehyde, (<i>S</i>)	<i>l</i> -Peri l l al dehyde	$_{10}H_{14}O$	18031-40-8	150.217	oi l		10 ⁴	0.9645 ²⁰	1.5072 ²⁰	
7857	4-(1-Met hyl vi nyl)-1-cycl ohexene-1-met hanol		$C_{10}H_{16}O$	536-59-4	152.233			244; 12.5 ¹²	0.9690 ²⁰	1.5005 ²⁰	
7858	(1-Met hyl vi nyl)cycl opropane		$_{6}C_{10}$	4663-22-3	82.143	li q	-102.3	70	0.75 ⁴	1.4252 ²⁰	
7859	Met hyl vi nyl et her		$_{3}HCO$	107-25-5	58.079	col gas	-122	5.5	0.772 ⁹	1.3730 ⁰	sl H ₂ O; vs Et OH, et h, ace, bz
7860	Met hyl Vi olet	C.I. Basi c Vi olet 1	$_{24}H_{28}ClN_2$	8004-87-3	393.952	bl-vi ol pow	137 dec				s H ₂ O, Et OH
7861	Met hysergi de		$_{27}H_{27}N_3O_2$	361-37-5	353.458	cry	195				
7862	Met hyst i ci n		$_{15}H_{14}O_5$	495-85-2	274.269	nd (MeOH), pr (ace)	137				
7863	Met obromuron	3- <i>p</i> -Bromophenyl)-1-met hoxyl-1-met hyl urea	$C_9H_{11}BrN_2O_2$	3060-89-7	259.099		95		1.60 ²⁰		
7864	Met ol achlor		$C_7H_{12}ClNO_2$	51218-45-2	283.795			100 ^{0.001}	1.12 ²⁰		
7865	Met ol azone		$C_6H_{16}ClN_2O_3S$	17560-51-9	365.834	cry (Et OH)	254				
7866	Met oprolol t art rat e		$_{34}H_{36}N_2O_{12}$	56392-17-7	684.815	cry	121				
7867	Met ri buzi n		$_{8}H_8N_4OS$	21087-64-9	214.288		126		1.31 ²⁰		
7868	Met roni dazole	2-Met hyl -5-ni t r o- <i>m</i> i dazol e-1-et hanol	$C_6H_9N_3O_3$	443-48-1	171.153		160.5				
7869	Met sul f uron-met hyl		$_{14}H_{15}N_5O_6S$	74223-64-6	381.364	wh cry	163				sl H ₂ O
7870	Mevi nphos		$C_7H_{13}O_8P$	7786-34-7	224.148		21 (<i>E</i>), 6.9 (<i>Z</i>)	101 ^{0.3}			
7871	Mexacbarbat e	4-(Di met hyl ami no)-3,5-xyl yl met hyl carbat e	$C_{12}H_{18}N_2O_2$	315-18-4	222.283	cry	85				vs Et OH, bz, ace
7872	MGK 264		$C_{17}H_{25}NO_2$	113-48-4	275.387		<-20	157	1.04		
7873	Mi f epr i st one	RU-486	$_{29}H_{35}NO_2$	84371-65-3	429.594	cry	150				
7874	Mi mosi ne		$_{8}H_{10}N_2O_4$	500-44-7	198.176	t ab (w)	228 dec				sl H ₂ O; i Et OH, et h, ace, bz; s di alk
7875	Mi nocycl i ne		$_{26}H_{27}N_5O_7$	10118-90-8	457.476	ye-oran amorp sol i d					
7876	Mi noxi di l		$_{9}H_9N_3O$	38304-91-5	209.248	cry	248				i ace, bz, chl , sl ; Et OH, MeOH
7877	Mi paf ox	Bi s(i sopropl ami do)fluorophosphat e	$_{16}H_{16}F_2O_2P$	371-86-8	182.175	cry (pet h)	65	125			sl H ₂ O
7878	Mi rex	Hexachl oropent adi ene di mer	$_{10}Cl_{12}$	2385-85-5	545.543	cry (bz)	485 dec				vs bz, di ox
7879	Mi soprost ol		$_{26}H_{36}O_5$	59122-46-2	382.534	ye oi l					s H ₂ O
7880	Mi t hramyci n	Pl i camyci n	$_{52}H_{60}O_{24}$	18378-89-7	1085.145	ye cry (ace)	182				s H ₂ O, Et OH, AcOEt ; sl bz, et h
7881	Mi t omyci n A		$_{16}H_{19}N_3O_6$	4055-39-4	349.338	purp nd	160 dec				
7882	Mi t omyci n B		$_{16}H_{19}N_3O_6$	4055-40-7	349.338	purp-bl nd	dec				
7883	Mi t omyci n C		$_{19}H_{18}N_3O_5$	50-07-7	334.328	bl-vi ol cry	360				s H ₂ O, MeOH, ace
7884	Mi t ot ane		$_{11}H_{10}Cl_4$	53-19-0	320.041		77				
7885	Mi t ragyni ne	9-Met hoxycorynant hei di ne	$_{23}H_{30}O_4$	4098-40-2	398.495	wh amor pow	104	235 ⁵			s Et OH, chl , HOAc
7886	Mol i nat e	Et hyl 1-hexamet hyl enei mi necarbot hi ol at e	$C_9H_{17}NOS$	2212-67-1	187.302			202 ¹⁰	1.063 ²⁰		
7887	Mol i ndone		$C_7H_{12}N_2O_2$	7416-34-4	276.374	cry	180				
7888	Mol ybdenum hexacarbonyl		C_6MoO_6	13939-06-5	264.00		dec 150				s os



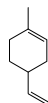
5-Methyluridine



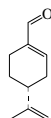
3-Methylvaline



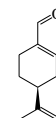
2-(1-Methyl-4-vinylphenyl)aniline



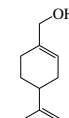
1-Methyl-4-vinylcyclohexene



4-(1-Methyl-4-vinyl-1-cyclohexene-1-carboxaldehyde)



4-(1-Methyl-4-vinyl-1-cyclohexene-1-carboxaldehyde)



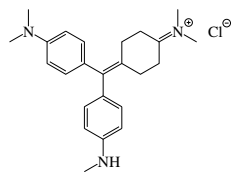
4-(1-Methyl-4-vinyl-1-cyclohexene-1-methanol)



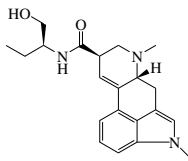
(1-Methyl-4-vinyl-1-cyclopropane)



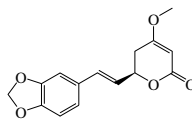
Methyl vinyl ether



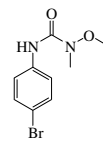
Methylviolate



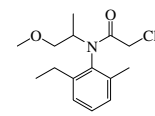
Methylsergide



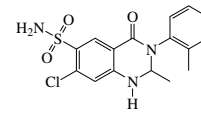
Methylcinnon



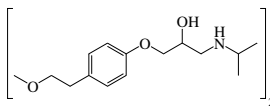
Methylbromuron



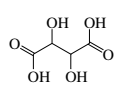
Methylachlor



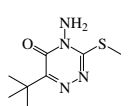
Methylazone



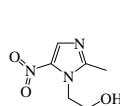
Methylproprate



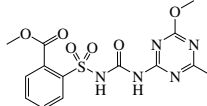
Methylribose



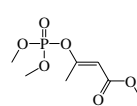
Methylronidazole



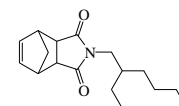
Methylsulfonylurea



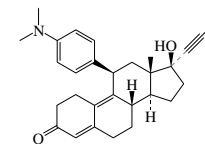
Methylphosphonate



Methylcarbate

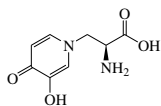


MGK 264

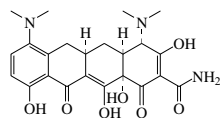


Methylamphetamine

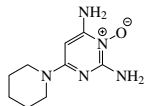
3-415



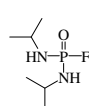
Mimosine



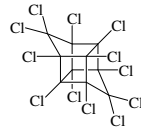
Minoxidil



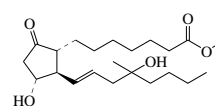
Minoxidil



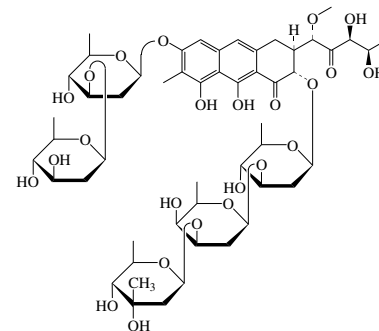
Minoxidil



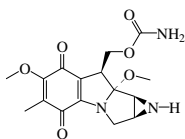
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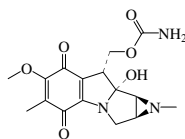
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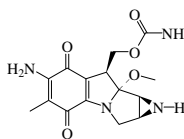
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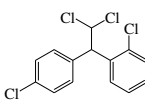
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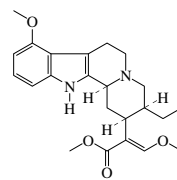
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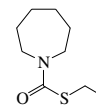
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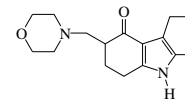
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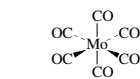
Minoxidil



Minoxidil

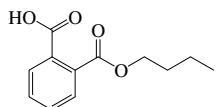


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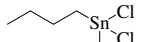


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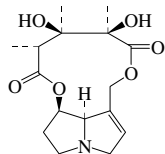
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7889	Monobutyl phthalate	1,2-Benzenedi carboxyl i c aci d, monobutyl est er	C ₁₂ H ₁₄ O ₄	131-70-4	222.237	pl (ace, al)	73.5				vs Et OH, chl
7890	Monobutyl tin chloride		C ₄ H ₉ ClSn	1118-46-3	282.183	hyg li q	-63	99	0.85 ²⁰		s bz, CH ₂ Cl ₂
7891	Monocrotaline		C ₁₀ H ₂₃ NO ₆	315-22-0	325.357	wh pr (Et OH)	198 dec				
7892	Monocrotaphos		CH ₁₄ N ₂ O ₃ P	6923-22-4	223.164		55	125 ^{0.0005}	1.33 ²⁰		
7893	Monolinuron	N-(4-Chlorophenyl)N-methyl-N-methyl urea	C ₉ H ₁₁ ClN ₂ O ₂	1746-81-2	214.648	sol i d	77				
7894	Monomethyl adipate		C ₁₀ H ₁₈ O ₄	627-91-8	160.168	lf (Meth-MeOH)	9	158 ¹⁰	1.0623 ²⁰	1.4283 ²⁰	s Et OH
7895	Monomethyl glutarate		C ₁₀ H ₁₈ O ₄	1501-27-5	146.141			158 ²⁷ , 150 ¹⁰	1.169 ²⁵	1.4381 ²⁰	
7896	Monosodium glutamate		C ₅ H ₉ NNaO ₄	142-47-2	169.113						s H ₂ O
7897	Moqui zone		C ₂₀ H ₂₁ N ₃ O ₃	19395-58-5	351.399		136				s chl
7898	Morin		C ₉ H ₁₀ O ₇	480-16-0	302.236	paye nd (+1 w, di l al)	303.5				sl H ₂ O, et h; vs Et OH; s bz, al k; i CS ₂
7899	Morphine		C ₁₇ H ₁₉ NO ₃	57-27-2	285.338	pr	255	sub 190			i H ₂ O, et h, ace; s MeOH, py; sl Et OH
7900	4-Morpholinamine		C ₆ H ₁₀ N ₂ O	4319-49-7	102.134			166	1.059 ²⁵	1.4772 ²⁰	
7901	Morpholine	Tetrahydro-1,4-oxazine	C ₄ H ₈ NO	110-91-8	87.120	hyg li q	-4.8	128	1.000 ⁹	1.4548 ²⁰	msc H ₂ O; s Et OH, et h, ace, bz; sl chl
7902	4-Morpholinecarboxaldehyde		C ₆ H ₁₀ NO ₂	4394-85-8	115.131		21	239	1.1520 ²⁰	1.4845 ²⁰	
7903	4-Morpholinethanamine		C ₆ H ₁₂ N ₂ O	2038-03-1	130.187		25.6	205	0.9897 ²⁰	1.4715 ²⁰	msc H ₂ O, Et OH, bz, li g; s ace
7904	4-Morpholinethanol		C ₆ H ₁₃ NO ₂	622-40-2	131.173	li q	-0.8	227	1.071 ⁹	1.4763 ²⁰	s H ₂ O, Et OH; sl ct c
7905	4-Morpholinopropanamine	4-(3-Aminopropyl)morpholine	C ₇ H ₁₄ N ₂ O	123-00-2	144.214	li q	-15	220, 134	0.9854 ²⁰	1.4762 ²⁰	msc H ₂ O, Et OH, bz, li g; s ace; sl ct c
7906	2-(4-Morpholinyl)benzoic acid	4-(2-Benzoylaminophenyl)morpholine	C ₁₄ H ₁₆ N ₂ O ₃	102-77-2	252.355	cry (Et OH)	85				
7907	4-(4-Morpholinyl)aniline		C ₁₀ H ₁₄ N ₂ O	2524-67-6	178.230		131.6				
7908	2-(4-Morpholinyl)benzoic acid		C ₁₄ H ₁₆ N ₂ O ₃	95-32-9	284.420		135				
7909	Muldamine		C ₈ H ₁₇ NO ₃	36069-45-1	457.688		210				
7910	Murexide	5,5'-Nitriolobarbituric acid, ammonium salt	C ₈ H ₁₀ N ₄ O ₇	3051-09-0	302.201						sl H ₂ O; i Et OH, et h; s al k
7911	Muscimol	5-(Aminomethyl)-2-imidazolidinone	C ₄ H ₈ N ₂ O ₂	2763-96-4	114.103	cry (Et OH)	175 dec				
7912	Myclobutanil		C ₁₃ H ₁₇ ClN ₄	88671-89-0	288.776	ye cry	65	205 ^{1.0}			i H ₂ O, pet h; s Et OH
7913	Mycophenolic acid		C ₁₃ H ₂₀ O ₆	24280-93-1	320.337	nd (w)	141				i H ₂ O; vs Et OH, et h, chl; sl bz, t ol
7914	β-Myrcene	7-Methyl-3-methylene-1,6-octadiene	C ₁₀ H ₁₆	123-35-3	136.234			167	0.8013 ¹⁵	1.4722 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, HOAc
7915	Myristicin		C ₁₁ H ₁₆ O ₃	607-91-0	192.211		<-20	276.5	1.1416 ²⁰	1.5403 ²⁰	i H ₂ O; sl Et OH; s et h, bz
7916	Nabam	Sodium ethylenedisulfocarbamate	C ₄ H ₆ N ₂ Na ₂ S ₄	142-59-6	256.344	cry (w)					s H ₂ O
7917	Nadolol		C ₁₇ H ₂₇ NO ₄	42200-33-9	309.401	cry (bz)	≈130				s Et OH; sl chl; i ace, et h, hx
7918	Naled	1,2-Dibromo-2,2-dichloroethyl phosphoric acid, dimethyl ester	C ₄ H ₄ Br ₂ Cl ₂ O ₄ P	300-76-5	380.784		27	110 ^{0.5}	1.96 ²⁰		
7919	Nalidixic acid		C ₁₂ H ₁₂ N ₂ O ₃	389-08-2	232.234		229.5				sl Et OH, et h; s chl
7920	Nalmefene		C ₂₁ H ₂₅ NO ₃	55096-26-9	339.429	cry (AcOEt)	189				
7921	Nalorphine	Acetorphine	C ₁₉ H ₂₁ NO ₃	62-67-9	311.375	cry (et h)	208				sl H ₂ O; s al k, ace, Et OH
7922	Naloxone		C ₁₉ H ₂₁ NO ₄	465-65-6	327.375	cry (AcOEt)	178				i pet h; s chl
7923	Naltrexone		C ₁₉ H ₂₃ NO ₄	16590-41-3	341.402	cry (ace)	169				
7924	Nandrolone	17-Hydroxyestr-4-en-3-one	C ₁₈ H ₂₆ O ₂	434-22-0	274.398	cry	112				s Et OH, et h, chl
7925	Naphazoline hydrochloride		C ₁₄ H ₁₄ ClN ₂	550-99-2	245.727						sl H ₂ O



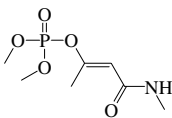
Monobutylphthalate



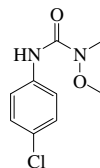
Monobutyltin dichloride



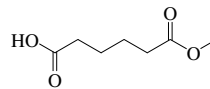
Monocrotaline



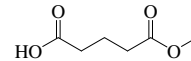
Monocrotophos



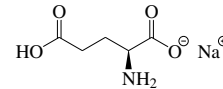
Monolignin



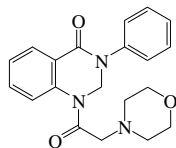
Monomethyladipate



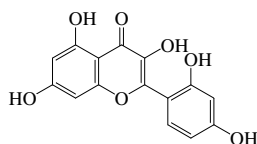
Monomethylglutarate



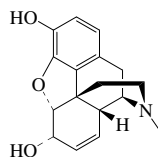
Monosodium L-glutamate



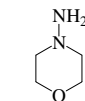
Moqui zone



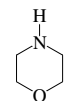
Morin



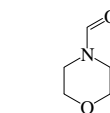
Morphine



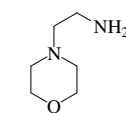
4-Morpholineamine



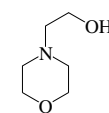
Morpholine



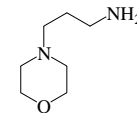
4-Morpholinecarboxaldehyde



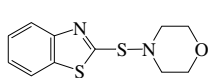
4-Morpholineethanamine



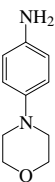
4-Morpholineethanol



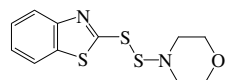
4-Morpholinepropanamine



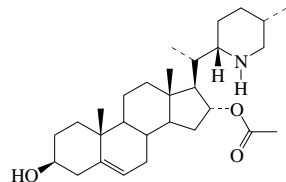
2-(4-morpholinyl)thiazole



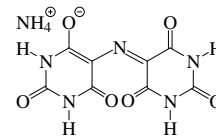
4-(4-morpholinyl)aniline



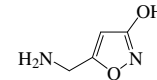
2-(4-morpholinyl)thiazole



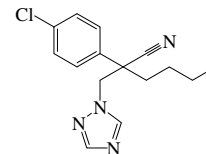
Muldamine



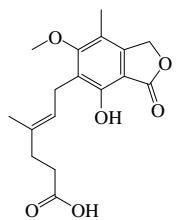
Murexide



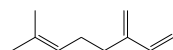
Muscimol



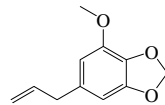
Myclobutanil



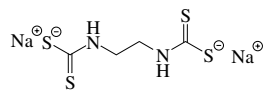
Mycophenolic acid



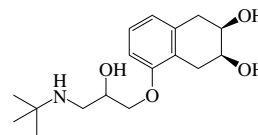
β-Myrcene



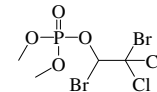
Myristicin



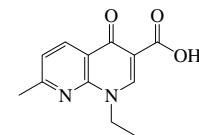
Nabam



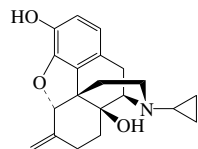
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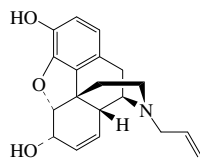
Naled



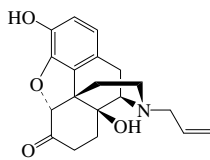
Nalidixic acid



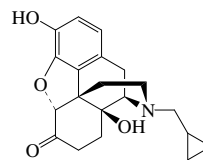
Nalmefene



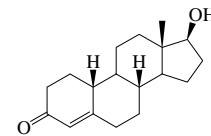
Nalorphine



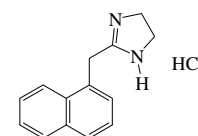
Naloxone



Naltrexone

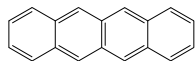


Nandrolone

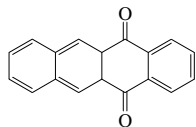


Naphazoline hydrochloride

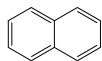
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7926	Napht hacene	2,3-Benzant hracene	C ₉ H ₁₂	92-24-0	228.288	oran-ye lf (bz, xyl)	357	sub			i H ₂ O; sl bz; s con sul f
7927	5,12-Napht hacenedi one		C ₉ H ₁₀ O ₂	1090-13-7	258.271		285 dec				sl ace, bz, gl HOAc
7928	Napht hal ene		C ₁₀ H ₈	91-20-3	128.171	mcl pl (al)	80.26	217.9	1.0253	1.5898 ²⁵	i H ₂ O; s Et OH; vs et h, ace, bz, C ₆ S ₆
7929	1-Napht hal eneacet ami de		C ₁₂ H ₁₁ NO	86-86-2	185.221	nd(w, al)		sub 180			i H ₂ O; s et h, bz, C ₆ S ₆ , HOAc
7930	1-Napht hal eneacet i c aci d	1-Napht hyl acet i c aci d	C ₁₂ H ₁₀ O ₂	86-87-3	186.206	nd (w)	135	dec			sl H ₂ O, Et OH; vs et h, ace, chl ; s bz
7931	2-Napht hal eneacet i c aci d	2-Napht hyl acet i c aci d	C ₁₂ H ₁₀ O ₂	581-96-4	186.206	lf (w) cry (bz)	143				vs et h, li g, chl
7932	1-Napht hal eneacet oni t ri le		C ₁₂ H ₁₀ O	132-75-2	167.206		32.5	192 ¹⁸ , 163 ¹²		1.6192 ²⁰	s Et OH
7933	1-Napht hal enecarboni t ri le		C ₁₁ H ₉ NO	86-53-3	153.181	nd (li g)	37.5	299	1.1080	1.6298 ¹⁸	i H ₂ O; vs Et OH, et h; s li g
7934	2-Napht hal enecarboni t ri le		C ₁₁ H ₉ NO	613-46-7	153.181	lf (li g)	66	306.5	1.0785		sl H ₂ O, chl ; s Et OH, et h, li g
7935	1-Napht hal enecarbonyl chl ori de		C ₁₁ H ₉ ClO	879-18-5	190.626		20	297.5			
7936	2-Napht hal enecarbonyl chl ori de		C ₁₁ H ₉ ClO	2243-83-6	190.626	cry (pet h)	51	305			vs bz, et h, chl
7937	1-Napht hal enecarboxal dehyde		C ₁₁ H ₉ O	66-77-3	156.181	pa ye	33.5	292	1.1503 ²⁰	1.6507 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, sul f
7938	2-Napht hal enecarboxal dehyde		C ₁₁ H ₉ O	66-99-9	156.181	lf (w)	62	160	1.0775 ⁹⁹	1.6211 ⁹⁹	sl H ₂ O; vs Et OH, et h; s ace
7939	1-Napht hal enecarboxyl i c aci d	1-Napht hoi c aci d	C ₁₁ H ₉ O ₂	86-55-5	172.181	nd (HOAc-w, w, al)	161	>300	1.398 ²⁵	1.46	i H ₂ O; vs et h, Et OH, chl
7940	2-Napht hal enecarboxyl i c aci d	2-Napht hoi c aci d	C ₁₁ H ₉ O ₂	93-09-4	172.181	nd (li g, chl , sub) pl (ace)	185.5	>300	1.077 ¹⁰⁰		sl H ₂ O, DMSO, li g; s Et OH, et h, chl
7941	1,5-Napht hal enedi ami ne	1,5-Di ami nonapht hal ene	C ₁₀ H ₁₀ O ₂	2243-62-1	158.199	pr (et h, al , w)	190	sub	1.4		s H ₂ O, Et OH, et h; vs chl
7942	1,8-Napht hal enedi ami ne	1,8-Di ami nonapht hal ene	C ₁₀ H ₁₀ O ₂	479-27-6	158.199		66.5	205 ¹²	1.1265 ⁹⁰	1.6828 ⁹⁹	vs et h, Et OH
7943	2,3-Napht hal enedi ami ne	2,3-Di ami nonapht hal ene	C ₁₀ H ₁₀ O ₂	771-97-1	158.199	lf (et h, w)	199		1.0908	1.6392 ²⁶	sl H ₂ O, DMSO; vs Et OH; s et h
7944	1,8-Napht hal enedi carboxyl i c aci d	Napht hal i c aci d	C ₁₂ H ₉ O ₂	518-05-8	216.190		260				i H ₂ O; sl Et OH, et h
7945	2,3-Napht hal enedi carboxyl i c aci d		C ₁₂ H ₉ O ₄	2169-87-1	216.190	pr (HOAc, w, sub)	244.5				i H ₂ O, bz, chl ; sl Et OH, et h, DMSO
7946	2,6-Napht hal enedi carboxyl i c aci d		C ₁₂ H ₉ O ₄	1141-38-4	216.190	nd (al or sub)	>300 dec				vs Et OH
7947	2,6-Napht hal enedi carboxyl i c aci d, di met hyl est er		C ₁₄ H ₁₂ O ₄	840-65-3	244.243		190.0				
7948	1,5-Napht hal ene di i socyanat e	1,5-Di i socyanat onapht hal ene	C ₁₂ H ₉ N ₂ O ₂	3173-72-6	210.188	cry	127	183 ¹⁰			
7949	1,3-Napht hal enedi ol	Napht horesorci nol	C ₁₀ H ₈ O ₂	132-86-5	160.170	lf (w)	123.5				s H ₂ O, Et OH, et h; sl ace, bz, li g
7950	1,4-Napht hal enedi ol		C ₁₀ H ₈ O ₂	571-60-8	160.170	mcl nd (bz, w)	192				s H ₂ O, Et OH, et h; sl ace; i bz
7951	1,5-Napht hal enedi ol		C ₁₀ H ₈ O ₂	83-56-7	160.170	pr (w), nd (sub)	262 dec	sub			sl H ₂ O, Et OH; vs et h, ace; i bz; s HOAc
7952	1,6-Napht hal enedi ol		C ₁₀ H ₈ O ₂	575-44-0	160.170	pr (bz)	138	sub			sl H ₂ O, Et OH; s et h, ace, bz, DMSO
7953	1,7-Napht hal enedi ol		C ₁₀ H ₈ O ₂	575-38-2	160.170	nd (bz or sub)	180.5	sub			sl H ₂ O; vs Et OH, et h; s bz, HOAc
7954	2,3-Napht hal enedi ol		C ₁₀ H ₈ O ₂	92-44-4	160.170	lf (w)	163.5				s H ₂ O, Et OH, et h, ace, bz, li g, HOAc
7955	2,6-Napht hal enedi ol		C ₁₀ H ₈ O ₂	581-43-1	160.170	ort h pl (w)	220	sub			sl H ₂ O, bz; s Et OH, et h, ace; i li g
7956	2,7-Napht hal enedi ol		C ₁₀ H ₈ O ₂	582-17-2	160.170	nd, (w, di l al), pl (di l al)	193	sub			s H ₂ O, Et OH, et h, bz, chl ; sl ace; i li g
7957	1,2-Napht hal enedi one	1,2-Napht hoqui none	C ₁₀ H ₈ O ₂	524-42-5	158.154	ye-red nd (et h) oran lf (bz)	146		1.450 ²⁵		s H ₂ O, Et OH, et h, sul f ; sl li g
7958	1,4-Napht hal enedi one	1,4-Napht hoqui none	C ₁₀ H ₈ O ₂	130-15-4	158.154	bt ye nd (al, pet h) ye (sub)	128.5	sub			sl H ₂ O; vs Et OH; s et h, bz, chl , C ₆ S ₆
7959	1,5-Napht hal enedi sul f oni c aci d	Armst rong's aci d	C ₁₀ H ₆ O ₆ S ₂	81-04-9	288.297	pl (+4w, di l HOAc)	242 dec		1.493 ²⁵		vs H ₂ O; s Et OH; i et h
7960	1,6-Napht hal enedi sul f oni c aci d	Napht hal ene-1,6-di sul f oni c aci d	C ₁₀ H ₆ O ₆ S ₂	525-37-1	288.297	oran pr (+4w, HOAc or w)	125 dec				vs H ₂ O; s Et OH; i et h



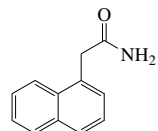
Naphthalene



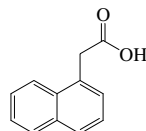
5,12-Naphthoquinone



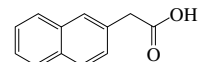
Naphthalene



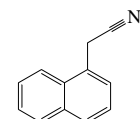
1-Naphthalenecarboxamide



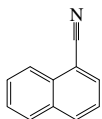
1-Naphthalenecarboxylic acid



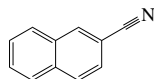
2-Naphthalenecarboxylic acid



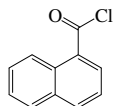
1-Naphthalenecarbonitrile



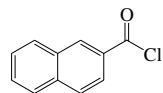
1-Naphthalenecarbonitrile



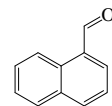
2-Naphthalenecarbonitrile



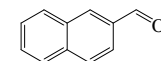
1-Naphthalenecarbonyl chloride



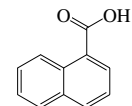
2-Naphthalenecarbonyl chloride



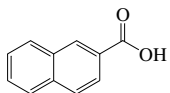
1-Naphthalenecarboxaldehyde



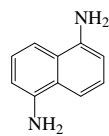
2-Naphthalenecarboxaldehyde



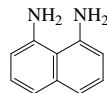
1-Naphthalenecarboxylic acid



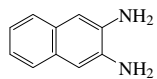
2-Naphthalenecarboxylic acid



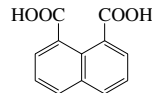
1,5-Naphthalenediamine



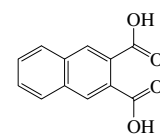
1,8-Naphthalenediamine



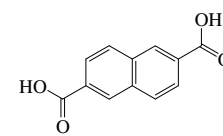
2,3-Naphthalenediamine



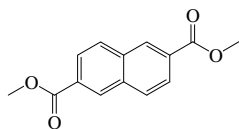
1,8-Naphthalenedicarboxylic acid



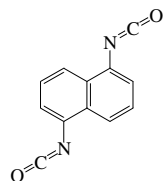
2,3-Naphthalenedicarboxylic acid



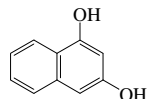
2,6-Naphthalenedicarboxylic acid



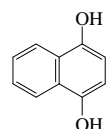
2,6-Naphthalenedicarboxylate dimethyl ester



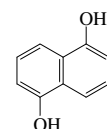
1,5-Naphthalenediisocyanate



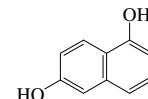
1,3-Naphthalenediol



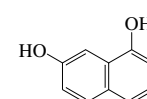
1,4-Naphthalenediol



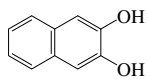
1,5-Naphthalenediol



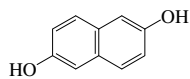
1,6-Naphthalenediol



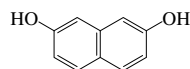
1,7-Naphthalenediol



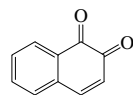
2,3-Naphthalenediol



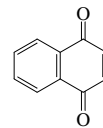
2,6-Naphthalenediol



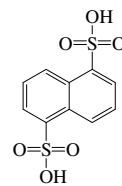
2,7-Naphthalenediol



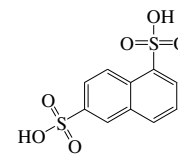
1,2-Naphthoquinone



1,4-Naphthoquinone

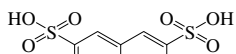


1,5-Naphthalenedisulfonic acid

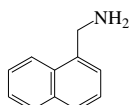


1,6-Naphthalenedisulfonic acid

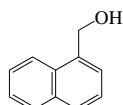
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7961	2,7-Napht hal enedi sul f oni c aci d	Napht hal ene-2,7-di sul f oni c aci d	C ₁₀ H ₆ O ₂ S ₂	92-41-1	288.297	hyg nd (conc HCl)	199				s H ₂ O; sl con HCl
7962	1-Napht hal enemet hanami ne		C ₁₁ H ₁₁ N	118-31-0	157.212			292	1.0958 ²⁰		s Et OH, et h, sul f, CS
7963	1-Napht hal enemet hanol		C ₁₀ H ₁₀ O	4780-79-4	158.196	nd (w, al), cry (bz-l i g)	64	304; 163 ¹²	1.1039 ⁹⁰		sl H ₂ O; vs Et OH, et h
7964	2-Napht hal enemet hanol		C ₁₀ H ₁₀ O	1592-38-7	158.196	lf	81.3	178			sl H ₂ O; s Et OH, et h
7965	1-Napht hal enesul f oni c aci d	α-Napht hyl sul f oni c aci d	C ₁₀ H ₇ O ₂ S	85-47-2	208.234	pr (+2 w, di l HCl)	140				s H ₂ O, Et OH; sl et h
7966	2-Napht hal enesul f oni c aci d	β-Napht hyl sul f oni c aci d	C ₁₀ H ₇ O ₂ S	120-18-3	208.234	hyg pl (+1w), cry (+3w, HCl)	91	dec	1.441 ²⁵		vs H ₂ O, Et OH; s et h; sl bz
7967	1-Napht hal enesul f onyl chl ori de		C ₁₀ H ₇ ClO	85-46-1	226.680	lf (et h)	68	209	1470 ⁹		vs bz, et h, Et OH
7968	2-Napht hal enesul f onyl chl ori de		C ₁₀ H ₇ ClO	93-11-8	226.680	pow or lf (bz-pet h)	81	201 ¹³ , 148 ^{0.5}			i H ₂ O; s Et OH, bz, chl; sl pet h; vs et h
7969	1,4,5,8-Napht hal enet et racarboxyl i c aci d		C ₁₄ H ₈ O ₈	128-97-2	304.209	lf or nd (w, di l HCl)	320				sl H ₂ O, bz, chl, Et OH; vs ace
7970	1-Napht hal enet hi ol	1-Napht hyl mercapt an	C ₁₀ H ₈ S	529-36-2	160.236			dec 285; 161 ²⁰	1.1607 ²⁰	1.6802 ²⁰	sl H ₂ O, di l al k; vs Et OH, et h
7971	2-Napht hal enet hi ol	2-Napht hyl mercapt an	C ₁₀ H ₈ S	91-60-1	160.236	pl (al)	81	288	1.550 ⁶		sl H ₂ O; vs Et OH, et h, li g
7972	N-(1-Napht hal enyl)-1,2-et hanedi ami ne, di hydrochl ori de		C ₁₂ H ₁₆ Cl ₂ N ₂	1465-25-4	259.174	hex pr	189				vs H ₂ O, Et OH
7973	1-Napht hal enyl t hi ourea	ANTU	C ₁₁ H ₁₀ N ₂ S	86-88-4	202.275	pr (al)	198				i H ₂ O; sl Et OH, et h, ace
7974	Napht ho[2,3-c]f uran-1,3-di one	2,3-Napht hal enedi carboxyl i c aci d anhydri de	C ₁₂ H ₆ O ₃	716-39-2	198.174		246				sl Et OH, chl; s et h, bz
7975	1-Napht hol	1-Napht hal enol	C ₁₀ H ₈ O	90-15-3	144.170	ye nd (w)	95.0	288; 184 ⁴⁰	1.0989 ⁹⁹	1.6224 ⁹⁹	i H ₂ O; vs Et OH, et h; s ace, bz; sl ct c
7976	2-Napht hol	2-Napht hal enol	C ₁₀ H ₈ O	135-19-3	144.170	mcl lf (w)	121.5	285	1.28		i H ₂ O; vs Et OH, et h; s bz, chl; sl li g
7977	1-Napht hol, acet at e	1-Napht hyl acet at e	C ₁₂ H ₁₆ O ₂	830-81-9	186.206	nd or pl (al)	49	114			i H ₂ O; s Et OH, et h
7978	2-Napht hol, acet at e	2-Napht hyl acet at e	C ₁₂ H ₁₆ O ₂	1523-11-1	186.206	nd (al)	71.0	132 ²			i H ₂ O; s Et OH, et h, chl
7979	p-Napht hol benzei n		C ₁₀ H ₁₈ O ₂	145-50-6	374.431		123				
7980	1 <i>H</i> ,3 <i>H</i> -Napht ho[1,8-cd]pyran-1,3-di one		C ₁₂ H ₆ O ₃	81-84-5	198.174		275.0				i H ₂ O, et h, bz; sl Et OH; s HOAc
7981	1-Napht hyl ami ne	α-Napht hyl ami ne	C ₁₀ H ₉ N	134-32-7	143.185		49.2	300.7	1.0228 ²⁰	1.6140 ²⁰	s chl
7982	2-Napht hyl ami ne	β-Napht hyl ami ne	C ₁₀ H ₉ N	91-59-8	143.185		113	306.2	1.6414 ⁹⁸	1.6493 ⁹⁸	s H ₂ O, Et OH, et h
7983	2-[(1-Napht hyl ami no) carbonyl]benzoi c aci d	Napht al am	C ₆ H ₁₃ NO ₃	132-66-1	291.301		185		1.4 ²⁰		i H ₂ O; sl Et OH, ace, bz, t f a
7984	2-Napht hyl benzoat e	2-Napht hal enol benzoat e	C ₁₇ H ₁₆ O ₂	93-44-7	248.276	nd or pr (al)	107				i H ₂ O; s Et OH; sl et h, HOAc
7985	N-1-Napht hyl enyl acet ami de		C ₁₂ H ₁₁ NO	575-36-0	185.221		160				s H ₂ O, Et OH; sl et h
7986	N-1-Napht hyl -1,2-et hanedi ami ne	N-(1-Napht hyl)et hyl enedi ami ne	C ₁₂ H ₁₆ N ₂	551-09-7	186.252	vi sc li g		204	1.114 ²⁵	1.6648 ²⁵	
7987	1-Napht hyl 2-hydroxybenzoat e	1-Napht hyl sal i cyl at e	C ₁₇ H ₁₂ O ₃	550-97-0	264.275		83				vs et h
7988	1-Napht hyl hydroxyl ami ne	N-Hydroxyl -1-napht hal enami ne	C ₁₀ H ₉ NO	607-30-7	159.184		79				
7989	1-Napht hyl i sot hi ocyanat e	1-Isot hi ocyanat onapht hal ene	C ₁₁ H ₉ NSC	551-06-4	185.246	wh nd (al)	58				vs bz, et h, Et OH, chl
7990	N-2-Napht hyl -2-napht hal enami ne	β,β'-Di napht hyl ami ne	C ₂₀ H ₁₅ N	532-18-3	269.340	lf (bz)	172.2	471			i H ₂ O; sl Et OH, bz, DMSO; s et h, HOAc
7991	(2-Napht hyl oxy)acet i c aci d	2-Napht hoxycet i c aci d	C ₁₂ H ₁₀ O ₃	120-23-0	202.205	pr(w)	156				s H ₂ O, Et OH, et h; sl DMSO
7992	1-Napht hyl phosphat e	1-Napht hal enol, di hydrogen phosphat e	C ₁₀ H ₉ O ₄ P	1136-89-6	224.149	cry	160				
7993	2-Napht hyl sal i cyl at e	2-Napht hyl 2-hydroxybenzoat e	C ₁₇ H ₁₂ O ₃	613-78-5	264.275	cry (al)	95.5		1.11 ¹⁶		i H ₂ O; sl Et OH; s et h, bz
7994	1,5-Napht hyri di ne	1,5-Di azanapht hal ene	C ₈ H ₆ N ₂	254-79-5	130.147	ye nd (pet h)	75	112 ²	1.2100 ²⁰		



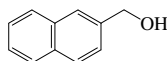
2,7-Napht hal enedi sulf oaricid



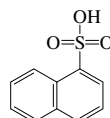
1-Napht hal enemet hanami ne



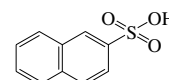
1-Napht hal enemet hanol



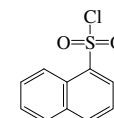
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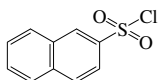
1-Napht hal enesul f oraricid



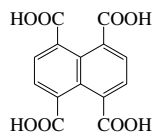
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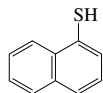
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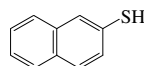
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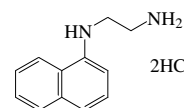
1,4,5,8-Napht hal enet et racarboxylicid



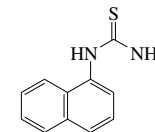
1-Napht hal enet hi ol



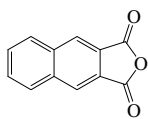
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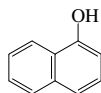
N-(1-Napht hal enyl)-1,2-et hanedi amididihydrochlori de



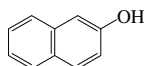
1-Napht hal enyl t hi urea



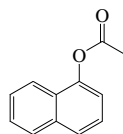
Napht ho[2,3-c]f uran-1,3-di one



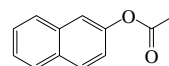
1-Napht hol



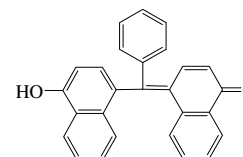
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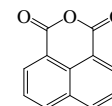
1-Napht hol acet at e



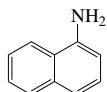
2-Napht hol acet at e



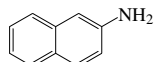
p-Napht hol benzei n



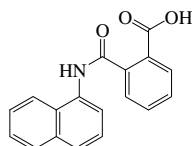
1*H*,3*H*-Napht ho[1,8-cd]pyran-1,3-di one



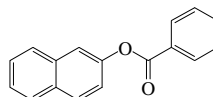
1-Napht hyl ami ne



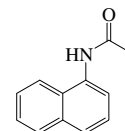
2-Napht hyl ami ne



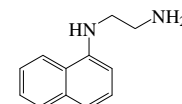
N-[(1-Napht hyl ami no)carbonyl]benzaicid



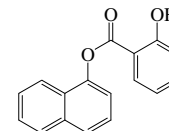
2-Napht hyl benzoat e



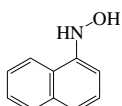
N-1-Napht hal enyl acet ami



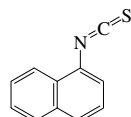
N-1-Napht hyl -1,2-et hanedi ami ne



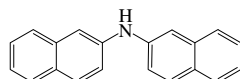
1-Napht hyl 2-hydroxybenzoat e



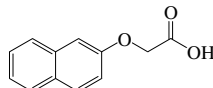
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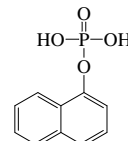
1-Napht hyl sot hi ocyanat e



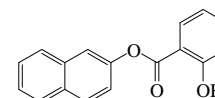
N-2-Napht hyl -2-napht hal enami ne



(2-Napht hyl oxy)acet aci d



1-Napht hyl fosphat e

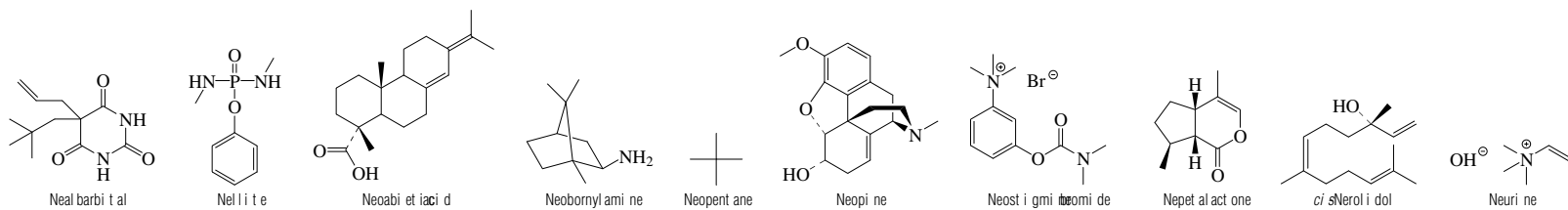
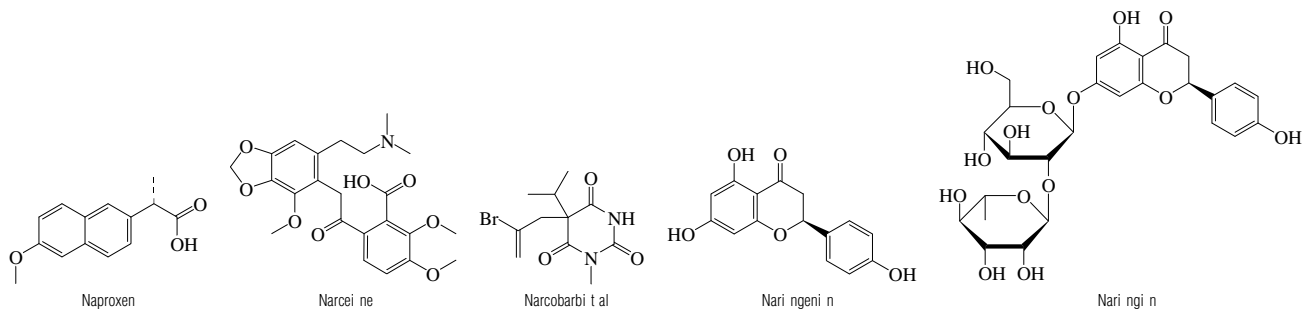
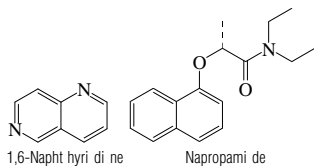


2-Napht hyl sal i cyl at e

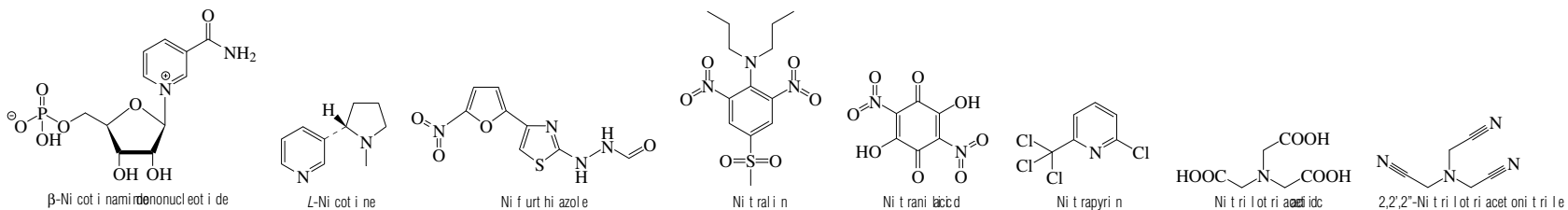
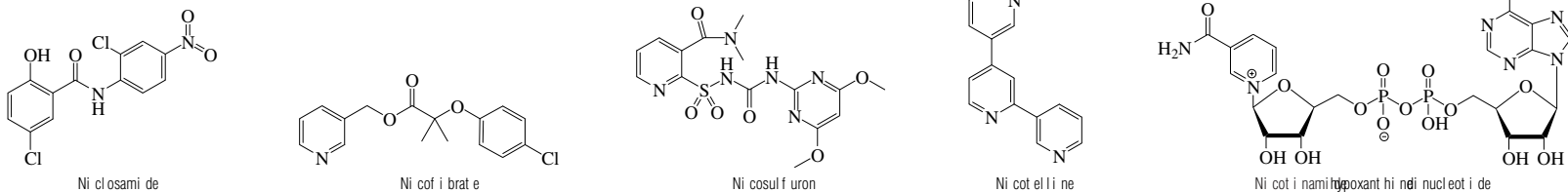
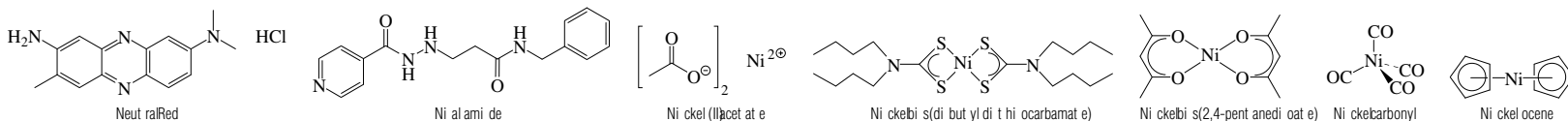


1,5-Napht hyl ri di ne

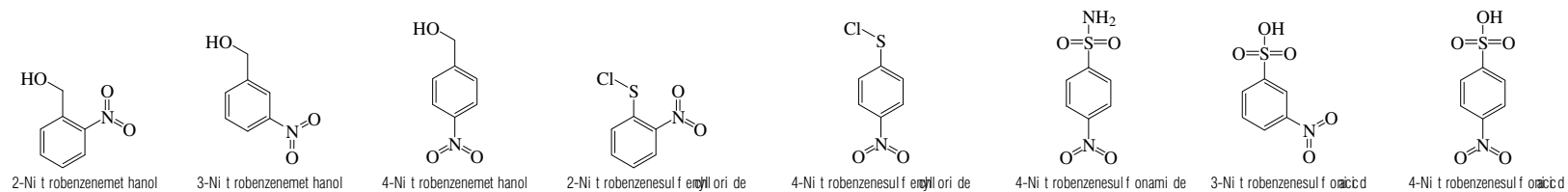
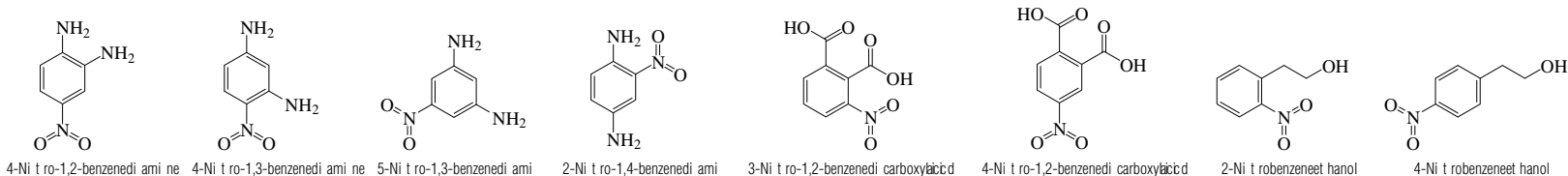
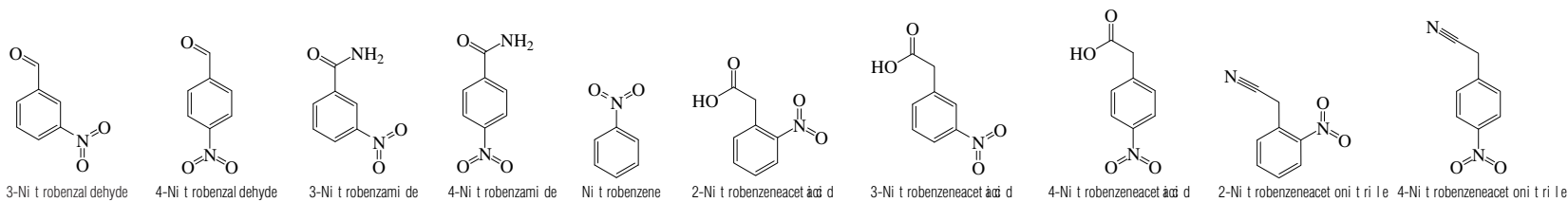
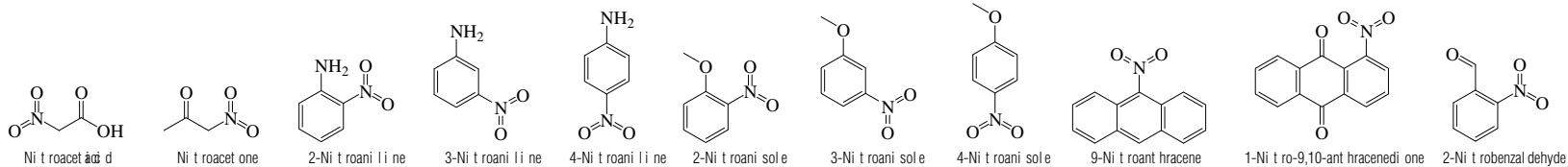
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
7995	1,6-Naphthhyri di ne		$\text{C}_{16}\text{H}_{10}\text{N}_2$	253-72-5	130.147		29.5				
7996	Napropami de	Propanami de <i>M,N</i> -di et hyl -2-(1-naphth hal enyl oxy)-	$\text{C}_{17}\text{H}_{21}\text{NO}_2$	15299-99-7	271.355		75				
7997	Naproxen	6-Met hoxycet met hyl -2-naphth hal enacet i c aci d	$\text{C}_{14}\text{H}_{14}\text{O}_3$	22204-53-1	230.259	cry (ace/hx)	155				i H ₂ O; sl et h; s MeOH, chl
7998	Narcei ne		$\text{C}_9\text{H}_{17}\text{NO}_8$	131-28-2	445.462		138				i H ₂ O
7999	Narcobarbi t al		$\text{C}_{15}\text{H}_{15}\text{BrN}_2\text{O}_3$	125-55-3	303.152		115				sl H ₂ O; s Et OH, py
8000	Nari ngeni n		$\text{C}_8\text{H}_{12}\text{O}_5$	480-41-1	272.253	nd (di l al)	251				vs bz, et h, Et OH
8001	Nari ngi n		$\text{C}_8\text{H}_{12}\text{O}_{14}$	10236-47-2	580.535	nd (w+8)					sl H ₂ O, Et OH; i et h, bz, chl; s HOAc
8002	Neal barbi t al		$\text{C}_7\text{H}_{18}\text{N}_2\text{O}_3$	561-83-1	238.282		156				vs ace, et h, Et OH
8003	Nelli t e	Di ami daf os	$\text{C}_8\text{H}_{13}\text{N}_2\text{O}_2\text{P}$	1754-58-1	200.175	cry (ct c)	103.5				sl AcOEt, bz
8004	Neoabi et i c aci d	8(14),13(15)-Abi et adi en-18-oi c aci d	$\text{C}_{20}\text{H}_{30}\text{O}_2$	471-77-2	302.451	cry (Et OH aq)	173				
8005	Neobornyl ami ne		$\text{C}_8\text{H}_{19}\text{N}$	2223-67-8	153.265	pow	184				vs ace, et h
8006	Neopent ane	2,2-Di met hyl propane	C_5H_{12}	463-82-1	72.149	col gas	-16.4	9.48	0.5852 ²⁵ (p>1 at m)	1.3476 ⁶	i H ₂ O; s Et OH, et h, ct c
8007	Neopi ne		$\text{C}_8\text{H}_{21}\text{NO}_3$	467-14-1	299.365	nd (pet h)	127.5				s H ₂ O, Et OH, et h, bz; vs chl; sl i g
8008	Neost i gmi ne bromi de		$\text{C}_{12}\text{H}_{13}\text{BrN}_2\text{O}_2$	114-80-7	303.195	cry (al-et h)	167 dec				vs H ₂ O; s Et OH
8009	Nepet al act one		$\text{C}_8\text{H}_{14}\text{O}_2$	490-10-8	166.217			71 ^{0.05}	1.0663 ²⁵	1.4859 ²⁵	
8010	<i>ci s</i> Nerol i dol		$\text{C}_{10}\text{H}_{16}\text{O}$	142-50-7	222.366			276; 70 ^{0.1}	0.8778 ²⁰	1.4898 ²⁰	vs Et OH; s et h, ace, HOAc
8011	Neuri ne		$\text{C}_7\text{H}_{13}\text{NO}$	463-88-7	103.163	syr					vs H ₂ O, et h, Et OH
8012	Neut ral Red		$\text{C}_8\text{H}_{17}\text{Cl}_2\text{N}_4$	553-24-2	288.776	grn pow					s H ₂ O, et hyl ene glycol, Et OH; i xyl
8013	Ni al ami de		$\text{C}_8\text{H}_{18}\text{N}_2\text{O}_2$	51-12-7	298.340		151.6				
8014	Ni ckel (II) acet at e		$\text{C}_4\text{H}_8\text{Ni}_2\text{O}_4$	373-02-4	176.782						vs H ₂ O; s Et OH
8015	Ni ckel bi s(di but yl di t hi ocarbamate)		$\text{C}_{18}\text{H}_{36}\text{N}_4\text{Ni}_2$	13927-77-0	467.445	grn cry (bz/ Et OH)	91				s bz, ace
8016	Ni ckel bi s(2,4-pent anedi oate)	Ni ckel acet yl acet onat e	$\text{C}_{10}\text{H}_{14}\text{Ni}_2\text{O}_8$	3264-82-2	256.909	grn ort h cry	230	227 ¹			s H ₂ O, bz, chl, Et OH; i et h
8017	Ni ckel carbonyl	Ni ckel t et racarbonyl	$\text{Ni}_2\text{O}_2\text{C}$	13463-39-3	170.734	col li q	-19.3	43 (exp 60)	1.3 ¹		
8018	Ni ckel ocene	Bi s(6-2,4-cycl opent adi en-1-yl) ni ckel	$\text{C}_{10}\text{H}_{10}\text{Ni}$	1271-28-9	188.879		172				
8019	Ni cl osami de		$\text{C}_8\text{H}_8\text{Cl}_2\text{N}_2\text{O}_4$	50-65-7	327.120		227				
8020	Ni cofibrat e		$\text{C}_8\text{H}_{16}\text{Cl}_2\text{NO}_3$	31980-29-7	305.756		49	180 ^{0.4}			
8021	Ni cosul f uron		$\text{C}_8\text{H}_{18}\text{N}_6\text{O}_6\text{S}$	111991-09-4	410.405		172				
8022	Ni cot el li ne	3,2':4',3''-Terpyri di ne	$\text{C}_{15}\text{H}_9\text{N}_3$	494-04-2	233.268	pri smat i c nd	148	>300			sl H ₂ O; et h; s bz, chl, Et OH
8023	Ni cot i nami de hypoxant hi ne di nucl eot i de	Ni cot i ni c aci d adeni ne di nucl eot i de	$\text{C}_8\text{H}_{16}\text{N}_6\text{O}_{15}\text{P}_2$	1851-07-6	664.410	pow					
8024	β -Ni cot i nami de mononucl eot i de	NMN	$\text{C}_{11}\text{H}_{19}\text{N}_2\text{O}_8\text{P}$	1094-61-7	334.219	amor pow					vs H ₂ O; i ace
8025	<i>L</i> -Ni cot i ne	3-(1-Met hyl -2-pyrrol i di nyl)pyri di nyl	$\text{C}_8\text{H}_{14}\text{N}_2$	54-11-5	162.231	hyg li q	-79	247; 12 ⁵	1.0097 ²⁰	1.5282 ²⁰	msc H ₂ O; vs Et OH, et h, chl; s l i g
8026	Ni f urt hi azol e		$\text{C}_8\text{H}_8\text{N}_4\text{O}_2\text{S}$	3570-75-0	254.224	cry	215 dec				
8027	Ni t rali n	4-(Met hyl sul f onyl)-2,6-di met hyl ro- <i>cis</i> -3,4,5-tri met hyl -2,6-di met hyl -1,4-di one	$\text{C}_{13}\text{H}_{19}\text{N}_3\text{O}_5\text{S}$	4726-14-1	345.371		150				
8028	Ni t rani li c aci d	2,5-Di hydroxy-3,6-di ni t ro-2,5- <i>Cis</i> - $\text{C}_6\text{H}_2\text{N}_2\text{O}_6$		479-22-1	230.088	gol d-ye pl (+w, di l HNQ)	170 dec				vs H ₂ O, Et OH; i et h
8029	Ni t rapyri n	Pyri di ne, 2-chl oro-6-(t ri chl oromet hyl)-	$\text{C}_6\text{H}_3\text{Cl}_4\text{N}$	1929-82-4	230.907		63	136 ¹¹			
8030	Ni t ri lot ri acet i c aci d	<i>N,N</i> -Bi s(carboxymet hyl)glyci ne	$\text{C}_8\text{H}_{10}\text{NO}_6$	139-13-9	191.138	pr cry (w)	242 dec				sl H ₂ O, DMSO; s Et OH
8031	2,2',2''-Ni t ri lot ri acet oni t ri le	Tri cyanot ri met hyl ami ne	$\text{C}_6\text{H}_6\text{N}_4$	7327-60-8	134.139	nd (Et OH)	125.5				



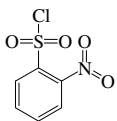
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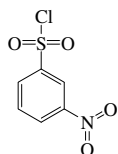
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8032	Ni t roacet i c aci d		$\text{C}_7\text{H}_5\text{NO}_4$	625-75-2	105.050	nd (chl)	92 dec				vs bz, et h, Et OH, chl
8033	Ni t roacet one		$\text{C}_8\text{H}_5\text{NO}_3$	10230-68-9	103.077	pl, nd (et h, bz)	50.3	108			vs bz, et h, Et OH
8034	2-Ni t roani li ne		$\text{C}_8\text{H}_7\text{NO}_2$	88-74-4	138.124		71.0	284	0.9015 ²⁵		sl H ₂ O; s Et OH; vs et h, ace, bz, chl
8035	3-Ni t roani li ne		$\text{C}_8\text{H}_7\text{NO}_2$	99-09-2	138.124		113.4	dec 306	0.9011 ²⁵		sl H ₂ O, bz; s Et OH, et h, ace; vs MeOH
8036	4-Ni t roani li ne		$\text{C}_8\text{H}_7\text{NO}_2$	100-01-6	138.124	pa ye mcl nd (w)	147.5	332	1.424 ²⁰		i H ₂ O; s Et OH, et h, ace; sl bz, DMSO
8037	2-Ni t roani sole	1-Met hoxy-2-ni t robenzene	$\text{C}_7\text{H}_7\text{NO}_3$	91-23-6	153.136		10.5	277; 144 ⁴	1.2540 ²⁰	1.5161 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
8038	3-Ni t roani sole	1-Met hoxy-3-ni t robenzene	$\text{C}_7\text{H}_7\text{NO}_3$	555-03-3	153.136	nd (al), pl (bz-l i g)	38.5	258	1.373 ¹⁸		i H ₂ O; s Et OH; vs et h
8039	4-Ni t roani sole	1-Met hoxy-4-ni t robenzene	$\text{C}_7\text{H}_7\text{NO}_3$	100-17-4	153.136	pr (al), nd (di l al)	54	274	1.2192 ⁶⁰	1.5070 ⁶⁰	i H ₂ O; vs Et OH, et h; s ct c; sl pet h
8040	9-Ni t roant hracene		$\text{C}_{10}\text{H}_9\text{NO}_2$	602-60-8	223.227	ye nd (al) pr (HOAc or xyl)	146	275 ¹⁷			i H ₂ O; sl Et OH, chl; vs ace, C ₆ S
8041	1-Ni t ro-9,10-ant hracenedi one		$\text{C}_{14}\text{H}_9\text{NO}_4$	82-34-8	253.211	nd (HOAc) ye pr (ace)	231.5	270 ⁷			i H ₂ O; sl Et OH, et h; s ace, bz
8042	2-Ni t robenzal dehyde		$\text{C}_8\text{H}_7\text{NO}_3$	552-89-6	151.120	ye nd (w)	43.5	153 ²³	1.2844 ²⁰		sl H ₂ O, chl; vs Et OH, et h, ace, bz
8043	3-Ni t robenzal dehyde		$\text{C}_8\text{H}_7\text{NO}_3$	99-61-6	151.120	l t ye nd (w)	58.5	164 ⁴	1.2792 ²⁰		sl H ₂ O; s Et OH, et h, chl; vs ace, bz
8044	4-Ni t robenzal dehyde		$\text{C}_8\text{H}_7\text{NO}_3$	555-16-8	151.120	l f, pr (w)	107	sub	1.498		sl H ₂ O, l i g; vs Et OH; s bz, chl, HOAc
8045	3-Ni t robenzami de		$\text{C}_8\text{H}_7\text{N}_2\text{O}_3$	645-09-0	166.134		142.7	312.5			s H ₂ O, Et OH, et h
8046	4-Ni t robenzami de		$\text{C}_8\text{H}_7\text{N}_2\text{O}_3$	619-80-7	166.134	nd (w)	200.7				i H ₂ O; s Et OH, et h
8047	Ni t robenzene		$\text{C}_7\text{H}_7\text{NO}_2$	98-95-3	123.110		5.7	210.8	1.2037 ²⁰	1.5562 ²⁰	sl H ₂ O, ct c; vs Et OH, et h, ace, bz
8048	2-Ni t robenzeneacet i c aci d	<i>o</i> -Ni t rophenyl acet i c aci d	$\text{C}_8\text{H}_7\text{NO}_4$	3740-52-1	181.147	nd (w, pl (di l al)	141.5				s ₂ B, Et OH
8049	3-Ni t robenzeneacet i c aci d	<i>m</i> -Ni t rophenyl acet i c aci d	$\text{C}_8\text{H}_7\text{NO}_4$	1877-73-2	181.147	nd (w)	122				vs Et OH
8050	4-Ni t robenzeneacet i c aci d	<i>p</i> -Ni t rophenyl acet i c aci d	$\text{C}_8\text{H}_7\text{NO}_4$	104-03-0	181.147	pa ye nd (w)	154				sl H ₂ O; s Et OH, et h, bz
8051	2-Ni t robenzeneacet oni t ri le	2-Ni t robenzyl cyani de	$\text{C}_8\text{H}_7\text{N}_2\text{O}$	610-66-2	162.146	nd (di l al), pr (HOAc, al)	84	178 ¹² , 138 ¹			vs ace, bz, et h, Et OH
8052	4-Ni t robenzeneacet oni t ri le	4-Ni t robenzyl cyani de	$\text{C}_8\text{H}_7\text{N}_2\text{O}$	555-21-5	162.146	pr (al)	117	196 ²			sl H ₂ O; s Et OH, et h, bz, chl
8053	4-Ni t ro-1,2-benzenedi ami ne	4-Ni t rophenyl enedi ami ne	$\text{C}_6\text{H}_6\text{N}_2\text{O}_2$	99-56-9	153.139	dk red nd (di l al)	199.5				s aci d
8054	4-Ni t ro-1,3-benzenedi ami ne		$\text{C}_6\text{H}_6\text{N}_2\text{O}_2$	5131-58-8	153.139	oran pr (w)	161				
8055	5-Ni t ro-1,3-benzenedi ami ne		$\text{C}_6\text{H}_6\text{N}_2\text{O}_2$	5042-55-7	153.139	red cry (w)	143				
8056	2-Ni t ro-1,4-benzenedi ami ne		$\text{C}_6\text{H}_6\text{N}_2\text{O}_2$	5307-14-2	153.139		140.0				
8057	3-Ni t ro-1,2-benzenedi carboxyli c aci d		$\text{C}_8\text{H}_5\text{NO}_6$	603-11-2	211.129	pa ye pr (w)	218				sl H ₂ O, ace; s Et OH; i bz, pet h, chl
8058	4-Ni t ro-1,2-benzenedi carboxyli c aci d		$\text{C}_8\text{H}_5\text{NO}_6$	610-27-5	211.129	pa ye nd (w, et h)	164.8				s H ₂ O, Et OH; i bz, chl, C ₆ S ₂ pet h
8059	2-Ni t robenzeneet hanol		$\text{C}_8\text{H}_9\text{NO}_3$	15121-84-3	167.162		1.0	267	1.19 ²⁵	1.5637 ²⁰	
8060	4-Ni t robenzeneet hanol		$\text{C}_8\text{H}_9\text{NO}_3$	100-27-6	167.162		63	148 ²			
8061	2-Ni t robenzenemet hanol	2-Ni t robenzyl alcohol	$\text{C}_7\text{H}_7\text{NO}_3$	612-25-9	153.136	nd (w)	74	270; 168 ²⁰			sl H ₂ O; s Et OH, et h
8062	3-Ni t robenzenemet hanol	3-Ni t robenzyl alcohol	$\text{C}_7\text{H}_7\text{NO}_3$	619-25-0	153.136	ort h nd (w)	30.5	177 ⁷	1.296 ¹⁹		s H ₂ O, Et OH, et h; sl chl
8063	4-Ni t robenzenemet hanol	4-Ni t robenzyl alcohol	$\text{C}_7\text{H}_7\text{NO}_3$	619-73-8	153.136	nd (w)	96.5	dec 255; 185 ¹²			sl H ₂ O, ace; s Et OH, et h
8064	2-Ni t robenzenesul f enyl chl ori de		$\text{C}_8\text{H}_7\text{ClNO}_2\text{S}$	7669-54-7	189.620	ye nd (bz)	75				vs et h, bz, chl
8065	4-Ni t robenzenesul f enyl chl ori de		$\text{C}_8\text{H}_7\text{ClNO}_2\text{S}$	937-32-6	189.620	ye l f (pet h)	52	125			vs bz
8066	4-Ni t robenzenesul f onami de		$\text{C}_8\text{H}_7\text{NO}_5\text{S}$	6325-93-5	202.188		180 dec				
8067	3-Ni t robenzenesul f oni c aci d		$\text{C}_8\text{H}_5\text{NO}_5\text{S}$	98-47-5	203.173	pl	48				vs H ₂ O; s Et OH; i et h, bz
8068	4-Ni t robenzenesul f oni c aci d		$\text{C}_8\text{H}_5\text{NO}_5\text{S}$	138-42-1	203.173		95				vs H ₂ O



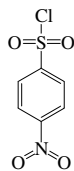
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8069	2-Ni t robenzenesulfonyl chl ori de		$\text{C}_6\text{H}_4\text{ClNO}_2\text{S}$	1694-92-4	221.619	pr (li g, et h-pet h)	68.5				s et h; sl pet h
8070	3-Ni t robenzenesulfonyl chl ori de		$\text{C}_6\text{H}_4\text{ClNO}_2\text{S}$	121-51-7	221.619	mcl pr (et h) nd (li g)	64				i H ₂ O; s Et OH
8071	4-Ni t robenzenesulfonyl chl ori de		$\text{C}_6\text{H}_4\text{ClNO}_2\text{S}$	98-74-8	221.619	mcl pr (pet h)	79.5	143 ⁵			s pet h
8072	5-Ni t ro- <i>N</i> -benzimidazole		$\text{C}_7\text{H}_6\text{N}_2\text{O}_2$	94-52-0	163.134	nd (w)	207.8				i H ₂ O, et h, bz, chl; s aci d; vs Et OH
8073	2-Ni t robenzoi c aci d		$\text{C}_7\text{H}_5\text{NO}_4$	552-16-9	167.120	t cl nd (w)	147.5		1.57 ⁹		s H ₂ O, et h; vs Et OH, ace; sl bz, li g
8074	3-Ni t robenzoi c aci d		$\text{C}_7\text{H}_5\text{NO}_4$	121-92-6	167.120	mcl pr (w)	141.1		1.494 ⁰		sl H ₂ O, bz; vs Et OH, et h, ace; s chl
8075	4-Ni t robenzoi c aci d		$\text{C}_7\text{H}_5\text{NO}_4$	62-23-7	167.120	mcl lf (w)	242	sub	1.61 ⁰		vs ace, et h, Et OH, chl, MeOH
8076	3-Ni t robenzoi c aci d, hydrazi de		$\text{C}_7\text{H}_4\text{N}_2\text{O}_3$	618-94-0	181.149		153.5				sl H ₂ O, Et OH; i et h, bz, chl
8077	4-Ni t robenzoi c aci d, hydrazi de		$\text{C}_7\text{H}_4\text{N}_2\text{O}_3$	636-97-5	181.149		215.5				sl H ₂ O, Et OH; i et h, bz, chl
8078	3-Ni t robenzoni tri le		$\text{C}_7\text{H}_4\text{N}_2\text{O}_2$	619-24-9	148.119		118	165 ¹⁶			s H ₂ O, Et OH, bz; vs et h, ace; i pet h
8079	4-Ni t robenzoni tri le		$\text{C}_7\text{H}_4\text{N}_2\text{O}_2$	619-72-7	148.119		150.0				sl H ₂ O, Et OH, et h; s chl, HOAc
8080	5-Ni t ro- <i>N</i> -benzotriazole		$\text{C}_7\text{H}_4\text{N}_3\text{O}_2$	2338-12-7	164.122		217				
8081	2-Ni t robenzoyl chl ori de		$\text{C}_7\text{H}_5\text{ClNO}_2$	610-14-0	185.565		20				vs et h; sl ct c
8082	3-Ni t robenzoyl chl ori de		$\text{C}_7\text{H}_5\text{ClNO}_2$	121-90-4	185.565		36	276.5			vs et h
8083	4-Ni t robenzoyl chl ori de		$\text{C}_7\text{H}_5\text{ClNO}_2$	122-04-3	185.565	ye nd (li g)	75	209 ⁵ , 151 ¹⁵			s et h
8084	2-Ni t robi phenyl	2-Ni t ro-1,1'-bi phenyl	$\text{C}_{12}\text{H}_9\text{NO}_2$	86-00-0	199.205	pl (al, MeOH)	37.2	320	1.44 ⁴		i H ₂ O; s Et OH, et h, chl
8085	3-Ni t robi phenyl	3-Ni t ro-1,1'-bi phenyl	$\text{C}_{12}\text{H}_9\text{NO}_2$	2113-58-8	199.205	ye pl or nd (di l al)	62	227 ³⁵ , 143 ⁹			i H ₂ O; s Et OH, et h, HOAc, li g
8086	4-Ni t robi phenyl	4-Ni t ro-1,1'-bi phenyl	$\text{C}_{12}\text{H}_9\text{NO}_2$	92-93-3	199.205	ye nd (al)	114	340			i H ₂ O; sl Et OH; s et h, bz, chl, HOAc
8087	2-Ni t ro-1,1-bis(chlorophenyl) propane		$\text{C}_{15}\text{H}_{13}\text{Cl}_2\text{NO}_2$	117-27-1	310.176	cry	81	180 ^{0,16}			
8088	1-Ni t robut ane		$\text{C}_4\text{H}_9\text{NO}_2$	627-05-4	103.120			153	0.970 ²⁵	1.4303 ²⁰	sl H ₂ O; msc Et OH, et h; s al k
8089	2-Ni t ro-1-but anol		$\text{C}_4\text{H}_9\text{NO}_3$	609-31-4	119.119		-47	105 ¹⁰	1.1332 ²⁵	1.4390 ²⁰	s H ₂ O, ace; msc Et OH, et h; sl ct c
8090	3-Ni t ro-2-but anol		$\text{C}_4\text{H}_9\text{NO}_3$	6270-16-2	119.119			91 ⁹ , 55 ^{9,5}	1.1260 ²⁰	1.4414 ²⁰	
8091	6-Ni t rochrysene		$\text{C}_{18}\text{H}_{11}\text{NO}_2$	7496-02-8	273.286	ye nd (bz)	≈215 dec				
8092	Ni t rocycl ohexane		$\text{C}_6\text{H}_{11}\text{NO}_2$	1122-60-7	129.157	li q	-34	205; 9 ⁵	1.0610 ²⁰	1.4612 ¹⁹	i H ₂ O; s Et OH, li g
8093	1-Ni t rodecane		$\text{C}_{11}\text{H}_{21}\text{NO}_2$	4609-87-4	187.280			86 ¹		1.4337 ²⁰	
8094	<i>N</i> -Ni t rodi ethyl ami ne	<i>N</i> -Et hyl- <i>N</i> -ni t roet hanami ne	$\text{C}_7\text{H}_{15}\text{NO}_2$	7119-92-8	118.134			206.5	1.057 ¹⁵		vs et h, Et OH
8095	Ni t roet hane		$\text{C}_2\text{H}_5\text{NO}_2$	79-24-3	75.067	li q	-89.5	114.0	1.044 ⁸	1.3917 ²⁰	sl H ₂ O; msc Et OH, et h; s ace, chl
8096	2-Ni t roet hanol		$\text{C}_2\text{H}_5\text{NO}_3$	625-48-9	91.066	li q	-80	194; 10 ²	1.270 ¹⁵	1.4438 ¹⁹	msc H ₂ O, Et OH, et h; i bz
8097	Ni t roet hene		$\text{C}_2\text{H}_3\text{NO}_2$	3638-64-0	73.051	li q	-55.5	98.5	1.221 ²	1.4282 ²⁰	vs Et OH, et h, ace, bz, chl
8098	(2-Ni t roet hyl)benzene		$\text{C}_8\text{H}_9\text{NO}_2$	6125-24-2	151.163	li q	-23	250; 13 ⁷	1.126 ²⁴	1.5407 ¹⁹	
8099	Ni t rofen	2,4-Di chl oro-1-(4-ni t rophenoxy) benzene	$\text{C}_{12}\text{H}_7\text{Cl}_2\text{NO}_3$	1836-75-5	284.095		70				
8100	2-Ni t ro- <i>H</i> -fluorene		$\text{C}_{13}\text{H}_9\text{NO}_2$	607-57-8	211.216	nd (50% HOAc ace)	159.3				i H ₂ O; s ace, bz
8101	2-Ni t ro- <i>H</i> -fluoren-9-one		$\text{C}_{13}\text{H}_9\text{NO}_3$	3096-52-4	225.200	ye nd or lf (HOAc)	224.3	sub			sl Et OH; s ace, sul f, HOAc
8102	5-Ni t ro-2-f ural dehyde di acet at e		$\text{C}_9\text{H}_9\text{NO}_7$	92-55-7	243.170		92.0				s chl
8103	2-Ni t rof uran		$\text{C}_4\text{H}_3\text{NO}_3$	609-39-2	113.072	ye mcl cry (pet h)	30	134 ¹²³ , 84 ¹³			s H ₂ O, Et OH, et h
8104	5-Ni t ro-2-f urancarboxal dehyde		$\text{C}_5\text{H}_4\text{NO}_4$	698-63-5	141.083	pa ye (pet h)	35.5	130 ⁰			sl H ₂ O; s pet h
8105	5-Ni t ro-2-f urancarboxyl i c aci d		$\text{C}_5\text{H}_3\text{NO}_5$	645-12-5	157.082	pa ye pl (w)	186	sub			s H ₂ O, Et OH, et h; sl ace, bz; i chl
8106	Ni t rof urant oi n		$\text{C}_5\text{H}_4\text{O}_4$	67-20-9	238.158		263				



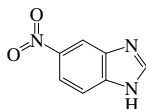
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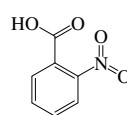
3-Ni t robenzesulf onijl ori de



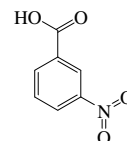
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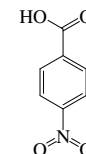
5-Ni t ro-*H*-benzi mi dazole



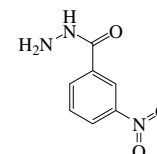
2-Ni t robenzoiaci d



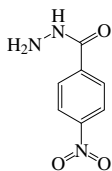
3-Ni t robenzoiaci d



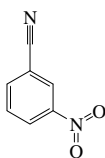
4-Ni t robenzoiaci d



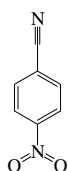
3-Ni t robenzoiaci dhydrazi de



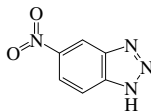
4-Ni t robenzoiaci dhydrazi de



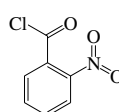
3-Ni t robenzoni t ri le



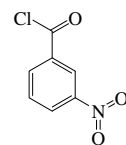
4-Ni t robenzoni t ri le



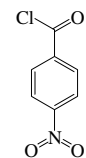
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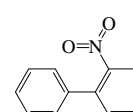
2-Ni t robenzoyl ori de



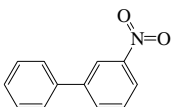
3-Ni t robenzoyl ori de



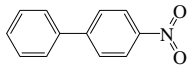
4-Ni t robenzoyl ori de



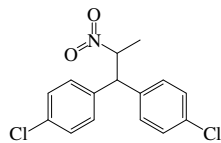
2-Ni t robi phenyl



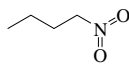
3-Ni t robi phenyl



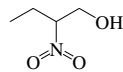
4-Ni t robi phenyl



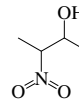
2-Ni t ro-1,1-bi(4-chl orophenyl)propane



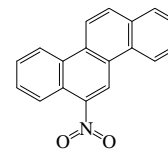
1-Ni t robut ane



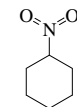
2-Ni t ro-1-but anol



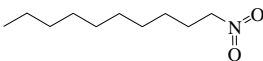
3-Ni t ro-2-but anol



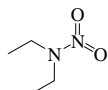
6-Ni t rochryse



Ni t rocycl ohexane



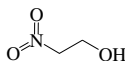
1-Ni t rodecane



N-Ni t rodi et hylami ne



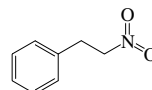
Ni t roet hane



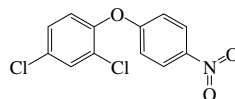
2-Ni t roet hanol



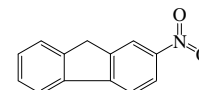
Ni t roet hene



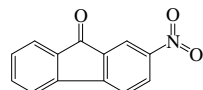
(2-Ni t roet hyl)benzene



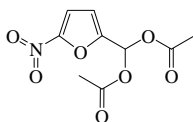
Ni t rof en



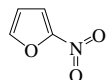
2-Ni t ro-*H* luorene



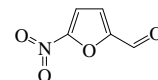
2-Ni t ro-*H* luoren-9-one



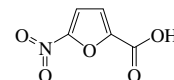
5-Ni t ro-2-f ural dehyd acet ate



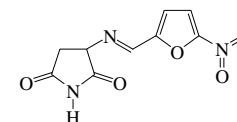
2-Ni t rof uran



5-Ni t ro-2-f urancarboxal dehyd

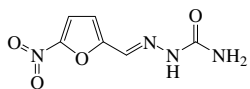


5-Ni t ro-2-f urancarboxylic acid

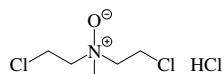


Ni t rof urant oi n

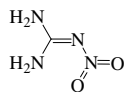
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8107	Ni t rof urazone	2-[(5-Ni t ro-2-f uranyl) met hyl ene]hydrazinecarboxamide	C ₈ H ₈ N ₄ O ₄	59-87-0	198.137	pa ye nd	238 dec				i H ₂ O, et h; sl Et OH, DMSO; s al k
8108	Ni t rogen must ardi-oxi de hydrochl ori de	Mechl oret hami ne oxi de hydrochl ori de	deH ₁₀ Cl ₃ NO	302-70-5	208.514	pr (ace)	110				s H ₂ O
8109	Ni t roguani di ne		Cl ₂ O ₂	556-88-7	104.069	nd or pr (w)	239 dec				sl H ₂ O, Et OH; i et h; vs al k
8110	1-Ni t rohexane		C ₆ H ₁₂ NO ₂	646-14-0	131.173			193; 84 ²¹	0.9396 ²⁰	1.4270 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, al k
8111	3-Ni t ro-4-hydroxyphenylarsoni c aci d	Roxarsone	C ₆ H ₅ AsNO ₆	121-19-7	263.037	ye nd or pl (w)	300				sl hot H ₂ O; i et h, Et OAc; vs MeOH, Et OH
8112	2-Ni t ro- <i>N</i> -i mi dazol e	Azomyci n	C ₇ H ₈ N ₂ O ₂	527-73-1	113.075	cry (MeOH)	287 dec				
8113	4-Ni t ro- <i>N</i> -i mi dazol e		C ₇ H ₈ N ₂ O ₂	3034-38-6	113.075		303 dec				
8114	5-Ni t ro- <i>N</i> -i ndazol e		C ₇ H ₇ N ₃ O ₂	5401-94-5	163.134	ye nd or col nd (al)	208				s Et OH, et h, bz; vs ace, HOAc; i li g
8115	6-Ni t ro- <i>N</i> -i ndazol e		C ₇ H ₇ N ₃ O ₂	7597-18-4	163.134	nd (w, al, ace)	181 dec				s H ₂ O, Et OH, et h, bz; vs ace; i li g
8116	4-Ni t ro-1,3-i sobenzof urandi one		C ₈ H ₆ O ₅	641-70-3	193.114	nd (ace, al)	164				i H ₂ O; s Et OH, ace, HOAc; sl bz
8117	5-Ni t ro-1,3-i sobenzof urandi one		C ₈ H ₆ O ₅	5466-84-2	193.114		120.3	196 ⁸			i H ₂ O, pet h; s Et OH, ace; sl et h
8118	2-Ni t roi sobut ane		C ₄ H ₈ NO ₂	594-70-7	103.120		26.23	127.16	0.9501 ²⁸	1.4015 ²⁰	msc Et OH, et h, ace, bz; vs chl; i al k
8119	5-Ni t ro- <i>N</i> -i soi ndol e-1,3(i)-di one		C ₈ H ₆ N ₂ O ₄	89-40-7	192.129	col nd (w), ye lf (al-ace)	202				vs ace
8120	Ni t romersol		C ₈ H ₈ HgNO ₃	133-58-4	351.71						i H ₂ O; sl ace, Et OH; s al k
8121	<i>N</i> -Ni t romet hanami ne		Cl ₂ O ₂	598-57-2	76.055		38	82 ¹⁰	1.2433 ⁴⁹	1.4616 ⁴⁹	vs H ₂ O, Et OH, bz, chl; s et h; sl pet h
8122	Ni t romet hane		C ₆ NO ₂	75-52-5	61.041	li q	-28.38	101.19	1.137 ⁴	1.3817 ²⁰	s H ₂ O, Et OH, et h, ace, ct c, al k
8123	(Ni t romet hyl)benzene		C ₇ H ₇ NO ₂	622-42-4	137.137	ye li q		226; 135 ⁵	1.1596 ²⁰	1.5323 ²⁰	vs ace, et h
8124	Ni t ron		C ₈ H ₁₆ N ₄	2218-94-2	312.368	ye lf (al), nd (chl)	189 dec				vs ace, bz, Et OH, chl
8125	1-Ni t ronapht hal ene		C ₁₀ H ₇ NO ₂	86-57-7	173.169	ye nd (al)	61	180 ⁴	1.332 ²⁰		i H ₂ O; vs Et OH, et h, bz, chl, py
8126	2-Ni t ronapht hal ene		C ₁₀ H ₇ NO ₂	581-89-5	173.169	ye ort h nd or pl (al)	79	314; 165 ¹⁵			i H ₂ O; vs Et OH, et h
8127	1-Ni t ro-2-napht hol		C ₁₀ H ₇ NO ₃	550-60-7	189.168	ye nd, lf or pr (al)	104	115 ^{0,05}			s H ₂ O, Et OH; vs et h; sl chl
8128	1-Ni t rooct ane		C ₈ H ₁₇ NO ₂	629-37-8	159.227		15	208.5	0.9346 ²⁰	1.4322 ²⁰	
8129	1-Ni t ropent ane		C ₅ H ₁₁ NO ₂	628-05-7	117.147			172.5	0.9525 ²⁰	1.4175 ²⁰	s Et OH, et h, bz
8130	3-Ni t ropent ane		C ₅ H ₁₁ NO ₂	551-88-2	117.147			154	0.957 ⁰		vs ace, et h, Et OH
8131	5-Ni t ro-1,10-phenant hrol i ne		C ₁₂ H ₉ N ₃ O ₂	4199-88-6	225.203		202.3				
8132	2-Ni t rophenol		C ₆ H ₅ NO ₃	88-75-5	139.109	ye nd or pr (et h, al)	44.8	216	1.2942 ⁴⁰	1.5723 ⁵⁰	sl H ₂ O; vs Et OH, et h, ace, bz, py
8133	3-Ni t rophenol		C ₆ H ₅ NO ₃	554-84-7	139.109	ye mcl (et h, aq Hcl)	96.8	194 ⁷⁰	1.2797 ¹⁰⁰		sl H ₂ O, DMSO; vs Et OH, et h, ace, bz
8134	4-Ni t rophenol		C ₆ H ₅ NO ₃	100-02-7	139.109	ye mcl pr (t o)	113.6		1.47 ⁹		sl H ₂ O; vs Et OH, et h, ace; st ol, py
8135	1-Ni t ro-2-phenoxybenzene		C ₈ H ₉ NO ₃	2216-12-8	215.204	ye li q	<-20	235; 184 ⁸	1.2539 ²²	1.575 ⁵⁰	vs bz, et h, Et OH, chl
8136	1-Ni t ro-4-phenoxybenzene		C ₈ H ₉ NO ₃	620-88-2	215.204	pl (pet h), MeOH)	61	320; 225 ³⁰			i H ₂ O; sl Et OH, ct c; s et h, bz
8137	<i>N</i> -(2-Ni t rophenyl)acet ami de		C ₈ H ₉ N ₂ O ₃	552-32-9	180.161		94	100 ^{0,1}	1.419 ¹⁵		s H ₂ O, Et OH, bz, chl, li g; vs et h
8138	<i>N</i> -(3-Ni t rophenyl)acet ami de		C ₈ H ₉ N ₂ O ₃	122-28-1	180.161	wh lf (al)	155	100 ^{0,74}			s H ₂ O, Et OH, chl; i et h; sl t f a
8139	<i>N</i> -(4-Ni t rophenyl)acet ami de		C ₈ H ₉ N ₂ O ₃	104-04-1	180.161	ye pr (w)	216	100 ^{0,008}			sl H ₂ O, et h, chl; s Et OH, t f a, al k
8140	2-Ni t rophenyl acet ate		C ₈ H ₉ NO ₄	610-69-5	181.147	nd or pr (li g)	40.5	dec 253; 141 ¹¹			s H ₂ O; vs Et OH, et h, ace, bz; sl li g



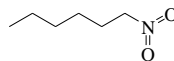
Ni t rof urazone



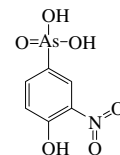
Ni t rogemust ardN-oxi dhydrochlori de



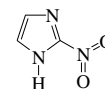
Ni t roguani di ne



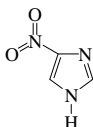
1-Ni t rohexane



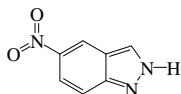
3-Ni t ro-4-hydroxyphenyl arsonaci d



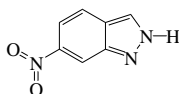
2-Ni t ro-#-i mi dazole



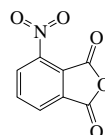
4-Ni t ro-#-i mi dazole



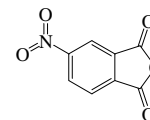
5-Ni t ro-#-i ndazole



6-Ni t ro-#-i ndazole



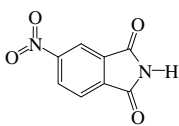
4-Ni t ro-1,3-i sobenzof urandi one



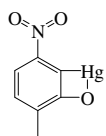
5-Ni t ro-1,3-i sobenzof urandi one



2-Ni t roi sobut ane



5-Ni t ro-#-i soi ndole-1,3-#-di one



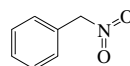
Ni t romersol



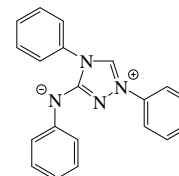
N-Ni t romet hanami ne



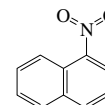
Ni t romet hane



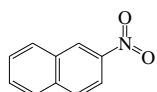
(Ni t romet hyl) benzene



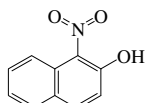
Ni t ron



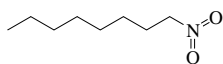
1-Ni t ronaph hal ene



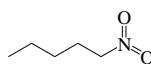
2-Ni t ronaph hal ene



1-Ni t ro-2-naphht hol



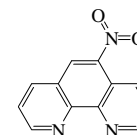
1-Ni t rooct ane



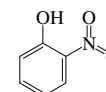
1-Ni t ropent ane



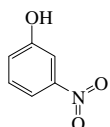
3-Ni t ropent ane



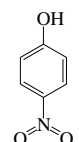
5-Ni t ro-1,10-phenant hrol i ne



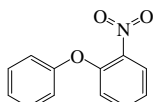
2-Ni t rophenol



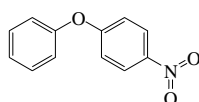
3-Ni t rophenol



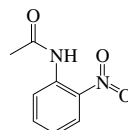
4-Ni t rophenol



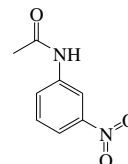
1-Ni t ro-2-phenoxybenzene



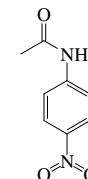
1-Ni t ro-4-phenoxybenzene



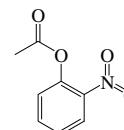
N-(2-Ni t rophenyl) acet ami de



N-(3-Ni t rophenyl) acet ami de

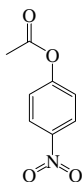


N-(4-Ni t rophenyl) acet ami de

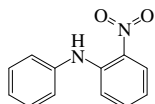


2-Ni t rophenylacet at e

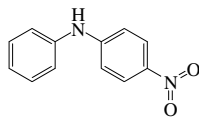
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8141	4-Ni t rophenyl acetate		₈ H ₉ O ₄	830-03-5	181.147	lf (di l al)	82.3				vs O ₂ ; bz; s Et OH, chl, li g
8142	2-Ni t ro- <i>N</i> -phenylani li ne		₁₂ H ₁₀ N ₂ O ₂	119-75-5	214.219		75.5	215 ¹⁵	1.3660 ²⁰		i H ₂ O; s Et OH; sl ct c
8143	4-Ni t ro- <i>N</i> -phenylani li ne		₁₂ H ₁₀ N ₂ O ₂	836-30-6	214.219		135.3	211 ³⁰			i H ₂ O; vs Et OH; sl ace; s con sul f
8144	(4-Ni t rophenyl)arsoni c aci d	Ni t arsone	₆ H ₅ AsNO ₅	98-72-6	247.038	lf or nd (w)	>310 dec				sl H ₂ O, Et OH, DMSO
8145	4-[(4-Ni t rophenyl)azo]-1,3-benzenedi ol	Magneson	C ₁₂ H ₉ N ₃ O ₄	74-39-5	259.217	red pow (al or MeOH)	200				i H ₂ O; sl Et OH, bz, HOAc, t ol
8146	1-[(4-Ni t rophenyl)azo]-2-napht hol		₁₆ H ₁₁ N ₃ O ₃	6410-10-2	293.276	br-oran pl (t o or bz)	257				vs bz, Et OH
8147	(3-Ni t rophenyl)boroni c aci d		₆ H ₇ BNO ₄	13331-27-6	166.928		274.5				
8148	1-(2-Ni t rophenyl)et hanone	2-Ni t roacet ophenone	₈ H ₇ NO ₃	577-59-3	165.147		28.5	178 ³² , 158 ¹⁶	1.2370 ²⁵	1.5468 ²⁰	i H ₂ O; vs Et OH, et h, chl
8149	1-(3-Ni t rophenyl)et hanone	3-Ni t roacet ophenone	₈ H ₇ NO ₃	121-89-1	165.147	nd (al)	81	202; 167 ⁹			vs H ₂ O, et h; sl Et OH, chl
8150	1-(4-Ni t rophenyl)et hanone	4-Ni t roacet ophenone	₈ H ₇ NO ₃	100-19-6	165.147	ye pr (al)	81.8	165 ⁹			vs et h, Et OH
8151	2-Ni t ro-1-phenylet hanone		₈ H ₇ NO ₃	614-21-1	165.147		106	158 ¹⁶ , 142 ¹⁰		1.5468 ³⁰	vs et h, Et OH
8152	(4-Ni t rophenyl)hydrazi ne		₆ H ₇ N ₃ O ₂	100-16-3	153.139	oran-red lf or nd (al)	158 dec				sl H ₂ O; s Et OH, et h, bz, chl, AcOEt
8153	(4-Ni t rophenyl)phenyl met hanone		₁₃ H ₉ NO ₃	1144-74-7	227.215	nd or lf (al)	138		1.406		vs bz
8154	3-(4-Ni t rophenyl)-1-phenyl-2-propen-1-one	Ni t rochal cone	₁₃ H ₁₁ NO ₃	1222-98-6	253.253	pa ye nd (al) pl (bz)	164				s Et OH, chl; i et h, li g
8155	4-Ni t rophenyl phosphat e	4-Ni t rophenyl di hydrogen phosphat e	₁₀ H ₉ NO ₆ P	330-13-2	219.089	ye-wh nd	155				i col d H ₂ O; s Et OH, chl, bz
8156	3-(2-Ni t rophenyl)propanoi c aci d	2-Ni t robeazeneopropanoi c aci d	₉ H ₉ NO ₃	2001-32-3	195.172	ye cry	115				
8157	3-(4-Ni t rophenyl)propanoi c aci d	4-Ni t robeazeneopropanoi c aci d	₉ H ₉ NO ₃	16642-79-8	195.172	nd (w)	163				
8158	3-(4-Ni t rophenyl)-2-propenal	4-Ni t roci nnamal dehyde	₉ H ₉ NO ₃	1734-79-8	177.157	nd (w, al)	141.5				s H ₂ O, et h, ace, bz; vs Et OH
8159	3-(2-Ni t rophenyl)-2-propynoi c aci d	o-Ni t rophenyl propi oli c aci d	₉ H ₇ NO ₄	530-85-8	191.141		≈157 dec; may expl ode				sl H ₂ O; vs Et OH, et h; i QS
8160	1-Ni t ro-4-(phenyl t hi o)benzene		₁₂ H ₉ NO ₂ S	952-97-6	231.270	pa ye mcl pr (li g)	56	288 ¹⁰⁰ , 240 ²⁵			vs et h, Et OH
8161	(4-Ni t rophenyl)urea	<i>p</i> -Ni t rophenyl urea	₈ H ₉ N ₃ O ₃	556-10-5	181.149	pr (al), nd (di l al)	238				vs H ₂ O, Et OH
8162	<i>N</i> -Ni t ropi peri di ne		₅ H ₉ N ₂ O ₂	7119-94-0	130.145	li q	-5.5	245; 12 ⁹	1.1519 ²⁸	1.4954 ²⁶	
8163	1-Ni t ropropane		₃ H ₇ NO ₂	108-03-2	89.094	li q	-108	131.1	0.996 ⁹	1.4018 ²⁰	sl H ₂ O; msc Et OH, et h; s chl
8164	2-Ni t ropropane		₃ H ₇ NO ₂	79-46-9	89.094	li q	-91.3	120.2	0.982 ⁹	1.3944 ²⁰	sl H ₂ O; s chl
8165	3-Ni t ropropanoi c aci d		₃ H ₇ NO ₄	504-88-1	119.077		62		1.59 ²⁰		vs H ₂ O, Et OH, et h; s chl; i li g
8166	2-Ni t ro-1-propanol		₃ H ₇ NO ₃	2902-96-7	105.093			120 ³² , 100 ¹²	1.1841 ²⁵	1.4379 ²⁰	s H ₂ O, Et OH, et h; sl chl
8167	1-Ni t ro-1-propene		₃ H ₅ NO ₂	3156-70-5	87.078			60 ³⁴ , 37 ¹⁰	1.0661 ²⁰	1.4527 ²⁰	s et h, ace, chl
8168	2-Ni t ro-1-propene		₃ H ₅ NO ₂	4749-28-4	87.078	ye-grn li q		52 ² , 32 ³⁰	1.0559 ²⁵	1.4358 ²⁰	s et h, ace, chl
8169	5-Ni t ro-2-propoxyani li ne		₉ H ₉ N ₂ O ₃	553-79-7	196.202	oran (PrOH-pet h)	49				vs Et OH
8170	<i>N</i> -(5-Ni t ro-2-propoxyphenyl)acet ami de	5'-Ni t ro-2'-propoxyacet ani li de	₁₁ H ₁₃ N ₂ O ₄	553-20-8	238.240	cry (PrOH)	102.5				
8171	1-Ni t ropyrene		₁₀ H ₆ NO ₂	5522-43-0	247.248	ye nd (MeCN)	152				
8172	5-Ni t ro-2-pyri di nami ne		₅ H ₆ O ₃	4214-76-0	139.113	ye lf (di l al)	188				sl OHet h, bz, li g; s Et OH
8173	4-Ni t ropyri di ne		₅ H ₆ N ₂ O ₂	1122-61-8	124.098	pl (aq al)	50				
8174	4-Ni t ropyri di ne 1-oxi de		₅ H ₆ O ₃	1124-33-0	140.097		160.5				
8175	5-Ni t ropyri mi di nami ne		₄ H ₆ NO ₂	3073-77-6	140.101	nd (al)	236.5				sl H ₂ O, DMSO; s Et OH, ace; i et h, bz
8176	5-Ni t ro-2,4,6-(<i>H</i> ,3 <i>H</i>)-pyri mi di nedi one	5-Ni t rouraci l	₄ H ₄ N ₂ O ₄	611-08-5	157.085	gol d nd (al)	>300 exp				sl H ₂ O; s Et OH
8177	5-Ni t ro-2,4,6-(<i>H</i> ,3 <i>H</i> ,5 <i>H</i>)-pyri mi di net ri one	5-Ni t robarbi t uri c aci d	₄ H ₄ NO ₅	480-68-2	173.084	pr, lf (w+3)	180.5				s H ₂ O, Et OH; i et h



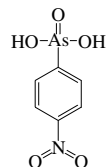
4-Ni t rophenylacetat e



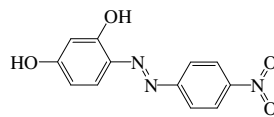
2-Ni t rophenylani li ne



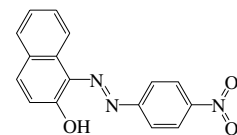
4-Ni t rophenylani li ne



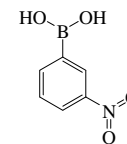
(4-Ni t rophenyl)arsoniáci d



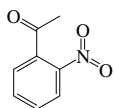
4-[(4-Ni t rophenyl)azo]-1,3-benzenedi ol



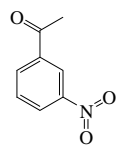
1-[(4-Ni t rophenyl)azo]-2-napht hol



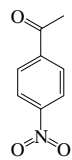
(3-Ni t rophenyl)boroniáci d



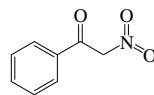
1-(2-Ni t rophenyl)et hanone



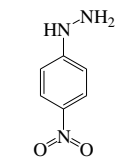
1-(3-Ni t rophenyl)et hanone



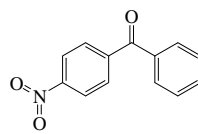
1-(4-Ni t rophenyl)et hanone



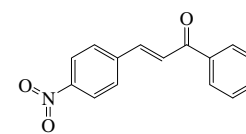
2-Ni t ro-1-phenyl et hanone



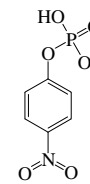
(4-Ni t rophenyl)hydrazi ne



(4-Ni t rophenyl)phenyl met hanone

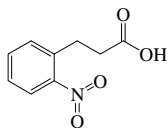


3-(4-Ni t rophenyl)-1-phenyl -2-propen-1-one

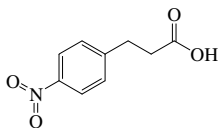


4-Ni t rophenylfosfhat e

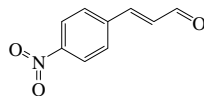
3-431



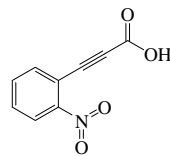
3-(2-Ni t rophenyl)propanoiáci d



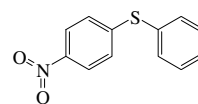
3-(4-Ni t rophenyl)propanoiáci d



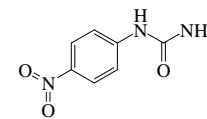
3-(4-Ni t rophenyl)-2-propenal



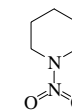
3-(2-Ni t rophenyl)-2-propynoiáci d



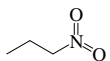
1-Ni t ro-4-(phenylt hi o)benzene



(4-Ni t rophenyl)urea



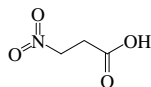
N-Ni t ropi peri di ne



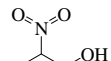
1-Ni t ropropane



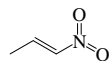
2-Ni t ropropane



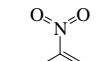
3-Ni t ropropanoiáci d



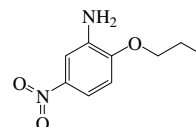
2-Ni t ro-1-propanol



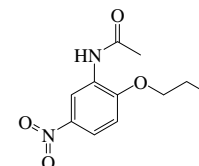
1-Ni t ro-1-propene



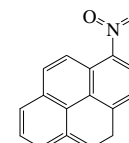
2-Ni t ro-1-propene



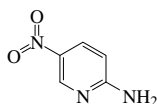
5-Ni t ro-2-propoxyani li ne



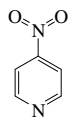
N-(5-Ni t ro-2-propoxyphenyl)acet ami de



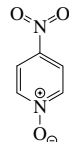
1-Ni t ropyrene



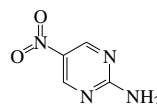
5-Ni t ro-2-pyri di nami ne



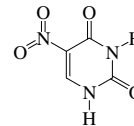
4-Ni t ropyri di ne



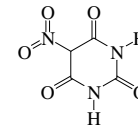
4-Ni t ropyri di t oxí de



5-Ni t ropyri mi di nami ne

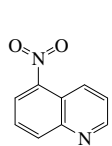


5-Ni t ro-2,4,6-triazin-3(1H)-one

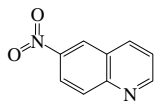


5-Ni t ro-2,4,6-triazin-3,5-dihydro-1,3,5-triazin-2(1H)-one

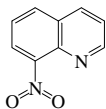
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8178	5-Ni t roqui noli ne		$\text{C}_9\text{H}_{10}\text{O}_2$	607-34-1	174.156	pl (w, al) nd (+w)	74	sub			sl H_2O , chl; s Et OH, bz
8179	6-Ni t roqui noli ne		$\text{C}_9\text{H}_{10}\text{O}_2$	613-50-3	174.156	ye pl (HCl-HOAc)	153.5	170 ⁰²			s H_2O , Et OH; sl et h, chl; vs bz
8180	8-Ni t roqui noli ne		$\text{C}_9\text{H}_{10}\text{O}_2$	607-35-2	174.156	mcl pr (al)	91.5				sl H_2O , chl; s Et OH, et h, bz, aci d
8181	4-Ni t roqui noli ne 1-oxi de		$\text{C}_9\text{H}_8\text{O}_3$	56-57-5	190.155	ye nd, pl (ace)	154				
8182	5-Ni t ro-8-qui noli nol	Ni t roxoli ne	$\text{C}_9\text{H}_8\text{N}_2\text{O}$	4008-48-4	190.155		180				
8183	Ni t rosobenzene		$\text{C}_6\text{H}_5\text{NO}$	586-96-9	107.110	ort h or mcl (al - et h)	67	58 ¹⁸			i H_2O ; s Et OH, et h, bz, li g
8184	N-Ni t rosodi but ylami ne	Di but yl ni t rosami ne	$\text{C}_8\text{H}_{18}\text{N}_2\text{O}$	924-16-3	158.241			105 ⁸			
8185	N-Ni t rosodi et hanolami ne	2,2'-(Ni t rosoi mi no)et hanol	$\text{C}_8\text{H}_{18}\text{N}_2\text{O}_2$	1116-54-7	134.133	wh-ye oi l		125 ⁹¹		1.4849 ²⁰	
8186	N-Ni t rosodi et hylami ne	Di et hyl ni t rosami ne	$\text{C}_8\text{H}_{18}\text{N}_2\text{O}$	55-18-5	102.134	ye oi l		176.9	0.9422 ⁹	1.4386 ²⁰	s H_2O , Et OH, et h; sl chl
8187	N-Ni t rosodi met hylami ne	Di met hyl ni t rosami ne	$\text{C}_8\text{H}_{19}\text{N}_2\text{O}$	62-75-9	74.081	ye li q		152	1.004 ⁹	1.4368 ²⁰	vs H_2O , Et OH, et h; s chl
8188	ρ -Ni t rosodi met hylami li ne		$\text{C}_8\text{H}_{17}\text{NO}$	138-89-6	150.177	grn pl (et h)	92.5			1.14 ⁹	sl H_2O ; s Et OH, et h, chl, HCONH ₂
8189	N-Ni t rosodi phenylami ne	N,N-Di phenyl ni t rosami ne	$\text{C}_8\text{H}_9\text{N}_2\text{O}$	86-30-6	198.219	ye pl (li g)	66.5				i ₂ OH sl Et OH, chl; s bz
8190	4-(N-Ni t rosomet hylami no)-1-(3-pyri dyl)-1-but anone	Ket one, 3-pyri dyl-3A'-met hyl-N-ni t rosami no)propyl	$\text{C}_{10}\text{H}_{13}\text{N}_3\text{O}_2$	64091-91-4	207.229		63				sl H_2O
8191	N-Ni t rosomet hyl et hylami ne		$\text{C}_8\text{H}_9\text{N}_2\text{O}$	10595-95-6	88.108	ye li q		6 ⁹			
8192	N-Ni t rosodi met hyl vi nylami ne	N-Met hyl-N-ni t rosodet henami ne	$\text{C}_8\text{H}_9\text{N}_2\text{O}$	4549-40-0	86.092	ye li q		47			sl H_2O
8193	4-Ni t rosomorpholi ne	N-Ni t rosomorpholi ne	$\text{C}_8\text{H}_9\text{N}_2\text{O}_2$	59-89-2	116.119		29	225; 140 ²⁵			s H_2O
8194	2-Ni t roso-1-napht hol		$\text{C}_{10}\text{H}_7\text{NO}_2$	132-53-6	173.169		157 dec				sl H_2O , et h, bz, chl; s Et OH, ace, HOAc
8195	1-Ni t roso-2-napht hol	1-Ni t rosoapht hol	$\text{C}_{10}\text{H}_7\text{NO}_2$	131-91-9	173.169	ye-br nd (pet h)	109.5				vs bz, et h
8196	N-Ni t rosonorni cot i ne	N-Ni t roso-3-(2-pyrrol i di nyl)pyri di nyl	$\text{C}_{11}\text{H}_{13}\text{N}_3\text{O}$	16543-55-8	177.202			155 ⁰²			
8197	4-Ni t rosophenol		$\text{C}_6\text{H}_5\text{NO}_2$	104-91-6	123.110	pa ye ort h nd (ace, bz)	144 dec				sl H_2O ; s Et OH, et h, ace, bz, di l alk
8198	4-Ni t rosodi phenylami li ne	ρ -Ni t rosodi phenylami ne	$\text{C}_{12}\text{H}_{19}\text{N}_2\text{O}$	156-10-5	198.219		143				sl H_2O , li g; vs Et OH, et h, bz
8199	N-Ni t rosopi peri di ne	1-Ni t rosopi peri di ne	$\text{C}_{10}\text{H}_{19}\text{NO}$	100-75-4	114.145	pa ye		219; 109 ²⁰	1.0631 ¹⁸	1.4933 ¹⁸	s H_2O , HCl
8200	N-Ni t rosodi propyl-1-propanami ne	N-Ni t rosodi propylami ne	$\text{C}_8\text{H}_{17}\text{N}_2\text{O}$	621-64-7	130.187	gol d		206; 113 ³⁰	0.9163 ²⁰	1.4437 ²⁰	sl H_2O ; msc Et OH, et h
8201	N-Ni t rosopyrrol i di ne		$\text{C}_8\text{H}_{17}\text{NO}$	930-55-2	100.119			214	1.085 ²⁵	1.4880 ²⁵	
8202	5-Ni t ro-2-t hi azolami ne	2-Ami no-5-ni t ro t hi azole	$\text{C}_5\text{H}_7\text{N}_3\text{O}_2\text{S}$	121-66-4	145.140	oran-ye pow	202 dec				
8203	N-(5-Ni t ro-2-t hi azolyl)acet ami de	Ami ni t rozole	$\text{C}_5\text{H}_7\text{N}_3\text{O}_3\text{S}$	140-40-9	187.177	nd (al), pl (HOAc)	264.5				s alk
8204	4-Ni t ro t hi oani sole		$\text{C}_7\text{H}_9\text{NO}_2\text{S}$	701-57-5	169.202		72	137 ²	1.2391 ⁸⁰	1.6401 ²⁰	i H_2O ; s ace, bz
8205	2-Ni t ro t hi ophene		$\text{C}_7\text{H}_9\text{NO}_2\text{S}$	609-40-5	129.138	l t ye mcl nd (pet h)	46.5	224.5	1.3644 ⁴⁵		i H_2O ; vs Et OH; s alk; sl pet h
8206	2-Ni t rot oluene		$\text{C}_7\text{H}_7\text{NO}_2$	88-72-2	137.137	li q	-10.4	222	1.161 ⁹	1.5450 ²⁰	i H_2O ; msc Et OH, et h; s ct c
8207	3-Ni t rot oluene		$\text{C}_7\text{H}_7\text{NO}_2$	99-08-1	137.137	pa ye	15.5	232	1.1581 ²⁰	1.5466 ²⁰	i H_2O ; s Et OH, bz, ct c; msc et h
8208	4-Ni t rot oluene		$\text{C}_7\text{H}_7\text{NO}_2$	99-99-0	137.137	ort h cry (al, et h)	51.63	238.3	1.1038 ⁷⁵		i H_2O ; s Et OH; vs et h, ace, bz, chl
8209	1-Ni t ro-2-(t ri fluoromet hyl)benzene		$\text{C}_7\text{H}_4\text{F}_3\text{NO}_2$	384-22-5	191.108	cry (al)	32.5	217; 105 ⁹			i H_2O ; vs Et OH, HOAc, bz; sl ct c
8210	1-Ni t ro-3-(t ri fluoromet hyl)benzene		$\text{C}_7\text{H}_4\text{F}_3\text{NO}_2$	98-46-4	191.108	li q	-2.4	202.8; 10 ⁹	1.4357 ¹⁵	1.4719 ²⁰	i H_2O ; s Et OH, et h; sl ct c
8211	Ni t rourea		$\text{C}_2\text{H}_3\text{N}_3\text{O}_3$	556-89-8	105.053	pl (al-pet h)	158 dec				vs ace, Et OH
8212	<i>t rans</i> (2-Ni t rovi nyl)benzene		$\text{C}_8\text{H}_9\text{NO}_2$	5153-67-3	149.148	ye pr (pet h, al)	60	255			i H_2O ; s Et OH, ace; vs et h, chl, CS_2
8213	Ni valenol		$\text{C}_{10}\text{H}_{20}\text{O}_7$	23282-20-4	312.316	cry (MeOH)	224 dec				sl H_2O ; s Et OH, MeOH
8214	Ni zat i di ne		$\text{C}_{12}\text{H}_{21}\text{N}_5\text{O}_2\text{S}_2$	76963-41-2	331.458	cry (Et OH/AcOEt)	131				sl H_2O ; s MeOH; vs chl; i bz, et h



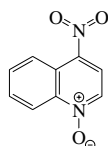
5-Ni t roqui nol i ne



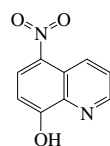
6-Ni t roqui nol i ne



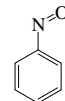
8-Ni t roqui nol i ne



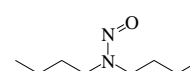
4-Ni t roqui nol i t raxi de



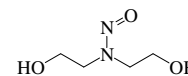
5-Ni t ro-8-qui nol i nol



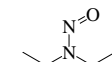
Ni t rosobenzene



N-Ni t rosodi but ylami ne



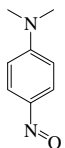
N-Ni t rosodi et hanol ami ne



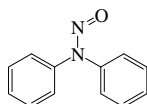
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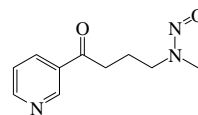
N-Ni t rosodi met hyl ami ne



p-Ni t rosod *N,N*-di met hyl ani li ne



N-Ni t rosodi phenyl ami ne



4-(*N*-Ni t rosomet hyl ami no)-1-(3-pyri dyl)-1-but anone

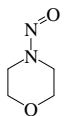


N-Ni t rosomet hyl et hyl ami ne

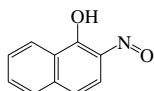


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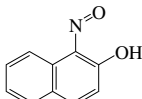
3-433



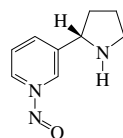
4-Ni t rosomorpho li i ne



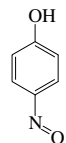
2-Ni t roso-1-napht hol



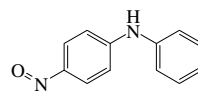
1-Ni t roso-2-napht hol



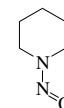
N-Ni t rosonomi cot i ne



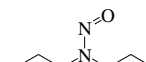
4-Ni t rosophenol



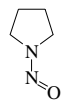
4-Ni t rosod *N*-phenyl ani li ne



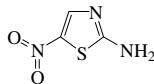
N-Ni t rosopi peri di ne



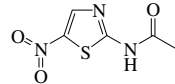
N-Ni t rosod *N*-propyl-1-propanami ne



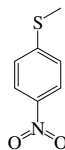
N-Ni t rosopyrro li di ne



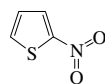
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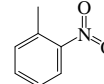
N-(5-Ni t ro-2-t hi azol yl)acet ami de



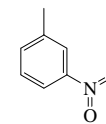
4-Ni t rot hi oani so le



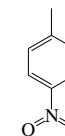
2-Ni t rot hi ophene



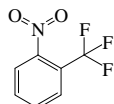
2-Ni t rot ol uene



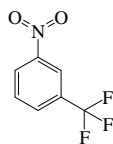
3-Ni t rot ol uene



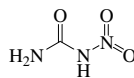
4-Ni t rot ol ue



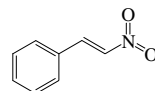
1-Ni t ro-2-(t ri f luoromet hyl)benzene



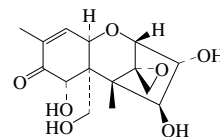
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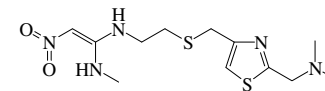
Ni t rourea



t rans(2-Ni t rovi nyl)benzene

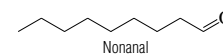
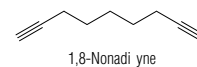
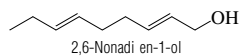
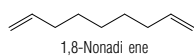
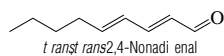
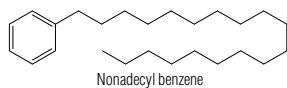
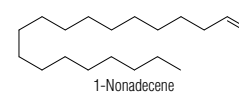
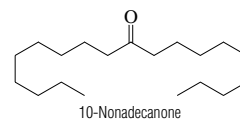
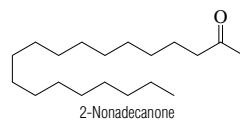
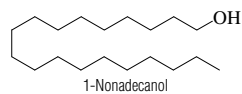
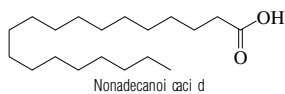
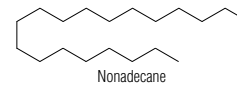
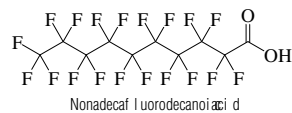
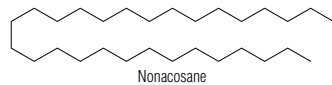
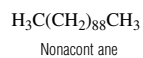
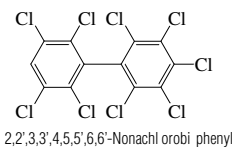


Ni valenol

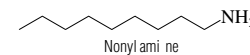
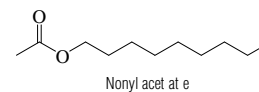
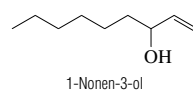
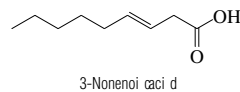
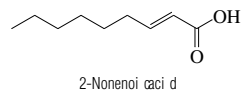
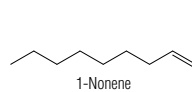
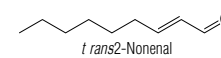
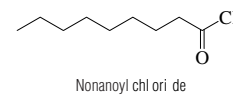
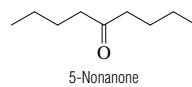
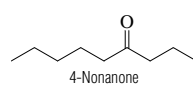
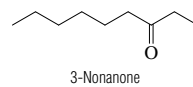
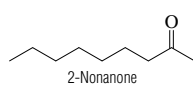
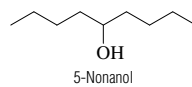
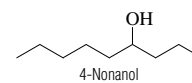
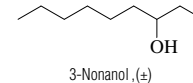
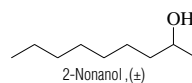
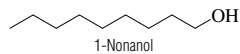
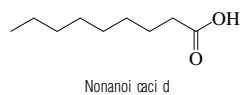
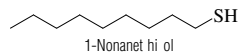
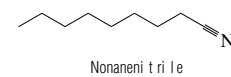
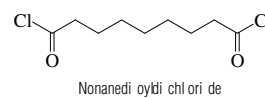
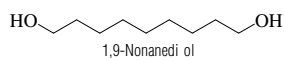
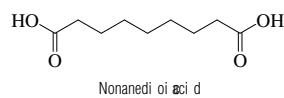
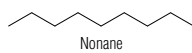


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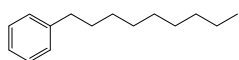
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8215	2,2',3,3',4,5,5',6,6'-Nonachloro bi phenyl		C ₁₂ HCl ₉	52663-77-1	464.213	cry	180.5				i H ₂ O
8216	Nonacosane		C ₃₀ H ₆₂	7667-51-8	424.540			612 ²⁰⁰			
8217	Nonacosane		C ₂₉ H ₆₀	630-03-5	408.786	ort h cry (pet h)	63.7	440.8	0.8083	1.4529 ²⁰	i H ₂ O; vs Et OH, et h, ace; s bz; sl chl
8218	Nonadecafluorodecanoic acid		CF ₁₉ F ₁₉ O ₂	335-76-2	514.084			219			
8219	Nonadecane		C ₁₉ H ₄₀	629-92-5	268.521	wax	32.0	329.9	0.7855 ²⁰	1.4409 ²⁰	i H ₂ O; sl Et OH; s et h, ace, ct c
8220	Nonadecanoic acid		C ₁₉ H ₃₈ O ₂	646-30-0	298.504	lf (al)	69.4	297 ¹ , 228 ¹⁰	0.8468 ⁷⁰		i H ₂ O; vs Et OH, et h, bz, chl, li g
8221	1-Nonadecanol		C ₁₉ H ₄₀ O	1454-84-8	284.520	cry (ace)	61.7	345; 166 ^{0,3}		1.4328 ⁷⁵	s et h, ace
8222	2-Nonadecanone		C ₁₉ H ₃₈ O	629-66-3	282.504	pr (al)	57	266 ¹⁰ , 165 ²	0.8108 ⁵⁶		i H ₂ O; sl Et OH; s ace, bz; vs et h, ct c
8223	10-Nonadecanone		C ₁₉ H ₃₈ O	504-57-4	282.504	lf (al)	65.5	>350; 156			i H ₂ O; sl Et OH; s et h, ace, li g; vs bz
8224	1-Nonadecene		C ₁₉ H ₃₈	18435-45-5	266.505		23.4	329.0	0.7886 ²⁵	1.4445 ²⁵	
8225	Nonadecyl benzene		C ₂₅ H ₄₄	29136-19-4	344.617		40	419	0.8545 ²⁰	1.4807 ²⁰	
8226	trans-2,4-Nonadienal		C ₉ H ₁₆ O	5910-87-2	138.206			98 ¹⁰	0.862 ²⁵	1.5207 ²⁰	
8227	1,8-Nonadiene		C ₉ H ₁₆	4900-30-5	124.223			142.5	0.7511 ²⁰	1.4302 ²⁰	
8228	2,6-Nonadiene-1-ol		C ₉ H ₁₆ O	7786-44-9	140.222			108 ²⁴ , 98 ¹¹	0.8604 ²⁵	1.4598 ²⁵	
8229	1,8-Nonadiene		C ₉ H ₁₂	2396-65-8	120.191	li q	-27.3	162	0.8158	1.4490 ²⁰	i H ₂ O; s et h, ace
8230	Nonanal	Nonaldehyde	C ₉ H ₁₈ O	124-19-6	142.238		-19.3	191	0.8264 ²²	1.4273 ²⁰	s et h, chl
8231	Nonane		C ₉ H ₂₀	111-84-2	128.255	li q	-53.46	150.82	0.7192	1.4058 ²⁰	i H ₂ O; vs Et OH, et h; msc ace, bz, hp
8232	Nonanediol diacid	Azelal diacid	C ₉ H ₁₆ O ₄	123-99-9	188.221	lf or nd	106.5	287 ⁰ , 225 ¹⁰	1.225 ²⁵	1.4303 ¹¹¹	sl H ₂ O, et h, bz, DMSO; s Et OH
8233	1,9-Nonanediol		C ₉ H ₂₀ O ₂	3937-56-2	160.254	cry (bz)	45.8	173 ²⁰ , 150 ³			sl H ₂ O; vs Et OH, et h; s bz; i li g
8234	Nonanediol dichloride		C ₉ H ₁₄ Cl ₂ O ₂	123-98-8	225.112			166 ¹⁸	1.143	1.4680 ²⁰	s et h; vs bz
8235	Nonanenitrile		C ₉ H ₇ N	2243-27-8	139.238	li q	-34.2	224.4	0.8178	1.4255 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
8236	1-Nonanethiol	Nonyl mercaptan	C ₉ H ₁₈ S	1455-21-6	160.320	li q	-20.1	220	0.842	1.4548 ²⁰	
8237	Nonanoic acid	Pelargonic acid	C ₉ H ₁₈ O ₂	112-05-0	158.238		12.4	254.5	0.9052 ²⁰	1.4343 ¹⁹	i H ₂ O; s Et OH, et h, chl
8238	1-Nonanol	Nonyl alcohol	C ₉ H ₂₀ O	143-08-8	144.254	li q	-5	213.37	0.8280	1.4333 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
8239	2-Nonanol, (±)		C ₉ H ₂₀ O	74683-66-2	144.254	li q	-35	193.5	0.8479	1.4353 ²⁰	i H ₂ O; vs et h, Et OH
8240	3-Nonanol, (±)		C ₉ H ₂₀ O	74742-08-8	144.254		22	195; 93 ¹⁸	0.8250 ²⁰	1.4289 ²⁰	i H ₂ O; s Et OH, et h
8241	4-Nonanol		C ₉ H ₂₀ O	52708-03-9	144.254			192.5; 94 ¹⁸	0.8282 ²⁰	1.4197 ²⁰	i H ₂ O; s Et OH, et h
8242	5-Nonanol	Diethyl carbonyl	C ₉ H ₁₈ O	623-93-8	144.254		5.6	193; 97 ²⁰	0.8220 ²⁰	1.4289 ²⁰	i H ₂ O; s Et OH
8243	2-Nonanone	Heptyl methyl ketone	C ₉ H ₁₈ O	821-55-6	142.238	li q	-7.5	195.3	0.8208	1.4210 ²⁰	i H ₂ O; s Et OH, et h, bz; vs ace, chl
8244	3-Nonanone	Ethyl hexyl ketone	C ₉ H ₁₈ O	925-78-0	142.238	li q	-8	190; 88	0.8241 ²⁰	1.4208 ²⁰	i H ₂ O; s Et OH, et h, bz, chl; vs ace
8245	4-Nonanone	Pentyl propyl ketone	C ₉ H ₁₈ O	4485-09-0	142.238			187.5	0.8190 ²⁵	1.4189 ²⁰	i H ₂ O; s Et OH, et h, chl; vs ace
8246	5-Nonanone	Diethyl ketone	C ₉ H ₁₈ O	502-56-7	142.238	li q	-3.8	188.45	0.8217	1.4195 ²⁰	i H ₂ O; s Et OH; vs et h, chl
8247	Nonanoyl chloride		C ₉ H ₁₇ ClO	764-85-2	176.683	li q	-60.5	215.3	0.9463		s et h, ace
8248	trans-2-Nonenal		C ₉ H ₁₆ O	18829-56-6	140.222	li q		109; 89 ¹²	0.846	1.4531 ²⁰	
8249	1-Nonene		C ₉ H ₁₈	124-11-8	126.239	li q	-81.3	146.9	0.7253	1.4257 ²⁰	
8250	2-Nonenoic acid		C ₉ H ₁₆ O ₂	3760-11-0	156.222			173 ²⁰ , 136 ⁵			
8251	3-Nonenoic acid		C ₉ H ₁₆ O ₂	4124-88-3	156.222		-4.4	156 ¹⁸ , 106 ¹	0.9254 ²⁰	1.4454 ²⁵	
8252	1-Nonene-3-ol	1-Vinylheptanol	C ₉ H ₁₆ O	21964-44-3	142.238			193.5	0.824 ²¹	1.4382 ¹⁵	
8253	Nonyl acetate		C ₉ H ₁₈ O ₂	143-13-5	186.292	li q	-26	210	0.8785	1.426 ²⁰	
8254	Nonylamine	1-Nonanamine	C ₉ H ₂₁ N	112-20-9	143.270	li q	-1	202.2	0.7886	1.4336 ²⁰	sl H ₂ O, chl; s Et OH, et h



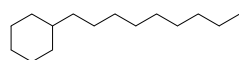
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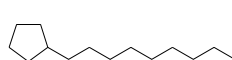
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8255	Nonyl benzene		C ₉ H ₂₀	1081-77-2	204.352	li q	-24	280.5	0.858 ⁴	1.4816 ²⁰	
8256	Nonyl cycl ohexane		C ₉ H ₁₈	2883-02-5	210.399	li q	-10	282	0.816 ³	1.4519 ²⁰	
8257	Nonyl cycl opent ane		C ₉ H ₁₈	2882-98-6	196.372	li q	-29	262	0.808 ⁴	1.4467 ²⁰	vs ace, bz, et h, Et OH
8258	Nonyl format e		C ₉ H ₁₈ O ₂	5451-92-3	172.265	li q	-33	214	0.86	1.421 ⁶	
8259	1-Nonyl naphthalene		C ₁₈ H ₂₆	26438-26-6	254.409		8	366	0.9371 ²⁰	1.5477 ²⁰	
8260	4-Nonyl phenol		C ₉ H ₁₀ O	104-40-5	220.351	visc ye li q	42	≈295; 180 ¹⁰	0.950 ²⁰	1.513 ²⁰	i H ₂ O; s bz, ct c, hp
8261	1-Nonyne	Heptyl acetylene	C ₉ H ₁₆	3452-09-3	124.223	li q	-50	150.8	0.765 ⁸	1.4217 ²⁰	i H ₂ O; s et h, bz, ct c
8262	Norbormide		C ₉ H ₁₂ N ₂ O ₃	991-42-4	511.570	cry (et h)	194				
8263	2,5-Norbornadiene	Bicyclo[2.2.1]hept-2,5-diene	C ₇ H ₈	121-46-0	92.139	li q	-19.1	89.5	0.906 ⁴	1.4702 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; misc t ol
8264	5-Norbornene-2,3-dicarboxylic anhydride		C ₉ H ₆ O ₃	826-62-0	164.158		166				
8265	5-Norbornene-2-methyl acrylate		C ₁₁ H ₁₄ O ₂	95-39-6	178.228	col li q		104	1.029		s os
8266	24-Norcholan-23-oidic acid, (±)	Norcholanidic acid	C ₂₄ H ₃₈ O ₂	511-18-2	346.547	nd(HOAc)	177				
8267	Nordazepam	7-Chloro-1,3-dihydro-5-phenyl-1,4-benzodiazepin-2-one	C ₁₅ H ₁₁ ClN ₂ O	1088-11-5	270.713		216.5				
8268	Nordi hydroguaiaretic acid		C ₁₈ H ₂₂ O ₄	500-38-9	302.366	nd(w, al, HOAc)	185.5				sl H ₂ O; s Et OH, et h, ace, al k, i, bz
8269	Norea		C ₁₃ H ₂₂ N ₂ O	18530-56-8	222.326		177				
8270	Norepinephrine	Noradrenaline	C ₈ H ₉ NO ₃	51-41-2	169.178		217 dec				sl H ₂ O, Et OH, et h; vs al k, di l HCl
8271	Norethisterone	19-Norpregn-4-en-20-yn-3-one, 17-hydroxy-, (17α)-	C ₂₀ H ₂₆ O ₂	68-22-4	298.419	cry	204				
8272	Noretynondrel		C ₁₆ H ₂₆ O ₂	68-23-5	298.419	cry (MeOH)	170				
8273	Norflurazon		C ₁₂ H ₉ ClF ₃ N ₂ O	27314-13-2	303.666		184				
8274	Norhysocyanine		C ₁₆ H ₂₁ NO ₃	537-29-1	275.343	nd	140.5				vs Et OH, chl
8275	DL-Noreucidine	2-Aminohexanoic acid, (DL)	C ₆ H ₁₃ NO ₂	616-06-8	131.173	lf (w)	327 dec		1.17 ²		s H ₂ O; sl Et OH; i et h
8276	L-Noreucidine	2-Aminohexanoic acid, (L)	C ₆ H ₁₃ NO ₂	327-57-1	131.173		301 dec				sl H ₂ O
8277	Normorphine		C ₁₆ H ₁₇ NO ₃	466-97-7	271.311		273				
8278	Norplant	Norgestrel, (-)	C ₂₁ H ₂₈ O ₂	797-63-7	312.446	cry (MeOH)	206				
8279	19-Norethisterone phenylpropionate	Nandrolone phenylpropionate	C ₂₇ H ₃₄ O ₃	62-90-8	406.557	cry	95				
8280	Nortriptyline hydrochloride		C ₁₅ H ₁₃ ClN	894-71-3	299.838	cry (et h)	214				s H ₂ O, Et OH; i bz, et h, ace
8281	DL-Norvaline	2-Aminopentanoic acid, (±)	C ₅ H ₉ NO ₂	760-78-1	117.147	lf (al, w)	303	sub			s H ₂ O; i Et OH, et h, chl, AcOEt, li g
8282	L-Norvaline	2-Aminopentanoic acid, (L)	C ₅ H ₉ NO ₂	6600-40-4	117.147	cry (di l al)	307				s H ₂ O
8283	Noscapine		C ₂₂ H ₂₃ NO ₇	128-62-1	413.421	pr or nd (al)	176				i H ₂ O; s Et OH, bz, chl; sl et h; vs ace
8284	Novobionin	Streptovincin	C ₃₁ H ₃₆ O ₂	303-81-1	612.624	wh-ye orth cry	154		1.3448		i H ₂ O; s Et OH, Et OAc, ace, py
8285	Nuariol		C ₁₂ H ₁₂ ClFN ₂ O	63284-71-9	314.740		126				
8286	Nylindrin	Buphenine	C ₁₃ H ₁₃ NO ₂	447-41-6	299.408	cry (MeOH)	111				
8287	Ochratexin A		C ₁₈ H ₁₈ ClNO ₃	303-47-9	403.813	cry (xyl)	169				
8288	Ochratexin B		C ₁₉ H ₁₉ NO ₃	4825-86-9	369.368	cry (MeOH)	221				
8289	Ochratexin C		C ₁₂ H ₁₂ ClNO ₃	4865-85-4	431.866	amor sol i d					
8290	Octacaine	3-(Diethylamino)-phenylbutanamide	C ₁₄ H ₂₂ N ₂ O	13912-77-1	234.337	cry	47	200 ¹			vs Et OH, bz, et h
8291	2,2',3,3',5,5',6,6'-Octachlorobiphenyl		C ₁₂ Cl ₈	2136-99-4	429.768	cry	161				i H ₂ O
8292	Octachlorocyclopentene	Perchlorocyclopentene	C ₅ Cl ₈	706-78-5	343.678	nd	40	283	1.8200 ⁵⁰	1.5660 ⁵⁰	i H ₂ O; vs Et OH
8293	Octachlorodibenzodioxin		C ₁₀ Cl ₈ O ₂	3268-87-9	459.751	nd	331				
8294	Octachloronaphthalene	Perchloronaphthalene	C ₁₀ Cl ₈	2234-13-1	403.731	nd (bz-CCl ₄)	197.5	441 ⁷ , 248 ^{9,5}			sl Et OH; vs bz, chl, li g
8295	Octachlorostyrene	Perchlorostyrene	C ₈ Cl ₈	29082-74-4	379.710	cry (ace/Et OH)	99				



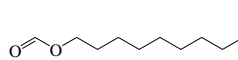
Nonyl benzene



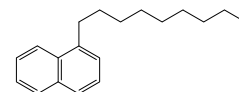
Nonyl cycl hexane



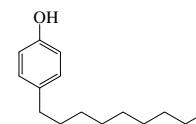
Nonyl cycl opent ane



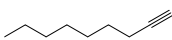
Nonyl f ormat e



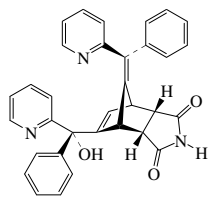
1-Nonyl naph thal ene



4-Nonyl phenol



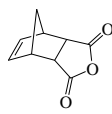
1-Nonyne



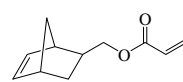
Norbormi de



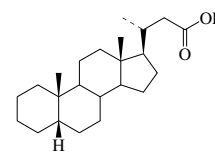
2,5-Norbormadi ene



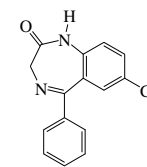
5-Norbornene-2,3-di carboxyl i aci d anhydri de



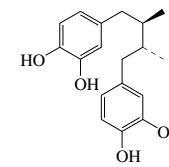
5-Norbornene-2-met hyl ol acrylat e



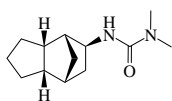
24-Norchol an-23-oi aci d (5β)



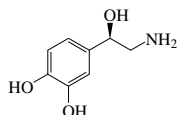
Nordazepam



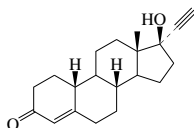
Nordi droguai aret aci d



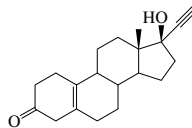
Norea



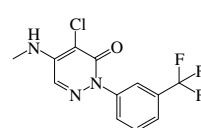
Norepi nephr i ne



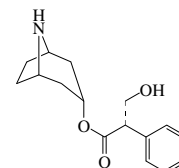
Noret hi st erone



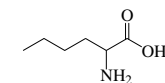
Noret hynodrel



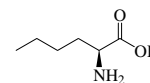
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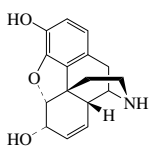
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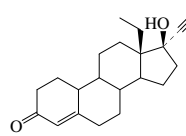
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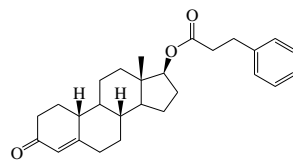
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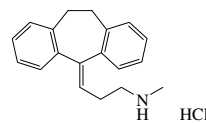
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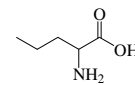
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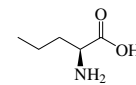
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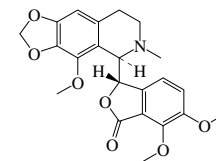
Nort ri pt yl i hydrochl ori de



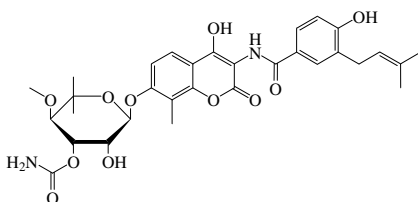
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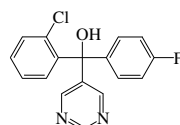
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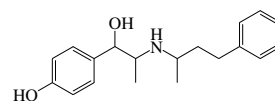
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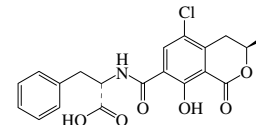
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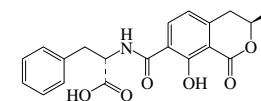
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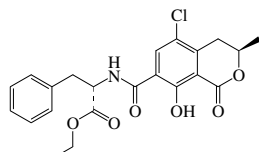
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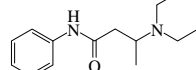
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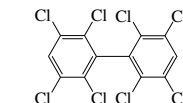
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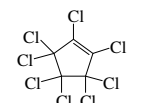
Ochrat ox i C



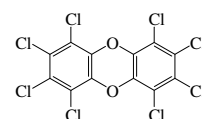
Oct aca i ne



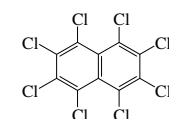
2,2',3,3',5,5',6,6'-Oct achl orobi phenyl



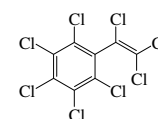
Oct achl orocycl opent ene



Oct achl orodi benz o-di ox i n



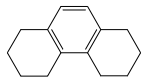
Oct achl oronaph thal ene



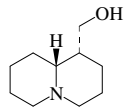
Oct achl orost yrene

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8296	Oct acotane		C ₁₆ H ₃₄	7667-88-1	1124.142		112	672			
8297	Oct acosane		C ₂₆ H ₅₈	630-02-4	394.761	mcl or ort h (bz-al)	61.1	431.6	0.8067 ²⁰	1.4330 ⁷⁰	i H ₂ O; msc ace; s bz, chl
8298	Oct acosanoi c aci d	Mont ani c aci d	C ₂₈ H ₅₆ O ₂	506-48-9	424.744		90.9		0.8191 ¹⁰⁰	1.4313 ¹⁰⁰	vs bz, chl
8299	1-Oct acosanol	Mont anyl al cohol	C ₂₈ H ₅₆ O	557-61-9	410.760	cry (ace, pet h)	83.4	200			i H ₂ O; s CS ₂
8300	<i>t rans, t rans</i> -1,2-Oct adecadi enoi c aci d	di nol elai di c aci d	C ₁₈ H ₃₄ O ₂	506-21-8	280.446	cry (MeOH)	28.5	181 ⁰⁵			sl H ₂ O; s ace, hx
8301	Oct adecahydrochrysene		C ₁₈ H ₃₀	2090-14-4	246.431		115	353			vs Et OH
8302	Oct adecamet hyl oct asi loxane		C ₁₈ H ₃₄ O ₇ Si ₈	556-69-4	607.302		-63	186 ²⁰ , 153 ⁵	0.913 ²⁵	1.3970 ²⁰	vs bz, pet h, li g
8303	Oct adecanami de		C ₁₈ H ₃₇ NO	124-26-5	283.493	lf (al)	109	250			vs et h, chl
8304	Oct adecane		C ₁₈ H ₃₈	593-45-3	254.495	nd (al, et h-MeOH)	28.2	316.3	0.7768 ²⁸	1.4390 ²⁰	i H ₂ O; sl Et OH; s et h, ace, chl, li g
8305	Oct adecaneni tri le		C ₁₈ H ₃₅ N	638-65-3	265.478		41	362	0.8325 ²⁰	1.4389 ⁴⁵	i H ₂ O; s Et OH; vs et h, ace, chl
8306	1-Oct adecanet hi ol	St earyl mercapt an	C ₁₈ H ₃₅ S	2885-00-9	286.560		30	207 ¹¹	0.8475 ²⁰	1.4645 ²⁰	vs et h
8307	1-Oct adecanol	St earyl al cohol	C ₁₈ H ₃₆ O	112-92-5	270.494	lf (al)	57.9	335; 210 ¹⁵	0.8124 ⁵⁹		i H ₂ O; s Et OH, et h; sl ace, bz
8308	Oct adecanoyl chl ori de		C ₁₈ H ₃₅ ClO	112-76-5	302.923		23	215 ⁵	0.8969 ⁹	1.4523 ²⁴	sl Et OH
8309	<i>t rans, ci s, t rans</i> -11,13-Oct adecadi enoi c aci d	<i>ci s</i> El eost eari c aci d	C ₁₈ H ₃₀ O ₂	506-23-0	278.430	nd (al)	49	235 ² dec, 170 ¹	0.9028 ⁵⁰	1.5112 ⁵⁰	vs et h, Et OH
8310	<i>t rans, t rans, t rans</i> -11,13-Oct adecadi enoi c aci d	<i>t rans</i> El eost eari c aci d	C ₁₈ H ₃₀ O ₂	544-73-0	278.430	lf (al)	71.5	188	0.8839 ⁸⁰	1.5000 ⁸⁰	vs Et OH
8311	<i>ci s</i> -9-Oct adecenami de		C ₁₈ H ₃₅ NO	301-02-0	281.477		76				vs et h
8312	1-Oct adecene		C ₁₈ H ₃₆	112-88-9	252.479		17.5	179 ¹⁵ , 145 ⁸	0.7891 ²⁰	1.4448 ²⁰	i H ₂ O; s ace, ct c
8313	<i>ci s</i> -9-Oct adeceneni tri le		C ₁₈ H ₃₃ N	112-91-4	263.462		-1	dec 332	0.847 ¹⁷	1.4566 ²⁰	vs Et OH
8314	<i>ci s</i> -6-Oct adecenoi c aci d	Pet rosel i ni c aci d	C ₁₈ H ₃₄ O ₂	593-39-5	282.462	lf	29.8	238	0.8700 ⁴⁰	1.4533 ⁴⁰	s et h; sl hp, MeOH
8315	<i>t rans</i> -11-Oct adecenoi c aci d	Vacceni c aci d	C ₁₈ H ₃₄ O ₂	693-72-1	282.462		44			1.4499 ⁶⁰	s ace
8316	<i>ci s</i> -9-Oct adecen-1-ol	Ol eyl al cohol	C ₁₈ H ₃₆ O	143-28-2	268.478		6.5	207 ¹⁵	0.8489 ²⁰	1.4606 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
8317	<i>ci s</i> -9-Oct adecenyl ami ne	Ol eyl ami ne	C ₁₈ H ₃₇ N	112-90-3	267.494	oi l	25	147			
8318	Oct adecyl acet at e		C ₂₀ H ₄₀ O ₂	822-23-1	312.531		34.5	208 ⁹	0.8510 ³⁰		vs Et OH
8319	Oct adecyl acryl at e	St earyl 2-propenoat e	C ₂₁ H ₄₀ O ₂	4813-57-4	324.542						s ct c, CS ₂
8320	Oct adecyl ami ne	1-Oct adecanami ne	C ₁₈ H ₃₇ N	124-30-1	269.510	cry (w)	52.9	346.8	0.8618 ²⁰	1.4522 ²⁰	i H ₂ O; s Et OH, et h, bz; sl ace
8321	Oct adecyl benzene		C ₁₈ H ₁₈	4445-07-2	330.590		36	400	0.85 ³⁶	1.479 ³⁶	
8322	Oct adecyl cycl ohexane		C ₂₄ H ₄₈	4445-06-1	336.638		41.6	409; 175 ¹	0.8300 ²⁰	1.4610 ²⁰	
8323	Oct adecyl 3-(3,5-di- <i>t</i> but yl-4-hydroxyphenyl)propanoat e	Irganox 1076	C ₃₅ H ₆₂ O ₃	2082-79-3	530.865	cry (MeOH/AcOEt)	50				
8324	Oct adecyl i socyanat e	1-Isocyanat ooct adecane	C ₁₉ H ₃₇ NO	112-96-9	295.503		15.5	172 ⁵			
8325	Oct adecyl met hacryl at e	St earyl met hacryl at e	C ₂₂ H ₄₂ O ₂	32360-05-7	338.567			195 ⁶	0.880 ²⁵	1.429 ²⁵	
8326	Oct adecyl oct adecanoat e	Oct adecyl st earat e	C ₃₆ H ₇₂ O ₂	2778-96-3	536.956	cry (Et OH)	60				
8327	3-(Oct adecyl oxy)-1,2-propanedi ol	Bat yl al cohol	C ₂₁ H ₄₂ O ₃	544-62-7	344.572		70.5	217 ²			vs et h
8328	Oct adecyl vi nyl et her	1-(Et henyloxy)oct adecane	C ₂₀ H ₄₀ O	930-02-9	296.531		30	182 ³	0.8138 ⁴⁰		sl chl
8329	1,7-Oct adi ene		C ₁₄ H ₂₆	3710-30-3	110.197			115.5	0.734 ²⁰	1.4245 ²⁰	
8330	1,7-Oct adi yne		C ₁₄ H ₁₀	871-84-1	106.165			135.5; 59 ³⁵	0.8169 ²¹	1.4521 ¹⁸	s et h
8331	2,2,3,3,4,4,5,5-Oct afluo-1-pent anol		C ₁₀ F ₁₈ O	355-80-6	232.072			140.5	1.6647 ²⁰	1.3178 ²⁰	
8332	1,2,3,4,5,6,7,8-Oct ahydroant hracene		C ₁₈ H ₁₈	1079-71-6	186.293	pl (al)	78	294	0.9703 ⁹	1.5372 ⁸⁰	i H ₂ O; s Et OH, HOAc; vs bz; sl ct c
8333	Oct ahydroazoci ne		C ₁₅ H ₁₅ N	1121-92-2	113.201		29	52 ¹⁵	0.896 ²⁵	1.4720 ²⁰	
8334	Oct ahydroi ndene		C ₁₁ H ₁₆	496-10-6	124.223	li q	-53	167	0.87 ⁸	1.4702 ²⁰	
8335	Oct ahydroi ndoli zi ne		C ₈ H ₉ N	13618-93-4	125.212			75 ⁴³	0.9074 ¹⁰	1.4748	vs et h, Et OH
8336	<i>t rans</i> -Oct ahydro-1(2 <i>H</i>)-naphthal enone		C ₁₀ H ₁₆ O	21370-71-8	152.233		33	122 ²⁰	0.986 ²⁰	1.4849 ²¹	

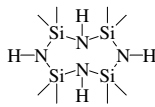
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8337	1,2,3,4,5,6,7,8-Oct ahydrophenant hrene		C ₁₄ H ₁₈	5325-97-3	186.293		16.7	295	1.026 ²⁰	1.5569 ¹⁷	i H ₂ O; s ace, bz, CS ₂ , HOAc
8338	<i>trans</i> Oct ahydro-2 <i>H</i> -qui nol i zi ne-1-met hanol, (R)	Lupi ni ne	C ₈ H ₁₉ NO	486-70-4	169.264	ort h (pet h)	70	270			s H ₂ O, Et OH, et h, bz, chl; sl pet h
8339	2,2,4,4,6,6,8,8-Oct amet hyl cycl ot et rasi l oxane		C ₈ H ₂₈ N ₄ Si ₄	1020-84-4	292.677		97				
8340	Oct amet hyl cycl ot et rasi l oxane		C ₈ H ₂₄ O ₄ Si ₄	556-67-2	296.617		17.5	175.8	0.9561 ²⁰	1.3968 ²⁰	i H ₂ O; s ct c
8341	1,1,1,3,5,7,7,7-Oct amet hyl t et rasi l oxane		C ₈ H ₂₅ O ₃ Si ₄	16066-09-4	282.632			170	0.8559 ²⁰	1.3854 ²⁰	
8342	Oct amet hyl t ri si l oxane		C ₈ H ₂₀ O ₂ Si ₃	107-51-7	236.533	li q	-80	153; 5 ⁹	0.8200 ²⁰	1.3840 ²⁰	sl Et OH; s bz, pet h
8343	Oct anal	Capryl i c al dehyde	C ₈ H ₁₆ O	124-13-0	128.212			171	0.8211 ²⁰	1.4217 ²⁰	vs ace, bz, et h, Et OH
8344	Oct anami de		C ₈ H ₁₇ NO	629-01-6	143.227	lf, pl	108	239	0.8450 ⁹		sl H ₂ O, bz, chl; vs Et OH; s et h, ace
8345	2-Oct anami ne, (±)		C ₈ H ₁₉ N	44855-57-4	129.244		97	164	0.7744 ²⁰	1.4232 ²⁵	vs et h, Et OH
8346	Oct ane		C ₈ H ₁₈	111-65-9	114.229	li q	-56.82	125.67	0.6986	1.3944 ²⁵	i H ₂ O; s et h; msc Et OH, ace, bz
8347	1,8-Oct anedi ami ne		C ₈ H ₂₀ N ₂	373-44-4	144.258	pl		51.64	225		vs H ₂ O, et h, Et OH
8348	Oct anedi ni t ri le	Suberoni t ri le	C ₈ H ₁₂ N ₂ C	629-40-3	136.194		-1.8	185 ¹⁵	0.954 ²⁵	1.4436 ²⁰	
8349	Oct anedi oi c aci d	Suberi c aci d	C ₈ H ₁₄ O ₄	505-48-6	174.195	lo nd or pl (w)	144	219 ⁹			i H ₂ O; msc et h, bz; sl DMSO
8350	1,2-Oct anedi ol		C ₈ H ₁₈ O ₂	1117-86-8	146.228		30	131 ¹⁰ , 104 ^{9,2}			
8351	1,8-Oct anedi ol		C ₈ H ₁₈ O ₂	629-41-4	146.228	nd (bz-li g), pr	63	172 ⁹			sl H ₂ O, et h, chl, li g; vs Et OH; s bz
8352	Oct aneni t ri le	Capryl ni t ri le	C ₈ H ₁₅ NC	124-12-9	125.212	li q	-45.6	205.25	0.8136 ⁹	1.4203 ²⁰	vs et h
8353	1-Oct anet hi ol	Oct yl mercapt an	C ₈ H ₁₇ S	111-88-6	146.294	li q	-49.2	199.1	0.8433 ⁹	1.4540 ²⁰	s Et OH; sl ct c
8354	Oct anoi c aci d	Capryl i c aci d	C ₈ H ₁₆ O ₂	124-07-2	144.212		16.5	239	0.9073 ²⁵	1.4285 ²⁰	sl H ₂ O; msc Et OH, chl, CH ₃ CN
8355	Oct anoi c anhydi de		C ₈ H ₁₆ O ₃	623-66-5	270.407	li q	-1	282.5	0.9065 ⁹	1.4358 ¹⁸	vs ace, et h, Et OH
8356	1-Oct anol	Capryl al cohoh	C ₈ H ₁₈ O	111-87-5	130.228	li q	-14.8	195.16	0.8262 ⁹	1.4295 ²⁰	i H ₂ O; msc Et OH, et h; s ct c
8357	2-Oct anol	(±)sec-Capryl i c al cohoh	C ₈ H ₁₈ O	4128-31-8	130.228	li q	-31.6	179.3	0.8193 ⁹	1.4203 ²⁰	sl H ₂ O; s Et OH, et h, ace
8358	3-Oct anol		C ₈ H ₁₈ O	589-98-0	130.228	li q	-45	171	0.8258 ⁹		
8359	4-Oct anol		C ₈ H ₁₈ O	74778-22-6	130.228	li q	-40.7	176.3	0.8186 ⁹	1.4248 ²⁰	sl H ₂ O, ct c; s Et OH
8360	2-Oct anone	Hexyl met hyl ket one	C ₈ H ₁₆ O	111-13-7	128.212	li q	-16	172.5	0.827 ⁹	1.4151 ²⁰	sl H ₂ O; msc Et OH, et h
8361	3-Oct anone	Et hyl pent yl ket one	C ₈ H ₁₆ O	106-68-3	128.212			167.5	0.822 ²⁵	1.4150 ²⁰	i H ₂ O; msc Et OH, et h
8362	4-Oct anone	But yl propyl ket one	C ₈ H ₁₆ O	589-63-9	128.212			163	0.8146 ²⁵	1.4173 ¹⁴	i H ₂ O; msc Et OH, et h; s ct c
8363	Oct anoyl chl ori de		C ₈ H ₁₅ ClO	111-64-8	162.657	li q	-63	195.6	0.9535	1.4335 ²⁰	s et h
8364	Oct aphenyl cycl ot et rasi l oxane		C ₄₈ H ₆₀ O ₄ Si ₄	546-56-5	793.172	nd (bz-al, HOAc)	200.5	330 ¹			i H ₂ O; sl Et OH; s bz, chl, HOAc
8365	1,3,5,7-Oct at et raene		C ₈ H ₁₀	1482-91-3	106.165	cry (bz)	50	sub			s pet h, HOAc
8366	<i>trans</i> 2-Oct enal		C ₈ H ₁₄ O	2548-87-0	126.196	li q		8 ⁹	0.846	1.4500 ²⁰	
8367	1-Oct ene	Capryl ene	C ₈ H ₁₆	111-66-0	112.213	li q	-101.7	121.29	0.714 ⁹	1.4087 ²⁰	i H ₂ O; msc Et OH; s et h, ace; sl ct c
8368	<i>cis</i> 2-Oct ene		C ₈ H ₁₆	7642-04-8	112.213	li q	-100.2	125.6	0.724 ⁹	1.4150 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl
8369	<i>trans</i> 2-Oct ene		C ₈ H ₁₆	13389-42-9	112.213	li q	-87.7	125	0.719 ⁹	1.4132 ²⁰	i H ₂ O; s Et OH, et h, ace, bz; vs chl
8370	<i>cis</i> 3-Oct ene		C ₈ H ₁₆	14850-22-7	112.213	li q	-126	122.9	0.715 ⁹	1.4135 ²⁰	vs ace, bz, et h, Et OH
8371	<i>trans</i> 3-Oct ene		C ₈ H ₁₆	14919-01-8	112.213	li q	-110	123.3	0.715 ²	1.4126 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, li g, ct c
8372	<i>cis</i> 4-Oct ene		C ₈ H ₁₆	7642-15-1	112.213	li q	-118.7	122.5	0.721 ²	1.4148 ²⁰	vs ace, bz, et h, Et OH
8373	<i>trans</i> 4-Oct ene		C ₈ H ₁₆	14850-23-8	112.213	li q	-93.8	122.3	0.714 ⁹	1.4114 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, li g; sl ct c
8374	1-Oct en-3-ol		C ₈ H ₁₆ O	3391-86-4	128.212			174; 69 ¹²	0.8395 ¹³	1.4391 ¹²	
8375	2-Oct en-1-ol		C ₈ H ₁₆ O	22104-78-5	128.212			88 ¹¹	0.850 ²⁰	1.4470 ²⁰	
8376	1-Oct en-3-yne		C ₈ H ₁₂	17679-92-4	108.181			134; 62 ⁶⁰	0.7749 ²⁰	1.4592 ²⁰	vs et h
8377	Oct hi li none	2-Oct yl 2 sot hi azol one	C ₁₁ H ₁₉ NOS	26530-20-1	213.340			120 ^{0.01}			



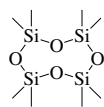
1,2,3,4,5,6,7,8-Octahydrophenanthrene



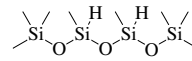
trans-Octahydro-2H-quinoline-1-one



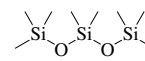
2,2,4,4,6,6,8,8-Octamethylcyclotetrasilazane



Octamethylcyclotetrasiloxane



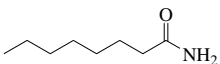
1,1,1,3,5,7,7-Heptamethyl-7-oxo-1,3,5,7-tetraoxa-1,3,5,7-tetraazacyclooctane



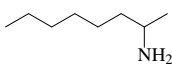
Octamethyltrisiloxane



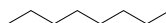
Octanal



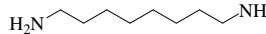
Octanamide



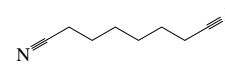
2-Octanamine



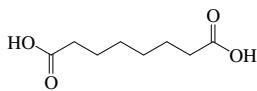
Octane



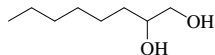
1,8-Octanediamine



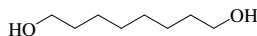
Octanedinitrile



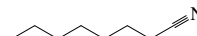
Octanedioic acid



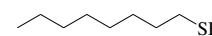
1,2-Octanediol



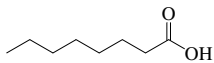
1,8-Octanediol



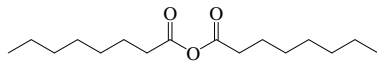
Octanenitrile



1-Octanethiol



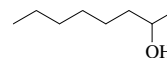
Octanoic acid



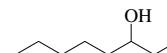
Octanoic anhydride



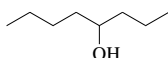
1-Octanol



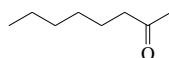
2-Octanol



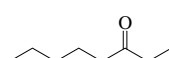
3-Octanol



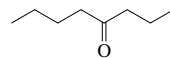
4-Octanol



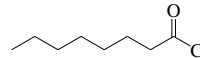
2-Octanone



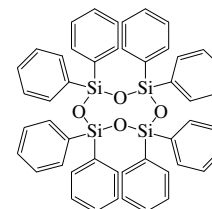
3-Octanone



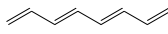
4-Octanone



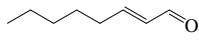
Octanoyl chloride



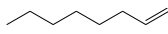
Octaphenylcyclotetrasiloxane



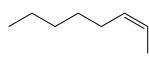
1,3,5,7-Octatetraene



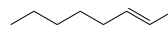
trans-2-Octenal



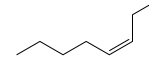
1-Octene



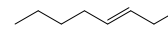
cis-2-Octene



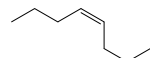
trans-2-Octene



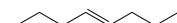
cis-3-Octene



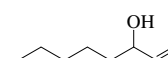
trans-3-Octene



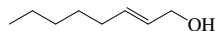
cis-4-Octene



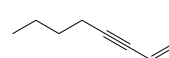
trans-4-Octene



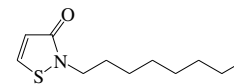
1-Octen-3-ol



2-Octen-1-ol

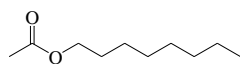


1-Octen-3-yne

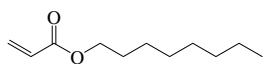


Octylisothiazole

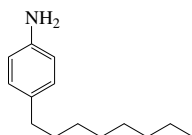
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8378	Oct yl acet at e		$\text{C}_{10}\text{H}_{20}\text{O}_2$	112-14-1	172.265	li q	-38.5	210	0.8705	1.4150 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
8379	Oct yl acryl at e	Oct yl 2-propenoat e	$\text{C}_{11}\text{H}_{20}\text{O}_2$	2499-59-4	184.276			229; 57 ^{0.05}	0.8810 ²⁰		
8380	Oct yl ami ne	1-Oct anami ne	$\text{C}_8\text{H}_{17}\text{N}$	111-86-4	129.244		0	179.6	0.7826 ²⁰	1.4292 ²⁰	sl H ₂ O; vs Et OH, et h; s ct c
8381	Oct yl ami ne hydrochl ori de	1-Oct anami ne hydrochl ori de	$\text{C}_8\text{H}_{17}\text{N}\cdot\text{OClN}$	142-95-0	165.705		196.5				s H ₂ O
8382	4-Oct yl ani li ne		$\text{C}_{14}\text{H}_{23}\text{N}$	16245-79-7	205.340		20	310; 138 ⁵	0.9128 ²⁰		vs et h
8383	Oct yl benzene		C_8H_{12}	2189-60-8	190.325	li q	-36	264	0.8562	1.4845 ²⁰	i H ₂ O; msc et h, bz
8384	Oct yl but anoat e		$\text{C}_{12}\text{H}_{24}\text{O}_2$	110-39-4	200.318	li q	-55.6	244.1	0.8629	1.4267 ¹⁵	vs Et OH
8385	Oct yl cycl ohexane		C_8H_{16}	1795-15-9	196.372	li q	-20	264	0.8138	1.4503 ²⁰	
8386	Oct yl cycl opent ane		C_8H_{16}	1795-20-6	182.345	li q	-44	243	0.8048	1.4446 ²⁰	
8387	2-Oct yl decanoi c aci d		$\text{C}_{18}\text{H}_{36}\text{O}_2$	619-39-6	284.478	nd or li f (al)	38.5	215	0.8447 ⁷⁰		vs et h, Et OH
8388	Oct yl di met hyl ami ne	<i>N,N</i> -Di met hyl -1-oct anami ne	$\text{C}_{10}\text{H}_{23}\text{N}$	7378-99-6	157.297			194			
8389	Oct yl di phenyl phosphat e		$\text{C}_{20}\text{H}_{27}\text{O}_4\text{P}$	115-88-8	362.399				1.09 ²⁵		
8390	Oct yl f ormat e		$\text{C}_{11}\text{H}_{22}\text{O}_2$	112-32-3	158.238	li q	-39.1	198.8	0.8744	1.4208 ¹⁵	i H ₂ O; s Et OH; msc et h; sl ct c
8391	Oct yl i socyanat e		$\text{C}_8\text{H}_7\text{NO}$	3158-26-7	155.237			78 ⁵			
8392	Oct yl met hacryl at e		$\text{C}_{12}\text{H}_{22}\text{O}_2$	2157-01-9	198.302			239.5			
8393	Oct yl ni t rat e		$\text{C}_8\text{H}_9\text{NO}_3$	629-39-0	175.226			110 ²⁰	0.975 ⁰		sl H ₂ O; s Et OH, et h
8394	Oct yl ni t ri t e		$\text{C}_8\text{H}_9\text{NO}_2$	629-46-9	159.227			174.5	0.862 ¹⁷	1.4127 ²⁰	sl H ₂ O; vs Et OH, et h
8395	Oct yl oct anoat e		$\text{C}_{18}\text{H}_{36}\text{O}_2$	2306-88-9	256.424	li q	-18.1	306.8	0.8554	1.4352 ²⁰	vs ace, et h, Et OH
8396	Oct yl oxi rane		$\text{C}_8\text{H}_{18}\text{O}$	2404-44-6	156.265	li q		128; 97 ³⁰			
8397	4-(Oct yl oxy)benzal dehyde		$\text{C}_{18}\text{H}_{22}\text{O}_2$	24083-13-4	234.335			131 ^{0.5}			
8398	4-Oct yl phenol		$\text{C}_8\text{H}_9\text{O}$	1806-26-4	206.324		43.0	169 ¹⁰ , 150 ⁴			
8399	Oct yl phenyl et her	(Oct yl oxy)benzene	$\text{C}_{14}\text{H}_{21}\text{O}$	1818-07-1	206.324		8	285	0.9131 ¹⁵	1.4875 ²⁰	i H ₂ O; s Et OH, et h
8400	4-Oct yl phenyl sal i cyl at e	2-Hydroxybenzoi c aci d, 4-oct yl phenyl est er	$\text{C}_{18}\text{H}_{25}\text{O}_3$	2512-56-3	326.429	wh cry	73				
8401	Oct yl propanoat e		$\text{C}_{11}\text{H}_{22}\text{O}_2$	142-60-9	186.292	li q	-42.6	228	0.8663	1.4221 ¹⁵	i H ₂ O; s Et OH, et h, bz; sl ct c
8402	1-Oct yne	Hexyl acet yl ene	C_8H_{14}	629-05-0	110.197	li q	-79.3	126.3	0.7467	1.4159 ²⁰	i H ₂ O; s Et OH, et h
8403	2-Oct yne	Met hyl pent yl acet yl ene	C_8H_{14}	2809-67-8	110.197	li q	-61.6	137.6	0.7598	1.4278 ²⁰	i H ₂ O; s Et OH, et h
8404	3-Oct yne		C_8H_{14}	15232-76-5	110.197	li q	-103.9	133.1	0.7529	1.4250 ²⁰	i H ₂ O; s Et OH, et h
8405	4-Oct yne	Di propyl acet yl ene	C_8H_{14}	1942-45-6	110.197	li q	-101	131.6	0.7509	1.4248 ²⁰	i H ₂ O; s Et OH, et h
8406	2-Oct yn-1-ol	2-Oct yno l	$\text{C}_8\text{H}_{14}\text{O}$	20739-58-6	126.196		-18	98 ¹⁵	0.8805 ²⁰	1.4556 ²⁰	vs et h
8407	Oleandri n		$\text{C}_{27}\text{H}_{48}\text{O}_3$	465-16-7	576.718	cry (Et OH)	250 dec				i H ₂ O; s Et OH, chl
8408	Ole an-12-en-3-ol, (β)	β-Amyri n	$\text{C}_{30}\text{H}_{50}\text{O}$	559-70-6	426.717	nd (li g or al)	197	260			i H ₂ O; sl Et OH, chl, li g; s et h, bz
8409	Oleanol i c aci d		$\text{C}_{30}\text{H}_{48}\text{O}_3$	508-02-1	456.700	nd or pr (al)	310 dec	sub 280			i H ₂ O; sl Et OH, et h, ace; vs py, HOAc
8410	Olei c aci d	<i>ci s</i> -9-Oct adeceni c aci d	$\text{C}_{18}\text{H}_{34}\text{O}_2$	112-80-1	282.462		13.4	360; 286 ¹⁰⁰	0.8935 ²⁰	1.4582 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, chl, ct c
8411	Omeprazol e		$\text{C}_7\text{H}_{13}\text{N}_3\text{O}_2\text{S}$	73590-58-6	345.416	cry (MeCN)	156				
8412	Omet hoat e		$\text{C}_{12}\text{H}_{17}\text{NO}_4\text{PS}$	1113-02-6	213.192	oi l	≈135 dec		1.32 ²⁰	1.4987 ²⁰	msc H ₂ O; i hx
8413	Orange I	1-Napht hol Orange	$\text{C}_{16}\text{H}_{11}\text{N}_2\text{NaO}_4\text{S}$	523-44-4	350.324	red-br pow					s H ₂ O; sl Et OH; i bz
8414	Orange IV	Tropaeol i n OO	$\text{C}_8\text{H}_{14}\text{N}_3\text{NaO}_3\text{S}$	554-73-4	375.377	ye pow					s H ₂ O
8415	Orcei n			1400-62-0		br-red pow					
8416	<i>L</i> -Orni t hi ne	2,5-Di ami nopen t anoi c aci d, (S)	$\text{C}_6\text{H}_{12}\text{N}_2\text{O}_2$	70-26-8	132.161	mi cro cry (al - et h)	140				vs H ₂ O, Et OH
8417	<i>L</i> -Orni t hi ne, monohydrochl ori de		$\text{C}_6\text{H}_{12}\text{ClN}_2\text{O}_2$	3184-13-2	168.622	nd	215				vs H ₂ O
8418	Orot i c aci d	1,2,3,6-Tet rahydro-2,6-di oxo-4-pyri mi di nocarboxyl i c aci d	$\text{C}_5\text{H}_4\text{N}_2\text{O}_4$	65-86-1	156.097	cry (w)	345.5				sl H ₂ O; i os



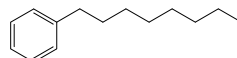
Octylacetate



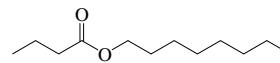
Octylacrylate



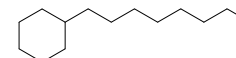
4-Octylaniline



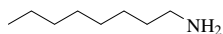
Octylbenzene



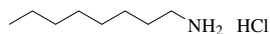
Octylbutanoate



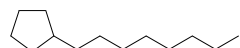
Octylcyclohexane



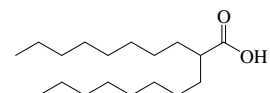
Octylamine



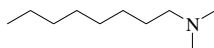
Octylammonium chloride



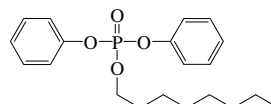
Octylcyclopentane



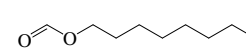
2-Octyldecanoic acid



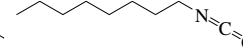
Octyldimethylamine



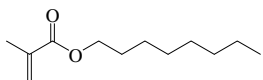
Octylidiphenylphosphate



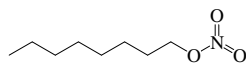
Octylformate



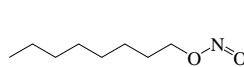
Octylisocyanate



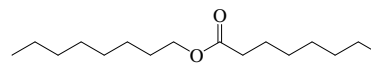
Octylmethacrylate



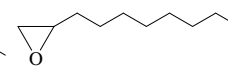
Octylnitrate



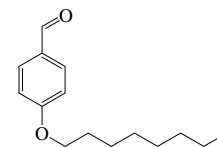
Octyltrinitrate



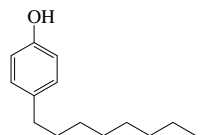
Octyloctanoate



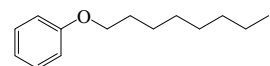
Octyloxirane



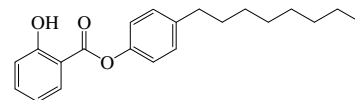
4-(Octyloxy)benzaldehyde



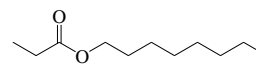
4-Octylphenol



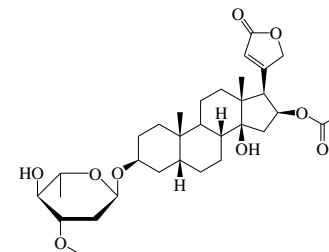
Octylphenylether



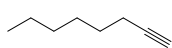
4-Octylphenylacetate



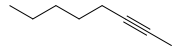
Octylpropanoate



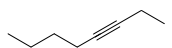
Oleandrin



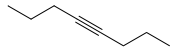
1-Octyne



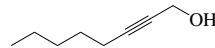
2-Octyne



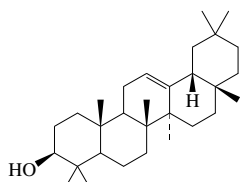
3-Octyne



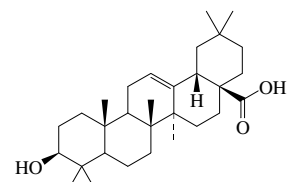
4-Octyne



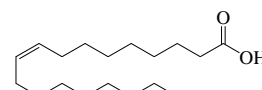
2-Octyn-1-ol



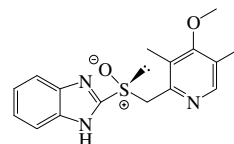
Olean-12-en-3-ol (3β)



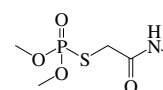
Oleanolic acid



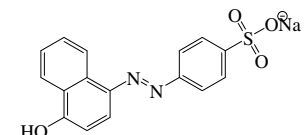
Oleic acid



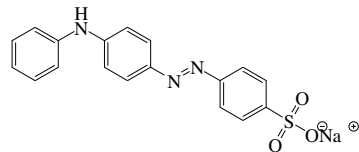
Omeprazole



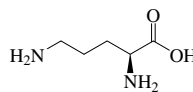
Ometoate



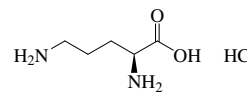
Orange I



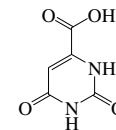
Orange IV



L-Ornithine

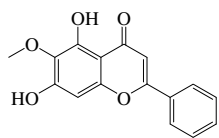


L-Ornithine, monohydrochloride

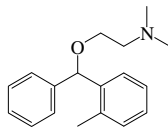


Orotic acid

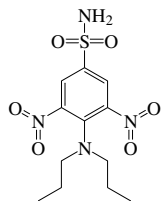
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8419	Oroxylin A	5,7-Di hydroxy-6-met hoxy-2-phenyl-4 <i>H</i> -1-benzopyran-4-one	C ₁₆ H ₁₂ O ₅	480-11-5	284.263	ye nd (al)	231.5				vs ace, et h, Et OH
8420	Orphenadrine		C ₁₆ H ₂₃ NO	83-98-7	269.382			195 ¹²			
8421	Oryzalin	Benzenesulfonamide, 4-(di propylamino)-3,5-dinitro-	C ₁₂ H ₁₈ N ₄ O ₆ S	19044-88-3	346.359		141				
8422	Ouabain		C ₂₉ H ₄₄ O ₁₂	630-60-4	584.652	hyg pl (+9w)	200				sl H ₂ O; vs Et OH
8423	7-Oxabicyclo[4.1.0]heptane		C ₆ H ₁₀ O	286-20-4	98.142		<-10	131.5	0.9663 ²⁰	1.4519 ²⁰	i H ₂ O; vs Et OH, et h, ace, bz; s chl; sl ct c
8424	6-Oxabicyclo[3.1.0]hexane		C ₆ H ₁₀ O	285-67-6	84.117			102	0.964 ²⁵	1.4336 ²⁰	
8425	Oxacyclohexadecan-2-one	Exaltolide	C ₁₅ H ₂₆ O ₂	106-02-5	240.382	thick oil		176	0.9549 ²⁰	1.4708 ²⁰	
8426	1,3,4-Oxadiazole	1-Oxa-3,4-diazacyclopentadiene	C ₂ H ₂ N ₂ O	288-99-3	70.049			150		1.4300 ²⁵	
8427	Oxadiazon		C ₆ H ₁₈ Cl ₂ N ₂ O ₃	19666-30-9	345.221		90				
8428	Oxadixyl		C ₆ H ₁₈ N ₂ O ₄	77732-09-3	278.304		104				
8429	Oxalidic acid		C ₂ H ₂ O ₄	144-62-7	90.035	orthym or oct	189.5 dec	sub 157	1.900		s H ₂ O; vs Et OH; sl et h; i bz, chl, pet h
8430	Oxalidic acid dihydrate		C ₂ H ₂ O ₆	6153-56-6	126.065	mcl tab or pr	101.5		1.65 ⁹		s H ₂ O, Et OH; sl et h
8431	Oxalacetidic acid	Oxalacetidic acid	C ₄ H ₄ O ₆	328-42-7	132.072		161 dec				
8432	Oxalyl chloride	Oxalyl dichloride	C ₂ Cl ₂ O ₂	79-37-8	126.926	liq	-16	63.5	1.478 ⁸	1.4316 ²⁰	s et h
8433	Oxalyl dihydrazide		C ₂ H ₂ N ₂ O ₂	996-98-5	118.095	nd (w)	244.0		1.458 ²²		s H ₂ O; sl Et OH, et h, bz, chl
8434	Oxamic acid		C ₂ H ₂ N ₂ O ₃	471-47-6	89.050	cry (w)	210 dec				sl H ₂ O; i Et OH, et h
8435	Oxamide		CH ₂ N ₂ O ₂	471-46-5	88.065	nd (w)	350 dec		1.667 ²⁰		sl H ₂ O, Et OH; i et h
8436	Oxamniquinone		C ₁₂ H ₁₄ N ₂ O ₃	21738-42-1	279.335	ye-oran cry	149				s ace, chl, MeOH
8437	Oxamyl		C ₇ H ₁₃ N ₃ O ₃ S	23135-22-0	219.261		109	dec	0.97 ²⁵		
8438	Oxandrolone		C ₁₉ H ₃₀ O ₃	53-39-4	306.439		236				
8439	1,4-Oxathiane		C ₂ H ₄ OS	15980-15-1	104.171	liq	-17	147	1.117 ⁴		sl H ₂ O
8440	Oxazepam		C ₁₅ H ₁₁ ClN ₂ O ₂	604-75-1	286.713	cry (Et OH)	205.5				i H ₂ O; s Et OH, chl, di ox
8441	Oxazole		C ₂ H ₂ NO	288-42-6	69.062			69.5		1.4285 ¹⁷	
8442	Oxepane		C ₆ H ₁₂ O	592-90-5	100.158			119	0.89 ²⁵	1.4400 ²⁰	
8443	2-Oxepanone	Caprolactone	C ₇ H ₁₂ O ₂	502-44-3	114.142	liq	-1.0	215	1.076 ⁴	1.4611 ²⁰	s Et OH, et h, ace
8444	Oxetane	Trimethylene oxide	C ₃ H ₆ O	503-30-0	58.079	liq	-97	47.6	0.893 ⁸	1.3961 ²⁰	msc H ₂ O, Et OH; s et h; vs ace
8445	2-Oxetanone	β-Propiolactone	C ₃ H ₄ O ₂	57-57-8	72.063	liq	-33.4	162	1.146 ⁸	1.4105 ²⁰	msc et h; s chl
8446	3-Oxetanone		C ₃ H ₄ O ₂	6704-31-0	72.063	unst ab liq		106	1.137		
8447	Oxirane	Ethylene oxide	C ₂ H ₄ O	75-21-8	44.052	vol liq or gas	-112.5	10.6	0.882 ⁴	1.3597 ⁷	s H ₂ O, Et OH, et h, ace, bz
8448	Oxiranecarboxaldehyde	Glycidaldehyde	C ₃ H ₄ O ₂	765-34-4	72.063	liq	-62	112.5	1.140 ⁸	1.4265 ²⁰	
8449	Oxiranemethanol, (±)	Glycidol	C ₃ H ₄ O ₂	61915-27-3	74.079		-45	dec 167; 66 ^{2,5}	1.1143 ²⁵	1.4287 ²⁰	vs H ₂ O, ace, et h, Et OH; s bz, chl
8450	α-Oxobenzeneacetaldehyde aldoxime	Isonitrosoacetophenone	C ₈ H ₇ NO ₂	532-54-7	149.148		129				sl H ₂ O; s chl
8451	α-Oxobenzeneacetic acid		C ₈ H ₆ O ₃	611-73-4	150.132	pr (CCl ₄)	66	163 ¹⁵			vs H ₂ O; s Et OH, et h; sl ct c; i C ₂ CS
8452	α-Oxobenzeneacetic acid, methyl ester		C ₉ H ₈ O ₃	15206-55-0	164.158			247		1.5268 ²⁰	
8453	α-Oxobenzeneacetone oxime		C ₈ H ₇ NO	613-90-1	131.132		32.5	206			i H ₂ O; vs Et OH, et h; sl chl
8454	γ-Oxobenzenebutanoic acid		C ₁₀ H ₁₀ O ₃	2051-95-8	178.184	lf (di l al)	116.5				s Et OH, et h, bz, chl, C ₂ S
8455	β-Oxobenzenepropanone oxime	Benzoylacetone oxime	C ₉ H ₇ NOC	614-16-4	145.158		80.5	160 ¹⁰			sl H ₂ O; s Et OH, et h, bz, chl, al k, aq KCN
8456	α-Oxobenzenepropanoic acid	3-Phenylpyruvic acid	C ₉ H ₈ O ₃	156-06-9	164.158	lf (bz, chl)	157.5				sl H ₂ O; vs Et OH, et h; s bz, chl; i l i g
8457	2-Oxo-2 <i>H</i> -1-benzopyran-3-carboxylic acid	Coumarin-3-carboxylic acid	C ₉ H ₆ O ₃	531-81-7	162.142	nd (w, bz)	190 dec				vs Et OH



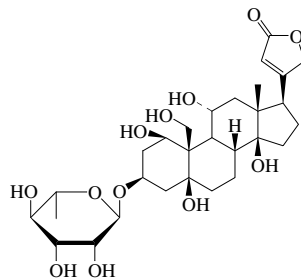
Oroxylin A



Orphenadrine



Oryzalin



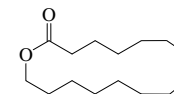
Ouabain



7-Oxabicyclo[4.1.0]heptane



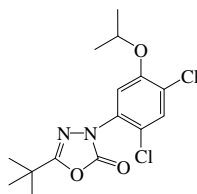
6-Oxabicyclo[3.1.0]hexane



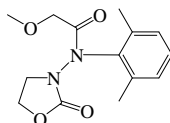
Oxacyclohexadecan-2-one



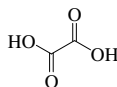
1,3,4-Oxadiazole



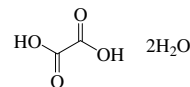
Oxadiazon



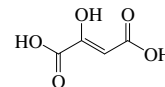
Oxadixyl



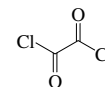
Oxalic acid



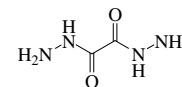
Oxalic acid dihydrate



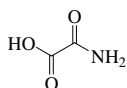
Oxaloacetic acid



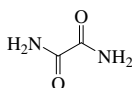
Oxalylchloride



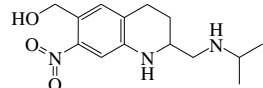
Oxalyl dihydrazide



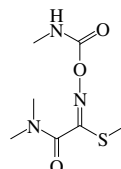
Oxamic acid



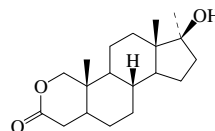
Oxamide



Oxamniquine



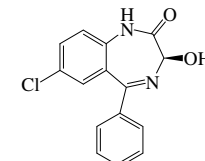
Oxamyl



Oxandrolone



1,4-Oxathiane



Oxazepam



Oxazole



Oxepane



2-Oxepanone



Oxetane



2-Oxetanone



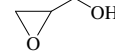
3-Oxetanone



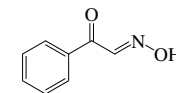
Oxirane



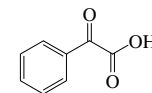
Oxiranecarboxaldehyde



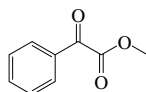
Oxiranemethanol(±)



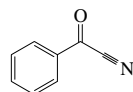
alpha-Oxobenzeneacetaldehyde oxime



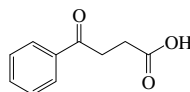
alpha-Oxobenzeneacetic acid



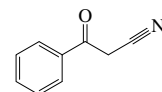
alpha-Oxobenzeneacetic acid dimethyl ester



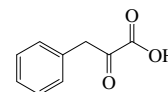
alpha-Oxobenzeneacetonitrile



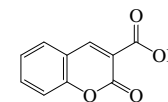
gamma-Oxobenzenebutanoic acid



beta-Oxobenzenepropanenitrile

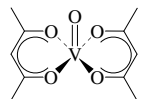


alpha-Oxobenzenepropanoic acid

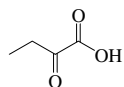


2-Oxo-2H-1-benzopyran-3-carboxylic acid

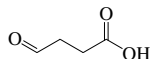
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8458	Oxobis(2,4-pentanedione)vanadium	Vanadyl acetylacetonate	$_{10}H_{14}O_8V$	3153-26-2	265.157	bl cry	258	174 ²			i H ₂ O; s Et OH, MeOH, bz, chl
8459	2-Oxobutan-2-ylideneacetone		$_{10}H_8O_3$	600-18-0	102.089		33	81 ¹⁶	1.200 ¹⁷	1.3972 ²⁰	vs H ₂ O, Et OH; sl et h
8460	4-Oxobutan-2-ylideneacetone		$_{10}H_8O_3$	692-29-5	102.089	oi l		139			s H ₂ O, Et OH, et h, bz
8461	2-Oxoglutaraldehyde	α-Ketoglutaraldehyde	$_{5}H_6O_5$	328-50-7	146.099	cry (ace-bz)	115.5				vs H ₂ O, Et OH, et h; s ace
8462	6-Oxoheptanal		$_{10}H_{16}O_3$	3128-07-2	144.168		40.2	251 ²⁰⁰ , 135 ¹		1.4306 ²⁵	vs H ₂ O, ace, et h, Et OH
8463	5-Oxohexanal		$_{10}H_{16}O_3$	3128-06-1	130.141		13.5	274.5	1.09 ²⁵	1.4451 ²⁰	s H ₂ O, Et OH, et h; sl ct c
8464	α-Oxo-1H-indole-3-propanoic acid	Indole-3-pyruvic acid	$_{11}H_{10}NO_3$	392-12-1	203.194	gray cry	211				
8465	Oxolindole-3-carboxylic acid		$_{13}H_{11}NO_5$	14698-29-4	261.230	cry (DMF)	313 dec				
8466	4-Oxopentanal		$_{7}H_{12}O_2$	626-96-0	100.117		<-21	dec 187	1.0134 ²¹	1.4257 ²²	vs H ₂ O, ace, et h, Et OH
8467	3-Oxopentanoic acid	Acetonedicarboxylic acid	$_{5}H_6O_5$	542-05-2	146.099	nd (AcOEt)	138 dec				s H ₂ O, Et OH; sl et h; i bz, chl, li g
8468	2-Oxopentanoic acid		$_{7}H_{12}O_3$	1821-02-9	116.116		6.5	179	1.0970 ¹⁴		sl H ₂ O; s et h, bz, chl, li g, CS
8469	4-Oxopentanoic acid	Levulinic acid	$_{5}H_8O_4$	123-76-2	116.116	lf or pl	33	dec 245	1.1335	1.4396 ²⁰	vs H ₂ O, Et OH, et h; s chl
8470	4-Oxo-4-(phenylamino)butanoic acid	Succinilic acid	$_{10}H_{11}NO_3$	102-14-7	193.199	nd (w)	148.5				sl H ₂ O; s Et OH; vs et h
8471	4-Oxo-4-(phenylamino)-2-butanone	Maleanilic acid	$_{10}H_{11}NO_3$	555-59-9	191.183	mcl ye cry	192 dec			1.418 ⁰	
8472	Oxophenylarsine	Phenylarsine oxide	$_{6}H_5AsO$	637-03-6	168.025	cry (bz-et h) or (chl-et h)	145				i H ₂ O, et h; sl Et OH; vs bz, chl
8473	4-Oxo-4-phenyl-2-butanone		$_{10}H_9O_3$	583-06-2	176.169	nd or pr (tol)	99				sl H ₂ O, chl, li g; s Et OH, et h, t ol
8474	2-Oxopropanal oxime	Isonitrosoacetone	$_{3}H_5NO_2$	306-44-5	87.078	nd(CCl ₄) lf (et h-pet h)	69	sub	1.0744 ⁶⁷		s H ₂ O, et h; sl bz, ct c, chl
8475	2-Oxopropanenitrile		$_{3}H_3CN$	631-57-2	69.062			92.3	0.9745 ²⁰	1.3764 ²⁰	s et h, ace, CH ₃ CN
8476	17-(1-Oxopropoxy)-androst-4-en-3-one, (17β)	Testosterone-17-propionate	$_{22}H_{32}O_3$	57-85-2	344.487		120				vs et h, py, Et OH
8477	2-Oxo-2H-pyran-5-carboxylic acid	Coumalic acid	$_{6}H_6O_4$	500-05-0	140.094	pr (MeOH)	207 dec	218 ¹⁰⁰			sl H ₂ O, et h, ace; i bz, chl; s Et OH, HOAc
8478	4-Oxo-4H-pyran-2,6-dicarboxylic acid	Chelidonic acid	$_{7}H_4O_6$	99-32-1	184.103	rose mcl nd (al-w,+1w)	262				sl H ₂ O, Et OH
8479	17-Oxosparteine		$_{17}H_{24}N_2O$	489-72-5	248.364	yetocol hygnd (pet h)	84	209 ¹²			vs H ₂ O, Et OH, et h; s chl
8480	4,4'-Oxybis(benzenesulfonylchloride)	Di(phenyl ether 4,4'-disulfonylchloride)	$_{12}H_6Cl_2O_5S_2$	121-63-1	367.225	cry (pet h)	128				
8481	4,4'-Oxybis(benzenesulfonylhydrazide)		$_{12}H_{14}N_4O_5S_2$	80-51-3	358.393	cry (H ₂ O)	164 dec				
8482	Oxybutyrimine		$_{2}H_3N_3O_3$	5633-20-5	357.486	cry	114				
8483	Oxycarboxin	Carboxy S,S-dioxide	$_{2}H_3N_3O_3S$	5259-88-1	267.301	pr (Et OH)	129				sl H ₂ O; s bz, Et OH; vs ace
8484	Oxychlorane		$_{10}H_4Cl_6O$	27304-13-8	423.762	cry (pentane)	100				
8485	Oxycodone	Di(4-hydroxycodeine)	$_{21}H_{27}NO_4$	76-42-6	315.365	rods (Et OH)	219				i H ₂ O, et h; s Et OH, chl
8486	Oxydemeton-methyl		$_{6}H_{15}O_4PS_2$	301-12-2	246.284		<-20	106 ⁰¹	1.289 ²⁰		
8487	10,10'-Oxydiphenoxarsine	10,10'-Oxybis(diphenoxarsine)	$_{24}H_{16}As_2O_3$	58-36-6	502.225	col mcl cry	185		1.41		i H ₂ O; s Et OH, chl; i CCl ₄
8488	Oxyfluorfen		$_{16}H_{11}ClF_3NO_4$	42874-03-3	361.701		84	dec 358	1.35 ⁷³		
8489	Oxymetazolinone		$_{10}H_{12}N_2O$	1491-59-4	260.374	cry (bz)	182				i et h, chl
8490	Oxymetolone		$_{12}H_{16}O_3$	434-07-1	332.477	cry	179				
8491	Oxymeturea		$_{6}H_8N_2O_3$	140-95-4	120.107	pr(al)	126	149 ⁵			s H ₂ O, Et OH, MeOH; i et h; sl DMSO
8492	Oxyphenbutazone		$_{19}H_{20}N_2O_3$	129-20-4	324.373	cry (et h/pet h)	124				s Et OH, MeOH, chl, bz, et h
8493	Oxyphenonibromide		$_{24}H_{34}BrNO_3$	50-10-2	428.404		191.5				vs H ₂ O; sl Et OH
8494	Oxytetraacycline		$_{22}H_{24}N_2O_3$	79-57-2	460.434		184.5		1.634 ²⁰		
8495	Oxytocin		$_{105}H_{165}N_{12}O_{17}S_2$	50-56-6	1007.187	wh pow					s H ₂ O, BuOH



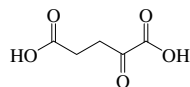
Oxobi s(2,4-pent anedi one)vanadi um



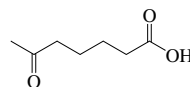
2-Oxobut anoi aci d



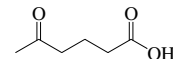
4-Oxobut anoi aci d



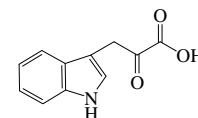
2-Oxogl ut ari aci d



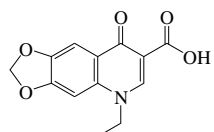
6-Oxohept anoi aci d



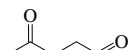
5-Oxohexanoi caci d



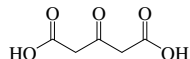
α -Oxo-1H-i ndole-3-propanoi aci d



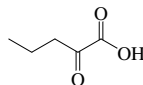
Oxoli ni aci d



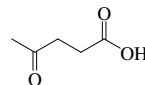
4-Oxopent anal



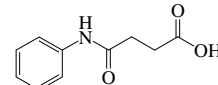
3-Oxopent anedi oi aci d



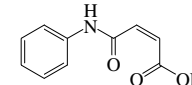
2-Oxopent anoi aci d



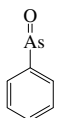
4-Oxopent anoi aci d



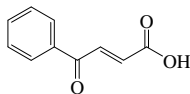
4-Oxo-4-(phenyl ami no)but anoi aci d



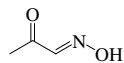
cis 4-Oxo-4-(phenyl ami no)-2-but enoi aci d



Oxophenyl arsi ne



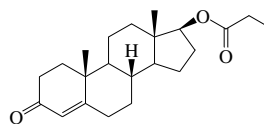
4-Oxo-4-phenyl-2-but enoi aci d



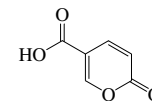
2-Oxopropanal oxime



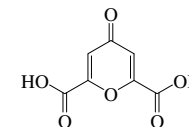
2-Oxopropaneni tr i le



17-(1-Oxopropoxy)-androst-4-en-3-one,(17 β)

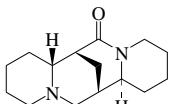


2-Oxo-2H-pyran-5-carboxyli aci d

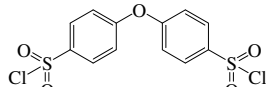


4-Oxo-4H-pyran-2,6-di carboxyli aci d

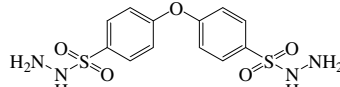
3-447



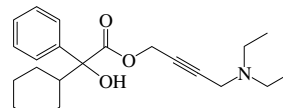
17-Oxospartei ne



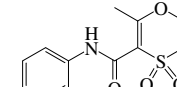
4,4'-Oxybi s(benzenesul f onyl ori de)



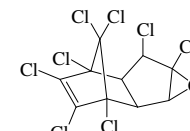
4,4'-Oxybi s(benzenesul f onyl drazi de)



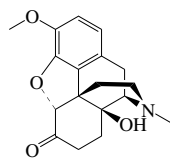
Oxybut yni n



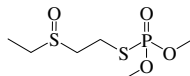
Oxycarboxi n



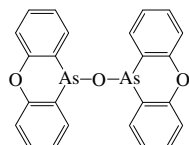
Oxychl ordane



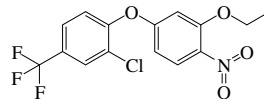
Oxycodone



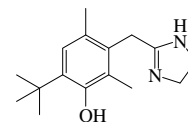
Oxydemet on-met hyl



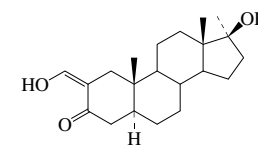
10,10'-Oxydi phenoxarsi ne



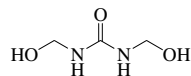
Oxyf l uorf en



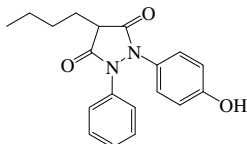
Oxymet azoli ne



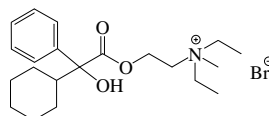
Oxymet hol one



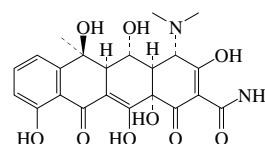
Oxymet hurea



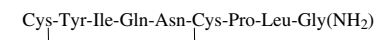
Oxyphenbut azone



Oxyphenoni umbromi de

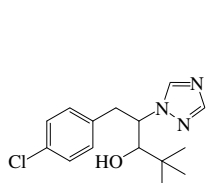


Oxyt et racycli i ne

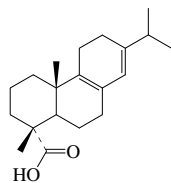


Oxyt oci n

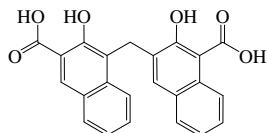
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8496	Pacl obut razol		$C_{12}H_{20}ClN_2O$	76738-62-0	293.792	wh cry	166		1.22		i H ₂ O; vs ace, MeOH; s xyl, hx
8497	Pal ust ri c aci d		$_{20}B_{30}O_2$	1945-53-5	302.451	cry (MeOH)	164.5				
8498	Pamoi c aci d		$C_{16}H_{16}O_6$	130-85-8	388.369		315				
8499	Pancuroni um di bromi de		$_{38}C_{60}Br_2N_2O_4$	15500-66-0	732.670	cry	215				sl chl
8500	Panose	4- α -Isomal t osyl gl ucase	$C_{18}H_{32}O_{16}$	33401-87-5	504.437		223 dec				
8501	Pant hesi n		$C_{12}H_{12}N_2O_5S$	135-44-4	388.522	pa ye pow (al)	158				vs H ₂ O, Et OH
8502	Pant ol act one		$C_{10}H_{10}O_3$	599-04-2	130.141		92				
8503	Pant ot heni c aci d		$_8C_8NO_3$	79-83-4	219.235	ye vi sc oi l					vs ₂ B, bz, et h
8504	Papaveral di ne		$C_8H_{19}NO_5$	522-57-6	353.369	nd (al),cry (bz, pet h)	210.5				i H ₂ O; sl Et OH, et h; s bz, chl
8505	Papaveri ne		$C_{20}H_{21}NO_4$	58-74-2	339.386	wh pr (al -et h), nd (chl -pet h)	147.5	sub 135	1.337 ²⁰	1.625	sl H ₂ O; vs Et OH, chl ; s ace, bz, py
8506	Papaveri ne hydrochl ori de	Cerespan	$_{20}H_{22}ClNO_4$	61-25-6	375.847	wh mcl pr (w)	224.5				vs H ₂ O, Et OH
8507	Paraf ormal dehyde		$(CHO)_x$	30525-89-4	30.026		164 dec				
8508	Paral dehyde	2,4,6-Tri met hyl -1,3,5-t ri oxane	$_6H_{10}O_3$	123-63-7	132.157		12.6	124.3	0.9943 ²⁰	1.4049 ²⁰	sl H ₂ O; msc Et OH, et h, chl
8509	Paramet hadi one		$_8H_7NO_3$	115-67-3	157.167	li q			1.12 ²¹	1.449 ²⁵	sl H ₂ O; s Et OH, chl , bz, et h
8510	Paraoxon	O,O-Di et hyD-(4-ni t rophenyl) phosphat e	$C_{10}H_{14}NO_5P$	311-45-5	275.195	oi ly li q		161	1.2683 ²⁵	1.5096	s et h
8511	Paraquat		$C_2H_{14}N_2$	4685-14-7	186.252	cat i on					
8512	Pararosani li ne hydrochl ori de	Basi c f uchs i n	$_{19}H_{18}ClN_8$	569-61-9	323.819	pal e vi ol pow	269 dec				
8513	Parasorbi c aci d		$_{20}H_{18}O_2$	10048-32-5	112.127	oi ly li g		100	1.079 ¹⁸	1.4736 ²⁰	vs H ₂ O, et h, Et OH
8514	Parat hi on		$C_8H_{14}NO_5PS$	56-38-2	291.261	ye li q	6.1	375	1.268 ²¹	1.5370 ²⁵	i H ₂ O; s et h, ace; sl ct c; vs Et OH, AcOEt
8515	Pat chouli al cohoh		$_{15}O_{26}$	5986-55-0	222.366		56		0.9906 ⁶⁵	1.5029 ⁶⁵	i H ₂ O; s Et OH, et h
8516	Pebul at e		$C_{10}H_{21}NOS$	1114-71-2	203.345			142 ²⁰	0.9458 ²⁰	1.4752 ²⁰	vs ace, bz, MeOH
8517	Pel argoni di n chl ori de		$_{13}H_7ClO_3$	134-04-3	306.698	red br hyg (anh) pr or pl	>350				s H ₂ O; vs Et OH; sl chl , MeOH
8518	Pel lot i ne		$_{13}H_{19}NO_3$	83-14-7	237.295	pl (al , pet h)	111.5				vs ace, et h, Et OH, pet h
8519	Pemoli ne	2-Ami no-5-phenyl -4,5-oxazol one	$C_8H_9N_2O_2$	2152-34-3	176.172	cry	256 dec				i H ₂ O, et h, ace; sl hot Et OH
8520	Pendi met hal i n	M-(1-Et hyl propyl)-3,4-di met hyl -2,6-C ₁₃ H ₁₉ N ₃ O ₄ di ni t roani li ne		40487-42-1	281.308		56	dec	1.19 ²⁵		
8521	Peni ci lli ami ne cyst ei ne di sul fide		$_{8}H_{16}NO_2S_2$	18840-45-4	268.354		195				
8522	Peni ci lli n G	Benzyl peni ci lli ni c aci d	$_{16}H_{18}N_2O_6S$	61-33-6	334.390	amor wh pow					sl H ₂ O; s MeOH, Et OH, et h, chl , bz, ace
8523	Peni ci lli n G procai ne		$_{29}HCN_4O_6S$	54-35-3	570.700		108 dec		1.2555 ²⁵		s H ₂ O, Et OH, chl
8524	Peni ci lli n V	Phenoxy met hyl peni ci lli n	$_{16}H_{18}N_2O_5S$	87-08-1	350.389	cry	124 dec				sl H ₂ O; s os
8525	1,2,3,4,5-Pent abromo-6-chl orocycl ohexane		$C_6H_4Br_5Cl$	87-84-3	513.085	cry	204				
8526	Pent abromomet hyl benzene		$_6H_3Br_5$	87-83-2	486.619		288		2.97 ¹⁷		i H ₂ O; sl Et OH, HOAc; s bz
8527	Pent abromophenol		$CHBr_5O$	608-71-9	488.591	mcl pr (HOAc) nd (al)	229.5	sub			i H ₂ O; s Et OH, bz, HOAc; sl et h
8528	1,1,1,3,3-Pent abromo-2-propanone	Pent abromoacet one	$_3BBr_5O$	79-49-2	452.559	nd (w, al) pr (et h)	79.5	sub			i H ₂ O; vs Et OH, et h, ace, chl
8529	Pent ac	Di enochl or	$_{10}Cl_{10}$	2227-17-0	474.637	t an cry (pet h)	122				
8530	Pent acene	Benzo[b]naph hacene	$C_{14}H_{14}$	135-48-8	278.346	ye grn nd or lf (xyl)	>300 dec				i H ₂ O; sl bz; s PhNO ₂
8531	2,3,4,5,6-Pent achl oroani li ne		$_6HCl_5N$	527-20-8	265.352	nd (al)	233.0				vs et h, Et OH, li g
8532	2,3,4,5,6-Pent achl oroani sol e	Met hyl pent achl orophenyl et her	$_{17}H_2C_6O$	1825-21-4	280.363	nd MeOH	108.5				



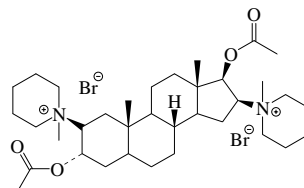
Paclitaxel



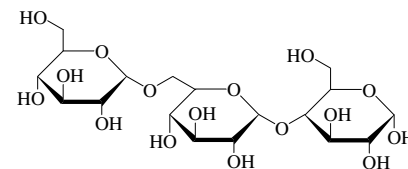
Palmitic acid



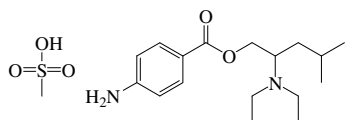
Palmitic acid



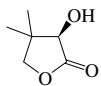
Pancuronium bromide



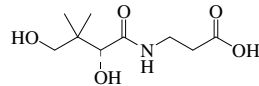
Panose



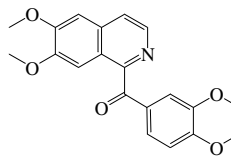
Pantethine



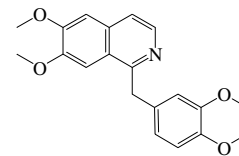
Pantolonic acid



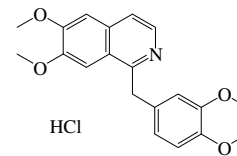
Pantothenic acid



Papaverine



Papaverine

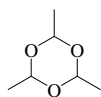


HCl

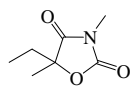
Papaverine hydrochloride



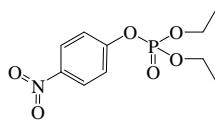
Parafomaldehyde



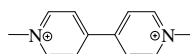
Paraldehyde



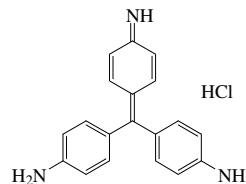
Paramethadone



Paraoxon

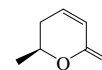


Paraquat

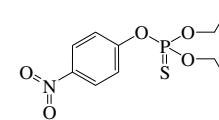


HCl

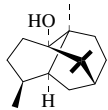
Pararosaniline hydrochloride



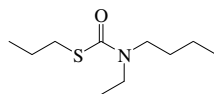
Parasorbic acid



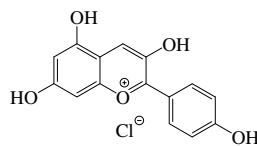
Parathion



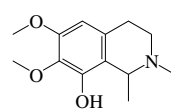
Pat choulalcohol



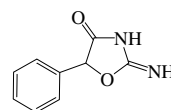
Pebulathene



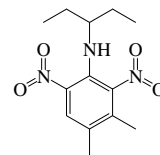
Pelargonic acid



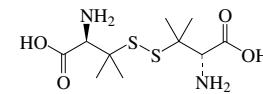
Pelletine



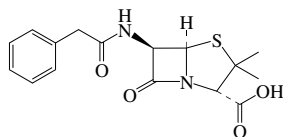
Pemoline



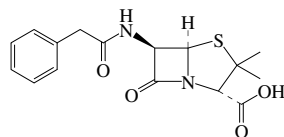
Pendi methalin



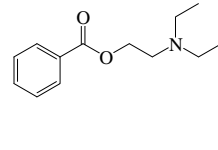
Penicillamoyl ethylsulfide



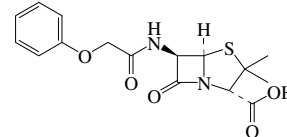
Penicillin G



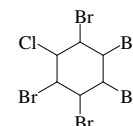
Penicillin procaine



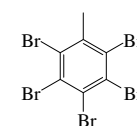
Penicillin V



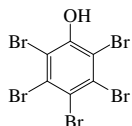
Penicillin V



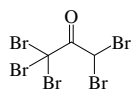
1,2,3,4,5-Pentabromo-6-chlorocyclohexane



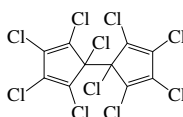
Pentabromomethylbenzene



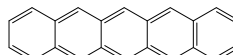
Pentabromophenol



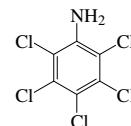
1,1,1,3,3-Pentabromo-2-propanone



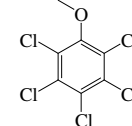
Pentachloro



Pentacene

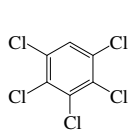


2,3,4,5,6-Pentachloroaniline

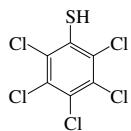


2,3,4,5,6-Pentachloroanisole

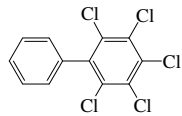
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8533	Pent achl orobenzene		CHCl ₅	608-93-5	250.337	nd (al)	86	277	1.8342 ⁵		i H ₂ O, Et OH; sl et h, bz, chl, CS
8534	Pent achl orobenzene thiol	Pent achl orophenyl mercaptan	C ₆ H ₄ ClS	133-49-3	282.402		231.5				
8535	2,3,4,5,6-Pent achl orobi phenyl		C ₁₀ H ₆ Cl ₅	18259-05-7	326.433	nd (pet h)	123.5				i H ₂ O
8536	2,2',4,5,5'-Pent achl orobi phenyl		C ₁₀ H ₆ Cl ₅	37680-73-2	326.433	cry (Et OH)	78.5				i H ₂ O
8537	1,2,3,4,7-Pent achl orodi benzodioxin		C ₁₂ H ₈ Cl ₅ O ₂	39227-61-7	356.416	cry (bz/MeOH)	195				
8538	Pent achl oroet hane	Ref ri gerant 120	CHCl ₃	76-01-7	202.294	li q	-28.78	162.0	1.6796	1.5025 ²⁰	i H ₂ O; msc Et OH, et h
8539	Pent achl orofluoroet hane		CF ₃ Cl	354-56-3	220.284	col li q	101.3	138	1.74		i H ₂ O; s Et OH, et h
8540	Pent achl oroni trobenzene	Qui nt ozene	C ₆ Cl ₅ NO ₂	82-68-8	295.335	cry (al)	144	dec 328	1.718 ⁵		i H ₂ O; sl Et OH; s bz, chl
8541	Pent achl orophenol		CHCl ₅ O	87-86-5	266.336	mcl pr (al + 1w) nd (bz)	174	dec 310	1.978 ²²		i H ₂ O; sl li g; vs Et OH, et h; s bz
8542	1,1,2,2,3-Pent achl oropropane		CH ₂ Cl ₅	16714-68-4	216.321			181 ⁵⁰⁰	1.633 ²⁵	1.5098 ²⁵	
8543	1,1,2,3,3-Pent achl oro-1-propene		CHCl ₅	1600-37-9	214.305			185	1.6317 ³⁴	1.5313 ²⁰	vs et h
8544	Pent achl oropyri dine		C ₅ H ₄ N	2176-62-7	251.326		125.5	280			vs bz, Et OH, li g
8545	2,3,4,5,6-Pent achl orol ol uene		C ₁₀ H ₆ Cl ₅	877-11-2	264.364	nd (bz, pet h)	224.8	301			sl Et OH, et h, CS; bz, t ol, pet h
8546	Pent acot ane		C ₁₀ H ₁₀ O ₂	6596-40-3	703.345		92.1	575.0			
8547	Pent acosane		C ₂₅ H ₅₂	629-99-2	352.681		53.93	401.9; 282 ⁴⁰	0.8012 ²⁰	1.4491 ²⁰	s bz, chl
8548	1 <i>H</i> -Pent adefcafluorohept ane		CF ₁₅	375-83-7	370.059			96.0	1.725 ²⁵	1.2690 ²⁵	
8549	Pent adefcafluoroctanoi c aci d		C ₈ HF ₁₅ O ₂	335-67-1	414.069		54.3	188			
8550	2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-Pent adefcafluoro-1-oct anol	1,1-Di hydroperfluoroct anol	C ₈ F ₁₅ O	307-30-2	400.085	waxy sol i d	47	164; 68			
8551	Pent adecanal		C ₁₅ H ₃₀ O	2765-11-9	226.398	nd	24.5	185 ²⁵			vs ace, et h, Et OH
8552	Pent adecane		C ₁₅ H ₃₂	629-62-9	212.415		9.95	270.6	0.7685 ²⁰	1.4315 ²⁰	i H ₂ O; vs Et OH, et h
8553	Pent adecanoi c aci d	Pent adecyl i c aci d	C ₁₅ H ₃₀ O ₂	1002-84-2	242.398	pl (di l al, HOAc) cry (pet h)	52.3	257 ¹⁰⁰ , 158 ¹	0.8423 ⁸⁰	1.4254 ⁸⁰	i H ₂ O; vs Et OH, ace; s et h; sl t f a
8554	1-Pent adecanol		C ₁₅ H ₃₂ O	629-76-5	228.414		43.9	300	0.8347 ²⁵		i H ₂ O
8555	2-Pent adecane		C ₁₅ H ₃₀ O	2345-28-0	226.398		39.5	294	0.8182 ³⁹		
8556	8-Pent adecane		C ₁₅ H ₃₀ O	818-23-5	226.398	cry (al)	43	291	0.8180 ⁹		s Et OH, et h, bz, ct c, chl
8557	1-Pent adecene		C ₁₅ H ₃₀	13360-61-7	210.399	li q	-1.4	268.2	0.776 ⁴	1.4389 ²⁰	i H ₂ O; s ace
8558	Pent adecyl ami ne	Pent adecanami ne	C ₁₅ H ₃₃ N	2570-26-5	227.430		37.3	307.6	0.8104 ²⁰	1.4480 ²⁰	vs et h, Et OH
8559	Pent adecyl benzene		C ₂₁ H ₃₆	2131-18-2	288.511		22	373	0.8548 ²⁰	1.4815 ²⁰	
8560	3-Pent adecyl -1,2-benzenedi ol	3-Pent adecyl cat echol	C ₂₁ H ₃₈ O ₂	492-89-7	320.510	nd (t o, pet h)	59.5				vs bz, et h, Et OH
8561	Pent adecyl cycl ohexane		C ₂₁ H ₄₂	6006-95-7	294.558		29	373	0.8267 ²⁰	1.4588 ²⁰	
8562	3-Pent adecyl phenol		C ₂₁ H ₃₈ O	501-24-6	304.510	nd (pet h)	53.5	230, 197 ¹⁵			vs ace, bz, Et OH
8563	1-Pent adecyne		C ₁₅ H ₂₈	765-13-9	208.383		10	268	0.7928 ²⁰	1.4419 ²⁰	vs ace
8564	1,2-Pent adi ene	Et hyl al l ene	C ₅ H ₈	591-95-7	68.118	li q	-137.3	44.9	0.6926	1.4209 ²⁰	msc Et OH, et h, ace, bz, ct c, hp
8565	<i>ci s</i> 1,3-Pent adi ene	<i>ci s</i> Pi perylene	C ₅ H ₈	1574-41-0	68.118	li q	-140.8	44.1	0.6910	1.4363 ²⁰	msc Et OH, et h, ace, bz, ct c, hp
8566	<i>t rans</i> 1,3-Pent adi ene	<i>t rans</i> Pi perylene	C ₅ H ₈	2004-70-8	68.118	li q	-87.4	42	0.6710	1.4301 ²⁰	
8567	1,4-Pent adi ene		C ₅ H ₈	591-93-5	68.118	vol li q or gas	-148.2	26	0.6608	1.3888 ²⁰	i H ₂ O; vs Et OH, et h, ace, bz
8568	2,3-Pent adi ene	1,3-Di met hyl al l ene	C ₅ H ₈	591-96-8	68.118	li q	-125.6	48.2	0.6950	1.4284 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, hp, ct c
8569	1,4-Pent adi en-3-ol		C ₅ H ₈ O	922-65-6	84.117			115.5	0.860 ²³	1.4400 ¹⁷	
8570	1,3-Pent adi yne	Met hyl di acet yl ene	C ₅ H ₄ C	4911-55-1	64.086	li q	-38.5	55	0.7909	1.4431 ²¹	i H ₂ O; s et h, bz, chl
8571	Pent aeryt hri t ol		C ₁₃ H ₂₀ O ₄	115-77-5	136.147	cry (di l HCl)	258	sub		1.548	s H ₂ O; i et h, bz
8572	Pent aeryt hri t ol t et raacet at e	2,2-Bi s[(acet yl oxy)met hyl]-1,3-propanedi ol di acet at e	C ₁₃ H ₂₀ O ₈	597-71-7	304.293	t et r nd (w, bz)	83.5		1.278		s H ₂ O; vs Et OH, et h



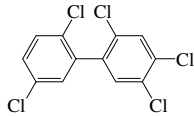
Pentachlorobenzene



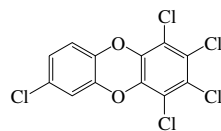
Pentachlorobenzenethiol



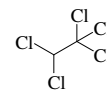
2,3,4,5,6-Pentachlorobiphenyl



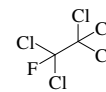
2,2',4,5,5'-Pentachlorobiphenyl



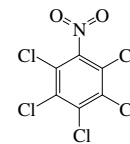
1,2,3,4,7-Pentachlorodibenzodioxin



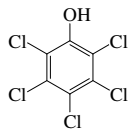
Pentachloroethane



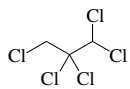
Pentachlorofluoroethane



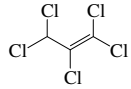
Pentachloronitrobenzene



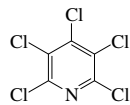
Pentachlorophenol



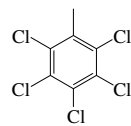
1,1,2,2,3-Pentachloropropane



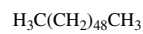
1,1,2,3,3-Pentachloropropene



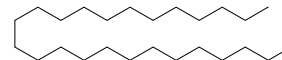
Pentachloropyridine



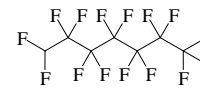
2,3,4,5,6-Pentachloro-1,3-butadiene



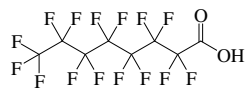
Pentacosane



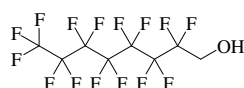
Pentacosane



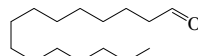
1H-pentadecafluoroheptane



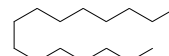
Pentadecafluorooctanoic acid



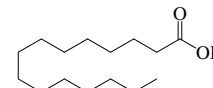
2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-Pentadecafluoro-1-octanol



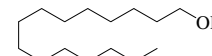
Pentadecanal



Pentadecane

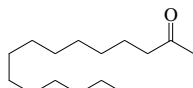


Pentadecanoic acid

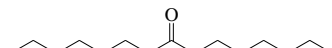


1-Pentadecanol

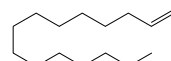
3-451



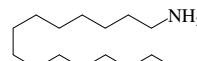
2-Pentadecanone



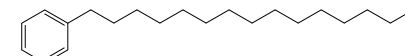
8-Pentadecanone



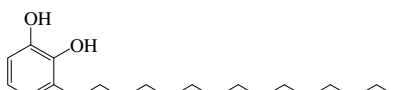
1-Pentadecene



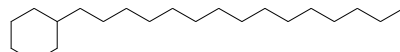
Pentadecylamine



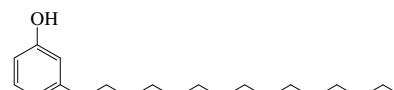
Pentadecylbenzene



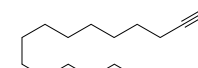
3-Pentadecyl-1,2-benzenediol



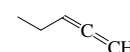
Pentadecylcyclohexane



3-Pentadecylphenol



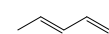
1-Pentadecyne



1,2-Pentadiene



cis-1,3-Pentadiene



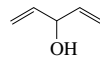
trans-1,3-Pentadiene



1,4-Pentadiene



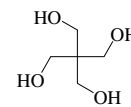
2,3-Pentadiene



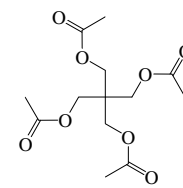
1,4-Pentadien-3-ol



1,3-Pentadiyne

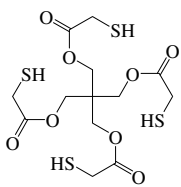


Penterythritol

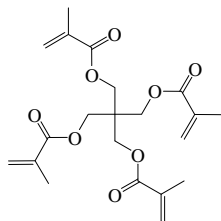


Penterythritol tetraacetate

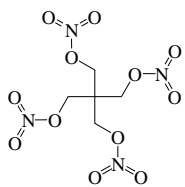
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8573	Pent aeryt hri t ol t et raki s(2-mercapt oacet at e)		C ₁₃ H ₂₀ O ₈ S ₄	10193-99-4	432.553	li q		250	1.385 ²⁵	1.5470 ²⁰	
8574	Pent aeryt hri t ol t et ramet hacryl at e	Tet ramet hyl ol met hane t et ramet hacryl at e	C ₂₁ H ₂₈ O ₈	3253-41-6	408.442		53.5				
8575	Pent aeryt hri t ol t et rani t rat e		C ₅ H ₈ N ₄ O ₂	78-11-5	316.138	t et r (ace) pr (ace-al)	140.5		1.773 ²⁰		sl H ₂ O, Et OH, et h; vs ace; s bz, py
8576	Pent aet hyl benzene		C ₁₀ H ₂₀	605-01-6	218.377		<-20	277	0.8971 ¹⁹	1.5127 ²⁰	
8577	Pent aet hyl t ant al at e	Et hanol , t ant al um(5+) salt	C ₁₀ H ₂₀ O ₅ Br	6074-84-6	406.251			151 ¹			
8578	2,3,4,5,6-Pent afluoroani li ne		C ₆ H ₃ F ₅ N	771-60-8	183.079		34	153.5			
8579	Pent afluorobenzal dehyde		C ₇ H ₃ F ₅ O	653-37-2	196.074		20	167		1.4506 ²⁰	
8580	Pent afluorobenzene		C ₆ H ₂ F ₄	363-72-4	168.064	li q	-47.4	85.74	1.514 ⁴	1.3905 ²⁰	
8581	Pent afluorobenzene thi ol		C ₆ H ₂ F ₄ S	771-62-0	200.129	li q	-24	143	1.504 ⁴	1.4645 ²⁰	
8582	Pent afluorobenzoi c aci d		C ₇ H ₂ F ₅ O ₂	602-94-8	212.074		101	220			
8583	Pent afluorobenzoni t ri le		C ₇ H ₂ F ₅ N	773-82-0	193.074		1.2	162	1.563 ²⁰	1.4402 ²⁵	
8584	Pent afluoroet hane		C ₅ H ₂ F ₈	354-33-6	120.021	col gas	-103	-48.1			
8585	Pent afluoroi odobenzene		C ₆ H ₂ F ₄ I	827-15-6	293.960	li q	-29	166	2.212 ²	1.4950 ²⁵	
8586	Pent afluoromet hoxybenzene	Met hyl pent afluorophenyl et her	C ₇ H ₃ F ₅ O	389-40-2	198.090	li q	-37	138.5	1.493 ³	1.4087 ²⁰	
8587	Pent afluorophenol		C ₆ H ₂ F ₄ O	771-61-9	184.063		37.5	145.6		1.4263 ²⁰	
8588	1,1,1,2,2-Pent afluoropropane	Ref ri gerant 245cb	C ₃ H ₂ F ₆	1814-88-6	134.048	col gas		-17.4			
8589	2,2,3,3,3-Pent afluoro-1-propanol		C ₃ H ₃ F ₅ O	422-05-9	150.047			26 ⁵⁰			
8590	2,3,4,5,6-Pent afluorot ol uene		C ₆ H ₂ F ₅	771-56-2	182.091	li q	-29.78	117.5	1.440 ⁴	1.4016 ²⁵	
8591	1,1,2,4,4-Pent afluoro-3-(t ri fluoromet hyl)-1,3-but adi ene		C ₅ F ₈	384-04-3	212.041			39	1.527 ⁰	1.3000 ⁰	vs ace, bz, et h
8592	Pent agast ri n		C ₃ H ₄₃ N ₇ O ₉ S	5534-95-2	767.892	col nd		230 dec			i H ₂ O, bz, Et OH, et h
8593	<i>trans</i> -3,3',4',5,7'-Pent ahydroxyflavanone, (±)	Taxi foli n	C ₁₅ H ₁₂ O ₇	480-18-2	304.252			227 dec			s chl
8594	Pent amet honi um bromi de		C ₁₁ H ₂₆ Br ₂ N ₂	541-20-8	348.161		301				sl H ₂ O
8595	Pent amet hyl benzene		C ₁₀ H ₁₆	700-12-9	148.245	pr (al)	54.5	232	0.917 ²⁰	1.527 ²⁰	i H ₂ O; vs Et OH, bz; s chl
8596	2,4,6,8,10-Pent amet hyl cycl opent asi l oxane		C ₅ H ₂₀ O ₅ Si ₅	6166-86-5	300.638	li q	-108	169	0.998 ⁵	1.3912 ²⁰	
8597	2,2,4,6,6-Pent amet hyl hept ane		C ₁₂ H ₂₆	13475-82-6	170.334	li q	-67	177.8	0.746 ³	1.4440 ²⁰	
8598	2,2,4,6,6-Pent amet hyl -3-hept ene		C ₁₂ H ₂₄	123-48-8	168.319	li q		180.5			
8599	2,2,3,3,4-Pent amet hyl pent ane		C ₁₀ H ₂₂	16747-44-7	142.282	li q	-36.4	166.1	0.776 ⁷	1.4361 ²⁰	
8600	2,2,3,4,4-Pent amet hyl pent ane		C ₁₀ H ₂₂	16747-45-8	142.282	li q	-38.7	159.3	0.763 ⁶	1.4307 ²⁰	
8601	Pent amet hyl phenol		C ₁₀ H ₁₆ O	2819-86-5	164.244	nd (al , pet h, ace)	128	267			i H ₂ O; s Et OH
8602	1,2,2,6,6-Pent amet hyl pi peri di ne	Pempi di ne	C ₁₀ H ₂₁ N	79-55-0	155.281			147	0.8580 ⁹	1.4550 ²¹	
8603	Pent amet hyl si lanami ne		C ₅ H ₁₀ NSi	2083-91-2	117.266			86	0.740 ⁹	1.4379 ²⁴	
8604	Pent anal	Val eral dehyde	C ₅ H ₁₀ O	110-62-3	86.132	li q	-91.5	103	0.809 ⁵	1.3944 ²⁰	sl H ₂ O; s Et OH, et h
8605	Pent anami de		C ₅ H ₁₁ NO	626-97-1	101.147	mcl pl (pet h, al)	106	225	0.873 ⁵	1.4183 ¹¹⁰	vs H ₂ O, Et OH, et h; sl chl
8606	3-Pent anami ne		C ₅ H ₁₃ N	616-24-0	87.164			89	0.7487 ²⁰	1.4063 ²⁰	s Et OH; sl chl
8607	Pent ane		C ₅ H ₁₂	109-66-0	72.149	li q	-129.67	36.06	0.626 ²	1.3575 ²⁰	sl H ₂ O; msc Et OH, et h, ace, bz, chl ; s ct c
8608	Pent anedi al	Gl ut aral dehyde	C ₅ H ₈ O ₂	111-30-8	100.117			dec 188			msc H ₂ O, Et OH; s bz
8609	1,5-Pent anedi ami ne	Cadaveri ne	C ₅ H ₁₄ N ₂	462-94-2	102.178		11.83	179	0.873 ²⁵	1.463 ²⁰	s H ₂ O, Et OH; sl et h
8610	Pent anedi ni t ri le	Gl ut aroni t ri le	C ₅ H ₈ N ₂ C	544-13-8	94.115	li q	-29	286	0.991 ⁴	1.4295 ²⁰	vs Et OH, chl
8611	1,2-Pent anedi ol , (±)		C ₅ H ₁₂ O ₂	91049-43-3	104.148			209	0.9723 ²⁰	1.4397 ¹⁹	



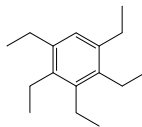
Pent aerytri hri ttõit raki s(2-mercapt oacet at e)



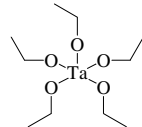
Pent aerytri hri ttõit rmet hacryl at e



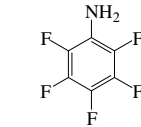
Pent aerytri hri ttõit rani t rat e



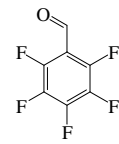
Pent aet hyl benzene



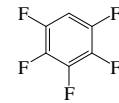
Pent aet hyl ant al at e



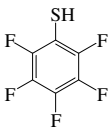
2,3,4,5,6-Pent af luoroani li ne



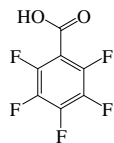
Pent af luorobenzal dehyde



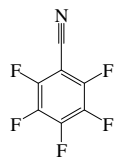
Pent af luorobenzene



Pent af luorobenzenet hio l



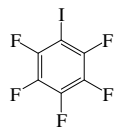
Pent af luorobenzoãci d



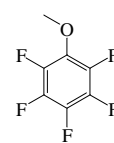
Pent af luorobenzoni t ri le



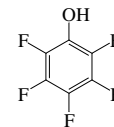
Pent af luoroet hane



Pent af luoro i odobenzene



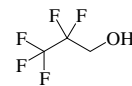
Pent af luoromet hoxybenzene



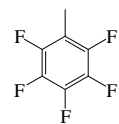
Pent af luorophenol



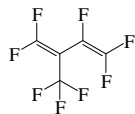
1,1,1,2,2-Pent af luoropropane



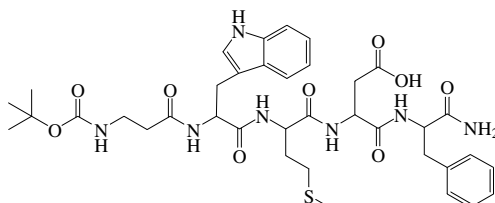
2,2,3,3,3-Pent af luoro-1-propanol



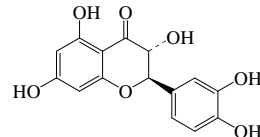
2,3,4,5,6-Pent af luorot ol uene



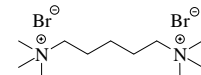
1,1,2,4,4-Pent af luoro-3-(t ri f luoromet hyl)-1,3-but



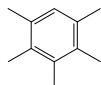
Pent agast ri n



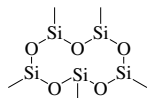
*t rans*3,3',4',5,7-Pent ahydroxyl avanon(±)



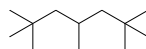
Pent amet honi ubromi de



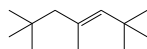
Pent amet hyl benzer



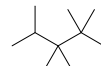
2,4,6,8,10-Pent amet hyl cycl opent asi l oxane



2,2,4,6,6-Pent amet hyl hept ane



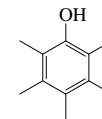
2,2,4,6,6-Pent amet hyl -3-hept ene



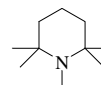
2,2,3,3,4-Pent amet hyl pent ane



2,2,3,4,4-Pent amet hyl pent ane



Pent amet hyl phenol



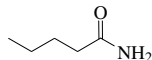
1,2,2,6,6-Pent amet hyl pi peri c



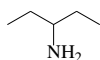
Pent amet hyl si l anami ne



Pent anal



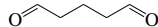
Pent anami de



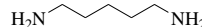
3-Pent anami ne



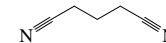
Pent ane



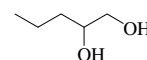
Pent anedi al



1,5-Pent anedi ami ne

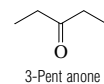
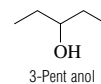
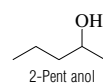
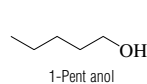
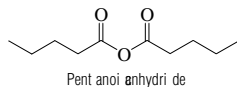
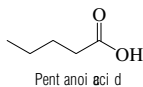
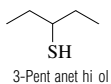
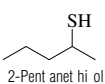
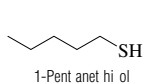
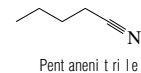
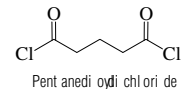
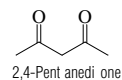
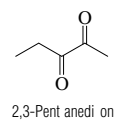
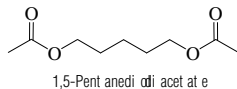
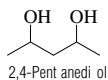
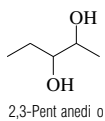
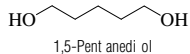
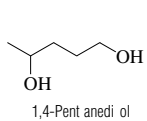


Pent anedi ni t ri le

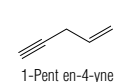
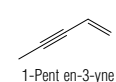
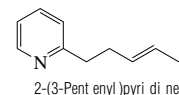
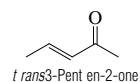
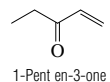
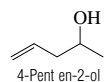
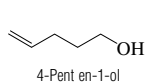
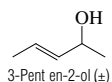
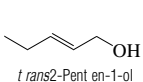
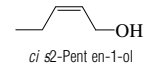
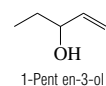
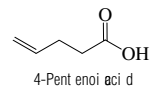
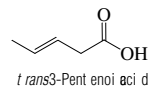
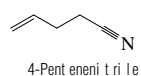
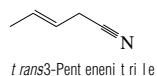
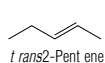
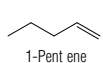
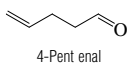
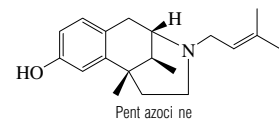
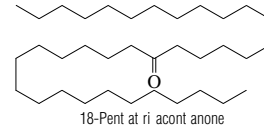
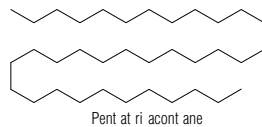
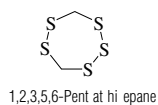
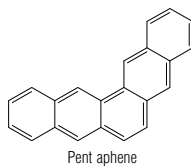
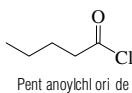
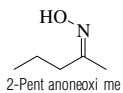


1,2-Pent anedi ol(±)

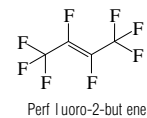
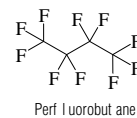
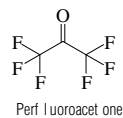
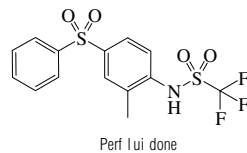
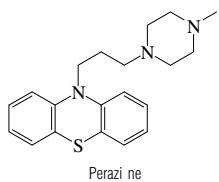
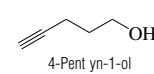
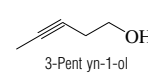
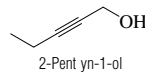
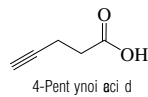
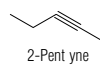
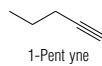
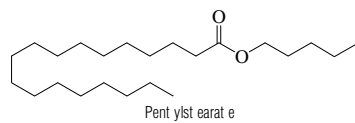
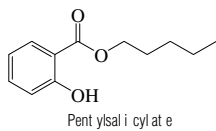
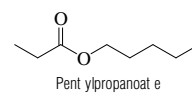
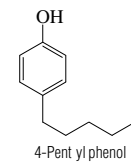
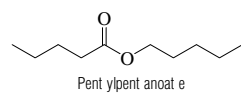
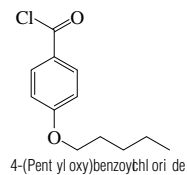
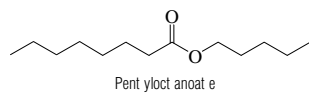
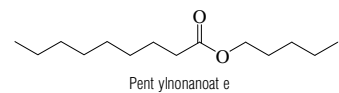
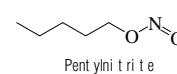
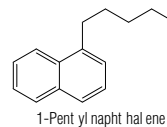
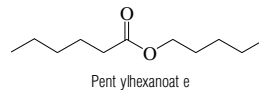
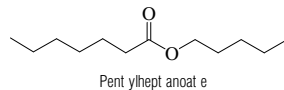
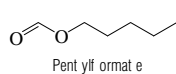
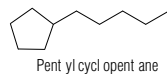
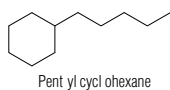
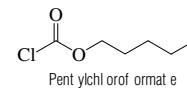
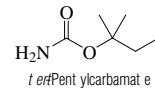
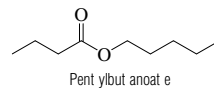
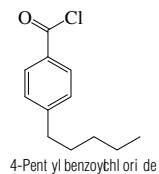
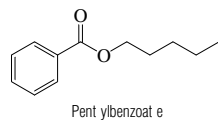
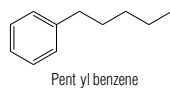
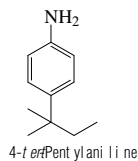
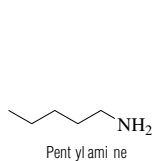
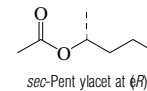
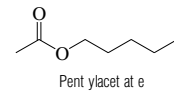
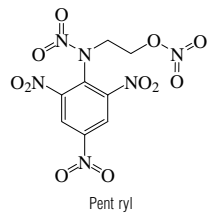
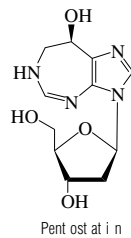
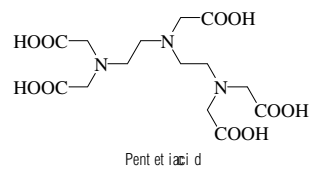
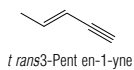
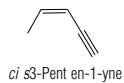
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8612	1,4-Pent anedi ol		$\text{C}_5\text{H}_{12}\text{O}_2$	626-95-9	104.148			202; 125 ¹⁰	0.9883 ²⁰	1.4452 ²³	vs H ₂ O, Et OH, chl
8613	1,5-Pent anedi ol	Pent amet hyl ene glycol	$\text{C}_5\text{H}_{12}\text{O}_2$	111-29-5	104.148	li q	-18	239	0.9914 ¹⁹	1.4494 ²⁰	s H ₂ O; Et OH; sl et h, bz
8614	2,3-Pent anedi ol		$\text{C}_5\text{H}_{12}\text{O}_2$	42027-23-6	104.148			187.5; 100 ¹⁷	0.9798 ¹⁹	1.4412 ²⁵	s H ₂ O, Et OH; sl et h
8615	2,4-Pent anedi ol	2,4-Amyl ene glycol	$\text{C}_5\text{H}_{12}\text{O}_2$	625-69-4	104.148			199; 97 ¹³	0.9635 ²⁰	1.4349 ²⁰	vs H ₂ O, Et OH
8616	1,5-Pent anedi ol di acet at e	Pent amet hyl ene acet at e	$\text{C}_9\text{H}_{18}\text{O}_4$	6963-44-6	188.221		2	241; 123 ³	1.0296 ²⁰	1.4261 ¹⁹	
8617	2,3-Pent anedi one	Acet yl propi onyl	$\text{C}_5\text{H}_{10}\text{O}_2$	600-14-6	100.117	dk ye li q		108	0.9565 ⁹	1.4014 ¹⁹	s H ₂ O; msc Et OH, et h, ace
8618	2,4-Pent anedi one	Acet yl acet one	$\text{C}_5\text{H}_{10}\text{O}_2$	123-54-6	100.117	li q	-23	138	0.9724 ⁹	1.4494 ²⁰	vs H ₂ O; msc Et OH, et h, ace, chl
8619	Pent anedi oyl di chl ori de		$\text{C}_5\text{H}_8\text{Cl}_2\text{O}_2$	2873-74-7	169.006			217	1.324 ²⁰	1.4728 ²⁰	s et h; sl chl
8620	Pent aneni t ri le	Val eroni t ri le	$\text{C}_5\text{H}_8\text{N}$	110-59-8	83.132	li q	-96.2	141.3	0.8008 ⁹	1.3971 ²⁰	s et h, ace, bz; sl ct c
8621	1-Pent anet hi ol	Pent yl mercapt an	$\text{C}_5\text{H}_{12}\text{S}$	110-66-7	104.214	li q	-75.65	126.6	0.850 ⁹	1.4469 ²⁰	i H ₂ O; msc Et OH, et h
8622	2-Pent anet hi ol	sec-Pent yl mercapt an	$\text{C}_5\text{H}_{12}\text{S}$	2084-19-7	104.214	li q	-169	112.9	0.8327 ⁹	1.4412 ²⁰	s Et OH, li g
8623	3-Pent anet hi ol	3-Pent yl mercapt an	$\text{C}_5\text{H}_{12}\text{S}$	616-31-9	104.214	li q	-110.8	105	0.8410 ⁹	1.4447 ²⁰	s Et OH; sl DMSO
8624	Pent anoi c aci d	Val eri c aci d	$\text{C}_5\text{H}_8\text{O}_2$	109-52-4	102.132	li q	-33.6	186.1	0.9339 ⁹	1.4085 ²⁰	s H ₂ O, Et OH, et h; sl ct c
8625	Pent anoi c anhydri de		$\text{C}_8\text{H}_{16}\text{O}_3$	2082-59-9	186.248	li q	-56.1	227	0.924 ⁹	1.4171 ²⁶	vs et h, Et OH
8626	1-Pent anol	Amyl al cohol	$\text{C}_5\text{H}_{12}\text{O}$	71-41-0	88.148	li q	-77.6	137.98	0.8144 ⁹	1.4101 ²⁰	sl H ₂ O; msc Et OH, et h; s ace, chl
8627	2-Pent anol	sec-Amyl al cohol	$\text{C}_5\text{H}_{12}\text{O}$	6032-29-7	88.148	li q	-73	119.3	0.8094 ⁹	1.4053 ²⁰	sl H ₂ O; s Et OH, et h, ct c, chl
8628	3-Pent anol	Di et hyl carbi nol	$\text{C}_5\text{H}_{12}\text{O}$	584-02-1	88.148	li q	-69	116.25	0.8203 ⁹	1.4104 ²⁰	sl H ₂ O; s Et OH, et h, ace, ct c
8629	2-Pent anone	Met hyl propyl ket one	$\text{C}_5\text{H}_{10}\text{O}$	107-87-9	86.132	li q	-76.8	102.26	0.809 ⁹	1.3895 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
8630	3-Pent anone	Di et hyl ket one	$\text{C}_5\text{H}_{10}\text{O}$	96-22-0	86.132	li q	-39	101.7	0.8098 ⁹	1.3905 ²⁵	s H ₂ O, ct c; msc Et OH, et h
8631	2-Pent anone oxi me	Met hyl propyl ket one oxi me	$\text{C}_5\text{H}_{12}\text{NO}$	623-40-5	101.147			168	0.9095 ²⁰	1.4450 ²⁰	vs H ₂ O, et h, Et OH
8632	Pent anoyl chl ori de	Val eroyl chl ori de	$\text{C}_5\text{H}_9\text{Cl O}$	638-29-9	120.577	li q	-110	109	1.0155	1.4200 ²⁰	
8633	Pent aphene	2,3,6,7-Di benzphenant hrene	$\text{C}_{14}\text{H}_{14}$	222-93-5	278.346	ye gm lf (xyl)	257				i ₂ H ₂ O; sl Et OH, xyl, et h; s bz
8634	1,2,3,5,6-Pent at hi epane	Lent hi oni ne	$\text{C}_5\text{H}_8\text{S}_6$	292-46-6	188.378		60.5				
8635	Pent at ri acont ane		$\text{C}_{33}\text{H}_{72}$	630-07-9	492.947	cry (al)	74.6	490	0.8157 ²⁰	1.4568 ²⁰	i H ₂ O; sl et h; s ace
8636	18-Pent at ri acont anone		$\text{C}_{33}\text{H}_{70}\text{O}$	504-53-0	506.930	lf (li g)	89.0	270	0.793 ⁹⁵		i H ₂ O; sl Et OH, et h, ace, bz, li g, chl
8637	Pent azoci ne		$\text{C}_5\text{H}_7\text{N O}$	359-83-1	285.423	cry (MeOH aq)	147				
8638	4-Pent enal		$\text{C}_5\text{H}_8\text{O}$	2100-17-6	84.117			99	0.852 ²⁰	1.4191 ²⁰	i H ₂ O; s et h, ace
8639	1-Pent ene	α -Amyl ene	C_5H_{10}	109-67-1	70.133	vol li q or gas	-165.12	29.96	0.6405 ⁹	1.3715 ²⁰	i H ₂ O; msc Et OH, et h; s bz; sl ct c
8640	ci s2-Pent ene	ci s β -Amyl ene	C_5H_{10}	627-20-3	70.133	li q	-151.36	36.93	0.6556 ⁹	1.3830 ²⁰	i H ₂ O; msc Et OH, et h; s bz, di l sulf
8641	t rans2-Pent ene	t rans β -Amyl ene	C_5H_{10}	646-04-8	70.133	li q	-140.21	36.34	0.6434 ⁹	1.3793 ²⁰	i H ₂ O; msc Et OH, et h; s bz; vs di l sulf
8642	t rans3-Pent eneni t ri le		$\text{C}_5\text{H}_{10}\text{N}$	16529-66-1	81.117	li q		144	0.837	1.4220 ⁹	
8643	4-Pent eneni t ri le		$\text{C}_5\text{H}_{10}\text{N}$	592-51-8	81.117			140	0.8239 ²⁴	1.4213 ¹⁴	i H ₂ O; msc Et OH, et h
8644	t rans3-Pent enoi c aci d		$\text{C}_5\text{H}_8\text{O}_2$	1617-32-9	100.117			193.2	0.989 ¹⁹		
8645	4-Pent enoi c aci d	All yl acet i c aci d	$\text{C}_5\text{H}_8\text{O}_2$	591-80-0	100.117	li q	-22.5	188.5	0.9809 ⁹	1.4281 ²⁰	sl H ₂ O; vs Et OH, et h
8646	1-Pent en-3-ol		$\text{C}_5\text{H}_{10}\text{O}$	616-25-1	86.132			115	0.839 ²⁰	1.4239 ²⁰	sl H ₂ O; msc Et OH, et h
8647	ci s2-Pent en-1-ol		$\text{C}_5\text{H}_{10}\text{O}$	1576-95-0	86.132			138	0.8529 ²⁰	1.4354 ²⁰	s Et OH, et h, ace
8648	t rans2-Pent en-1-ol		$\text{C}_5\text{H}_{10}\text{O}$	1576-96-1	86.132			138	0.8471 ²⁰	1.4341 ²⁰	s Et OH, et h, ace
8649	3-Pent en-2-ol, (\pm)		$\text{C}_5\text{H}_{10}\text{O}$	42569-16-4	86.132			121.6; 65 ⁷⁰	0.8328 ²⁵	1.4280 ²⁰	vs ace, et h, Et OH
8650	4-Pent en-1-ol		$\text{C}_5\text{H}_{10}\text{O}$	821-09-0	86.132			141	0.8457 ²⁰	1.4309 ²⁰	sl H ₂ O, ct c; s et h
8651	4-Pent en-2-ol		$\text{C}_5\text{H}_{10}\text{O}$	625-31-0	86.132			116	0.8367 ²⁰	1.4225 ²⁰	vs H ₂ O; msc Et OH, et h
8652	1-Pent en-3-one	Et hyl vi nyl ket one	$\text{C}_5\text{H}_8\text{O}$	1629-58-9	84.117			103; 44 ⁹⁰	0.8468 ²⁰	1.4195 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl
8653	t rans3-Pent en-2-one		$\text{C}_5\text{H}_8\text{O}$	3102-33-8	84.117			122	0.8624 ²⁰	1.4350 ²⁰	s H ₂ O, et h, ace, ct c
8654	2-(3-Pent enyl)pyri di ne		$\text{C}_{10}\text{H}_{13}\text{N}$	2057-43-4	147.217			216; 93 ¹²	0.9234 ²⁵	1.5076 ²⁵	
8655	1-Pent en-3-yne	Met hyl vi nyl acet yl ene	C_5H_6	646-05-9	66.102			59.5	0.7401 ²⁰	1.4496 ²⁰	vs bz, et h
8656	1-Pent en-4-yne		C_5H_6	871-28-3	66.102			42.5	0.738 ¹⁶	1.4125 ¹⁶	i H ₂ O; s et h, bz



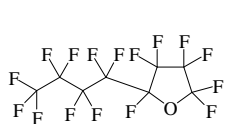
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No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8657	<i>ci s</i> 3-Pent en-1-yne		C ₅ H ₆	1574-40-9	66.102			44.6			
8658	<i>t rans</i> 3-Pent en-1-yne		C ₅ H ₆	2004-69-5	66.102			52.2			
8659	Pent et i c aci d	Di et hyl enet ri ami nepent acet i c aci d	C ₁₀ H ₁₉ N ₃ O ₁₀ Cl	67-43-6	393.347	cry (w)	219				s H ₂ O, al k
8660	Pent ost at i n		C ₁₁ H ₁₆ N ₄ O ₄	53910-25-1	268.270	wh cry (MeOH aq)	222				
8661	Pent nyl	2- <i>N</i> (2,4,6-Tet rani t roani li no)et hanol	C ₈ H ₁₆ NO ₂	4481-55-4	362.167	wh-ye cry	129		1.82		i H ₂ O, ct c; s chl; vs et h, bz
8662	Pent yl acet at e	Amyl acet at e	C ₇ H ₁₄ O ₂	628-63-7	130.185	li q	-70.8	149.2	0.8756 ⁸	1.4023 ²⁰	sl H ₂ O; msc Et OH, et h; s ct c
8663	<i>sec</i> -Pent yl acet at e	<i>sec</i> -Amyl acet at e	C ₇ H ₁₄ O ₂	54638-10-7	130.185			142	0.8803 ¹⁸	1.4012 ²⁰	vs et h, Et OH
8664	Pent yl ami ne	Amyl ami ne	C ₆ H ₁₃ N	110-58-7	87.164	li q	-55	104.3	0.7544 ⁸	1.448 ²⁰	msc H ₂ O, Et OH, et h; vs ace, bz; sl chl
8665	4- <i>t et</i> Pent yl ani li ne		C ₁₁ H ₁₇ N	2049-92-5	163.260			260.5			
8666	Pent yl benzene	Amyl benzene	C ₇ H ₁₆	538-68-1	148.245	li q	-75	205.4	0.8585 ⁸	1.4878 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
8667	Pent yl benzoat e		C ₁₁ H ₁₆ O ₂	2049-96-9	192.254			137 ¹⁵			
8668	4-Pent yl benzoyl chl ori de		C ₁₂ H ₁₅ ClO	49763-65-7	210.699			144 ⁹ , 121 ⁸	1.036 ²⁵	1.5300 ²⁰	
8669	Pent yl but anoat e	Amyl but yrat e	C ₇ H ₁₄ O ₂	540-18-1	158.238	li q	-73.2	186.4	0.8719 ⁸	1.4123 ²⁰	i H ₂ O; vs Et OH, et h
8670	<i>t et</i> Pent yl carbamat e	<i>t et</i> Amyl carbamat e	C ₇ H ₁₃ NO ₂	590-60-3	131.173	nd (di l al)	86				vs ace, bz
8671	Pent yl chl orof ormat e		C ₆ H ₉ ClO ₂	638-41-5	150.603			61 ¹⁵		1.4181 ¹⁸	s et h
8672	Pent yl cycl ohexane		C ₇ H ₁₂	4292-92-6	154.293	li q	-57.5	203.7	0.8037 ⁸	1.4437 ²⁰	vs ace, bz, et h, Et OH
8673	Pent yl cycl opent ane		C ₆ H ₁₀	3741-00-2	140.266	li q	-83	180	0.7912 ⁸	1.4356 ²⁰	i H ₂ O; vs ace, bz, et h, Et OH
8674	Pent yl f ormat e	Amyl f ormat e	C ₆ H ₁₂ O ₂	638-49-3	116.158	li q	-73.5	130.4	0.8853 ⁸	1.3992 ²⁰	sl H ₂ O; msc Et OH, et h
8675	Pent yl hept anoat e	Amyl enant hat e	C ₁₂ H ₂₄ O ₂	7493-82-5	200.318	li q	-50	245.4	0.8623 ⁸	1.4263 ¹⁵	vs ace, bz, et h, Et OH
8676	Pent yl hexanoat e	Amyl caproat e	C ₁₁ H ₂₂ O ₂	540-07-8	186.292	li q	-47	226	0.8612 ⁸	1.4202 ²⁵	s Et OH, et h, ace; sl ct c
8677	1-Pent yl naph t hal ene		C ₁₄ H ₁₈	86-89-5	198.304	li q	-22	307	0.9656 ⁸	1.5725 ²⁰	
8678	Pent yl ni t ri t e	Amyl ni t ri t e	C ₅ H ₁₁ NO ₂	463-04-7	117.147			104.5	0.8817 ²⁰	1.3851 ²⁰	sl H ₂ O; msc Et OH, et h
8679	Pent yl nonanoat e	Pent yl pel argonat e	C ₁₄ H ₂₈ O ₂	61531-45-1	228.371		-27	131 ²⁰	0.8506 ²⁵	1.4318 ²⁰	
8680	Pent yl oct anoat e	Amyl oct anoat e	C ₁₃ H ₂₆ O ₂	638-25-5	214.344	li q	-34.8	260.2	0.8613 ⁸	1.4262 ²⁵	i H ₂ O; s Et OH, et h, ace
8681	4-(Pent yl oxy)benzoyl chl ori de		C ₁₂ H ₁₅ ClO ₂	36823-84-4	226.699			198 ³⁰ , 182 ²⁵	1.087 ²⁵	1.5434 ²⁰	
8682	Pent yl pent anoat e		C ₁₀ H ₂₀ O ₂	2173-56-0	172.265	li q	-78.8	203.7	0.8638 ⁸	1.4164 ²⁰	sl H ₂ O; msc Et OH, et h
8683	4-Pent yl phenol		C ₇ H ₁₀ O	14938-35-3	164.244		23	250.5	0.960 ²⁰	1.5272 ²⁵	vs et h, Et OH
8684	Pent yl propanoat e		C ₈ H ₁₆ O ₂	624-54-4	144.212	li q	-73.1	168.6	0.876 ⁸	1.4096 ¹⁵	i H ₂ O; msc Et OH, et h; s bz; sl ct c
8685	Pent yl sal i cyl at e		C ₁₂ H ₁₆ O ₃	2050-08-0	208.253			270	1.064 ¹⁵	1.506 ²⁰	sl H ₂ O; msc Et OH, et h
8686	Pent yl st earat e		C ₂₀ H ₄₀ O ₂	6382-13-4	354.610	pl	30			1.434 ²⁰	vs et h, Et OH
8687	1-Pent yne	Propyl acet yl ene	C ₅ H ₈	627-19-0	68.118	li q	-90	40.1	0.690 ⁸	1.3852 ²⁰	i H ₂ O; vs Et OH; msc et h; s bz, chl; sl ct c
8688	2-Pent yne		C ₅ H ₈	627-21-4	68.118	li q	-109.3	56.1	0.705 ⁸	1.4039 ²⁰	i H ₂ O; vs Et OH; msc et h; s bz, chl
8689	4-Pent ynoi c aci d	Propargyl acet i c aci d	C ₃ H ₆ O ₂	6089-09-4	98.101		57.7	110 ³⁰ , 102 ¹⁷			vs et h, Et OH
8690	2-Pent yn-1-ol		C ₅ H ₈ O	6261-22-9	84.117	li q	-49.7	154, 6 ⁸	0.909 ²⁰	1.4518 ¹⁷	
8691	3-Pent yn-1-ol		C ₅ H ₈ O	10229-10-4	84.117			154	0.9002 ²⁰	1.4454 ²⁰	
8692	4-Pent yn-1-ol		C ₅ H ₈ O	5390-04-5	84.117			154	0.913 ²⁰	1.4414 ²⁰	
8693	Perazi ne	10-[3-(4-Met hyl -1-pi perazi nyl) propyl]-10 <i>H</i> -phenot hi azi ne	C ₂₀ H ₂₅ N ₃ S	84-97-9	339.498	cry	52	165 ^{0.001}			
8694	Perflui done		C ₆ H ₁₂ F ₃ NO ₄ S ₂	37924-13-3	379.375		143				
8695	Perfluoroacet one	Hexafluoroacet one	C ₂ F ₆ O	684-16-2	166.021	col gas	-125.45	-27.4			
8696	Perfluorobut ane	Decafluorobut ane	C ₄ F ₁₀	355-25-9	238.027	col gas	-129.1	-1.9	1.6484 ⁵		s bz, chl
8697	Perfluoro-2-but ene		C ₄ F ₈	360-89-4	200.030	col gas	-129	1.5	1.529 ⁷⁵		



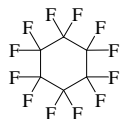
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8698	Perfluoro-2-butyl et rahydrof uran		C ₈ F ₁₆ O	335-36-4	416.059			102.6			
8699	Perfluorocycl obut ane	Oct afluorocycl obut ane	C ₈ F ₈	115-25-3	200.030	col gas	-40.19	-5.9	1.500 ²⁵ (p>1 at m)		i H ₂ O; s et h
8700	Perfluorocycl ohexane		C ₆ F ₁₂	355-68-0	300.045		62.5 (t ri pl e poi nt)	52.8 sp			
8701	Perfluorocycl ohexene		C ₆ F ₁₀	355-75-9	262.048			52.0	1.6650 ²⁵	1.293 ²⁰	
8702	Perfluorodecal i n		C ₁₀ F ₁₈	306-94-5	462.078	li q	-10	142			
8703	Perfluorodecane		C ₁₀ F ₂₂	307-45-9	538.072			144.2			i H ₂ O
8704	Perfluorodi met hoxymet hane		C ₈ F ₁₆ O ₂	53772-78-4	220.018	col gas	-161	-10			
8705	Perfluoro-2,3-di met hyl but ane		C ₆ F ₁₄	354-96-1	338.042	li q	-15	59.8			
8706	Perfluoroet hyl et hyl et her		C ₄ H ₂ F ₈ O	22052-81-9	164.074	vol li q or gas		28.11			
8707	Perfluoroet hyl 2,2,2-t ri fluoroet hyl et her		C ₄ H ₂ F ₈ O	156053-88-2	218.045	vol li q or gas		27.89			
8708	Perfluorohept ane		C ₇ F ₁₆	335-57-9	388.049	li q	-51.2	82.5	1.733 ³	1.2618 ²⁰	i H ₂ O; vs ace, et h, Et OH, chl
8709	Perfluoro-1-hept ene		C ₇ F ₁₄	355-63-5	350.053			81.0			
8710	Perfluorohexane		C ₆ F ₁₄	355-42-0	338.042	li q	-88.2	56.6	1.699 ⁵	1.2515 ²⁰	i H ₂ O; s et h, bz, chl
8711	Perfluoro-1-hexene		C ₆ F ₁₂	755-25-9	300.045			57.0			vs chl
8712	Perfluoroi sobut ane		C ₄ F ₈	354-92-7	238.027	col gas		0			
8713	Perfluoroi sobut ene	Perfluoroi sobut yl ene	C ₄ F ₆	382-21-8	200.030	col gas	-130	7	1.592 ²		
8714	Perfluoroi sopropyl met hyl et her		C ₄ H ₂ F ₈ O	22052-84-2	200.055	vol li q or gas		29.34	1.420 ⁵		
8715	Perfluoromet hyl cycl ohexane		C ₆ F ₁₄	355-02-2	350.053	li q	-44.7	76.3	1.787 ⁸	1.285 ¹⁷	s ace, bz, ct c, t ol, AcOEt
8716	Perfluoro-2-met hyl pent ane		C ₆ F ₁₄	355-04-4	338.042			57.6	1.7326 ²⁰	1.2564 ²²	i H ₂ O; s bz
8717	Perfluoro-3-met hyl pent ane		C ₆ F ₁₄	865-71-4	338.042	li q	-115	58.4			s bz
8718	Perfluoronapht hal ene		C ₁₀ F ₈	313-72-4	272.094		87.5	209			
8719	Perfluorononane		C ₉ F ₂₀	375-96-2	488.064			125.3	1.800 ²⁵		
8720	Perfluorooct ane		C ₈ F ₁₈	307-34-6	438.057			105.9	1.73 ²⁰	1.282 ²⁰	i H ₂ O
8721	Perfluorooct yl sul f onyl fluori de		C ₈ F ₁₆ O ₂ S	307-35-7	502.121	li q		154			
8722	Perfluorooxet ane		C ₄ F ₈ O	425-82-1	166.021	col gas	-117	-28.4			
8723	Perfluoropent ane		C ₅ F ₁₂	678-26-2	288.035	vol li q or gas	-10	29.2			i ₂ OH
8724	Perfluoropropane		C ₃ F ₈	76-19-7	188.019	col gas	-147.70	-36.6			i H ₂ O
8725	Perfluoropropene		C ₃ F ₆	116-15-4	150.022	col gas	-156.5	-29.6		1.583 ⁴⁰	i H ₂ O
8726	Perfluoropropyl met hyl et her		C ₄ H ₂ F ₈ O	375-03-1	200.055			34.23	1.4092 ²⁰		
8727	Perfluoropyri di ne	Pent afluoropyri di ne	C ₅ F ₁₀	700-16-3	169.053			83.7			
8728	Perfluorot ol uene		C ₇ F ₈	434-64-0	236.062	li q	-65.49	104.5		1.367 ⁸	
8729	Perfluorot ri propyl ami ne		C ₉ F ₁₈ N	338-83-0	521.069			130	1.822 ⁴	1.279 ²⁵	
8730	1 <i>H</i> -Peri mi di ne		C ₈ H ₈ N ₂	204-02-4	168.195	grn cry (di l al)	223.0				i ₂ OH; s Et OH, et h, ace, bz; sl DMSO
8731	Permet hri n		C ₁₀ H ₂₀ Cl ₂ O ₃	52645-53-1	391.288	cry or ye li q	34	200 ¹	1.23 ²⁰		i H ₂ O; s os
8732	Peroxyacet i c aci d	Et haneperoxi c aci d	C ₂ H ₂ O ₃	79-21-0	76.051	li q	-0.2	110	1.22 ⁶	1.3974 ²⁰	vs H ₂ O, et h, sul f ; s Et OH
8733	Peroxypropano c aci d	Propaneperoxi c aci d	C ₃ H ₄ O ₃	4212-43-5	90.078			exp 119.7		1.4148 ¹⁵	
8734	Perphenazi ne		C ₁₇ H ₂₆ Cl N ₂ O S	58-39-9	403.968		97				
8735	Pert hane	Et hane, 1,1-di chl oro-2,2-bi s(et hyl phenyl)-	C ₁₈ H ₂₀ Cl ₂	72-56-0	307.258		56				
8736	Peryl ene	Di benz(de,kl)ant hracene	C ₂₆ H ₁₂	198-55-0	252.309	gol d-br, ye pl (bz, HOAc)	277.76		1.35 ²⁵		i H ₂ O; sl Et OH, et h; vs ace, chl ; s bz
8737	Peucedani n	3-Met hoxy-2-i sopropyl-7-uro[3,2-g][1]benzopyran-7-one	C ₁₅ H ₁₄ O ₄	133-26-6	258.270	pr or pl (bz-pet h)	85	278 ¹⁷			sl H ₂ O, bz; s Et OH, et h; vs chl , C ₅



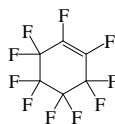
Perfluorobut-2-yl tetrahydrofuran



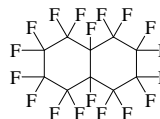
Perfluorocyclobutane



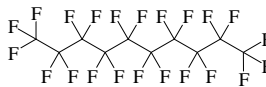
Perfluorocyclohexane



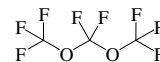
Perfluorocyclohexene



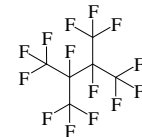
Perfluorodecalin



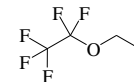
Perfluorodecane



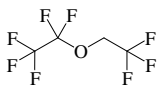
Perfluorodimethyl ether



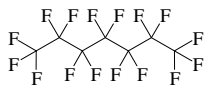
Perfluoro-2,3-dimethylbutane



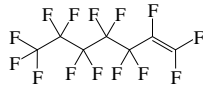
Perfluoroethyl ether



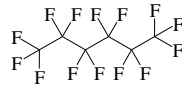
Perfluoroethyl ether



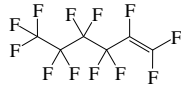
Perfluoroheptane



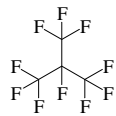
Perfluoro-1-heptene



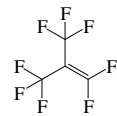
Perfluorohexane



Perfluoro-1-hexene



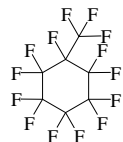
Perfluorobutane



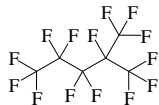
Perfluorobutene



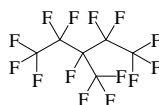
Perfluoroisopropyl ether



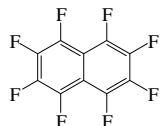
Perfluoromethylcyclohexane



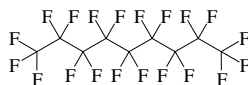
Perfluoro-2-methylpentane



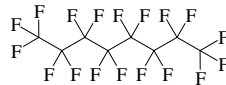
Perfluoro-3-methylpentane



Perfluoronaphthalene



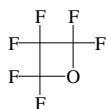
Perfluorononane



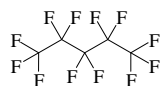
Perfluorooctane



Perfluorooctylsulfonamide



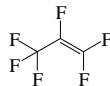
Perfluoroacetone



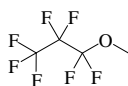
Perfluoropentane



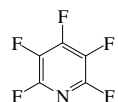
Perfluoropropane



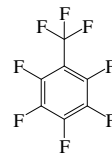
Perfluoropropene



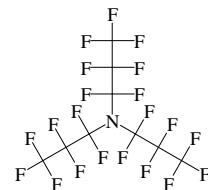
Perfluoropropyl ether



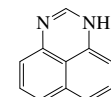
Perfluoropyridine



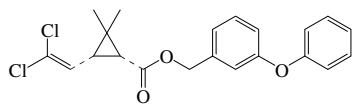
Perfluorotoluene



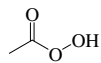
Perfluoro-N-propylamine



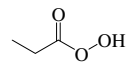
1H-Perimidine



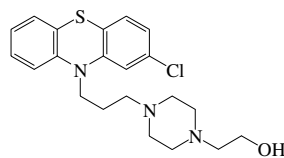
Permethrin



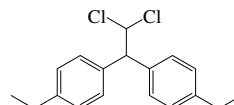
Peroxyacetic acid



Peroxypropionic acid



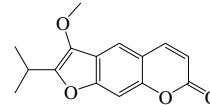
Perphenazine



Pertane

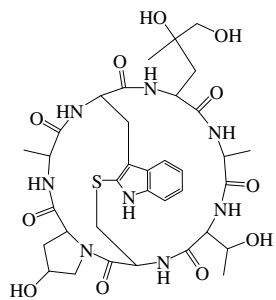


Perylene

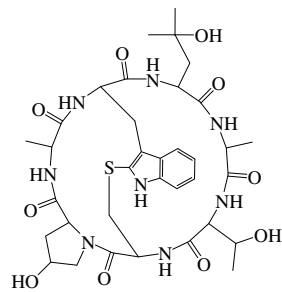


Peucedaniin

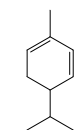
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8738	Phaloi di n		$C_{36}H_{48}N_6O_{11}S$	17466-45-4	788.868	nd (w)	281 (hyd)				s Et OH, MeOH, py
8739	Phaloi n		$C_{38}H_{48}N_6O_{10}S$	28227-92-1	772.869	cry (w)	250 dec				
8740	α -Phellandrene	2-Met hyl -5-(1-met hyl et hyl)-1,3-cycl ohexadi ene	$C_{10}H_{16}$	99-83-2	136.234		238	174.9	0.8410 ²⁰	1.471 ²⁵	i H ₂ O; s et h
8741	β -Phellandrene	p -Ment ha-1(7),2-di ene	$C_{10}H_{16}$	555-10-2	136.234			171.5	0.8520 ²⁰	1.4788 ²⁰	i H ₂ O, Et OH; s et h
8742	9-Phenant hrenami ne		$C_9H_{11}N$	947-73-9	193.244	l t ye cry (al)	138.3	sub			sl et h, bz, chl
8743	Phenant hrene		C_8H_{10}	85-01-8	178.229	mcl pl (al), lf (sub)	99.24	340	0.9800 ⁴	1.5943	i H ₂ O; s Et OH, et h, ace, bz, C ₆ S
8744	9,10-Phenant hrenedi one	Phenant hrenequi none	$C_8H_8O_2$	84-11-7	208.213	oran nd (t o) oran-red pl (sub)	209		1.405 ²²		i H ₂ O; sl Et OH, bz; s et h
8745	Phenant hri di ne		C_8H_9N	229-87-8	179.217	nd (di l al)	107.4	348.9			sl B; vs Et OH, et h, bz, C ₆ S s ace
8746	1,7-Phenant hrol i ne		$C_8H_9N_2$	230-46-6	180.205	pl (anh), nd (w+2)	78	360			s H ₂ O; vs Et OH; i et h, bz, li g
8747	1,10-Phenant hrol i ne	α -Phenant hrol i ne	$C_8H_9N_2$	66-71-7	180.205	wh nd (bz) cry (w+1)	117	>300			vs H ₂ O; s Et OH, ace, bz; i pet h
8748	4,7-Phenant hrol i ne		$C_8H_9N_2$	230-07-9	180.205	nd (w)	177	sub 100			s H ₂ O, li g; vs Et OH; sl et h, bz, C ₆ S
8749	1,10-Phenant hrol i ne monohydrat e	α -Phenant hrol i ne monohydrat e	$C_{12}H_{10}N_2O$	5144-89-8	198.219	wh cry pow	93				s Et OH, ace; sl bz
8750	Phenazi ne	Di benzopyrazi ne	$C_{12}H_8N_2$	92-82-0	180.205	ye-red nd (HOAc)	176.5				sl H ₂ O, et h; s bz, Et OH
8751	2,3-Phenazi nedi ami ne	2,3-Di ami nopenazi ne	$C_{12}H_{10}N_4$	655-86-7	210.234	ye nd	264	sub			vs bz, Et OH
8752	1-Phenazi nol	Hemi pyocyani ne	$C_{12}H_8N_2O$	528-71-2	196.204	ye nd (bz, di l MeOH)	158	sub			sl H ₂ O, Et OH; s bz, py, di l al k
8753	Phenazopyri di ne	2,6-Di ami no-3-phenyl azopyri di ne	$C_{11}H_{11}O_5$	94-78-0	213.239	red cry	139				
8754	Phenazopyri di ne hydrochl ori de	3-(Phenyl azo)-2,6-pyri di nedi ami monohydrochl ori de	$C_{16}H_{12}ClN_5$	136-40-3	249.700	ye-red cry					sl H ₂ O, Et OH; i bz, ace; s HOAc
8755	Phencarbami de		$C_{16}H_{24}N_2OS$	3735-90-8	328.471		48.5	121 ^{0.01}			vs et h, chl, MeOH, pet h
8756	Phendi met razi ne	3,4-Di met hyl -2-phenyl morphol i ne	$C_{17}H_{17}NO$	634-03-7	191.269			134 ¹² , 78 ^{0.35}			
8757	Phenet hi ci lli n pot assi um		$C_{17}H_{19}BN_2O_5S$	132-93-4	402.506	cry (ace)	235				s H ₂ O
8758	Pheni ci n		$C_{18}H_{10}O_6$	128-68-7	274.225	ye-br (al)	230.5				sl H ₂ O; vs Et OH, chl, HOAc
8759	Pheni ndami ne		$C_{18}H_{19}N$	82-88-2	261.361	cry	91		1.17		
8760	Phenmedi pham		$C_{16}H_{16}N_2O_4$	13684-63-4	300.309		143				
8761	Phenobarbi t al	5-Et hyl -5-phenyl -2,4,6-(3 <i>H</i> ,5 <i>H</i>)-pyri mi di net ri one	$C_{12}H_{12}N_2O_3$	50-06-6	232.234	pl (w)	174				i H ₂ O, bz; s Et OH, et h; sl DMSO
8762	Phenol	Hydroxybenzene	C_6H_6O	108-95-2	94.111		40.89	181.87	1.0545 ⁴⁵	1.5408 ⁴¹	s H ₂ O, Et OH; vs et h; msc ace, bz
8763	Phenol pht hal ei n	3,3-Bi s(4-hydroxyphenyl)- <i>H</i> (3) i sobenzof uranone	$C_{20}H_{14}O_4$	77-09-8	318.323	wh ort h nd	262.5		1.277 ²		i H ₂ O, bz; vs Et OH, ace; s et h, chl
8764	Phenol pht hal i n	2-[Bi s(4-hydroxyphenyl) met hyl]benzoi c aci d	$C_{20}H_{16}O_4$	81-90-3	320.339	nd (w)	230.5				vs et h, Et OH
8765	Phenol pht hal ol		$C_{18}H_{16}O_3$	81-92-5	306.355	cry (di l al)	201.5				
8766	Phenol Red	Phenol sul f onpht hal ei n	$C_{19}H_{16}O_5S$	143-74-8	354.376	dk red nd or pl	>300				sl H ₂ O, Et OH, ace, bz; i et h, chl
8767	10 <i>H</i> -Phenot hi azi ne	Thi odi phenyl ami ne	$C_{12}H_9NS$	92-84-2	199.271	ye pr (al) ye lf or pl (t ol)	187.5	371			vs ace, bz, et h, Et OH
8768	Phenot hri n		$C_{21}H_{26}O_3$	26002-80-2	350.450	col li q			1.061	1.5483 ²⁵	i H ₂ O; s ace, xyl
8769	10 <i>H</i> -Phenoxazi ne		C_8H_8NO	135-67-1	183.205	lf (di l al, bz)	156	dec			vs bz, et h, Et OH
8770	Phenoxyacet i c aci d		$C_8H_8O_3$	122-59-8	152.148	nd or pl (w)	98.5	dec 285			s H ₂ O; vs Et OH, et h, bz, C ₆ S
8771	Phenoxyacet yl chl ori de		$C_8H_7ClO_2$	701-99-5	170.594			225.5			s et h



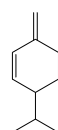
Phalloidin



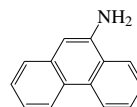
Phalloin



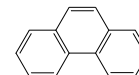
α-Phellandrene



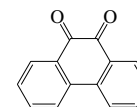
β-Phellandrene



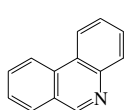
9-Phenanthrenamine



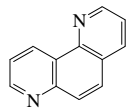
Phenanthrene



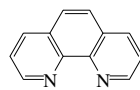
9,10-Phenanthrene-9,10-dione



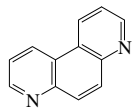
Phenanthridine



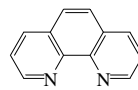
1,7-Phenanthroline



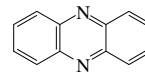
1,10-Phenanthroline



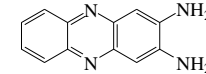
4,7-Phenanthroline



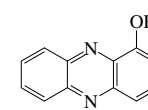
1,10-Phenanthroline monohydrate



Phenazine

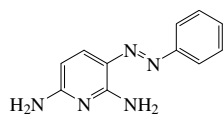


2,3-Phenazinediamine

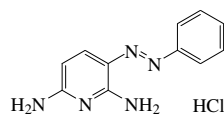


1-Phenazolinol

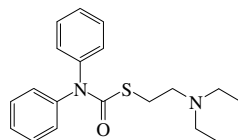
3-461



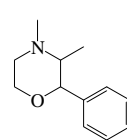
Phenazopyridine



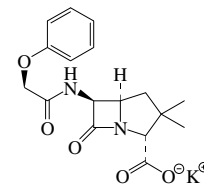
Phenazopyridine hydrochloride



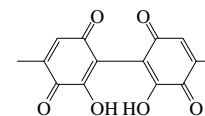
Phencarbamide



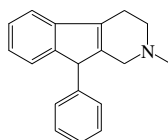
Phenmetrazine



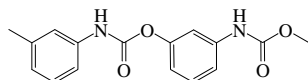
Phenethylpibissium



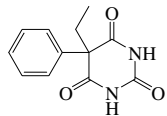
Phenicene



Phenindane



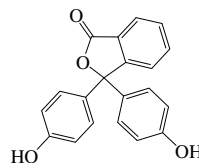
Phenmedipham



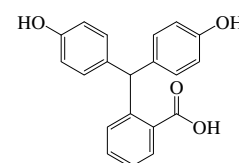
Phenobarbital



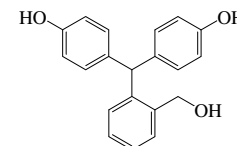
Phenol



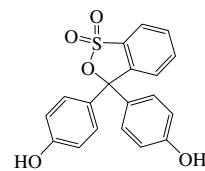
Phenolphthalein



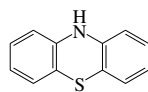
Phenolphthalein sodium salt



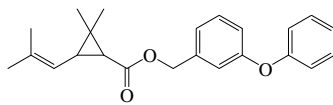
Phenolphthalein alcohol



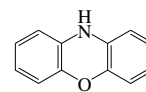
Phenol Red



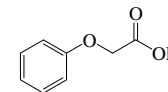
10H-Phenothiazine



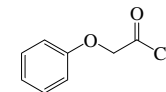
Phenothrin



10H-Phenoxazine

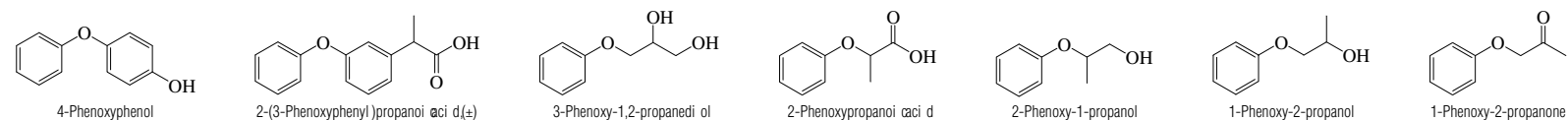
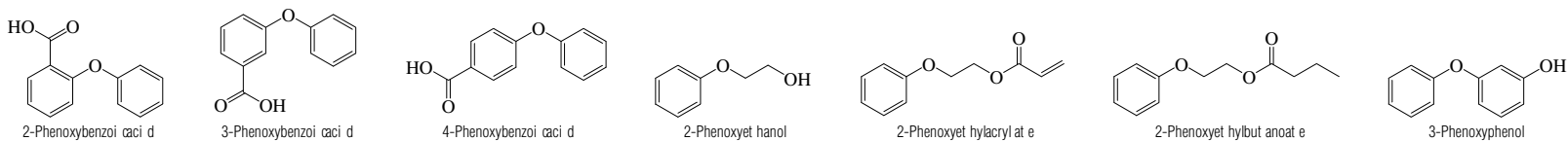
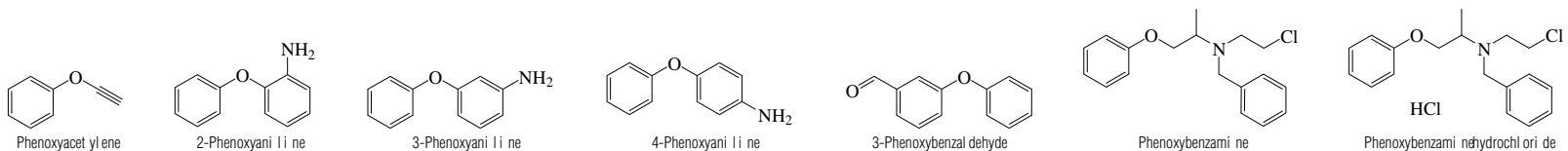


Phenoxacetic acid

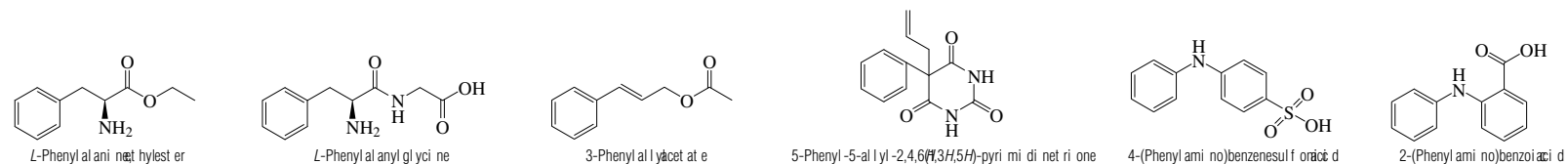
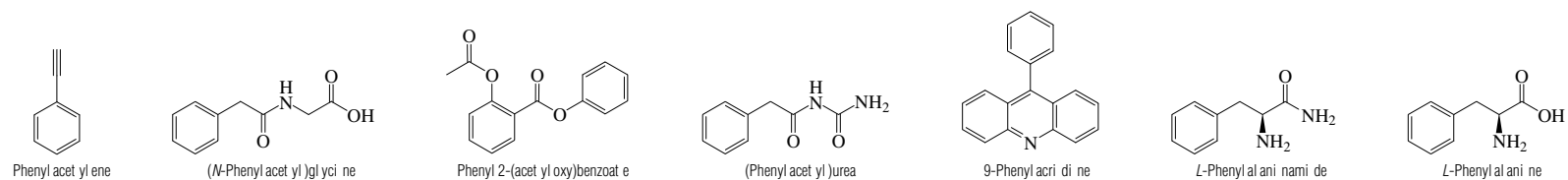
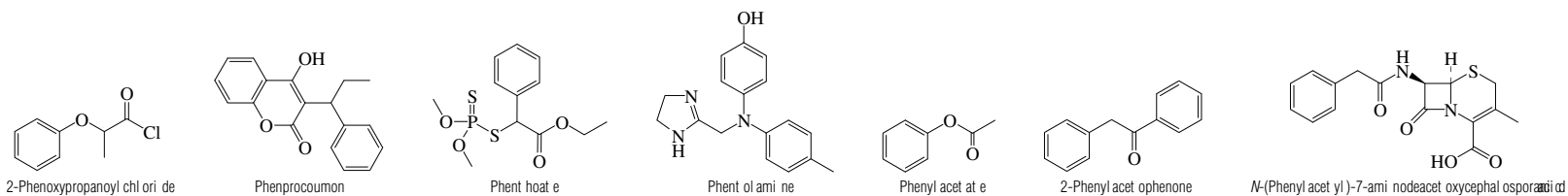


Phenoxacetyl chloride

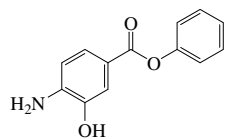
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8772	Phenoxyacet yl ene		C ₈ H ₁₀ O	4279-76-9	118.133		-36	61 ²⁵	1.0614 ²⁰	1.5125 ²⁰	vs et h, Et OH
8773	2-Phenoxyani li ne		C ₈ H ₁₁ NO	2688-84-8	185.221	cry (li g)	45.8	308; 172 ²			s Et OH; s et h, ace, bz
8774	3-Phenoxyani li ne		C ₈ H ₁₁ NO	3586-12-7	185.221	pr (li g)	37	315; 180 ²	1.1583 ²⁵		s Et OH, et h, ace, bz; sl li g
8775	4-Phenoxyani li ne		C ₈ H ₁₁ NO	139-59-3	185.221	nd (w), cry (di l al)	85.5				s H ₂ O; vs Et OH, et h; sl li g
8776	3-Phenoxybenzal dehyde		C ₉ H ₁₀ O ₂	39515-51-0	198.217		14.0	169 ¹¹ , 140 ^{0.1}	1.147 ²⁵	1.5954 ²⁰	
8777	Phenoxybenzami ne		C ₉ H ₁₂ ClNO	59-96-1	303.827		39				s bz
8778	Phenoxybenzami ne hydrochl ori de		C ₉ H ₁₃ Cl ₂ NO	63-92-3	340.288		139				sl H ₂ O; s Et OH
8779	2-Phenoxybenzoi c aci d		C ₉ H ₁₀ O ₃	2243-42-7	214.216	lf (di l al)	113	355	1.1553		i H ₂ O; vs Et OH, et h; s chl
8780	3-Phenoxybenzoi c aci d		C ₉ H ₁₀ O ₃	3739-38-6	214.216	nd (aq al)	145.8				i H ₂ O; s Et OH, et h
8781	4-Phenoxybenzoi c aci d		C ₉ H ₁₀ O ₃	2215-77-2	214.216	pr (chl)	161				sl H ₂ O; s Et OH, et h, chl
8782	2-Phenoxyet hanol		C ₉ H ₁₀ O ₂	122-99-6	138.164	oi l	14	245	1.102 ²	1.534 ²⁰	i H ₂ O; s Et OH, et h, chl, al k
8783	2-Phenoxyet hyl acryl at e	Phenyl Cel l osol ve acryl at e	C ₁₁ H ₁₄ O ₃	48145-04-6	192.211			110 ²	1.090 ²⁵		vs ace, et h, chl
8784	2-Phenoxyet hyl but anoat e		C ₁₂ H ₁₆ O ₃	23511-70-8	208.253			251; 88 ²	1.0388 ²¹		vs ace, et h, Et OH
8785	3-Phenoxyphenol		C ₉ H ₁₀ O ₂	713-68-8	186.206			175 ⁷			
8786	4-Phenoxyphenol		C ₉ H ₁₀ O ₂	831-82-3	186.206		84.0				
8787	2-(3-Phenoxyphenyl)propanoi c aci d, Fenoprof en (±)		C ₁₅ H ₁₄ O ₃	31879-05-7	242.270	vi sc oi l		170 ²		1.5742 ²⁵	
8788	3-Phenoxy-1,2-propanedi ol	Phenyl glyceryl et her	C ₉ H ₁₀ O ₃	538-43-2	168.189	nd (et h, pet h)	67.5	200 ²	1.225 ²⁰		vs H ₂ O, bz, et h, Et OH
8789	2-Phenoxypropanoi c aci d		C ₉ H ₁₀ O ₃	940-31-8	166.173	nd (w)	115.5	266; 105 ⁵	1.1865 ²⁰	1.5184 ²⁰	
8790	2-Phenoxy-1-propanol		C ₉ H ₁₂ O ₂	4169-04-4	152.190			244	0.9801 ²⁵	1.4760 ²⁵	s Et OH, et h
8791	1-Phenoxy-2-propanol		C ₉ H ₁₂ O ₂	770-35-4	152.190			233; 134 ²⁰	1.0622 ²⁰	1.5232 ²⁰	
8792	1-Phenoxy-2-propanone	Phenoxyacet one	C ₉ H ₁₀ O ₂	621-87-4	150.174			229.5	1.0903 ²⁰	1.5228 ²⁰	s et h, ace
8793	2-Phenoxypropanoyl chl ori de		C ₉ H ₉ ClO ₂	122-35-0	184.619			147; 116 ¹⁰	1.1865 ²⁰	1.5178 ²⁰	s et h
8794	Phenprocoumon	3-(α-Et hyl benzyl)-4-hydroxycoumarin	C ₁₈ H ₁₆ O ₃	435-97-2	280.318	pr (MeOH aq)	179				
8795	Phent hoat e		C ₉ H ₁₇ O ₄ PS ₂	2597-03-7	320.364	ye oi l		128 ⁹¹			sl H ₂ O; s hx
8796	Phent olami ne		C ₉ H ₁₉ N ₃ O	50-60-2	281.352		175				
8797	Phenyl acet at e		C ₉ H ₁₀ O ₂	122-79-2	136.149			196; 75 ³	1.0780 ²⁰	1.5035 ²⁰	sl H ₂ O; msc Et OH, et h, chl; s ct c
8798	2-Phenyl acet ophenone		C ₉ H ₁₂ O	451-40-1	196.244	pl (al)	60	320	1.20 ¹		sl H ₂ O; s Et OH, et h, ct c, chl
8799	N-(Phenyl acet yl)-7-ami nodeacet oxycephal osporani c aci d	Phenyl acet ami dodeacet oxycephal osporani c aci d	C ₁₆ H ₁₆ N ₂ O ₄ S	27255-72-7	332.374	cry (2-PrOH/ pet h)	200				
8800	Phenyl acet yl ene	Et hynyl benzene	C ₈ H ₆	536-74-3	102.134	li q	-44.8	143	0.9300 ²	1.5470 ²⁰	i H ₂ O; msc Et OH, et h; s ace; sl chl
8801	(N-Phenyl acet yl)glyci ne	Phenacet uri c aci d	C ₁₀ H ₁₁ NO ₃	500-98-1	193.199	lf (Et OH)	143				
8802	Phenyl 2-(acet yl oxy)benzoat e	Phenyl acet yl sal i cyl at e	C ₁₃ H ₁₂ O ₄	134-55-4	256.254		96				
8803	(Phenyl acet yl)urea	Phenacemi de	C ₉ H ₁₀ N ₂ O ₂	63-98-9	178.187	cry (al)	215				vs bz, et h, Et OH
8804	9-Phenyl acri di ne		C ₉ H ₁₃ N	602-56-2	255.313	ye nd, lf (al)	184	404			i ₂ H ₂ O sl Et OH; s et h; vs bz
8805	L-Phenyl al ani nami de	α-Ami nobenzenepropanami de, (S)-	C ₉ H ₁₂ N ₂ O	5241-58-7	164.203		82				
8806	L-Phenyl al ani ne	α-Ami nobenzenepropanoi c aci d(S)	C ₉ H ₁₁ NO ₂	63-91-2	165.189	pr (w)	283 dec				sl H ₂ O; i Et OH, et h, bz, aci d
8807	L-Phenyl al ani ne, et hyl est er	Et hyl 2-ami no-3-phenyl propi onat e	C ₉ H ₁₃ NO ₂	3081-24-1	193.243		136	148 ¹³	1.065 ¹⁵		sl H ₂ O
8808	L-Phenyl al anyl glyci ne		C ₁₁ H ₁₄ N ₂ O ₃	721-90-4	222.240			262 dec			s H ₂ O
8809	3-Phenyl al lyl acet at e		C ₁₁ H ₁₂ O ₂	103-54-8	176.212			123 ⁵			
8810	5-Phenyl -5- al lyl -2,4,6-(H,3H,5H)-pyri mi di net ri one	Phenal l ymal	C ₉ H ₁₂ N ₂ O ₃	115-43-5	244.245		156.5				sl H ₂ O, bz, DMSO; vs Et OH, et h; i li g
8811	4-(Phenyl ami no)benzenesul f oni c aci d	N-Phenyl sul f ani li c aci d	C ₁₂ H ₁₁ NO ₃ S	101-57-5	249.285	pl (al-et h)	206				vs H ₂ O, Et OH
8812	2-(Phenyl ami no)benzoi c aci d	N-Phenyl ant hrani li c aci d	C ₁₃ H ₁₁ NO ₂	91-40-7	213.232	lf (al)	183.5				i ₂ H ₂ O vs Et OH; sl et h, bz



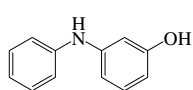
3-463



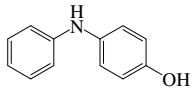
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8813	Phenyl 4-ami no-3-hydroxybenzoat e	Phenyl-ami nosal i c yl at e	$C_6H_7NO_3$	133-11-9	229.231		153				
8814	3-(Phenyl ami no)phenol		C_6H_7NO	101-18-8	185.221	lf (w)	81.5	340			sl H_2O ; vs Et OH, et h, ace; s bz, aci d
8815	4-(Phenyl ami no)phenol		C_6H_7NO	122-37-2	185.221	lf (w)	73	330			sl H_2O ; vs Et OH, et h, bz, chl; s aci d
8816	9-Phenyl ant hracene		$C_{14}H_{14}$	602-55-1	254.325	bl lf (al)(HOAc)	156	417			i_2OH s Et OH, et h, bz, chl, CS
8817	Phenyl arsonous di i odi de		$C_6H_5AsI_2$	6380-34-3	405.835		15	205 ¹⁴ , 185 ¹⁰	1.6264 ¹⁵		
8818	4-(Phenyl azo)-1,3-benzenedi ami ne monohydrochl ori de	Chrysoi di ne hydrochl ori de	$C_6H_5ClN_2$	532-82-1	248.711	red-br cry pow	118.5				vs ace
8819	4-(Phenyl azo)-1,3-benzenedi ol		$C_6H_7N_2O_2$	2051-85-6	214.219	dk red nd (di l al)	170				i_2OH ; vs Et OH, et h, bz, HOAc
8820	4-Phenyl azodi phenyl ami ne	<i>N</i> -Phenyl -4-(phenyl azo)benzenami ne	$C_6H_5N_3$	101-75-7	273.332	ye pl or pr	84.0				i_2OH ; vs Et OH, et h, li g
8821	4-(Phenyl azo)-1-napht hal enami ne	α -Napht hyl Red	$C_{10}H_{13}N_3$	131-22-6	247.294	red-vi ol cry (Et OH)	123				s Et OH, di l HCl, bz
8822	1-(Phenyl azo)-2-napht hal enami ne	Yel l ow AB	$C_{10}H_{13}N_3$	85-84-7	247.294	red pl (al)	103				vs Et OH, HOAc
8823	1-(Phenyl azo)-2-napht hol	Sudan I	$C_{16}H_{17}N_2O$	842-07-9	248.278	ye cry	132				
8824	4-(Phenyl azo)phenol		$C_6H_7N_2O$	1689-82-3	198.219	ye lf (bz) oran pr (al)	155	225 ²⁰ dec			i_2OH ; vs Et OH, et h; s bz, con sul f
8825	1-[[4-(Phenyl azo)phenyl]azo]-2-napht hol	Sudan III	$C_{22}H_{16}N_4O$	85-86-9	352.388	br lf (grm l ust re)195 (HOAc)	195				i_2OH ; s Et OH, et h, ace, bz, xyl, chl
8826	<i>N</i> -Phenyl benzami de	Benzani li de	C_6H_7NO	93-98-1	197.232	lf (al)	163	sub 117	1.375		i_2OH ; sl Et OH, et h, HOAc
8827	α -Phenyl benzeneacet aldehyde		C_6H_7O	947-91-1	196.244			dec 315; 157 ⁷	1.1061 ²¹	1.5920 ²¹	i_2OH ; vs Et OH, et h, bz
8828	α -Phenyl benzeneacet i c aci d	Di phenyl acet i c aci d	$C_6H_7O_2$	117-34-0	212.244	nd (w), lf (al)	147.29	194	1.257 ¹⁵		sl H_2O ; vs Et OH; s et h, chl
8829	α -Phenyl benzeneacet oni t ri le		C_6H_7N	86-29-3	193.244	pr (et h), lf (di l 74.3 al)		184 ¹⁶			s Et OH, chl; vs et h; sl li g
8830	α -Phenyl benzeneacet yl chl ori de		C_6H_7ClO	1871-76-7	230.689		56.5	170 ⁶			s li g
8831	<i>N</i> -Phenyl benzenecarbot hi oami de		C_6H_7NS	636-04-4	213.298	ye pl or pr (al)	102	dec			i_2OH ; vs Et OH; s et h, bz, chl; sl li g
8832	<i>N</i> -Phenyl -1,2-benzenedi ami ne		$C_6H_7N_2$	534-85-0	184.236	nd(w)	79.5	313			sl H_2O , li g; s ace, bz, chl
8833	<i>N</i> -Phenyl -1,4-benzenedi ami ne	<i>p</i> -Ami nodi phenyl ami ne	$C_6H_7N_2$	101-54-2	184.236	nd(al)	66	354			sl H_2O , chl; vs Et OH; s et h, li g
8834	α -Phenyl benzeneet hanami ne		$C_6H_7N_2$	25611-78-3	197.276			311; 175 ¹⁵	1.031 ¹⁵		vs et h, Et OH
8835	α -Phenyl benzeneet hanol		C_6H_7O	614-29-9	198.260	nd (pet h-bz)	67	177 ⁵	1.0360 ⁷⁰		
8836	α -Phenyl benzenemet hanami ne	Benzhydryl ami ne	C_6H_7N	91-00-9	183.249	hex pl	34	304; 176 ³	1.0633 ²⁰	1.5963	sl H_2O ; s ace
8837	α -Phenyl benzenemet hani mi ne		C_6H_7N	1013-88-3	181.233			282	1.0847 ¹⁹	1.6191 ¹⁹	vs et h
8838	β -Phenyl benzenepropanoi c aci d		$C_6H_7O_2$	606-83-7	226.271	nd (di l al)	156.0				sl H_2O ; vs Et OH; s et h, ace
8839	2-Phenyl benzi mi dazol e	Phenzi dol e	$C_6H_7N_2$	716-79-0	194.231	pl (HOAc) (al - w) nd (bz, w)	293				sl H_2O , bz; s Et OH, chl, HOAc
8840	Phenyl benzoat e		$C_6H_5O_2$	93-99-2	198.217	mcl pr (et h-al)	71	314	1.235		i_2OH ; s Et OH, et h, chl
8841	2-Phenyl benzo i c aci d		$C_6H_5O_2$	947-84-2	198.217	lf (di l al)	114.3	343.5			i_2OH ; vs Et OH, bz, HOAc
8842	4-Phenyl benzo i c aci d		$C_6H_5O_2$	92-92-2	198.217	nd (bz, al)	228	sub			i_2OH ; s Et OH, et h, bz
8843	2-Phenyl -4 <i>H</i> -1-benzopyran-4-one	Fl avone	$C_{15}H_{10}O_2$	525-82-6	222.239	nd (li g), cry (30% al)	100				i_2OH ; s Et OH, et h, ace, bz
8844	3-Phenyl -4 <i>H</i> -1-benzopyran-4-one	Isoflavone	$C_{15}H_{10}O_2$	574-12-9	222.239		148				
8845	2-Phenyl benzo t hi azol e		C_6H_5NS	883-93-2	211.282	nd (di l al)	115	371			i_2OH s Et OH, et h, CS
8846	<i>N</i> -Phenyl - <i>N</i> -benzyl benzenemet hanami ne		$C_{20}H_{19}N$	91-73-6	273.372		69	226 ¹⁰	1.0444 ⁸⁰	1.6065 ⁸⁰	i_2OH ; sl Et OH, HOAc; s et h, bz
8847	Phenyl bi guani de	<i>N</i> -Phenyl i mi dodi carboni mi di c di ami de	$C_8H_{11}N_5$	102-02-3	177.207		143				



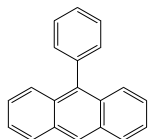
Phenyl 4-ami no-3-hydroxybenzoate



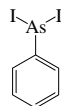
3-(Phenyl amino)phenol



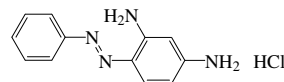
4-(Phenyl amino)phenol



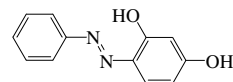
9-Phenylanthracene



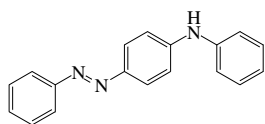
Phenyl arsonous diiodide



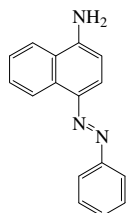
4-(Phenylazo)-1,3-benzenediamine monohydrochloride



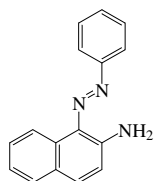
4-(Phenylazo)-1,3-benzenediol



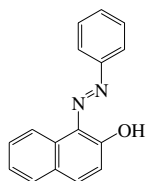
4-Phenyl azodi phenyl amine



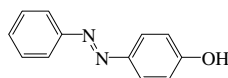
4-(Phenyl azo)-1-naphthalenamine



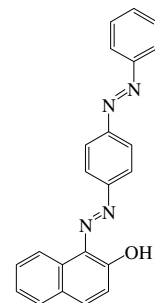
1-(Phenyl azo)-2-naphthalenamine



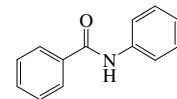
1-(Phenyl azo)-2-naphthol



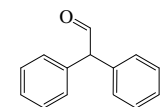
4-(Phenyl azo)phenol



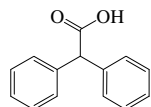
1-[[4-(Phenyl azo)phenyl]azo]-2-naphthol



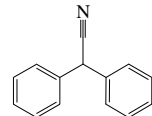
N-Phenyl benzamide



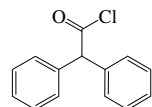
alpha-Phenyl benzenealdehyde



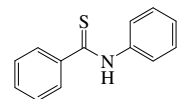
alpha-Phenyl benzoic acid



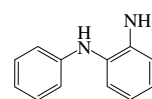
alpha-Phenyl benzeneacetonitrile



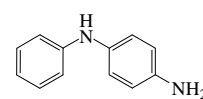
alpha-Phenyl benzeneacetyl chloride



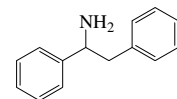
N-Phenyl benzeneacetamide



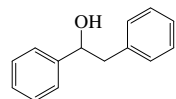
N-Phenyl-1,2-benzenediamine



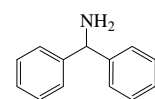
N-Phenyl-1,4-benzenediamine



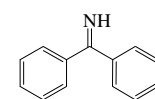
alpha-Phenyl benzeneethanamine



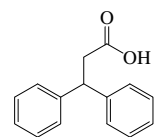
alpha-Phenyl benzeneethanol



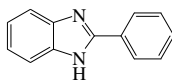
alpha-Phenyl benzenemethanamine



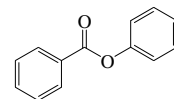
alpha-Phenyl benzenemethanimine



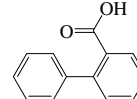
beta-Phenyl benzenepropanoic acid



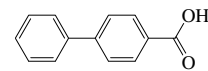
2-Phenyl benzimidazole



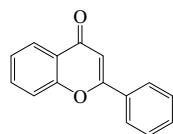
Phenyl benzoate



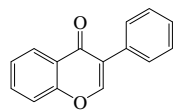
2-Phenyl benzoic acid



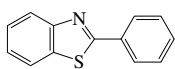
4-Phenyl benzoic acid



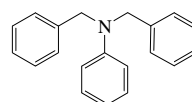
2-Phenyl-4H-1-benzopyran-4-one



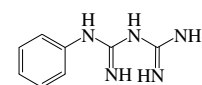
3-Phenyl-4H-1-benzopyran-4-one



2-Phenyl benzothiazole

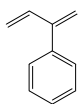


N-Phenyl-N-benzyl benzenemethanamine

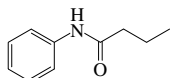


Phenyl biguanide

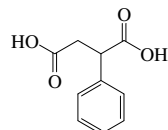
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility	
8848	2-Phenyl-1,3-butadiene		$C_{10}H_{10}$	2288-18-8	130.186			60 ¹⁷	0.925 ²⁰	1.5489 ²⁰	i H ₂ O; s et h, bz, chl	
8849	N-Phenylbutanamide		$C_{10}H_{13}NO$	1129-50-6	163.216	mcl pr (al, bz, et h)	97	189 ¹⁵	1.134 ²⁵		i H ₂ O; vs Et OH, et h; sl chl	
8850	Phenylbutanediol	(±)	$C_{10}H_{12}O_2$	10424-29-0	194.184	lf or nd (w)	168	dec			sl H ₂ O, chl; vs Et OH, et h, ace; i bz	
8851	1-Phenyl-1,3-butadiene		$C_{10}H_{10}$	93-91-4	162.185	pr	56	261.5	1.0599 ¹⁴	1.5678 ⁷⁸	i H ₂ O; s et h; sl chl	
8852	Phenylbutanoate	Phenylbutyrate	$C_{10}H_{12}O_2$	4346-18-3	164.201			225	1.0382 ¹⁵		i H ₂ O; s Et OH, et h	
8853	1-Phenyl-1-butanol		$C_{10}H_{12}O$	495-40-9	148.201			12	228.5	0.988 ²⁰	1.5203 ²⁰	i H ₂ O; msc Et OH, et h; vs ace; s ct c
8854	1-Phenyl-2-butanol		$C_{10}H_{12}O$	1007-32-5	148.201			228; 111 ¹⁶	0.9877 ²⁰		i H ₂ O; s Et OH, ct c; msc et h; vs ace	
8855	4-Phenyl-2-butanol		$C_{10}H_{12}O$	2550-26-7	148.201	li q	-13	233.5	0.9849	1.511 ²²	i H ₂ O; s Et OH, et h, ct c; vs ace	
8856	Phenylbutazone		$C_{10}H_{12}N_2O_2$	50-33-9	308.374		105					
8857	2-Phenyl-1-butene	α-Ethylstyrene	$C_{10}H_{12}$	2039-93-2	132.202			182	0.887 ²⁵	1.5288 ²⁰		
8858	1-Phenyl-2-buten-1-ol		$C_{10}H_{10}O$	495-41-0	146.185			20.5	111 ⁹	1.025 ¹⁵	1.5626 ¹⁸	
8859	trans-4-Phenyl-3-buten-2-ol	Benzylideneacetone	$C_{10}H_{10}O$	1896-62-4	146.185	pl	41.5	261	1.009 ⁷⁵	1.5836 ⁴⁵	i H ₂ O; vs Et OH; s et h, ace, bz; sl pet h	
8860	4-Phenyl-3-buten-2-ol		$C_{10}H_{10}O$	1817-57-8	144.170		4.5	79 ²	1.0215 ²⁰	1.5762 ²⁰		
8861	Phenylchloroacetate		$C_8H_7ClO_2$	620-73-5	170.594	nd or pl (al)	44.5	232.5	1.220 ²⁴	1.5146 ⁴⁴	i H ₂ O; vs Et OH, et h	
8862	Phenylchloroformate		$C_8H_7ClO_2$	1885-14-9	156.567			71 ⁹				
8863	4-Phenyl-2-chlorophenol	3-Chloro-(1,1'-biphenyl)-4-ol	$C_{12}H_9ClO$	92-04-6	204.651	wh-ye cry	77	161 ⁷				
8864	2-Phenyl-2,5-cyclohexadiene-1,4-dione		$C_{12}H_8O_2$	363-03-1	184.191	ye lf (pet h, al)	114				sl H ₂ O; s Et OH, bz, pet h; vs chl	
8865	4-Phenylcyclohexanone		$C_{12}H_{14}O$	4894-75-1	174.238	cry (pet h)	79	158 ²				
8866	1-(1-Phenylcyclohexyl)picridine	Phencyclidine	$C_{17}H_{25}N$	77-10-1	243.388		46.5	136 ^{1,0}				
8867	3-Phenyl-2-cyclohexen-1-ol		$C_{11}H_{14}O$	3810-26-2	158.196	li q	-23	234.2	0.971 ¹⁹	1.5440 ²⁰	s Et OH, ace, chl; sl et h	
8868	N-Phenyl-N,N-dimethanamine		$C_{10}H_{13}NO_2$	120-07-0	181.232		57	200 ¹⁰	1.201 ⁶⁰		vs ace, bz, et h, Et OH	
8869	2-Phenyl-1,3-dioxane		$C_{10}H_{12}O_2$	772-01-0	164.201	nd (pet h)	41	253	1.605 ³⁹		vs Et OH, et h	
8870	4-Phenyl-1,3-dioxane		$C_{10}H_{12}O_2$	772-00-9	164.201			247	1.1038 ²⁰	1.5306 ¹⁸	i H ₂ O; s os	
8871	1-Phenyl-1-dodecanone		$C_{13}H_{26}O$	1674-38-0	260.414		47	201 ⁹ , 181 ⁵	0.8794 ¹⁸	1.4700 ¹⁸	i H ₂ O; s ace; sl ct c	
8872	1-Phenyl-1,2-ethanediol	Styrene glycol	$C_8H_{10}O_2$	93-56-1	138.164	nd (li g)	67.5	273			vs H ₂ O, et h, bz, Et OH; sl li g	
8873	N-Phenylethanamine		$C_8H_{11}NO$	122-98-5	137.179			279.5; 150 ¹⁰	1.0945 ²⁰	1.5760 ²⁰	sl H ₂ O; vs Et OH, et h, chl	
8874	1-Phenylethanoxime		C_8H_9NO	613-91-2	135.163	nd (w)	60	245	1.0515 ⁷⁸		sl H ₂ O; vs Et OH, et h, ace, bz; s ct c	
8875	2-Phenylethanoate		$C_{10}H_{12}O_2$	103-45-7	164.201	li q	-31.1	232.6	1.088 ⁹	1.5171 ²⁰	vs et h, Et OH	
8876	1-Phenylethyl hydroperoxide		$C_8H_9O_2$	3071-32-7	138.164	li q		50 ¹¹				
8877	N-(2-Phenylethyl)dimethylcarbamidohydrochloride	Phenormin hydrochloride	$C_{10}H_{15}ClN_2$	834-28-6	241.721	cry	177.3				s H ₂ O	
8878	2-Phenylethyl 2-methylpropanoate	Benzylcarbolisobutyrate	$C_{12}H_{16}O_2$	103-48-0	192.254			250; 123 ¹⁵	0.9950 ¹⁵	1.4871 ²⁰		
8879	2-Phenylethyl phenylacetate		$C_{16}H_{16}O_2$	102-20-5	240.297		26.5	177 ⁴⁵	1.077 ²⁵		vs Et OH	
8880	2-Phenylethyl propanoate	Phenetpropionate	$C_{11}H_{14}O_2$	122-70-3	178.228	li q		244	1.02 ²	1.4950 ²⁰		
8881	2-(2-Phenylethyl)pyridine		$C_{13}H_{13}N$	2116-62-3	183.249	li q	-1.5	289	1.046 ⁵			
8882	N-Phenylformamide	Formaniline	C_7H_9NO	103-70-8	121.137	mcl pr (li g-xyl)	46	271	1.118 ⁶		s H ₂ O, et h, bz; vs Et OH	
8883	Phenylformate		$C_7H_7O_2$	1864-94-4	122.122	li q		178; 8 ²				
8884	2-Phenylforman		C_7H_8O	17113-33-6	144.170			108 ¹⁸ , 82 ²	1.083 ²⁰	1.5920 ²⁰	vs ace, bz	
8885	Phenyl α-D-glucopyranoside		$C_{16}H_{16}O_6$	4630-62-0	256.251		174					
8886	Phenylglycidyl ether		$C_8H_8O_2$	122-60-1	150.174			243	1.1109 ²¹	1.5307 ²¹		
8887	N-Phenylglycine	Phenylaminoacetic acid	$C_8H_9NO_2$	103-01-5	151.163		127.5				vs H ₂ O, Et OH	
8888	1-Phenyl-1-heptanone		$C_8H_{16}O$	1671-75-6	190.281	lf	16.4	283.3	0.951 ⁶	1.5060 ²⁰	vs ace, et h, Et OH	



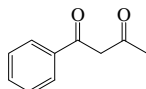
2-Phenyl-1,3-butadiene



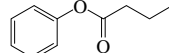
N-Phenylbutanamide



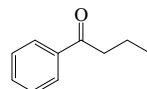
Phenylbutanedioic acid (±)



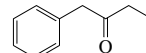
1-Phenyl-1,3-butanedione



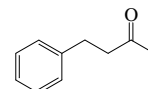
Phenylbutanoate



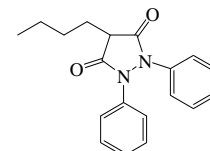
1-Phenyl-1-butanone



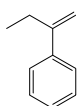
1-Phenyl-2-butanone



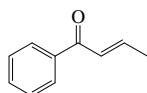
4-Phenyl-2-butanone



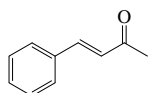
Phenylbutazone



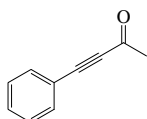
2-Phenyl-1-butene



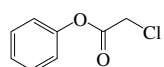
1-Phenyl-2-buten-1-one



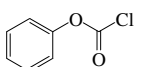
trans-4-Phenyl-3-buten-2-one



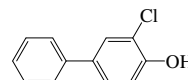
4-Phenyl-3-butyne-2-one



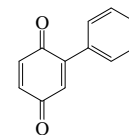
Phenyl chloroacetate



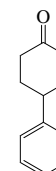
Phenyl chloroformate



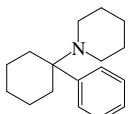
4-Phenyl-2-chlorophenol



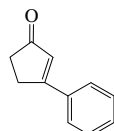
2-Phenyl-2,5-cyclohexadiene-1,4-dione



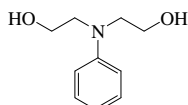
4-Phenylcyclohexanone



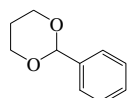
1-(1-Phenylcyclohexyl)pyrrolidine



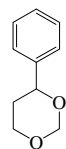
3-Phenyl-2-cyclopenten-1-one



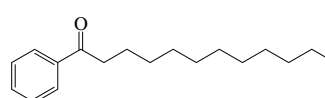
N-Phenyl-N,N'-diethylethane-1,2-diamine



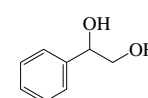
2-Phenyl-1,3-dioxane



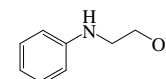
4-Phenyl-1,3-dioxane



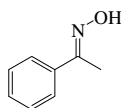
1-Phenyl-1-dodecanone



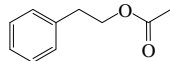
1-Phenyl-1,2-ethanediol



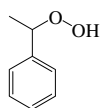
N-Phenylethane-1,2-diamine



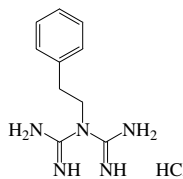
1-Phenylacetone oxime



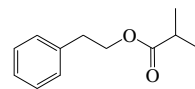
2-Phenylacetate



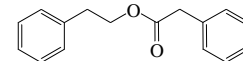
1-Phenyl hydroperoxide



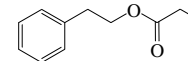
N-(2-Phenylethyl)hydrazine dihydrochloride



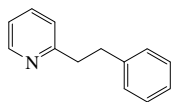
2-Phenylethyl 2-methylpropanoate



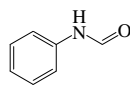
2-Phenylethyl benzoate



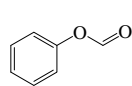
2-Phenylethyl propanoate



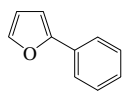
2-(2-Phenylethyl)pyridine



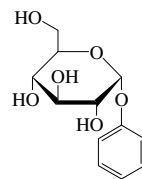
N-Phenylformamide



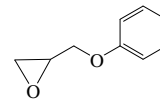
Phenyl formate



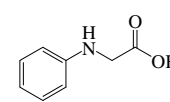
2-Phenylfuran



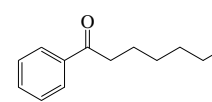
Phenyl alpha-D-glucopyranoside



Phenyl glycidyl ether

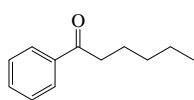


N-Phenylglycine

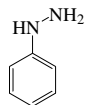


1-Phenyl-1-heptanone

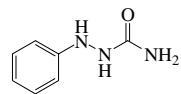
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8889	1-Phenyl-1-hexanone		C ₁₂ H ₁₆ O	942-92-7	176.254	fl	27	265	0.9576 ²⁵	1.5027 ²⁵	sl H ₂ O, ct c; s Et OH, et h, ace
8890	Phenyl hidrazi ne		C ₇ H ₇ N ₂	100-63-0	108.141	mcl pr or pl	20.6	243.5	1.0986 ⁹	1.6084 ¹⁰	s H ₂ O; msc Et OH, et h, bz; vs ace
8891	2-Phenyl hidrazi necarboxami de	Pheni carbazi de	C ₇ H ₇ N ₂ O	103-03-7	151.165		172				sl H ₂ O, et h, bz, li g; s Et OH, ace
8892	N-Phenyl hidrazi necarboxami de	4-Phenyl semi carbazi de	C ₇ H ₇ N ₂ O	537-47-3	151.165	nd (bz), pl (w)	128				sl H ₂ O; vs Et OH, chl; i et h
8893	Phenyl hidrazi ne monohidrochl ori de		C ₇ H ₆ ClN ₂	59-88-1	144.601	lf (al)	244 dec	sub			vs H ₂ O, Et OH
8894	Phenyl hidroksil ami ne	N-Hidroksibenzenami ne	C ₇ H ₇ NO	100-65-2	109.126	nd (w, bz, pet h)	83.5				vs bz, et h, Et OH, chl
8895	Phenyl 1-hidroksi-2-naphtal enecarboxilat e		C ₁₇ H ₁₂ O ₃	132-54-7	264.275		96				vs bz, Et OH
8896	1-Phenyl-1 <i>H</i> -i mi dazol e		C ₈ H ₈ N ₂	7164-98-9	144.173		13	276	1.1397 ¹⁵	1.6025 ²⁵	i H ₂ O; vs et h, ace, chl
8897	2-Phenyl-1 <i>H</i> -i mi dazol e		C ₈ H ₈ N ₂	670-96-2	144.173	lf (bz)	149.3	340			vs Et OH
8898	5-Phenyl-2,4-i mi dazol i di nedione	5-Phenyl hidant oi n	C ₉ H ₈ N ₂ O ₂	89-24-7	176.172		184.5				
8899	Phenyl i mi docarbonyl chl ori de		C ₇ H ₆ Cl ₂ N	622-44-6	174.028	li q		210; 105 ⁹	1.28 ¹⁵		
8900	2-[(Phenyl i mi no)met hyl]phenol		C ₁₃ H ₁₁ NO	779-84-0	197.232		49.5		1.087 ²⁵		i H ₂ O; s Et OH
8901	4-[(Phenyl i mi no)met hyl]phenol	N-(4-Hidroksibenzi li dene)ani li ne	C ₁₃ H ₁₁ NO	1689-73-2	197.232		196.0				i H ₂ O; s Et OH, et h; sl bz, chl
8902	1-Phenyl-1 <i>H</i> -i ndene		C ₉ H ₁₀	1961-96-2	122.152	oi l		158			
8903	2-Phenyl-1 <i>H</i> -i ndene-1,3(2 <i>H</i>)-di one	Pheni ndi one	C ₉ H ₁₀ O ₂	83-12-5	222.239	lf (al, bz)	150				i ₂ OH; s Et OH, et h, ace, bz, MeOH, chl
8904	2-Phenyl-1 <i>H</i> -i ndol e		C ₉ H ₉ N	948-65-2	133.144		190.5	250 ¹⁰			sl H ₂ O; s et h, bz, chl, HOAc, C ₆ H ₆
8905	Phenyl i odine di acet at e	iodobenzene di acet at e	C ₁₀ H ₁₁ IO ₂	3240-34-4	322.096	cry	161				
8906	Phenyl i soyfanat e		C ₇ H ₇ NO	103-71-9	119.121			163; 55 ¹³	1.0956 ²⁰	1.5368 ²⁰	vs et h; sl chl
8907	2-Phenyl-1 <i>H</i> -i soi ndole-1,3(2 <i>H</i>)-di one		C ₁₄ H ₉ NO ₂	520-03-6	223.227	wh nd (al)	210	sub			i H ₂ O; sl Et OH; msc chl
8908	Phenyl i sopropyl et her	Isopropoxybenzene	C ₉ H ₁₂ O	2741-16-4	136.190	li q	-33	176.8	0.940 ⁸	1.4975 ²⁰	s H ₂ O, Et OH, ace, bz
8909	Phenyl i sot hi ocyanat e		C ₇ H ₇ ONS	103-72-0	135.187	li q	-21	221	1.130 ⁸	1.6492 ²³	i H ₂ O; s Et OH, et h, ct c
8910	3-Phenyl-2-i soxazol i n-5-one		C ₉ H ₇ NO ₂	1076-59-1	161.158		151				sl chl
8911	Phenyl laurat e	Phenyl dodecanoat e	C ₁₈ H ₂₅ O ₂	4228-00-6	276.414	lf (al)	24.5	210	0.9354 ³⁰		vs ace, et h, Et OH
8912	Phenyl magnesi um chl ori de	Chl orophenyl magnesi um	C ₈ H ₇ ClMg	100-59-4	136.862	cry					reac H ₂ O; s t hf, et h
8913	Phenyl mercuri c chl ori de	Chl orophenyl mercury	C ₈ H ₇ ClHg	100-56-1	313.15	pl (bz)	251				i H ₂ O; sl Et OH, bz
8914	Phenyl mercuri c ni tr at e		C ₈ H ₇ HgNO ₃	55-68-5	339.70		≈181				
8915	4-(Phenyl met hoxi)benzal dehide		C ₉ H ₈ O ₂	4397-53-9	212.244		73	217 ¹³			
8916	N2-[(Phenyl met hoxi)carbonyl]i-argi ni ne		C ₁₄ H ₂₀ N ₄ O ₄	1234-35-1	308.334		174				
8917	N-[(Phenyl met hoxi)carbonyl]i-aspart i c aci d		C ₁₂ H ₁₃ NO ₆	1152-61-0	267.234		117.0				
8918	2-(Phenyl met hoxi)phenol		C ₉ H ₁₀ O ₂	6272-38-4	200.233			205 ²⁰ , 173 ¹³	1.154 ²²	1.5906 ¹⁸	vs et h, Et OH
8919	4-(Phenyl met hoxi)phenol	Monobenzene	C ₉ H ₁₀ O ₂	103-16-2	200.233	pl (w)	122				sl H ₂ O; vs Et OH, bz, et h; s ace
8920	N-(Phenyl met hyl ene)ani li ne	Benzyl i deneani li ne	C ₁₃ H ₁₁ NC	538-51-2	181.233	pa ye nd (CS ₂) pl (di l al)	54	310	1.038 ⁵⁵	1.600 ¹⁰⁰	i H ₂ O; s Et OH, et h, NH ₃ sl chl
8921	<i>ci</i> -sox-(Phenyl met hyl ene)benzeneacet i c aci d	<i>ci</i> -sox-Phenyl ci niami c aci d	C ₁₅ H ₁₂ O ₂	91-47-4	224.255	si l ky needl es	174				s H ₂ O, Et OH, MeOH, et h, bz
8922	<i>t</i> -ransox-(Phenyl met hyl ene)benzeneacet i c aci d	<i>t</i> -ransox-Phenyl ci niami c aci d	C ₁₅ H ₁₂ O ₂	91-48-5	224.255	pri sms	138				vs H ₂ O; s Et OH, MeOH, et h, bz
8923	N-(Phenyl met hyl ene)benzenemet hanami ne		C ₁₄ H ₁₃ N	780-25-6	195.260			205 ²⁰			
8924	2-(Phenyl met hyl ene)but anal		C ₁₁ H ₁₂ O	28467-92-7	160.212		18	243; 157 ⁵	1.0201 ²²	1.578 ²⁰	
8925	N-(Phenyl met hyl ene)et hanami ne		C ₉ H ₉ N	6852-54-6	133.190			195	0.937 ²⁰	1.5378 ¹⁵	i H ₂ O; s Et OH, et h
8926	2-(Phenyl met hyl ene)hept anal		C ₁₄ H ₁₈ O	122-40-7	202.292	ye oi l	80	174	0.9711 ²⁰	1.5381 ²⁰	i H ₂ O; s ace, ct c



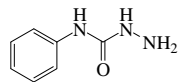
1-Phenyl-1-hexanone



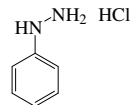
Phenylhydrazine



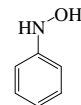
2-Phenylhydrazinecarboxamide



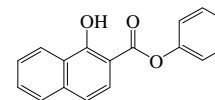
N-Phenylhydrazinecarboxamide



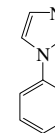
Phenylhydrazine hydrochloride



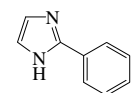
Phenylhydroxylamine



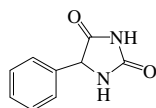
Phenyl 1-hydroxy-2-naphthalenecarboxylate



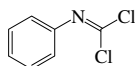
1-Phenyl-1H-imidazole



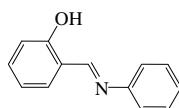
2-Phenyl-1H-imidazole



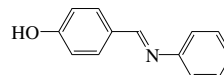
5-Phenyl-2,4-imidazolidinone



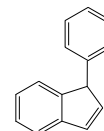
Phenyl di carbonyl chloride



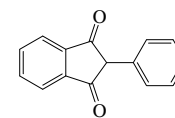
2-((Phenyl(mono)methyl)phenol)



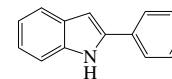
4-((Phenyl(mono)methyl)phenol)



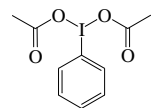
1-Phenyl-1H-indene



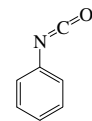
2-Phenyl-1H-indene-1,3-dione



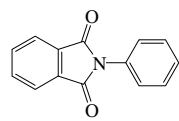
2-Phenyl-1H-indole



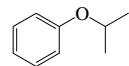
Phenyl diacetate



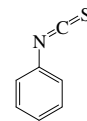
Phenyl isocyanate



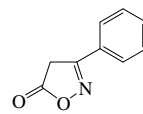
2-Phenyl-1H-indole-1,3-dione



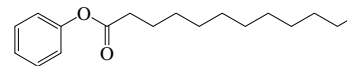
Phenyl isopropyl ether



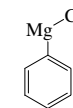
Phenyl isothiocyanate



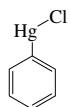
3-Phenyl-2-imidazole-5-one



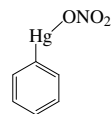
Phenyl laurate



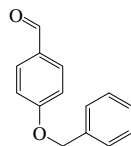
Phenylmagnesium chloride



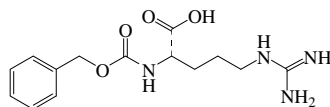
Phenylmercuric chloride



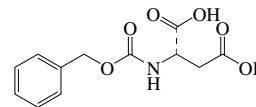
Phenylmercuric nitrate



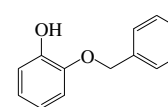
4-(Phenylmethoxy)benzaldehyde



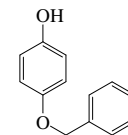
N2-((Phenylmethoxy)carbonyl)-L-arginine



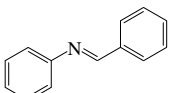
N-((Phenylmethoxy)carbonyl)-L-aspartic acid



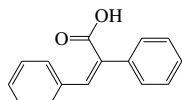
2-(Phenylmethoxy)phenol



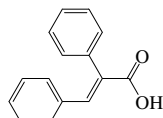
4-(Phenylmethoxy)phenol



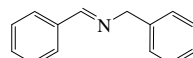
N-(Phenylmethylene)aniline



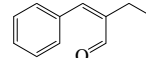
cis-(Phenylmethylene)benzeneacetic acid



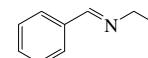
trans-(Phenylmethylene)benzeneacetic acid



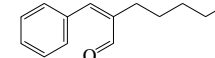
N-(Phenylmethylene)benzenemethanamine



2-(Phenylmethylene)butanal

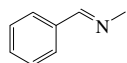


N-(Phenylmethylene)ethanamine

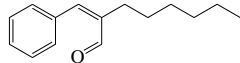


2-(Phenylmethylene)heptanal

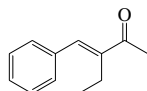
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8927	<i>N</i> -(Phenyl met hyl ene)met hanami ne	Benzyl i denemet hyl ami ne	$\text{C}_9\text{H}_9\text{N}$	622-29-7	119.164			185; 92 ³⁴	0.9671 ¹⁴	1.5526 ²⁰	s Et OH, et h, ace, chl
8928	2-(Phenyl met hyl ene)oct anal	2-Hexyl -3-phenyl -2-propenal	$\text{C}_{15}\text{H}_{20}\text{O}$	101-86-0	216.319	li q	4	252; 169			
8929	3-(Phenyl met hyl ene)-2-pent anone	Met hyl et hyl st yryl ket one	$\text{C}_{12}\text{H}_{14}\text{O}$	3437-89-6	174.238			137 ¹²	1.0005 ²²	1.5650 ²²	
8930	<i>N</i> -(Phenyl met hyl)-1,2-et hanedi ami ne		$\text{C}_9\text{H}_{11}\text{N}_2$	4152-09-4	150.220			130 ¹¹			
8931	Phenyl met hyl 4-hydroxybenzoat e		$\text{C}_9\text{H}_9\text{O}_3$	94-18-8	228.243						sl chl
8932	1-Phenyl -2-met hyl -2-propanol		$\text{C}_{10}\text{H}_{14}\text{O}$	100-86-7	150.217	nd	24	215	0.9787 ¹⁶	1.5173 ¹⁶	
8933	<i>N</i> -(Phenyl met hyl)- β -puri n-6-ami ne		$\text{C}_{12}\text{H}_{13}\text{N}_5$	1214-39-7	225.249			232.8			
8934	4-Phenyl morphol i ne		$\text{C}_{11}\text{H}_{13}\text{NO}$	92-53-5	163.216	cry (al -et h)	58.3				i β ; Et OH; vs et h
8935	<i>N</i> -Phenyl -1-napht hal enami ne	1-Napht hyl phenyl ami ne	$\text{C}_{16}\text{H}_{17}\text{N}$	90-30-2	219.281		61				sl H_2O , ct c; s Et OH, et h, bz, HOAc
8936	<i>N</i> -Phenyl -2-napht hal enami ne	<i>N</i> -Phenyl - β -napht hyl ami ne	$\text{C}_{16}\text{H}_{15}\text{N}$	135-88-6	219.281		108	395.5			i H_2O ; s Et OH, et h, bz, HOAc; sl chl
8937	1-Phenyl napht hal ene		$\text{C}_{16}\text{H}_{12}$	605-02-7	204.266	cry	45	334	1.096 ²⁰	1.6664 ²⁰	i H_2O ; vs Et OH, et h, bz, HOAc; s ct c
8938	2-Phenyl napht hal ene		$\text{C}_{16}\text{H}_{12}$	612-94-2	204.266	lf (al)	103.5	345.5	1.2180		s Et OH, bz, chl, HOAc; vs et h
8939	1-Phenyl -1-oct anone		$\text{C}_{14}\text{H}_{20}\text{O}$	1674-37-9	204.308		22.8	285; 164 ¹⁵	0.9360 ³⁰		s Et OH, et h
8940	Phenyl oxl rane	St yrene-7,8-oxi de	$\text{C}_9\text{H}_8\text{O}$	96-09-3	120.149	col orless li q	-35.6	194.1	1.0490	1.5342 ²⁰	i H_2O ; s Et OH, et h, chl
8941	3-Phenyl oxl ranecarboxyl i c aci d, et hyl est er		$\text{C}_{11}\text{H}_{12}\text{O}_3$	121-39-1	192.211			136 ⁵			
8942	5-Phenyl -2,4-pent adi enal		$\text{C}_{10}\text{H}_{10}\text{O}$	13466-40-5	158.196		42.5	160 ³ ; 133 ¹⁰			i H_2O ; msc Et OH, bz; vs et h
8943	1-Phenyl -1,4-pent anedi one		$\text{C}_{10}\text{H}_{12}\text{O}_2$	583-05-1	176.212	ye oi l		162		1.5250 ³⁰	vs ace
8944	1-Phenyl -1-pent anol		$\text{C}_{10}\text{H}_{12}\text{O}$	583-03-9	164.244			141 ²⁵ ; 102 ³	0.9655 ²⁰	1.4086 ²⁵	vs ace, et h, Et OH
8945	1-Phenyl -1-pent anone		$\text{C}_{10}\text{H}_{14}\text{O}$	1009-14-9	162.228	li q	-9.4	245	0.986	1.5158 ²⁰	i H_2O ; vs Et OH, et h; sl ct c
8946	1-Phenyl -1-pent en-3-one		$\text{C}_{10}\text{H}_{12}\text{O}$	3152-68-9	160.212	lf (li g)	38.5	142	0.8697 ²⁰	1.5684 ²⁰	sl H_2O , chl; vs Et OH, et h, bz
8947	Phenyl phosphi ne	Monophenyl phosphi ne	$\text{C}_6\text{H}_5\text{P}$	638-21-1	110.094				160.5	1.001 ¹⁵	1.5796 ²⁰
8948	Phenyl phosphi ni c aci d	Benzenephosphi ni c aci d	$\text{C}_6\text{H}_5\text{OP}$	1779-48-2	142.093		83.8				s H_2O ; vs Et OH; sl et h, chl
8949	Phenyl phosphoni c aci d	Benzenephosphoni c aci d	$\text{C}_6\text{H}_5\text{O}_2\text{P}$	1571-33-1	158.092	lf (w)	160				vs H_2O ; s Et OH, et h, ace; i bz
8950	Phenyl phosphoni c di chl ori de		$\text{C}_6\text{H}_4\text{Cl}_2\text{OP}$	824-72-6	194.983		1	258	1.197 ²⁵	1.5581 ²⁵	sl DMSO
8951	Phenyl phosphonot hi oi c di chl ori de	Di chl orophenyl phosphi ne sul fide	$\text{C}_6\text{H}_4\text{Cl}_2\text{P}_2\text{S}$	3497-00-5	211.049			205 ¹³⁰	1.376 ¹³		
8952	Phenyl phosphonous di chl ori de	Di chl orophenyl phosphi ne	$\text{C}_6\text{H}_4\text{Cl}_2\text{P}$	644-97-3	178.984	li q	-51	225; 142	1.356 ²⁰	1.6030 ²⁰	vs bz
8953	Phenyl phosphorodi chl ori de	Phenyl di chl orophosphat e	$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2\text{P}$	770-12-7	210.983	hyg li q		242; 100	1.412 ²⁰	1.5230 ²⁰	
8954	1-Phenyl pi perazi ne		$\text{C}_{10}\text{H}_{14}\text{N}_2$	92-54-6	162.231	pa ye oi l		286.5; 167	1.0621 ²⁰	1.5875 ²⁰	i H_2O ; msc Et OH, et h; s chl
8955	1-Phenyl pi peri di ne		$\text{C}_{11}\text{H}_{15}\text{N}$	4096-20-2	161.244		4.7	258	0.9944 ²⁵	1.5598 ²⁵	vs Et OH, et h, bz, chl
8956	4-Phenyl pi peri di ne		$\text{C}_{11}\text{H}_{15}\text{N}$	771-99-3	161.244		60.5	257	0.9996 ¹⁶		s chl
8957	<i>N</i> -Phenyl propanami de		$\text{C}_9\text{H}_{11}\text{NO}$	620-71-3	149.189	pl (et h, al, bz)	105.5	222.2	1.175		sl H_2O ; vs Et OH, et h
8958	1-Phenyl -1,2-propanedi one		$\text{C}_9\text{H}_{10}\text{O}_2$	579-07-7	148.159	ye oi l	<20	222; 102	1.1006 ²⁰	1.537 ¹⁰	s H_2O , Et OH, et h
8959	1-Phenyl -1,2-propanedi one, 2-oxi me		$\text{C}_9\text{H}_{10}\text{NO}_2$	119-51-7	163.173	wh nd (w)	115				
8960	Phenyl propanoat e		$\text{C}_9\text{H}_{10}\text{O}_2$	637-27-4	150.174	pr	20	211	1.0436 ²⁵	1.4980 ²⁰	i H_2O ; vs Et OH, et h; s bz
8961	2-Phenyl -1-propanol		$\text{C}_9\text{H}_{12}\text{O}$	1123-85-9	136.190			121 ²⁶ ; 105 ¹¹	0.975 ²⁵	1.5582 ²	i H_2O ; s Et OH
8962	1-Phenyl -2-propanol		$\text{C}_9\text{H}_{12}\text{O}$	698-87-3	136.190			125 ²⁵ ; 120 ²⁰	0.991 ²⁰	1.5190 ²⁰	
8963	Phenyl propanol ami ne hydrochl ori de		$\text{C}_9\text{H}_{11}\text{ClNO}$	154-41-6	187.666		194				vs H_2O ; s Et OH; i et h, bz, chl
8964	1-Phenyl -1-propanone	Propi ophenone	$\text{C}_9\text{H}_{10}\text{O}$	93-55-0	134.174		18.6	217.5	1.0096 ²⁰	1.5269 ²⁰	i H_2O ; s Et OH, et h, chl
8965	1-Phenyl -2-propanone	Phenyl acet one	$\text{C}_9\text{H}_{10}\text{O}$	103-79-7	134.174	li q	-15	216.5	1.0157	1.5168 ²⁰	i H_2O ; vs Et OH, et h; msc bz, xyl; s chl
8966	<i>ci s</i> -3-Phenyl -2-propene ni t ri le		$\text{C}_9\text{H}_7\text{N}$	24840-05-9	129.159	li q	-4.4	249; 139	1.0289 ²⁰	1.5843 ²⁰	i H_2O ; s Et OH; vs bz
8967	<i>t rans</i> -3-Phenyl -2-propene ni t ri le		$\text{C}_9\text{H}_7\text{N}$	1885-38-7	129.159		22	263.8	1.0304 ²⁰	1.6013 ²⁰	i H_2O ; s Et OH, ace, ct c



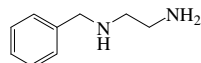
N-(Phenylmethylene)metanamine



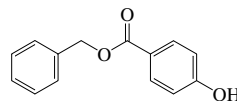
2-(Phenylmethylene)octanal



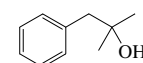
3-(Phenylmethylene)-2-pentanone



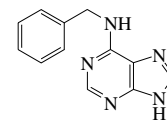
N-(Phenylmethyl)-1,2-ethanediamine



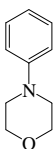
Phenylmethoxy-4-hydroxybenzoate



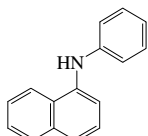
1-Phenyl-2-methyl-2-propanol



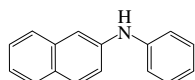
N-(Phenylmethyl)-9-purin-6-amine



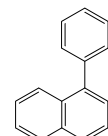
4-Phenylmorpholine



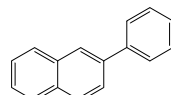
N-Phenyl-1-naphthalenamine



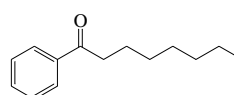
N-Phenyl-2-naphthalenamine



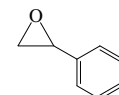
1-Phenyl-naphthalene



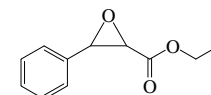
2-Phenyl-naphthalene



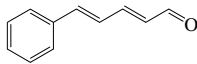
1-Phenyl-1-octanone



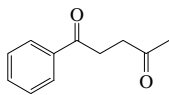
Phenyl oxirane



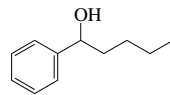
3-Phenyl oxirane-2-carboxylate ethyl ester



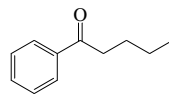
5-Phenyl-2,4-pentadienal



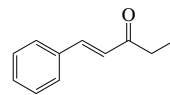
1-Phenyl-1,4-pentanedione



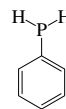
1-Phenyl-1-pentanol



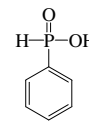
1-Phenyl-1-pentanone



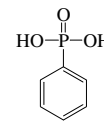
1-Phenyl-1-penten-3-one



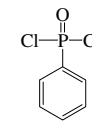
Phenylphosphine



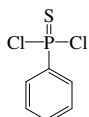
Phenylphosphinic acid



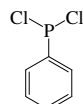
Phenylphosphonic acid



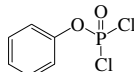
Phenylphosphonic dichloride



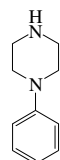
Phenylphosphonic dichloride



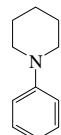
Phenylphosphonic dichloride



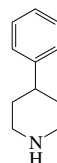
Phenylphosphorodichloride



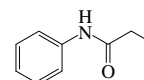
1-Phenylpiperazine



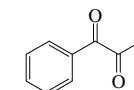
1-Phenylpiperidine



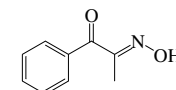
4-Phenylpiperidine



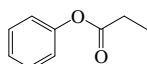
N-Phenylpropanamide



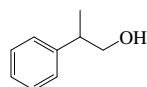
1-Phenyl-1,2-propanedione



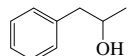
1-Phenyl-1,2-propanedione-2-oxime



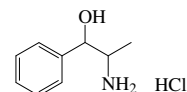
Phenyl propanoate



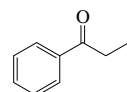
2-Phenyl-1-propanol



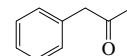
1-Phenyl-2-propanol



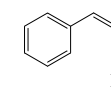
Phenylpropanamine hydrochloride



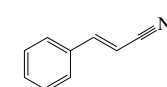
1-Phenyl-1-propanone



1-Phenyl-2-propanone

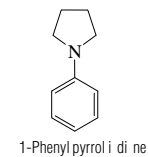
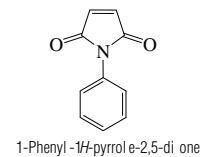
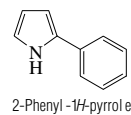
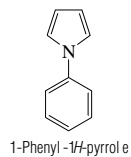
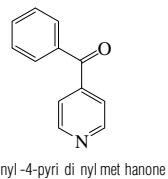
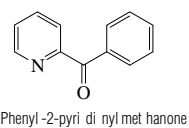
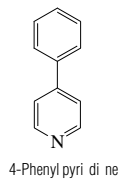
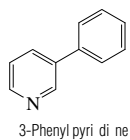
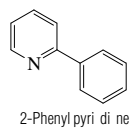
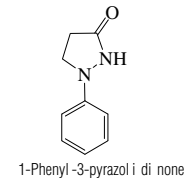
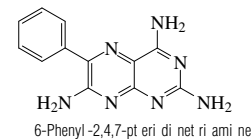
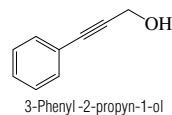
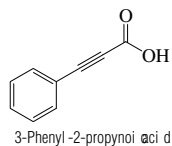
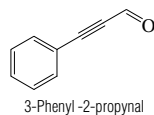
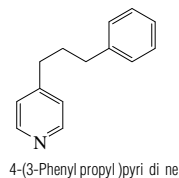
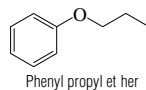
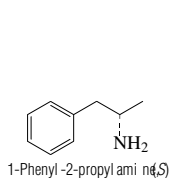
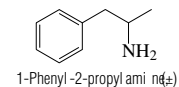
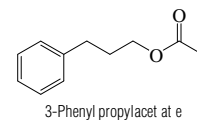
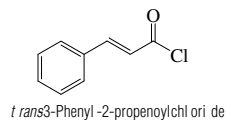
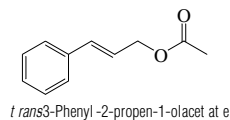
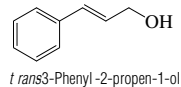
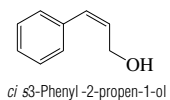
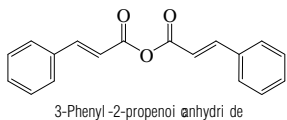


cis-3-Phenyl-2-propene

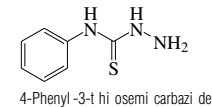
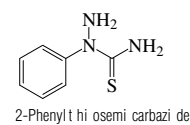
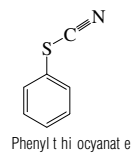
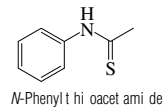
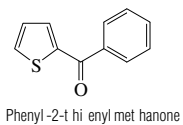
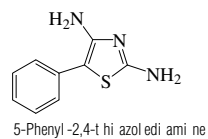
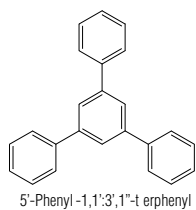
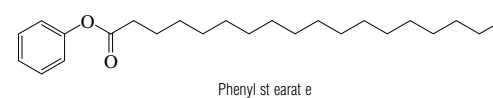
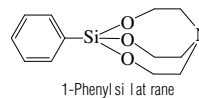
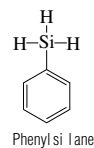
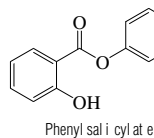
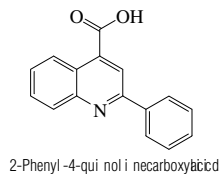
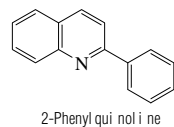
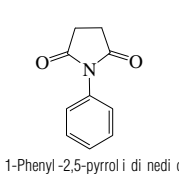


trans-3-Phenyl-2-propene

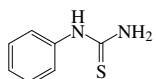
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
8968	3-Phenyl-2-propenoic anhydride	Cinnamic anhydride	C ₁₈ H ₁₄ O ₃	538-56-7	278.302	nd (bz or al) pt (al)	136				vs bz
8969	<i>cis</i> -3-Phenyl-2-propen-1-ol		C ₉ H ₁₀ O	4510-34-3	134.174	wh nd (et h-pet h)	34	257.5	1.0440 ²⁰	1.5819 ²⁰	vs et h, Et OH
8970	<i>trans</i> -3-Phenyl-2-propen-1-ol		C ₉ H ₁₀ O	4407-36-7	134.174	wh nd (et h-pet h)	34	257.5	1.0440 ²⁰	1.5819 ²⁰	sl H ₂ O, chl; vs Et OH, et h
8971	<i>trans</i> -3-Phenyl-2-propen-1-ol acetate	Cinnamic acetate	C ₁₁ H ₁₂ O ₂	21040-45-9	176.212			265; 145 ¹⁵	1.0567 ²⁰	1.5425 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl
8972	<i>trans</i> -3-Phenyl-2-propenoic chloride	Cinnamoyl chloride	C ₉ H ₇ ClO	17082-09-6	166.604	ye cry	37.5	257.5	1.1617 ⁵	1.6144 ²	i H ₂ O; s Et OH, ct c, li g
8973	3-Phenylpropyl acetate	Benzeneopropanol, acetate	C ₁₁ H ₁₄ O ₂	122-72-5	178.228	col li q	-40	69			
8974	1-Phenyl-2-propylamine, (±)	Amphetamine	C ₉ H ₁₁ N	300-62-9	135.206	oi l		203	0.9306	1.518 ²⁶	sl H ₂ O, et h; s chl, Et OH
8975	1-Phenyl-2-propylamine, (S)	Dexamphetamine	C ₉ H ₁₁ N	51-64-9	135.206	oi l	27.5	203.5; 80	0.949 ¹⁵	1.4704 ²⁰	sl H ₂ O; s Et OH, et h
8976	Phenylpropyl ether	Propoxybenzene	C ₉ H ₁₂ O	622-85-5	136.190	li q	-27	189.9	0.9474	1.5014 ²⁰	s Et OH, et h
8977	4-(3-Phenylpropyl)pyridine		C ₁₄ H ₁₅ N	2057-49-0	197.276			322; 150 ⁵	1.024 ²⁵	1.5616 ²⁵	vs bz, et h, py, Et OH
8978	3-Phenyl-2-propynal		C ₉ H ₈ O	2579-22-8	130.143			127 ²⁶ , 104 ¹¹	1.0622 ²⁰	1.6079 ¹²	
8979	3-Phenyl-2-propynoic acid	Phenylacetylenecarboxylic acid	C ₉ H ₆ O ₂	637-44-5	146.143	nd (w)	137.5		1.28 ²⁰		sl H ₂ O; vs Et OH, et h
8980	3-Phenyl-2-propyn-1-ol		C ₉ H ₈ O	1504-58-1	132.159			137 ¹⁵	1.078 ²⁰	1.5873 ²⁸	s et h, ace, bz
8981	6-Phenyl-2,4,7-pyridinetrine	Triamterene	C ₁₂ H ₁₁ N ₃	396-01-0	253.262	ye pl (BuOH)	316				i et h; sl Et OH, chl
8982	1-Phenyl-3-pyrazolidine		C ₉ H ₁₀ N ₂ O	92-43-3	162.187			126			i et h, li g
8983	2-Phenylpyridine		C ₉ H ₇ N	1008-89-5	155.196			271	1.0833 ²⁵	1.6210 ²⁰	sl H ₂ O; msc Et OH, et h
8984	3-Phenylpyridine		C ₉ H ₇ N	1008-88-4	155.196	pa ye oi l	164	272		1.612 ²⁸	sl H ₂ O; s Et OH, et h
8985	4-Phenylpyridine		C ₉ H ₇ N	939-23-1	155.196	pl (w)	77.5	281			s H ₂ O, Et OH, et h
8986	Phenyl-2-pyridinylmethanone		C ₁₂ H ₉ NO	91-02-1	183.205			42	1.1556 ²⁰		s chl
8987	Phenyl-4-pyridinylmethanone		C ₁₂ H ₉ NO	14548-46-0	183.205	nd (pet h), pl (w)	72	315; 170 ¹⁰			sl H ₂ O; s Et OH, et h, bz
8988	1-Phenyl-1H-pyrrole		C ₁₀ H ₉ N	635-90-5	143.185	pl (sub), red in air	62	234			i H ₂ O; s Et OH, et h, ace, bz; vs pet h
8989	2-Phenyl-1H-pyrrole		C ₁₀ H ₉ N	3042-22-6	143.185	pl (al, sub)	129	272			i H ₂ O; vs Et OH, et h, bz, chl; sl li g
8990	1-Phenyl-1H-pyrrole-2,5-dione	<i>N</i> -Phenylmaleimide	C ₁₀ H ₇ NO ₂	941-69-5	173.169	ye nd (bz-li g)	90.5	162			vs bz, et h, Et OH
8991	1-Phenylpyrrolidine		C ₁₀ H ₁₃ N	4096-21-3	147.217		11	119 ¹² , 102 ⁵	1.018 ²⁰	1.5813 ²⁰	s et h
8992	1-Phenyl-2,5-pyrrolidinedione	Succinimide	C ₁₀ H ₉ NO ₂	83-25-0	175.184	mcl pr or nd (w, al)	156	400	1.356 ²⁵		i H ₂ O; s Et OH, et h
8993	2-Phenylquinoline		C ₁₅ H ₁₁ N	612-96-4	205.255	nd (di l al)	86	363; 194			sl H ₂ O, pet h; vs Et OH, et h, ace, bz
8994	2-Phenyl-4-quinolinecarboxylic acid	Cinchophen	C ₁₆ H ₁₁ NO ₂	132-60-5	249.264	nd	214.5				i H ₂ O; s Et OH, et h, al k; sl ace, bz
8995	Phenylsilylate		C ₁₃ H ₁₀ O ₃	118-55-8	214.216		43	173 ¹²	1.2614 ³⁰		i H ₂ O; vs Et OH, ace, bz; s et h, HOAc
8996	Phenylsilane		C ₉ H ₉ Si	694-53-1	108.214			119	0.8681 ⁰	1.5125 ²⁰	i H ₂ O
8997	1-Phenylsilatrane		C ₉ H ₁₇ NO ₃ Si	2097-19-0	251.354	pr or nd (ace)	209				
8998	Phenylstearate		C ₂₄ H ₄₀ O ₂	637-55-8	360.574		52	267 ¹⁵			i H ₂ O; s Et OH, et h
8999	5-Phenyl-1,1',3',1''-terphenyl		C ₂₁ H ₁₈	612-71-5	306.400	ort h nd (al or HOAc)	176	462	1.199 ³⁰		i H ₂ O; s Et OH, et h, HOAc; vs bz; sl chl
9000	5-Phenyl-2,4-thiazolidine	Amphenazole	C ₉ H ₇ N ₂ S	490-55-1	191.252	fl (di l al) br in air	163 dec				
9001	Phenyl-2-thienylmethanone		C ₁₁ H ₉ OS	135-00-2	188.246	nd (di l al)	56.5	300	1.1890	1.6181 ⁵⁴	i H ₂ O; s Et OH, et h
9002	<i>N</i> -Phenylthioacetamide	Thioacetanilide	C ₈ H ₉ NS	637-53-6	151.229	nd (w)	75.5	dec			
9003	Phenylthiocyanate		C ₇ H ₅ NS	5285-87-0	135.187			232.5	1.153 ¹⁸		i H ₂ O; s Et OH, et h
9004	2-Phenylthiosemicarbazide	2-Phenylhydrazinecarbothiouamide	C ₉ H ₉ N ₃ SC	645-48-7	167.231	pr (al)	200 dec				
9005	4-Phenyl-3-thiosemicarbazide	<i>N</i> -Phenylhydrazinecarbothiouamide	C ₉ H ₉ N ₃ S	5351-69-9	167.231	pl (al)	140 dec				i Et OH, li g; sl bz



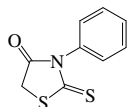
3-473



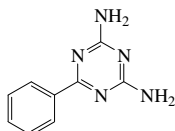
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9006	Phenyl thiourea		C ₆ H ₅ N ₂ S	103-85-5	152.217	nd (w), pr (al)	154				sl H ₂ O; s Et OH, NaOH
9007	3-Phenyl-2-thio-4-azolo[3,4-b]pyridine	3-Phenylrhodanine	C ₉ H ₇ NOS ₂	1457-46-1	209.288	ye pr (HOAc) nd or pr (al)	194.5				i H ₂ O; sl Et OH, et h; s ace, chl, HOAc
9008	6-Phenyl-1,3,5-triazine-2,4-diamine	Benzoguanamine	C ₉ H ₇ N ₃	91-76-9	187.201	nd, pl (al)	226.5				s Et OH, et h; sl t f a
9009	N-Phenyl-1,3,5-triazine-2,4-diamine	Amanozine	C ₉ H ₇ N ₃	537-17-7	187.201	cry (di ox, 50% al)	235.5				
9010	4-Phenyl-1,2,4-triazole-3,5-dione		C ₈ H ₆ N ₂ O ₂	15988-11-1	177.161		205.5				
9011	Phenyltrimethylammonium iodide		C ₉ H ₁₄ IN	98-04-4	263.118	lf (al)	224				vs H ₂ O; s Et OH, HOAc; sl ace; i chl
9012	Phenyl(trimethylammonium)azene		C ₉ H ₁₄ N ₂	981-18-0	348.440		111 dec				
9013	Phenyl urea		C ₈ H ₉ N ₂ O	64-10-8	136.151	mcl pr (w, al)	147	238	1.302 ²⁵		sl H ₂ O, et h, DMSO; s Et OH, AcOEt
9014	trans-(2-Phenylvinyl)-1,3-benzenediol	Pinosylvin	C ₁₀ H ₁₂ O ₂	22139-77-1	212.244	nd (HOAc)	156				vs ace, bz, chl, HOAc
9015	Phenylvinylether		C ₉ H ₈ O	766-94-9	120.149			155.5	0.9770 ²⁰	1.5224 ²⁰	i H ₂ O; vs et h
9016	Phenylamine	5,5-Diphenyl-2,4-dimethyl-2,4-diazolinediimine	C ₁₁ H ₁₂ N ₂ O ₂	57-41-0	252.268	nd (al)	286				i H ₂ O; s Et OH, ace; sl et h, bz
9017	Phloridine		C ₁₀ H ₁₄ O ₅	60-82-2	274.269	nd (di l al), cry (ace)	263 dec				sl H ₂ O, chl; msc Et OH, bz; i et h; s ace
9018	Phorate		C ₄ H ₇ O ₂ PS ₃	298-02-2	260.378		<-15	119 ^{0.5}	1.16 ²⁵		
9019	Phorbol		C ₂₆ H ₂₈ O ₆	17673-25-5	364.432	cry (Et OH)	250 dec				s H ₂ O, ace
9020	Phorone		C ₈ H ₁₄ O	504-20-1	138.206	ye-grn pr	28	197.5	0.8850 ²⁰	1.4998 ²⁰	sl H ₂ O; s Et OH, et h, ace, ct c
9021	Phosalone		C ₇ H ₁₅ ClNQP S ₂	2310-17-0	367.808		46				
9022	Phosfolan		C ₆ H ₁₁ N ₂ O ₂ PS ₂	947-02-4	255.295		36.5	117 ^{0.001}			vs H ₂ O, bz, ace; sl et h; s hx
9023	Phosmet		C ₇ H ₁₂ N ₂ O ₂ PS ₂	732-11-6	317.321		72	dec			
9024	Phosphamidon		C ₁₀ H ₁₉ ClNQP	13171-21-6	299.689	oi l	-45	162 ²⁵	1.2132 ²⁵	1.4718 ²⁵	msc H ₂ O; s hx
9025	N-Phospho-L-arginine		C ₁₀ H ₁₉ N ₅ O ₇ P	1189-11-3	254.181	cry (ace aq)	177				
9026	O-Phosphoryl ethanolamine	Ethanolaminophosphate	C ₄ H ₁₁ NO ₄ P	1071-23-4	141.063	cry (Et OH aq)	242				
9027	O-Phosphoserine		C ₄ H ₉ NO ₆ P	407-41-0	185.073	cry	166 dec				
9028	Phthalazine	2,3-Benzodiazine	C ₈ H ₆ N ₂	253-52-1	130.147		90.5	316			s H ₂ O, Et OH, bz; sl et h; i li g
9029	Phthalic acid	1,2-Benzenedicarboxylic acid	C ₈ H ₆ O ₄	88-99-3	166.132	pl (w)	230 dec	dec	2.18 ⁹¹		sl H ₂ O, et h; i chl; s Et OH
9030	Phthalic anhydride		C ₈ H ₆ O ₃	85-44-9	148.116	wh nd (al, bz)	130.8	295	1.527 ⁷		sl H ₂ O, et h; s Et OH, ace, bz
9031	29H,31H-Phthalocyanine		C ₁₈ H ₁₈ N ₈	574-93-6	514.539	grsh-bl mcl (qui nol i ne)		sub 550			i H ₂ O, Et OH, et h; s PhNH ₂
9032	Phthalylsulfathiazole		C ₁₇ H ₁₂ N ₃ O ₅ S ₂	85-73-4	403.432		273				i H ₂ O, et h, chl; sl Et OH; s aci d, al k
9033	Physostigmine		C ₁₉ H ₂₁ N ₃ O ₂	57-47-6	275.347	ort h pr (et h, bz)	105.5				sl H ₂ O; s Et OH, et h, bz, chl
9034	Phytol	3,7,11,15-Tetramethyl-2-hexadecanol, [R*,R*,R*-(E)]	C ₂₀ H ₄₀ O	150-86-7	296.531	oi ly li q		203	0.8497 ²⁵	1.4595 ²⁵	
9035	Phytol	Benzo[a]chrysenes	C ₂₂ H ₁₄	213-46-7	278.346	lf, pl (xyl, py, sub)	368	519			i H ₂ O; sl Et OH, bz, chl; s con sul f
9036	Picrotoxinic acid		C ₁₀ H ₈ N ₂ O ₅	550-74-3	264.195	ye nd (al)	116	dec			sl H ₂ O; s Et OH, et h, MeOH
9037	Picrophyllin		C ₂₂ H ₂₂ O ₆	477-47-4	414.405	col nd (al, bz)	228				vs ace, bz, et h, Et OH
9038	Picrotin		C ₃₁ H ₃₄ O ₁₃	124-87-8	602.583	ort h lf	203.5				vs py, Et OH
9039	Pilocarpine		C ₁₁ H ₁₆ N ₂ O ₂	92-13-7	208.257	nd	34	260 ⁵			s H ₂ O, Et OH; sl et h, bz; vs chl; i pet h
9040	Pilocarpine, monohydrochloride		C ₁₁ H ₁₇ ClN ₂ O ₂	54-71-7	244.718	hyg cry	204.5				vs H ₂ O, Et OH
9041	Pilocarpine, mononitrate		C ₁₁ H ₁₆ N ₃ O ₅	148-72-1	271.270	wh pow or cry (al)	178				vs H ₂ O
9042	Pilosine		C ₁₀ H ₁₆ N ₂ O ₃	13640-28-3	286.325	nd (al)	179				



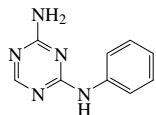
Phenyl thiourea



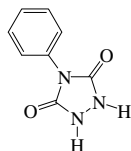
3-Phenyl-2-thioxo-1,3-diazol-4-ene



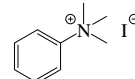
Phenyl-1,3,5-triazine-2,4-diamine



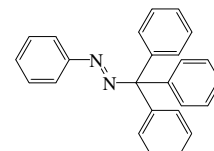
Phenyl-1,3,5-triazine-2-amino-4-ene



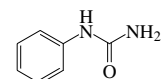
Phenyl-1,2,4-triazole-3,5-dione



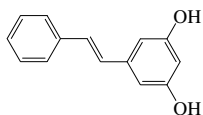
Phenyl trimethylammonium iodide



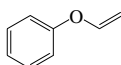
Phenyl (tri-phenylmethyl) diazene



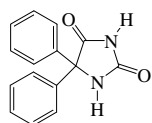
Phenyl urea



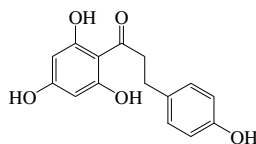
trans-5-(2-Phenylvinyl)-1,3-benzenediol



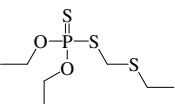
Phenyl vinyl ether



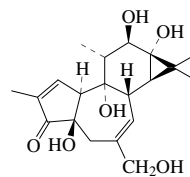
Phenyl oxindole



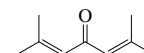
Phloretin



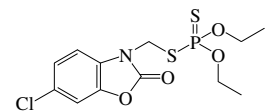
Phorate



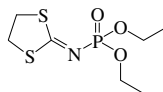
Phorbol



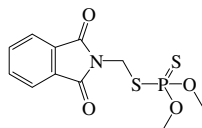
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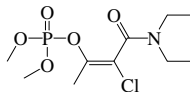
Phosalone



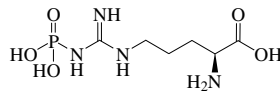
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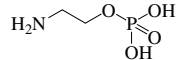
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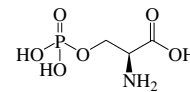
Phosphamidon



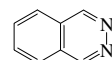
M-Phospho-L-arginine



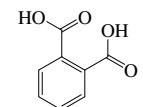
O-Phosphoryl ethanolamine



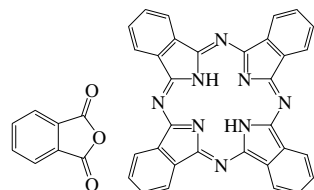
O-Phosphoserine



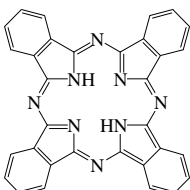
Phtalazine



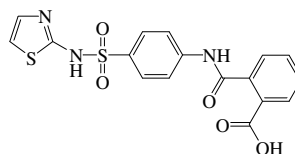
Phtalate



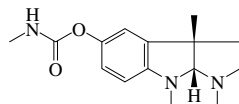
Phtalimide



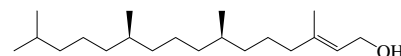
29H,31H-Phtalocyanine



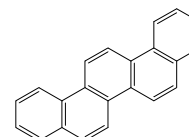
Phtalylsulfathiazole



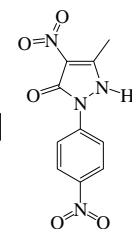
Physostigmine



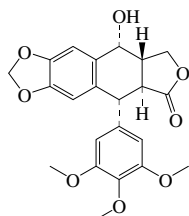
Phytol



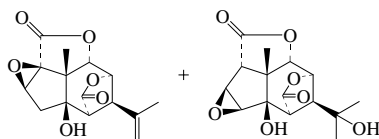
Pincene



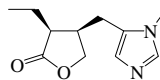
Picrotin



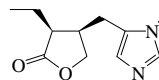
Picrophyllin



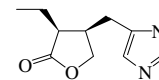
Picrotin



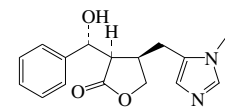
Pilocarpine



Pilocarpine monohydrochloride

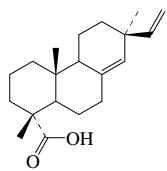


Pilocarpine nononitrate



Pilocaine

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9043	Pi mari c aci d	Dext ropi mari c aci d	$_{20}H_{30}O_2$	127-27-5	302.451	ort h (ace) pr (al)	218.5	282 ¹⁸			vs et h, py, Et OH
9044	Pi nane	2,6,6-Tri met hyl bi cycl o[3.1.1]hept ane	$H_{10}C_7$	473-55-2	138.250	oi l	-53	169	0.8467 ⁷	1.4605 ²¹	
9045	<i>t rans</i> -2-Pi nanol	Pi nene hydrat e	$_{10}H_{18}O$	35408-04-9	154.249		60	81 ¹⁰			
9046	Pi ndol ol		$_{10}H_{20}N_2O_2$	13523-86-9	248.321	cry (Et OH)	172				
9047	α -Pi nene	2-Pi nene	$_{16}H_{16}$	80-56-8	136.234	li q	-64	156.2	0.8539 ⁹	1.4632 ²⁵	i H ₂ O; msc Et OH, et h, chl
9048	β -Pi nene	Nopi nene	$_{16}H_{16}$	127-91-3	136.234	li q	-61.5	166	0.860 ⁹	1.4768 ²⁵	i H ₂ O; s bz, Et OH, et h, chl
9049	Pi perazi ne	Di et hyl enedi ami ne	$_{4}H_{10}N_2$	110-85-0	86.135	hyg pl or lf (al)	106	146		1.44 ⁸	vs H ₂ O; s Et OH, chl; i et h
9050	1-Pi perazi necarboxal dehyde		$_{5}H_{10}N_2O$	7755-92-2	114.145			95 ^{9,5}		1.5094 ²⁰	
9051	1,4-Pi perazi nedi et hanol		$_{8}H_{16}N_2O_2$	122-96-3	174.241		135	217 ³⁰			
9052	Pi perazi ne di hydrochl ori de	Di et hyl enedi ami ne di hydrochl ori de	$_{10}H_{16}Cl_2N_2$	142-64-3	159.057						sl H ₂ O; i Et OH
9053	2,5-Pi perazi nedi one		$_{10}H_{16}N_2O_2$	106-57-0	114.103	t ab or pl (w)	312 dec	sub 260			sl H ₂ O, Et OH; s HCl
9054	1,4-Pi perazi nedi propanami ne	1,4-Bi s(3-ami nopropyl)pi perazi ne	$_{10}H_{24}N_2$	7209-38-3	200.325		15	151 ²	0.973 ²⁵	1.5015 ²⁰	
9055	1-Pi perazi neet hanami ne	1-(2-Ami noet hyl)pi perazi ne	$_{8}H_{16}N_2$	140-31-8	129.203			220	0.985 ²⁵	1.4983 ²⁰	
9056	1-Pi perazi neet hanol		$_{8}H_{16}N_2O$	103-76-4	130.187			246	1.061 ²⁵	1.5065 ²⁰	
9057	1-Pi peri di nami ne		$_{5}H_{10}N_2$	2213-43-6	100.162			147	0.928 ²⁵	1.4750 ²⁰	
9058	Pi peri di ne	Azacycl ohexane	$_{5}H_{10}N$	110-89-4	85.148	li q	-11.02	106.22	0.860 ⁹	1.4530 ²⁰	msc H ₂ O, Et OH; s et h, ace, bz, chl
9059	1-Pi peri di necarboxal dehyde		$_{5}H_{10}NO$	2591-86-8	113.157	li q	-30.8	222.5	1.015 ⁸	1.4805 ²⁵	msc H ₂ O, Et OH, et h, bz, chl, li g
9060	4-Pi peri di necarboxami de		$_{6}H_{12}N_2O$	39546-32-2	128.171			138.5			
9061	2-Pi peri di necarboxyl i c aci d	<i>L</i> -Pi pecol i c aci d	$_{6}H_{12}NO_2$	3105-95-1	129.157	nd (MeOH/et h)	260				
9062	3-Pi peri di necarboxyl i c aci d	Ni pecot i c aci d	$_{6}H_{11}NO_2$	498-95-3	129.157		261 dec				vs H ₂ O
9063	4-Pi peri di necarboxyl i c aci d	Isoni pecot i c aci d	$_{6}H_{11}NO_2$	498-94-2	129.157	nd	336				
9064	1-Pi peri di neet hanol		$_{7}H_{14}NO$	3040-44-6	129.200		17.9	202; 90 ¹²	0.9703 ²⁵	1.4749 ²⁰	msc H ₂ O; vs Et OH
9065	2-Pi peri di neet hanol	2-(2-Hydroxyet hyl)pi peri di ne	$_{7}H_{15}NOC$	1484-84-0	129.200		69	202; 145 ³⁶	1.01 ²⁷		vs H ₂ O
9066	4-Pi peri di neet hanol	4-(2-Hydroxyet hyl)pi peri di ne	$_{7}H_{15}NOC$	622-26-4	129.200	syr	132.5	227.5	1.0059 ¹⁵	1.4907 ²⁰	vs H ₂ O, et h, Et OH
9067	Pi peri di ne, hydrochl ori de	Pi peri di ni um chl ori de	$_{5}H_{12}ClNC$	6091-44-7	121.609			142 dec			vs H ₂ O, chl
9068	4-Pi peri di nemet hanami ne	4-(Ami nomet hyl)pi peri di ne	$_{6}H_{14}N_2C$	7144-05-0	114.188		25	200; 31 ¹⁰		1.4900 ²⁰	
9069	2-Pi peri di nemet hanol		$_{6}H_{14}NO$	3433-37-2	115.173		69	104 ¹⁰ , 80 ¹			sl chl
9070	3-Pi peri di nemet hanol		$_{6}H_{14}NO$	4606-65-9	115.173		61	106 ^{3,5}	1.0263 ²⁰	1.4964 ²⁰	sl chl
9071	1-Pi peri di nepropaneni t ri le		$_{8}H_{14}N_2$	3088-41-3	138.210		-6.8	145 ⁵⁰	0.9403 ²⁵	1.4676 ²⁵	
9072	2-Pi peri di none		$_{8}H_{16}NO$	675-20-7	99.131	hyg	39.5	256			vs H ₂ O, Et OH, et h; s di l aci d; i con al k
9073	2-(1-Pi peri di nyl met hyl) cycl ohexanone	Pi mecl one	$_{12}H_{21}NO$	534-84-9	195.301			119 ¹⁴			
9074	1-(2-Pi peri di nyl)-2-propanone, (\pm)		$_{8}H_{16}NO$	539-00-4	141.211	oi l		9 [#]	0.9624 ²⁰	1.4683 ²⁰	vs Et OH, chl
9075	3-(2-Pi peri di nyl)pyri di ne, (\pm)	Anabasi ne	$_{10}H_{14}N_2$	494-52-0	162.231	li q	9	276; 14 ⁶	1.0455 ²⁰	1.5430 ²⁰	msc H ₂ O; s Et OH, et h, bz
9076	Pi peri ne		$_{17}H_{19}NO_3$	94-62-2	285.338	pr (AcOEt) pl or mcl pr (al), cry	131.5				i H ₂ O; s Et OH, bz, py; sl et h; vs chl
9077	Pi peronyl but oxi de		$_{19}H_{30}O_5$	51-03-6	338.438			180 ¹	1.05 ²⁵		
9078	Pi peronyl sulf oxi de	Isosaf role oct yl sulf oxi de	$_{18}H_{28}O_3S$	120-62-7	324.478	ye-br li q		dec		1.53 ⁸	sl H ₂ O; mi sc os
9079	Pi pobroman		$_{10}H_{16}Br_2N_2O_2$	54-91-1	356.054		106				
9080	Pi prot al	Tropi t al	$_{24}H_{30}O_3$	5281-13-0	456.570	li q		215 ⁹⁴			
9081	Pi ri mi carb		$_{11}H_{18}N_4O_2$	23103-98-2	238.287		90.5				
9082	Pi ri mi phos-et hyl		$_{13}H_{24}N_3O_3PS$	23505-41-1	333.387			dec >130	1.14 ²⁰		
9083	Pi ri mi phos-met hyl		$_{11}H_{20}N_3O_3PS$	29232-93-7	305.334		15	dec	1.17 ²⁰		



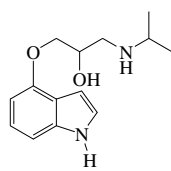
Pi mari aci d



Pi nane



trans-2-Pi nanol



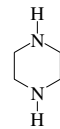
Pi ndolol



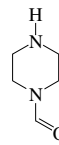
α -Pi nene



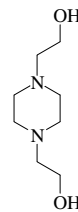
β -Pi nene



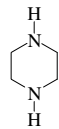
Pi perazi ne



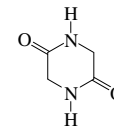
1-Pi perazi necarboxaldehyde



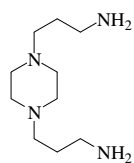
1,4-Pi perazi nedi et hanol



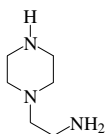
Pi perazi nedi hydrochl ori de 2HCl



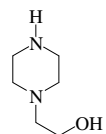
2,5-Pi perazi nedi one



1,4-Pi perazi nedi propanami ne



1-Pi perazi neet hanami ne



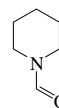
1-Pi perazi neet hanol



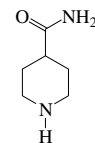
1-Pi peri di nami ne



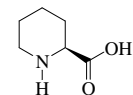
Pi peri di ne



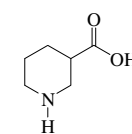
1-Pi peri di necarboxaldehyde



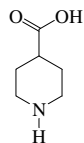
4-Pi peri di necarboxami de



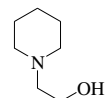
2-Pi peri di necarboxybi cid(S)



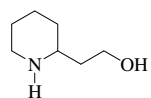
3-Pi peri di necarboxybi cid



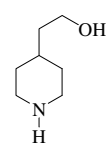
4-Pi peri di necarboxybi cid



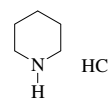
1-Pi peri di neet hanol



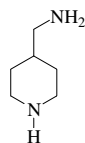
2-Pi peri di neet hanol



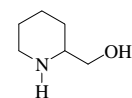
4-Pi peri di neet hanol



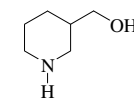
Pi peri di hydrochl ori de HCl



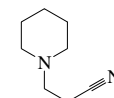
4-Pi peri di nemet hanami ne



2-Pi peri di nemet hanol



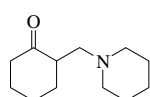
3-Pi peri di nemet hanol



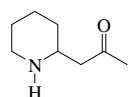
1-Pi peri di nepropaneni t ri le



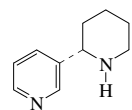
2-Pi peri di none



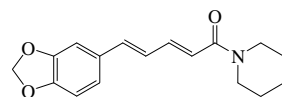
2-(1-Pi peri di nyl met hyl)cycl ohexanone



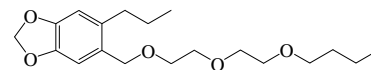
1-(2-Pi peri di nyl)-2-propanone



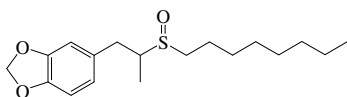
3-(2-Pi peri di nyl)pyri di(S)e



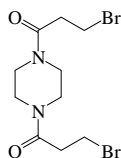
Pi peri ne



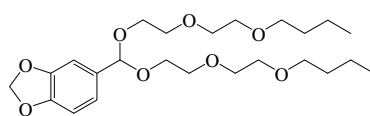
Pi peronybut oxi de



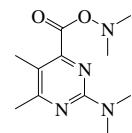
Pi peronybutyl f oxi de



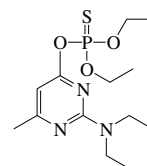
Pi pobroman



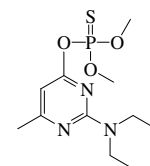
Pi prot al



Pi ri mi carb

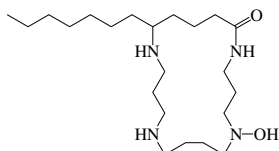


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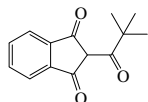


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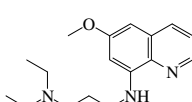
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9084	Pithecobolone		$C_{22}H_{46}N_4O_2$	22368-82-7	398.626	cry	68	230 ^{0.007}			s H ₂ O, chl, et h, Et OH, pet h
9085	2-Pivaloyl-1,3-indandione	Pindone	$C_{14}H_{14}O_3$	83-26-1	230.259	ye cry	109				
9086	Plasmocid		$C_7H_{25}N_3O$	551-01-9	287.400			182 ^{1.0}	1.0569 ²⁴	1.5855 ²⁴	
9087	Plumericin		$C_{19}H_{14}O_6$	77-16-7	290.268						s chl
9088	Podophyllotoxin		$C_{26}H_{22}O_8$	518-28-5	414.405		183				sl H ₂ O; vs Et OH; i et h; s ace, bz, HOAc
9089	Polychinazide		$C_{11}H_{13}ClF_3N_3O_4S_3$	346-18-9	439.882		214				
9090	Ponceau 3R	C.I. Food Red 6	$C_{16}H_{16}N_2Na_2O_7S_2$	3564-09-8	494.449	dk red pow					s H ₂ O; sl Et OH
9091	Populin		$C_8H_{22}O_8$	99-17-2	390.384	nd (w+2), pr (al)	180				
9092	21H,23H-Porphine		$C_{60}H_{14}N_4$	101-60-0	310.352	red or orange (chl-MeOH)	360	sub 300	1.336 ²⁵		i H ₂ O, et h, ace, bz; sl Et OH; s di ox
9093	Potassium benzoate		$C_7H_5KO_2$	582-25-2	160.212	hyg cry					
9094	Potassium dichloroisocyanurate	Trolosene potassium	$C_3Cl_2K_2N_3O_3$	2244-21-5	236.054	hyg cry	250 dec				
9095	Potassium digluconate		$C_{12}H_{21}KO_7$	299-27-4	234.245	ye-wh cry	183 dec				vs H ₂ O; i Et OH, et h, bz, chl
9096	Potassium hexadecane-2,4-hexadienoate	Potassium sorbate	$C_{18}H_{31}KO_2$	24634-61-5	150.217		>270 dec		1.361 ²⁵		vs H ₂ O; s Et OH
9097	Potassium hydrogen phthalate	Potassium biphenylate	$C_8H_5KO_4$	877-24-7	204.222				1.636 ²⁵		s H ₂ O; sl Et OH
9098	Potassium octadecanoate	Potassium oleate	$C_{18}H_{35}KO_2$	143-18-0	320.552	ye-br solid					s H ₂ O, Et OH
9099	Prazosin		$C_{19}H_{21}N_5O_4$	19216-56-9	383.402	cry	279				
9100	Prednisolone		$C_{21}H_{28}O_5$	50-24-8	360.444		235				
9101	5 α -Pregnane	Allopregnane	$C_{27}H_{46}$	641-85-0	288.511		84.5				
9102	5 β -Pregnane	17 β -Ethylocholeane	$C_{27}H_{46}$	481-26-5	288.511	mcl sc or pl (MeOH)	83.5		1.032 ¹⁵		i H ₂ O; s chl, MeOH
9103	5 α -Pregnane-3 α ,20 α -diol	Allopregnane-20 α -diol	$C_{27}H_{48}O_2$	566-58-5	320.510	cry (MeOH)	244				
9104	5 β -Pregnane-3 α ,20S-diol	Pregnanediol	$C_{27}H_{48}O_2$	80-92-2	320.510	pl (ace)	243.5		1.15 ⁵		sl Et OH, et h; s ace
9105	5 α -Pregnane-3,20-dione	3,20-Allopregnanedione	$C_{27}H_{44}O_2$	566-65-4	316.478	cry	200				
9106	5 β -Pregnane-3,20-dione		$C_{27}H_{44}O_2$	128-23-4	316.478	nd (di l al) cry (di l ace)	123				i H ₂ O; vs Et OH; s et h, ace
9107	5-Pregnane-3,17,21-triol-20-one	3,17,21-Trihydroxypregnan-20-one, (3 α ,5 β)	$C_{27}H_{44}O_4$	68-60-0	350.493	cry (Et OAc)	226				
9108	Pregnan-3 α -ol-20-one		$C_{27}H_{44}O_2$	128-20-1	318.494	nd (bz), cry (di l al)	149.5				vs Et OH
9109	Pregnenolone		$C_{27}H_{46}O_2$	145-13-1	316.478	nd (di l al)	192				
9110	Prenoxidazine hydrochloride		$C_{23}H_{26}ClN_2O$	982-43-4	397.940		186.5				
9111	Prephenic acid		$C_{10}H_{10}O_6$	126-49-8	226.182	f ree acid unst ab					
9112	Prindolol	1,1-Diphenyl-3-(1-piperidinyl)propanol	$C_{20}H_{25}NO$	511-45-5	295.419	cry	120				s ace
9113	Prilocaine	N-(2-Methylphenyl)-2-(propylamino)propanamide	$C_{13}H_{20}N_2O$	721-50-6	220.310	nd	38	160 ¹		1.5299 ²⁰	
9114	Procainamide	4-Amino-2-(diethylamino)ethylbenzamide	$C_{13}H_{21}N_3O$	51-06-9	235.325		47	212 ²			
9115	Procainamide hydrochloride		$C_{13}H_{22}ClN_3O$	614-39-1	271.786		166				vs H ₂ O; s Et OH; i et h, bz; sl chl
9116	Procarbazone hydrochloride		$C_{10}H_{12}ClN_2O$	366-70-1	257.759	cry (MeOH)	225				
9117	Prochlorperazine		$C_{17}H_{21}ClN_2S$	58-38-8	373.943		228				
9118	Procymidone		$C_9H_{11}Cl_2NO_2$	32809-16-8	284.138		166		1.452 ²⁵		



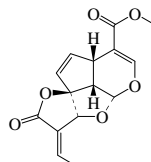
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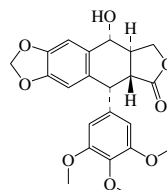
2-Pi val oyl-1,3-i ndandi one



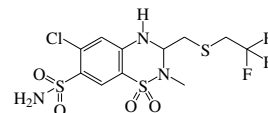
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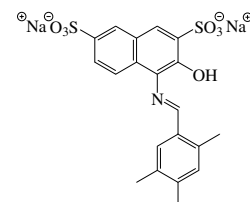
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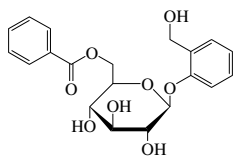
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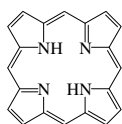
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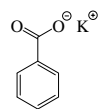
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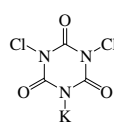
Populi n



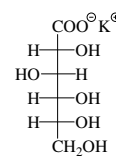
21H,23H-Porphi ne



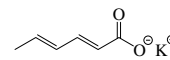
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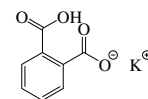
Pot assi urdi chloroi socyanurate



Pot assi urnD-gluconat e

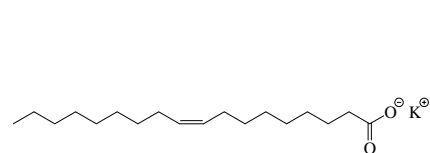


Pot assi urtr ans2,4-hexadi enoate

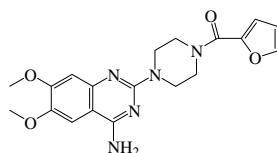


Pot assi urhydrogen pht halate

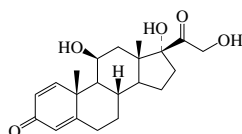
3-479



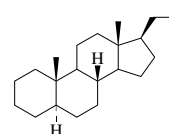
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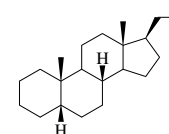
Prazosi n



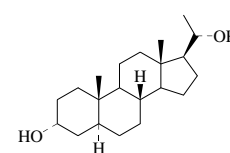
Predni sol one



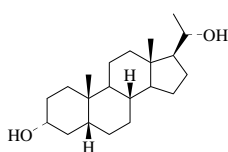
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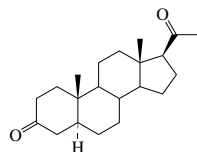
5β-Pregnane



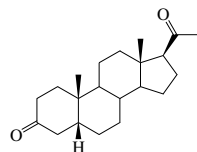
5α-Pregnane-3α,20α-di ol



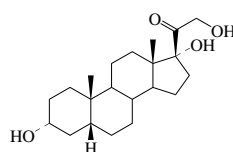
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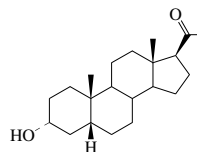
5α-Pregnane-3,20-di one



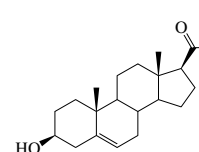
5β-Pregnane-3,20-di one



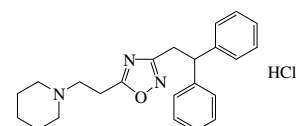
5-Pregnane-3,17,21-tri ol-20-one



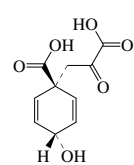
Pregnan-3α-ol-20-one



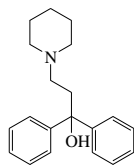
Pregnenol one



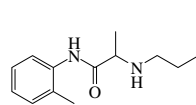
Prenoxdi azi nhydrochlori de



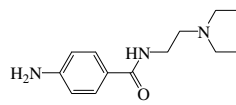
Prepheni taci d



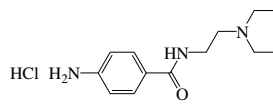
Pri di nol



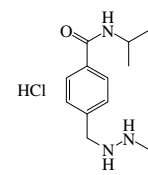
Pri l ocai ne



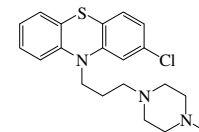
Procai nami de



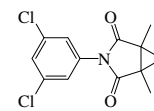
Procai nami dhydrochlori de



Procarbazi nhydrochlori de

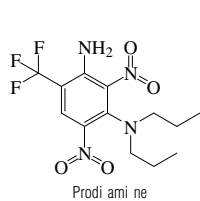


Prochl operazi ne

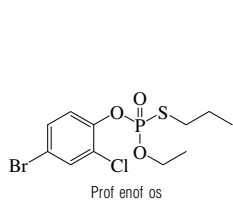


Procymi done

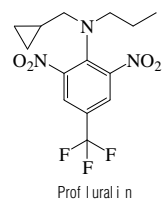
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9119	Prodi ami ne		$\text{C}_{17}\text{F}_3\text{N}_4\text{O}_4$	29091-21-2	350.294		124		1.47 ²⁵		
9120	Prof enof os		$\text{C}_{15}\text{BrClO}_3\text{P}_5\text{S}$	41198-08-7	373.631			110 ^{0.001}	1.455 ²⁰		
9121	Proflurali n		$\text{C}_8\text{H}_{16}\text{F}_3\text{N}_3\text{O}_4$	26399-36-0	347.290		34				
9122	Progest erone	Pregn-4-ene-3,20-di one	$\text{C}_{27}\text{H}_{46}\text{O}_2$	57-83-0	314.462	pr	129		1.166 ²³		i H ₂ O; s Et OH, di ox, ace
9123	DL-Proli ne		$\text{C}_6\text{H}_9\text{NO}_2$	609-36-9	115.131	hyg nd (al-et h) cry (+w)	205 dec				vs H ₂ O, Et OH
9124	L-Proli ne	2-Pyrrol i di necarboxyl i c aci d	$\text{C}_5\text{H}_9\text{NO}_2$	147-85-3	115.131	nd (al-et h) pr (w)	221 dec				vs H ₂ O; sl Et OH, ace, bz; i et h, PrOH
9125	Promazi ne		$\text{C}_{17}\text{H}_{20}\text{N}_2\text{S}$	58-40-2	284.419			206 ^{0.3}			
9126	Promecarb	Phenol , 3-met hyl -5-(1-met hyl et hyl)-10-et hyl carbamat e	$\text{C}_{17}\text{H}_{17}\text{NO}_2$	2631-37-0	207.269		87	117 ^{0.01}			
9127	Promet hazi ne	N,N,α-Tri met hyl -10-phenot hi azi ne-10-et hani mi ne	$\text{C}_{17}\text{H}_{20}\text{N}_2\text{S}$	60-87-7	284.419		60	191 ^{0.5}			i H ₂ O; vs di l HCl
9128	Promet hazi ne hydrochl ori de	Di prazi n	$\text{C}_{17}\text{H}_{19}\text{ClN}_2\text{S}$	58-33-3	320.880		231				vs H ₂ O, Et OH, chl
9129	Promet one		$\text{C}_{10}\text{H}_{13}\text{N}_3\text{O}$	1610-18-0	225.291	sol i d	91.5				
9130	Promet ryn	N,N'-Di i sopropyl -6-(met hyl t hi o)-1,3,5-t ri azi ne-2,4-di ami ne	$\text{C}_{10}\text{H}_{13}\text{N}_3\text{S}$	7287-19-6	241.357		119		1.157 ²⁰		
9131	Propachl or	Acet ami de, 2-chl or-1-met hyl et hyl-phenyl -	$\text{C}_{11}\text{H}_{14}\text{ClNO}$	1918-16-7	211.688		77	110 ^{0.03}	1.242 ²⁵		
9132	Propanal	Propi onal dehyde	$\text{C}_3\text{H}_6\text{O}$	123-38-6	58.079	li q	-80	48	0.865 ⁷	1.3636 ²⁰	s H ₂ O; msc Et OH, et h
9133	Propanal oxime		$\text{C}_3\text{H}_7\text{NO}$	627-39-4	73.094		40	131.5	0.9258 ²⁰	1.4287 ²⁰	
9134	Propanami de	Propi onami de	$\text{C}_3\text{H}_7\text{NO}$	79-05-0	73.094	rhom, pl (bz)	81.3	213	0.9262 ¹⁰	1.4180 ¹¹⁰	vs H ₂ O, Et OH, et h, chl
9135	Propane		C_3H_8	74-98-6	44.096	col gas	-187.63	-42.1	0.493 ²⁵ (p>1 at m)		s H ₂ O, Et OH; vs et h, bz; sl ace
9136	Propanedi ami de		$\text{C}_3\text{H}_8\text{N}_2\text{O}_2$	108-13-4	102.092	mcl pr(w)	170.8				s H ₂ O; i Et OH, et h, bz; sl DMSO
9137	1,2-Propanedi ami ne, (±)	Propyl enedi ami ne	$\text{C}_3\text{H}_8\text{N}_2$	10424-38-1	74.124	hyg		119.5	0.878 ¹⁵	1.4460 ²⁰	vs H ₂ O; i et h; vs chl
9138	1,3-Propanedi ami ne	1,3-Di ami nopropane	$\text{C}_3\text{H}_8\text{N}_2$	109-76-2	74.124	li q	-10.8	139.8	0.884 ⁴	1.4600 ²⁰	s H ₂ O; msc Et OH, et h
9139	1,2-Propanedi ol di acet at e		$\text{C}_7\text{H}_{14}\text{O}_4$	623-84-7	160.168			190.5	1.059 ²⁰	1.4173 ²⁰	vs H ₂ O; s Et OH, et h
9140	1,3-Propanedi ol di acet at e		$\text{C}_7\text{H}_{14}\text{O}_4$	628-66-0	160.168			209.5	1.070 ¹⁴	1.4192	vs H ₂ O; s Et OH
9141	1,2-Propanedi ol 1-met hacryl at e	2-Hydroxypropyl met hacryl at e	$\text{C}_7\text{H}_{12}\text{O}_3$	923-26-2	144.168			90 ⁹ , 57 ^{0.5}	1.066 ²⁵	1.4458 ²⁰	
9142	1,2-Propanedi one	Pyruval dehyde	$\text{C}_3\text{H}_4\text{O}_2$	78-98-8	72.063	ye hyg li q		72	1.045 ⁹	1.4002 ¹⁸	s Et OH, et h, bz
9143	Propanedi oyl di chl ori de		$\text{C}_3\text{H}_4\text{Cl}_2\text{O}_2$	1663-67-8	140.953			57 ²⁸	1.4509 ²⁰	1.4639 ²⁰	s et h, AcOEt
9144	1,2-Propanedi t hi ol		$\text{C}_3\text{H}_6\text{S}_2$	814-67-5	108.226			152	1.08 ²⁰	1.532 ²⁰	s chl
9145	1,3-Propanedi t hi ol	Tri met hyl ene di mercapt an	$\text{C}_3\text{H}_6\text{S}_2\text{C}$	109-80-8	108.226	li q	-79	172.9	1.077 ²	1.5392 ²⁰	sl H ₂ O, ct c; msc Et OH, et h, bz
9146	2,2'-(1,3-Propanedi yl bi s(ni t ri lomet hyl i dyne) bi sphenol	Di sal i cyl i dene-1,3-propanedi ami ne	$\text{C}_{17}\text{H}_{18}\text{O}_2$	120-70-7	282.337		54.3				
9147	Propaneni t ri le	Et hyl cyani de	$\text{C}_3\text{H}_5\text{NC}$	107-12-0	55.079	li q	-92.78	97.14	0.781 ⁸	1.3655 ²⁰	vs H ₂ O; s Et OH, et h, ace, bz, ct c
9148	1-Propanesul f oni c aci d		$\text{C}_3\text{H}_7\text{O}_3\text{S}$	5284-66-2	124.159		8	136 ¹	1.2516 ²⁵		
9149	1-Propanesul f onyl chl ori de		$\text{C}_3\text{H}_7\text{ClO}_2\text{S}$	10147-36-1	142.605			dec 180; 77 ¹²	1.267 ²⁰	1.452 ²⁰	
9150	1,3-Propane sul t one	1,2-Oxat hi ol ane, 2,2-di oxi de	$\text{C}_3\text{H}_6\text{O}_3\text{S}$	1120-71-4	122.143						s chl
9151	1-Propanet hi ol	Propyl mercapt an	$\text{C}_3\text{H}_7\text{S}$	107-03-9	76.161	li q	-113.13	67.8	0.841 ⁴	1.4380 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz
9152	2-Propanet hi ol	Isopropyl mercapt an	$\text{C}_3\text{H}_7\text{S}$	75-33-2	76.161	li q	-130.5	52.6	0.814 ³	1.4255 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace; s chl
9153	1,2,3-Propanet ri ami ne	1,2,3-Tri ami nopropane	$\text{C}_3\text{H}_9\text{N}_3$	21291-99-6	89.139	vi sc oi l		190; 92			s H ₂ O
9154	1,2,3-Propanet ri carboxyl i c aci d	Tri carbal yl i c aci d	$\text{C}_3\text{H}_2\text{O}_6$	99-14-9	176.124	ort h (et h)	166				vs H ₂ O, Et OH; sl et h



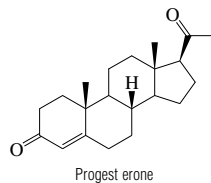
Prodi amine



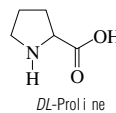
Profenofos



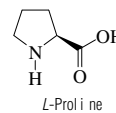
Profuralin



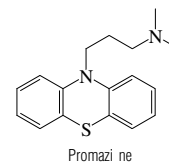
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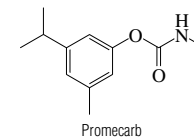
DL-Proline



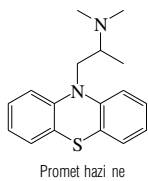
L-Proline



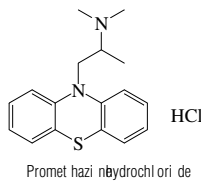
Promazine



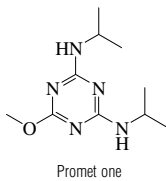
Promecarb



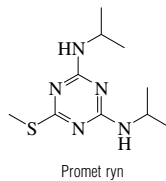
Prometazine



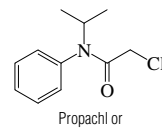
Prometazine hydrochloride



Promethazine



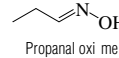
Promethazine



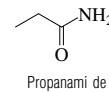
Propachlor



Propanal



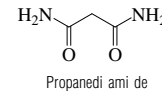
Propanal oxime



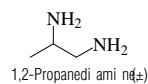
Propanamide



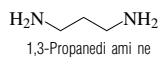
Propane



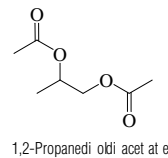
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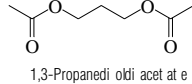
1,2-Propanediamine



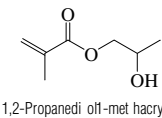
1,3-Propanediamine



1,2-Propanediol diacetate



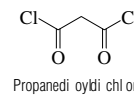
1,3-Propanediol diacetate



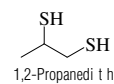
1,2-Propanediol methacrylate



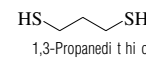
1,2-Propanediol



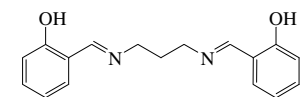
Propanediol dichloride



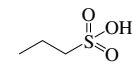
1,2-Propanedithiol



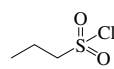
1,3-Propanedithiol



2,2'-[1,3-Propanediylbis(s-trimethylololonyl)]bisphenol



1-Propanesulfonic acid



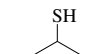
1-Propanesulfonyl chloride



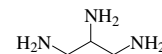
1,3-Propanesultone



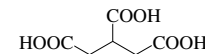
1-Propanethiol



2-Propanethiol

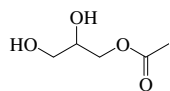


1,2,3-Propanetriamine

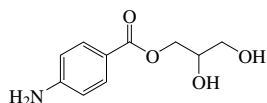


1,2,3-Propanetricarboxylic acid

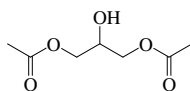
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9155	1,2,3-Propanetriol-1-acetate		$\text{C}_5\text{H}_{10}\text{O}_4$	106-61-6	134.131			158 ¹⁶⁵ , 129 ³	1.2060 ²⁰	1.4157 ²⁰	vs H ₂ O, Et OH
9156	1,2,3-Propanetriol 1-(4-aminobenzoate)	Glyceryl- <i>p</i> -aminobenzoate	$\text{C}_{10}\text{H}_{13}\text{NO}_4$	136-44-7	211.215						i H ₂ O; s Et OH
9157	1,2,3-Propanetriol-1,3-diacetate	1,3-Diacetate	$\text{C}_7\text{H}_{12}\text{O}_6$	105-70-4	176.167	hyg liq		260; 149	1.179 ¹⁵	1.4395 ²⁰	vs H ₂ O, Et OH; sl et h; i CS
9158	1,2,3-Propanetriol tribenzoate		$\text{C}_{24}\text{H}_{30}\text{O}_6$	614-33-5	404.412	nd (MeOH)	76		1.228 ¹²		i H ₂ O; s Et OH; vs et h, ace, bz, chl
9159	1,2,3-Propanetriol tripropanoate		$\text{C}_{12}\text{H}_{20}\text{O}_6$	139-45-7	260.283			175 ²⁰ , 157 ¹³	1.108 ¹⁵	1.4318 ¹⁹	i H ₂ O; s Et OH, chl; vs et h
9160	1,2,3-Propanetriol hexanoate		$\text{C}_{21}\text{H}_{38}\text{O}_6$	621-70-5	386.523		-60	>200	0.9867 ²⁰	1.4427 ²⁰	i H ₂ O; msc Et OH, et h, bz; vs ace
9161	1,2,3-Propanetriol octanoate		$\text{C}_{27}\text{H}_{50}\text{O}_6$	538-23-8	470.682		10	233	0.9540 ²⁰	1.4482 ²⁰	i H ₂ O; msc Et OH; vs et h, bz, chl, liq
9162	Propanedial		$\text{C}_3\text{H}_4\text{NO}_2$	1421-14-3	337.411			211 ⁰⁷			i H ₂ O; s Et OH, chl
9163	Propanil	Propanamide (3,4-dichlorophenyl)	$\text{C}_9\text{H}_8\text{Cl}_2\text{NO}$	709-98-8	218.079		92		1.25 ²⁵		
9164	Propanoic acid	Propionic acid	$\text{C}_3\text{H}_6\text{O}_2$	79-09-4	74.079	liq	-20.5	141.15	0.988 ²	1.3809 ²⁰	msc H ₂ O, Et OH; s et h; sl chl
9165	Propanoic anhydride	Propionic anhydride	$\text{C}_6\text{H}_{10}\text{O}_3$	123-62-6	130.141	liq	-45	170; 67.9	1.0110 ²⁰	1.4038 ²⁰	msc et h; sl ct c
9166	1-Propanol	Propyl alcohol	$\text{C}_3\text{H}_8\text{O}$	71-23-8	60.095	liq	-124.39	97.2	0.7997	1.3850 ²⁰	msc H ₂ O, Et OH, et h; s ace, chl; vs bz
9167	2-Propanol	Isopropyl alcohol	$\text{C}_3\text{H}_8\text{O}$	67-63-0	60.095	liq	-87.9	82.3	0.7809	1.3776 ²⁰	msc H ₂ O, Et OH, et h; s ace, chl; vs bz
9168	2-Propanone oxime	Acetoxime	$\text{C}_3\text{H}_7\text{NO}$	127-06-0	73.094	pr (al)	61	136; 6 ¹²⁰	0.9113 ⁶²	1.4156 ²⁰	s H ₂ O, Et OH, et h, chl, liq
9169	2-Propanone phenyl hydrazone	Acetone phenyl hydrazone	$\text{C}_{11}\text{H}_{12}\text{N}_2$	103-02-6	148.204	ort h	42	163 ³			s Et OH, et h, di l aci d
9170	Propanoyl chloride	Propionyl chloride	$\text{C}_3\text{H}_5\text{ClO}$	79-03-8	92.524	liq	-94	80	1.0646	1.4032 ²⁰	s et h
9171	Propanoyl fluoride	Propionyl fluoride	$\text{C}_3\text{H}_5\text{FO}$	430-71-7	76.069			44	0.972 ¹⁵	1.329 ¹³	
9172	Propanthelene bromide		$\text{C}_3\text{H}_5\text{BrNO}_3$	50-34-0	448.393	cry	160				vs H ₂ O, Et OH, chl; i et h, bz
9173	Propargyl ether		$\text{C}_4\text{H}_6\text{O}_2\text{S}$	2312-35-8	350.472				1.10 ²⁵		
9174	Propargyl acetate		$\text{C}_5\text{H}_8\text{O}_2$	627-09-8	98.101			121.5	0.9982 ²⁰	1.4187 ²⁰	sl H ₂ O; s Et OH, et h
9175	Propargyl alcohol	3-Hydroxy-1-propyne	$\text{C}_3\text{H}_4\text{O}$	107-19-7	56.063	liq	-51.8	113.6	0.947 ⁸	1.4322 ²⁰	s H ₂ O, chl; msc Et OH, et h
9176	Propargyl nitrate	2-Ethyl-2-[(nitroxy)methyl]-1,3-propanediol, dinitrate	$\text{C}_8\text{H}_{11}\text{N}_3\text{O}_9$	2921-92-8	269.166	wh pow	52		1.49		i H ₂ O; s Et OH, ace
9177	Propazone	6-Chloro- <i>N,N'</i> -diisopropyl-1,3,5-triazine-2,4-diamine	$\text{C}_9\text{H}_{16}\text{ClN}_3$	139-40-2	229.710		213		1.162 ²⁰		
9178	Propene	Propylene	C_3H_6	115-07-1	42.080	col gas	-185.24	-47.69	0.505 ⁵ (p>1 at m)	1.3567 ⁷⁰	sl H ₂ O; vs Et OH, HOAc
9179	<i>trans</i> -1-Propene-1,2-dicarboxylic acid	Mesaconic acid	$\text{C}_6\text{H}_8\text{O}_4$	498-24-8	130.100	ort h nd or mcl pr (et h)	204.5	sub	1.466 ²⁰		sl H ₂ O, bz, CS ₂ ; vs Et OH; s et h, t f a
9180	1-Propene-2,3-dicarboxylic acid	Itaconic acid	$\text{C}_6\text{H}_8\text{O}_4$	97-65-4	130.100	rhomb (bz)	175	dec	1.632 ²⁵		s H ₂ O, Et OH, ace; sl et h, bz, pet h
9181	2-Propene-1-thiol		$\text{C}_3\text{H}_6\text{S}$	870-23-5	74.145			65	0.925 ²³	1.4832 ²⁰	i H ₂ O; msc Et OH, et h; s chl
9182	<i>cis</i> -1-Propene-1,2,3-tricarboxylic acid	<i>cis</i> -aconitic acid	$\text{C}_6\text{H}_8\text{O}_6$	585-84-2	174.108	nd (w)	125				s H ₂ O; sl et h
9183	<i>trans</i> -1-Propene-1,2,3-tricarboxylic acid	<i>trans</i> -aconitic acid	$\text{C}_6\text{H}_8\text{O}_6$	4023-65-8	174.108	lf (w) nd (w, et h)	196 dec				vs H ₂ O, Et OH
9184	1-Propen-1-one	Methyl ketene	$\text{C}_3\text{H}_4\text{O}$	6004-44-0	56.063	col gas	-80	-23			vs et h
9185	2-Propenoyl chloride	Acrylyl chloride	$\text{C}_3\text{H}_3\text{ClO}$	814-68-6	90.508			75.5	1.1136 ¹⁰	1.4343 ²⁰	vs chl
9186	<i>cis</i> -1-Propenyl benzene		C_9H_{10}	766-90-5	118.175	liq	-61.6	167.5	0.908 ⁸	1.5420 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
9187	<i>trans</i> -1-Propenyl benzene		C_9H_{10}	873-66-5	118.175	liq	-29.3	178.3	0.902 ³	1.5506 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz
9188	<i>trans</i> -5-(1-Propenyl)-1,3-benzodioxole		$\text{C}_{10}\text{H}_{10}\text{O}_2$	4043-71-4	162.185		6.8	253	1.1224 ²⁰	1.5782 ²⁰	i H ₂ O; msc Et OH, et h; vs ace; s chl
9189	4-(1-Propenyl)phenol	<i>p</i> -Anol	$\text{C}_9\text{H}_{10}\text{O}$	539-12-8	134.174	lf	94	dec 250			sl H ₂ O; vs DMF



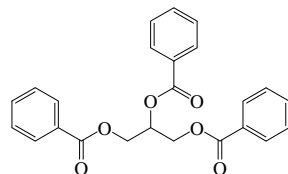
1,2,3-Propanetriol-1-acetate



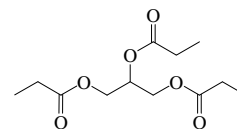
1,2,3-Propanetriol-(4-aminobenzoate)



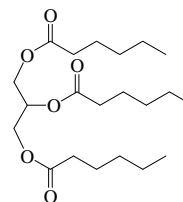
1,2,3-Propanetriol-1,3-diacetate



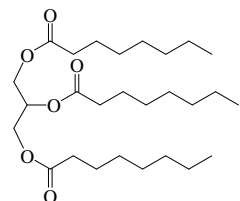
1,2,3-Propanetriol dibenzoate



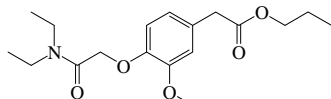
1,2,3-Propanetriol diethyl propanoate



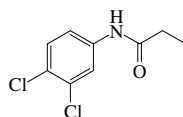
1,2,3-Propanetriol trihexanoate



1,2,3-Propanetriol triacetate



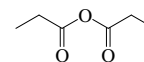
Propanediol



Propanol



Propanoic acid



Propanoic anhydride

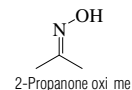


1-Propanol

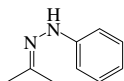


2-Propanol

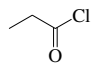
3-483



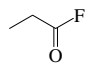
2-Propanone oxime



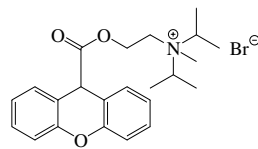
2-Propanone phenyl hydrazone



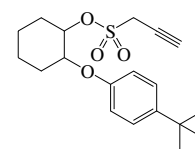
Propanoyl chloride



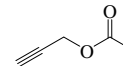
Propanoyl fluoride



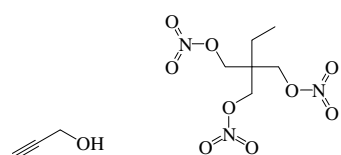
Propantelium bromide



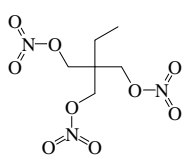
Propargite



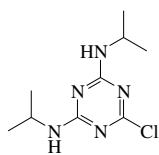
Propargyl acetate



Propargyl alcohol



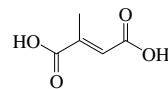
Propyl nitrate



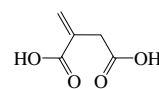
Propazine



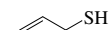
Propene



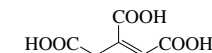
trans-1-Propene-1,2-dicarboxylic acid



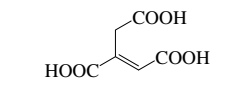
1-Propene-2,3-dicarboxylic acid



2-Propene-1-thiol



cis-1-Propene-1,2,3-tricarboxylic acid



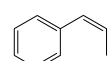
trans-1-Propene-1,2,3-tricarboxylic acid



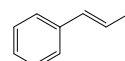
1-Propen-1-one



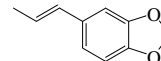
2-Propenyl chloride



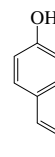
cis-1-Propenyl benzene



trans-1-Propenyl benzene

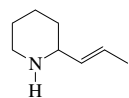


trans-5-(1-Propenyl)-1,3-benzodioxole

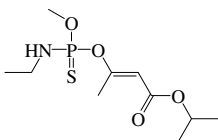


4-(1-Propenyl)phenol

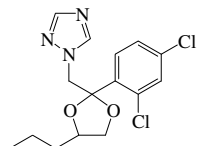
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9190	2-(1-Propenyl)pi peridi ne	β-Coni cei ne	C ₈ H ₁₃ N	538-90-9	125.212		8	168	0.8716 ¹⁵		
9191	Propet amphos		C ₁₀ H ₂₀ NO ₄ PS	31218-83-4	281.309			88 ^{0.005}	1.1294 ²⁰		
9192	Propi conazol e		C ₁₇ H ₁₇ Cl ₂ N ₃ O ₂	60207-90-1	342.221			180 ^{0.1}	1.27 ²⁰		
9193	Propi omazi ne		C ₁₂ H ₂₄ N ₂ O ₅ S	362-29-8	340.482			240 ^{0.5}			
9194	Propi onylL-carni ti ne	Carni ti onylpropanoyl	C ₁₀ H ₁₉ NO ₄	20064-19-1	217.263	hyg pr (2-PrOH)	147 dec				
9195	Propof ol		C ₈ H ₁₈ O	2078-54-8	178.270		19	256; 136 ³⁰	0.955 ²⁰	1.5140 ²⁰	
9196	Propoxur	Phenol, 2-(1-met hyl et hoxy)-, met hyl carbat e	C ₁₁ H ₁₅ NO ₃	114-26-1	209.242		87	dec	1.12 ²⁰		
9197	2-Propoxyet hanol	Et hyl ene glycol monopropyl et her	C ₇ H ₁₄ O ₂	2807-30-9	104.148			149.8	0.9112 ²⁰	1.4133 ²⁰	s H ₂ O; vs Et OH, et h
9198	D-Propoxyphene	Dext ropoxyphene	C ₂₂ H ₂₃ NO ₂	469-62-5	339.471	cry (pet h)	75.5				
9199	L-Propoxyphene	Levopropoxyphene	C ₂₂ H ₂₃ NO ₂	2338-37-6	339.471	cry (pet h)	75.5				
9200	1-Propoxy-2-propanol	1,2-Propyl ene glycol 1-propyl et her	C ₇ H ₁₄ O ₂	1569-01-3	118.174			150	0.8886 ²⁰	1.4130 ²⁰	
9201	3-Propoxy-1-propene		C ₈ H ₁₆ O	1471-03-0	100.158			91	0.7764 ²⁰	1.3919 ²⁰	vs ace, et h, Et OH
9202	Propranol ol		C ₁₆ H ₂₁ NO ₂	525-66-6	259.344	cry (cyhex)	96				
9203	Propyl acet at e		C ₆ H ₁₀ O ₂	109-60-4	102.132	li q	-93	101.54	0.887 ⁸	1.3842 ²⁰	sl H ₂ O; msc Et OH, et h; s ct c
9204	Propyl acryl at e	2-Propeni c aci d, propyl est er	C ₆ H ₁₀ O ₂	925-60-0	114.142			122; 63 ¹⁰⁰			
9205	Propyl ami ne	1-Propanami ne	C ₃ H ₉ N	107-10-8	59.110	li q	-84.75	47.22	0.717 ⁹	1.3870 ²⁰	msc H ₂ O; vs Et OH, ace; s bz, chl; sl ct c
9206	Propyl ami ne hydrochl ori de	1-Propanami ne hydrochl ori de	C ₃ H ₉ ClN	556-53-6	95.571			163.5			s DMSO
9207	Propyl 4-ami nobenzoat e	Ri socai ne	C ₁₀ H ₁₃ NO ₂	94-12-2	179.216	pr	75				vs bz, et h, Et OH, chl
9208	2-(Propyl ami no)et hanol		C ₈ H ₁₃ NO	16369-21-4	103.163			182	0.9005 ²⁰	1.4428 ²⁰	
9209	4-Propyl ani li ne		C ₉ H ₁₃ N	2696-84-6	135.206			227			
9210	N-Propyl ani li ne		C ₉ H ₁₃ N	622-80-0	135.206			222; 98 ¹¹	0.9443 ²⁰	1.5428 ²⁰	vs et h, Et OH
9211	Propyl arsoni c aci d	1-Propanearsoni c aci d	C ₃ H ₉ AsO ₃	107-34-6	168.023	nd (al), pl (w)	134.5				vs H ₂ O, Et OH; i et h
9212	Propyl benzene	Isocumene	C ₉ H ₁₂	103-65-1	120.191	li q	-99.6	159.24	0.859 ⁹	1.4895 ²⁵	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
9213	α-Propyl benzenemet hanol (R)		C ₁₀ H ₁₄ O	22144-60-1	150.217		16	232	0.9740 ²⁰	1.5139 ²⁰	vs et h, Et OH
9214	Propyl benzenesul fonat e		C ₉ H ₁₂ O ₂ S	80-42-2	200.254			162 ¹⁵	1.1804 ¹⁷	1.5035 ²⁵	sl H ₂ O; s Et OH; vs et h, chl
9215	Propyl benzoat e		C ₁₀ H ₁₂ O ₂	2315-68-6	164.201	li q	-51.6	211	1.023 ⁹	1.5000 ²⁰	i H ₂ O; msc Et OH, et h
9216	5-Propyl -1,3-benzodi oxol e	Di hydrosaf rol e	C ₁₀ H ₁₂ O ₂	94-58-6	164.201			228			s ct c
9217	Propyl but anoat e		C ₈ H ₁₆ O ₂	105-66-8	130.185	li q	-95.2	143.0	0.873 ⁹	1.4001 ²⁰	sl H ₂ O; msc Et OH, et h
9218	Propyl carbat e		C ₇ H ₁₄ NO ₂	627-12-3	103.120	pr	60	196			vs ace, et h, Et OH
9219	Propyl chl oroacet at e		C ₆ H ₁₃ ClO ₂	5396-24-7	136.577			161	1.104 ²⁰	1.4261 ²⁰	vs et h
9220	Propyl 2-chl orobut anoat e		C ₈ H ₁₅ ClO ₂	62108-71-8	164.630			183	1.0252 ²⁰		
9221	Propyl chl oroarbonat e		C ₆ H ₁₁ ClO ₂	109-61-5	122.551			115.2	1.0901 ²⁰	1.4035 ²⁰	msc Et OH, et h
9222	Propyl 3-chl oropropanoat e		C ₆ H ₁₁ ClO ₂	62108-66-1	150.603			180	1.0656 ²⁰	1.4290 ²⁰	vs et h, Et OH
9223	S-Propyl chl orot hi of ormat e	S-Propyl carbonochl ori dot hi oat e	C ₄ H ₉ ClOS	13889-92-4	138.616	li q		59			
9224	Propyl t ransci namat e	Propyl t rans3-phenyl -2-propenoat e	C ₉ H ₁₄ O ₂	74513-58-9	190.238			285	1.0433 ⁹		i H ₂ O
9225	Propyl cycl ohexane		C ₉ H ₁₈	1678-92-8	126.239	li q	-94.9	156.7	0.793 ⁹	1.4370 ²⁰	i H ₂ O; msc Et OH, ace, ct c; s et h, bz
9226	2-Propyl cycl ohexanone		C ₉ H ₁₆ O	94-65-5	140.222			197	0.927 ²⁰	1.4538 ²⁰	i H ₂ O; s Et OH, ace; vs et h, bz
9227	Propyl cycl opent ane		C ₈ H ₁₆	2040-96-2	112.213	li q	-117.3	131	0.776 ⁹	1.4266 ²⁰	i H ₂ O; msc Et OH, et h, ace; s bz; vs ct c
9228	1-Propyl cycl opent anol		C ₈ H ₁₆ O	1604-02-0	128.212	li q	-37.5	173.5	0.904 ⁹	1.4502 ²⁵	
9229	Propyl ene carbonat e	4-Met hyl -1,3-di oxol an-2-one	C ₄ H ₆ O ₃	108-32-7	102.089	li q	-48.8	242	1.204 ⁷	1.4189 ²⁰	vs H ₂ O, Et OH, et h, ace, bz
9230	1,2-Propyl ene glycol	1,2-Propanedi ol	C ₃ H ₈ O ₂	57-55-6	76.095	li q	-60	187.6	1.036 ⁹	1.4324 ²⁰	msc H ₂ O, Et OH; s et h, bz, chl



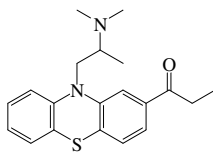
2-(1-Propenyl)pyrrolidine



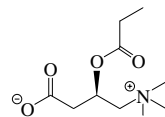
Propetamphos



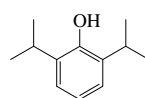
Propiconazole



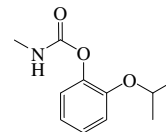
Propiomazine



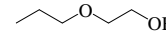
Propionyl-L-carnitine



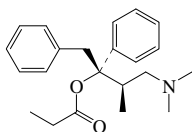
Propofol



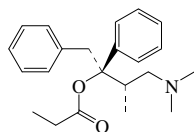
Propoxur



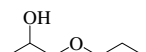
2-Propoxyethanol



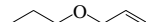
D-Propoxyphene



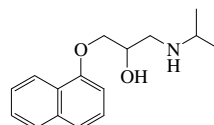
L-Propoxyphene



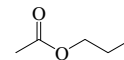
1-Propoxy-2-propanol



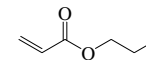
3-Propoxy-1-propene



Propranolol



Propyl acetate



Propyl acrylate

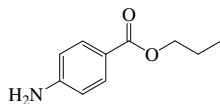


Propylamine

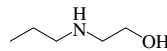
3-485



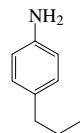
Propylamine hydrochloride



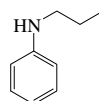
Propyl 4-aminobenzoate



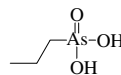
2-(Propylamino)ethanol



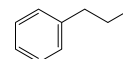
4-Propylaniline



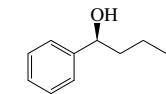
N-Propylaniline



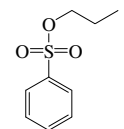
Propylarsonic acid



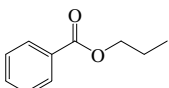
Propylbenzene



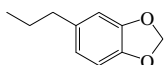
α -Propylbenzenemethanol



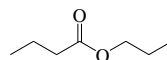
Propyl benzenesulfonate



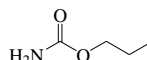
Propyl benzoate



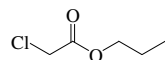
5-Propyl-1,3-benzodioxole



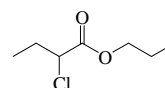
Propyl butanoate



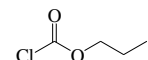
Propyl carbamate



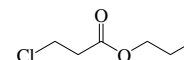
Propyl chloroacetate



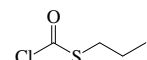
Propyl 2-chloropropanoate



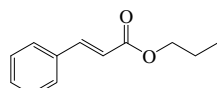
Propyl chloroformate



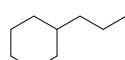
Propyl 3-chloropropanoate



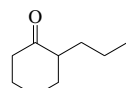
S-Propyl chlorothioformate



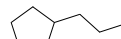
Propyl trans-cinnamate



Propyl cyclohexane



2-Propyl cyclohexanone



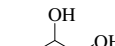
Propyl cyclopentane



1-Propyl cyclopentanol

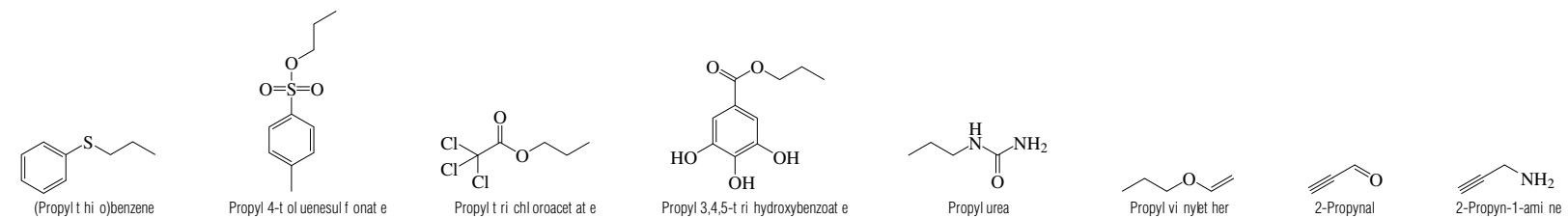
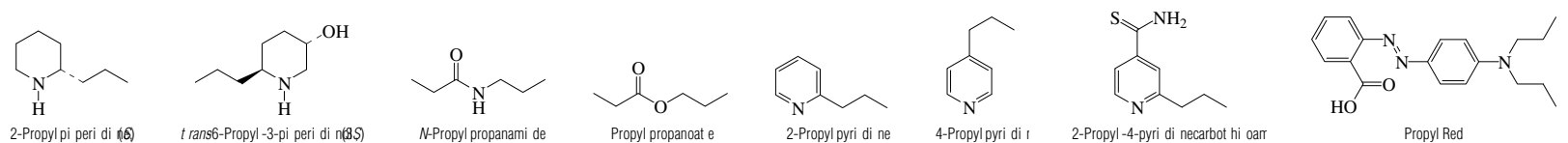
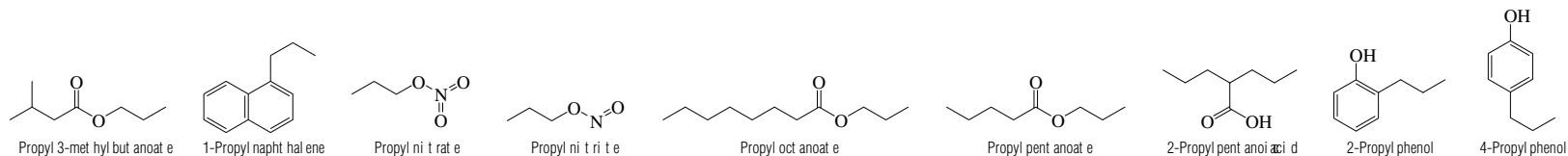
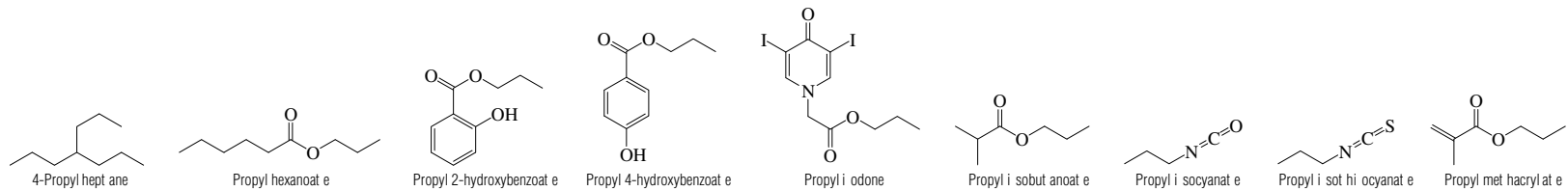
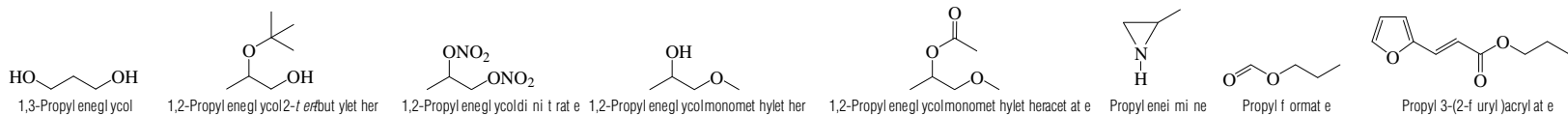


Propyl enecarbonate

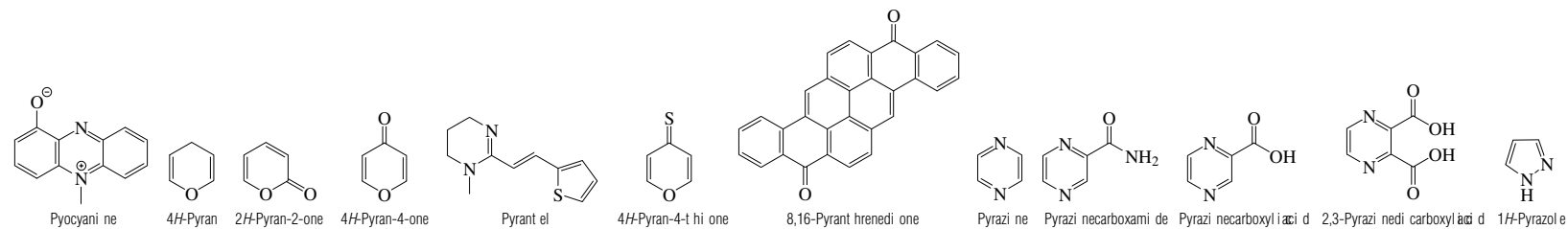
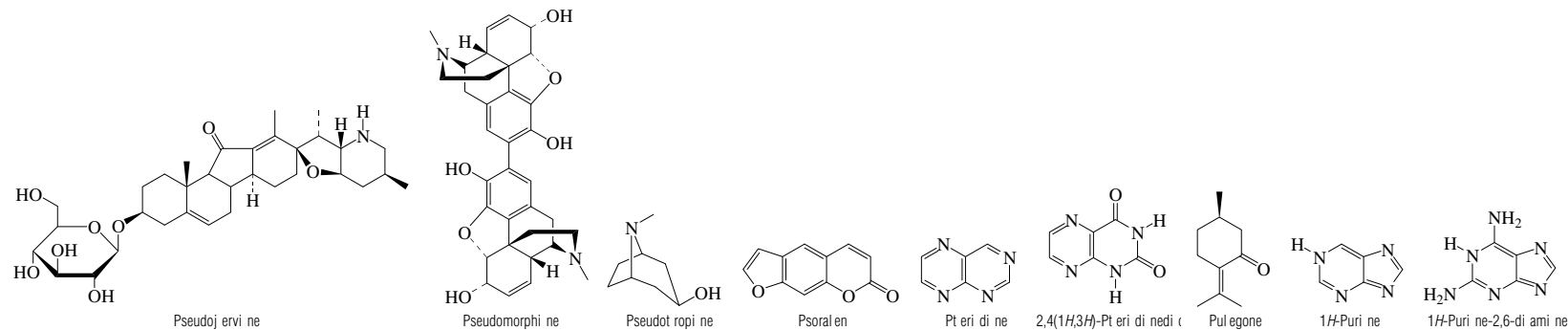
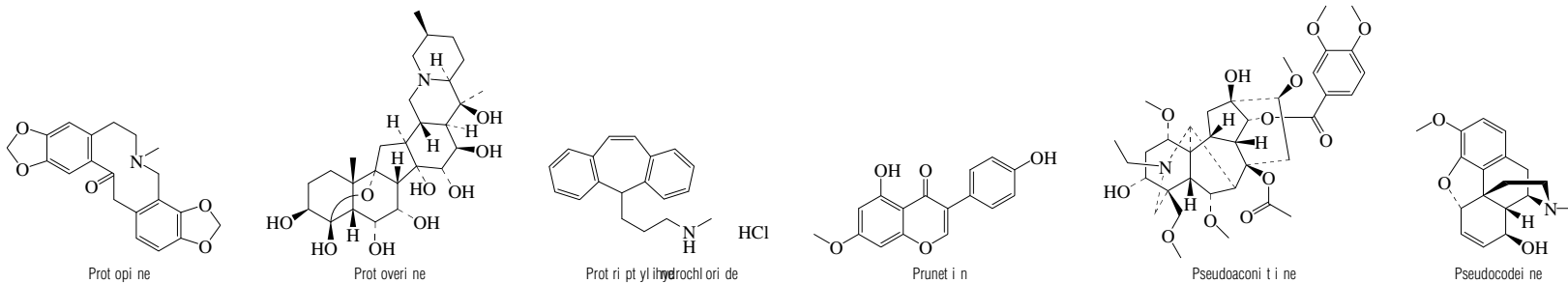
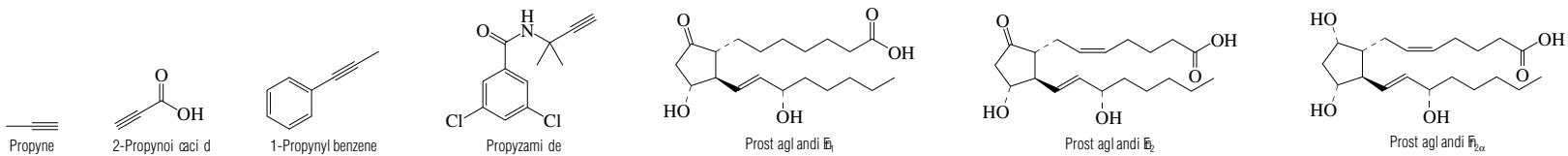


1,2-Propylene glycol

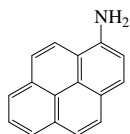
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9231	1,3-Propyl ene glycol	Tri met hyl ene glycol	$\text{C}_3\text{H}_8\text{O}_2$	504-63-2	76.095	li q	-27.7	214.4	1.0538	1.4398 ²⁰	msc H ₂ O, Et OH; vs et h; sl bz
9232	1,2-Propyl ene glycol 2-ethyl et her	2-(1,1-Di met hyl et hoxyl)-1-propanol	$\text{C}_4\text{H}_{10}\text{O}_2$	94023-15-1	132.201	li q		152	0.87		
9233	1,2-Propyl ene glycol di ni t rat e		$\text{C}_3\text{H}_8\text{N}_2\text{O}_6$	6423-43-4	166.089	li q	exp	92			
9234	1,2-Propyl ene glycol monomet hyl et her	1-Met hoxyl-2-propanol	$\text{C}_3\text{H}_8\text{O}_2$	107-98-2	90.121			119	0.9620 ²⁰	1.4034 ²⁰	
9235	1,2-Propyl ene glycol monomet hyl et her acet at e	2-Acet oxy-1-met hoxylpropane	$\text{C}_4\text{H}_{10}\text{O}_3$	108-65-6	132.157	li q		147			
9236	Propyl enei mi ne	2-Met hyl azi ri di ne	$\text{C}_3\text{H}_7\text{NC}$	75-55-8	57.095			67	0.812 ¹⁶		
9237	Propyl f ormat e		$\text{C}_3\text{H}_5\text{O}_2$	110-74-7	88.106	li q	-92.9	80.9	0.9078	1.377 ²⁰	sl H ₂ O, ct c; msc Et OH, et h
9238	Propyl 3-(2-f uryl)acryl at e		$\text{C}_{10}\text{H}_{12}\text{O}_3$	623-22-3	180.200			113 ¹⁶ , 92 ³	1.0744 ²⁰	1.5392 ²⁴	vs bz, et h, Et OH
9239	4-Propyl hept ane		$\text{C}_{10}\text{H}_{22}$	3178-29-8	142.282			157.5	0.7321 ²⁵	1.4135 ²⁰	
9240	Propyl hexanoat e		$\text{C}_9\text{H}_{18}\text{O}_2$	626-77-7	158.238	li q	-68.7	187	0.8672	1.4170 ²⁰	vs et h, Et OH
9241	Propyl 2-hydroxybenzoat e		$\text{C}_9\text{H}_{10}\text{O}_3$	607-90-9	180.200		97	239	1.0979 ²⁰	1.5161 ²⁰	s ct c, C ₅
9242	Propyl 4-hydroxybenzoat e	Propyl paraben	$\text{C}_9\text{H}_{12}\text{O}_3$	94-13-3	180.200	pr (et h)	97		1.0630 ⁹²	1.5050 ¹⁰²	i H ₂ O; s Et OH, et h; sl chl
9243	Propyl i odone		$\text{C}_6\text{H}_{11}\text{NO}_3$	587-61-1	447.008		186				
9244	Propyl i sobut anoat e		$\text{C}_8\text{H}_{16}\text{O}_2$	644-49-5	130.185			135.4	0.8843 ⁰	1.3955 ²⁰	sl H ₂ O; s Et OH, ace; vs et h
9245	Propyl i socyanat e	1-Isocyanat opropane	$\text{C}_3\text{H}_7\text{NO}$	110-78-1	85.105			83.5	0.908 ²⁵	1.3970 ²⁰	
9246	Propyl i sot hi ocyanat e	1-Isot hi ocyanat opropane	$\text{C}_3\text{H}_7\text{NS}$	628-30-8	101.171			153	0.9781 ¹⁶	1.5085 ¹⁶	sl H ₂ O; msc Et OH, et h
9247	Propyl met hacryl at e		$\text{C}_8\text{H}_{10}\text{O}_2$	2210-28-8	128.169			141	0.9022 ²⁰	1.4190 ²⁰	i H ₂ O; msc Et OH, et h
9248	Propyl 3-met hyl but anoat e	Propyl i sopent anoat e	$\text{C}_8\text{H}_{16}\text{O}_2$	557-00-6	144.212			155.9	0.8617 ²⁰	1.4031 ²⁰	vs et h, Et OH
9249	1-Propyl naph t hal ene		$\text{C}_{10}\text{H}_{14}$	2765-18-6	170.250	li q	-8.6	274.5	0.9897	1.5923 ²⁰	
9250	Propyl ni t rat e		$\text{C}_3\text{H}_7\text{NO}_3$	627-13-4	105.093			110	1.0538 ²⁰	1.3973 ²⁰	sl H ₂ O; s Et OH, et h, ct c
9251	Propyl ni t ri t e		$\text{C}_3\text{H}_7\text{NO}_2$	543-67-9	89.094	li q		48	0.888	1.3604 ²⁰	sl H ₂ O; s Et OH, et h
9252	Propyl oct anoat e		$\text{C}_9\text{H}_{18}\text{O}_2$	624-13-5	186.292	li q	-46.2	226.4	0.8659	1.4191 ²⁵	vs ace, et h, Et OH
9253	Propyl pent anoat e		$\text{C}_8\text{H}_{16}\text{O}_2$	141-06-0	144.212	li q	-70.7	167.5	0.8699	1.4065 ²⁰	i H ₂ O; s Et OH, et h, chl
9254	2-Propyl pent anoi c aci d	Val proi c aci d	$\text{C}_8\text{H}_{16}\text{O}_2$	99-66-1	144.212	col li q		221; 120	0.904 ²⁵	1.425 ²⁵	sl H ₂ O
9255	2-Propyl phenol		$\text{C}_9\text{H}_{10}\text{O}$	644-35-9	136.190		7	220	1.015 ²⁰		vs et h, Et OH
9256	4-Propyl phenol		$\text{C}_9\text{H}_{10}\text{O}$	645-56-7	136.190		22	232.6	1.009 ²⁰	1.5379 ²⁵	sl H ₂ O, ct c; s Et OH
9257	2-Propyl pi peri di n(ol)	Coni i ne	$\text{C}_8\text{H}_{17}\text{N}$	458-88-8	127.228	li q	-1.0	166.5	0.8440	1.4512 ²²	sl H ₂ O, chl; msc Et OH; vs et h; s bz
9258	trans-6-Propyl -3-pi peri di nol S(3)	Pseudoconhydr i ne	$\text{C}_8\text{H}_{17}\text{NO}$	140-55-6	143.227	hyg nd (et h)	106	236			vs H ₂ O, et h, Et OH
9259	N-Propyl propanami de		$\text{C}_8\text{H}_{15}\text{NO}$	3217-86-5	115.173			154	215; 108 ⁹	0.8985 ²⁵	sl H ₂ O, et h
9260	Propyl propanoat e	Propyl propi onat e	$\text{C}_8\text{H}_{16}\text{O}_2$	106-36-5	116.158	li q	-75.9	122.5	0.8809	1.3935 ²⁰	sl H ₂ O, ct c; msc Et OH, et h; s ace
9261	2-Propyl pyri di ne		$\text{C}_8\text{H}_{11}\text{N}$	622-39-9	121.180		1.0	167	0.9119 ²⁰	1.4925 ²⁰	sl H ₂ O; msc Et OH, et h; vs ace
9262	4-Propyl pyri di ne		$\text{C}_8\text{H}_{11}\text{N}$	1122-81-2	121.180			185	0.9381 ¹⁵	1.4966 ²⁰	vs et h, Et OH
9263	2-Propyl -4-pyri di ncarbot hi oami de	Prot i onami de	$\text{C}_9\text{H}_{17}\text{N}_2\text{S}$	14222-60-7	180.269			136.7			
9264	Propyl Red	Benzo i c aci d, 2-[[4-(di propyl ami no)phenyl]azo]-	$\text{C}_{19}\text{H}_{23}\text{N}_3\text{O}_2$	2641-01-2	325.405	vi ol-bl or purp red cry (al)					s Et OH, KOH
9265	(Propyl t hi o)benzene		$\text{C}_9\text{H}_{12}\text{S}$	874-79-3	152.256	li q	-45	220	0.9995	1.5571 ²⁰	
9266	Propyl 4-t ol uenesul f onat e		$\text{C}_{10}\text{H}_{14}\text{O}_3\text{S}$	599-91-7	214.281		<-20	189 ⁹	1.144 ²⁰	1.4998 ²⁰	
9267	Propyl t ri chl oroacet at e		$\text{C}_3\text{HCl}_3\text{O}_2$	13313-91-2	205.468			187	1.3221 ²⁰	1.4501 ²⁰	vs et h, Et OH
9268	Propyl 3,4,5-t ri hydroxybenzoat e	Propyl gall at e	$\text{C}_{10}\text{H}_{10}\text{O}_5$	121-79-9	212.199	nd (w)	130				sl H ₂ O
9269	Propyl urea		$\text{C}_6\text{H}_{10}\text{N}_2\text{O}$	627-06-5	102.134	pr (al)	108.5				sl H ₂ O, DMSO; s Et OH
9270	Propyl vi nyl et her	1-(Et henyloxy)propane	$\text{C}_8\text{H}_{16}\text{O}$	764-47-6	86.132			65	0.7674 ²⁰	1.3908 ²⁰	
9271	2-Propynal	Propargyl al dehyde	$\text{C}_3\text{H}_2\text{O}$	624-67-9	54.047			60	0.9152 ²⁰	1.4033 ²⁵	msc H ₂ O; s Et OH, et h, ace, bz, t ol
9272	2-Propyn-1-ami ne		$\text{C}_3\text{H}_3\text{N}$	2450-71-7	55.079			83	0.803 ²⁵	1.4480 ²⁰	



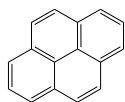
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9273	Propyne	Met hyl acet yl ene	C_3H_4	74-99-7	40.064	col gas	-102.7	-23.2	0.607 ²⁵ (p>1 at m)	1.3863 ⁴⁰	sl H ₂ O; vs Et OH; s bz, chl
9274	2-Propynoi c aci d	Propi ol i c aci d	$\text{C}_3\text{H}_2\text{O}_2$	471-25-0	70.047	cry (CS ₂)	9	dec 144; 72 ⁵⁰	1.1380 ²⁰	1.4306 ²⁰	vs H ₂ O, et h, Et OH, chl
9275	1-Propynyl benzene		C_8H_8	673-32-5	116.160			183	0.942 ¹⁵	1.563 ¹⁵	
9276	Propyzami de	M-(1,1-Di met hyl -2-propynyl)-3,5-di chl orobenzami de	$\text{C}_{12}\text{H}_{11}\text{Cl}_2\text{NO}$	23950-58-5	256.127		155				
9277	Prost agl andi n ₁ E	11,15-Di hydroxy-9-oxo-13-prost enoi c aci d	$\text{C}_{20}\text{H}_{34}\text{O}_5$	745-65-3	354.481	cry (Et OAc)	115				s H ₂ O
9278	Prost agl andi n ₂ E	11,15-Di hydroxy-9-oxo-5,13-prost adi enoi c aci d	$\text{C}_{20}\text{H}_{32}\text{O}_5$	363-24-6	352.465	col cry	67				s H ₂ O, t hf
9279	Prost agl andi n ₂ F ₂	9,11,15-Tri hydroxyprost a-5,13-di enoi c aci d	$\text{C}_{20}\text{H}_{34}\text{O}_5$	551-11-1	354.481	oi l or sol i d	≈30				sl H ₂ O; s Et OH, MeOH, chl , AcOEt
9280	Prot opi ne	Fumari ne	$\text{C}_4\text{H}_4\text{NO}_5$	130-86-9	353.369	mcl pr (al -chl)	208				i ₂ B; sl Et OH, et h, bz, pet h; s chl
9281	Prot overi ne		$\text{C}_7\text{H}_{13}\text{NO}_9$	76-45-9	525.632	nd (MeOH)	221				i H ₂ O; s Et OH, bz, aq aci d, MeOH
9282	Prot ri pt yl i ne hydrochl ori de	Tri pt i l	$\text{C}_{19}\text{H}_{22}\text{ClN}$	1225-55-4	299.838	cry (2-PrOH/et h)	170				
9283	Prunet i n		$\text{C}_6\text{H}_{12}\text{O}_5$	552-59-0	284.263		239.5				
9284	Pseudoaconi t i ne		$\text{C}_{30}\text{H}_{51}\text{NO}_{12}$	127-29-7	689.790	t cl (MeOH)	214				vs et h, Et OH
9285	Pseudocodei ne		$\text{C}_9\text{H}_{21}\text{NO}_3$	466-96-6	299.365	wh nd	181.5		1.290 ⁸⁰	1.574	
9286	Pseudoj ervi ne		$\text{C}_8\text{H}_{19}\text{NO}_8$	36069-05-3	587.744	wh nd or hex cry	304 dec				i H ₂ O, et h, bz, chl , t ol , pet h; s Et OH
9287	Pseudomorphi ne		$\text{C}_{24}\text{H}_{36}\text{N}_2\text{O}_6$	125-24-6	568.659	cry (aq NH ₃ , + 3 w)	282.5				i H ₂ O, Et OH, et h, chl , sul f ; s py, NH ₃
9288	Pseudot ropi ne	8-Met hyl -8-azabi cycl o[3.2.1]oct an-3-ol , <i>exo</i>	$\text{C}_8\text{H}_{15}\text{NO}$	135-97-7	141.211	ort h cry (et h), ort h bi pym (pet h-bz)	109	241			vs H ₂ O, Et OH; sl et h; s bz, chl
9289	Psoral en		$\text{C}_9\text{H}_6\text{O}_3$	66-97-7	186.164	nd (w, Et OH)	171				
9290	Pt eri di ne	Pyrazi no[2,3-d]pyri mi di ne	$\text{C}_8\text{H}_8\text{N}_2$	91-18-9	132.123	ye pl (bz, sub)	139.5	sub 125			vs H ₂ O; s Et OH; sl et h, bz
9291	2,4(1 <i>H</i> ,3 <i>H</i>)-Pt eri di nedione	Lumazi ne	$\text{C}_8\text{H}_8\text{N}_2\text{O}_2$	487-21-8	164.122	ye-oran nd (w)	348.5				vs HOAc
9292	Pul egone		$\text{C}_{10}\text{H}_{16}\text{O}$	89-82-7	152.233			224	0.9346 ⁶⁵	1.4894 ²⁰	i H ₂ O; msc Et OH, et h, chl ; s ct c
9293	1 <i>H</i> -Puri ne	θ <i>H</i> lmi dazo[4,5-d]pyri mi di ne	$\text{C}_4\text{H}_4\text{N}_4$	120-73-0	120.113		216.5				vs H ₂ O, Et OH; sl et h, chl ; s ace
9294	1 <i>H</i> -Puri ne-2,6-di ami ne	2,6-Di ami nopuri ne	$\text{C}_4\text{H}_6\text{N}_6$	1904-98-9	150.142	cry (di l al)	302				
9295	Pyocyani ne		$\text{C}_9\text{H}_{10}\text{N}_2\text{O}$	85-66-5	210.230	dk bl nd (w+1) (chl -pet h)	133 dec				sl H ₂ O, bz; s Et OH, ace; i et h; vs chl
9296	4 <i>H</i> -Pyran	1,4-Pyran	$\text{C}_4\text{H}_6\text{O}$	289-65-6	82.101	unst ab oi l		80		1.4599	s Et OH, et h, bz
9297	2 <i>H</i> -Pyran-2-one		$\text{C}_4\text{H}_4\text{O}_2$	504-31-4	96.085		8.5	207.5	1.200 ²⁰	1.5270 ²⁵	msc H ₂ O; vs ace
9298	4 <i>H</i> -Pyran-4-one		$\text{C}_4\text{H}_4\text{O}_2$	108-97-4	96.085		32.5	212.5	1.190 ²⁵	1.5238	vs H ₂ O, chl , et h; s Et OH, bz; sl C ₆ S
9299	Pyrant el		$\text{C}_6\text{H}_{14}\text{N}_2\text{S}$	15686-83-6	206.307	cry (MeOH)	178				
9300	4 <i>H</i> -Pyran-4-t hi one		$\text{C}_4\text{H}_4\text{OS}$	1120-93-0	112.150		49				s H ₂ O
9301	8,16-Pyranthre尼迪 one		$\text{C}_8\text{H}_{14}\text{O}_2$	128-70-1	406.431	red-ye or red-br nd (PhNO ₂)	dec	sub			
9302	Pyrazi ne	1,4-Di azi ne	$\text{C}_4\text{H}_6\text{N}_2$	290-37-9	80.088	pr (w)	51.0	115	1.0311 ⁶¹	1.4953 ⁶¹	s H ₂ O, Et OH, et h, ace; sl ct c
9303	Pyrazi necarboxami de	Pyrazi nami de	$\text{C}_5\text{H}_7\text{N}_3\text{O}$	98-96-4	123.113	wh nd (w, al)	192	sub			s H ₂ O, Et OH
9304	Pyrazi necarboxyl i c aci d	Pyrazi noi c aci d	$\text{C}_5\text{H}_7\text{N}_3\text{O}_2$	98-97-5	124.098	wh nd (w)	225 dec	sub			
9305	2,3-Pyrazi ned i carboxyl i c aci d	2,3-Di carboxypyrazi ne	$\text{C}_5\text{H}_7\text{N}_3\text{O}_4$	89-01-0	168.107	pr (w+2)	193 dec				vs H ₂ O; sl Et OH, et h, bz; s ace, MeOH
9306	1 <i>H</i> -Pyrazole	1,2-Di azole	$\text{C}_4\text{H}_4\text{N}_2$	288-13-1	68.077	nd or pr (li g)	70.7	187		1.4203	s H ₂ O, Et OH, et h, bz; sl chl



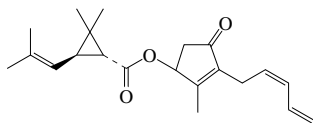
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9307	1-Pyrenami ne		C ₁₆ H ₁₁ N	1606-67-3	217.265	yellow (hex) l f (di l i 117.5 al)					s Et OH, ace, hx, aci d; sl chl
9308	Pyrene	Benzo[def]phenanthrene	C ₁₆ H ₁₀	129-00-0	202.250	pa yellow (t o, sub)	150.62	404	1.271 ²³		i H ₂ O; s Et OH, et h, bz, t ol; sl ct c
9309	Pyret hri n I		C ₁₈ H ₂₆ O ₃	121-21-1	328.445	visc li q		170 dec	1.5192 ¹⁸	1.5192 ¹⁸	i H ₂ O; s Et OH, et h, ct c, pet h
9310	Pyret hri n II		C ₁₈ H ₂₆ O ₃	121-29-9	372.454	visc li q		200 dec		1.5258 ²⁰	i H ₂ O; s Et OH, et h, ct c, pet h
9311	Pyridate		C ₇ H ₁₃ ClN ₂ O ₂ S	55512-33-9	378.916	br oil	27	220 ¹	1.555 ²⁰	1.568 ²⁰	i H ₂ O
9312	Pyridazine	1,2-Diazabenzene	C ₆ H ₆ N ₂	289-80-5	80.088	li q	-8	208	1.103 ⁵	1.5218 ²⁰	misc H ₂ O, Et OH; vs et h, ace, bz; i pet h
9313	2-Pyridamine	2-Aminopyridine	C ₅ H ₆ N ₂	504-29-0	94.115	l f (li g)	57.5	105			s Et OH, et h, ace, bz; sl chl
9314	3-Pyridamine	3-Aminopyridine	C ₅ H ₆ N ₂	462-08-8	94.115	l f (bz-li g)	64.5	252			s Et OH, et h; sl li g
9315	4-Pyridamine	4-Aminopyridine	C ₅ H ₆ N ₂	504-24-5	94.115	nd (bz)	158.5	273			s H ₂ O, et h, bz; vs Et OH; sl li g
9316	Pyridine	Azine	C ₅ H ₅ N	110-86-1	79.101	li q	-41.70	115.23	0.981 ⁹	1.5095 ²⁰	misc H ₂ O, Et OH, et h, ace, bz, chl
9317	2-Pyridinecarbonyl		C ₆ H ₄ NO	100-70-9	104.109	nd or pr (et h)	29	224.5	1.081 ⁶	1.5242 ²⁵	s H ₂ O, chl; vs Et OH, et h, bz; sl ct c
9318	3-Pyridinecarbonyl		C ₆ H ₄ NO	100-54-9	104.109	nd (li g), pet h-et h)	51	206.9; 170 ³⁰⁰	1.1590 ²⁵		vs H ₂ O, Et OH, et h, bz; s chl; sl li g
9319	4-Pyridinecarbonyl		C ₆ H ₄ NO	100-48-1	104.109	nd (li g-et h)	83	186			s Et OH, et h, bz, chl; sl li g
9320	3-Pyridinecarboxamide		C ₆ H ₅ NO ₂ S	4621-66-3	138.190		192				
9321	4-Pyridinecarboxamide		C ₆ H ₅ NO ₂ S	2196-13-6	138.190		198 dec				
9322	2-Pyridinecarboxaldehyde		C ₆ H ₄ NO	1121-60-4	107.110			180; 62 ¹³	1.1181 ²⁵	1.5389 ¹⁸	s H ₂ O, Et OH, et h, AcOEt; sl ct c
9323	3-Pyridinecarboxaldehyde	Nicotinaldehyde	C ₆ H ₄ NO	500-22-1	107.110			92 ²³	1.1394 ²⁵		s H ₂ O, Et OH, ace, chl; sl et h, pet h
9324	4-Pyridinecarboxaldehyde		C ₆ H ₄ NO	872-85-5	107.110			77 ¹²		1.5423 ²⁰	s H ₂ O, et h, ct c
9325	2-Pyridinecarboxaldehyde oxide		C ₆ H ₃ FN ₂ O	873-69-8	122.124		112.5				
9326	2-Pyridinecarboxamide		C ₆ H ₅ N ₂ O	1452-77-3	122.124	mcl pr (w)	108.3				sl H ₂ O, chl; s Et OH, bz
9327	3-Pyridinecarboxamide	Nicotinamide	C ₆ H ₆ NO	98-92-0	122.124	wh pw, nd (bz)	130	157 ^{0.0005}	1.400 ²⁵	1.466	vs H ₂ O, Et OH, glycerol; sl chl
9328	4-Pyridinecarboxamide		C ₆ H ₅ N ₂ O	1453-82-3	122.124		157.5				
9329	2-Pyridinecarboxylic acid	Picolinic acid	C ₆ H ₅ NO ₂ C	98-98-6	123.110	nd (w, al, bz)	136.5	sub			sl H ₂ O, bz; s Et OH; i et h, chl, CS
9330	3-Pyridinecarboxylic acid	Nicotinic acid	C ₆ H ₅ NO ₂ C	59-67-6	123.110	nd (al, w)	236.6	sub	1.473 ⁵		sl H ₂ O, Et OH, et h
9331	4-Pyridinecarboxylic acid	Isonicotinic acid	C ₆ H ₅ NO ₂ C	55-22-1	123.110	nd(w)	315	sub 260			sl H ₂ O, Et OH, et h, bz
9332	3-Pyridinecarboxylic acid 1-oxide	Oxynicotinic acid	C ₆ H ₄ NO ₃ C	2398-81-4	139.109	nd	254 dec				vs H ₂ O, MeOH
9333	4-Pyridinecarboxylic acid 1-oxide		C ₆ H ₄ NO ₃ C	13602-12-5	139.109		273 dec				
9334	2,3-Pyridinediamine		C ₅ H ₆ N ₂	452-58-4	109.130	l f or pl (di l al)	120.8	149			s H ₂ O, Et OH, bz
9335	2,5-Pyridinediamine	2,5-Diaminopyridine	C ₅ H ₆ N ₂	4318-76-7	109.130	nd	110.3	182 ¹²			vs H ₂ O, Et OH
9336	2,6-Pyridinediamine		C ₅ H ₆ N ₂	141-86-6	109.130		121.5	285; 148 ⁵			sl H ₂ O, ace
9337	3,4-Pyridinediamine		C ₅ H ₆ N ₂	54-96-6	109.130	nd or l f	219.3				
9338	2,3-Pyridinedicarboxylic acid	Quinolinic acid	C ₇ H ₄ NO ₄ C	89-00-9	167.120	mcl pr (w)	228.5				sl H ₂ O, t f a; i Et OH, et h, bz
9339	2,4-Pyridinedicarboxylic acid	Lutidinic acid	C ₇ H ₄ NO ₄ C	499-80-9	167.120	l f (w+1)	249		0.94 ²		sl H ₂ O; s Et OH; i et h, bz, CS
9340	2,5-Pyridinedicarboxylic acid	Isocinchomeronic acid	C ₇ H ₄ NO ₄ C	100-26-5	167.120	l f or pr (di l HCl)	254				s Et OH, HCl; sl Et OH; i et h, bz
9341	2,6-Pyridinedicarboxylic acid	Dipicolinic acid	C ₇ H ₄ NO ₄ C	499-83-2	167.120	nd (w+3/2)	252				sl H ₂ O, Et OH, HOAc
9342	3,4-Pyridinedicarboxylic acid	Cinchomeronic acid	C ₇ H ₄ NO ₄ C	490-11-9	167.120	cry (w)	256	sub			sl H ₂ O, Et OH, bz; i et h, chl
9343	3,5-Pyridinedicarboxylic acid	Dinicotinic acid	C ₇ H ₄ NO ₄ C	499-81-0	167.120	cry (w)	324	sub			i H ₂ O; sl et h, HOAc; s DMSO, HCl
9344	2,3-Pyridinedicarboxylic acid anhydride	Furo[3,4-b]pyridine-5,7-dione	C ₇ H ₄ NO ₃	699-98-9	149.104		138				
9345	2-Pyridine nectanamine		C ₇ H ₆ N ₂	2706-56-1	122.167			213; 131 ⁵⁰	1.0220 ²⁵	1.5335 ²⁵	
9346	4-Pyridine nectanamine		C ₇ H ₆ N ₂	13258-63-4	122.167			121 ¹⁰	1.0302 ²⁵	1.5381 ²⁵	vs H ₂ O
9347	2-Pyridine nectanol		C ₇ H ₇ NO	103-74-2	123.152		-7.8	190 ²⁰⁰ ; 170 ¹⁰⁰	1.091 ²⁵	1.5366 ²⁰	vs H ₂ O, Et OH, chl; sl et h



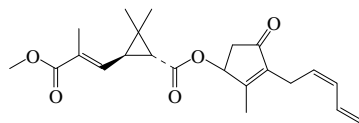
1-Pyrenamine



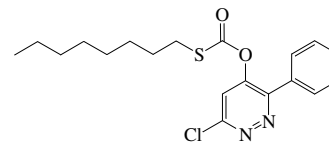
Pyrene



Pyrethrin



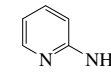
Pyrethrin II



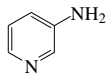
Pyridate



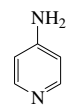
Pyridazine



2-Pyridinamine



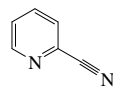
3-Pyridinamine



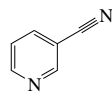
4-Pyridinamine



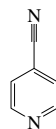
Pyridine



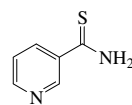
2-Pyridine nitrile



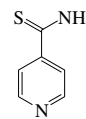
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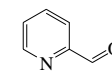
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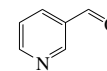
3-Pyridine thioamide



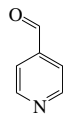
4-Pyridine thioamide



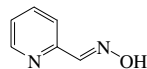
2-Pyridine carboxaldehyde



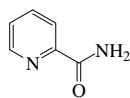
3-Pyridine carboxaldehyde



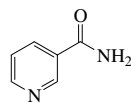
4-Pyridine carboxaldehyde



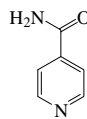
2-Pyridine carboxaldehyde oxime



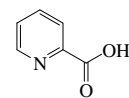
2-Pyridine carboxamide



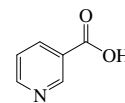
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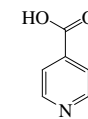
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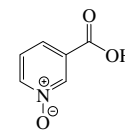
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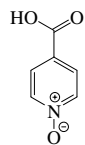
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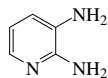
4-Pyridine carboxylic acid



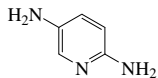
3-Pyridine carboxylic acid dioxide



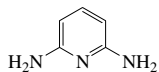
4-Pyridine carboxylic acid dioxide



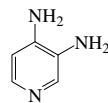
2,3-Pyridinediamine



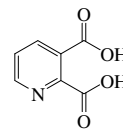
2,5-Pyridinediamine



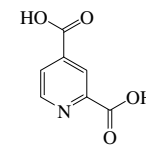
2,6-Pyridinediamine



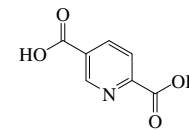
3,4-Pyridinediamine



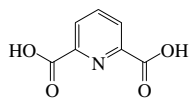
2,3-Pyridine dicarboxylic acid



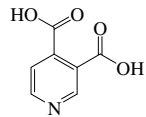
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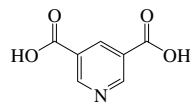
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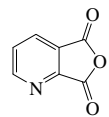
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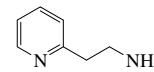
3,4-Pyridine dicarboxylic acid



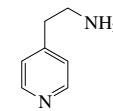
3,5-Pyridine dicarboxylic acid



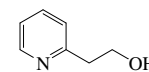
2,3-Pyridine dicarboxylic acid anhydride



2-Pyridylpropanamine

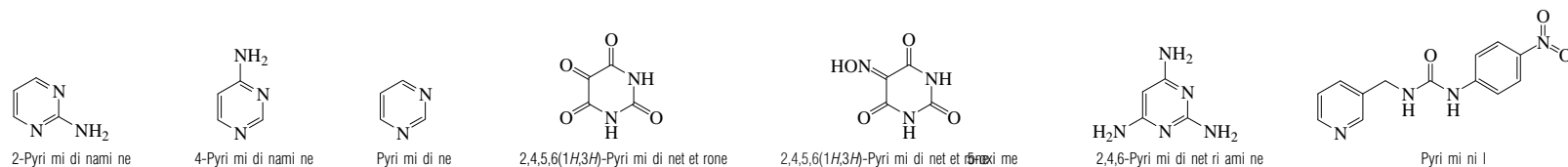
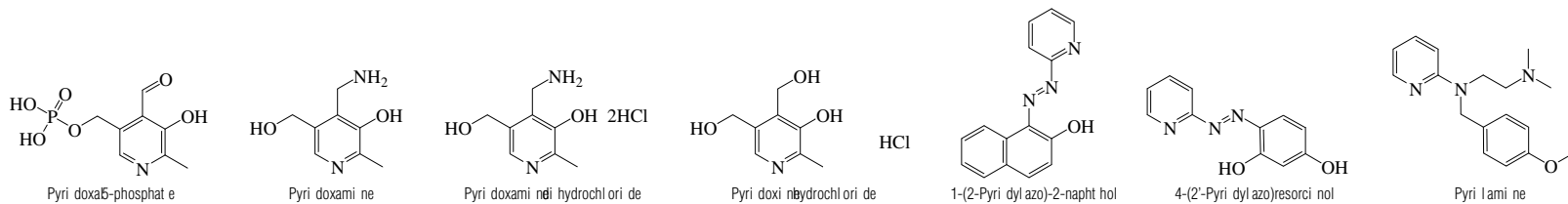
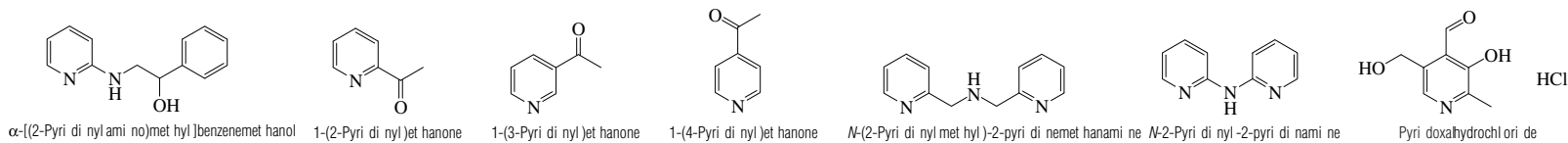
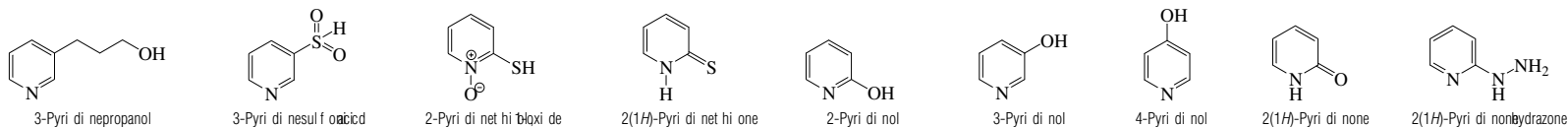
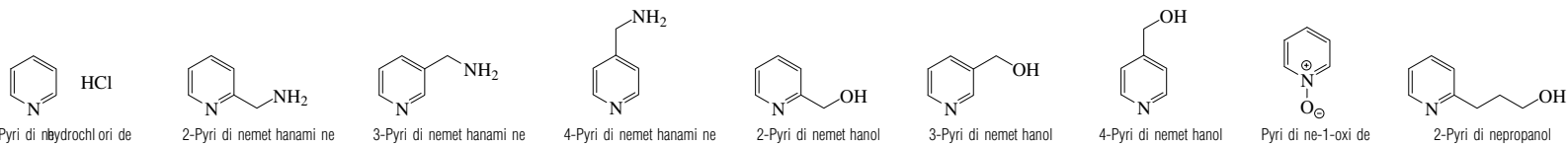


4-Pyridylpropanamine

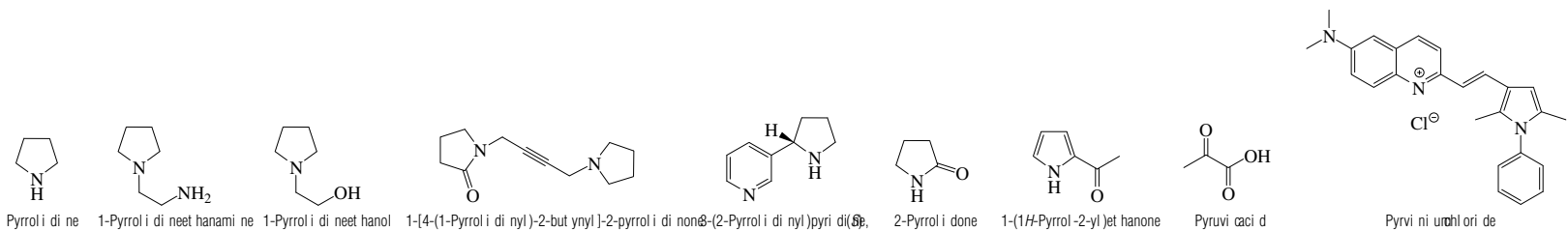
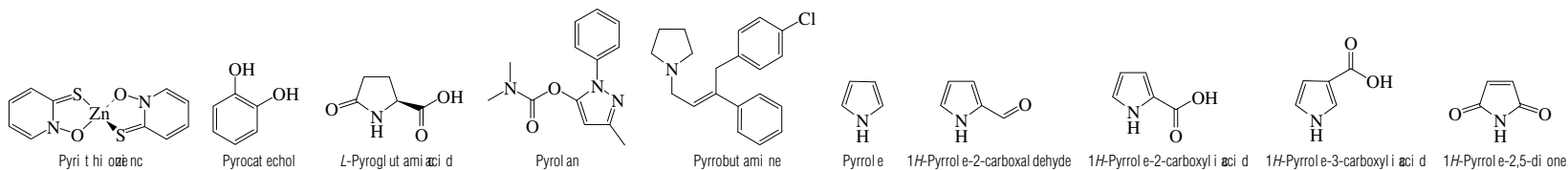


2-Pyridylpropanol

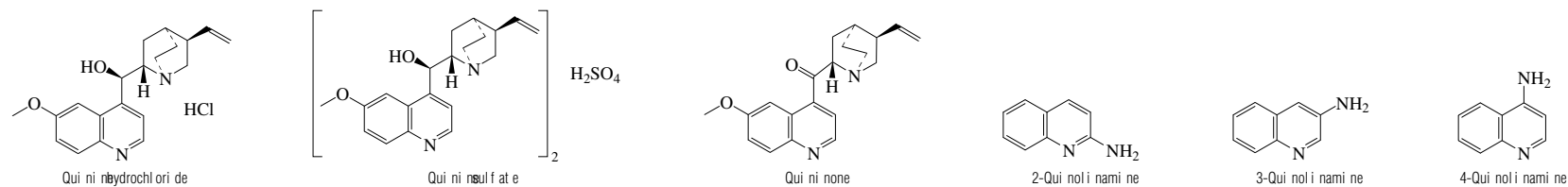
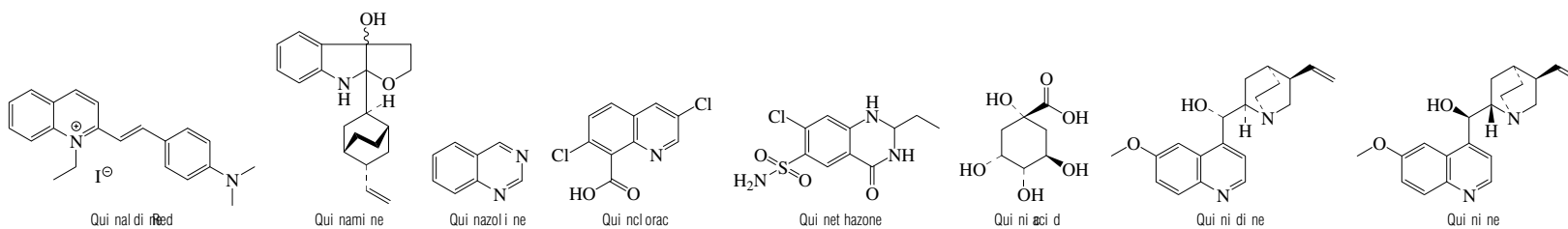
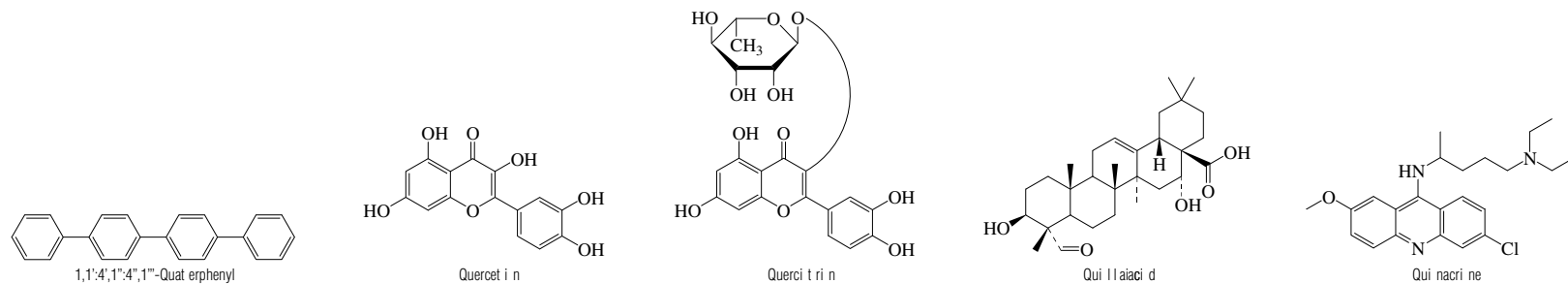
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9348	Pyri di ne hydrochl ori de		$\text{C}_6\text{H}_5\text{ClN}$	628-13-7	115.562	hyg pl or sc (al)	146	222			vs H_2O , Et OH, chl
9349	2-Pyri di nemet hanami ne		$\text{C}_6\text{H}_5\text{N}_2$	3731-51-9	108.141			203; 91 ¹⁷	1.0525 ²⁵	1.5431 ²⁵	vs H_2O
9350	3-Pyri di nemet hanami ne		$\text{C}_6\text{H}_5\text{N}_2$	3731-52-0	108.141	li q	-21.1	226	1.064 ⁴	1.552 ²⁰	vs H_2O , et h, Et OH
9351	4-Pyri di nemet hanami ne		$\text{C}_6\text{H}_5\text{N}_2$	3731-53-1	108.141	li q	-7.6	230; 109	1.072 ²⁰	1.5495 ²⁵	vs H_2O
9352	2-Pyri di nemet hanol		$\text{C}_6\text{H}_5\text{CNO}$	586-98-1	109.126			112 ¹⁶ , 102.5 ⁸	1.1317 ²⁰	1.5444 ²⁰	msc H_2O ; vs Et OH, et h, ace, bz
9353	3-Pyri di nemet hanol	Ni cot i nyl alcohoh	$\text{C}_6\text{H}_5\text{NCO}$	100-55-0	109.126	li q	-6.5	266	1.139 ⁴	1.5455 ²⁰	vs H_2O , et h
9354	4-Pyri di nemet hanol	4-Pi colyl alcohoh	$\text{C}_6\text{H}_5\text{NO}$	586-95-8	109.126		53	141 ¹²			s chl
9355	Pyri di ne-1-oxi de	Pyri di nhexi de	$\text{C}_6\text{H}_5\text{NO}$	694-59-7	95.100		65.5	146 ¹³			
9356	2-Pyri di nepropanol		$\text{C}_6\text{H}_7\text{NO}$	2859-68-9	137.179		34	260.2; 116 ⁴	1.060 ²⁵	1.5298 ²⁰	vs H_2O
9357	3-Pyri di nepropanol		$\text{C}_6\text{H}_7\text{NO}$	2859-67-8	137.179			284; 130 ³	1.063 ²⁵	1.5313 ²⁰	vs H_2O
9358	3-Pyri di nesulf oni c aci d	3-Pyri dyl sulf oni c aci d	$\text{C}_6\text{H}_5\text{NO}_2\text{SC}$	636-73-7	159.164	ort h	357 dec		1.713 ⁵		vs H_2O ; sl Et OH; i et h
9359	2-Pyri di net hi ol , 1-oxi de		$\text{C}_6\text{H}_5\text{NOS}$	1121-31-9	127.165		70.5				
9360	2(1 <i>H</i>)-Pyri di net hi one		$\text{C}_6\text{H}_5\text{ONS}$	2637-34-5	111.166		130.0				s H_2O , Et OH, bz, chl
9361	2-Pyri di nol		$\text{C}_6\text{H}_5\text{NO}$	72762-00-6	95.100	nd (bz)	107.8		1.3910 ²⁰		vs H_2O , bz, Et OH
9362	3-Pyri di nol		$\text{C}_6\text{H}_5\text{NO}$	109-00-2	95.100	nd (bz)	129				s H_2O , Et OH; sl et h, chl
9363	4-Pyri di nol		$\text{C}_6\text{H}_5\text{NO}$	626-64-2	95.100	pr or nd (w+1)	149.8	>350; 257 ¹⁰			s H_2O , Et OH; i et h, bz
9364	2(1 <i>H</i>)-Pyri di none		$\text{C}_6\text{H}_5\text{NO}$	142-08-5	95.100	nd (bz)	107.8	280	1.3910 ²⁰		s H_2O , Et OH, bz, chl; sl et h, DMSO
9365	2(1 <i>H</i>)-Pyri di none hidrazone	2-Pyri di nyl hidrazi ne	$\text{C}_6\text{H}_5\text{N}_2$	4930-98-7	109.130		46.6	185 ¹⁴⁰ , 90 ¹			s chl
9366	α -[(2-Pyri di nyl ami no) met hyl]benzenemet hanol	Phenyrami dol	$\text{C}_8\text{H}_{14}\text{N}_2\text{O}$	553-69-5	214.262	cry (di l MeOH)	83.5				
9367	1-(2-Pyri di nyl)et hanone		$\text{C}_7\text{H}_7\text{CNO}$	1122-62-9	121.137	ye i n ai r		192	1.077 ⁷	1.5203 ²⁰	s Et OH, et h, HOAc; sl ct c
9368	1-(3-Pyri di nyl)et hanone	Met hyl pyri dyl ket one	$\text{C}_7\text{H}_7\text{CNO}$	350-03-8	121.137		13.5	220		1.5341 ²⁰	s H_2O , Et OH, et h, aci d
9369	1-(4-Pyri di nyl)et hanone		$\text{C}_7\text{H}_7\text{CNO}$	1122-54-9	121.137		16	212	1.097 ²⁵	1.5282 ²⁵	sl Et OH, et h, aci d
9370	<i>N</i> -(2-Pyri di nyl met hyl)-2-pyri di nemet hanami ne		$\text{C}_{12}\text{H}_{13}\text{N}_3$	1539-42-0	199.251			200 ¹⁰ , 139 ¹	1.1074 ²⁵	1.5757 ²⁵	
9371	<i>N</i> -2-Pyri di nyl -2-pyri di nami ne		$\text{C}_{10}\text{H}_{10}\text{N}_3$	1202-34-2	171.198		90.5	307.5			sl H_2O , chl; vs Et OH, et h, ace, bz
9372	Pyri doxal hydrochl ori de	Vi t ami n B6	$\text{C}_8\text{H}_{10}\text{ClNO}_3$	65-22-5	203.623	ort h	165 dec				vs H_2O ; sl Et OH
9373	Pyri doxal 5-phosphat e	Pyri doxal 5-(di hydrogen phosphat e)	$\text{C}_8\text{H}_{10}\text{NO}_6\text{P}$	54-47-7	247.142	wh-ye pow or cry	141				
9374	Pyri doxami ne	4-(Ami nomet hyl)-5-hydroxy-6-met hyl -3-pyri di nemet hanol	$\text{C}_8\text{H}_{12}\text{N}_2\text{O}_2$	85-87-0	168.193	cry	198				s Et OH, aci d
9375	Pyri doxami ne di hydrochl ori de		$\text{C}_8\text{H}_{12}\text{Cl}_2\text{N}_2\text{O}_2$	524-36-7	241.115	pl (al)	226 dec				vs H_2O ; sl Et OH
9376	Pyri doxi ne hydrochl ori de	5-Hydroxy-6-met hyl -3,4-pyri di nedi met hanol hydrochl ori de	$\text{C}_8\text{H}_{12}\text{ClNO}_3$	58-56-0	205.639	pl (al, ace)	207	sub			vs H_2O
9377	1-(2-Pyri dyl azo)-2-napth hol	PAN	$\text{C}_{11}\text{H}_{11}\text{N}_3\text{O}$	85-85-8	249.267	red-br cry	130				i H_2O ; s Et OH, et h, chl
9378	4-(2'-Pyri dyl azo)resorci nol	PAR	$\text{C}_{11}\text{H}_9\text{N}_3\text{O}_2$	1141-59-9	215.208	red-br cry	187 dec				
9379	Pyri l ami ne		$\text{C}_8\text{H}_{12}\text{N}_3\text{O}$	91-84-9	285.384			201 ⁵			
9380	2-Pyri mi di nami ne		$\text{C}_7\text{H}_7\text{N}_3$	109-12-6	95.103	nd (AcOEt)	127.5	sub			s H_2O ; sl chl
9381	4-Pyri mi di nami ne		$\text{C}_7\text{H}_7\text{N}_3$	591-54-8	95.103	pl (AcOEt)	151.5				vs H_2O , Et OH
9382	Pyri mi di ne	1,3-Di azi ne	$\text{C}_4\text{H}_4\text{N}_2$	289-95-2	80.088		22	123.8		1.4998 ²⁰	msc H_2O ; s Et OH
9383	2,4,5,6(1 <i>H</i> ,3 <i>H</i>)-Pyri mi di net et rone	All oxan	$\text{C}_4\text{H}_4\text{N}_2\text{O}_4$	50-71-5	142.070		256 dec	sub			vs H_2O ; s Et OH, ace, bz, HOAc
9384	2,4,5,6(1 <i>H</i> ,3 <i>H</i>)-Pyri mi di net et rone 5-Vi ol uri c aci d oxi me		$\text{C}_4\text{H}_3\text{N}_3\text{O}_4$	87-39-8	157.085	pa ye ort h	203 dec				sl H_2O ; s Et OH
9385	2,4,6-Pyri mi di net ri ami ne		$\text{C}_4\text{H}_4\text{N}_6$	1004-38-2	125.133		248 dec				
9386	Pyri mi ni l		$\text{C}_{13}\text{O}_{12}\text{N}_4\text{O}_3$	53558-25-1	272.259	sol i d	224 dec				



No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9387	Pyri t hi one zi nc		$_{10}H_{16}N_2O_2S_2Zn$	13463-41-7	317.722	wh sol i d	262				s chl , DMSO, DMF
9388	Pyrocatechol	1,2-Benzenedi ol	$_{6}H_6O_2$	120-80-9	110.111	cry	104.6	245	1.344 ²⁰	1.604 ²⁵	vs H ₂ O, bz, et h, Et OH
9389	L-Pyroglutami c aci d	5-Oxoprol i ne	$_{5}H_7NO_3$	98-79-3	129.115		162				s DMSO
9390	Pyrol an		$_{13}H_{15}N_3O_2$	87-47-8	245.277		50	161 ⁰²			s ct c, C ₅
9391	Pyrrbutami ne	1-[4-(4-Chl orophenyl)-3-phenyl -2-but enyl]pyrrol i di ne	$_{20}H_{22}ClN$	91-82-7	311.849	cry	49	192 ⁵			
9392	Pyrr ol e	Imi dole	$_{4}H_5N$	109-97-7	67.090	li q	-23.39	129.79	0.969 ⁸	1.5085 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz, chl
9393	1 <i>H</i> -Pyrr ol e-2-carboxal dehyde		$_{4}H_5NO$	1003-29-8	95.100	ort h pr (pet h)	46.5	218		1.593 ⁹	sl chl , li g
9394	1 <i>H</i> -Pyrr ol e-2-carboxyl i c aci d		$_{5}H_6NO_2$	634-97-9	111.100	lf (w)	208 dec				s H ₂ O, Et OH, et h
9395	1 <i>H</i> -Pyrr ol e-3-carboxyl i c aci d	3-Pyrr ol ecarboxyl i c aci d	$_{5}H_6NO_2$	931-03-3	111.100	nd (li g)	161.5				
9396	1 <i>H</i> -Pyrr ol e-2,5-di one		$_{4}H_5NO_2$	541-59-3	97.073	pl (bz)	94	sub	1.2493 ⁰⁶		s H ₂ O, Et OH, et h
9397	Pyrr ol i di ne	Azacycl opent ane	$_{4}H_7N$	123-75-1	71.121	col li q	-57.79	86.56	0.858 ⁸⁶	1.4431 ²⁰	msc H ₂ O; s Et OH, et h; sl bz, chl
9398	1-Pyrr ol i di neet hanami ne		$_{6}H_9N_2$	7154-73-6	114.188			166; 68 ²³	0.901 ²⁵	1.4687 ²⁰	
9399	1-Pyrr ol i di neet hanol		$_{6}H_9NO$	2955-88-6	115.173			187; 80 ¹³	0.9750 ²⁰	1.4713 ²⁰	
9400	1-[4-(1-Pyrr ol i di nyl)-2-but nyl]-2-pyrr ol i di none	Oxot remori ne	$_{12}H_{18}N_2O$	70-22-4	206.283	pa ye li q		124 ¹	0.991 ²⁵	1.5160 ²⁰	
9401	3-(2-Pyrr ol i di nyl)pyri di ne	Norni cot i ne	$_{8}H_{12}N_2$	494-97-3	148.204	hyg		270	1.0737 ¹⁹	1.5378 ¹⁸	vs H ₂ O, ace, et h, Et OH
9402	2-Pyrr ol i done	γ-But yrol act am	$_{4}H_7NO$	616-45-5	85.105	cry (pet h)	25	251; 133 ²	1.120 ²⁰	1.4806 ³⁰	vs H ₂ O, Et OH, et h, bz, chl , C ₅
9403	1-(1 <i>H</i> -Pyrr ol -2-yl)et hanone		$_{5}H_7NO$	1072-83-9	109.126	mcl nd (w)	90	220			s H ₂ O, Et OH, et h
9404	Pyruvi c aci d		$_{3}H_4O_3$	127-17-3	88.062		13.8	dec 165; 54 ¹⁰	1.2272 ²⁰	1.4280 ²⁰	msc H ₂ O, Et OH, et h; s ace
9405	Pyruvi ni um chl ori de		$_{26}ClN_3$	548-84-5	417.973	red pow (w)	250 dec				
9406	1,1':4,1":4",1'''-Quat erphenyl		$_{18}H_{18}$	135-70-6	306.400		320	428 ¹⁸			i H ₂ O, Et OH, et h, chl ; s bz, PhNO ₂ , HOAc
9407	Quercet i n		$_{10}H_{10}O_7$	117-39-5	302.236	ye nd (di l al , + 2 w)	316.5	sub			sl H ₂ O, et h, MeOH; s Et OH, ace, py
9408	Querci t ri n	Quercet i n-β-D-glucosyl de	$_{21}H_{20}O_{11}$	522-12-3	448.377	pa ye nd or pl (+2w, di l al)	170				i H ₂ O, et h; s Et OH, HOAc, MeOH, alk
9409	Qui l l ai c aci d		$_{30}H_{46}O_5$	631-01-6	486.683	nd (di l al)	294				vs ace, et h, py, Et OH
9410	Qui nacri ne	Mepacri ne	$_{28}ClN_4O$	83-89-6	399.956	ye oi l	87				
9411	Qui nal di ne Red		$_{23}H_{23}N_2$	117-92-0	430.325	dk red pow					s H ₂ O; vs Et OH
9412	Qui nami ne		$_{12}H_{12}N_2O_2$	464-85-7	312.406	pr (bz), nd (80% al)	185.5				i H ₂ O; vs Et OH, bz; s et h, ace
9413	Qui nazol i ne	1,3-Benzodi azi ne	$_{8}H_{10}N_2$	253-82-7	130.147	ye pl (pet h)	48	241			vs H ₂ O; s Et OH, et h, ace, bz; sl chl
9414	Qui ncl orac	3,7-Di chl oroqui nol i ne-8-carboxyl i c aci d	$_{10}H_6Cl_2NO_2$	84087-01-4	242.059		274		1.75		
9415	Qui net hazone		$_{12}H_{12}ClN_2O_3S$	73-49-4	289.738						s t f a
9416	Qui ni c aci d		$_{16}H_{16}O_6$	77-95-2	192.166		162.5		1.64 ²⁵		vs H ₂ O, Et OH, HOAc
9417	Qui ni di ne		$_{20}H_{24}N_2O_2$	56-54-2	324.417	cry (+2.5w, di l al)	174				sl H ₂ O, et h; s Et OH, bz; vs chl ; i pet h
9418	Qui ni ne	6'-Met hoxyci nchonon-9-ol(β)	$_{20}H_{24}N_2O_2$	130-95-0	324.417		57			1.625 ¹⁵	sl H ₂ O, ace; vs Et OH, py; s et h, chl
9419	Qui ni ne hydrochl ori de	6'-Met hoxyci nchonon-9-ol monohydrochl ori de, (β,9β)	$_{20}H_{25}ClN_2O_2$	130-89-2	360.878	si l ky ef flor nd (w)	159				vs H ₂ O, Et OH, chl
9420	Qui ni ne sul f ate		$_{20}H_{24}N_2O_6S$	804-63-7	746.912	si l ky nd (w)	235.2				vs Et OH
9421	Qui ni none		$_{12}H_{12}N_2O_2$	84-31-1	322.401	nd, lf (et h)	108				vs bz, et h, Et OH
9422	2-Qui nol i nami ne	2-Ami noqui nol i ne	$_{8}H_8NC$	580-22-3	144.173	lf (w)	131.5	sub			vs H ₂ O; s Et OH, et h, ace, chl ; sl bz
9423	3-Qui nol i nami ne	3-Ami noqui nol i ne	$_{8}H_8NC$	580-17-6	144.173	ort h (w, di l al)	94				vs et h, Et OH, chl
9424	4-Qui nol i nami ne	4-Ami noqui nol i ne	$_{8}H_8NC$	578-68-7	144.173	nd (bz, di l al)	154.8	180			s H ₂ O, bz, chl ; vs Et OH, et h

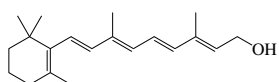


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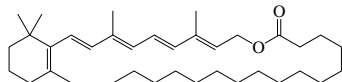


No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9425	5-Quinolamine	5-Aminoquinoline	$C_8H_8N_2$	611-34-7	144.173	yellow liquid (ethanol)	110	310; 184 ¹⁰			sl H ₂ O; vs Et OH, ethanol; s benzene; liquid
9426	6-Quinolamine	6-Aminoquinoline	$C_8H_8N_2$	580-15-4	144.173	crystal (w+2), (ethanol)	114	187 ¹²			sl H ₂ O, ethanol; s NH ₃ , Et OH
9427	8-Quinolamine	8-Aminoquinoline	$C_8H_8N_2$	578-66-5	144.173	yellow liquid (sublimation), (ethanol, liquid)	70	157 ¹⁹			vs H ₂ O, Et OH
9428	Quinoline	1-Azaphthalene	C_8H_7N	91-22-5	129.159	liquid	-14.78	237.16	1.097 ⁷	1.6268 ²⁰	sl H ₂ O; misc Et OH, ethanol, acetone, benzene, CS ₂ , acetone
9429	4-Quinolincarboxaldehyde	Cinchoninaldehyde	$C_{10}H_9NO$	4363-93-3	157.169	solid (t-o-petroleum)	51	122			vs ethanol, toluene
9430	2-Quinolincarboxylic acid	Quinolinecarboxylic acid	$C_9H_7NO_2$	93-10-7	173.169		156				s H ₂ O; vs benzene
9431	8-Quinolincarboxylic acid	8-Carboxyquinoline	$C_9H_7NO_2$	86-59-9	173.169	solid (water)	187	sub			vs Et OH
9432	2(1H)-Quinolinetriamine		$C_8H_8N_3$	2637-37-8	161.224		187				in H ₂ O; vs Et OH, ethanol, benzene; sl DMSO
9433	2-Quinolinalcohol	2-Hydroxyquinoline	C_8H_7NO	59-31-4	145.158	pr (MeOH)	199.5	sub			sl H ₂ O, DMSO; vs Et OH, ethanol; s diethyl ether, HCl
9434	3-Quinolinalcohol	3-Hydroxyquinoline	C_8H_7NO	580-18-7	145.158	crystal (benzene, diethyl ether)	201.3				in Et OH, s Et OH; sl ethanol, chloroform; vs benzene
9435	4-Quinolinalcohol	4-Hydroxyquinoline	C_8H_7NO	611-36-9	145.158	solid (w+3)	210				vs H ₂ O, Et OH; sl ethanol, benzene, petroleum ether
9436	5-Quinolinalcohol	5-Hydroxyquinoline	C_8H_7NO	578-67-6	145.158	solid (alcohol), (petroleum)	226 dec	sub			s H ₂ O, benzene, chloroform; sl Et OH; vs MeOH; liquid
9437	6-Quinolinalcohol	6-Hydroxyquinoline	C_8H_7NO	580-16-5	145.158	pr (alcohol, ethanol)	195	360			in Et OH, benzene, chloroform; sl Et OH, ethanol; s alcohol
9438	7-Quinolinalcohol	7-Hydroxyquinoline	C_8H_7NO	580-20-1	145.158	pr (alcohol), solid (diethyl ether-ethanol)	239	sub			vs Et OH
9439	8-Quinolinalcohol	8-Hydroxyquinoline	C_8H_7NO	148-24-3	145.158	solid (diethyl ether)	75.5	267	1.034		in H ₂ O, ethanol; vs Et OH, benzene, chloroform; s acetone
9440	8-Quinolinalcohol benzoate	Benzoyloxyquinoline	$C_{15}H_{13}NO_2$	86-75-9	249.264						sl chloroform
9441	8-Quinolinalcohol sulfate (2:1)	8-Hydroxyquinoline sulfate	$C_{18}H_{15}N_2O_6S$	134-31-6	388.934		177.5				vs H ₂ O; s Et OH; liquid
9442	Quinolinecarboxylic acid		$C_8H_6NO_2$	465-74-7	166.133	solid (petroleum)	298 dec				
9443	Quinolinecarboxylic acid		$C_8H_6NO_2$	7658-08-4	164.156	crystal (AcOEt)	139.5				vs H ₂ O, Et OH
9444	Quinoxaline	1,4-Benzodiazine	$C_8H_6N_2$	91-19-0	130.147	crystal (petroleum)	28	229.5	1.1334 ⁸	1.6231 ⁴⁸	s H ₂ O; misc Et OH, ethanol, acetone, benzene; sl chloroform
9445	2(1H)-Quinoxaline		$C_8H_6N_2O$	1196-57-2	146.146	liquid (alcohol)	271	sub 200			
9446	Quinoxaline		$C_8H_6N_2$	76578-14-8	372.802	white crystal	93	220 ⁰²			in H ₂ O; s benzene, Et OH, acetone, xylene
9447	Quinoxaline		$C_8H_6N_2$	10088-95-6	236.220		221.5				sl chloroform
9448	Rafinose		$C_{18}H_{32}O_{16}$	512-69-6	504.437		80		1.465 ²⁵		s H ₂ O, pyridine; vs MeOH; sl Et OH; liquid
9449	Ranitidine		$C_{13}H_{12}N_4O_2S$	66357-35-5	314.404	solid	69.5				
9450	Raubasine		$C_7H_{24}N_2O_3$	483-04-5	352.427		258 dec				in H ₂ O; s MeOH
9451	Raunescine		$C_8H_{38}N_2O_3$	117-73-7	564.626		165				in H ₂ O; s Et OH, chloroform, HOAc
9452	Reinecke salt		$C_4H_4CrN_4O_4$	13573-16-5	354.440	red crystal (water)	270 dec				s H ₂ O, Et OH, acetone; liquid
9453	Resazurin	7-Hydroxy-3H-phenoxazin-3-one, 10-oxide	$C_{12}H_7NO_4$	550-82-3	229.189	dark red to gray or purple (HOAc)		sub			in H ₂ O, ethanol; sl Et OH, HOAc; s alcohol
9454	Rescinnamine		$C_{31}H_{42}N_2O_3$	24815-24-5	634.716	solid (benzene)	238.5				in H ₂ O; sl Et OH; s acetone, chloroform, AcOEt
9455	Reserpinecarboxylic acid		$C_{28}H_{32}N_2O_5$	83-60-3	400.467	crystal (MeOH)	242				
9456	Reserpine		$C_{28}H_{32}N_2O_4$	50-55-5	608.679	liquid (diethyl ether)	264.5				sl Et OH, ethanol, acetone; s Et OH, benzene, AcOEt
9457	Reserpine, (-)		$C_{28}H_{32}O_3$	10453-86-8	338.439		75				
9458	Resorcinol	1,3-Benzenediol	$C_6H_6O_2$	108-46-3	110.111	solid (benzene), (water)	109.4	276.5; 178 ⁶	1.278 ²⁰	1.578 ²⁵	vs H ₂ O, carbon tetrachloride; s Et OH, ethanol; sl benzene, chloroform
9459	11-cis-Resorcinol	Vitamin A aldehyde	$C_{20}H_{28}O$	564-87-4	284.435	crystal					
9460	Retinal (all-trans)		$C_{20}H_{28}O$	116-31-4	284.435	orange crystal	64				in H ₂ O; s Et OH, chloroform, cyclohexane, petroleum ether
9461	13-cis-Resorcinolcarboxylic acid	Accutane	$C_{20}H_{28}O_2$	4759-48-2	300.435	crystal (Et OH)	189				
9462	13-trans-Resorcinolcarboxylic acid		$C_{20}H_{28}O_2$	302-79-4	300.435	crystal (MeOH)	181.5				

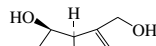
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9463	Ret i nol	Vi t ami n A	$_{20}H_{30}O$	68-26-8	286.451	ye pr (pet h)	63.5	137 ⁰⁰⁰⁰⁰¹			i H ₂ O; s Et OH, et h, ace, bz
9464	Ret i nyl pal mi t at e	Ret i nol, hexadecanoat e	$_{36}H_{60}O_2$	79-81-2	524.860		28				
9465	Ret roneci ne, (+)		$_{11}H_{13}NO_2$	480-85-3	155.195	cry (ace)	121				s H ₂ O, Et OH; sl et h
9466	Ret rorsi ne		$_{19}H_{25}NO_6$	480-54-6	351.395	cry (AcOEt)	212				sl H ₂ O, ace; s Et OH, chl; i et h
9467	Rhamnet i n		$_{16}H_{12}O_7$	90-19-7	316.262	ye nd (al)	295				sl H ₂ O; s Et OH, ace, PhOH; vs di l alk
9468	DL-α-Rhamnose		$_{12}H_{18}O_5$	116908-82-8	164.156	cry (w)	151				vs H ₂ O, Et OH
9469	D-Rhamnose	6-Deoxy-D-mannose	$_{12}H_{18}O_5$	634-74-2	164.156						s H ₂ O
9470	Rheadi ne		$_{21}H_{21}NO_6$	2718-25-4	383.395	nd (chl, et h, al)	257	sub			
9471	Rhei n		$_{6}H_6O_6$	478-43-3	284.221	ye or oran nd (MeOH, py)	321	sub			sl H ₂ O, Et OH, et h, ace, bz; vs py
9472	Rheni um carbonyl	Di rheni um decacarbonyl	$_{10}Re_2$	14285-68-8	652.515	ye-wh cry	170 dec		2.87		s os
9473	Rhi zopt eri n		$_{19}H_{12}N_6O_4$	119-20-0	340.294	l t ye pl (w)	>300				i ₂ Et OH, et h; s aq al k, aq NH ₄ py
9474	Rhodami ne B		$_{22}H_{22}ClN_2O_3$	81-88-9	480.018		165				s H ₂ O, Et OH, et h, bz, xyl
9475	Rhodi um carbonyl chl ori de	Di rhodi um t et racarbonyl di chl ori	$_{10}Rh_2O_6$	14523-22-9	388.758	red-oran cry	124				s os
9476	Ri bavi ri n	Tri bavi ri n	$_{8}H_{12}O_5$	36791-04-5	244.205	col cry (Et OH)	175				s H ₂ O
9477	Ri bi t ol	Adoni t ol	$_{5}H_{12}O_5$	488-81-3	152.146	pr (w), nd (al)	104				s H ₂ O, Et OH; i et h, li g
9478	Ri boflavi n		$_{20}H_{20}N_4O_6$	83-88-5	376.364	ye or oran-ye nd (w)	280 dec				i H ₂ O, et h, ace, chl; sl Et OH
9479	Ri boflavi n-5'-phosphat e		$_{20}H_{20}N_4O_9P$	146-17-8	455.336	ye cry (w)					
9480	D-Ri bose		$_{6}H_{10}O_5$	50-69-1	150.130	pl (al)	88				s H ₂ O; sl Et OH
9481	L-Ri bose		$_{6}H_{10}O_5$	24259-59-4	150.130		81				
9482	D-Ri bul ose	eryt hre2-Pent ul ose	$_{6}H_{10}O_5$	488-84-6	150.130	syrupe					vs H ₂ O
9483	Ri ci ni ne	1,2-Di hydro-4-met hoxy-1-met hyl-2-oxo-3-pyri di necarboni t ri le	$_{28}H_{38}N_2O_2$	524-40-3	164.162	pr or lf (w, al)	201.5	sub 170			s H ₂ O, chl; sl Et OH, bz; vs py; i pet h
9484	Ri f abut i n		$_{40}H_{62}N_4O_{11}$	72559-06-9	847.004	vi ol-red cry					i ₂ Et; vs chl; s MeOH; sl Et OH
9485	Ri f ampi n		$_{46}H_{58}N_4O_{12}$	13292-46-1	822.941	red-oran pl (ace)	185 dec				
9486	Ri nderi ne	Echi nat i ne-3'-epi mer	$_{15}H_{20}NO_5$	6029-84-1	299.364	cry (ace)	100.5				
9487	Ronnel		$_{6}H_6Cl_3O_3PS$	299-84-3	321.546		41	152 ^{0.4}	1.44 ³²	1.5335 ³⁵	
9488	Rot enone		$_{25}H_{22}O_6$	83-79-4	394.417	nd or lf (al, aq-ace)	176	215 ^{0.5}			i H ₂ O; s Et OH, ace, bz; sl et h; vs chl
9489	Rubi j ervi ne		$_{29}H_{43}NO_2$	79-58-3	413.636	nd (+1w, di l al)	242				vs bz, Et OH, chl
9490	Rubrat ox i n B		$_{30}H_{30}O_{11}$	21794-01-4	518.509	cry (MeCN)	169 dec				
9491	Rut ecarpi ne		$_{16}H_{13}N_3O$	84-26-4	287.315	ye nd (al, AcOEt)	259.5				sl Et OH, ace, bz
9492	Rut heni um dodecacarbonyl	Tri rut heni um dodecacarbonyl	$_{12}Ru_3$	15243-33-1	639.33	oran cry	dec 150				
9493	Rut heni um(III) 2,4-pent anedi oat e	Rut heni um(III) acet yl acet onat e	$_{15}H_{21}O_6Ru$	14284-93-6	398.39		230				
9494	Rut i nose		$_{12}H_{22}O_{10}$	90-74-4	326.297	hyg pow (al, et h)	190 dec				vs H ₂ O, Et OH
9495	Sabadi ne		$_{29}H_{47}NO_8$	124-80-1	537.685	nd (et h)	258				vs ace, Et OH
9496	Sacchari n		$_{6}H_6NO_3S$	81-07-2	183.185	nd (ace) pr (al), lf (w)	228 dec	sub	0.828 ²⁵		sl H ₂ O, bz, et h, chl; s ace, Et OH
9497	Sacchari n sodi um	1,2-Benzi sot hi azol i n-3-one, 1,1-di ox i de, sodi um sal t	$_{7}H_4NNaO_3S$	128-44-9	205.168	wh cry	229				s H ₂ O
9498	Saf ranal	2,6,6-Tri met hyl -1,3-cycl ohexadi ene-1-carboxal dehyde	$_{10}H_{14}O$	116-26-7	150.217			70 ¹	0.9734 ¹⁹	1.5281 ¹⁹	vs Et OH, pet h



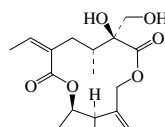
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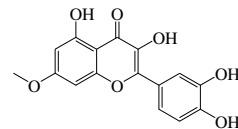
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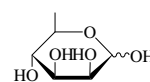
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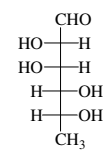
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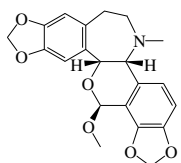
Rhamnet i n



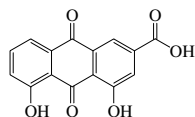
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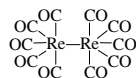
D-Rhamnose



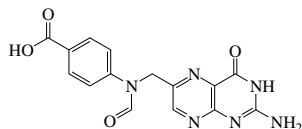
Rheadi ne



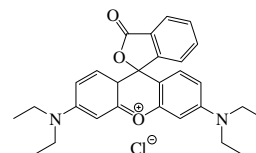
Rhei n



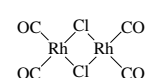
Rheni umcarbonyl



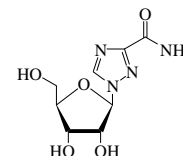
Rhi zopteri n



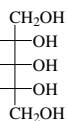
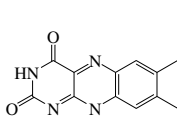
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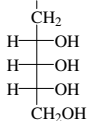
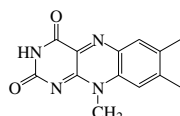
Rhodi umcarbonyl chlori de



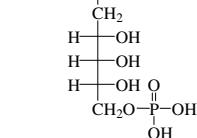
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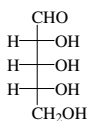
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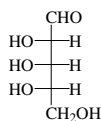
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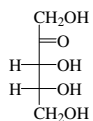
Ri bof lavi n-5'-phospat e



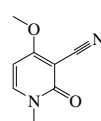
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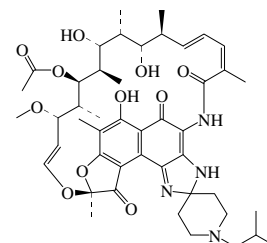
L-Ri bose



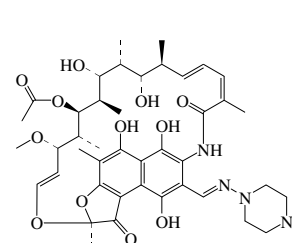
D-Ri bul ose



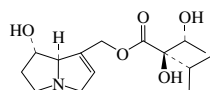
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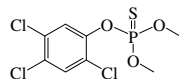
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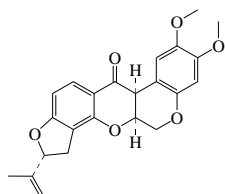
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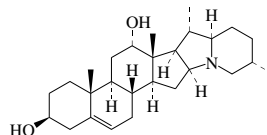
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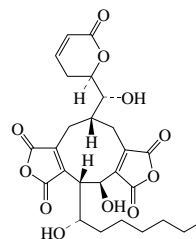
Ronnel



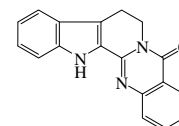
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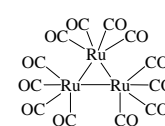
Rubi j ervi ne



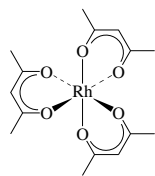
Rubrat oxi B



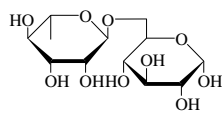
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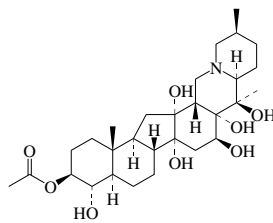
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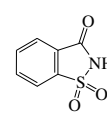
Rut heni um(II) 4-pent anedi oate



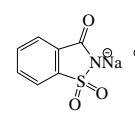
Rut i nose



Sabadi ne



Sacchari n

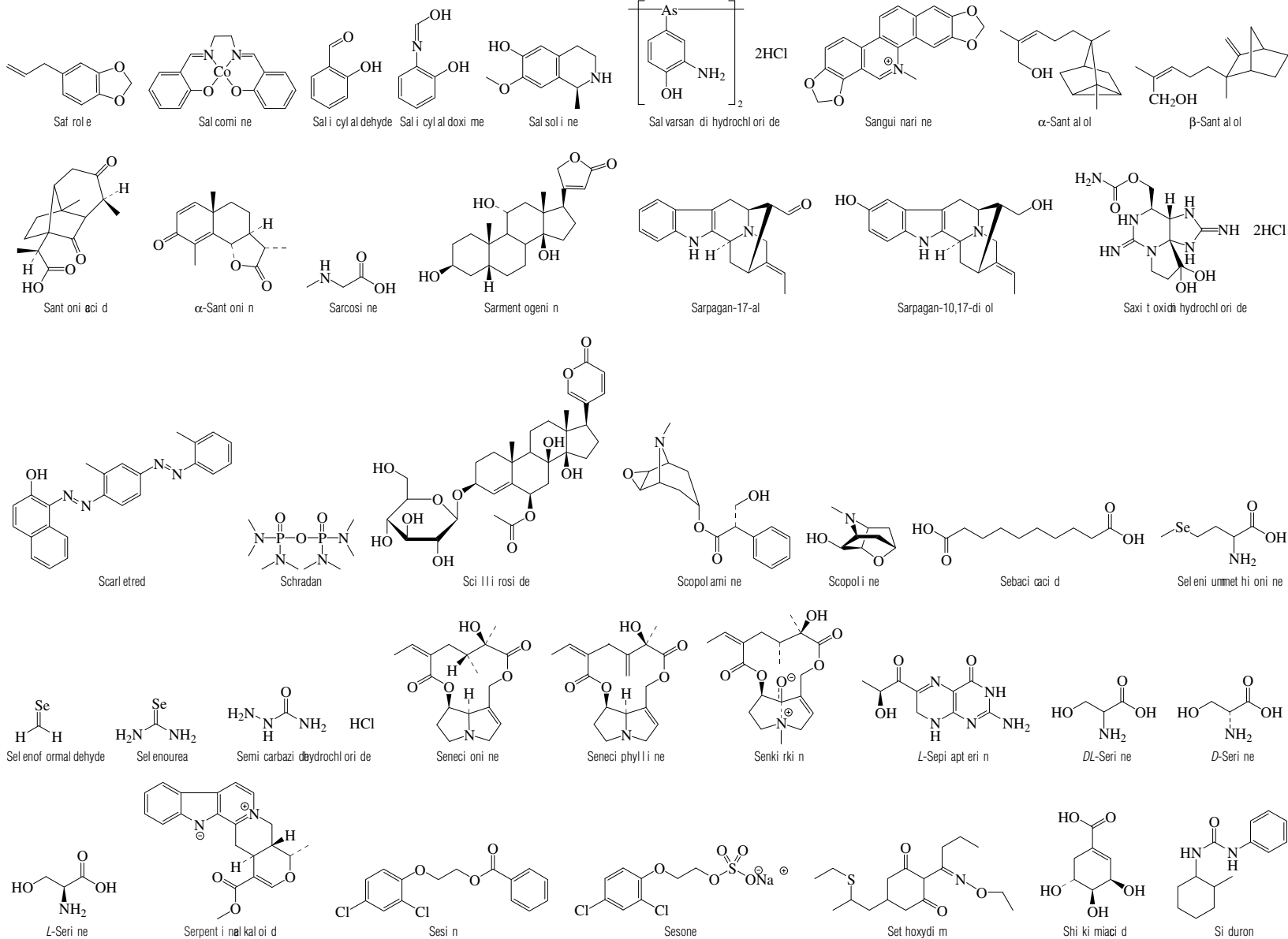


Sacchari rsodi um

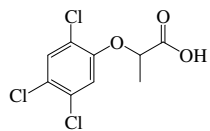


Saf ranal

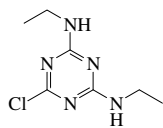
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9499	Safrole	5-(2-Propenyl)-1,3-benzodioxole	C ₁₀ H ₁₀ O ₂	94-59-7	162.185	mcl	11.2	234.5	1.1000 ²⁰	1.5381 ²⁰	i H ₂ O; vs Et OH; msc et h, chl
9500	Salcomine	<i>N,N'</i> -Bis(salicylidene)ethylenediaminecobalt(II)	C ₁₆ H ₁₄ CoN ₂ O ₂	14167-18-1	325.227	red cry (DMF)					s bz, chl, py
9501	Salicylaldehyde	2-Hydroxybenzaldehyde	C ₇ H ₆ O ₂	90-02-8	122.122	liq	-7	197	1.1674 ⁹	1.5740 ²⁰	sl H ₂ O, chl; msc Et OH; vs ace, bz
9502	Salicylaldoxime		C ₇ H ₇ NO ₂	94-67-7	137.137		57				sl H ₂ O; vs Et OH, et h, bz; s chl; i liq
9503	Salsoine		C ₇ H ₁₅ NO ₂	89-31-6	193.243	pow or cry (al)	221.5				sl H ₂ O, Et OH; i et h, pet h; s chl, al k
9504	Salvarsan dihydrochloride	Arsphenamine	C ₁₂ H ₄ As ₂ Cl ₂ N ₂ O ₂	139-93-5	439.001	ye hyg pow	190 dec				vs H ₂ O
9505	Sanguinaria		C ₁₅ H ₁₅ NO ₅	2447-54-3	349.337	cry (et h, al)	266				vs ace, bz, et h, Et OH
9506	α-Santalol		C ₁₅ H ₂₄ O	115-71-9	220.351			301.5	0.9679 ²⁰	1.5023 ²⁰	i H ₂ O; s Et OH
9507	β-Santalol		C ₁₅ H ₂₄ O	77-42-9	220.351			167 ¹⁰	0.9750 ²⁰	1.5115 ²⁰	
9508	Santonin acid		C ₁₅ H ₂₀ O ₄	510-35-0	264.318	cry	171	285 ¹⁵			sl H ₂ O; s chl, et h, HOAc, Et OH
9509	α-Santonin		C ₁₅ H ₁₈ O ₃	481-06-1	246.302	ort h (w, et h)	175		1.590		sl H ₂ O, Et OH, et h; s bz, chl; i pet h
9510	Sarcosine	<i>N</i> -Methylglycine	C ₂ H ₅ NO ₂	107-97-1	89.094	cry (al)	212 dec				s H ₂ O
9511	Sarmentogenin		C ₁₃ H ₃₄ O ₅	76-28-8	390.513	pr (95% al, MeOH-et h)	280				i H ₂ O, et h, bz; s Et OH; sl ace, chl
9512	Sarpagan-17-al	Vellorimine	C ₁₉ H ₂₀ N ₂ O	6874-98-2	292.374	cry (MeOH)	305.5	sub 180			
9513	Sarpagan-10,17-diol	Sarpagine	C ₁₉ H ₂₂ N ₂ O ₂	482-68-8	310.390	nd	320				i H ₂ O; s Et OH
9514	Saxitoxin dihydrochloride		C ₁₀ H ₁₂ Cl ₂ N ₂ O ₄	35554-08-6	372.209	hyg wh sol id					vs H ₂ O, MeOH, Et OH
9515	Scarlet red		C ₁₈ H ₂₀ N ₄ O	85-83-6	380.442	dk br pow or nd	185; dec 260				i H ₂ O; sl ace, bz; vs chl, pet h
9516	Schradan		C ₈ H ₂₂ N ₄ O ₃ P ₂	152-16-9	286.250		17	154 ²⁰	1.09 ²⁵	1.462 ²⁵	vs H ₂ O, Et OH, chl
9517	Scilliroside		C ₃₂ H ₄₄ O ₁₂	507-60-8	620.684	lo pr (dil MeOH)	169	dec			sl H ₂ O, ace, chl; vs Et OH, di ox; i et h
9518	Scopolamine		C ₁₇ H ₂₁ NO ₄	51-34-3	303.354	visc liq					vs hot; Et OH, ace; sl bz
9519	Scopolin		C ₁₇ H ₁₉ NO ₂	487-27-4	155.195	hyg nd (liq, et h, chl, pet h)	108.5	248	1.0891 ¹³⁴		s H ₂ O
9520	Sebacin acid		C ₁₈ H ₃₆ O ₄	111-20-6	202.248	lf	130.9	295 ⁰ , 232 ¹⁰	1.2705 ²⁰	1.422 ¹³³	sl H ₂ O; s Et OH, et h; i bz
9521	Selenium methionine	Selenomethionine	C ₅ H ₁₁ NO ₂ Se	1464-42-2	196.11	hex pl (MeOH aq)	265 dec				
9522	Selenoformaldehyde		C ₂ H ₂ Se	6596-50-5	92.99	unst ab gas					
9523	Selenourea	Carbamiimidoseleinc acid	C ₂ H ₄ OSe	630-10-4	123.02	pr or nd (w)		dec 200			vs H ₂ O
9524	Semicarbazide hydrochloride		C ₂ H ₅ N ₃ O	563-41-7	111.531	pr (dil al)	176 dec				vs H ₂ O
9525	Senecionine		C ₁₅ H ₂₅ NO ₅	130-01-8	335.396	pl	232				i H ₂ O; sl Et OH, et h; s chl
9526	Seneciophyllin		C ₁₈ H ₂₃ NO ₅	480-81-9	333.380	pl (AcOEt)	217 dec				s chl; sl Et OH, ace; i et h
9527	Senkirkine		C ₁₇ H ₂₇ NO ₆	2318-18-5	365.420	pl (ace)	197				
9528	<i>L</i> -Serpentine	6-Lactoyl-7,8-dihydropterin	C ₉ H ₁₁ NO ₃	17094-01-8	237.215	ye pow or cry					
9529	<i>DL</i> -Serine		C ₃ H ₇ NO ₃	302-84-1	105.093	mcl pr or lf (w)	246 dec		1.603		s H ₂ O; i Et OH, et h, bz, HOAc
9530	<i>D</i> -Serine		C ₃ H ₇ NO ₃	312-84-5	105.093	nd or hex pr (w)	229 dec	dec			vs H ₂ O; i Et OH, et h, bz, HOAc
9531	<i>L</i> -Serine	2-Amino-3-hydroxypropanoic acid, (S)	C ₃ H ₇ NO ₃	56-45-1	105.093	hex pl or pr (w)	228 dec	sub 150	1.6 ²		s H ₂ O; i Et OH, et h, bz, HOAc
9532	Serpentine alkaloid		C ₂₁ H ₂₀ N ₂ O ₃	18786-24-8	348.395		175				i H ₂ O; s Et OH, et h, ace
9533	Sesin	2,4-Dichlorophenoxyethyl benzoate	C ₁₃ H ₉ Cl ₂ O ₃	94-83-7	311.160	cry	66	185 ¹⁵			
9534	Sesone	Sodium 2-(2,4-dichlorophenoxy)ethyl sulfite	C ₈ H ₇ Cl ₂ NaO ₃ S	136-78-7	309.100		245 dec				
9535	Setoxydim		C ₁₁ H ₂₉ NO ₃ S	74051-80-2	327.482			>90 ^{0.00003}	1.043 ²⁵		
9536	Shikimic acid		C ₇ H ₉ O ₅	138-59-0	174.151	nd	184	subl			sl Et OH; i et h, bz, chl
9537	Siduron		C ₄ H ₂₀ N ₂ O	1982-49-6	232.321	cry sol id	135				s Et OH, DMF, CH ₂ Cl ₂



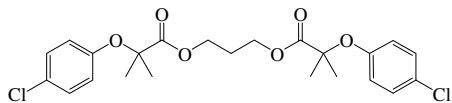
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9538	Si lvev	Propanoi c aci d, 2-(2,4,5-t ri chl orophenoxy)-	C ₉ H ₇ Cl ₃ O ₃	93-72-1	269.509		181.6				
9539	Si mazi ne	1,3,5-Tri azi ne-2,4-di ami ne, 6-chl or	C ₆ H ₁₂ ClN ₃	122-34-9	201.657		226		1.302 ²⁰		
9540	Si mfi brat e		C ₂₉ H ₂₆ Cl ₂ O ₆	14929-11-4	469.354	cry	52	225 ^{0.15}			
9541	Si napi ni c aci d	3-(4-Hydroxy-3,5-di met hoxyphe nyl)-2-propeno i c aci d	C ₁₁ H ₁₂ O ₅	530-59-6	224.210	wh pow					i H ₂ O; s MeOH, ace
9542	Si nomeni ne		C ₇ H ₁₂ NO ₄	115-53-7	329.391	nd (bz)	162				sl H ₂ O, et h, bz; s Et OH, ace, di l al k
9543	α ₁ -Si t ost erol	4-Met hyl st i gmast a-7,24(28)-di en-3-ol, (3β,4α,5α,24Z)	C ₃₀ H ₅₀ O	474-40-8	426.717	nd (al)	166				vs Et OH, chl
9544	Sodi um arsan i lat e	Sodi um (4-ami nophenyl) arsonat e	C ₆ H ₇ AsNNaO ₃	127-85-5	239.037	wh cry					s H ₂ O
9545	Sodi um ascorbat e		C ₆ H ₇ NaO ₆	134-03-2	198.106	cry	218 dec				
9546	Sodi um benzenesul finat e		C ₆ H ₅ NaO ₂ S	873-55-2	164.158	cry	300				
9547	Sodi um benzenesul fonat e	Monosodi um benzenesul fonat e	C ₆ H ₅ NaO ₂ S	515-42-4	180.157		>300				s H ₂ O; sl Et OH
9548	Sodi um benzoat e		C ₇ H ₅ NaO ₂	532-32-1	144.104		>300				s H ₂ O
9549	Sodi um cacodyl at e	Sodi um di met hyl arsonat e	C ₂ H ₆ AsNaO ₂	124-65-2	159.980	gran cry	60 (hyd)				vs H ₂ O; s Et OH
9550	Sodi um 2,2-di chl oropropanoat e		C ₃ HCl ₂ NaO ₂	127-20-8	164.951	hyg pow	166 dec				
9551	Sodi um di et hyl di t hi ocarbamat e	Di t hi ocarb sodi um	C ₃ H ₁₀ NNa ₂ S ₂	148-18-5	171.260	cry (Et OH)	95				s H ₂ O, Et OH, MeOH, ace; i et h, bz
9552	Sodi um di et hyl di t hi ocarbamat e t ri hydrat e	Di et hyl di t hi ocarbamat e sodi um t ri hydrat e	C ₆ H ₁₆ NNa ₂ O ₃ S ₂	20624-25-3	225.306	ort h cry (ace)	95				vs H ₂ O; s Et OH, ace; i bz, et h
9553	Sodi um 4,5-di hydroxy-2,7-naphthalenedi sulfoni c aci d	Chromot ropi c aci d di sodi um salt	C ₁₀ H ₆ Na ₂ O ₈ S ₂	129-96-4	364.260	wh nd or lf (w)					vs H ₂ O
9554	Sodi um di met hyl di t hi ocarbamat e		C ₃ H ₇ Na ₂ S ₂	128-04-1	144.215	col cry (w)	121 (hyd)				
9555	Sodi um 4-dodecyl benzenesul fonat e		C ₁₈ H ₃₃ NaO ₂ S	2211-98-5	348.476	cry	144				
9556	Sodi um dodecyl sulf at e	Sodi um lauryl sulf at e	C ₁₂ H ₂₅ NaO ₄ S	151-21-3	288.379	wh pow	205				
9557	Sodi um et hanol at e	Sodi um et hoxi de	C ₂ H ₅ NaO	141-52-6	68.050	hyg wh pow	260 dec				rac H ₂ O; s Et OH
9558	Sodi um fluoroacet at e		C ₂ F ₃ NaO ₂	62-74-8	100.024	wh mcl cry	200				i ace, chl; sl Et OH, MeOH
9559	Sodi um f ormal dehyd e bi sulf it e	Sodi um hydroxymet hanesul fonat e	C ₃ HO ₃ SH	870-72-4	134.088	cry (Et OH aq)					
9560	Sodi um f ormal dehyd esul f oxy l at e	Sodi um hydroxymet hanesul finat e	C ₃ NaO ₃ SH	149-44-0	118.088	cry (w)	63 (hyd)				s H ₂ O; i Et OH, bz, et h
9561	Sodi um gl uconat e		C ₆ H ₁₁ NaO ₇	527-07-1	218.137						s H ₂ O
9562	Sodi um 2-hydroxyet hanesul fonat e	Monosodi um 2-hydroxyet hanesul fonat e	C ₂ H ₃ NaO ₄ S	1562-00-1	148.114						s H ₂ O
9563	Sodi um 2-hydroxy-2-propanesul fonat e	Monosodi um 2-hydroxy-2-propanesul fonat e	C ₃ H ₇ NaO ₄ S	540-92-1	162.141	cry					s H ₂ O; sl Et OH
9564	Sodi um i odomet hanesul fonat e	Met hi odal sodi um	C ₂ INaO ₃ S	126-31-8	243.984	cry					sl Et OH, ace, bz
9565	Sodi um O-i sopropyl xant hat e		C ₄ HN ₃ NaOS ₂	140-93-2	158.218	hyg wh-ye pow	150 dec				
9566	Sodi um met hanol at e	Sodi um met hoxi de	C ₂ NaOH	124-41-4	54.024	wh hyg t et r cry	300				rac H ₂ O; s MeOH, Et OH
9567	Sodi um met hyl arsonat e		C ₆ H ₅ NaO ₃	2163-80-6	161.953	cry (w)	115				vs H ₂ O; s MeOH; i os
9568	Sodi um met hyl di t hi ocarbamat e	Met ham sodi um	C ₂ H ₄ NNa ₂ S ₂	137-42-8	129.180	cry (w)					vs H ₂ O
9569	Sodi um β-naphthoqui none-4-sul fonat e	Sodi um 3,4-di hydro-3,4-di oxo-1-naphthalenedi sulfoni c aci d	C ₁₀ H ₆ NaO ₄ S	521-24-4	260.199		287 dec				
9570	Sodi um 2-oxopropanoat e		C ₃ H ₅ NaO ₃	113-24-6	110.044						s H ₂ O; sl abs Et OH
9571	Sodi um phenol at e	Sodi um phenoxi de	C ₆ H ₅ NaO	139-02-6	116.093	hyg cry	384				vs H ₂ O; s Et OH, t hf
9572	Sodi um propanoat e		C ₃ H ₇ NaO ₂	137-40-6	96.061						sl H ₂ O
9573	Sodi um sul f obromopt hal ei n	Sul f obromopt hal ei n sodi um	C ₂₀ H ₈ Br ₂ Na ₂ O ₁₀ S ₂	71-67-0	837.998	hyg cry					s H ₂ O; i Et OH, ace
9574	Sodi um t art rat e		C ₄ HCN ₂ O ₆	868-18-8	194.051						s H ₂ O
9575	Sodi um t art rat e di hydrat e		C ₄ H ₆ Na ₂ O ₈	6106-24-7	230.082				1.545 ²⁵		s H ₂ O; i Et OH



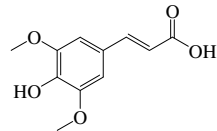
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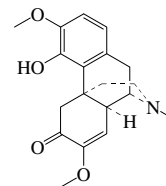
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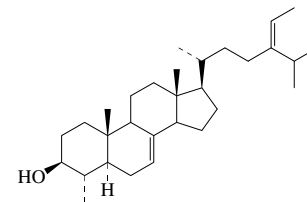
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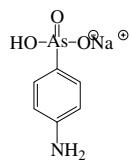
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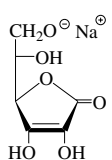
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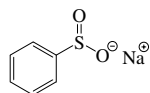
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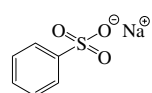
Sodi umarsani l at e



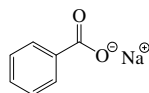
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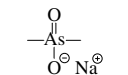
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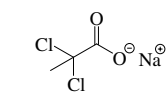
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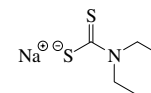
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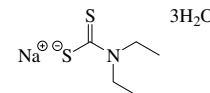
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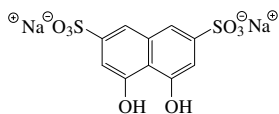
Sodi um2,2-di chl oroproanoat e



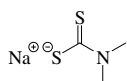
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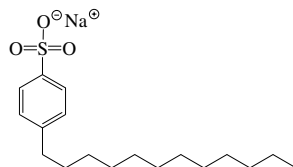
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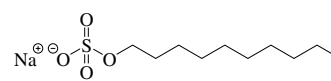
Sodi um4,5-di hydroxy-2,7-napht hal enedi sul f onat e



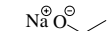
Sodi umdi met hyl di t hi ocarbat e



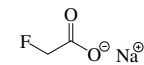
Sodi um4-dodecyl benzenesul f onat e



Sodi umdodecyl sul f at e

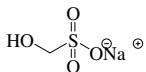


Sodi umet hanol at e

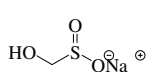


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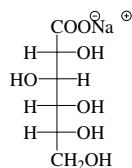
3-503



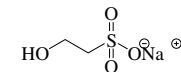
Sodi umf ormal dehydri sul f i t e



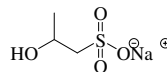
Sodi umf ormal dehydresul f oxylat e



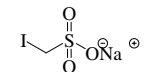
Sodi umgl uconat e



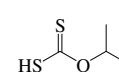
Sodi um2-hydroxyet hanesul f onat e



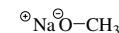
Sodi um2-hydroxy-2-propanesul f onat e



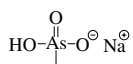
Sodi umi odomet hanesul f onat e



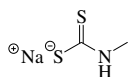
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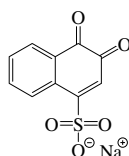
Sodi ummet hanol at e



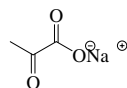
Sodi ummet hyl arsonat e



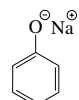
Sodi ummet hyl di t hi ocarbat e



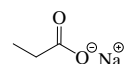
Sodi umβ-napht hoqui none-4-sul f onat e



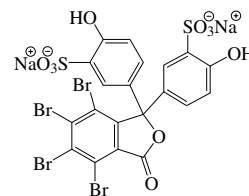
Sodi um2-oxoproanoat e



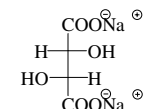
Sodi umphenol at e



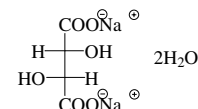
Sodi umproanoat e



Sodi umsul f obromopht hal ei n

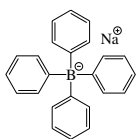


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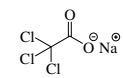


Sodi umt art rat e hydrat e

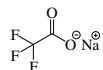
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9576	Sodium tetraperphenyl borate		$_{24}B_{10}Na$	143-66-8	342.217	nd	300				s H ₂ O, Et OH, ace; sl et h, chl; i pet h
9577	Sodium tetrachloroacetate		$_2Cl_4NaO_2$	650-51-1	185.369	ye-wh pow	300				s H ₂ O, Et OH
9578	Sodium tetrafluoroacetate		$_2F_4NaO_2$	2923-18-4	136.005	cry	207 dec				
9579	Solani d-5-ene-3,18-di ol, (β)	Isorubi jervi ne	$_{27}C_{43}NO_2$	468-45-1	413.636	pr(al)	242.5				vs bz, chl
9580	Solanine		$_{67}C_{123}NO_{15}$	20562-02-1	868.060	nd (Et OH aq)	286 dec				i H ₂ O, et h, chl; s hot Et OH
9581	Solanone		$C_3H_{22}O$	1937-54-8	194.313			60 ¹	0.870 ²⁰	1.4755 ²⁰	
9582	Soman		$C_7H_{16}FO_2P$	96-64-0	182.173	liq					
9583	Sophoricoside		$_{28}C_{20}O_{10}$	152-95-4	432.378		274				
9584	Sorbital		$_{24}C_{44}O_6$	1338-43-8	428.602	ye oil			0.986	1.480 ⁹	i H ₂ O; s Et OH
9585	L-Sorbose	L-Sorbinose	$_{24}C_{44}O_6$	87-79-6	180.155	orth (al)	165		1.612 ⁷		s H ₂ O; sl Et OH, et h, MeOH
9586	Spartine		$_{27}C_{46}N_2$	90-39-1	234.380		30.5	325; 173 ⁸	1.0196 ²⁰	1.5312 ²⁰	vs et h, Et OH, chl
9587	Spirulose		$_{26}C_{46}O_5$	85-23-4	184.147	red-bl	202.5	sub 120			sl H ₂ O; s alk
9588	Spironolactone		$_{26}C_{32}O_4S$	52-01-7	416.574			134			
9589	Spiro[2.2]pentane		C_5H_8	157-40-4	68.118	liq	-107.0	39	0.726 ⁶	1.4120 ²⁰	
9590	Spirosol-3-ol, (β,5α,22β,25S)	Tomatidine	$_{27}C_{45}NO_2$	77-59-8	415.652	pl	210.5				s Et OH, et h
9591	Spirosol-5-en-3-ol, (β,22α,25R)	Solasodine	$_{27}C_{45}NO_2$	126-17-0	413.636	hex pl (sub)	202				s Et OH, ace, bz, di ox, py; sl et h; vs chl
9592	Spirost-2,3-di ol, (α,2β,5α,25R)	Gitogenin	$_{26}C_{44}O_4$	511-96-6	432.636	lf (bz), nd (et h)	271.5				i H ₂ O; s Et OH, chl; sl et h
9593	Spirost-3-ol, (β,5α,25R)	Tigogenin	$_{26}C_{44}O_3$	77-60-1	416.636	lf (al +1w) pr (ace)	205.5				s Et OH, et h, ace, ct c, MeOH, pet h
9594	Spirost-3-ol, (β,5β,25R)	Smilagenin	$_{26}C_{44}O_3$	126-18-1	416.636	nd (ace)	185				vs ace, bz, Et OH
9595	Spirost-3-ol, (β,5β,25S)	Sarsasapogenin	$_{26}C_{44}O_3$	126-19-2	416.636	lo pr, nd (ace)	200.5				s Et OH, ace, bz, chl
9596	Spirost-2,3,15-tri ol, (2α,3β,5α,15β,25R)	Digitogenin	$_{27}C_{44}O_5$	511-34-2	448.635	nd (al)	281.5				vs chl
9597	Spirost-5-en-3-ol, (β,25R)	Diosgenin	$_{26}C_{42}O_3$	512-04-9	414.620	cry (ace)	205.5				vs Et OH
9598	Spiro[5.5]undecane		$C_{11}H_{20}$	180-43-8	152.277			208	0.8783 ²⁰	1.4731	
9599	S-Propyl thiocacetate		$_3HC_3OS$	2307-10-0	118.197			137.9	0.9535 ²⁵		
9600	Squalene		$C_{30}H_{50}$	111-02-4	410.718	oil	-4.8	421.3; 280 ¹	0.8584 ²⁰	1.4990 ²⁰	i H ₂ O; sl Et OH; s et h, ace, ct c
9601	Stachydriene		$_{27}C_{43}NO_2$	471-87-4	143.184	cry (w+1)	235				vs H ₂ O, Et OH
9602	Stanozolol		$_{27}C_{32}N_2O$	10418-03-8	328.491	cry (Et OH)	≈236				
9603	Stearaldehyde		$C_{18}H_{36}O$	638-66-4	268.478	nd (pet h)		261			
9604	Stearic acid	Octadecanoic acid	$_{18}H_{36}O_2$	57-11-4	284.478	mcl lf (al)	69.3	dec 350; 232 ¹⁵	0.9408 ²⁰	1.4299 ⁸⁰	i H ₂ O; sl Et OH, bz; s ace, chl, C ₈
9605	Stearic anhydride	Octadecanoic anhydride	$_{36}H_{70}O_3$	638-08-4	550.939		72		0.8365 ⁸²	1.4362 ⁸⁰	i H ₂ O, Et OH; sl et h, bz
9606	Stergmatocystin		$_{18}C_{20}O_6$	10048-13-2	324.284	yend	246 dec				
9607	Stigmast-5,7-di en-3-ol(β)	7-Dehydrostigmasterol	$_{28}C_{48}O$	521-04-0	412.690		144.5				vs bz, et h, Et OH
9608	Stigmast-5,22-di en-3-ol(β,22E)	Stigmasterol	$_{28}C_{48}O$	83-48-7	412.690		170				vs bz, et h, Et OH
9609	Stigmast-3-ol, (β,5α)		$C_{29}H_{52}O$	83-45-4	416.722		144				
9610	Stigmast-5-en-3-ol, (β,24R)	β-Sitosterol	$_{28}C_{50}O$	83-46-5	414.706	pl (al)	137				s Et OH, et h, HOAc
9611	Stigmast-5-en-3-ol, (β,24S)	γ-Sitosterol	$_{28}C_{50}O$	83-47-6	414.706	cry (Et OH)	148				s Et OH
9612	cis-Sitosterol	cis-1,2-Di phenylethene	$_{18}C_{12}$	645-49-8	180.245		-5	141 ¹²	1.0143 ²⁰	1.6130 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, pet h, chl
9613	trans-Sitosterol	trans-1,2-Di phenylethene	$_{18}C_{12}$	103-30-0	180.245	cry (al)	124.2	307; 166 ²	0.9707 ²⁰	1.6264 ¹⁷	i H ₂ O; sl Et OH, chl; vs et h, bz
9614	Streptomycin	N-Methyl-L-glucosamine dihydrochloride	$C_{27}H_{39}N_7O_{12}$	57-92-1	581.575	hyg pow					s H ₂ O
9615	Streptomycin sulfate		$_{42}HC_{14}N_{14}O_{36}S_3$	3810-74-0	1457.383	pow	≈230 dec				



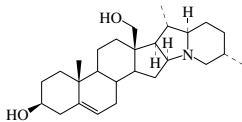
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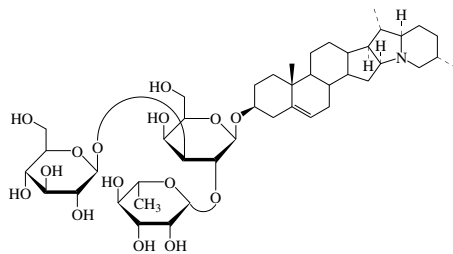
Sodi um t ri chloroacet at e



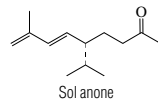
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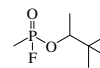
Solani d-5-ene-3,18-di-ol(β)



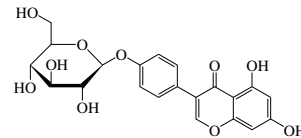
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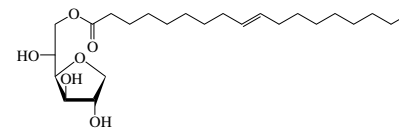
Sol anone



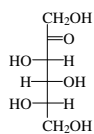
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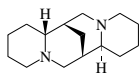
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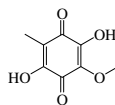
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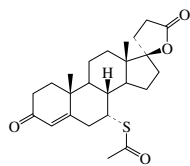
L-Sorbose



Spart ei ne



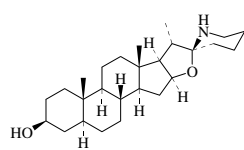
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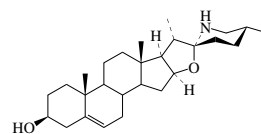
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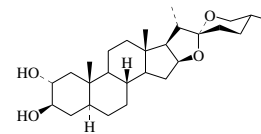
Spi rol(2,2)pent ane



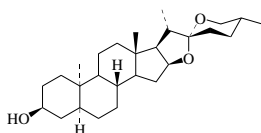
Spi rosolan-3-ol(3β,5α,22β,25)



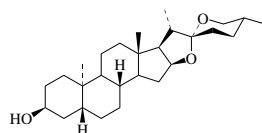
Spi rosolan-5-en-3-ol(3β,22α,25)



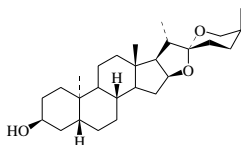
Spi rostan-2,3-di-ol(2α,3β,5α,25)



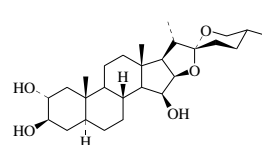
Spi rostan-3-ol(3β,5α,25)



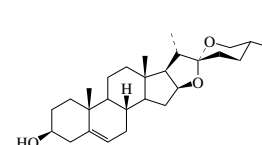
Spi rostan-3-ol(3β,5β,25)



Spi rostan-3-ol(3β,5β,25)



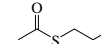
Spi rostan-2,3,15-tri-ol(2α,3β,5α,15β,25)



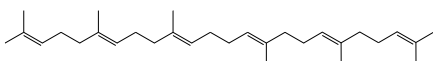
Spi rostan-5-en-3-ol(3β,25)



Spi rol[5.5]undecane



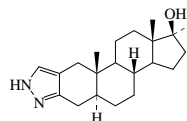
S-Propyl thiocacetate



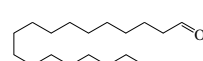
Squalene



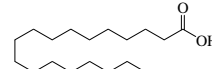
St achydrine



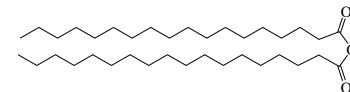
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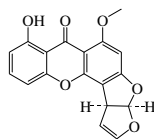
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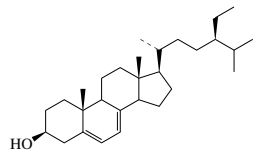
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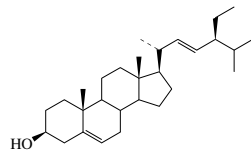
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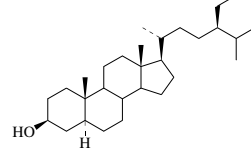
St eri gmat ocyst i n



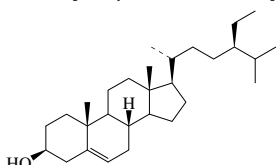
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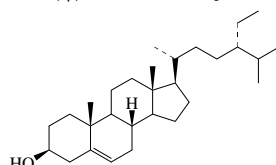
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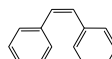
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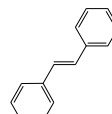
St i gmat -5-en-3-ol(β,24)



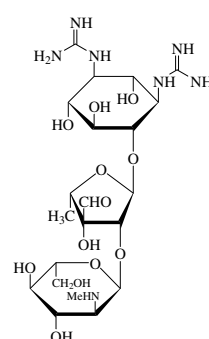
St i gmat -5-en-3-ol(β,24S)



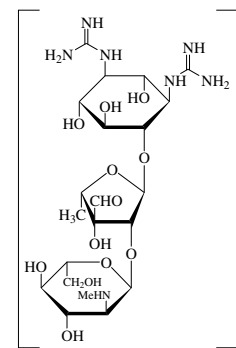
ci sSt i l bene



t ransSt i l bene



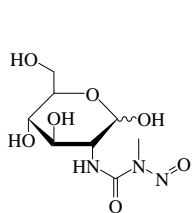
St rept omyci n



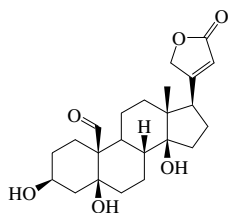
St rept omyci sul f i at e

3H₂SO₄

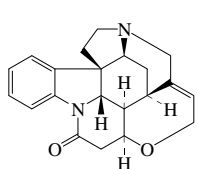
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9616	St rept ozot oci n		${}_8\text{F}_6\text{N}_3\text{O}_7$	18883-66-4	265.221	pl	115 dec				s H ₂ O, Et OH
9617	St rophant hi di n		${}_{23}\text{C}_{32}\text{O}_6$	66-28-4	404.496	ort h t ab (MeOH-w) lf (w+2)	173 dec				i H ₂ O, et h; s Et OH, ace, bz, HOAc, chl
9618	St rychni di n-10-one mononi t rat e	St rychni ne ni t rat e	${}_{21}{}_{23}\text{H}_{23}\text{N}_3\text{O}_5$	66-32-0	397.425	nd (w)	295		1.627 ²⁵		vs H ₂ O, MeOH; sl bz; s chl, Et OH
9619	St rychni di n-10-one sul f at e (2:1)	St rychni ne sul f at e	${}_{42}\text{H}_{46}\text{N}_4\text{O}_5\text{S}$	60-41-3	766.901		200 dec				s H ₂ O, Et OH, MeOH; i et h; sl chl
9620	St rychni ne		${}_{21}\text{H}_{22}\text{N}_2\text{O}_2$	57-24-9	334.412	ort h pr (al)	287	270	1.36 ²⁰		sl H ₂ O, Et OH, ace, bz; i et h; s chl
9621	St yrene	Vi nyl benzene	${}_{8}\text{C}_8$	100-42-5	104.150	l i q	-30.65	145	0.901 ⁶	1.5440 ²⁵	i H ₂ O; s Et OH, et h, ace; msc bz; sl ct c
9622	Succi mer	2,3-Di mercapt obut anedi oi c aci d (R*, S*)	$\text{C}_4\text{H}_6\text{O}_4\text{S}_2$	304-55-2	182.219	wh cry (MeOH)	193				
9623	Succi nami de		${}_{18}\text{H}_{12}\text{O}_2$	110-14-5	116.119	ort h nd (w)	268 dec	sub 125			s H ₂ O
9624	Succi ni c aci d		${}_{16}\text{C}_6\text{O}_4$	110-15-6	118.089	t cl or mcl pr	187.9	dec 235	1.57 ²	1.450	sl H ₂ O, DMSO; s Et OH, et h, ace; i bz
9625	Succi ni c anhydri de		${}_{16}\text{C}_6\text{O}_3$	108-30-5	100.073	nd (al), ort h pym (chl)	119	261	1.2 ²⁰		i H ₂ O; s Et OH, chl; sl et h
9626	Succi ni mi de		${}_{16}\text{C}_6\text{NO}_2$	123-56-8	99.089	pl (+1w, al) ort h (ace)	126.5	dec 287	1.418 ²⁵		s H ₂ O; sl Et OH, et h, ace
9627	Succi noni t ri le	But anedi ni t ri le	${}_{4}\text{H}_4\text{N}_2\text{C}$	110-61-2	80.088		57.98	266	0.9867 ⁶⁰	1.4173 ⁶⁰	vs H ₂ O; s Et OH, ace, bz, chl; sl et h
9628	Succi nyl chol i ne chl ori de	Suxamet honi um chl ori de	${}_{14}\text{H}_{20}\text{ON}_2\text{O}_4$	71-27-2	361.305	cry (w)	190				sl Et OH, bz, chl; i et h
9629	Succi nyl sul phat hi azole		${}_{13}\text{H}_9\text{N}_3\text{O}_5\text{S}_2$	116-43-8	355.389	cry	193.5				i H ₂ O, et h, chl; sl Et OH, ace; s al k
9630	Sucral f at e		${}_{19}\text{H}_{24}\text{Al}_6\text{O}_{75}\text{S}_8$	54182-58-0	2086.737	wh amorp pow					i H ₂ O, Et OH, chl; s di l HCl, al k
9631	Sucrose		$\text{C}_{12}\text{H}_{22}\text{O}_{11}$	57-50-1	342.296	mcl	185.5		1.5805 ⁷	1.5376	s H ₂ O, py; sl Et OH; i et h
9632	Sucrose monohexadecanoat e	Sucrose pal mi t at e	${}_{28}\text{H}_{42}\text{O}_{12}$	26446-38-8	580.706	cry	61				s H ₂ O
9633	Sucrose oct aacet at e		${}_{28}\text{H}_{38}\text{O}_{19}$	126-14-7	678.591	nd (al)	86.5	250	1.27 ¹⁵	1.4660	sl H ₂ O; s Et OH, et h, ace, bz, chl
9634	Sul f ent ani l		${}_{22}\text{H}_{30}\text{N}_2\text{O}_2\text{S}$	56030-54-7	386.550	cry (pet h)	96.6				
9635	Sul f abenzami de	N-[(4-Ami nophenyl) sul f onyl]benzami de	$\text{C}_{13}\text{H}_{12}\text{N}_2\text{O}_3\text{S}$	127-71-9	276.310	hex pr (60% al)	181.5				
9636	Sul f achl orpyri dazi ne		${}_{10}\text{H}_6\text{Cl}_2\text{N}_4\text{O}_2\text{S}$	80-32-0	284.722		187				
9637	Sul f acyt i ne		${}_{12}\text{H}_{14}\text{N}_4\text{O}_3\text{S}$	17784-12-2	294.329	cry (MeOH/ BuOH)	167				i H ₂ O; s al k
9638	Sul f adi met hoxi ne		${}_{12}\text{H}_6\text{N}_4\text{O}_4\text{S}$	122-11-2	310.329		203.5				
9639	Sul f aguani di ne		${}_{7}\text{H}_6\text{N}_4\text{O}_5\text{S}$	57-67-0	214.245	nd (w)	191.5				
9640	Sul f al l at e	Carbamodi t hi oi c aci d, di et hyl chl oro-2-propenyl est er	$\text{C}_2\text{H}_{14}\text{Cl}_2\text{N}_2\text{S}$	95-06-7	223.787			129 ¹	1.088		
9641	Sul f amerazi ne		${}_{11}\text{H}_{12}\text{N}_4\text{O}_2\text{S}$	127-79-7	264.304	cry	236				sl H ₂ O, Et OH, ace, DMSO; i et h, chl
9642	Sul f amet hazi ne		${}_{12}\text{H}_{14}\text{N}_4\text{O}_2\text{S}$	57-68-1	278.330	pa ye (w+1/2) cry (di ox-w)	198.5				s H ₂ O, aci d, al k; sl DMSO
9643	Sul f amet hi azole		${}_{9}\text{H}_6\text{N}_4\text{O}_2\text{S}_2$	144-82-1	270.331	cry (w)	210				sl hot H ₂ O
9644	Sul f amet hoxazole		${}_{10}\text{H}_{11}\text{N}_3\text{O}_3\text{S}$	723-46-6	253.277	ye-wh pow	171				i et h
9645	Sul f amet hoxypyri dazi ne		${}_{11}\text{H}_2\text{N}_4\text{O}_5\text{S}$	80-35-3	280.303		182.5				
9646	Sul f amet hyl t hi azole		${}_{10}\text{H}_6\text{N}_3\text{O}_2\text{S}_2$	515-59-3	269.343		237				vs Et OH
9647	N ⁴ -Sul f ani lyl sul f ani lami de	4-Ami nophenyl phenyl]benzenesul f onami de	$\text{C}_{12}\text{H}_{13}\text{N}_3\text{O}_4\text{S}_2$	547-52-4	327.379		137				sl H ₂ O; s Et OH, et h, ace; i chl, pet h
9648	Sul f ani l yl urea		${}_{7}\text{H}_6\text{N}_3\text{O}_3\text{S}$	547-44-4	215.229	cry (w)	147 dec				
9649	Sul f aphenazole		${}_{18}\text{H}_{14}\text{N}_4\text{O}_5\text{S}$	526-08-9	314.363	cry (Et OH)	181				sl Et OH, MeOH, gl HOAc
9650	Sul f asal azi ne		${}_{18}\text{H}_{14}\text{N}_4\text{O}_5\text{S}$	599-79-1	398.393		220 dec				



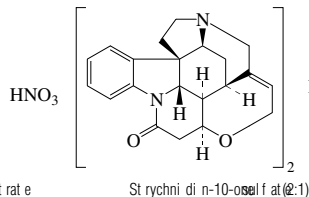
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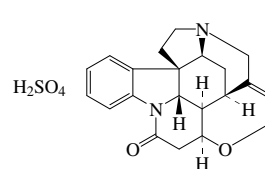
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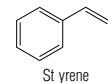
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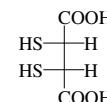
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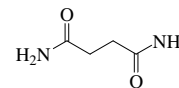
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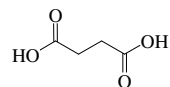
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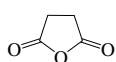
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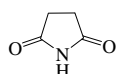
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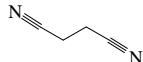
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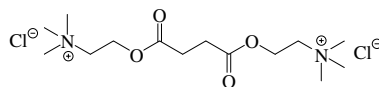
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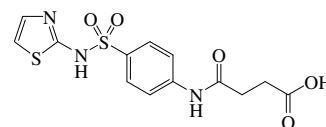
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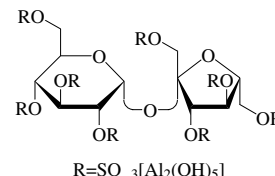
Succi noni t ri le



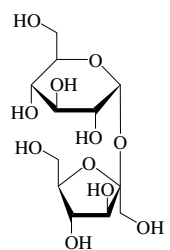
Succi nyl chol i dibromi de



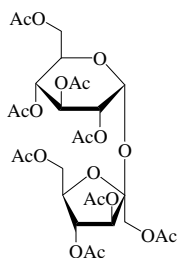
Succi nyl sul phat hi azole



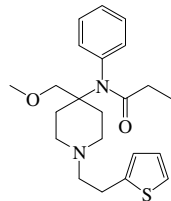
Sucralfat e



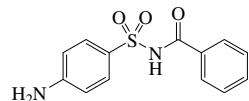
Sucrose



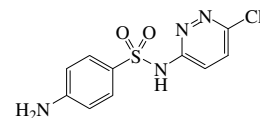
Sucrose octaacetate



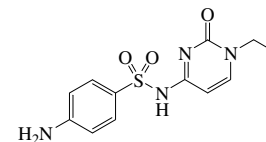
Sulfentani l



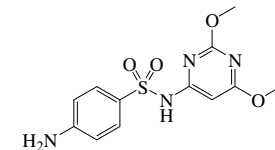
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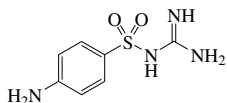
Sulfachlorpyridazi ne



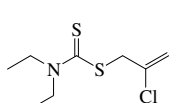
Sulfacyt i ne



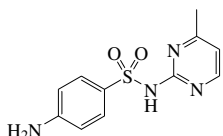
Sulfadimetoxi ne



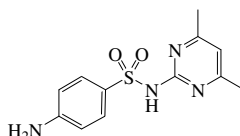
Sulfaguani di ne



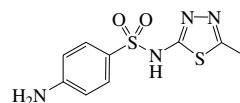
Sulfalate



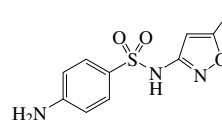
Sulfamerazi ne



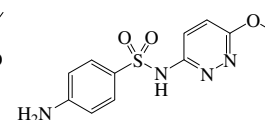
Sulfamethazi ne



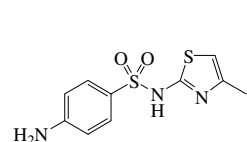
Sulfameti azole



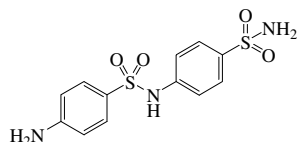
Sulfamet hoxazole



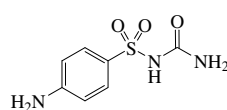
Sulfamet hoxypyridazi ne



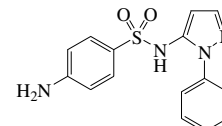
Sulfamet hylthiazole



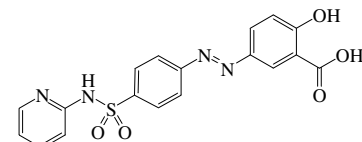
M-Sulfanil sulfanilami de



Sulfanilylurea

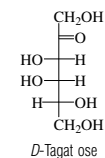
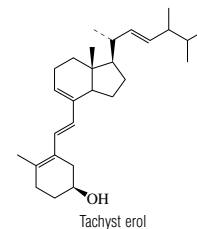
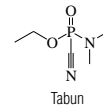
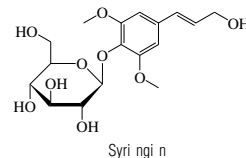
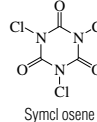
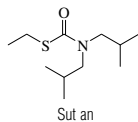
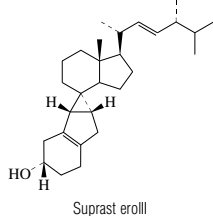
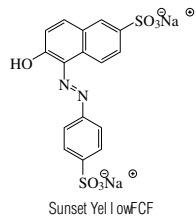
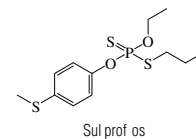
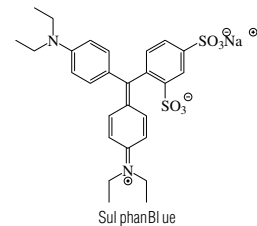
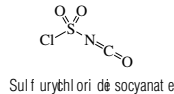
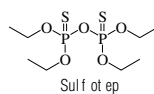
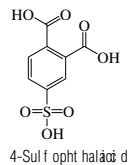
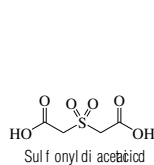
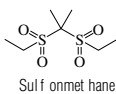
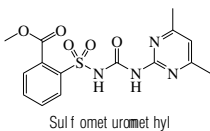
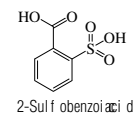
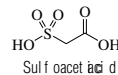
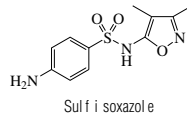
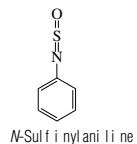
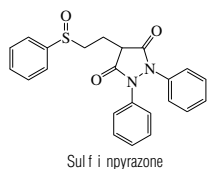
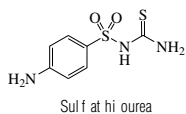
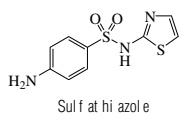


Sulfaphenazole

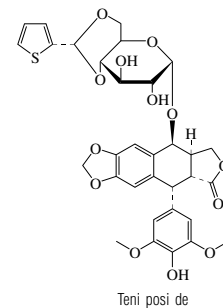
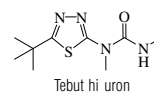
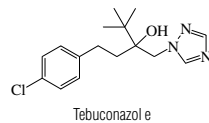
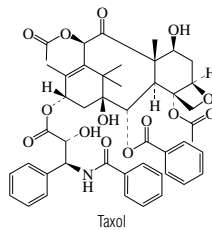
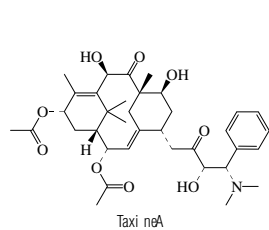
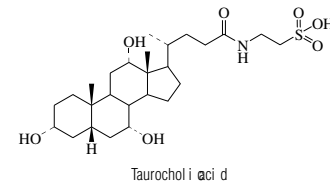
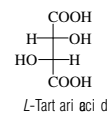
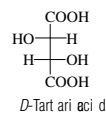
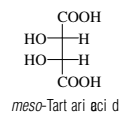
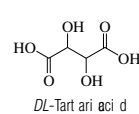
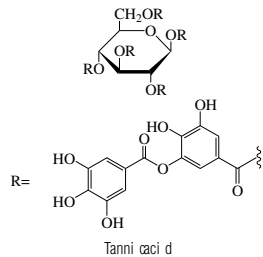
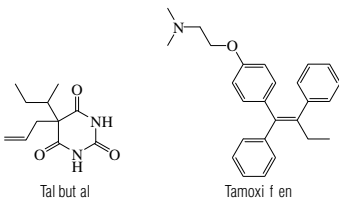


Sulfasalazi ne

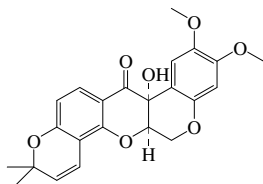
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9651	Sulf at hi azole	4-Amino-2-thiazolyl benzenesulfonamide	C ₈ H ₈ N ₂ O ₂ S ₂	72-14-0	255.316	br pl, rods or pow (45% al)	175(f orm a); 202(f orm b)				sl H ₂ O, Et OH, DMSO
9652	Sulf at hi ourea		C ₇ H ₆ N ₂ O ₂ S ₂	515-49-1	231.295		182				i H ₂ O; sl Et OH
9653	Sulf inpyrazone		C ₂₃ H ₂₀ N ₂ O ₂ S	57-96-5	404.481		137				
9654	N-Sulfinyl aniline		C ₇ H ₇ NOS	1122-83-4	139.175			200	1.236 ²⁵	1.6270 ²⁰	
9655	Sulfisoxazole		C ₇ H ₁₃ N ₂ O ₂ S	127-69-5	267.304		191				
9656	Sulfacetamide		C ₇ H ₉ N ₂ O ₂ S	123-43-3	140.115	hyg tab (w+1)	85	dec 245			vs H ₂ O, ace, Et OH
9657	2-Sulfobenzamide		C ₇ H ₇ N ₂ O ₂ S	632-25-7	202.185	nd (w+3)	141				vs H ₂ O, Et OH
9658	Sulfolane	Tetrahydrothiophene, 1,1-dioxide	C ₄ H ₆ O ₂ S	126-33-0	120.171		27.6	287.3	1.2723 ¹⁸	1.4833 ¹⁸	s chl
9659	Sulfometuron methyl		C ₁₃ H ₁₆ N ₂ O ₂ S	74222-97-2	364.377	wh solid	202				
9660	Sulfonmethane	2,2-Bis(ethylsulfanyl)propane	C ₇ H ₁₆ CS ₂	115-24-2	228.330	mcl (w), pr (al)	125.8	dec 300			vs bz, Et OH, chl
9661	Sulfonamide		C ₇ H ₉ CS ₂	123-45-5	182.152		187				vs H ₂ O, Et OH; s et h, sul f
9662	4-Sulfophthalic acid	4-Sulfobenzenedicarboxylic acid	C ₈ H ₆ O ₄ S	89-08-7	246.195	cry	139				
9663	Sulfotep		C ₈ H ₁₀ O ₃ P ₂ S ₂	3689-24-5	322.320			137 ²	1.196 ²⁵	1.4753 ²⁵	i H ₂ O; s Et OH
9664	Sulfuryl chloride isocyanate		CCl ₂ NO	1189-71-5	141.534	liq	-44	107	1.626	1.4467 ²⁰	
9665	Sulphan Blue		C ₇ H ₃₁ N ₂ NaO ₆ S ₂	129-17-9	566.664	viol pow					s Et OH
9666	Sulprofos		C ₁₂ H ₁₉ O ₂ PS ₃	35400-43-2	322.447			156 ^{0.1}	1.20 ²⁰	1.5859	sl H ₂ O
9667	Sunset Yellow FCF	C.I. Food Yellow 3	C ₁₈ H ₁₀ N ₂ Na ₂ O ₇ S ₂	2783-94-0	452.369	cry	>300				s H ₂ O; sl Et OH
9668	Suprofen		C ₁₆ H ₁₄ O	562-71-0	396.648	pr	110	190 ^{0.005}			s MeOH
9669	Sutan	Carbamothioic acid, bis(2-methylpropyl)-S-ethyl ester	C ₁₁ H ₂₃ NOS	2008-41-5	217.372			138 ²¹	0.9402 ²⁵		
9670	Symcicose	1,3,5-Trichloro-1,3,5-triazine-2,4,6-trihydro-5H-1,3,5-triazine	C ₃ Cl ₃ N ₃ O ₃	87-90-1	232.409			246.7 dec			
9671	Syringic acid		C ₉ H ₈ O ₄	118-34-3	372.368	cry (w), nd (al)	192				vs Et OH
9672	Tabun	Diethyl phosphorothioic acid, diethyl ester	C ₈ H ₁₁ N ₂ O ₂ P	77-81-6	162.127	liq	-50	240	1.077	1.4250	msc H ₂ O
9673	Tachystrol	9,10-Secoergost a-5(10),6,8,22-tetraen-3-ol, (6E,22E)-	C ₂₈ H ₄₄ O	115-61-7	396.648						i H ₂ O, MeOH; s Et OH, et h, ace, bz
9674	D-Tagatose		C ₆ H ₁₂ O ₆	87-81-0	180.155	cry (di l al)	134.5				vs H ₂ O
9675	Talbutal		C ₁₅ H ₁₅ N ₂ O ₃	115-44-6	224.256	cry	109				i H ₂ O, pet h; s Et OH, ace, et h, chl
9676	Tamoxifen		C ₂₆ H ₂₉ NO	10540-29-1	371.514	cry (pet h)	97				
9677	Tannic acid	Tannin	C ₂₈ H ₃₂ O ₁₆	1401-55-4	1701.198	ye-br amorp pow	≈210 dec				vs Et OH, ace; i bz, chl, et h, ct c
9678	DL-Tartaric acid	2,3-Dihydroxybutanedioic acid, (C ₄ H ₆ O ₆) ^(±)	C ₄ H ₆ O ₆	133-37-9	150.087	mcl pr (w, al +1w)	206		1.788 ²⁵		s H ₂ O, Et OH; sl et h; i bz
9679	meso-Tartaric acid		C ₄ H ₆ O ₆	147-73-9	150.087	tbl pl (w)	147		1.660		vs H ₂ O, Et OH
9680	D-Tartaric acid	2,3-Dihydroxybutanedioic acid, [(R*,R*)]-	C ₄ H ₆ O ₆	147-71-7	150.087	mcl, ort h pr (w+1)	172.5		1.7598 ²⁰	1.4955 ²⁰	sl DMSO
9681	L-Tartaric acid	2,3-Dihydroxybutanedioic acid, [(R*,R*)]-	C ₄ H ₆ O ₆	87-69-4	150.087		169				
9682	Taurolidine	Choline	C ₅ H ₁₁ NO ₂ S	81-24-3	515.703	pr (al-et h)	125 dec				vs H ₂ O, Et OH; sl et h, AcOEt
9683	Taxin A		C ₂₆ H ₄₇ NO ₁₀	1361-49-5	641.749	cry (ace)	205				i H ₂ O; s Et OH, et h, chl
9684	Taxol	Paclitaxel	C ₄₇ H ₅₁ NO ₁₄	33069-62-4	853.907	nd (MeOH aq)	214 dec				
9685	Tebuconazole		C ₁₃ H ₂₃ ClN ₂ O	107534-96-3	308.826		102.4				
9686	Tebuturon		C ₁₁ H ₁₆ N ₂ O ₂ S	34014-18-1	228.314		163 dec				
9687	Teniposide		C ₃₂ H ₃₂ O ₁₃ S	29767-20-2	656.653	cry (Et OH)	244				



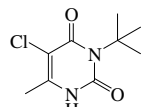
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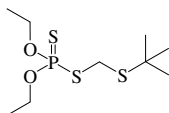
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9688	Tephrosi n		C ₉ H ₂₂ O ₇	76-80-2	410.417	pr (chl -MeOH)	198				vs ace, et h, chl
9689	Terbaci l	5-Chl oro-3- <i>tert</i> but yl -6-met hyl -2,4(1 <i>H</i> ,3 <i>H</i>)-pyri mi di nedi one	C ₉ H ₁₃ ClN ₂ O ₂	5902-51-2	216.664		176	sub 175	1.34 ²⁵		
9690	Terbuf os		C ₇ H ₇ O ₂ PS ₃	13071-79-9	288.431		-29.2	69 ^{0.01}	1.105 ²⁴		
9691	Terbut hyl azi ne	6-Chl or <i>o</i> - <i>t</i> <i>ert</i> but yl <i>N'</i> -et hyl -1,3,5-t ri azi ne-2,4-di ami ne	C ₉ H ₁₆ ClN ₂	5915-41-3	229.710		178		1.188 ²⁰		
9692	Terbut ryn		C ₁₀ H ₁₃ N ₅ S	886-50-0	241.357		104	157 ^{0.06}	1.115 ²⁰		
9693	Terebi c aci d	Tet rahydro-2,2-di met hyl -5-oxo-3-f urancarboxyl i c aci d	C ₇ H ₁₀ O ₄	79-91-4	158.152	cry	175		0.815		sl H ₂ O; s Et OH
9694	Terephal i c aci d	1,4-Benzenedi carboxyl i c aci d	C ₆ H ₄ O ₂	100-21-0	166.132	nd (sub)		sub 300			i H ₂ O, Et OH, et h, chl, HOAc; sl ct c
9695	Tert enadi ne	Sel dane	C ₈ H ₁₁ NO ₂	50679-08-8	471.674		147				i H ₂ O; s Et OH; sl hx
9696	<i>o</i> -Terphenyl		C ₁₈ H ₁₄	84-15-1	230.304	mcl pr (MeOH)	56.20	332			i H ₂ O; s ace, bz, chl, MeOH
9697	<i>m</i> -Terphenyl		C ₁₈ H ₁₄	92-06-8	230.304	ye nd (al)	87	363	1.199 ⁰		i H ₂ O; s Et OH, et h, bz, HOAc; sl chl
9698	<i>p</i> -Terphenyl		C ₁₈ H ₁₄	92-94-4	230.304		213.9	376			i H ₂ O; sl Et OH; s et h, bz, C ₆ S
9699	<i>α</i> -Terpi nene	4-Isopropyl -1-met hyl -1,3-cycl ohexadi ene	C ₁₀ H ₁₆	99-86-5	136.234			174	0.8375 ¹⁹	1.477 ¹⁹	i H ₂ O; msc Et OH, et h
9700	<i>γ</i> -Terpi nene		C ₁₀ H ₁₆	99-85-4	136.234			183	0.849 ²⁰	1.4765 ¹⁴	
9701	<i>α</i> -Terpi neol		C ₁₀ H ₁₈ O	2438-12-2	154.249	cry (pet h)	40.5	220	0.9337 ²⁰	1.4831 ²⁰	sl H ₂ O; vs ace, bz, et h, Et OH
9702	<i>α</i> -Terpi neol acet at e		C ₁₂ H ₂₀ O ₂	80-26-2	196.286			140 ⁴⁰ , 105 ¹¹	0.9659 ²¹	1.4689 ²¹	i H ₂ O; s Et OH, et h, bz
9703	Terpi nol ene	<i>p</i> -Ment ha-1,4(8)-di ene	C ₁₀ H ₁₆	586-62-9	136.234			186	0.8632 ¹⁵	1.4883 ²⁰	i H ₂ O; msc Et OH, et h; s bz, ct c
9704	2,2':6',2''-Terpyri di ne		C ₁₁ H ₁₁ N ₃	1148-79-4	233.268		88.0	370			
9705	Terrazol e	1,2,4-Thi adi azol e, 5-et hoxy-3-(t ri chl oromet hyl)-	C ₂ H ₂ Cl ₃ N ₂ OS	2593-15-9	247.530		19.9	95 ¹	1.503 ²⁵		
9706	2,2':5',2''-Tert hi ophene	<i>α</i> -Tert hi enyl	C ₁₂ H ₈ S ₃	1081-34-1	248.387	ye-oran pl (MeOH)	93				i H ₂ O; sl Et OH; s bz, et h, ace, pet h
9707	Test ol act one		C ₁₂ H ₂₄ O ₃	968-93-4	300.392	cry (ace)	218				
9708	3,6,9,12-Tet raazat et radecane-1,14-di ami ne	Pent aet hyl enehexami ne	C ₁₀ H ₂₈ N ₆	4067-16-7	232.369	li q			0.950	1.509 ⁰	
9709	Tet rabenazi ne		C ₁₂ H ₂₇ NO ₃	58-46-8	317.422		128				s chl
9710	1,2,4,5-Tet rabromobenzene		C ₆ H ₂ Br ₄	636-28-2	393.696	mcl pr (CS ₂)	182	3.1 ²⁰	3.072 ²⁰		i H ₂ O; vs et h
9711	1,1,2,2-Tet rabromoet hane	Acet yl ene t et rabromi de	C ₂ H ₂ Br ₄	79-27-6	345.653	ye vi sc li q	0	243.5; 15 ⁴	2.9655 ²⁰	1.6353 ²⁰	i H ₂ O; msc Et OH, et h; s ace, bz; sl ct c
9712	Tet rabromoet hene	Tet rabromoet hyl ene	C ₂ Br ₄	79-28-7	343.637	pl (di l al), nd (al)	56.5	226			i H ₂ O; s Et OH, et h, ace; vs chl
9713	2',4',5',7'-Tet rabromofluorescei n, di sodi um sal t	Eosi ne YS	C ₂₀ H ₆ Br ₄ Na ₂ O ₃	17372-87-1	691.855	ye-red cry	295.5				vs Et OH
9714	4,5,6,7-Tet rabromo-1,3-i sobenzof urandi one		C ₈ Br ₄ O ₃	632-79-1	463.700	nd (xyl, HOAc)	280				i H ₂ O, Et OH; sl bz; s PhN ₂
9715	Tet rabromomet hane	Carbon t et rabromi de	C ₂ Br ₄	558-13-4	331.627	mcl t ab (di l al)	92.3	189.5	2.960 ⁸	1.5942 ¹⁰⁰	i H ₂ O; s Et OH, et h, chl; vs C ₆ S
9716	2,3,4,5-Tet rabromo-6-met hyl phenol	3,4,5,6-Tet rabromoeresol	C ₇ H ₂ Br ₄ O	576-55-6	423.722	ye nd (chl, HOAc)	208	dec			i H ₂ O; s Et OH, et h, bz, chl; sl li g, HOAc
9717	3',3'',5',5''-Tet rabromophenol pht hal ei n		C ₂₀ H ₁₀ Br ₄ O ₄	76-62-0	633.907	nd (al, et h)	296				i H ₂ O; sl Et OH; vs et h; s al k, HOAc
9718	3',3'',5',5''-Tet rabromophenol pht hal ei n et hyl est er		C ₂₂ H ₁₄ Br ₄ O ₄	1176-74-5	661.960	ye cry (bz)	210				
9719	3',3'',5',5''-Tet rabromophenol pht hal ei n et hyl est er, pot assi um sal t		C ₂₂ H ₁₃ Br ₄ KO ₄	62637-91-6	700.050		210				
9720	Tet rabut yl ammoni um bromi de	TMAB	C ₁₆ H ₃₆ BrN	1643-19-2	322.368		99				s chl
9721	Tet rabut yl ammoni um chl ori de		C ₁₆ H ₃₆ ClN	1112-67-0	277.917	cry	74				



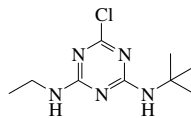
Tephrosin



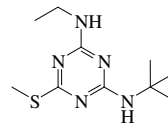
Terbacil



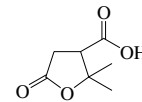
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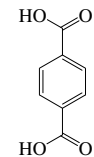
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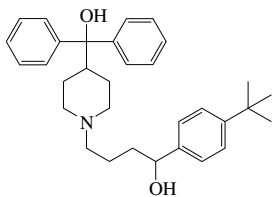
Terbutryn



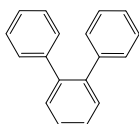
Terebaciid



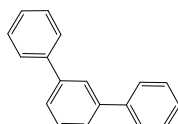
Terephthalic acid



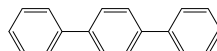
Terfenadine



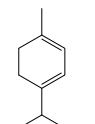
o-Terphenyl



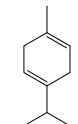
m-Terphenyl



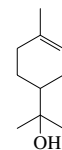
p-Terphenyl



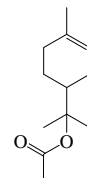
alpha-Terpinene



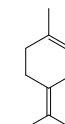
gamma-Terpinene



alpha-Terpinol

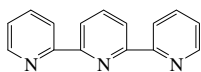


alpha-Terpinolacetate

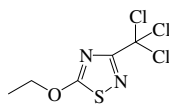


Terpinolene

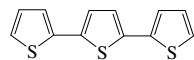
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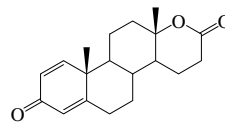
2,2':6',2''-Terpyridine



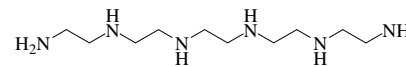
Terrazole



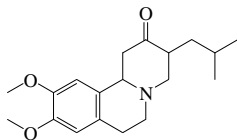
2,2':5',2''-Terthiophene



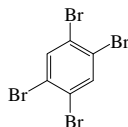
Testolactone



3,6,9,12-Tetraazatetradecane-1,14-diamine



Tetrabenzazine



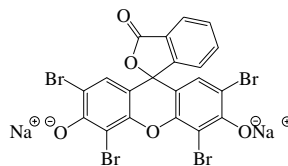
1,2,4,5-Tetrabromobenzene



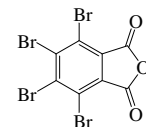
1,1,2,2-Tetrabromoethane



Tetrabromoethene



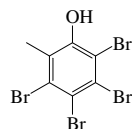
2,4,5',7'-Tetrabromofluorescein sodium salt



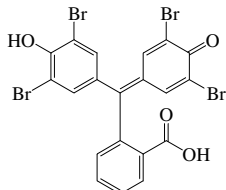
4,5,6,7-Tetrabromo-1,3-dibenzofuranone



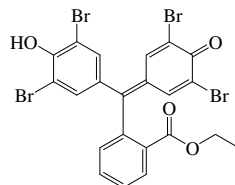
Tetrabromometane



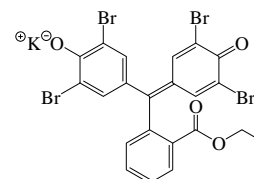
2,3,4,5-Tetrabromo-6-methylphenol



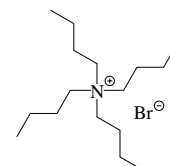
3',3'',5',5''-Tetrabromophenolphthalein



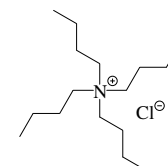
3',3'',5',5''-Tetrabromophenolphthalein ethylester



3',3'',5',5''-Tetrabromophenolphthalein potassium salt

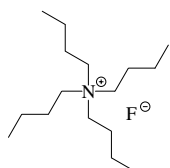


Tetraethylammonium bromide

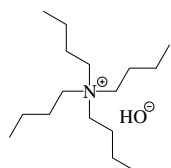


Tetraethylammonium chloride

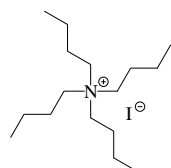
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9722	Tet rabut ylammoni um fluori de		${}_{16}\text{H}_{35}\text{FN}$	429-41-4	261.462	cry (w)	37				
9723	Tet rabut ylammoni um hydroxi de		${}_{16}\text{H}_{37}\text{NO}$	2052-49-5	259.471	st ab i n sol n					s, H_2O , MeOH
9724	Tet rabut ylammoni um i odi de		${}_{16}\text{H}_{37}\text{IN}$	311-28-4	369.368	lf (w, bz)	148				sl H_2O , chl; vs Et OH
9725	Tet rabut ylammoni um sul f at e		${}_{32}\text{H}_{51}\text{O}_2\text{S}$	32503-27-8	580.990		170				sl chl
9726	Tet rabut ylphosphoni um bromi de		${}_{16}\text{H}_{35}\text{BrP}$	3115-68-2	339.335	cry (ace/et h)	102				
9727	Tet rabut yl si li cat e	Si li ci c aci d, t et rabut yl est er	${}_{16}\text{H}_{35}\text{O}_4\text{Si C}$	4766-57-8	320.541			256; 120	0.8990 ²⁰	1.4128 ²⁰	
9728	Tet rabut yl st annane		${}_{16}\text{H}_{35}\text{Sn}$	1461-25-2	347.167	li q	-97	148; 95 ^{0,28}	1.06 ²⁰		
9729	<i>N,N,N',N'</i> - Tet rabut ylt hi operoxydi carboni c di ami de	Bi s(di but ylt hi ocarbamoyl) di sul fide	${}_{16}\text{H}_{35}\text{N}_2\text{S}_4$	1634-02-2	408.752		39.5		1.03 ²⁰		i H_2O ; sl Et OH; s et h
9730	Tet rabut yl ti t anat e	Ti t ani um(IV) but oxi de	${}_{16}\text{H}_{35}\text{O}_4\text{Ti}$	5593-70-4	340.322			292.4			
9731	Tet racai ne hydrochl ori de		${}_{15}\text{B}_{25}\text{Cl N}_2\text{O}_2$	136-47-0	300.825		147				
9732	1,2,3,4-Tet rachi orobenzene		$\text{C}_6\text{H}_2\text{Cl}_4$	634-66-2	215.892	nd (al)	47.5	254			i H_2O ; sl Et OH; vs et h, CS
9733	1,2,3,5-Tet rachi orobenzene		$\text{C}_6\text{H}_2\text{Cl}_4$	634-90-2	215.892	nd (al)	54.5	246			i H_2O
9734	1,2,4,5-Tet rachi orobenzene		$\text{C}_6\text{H}_2\text{Cl}_4$	95-94-3	215.892	nd, mcl pr (et h, al or bz)	139.5	244.5	1.858 ²²		i H_2O ; sl Et OH; s et h, bz, chl, CS
9735	3,4,5,6-Tet rachi oro-1,2-benzenedi ol		${}_{6}\text{H}_2\text{Cl}_2\text{O}_2$	1198-55-6	247.891	cry (di l al, bz)	194				sl H_2O
9736	2,3,5,6-Tet rachi oro-1,4-benzenedi ol		${}_{6}\text{H}_2\text{Cl}_2\text{O}_2$	87-87-6	247.891	nd (HOAc)		sub			i H_2O , bz, ct c; vs Et OH, et h; sl HOAc
9737	2,2',4',5'-Tet rachi orobi phenyl		${}_{12}\text{H}_{16}\text{Cl}_4$	41464-40-8	291.988	cry (MeOH)	66.5				i H_2O
9738	2,3,4,5-Tet rachi orobi phenyl		${}_{12}\text{H}_{16}\text{Cl}_4$	33284-53-6	291.988	cry	92.2				i H_2O
9739	3,3',4',4'-Tet rachi orobi phenyl		${}_{12}\text{H}_{16}\text{Cl}_4$	32598-13-3	291.988	cry (Et OH)	180				
9740	2,2',6,6'-Tet rachi orobi sphenol A		${}_{16}\text{H}_{12}\text{Cl}_4\text{O}_2$	79-95-8	366.067	cry (HOAc)	136				
9741	2,3,5,6-Tet rachi oro-2,5- cycl ohexadi ene-1,4-di one	Chl orani l	${}_{6}\text{C}_4\text{O}_2$	118-75-2	245.875	ye mcl, pr (bz) ye lf (HOAc)	290	sub			i H_2O , li q; sl Et OH, chl; s et h
9742	3,4,5,6-Tet rachi oro-3,5- cycl ohexadi ene-1,2-di one		$\text{C}_6\text{Cl}_4\text{O}_2$	2435-53-2	245.875		130.5				
9743	2,3,7,8-Tet rachi orodi benzof di oxi n	Di oxi n	${}_{12}\text{H}_6\text{Cl}_4\text{O}_2$	1746-01-6	321.971	nd	295				
9744	2,3,7,8-Tet rachi orodi benzof uran		${}_{12}\text{H}_6\text{Cl}_4\text{O}$	51207-31-9	305.971	cry	227				
9745	1,1,1,2-Tet rachi oro-2,2- di fluoroet hane		$\text{C}_2\text{Cl}_4\text{F}_2$	76-11-9	203.830		41.0	92.8	1.649 ²⁵		i H_2O ; s Et OH, et h, chl
9746	1,1,2,2-Tet rachi oro-1,2- di fluoroet hane		$\text{C}_2\text{Cl}_4\text{F}_2$	76-12-0	203.830		24.8	92.8	1.5951 ⁵⁰	1.4130 ²⁵	i H_2O ; s Et OH, et h, chl
9747	1,2,3,4-Tet rachi oro-5,5-di met hoxi- 1,3-cycl opent adi ene		$\text{C}_7\text{H}_6\text{Cl}_4\text{O}_2$	2207-27-4	263.934			109	1.501 ²⁵	1.5282 ²⁰	
9748	1,2,3,4-Tet rachi oro-5,6- di met hyl benzene		$\text{C}_8\text{H}_6\text{Cl}_4$	877-08-7	243.946		228				i H_2O ; s Et OH, et h, bz
9749	1,2,3,5-Tet rachi oro-4,6- di met hyl benzene		$\text{C}_8\text{H}_6\text{Cl}_4$	877-09-8	243.946		223		1.703 ²⁵		i H_2O , Et OH, et h, bz, chl
9750	1,1,2,2-Tet rachi oro-1,2- di met hyl di si l ane		$\text{C}_2\text{H}_6\text{Cl}_4\text{Si}_2$	4518-98-3	228.052			154			
9751	1,1,1,2-Tet rachi oroet hane		${}_{2}\text{H}_2\text{Cl}_4$	630-20-6	167.849	li q	-70.2	130.2	1.540 ⁶	1.4821 ²⁰	sl H_2O ; s ace, bz, chl; msc Et OH, et h
9752	1,1,2,2-Tet rachi oroet hane	Acet yl ene t et rachi ori de	${}_{2}\text{H}_2\text{CC}$	79-34-5	167.849	li q	-42.4	145.2	1.595 ³	1.4940 ²⁰	sl H_2O ; s ace, bz, chl; msc Et OH, et h
9753	Tet rachi oroet hane	Perchl oroet hyl ene	${}_{2}\text{CC}$	127-18-4	165.833	li q	-22.3	121.3	1.623 ⁰	1.5059 ²⁰	i H_2O ; msc Et OH, et h, bz
9754	1,1,1,2-Tet rachi oro-2-fluoroet hane		${}_{2}\text{HCl}_4\text{F}$	354-11-0	185.839	li q	-95.3	117.1			
9755	1,1,2,2-Tet rachi oro-1-fluoroet hane		${}_{2}\text{HCl}_4\text{F}$	354-14-3	185.839	li q	-82.6	116.7	1.549 ⁷	1.4390 ²⁰	



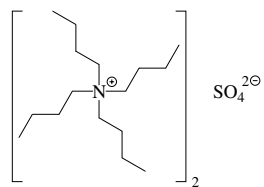
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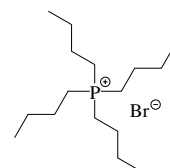
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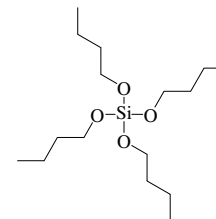
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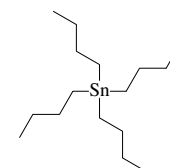
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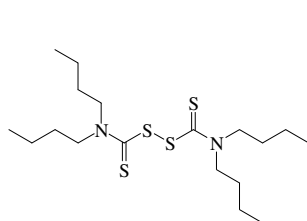
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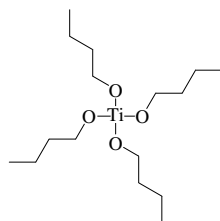
Tet rabut yl i cat e



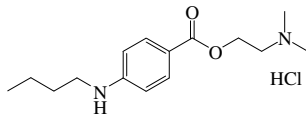
Tet rabut yl stannane



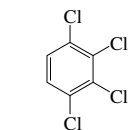
N,N,N',N'-Tet rabut yl t hi operoxydi carbdiniam de



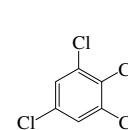
Tet rabut yl i t anat e



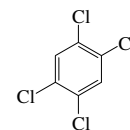
Tet racai nhydrochl ori de



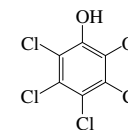
1,2,3,4-Tet rachl orobenzene



1,2,3,5-Tet rachl orobenzene

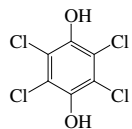


1,2,4,5-Tet rachl orobenzene

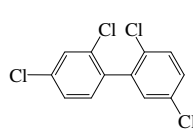


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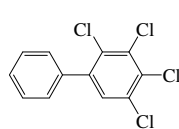
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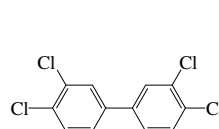
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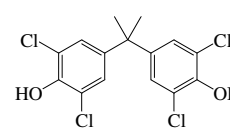
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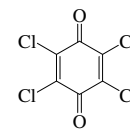
2,3,4,5-Tet rachl orobi phenyl



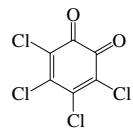
3,3',4,4'-Tet rachl orobi phenyl



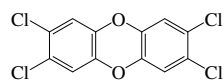
2,2',6,6'-Tet rachl orobi sphenyl



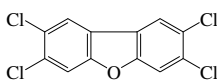
2,3,5,6-Tet rachl oro-2,5-cycl ohexadi ene-1,4-di one



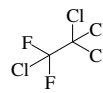
3,4,5,6-Tet rachl oro-3,5-cycl ohexadi ene-1,2-di one



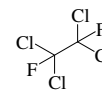
2,3,7,8-Tet rachl orodi benz-d i oxi n



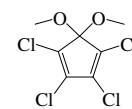
2,3,7,8-Tet rachl orodi benzof uran



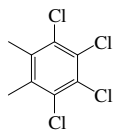
1,1,1,2-Tet rachl oro-2,2-di f luoroet h



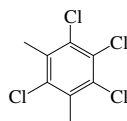
1,1,1,2-Tet rachl oro-1,2-di f luoroet h



1,2,3,4-Tet rachl oro-5,5-di met hoxy-1,3-cycl opent adi ene



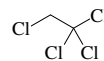
1,2,3,4-Tet rachl oro-5,6-di met hyl benzene



1,2,3,5-Tet rachl oro-4,6-di met hyl benzene



1,1,2,2-Tet rachl oro-1,2-di met hyl di si lan



1,1,2,2-Tet rachl oroet hane



1,1,2,2-Tet rachl oroet hane



Tet rachl oroet hene



1,1,1,2-Tet rachl oro-2-f luoroet hane

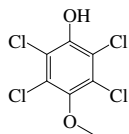


1,1,2,2-Tet rachl oro-1-f luoroet hane

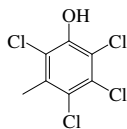
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9756	Tet rachi oromet hane	Carbon t et rachi ori de	C_4Cl_4	56-23-5	153.823	li q	-22.62	76.8	1.594 ⁹	1.4601 ²⁰	i H ₂ O; s Et OH, ace; msc et h, bz, chl
9757	2,3,5,6-Tet rachi oro-4-met hoxi phenol	Drosophi li n A	$\text{C}_6\text{H}_4\text{Cl}_2\text{O}_2$	484-67-3	261.918		116				
9758	2,3,4,6-Tet rachi oro-5-met hyl phenol		$\text{C}_6\text{H}_3\text{Cl}_3\text{O}$	10460-33-0	245.918	nd (pet h)	189.5				i H ₂ O; s Et OH, et h, ace, bz, KOH
9759	1,2,3,4-Tet rachi oronapt hal ene		$\text{C}_6\text{H}_4\text{Cl}_4$	20020-02-4	265.951		199				
9760	1,2,3,4-Tet rachi oro-5-ni t robenzene		$\text{C}_6\text{HCl}_3\text{NO}_2$	879-39-0	260.890		66				
9761	1,2,4,5-Tet rachi oro-3-ni t robenzene		$\text{C}_6\text{HCl}_3\text{NO}_2$	117-18-0	260.890		99.5	304	1.744 ²⁵		i H ₂ O; s Et OH, bz, chl
9762	2,3,4,5-Tet rachi orophenol		$\text{C}_6\text{H}_2\text{Cl}_2\text{O}$	4901-51-3	231.891	nd (pet h, sub)	116.5	sub			vs Et OH
9763	2,3,4,6-Tet rachi orophenol		$\text{C}_6\text{H}_2\text{Cl}_2\text{O}$	58-90-2	231.891	nd (li g)	70	15 ⁹			i H ₂ O; s Et OH, bz, chl, HOAc; vs NaOH
9764	2,3,5,6-Tet rachi orophenol		$\text{C}_6\text{H}_2\text{Cl}_2\text{O}$	935-95-5	231.891	lf (li g)	115				sl et h
9765	Tet rachi oropt hal i c anhydri de		$\text{C}_6\text{Cl}_4\text{O}_3$	117-08-8	285.896		254.5	sub	1.49 ²⁷⁵		sl et h
9766	1,1,1,2-Tet rachi oropropane		$\text{C}_3\text{H}_3\text{Cl}_4$	812-03-3	181.876	li q	-64	152.5	1.47 ⁹	1.4867 ²⁰	i H ₂ O; vs Et OH; s et h, chl
9767	1,1,1,3-Tet rachi oropropane		$\text{C}_3\text{H}_3\text{Cl}_4$	1070-78-6	181.876			157	1.4509 ²⁰	1.4825 ²⁰	i H ₂ O; vs Et OH, et h, bz, chl
9768	1,1,2,3-Tet rachi oropropane		$\text{C}_3\text{H}_3\text{Cl}_4$	18495-30-2	181.876			179.5	1.513 ¹⁷	1.5037 ¹⁷	i H ₂ O; s Et OH, chl; vs et h
9769	1,2,2,3-Tet rachi oropropane		$\text{C}_3\text{H}_3\text{Cl}_4$	13116-53-5	181.876			165	1.500 ¹⁸	1.4940 ¹⁸	i H ₂ O; vs Et OH, et h; s chl
9770	1,1,2,3-Tet rachi oropropane		$\text{C}_3\text{H}_3\text{Cl}_4$	10436-39-2	179.860	li q		167.2; 59	1.55 ²⁰		
9771	2,3,5,6-Tet rachi oropyri di ne		$\text{C}_8\text{HCl}_3\text{N}$	2402-79-1	216.881	cry (aq al)	90.5	250.5			vs et h, Et OH, pet h
9772	Tet rachi oropyri mi di ne		$\text{C}_8\text{Cl}_3\text{N}_2$	1780-40-1	217.868		69.0				
9773	3,3',4',5-Tet rachi orosal i cylan i li de	3,5-Di chl-4-di chl orophenyl -2-hydroxybenzami de	$\text{C}_{13}\text{H}_7\text{Cl}_4\text{NO}_2$	1154-59-2	351.013		161				
9774	2,3,5,6-Tet rachi orot erpht hal oyl di chl ori de		$\text{C}_6\text{Cl}_6\text{O}_2$	719-32-4	340.803	cry (ct c)	146.5				
9775	Tet rachi orot hi ophene		$\text{C}_6\text{O}_4\text{S}$	6012-97-1	221.920	nd (di l al)	30.5	233.4	1.703 ⁶	1.5915 ³⁰	i H ₂ O; vs Et OH; msc et h
9776	Tet rachi orovi nphos		$\text{C}_6\text{H}_9\text{Cl}_4\text{O}_4\text{P}$	961-11-5	365.961		97				
9777	Tet racoet ane		C_8H_{82}	4181-95-7	563.079		81.5	522; 400 ⁵⁰	0.8171 ²⁵	1.4572 ²⁵	
9778	Tet racosamet hyl undecasi l oxane	Tet racosamet hyl hendecasi l oxane	$\text{C}_{24}\text{H}_{72}\text{O}_5\text{Si}_{11}$	107-53-9	829.764			322.8; 202 ⁴⁷	0.9247 ²⁵	1.3994 ²⁰	vs bz
9779	Tet racosane		$\text{C}_{24}\text{H}_{50}$	646-31-1	338.654	cry (et h)	50.4	391.3	0.799 ⁹	1.4283 ⁷⁰	i H ₂ O; sl Et OH; vs et h
9780	Tet racosanoi c aci d	Li gnoceri c aci d	$\text{C}_{24}\text{H}_{48}\text{O}_2$	557-59-5	368.637		87.5	272 ¹⁰	0.8207 ¹⁰⁰	1.4287 ¹⁰⁰	vs bz, et h
9781	1-Tet racosanol		$\text{C}_{24}\text{H}_{50}\text{O}$	506-51-4	354.653		77	210 ⁰⁴			
9782	ci s15-Tet racosenoi c aci d	Nervoni c aci d	$\text{C}_{24}\text{H}_{46}\text{O}_2$	506-37-6	366.621		43				
9783	Tet racyanoet hene	Tet racyanoet hyl ene	C_6N_6	670-54-2	128.091		199	223	1.348 ²⁵	1.560 ²⁵	sl et h, bz, ct c, chl; s ace
9784	Tet racycl i ne		$\text{C}_{22}\text{H}_{24}\text{N}_2\text{O}_8$	60-54-8	444.434	cry (+3w)	172 dec				
9785	Tet racycl i ne hydrochl ori de		$\text{C}_{22}\text{H}_{25}\text{ClN}_2\text{O}_8$	64-75-5	480.895		214				
9786	Tet radecahydrophenat hrene		$\text{C}_{24}\text{H}_{24}$	5743-97-5	192.341	li q	-3	270; 87	0.944 ²⁰	1.5011 ²⁰	i H ₂ O; s et h, ace, bz
9787	Tet radecamet hyl hexasi l oxane		$\text{C}_{14}\text{H}_{22}\text{O}_5\text{Si}_6$	107-52-8	458.993	li q	-59	245.5	0.891 ⁹	1.3948 ²⁰	vs bz
9788	Tet radecanal		$\text{C}_{24}\text{H}_{48}\text{O}$	124-25-4	212.371	lf	30				i H ₂ O; s Et OH, et h, ace
9789	Tet radecanami de		$\text{C}_{24}\text{H}_{49}\text{NO}$	638-58-4	227.386	lf (ace)	104	217			vs Et OH
9790	Tet radecane		$\text{C}_{24}\text{H}_{50}$	629-59-4	198.388		5.82	253.58	0.7596 ²⁰	1.4290 ²⁰	i H ₂ O; vs Et OH, et h; s ct c
9791	Tet radecanedi oi c aci d		$\text{C}_{24}\text{H}_{48}\text{O}_4$	821-38-5	258.354		125.5				
9792	1,14-Tet radecanedi ol		$\text{C}_{24}\text{H}_{50}\text{O}_2$	19812-64-7	230.387	nd (bz)	85.8	200 ⁹			vs et h, Et OH
9793	Tet radecaneni t ri le	Myri st oni t ri le	$\text{C}_{24}\text{H}_{48}\text{N}_2$	629-63-0	209.371		19	226 ¹⁰⁰ ; 119 ¹	0.8281 ¹⁹	1.4392 ²³	i H ₂ O; msc Et OH, et h, ace, bz; sl ct c
9794	1-Tet radecanet hi ol		$\text{C}_{24}\text{H}_{50}\text{O}$	2079-95-0	230.453		7	310; 178 ²²	0.8641 ²⁰	1.4597 ²⁰	i H ₂ O; s Et OH, et h, ct c
9795	Tet radecanoi c aci d	Myri st i c aci d	$\text{C}_{24}\text{H}_{48}\text{O}_2$	544-63-8	228.371	lf (et h)	54.2	25 ⁹	0.8622 ⁵⁴	1.4723 ⁷⁰	i H ₂ O; s Et OH, ace, chl; sl et h; vs bz
9796	Tet radecanoi c anhydri de		$\text{C}_{26}\text{H}_{54}\text{O}_3$	626-29-9	438.727	lf (pet h)	53.4		0.850 ²	1.4335 ⁷⁰	vs et h, Et OH



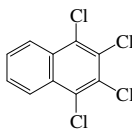
Tet rachi oromet hane



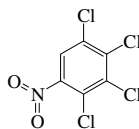
2,3,5,6-Tet rachi oro-4-met hoxyphehol



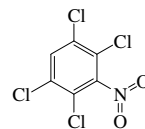
2,3,4,6-Tet rachi oro-5-met hylphenol



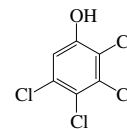
1,2,3,4-Tet rachi oronapht hal ene



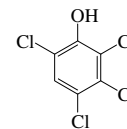
1,2,3,4-Tet rachi oro-5-ni t robenzene



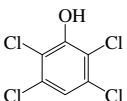
1,2,4,5-Tet rachi oro-3-ni t robenzene



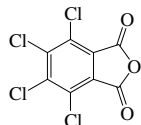
2,3,4,5-Tet rachi orophenol



2,3,4,6-Tet rachi orophenol



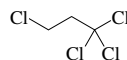
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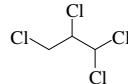
Tet rachi oropht halãrdhrydi de



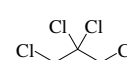
1,1,1,2-Tet rachi oropropane



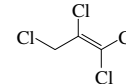
1,1,1,3-Tet rachi oropropane



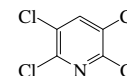
1,1,2,3-Tet rachi oropropane



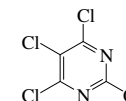
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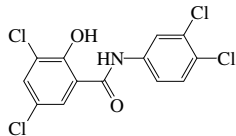
1,1,2,3-Tet rachi oropropene



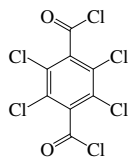
2,3,5,6-Tet rachi oropyri di ne



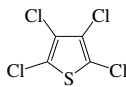
Tet rachi oropyri mi di ne



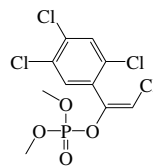
3,3',4',5'-Tet rachi orosal i cylanil i de



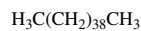
2,3,5,6-Tet rachi orot erpht halãrdhrydi ori de



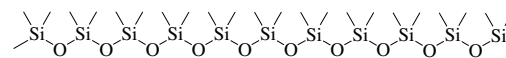
Tet rachi orot hi ophene



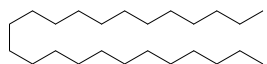
Tet rachi orovi nphos



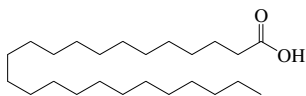
Tet racont ane



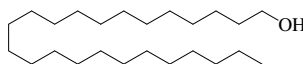
Tet racosamet hyl undecasi l oxane



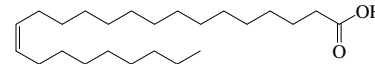
Tet racosane



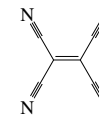
Tet racosanoi aci d



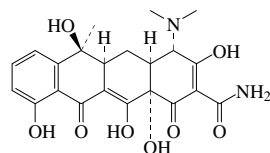
1-Tet racosanol



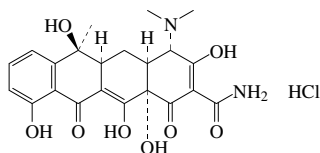
ci s15-Tet racosenoi aci d



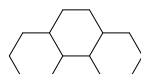
Tet racyanoet heni



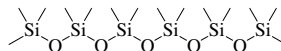
Tet racycl i ne



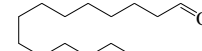
Tet racycl i rihydrochl ori de



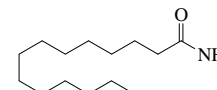
Tet radecahydrophenant hrene



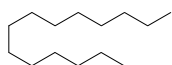
Tet radecamet hyl hexasi l oxane



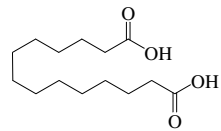
Tet radecanal



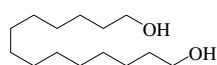
Tet radecanami de



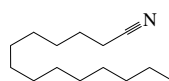
Tet radecane



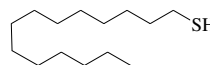
Tet radecanedi oi aci d



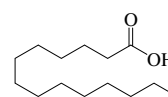
1,14-Tet radecanedi ol



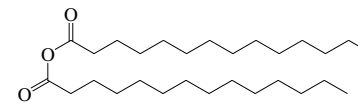
Tet radecaneni t ri le



1-Tet radecanet hi ol

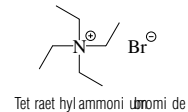
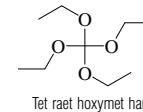
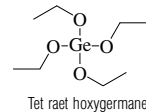
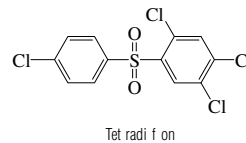
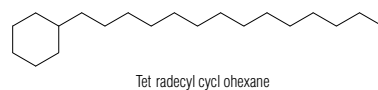
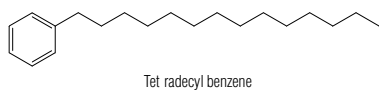
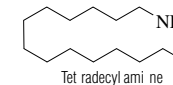
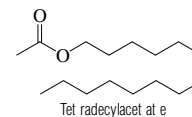
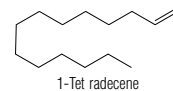
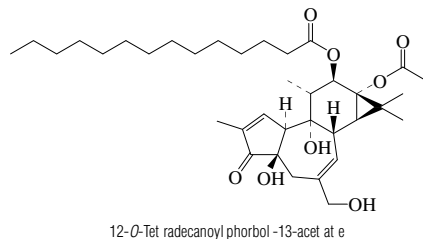
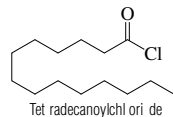
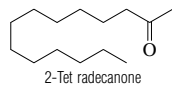
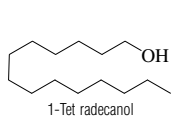


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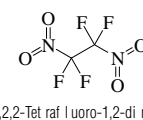
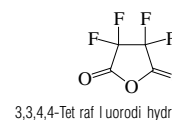
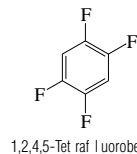
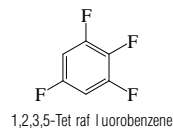
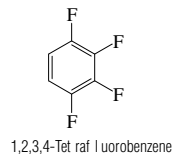
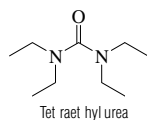
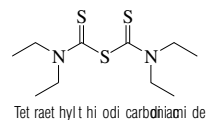
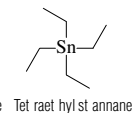
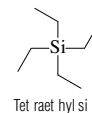
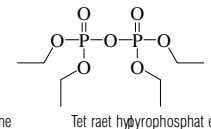
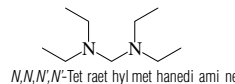
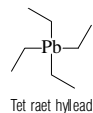
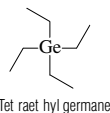
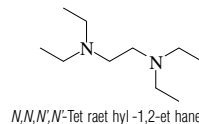
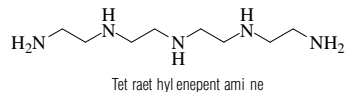
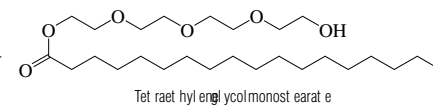
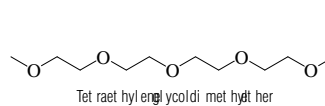
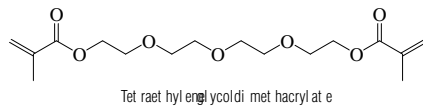
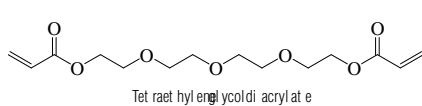
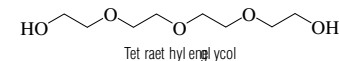
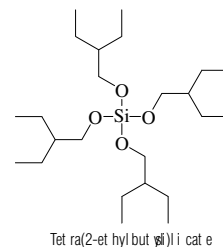
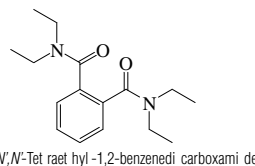
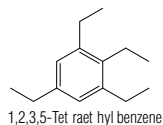
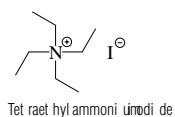
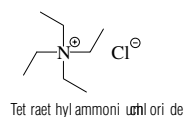


Tet radecanoi anhydri de

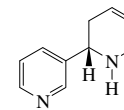
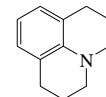
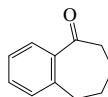
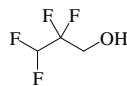
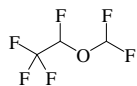
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9797	1-Tet radecanol	Tet radecyl alcohoh	$C_{14}H_{30}O$	112-72-1	214.387	lf	38.2	287	0.8238		i H ₂ O; vs Et OH, et h, ace, bz, chl
9798	2-Tet radecanone	Dodecyl met hyl ket one	$C_{14}H_{28}O$	2345-27-9	212.371	cry (di l al)	33.5	209 ⁹ , 134 ¹³			i H ₂ O; s Et OH, ace
9799	Tet radecanoyl chl ori de	Myri st oyl chl ori de	$C_{14}H_{27}ClO$	112-64-1	246.816		-1	171 ¹⁶	0.9078 ²⁵		s et h
9800	12- <i>O</i> -Tet radecanoyl phorbol -13-acet at e	Cocarci nogen A1	$C_{36}H_{56}O_8$	16561-29-8	616.825	oi l					
9801	1-Tet radecene		$C_{14}H_{28}$	1120-36-1	196.372	li q	-12	233	0.7745	1.4351 ²⁰	i H ₂ O; vs Et OH, et h; s bz; sl ct c
9802	Tet radecyl acet at e	1-Tet radecanol, acet at e	$C_{16}H_{32}O_2$	638-59-5	256.424			173 ¹⁰			
9803	Tet radecyl ami ne	1-Tet radecanami ne	$C_{14}H_{29}N$	2016-42-4	213.403		83.1	291.2	0.8079 ²⁰	1.4463 ²⁰	i H ₂ O; vs Et OH, et h, bz, chl; s ace
9804	Tet radecyl benzene		$C_{20}H_{34}$	1459-10-5	274.484		16	359	0.8549 ²⁰	1.4818 ²⁰	
9805	Tet radecyl cycl ohexane		$C_{20}H_{34}$	1795-18-2	280.532		24	360	0.8254 ²⁰	1.4579 ²⁰	
9806	Tet radi f on	1,2,4-Tri chl oro-5-[(4-chl orophenyl) sul f onyl]benzene	$C_{17}H_6Cl_4O_2S$	116-29-0	356.052		146		1.151 ²⁰		
9807	Tet raet hoxgermane	Et hanol, germani um(4+) salt	$8H_{12}GeO_4$	14165-55-0	252.88			139 ²⁰⁰			
9808	Tet raet hoxymet hane	Tet raet hyl ort hocarbonat e	$8H_{20}O_4$	78-09-1	192.253			159.5	0.9186 ²⁰	1.3905 ²⁵	msc Et OH, et h; s ct c
9809	Tet raet hyl ammoni um bromi de		$8H_{20}BrN$	71-91-0	210.156	hyg (al)	286 dec		1.397 ⁹⁰		vs H ₂ O, Et OH, chl, MeOH
9810	Tet raet hyl ammoni um chl ori de		$8H_{20}ClN$	56-34-8	165.705	hyg cry					vs H ₂ O, Et OH, ace, chl
9811	Tet raet hyl ammoni um i odi de		$8H_{20}IN$	68-05-3	257.156	cry (w)	300 dec				s H ₂ O
9812	1,2,3,5-Tet raet hyl benzene		$C_{10}H_{12}$	38842-05-6	190.325			249.0			
9813	<i>N,N,N',N'</i> -Tet raet hyl -1,2-benzenedi carboxami de	<i>N,N,N',N'</i> -Tet raet hyl pht hal ami de	$C_{16}H_{24}N_2O_2$	83-81-8	276.374		36	204 ¹⁶			
9814	Tet ra(2-et hyl but yl) sil i cat e	Sil i ci c aci d, tet raki s(2-et hyl but yl) sil i cat e	$C_{16}H_{34}Si$	78-13-7	432.754	li q			0.8920	1.4307 ²⁰	i H ₂ O; sl Et OH, ct c; s et h, bz
9815	Tet raet hyl ene glycol	3,6,9-Tri oxaundecane-1,11-di ol	$8H_{18}O_5$	112-60-7	194.226	li q	-6.2	328	1.1285	1.4577 ²⁰	vs H ₂ O; s Et OH, et h, ct c, di ox
9816	Tet raet hyl ene glycol di acryl at e		$C_{14}H_{20}O_7$	17831-71-9	302.321				1.125 ²⁵		
9817	Tet raet hyl ene glycol di met hacryl at e		$C_{16}H_{26}O_7$	109-17-1	330.373			220 ¹		1.4610 ²⁵	
9818	Tet raet hyl ene glycol di met hyl et her		$C_{10}H_{12}O_3$	143-24-8	222.279			275.3	1.0114 ²⁰		msc H ₂ O; s Et OH, et h, ct c
9819	Tet raet hyl ene glycol monost earat e		$C_{26}H_{46}O_6$	106-07-0	460.687		40	328	1.1285 ¹⁵	1.4593 ²⁰	
9820	Tet raet hyl enepent ami ne		$8HCN_5$	112-57-2	189.303			341.5	1.5042 ²⁰		s H ₂ O
9821	<i>N,N,N',N'</i> -Tet raet hyl -1,2-et hanedi ami ne		$C_{10}H_{24}N_2$	150-77-6	172.311			192	0.808 ²⁵	1.4343 ²⁰	
9822	Tet raet hyl germane		$8H_{20}Ge$	597-63-7	188.89			164.5	1.199		
9823	Tet raet hyl lead		$8H_{20}Pb$	78-00-2	323.4			dec 200	1.653 ²⁰	1.5198 ²⁰	i H ₂ O; s bz; sl Et OH
9824	<i>N,N,N',N'</i> -Tet raet hyl met hanedi ami ne		$8H_{20}N_2$	102-53-4	158.284			165.8	0.8000 ²⁰	1.4420 ²⁵	
9825	Tet raet hyl pyrophosphat e		$8H_{20}O_7P_2$	107-49-3	290.188		170 dec	155 ³	1.1847 ²⁰	1.4180 ²⁰	msc H ₂ O, Et OH, et h, ace, xyl, chl; sl ct c
9826	Tet raet hyl sil ane		$8H_{20}Si$	631-36-7	144.331			154.7	0.7658 ⁹	1.4268 ²⁰	i H ₂ O
9827	Tet raet hyl st annane	Ti n t et raet hyl	$8H_{20}Sn$	597-64-8	234.955	li q	-112	181, 6 ⁴	1.187 ²⁵	1.4730 ²⁰	
9828	Tet raet hyl t hi odi carboni c di ami de	Sul f iram	$C_{10}H_{20}N_4S_3$	95-05-6	264.474			232 ³	1.12 ²⁰		s chl
9829	Tet raet hyl urea		$8H_{20}N_2O$	1187-03-7	172.267			209	0.919 ²⁰	1.4474 ²⁰	i H ₂ O, al k, aci d
9830	1,2,3,4-Tet rafluorobenzene		$C_6H_2F_4$	551-62-2	150.074			94.3		1.4054 ²⁰	
9831	1,2,3,5-Tet rafluorobenzene		$C_6H_2F_4$	2367-82-0	150.074	li q	-46.25	84.4	1.319	1.4035 ²⁰	
9832	1,2,4,5-Tet rafluorobenzene		$C_6H_2F_4$	327-54-8	150.074		3.88	90.2	1.4255 ²⁰	1.4075 ²⁰	
9833	3,3,4,4-Tet rafluorodi hydro-2,5-f urandi one		$C_4F_4O_3$	699-30-9	172.035			54.5	1.6209 ²⁰	1.3240 ²⁰	
9834	1,1,2,2-Tet rafluoro-1,2-di ni t roet hane		$2F_4N_2O_4$	356-16-1	192.026	li q	-41.5	58.5	1.6024 ⁴	1.3265 ²⁵	i H ₂ O; s ace
9835	1,1,1,2-Tet rafluoroet hane		$8H_2F_4$	811-97-2	102.031	col gas	-103.3	-26.08	1.207 ²⁵		i H ₂ O; s et h



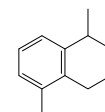
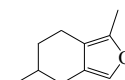
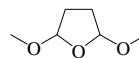
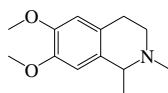
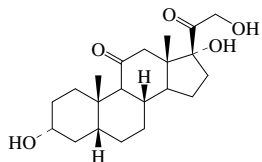
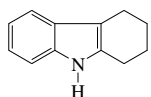
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No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9836	1,1,2,2-Tet rafluoroet hane		C_2F_4	359-35-3	102.031	col gas	-89	-19.9			
9837	Tet rafluoroet hene	Tet rafluoroet hylene	C_2F_4	116-14-3	100.015	col gas	-131.15	-75.9	1.519 ⁷⁶		i H ₂ O
9838	1,2,2,2-Tet rafluoroet hyl di fluoromet hyl et her	Ref ri gerant 236me	$\text{C}_2\text{F}_6\text{O}$	57041-67-5	168.037	vol li q or gas		23.35	1.454 ⁸⁰		
9839	Tet rafluoromet hane	Carbon t et rafluori de	C_2F_6	75-73-0	88.005	col gas	-183.60	-128.0	3.034 ²⁵		i H ₂ O; s bz, chl
9840	2,2,3,3-Tet rafluoro-1-propanol		$\text{C}_3\text{H}_7\text{F}_4\text{O}$	76-37-9	132.057	li q	-15	109.5	1.485 ³⁹	1.3197 ²⁰	s Et OH, ace, chl
9841	6,7,8,9-Tet rahydro-9H-benzocycl ohept en-5-one		$\text{C}_{11}\text{H}_{12}\text{O}$	826-73-3	160.212			175 ⁴⁰ , 124 ⁷	1.080 ²⁰	1.5698 ²⁰	s Et OH
9842	2,3,6,7-Tet rahydro-4,5,6,7-tetrahydro-1H-benzodiazepine	Jul ol i di ne	$\text{C}_{12}\text{H}_{15}\text{N}$	479-59-4	173.254		40	dec 280; 155 ¹⁷	1.003 ²⁰	1.568 ²⁵	
9843	1,2,3,6-Tet rahydro-2,3-bi pyri di ne, (S)	Anat abi ne	$\text{C}_8\text{H}_{12}\text{N}_2$	581-49-7	160.215			145 ¹⁰	1.091 ¹⁹	1.5676 ²⁰	msc H ₂ O; s Et OH, et h, bz
9844	2,3,4,9-Tet rahydro-1H-carbazol e		$\text{C}_{12}\text{H}_{13}\text{N}$	942-01-8	171.238	lf (di l al)	120	327.5			s Et OH; vs et h, bz, MeOH
9845	Tet rahydrocort i sone		$\text{C}_{21}\text{H}_{32}\text{O}_5$	53-05-4	364.476	cry (Et OAc)	190				
9846	1,2,3,4-Tet rahydro-6,7-di met hoxy-1,2-di met hyl i soqui nol i ne, (±)	Carnegi ne	$\text{C}_{19}\text{H}_{19}\text{NO}_2$	490-53-9	221.296	pa br syr		170 ¹			vs H ₂ O, et h, Et OH
9847	Tet rahydro-2,5-di met hoxyl uran		$\text{C}_8\text{H}_8\text{O}_3$	696-59-3	132.157			145.7	1.02 ²⁵	1.4180 ²⁰	
9848	4,5,6,7-Tet rahydro-3,6-di met hyl benzof uran		$\text{C}_{10}\text{H}_{14}\text{O}$	494-90-6	150.217		86	80 ¹⁸	0.972 ¹⁵		
9849	1,2,3,4-Tet rahydro-1,5-di met hyl naph hal ene		$\text{C}_{12}\text{H}_{16}$	21564-91-0	160.255			239	0.941 ²⁰	1.526 ²⁰	
9850	Tet rahydro-2,2-di met hyl -5-oxo-3-f uranacet i c aci d	Terpenyl i c aci d	$\text{C}_8\text{H}_{12}\text{O}_4$	26754-48-3	172.179	lf or pr (w+1)	90				vs H ₂ O
9851	1,2,3,4-Tet rahydro-2,5-di met hyl i soophene		$\text{C}_8\text{H}_{10}\text{S}$	5161-13-7	116.224	li q	-89	142.3	0.922 ²²	1.4799 ²⁰	vs ace, bz, et h, Et OH
9852	1,2,3,4-Tet rahydro-9H-fluoren-9-one	Phent ydrone	$\text{C}_{15}\text{H}_{12}\text{O}$	634-19-5	184.233	lt ye nd or pr (pent ane)	81.5	139 ^{0,05}			
9853	5,6,7,8-Tet rahydrof ol i c aci d		$\text{C}_{19}\text{H}_{23}\text{NO}_6$	135-16-0	445.429	pow					s H ₂ O
9854	Tet rahydrof uran	Tet ramet hyl ene ox i de	$\text{C}_4\text{H}_8\text{O}$	109-99-9	72.106	li q	-108.44	65	0.883 ³⁸	1.4050 ²⁵	s H ₂ O, chl; vs Et OH, et h, ace, bz
9855	Tet rahydro-2-f uranmet hanami ne	Tet rahydrof urf uryl ami ne	$\text{C}_4\text{H}_9\text{NO}$	4795-29-3	101.147			153	0.9752 ²⁰	1.4551 ²⁰	vs H ₂ O, et h, Et OH
9856	Tet rahydro-2-f uranmet hanol propanoat e		$\text{C}_8\text{H}_{14}\text{O}_3$	637-65-0	158.195			205.5	1.044 ²⁰		vs et h, Et OH, chl
9857	Tet rahydro-3-f uranol		$\text{C}_4\text{H}_8\text{O}_2$	453-20-3	88.106			181	1.09 ²⁵	1.4500 ²⁰	
9858	Tet rahydrof urf uryl acet at e		$\text{C}_7\text{H}_{12}\text{O}_3$	637-64-9	144.168			193; 89 ¹⁸	1.0624 ²⁰	1.4350 ²⁵	vs H ₂ O, et h, Et OH, chl
9859	Tet rahydrof urf uryl acryl at e		$\text{C}_7\text{H}_{10}\text{O}_3$	2399-48-6	156.179		<-60	96 ⁵	1.061 ²⁰		
9860	Tet rahydrof urf uryl alcohol	Tet rahydro-2-f urancarbi nol	$\text{C}_4\text{H}_9\text{O}_2$	97-99-4	102.132		<-80	178	1.0524 ²⁰	1.4520 ²⁰	vs ace, et h
9861	Tet rahydrof urf uryl met hacryl at e		$\text{C}_7\text{H}_{10}\text{O}_3$	2455-24-5	170.205			265; 81 ⁴	1.040 ²⁵	1.4554 ²⁵	
9862	Tet rahydroi mi dazo[4,5-d]i mi dazol e-Acet yl eneurea 2,5(1H,3H)-di one		$\text{C}_6\text{H}_8\text{N}_2\text{O}_2$	496-46-8	142.117	nd or pr (w)	300 dec				sl H ₂ O; i Et OH, HOAc; s et h, HCl, al k
9863	1,3,4,7,8-Tet rahydro-1,3-bi sobenzof urandi one	4-Cycl ohexene-1,2-di carboxyl i caci d	$\text{C}_{10}\text{H}_{12}\text{O}_3$	935-79-5	152.148	cry (pet h)	103.5				s Et OH, ace, chl, bz; sl pet h
9864	1,3,4,7,8-Tet rahydro-1,3-bi sobenzof urandi one	1-Cycl ohexene-1,2-di carboxyl i caci d	$\text{C}_{10}\text{H}_{12}\text{O}_3$	2426-02-0	152.148	pl (Et OH)	74		1.2 ²⁵		s Et OH, ace, chl; vs et h
9865	1,2,3,4-Tet rahydroi soqui nol i ne		$\text{C}_8\text{H}_{10}\text{N}$	91-21-4	133.190		<-15	232.5	1.0642 ²⁴	1.5668 ²⁰	i H ₂ O; s Et OH, bz, aci d, xyl
9866	3,4,5,6-Tet rahydro-7-met hoxy-2H-azepi ne		$\text{C}_7\text{H}_{13}\text{NO}$	2525-16-8	127.184	li q		49; 66 ²⁴	0.887	1.4630 ²⁰	
9867	1,2,3,4-Tet rahydro-6-met hoxiqui nol i ne		$\text{C}_{10}\text{H}_{13}\text{NO}$	120-15-0	163.216	pr (pet h, al) ort h pym (w)	42.5	284; 128 ¹		1.5718 ²⁰	s chl
9868	1,2,3,4-Tet rahydro-1-met hyl naph hal ene		$\text{C}_{11}\text{H}_{14}$	1559-81-5	146.229			220.6	0.9583 ²⁰	1.5353 ²⁰	



1,1,2,2-Tet raf luoroet hane Tet raf luoroet hene 1,2,2,2-Tet raf luoroet hyl f luoromet hyl her Tet raf luoromet hane 2,2,3,3-Tet raf luoro-1-propanol 6,7,8,9-Tet rahydro-5H-benzocycl ohept en-5-one 2,3,6,7-Tet rahydro-1H,5H-benzol i j]qui nol i zi 1,2,3,6-Tet rahydro-2,3'-bi pyri di (16)

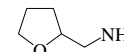
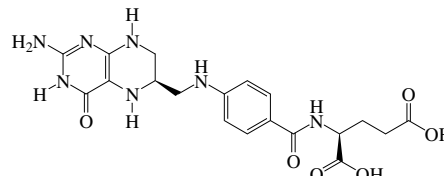
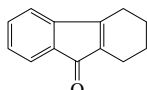
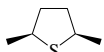
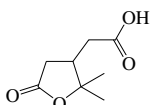


2,3,4,9-Tet rahydro-1H-carbazol e

Tet rahydrocort i sone

1,2,3,4-Tet rahydro-6,7-di met hoxy-1,2-di met hyl i soqui n(aj) i ne, Tet rahydro-2,5-di met hoxyf uran 4,5,6,7-Tet rahydro-3,6-di met hyl benzof uran 1,2,3,4-Tet rahydro-1,5-di met hyl naph t hal ene

3-519



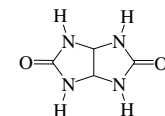
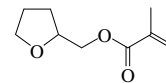
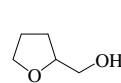
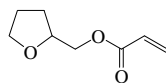
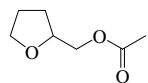
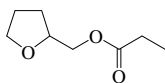
Tet rahydro-2,2-di met hyl-5-oxo-3-f uranaceti d

ci sTet rahydro-2,5-di met hyl thi ophene 1,2,3,4-Tet rahydro-9H-fl uoren-9-one

5,6,7,8-Tet rahydrof ol i gandi

Tet rahydrof uran

Tet rahydro-2-f uranmet hanami ne



Tet rahydro-2-f uranmet hanpropanoate e

Tet rahydro-3-f uranol

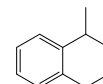
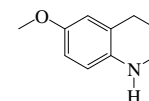
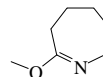
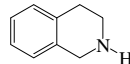
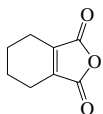
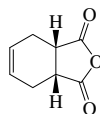
Tet rahydrofurf uyl acetate e

Tet rahydrofurf uyl acrylat e

Tet rahydrofurf uyl alcol

Tet rahydrofurf uyl metyl acrylat e

Tet rahydroi mi dazo[4,5-d] mi dazo[e-2H,3H]-di one



ci s3a,4,7,7a-Tet rahydro-1,3-i sobenzof urandi one

4,5,6,7-Tet rahydro-1,3-i sobenzof urandi one

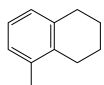
1,2,3,4-Tet rahydroi soqui nol i ne

3,4,5,6-Tet rahydro-7-met hoxy-2-azepi ne

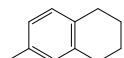
1,2,3,4-Tet rahydro-6-met hoxyqui nol i ne

1,2,3,4-Tet rahydro-1-met hyl naph t hal ene

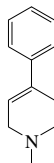
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9869	1,2,3,4-Tet rahydro-5-met hyl naphthalene		C ₁₁ H ₁₄	2809-64-5	146.229	liq	-23	234	0.9720	1.5439 ²⁰	
9870	1,2,3,4-Tet rahydro-6-met hyl naphthalene		C ₁₁ H ₁₄	1680-51-9	146.229	liq	-40	229	0.9537	1.5357 ²⁰	
9871	1,2,3,6-Tet rahydro-1-met hyl-4-phenyl pyridine	MPTP	C ₁₂ H ₁₅ N	28289-54-5	173.254	cry	41	870 ⁸			
9872	Tet rahydro-3-met hyl-2-thiopyran		C ₆ H ₁₂ S	5258-50-4	116.224	liq	-60	158	0.9478	1.4922 ²⁰	
9873	5,6,7,8-Tet rahydro-1-naphthalenamine		C ₁₀ H ₁₃ N	2217-41-6	147.217		38	279	1.0625 ¹⁶	1.5900 ²⁰	sl H ₂ O; s Et OH, et h, aci d
9874	1,2,3,4-Tet rahydronaphthalene	Tetralin	C ₁₀ H ₈	119-64-2	132.202	liq	-35.7	207.6	0.9645	1.5413 ²⁰	i H ₂ O; vs Et OH, et h; s chl, PhNH
9875	1,2,3,4-Tet rahydro-1-naphthol	1,2,3,4-Tet rahydronaphthol	C ₁₀ H ₁₂ O	529-33-9	148.201		34.5	255; 103 ²	1.0996 ²⁰	1.5638 ²⁰	
9876	5,6,7,8-Tet rahydro-1-naphthol	5,6,7,8-Tet rahydronaphthol	C ₁₀ H ₁₂ O	529-35-1	148.201		70	266; 143 ¹¹	1.0556 ⁷⁵		
9877	1,2,3,4-Tet rahydro-2-naphthol	Tetralol	C ₁₀ H ₁₂ O	530-91-6	148.201		15.5	140 ¹²			
9878	5,6,7,8-Tet rahydro-2-naphthol	5,6,7,8-Tet rahydronaphthol	C ₁₀ H ₁₂ O	1125-78-6	148.201		57	275.5	1.0552 ⁶⁵		
9879	Tet rahydro-6-pentyl-2-pyran-2-one	5-Hydroxydecanolactone	C ₁₀ H ₁₈ O ₂	705-86-2	170.249	liq	-27	121			
9880	1,2,3,4-Tet rahydrophenanthrene		C ₁₄ H ₁₄	1013-08-7	182.261	lf (MeOH)	33.5	179	1.0601 ⁴⁰		i H ₂ O; s Et OH, et h, ace, bz, HOAc, chl, lig
9881	1,2,3,6-Tet rahydropteralimide		C ₈ H ₁₀ N ₂ O ₂	85-40-5	151.163	cry (Et OH)	137				
9882	Tet rahydro-6-propyl-2-pyran-2-one	5-Hydroxyoctolactone	C ₉ H ₁₄ O ₂	698-76-0	142.196	liq	-13	128			
9883	2,3,4,5-Tet rahydro-6-propylpyridine	γ-Coniceine	C ₁₁ H ₁₅ N	1604-01-9	125.212			174	0.8753 ¹⁵	1.4661 ¹⁶	
9884	Tet rahydropyran	Oxane	C ₆ H ₁₀ O	142-68-7	86.132	liq	-49.1	88	0.8814	1.4200 ²⁰	s Et OH, et h, bz, ct c
9885	Tet rahydro-2H-pyran-2-methanol		C ₆ H ₁₀ O ₂	100-72-1	116.158			185	1.027 ²⁵	1.458 ²⁰	
9886	Tet rahydro-2H-pyran-2-one		C ₆ H ₈ O ₂	542-28-9	100.117	liq	-12.5	219	1.1088	1.4503 ²⁰	s H ₂ O; msc Et OH, et h; sl ct c
9887	Tet rahydro-4H-pyran-4-one		C ₆ H ₈ O ₂	29943-42-8	100.117			166.5	1.084 ²⁵	1.4520 ²⁰	
9888	1,2,5,6-Tet rahydropyridine	Δ ³ -Piperidine	C ₆ H ₁₀ N	694-05-3	83.132	liq	-48	108	0.914 ⁹	1.4800 ²⁰	s chl
9889	1,2,5,6-Tet rahydro-3-pyridinecarboxylic acid	Guvacine	C ₇ H ₁₀ N ₂ O ₂	498-96-4	127.141	pr (w), rods (+1w dilal)	295 dec				vs H ₂ O
9890	3,4,5,6-Tet rahydro-2(1H)-pyridine	Hexahydropyridine-2-thione	C ₆ H ₁₀ S	2055-46-1	116.185		211		1.33 ²⁰		
9891	1,2,3,4-Tet rahydroquinoline		C ₈ H ₈ N	635-46-1	133.190	nd	20	251	1.0588 ²⁰	1.6062 ¹⁹	s H ₂ O, chl; msc Et OH, et h
9892	5,6,7,8-Tet rahydroquinoline	2,3-Cycl ohexenopyridine	C ₈ H ₁₀ N	10500-57-9	133.190			222	1.0304 ¹³	1.5435 ²⁰	sl H ₂ O; s Et OH, et h, ace, bz
9893	1,2,3,4-Tet rahydroquinoline		C ₈ H ₁₀ N ₂	3476-89-9	134.178	lf (w, et h, pet h)	99	289			s chl; vs Et OH, et h, bz; sl pet h
9894	6,7,8,9-Tet rahydro-5H-tetrazolo[1,5-a]azepine	Pentylenetetrazole	C ₆ H ₁₀ N ₄	54-95-5	138.170	cry (bz-lig)	59.5	194			vs H ₂ O, Et OH, ace; s et h, bz; sl chl
9895	Tet rahydrothiophene	Thiacyclopentane	C ₄ H ₈ S	110-01-0	88.172	liq	-96.2	121.1	0.9987	1.4871 ¹⁸	i H ₂ O; msc Et OH, et h, ace, bz; s chl
9896	1,2,3,4-Tet rahydro-1,1,6-trimethylnaphthalene		C ₁₃ H ₁₈	475-03-6	174.282			240; 90 ⁴	0.9303 ²⁰	1.5257 ²⁰	s Et OH, et h, bz, chl
9897	1,2,5,8-Tet rahydroxy-9,10-antihracenedione	Quinazoline	C ₁₄ H ₈ O ₆	81-61-8	272.210	oran nd	>275				sl H ₂ O, ace, bz, Et OH, et h
9898	2,3,4,6-Tet rahydroxy-5H-benzocyclohepten-5-one	Purpurogallin	C ₁₄ H ₈ O ₅	569-77-7	220.179	red nd (gl HOAc)	274 dec				
9899	2,2',4,4'-Tet rahydroxybenzophenone		C ₁₃ H ₁₀ O ₅	131-55-5	246.215	ye nd (w+1)	197				vs H ₂ O, ace, et h, Et OH
9900	2,3,5,6-Tet rahydroxy-2,5-cycl ohexadiene-1,4-dione	Tetraquinone	C ₁₀ H ₆ O ₆	319-89-1	172.092	bl-blk cry					sl H ₂ O, et h, ct c; vs Et OH
9901	11,17,20,21-Tet rahydroxypregn-4-en-3-one, (11β,20R)	4-Pregnene-11β,17α,20β,21-tetrol-3-one	C ₂₇ H ₃₂ O ₅	116-58-5	364.476	cry (aq ace)	125 dec				vs ace, Et OH



1,2,3,4-Tet rahydro-5-met hyl naphth hal ene



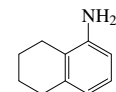
1,2,3,4-Tet rahydro-6-met hyl naphth hal ene



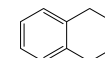
1,2,3,6-Tet rahydro-1-met hyl -4-phenyl pyri di ne



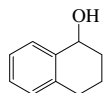
Tet rahydro-3-met hyl -2H pi opyra



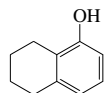
5,6,7,8-Tet rahydro-1-naphth hal enam i ne



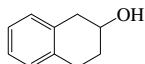
1,2,3,4-Tet rahydronaphth hal ene



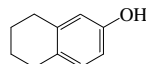
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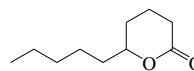
5,6,7,8-Tet rahydro-1-naphth hol



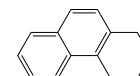
1,2,3,4-Tet rahydro-2-naphth hol



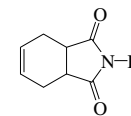
5,6,7,8-Tet rahydro-2-naphth hol



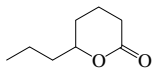
Tet rahydro-6-pent yl -2H pyran-2-one



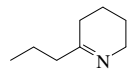
1,2,3,4-Tet rahydrophenant hrene



1,2,3,6-Tet rahydrophth hal i mi de



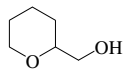
Tet rahydro-6-propyl -2H pyran-2-one



2,3,4,5-Tet rahydro-6-propyl pyri di ne



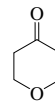
Tet rahydropyran



Tet rahydro-2H-pyran-2-met hanol



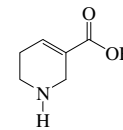
Tet rahydro-2H-pyran-2-one



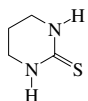
Tet rahydro-4H-pyran-4-one



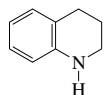
1,2,5,6-Tet rahydropyri di ne



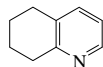
1,2,5,6-Tet rahydro-3-pyri di ncarboxyl i čci d



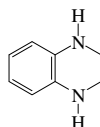
3,4,5,6-Tet rahydro-2(1H)-pyri mi di net hi one



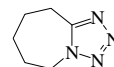
1,2,3,4-Tet rahydroqui nol i



5,6,7,8-Tet rahydroqui nol i ne



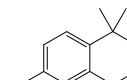
1,2,3,4-Tet rahydroqui noxal i



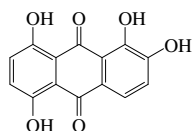
6,7,8,9-Tet rahydro-9H et razol o[1,5-a]jzepi ne



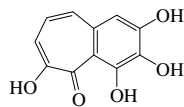
Tet rahydrothi ophene



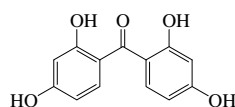
1,2,3,4-Tet rahydro-1,1,6-tri met hyl naphth hal ene



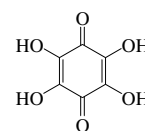
1,2,5,8-Tet rahydroxy-9,10-ant hracenedi one



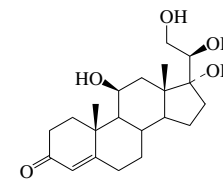
2,3,4,6-Tet rahydroxy-9H-benzocycl ohept en-5-one



2,2',4,4'-Tet rahydroxybiphenone

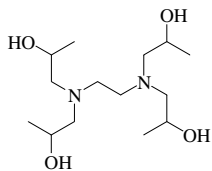


2,3,5,6-Tet rahydroxy-2,5-cycl ohexadi ene-1,4-di one



11,17,20,21-Tet rahydroxypregn-4-en-3-one,(11β,20R)

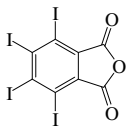
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9902	<i>N,N,N',N'</i> -Tetra(2-hydroxypropyl) ethylenediamine	ENTPROL	C ₁₄ H ₃₂ N ₂ O ₄	102-60-3	292.415				1.030 ²⁵	1.478 ²⁵	sl chl
9903	Tetraodoethene	Tetraodoethylene	C ₂ H ₂	513-92-8	531.639	yellow, pr (et h)	187	sub	2.98 ³		vs bz, chl
9904	4,5,6,7-Tetraodo-1,3-dibenzofuranone		C ₈ H ₄ O ₃	632-80-4	651.702	yellow, nd (HOAc) nd (sub)	327.5	sub			i H ₂ O, Et OH, bz; sl HOAc
9905	Tetraodometane	Carbon tetrachloride	CCl ₄	507-25-5	519.629	red lf (bz, chl)	171	135	4.23 ²⁰		vs py, chl
9906	2,3,4,5-Tetraodo- <i>N</i> -pyrrole	lodypyrrole	C ₄ H ₂ N ₂	87-58-1	570.676	yellow nd (al)	150 dec				vs ace, et h, chl
9907	Tetraobutyltinane	2-Methyl-1-propanol, titanium tetrakis salt	C ₁₆ H ₃₄ O ₄ Ti	7425-80-1	340.322			256 ⁵⁰⁰	0.960 ⁵⁰		dec H ₂ O
9908	Tetraopropyltinane	2-Propanol, titanium(4+) salt	C ₁₂ H ₂₆ O ₄ Ti	546-68-9	284.215			227.5	0.9711 ²⁰		dec H ₂ O; s Et OH, et h, bz, chl
9909	<i>N,N,N',N'</i> -Tetra(2-hydroxyethyl)-1,2-ethanediamine		C ₁₀ H ₂₄ N ₂ O ₄	140-07-8	236.309						sl H ₂ O, Et OH
9910	Tetra(2-hydroxyethyl)phosphonium chloride		C ₈ H ₁₂ Cl ₄ P	124-64-1	190.562		152.5				s H ₂ O
9911	Tetra(methylsilyl)metane		C ₄ H ₁₂ Si ₄	6156-25-8	200.409						s chl
9912	1-Tetraol		C ₆ H ₁₀ O	529-34-0	146.185		8	115 ⁶	1.0988 ¹⁶	1.5672 ²⁰	
9913	Tetraoxymethane		C ₃ H ₁₂ O ₄	1850-14-2	136.147	liq	-2.5	114	1.02 ³	1.3845 ²⁰	
9914	1,1,3,3-Tetraoxopropane		C ₃ H ₆ O ₄	102-52-3	164.200			183; 66 ¹²	0.997 ²⁵	1.4081 ²⁰	
9915	Tetraoxonine		C ₉ H ₂₅ NO ₄	7696-12-0	331.407	wh cry	-65-80		1.108 ²⁰	1.5175 ²¹	
9916	<i>N,N,N',N'</i> -Tetra(2-hydroxy-3,6-acridinediamine, monohydrochloride)	Acridine Orange	C ₁₉ H ₂₀ ClN ₃	65-61-2	301.814	orange soln					s H ₂ O, Et OH
9917	Tetraethylammonium bromide		C ₈ H ₁₈ BrN	64-20-0	154.049	hyg bi pym	230 dec		1.56 ⁶		vs H ₂ O; sl Et OH; i et h, bz, chl; s MeOH
9918	Tetraethylammonium chloride		C ₈ H ₁₈ ClN	75-57-0	109.598	hyg bi pym (dil 420 dec al)			1.169 ²⁰		s H ₂ O; sl Et OH; i et h, bz, chl; vs MeOH
9919	Tetraethylammonium iodide		C ₈ H ₁₈ I ₄ N	75-58-1	201.049		>230 dec		1.829 ²⁵		sl H ₂ O, al k, Et OH, ace; i et h, chl
9920	<i>N,N,N',N'</i> -Tetraethylamine		C ₁₀ H ₁₆ N	769-06-2	149.233	liq	-36	196; 88 ⁸	0.9147 ²⁰		
9921	1,2,3,4-Tetraethylbenzene		C ₁₀ H ₁₄	488-23-3	134.218	liq	-6.2	205	0.905 ²	1.5203 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
9922	1,2,3,5-Tetraethylbenzene	Isodurene	C ₁₀ H ₁₄	527-53-7	134.218	liq	-23.7	198	0.890 ³	1.5130 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
9923	1,2,4,5-Tetraethylbenzene	Durene	C ₁₀ H ₁₄	95-93-2	134.218		79.3	196.8	0.8380 ⁸¹	1.4790 ⁸¹	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
9924	<i>N,N,N',N'</i> -Tetraethyl-1,2-benzenediamine		C ₁₀ H ₁₆ N ₂	704-01-8	164.247		8.9	215.5	0.9560 ²⁰		
9925	<i>N,N,N',N'</i> -Tetraethyl-1,4-benzenediamine	Tetraethyl-phenylenediamine	C ₁₀ H ₁₆ N ₂	100-22-1	164.247	lf (dil al or li g)	51	260			s Et OH, et h, bz, chl
9926	2,3,5,6-Tetraethyl-1,4-benzenediol	Durohydroquinone	C ₁₀ H ₁₆ O ₂	527-18-4	166.217	nd (al)	233				s Et OH; sl et h
9927	Tetraethyl-1,2,4,5-benzenetetracarboxylate		C ₁₄ H ₁₄ O ₈	635-10-9	310.256	nd (al)	144	sub			vs Et OH
9928	3,3',5,5'-Tetraethyl-[1,1'-biphenyl]-4,4'-diamine		C ₁₆ H ₂₀ N ₂	54827-17-7	240.343		168.5				
9929	<i>N,N,N',N'</i> -Tetraethyl-[1,1'-biphenyl]-4,4'-diamine		C ₁₆ H ₂₀ N ₂	366-29-0	240.343		196.0				
9930	3,3',5,5'-Tetraethyl-[1,1'-biphenyl]-4,4'-diol		C ₁₆ H ₁₈ O ₂	2417-04-1	242.313	pa yellow or pr (HOAc)	221.8	sub			sl Et OH, bz, gl HOAc, t ol; i li g
9931	2,2,3,3-Tetraethylbutane		C ₈ H ₁₈	594-82-1	114.229	lf (et h)	100.7	106.45	0.824 ²	1.4695 ²⁰	i H ₂ O; s et h, chl



N,N,N',N'-Tetra(2-hydroxypropyl)et hyl enedi ami ne



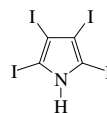
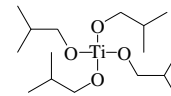
Tet rai odoet hene



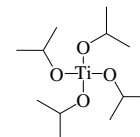
4,5,6,7-Tet rai odo-1,3-i sobenzof urandi one



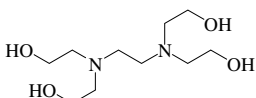
Tet rai odomet hane

2,3,4,5-Tet rai odo-~~4~~-pyrrol e

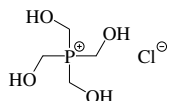
Tet rai sobut yl t anat e



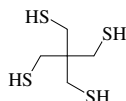
Tet rai sopropyl i t anat e



N,N,N',N'-Tet raki s(2-hydroxyet hyl)-1,2-et hanedi ami ne



Tet raki s(hydroxymet hyl)phosphoni um hlori de



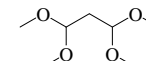
Tet raki s(met hyl t hi o)met hane



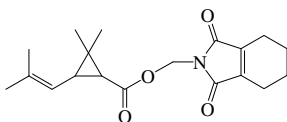
1-Tet rai one



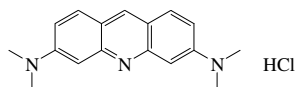
Tet ramet hoxymet hane



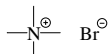
1,1,3,3-Tet ramet hoxipropane



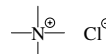
Tet ramet hri n



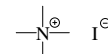
N,N,N',N'-Tet ramet hyl -3,6-aci ri di nedi ammi um hdrochl ori de



Tet ramet hyl ammi um broma di de



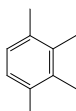
Tet ramet hyl ammi um chl ori de



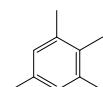
Tet ramet hyl ammi um iodi de



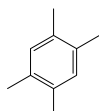
N,N,2,6-Tet ramet hyl ani li ne



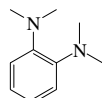
1,2,3,4-Tet ramet hyl benzen



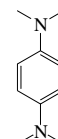
1,2,3,5-Tet ramet hyl benzene



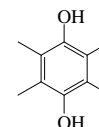
1,2,4,5-Tet ramet hyl benzen



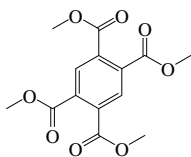
N,N,N',N'-Tet ramet hyl -1,2-benzenedi ami ne



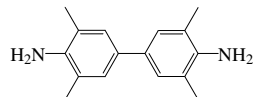
N,N,N',N'-Tet ramet hyl -1,4-benzenedi ami ne



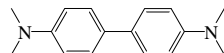
2,3,5,6-Tet ramet hyl -1,4-benzenedi



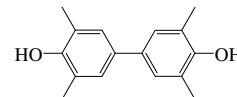
Tet ramet hyl 2,4,5-benzenet et racarboxyl at e



3,3',5,5'-Tet ramet hyl -[1,1'-bi phenyl]-4,4'-di ami ne



N,N,N',N'-Tet ramet hyl -[1,1'-bi phenyl]-4,4'-di ami ne

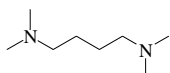


3,3',5,5'-Tet ramet hyl -[1,1'-bi phenyl]-4,4'-di ol

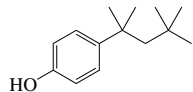


2,2,3,3-Tet ramet hyl but ane

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9932	<i>N,N,N',N'</i> -Tet ramet hyl -1,4-but anedi ami ne		C ₈ H ₂₀ N ₂	111-51-3	144.258			168	0.7942 ¹⁵	1.4621 ²⁵	msc H ₂ O; s Et OH, et h
9933	4-(1,1,3,3-Tet ramet hyl but yl)phenol		¹⁴ C ₁₂ O	140-66-9	206.324		85.8	279			
9934	2,2,4,4-Tet ramet hyl -1,3-cycl obut anedi one		C ₈ H ₁₂ O ₂	933-52-8	140.180						s chl
9935	2,3,5,6-Tet ramet hyl -2,5-cycl ohexadi ene-1,4-di one	Duroqui none	C ₁₀ H ₁₂ O ₂	527-17-3	164.201	ye nd (al or li g)	111.5				i ₂ OH s Et OH, et h, ace, bz, sul f, chl
9936	1,2,3,4-Tet ramet hyl cycl ohexane		¹⁰ H ₂₀	3726-45-2	140.266				0.8219 ²⁰	1.4531 ²⁰	
9937	1,1,3,3-Tet ramet hyl cycl opent ane		⁸ H ₁₆	50876-33-0	126.239	li q	-88.4	118	0.7469	1.4125 ²⁰	
9938	1,1,2,2-Tet ramet hyl cycl opropane		⁸ B ₁₄	4127-47-3	98.186	li q	-81	76			
9939	2,4,6,8-Tet ramet hyl cycl ot et rasi i oxane		⁴ H ₁₆ O ₄ Si ₄	2370-88-9	240.510	li q	-65	134.5	0.9912	1.3870 ²⁰	i H ₂ O
9940	2,4,7,9-Tet ramet hyl -5-decyne-4,7-di ol		C ₁₄ H ₂₆ O ₂	126-86-3	226.355		47	165 ⁴⁰			
9941	<i>N,N,N',N'</i> -Tet ramet hyl -4,4'-di ami nobenzophenone	Mi chl er's ket one	¹⁰ H ₂₀ N ₂ O	90-94-8	268.353	lf (al), nd (bz)	179	dec 360			i ₂ OH et h; sl Et OH; vs bz; s chl
9942	Tet ramet hyl di arsi ne	Cacodyl	⁴ H ₆ As ₂	471-35-2	209.981	li q	-6	165	1.447		vs et h, Et OH
9943	1,1,3,3-Tet ramet hyl -1,3-di phenyl di si i oxane		C ₁₆ H ₂₂ O ₂ Si ₂	56-33-7	286.516	li q	-80	292; 156	0.9763 ²⁰	1.5176 ²⁰	s ct c
9944	1,1,3,3-Tet ramet hyl di si i oxane		⁴ H ₁₀ O ₂ Si ₂	3277-26-7	134.324			71	0.756 ²⁰	1.3700 ²⁰	
9945	1,1,3,3-Tet ramet hyl -1,3-di si i oxanedi ol		C ₄ H ₁₄ O ₃ Si ₂	1118-15-6	166.323		66		1.095 ²⁵		
9946	<i>N,N,N',N'</i> -Tet ramet hyl -1,2-et hanedi ami ne	1,2-Di met hyl ami noet hane	⁶ H ₁₄ N ₂	110-18-9	116.204	li q	-55	121	0.77	1.4179 ²⁰	
9947	Tet ramet hyl germane	Germani um t et ramet hyl	⁴ H ₁₂ Ge	865-52-1	132.78			32 ⁵⁰⁰	1.006		
9948	1,1,3,3-Tet ramet hyl guani di ne		⁴ H ₁₀ N ₃	80-70-6	115.177						s ct c
9949	2,2,6,6-Tet ramet hyl -3,5-hept anedi one	Di pi val oyl met hane	¹¹ H ₂₀ O ₂	1118-71-4	184.276			93 ⁹⁵ , 72 ⁶	0.883 ²⁵	1.4589 ²⁰	sl ct c
9950	3,7,11,15-Tet ramet hyl hexadecanoi c aci d	Phyt ani c aci d	²⁶ H ₄₀ O ₂	14721-66-5	312.531		-65				
9951	3,7,11,15-Tet ramet hyl -1-hexadecen-3-ol	Isophyt ol	C ₂₀ H ₄₀ O	505-32-8	296.531	oi l		108 ⁹¹	0.8519 ²⁰	1.4571 ²⁰	vs bz, et h, Et OH
9952	2,2,3,3-Tet ramet hyl hexane		¹⁰ H ₂₂	13475-81-5	142.282	li q	-54	160.3	0.7609	1.4282 ²⁰	
9953	2,2,5,5-Tet ramet hyl hexane		¹⁰ H ₂₂	1071-81-4	142.282	li q	-12.6	137.4	0.7146	1.4055 ²⁰	
9954	3,3,4,4-Tet ramet hyl hexane		¹⁰ H ₂₂	5171-84-6	142.282			170.0	0.7789 ²⁵	1.4368 ²⁰	
9955	<i>N,N,N',N'</i> -Tet ramet hyl -1,6-hexanedi ami ne		C ₁₀ H ₂₄ N ₂	111-18-2	172.311			209.5	0.806 ²⁵	1.4359 ²⁰	
9956	Tet ramet hyl l ead		⁴ B ₁₂ Pb	75-74-1	267.3	li q	-30.2	110	1.995		
9957	<i>N,N,N',N'</i> -Tet ramet hyl met hanedi ami ne		C ₈ H ₁₄ N ₂	51-80-9	102.178			83	0.7491 ¹⁶		s H ₂ O
9958	Tet ramet hyl ox i rane		⁶ H ₁₂ O	5076-20-0	100.158			90.4	0.8156 ¹⁶	1.3984 ¹⁶	s H ₂ O
9959	2,6,10,14-Tet ramet hyl pent adecane	Pri st ane	¹⁸ H ₃₆	1921-70-6	268.521			296	0.7791 ²⁵	1.4370 ²⁵	vs bz, et h, chl, pet h
9960	2,2,3,3-Tet ramet hyl pent ane		¹⁰ H ₂₀	7154-79-2	128.255	li q	-9.75	140.2	0.7536	1.4236 ²⁰	
9961	2,2,3,4-Tet ramet hyl pent ane		¹⁰ H ₂₀	1186-53-4	128.255	li q	-121.0	133.0	0.7389	1.4147 ²⁰	
9962	2,2,4,4-Tet ramet hyl pent ane	Di er but yl met hane	¹⁰ H ₂₀	1070-87-7	128.255	li q	-66.54	122.29	0.7195	1.4069 ²⁰	i H ₂ O; vs Et OH, bz
9963	2,3,3,4-Tet ramet hyl pent ane		¹⁰ H ₂₀	16747-38-9	128.255	li q	-102.1	141.5	0.7547	1.4222 ²⁰	
9964	2,2,4,4-Tet ramet hyl -3-pent anol		¹⁰ H ₂₀ O	14609-79-1	144.254		52	165.5			
9965	2,3,4,5-Tet ramet hyl phenol	Prehni t enol	¹⁰ H ₁₀ O	488-70-0	150.217	nd (li g, aq al)	85.3	266			sl ₂ B, li g; vs Et OH, et h
9966	2,3,4,6-Tet ramet hyl phenol		¹⁰ H ₁₄ O	3238-38-8	150.217	cry (pet h)	80.5	240			s Et OH
9967	2,3,5,6-Tet ramet hyl phenol		¹⁰ H ₁₄ O	527-35-5	150.217	nd (li g), pr (al)	118.5	247			s chl, pet h, HOAc



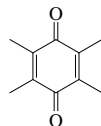
N,N,N',N'-Tetramethyl-1,4-butanediimine



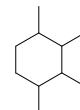
4-(1,1,3,3-Tetramethylbutyl)phenol



2,2,4,4-Tetramethyl-1,3-cyclobutanedi-one



2,3,5,6-Tetramethyl-2,5-cyclohexadiene-1,4-dione



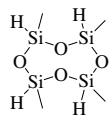
1,2,3,4-Tetramethylcyclohexane



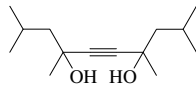
1,1,3,3-Tetramethylcyclopentane



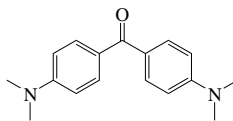
1,1,2,2-Tetramethylcyclopropane



2,4,6,8-Tetramethylcyclotetrasiloxane



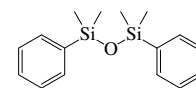
2,4,7,9-Tetramethyl-5-decyne-4,7-diol



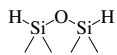
N,N,N',N'-Tetramethyl-4,4'-diaminobenzophenone



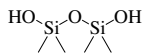
Tetramethylarsine



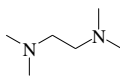
1,1,3,3-Tetramethyl-1,3-diphenylsiloxane



1,1,3,3-Tetrahydro-1,3-dioxane



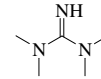
1,1,3,3-Tetrahydro-1,3-dioxanediol



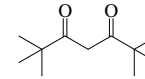
N,N,N',N'-Tetramethyl-1,2-ethanediamine



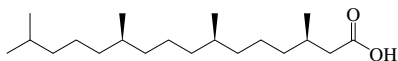
Tetramethylgermane



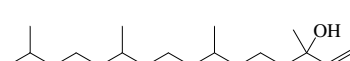
1,1,3,3-Tetramethylguanidine



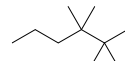
2,2,6,6-Tetramethyl-3,5-heptanedione



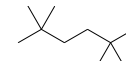
3,7,11,15-Tetramethylhexadecanoic acid



3,7,11,15-Tetramethyl-1-hexadecen-3-ol



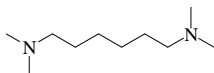
2,2,3,3-Tetramethylhexane



2,2,5,5-Tetramethylhexane



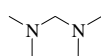
3,3,4,4-Tetramethylhexane



N,N,N',N'-Tetramethyl-1,6-hexanediamine



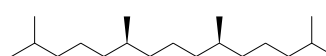
Tetramethyllead



N,N,N',N'-Tetramethylmethanediamine



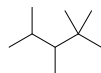
Tetramethyloxirane



2,6,10,14-Tetramethylpentadecane



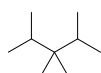
2,2,3,3-Tetramethylpentane



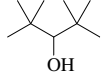
2,2,3,4-Tetramethylpentane



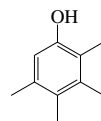
2,2,4,4-Tetramethylpentane



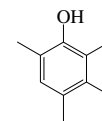
2,3,3,4-Tetramethylpentane



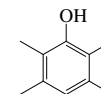
2,2,4,4-Tetramethyl-3-pentanol



2,3,4,5-Tetramethylphenol

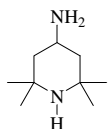


2,3,4,6-Tetramethylphenol

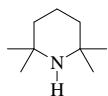


2,3,5,6-Tetramethylphenol

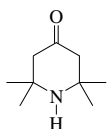
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
9968	2,2,6,6-Tet ramet hyl -4-pi peri di nami ne		$\text{C}_9\text{H}_{20}\text{N}_2$	36768-62-4	156.268		17	188.5	0.912 ²⁵	1.4706 ²⁰	
9969	2,2,6,6-Tet ramet hyl pi peri di ne	Norpempi di ne	$\text{C}_9\text{H}_{19}\text{NC}$	768-66-1	141.254		28	156	0.8367 ¹⁶	1.4455 ²⁰	vs et h
9970	2,2,6,6-Tet ramet hyl -4-pi peri di none		$\text{C}_9\text{H}_{17}\text{NO}$	826-36-8	155.237	ort h pl (et h-w) nd (et h)	36	205			s H ₂ O, Et OH, et h; sl chl
9971	<i>N,N,N',N'</i> -Tet ramet hyl -1,3-propanedi ami ne		$\text{C}_7\text{H}_{16}\text{N}_2$	110-95-2	130.231			144	0.7837 ¹⁸		msc H ₂ O, Et OH, et h
9972	Tet ramet hyl pyrazi ne		$\text{C}_8\text{H}_8\text{N}_2$	1124-11-4	136.194	cry (w)	86	190			
9973	Tet ramet hyl si l ane	TMS	$\text{C}_4\text{H}_8\text{Si}$	75-76-3	88.224	vol li q or gas	-99.06	26.6	0.648	1.3587 ²⁰	i H ₂ O; vs Et OH, et h; i sulf
9974	Tet ramet hyl si li cat e	Met hyl si li cat e	$\text{C}_4\text{H}_{12}\text{O}_2\text{SiC}$	681-84-5	152.222	li q	-1.0	121	1.029 ²	1.3683 ²⁰	vs Et OH
9975	Tet ramet hyl st annane		$\text{C}_4\text{H}_8\text{Sn}$	594-27-4	178.848		-55.1	78	1.314 ⁴	1.4386	i H ₂ O; s ct c, CS ₂
9976	Tet ramet hyl succi noni t ri le	Tet ramet hyl but anedi ni t ri le	$\text{C}_8\text{H}_{12}\text{N}_2$	C 3333-52-6	136.194	mcl pl, lf, pr(di fl 70.5 al)		170.5	1.070 ²⁵		s Et OH
9977	2,4,6,8-Tet ramet hyl -2,4,6,8-t et raphenyl cycl ot et rasi l oxane		$\text{C}_{28}\text{H}_{32}\text{O}_4\text{Si}_4$	77-63-4	544.894	cry (HOAc)	99	237 ¹¹⁵	1.1183 ²⁰	1.5461 ²⁰	i H ₂ O; msc ace, hp
9978	Tet ramet hyl t hi odi carboni c di ami de		$\text{C}_8\text{H}_{12}\text{N}_2\text{S}_3$	97-74-5	208.367		109.5		1.37 ²⁵		i H ₂ O; s Et OH, ace, bz, chl; sl et h
9979	Tet ramet hyl t hi ourea		$\text{C}_8\text{H}_{12}\text{N}_2\text{S}$	2782-91-4	132.227		79.3	245			s H ₂ O, Et OH, chl; sl et h
9980	Tet ramet hyl urea		$\text{C}_8\text{H}_{12}\text{N}_2\text{O}$	632-22-4	116.161	li q	-0.6	176.5	0.9687 ⁷	1.4496 ²³	sl Et OH, et h, ct c
9981	Tet rani t romet hane		$\text{C}_8\text{H}_{12}\text{N}_2$	509-14-8	196.033		13.8	126.1	1.6380 ²⁰	1.4384 ²⁰	i H ₂ O; s Et OH, et h
9982	2,4,8,10-Tet ra oxaspi ro[5.5]undecane		$\text{C}_{12}\text{H}_{20}\text{O}_4$	126-54-5	160.168		48.3	147 ⁶³ , 68 ¹			vs H ₂ O, ace, et h, Et OH
9983	2,5,8,11-Tet ra oxat ri decan-13-ol		$\text{C}_{16}\text{H}_{26}\text{O}_5$	23783-42-8	208.252			164 ¹¹	0.987 ²⁵	1.4453 ²⁰	
9984	Tet raphenoxysi l ane		$\text{C}_{20}\text{H}_{20}\text{O}_4\text{Si}$	1174-72-7	400.500		49	417; 236	1.1412 ⁶⁰		
9985	1,1,4,4-Tet raphenyl -1,3-but adi ene		$\text{C}_{28}\text{H}_{22}$	1450-63-1	358.475		203.5				s Et OH, bz, chl, HOAc
9986	2,3,4,5-Tet raphenyl -2,4-cycl opent adi en-1-one		$\text{C}_{28}\text{H}_{20}\text{O}$	479-33-4	384.468	bl k-vi ol lf (HOAc, xyl)	222.3				s Et OH, bz, xyl, HOAc
9987	1,1,2,2-Tet raphenyl et hane		$\text{C}_{28}\text{H}_{22}$	632-50-8	334.453	cry (bz), ort h nd (chl)	214.5	360			sl Et OH; s bz, HOAc
9988	1,1,2,2-Tet raphenyl -1,2-et hanedi ol	Benzopi nacol	$\text{C}_{28}\text{H}_{26}\text{O}_2$	464-72-2	366.452	pr (bz), cry (ace)	182				i H ₂ O, pet h; sl Et OH; s et h, ace, CS ₂
9989	1,1,2,2-Tet raphenyl et hene		$\text{C}_{28}\text{H}_{20}$	632-51-9	332.437	mcl or ort h (bz-et h or chl -al)	225	420	1.155 ⁰		i H ₂ O; sl Et OH, chl, et h; vs bz
9990	Tet raphenyl germane	Germani um t et raphenyl	$\text{C}_{24}\text{H}_{20}\text{Ge}$	1048-05-1	381.06		229.0				
9991	Tet raphenyl met hane		$\text{C}_{28}\text{H}_{20}$	630-76-2	320.427	ort h nd (bz, sub)	282	431			i H ₂ O, Et OH, et h, li g, HOAc; s bz, t ol
9992	5,6,11,12-Tet raphenyl naph t hacene	Rubrene	$\text{C}_{28}\text{H}_{28}$	517-51-1	532.671	oran-red (bz-li g)	332.5				i H ₂ O; sl Et OH, et h, ace, py; s bz
9993	Tet raphenyl pl umbane		$\text{C}_{28}\text{H}_{20}\text{Pb}$	595-89-1	515.6		228.3	126 ¹³	1.5298 ²⁰		s chl
9994	Tet raphenyl si l ane		$\text{C}_{28}\text{H}_{20}\text{Si}$	1048-08-4	336.502		236.5	228	1.078 ²⁰		s ct c, CS ₂
9995	Tet raphenyl st annane		$\text{C}_{24}\text{H}_{20}\text{Sn}$	595-90-4	427.126		228	420			sl chl
9996	Tet rapropoxysi l ane		$\text{C}_{28}\text{H}_{26}\text{O}_2\text{Si}$	682-01-9	264.434			226	0.9158 ⁹	1.4012 ²⁰	s ct c, CS ₂
9997	Tet rapropyl ammoni um bromi de	<i>N,N,N</i> -Tri propyl -1-propanami ni um bromi de	$\text{C}_{12}\text{H}_{28}\text{BrN}$	1941-30-6	266.261		252				vs H ₂ O, chl
9998	Tet rapropyl ammoni um i odi de		$\text{C}_{12}\text{H}_{28}\text{IN}$	631-40-3	313.261	ort h bi pym	280 dec		1.3138		vs H ₂ O, chl; s Et OH, HOAc; sl et h
9999	Tet rapropyl st annane		$\text{C}_{12}\text{H}_{28}\text{Sn}$	2176-98-9	291.060	li q	-109.1	228	1.1065	1.4745 ²⁰	
10000	Tet rapropyl t hi odi phosphat e	Aspon	$\text{C}_{12}\text{H}_{20}\text{O}_5\text{P}_2\text{S}_2$	3244-90-4	378.425	amber li q		104 ¹	1.12 ²⁵	1.4710 ²¹	sl H ₂ O, pet h
10001	Tet rapropyl t i t anat e	1-Propanol, t i t ani um(4+) salt	$\text{C}_{12}\text{H}_{28}\text{O}_4\text{TC}$	3087-37-4	284.215				206 ¹⁰⁰		
10002	Tet rasodi um EDTA	Edet at e sodi um	$\text{C}_{10}\text{H}_{16}\text{N}_2\text{Na}_4\text{O}_8$	64-02-8	380.169	amorp pow	300 (di hydrat e)				sl Et OH
10003	Tet rat et racont ane		$\text{C}_{44}\text{H}_{80}$	7098-22-8	619.186		85.6				
10004	Tet rat ri acont ane		$\text{C}_{34}\text{H}_{70}$	14167-59-0	478.920	pl (et h)	72.5	285.4	0.7728 ⁹⁰	1.4296 ⁹⁰	



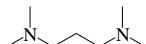
2,2,6,6-Tetramet hyl-4-pi peri di nami ne



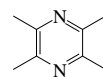
2,2,6,6-Tetramet hyl pi peri di ne



2,2,6,6-Tetramet hyl-4-pi peri di none



N,N,N',N'-Tetramet hyl-1,3-propanedi ami ne



Tetramet hyl pyrazi ne



Tetramet hyl si l ane



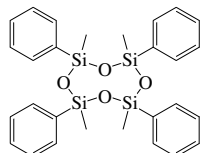
Tetramet hyl i l i cat e



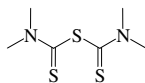
Tetramet hyl st annane



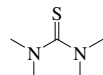
Tetramet hyl succi noni t ri l e



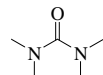
2,4,6,8-Tetramet hyl-2,4,6,8-t et raphenyl cycl ot et rasi l oxane



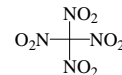
Tetramet hyl t hi odi carbodi ami de



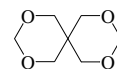
Tetramet hyl t hi ourea



Tetramet hyl urea

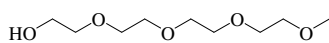


Tet rani t romet hane

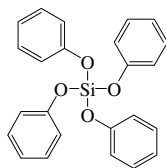


2,4,8,10-Tet raxoaspi ro[5.5]undecane

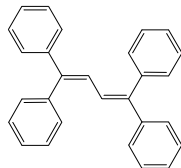
3-527



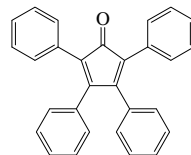
2,5,8,11-Tet raxoxat ri decan-13-ol



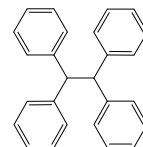
Tet raphenoxysi l ane



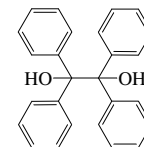
1,1,4,4-Tet raphenyl-1,3-but adi ene



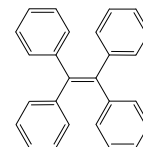
2,3,4,5-Tet raphenyl-2,4-cycl opent adi en-1-one



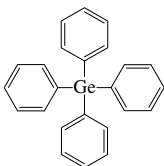
1,1,2,2-Tet raphenyl et hane



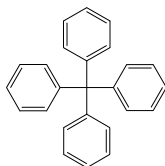
1,1,2,2-Tet raphenyl-1,2-et hanedi ol



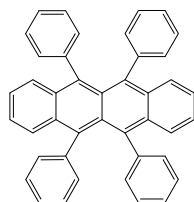
1,1,2,2-Tet raphenyl et hene



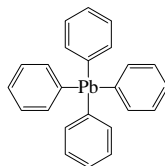
Tet raphenyl germane



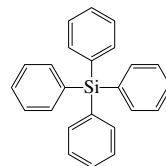
Tet raphenyl met hane



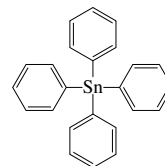
5,6,11,12-Tet raphenyl naph t hacer



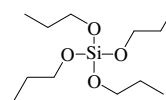
Tet raphenyl pl umbane



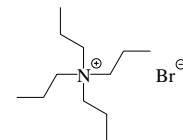
Tet raphenyl si l ane



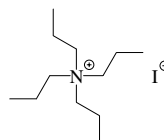
Tet raphenyl st annane



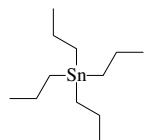
Tet raxopoxysi l ane



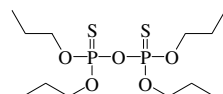
Tet raxopyl ammoni um bromi de



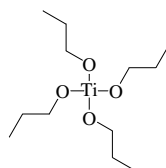
Tet raxopyl ammoni umodi de



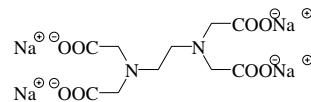
Tet raxopyl st annane



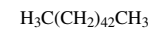
Tet raxopyl t hi odi phospat e



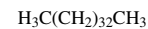
Tet raxopyl i t anat e



Tet rasodi ur EDTA



Tet rat et racont ane

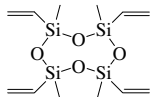


Tet rat ri acont ane

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10005	Tet rami nyl silane		$\text{H}_8\text{Cl}_2\text{Si}$	1112-55-6	136.267			130.2	0.7999 ⁹	1.4625 ²⁰	
10006	2,4,6,8-Tet rami nyl -2,4,6,8-t et rami nyl cycl ot et rasi loxane		$\text{C}_{12}\text{H}_{24}\text{O}_4\text{Si}_4$	2554-06-5	344.659	li q	-43.5	224; 11 ⁹	0.9875 ²⁰		s ct c, CS ₂
10007	1,2,4,5-Tet razi ne	<i>sym</i> -Tet razi ne	$\text{C}_8\text{H}_8\text{N}_4$	290-96-0	82.064	dk red pr	99	sub			s H ₂ O, Et OH, et h, sulf
10008	1 <i>H</i> -Tet razi ol -5-ami ne		C_8H_8	4418-61-5	85.069		204 dec				
10009	1 <i>H</i> -Tet razi ol e		$\text{C}_8\text{H}_8\text{N}_4$	288-94-8	70.054	pl (al)	157.3	sub	1.406 ⁹		sl H ₂ O
10010	Tet rodol oxi n		$\text{C}_{17}\text{H}_{17}\text{N}_3\text{O}_3$	4368-28-9	319.268	cry	225 dec				sl H ₂ O, et h, Et OH; s di l HOAc
10011	Thal i domi de	2-(2,6-Di oxo-3-pi peri di hyl)-1 i soi ndol e-1,3 <i>H</i> -di one	$\text{C}_{13}\text{H}_{10}\text{N}_2\text{O}_4$	50-35-1	258.229	nd	270				vs py, di ox
10012	Thal i um(l) et hanol at e	Thal i ous et hoxi de	H_2O	20398-06-5	249.443	cl ousy li q	-3	dec 130	3.49		dec ⁹
10013	Thebai ne		$\text{C}_9\text{H}_{21}\text{NO}_3$	115-37-7	311.375	pl (et h), pr (di l al)	193	sub 91	1.305 ²⁰		i H ₂ O; vs Et OH, chl; sl et h; s bz
10014	Thebai none		$\text{C}_9\text{H}_{21}\text{NO}_3$	467-98-1	299.365	nd or pr (al)	151.5				sl H ₂ O, Et OH, et h; s ace, bz, AcOEt
10015	Thenal di ne	1-Met hyl-phenyl - <i>N</i> -(2-t hi enyl met hyl)-4-pi peri di nami ne	$\text{C}_{17}\text{H}_{22}\text{N}_2\text{S}$	86-12-4	286.435		96	159 ^{0.02}			
10016	Thenyl di ami ne		$\text{C}_8\text{H}_{13}\text{N}_3\text{S}$	91-79-2	261.386			170 ¹		1.5915 ²⁰	
10017	Theobromi ne		$\text{C}_7\text{H}_8\text{N}_4\text{O}_2$	83-67-0	180.165	ort h or mcl nd (w)	357	sub 290			sl H ₂ O, Et OH; i et h, bz, ct c, li g, chl
10018	Theophyll i ne	3,7-Di hydro-1,3-di met hyl-1 puri ne-2,6-di one	$\text{C}_7\text{H}_8\text{N}_4\text{O}_2$	58-55-9	180.165	nd or pl (w+1)	273				s H ₂ O; sl Et OH, et h, chl
10019	Thi abendazol e	<i>H</i> -Benzi mi dazol e, 2-(4-t hi azol yl)-	$\text{C}_8\text{H}_8\text{N}_4\text{S}$	148-79-8	201.248			sub 305			
10020	Thi acet azone		$\text{C}_8\text{H}_{12}\text{N}_4\text{OS}$	104-06-3	236.293		225 dec				i H ₂ O, os, CS ₂
10021	Thi acyl oxhexane		$\text{C}_{10}\text{H}_{16}\text{N}_2\text{S}$	1613-51-0	102.198		19	141.8	0.9861 ²⁰	1.5067 ²⁰	i H ₂ O; s Et OH, et h, ace, bz
10022	1,2,5-Thi adi azol e	Pi azt hi ol e	$\text{C}_4\text{H}_6\text{N}_2\text{S}$	288-39-1	86.115	li q	-50.1	94	1.26 ⁸	1.5150 ²⁵	
10023	1,3,4-Thi adi azol e		$\text{C}_4\text{H}_6\text{N}_2\text{S}$	289-06-5	86.115	cry (sub)	42.5	204			
10024	1,3,4-Thi adi azol i di ne-2,5-di t hi one		$\text{C}_4\text{H}_6\text{N}_2\text{S}_3$	1072-71-5	150.245	ye cry (MeOH)	168				s H ₂ O
10025	Thi ami ne chl ori de		$\text{C}_7\text{H}_7\text{ClN}_2\text{OS}$	59-43-8	300.807	cry	164				s H ₂ O
10026	Thi ami ne hydrochl ori de		$\text{C}_7\text{H}_8\text{Cl}_2\text{N}_2\text{OS}$	67-03-8	337.268	mcl pl	248 dec				vs H ₂ O; sl Et OH; i et h, bz, chl
10027	Thi ami ne- <i>o</i> -phosphat e, chl ori de		$\text{C}_7\text{H}_8\text{ClN}_2\text{O}_4\text{P}$	532-40-1	380.787		200				
10028	Thi ant hrene		$\text{C}_8\text{H}_8\text{S}_2$	92-85-3	216.322	mcl pr or pl (al)	159.3	365	1.442 ⁹		i H ₂ O; sl Et OH; s et h, bz, CS
10029	2-Thi azol ami ne	2-Ami not hi azol e	$\text{C}_4\text{H}_6\text{N}_2\text{S}$	96-50-4	100.142	ye pl (al)	93	140 ¹			sl H ₂ O, Et OH, et h, chl; vs di l HCl
10030	Thi azol e		$\text{C}_4\text{H}_4\text{N}_2\text{S}$	288-47-1	85.128		-33.62	118	1.1998 ¹⁷	1.5969 ²⁰	sl H ₂ O; s Et OH, et h, ace
10031	Thi azol i di ne		$\text{C}_4\text{H}_6\text{N}_2\text{S}$	504-78-9	89.160			164.5	1.131 ²⁵	1.551 ²⁰	msc H ₂ O; s Et OH, ct c; vs et h, ace
10032	4-Thi azol i di ne carboxyl i c aci d	Ti monaci c	$\text{C}_4\text{H}_4\text{N}_2\text{O}_2\text{S}$	444-27-9	133.170	cry (w)	196.5				vs H ₂ O
10033	2,4-Thi azol i di nedi one		$\text{C}_4\text{H}_4\text{N}_2\text{O}_2\text{S}$	2295-31-0	117.127	pl (w), pr (al)	128	179 ⁹			vs et h
10034	2-Thi azol i di net hi one		$\text{C}_4\text{H}_4\text{N}_2\text{S}_2$	96-53-7	119.209	nd (w, MeOH)	107.3				s H ₂ O, bz, chl; sl Et OH; i et h, CS
10035	Thi di azuron	<i>N</i> -Phenyl - <i>N'</i> -1,2,3-t hi adi azol -5-yl - urea	$\text{C}_9\text{H}_{10}\text{N}_4\text{OS}$	51707-55-2	220.251		211 dec				
10036	1-(2-Thi enyl)et hanone		$\text{C}_8\text{H}_8\text{OS}$	88-15-3	126.176		10.5	213.5	1.1679 ²⁰	1.5667 ²⁰	sl H ₂ O; msc Et OH, et h; s ct c
10037	Thi epane	Hexamet hyl ene sul fide	$\text{C}_6\text{H}_{12}\text{S}$	4753-80-4	116.224	li q	0.5	173.5	0.99 ⁹	1.5044 ¹⁸	i H ₂ O; s et h, ace, chl
10038	Thi et ane	Tri met hyl ene sul fide	$\text{C}_3\text{H}_6\text{S}$	287-27-4	74.145	li q	-73.24	95.0	1.020 ⁹	1.5102 ²⁰	i H ₂ O; vs Et OH, bz; s ace
10039	Thi et ane 1,1-di oxi de	Tri met hyl ene sul f one	$\text{C}_3\text{H}_4\text{O}_2\text{S}$	5687-92-3	106.144		75.5	91.2 ¹⁴		1.5156 ²⁰	s H ₂ O, Et OH; sl et h, pet h
10040	Thi et hyl perazi ne		$\text{C}_{22}\text{H}_{29}\text{N}_3\text{S}_2$	1420-55-9	399.615	cry	63	227 ^{0.01}			sl ace
10041	Thi i rane	Et hyl ene sul fide	$\text{C}_2\text{H}_4\text{S}$	420-12-2	60.118		-109	dec 57	1.0130 ²⁰	1.4935 ²⁰	sl Et OH, et h; s ace, chl
10042	Thi oacet al dehyde t ri mer	2,4,6-Tri met hyl -1,3,5-t ri t hi ane	$\text{C}_6\text{H}_{12}\text{S}_3$	2765-04-0	180.354	α -mcl pl β -nd (ace)	101	246.5			i H ₂ O; s Et OH, et h, ace; vs bz, chl



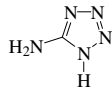
Tetrasilane



2,4,6,8-Tetraethyl-2,4,6,8-tetraoxane



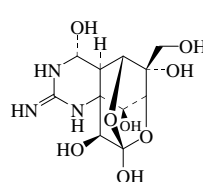
1,2,4,5-Tetrazine



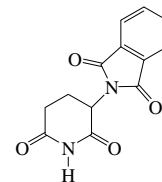
1H-Tetrazol-5-amine



1H-Tetrazole



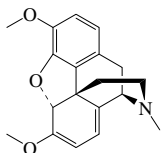
Tetrahydroxynitro



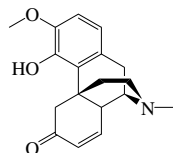
Thiazolidine



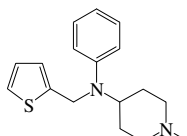
Thiourea



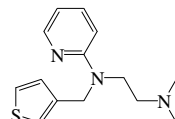
Thebaine



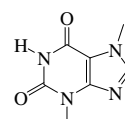
Thebaine



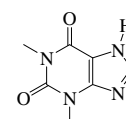
Thienidine



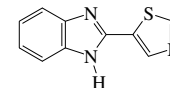
Thienidamine



Theobromine

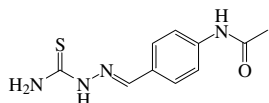


Theophylline



Thiazobenzazole

3-529



Thiacetazone



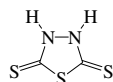
Thiacyclohexane



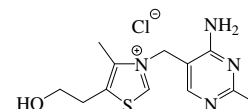
1,2,5-Thiazazole



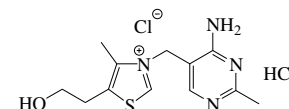
1,3,4-Thiazazole



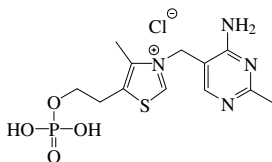
1,3,4-Thiazadiazole



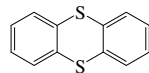
Thiamicin hydrochloride



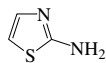
Thiamicin hydrochloride



Thiamicin phosphate chloride



Thianthrene



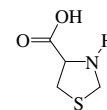
2-Thiazolamine



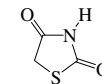
Thiazole



Thiazolidine



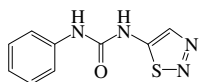
4-Thiazolidinecarboxylic acid



2,4-Thiazolidinedione



2-Thiazolidine



Thiazuron



1-(2-Thienyl)ethanone



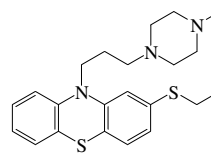
Thiopentane



Thietylene



Thiethane-1,1-dioxide



Thiazepazine

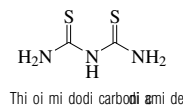
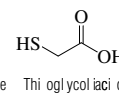
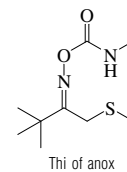
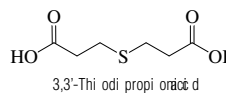
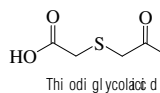
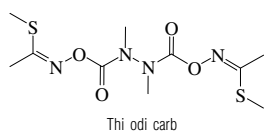
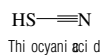
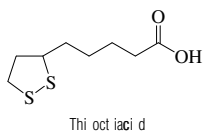
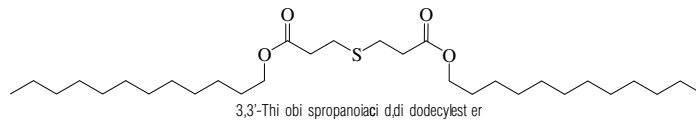
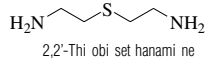
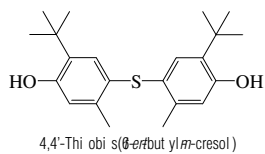
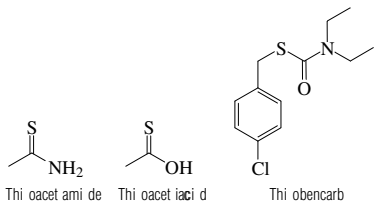


Thirane

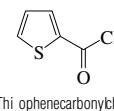
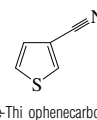
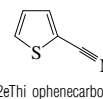
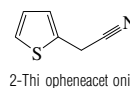
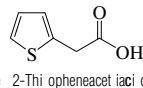
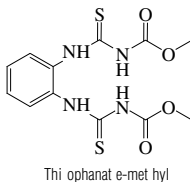
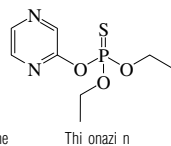
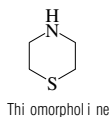
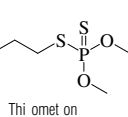
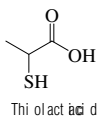


Thioacetaldehyde

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10043	Thi oacet ami de	Et hanet hi oami de	$\text{C}_2\text{H}_5\text{NS}$	62-55-5	75.133		115.5				vs H ₂ O, Et OH; sl et h, bz; s DMSO
10044	Thi oacet i c aci d		$\text{C}_2\text{H}_5\text{OOS}$	507-09-5	76.117	ye f umi ng li q	<-17	93; 96	1.064 ²⁰	1.4648 ²⁰	s H ₂ O, chl; vs Et OH, ace; msc et h
10045	Thi obencarb		$\text{C}_7\text{H}_7\text{Cl NOS}$	28249-77-6	257.779		1.7	127 ^{0.008}	1.16 ²⁰		
10046	4,4'-Thi obi s(θ- <i>tert</i> -but yl- <i>m</i> -cresol)	Bi s(5- <i>tert</i> -but yl-4-hydroxy-2-met hyl phenyl) sul fide	$\text{C}_{22}\text{H}_{30}\text{O}_2\text{S}$	96-69-5	358.537	cry	163				
10047	2,2'-Thi obi set hanami ne	Bi s(2-ami noet hyl) sul fide	$\text{C}_4\text{H}_{12}\text{N}_2\text{S}$	871-76-1	120.216	ye cry		232; 119 ¹⁷			
10048	3,3'-Thi obi spropanoi c aci d, di dodecyl dodecyl t hi obi spropanoat e ester		$\text{C}_{30}\text{H}_{50}\text{O}_4\text{S}$	123-28-4	514.845		39				
10049	Thi oct i c aci d	1,2-Di t hi ol ane-3-pent anoi c aci d	$\text{C}_8\text{H}_{14}\text{O}_2\text{S}_2$	62-46-4	206.326	ye nd	61	162			i H ₂ O
10050	Thi ocyani c aci d		CHNS	463-56-9	59.091			dec 0			vs Et s os
10051	Thi odi carb		$\text{C}_7\text{H}_{13}\text{N}_2\text{O}_3\text{S}_3$	59669-26-0	354.470		173		1.4 ²⁰		
10052	Thi odi glycol i c aci d	Thi odi acet i c aci d	$\text{C}_4\text{H}_6\text{O}_4\text{S}$	123-93-3	150.154	cry (w)	129				sl H ₂ O; vs Et OH; s bz
10053	3,3'-Thi odi propi oni c aci d		$\text{C}_6\text{H}_{10}\text{O}_4\text{S}$	111-17-1	178.206	cry wh pow	129				vs H ₂ O, Et OH
10054	Thi of anox		$\text{C}_7\text{H}_{13}\text{N}_2\text{O}_2\text{S}$	39196-18-4	218.316		57				
10055	Thi of ormal dehyde	Met hanet hi al	C_2SCH	865-36-1	46.092	unst ab gas					
10056	Thi oglycol i c aci d		$\text{C}_4\text{H}_6\text{O}_2\text{S}$	68-11-1	92.117		-16.5	120 ²⁰	1.3253 ²⁰	1.5080 ²⁰	msc H ₂ O, Et OH, et h; sl chl
10057	Thi oi mi dodì carboni c di ami de	2,4-Di t hi obi uret	$\text{C}_2\text{H}_4\text{N}_2\text{S}_2$	541-53-7	135.211	mcl cry	181 dec				vs ace
10058	Thi olact i c aci d		$\text{C}_3\text{H}_4\text{O}_2\text{S}$	71563-86-5	106.144		12	106 ¹⁵	1.1938 ²⁰	1.4810 ²⁰	s H ₂ O, Et OH, et h; sl chl
10059	Thi omet on		$\text{C}_7\text{H}_{10}\text{O}_2\text{PS}_3$	640-15-3	246.351	oi l		110 ¹ ; 77 ^{0.01}	1.209 ²⁰		sl H ₂ O; s os
10060	Thi omorphol i ne	Thi amorphol i ne	$\text{C}_4\text{H}_8\text{NS}$	123-90-0	103.186			175; 110 ¹⁰⁰	1.0882 ²⁰	1.5386 ²⁰	vs H ₂ O, ace, et h, Et OH
10061	Thi onazi n	Phosphorot hi oi c ad, di et hyD-pyrazi nyl ester	$\text{C}_8\text{H}_{13}\text{N}_2\text{O}_3\text{PS}$	297-97-2	248.239	li q	-0.9	80			
10062	Thi ophanat e-met hyl		$\text{C}_{12}\text{H}_{14}\text{N}_4\text{O}_4\text{S}_2$	23564-05-8	342.394			172 dec			
10063	Thi ophene	Thi of uran	$\text{C}_6\text{H}_6\text{S}$	110-02-1	84.140	li q	-38.21	84.0	1.064 ⁹	1.5289 ²⁰	msc Et OH, et h, ace, bz, ct c, di ox, py; sl chl
10064	2-Thi opheneacet i c aci d		$\text{C}_8\text{H}_8\text{O}_2\text{S}$	1918-77-0	142.176	cry (w)	76				vs H ₂ O, et h, Et OH
10065	2-Thi opheneacet oni t ri le		$\text{C}_8\text{H}_8\text{OS}$	20893-30-5	123.176			120 ²³	1.155 ²⁵	1.5425 ²⁰	
10066	2-Thi ophenecarboni t ri le	2-Cyanot hi ophene	$\text{C}_7\text{H}_5\text{NS}$	1003-31-2	109.150			192	1.172 ²⁵	1.5629 ²⁰	s chl
10067	3-Thi ophenecarboni t ri le	3-Cyanot hi ophene	$\text{C}_7\text{H}_5\text{NS}$	1641-09-4	109.150	oi l		204; 85 ²⁸⁰			
10068	2-Thi ophenecarbonyl chl ori de		$\text{C}_7\text{H}_5\text{Cl OS}$	5271-67-0	146.595			197; 85 ²⁸⁰	1.2127 ²¹	1.5920 ²⁰	i H ₂ O; vs Et OH; s et h; sl chl
10069	2-Thi ophenecarboxal dehyde		$\text{C}_7\text{H}_5\text{OS}$	98-03-3	112.150	pa ye li q		86.7 ²⁰		1.5855 ²⁰	i H ₂ O; vs Et OH, et h
10070	3-Thi ophenecarboxal dehyde	3-Formyl t hi ophene	$\text{C}_7\text{H}_5\text{OS}$	498-62-4	112.150			dec 260			vs H ₂ O, Et OH, et h; s chl; sl pet h
10071	2-Thi ophenecarboxyl i c aci d	2-Carboxyl t hi ophene	$\text{C}_7\text{H}_4\text{O}_2\text{S}$	527-72-0	128.150	nd (w)	129.5				s H ₂ O
10072	3-Thi ophenecarboxyl i c aci d	3-Thenoi c aci d	$\text{C}_7\text{H}_4\text{O}_2\text{S}$	88-13-1	128.150		138				
10073	2,5-Thi ophenedi carboxyl i c aci d	2,5-Di carboxyl t hi ophene	$\text{C}_7\text{H}_2\text{O}_4\text{S}$	4282-31-9	172.159		359	sub 150			sl H ₂ O; s Et OH, et h
10074	2-Thi ophenemet hanol		$\text{C}_7\text{H}_8\text{OS}$	636-72-6	114.166			207; 86 ¹⁰	1.2053 ¹⁶	1.5280 ²⁰	s Et OH, ace
10075	2-Thi ophenesul f onyl chl ori de		$\text{C}_7\text{H}_6\text{Cl OS}_2$	16629-19-9	182.649		28	100 ⁶			s et h
10076	Thi opropazat e		$\text{C}_7\text{H}_{12}\text{Cl N}_2\text{O}_2\text{S}$	84-06-0	446.005			216 ^{0.1}			
10077	4 <i>H</i> -Thi opyran-4-t hi one		$\text{C}_6\text{H}_8\text{S}_2$	1120-94-1	128.216		47				
10078	Thi oqui nox		$\text{C}_6\text{H}_4\text{N}_2\text{S}_3$	93-75-4	236.336	br-ye pow	180				i H ₂ O; sl ace, Et OH, pet h
10079	Thi ori dazi ne		$\text{C}_{12}\text{H}_{26}\text{N}_2\text{S}_2$	50-52-2	262.477	cry	73	230 ^{0.02}			sl ace
10080	<i>ci s</i> Thi ot hi xene		$\text{C}_{12}\text{H}_{26}\text{N}_2\text{O}_2\text{S}_2$	3313-26-6	443.625	cry	148				
10081	Thi ourea	Thi ocarbami de	$\text{C}_2\text{H}_4\text{S}$	62-56-6	76.121	ort h (al)	178		1.405 ⁵		s H ₂ O, Et OH; i et h
10082	9 <i>H</i> -Thi oxant hene	Di benzot hi opyran	$\text{C}_{13}\text{H}_8\text{S}$	261-31-4	198.283	nd (al -chl)	128.5	341			s chl
10083	9 <i>H</i> -Thi oxant hen-9-one	Thi oxant hone	$\text{C}_{13}\text{H}_8\text{OS}$	492-22-8	212.267	ye nd (chl)	209	373			i H ₂ O, pet h; sl Et OH; s bz, chl, C ₆ S
10084	2-Thi oxo-4-i mi dazol i di none	2-Thi ohydant oi n	$\text{C}_3\text{H}_4\text{N}_2\text{OS}$	503-87-7	116.141	wh nd (w)	230 dec				vs H ₂ O, Et OH; s et h, al k



3-531



Thiocetane-1,2-dithiolane-5-carboxylic acid

Thiocetane-1,2-dithiolane-5-carboxylic acid

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Thiocetane-1,2-dithiolane-5-carboxylic acid

Thiocetane-1,2-dithiolane-5-carboxylic acid

Thiophene

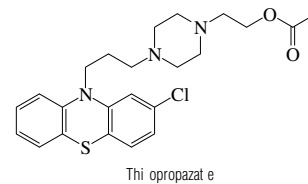
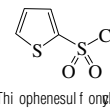
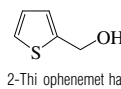
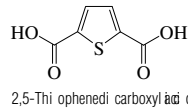
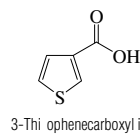
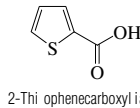
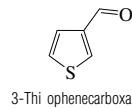
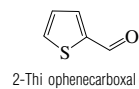
2-Thiophenecarboxylic acid

2-Thiophenecarbonitrile

2-Thiophenecarbonitrile

2-Thiophenecarbonitrile

2-Thiophenecarboxylic acid



2-Thiophenecarboxaldehyde

3-Thiophenecarboxaldehyde

2-Thiophenecarboxylic acid

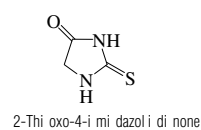
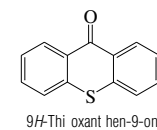
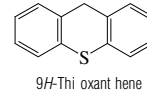
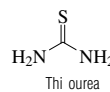
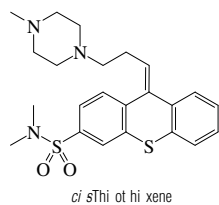
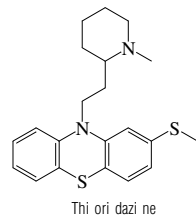
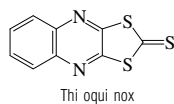
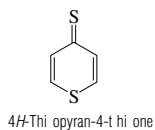
3-Thiophenecarboxylic acid

2,5-Thiophenedicarboxylic acid

2-Thiophenemethanol

2-Thiophenesulfonyl chloride

Thiopropazine



4H-Thiopyran-4-thione

Thiopyrimidinone

Thiopyrimidinone

Thiopyrimidinone

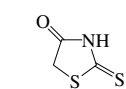
Thiourea

9H-Thioxanthene

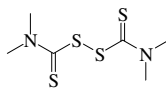
9H-Thioxanthene-9-one

2-Thioxo-4-imidazole-diazole

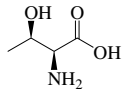
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10085	2-Thi oxo-4-t hi azoli di none	Rhodani ne	$\text{C}_3\text{H}_3\text{NDS}_2$	141-84-4	133.192	l t ye pr (al, w)	170		0.868		sl H_2O , DMSO; vs Et OH, et h
10086	Thi ram		$\text{C}_8\text{H}_{12}\text{N}_2\text{S}_4$	137-26-8	240.432	wh or ye mcl (chl -al)	155.6	129 ²⁰			vs chl
10087	L-Threoni ne	2-Ami no-3-hydroxybut anoi c aci/RB, [(R*,S*)]	$\text{C}_4\text{H}_9\text{NO}_3$	72-19-5	119.119		256 dec				s H_2O ; i Et OH, et h, chl
10088	D-Threose		$\text{C}_4\text{H}_8\text{O}_4$	95-43-2	120.105	hyg-syr or nd (w)	129				
10089	L-Threose		$\text{C}_4\text{H}_8\text{O}_4$	95-44-3	120.105						vs H_2O
10090	Thuj i c aci d	5,5-Di met hyl -1,3,6-cycl ohept at ri c 1-carboxyl i c aci d	$\text{C}_{10}\text{H}_{12}\text{O}_2$	499-89-8	164.201	cry (pet h)	88.5				
10091	α -Thuj one	4-Met hyl -1-(1-met hyl et hyl)-bi cycl o(3.1.0)hexan-3-one, (R)	$\text{C}_{10}\text{H}_{16}\text{O}$	546-80-5	152.233			201.2	0.9109 ²⁵	1.4490 ¹⁵	i H_2O ; s Et OH
10092	3-Thuj opsene	Wi ddrene	C_9H_{14}	470-40-6	204.352	l i q		122	0.932 ²⁴	1.5031 ²⁵	
10093	Thymi di ne	Thymi ne 2-desoxyri boside	$\text{C}_{10}\text{H}_{12}\text{N}_2\text{O}_5$	50-89-5	242.228	nd (AcOEt)	186.5				s H_2O , Et OH, ace, py, HOAc; sl chl
10094	Thymi ne		$\text{C}_8\text{H}_8\text{N}_2\text{O}_2$	65-71-4	126.114		316				sl H_2O , Et OH, et h, DMSO
10095	Thymol	2-Isopropyl -5-met hyl phenol	$\text{C}_{10}\text{H}_{14}\text{O}$	89-83-8	150.217		49.5	232.5	0.970 ²⁵	1.5227 ²⁰	i H_2O ; vs Et OH, et h, chl, AcOEt
10096	Thymol Bl ue		$\text{C}_7\text{H}_{30}\text{O}_5\text{S}$	76-61-9	466.589	grn-red (al, et h)	222 dec				sl H_2O , ace, bz; s Et OH, HOAc, PhNH_2
10097	Thymol i odi de		$\text{C}_8\text{H}_{24}\text{I}_2\text{O}_2$	552-22-7	550.213	amorp					i H_2O ; s et h; vs Et OH
10098	Thymol pht hal ei n		$\text{C}_{28}\text{H}_{30}\text{O}_4$	125-20-2	430.536	pr or nd (al)	253				i H_2O ; s Et OH, et h, ace; sl DMSO
10099	L-Thyroxi ne		$\text{C}_9\text{H}_{11}\text{I}_4\text{NO}_4$	51-48-9	776.871	nd	235				sl H_2O ; i Et OH, bz
10100	Ti mol ol		$\text{C}_8\text{H}_{24}\text{N}_4\text{O}_3\text{S}$	26839-75-8	316.420	oi l					
10101	Ti ocarl i de		$\text{C}_{24}\text{H}_{32}\text{N}_2\text{O}_2\text{S}$	910-86-1	400.577			146			
10102	Ti pepi di ne	3-(Di -2-t hi enyl met hyl ene)-1-met hyl pi peri di ne	$\text{C}_{15}\text{H}_{17}\text{NS}_2$	5169-78-8	275.433	ye cry	65	181 ^{4,5}			
10103	Tobramyci n		$\text{C}_{28}\text{H}_{37}\text{N}_5\text{O}_9$	32986-56-4	467.516	cry					s H_2O
10104	β -Tocopherol	5,8-Di met hyl t ocol	$\text{C}_{55}\text{H}_{100}\text{O}_2$	148-03-8	416.680	pa ye vi sc oi l		205			vs ace, et h, Et OH, chl
10105	γ -Tocopherol	7,8-Di met hyl t ocol	$\text{C}_{55}\text{H}_{100}\text{O}_2$	7616-22-0	416.680	pa ye vi sc oi l	-1.5	205			i H_2O ; msc Et OH, et h, ace, chl
10106	δ -Tocopherol	8-Met hyl t ocol	$\text{C}_{55}\text{H}_{100}\text{O}_2$	119-13-1	402.653	pa ye vi sc oi l		150 ⁰¹			i H_2O ; vs Et OH, et h, ace, chl
10107	Tol azami de		$\text{C}_8\text{H}_{12}\text{N}_3\text{O}_3\text{S}$	1156-19-0	311.400	cry	172				
10108	Tol but ami de	M-[(But yl ami no)carbonyl]-4-met hyl benzenesul f onami de	$\text{C}_{12}\text{H}_{18}\text{N}_2\text{O}_3\text{S}$	64-77-7	270.347	ort h cry	128.5		1.245 ⁵		sl H_2O ; s Et OH, et h, chl
10109	α -Tol i di ne	3,3'-Di met hyl benzi di ne	$\text{C}_{14}\text{H}_{16}\text{O}_2$	119-93-7	212.290	wh-red l f (Et OH 131 aq)					sl H_2O , chl; vs Et OH, et h
10110	Tol met i n		$\text{C}_8\text{H}_{15}\text{NO}_3$	26171-23-3	257.285	cry (MeCN)	156 dec				
10111	Tol uene	Met hyl benzene	C_7H_8	108-88-3	92.139	l i q	-94.95	110.63	0.8668	1.4961 ²⁰	i H_2O ; msc Et OH, et h; s ace, CS_2
10112	Tol uene-2,4-di ami ne	4-Met hyl -1,3-benzenedi ami ne	$\text{C}_7\text{H}_{10}\text{O}_2$	95-80-7	122.167	nd (w), cry (al)	99	292			vs H_2O , Et OH, et h, bz; s chl
10113	Tol uene-3,5-di ami ne	5-Met hyl -1,3-benzenedi ami ne	$\text{C}_7\text{H}_{10}\text{O}_2$	108-71-4	122.167	oi l		284			
10114	Tol uene-2,4-di i socyanat e		$\text{C}_7\text{H}_6\text{N}_2\text{O}_2$	584-84-9	174.156		20.5	251	1.2244 ²⁰		vs ace, bz, et h
10115	Tol uene-2,6-di i socyanat e		$\text{C}_7\text{H}_6\text{N}_2\text{O}_2$	91-08-7	174.156		18.3				dec H_2O ; s ace, bz
10116	p -Tol uenesul f oni c aci d		$\text{C}_7\text{H}_6\text{O}_3\text{S}$	104-15-4	172.202	hyg pl (w+1) mcl l f or pl	104.5	140 ²⁰			vs H_2O ; s Et OH, et h
10117	p -Tol uenesul f oni c aci d monohydrat e	4-Met hyl benzenesul f oni c aci d, C	$\text{C}_7\text{H}_{10}\text{O}_3\text{S}$	6192-52-5	190.217		105.3				s H_2O
10118	p -Tol uenesul f onyl chl ori de		$\text{C}_7\text{H}_6\text{ClO}_2\text{S}$	98-59-9	190.648	t cl (et h, pet h)	71	145			i H_2O ; s Et OH, et h, chl; vs bz
10119	o -Tol ui c aci d		$\text{C}_7\text{H}_6\text{O}_2$	118-90-1	136.149	pr or nd (w)	103.5	259	1.062 ¹¹⁵	1.512 ¹¹⁵	i H_2O ; vs Et OH, et h; s chl
10120	m -Tol ui c aci d		$\text{C}_7\text{H}_6\text{O}_2$	99-04-7	136.149		109.9		1.054 ¹¹²	1.509	sl H_2O , chl; vs Et OH, et h
10121	p -Tol ui c aci d		$\text{C}_7\text{H}_6\text{O}_2$	99-94-5	136.149		179.6				i H_2O ; vs Et OH, et h, MeOH; sl t f a



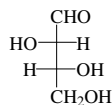
2-Thio-4-thiazolidinone



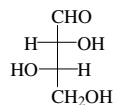
Thiuram



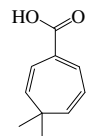
L-Threonine



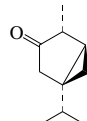
D-Threose



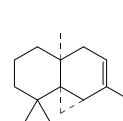
L-Threose



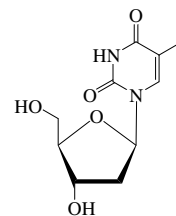
Thujic acid



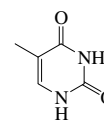
alpha-Thujone



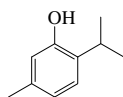
3-Thujopsene



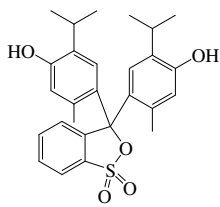
Thymidine



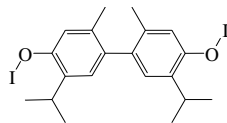
Thymine



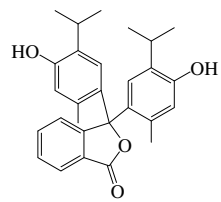
Thymol



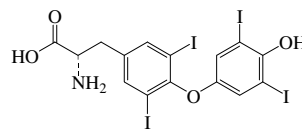
Thymol Blue



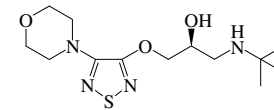
Thymol diiodide



Thymolphthalein

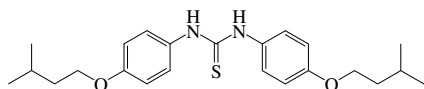


L-Thyronine

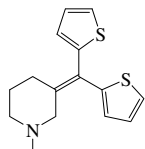


Thiomol

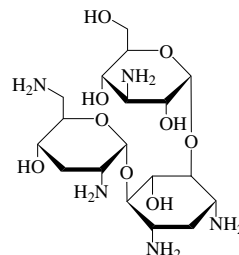
3-533



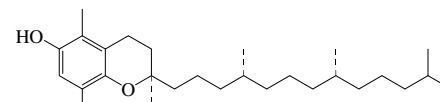
Thiocarbonyl diisobutyl ether



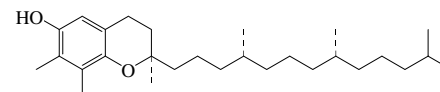
Thiopyridine



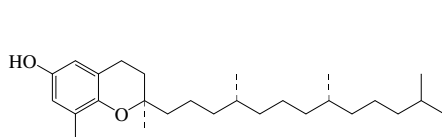
Tobramycin



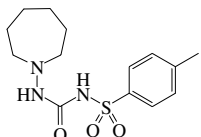
beta-Tocopherol



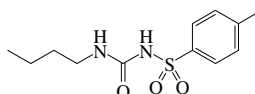
gamma-Tocopherol



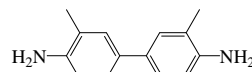
delta-Tocopherol



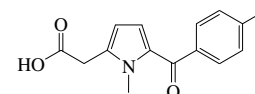
Tolazamide



Tolbutamide



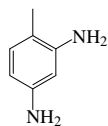
o-Toluidine



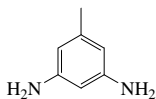
Tolmetin



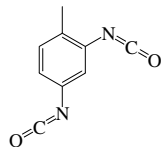
Toluene



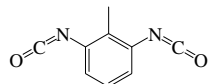
2,4-Diaminotoluene



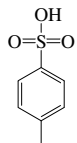
3,5-Diaminotoluene



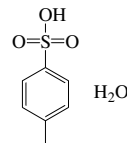
2,4-Diaminotoluene isocyanate



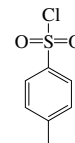
2,6-Diaminotoluene isocyanate



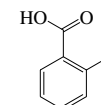
p-Toluenesulfonic acid



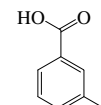
p-Toluenesulfonic acid monohydrate



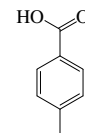
p-Toluenesulfonyl chloride



o-Toluidic acid

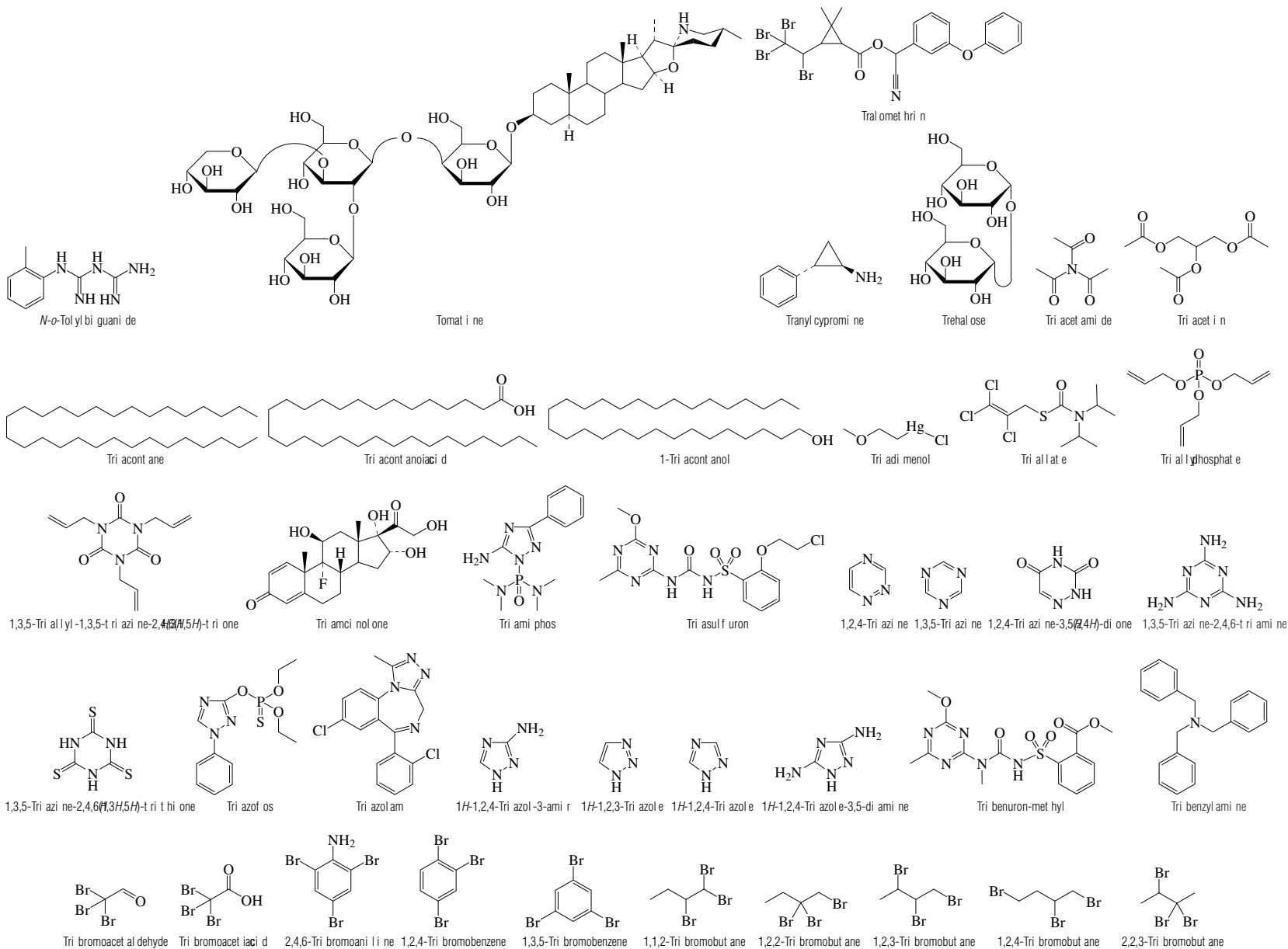


m-Toluidic acid



p-Toluidic acid

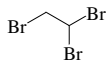
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10122	<i>N</i> - <i>o</i> -Tolyl bi guani de	<i>N</i> -(2-Met hyl phenyl) i mi dodì carboni mi di c di ami de	C ₉ H ₁₃ N ₅	93-69-6	191.233	nd or pl (w+1)	145.0				sl H ₂ O; vs Et OH, ace; i bz, chl, et h
10123	Tomat i ne		C ₉ H ₁₃ NO ₂₁	17406-45-0	1034.188	nd (MeOH)	270				vs Et OH, di ox
10124	Tralomet hri n		C ₂ H ₁₉ Br ₄ NO ₃	66841-25-6	665.007	oran-ye sol i d					
10125	Tranyl cypromi ne	2-Phenyl cycl opropyl ami ne	C ₉ H ₉ N	155-09-9	133.190	cry	44	127 ³²			
10126	Trehal ose		C ₁₂ H ₂₂ O ₁₁	99-20-7	342.296	ort h cry	203		1.58 ⁴		vs H ₂ O; s Et OH; i et h, bz
10127	Tri acet ami de		C ₉ H ₉ NO ₃	641-06-5	143.140	nd (et h)	79				vs et h
10128	Tri acet i n	Glycerol t ri acet at e	C ₉ H ₁₄ O ₆	102-76-1	218.203	col oi ly li q	-78	259	1.1983	1.4301 ²⁰	sl H ₂ O; msc Et OH, et h, bz; vs ace
10129	Tri acont ane		C ₉ H ₆ z	638-68-6	422.813	ort h (et h, bz)	65.1	449.7	0.8097	1.4352 ⁷⁰	i H ₂ O; sl Et OH; s et h; vs bz
10130	Tri acont anoi c aci d		C ₃₀ H ₂₀ O ₂	506-50-3	452.796	sc, nd (al, ace)	93.6			1.4323 ⁰⁰	vs bz, CS ₂ , chl
10131	1-Tri acont anol	Myri cyl al cohoh	C ₃₀ H ₆₀ O	593-50-0	438.812	nd (et h), pl (bz)	88		0.777		vs bz, et h, Et OH
10132	Tri adi menol	Mercury, chl oro(2-met hoxyet hyl)-	C ₂ H ₃ Cl HgO	123-88-6	295.13	cry	115				i H ₂ O; s Et OH, ace
10133	Tri al lat e		C ₁₀ H ₁₆ Cl ₃ NOS	2303-17-5	304.664		29	1170.0003	1.273 ²⁵		
10134	Tri al lyl phosphat e		C ₉ H ₆ O ₄ P	1623-19-4	218.186		-50	108 ⁷	1.0815 ²⁰		sl chl
10135	1,3,5-Tri al lyl-1,3,5-t ri azi ne-2,4,6-(1 <i>H</i> ,3 <i>H</i> ,5 <i>H</i>)-t ri one		C ₁₂ H ₁₅ N ₃ O ₃	1025-15-6	249.265		20.5	149 ⁴ , 105 ⁹⁵	1.1590 ²⁰		
10136	Tri amci nol one	Fl uoxi predni sol one	C ₂₁ H ₂₉ FO ₆	124-94-7	394.433	cry	270				
10137	Tri ami phos		C ₉ H ₁₉ N ₆ OP	1031-47-6	294.292	cry (Et OH aq)	167				sl H ₂ O; s os
10138	Tri asul f uron		C ₉ H ₁₆ Cl N ₃ O ₅ S	82097-50-5	401.826		186				
10139	1,2,4-Tri azi ne		C ₃ H ₃ N ₃	290-38-0	81.076	pa ye oi l	16.5	157		1.5149	
10140	1,3,5-Tri azi ne		C ₃ H ₃ N ₃	290-87-9	81.076		80.3	114	1.38 ²⁵		s Et OH, et h
10141	1,2,4-Tri azi ne-3,5-(2 <i>H</i> ,4 <i>H</i>)-di one		C ₈ H ₈ N ₂ O ₂	461-89-2	113.075		276.8				
10142	1,3,5-Tri azi ne-2,4,6-t ri ami ne	Mel ami ne	C ₃ H ₆ N ₆	108-78-1	126.120	mcl pr (w)	345 dec	sub	1.573 ⁶	1.872 ²⁰	sl H ₂ O, Et OH; i et h
10143	1,3,5-Tri azi ne-2,4,6-(1 <i>H</i> ,3 <i>H</i> ,5 <i>H</i>)-t ri t hi one	Tri t hi ocyanuri c aci d	C ₃ H ₃ O ₃ S ₃	638-16-4	177.271	ye pr	>300	100 ²²			
10144	Tri azof os		C ₉ H ₁₆ N ₂ O ₃ PS	24017-47-8	313.312	ye-br oi l	5		1.2514		i H ₂ O; s os
10145	Tri azol am		C ₈ H ₁₂ Cl ₂ N ₄	28911-01-5	343.210	t an cry (2-PrOH)	234				
10146	1 <i>H</i> -1,2,4-Tri azol -3-ami ne	Ami t role	C ₄ H ₅ N ₃	61-82-5	84.080	cry (w, al)	159				vs H ₂ O, Et OH; i et h, ace; s chl; sl AcOEt
10147	1 <i>H</i> -1,2,3-Tri azole		C ₄ H ₅ N ₃	288-36-8	69.065	hyg cry	23	204	1.1861 ²⁵	1.4854 ²⁵	s H ₂ O; s et h, ace; i li g
10148	1 <i>H</i> -1,2,4-Tri azole	Pyrrodi azole	C ₄ H ₅ N ₃	288-88-0	69.065	nd (bz/Et OH)	120.5	260 dec			s H ₂ O, Et OH
10149	1 <i>H</i> -1,2,4-Tri azole-3,5-di ami ne		C ₄ H ₅ N ₃	1455-77-2	99.095		211.5				s H ₂ O, Et OH; i et h, bz
10150	Tri benuron-met hyl		C ₁₇ H ₁₇ N ₅ O ₆ S	101200-48-0	395.391	sol i d	141				
10151	Tri benzyl ami ne	<i>N,N</i> -Bi s(phenyl met hyl) benzenemet hanami ne	C ₂₁ H ₂₁ N	620-40-6	287.399	pl (et h), mcl (al)	91.5	385	0.9912 ⁹⁵		sl H ₂ O, Et OH; s et h, ct c
10152	Tri bromoacet al dehyde	Bromal	C ₂ Br ₃ O	115-17-3	280.740			174	2.6649 ²⁵	1.5939 ²⁰	vs ace, et h, Et OH
10153	Tri bromoacet i c aci d		C ₂ HBr ₃ O ₂	75-96-7	296.740	mcl	132	dec 245			s H ₂ O, Et OH, et h
10154	2,4,6-Tri bromoani li ne		C ₆ H ₃ Br ₃ N	147-82-0	329.815	nd (al, bz)	122	300	2.35 ⁹⁰		i H ₂ O; sl Et OH; s et h, chl
10155	1,2,4-Tri bromobenzene		C ₆ H ₃ Br ₃	615-54-3	314.800		44.5	275			i H ₂ O; s Et OH; vs et h, ace; sl bz
10156	1,3,5-Tri bromobenzene		C ₆ H ₃ Br ₃	626-39-1	314.800	nd or pr (al)	122.8	271			i H ₂ O; sl Et OH; s et h, bz, chl
10157	1,1,2-Tri bromobut ane		C ₄ H ₇ Br ₃	3675-68-1	294.811			216.2	2.1835 ²⁰	1.5626 ¹⁷	vs et h, Et OH, chl
10158	1,2,2-Tri bromobut ane		C ₄ H ₇ Br ₃	3675-69-2	294.811			213.8	2.1692 ²⁰	1.568 ²⁰	vs et h, Et OH, chl
10159	1,2,3-Tri bromobut ane		C ₄ H ₇ Br ₃	632-05-3	294.811	li q	-19	220	2.1907	1.5680 ²⁰	vs et h, Et OH, chl
10160	1,2,4-Tri bromobut ane		C ₄ H ₇ Br ₃	38300-67-3	294.811	li q	-18	215	2.170	1.5608 ²⁰	vs et h, Et OH, chl
10161	2,2,3-Tri bromobut ane		C ₄ H ₇ Br ₃	62127-47-3	294.811		0.9	206	2.1723 ²⁰	1.5602 ²⁰	i H ₂ O; s Et OH, et h, chl; sl ct c



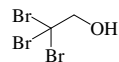
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10162	Tri bromochloromet hane		CBrCl	594-15-0	287.176	lf (et h)	55	158.5	2.71		vs et h
10163	1,1,2-Tri bromoet hane		Br ₃ Br ₃	78-74-0	266.757	li q	-29.3	188.93	2.6210	1.5933 ²⁰	i H ₂ O; s Et OH, et h, bz, ct c
10164	2,2,2-Tri bromoet hanol		Br ₃ Br ₃ O	75-80-9	282.756	nd or pr (pet h)	81	92 ⁰			vs bz, et h, Et OH
10165	Tri bromoet hene		Br ₃ Br ₃	598-16-3	264.741			164	2.708 ²⁰	1.6045 ¹⁶	sl H ₂ O; vs Et OH; s et h, ace, chl
10166	Tri bromofluoromet hane		CBF	353-54-8	270.721	li q	-73.6	108			i ₂ Et; s Et OH
10167	Tri bromomet hane	Bromof orm	CHBr	75-25-2	252.731		8.69	149.1	2.8788 ²⁵	1.5948 ²⁵	sl H ₂ O; msc Et OH, et h; s bz, li g, chl
10168	1,3,5-Tri bromo-2-met hoxybenzene		Br ₃ Br ₃ O	607-99-8	344.826	nd (al)	88	298	2.491 ²⁵		sl H ₂ O, Et OH; vs ace, bz; s ct c
10169	2,4,6-Tri bromo-3-met hylphenol	2,4,6-Tri bromoeresol	C ₆ H ₃ Br ₃ O	4619-74-3	344.826			84			s Et OH, et h, bz, HOAc; sl chl, pet h
10170	1,1,1-Tri bromo-2-met hyl-2-propanol	1,1,1-Tri bromo- <i>tert</i> -butyl alcohol	Br ₃ Br ₃ O	76-08-4	310.810	nd (li g) cry (di l al)	169	sub			sl H ₂ O, chl; s Et OH, et h
10171	Tri bromoni t romet hane		Br ₃ Br ₃ O ₂	464-10-8	297.729	pr	10	127 ¹⁸	2.811 ¹²	1.5790 ²⁰	i H ₂ O; s Et OH, et h; vs ace, bz
10172	2,4,6-Tri bromophenol		Br ₃ Br ₃ O	118-79-6	330.799	nd (al), pr (bz)	95.5	286	2.55 ⁰		i H ₂ O; vs Et OH; s et h, bz, HOAc, chl
10173	1,1,2-Tri bromopropane		CH ₂ Br ₃	14602-62-1	280.784			200.5	2.3547 ²⁰	1.5790 ²⁰	i H ₂ O; s Et OH, chl, HOAc; vs et h
10174	1,2,2-Tri bromopropane		CH ₂ Br ₃	14476-30-3	280.784			190.5	2.2984 ²⁰	1.5670 ²⁰	vs et h, Et OH, chl
10175	1,2,3-Tri bromopropane		CH ₂ Br ₃	96-11-7	280.784		16.9	222.1	2.4208 ²⁰	1.5862 ²⁰	i H ₂ O; vs Et OH, et h; sl ct c
10176	2,3,5-Tri bromot hi ophene		Br ₃ Br ₃ S	3141-24-0	320.828	nd (al)	29	260			s chl
10177	Tri bromot ri met hyl di al umi num	Met hyl al umi num sesqui bromi	Br ₃ Al ₂ Br ₃ C	12263-85-3	338.778	hyg col li q		110			
10178	Tri but yl 2-(acet yl oxy)-1,2,3-propanet ri carboxyl at e		C ₂₀ H ₃₄ O ₈	77-90-7	402.479			173 ¹			sl chl
10179	Tri but yl al umi nat e	1-But anol, al umi num salt	H ₂₇ AlCl ₃	3085-30-1	246.322			260 ⁵			
10180	Tri but yl al umi num		H ₂₇ Al	1116-70-7	198.324			102 ²			
10181	Tri but yl ami ne	<i>N,N</i> -Di but yl -1-but anami ne	C ₁₇ H ₃₇ N	102-82-9	185.349	li q	-70	216.5	0.777 ⁰	1.4299 ²⁰	sl H ₂ O, ct c; vs Et OH, et h; s ace, bz
10182	Tri but yl borat e		Br ₃ BO ₃	688-74-4	230.151	oi l	<-70	234	0.856 ⁷	1.4106 ¹⁸	s Et OH, bz; vs et h, MeOH
10183	Tri but yl fluorost annane	Tri but yl t i n fluori de	H ₂₇ FSn	1983-10-4	309.050	nd	=260	sub >200			
10184	2,4,6-Tri <i>tert</i> -but yl phenol		CH ₃₀ O	732-26-3	262.430	cry (al, pet h)	131	278	0.864 ⁷		i H ₂ O, al k; s Et OH, ace, ct c
10185	Tri but yl phosphat e		Br ₃ P ₃ O ₄	126-73-8	266.313			289	0.9727 ²⁵	1.4224 ²⁵	s H ₂ O, et h, bz, C ₆ S ₆ ; msc Et OH
10186	Tri but yl phosphi ne		Br ₃ P	998-40-3	202.316			240; 150 ⁵⁰	0.812 ²⁵	1.4619 ²⁰	
10187	Tri but yl phosphi t e	Tri but oxyphosphi ne	H ₂₇ OP ₃	102-85-2	250.314			137 ²⁶ , 122 ¹²	0.9259 ²⁰	1.4321 ¹⁹	s Et OH; sl ct c; vs et h
10188	<i>S,S,S</i> -Tri but yl phosphorot ri hi oat e, <i>S,S,S</i> -Tri but yl t ri t hi ophosphat e		H ₂₇ OPS ₃	78-48-8	314.510		<-25	150 ¹³	1.057 ²⁰		
10189	Tri but yl sil ane		H ₂₇ Si	998-41-4	200.436			221	0.7794 ⁰	1.4380 ²⁰	
10190	Tri but yl st annane	Tri but yl t i n hydri de	H ₂₇ Sn	688-73-3	291.060	li q		113 ⁷⁶ , 0.7	1.103 ²⁰		
10191	Tri but yri n	But anoi c aci d, 1,2,3-propanet ri yl C ₁₃ H ₂₅ O ₆ ester	C ₁₃ H ₂₅ O ₆	60-01-5	302.363	li q	-75	307.5	1.035 ⁰	1.4359 ²⁰	i H ₂ O; s Et OH, ace, bz; sl ct c; vs et h
10192	Tri cal ci um ci t rat e	Cal ci um ci t rat e	H ₁₀ CaO ₁₄	813-94-5	498.433	cry (w)	=100 dec (hyd)				sl H ₂ O; i Et OH
10193	Tri chl orf on		Br ₃ Cl ₃ O ₄ P	52-68-6	257.437		77	100 ¹	1.73 ²⁰		
10194	Tri chl oroacet al dehyde	Chloral	CHCl ₃ O	75-87-6	147.387	li q	-57.5	97.8	1.51 ²	1.4580 ²⁰	vs H ₂ O; s Et OH, et h
10195	2,2,2-Tri chl oroacet ami de		CHCl ₃ NO	594-65-0	162.402		142	240			sl H ₂ O; vs Et OH, et h
10196	Tri chl oroacet i c aci d		CHCl ₃ O ₂	76-03-9	163.387	hyg cry	59.2	196.5	1.6126 ⁶⁴	1.4603 ⁶¹	vs H ₂ O; s Et OH, et h; sl ct c
10197	Tri chl oroacet i c anhydri de		CCl ₃ O ₃	4124-31-6	308.759			dec 223; 139 ⁶⁰	1.6908 ²⁰		vs et h, HOAc
10198	Tri chl oroacet oni t ri le		Cl ₃ N	545-06-2	144.387	li q	-42	85.7	1.440 ³	1.4409 ²⁰	i H ₂ O
10199	Tri chl oroacet yl chl ori de		CCl ₃ O	76-02-8	181.832			117.9	1.6202 ²⁰	1.4695 ²⁰	msc et h
10200	2,3,4-Tri chl oroani li ne		HCCl ₃ N	634-67-3	196.462	nd (li g)	73	292			vs Et OH
10201	2,4,5-Tri chl oroani li ne		HCCl ₃ N	636-30-6	196.462	nd (li g)	96.5	270			s Et OH, et h; vs C ₆ S ₆ li g



Tri bromochloromet hane



1,1,2-Tri bromoet hane



2,2,2-Tri bromoet hanol



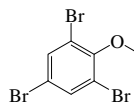
Tri bromoet hene



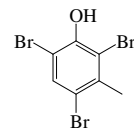
Tri bromof l uoromet hane



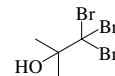
Tri bromomet hane



1,3,5-Tri bromo-2-met hoxybenzene



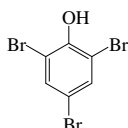
2,4,6-Tri bromo-3-met hyl phenol



1,1,1-Tri bromo-2-met hyl -2-propanol



Tri bromoni t romet hane



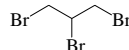
2,4,6-Tri bromophenol



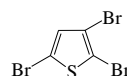
1,1,2-Tri bromopropane



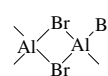
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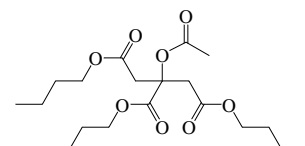
1,2,3-Tri bromopropane



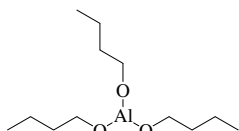
2,3,5-Tri bromot hi ophene



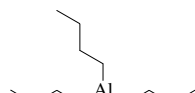
Tri bromot ri met hyl di al umi num



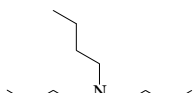
Tri tert-butyl-(acet yl oxy)-1,2,3-propanet ri carboxylat e



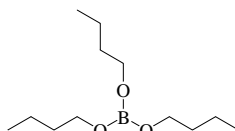
Tri tert-butyl umi nat e



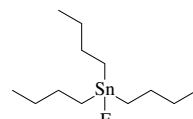
Tri tert-butyl al umi num



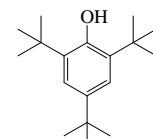
Tri tert-butyl ami ne



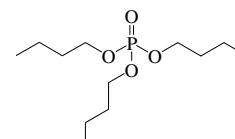
Tri tert-butyl borat e



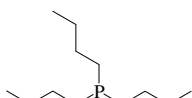
Tri tert-butyl fluorost annane



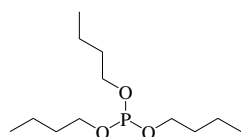
2,4,6-Tri tert-butyl phenol



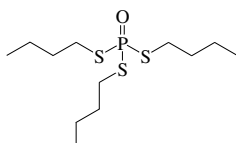
Tri tert-butyl phosphat e



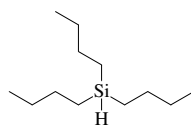
Tri tert-butyl phosphi ne



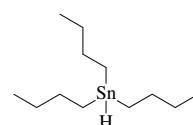
Tri tert-butyl phosphi t e



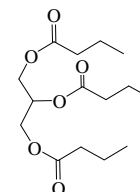
S,S,S-Tri tert-butyl phosphorot rot hi oat e



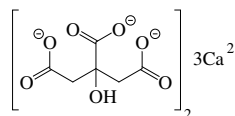
Tri tert-butyl sila ne



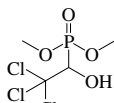
Tri tert-butyl st annane



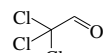
Tri tert-butyl uri n



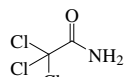
Tri tert-butyl calci umi t rat e



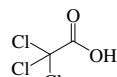
Tri chl orof on



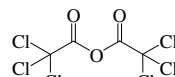
Tri chl oroacet al dehyde



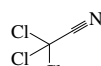
2,2,2-Tri chl oroacet ami de



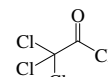
Tri chl oroacet iaci d



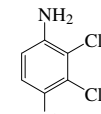
Tri chl oroacet anhydri de



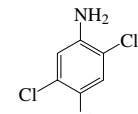
Tri chl oroacet oni t ri le



Tri chl oroacet yl chl ori de

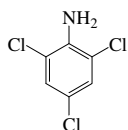


2,3,4-Tri chl oroani li ne

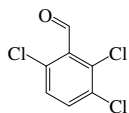


2,4,5-Tri chl oroani li ne

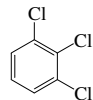
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10202	2,4,6-Tri chl oroani li ne		$\text{C}_6\text{H}_3\text{Cl}_3\text{N}$	634-93-5	196.462	cry (al), nd (li g or pet h)	78.5	262			i H ₂ O; s Et OH, et h, chl; vs C ₆ S
10203	2,3,6-Tri chl orobenzal dehyde		$\text{C}_9\text{H}_7\text{Cl}_3\text{O}$	4659-47-6	209.457	nd (li g)	87.3				vs ace, bz, et h
10204	1,2,3-Tri chl orobenzene		$\text{C}_9\text{H}_7\text{Cl}_3$	87-61-6	181.447	pl (al)	51.3	218.5	1.4533 ⁹		i H ₂ O; sl Et OH, chl; vs et h, bz
10205	1,2,4-Tri chl orobenzene		$\text{C}_9\text{H}_7\text{Cl}_3$	120-82-1	181.447	ort h	16.92	213.5	1.459 ⁹	1.5717 ²⁰	i H ₂ O; sl Et OH, chl; vs et h
10206	1,3,5-Tri chl orobenzene		$\text{C}_9\text{H}_7\text{Cl}_3$	108-70-3	181.447	nd	62.8	208			i H ₂ O; sl Et OH; vs et h, bz; s chl
10207	2,3,6-Tri chl orobenzeneacet i c aci d	Chl orf enac	$\text{C}_9\text{H}_7\text{Cl}_3\text{O}_2$	85-34-7	239.484		161				
10208	3,4,5-Tri chl oro-1,2-benzenedi ol		$\text{C}_6\text{H}_2\text{Cl}_3\text{O}_2$	56961-20-7	213.446	(i) pr (HOAc) (i i) pr (bz)	115(f orm a); 134(f orm b)				sl H ₂ O; vs et h, Et OH, HOAc
10209	2,3,6-Tri chl orobenzoi c aci d		$\text{C}_9\text{H}_5\text{Cl}_3\text{O}_2$	50-31-7	225.457		124.5				sl H ₂ O; s et h
10210	2,4,5-Tri chl orobi phenyl		$\text{C}_9\text{H}_7\text{Cl}_3$	15862-07-4	257.543	cry	78.5				i H ₂ O
10211	2,4,6-Tri chl orobi phenyl		$\text{C}_9\text{H}_7\text{Cl}_3$	35693-92-6	257.543	cry (Et OH aq)	62.5	172 ⁵			i H ₂ O
10212	1,1,1-Tri chl oro-2,2-bi s(4-chl orophenyl)et hane	Di chl orodi phenyl t ri chl oroet hane (DDT)	$\text{C}_{14}\text{H}_9\text{Cl}_5$	50-29-3	354.486	nd (al)	108.5	260; 186 ⁰⁵			i H ₂ O; sl Et OH; vs et h, ace, bz, py
10213	2,2,3-Tri chl orobut anal	2,2,3-Tri chl orobut yral dehyde	$\text{C}_4\text{H}_7\text{Cl}_3\text{O}$	76-36-8	175.441			164	1.3956 ²⁰	1.4755 ²⁰	vs H ₂ O, et h, Et OH
10214	2,3,4-Tri chl oro-1-but ene		$\text{C}_4\text{H}_5\text{Cl}_3$	2431-50-7	159.442			60 ²⁰ , 40 ¹⁰	1.3430 ²⁰	1.4944 ²⁰	vs ace, chl
10215	3,4,4'-Tri chl orocarbanil i de	Tri cl ocarban	$\text{C}_{13}\text{H}_9\text{Cl}_3\text{N}_2\text{O}$	101-20-2	315.581	fine pl	256				
10216	1,2,4-Tri chl oro-5-(chl oromet hyl) benzene		$\text{C}_7\text{H}_4\text{Cl}_4$	3955-26-8	229.919			273	1.547 ²⁰		vs ace, et h, Et OH
10217	Tri chl oro(chl oromet hyl)si lane	(Chl oromet hyl) t ri chl orosi lane	$\text{C}_2\text{Cl}_5\text{Si CH}$	1558-25-4	183.925			118	1.465 ⁹	1.4555 ²⁰	
10218	Tri chl oro(4-chl orophenyl)si lane		$\text{C}_6\text{H}_4\text{Cl}_4\text{Si}$	825-94-5	245.994			233; 116 ⁹	1.4062 ²⁰	1.5418 ²⁰	
10219	Tri chl oro(3-chl oropropyl)si lane		$\text{C}_3\text{H}_7\text{Cl}_4\text{Si}$	2550-06-3	211.978			181.5	1.359 ⁹	1.4668 ²⁰	
10220	Tri chl oro(di chl oromet hyl)si lane	(Di chl oromet hyl) t ri chl orosi lane	$\text{C}_2\text{Si CHCl}$	1558-24-3	218.370			145	1.551 ⁸	1.4714 ²⁰	
10221	1,1,1-Tri chl oro-2,2-di fluoroet hane		$\text{C}_2\text{HCl}_3\text{F}_2$	354-12-1	169.385			73			
10222	1,2,2-Tri chl oro-1,1-di fluoroet hane		$\text{C}_2\text{HCl}_2\text{F}_2$	354-21-2	169.385		-140	71.9	1.5447 ²⁰	1.3889 ²⁰	
10223	1,2,2-Tri chl oro-1,2-di fluoroet hane		$\text{C}_2\text{HCl}_2\text{F}_2$	354-15-4	169.385		-174	72.5			
10224	2,4,6-Tri chl oro-3,5-di met hylphenol		$\text{C}_8\text{H}_7\text{Cl}_3\text{O}$	6972-47-0	225.500	ye nd (pet h)	175				i H ₂ O; s chl; vs pet h
10225	1,1,1-Tri chl oro-2,2-di phenylet hane		$\text{C}_{14}\text{H}_9\text{Cl}_3$	2971-22-4	285.596		65				s Et OH; sl chl
10226	Tri chl orododecyl si lane	Dodecyl t ri chl orosi lane	$\text{C}_{12}\text{H}_{25}\text{Cl}_3\text{Si}$	4484-72-4	303.772			159 ⁹		1.4581 ²⁰	
10227	1,1,1-Tri chl oro-3,4-epoxybut ane	(2,2,2-Tri chl oroet hyl)oxi rane	$\text{C}_4\text{H}_5\text{Cl}_3\text{O}$	3083-25-8	175.441	li q			110 ⁰		
10228	1,1,1-Tri chl oroet hane	Met hyl chl orof orm	$\text{C}_2\text{H}_3\text{Cl}_3$	71-55-6	133.404	li q	-30.01	74.09	1.339 ⁹	1.4379 ²⁰	sl H ₂ O; s Et OH, chl; msc et h
10229	1,1,2-Tri chl oroet hane	Vi nyl t ri chl ori de	$\text{C}_2\text{H}_3\text{Cl}_2$	79-00-5	133.404	li q	-36.3	113.8	1.439 ⁷	1.4714 ²⁰	i H ₂ O; s Et OH, et h, chl
10230	2,2,2-Tri chl oroet hanol		$\text{C}_2\text{HCl}_3\text{O}$	115-20-8	149.403	hyg ort h t ab or pl	19	152; 52 ¹¹		1.4861 ²⁰	sl H ₂ O, ct c; msc Et OH, et h; s alk
10231	Tri chl oroet hene	Tri chl oroet hylene	C_2HCl_3	79-01-6	131.388	li q	-84.7	87.21	1.464 ²	1.4773 ²⁰	sl H ₂ O, ct c; msc Et OH, et h; s ace
10232	2,2,2-Tri chl oro-1-et hoxylet hanol	Chl oral al coholate	$\text{C}_2\text{H}_2\text{Cl}_3\text{O}_2$	515-83-3	193.457		56.5	115.5	1.143 ⁴⁰		s H ₂ O, Et OH, et h
10233	Tri chl oroet hoxysi lane		$\text{C}_2\text{HCl}_3\text{OSi}$	1825-82-7	179.505	li q	-135	101.9	1.227 ⁴	1.4045 ²⁰	vs Et OH
10234	2,2,2-Tri chl oroet hyl- <i>D</i> -gl ucopyranosi duroni c aci d	Urochl oral i c aci d	$\text{C}_6\text{H}_7\text{Cl}_3\text{O}_7$	97-25-6	325.528	nd	142				vs H ₂ O, Et OH
10235	Tri chl oroet hyl si lane	Et hyl t ri chl orosi lane	$\text{C}_2\text{H}_5\text{Cl}_3\text{Si}$	115-21-9	163.506	li q	-105.6	100.5	1.237 ³	1.4256 ²⁰	s ct c
10236	1,1,1-Tri chl oro-2-fluoroet hane	Ref ri gerant 131b	$\text{C}_2\text{H}_2\text{Cl}_3\text{F}$	2366-36-1	151.394	li q		86.5			
10237	1,1,2-Tri chl oro-1-fluoroet hane	Ref ri gerant 131a	$\text{C}_2\text{H}_3\text{Cl}_2\text{F}$	811-95-0	151.394		-104.7	88.0	1.492 ²⁰		
10238	1,1,2-Tri chl oro-2-fluoroet hane		$\text{C}_2\text{H}_3\text{Cl}_2\text{F}$	359-28-4	151.394			102.4	1.5393 ²⁰	1.4390 ²⁰	i H ₂ O
10239	Tri chl orofluoromet hane	Ref ri gerant 11	C_2HCl_3	75-69-4	137.368	vol li q or gas	-110.44	23.7			i ₂ OH
10240	2,2,3-Tri chl oro-1,1,1,3,4,4,4-hept afluorobut ane		$\text{C}_4\text{Cl}_7\text{F}_7$	335-44-4	287.391		2.0	98	1.7484 ²⁰	1.3530 ²⁰	
10241	Tri chl orohexyl si lane	Hexyl t ri chl orosi lane	$\text{C}_6\text{H}_{13}\text{Cl}_3\text{Si}$	928-65-4	219.612			190	1.110 ⁹		dec H ₂ O



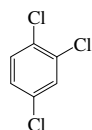
2,4,6-Tri chl orani li ne



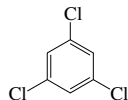
2,3,6-Tri chl orobenzal dehyde



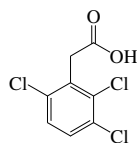
1,2,3-Tri chl orobenzene



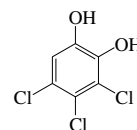
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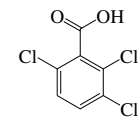
1,3,5-Tri chl orobenzene



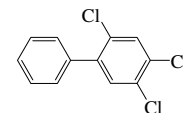
2,3,6-Tri chl orobenzeneacet aci d



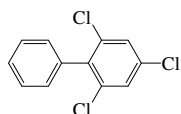
3,4,5-Tri chl oro-1,2-benzenedi ol



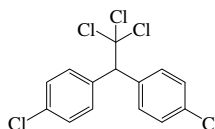
2,3,6-Tri chl orobenzoiaci d



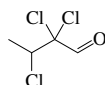
2,4,5-Tri chl orobi phenyl



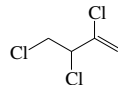
2,4,6-Tri chl orobi phenyl



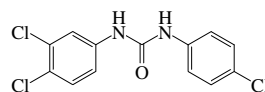
1,1,1-Tri chl oro-2,2-bi s(4-chl orophenyl) et hane



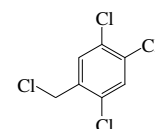
2,2,3-Tri chl orobut anal



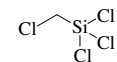
2,3,4-Tri chl oro-1-but ene



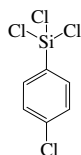
3,4,4'-Tri chl orocarbani li de



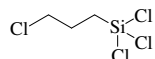
1,2,4-Tri chl oro-5-(chl oromet hyl) benzene



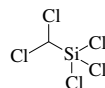
Tri chl oro(chl oromet hyl) si l ane



Tri chl oro(4-chl orophenyl) si l ane



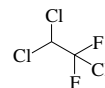
Tri chl oro(3-chl oropropyl) si l ane



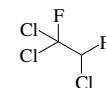
Tri chl oro(di chl oromet hyl) si l ane



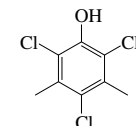
1,1,1-Tri chl oro-2,2-di f luoroet hane



1,2,2-Tri chl oro-1,1-di f luoroet hane

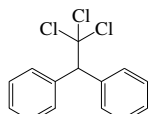


1,2,2-Tri chl oro-1,2-di f luoroet hane

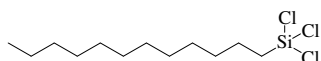


2,4,6-Tri chl oro-3,5-di met hyl phenol

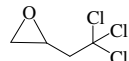
3-539



1,1,1-Tri chl oro-2,2-di phenyl et hane



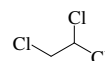
Tri chl orododecyl si l ane



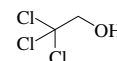
1,1,1-Tri chl oro-3,4-epoxybut ane



1,1,1-Tri chl oroet hane



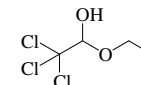
1,1,2-Tri chl oroet hane



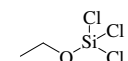
2,2,2-Tri chl oroet hanol



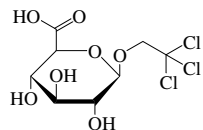
Tri chl oroet hene



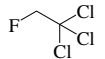
2,2,2-Tri chl oro-1-et hoxyet hanol



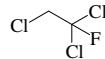
Tri chl oroet hoxysi l ane


 2,2,2-Tri chl oroet hyl- β -D-glucopyra nosi duronaci d


Tri chl oroet hyl si l ane



1,1,1-Tri chl oro-2-f luoroet hane



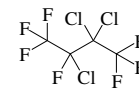
1,1,2-Tri chl oro-1-f luoroet hane



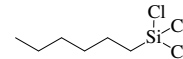
1,1,2-Tri chl oro-2-f luoroet hane



Tri chl orof luoromet hanol

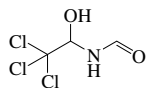


2,2,3-Tri chl oro-1,1,1,3,4,4,4-hept a f luorobut ane

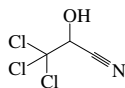


Tri chl orohexyl si l ane

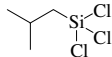
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10242	N-(2,2,2-Tri chloro-1-hydroxyethyl)formamide	Chloroformamide	$\text{C}_2\text{Cl}_3\text{NO}_2$	515-82-2	192.429	cry	120				vs ace, et h, Et OH
10243	3,3,3-Tri chloro-2-hydroxypropanetriole	Chloroacrylonitrile	$\text{C}_3\text{H}_2\text{Cl}_3\text{NO}$	513-96-2	174.413	pl (w)	61	dec 217			vs H ₂ O, et h, Et OH
10244	Tri chloroethylsilane		$\text{C}_2\text{H}_3\text{Cl}_3\text{Si}$	18169-57-8	191.559			143.3	1.154 ⁴⁰		dec H ₂ O
10245	Tri chloroethane	Chloroform	CHCl_3	67-66-3	119.378	liq	-63.41	61.17	1.478 ⁸	1.4459 ²⁰	sl H ₂ O; msc Et OH, et h, bz; s ace, ct c
10246	Tri chloroethylmethylchloride	Perchloromethyl mercaptan	$\text{C}_2\text{S}_2\text{Cl}_3$	594-42-3	185.888	ye oil		149	1.694 ⁷	1.5484 ²⁰	s et h
10247	Tri chloroethylmethylchloride		$\text{C}_2\text{Cl}_3\text{S}$	2547-61-7	217.887	cry (al-w)	140.5	170			i H ₂ O; s Et OH, et h, C ₆ H ₆
10248	Tri chloroethylmethylchloride	Tri chloroethyl mercaptan	C_2SCHCl_3	75-70-7	151.443	oran oil		125			
10249	Tri chloroethylazide		$\text{C}_2\text{HCl}_3\text{N}_3\text{O}_2\text{S}_2$	133-67-5	380.657		270 dec				sl H ₂ O; s Et OH
10250	1,2,4-Tri chloro-5-methoxybenzene		$\text{C}_7\text{H}_4\text{Cl}_3\text{O}$	6130-75-2	211.473	nd (di l al)	77.5	254			vs Et OH, ace
10251	1,3,5-Tri chloro-2-methoxybenzene	2,4,6-Tri chloroanisole	$\text{C}_7\text{H}_3\text{Cl}_3\text{O}$	87-40-1	211.473	mcl nd (al)	61.5	241	1.64 ⁸		s Et OH, bz, chl; vs ace
10252	1,2,4-Tri chloro-5-methylbenzene	2,4,5-Tri chlorotoluene	$\text{C}_7\text{H}_2\text{Cl}_3$	6639-30-1	195.474	nd or lf (al)	82.4	231			i ₂ H ₂ O; s Et OH, ace
10253	(Tri chloroethyl)benzene	Benzotrichloride	$\text{C}_7\text{H}_2\text{Cl}_3$	98-07-7	195.474	liq	-4.42	221	1.372 ²⁹	1.5580 ²⁰	i H ₂ O; s Et OH, et h, bz
10254	(Tri chloroethyl)oxirane		$\text{C}_3\text{HCl}_3\text{O}$	3083-23-6	161.414			149; 44 ¹³	1.495 ²⁰	1.4737 ²⁵	vs et h; s chl
10255	2,3,4-Tri chloro-6-methylphenol	4,5,6-Tri chlororesorcinol	$\text{C}_6\text{H}_2\text{Cl}_3\text{O}$	551-78-0	211.473	nd (pet h)	77				
10256	2,3,6-Tri chloro-4-methylphenol	2,3,6-Tri chlororesorcinol	$\text{C}_6\text{H}_2\text{Cl}_3\text{O}$	551-77-9	211.473	nd (HOAc, pet h)	66.5				vs Et OH
10257	2,4,6-Tri chloro-3-methylphenol	2,4,6-Tri chlororesorcinol	$\text{C}_6\text{H}_2\text{Cl}_3\text{O}$	551-76-8	211.473	nd or pl (w, pet h)	46	265			i H ₂ O; vs Et OH, MeOH, chl
10258	1,1,1-Tri chloro-2-methyl-2-propanol	1,1,1-Tri chlorobutyl alcohol	$\text{C}_4\text{H}_7\text{Cl}_3\text{O}$	57-15-8	177.457	hyg nd (w + 1)	97	167			i H ₂ O; s Et OH, et h, ace, bz, li g, chl
10259	Tri chloroacetone		$\text{C}_3\text{H}_2\text{Cl}_3\text{O}_2$	327-98-0	333.599	ye liq		10 ⁸	1.365 ²⁰		
10260	1,2,4-Tri chloro-5-nitrobenzene		$\text{C}_7\text{H}_2\text{Cl}_3\text{NO}_2$	89-69-0	226.445	pr (al), nd (al)	57.5	288	1.79 ⁸		i H ₂ O; sl Et OH; s et h, bz, chl, C ₆ H ₆
10261	Tri chloroethane	Chloroform	C_2HCl_3	76-06-2	164.376	liq	-64	112	1.655 ⁸	1.4611 ²⁰	s H ₂ O; msc Et OH, ace, bz, MeOH, HOAc
10262	3,4,6-Tri chloro-2-nitrophenol		$\text{C}_6\text{HCl}_3\text{NO}_3$	82-62-2	242.444	pa ye cry (pet h)	92.5				
10263	Tri chloroacetone	Octadecyltrichlorosilane	$\text{C}_{18}\text{H}_{37}\text{Cl}_3\text{Si}$	112-04-9	387.932			223 ³⁰	0.984 ²⁵	1.4602 ²⁰	
10264	Tri chloroethylsilane	Octyltrichlorosilane	$\text{C}_8\text{H}_{17}\text{Cl}_3\text{Si}$	5283-66-9	247.666			232		1.448 ⁸	dec H ₂ O, Et OH; s ct c
10265	1,2,3-Tri chloro-1,1,2,3,3-pentafluoropropane		$\text{C}_3\text{Cl}_3\text{F}_5$	76-17-5	237.383	liq	-72	73.7	1.663 ⁴	1.3512 ²⁰	
10266	Tri chloroethylsilane	Amyltrichlorosilane	$\text{C}_5\text{H}_{11}\text{Cl}_3\text{Si}$	107-72-2	205.586			172; 60.5 ⁵	1.1330 ²⁰	1.4503 ²⁰	
10267	2,3,4-Tri chloroethanol		$\text{C}_3\text{H}_3\text{Cl}_3\text{O}$	15950-66-0	197.446	nd (bz, li g, sub)	83.5	sub			s Et OH, et h, bz, al k, HOAc
10268	2,3,5-Tri chloroethanol		$\text{C}_3\text{H}_3\text{Cl}_3\text{O}$	933-78-8	197.446	nd (al)	62	248 ³⁰			vs et h, Et OH
10269	2,3,6-Tri chloroethanol		$\text{C}_3\text{H}_3\text{Cl}_3\text{O}$	933-75-5	197.446	nd (di l al, li g)	58				s Et OH, et h, bz; s HOAc
10270	2,4,5-Tri chloroethanol		$\text{C}_3\text{H}_3\text{Cl}_3\text{O}$	95-95-4	197.446	nd (al, pet h)	69	247			sl H ₂ O; vs Et OH, et h, bz; s HOAc
10271	2,4,6-Tri chloroethanol		$\text{C}_3\text{H}_3\text{Cl}_3\text{O}$	88-06-2	197.446	ort h nd (HOAc)	69	246	1.490 ¹⁵		sl H ₂ O; s Et OH, et h, HOAc
10272	3,4,5-Tri chloroethanol		$\text{C}_3\text{H}_3\text{Cl}_3\text{O}$	609-19-8	197.446	nd (li g)	101	275			sl H ₂ O, li g; s et h
10273	2,4,5-Tri chloroethoxyacetate	2,4,5-T	$\text{C}_5\text{HCl}_3\text{O}_3$	93-76-5	255.483	cry (bz)	153	dec			i H ₂ O; s Et OH; vs bz
10274	2-(2,4,5-Tri chloroethoxy)ethyl 2,2-dichloropropanoate		$\text{C}_{10}\text{H}_2\text{Cl}_5\text{O}_3$	136-25-4	366.452		49	162 ¹⁵	1.55 ⁵⁰		i H ₂ O; s Et OH, ace, xyl
10275	Tri chloro(2-phenylethyl)silane		$\text{C}_9\text{H}_7\text{Cl}_3\text{Si}$	940-41-0	239.602			242; 9 ⁸	1.2397 ²⁰	1.5185 ²⁰	
10276	(2,4,6-Tri chlorophenyl)hydrazine		$\text{C}_6\text{H}_2\text{Cl}_3\text{N}_2$	5329-12-4	211.476	cry (bz)	143				s H ₂ O, bz
10277	Tri chlorophenylsilane		$\text{C}_6\text{HCl}_3\text{Si}$	98-13-5	211.549			201	1.32 ⁴⁰	1.5230 ²⁰	s ct c, chl, C ₆ H ₆
10278	1,1,2-Tri chloropropane		$\text{C}_3\text{H}_2\text{Cl}_3$	598-77-6	147.431			132.0; 117 ⁵⁰	1.372 ¹⁵		i H ₂ O; s Et OH, chl; vs et h; sl ct c
10279	1,1,3-Tri chloropropane		$\text{C}_3\text{H}_2\text{Cl}_3$	20395-25-9	147.431	liq	-59	145.5	1.355 ⁷	1.4718 ²⁰	vs et h, Et OH, chl



N-(2,2,2-Tri chl oro-1-hydroxyet hyl)f ormami de



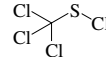
3,3,3-Tri chl oro-2-hydroxypropaneni t ri l e



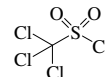
Tri chl oro i sobut yl si l ane



Tri chl oromet hane



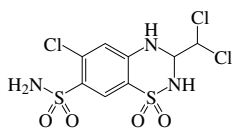
Tri chl oromet hanesul f edyl ori de



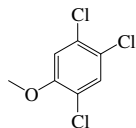
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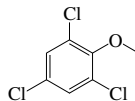
Tri chl oromet hanet hi ol



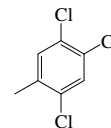
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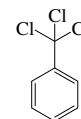
1,2,4-Tri chl oro-5-met hoxybenzene



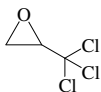
1,3,5-Tri chl oro-2-met hoxybenzene



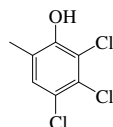
1,2,4-Tri chl oro-5-met hyl benzene



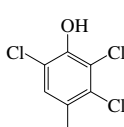
(Tri chl oromet hyl)benzene



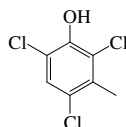
(Tri chl oromet hyl)oxi rane



2,3,4-Tri chl oro-6-met hyl phenol



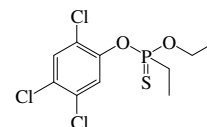
2,3,6-Tri chl oro-4-met hyl phenol



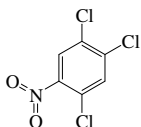
2,4,6-Tri chl oro-3-met hyl phenol



1,1,1-Tri chl oro-2-met hyl -2-propanol



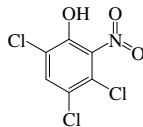
Tri chl oronat e



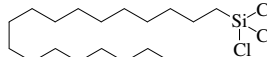
1,2,4-Tri chl oro-5-ni t robenzene



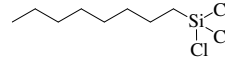
Tri chl oroni t romet hane



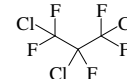
3,4,6-Tri chl oro-2-ni t rophenol



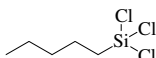
Tri chl orooc t adecyl si l ane



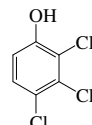
Tri chl orooc t yl si l ane



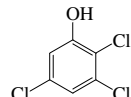
1,2,3-Tri chl oro-1,1,2,3,3-pent af l uoropropane



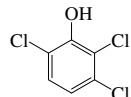
Tri chl oropent yl si l ane



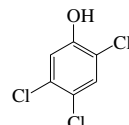
2,3,4-Tri chl orophenol



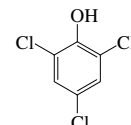
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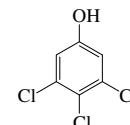
2,3,6-Tri chl orophenol



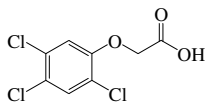
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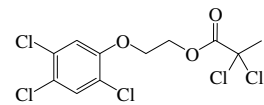
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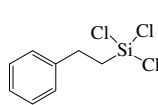
3,4,5-Tri chl orophenol



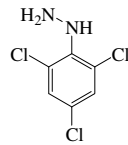
2,4,5-Tri chl orophenoxyacet aci d



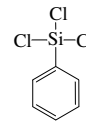
2-(2,4,5-Tri chl orophenoxy)et hyl 2-di chl oropropanoat e



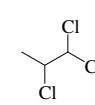
Tri chl oro(2-phenyl)et hyl si l ane



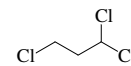
(2,4,6-Tri chl orophenyl)hydrazi ne



Tri chl orophenyl si l ane

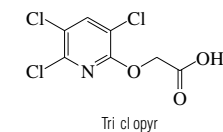
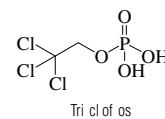
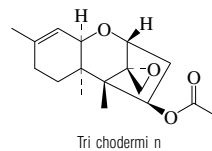
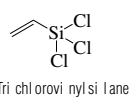
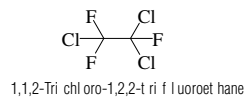
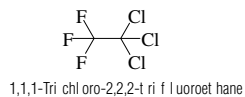
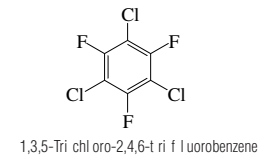
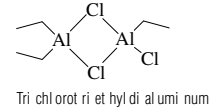
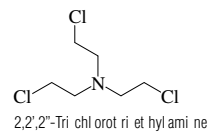
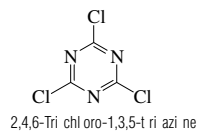
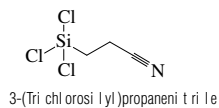
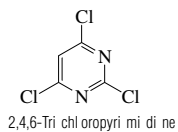
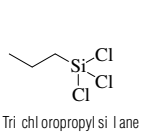
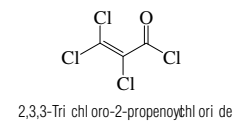
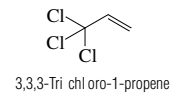
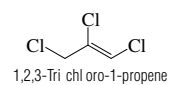
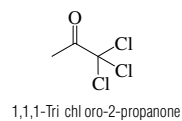
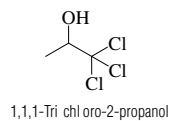
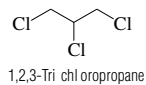
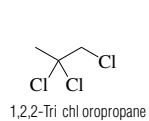


1,1,2-Tri chl oropropane

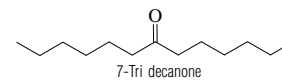
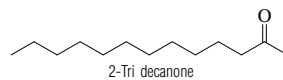
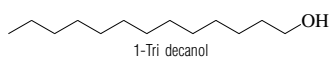
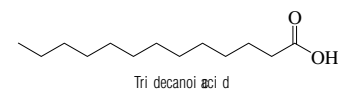
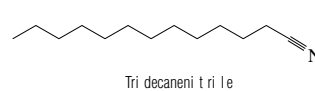
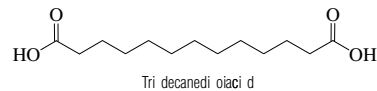
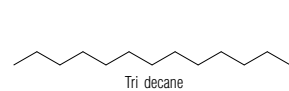
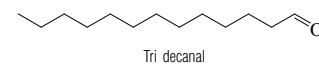
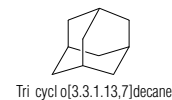
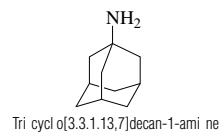
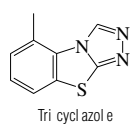
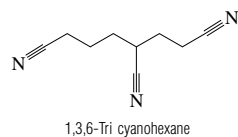
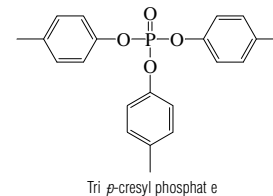
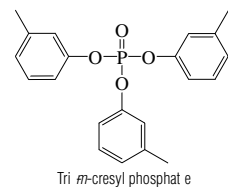
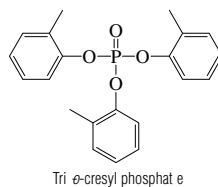
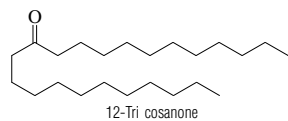
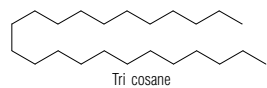


1,1,3-Tri chl oropropane

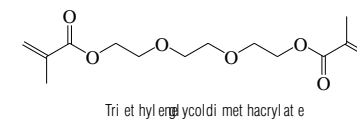
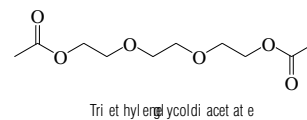
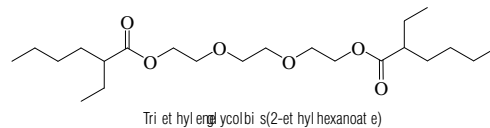
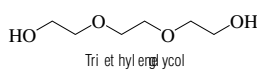
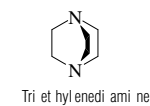
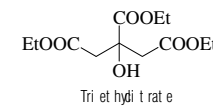
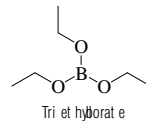
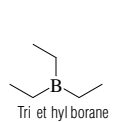
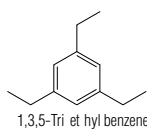
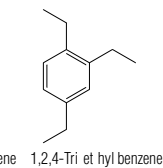
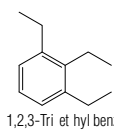
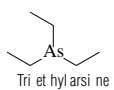
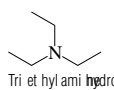
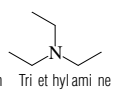
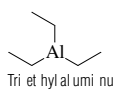
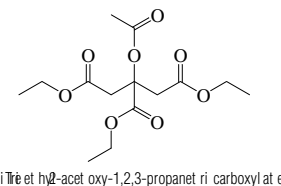
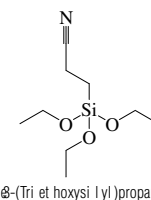
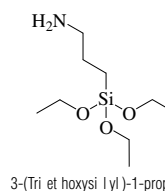
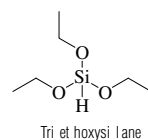
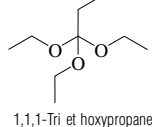
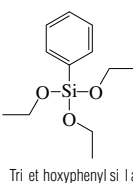
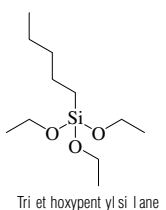
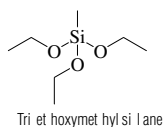
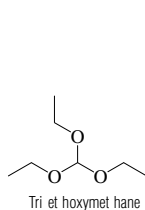
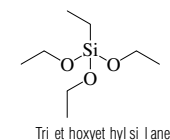
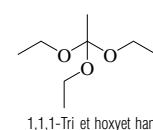
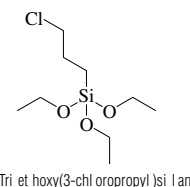
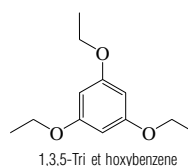
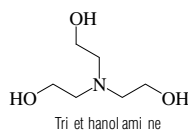
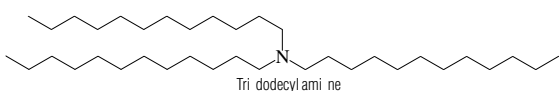
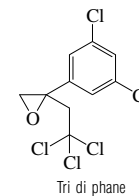
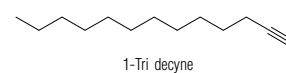
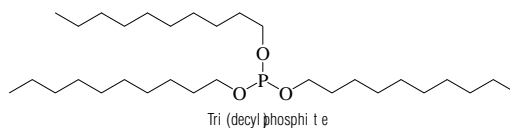
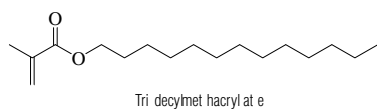
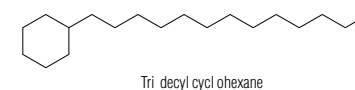
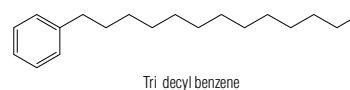
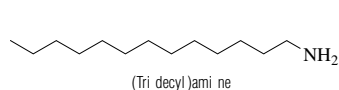
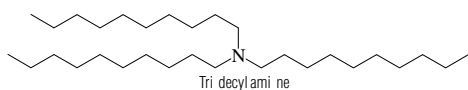
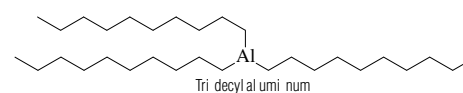
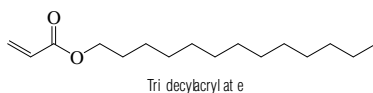
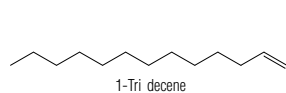
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility	
10280	1,2,2-Tri chloropropane		C ₃ H ₅ Cl ₃	3175-23-3	147.431			124	1.318 ²⁵	1.4609 ²⁰	i H ₂ O; s Et OH, et h; vs chl	
10281	1,2,3-Tri chloropropane		C ₃ H ₄ Cl ₃	96-18-4	147.431	li q	-14.7	157	1.388 ⁹	1.4852 ²⁰	sl H ₂ O, ct c; s Et OH, et h; vs chl	
10282	1,1,1-Tri chloro-2-propanol		C ₃ H ₂ Cl ₃ O	76-00-6	163.430		50.5	163; 54 ¹²			vs ace, bz, et h, Et OH	
10283	1,1,1-Tri chloro-2-propanone	1,1,1-Tri chloroacetone	C ₃ HCl ₃ O	918-00-3	161.414			149; 28 ¹⁰	1.435 ²⁰	1.4635 ¹⁷	i H ₂ O; vs Et OH, et h	
10284	1,2,3-Tri chloro-1-propene		C ₃ HCl ₃	96-19-5	145.415			142	1.412 ²⁰	1.5030 ²⁰	i H ₂ O; vs Et OH, et h; s bz, chl	
10285	3,3,3-Tri chloro-1-propene		C ₃ H ₂ Cl ₃	2233-00-3	145.415	li q	-30	114.5	1.367 ⁹	1.4827 ²⁰	i H ₂ O; s Et OH, et h, bz, chl	
10286	2,3,3-Tri chloro-2-propenyl chloride		C ₃ HCl ₃	815-58-7	193.843			158		1.5271 ¹⁸	vs bz	
10287	Tri chloropropyl silane	Propyl tri chlorosilane	C ₃ H ₂ Cl ₃ Si	141-57-1	177.533			123.5	1.199 ⁹	1.4310 ²⁰		
10288	2,4,6-Tri chloropyrimidine		C ₄ HCl ₃ N ₂	3764-01-0	183.423		22.5	212.5		1.5700 ²⁰		
10289	3-(Tri chlorosilyl)propanetriole		C ₃ H ₄ Cl ₃ Si	1071-22-3	188.516			109 ⁹				
10290	2,4,6-Tri chloro-1,3,5-triazine	Cyanuric acid tri chloride	C ₃ Cl ₃ N ₃	108-77-0	184.411	cry (et h, bz)	154	192			vs Et OH	
10291	2,2',2''-Tri chlorotriethylamine		C ₆ H ₁₂ Cl ₃ N	555-77-1	204.525	pa ye	-2.0	143 ¹⁵			vs bz, et h, Et OH	
10292	Tri chlorotriethylaluminum	Et hyl al umi num sesqui chl ori de	C ₆ H ₉ Al ₂ Cl ₃	12075-68-2	247.505	ye li q		115.9, 36.2 ^{20,2}				
10293	1,3,5-Tri chloro-2,4,6-trifluorobenzene		C ₆ Cl ₃ F ₃	319-88-0	235.418			198.4				
10294	1,1,1-Tri chloro-2,2,2-trifluoroethane		C ₂ Cl ₃ F ₃	354-58-5	187.375		14.37	45.5	1.5790 ²⁰	1.3610 ³⁵	i H ₂ O; s Et OH, et h, chl	
10295	1,1,2-Tri chloro-1,2,2-trifluoroethane		C ₂ Cl ₃ F ₃	76-13-1	187.375	li q	-36.22	47.7	1.563 ⁵	1.3557 ²⁵	i H ₂ O; s Et OH; msc et h, bz	
10296	Tri chlorovinyl silane	Vinyl tri chlorosilane	C ₂ H ₃ Cl ₃ Si	75-94-5	161.490	li q	-95	91.5	1.2426	1.4295 ²⁰	vs chl	
10297	Tri chodermine	12,13-Epoxytri chloro-9-en-4-ol acetate	C ₁₇ H ₂₄ O ₄	4682-50-2	292.371	cry	59	111 ^{0,5}			sl H ₂ O; s Et OH, chl	
10298	Tri chlorophosphate	2,2,2-Tri chloroethanol dihydrogen phosphate	C ₂ H ₂ Cl ₃ O ₄ P	306-52-5	229.383	cry (bz)	120.5					
10299	Tri chloropyridine	Acetic acid, [(3,5,6-trichloro-2-pyridyl)oxy]-	C ₇ H ₄ Cl ₃ N ₂	55335-06-3	256.471		149	dec 290				
10300	Tri cosane		C ₂₉ H ₅₈	638-67-5	324.627	lf (et h-al)	47.76	380	0.778 ⁵	1.4468 ²⁰	i H ₂ O; sl Et OH; s et h, ct c	
10301	12-Tri cosanone	Di undecyl ketone	C ₂₈ H ₅₆ O	540-09-0	338.610	lf (al)	70.2		0.809 ⁶	1.4283 ⁸⁰	vs bz, et h, chl	
10302	Tri <i>o</i> -cresyl phosphat e	Tri- <i>o</i> -tolyl phosphat e	C ₂₁ H ₂₁ O ₄ P	78-30-8	368.363	col or pa ye	11	410	1.195 ⁵⁰	1.5575 ²⁰	i H ₂ O; vs Et OH, et h, ct c, t ol; s HOAc	
10303	Tri <i>m</i> -cresyl phosphat e	Tri- <i>m</i> -tolyl phosphat e	C ₂₁ H ₂₁ O ₄ P	563-04-2	368.363	wax	25.5	260 ¹⁵	1.150 ²⁵	1.5575 ²⁰	i H ₂ O; sl Et OH; s et h; vs ct c, t ol	
10304	Tri <i>p</i> -cresyl phosphat e	Tri- <i>p</i> -tolyl phosphat e	C ₂₁ H ₂₁ O ₄ P	78-32-0	368.363	nd (al), t ab (et h)	77.5	224 ³⁵	1.247 ²⁵		s Et OH, et h, bz, chl, HOAc	
10305	1,3,6-Tri cyanohexane		C ₆ H ₃ N ₃	1772-25-4	161.203			257	1.040	1.4660 ²⁰		
10306	Tri cyclazole	1,2,4-Tri azolo[3,4-b]benzotriazole-5-methyl-	C ₈ H ₄ N ₄ S	41814-78-2	189.237			187				
10307	Tri cyclene	1,7,7-Tri methyltricyclo[2.2.1]heptane	C ₁₀ H ₁₆	508-32-7	136.234	cry (al)	67.5	152.5	0.8668 ⁸⁰	1.4296 ⁸⁰		
10308	Tri cycl o[3.3.1.1 ^{3,7}]decan-1-amine	Amantadine	C ₁₀ H ₁₇ N	768-94-5	151.249		180				sl H ₂ O	
10309	Tri cycl o[3.3.1.1 ^{3,7}]decane	Adamantane	C ₁₀ H ₁₆	281-23-2	136.234	nd (sub)	268	sub	1.07 ²⁵	1.568	s bz, ct c	
10310	Tri decanal		C ₁₀ H ₂₀ O	10486-19-8	198.344		14	156 ¹³	0.8356 ¹⁸	1.4384 ¹⁸	i H ₂ O; s Et OH	
10311	Tri decane		C ₁₀ H ₂₂	629-50-5	184.361	li q	-5.4	235.47	0.756 ⁴	1.4256 ²⁰	i H ₂ O; vs Et OH, et h; s ct c	
10312	Tri decanediol acicid		C ₁₀ H ₂₀ O ₄	505-52-2	244.328			114			sl H ₂ O, bz, t f a; s Et OH, et h, chl	
10313	Tri decanetriole		C ₁₀ H ₁₈ O ₃	629-60-7	195.345			9.7	293	0.8257 ²⁰	1.4378 ²⁰	vs Et OH, et h
10314	Tri decanoidiacid	Tri decyl diacetic acid	C ₁₀ H ₁₈ O ₄	638-53-9	214.344	cry (pet h ace)	41.5	238 ⁹⁰ , 140 ¹	0.8458 ⁸⁰	1.4286 ⁶⁰	i H ₂ O; vs Et OH, et h, HOAc; s ace	
10315	1-Tri decanol	Tri decyl alcohol	C ₁₀ H ₂₂ O	112-70-9	200.360	cry (al)	31.7	274; 152 ⁴	0.8223 ³¹		i H ₂ O; s Et OH, et h	
10316	2-Tri decanone	Methyl undecyl ketone	C ₁₀ H ₂₀ O	593-08-8	198.344		30.5	263	0.8217 ³⁰	1.4318 ²⁰	i H ₂ O; vs Et OH, et h, ace, bz, chl	
10317	7-Tri decanone	Di hexyl ketone	C ₁₀ H ₂₀ O	462-18-0	198.344	lf (al)	33	261	0.825		s Et OH, chl, li g; vs et h	

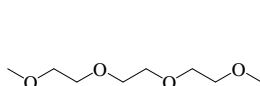


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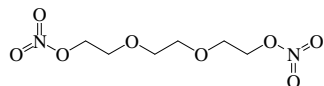


No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10318	1-Tri decene		C ₉ H ₂₀	2437-56-1	182.345	li q	-13	232.8	0.7658	1.4340 ²⁰	i H ₂ O; vs Et OH, et h; s bz
10319	Tri decyl acrylat e		¹⁸ C ₃₀ O ₂	3076-04-8	254.408	li q		150	0.88 ²⁰		
10320	Tri decyl al umi num		³⁰ B ₆₃ Al	1726-66-5	450.803	hyg vi sc li q	-38				
10321	Tri decyl ami ne	<i>N,N</i> -Di decyl -1-decanami ne	³⁰ H ₆₃ N	1070-01-5	437.828			406			
10322	(Tri decyl)ami ne	1-Tri decanami ne	¹³ C ₂₉ N	2869-34-3	199.376		27.4	275.8	0.8049 ²⁰	1.4443 ²⁰	sl H ₂ O; s Et OH, et h
10323	Tri decyl benzene	1-Phenyl t ri decane	¹⁹ C ₃₂	123-02-4	260.457		10	346	0.8550 ²⁰	1.4821 ²⁰	
10324	Tri decyl cycl ohexane		¹⁸ C ₃₆	6006-33-3	266.505		18.5	346	0.8239 ²⁰	1.4570 ²⁰	
10325	Tri decyl met hacryl at e		¹⁷ C ₃₂ O ₂	2495-25-2	268.435			118 ¹	0.881 ²⁰	1.448 ²⁵	
10326	Tri (decyl) phosphi t e		³⁰ O ₆₃ P	2929-86-4	502.793	li q		255 180 ¹¹			
10327	1-Tri decyne		C ₉ H ₁₄	26186-02-7	180.330		2.5	234; 94 ²⁵	0.7842 ²⁰	1.4309 ²⁰	vs bz, et h
10328	Tri di phane	2-(3,5-Di chl orophenyl)-2-(2,2,2-t ri chl oroet hyl)oxi rane, (±)	C ₁₀ H ₇ Cl ₅ O	58138-08-2	320.427		42.8				
10329	Tri dodecyl ami ne	<i>N,N</i> -Di dodecyl -1-dodecanami ne	³⁶ H ₇₅ N	102-87-4	521.988		16.4	220 ^{0,03}			
10330	Tri et hanol ami ne	Tri s(2-hydroxyet hyl)ami ne	⁶ H ₁₅ NO ₃	102-71-6	149.188	hyg cry	20.5	335.4	1.1242 ²⁰	1.4852 ²⁰	msc H ₂ O, Et OH; sl et h, bz; s chl
10331	1,3,5-Tri et hoxyl benzene		⁶ C ₉ H ₁₀ O ₃	2437-88-9	210.269	cry (al, di l al)	43.5	170			vs et h, Et OH
10332	Tri et hoxyl(3-chl oropropyl)si l ane	(3-Chl oropropyl)t ri et hoxysi l ane	⁶ H ₂₁ Cl ₃ Si	5089-70-3	240.800	col gas		-149			
10333	1,1,1-Tri et hoxet hane		⁶ B ₁₈ O ₃	78-39-7	162.227		145	158.5	0.8847 ²⁵	1.3980 ²⁰	i H ₂ O; msc Et OH, et h, ct c, chl
10334	Tri et hoxet hyl si l ane		⁶ H ₁₀ O ₃ Si	78-07-9	192.329			158.5	0.8963 ⁹	1.3955 ²⁰	i H ₂ O; msc Et OH, et h; s chl
10335	Tri et hoxymet hane		⁷ B ₁₆ O ₃	122-51-0	148.200			143; 60 ²⁰	0.8909 ²⁰	1.3922 ²⁰	s Et OH, et h
10336	Tri et hoxymet hyl si l ane		⁷ H ₁₀ O ₃ Si	2031-67-6	178.302			142	0.8948 ⁵	1.3832 ²⁰	
10337	Tri et hoxypent yl si l ane		¹¹ H ₂₆ O ₃ Si	2761-24-2	234.408			100 ⁹ ; 95 ¹³	0.8862 ²⁰	1.4059 ²⁰	
10338	Tri et hoxyphe nyl si l ane		¹² H ₂₀ O ₃ Si	780-69-8	240.371			232; 113 ⁹	0.996 ²⁵	1.4604 ²⁰	
10339	1,1,1-Tri et hoxypropane		⁶ H ₁₂ O ₃	115-80-0	176.253			171		1.4000 ²⁵	vs et h, Et OH
10340	Tri et hoxysi l ane		⁶ H ₁₆ O ₃ Si	998-30-1	164.275			133.5	0.8749 ⁹		
10341	3-(Tri et hoxysi lyl)-1-propanami ne		⁶ H ₁₉ NO ₃ Si	919-30-2	221.370			119 ⁹	0.9506 ²⁰	1.4225 ²⁰	
10342	3-(Tri et hoxysi lyl)propaneni t ri le		⁶ H ₁₉ NO ₃ Si	919-31-3	217.338	li q		109	0.974 ²⁰		
10343	Tri et hyl 2-acet oxy-1,2,3-propanet ri carboxyl at e	Tri et hyl acet yl ci t rat e	¹⁴ H ₂₂ O ₈	77-89-4	318.320			214 ⁴⁰	1.135 ²⁵	1.4380	
10344	Tri et hyl al umi num	Hexaet hyl di al umi num	⁶ H ₁₅ AlCl	97-93-8	114.165	col hyg li q	-46	194; 100	0.832 ²⁵		
10345	Tri et hyl ami ne	<i>N,N</i> -Di et hyl et hanami ne	⁶ H ₉ N	121-44-8	101.190	li q	-114.7	89	0.727 ⁹	1.4010 ²⁰	s H ₂ O, Et OH, et h, ct c; vs ace, bz, chl
10346	Tri et hyl ami ne hydrochl ori de	<i>N,N</i> -Di et hyl et hanami ne hydrochl ori de	⁶ H ₁₁ ClN	554-68-7	137.651	hex (al)	260 dec	sub 245	1.0689 ⁹		vs H ₂ O, Et OH, chl
10347	Tri et hyl arsi ne		⁶ H ₉ As	617-75-4	162.105			138.5	1.150 ²⁰	1.467 ²⁰	vs ace, et h, Et OH
10348	1,2,3-Tri et hyl benzene		¹² H ₁₈	42205-08-3	162.271	col li q	-26	172			
10349	1,2,4-Tri et hyl benzene		¹² H ₁₈	877-44-1	162.271			218; 99 ¹⁵	0.8738 ²⁰	1.5024 ²⁰	i H ₂ O; s Et OH, et h
10350	1,3,5-Tri et hyl benzene		¹² H ₁₈	102-25-0	162.271	li q	-66.5	215.9	0.863 ⁹	1.4969 ²⁰	i H ₂ O; vs Et OH, et h
10351	Tri et hyl borane		⁶ B ₁₂ B	97-94-9	97.994	li q	-93	95	0.70 ⁹	1.3971	s Et OH, et h
10352	Tri et hyl borat e	Bori c aci d, t ri et hyl est er	⁶ H ₁₂ BO ₃	150-46-9	145.992	li q	-84.8	120	0.854 ⁹	1.3749 ²⁰	msc Et OH, et h
10353	Tri et hyl ci t rat e		¹² H ₂₀ O ₇	77-93-0	276.283			294	1.1369 ²⁰	1.4455 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
10354	Tri et hyl enedi ami ne		⁶ H ₉ N ₂	280-57-9	112.172		159				s chl
10355	Tri et hyl ene glycol	Tri glycol	⁶ H ₁₂ O ₄	112-27-6	150.173	hyg li q	-7	285	1.127 ⁴	1.4531 ²⁰	msc H ₂ O, Et OH, bz; sl et h, chl; i pet h
10356	Tri et hyl ene glycol bi s(2-et hyl hexanoat e)		C ₂₂ H ₄₂ O ₆	94-28-0	402.564						s chl
10357	Tri et hyl ene glycol di acet at e		¹⁰ H ₁₈ O ₆	111-21-7	234.246	li q	-50	286	1.115 ⁹		vs H ₂ O, et h, Et OH
10358	Tri et hyl ene glycol di met hacryl at e		¹⁴ H ₂₂ O ₆	109-16-0	286.321			170 ⁵	1.092 ²⁰	1.4595 ²⁵	vs ace, et h, Et OH, pet h

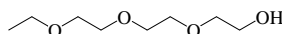




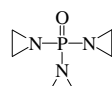
Tri et hyl englycol di met hyl et her



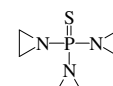
Tri et hyl englycol di ni t rat e



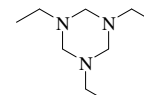
Tri et hyl englycol mono et hyl et her



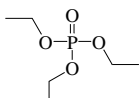
Tri et hyl enephosphora mi de



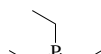
Tri et hyl en et hi ophosphora mi de



1,3,5-Tri et hyl hexahydro-1,3,5-t ri azi ne



Tri et hyl phospha t e



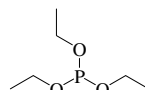
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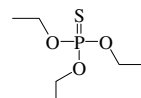
Tri et hyl phosphi oxi de



Tri et hyl phosphi sul fi de



Tri et hyl phosphi t e



0,0,0-Tri et hyl phosphorot hi oate e



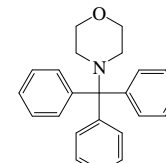
Tri et hyl si l ane



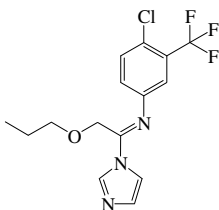
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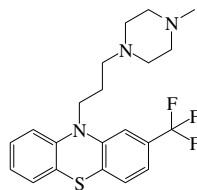
Tri et hyl st i bi ne



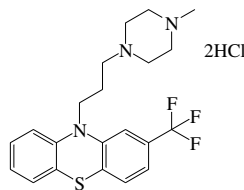
Tri f enmorph



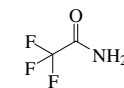
Tri f l umi zole



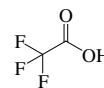
Tri f luoperazi ne



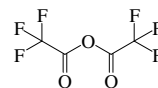
Tri f luoperazi dihydrochl ori de



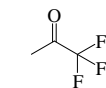
2,2,2-Tri f luoroacet ami de



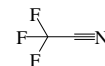
Tri f luoroaceta cid



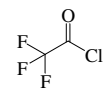
Tri f luoroaceta cid anhy dri de



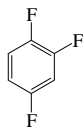
1,1,1-Tri f luoroacet one



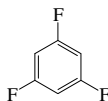
Tri f luoroacet oni t ri



Tri f luoroaceta cid di chl ori de



1,2,4-Tri f luorobenze



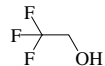
1,3,5-Tri f luorobenze



1,1,1-Tri f luoroet hane



1,1,2-Tri f luoroet hane



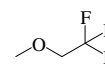
2,2,2-Tri f luoroet hanol



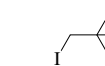
Tri f luoroet hene



2,2,2-Tri f luoroet hyl ami ne



2,2,2-Tri f luoroet hyl et hyl et her



1,1,1-Tri f luoro-2-i doet hane



Tri f luoro i do met hane



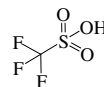
Tri f luoro i so cyanomet hane



Tri f luoro met hane



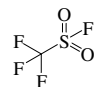
Tri f luoro met hanesul f et hyl ri de



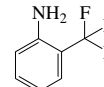
Tri f luoro met hanesul f aci d



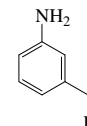
Tri f luoro met hanesul f et hyl ri de



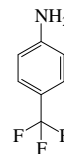
Tri f luoro met hanesul f et hyl ri de



2-(Tri f luoro met hyl) ani li n e

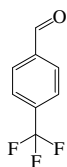


1-(Tri f luoro met hyl) ani li n e

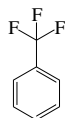


1-(Tri f luoro met hyl) ani li n e

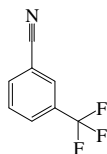
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10403	4-(Tri fluoromet hyl)benzaldehyde		$\text{C}_7\text{H}_4\text{F}_3\text{O}$	455-19-6	174.120			80 ²⁵		1.4630 ²⁰	
10404	(Tri fluoromet hyl)benzene	Benzotrifluoride	$\text{C}_6\text{H}_3\text{F}_3$	98-08-8	146.110	liq	-28.95	102.1	1.1884 ⁶	1.4146 ²⁰	misc Et OH, et h, ace, bz, ct c
10405	3-(Tri fluoromet hyl)benzoni trile		$\text{C}_6\text{H}_4\text{FCN}$	368-77-4	171.120		14.5	189	1.2813 ²⁰	1.4508 ²⁰	
10406	4-(Tri fluoromet hyl)benzoni trile		$\text{C}_6\text{H}_4\text{FCN}$	455-18-5	171.120		37.5				
10407	3-(Tri fluoromet hyl)benzoyl chloride		$\text{C}_7\text{H}_4\text{ClF}_3\text{O}$	2251-65-2	208.565	oil		186; 80 ⁶	1.383	1.4770 ²⁰	
10408	Tri fluoromet hyl difluoromet hyl ether		$\text{C}_2\text{HF}_4\text{O}$	3822-68-2	136.020	col gas	-157	-38			
10409	2-(Tri fluoromet hyl)phenol		$\text{C}_6\text{H}_4\text{F}_3\text{O}$	444-30-4	162.109		45.5	147.5			
10410	3-(Tri fluoromet hyl)phenol		$\text{C}_6\text{H}_4\text{F}_3\text{O}$	98-17-9	162.109	liq	-0.9	178	1.3418 ⁶		
10411	2-[[3-(Tri fluoromet hyl)phenyl]amino]benzoic acid	Flufenamic acid	$\text{C}_{14}\text{H}_9\text{F}_3\text{NO}_2$	530-78-9	281.230		133.5				s DMSO
10412	Tri fluoromet hylsilane		SiF_4	373-74-0	100.116	col gas	-73	-30			
10413	(Tri fluoromet hyl)silane		SiF_4	10112-11-5	100.116	col gas	-124	-38.3			
10414	Tri fluoromet hyl 1,1,2,2-tetrafluoroethyl ether		$\text{C}_2\text{HF}_5\text{O}$	2356-61-8	186.028	col gas	-141	-3			
10415	1,1,1-Tri fluoro-2,4-pentanedione	1,1,1-Tri fluoroacetylacetone	$\text{C}_5\text{H}_7\text{FO}_2$	367-57-7	154.088	liq		107			s os
10416	4,4,4-Tri fluoro-1-phenyl-1,3-butanedione		$\text{C}_{10}\text{H}_7\text{F}_3\text{O}_2$	326-06-7	216.157	cry	39	224			i H ₂ O; s Et OH, ace
10417	2,2,2-Tri fluoro-1-phenylethanone		$\text{C}_8\text{H}_7\text{F}_3\text{O}$	434-45-7	174.120	liq	-40	153	1.279 ⁶	1.4583 ²⁰	
10418	Tri fluorophenylsilane		$\text{C}_6\text{H}_3\text{F}_3\text{Si}$	368-47-8	162.185	liq	-18	101.5	1.2109 ⁶	1.4110 ²⁰	vs bz, Et OH
10419	1,1,1-Tri fluoroethane		$\text{C}_2\text{H}_2\text{F}_3$	421-07-8	98.067	col gas		-13			
10420	1,1,1-Tri fluoro-2-propanol, (±)		$\text{C}_3\text{H}_4\text{F}_3\text{O}$	17556-48-8	114.066	liq	-52	78	1.2632 ⁶	1.3130 ²⁵	vs Et OH, et h; s ace, bz; sl ct c
10421	3,3,3-Tri fluoroethane		$\text{C}_2\text{H}_3\text{F}_3$	677-21-4	96.051	col gas		-17			
10422	3,3,3-Tri fluoro-1-propyne	(Tri fluoromet hyl)acetylene	C_3HF_3	661-54-1	94.035	col gas		-48.3			
10423	4,4,4-Tri fluoro-1-(2-thienyl)-1,3-butanedione	Thienyl tri fluoroacetone	$\text{C}_8\text{H}_6\text{F}_3\text{O}_2\text{S}$	326-91-0	222.185		42.8	97 ⁶			
10424	Tri fluoro(tetrafluoroethyl)oxide	Perfluoropropylene oxide	$\text{C}_3\text{F}_6\text{O}$	428-59-1	166.021	gas		-27.4			
10425	Tri flupromazine	Flupromazine	$\text{C}_{18}\text{H}_{19}\text{F}_3\text{N}_2\text{S}$	146-54-3	352.417	visc oil		176		1.5780 ²³	
10426	Tri fluralin	2,6-Dimethyl-4-(tri fluoromet hyl)aniline	$\text{C}_{13}\text{H}_{16}\text{F}_3\text{N}_3\text{O}_4$	1582-09-8	335.279		49	140 ^{4,2}			
10427	Tri fluorine		Cl_3F_3	26644-46-2	434.962			155 dec			
10428	Tri gonelline		$\text{C}_6\text{H}_5\text{NO}_2$	535-83-1	137.137	pr (aq, al, +1w)					vs H ₂ O
10429	Tri hexylamine	N,N-Di hexyl-1-hexanamine	$\text{C}_{18}\text{H}_{39}\text{N}$	102-86-3	269.510			261.7	0.7976 ²¹		i H ₂ O; vs Et OH, et h; s acid
10430	Tri hexyl borate		$\text{C}_6\text{H}_{13}\text{BO}_3$	5337-36-0	314.312			143 ²			sl ct c
10431	Tri hexylphenyl hydrochloride	α-Cylohexyl α-phenyl-1-piperidinepropanol hydrochloride	$\text{C}_{20}\text{H}_{32}\text{ClNO}$	52-49-3	337.927			258.5			
10432	Tri hydro(pyridine)boron	Borane pyridine	$\text{C}_5\text{H}_6\text{BN}$	110-51-0	92.936		10.5		0.920 ²⁰	1.5280 ²⁵	i H ₂ O; dec acid
10433	1,2,3-Tri hydroxy-9,10-anthracenedione	Anthracenol	$\text{C}_{14}\text{H}_6\text{O}_5$	602-64-2	256.211	ye nd (dil al)	313	sub 290			sl ₂ H ₂ O; s Et OH, et h, HOAc, C ₆ S
10434	1,2,4-Tri hydroxy-9,10-anthracenedione	Purpurin	$\text{C}_{14}\text{H}_6\text{O}_5$	81-54-9	256.211	oran red or oran-ye nd (al)	259	sub			sl H ₂ O; vs Et OH, bz, HOAc; s et h
10435	2,3,4-Tri hydroxybenzoic acid		$\text{C}_7\text{H}_6\text{O}_5$	610-02-6	170.120	nd (+w)	221	sub			sl H ₂ O; s Et OH, et h, ace; i bz, C ₆ S
10436	2,4,6-Tri hydroxybenzoic acid		$\text{C}_7\text{H}_6\text{O}_5$	83-30-7	170.120	cry (w+1)	100 dec				sl H ₂ O; s Et OH; vs et h; i bz
10437	3,4,5-Tri hydroxybenzoic acid	Gallonic acid	$\text{C}_7\text{H}_6\text{O}_5$	149-91-7	170.120	pr (w+1)	253 dec		1.694 ⁶		sl H ₂ O, et h; vs Et OH; s ace; i bz, chl
10438	2,3,4-Tri hydroxybenzophenone	Alizarin Yellow A	$\text{C}_{13}\text{H}_8\text{O}_4$	1143-72-2	230.216	ye nd (dil al)	140.5				sl ₂ H ₂ O, bz; s Et OH, et h, ace, HOAc
10439	2',4,4'-Tri hydroxychalcone	Isoliquiritigenin	$\text{C}_{15}\text{H}_{12}\text{O}_6$	961-29-5	256.254	ye nd (Et OH-w)	200				



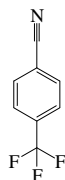
4-(Tri f luoromet hyl)benzal dehyde



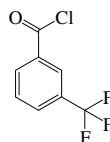
(Tri f luoromet hyl)benzene



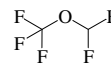
3-(Tri f luoromet hyl)benzoni t ri le



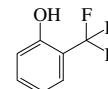
4-(Tri f luoromet hyl)benzoni t ri le



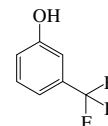
3-(Tri f luoromet hyl)benzoyl ori de



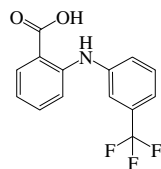
Tri f luoromet hyl f luoromet hyl ether



2-(Tri f luoromet hyl)phenol



3-(Tri f luoromet hyl)phenol



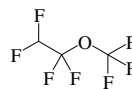
2-[[3-(Tri f luoromet hyl)phenyl]ami no]benzoi c



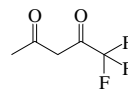
Tri f luoromet hyl si lane



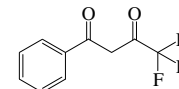
(Tri f luoromet hyl)si lane



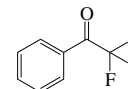
Tri f luoromet hyl 2,2,2- t raf luoroet hyl ether



1,1,1-Tri f luoro-2,4- pent anedi one

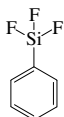


4,4,4-Tri f luoro-1-phenyl-1,3- but anedi one



2,2,2-Tri f luoro-1-phenyl et hanone

3-549



Tri f luorophenyl si lane



1,1,1-Tri f luoropropane



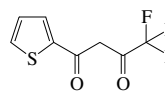
1,1,1-Tri f luoro-2- propanol



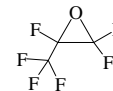
3,3,3-Tri f luoropropene



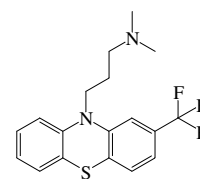
3,3,3-Tri f luoro-1- propyne



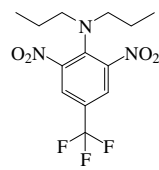
4,4,4-Tri f luoro-1-(2- th i enyl)-1,3- but anedi one



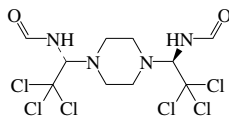
Tri f luoro(tri f luoromet hyl)oxi rane



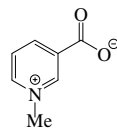
Tri f luopromazi ne



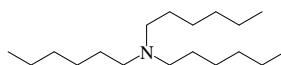
Tri f lurali n



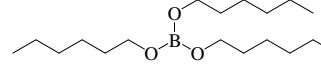
Tri f lurali n



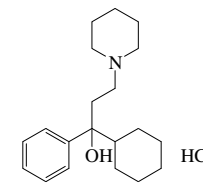
Tri gonelli ne



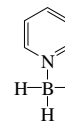
Tri hexyl ami ne



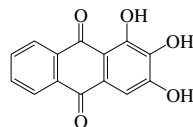
Tri hexyl borat e



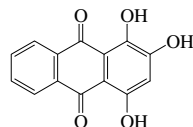
Tri hexylpheni dihydrochl ori de



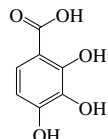
Tri hydro(pyri di ne) boron



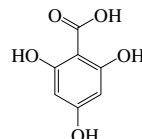
1,2,3-Tri hydroxy-9,10- ant hracenedi one



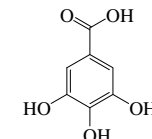
1,2,4-Tri hydroxy-9,10- ant hracenedi one



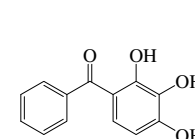
2,3,4-Tri hydroxybenzoi aci d



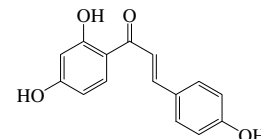
2,4,6-Tri hydroxybenzoi aci d



3,4,5-Tri hydroxybenzoi aci d

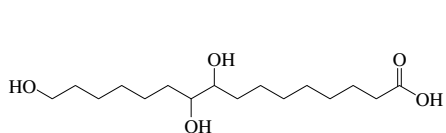


2,3,4-Tri hydroxybenzophenone

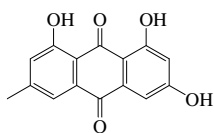


2',4,4'-Tri hydroxychal cone

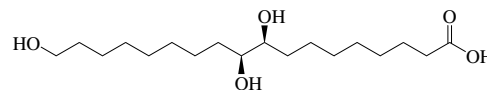
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10440	9,10,16-Tri hydroxyhexadecanoi c aci d	Al euri t i c aci d	$C_{16}H_{32}O_3$	6949-98-0	304.422	lf (di l al), nd(w)	102				sl OH
10441	1,3,8-Tri hydroxy-6-met hyl-9,10-ant hracenedi one	Emodi n	$C_9H_{10}O_5$	518-82-1	270.237	oran-red mcl nd (HOAc)	257	sub			vs et h, Et OH
10442	9,10,18-Tri hydroxyoct adecanoi c aci d (R*, R')	Phl oi onol i c aci d	$C_{18}H_{36}O_5$	583-86-8	332.476	cry (di l al)	101.5				
10443	5,6,7-Tri hydroxy-2-phenyl -#-1-benzopyran-4-one	Bai cal ei n	$C_{19}H_{18}O_5$	491-67-8	270.237	ye pr (al)	264 dec				sl H ₂ O, bz; s Et OH, et h, ace, HOAc
10444	1-(2,4,5-Tri hydroxyphenyl)-1-but anone		$C_{10}H_{12}O_4$	1421-63-2	196.200		153.8				
10445	1-(2,3,4-Tri hydroxyphenyl)et hanone	Gal l acet ophenone	$C_9H_{10}O_4$	528-21-2	168.148		173				s H ₂ O, et h; vs Et OH, ace; sl bz, chl
10446	1-(2,4,6-Tri hydroxyphenyl)et hanone	2',4',6'-Tri hydroxyacet ophenone	$C_9H_{10}O_4$	480-66-0	168.148		221.0				sl H ₂ O, chl, bz; vs Et OH, et h, ace
10447	1-(2,4,6-Tri hydroxyphenyl)-1-propanone	Fl opropi one	$C_9H_{10}O_4$	2295-58-1	182.173	nd (w, +1w)	175.5				vs et h, Et OH
10448	2,6,7-Tri hydroxy-9-phenyl -#-xant hen-3-one	Phenyl fluorone	$C_{19}H_{12}O_5$	975-17-7	320.295	oran red (al - HCl)	>300				
10449	2,3,5-Tri i odobenzo i c aci d		$C_7H_3O_2$	88-82-4	499.811	pr (al)	225				i H ₂ O; vs Et OH, et h; sl bz
10450	Tri i odomet hane	Iodof orm	CHI_3	75-47-8	393.732	ye cry	121.2	218	4.008 ²⁵		i H ₂ O, bz; s Et OH, et h, ace; sl DMSO
10451	2,4,6-Tri i odophenol		$C_6H_3O_3$	609-23-4	471.800	nd (di l al)	159.8	sub			i H ₂ O; sl Et OH; s et h, ace
10452	3,3',5'-Tri i odot hyopropano i c aci d		$C_{10}H_7Cl_3O_4$	51-26-3	635.959	cry (Et OH)	200				sl Et OH
10453	Tri i sobut yl al umi nat e	2-Met hyl-1-propanol, al umi num salt	$Al_2O_3 \cdot 3Al_2O_3$	3453-79-0	246.322				275 ⁵⁰		
10454	Tri i sobut yl al umi num		$C_{12}H_{27}Al$	100-99-2	198.324	li q	6	86			
10455	Tri i sobut yl ami ne	2-Met hyl-1-propanami ne	$C_{12}H_{27}N$	1116-40-1	185.349	li q	-21.8	191.5	0.768 ⁴⁹	1.4252 ¹⁷	vs et h, Et OH
10456	Tri i sobut yl borane		$B_2H_6 \cdot 3B$	1116-39-8	182.153			188; 86 ²⁰	0.7380 ²⁵	1.4188 ²³	vs bz, et h, Et OH
10457	Tri i sobut yl phosphat e		$C_8H_{17}O_4P$	126-71-6	266.313			264	0.9681 ²⁰	1.4193 ²⁰	vs H ₂ O, bz, et h, Et OH
10458	Tri i sopent yl ami ne	3-Met hyl-1-but anami ne	$C_{15}H_{33}N$	645-41-0	227.430			235	0.7848 ²⁰	1.4331 ²⁰	i H ₂ O; vs Et OH; msc et h, bz, ct c
10459	Tri i sopropanol ami ne		$C_9H_{19}NO_3$	122-20-3	191.268		45	175 ¹⁰	1.0 ²⁰		s H ₂ O, Et OH; sl chl
10460	Tri i sopropoxymet hane	Isopropyl ort hof ormat e	$C_{10}H_{20}O_3$	4447-60-3	190.280			167	0.8621 ²⁰	1.4000 ²⁰	vs et h, Et OH
10461	Tri i sopropoxyvi nyl si l ane		$C_{11}H_{24}O_3Si$	18023-33-1	232.393			179.5; 7 ²⁰	0.8627 ²⁵	1.3981 ²⁰	s ct c
10462	1,2,4-Tri i sopropyl benzene		$C_{18}H_{24}$	948-32-3	204.352			244	0.8574 ²⁵	1.4896 ²⁵	
10463	1,3,5-Tri i sopropyl benzene		$C_{18}H_{24}$	717-74-8	204.352	li q	-7.4	238	0.854 ⁴⁹	1.4882 ²⁰	s ace, bz, chl
10464	Tri i sopropyl borat e		$B_2H_6 \cdot 3B$	5419-55-6	188.072			140; 75 ⁷⁶	0.8251 ²⁰	1.3777 ²⁰	vs Et OH, et h, bz, PrOH
10465	Tri i sopropyl phosphat e		$C_8H_{17}O_4P$	513-02-0	224.234			219	0.9867 ²⁰	1.4057 ²⁰	vs Et OH
10466	Tri i sopropyl phosphi t e		$C_9H_{19}O_3P$	116-17-6	208.235			74 ²⁰ , 60 ¹⁰	0.9063 ²⁰	1.4085 ²⁵	s Et OH, et h, chl
10467	Tri i sopropyl vanadat e	Vanadi um, oxot ri s(2-propanol at o)- (T-4)-	$C_9H_{21}O_4V$	5588-84-1	244.203			104 ¹⁰			
10468	Tri mecai ne	2-Di et hyl ami no-2',4',6'-t ri met hylacet ani l i de	$C_{15}H_{24}N_2O$	616-68-2	248.364	cry	44	187 ⁶			
10469	Tri mel l i t i c anhydri de		$C_6H_4O_3$	552-30-7	192.125			162		241 ¹⁴	
10470	Tri meprazi ne	N,N'-Tri met hyl -#-phenot hi azi ne-10-propanami ne	$C_{18}H_{22}N_2S$	84-96-8	298.446	cry	68			162 ^{0,3}	
10471	Tri met hoat e		$B_2O_3 \cdot 3PS_2$	2275-18-5	285.364	sol i d	28.5	135 ¹			sl H ₂ O
10472	Tri met hobenzami de hydrochl ori de		$C_{21}H_{25}ClN_3O_5$	554-92-7	424.918	cry	188				vs H ₂ O
10473	Tri met hopri m		$C_{18}H_{18}N_4O_3$	738-70-5	290.318	ye cry	201				sl chl, MeOH; i et h, bz
10474	3,4,5-Tri met hoxyani l i ne		$C_9H_{13}NO_3$	24313-88-0	183.204		112.8				
10475	2,3,4-Tri met hoxybenzal dehyde		$C_9H_{12}O_4$	2103-57-3	196.200			122 ^{0,5}		1.5547 ²⁰	



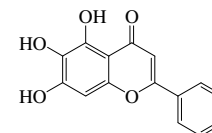
9,10,16-Tri hydroxyhexadecanoic acid



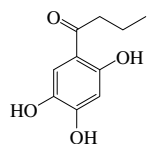
1,3,8-Tri hydroxy-6-methyl-9,10-antihydroxyanthraquinone



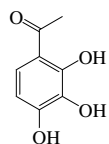
9,10,18-Tri hydroxyoctadecanoic acid (*R*,R**)



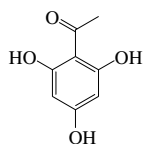
5,6,7-Tri hydroxy-2-phenyl-4H-1-benzopyran-4-one



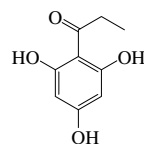
1-(2,4,5-Tri hydroxyphenyl)-1-butanol



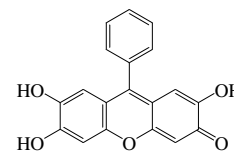
1-(2,3,4-Tri hydroxyphenyl)ethanol



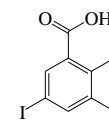
1-(2,4,6-Tri hydroxyphenyl)ethanol



1-(2,4,6-Tri hydroxyphenyl)-1-propanol



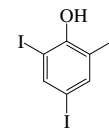
2,6,7-Tri hydroxy-9-phenyl-9H-xanthene-3-one



2,3,5-Tri iodobenzoic acid

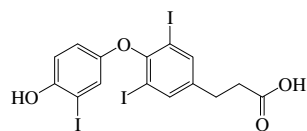


Triiodomethane

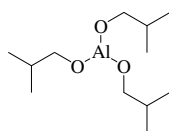


2,4,6-Tri iodophenol

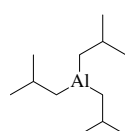
3-511



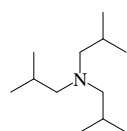
3,3',5-Tri iododipropionic acid



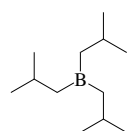
Triisobutylaluminum



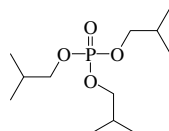
Triisobutylaluminum



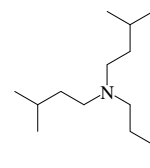
Triisobutylamine



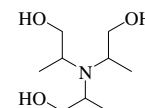
Triisobutylborane



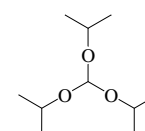
Triisobutylphosphate



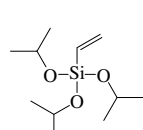
Triisopentylamine



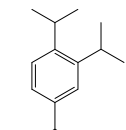
Triisopropanolamine



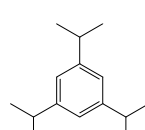
Triisopropylmethane



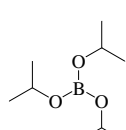
Triisopropoxydimethylsilane



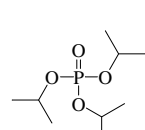
1,2,4-Triisopropylbenzene



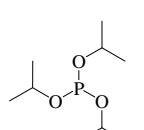
1,3,5-Triisopropylbenzene



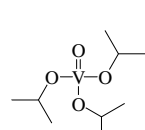
Triisopropylborate



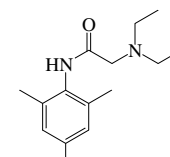
Triisopropylphosphate



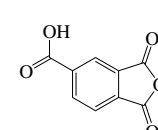
Triisopropylphosphite



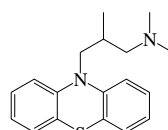
Triisopropylphosphonate



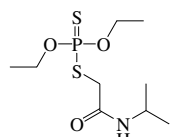
Triisocetylamine



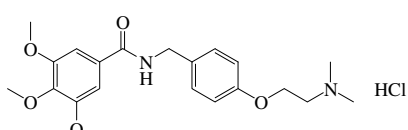
Triisobutylidene



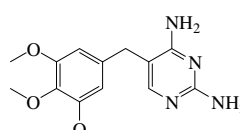
Triisopropylamine



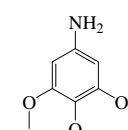
Triisopropylsulfonamide



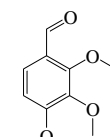
Triisobutylamine hydrochloride



Triisobutylamine

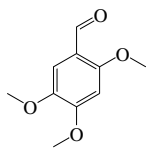


3,4,5-Triisobutylamine

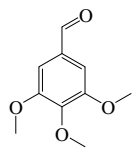


2,3,4-Triisobutylbenzaldehyde

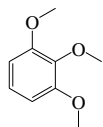
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10476	2,4,5-Tri met hoxyl benzal dehyde		$_{10}\text{H}_{12}\text{O}_4$	4460-86-0	196.200		114				s H ₂ O, et h, chl, li g
10477	3,4,5-Tri met hoxyl benzal dehyde		$_{10}\text{H}_{12}\text{O}_4$	86-81-7	196.200		72.5	148 ⁵			s chl
10478	1,2,3-Tri met hoxyl benzene		$_{11}\text{H}_{12}\text{O}_3$	634-36-6	168.189	ort h nd (al)	48.5	235	1.100 ⁹		i H ₂ O; s Et OH, et h, bz
10479	1,3,5-Tri met hoxyl benzene		$_{11}\text{H}_{12}\text{O}_3$	621-23-8	168.189	pr (al), lf (pet h)	54.5	255.5			i H ₂ O; s Et OH, et h, bz
10480	3,4,5-Tri met hoxyl benzenet hanami ne	Mescal i ne	$_{11}\text{H}_{11}\text{NO}_3$	54-04-6	211.258	cry	35.5	180 ¹²			s H ₂ O, Et OH, bz, chl; i et h, pet h
10481	3,4,5-Tri met hoxyl benzenet hanol	3,4,5-Tri met hoxyl benzyl al cohoh	$_{10}\text{H}_{14}\text{O}_4$	3840-31-1	198.216		3	228 ²⁵	1.1427 ²⁰	1.5439 ²⁰	
10482	2,4,5-Tri met hoxyl benzoi c aci d		$_{10}\text{H}_8\text{O}_5$	490-64-2	212.199	nd (al or bz-pet h)	145	300			vs H ₂ O, bz, Et OH, pet h
10483	3,4,5-Tri met hoxyl benzoi c aci d		$_{10}\text{H}_8\text{O}_5$	118-41-2	212.199	mcl nd (w)	172.3	226 ⁹			sl H ₂ O; vs Et OH, et h, chl
10484	3,4,5-Tri met hoxyl benzoyl chl ori de		$_{10}\text{H}_7\text{ClO}_4$	4521-61-3	230.645		82	185 ¹⁸			
10485	Tri met hoxyl boroxi n		$_{3}\text{B}_3\text{O}_6$	102-24-9	173.532					1.40 ²⁵	
10486	6,6',7-Tri met hoxyl-2,2'-di met hyl berbami ne	Berbami ne	$_{67}\text{H}_{40}\text{N}_2\text{O}_6$	478-61-5	608.723	lf (+2w, al) cry (pet h)	198.5				sl H ₂ O; s Et OH, et h, chl, pet h
10487	6,6',7-Tri met hoxyl-2,2'-di met hyl oxyacant han-12'-ol	Oxyacant hi ne	$_{67}\text{H}_{40}\text{N}_2\text{O}_6$	548-40-3	608.723	nd (al, et h)	216.5				i H ₂ O; s Et OH, et h, bz, chl; i li g
10488	7',10,11-Tri met hoxyl met an-6'-ol	Cephael i ne	$_{28}\text{H}_{36}\text{N}_2\text{O}_4$	483-17-0	466.613	nd (et h)	115.5				vs ace, Et OH, MeOH, chl
10489	1,1,1-Tri met hoxyl et hane		$_{2}\text{B}_{12}\text{O}_3$	1445-45-0	120.147			108	0.9438 ²⁵	1.3859 ²⁵	vs et h, Et OH
10490	4,7,8-Tri met hoxyl uro[2,3-b]qui nol i ne	Ski mmi ani ne	$_{14}\text{H}_{13}\text{NO}_4$	83-95-4	259.258	pym (al)	177				i H ₂ O, pet h; s Et OH, chl; sl et h, CS ₂
10491	Tri met hoxyl et hane		$_{3}\text{B}_{10}\text{O}_3$	149-73-5	106.120		15	104	0.9676 ²⁰	1.3793 ²⁰	s Et OH, et h
10492	Tri met hoxyl et hyl si l ane		$_{4}\text{H}_{10}\text{O}_2\text{Si}$	1185-55-3	136.222			102.5	0.9548 ⁹	1.3696 ²⁰	s chl
10493	Tri met hoxyl phenyl si l ane		$_{9}\text{H}_{14}\text{O}_2\text{Si}$	2996-92-1	198.291			136 ⁹ , 110 ²⁰	1.064 ²⁰	1.4734 ²⁰	s ct c, CS ₂
10494	Tri met hoxyl si l ane		$_{3}\text{H}_6\text{O}_2\text{Si}$	2487-90-3	122.195			32 ²⁰			
10495	3-(Tri met hoxyl yl)-1-propanet hi ol	(3-Mercapt oproyl)l ri met hoxyl	$_{10}\text{H}_{18}\text{O}_5\text{SSi}$	4420-74-0	196.340			128 ⁹ , 93 ¹⁰	1.015 ²⁵	1.4420 ²⁵	
10496	N-[3-(Tri met hoxyl yl)propyl]-1,2-et hanedi ami ne		$_{6}\text{H}_{22}\text{N}_2\text{O}_3\text{Si}$	1760-24-3	222.358			140 ⁵	1.01 ²⁵	1.4416 ²⁵	
10497	3-(Tri met hoxyl yl)propyl met hacryl at e		$_{10}\text{H}_{20}\text{O}_5\text{Si}$	2530-85-0	248.349	li q		10795 ¹			
10498	Tri met hyl al umi num		$_{3}\text{HAl}$	75-24-1	72.085		15.4	130; 20 ⁹	0.752 ²⁰		
10499	Tri met hyl ami ne	N,N-Di met hyl met hanami ne	$_{3}\text{HON}$	75-50-3	59.110	col gas	-117.1	2.87	0.627 ²⁵ (p>1 at m)	1.3631 ⁰	vs H ₂ O, chl, t ol; s Et OH, et h, bz
10500	Tri met hyl ami ne borane	N,N-Di met hyl met hanami ne borane	$_{3}\text{HCBN}$	75-22-9	72.945		94	172	0.792 ²⁵		vs et h, Et OH
10501	Tri met hyl ami ne hydrochl ori de	N,N-Di met hyl met hanami ne hydrochl ori de	$_{3}\text{H}_{10}\text{ClN}$	593-81-7	95.571	mcl hyg nd (al)	277.5	sub 200			vs H ₂ O, Et OH, chl
10502	Tri met hyl ami ne oxidi	N,N-Di met hyl met hanami ne oxidi	$_{3}\text{H}_2\text{NO}$	1184-78-7	75.109	hyg nd (w+2)	256				vs H ₂ O, Et OH
10503	2,4,5-Tri met hyl ani li ne		$_{9}\text{H}_9\text{N}$	137-17-7	135.206	nd (w)	68	234.5	0.957 ²⁵		vs Et OH
10504	2,4,6-Tri met hyl ani li ne	Mesi tyl ami ne	$_{9}\text{H}_{13}\text{N}$	88-05-1	135.206	li q	-2.5	232.5	0.963 ³	1.5495 ²⁰	sl ct c
10505	Tri met hyl arsi ne		$_{3}\text{HAs}$	593-88-4	120.025	li q	-87.3	52	1.14 ⁴		vs bz, et h, Et OH
10506	2,4,6-Tri met hyl benzal dehyde		$_{10}\text{H}_{12}\text{O}$	487-68-3	148.201		14	238.5	1.0154 ²⁵		i H ₂ O; s Et OH, et h, ace, bz
10507	1,2,3-Tri met hyl benzene	Hemi mel li t ene	$_{9}\text{H}_{12}\text{C}$	526-73-8	120.191	li q	-25.4	176.12	0.894 ⁴	1.5139 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
10508	1,2,4-Tri met hyl benzene	Pseudocumene	$_{9}\text{H}_{12}$	95-63-6	120.191	li q	-43.77	169.38	0.875 ⁹	1.5048 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
10509	1,3,5-Tri met hyl benzene	Mesi tyl ene	$_{9}\text{H}_6$	108-67-8	120.191	li q	-44.72	164.74	0.861 ⁵	1.4994 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
10510	2,3,5-Tri met hyl -1,4-benzenedi ol		$_{9}\text{H}_6\text{O}_2$	700-13-0	152.190	nd (w)	169 dec				sl H ₂ O; vs Et OH, et h, bz
10511	N,α,α-Tri met hyl benzenet hanami ne	Mephent ermi ne	$_{11}\text{H}_{17}\text{N}$	100-92-5	163.260	li q		95			i H ₂ O; s et h; vs Et OH
10512	Tri met hyl 1,2,4-benzenet ri carboxyl at e	Tri met hyl t ri mel li t at e	$_{12}\text{H}_{12}\text{O}_6$	2459-10-1	252.219	vi sc oi l	-13	194	1.261	1.5230 ²⁰	



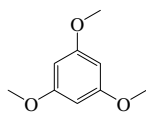
2,4,5-Tri met hoxyl benzaldehyde



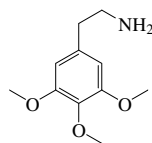
3,4,5-Tri met hoxyl benzaldehyde



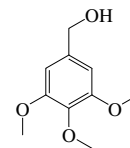
1,2,3-Tri met hoxyl benzene



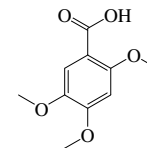
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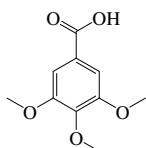
3,4,5-Tri met hoxyl benzeneethylamine



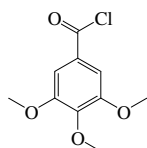
3,4,5-Tri met hoxyl benzeneethyl alcohol



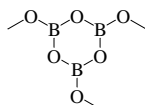
2,4,5-Tri met hoxyl benzoic acid



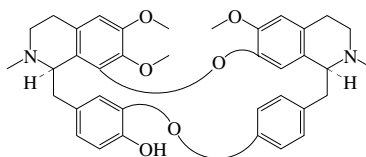
3,4,5-Tri met hoxyl benzoic acid



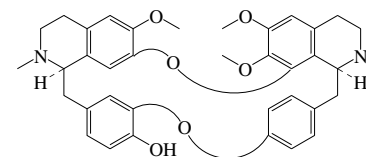
3,4,5-Tri met hoxyl benzoyl chloride



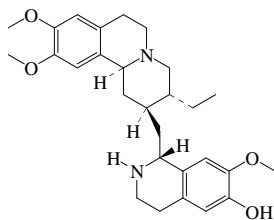
Tri met hoxyl boroxine



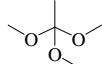
6,6',7-Tri met hoxyl-2,2'-di ethyl berbaman-12-ol



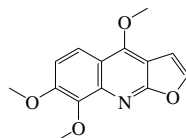
6,6',7-Tri met hoxyl-2,2'-di ethyl oxyacant han-12-ol



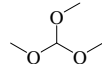
7,10,11-Tri met hoxylmet an-6-ol



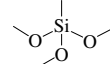
1,1,1-Tri met hoxyl ethane



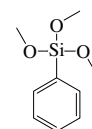
4,7,8-Tri met hoxyl uro[2,3-b]qui nol i ne



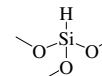
Tri met hoxyl ethane



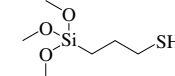
Tri met hoxylmet hyl silane



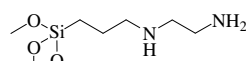
Tri met hoxylphenyl silane



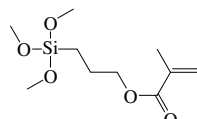
Tri met hoxyl ethane



3-(Tri met hoxyl lyl)-1-propanethiol



N-(3-(Tri met hoxyl lyl)propyl)-1,2-ethanediamine



3-(Tri met hoxyl lyl)propyl acrylate



Tri met hylaluminum



Tri met hylamine



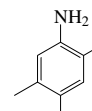
Tri met hylborane



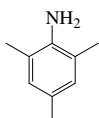
Tri met hylamine hydrochloride



Tri met hylamine oxide



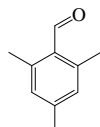
2,4,5-Tri met hylbenzylamine



2,4,6-Tri met hylbenzylamine



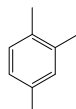
Tri met hylarsine



2,4,6-Tri met hyl benzaldehyde



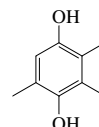
1,2,3-Tri met hyl benzene



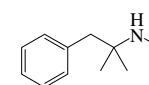
1,2,4-Tri met hyl benzene



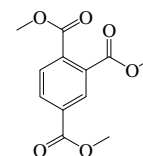
1,3,5-Tri met hyl benzene



2,3,5-Tri met hyl-1,4-benzenediol

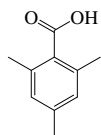


N,α,α-Tri met hyl benzeneethylamine

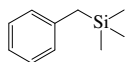


Tri met hyl,2,4-benzenetricarboxylic acid

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10513	2,4,6-Tri met hyl benzoi c aci d		₁₀ H ₁₂ O ₂	480-63-7	164.201	pr (li g)	156.5				sl H ₂ O; s Et OH, et h, ace, chl
10514	Tri met hyl benzyl si l ane		₁₀ H ₁₆ Si	770-09-2	164.320			190.5	0.8933 ⁹	1.4941 ²⁰	
10515	1,7,7-Tri met hyl bi cycl of[2.2.1]hept ane		₁₀ H ₁₆	464-15-3	138.250	hex pl (al), pr(MeOH)		161			i H ₂ O; s Et OH, et h, AcOEt, MeOH
10516	1,3,3-Tri met hyl bi cycl of[2.2.1]hept an- α -Fenchyl al cohoh, β -2-ol, (1 <i>S</i> -endo)		C ₁₀ H ₁₈ O	512-13-0	154.249	pr	48	94 ²⁰	0.9034 ⁶⁴		
10517	1,7,7-Tri met hyl bi cycl of[2.2.1]hept an-Bornyl acet at e 2-ol acet at <i>endo</i>		₁₀ H ₂₀ O ₂	76-49-3	196.286		29	221			
10518	1,7,7-Tri met hyl bi cycl of[2.2.1]hept -2-ene		C ₁₀ H ₁₆	464-17-5	136.234	cry (al)	113	146			vs bz, et h, Et OH
10519	4,6,6-Tri met hyl bi cycl of[3.1.1]hept -3-en-2-ol, (1 α ,2 α ,5 α)		C ₁₀ H ₁₆ O	1820-09-3	152.233		24	92 ¹⁰	0.9657 ²⁵	1.4908 ²⁵	
10520	4,6,6-Tri met hyl bi cycl of[3.1.1]hept -3-en-2-ol, (1 α ,2 β ,5 α)		C ₁₀ H ₁₆ O	1845-30-3	152.233		15.5	90 ¹⁰	0.9684 ²⁵	1.4912 ²⁵	
10521	2,7,7-Tri met hyl bi cycl of[3.1.1]hept -2-Chry sant henone en-6-one		C ₁₀ H ₁₄ O	473-06-3	150.217			88 ¹²		1.4720 ²²	vs Et OH
10522	Tri met hyl borane		₁₀ B	593-90-8	55.914	col gas	-161.5	-20.2			
10523	Tri met hyl borat e		₁₀ H ₆ BO ₃	121-43-7	103.912	li q	-29.3	67.5	0.915	1.3568 ²⁰	vs et h, MeOH
10524	2,2,3-Tri met hyl but ane	Tri pt ane	₇ H ₁₆	464-06-2	100.202	li q	-24.6	80.86	0.690 ⁹	1.3864 ²⁰	i H ₂ O; s Et OH, et h; vs ace, bz, pet h, ct c
10525	2,3,3-Tri met hyl -2-but anol		₇ H ₁₆ O	594-83-2	116.201	cry (di l al +1/2w)	17	131	0.8380 ²⁵	1.4233 ²²	sl H ₂ O; vs ace, et h, Et OH
10526	2,3,3-Tri met hyl -1-but ene		₇ H ₁₄	594-56-9	98.186	li q	-109.9	77.9	0.705 ⁹	1.4025 ²⁰	i H ₂ O; s et h, bz, chl, MeOH
10527	Tri met hyl chl orosi l ane		₃ H ₁₀ Cl Si	75-77-4	108.642	li q	-40	60	0.856	1.3870 ²⁰	
10528	Tri met hyl ci t rat e		₉ H ₁₀ O ₇	1587-20-8	234.203	t cl	79.3	285; 176 ⁶			vs et h, Et OH
10529	2,6,6-Tri met hyl -2,4-cycl ohept adi en-Eucarvone 1-one		C ₁₀ H ₁₄ O	503-93-5	150.217			210; 105 ²²	0.9490 ²⁰	1.5087 ²⁰	s et h, ace
10530	1,1,2-Tri met hyl cycl ohexane		₉ H ₁₈	7094-26-0	126.239	li q	-29	145.2	0.7963	1.4382 ²⁰	
10531	1,1,3-Tri met hyl cycl ohexane		₉ H ₁₈	3073-66-3	126.239	li q	-65.7	136.6	0.774 ⁹	1.4295 ²⁰	i H ₂ O
10532	1 α ,2 β ,4 β -1,2,4-Tri met hyl cycl ohexane		C ₉ H ₁₈	7667-60-9	126.239	li q	-83.5	142.9	0.787 ⁹	1.4341 ²⁰	
10533	1 α ,3 α ,5 β -1,3,5-Tri met hyl cycl ohexane	<i>t rans</i> 1,3,5-Tri met hyl cycl ohexane	₉ H ₁₈	1795-26-2	126.239	li q	-107.4	140.5	0.779 ⁹	1.4307 ²⁰	vs bz, et h, li g
10534	<i>ci s</i> 3,3,5-Tri met hyl cycl ohexanol		₉ H ₁₈ O	933-48-2	142.238		37.3	202; 92 ¹²	0.9006 ¹⁶	1.4550 ¹⁶	i H ₂ O; s Et OH, et h, chl
10535	<i>t rans</i> 3,3,5-Tri met hyl cycl ohexanol		₉ H ₁₈ O	767-54-4	142.238	cry (et h)	55.8	189.2	0.863 ¹⁹		i H ₂ O; s Et OH, et h, chl
10536	2,2,6-Tri met hyl cycl ohexanone		₉ H ₁₆ O	2408-37-9	140.222	li q	-31.8	178.5	0.904 ³	1.4470 ²⁰	
10537	2,4,4-Tri met hyl cycl ohexanone		₉ H ₁₆ O	2230-70-8	140.222			191	0.902 ²⁰	1.4493 ²⁰	
10538	3,3,5-Tri met hyl cycl ohexanone	Di hydroi sopherone	₉ H ₁₆ O	873-94-9	140.222	ye oi l		189	0.891 ⁹	1.4454 ¹⁵	
10539	2,6,6-Tri met hyl -1-cycl ohexene-1-carboxal dehyde	β -Cycl oci t ral	₁₀ H ₁₆ O	432-25-7	152.233			112 ²⁹ , 97 ¹⁵	0.959 ¹⁵	1.4971 ¹⁵	
10540	3,5,5-Tri met hyl -2-cycl ohexen-1-ol	Isophorol	₉ H ₁₆ O	470-99-5	140.222			69 ⁵	0.914 ²⁰	1.4717 ²⁰	
10541	4-(2,6,6-Tri met hyl -1-cycl ohexen-1-yl)-3-but en-2-ol	β -lonol	C ₉ H ₂₂ O	22029-76-1	194.313			130 ¹⁴	0.9243 ²⁰	1.4969 ²⁰	s Et OH, et h, ace
10542	4-(2,6,6-Tri met hyl -2-cycl ohexen-1-yl)-3-but en-2-ol	α -lonol	C ₉ H ₂₂ O	25312-34-9	194.313	oi l		12 ⁷	0.9189 ²⁰	1.4735 ²⁰	
10543	1,1,2-Tri met hyl cycl opent ane		₈ H ₁₆	4259-00-1	112.213	li q	-21.6	114; 59 ⁹	0.7660 ²⁰	1.4199 ²⁰	
10544	1,1,3-Tri met hyl cycl opent ane		₈ H ₁₆	4516-69-2	112.213	li q	-142.4	104.9	0.743 ⁹	1.4112 ²⁰	i H ₂ O
10545	1 α ,2 α ,4 β -1,2,4-Tri met hyl cycl opent ane		C ₈ H ₁₆	4850-28-6	112.213	li q	-132.6	116.7	0.759 ²	1.4186 ²⁰	



2,4,6-Tri met hyl benzoic acid



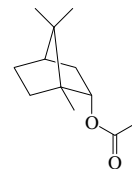
Tri met hyl benzyl silane



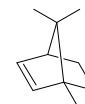
1,7,7-Tri met hyl bicyclo[2.2.1]heptane



1,3,3-Tri met hyl bicyclo[2.2.1]heptan-2-ol; *endo*



1,7,7-Tri met hyl bicyclo[2.2.1]heptan-2-yl acetate; *endo*



1,7,7-Tri met hyl bicyclo[2.2.1]hept-2-ene



4,6,6-Tri met hyl bicyclo[3.1.1]hept-3-en-2-ol; *exo*



4,6,6-Tri met hyl bicyclo[3.1.1]hept-3-en-2-ol; *exo*



2,7,7-Tri met hyl bicyclo[3.1.1]hept-2-en-6-one



Tri met hyl borane



Tri met hyl borate



2,2,3-Tri met hyl butane



2,3,3-Tri met hyl-2-butanol

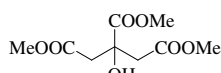
3-555



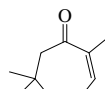
2,3,3-Tri met hyl-1-butene



Tri met hyl chlorosilane



Tri met hyl trimethylacrylate



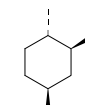
2,6,6-Tri met hyl-2,4-cycloheptadien-1-one



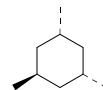
1,1,2-Tri met hyl cyclohexane



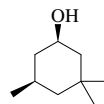
1,1,3-Tri met hyl cyclohexane



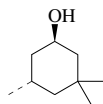
1 α ,2 β ,4 β -1,2,4-Tri met hyl cyclohexane



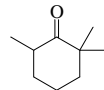
1 α ,3 α ,5 β -1,3,5-Tri met hyl cyclohexane



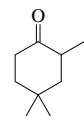
cis-3,3,5-Tri met hyl cyclohexanol



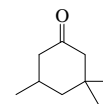
trans-3,3,5-Tri met hyl cyclohexanol



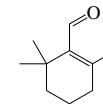
2,2,6-Tri met hyl cyclohexanone



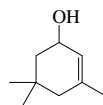
2,4,4-Tri met hyl cyclohexanone



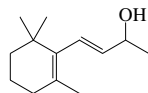
3,3,5-Tri met hyl cyclohexanone



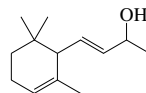
2,6,6-Tri met hyl-1-cyclohexene-1-carboxaldehyde



3,5,5-Tri met hyl-2-cyclohexen-1-ol



4-(2,6,6-Tri met hyl-1-cyclohexen-1-yl)-3-butanol



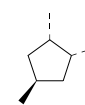
4-(2,6,6-Tri met hyl-2-cyclohexen-1-yl)-3-butanol



1,1,2-Tri met hyl cyclopentane

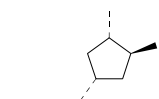


1,1,3-Tri met hyl cyclopentane

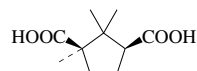


1 α ,2 α ,4 β -1,2,4-Tri met hyl cyclopentane

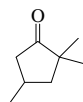
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10546	1 α ,2 β ,4 α -1,2,4-Tri met hyl cycl opent ane		C ₈ H ₁₆	16883-48-0	112.213	li q	-130.8	109.3	0.743 6	1.4106 ²⁰	
10547	1,2,2-Tri met hyl -1,3-cycl opent anedi carboxyl i c aci d (1,3S)	(+)-Camphori c aci d	C ₁₀ H ₁₆ O ₄	124-83-4	200.232	pr, lf (w)	187		1.18 6		sl H ₂ O; vs Et OH, et h; s ace; i bz, chl
10548	2,2,4-Tri met hyl cycl opent anone		C ₈ H ₁₄ O	28056-54-4	126.196	li q	-40.6	158	0.877 7	1.4300 ²⁰	
10549	2,4,4-Tri met hyl cycl opent anone		C ₈ H ₁₄ O	4694-12-6	126.196	li q	-25.6	160.5	0.878 5	1.433 ¹⁸	
10550	1,1,2-Tri met hyl cycl opropane		C ₆ H ₁₂	4127-45-1	84.159	li q	-138.2	54	0.6897 7	1.3864 ²⁰	
10551	3,7,11-Tri met hyl -2,6,10-dodecat ri enal		C ₁₅ H ₂₄ O	19317-11-4	220.351			172 ¹⁴	0.893 ¹⁸	1.4995	
10552	Tri met hyl gal li um		C ₃ H ₆ Ga	1445-79-0	114.826			55.7			dec H ₂ O (exp)
10553	2,2,6-Tri met hyl hept ane		C ₁₀ H ₂₂	1190-83-6	142.282	li q	-105	148.9	0.720 6	1.4078 ²⁰	
10554	2,5,5-Tri met hyl hept ane		C ₁₀ H ₂₂	1189-99-7	142.282			152.8	0.7362 ²⁵	1.4149 ²⁰	
10555	3,3,5-Tri met hyl hept ane		C ₁₀ H ₂₂	7154-80-5	142.282			155.7	0.7248 ²⁰	1.4170 ²⁰	i H ₂ O; s bz, ct c, chl
10556	3,4,5-Tri met hyl hept ane		C ₁₀ H ₂₂	20278-89-1	142.282			162.5	0.7519 ²⁵	1.4229 ²⁰	
10557	2,2,3-Tri met hyl hexane		C ₉ H ₂₀	16747-25-4	128.255			133.6	0.7257 ²⁵	1.4106 ²⁰	
10558	2,2,4-Tri met hyl hexane		C ₉ H ₂₀	16747-26-5	128.255	li q	-120	126.5	0.717 9	1.4033 ²⁰	
10559	2,2,5-Tri met hyl hexane		C ₉ H ₂₀	3522-94-9	128.255	li q	-105.7	124.09	0.707 2	1.3997 ²⁰	i H ₂ O; vs Et OH, et h, ace, bz; s ct c
10560	2,3,3-Tri met hyl hexane		C ₉ H ₂₀	16747-28-7	128.255	li q	-116.8	137.7	0.734 5	1.4141 ²⁰	
10561	2,3,4-Tri met hyl hexane		C ₉ H ₂₀	921-47-1	128.255			139.1	0.7354 ²⁵	1.4144 ²⁰	
10562	2,3,5-Tri met hyl hexane		C ₉ H ₂₀	1069-53-0	128.255	li q	-127.9	131.4	0.721 8	1.4051 ²⁰	
10563	2,4,4-Tri met hyl hexane		C ₉ H ₂₀	16747-30-1	128.255	li q	-113.4	130.7	0.720 7	1.4074 ²⁰	
10564	3,3,4-Tri met hyl hexane		C ₉ H ₂₀	16747-31-2	128.255	li q	-101.2	140.5	0.7414 4	1.4178 ²⁰	
10565	3,5,5-Tri met hyl hexanoi c aci d	Isononanoi c aci d	C ₉ H ₁₈ O ₂	3302-10-1	158.238	li q		127, 85 ⁴			
10566	3,5,5-Tri met hyl -1-hexanol		C ₉ H ₂₀ O	3452-97-9	144.254			194	0.8236 ²⁵	1.4300 ²⁵	
10567	1,2,3-Tri met hyl i ndene		C ₁₂ H ₁₄	4773-83-5	158.239	li q		100.5 9	0.9714 ²⁰	1.5521 ²⁰	
10568	Tri met hyl i ndi um	Indi um tri met hyl	C ₃ H ₆ In	3385-78-2	159.921			135.7	1.568 ¹⁹		
10569	2,3,3-Tri met hyl #3-i ndole		C ₈ H ₁₃ N	1640-39-7	159.228			107 ¹¹			
10570	Tri met hyl (4-met hyl phenyl)si l ane		C ₁₀ H ₁₆ Si	3728-43-6	164.320		38	192; 73 ⁰	0.8666 ²⁰	1.4900 ²⁰	
10571	1,4,5-Tri met hyl napht hal ene		C ₁₃ H ₁₄	2131-41-1	170.250	lf (MeOH)	63	145			i H ₂ O
10572	1,3,5-Tri met hyl -2-ni t robenzene		C ₇ H ₅ NO ₂	603-71-4	165.189	ort h pr (al)	44	255	1.5 8		vs Et OH
10573	2,6,8-Tri met hyl -4-nonanol		C ₁₂ H ₂₆ O	123-17-1	186.333			225.4	0.8178 ²⁰		sl ct c
10574	2,4,7-Tri met hyl oct ane		C ₁₁ H ₂₄	62016-38-0	156.309			168.1			
10575	Tri met hyl ol propane		C ₃ H ₈ O ₃	77-99-6	134.173	wh pow or pl	58	16 0			vs H ₂ O, Et OH
10576	3,5,5-Tri met hyl -2,4-oxazol i di nedi one	Tri met hadi one	C ₆ H ₁₀ NO ₂	127-48-0	143.140		46	79 ⁵			s H ₂ O; vs Et OH, et h, ace, bz; i pet h
10577	Tri met hyl oxoni um fluoborat e		C ₃ H ₉ BF ₄ O	420-37-1	147.907	hyg nd	148 dec				vs ace, chl
10578	2,4,4-Tri met hyl -2-pent anami ne		C ₈ H ₁₇ N	107-45-9	129.244						s chl
10579	2,2,3-Tri met hyl pent ane		C ₈ H ₁₈	564-02-3	114.229	li q	-112.2	110	0.716 9	1.4030 ²⁰	i H ₂ O; msc Et OH, et h, ace, hp; s bz
10580	2,2,4-Tri met hyl pent ane	Isooct ane	C ₈ H ₁₈	540-84-1	114.229	li q	-107.3	99.22	0.687 8	1.3884 ²⁵	i H ₂ O; msc Et OH, ace, hp; s et h, ct c
10581	2,3,3-Tri met hyl pent ane		C ₈ H ₁₈	560-21-4	114.229	li q	-100.9	114.8	0.726 2	1.4075 ²⁰	i H ₂ O; vs Et OH; msc et h, ace, bz, hp
10582	2,3,4-Tri met hyl pent ane		C ₈ H ₁₈	565-75-3	114.229	li q	-109.2	113.5	0.719 9	1.4042 ²⁰	i H ₂ O; vs Et OH; msc et h, ace, bz; sl ct c
10583	2,2,4-Tri met hyl -1,3-pent anedi ol		C ₈ H ₁₆ O ₂	144-19-4	146.228	pl (bz)	51.5	235; 81 ¹	0.936 ¹⁵	1.4513 ¹⁵	sl H ₂ O; vs Et OH, et h; s bz, chl
10584	2,4,4-Tri met hyl -2-pent anet hi ol		C ₈ H ₁₆ S	141-59-3	146.294	li q		7 6			
10585	2,4,4-Tri met hyl -2-pent anol		C ₈ H ₁₆ O	690-37-9	130.228	li q	-20	147.5	0.822 5	1.4284 ²⁰	i H ₂ O; sl Et OH; s et h
10586	2,2,4-Tri met hyl -3-pent anol		C ₈ H ₁₆ O	5162-48-1	130.228	li q	-13	150.5	0.8297 7	1.4288 ²⁰	



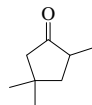
1,2,4-Tri met hyl cycl opent ane



1,2,2-Tri met hyl -1,3-cycl opent anedi carboxyli d(1,3)



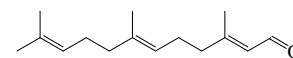
2,2,4-Tri met hyl cycl opent ane



2,4,4-Tri met hyl cycl opent ane



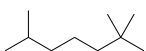
1,1,2-Tri met hyl cycl opropane



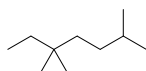
3,7,11-Tri met hyl -2,6,10-dodecat ri enal



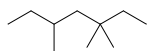
Tri met hyl gal li um



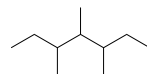
2,2,6-Tri met hyl hept ane



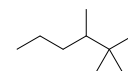
2,5,5-Tri met hyl hept ane



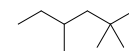
3,3,5-Tri met hyl hept ane



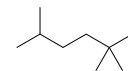
3,4,5-Tri met hyl hept ane



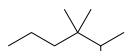
2,2,3-Tri met hyl hexane



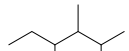
2,2,4-Tri met hyl hexane



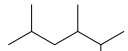
2,2,5-Tri met hyl hexane



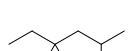
2,3,3-Tri met hyl hexane



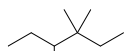
2,3,4-Tri met hyl hexane



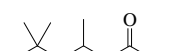
2,3,5-Tri met hyl hexane



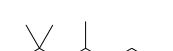
2,4,4-Tri met hyl hexane



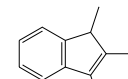
3,3,4-Tri met hyl hexane



3,5,5-Tri met hyl hexanoici d



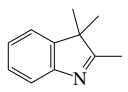
3,5,5-Tri met hyl -1-hexanol



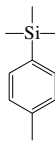
1,2,3-Tri met hyl i ndene



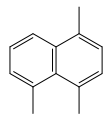
Tri met hyl i ndi



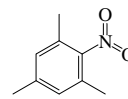
2,3,3-Tri met hyl i ndole



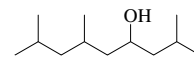
Tri met hyl (4-met hyl phenyl) si l ane



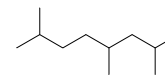
1,4,5-Tri met hyl napht hal e



1,3,5-Tri met hyl -2-ni t robenz



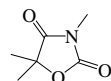
2,6,8-Tri met hyl -4-nonanol



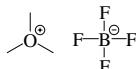
2,4,7-Tri met hyl oct ane



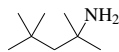
Tri met hyl ol propane



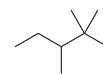
3,5,5-Tri met hyl -2,4-oxazol i di nedi one



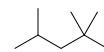
Tri met hyl oxoni um difluorobat e



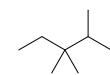
2,4,4-Tri met hyl -2-pent anami ne



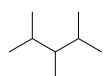
2,2,3-Tri met hyl pent ane



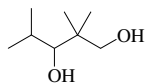
2,2,4-Tri met hyl pent ane



2,3,3-Tri met hyl pent ane



2,3,4-Tri met hyl pent ane



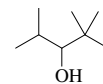
2,2,4-Tri met hyl -1,3-pent anedi ol



2,4,4-Tri met hyl -2-pent anet hi ol



2,4,4-Tri met hyl -2-pent anol

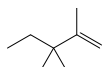


2,2,4-Tri met hyl -3-pent anol

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10587	2,2,4-Tri met hyl -3-pent anone	<i>t</i> #But yl i sopropyl ket one	$\text{C}_{10}\text{H}_{18}\text{O}$	5857-36-3	128.212			135.1	0.8065 ²⁰	1.4060	i H ₂ O; s et h, ace
10588	2,3,3-Tri met hyl -1-pent ene		$\text{C}_{10}\text{H}_{18}$	560-23-6	112.213	li q	-69	108.3	0.7308	1.4174 ²⁰	
10589	2,4,4-Tri met hyl -1-pent ene		$\text{C}_{10}\text{H}_{18}$	107-39-1	112.213	li q	-93.5	101.4	0.7150	1.4086 ²⁰	i H ₂ O; s et h, bz, ct c, chl, li g
10590	2,3,4-Tri met hyl -2-pent ene		$\text{C}_{10}\text{H}_{18}$	565-77-5	112.213	li q	-113.4	116.5	0.7434	1.4274 ²⁰	
10591	2,4,4-Tri met hyl -2-pent ene		$\text{C}_{10}\text{H}_{18}$	107-40-4	112.213	li q	-106.3	104.9	0.7218	1.4160 ²⁰	i H ₂ O; s et h, bz, ct c, chl; vs li g
10592	2,3,4-Tri met hyl phenol		$\text{C}_9\text{H}_{12}\text{O}$	526-85-2	136.190	nd (pet h)	81	236			vs bz, et h, Et OH
10593	2,3,5-Tri met hyl phenol		$\text{C}_9\text{H}_{12}\text{O}$	697-82-5	136.190		94.5	233			
10594	2,3,6-Tri met hyl phenol		$\text{C}_9\text{H}_{12}\text{O}$	2416-94-6	136.190		63				
10595	2,4,5-Tri met hyl phenol		$\text{C}_9\text{H}_{12}\text{O}$	496-78-6	136.190	nd (li g)	72	232			i C_2H_5 ; vs Et OH, et h
10596	2,4,6-Tri met hyl phenol		$\text{C}_9\text{H}_{12}\text{O}$	527-60-6	136.190	nd (pet h, MeOH)	73	220			vs et h, Et OH
10597	3,4,5-Tri met hyl phenol		$\text{C}_9\text{H}_{12}\text{O}$	527-54-8	136.190	nd (pet h)	108	248.5			
10598	Tri met hyl phenoxysi l ane		$\text{C}_9\text{H}_{10}\text{OSi}$	1529-17-5	166.292	li q	-55	119	0.8681	1.5125 ²⁰	
10599	Tri met hyl phenyl ammoni um chl ori de	Phenyl t ri met hyl ammoni um chl ori de	$\text{C}_9\text{H}_{11}\text{ClN}$	138-24-9	171.667						vs H ₂ O, Et OH
10600	1-(2,4,6-Tri met hyl phenyl)et hanone		$\text{C}_{11}\text{H}_{17}\text{O}$	1667-01-2	162.228			241; 120 ¹²	0.9754 ²⁰	1.5175 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, ct c
10601	1,1,1-Tri met hyl-N-phenyl si lanami ne	Phenyl (t ri met hyl si yl)ami ne	$\text{C}_9\text{H}_{15}\text{NSiC}$	3768-55-6	165.308			206	0.948 ⁹		
10602	Tri met hyl phenyl si l ane		$\text{C}_9\text{H}_{15}\text{Si}$	768-32-1	150.293			169.5	0.8722 ⁹	1.4907 ²⁰	s ct c, C S_2
10603	Tri met hyl phosphat e	Met hyl phosphat e	$\text{C}_3\text{H}_7\text{OP}$	512-56-1	140.074	li q	-46	197.2	1.2144	1.3967 ²⁰	vs H ₂ O; sl Et OH; s et h
10604	Tri met hyl phosphi ne		$\text{C}_3\text{H}_7\text{P}$	594-09-2	76.077	li q	-85	37.5			i C_2H_5 ; s et h
10605	Tri met hyl phosphi t e		$\text{C}_3\text{H}_7\text{OP}$	121-45-9	124.075			111.5	1.0518 ²⁰	1.4095 ²⁰	vs Et OH, et h; sl ct c
10606	1,2,4-Tri met hyl pi perazi ne		$\text{C}_7\text{H}_{11}\text{N}_2$	120-85-4	128.215			149.5		1.4433 ²⁰	s ct c
10607	2,2,4-Tri met hyl pi peri di ne		$\text{C}_8\text{H}_{13}\text{N}$	101257-71-0	127.228			148	0.832 ¹⁵	1.4458 ²⁰	vs et h, Et OH
10608	Tri met hyl pyrazi ne		$\text{C}_6\text{H}_9\text{N}_2$	14667-55-1	122.167			87 ²⁵			
10609	1,3,5-Tri met hyl #pyrazol e		$\text{C}_6\text{H}_9\text{N}_2$	1072-91-9	110.156		37	170	0.9269 ⁴⁰	1.4589 ⁵⁷	
10610	2,3,6-Tri met hyl pyri di ne	2,3,6-Col li di ne	$\text{C}_8\text{H}_{11}\text{NC}$	1462-84-6	121.180			171.6	0.9220 ²⁵	1.5053 ²⁰	s H ₂ O, Et OH, et h, ace, bz
10611	2,4,6-Tri met hyl pyri di ne	2,4,6-Col li di ne	$\text{C}_8\text{H}_{11}\text{NC}$	108-75-8	121.180	li q	-46	170.6	0.9166	1.4959 ²⁵	s H ₂ O, Et OH, et h, ace, ct c
10612	1,2,5-Tri met hyl #pyrrol e		$\text{C}_5\text{H}_7\text{N}$	930-87-0	109.169			171	0.807 ²⁵	1.4969 ²⁰	
10613	<i>N,N</i> ,2-Tri met hyl -6-qui nol i nami ne		$\text{C}_{12}\text{H}_{19}\text{N}_2$	92-99-9	186.252	ye, pr (HOAc, AcOEt)	101	319			s ct c, C S_2
10614	Tri met hyl si l ane		$\text{C}_8\text{H}_9\text{Si}$	993-07-7	74.197	col gas	-135.9	6.7			
10615	1-(Tri met hyl si yl)fl mi dazol e		$\text{C}_8\text{H}_{12}\text{N}_2\text{Si}$	18156-74-6	140.258						s chl
10616	3-(Tri met hyl si yl)-1-propanol		$\text{C}_8\text{H}_{17}\text{OSi}$	2917-47-7	132.276			141; 82 ⁴	0.822 ²⁵	1.4298 ²⁰	
10617	Tri met hyl st i bi ne		$\text{C}_3\text{H}_5\text{Sb}$	594-10-5	166.863	li q	-62	80.6	1.523	1.42 ¹⁵	i H ₂ O; s Et OH, et h, C S_2
10618	Tri met hyl sul f oni um i odi de		$\text{C}_3\text{H}_7\text{ISC}$	2181-42-2	204.072	cry (et h)	211 dec				
10619	Tri met hyl t hi oure		$\text{C}_4\text{H}_9\text{N}_2\text{S}$	2489-77-2	118.200	pr (bz-li g)	87.5				vs bz, Et OH, chl
10620	2,4,6-Tri met hyl -2,4,6-tri phenyl cycl ot ri si loxane		$\text{C}_{21}\text{H}_{24}\text{O}_3\text{Si}_3$	546-45-2	408.671		100	190 ¹⁵	1.1062 ²⁰	1.5397 ²⁰	
10621	Tri met hyl urea		$\text{C}_3\text{H}_7\text{N}_2\text{O}$	632-14-4	102.134	pr (et h)	75.5	232.5	1.1900 ⁹		s H ₂ O, Et OH; sl et h, bz
10622	Tri ni t roacet oni t ri le		$\text{C}_2\text{N}_4\text{O}_6$	630-72-8	176.044	wax	41.5	exp 220			vs et h
10623	2,4,6-Tri ni t roani li ne		$\text{C}_6\text{H}_3\text{N}_3\text{O}_6$	489-98-5	228.119	dk ye pr (HOAc)	193.5	exp	1.762 ¹⁰		i H ₂ O; sl Et OH, et h; s ace, bz, AcOEt
10624	1,3,5-Tri ni t robenzene	<i>sym</i> -Tri ni t robenzene	$\text{C}_6\text{H}_3\text{N}_3\text{O}_6$	99-35-4	213.104	ort h pl (bz) lf (w)	122.9	315	1.4775 ¹⁵²		sl H ₂ O, Et OH, et h; vs ace; s bz, py
10625	2,4,6-Tri ni t ro-1,3-benzenedi ol	St yphni c aci d	$\text{C}_6\text{H}_3\text{N}_3\text{O}_8$	82-71-3	245.103	hex ye cry (di l al)	175.5	sub			vs et h, Et OH
10626	2,4,6-Tri ni t robenzoi c aci d		$\text{C}_6\text{H}_3\text{N}_3\text{O}_8$	129-66-8	257.114	ort h (w)	228 dec				sl H ₂ O, bz; vs Et OH; s et h, ace



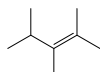
2,2,4-Tri met hyl -3-pent anone



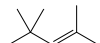
2,3,3-Tri met hyl -1-pent ene



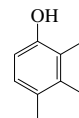
2,4,4-Tri met hyl -1-pent ene



2,3,4-Tri met hyl -2-pent ene



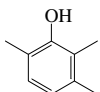
2,4,4-Tri met hyl -2-pent ene



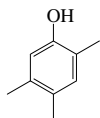
2,3,4-Tri met hyl phenol



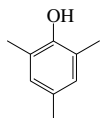
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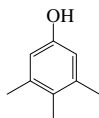
2,3,6-Tri met hyl phenol



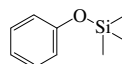
2,4,5-Tri met hyl phenol



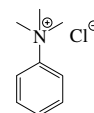
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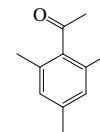
3,4,5-Tri met hyl phenol



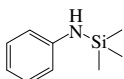
Tri met hyl phenoxysi lane



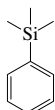
Tri met hyl phenyl ammoni diti ori de



1-(2,4,6-Tri met hyl phenyl)et hanone



1,1,1-Tri met hyl-N-phenyl si lanami ne



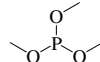
Tri met hyl phenyl si lane



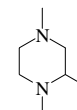
Tri met hylphospat e



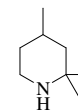
Tri met hyl phosphi ne



Tri met hylphosphi t e



1,2,4-Tri met hyl pi perazi ne



2,2,4-Tri met hyl pi peri di ne



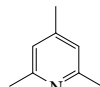
Tri met hyl pyrazi ne



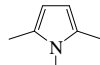
1,3,5-Tri met hyl #pyrazole



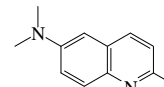
2,3,6-Tri met hyl pyri di ne



2,4,6-Tri met hyl pyri di ne



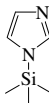
1,2,5-Tri met hyl #pyrrol e



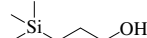
N,N'-2-Tri met hyl -6-qui nol i nami ne



Tri met hyl si lane



1-(Tri met hyl si yl)-1H-imi dazol



3-(Tri met hyl si yl)-1-propanol



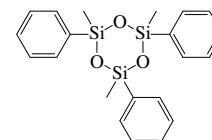
Tri met hyl sti bi ne



Tri met hyl sul f onii uidi de



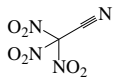
Tri met hyl thi ourea



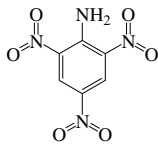
2,4,6-Tri met hyl -2,4,6-t ri phenyl cycl otri si loxane



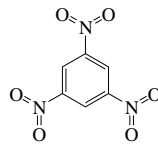
Tri met hyl urea



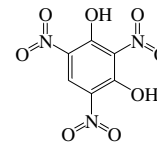
Tri ni t roacet oni t ri le



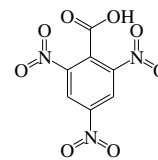
2,4,6-Tri ni t roani li ne



1,3,5-Tri ni t robenzene

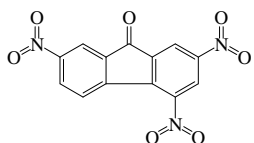


2,4,6-Tri ni t ro-1,3-benzenedi ol

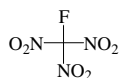


2,4,6-Tri ni t robenzoat d

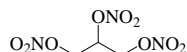
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10627	2,4,7-Tri nitrofluoren-9-one		C ₁₃ H ₅ N ₃ O ₇	129-79-3	315.195	pa ye nd (bz, HOAc)	175.8				sl H ₂ O; vs ace, bz, chl
10628	Tri nitrofluoromet hane	Fluorotri nitromet hane	C ₆ F ₆ N ₃ O	1840-42-2	169.025			86.3	1.59 ²⁰		
10629	Tri nitrogl ycerol	Nitrogl ycerin	C ₃ H ₅ N ₃ O ₉	55-63-0	227.087	pa ye t cl or ort h	13.5	exp 218; 93 ^{0,31}	1.5931 ²⁰	1.4786 ¹²	sl H ₂ O; s Et OH, bz; msc et h; vs ace, chl
10630	Tri nitromet hane		C ₃ H ₃ N ₃ O	517-25-9	151.035		15	exp	1.479 ²⁰	1.4451 ²⁴	vs ace, Et OH
10631	2,4,6-Tri nitrophenol	Picric acid	C ₆ H ₃ N ₃ O ₇	88-89-1	229.104	ye lf (w), pr (et h) pl (al)	122.5	exp 300		1.763	sl H ₂ O; s Et OH, et h, bz, chl; vs ace
10632	2,4,6-Tri nitrophenol, sodi um salt	Sodi um picrate	C ₆ H ₂ N ₃ NaO ₇	3324-58-1	251.086	nd (w)	270.4				
10633	2,4,6-Tri nitrool uene	2-Met hyl-1,3,5-tri nitrobenzene	C ₇ H ₅ N ₃ O ₆	118-96-7	227.131	ort h (al)	80.5	exp 240	1.65 ⁴		i H ₂ O; sl Et OH; s et h; vs ace, bz
10634	2,4,6-Tri nitro- <i>m</i> -(2,4,6-tri nitrophenyl)di pi crylami ne ani li ne		C ₁₂ H ₉ N ₉ O ₁₂	131-73-7	439.208	pa ye pr(HOAc)	244 dec				i H ₂ O, Et OH, bz, ct c; sl et h, ace; vs py
10635	Tri oct yl al umi num		C ₂₄ H ₅₁ Al	1070-00-4	366.644	hyg vi sc li q	-62			0.701	
10636	Tri oct yl ami ne	<i>N,N</i> -Di oct yl-1-oct anami ne	C ₂₄ H ₅₁ N	1116-76-3	353.669	li q	-34.6	366		0.811 ¹⁰	1.4510 ¹⁹
10637	Tri oct yl phosphi ne oxi de	TOPO	C ₂₄ H ₄₉ OP	78-50-2	386.635		52	201 ²			
10638	1,3,5-Tri oxane	Formaldehyde, tri mer	C ₃ H ₆ O ₃	110-88-3	90.078	ort h nd (et h)	60.29	114.5	1.1 ¹⁷		vs H ₂ O; s Et OH, et h, bz, C ₂ S ₂ i pet h
10639	1,3,5-Tri oxane-2,4,6-tri mi ne	Cyameli de	C ₃ H ₂ N ₃ O ₃	462-02-2	129.074	amor pow	dec	dec	1.127 ¹⁵		vs et h, Et OH
10640	4,7,10-Tri oxat ri decane-1,13-di ami ne	Di et hyl eneglycol di ami nopropyl ether	C ₁₀ H ₁₈ N ₂ O ₃	4246-51-9	220.309	li q		147	1.005	1.4640 ²⁰	
10641	3,7,12-Tri oxochol an-24-oi c aci d	Dehydrochol i c aci d	C ₂₆ H ₃₄ O ₅	81-23-2	402.524		237				i H ₂ O, et h; sl Et OH, bz; s ace, AcOEt
10642	Tri pent yl ami ne	<i>N,N</i> -Di pent yl-1-pent anami ne	C ₁₅ H ₃₃ N	621-77-2	227.430			242.5	0.7907 ²⁰	1.4366 ²⁰	i H ₂ O; s Et OH, et h, aci d
10643	Tri phenyl ami ne	<i>N,N</i> -Di phenyl benzenami ne	C ₁₈ H ₁₅ N	603-34-9	245.319	mcl (MeOH, bz)	126.5	365	0.774 ⁰	1.353 ¹⁶	i H ₂ O; sl Et OH; s et h, bz, MeOH
10644	Tri phenyl arsi ne		C ₁₈ H ₁₅ As	603-32-7	306.234		61	360	1.2634 ¹⁵	1.6888 ²¹	i H ₂ O; sl Et OH; vs et h, bz; s chl
10645	Tri phenyl arsi ne oxi de		C ₁₈ H ₁₅ AsO	1153-05-5	322.233		192	324.0			
10646	Tri phenyl bi smut hi ne		C ₁₈ H ₁₅ Bi	603-33-8	440.292		77.6	242 ¹	1.715 ⁷⁵	1.7040 ⁷⁵	sl Et OH, chl; s et h, ace, bz, C ₂ S ₂
10647	Tri phenyl borane		C ₆ H ₆ B	960-71-4	242.123	wh cry	142				i H ₂ O; sl et h; s bz, li g
10648	Tri phenyl ene	Benzo[1]phenant hrene	C ₁₂ H ₁₂	217-59-4	228.288	nd (al, chl, bz)	197.8	425			i H ₂ O; s Et OH, HOAc; vs bz, chl
10649	1,1,2-Tri phenyl et hane		C ₁₈ H ₁₈	1520-42-9	258.357	mcl lf (di l al), 57 nd (al)					i H ₂ O; vs Et OH, et h, bz; sl MeOH
10650	1,1,2-Tri phenyl et hene		C ₁₈ H ₁₆	58-72-0	256.341	lf (al)	72.5	220	1.0373 ⁷⁵	1.6292 ⁷⁵	i H ₂ O; s Et OH, chl, MeOH; vs et h
10651	<i>N,N',N''</i> -Tri phenyl guani di ne		C ₁₈ H ₁₇ N ₃	101-01-9	287.358	nd or pr (al)	146.5	dec	1.163 ³⁰		sl H ₂ O; s Et OH
10652	2,4,5-Tri phenyl - <i>m</i> -i mi dazol e		C ₂₁ H ₁₆ N ₂	484-47-9	296.365	nd (al)	275	sub			i H ₂ O; s Et OH, et h
10653	Tri phenyl met hane		C ₁₈ H ₁₈	519-73-3	244.330	ort h (al)	93.4	359; 200 ⁰	1.014 ⁹⁹	1.5839 ⁹⁹	i H ₂ O; sl Et OH; vs et h, py, chl; s bz
10654	Tri phenyl met hanol		C ₁₈ H ₁₈ O	76-84-6	260.329	pl (al), t rg (bz)	164.2	380	1.199		i H ₂ O, pet h; vs Et OH, et h; s ace, bz
10655	Tri phenyl phosphat e		C ₁₈ H ₁₅ O ₄ P	115-86-6	326.283	cry (li g), pr (al) nd (et h)	50.5	245 ¹¹	1.2055 ⁵⁰		i H ₂ O; s Et OH; vs et h, bz, ct c, chl
10656	Tri phenyl phosphi ne		C ₁₈ H ₁₅ P	603-35-0	262.286		80	188 ¹	1.0749 ⁹⁰	1.6358 ⁹⁰	i H ₂ O; s Et OH, bz, chl; vs et h
10657	Tri phenyl phosphi ne oxi de		C ₁₈ H ₁₅ OP	791-28-6	278.285	pr	156.5	>360	1.2124 ²³		sl H ₂ O, et h, chl; vs Et OH, bz
10658	Tri phenyl phosphi t e		C ₁₈ H ₁₅ O ₃ P	101-02-0	310.284		25	360	1.1842 ²⁰	1.5900 ²⁰	i H ₂ O; vs Et OH
10659	Tri phenyl si l ane		C ₁₈ H ₁₅ Si	789-25-3	260.406						s ct c, C ₂ S ₂
10660	Tri phenyl si l anol		C ₁₈ H ₁₅ OSi	791-31-1	276.405		154.8		1.177 ⁷⁰		s ct c, C ₂ S ₂
10661	Tri phenyl st i bi ne		C ₁₈ H ₁₅ Sb	603-36-1	353.072	pr (pet h)	53.5	>360	1.4343 ⁵	1.6948 ⁴²	i H ₂ O; s Et OH; vs et h, ace, bz, chl
10662	Tri phenyl t et razol i um chl ori de		C ₁₈ H ₁₅ ClN ₄	298-96-4	334.802	nd (al, chl)	243 dec				s H ₂ O, Et OH, ace, chl; i et h
10663	Tri phenyl t i n hydroxi de	St annane, hydroxyt ri phenyl-	C ₁₈ H ₁₅ TiSn	76-87-9	367.029		119		1.54 ²⁰		
10664	2,4,6-Tri phenyl-1,3,5-tri azi ne		C ₂₁ H ₁₅ N ₃	493-77-6	309.364		257				



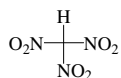
2,4,7-Tri ni t r o f l u o r e n e - 9 - o n e



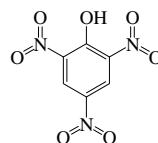
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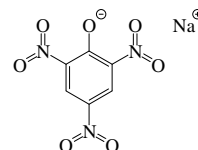
Tri ni t r o g l y c e r o l



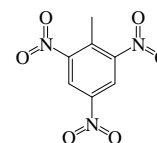
Tri ni t r o m e t h a n e



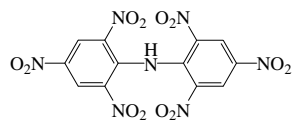
2,4,6-Tri ni t r o p h e n o l



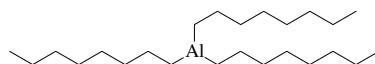
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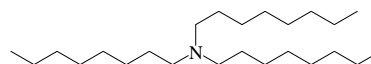
2,4,6-Tri ni t r o t o l u e n e



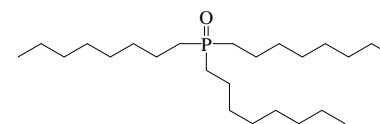
2,4,6-Tri ni t r o - (2,4,6 - t r i n i t r o p h e n y l) a m i n e



Tri o c t y l a l u m i n u m



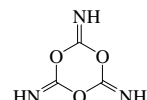
Tri o c t y l a m i n e



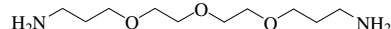
Tri o c t y l p h o s p h i n e o x i d e



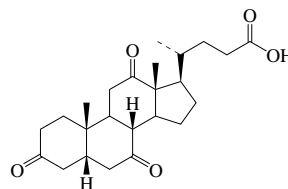
1,3,5-Tri o x a n e



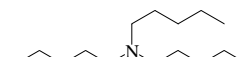
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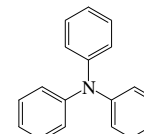
4,7,10-Tri o x a t r i d e c a n e - 1,13 - d i a m i n e



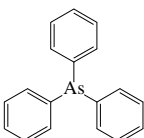
3,7,12-Tri o x o c h o l a n - 24 - o i c a c i d (5 β)



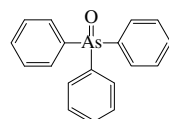
Tri e t h y l a m i n e



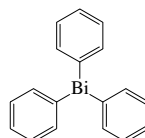
Tri p h e n y l a m i n e



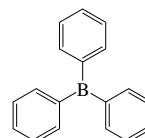
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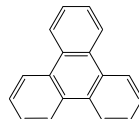
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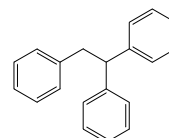
Tri p h e n y l b i s m u t h i n e



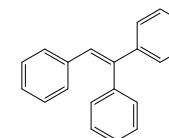
Tri p h e n y l b o r a n e



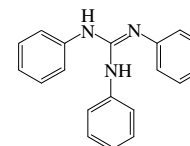
Tri p h e n y l e n e



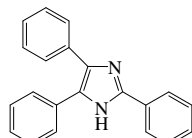
1,1,2-Tri p h e n y l e t h a n e



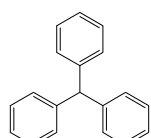
1,1,2-Tri p h e n y l e t h e n e



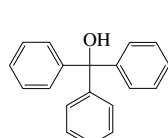
N,N',N''-Tri p h e n y l g u a n i d i n e



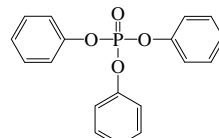
2,4,5-Tri p h e n y l - 1 H - i m i d a z o l e



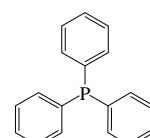
Tri p h e n y l m e t h a n e



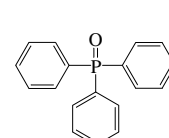
Tri p h e n y l m e t h a n o l



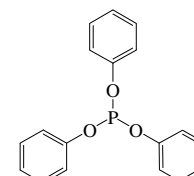
Tri p h e n y l p h o s p h a t e



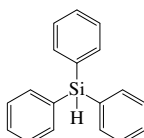
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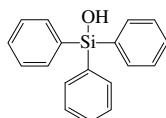
Tri p h e n y l p h o s p h i n e o x i d e



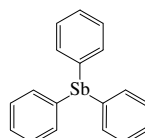
Tri p h e n y l p h o s p h i t e



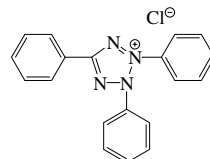
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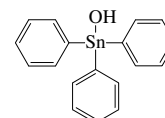
Tri p h e n y l s i l a n o l



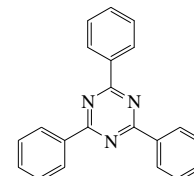
Tri p h e n y l s t i b i n e



Tri p h e n y l t e t r a z o l o n e

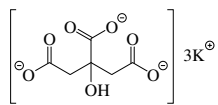


Tri p h e n y l t i n h y d r o x i d e

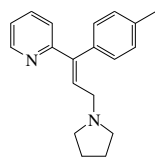


2,4,6-Tri p h e n y l - 1,3,5 - t r i a z i n e

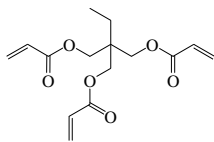
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10665	Tri pot assi um ci t rat e	Pot assi um ci t rat e	K_2CO_3	866-84-2	306.395	wh cry (w)	275 dec				vs H ₂ O; i Et OH
10666	Tri proli di ne		B_2N_2	486-12-4	278.391	cry (pet h)	60				
10667	Tri -2-propenoyl -2-et hyl -2-(hydroxymet hyl)-1,3-propanedi ol	Tri met hyl ol propane t ri acryl at e	$\text{C}_9\text{H}_{16}\text{O}_6$	15625-89-5	296.316			>200 ¹		1.4735 ²⁰	
10668	Tri propyl ami ne	<i>N,N</i> -Di propyl -1-propanami ne	$\text{C}_9\text{H}_{21}\text{N}$	102-69-2	143.270	li q	-93.5	156	0.755 ⁸	1.4181 ²⁰	vs et h, Et OH
10669	Tri propyl borane		$\text{C}_9\text{H}_{21}\text{B}$	1116-61-6	140.074	li q	-56	159	0.720 ⁴	1.4135 ²²	
10670	Tri propyl borat e	Bori c aci d, t ri propyl est er	$\text{C}_9\text{H}_{21}\text{BO}_3$	688-71-1	188.072			179.5	0.8576 ²⁰	1.3948 ²⁰	vs Et OH; msc et h; s PrOH
10671	Tri propyl ene glycol	[(1-Met hyl -1,2-et hanedi yl)bi s(oxo)]bi spropanol	$\text{C}_9\text{H}_{20}\text{O}_4$	24800-44-0	192.253	li q		268; 115	1.02 ²⁰	1.4440 ²⁰	
10672	Tri propyl ene glycol di acryl at e		$\text{C}_{15}\text{H}_{24}\text{O}_6$	42978-66-5	300.348			>120 ¹			
10673	Tri propyl ene glycol monomet hyl et her	1-[2-(2-Met hoxyl -1-met hyl et hoxyl)met hyl et hoxyl]-2-propanol	$\text{C}_{11}\text{H}_{22}\text{O}_4$	20324-33-8	206.280			241.3			
10674	Tri propyl phosphat e		$\text{C}_9\text{H}_{21}\text{O}_4\text{P}$	513-08-6	224.234			252	1.0121 ²⁰	1.4165 ²⁰	sl H ₂ O, chl; s Et OH, et h, t ol, CS
10675	Tri propyl phosphi t e	Tri propoxyphosphi ne	$\text{C}_9\text{H}_{21}\text{O}_3\text{P}$	923-99-9	208.235			206.5	0.9417 ²⁰	1.4282 ²⁰	vs et h, Et OH
10676	Tri propyl silane		$\text{C}_9\text{H}_{21}\text{Si}$	998-29-8	158.357			172	0.772 ³	1.4280 ²⁰	i H ₂ O
10677	Tri s(4-ami nophenyl)met hanol	C.I. Basi c Red 9	$\text{C}_{21}\text{H}_{23}\text{N}_3\text{O}$	467-62-9	305.373	purp cry	205				
10678	2,4,6-Tri s(1-azi ri di nyl)-1,3,5-t ri azi ne	Tri et hyl enemel ami ne	$\text{C}_9\text{H}_{12}\text{N}_6$	51-18-3	204.231	cry pow	139 dec				s H ₂ O
10679	Tri s(2-but oxyet hyl) phosphat e		$\text{C}_{18}\text{H}_{39}\text{O}_4\text{P}$	78-51-3	398.473	li q		25 ⁹	1.02 ²⁵		i H ₂ O
10680	Tri s(2-chl oroet hyl) phosphat e		$\text{C}_6\text{H}_2\text{Cl}_3\text{O}_4\text{P}$	115-96-8	285.489			330; 194 ¹⁰	1.39 ²⁵	1.4721 ²⁰	s ct c
10681	Tri s(2-chl oroet hyl) phosphi t e		$\text{C}_6\text{H}_2\text{Cl}_3\text{O}_3\text{P}$	140-08-9	269.490			120 ³	1.3443 ²⁶	1.4868 ²⁰	
10682	Tri s(1,3-di chl oro-2-propyl) phosphat e	Fyrol FR-2	$\text{C}_9\text{H}_{15}\text{Cl}_6\text{O}_4\text{P}$	13674-87-8	430.904	vi sc li q		236		1.5022 ²⁰	i H ₂ O
10683	Tri s(4-di met hyl ami nophenyl)met hane	Paral eucani li ne	$\text{C}_{26}\text{H}_{31}\text{N}_4$	603-48-5	373.534	lf (al), nd (bz)	176.5				vs bz, et h, chl
10684	Tri s(2,4-di met hyl phenyl) phosphat e	2,4-Xyl enol, phosphat e (3:1)	$\text{C}_{24}\text{H}_{27}\text{O}_4\text{P}$	3862-12-2	410.442			233.5	1.142 ³⁸	1.5550 ²⁰	i H ₂ O; s bz, chl, hx
10685	Tri s(2,5-di met hyl phenyl) phosphat e	2,5-Xyl enol, phosphat e (3:1)	$\text{C}_{24}\text{H}_{27}\text{O}_4\text{P}$	19074-59-0	410.442		79.8	262 ⁸	1.197 ²⁵		i H ₂ O; sl Et OH, hx; s et h, bz, ct c
10686	Tri s(2,6-di met hyl phenyl) phosphat e	2,6-Xyl enol, phosphat e (3:1)	$\text{C}_{24}\text{H}_{27}\text{O}_4\text{P}$	121-06-2	410.442	wax	137.8	263 ⁸			i H ₂ O; sl Et OH, hx; s bz
10687	Tri s(3,5-di met hyl phenyl) phosphat e		$\text{C}_{24}\text{H}_{27}\text{O}_4\text{P}$	25653-16-1	410.442		46.2	290 ¹⁰			i H ₂ O; sl Et OH, chl, hx; s HOAc
10688	Tri s(2-et hyl hexyl) phosphat e		$\text{C}_{24}\text{H}_{51}\text{O}_4\text{P}$	78-42-2	434.633	li q		215	0.99 ²⁰		
10689	Tri s(et hyl t hi o)met hane	Tri et hyl ort hot hi of ormat e	$\text{C}_7\text{H}_{16}\text{S}_3$	6267-24-9	196.397			dec 235; 127 ¹²	1.053 ²⁰	1.5410 ¹⁵	vs et h, Et OH
10690	1,3,5-Tri s(2-hydroxyet hyl) i socyanuri c aci d		$\text{C}_9\text{H}_{15}\text{N}_3\text{O}_6$	839-90-7	261.231	cry	136				
10691	1,1,1-Tri s(hydroxymet hyl)et hane t ri ni t rat e	2-Met hyl -2-[(ni t rooxy)met hyl]-1,3-propanedi ol, di ni t rat e	$\text{C}_2\text{H}_3\text{N}_3\text{O}_9$	3032-55-1	255.140			83 ⁰ 05			
10692	<i>N,N',N''</i> -Tri s(hydroxymet hyl)mel ami ne	Tri met hyl ol mel ami ne	$\text{C}_6\text{H}_{12}\text{N}_6\text{O}_3$	1017-56-7	216.197	cry	148				
10693	Tri s(hydroxymet hyl)met hyl ami ne	2-Ami no-2-(hydroxymet hyl)-1,3-propanedi ol	$\text{C}_4\text{H}_{11}\text{NO}_3$	77-86-1	121.135			171.5	219 ¹⁰		vs H ₂ O; s MeOH
10694	Tri s(met hoxet hoxyl)vi nyl si lane		$\text{C}_{11}\text{H}_{20}\text{O}_6\text{Si}$	1067-53-4	280.391						s ct c
10695	Tri s(4-met hoxylphenyl)chl oroet hene	Chl orot ri ani sene	$\text{C}_{23}\text{H}_{21}\text{ClO}_3$	569-57-3	380.864			115			
10696	Tri s(2-met hyl phenyl)phosphi ne		$\text{C}_{21}\text{H}_{21}\text{P}$	6163-58-2	304.366			127.0			
10697	Tri s(3-met hyl phenyl)phosphi ne		$\text{C}_{21}\text{H}_{21}\text{P}$	6224-63-1	304.366			101.0			
10698	Tri s(4-met hyl phenyl)phosphi ne		$\text{C}_{21}\text{H}_{21}\text{P}$	1038-95-5	304.366			147.0			
10699	Tri s(2-met hyl -2-propenoyl)-2-et hyl -1,1,1-Tri met hyl ol propane 2-hydroxymet hyl -1,3-propanedi ol	t ri met hyl acryl at e	$\text{C}_{18}\text{H}_{26}\text{O}_6$	3290-92-4	338.395			>200 ¹		1.470 ²⁵	
10700	Tri sodi um ci t rat e	Sodi um ci t rat e	$\text{C}_6\text{H}_5\text{NaO}_7$	68-04-2	258.069	wh cry (w)	300				vs H ₂ O; i Et OH
10701	Tri sodi um-2-hydroxyet hyl et hyl enedi ami net ri aci t a t e	Versen-OI	$\text{C}_{10}\text{H}_{15}\text{N}_2\text{Na}_3\text{O}_7$	139-89-9	344.204			288 (hyd)			



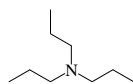
Tri pot assi umi t r a t e



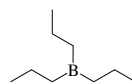
Tri proli di ne



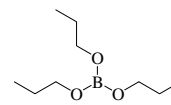
Tri -2-propenoyl -2-et hyl -2-(hydroxymet hyl)-1,3-propanedi ol



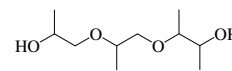
Tri propyl ami ne



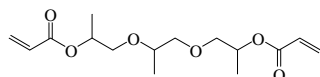
Tri propyl borane



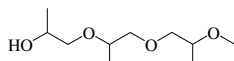
Tri propyl borat e



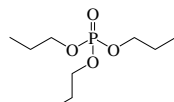
Tri propyl enyl ycol



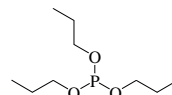
Tri propyl enyl ycol di acrylat e



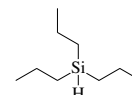
Tri propyl enyl ycol monomet hylet her



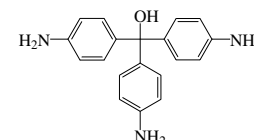
Tri propyl phosphat e



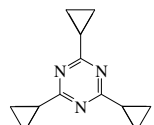
Tri propyl phosphi t e



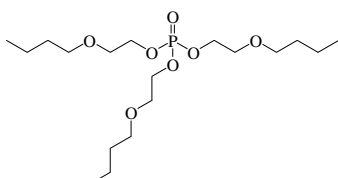
Tri propyl si l a n e



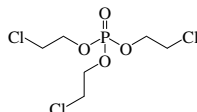
Tri s(4-ami nophenyl)met hanol



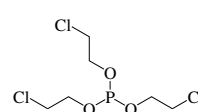
2,4,6-Tri s(1-azi ri di nyl)-1,3,5-t ri azi ne



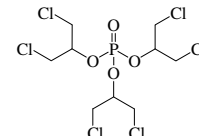
Tri s(2-but oxyet hyl)phospat e



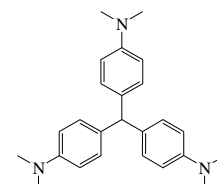
Tri s(2-chl or et hyl)phospat e



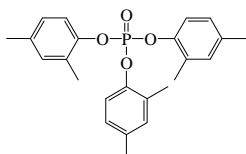
Tri s(2-chl or et hyl)phosphi t e



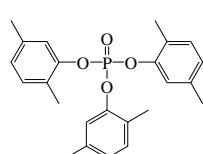
Tri s(1,3-di chl or o-2-propyl)phospat e



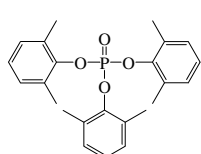
Tri s(4-di met hyl ami nophenyl)met hane



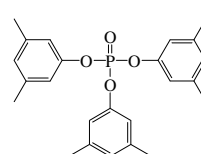
Tri s(2,4-di met hyl phenyl)phospat e



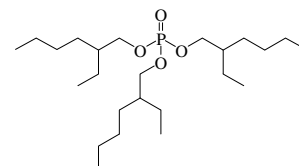
Tri s(2,5-di met hyl phenyl)phospat e



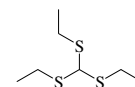
Tri s(2,6-di met hyl phenyl)phospat e



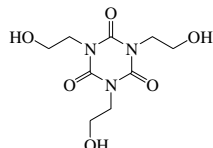
Tri s(3,5-di met hyl phenyl)phospat e



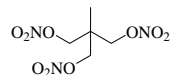
Tri s(2-et hyl hexyl)phospat e



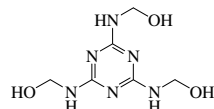
Tri s(et hyl t hi o)met hane



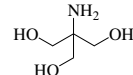
1,3,5-Tri s(2-hydroxet hyl)so cyanuri aci d



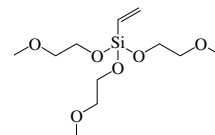
1,1,1-Tri s(hydroxymet hyl)et habei ni t r a t e



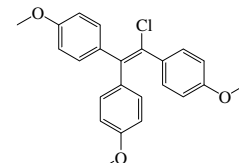
N,N,N'-Tri s(hydroxymet hyl)mel ami ne



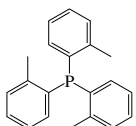
Tri s(hydroxymet hyl)met hyl ami ne



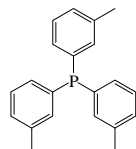
Tri s(met hoxet hoxyl)vi nyl si l a n e



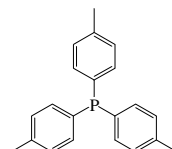
Tri s(4-met hoxylphenyl)chl or et hane



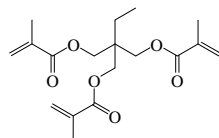
Tri s(2-met hyl phenyl)phosphi ne



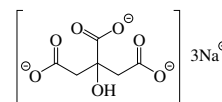
Tri s(3-met hyl phenyl)phosphi ne



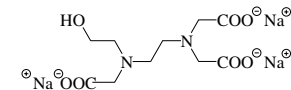
Tri s(4-met hyl phenyl)phosphi ne



Tri s(2-met hyl -2-propenoyl)-2-et hyl -2-hydroxymet hyl -1,3-propanedi ol

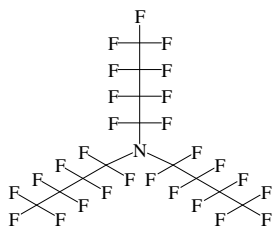


Tri sodi umi t r a t e

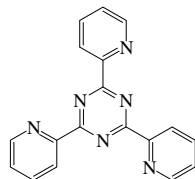


Tri sodi um N-hydroxet hyl et hyl enedi ami net ri acet at e

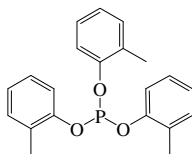
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10702	Tri s(perfluorobutyl)ami ne	Tri nonafluorobutyl ami ne	$C_{12}F_{27}N_3$	311-89-7	671.092			178	1.884 ²⁵	1.291 ²⁵	s ace
10703	2,4,6-Tri s(2-pyri di nyl)-1,3,5-t ri azi ne	2,4,6-Tri pyri di zi ne	$C_{18}H_{12}N_6$	3682-35-7	312.328		210				
10704	Tri s(ol yl) phosphi te		$C_{21}H_{21}O_3P$	2622-08-4	352.364		11	238 ¹¹ , 197 ²	1.1423 ²⁰	1.5740 ²⁸	s et h; sl chl
10705	Tri s(ol yl) phosphi te		$C_{21}H_{21}O_3P$	620-42-8	352.364	pa ye	52	252 ¹⁰	1.1280 ²⁵	1.5703 ²⁸	vs et h
10706	Tri s(tri phenyl phosphi ne) rhodi um carbonyl hydri de	Carbonyl hydrot ri s(tri phenyl phosphi e)rhodi um	$C_{55}H_{46}OP_3Rh$	17185-29-4	918.781	ye cry	121		1.33		sl bz, chl
10707	1,3,5-Tri t hi ane		C_6S_3	291-21-4	138.275	hex (bz), pr (w) nd (al)	220	sub	1.6374 ²⁴		sl H ₂ O, Et OH, et h; s bz
10708	Tri t hi ocarboni c aci d		C_3H	594-08-1	110.222	red oi l	-26.9	57.8	1.476	1.8225 ²⁰	dec H ₂ O, Et OH; vs t ol, chl
10709	Tri t ri acont ane		$C_{33}H_{68}$	630-05-7	464.893		71.2				
10710	Tropacocai ne		$C_{15}H_{19}NO_2$	537-26-8	245.318	pl or t ab	49	dec	1.0426 ⁶⁰	1.5080 ¹⁰⁰	vs bz, et h, Et OH, pet h
10711	Tropi ne	8-Met hyl-8-azabi cycl o[3.2.1]oct an-3-ol, <i>endo</i>	$C_8H_{15}NO$	120-29-6	141.211	hyg pl (et h)	64	233	1.016 ⁶⁰	1.4811 ¹⁰⁰	vs H ₂ O, et h, Et OH
10712	Trypan bl ue		$C_{24}H_{24}N_6Na_4O_{14}S_3$	72-57-1	960.805	dk bl cry	300				s H ₂ O, aci d; i Et OH
10713	Trypt ami ne		$C_8H_{12}N_2$	61-54-1	160.215	nd (al-bz, li g)	118	137 ⁵			i H ₂ O, et h, bz, chl; s Et OH, ace
10714	L-Trypt ophan	α -Amino ndole-3-propi oni c aci d,	$(C_{11}H_{12}N_2O_2)$	73-22-3	204.225	lf or pl (di l al)	289 dec				s D; HOAc; s Et OH; i et h, chl
10715	Tsudurani ne		$C_9H_{19}NO_3$	517-97-5	297.349	nd (et h)	204				vs ace, et h, Et OH
10716	T-2 Toxi n	Mycot oxin T2	$C_{26}H_{34}O_9$	21259-20-1	466.522	nd	151				sl H ₂ O, pet h; s Et OH, chl, DMSO
10717	Tubocurari ne di chl ori de		$C_{37}H_{42}Cl_2N_2O_6$	57-94-3	681.644	hyg cry	275 dec				s MeOH; i py, bz, ace, et h
10718	Tungst en carbonyl	Tungst en hexacarbonyl	W_6O_6	14040-11-0	351.90	wh cry	dec 170	sub	2.65		i H ₂ O; s os
10719	Turanose		$C_{12}H_{22}O_{11}$	547-25-1	342.296	pr (w-al, MeOH)	168				vs H ₂ O; s Et OH, MeOH
10720	Tybamate		$C_3H_{26}N_2O_4$	4268-36-4	274.356	cry	50	151 ⁰⁶			
10721	L-Tyrosi ne	4-Hydroxy L-phenyl alani ne	$C_9H_9NO_3$	60-18-4	181.188	nd (w)	343 dec	sub			sl H ₂ O, HOAc; i Et OH, et h
10722	Tyrosi neami de		$C_{12}H_{12}N_2O_2$	4985-46-0	180.203	pl or pl (al)	153.5				vs Et OH, Et OH
10723	L-Tyrosi ne, et hyl est er		$C_{11}H_{13}NO_3$	949-67-7	209.242	pr (AcOEt)	108.5				vs bz, Et OH, AcOEt
10724	L-Tyrosi ne, met hyl est er, hydrochl ori de		$C_{10}H_{14}ClNO_3$	3417-91-2	231.676		191.0				s H ₂ O
10725	1,10-Undecadi yne		$C_{11}H_{16}$	4117-15-1	148.245		-17	83 ¹²	0.8182 ²¹	1.453 ²¹	vs ace, bz
10726	Undecafluorocycl ohexane		C_6HF_{11}	308-24-7	282.054			62.0			
10727	Undecanal		$C_{11}H_{22}O$	112-44-7	170.292		-2.0	117 ¹⁸	0.8251 ²³	1.4520 ²⁰	i H ₂ O; s Et OH, et h
10728	Undecane	Henecane	$C_{11}H_{24}$	1120-21-4	156.309	li q	-25.5	195.9	0.740 ²	1.4164 ²⁰	i H ₂ O; msc Et OH, et h
10729	Undecanenit ri le	Decyl cyani de	$C_{11}H_{21}N$	2244-07-7	167.292			253	0.8254 ³⁰	1.4293 ³⁰	i H ₂ O; s Et OH, et h, ct c
10730	1-Undecanet hi ol	Undecyl mercapt an	$C_{11}H_{23}S$	5332-52-5	188.374	li q	-1.5	257.4	0.844 ⁸	1.4585 ²⁰	
10731	Undecanoi c aci d		$C_{11}H_{22}O_2$	112-37-8	186.292	cry (ace)	28.6	280	0.8907 ²⁰	1.4294 ⁴⁵	i H ₂ O; vs Et OH, ace; s et h; msc bz
10732	1-Undecanol	Undecyl al colol	$C_{11}H_{24}O$	112-42-5	172.308		15.9	245	0.8298 ²⁰	1.4392 ²⁰	i H ₂ O; s Et OH; vs et h
10733	2-Undecanol	sec-Undecyl al colol	$C_{11}H_{24}O$	1653-30-1	172.308	col li q	0	229.7	0.8234	1.4352 ²⁵	
10734	2-Undecanone	Met hyl nonyl ket one	$C_{11}H_{22}O$	112-12-9	170.292		15	231.5	0.8250 ²⁰	1.4291 ²⁰	i H ₂ O; s Et OH, et h, ace, bz, chl
10735	6-Undecanone	But yl hexyl ket one	$C_{11}H_{22}O$	927-49-1	170.292		14.5	228	0.8308 ²⁰	1.4270 ²⁰	i H ₂ O; vs Et OH, et h
10736	Undecanoyl chl ori de		$C_{11}H_{21}ClO$	17746-05-3	204.737						sl ct c
10737	10-Undecenal		$C_{11}H_{20}O$	112-45-8	168.276						sl ct c
10738	1-Undecene		$C_{11}H_{22}$	821-95-4	154.293	li q	-49.2	192.7	0.750 ⁸	1.4261 ²⁰	i H ₂ O; s et h, chl, li g
10739	<i>ci s</i> -2-Undecene		$C_{11}H_{22}$	821-96-5	154.293	li q	-66.5	196.1	0.757 ⁸		
10740	<i>t rans</i> -2-Undecene		$C_{11}H_{22}$	693-61-8	154.293	li q	-48.3	192.5	0.752 ⁸	1.4292 ²⁰	
10741	<i>ci s</i> -4-Undecene		$C_{11}H_{22}$	821-98-7	154.293	li q	-97	192.6	0.754 ⁴	1.4302 ²⁰	
10742	<i>t rans</i> -4-Undecene		$C_{11}H_{22}$	693-62-9	154.293	li q	-63.7	193	0.750 ⁸	1.4285 ²⁰	



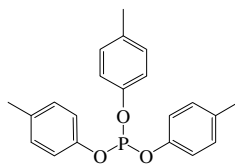
Tri s(perf luorobut yl)ami ne



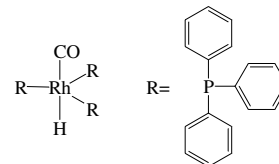
2,4,6-Tri s(2-pyri di nyl)-1,3,5-t ri azi ne



Tri *o*-tol yl)phosphi te



Tri *p*-tol yl)phosphi te



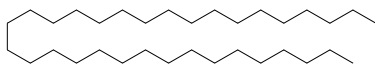
Tri s(tri phenylphosphi te)di carbonyl hydi de



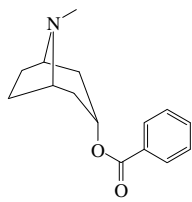
1,3,5-Tri t hi a



Tri t hi ocarbonyl



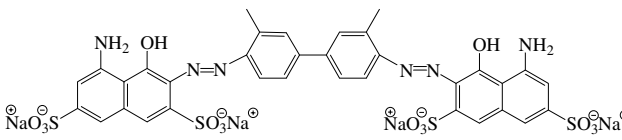
Tri t ri acont ane



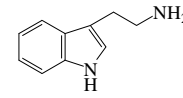
Tropacocai ne



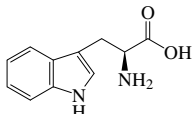
Tropi ne



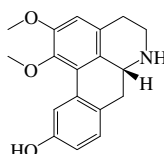
Trypan bl ue



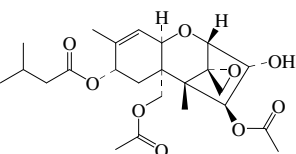
Trypt ami ne



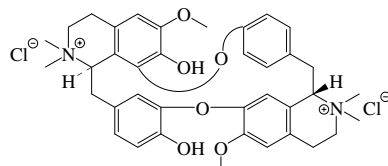
L-Trypt ophan



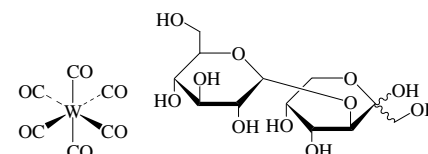
Tsudurani ne



T-2 Toxi n

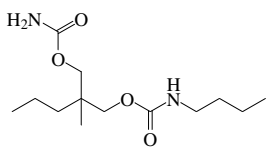


Tubocurari nedi chl ori de

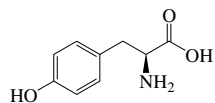


Tungst encarbonyl

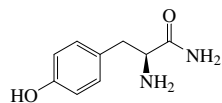
Turanose



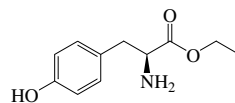
Tybamat e



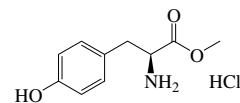
L-Tyrosi ne



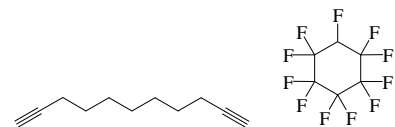
Tyrosi neami de



L-Tyrosi neet hylest er

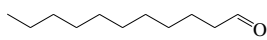


L-Tyrosi ne,met hylest er,hydrochl ori de

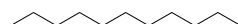


1,10-Undecadi ene

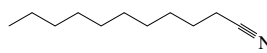
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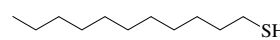
Undecanal



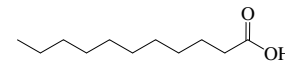
Undecane



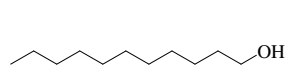
Undecanenit ri le



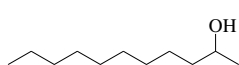
1-Undecanet hi ol



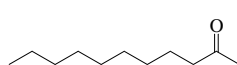
Undecanoi caci d



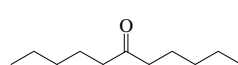
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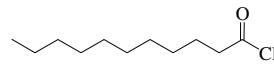
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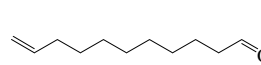
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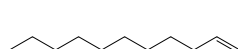
6-Undecanone



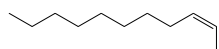
Undecanoyl chl ori de



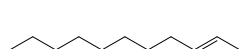
10-Undecenal



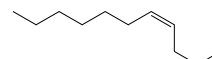
1-Undecene



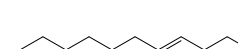
ci s-2-Undecene



t rans-2-Undecene



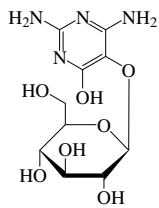
ci s-4-Undecene



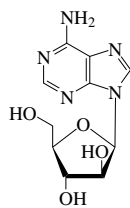
t rans-4-Undecene

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10743	<i>ci s</i> -Undecene		C ₁₁ H ₂₂	764-96-5	154.293	li q	-106.5	192.3	0.7537 ⁷	1.4302 ²⁰	
10744	<i>trans</i> -5-Undecene		C ₁₁ H ₂₂	764-97-6	154.293	li q	-61.1	192	0.7497 ⁷	1.4285 ²⁰	vs et h, chl, li g
10745	10-Undecenoic acid	Undecylenic acid	C ₁₁ H ₂₀ O ₂	112-38-9	184.276	cry	24.5	275	0.9072 ²⁴	1.4486 ²⁴	i H ₂ O; s Et OH, et h; sl ct c
10746	10-Undecen-1-ol		C ₁₁ H ₂₂ O	112-43-6	170.292	li q	-1.0	250	0.8495 ⁵	1.4500 ²⁰	i H ₂ O; s Et OH, et h; sl ct c
10747	10-Undecenyl chloride		C ₁₁ H ₁₉ Cl	38460-95-6	202.721			127 ³	0.944 ²⁰	1.454 ²⁰	
10748	Undecylamine	1-Undecanamine	C ₁₁ H ₂₃ N	7307-55-3	171.324	cry (et h, al)	17	242	0.797 ⁹	1.4398 ²⁰	s H ₂ O, Et OH; i et h; sl ct c
10749	Undecylbenzene		C ₁₇ H ₂₈	6742-54-7	232.404	li q	-5	316	0.855 ³	1.4828 ²⁰	
10750	1-Undecyne		C ₁₁ H ₂₀	2243-98-3	152.277	li q	-25	196	0.772 ⁸	1.4306 ²⁰	vs ace, bz, et h, Et OH
10751	2-Undecyne		C ₁₁ H ₂₀	60212-29-5	152.277	li q	-30.1	204.2	0.782 ⁷	1.4391 ²⁰	
10752	Uracil		C ₄ H ₄ N ₂ O ₂	66-22-8	112.087	nd (w)	338				sl H ₂ O; vs Et OH, et h; s di l H ₂ O
10753	Uracil mustard		C ₄ H ₂ Cl ₂ N ₂ O ₂	66-75-1	252.098		206 dec				sl H ₂ O
10754	Uranyl acetate dihydrate		C ₄ H ₆ O ₉ U	6159-44-0	424.146	ye cry (HOAc)	80 dec		2.89		sl Et OH
10755	Urazole		C ₈ H ₈ N ₂ O ₂	3232-84-6	101.064	lf (w)	249 dec				
10756	Urea	Carbamide	CH ₄ N ₂ O	57-13-6	60.055	t et r pr (al)	133.3	dec	1.323 ⁰	1.484	vs H ₂ O, Et OH; i et h, bz; s HOAc, py
10757	Urea hydrochloride		CH ₅ ClN ₂ O	506-89-8	96.516		145 dec				s H ₂ O
10758	Ureanitrile		CN ₂ O ₄	124-47-0	123.069	mcl lf (w)	152 dec		1.69 ⁰		vs Et OH
10759	Uric acid		C ₅ H ₄ N ₄ O ₃	69-93-2	168.111	ort h pr or pl	dec	dec	1.8 ⁸		i H ₂ O, Et OH, et h; s al k, glycerol; sl aci d
10760	Uridine	β-D-Ri bof uranosyl uracil	C ₉ H ₁₂ N ₂ O ₆	58-96-8	244.200	nd (aq al)	165				s H ₂ O, Et OH, py
10761	5-Uridylidene acid	Uridine 5'-phosphoric acid	C ₉ H ₁₃ N ₂ O ₉ P	58-97-9	324.180	pr (MeOH)	202 dec				vs H ₂ O; s MeOH
10762	Urocanic acid	Imidazole-4-acrylidene acid	C ₈ H ₈ N ₂ O ₂	104-98-3	138.124		227				s H ₂ O, ace; i Et OH, et h
10763	Urs-12-en-3-ol, (3β)	α-Amyrin	C ₃₀ H ₅₀ O	638-95-9	426.717	nd (al)	186	243 ⁵			s Et OH, et h, bz, chl, HOAc; sl pet h
10764	Ursolic acid		C ₃₀ H ₄₈ O ₃	77-52-1	456.700	pl (al)	284				vs ace, et h, chl
10765	Uzarin		C ₂₆ H ₅₄ O ₁₄	20231-81-6	698.796	pr	269				
10766	Vaccininin	D-Glucose, 6-benzoate	C ₂₆ H ₃₆ O ₇	14200-76-1	284.262	amorp (aq ace, +1w)	122				vs H ₂ O, ace, Et OH, et h
10767	Valiamycin A		C ₂₆ H ₃₅ NO ₁₃	37248-47-8	497.491	amorp pow	95 dec				
10768	L-Valine	2-Aminoisovaleric acid	C ₆ H ₁₁ NO ₂	72-18-4	117.147	lf (w-al)	315	sub	1.23		s H ₂ O
10769	Valinomycin		C ₅₇ H ₉₀ N ₆ O ₁₈	2001-95-8	1111.322	cry	187				
10770	Valium		C ₁₆ H ₁₃ ClN ₂ O	439-14-5	284.739		132				
10771	Vamidotinon		C ₁₀ H ₁₈ NO ₄ PS ₂	2275-23-2	287.337	oi l					i pet h; s os
10772	Vanadium carbonyl	Vanadium hexacarbonyl	C ₆ V	14024-00-1	219.002	bl-grn cry	dec 60	sub			
10773	Vanadium(III) 2,4-pentanedioate	Vanadium(III) acetylacetonate	C ₁₅ H ₂₁ O ₆ V	13476-99-8	348.266	brn cry	=185	sub	=1.0		s MeOH, ace, bz, chl
10774	DL-Vasidene	DL-Peganine	C ₇ H ₁₂ N ₂ O	6159-56-4	188.225	nd (al)	210.8				sl H ₂ O, et h, bz; s Et OH, ace, chl
10775	L-Vasidene	L-Peganine	C ₇ H ₁₂ N ₂ O	6159-55-3	188.225	nd (al)	211.5				sl H ₂ O, et h, bz; s Et OH, ace, chl
10776	Verapamil		C ₂₇ H ₃₈ N ₂ O ₄	52-53-9	454.602	ye oi l		245 ⁹¹		1.5448 ²⁵	i H ₂ O; vs Et OH, ace; sl bz, hx
10777	Veratramine		C ₁₇ H ₃₃ NO ₂	60-70-8	409.605	nd	206				s Et OH, bz, chl, di l aci d; i di l al k
10778	Veratramine, 3-glucoside		C ₃₃ H ₄₉ NO ₇	475-00-3	571.745	nd (aq, MeOH)	242 dec				
10779	Veratriene		C ₁₅ H ₂₁ NO ₁₁	71-62-5	673.790	ye amorp pow	180				i H ₂ O; sl et h
10780	α-Verbenone		C ₁₀ H ₁₄ O	18309-32-5	150.217		9.8	227.5	0.9978 ²⁰	1.4993 ¹⁸	s H ₂ O, Et OH, ace, bz
10781	Vernolate	Carbamate of isocaproic acid, diisopropyl-, propyl ester	C ₁₀ H ₂₁ NOS	1929-77-7	203.345			150 ³⁰	0.952 ²⁰		
10782	Versalide		C ₆ H ₂₆ O	88-29-9	258.398	cry	46.5	130 ²			s Et OH
10783	α-Vetivone	Isonootkatone	C ₁₅ H ₂₂ O	15764-04-2	218.335	cry (pet h)	51.5	144	1.0035 ²⁰	1.5370 ²⁰	vs ace
10784	β-Vetivone		C ₁₅ H ₂₂ O	18444-79-6	218.335	cry (pet h)	44.5	144	1.0001 ²⁰	1.5309 ²⁰	s ace

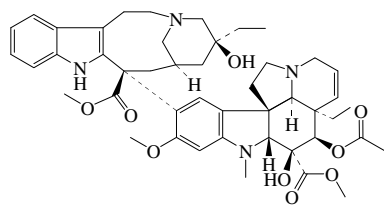
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10785	Vi ci ne	2,6-Di amino-β-D-glucopyranosyl-4(1H)-pyrimidinone	C ₁₀ H ₁₆ N ₄ O ₇	152-93-2	304.257	nd (w, dilal, +1 w)	240 dec				sl H ₂ O; vs aci d, alk
10786	Vi darabi ne	β-D-9-Arabinofuranosyladenine	C ₁₅ H ₁₅ N ₅ O ₅	5536-17-4	285.257	nd (w)	257				
10787	Vi nblasti ne		C ₃₈ H ₅₈ N ₄ O ₉	865-21-4	810.975	nd (MeOH)	216				i H ₂ O; s Et OH, ace, chl, AcOEt
10788	Vi ncami ne		C ₁₂ H ₂₀ N ₂ O ₃	1617-90-9	354.442		231.5				
10789	Vi nclazol i n		C ₉ H ₉ Cl ₂ NO ₃	50471-44-8	286.110		108	131 ⁰⁰⁵	1.51		
10790	Vi ncri sti ne		C ₁₆ H ₂₆ N ₄ O ₁₀	57-22-7	824.958		219				
10791	Vi nyl acetate		C ₄ H ₆ O ₂	108-05-4	86.090	li q	-93.2	72.8	0.9256	1.3926 ²⁵	sl H ₂ O; msc Et OH; s et h, ace, bz, chl
10792	4-Vi nyl ani li ne		C ₈ H ₁₀ N	1520-21-4	119.164		23.5	116 ⁹	1.010 ²⁰	1.6250 ²²	s ace, bz
10793	α-Vi nyl benzenemetanol	1-Phenylalyl alcohol	C ₉ H ₁₀ O	4393-06-0	134.174				1.0249 ²¹	1.5406 ²⁰	sl H ₂ O; s Et OH, et h, bz, chl
10794	Vi nyl butanoate		C ₈ H ₁₄ O ₂	123-20-6	114.142			116.7; 64 ¹³⁰	0.9006 ²⁰		
10795	Vi nyl rans2-butanoate	Vi nyl crotonate	C ₈ H ₁₂ O ₂	3234-54-6	112.127						s ct c
10796	9-Vi nyl -β-carbazole		C ₁₄ H ₁₁ N	1484-13-5	193.244	cry (al)	66				i H ₂ O; sl Et OH; vs et h
10797	Vi nyl cyclohexane		C ₈ H ₁₄	695-12-5	110.197			128	0.8166 ¹⁹	1.455 ¹⁹	
10798	1-Vi nyl cyclohexene		C ₈ H ₁₂	2622-21-1	108.181			145	0.8623 ¹⁵	1.4915 ²⁰	i H ₂ O; s et h, bz; vs MeOH
10799	4-Vi nyl cyclohexene		C ₈ H ₁₂	100-40-3	108.181	li q	-108.9	128	0.8299	1.4639 ²⁰	i H ₂ O; s et h, bz, pet h
10800	Vi nyl cyclopentane		C ₇ H ₁₂	3742-34-5	96.170	li q	-126.5	97	0.7834	1.4360 ²⁰	
10801	Vi nyl diethylsilyl ether		C ₇ H ₁₆ OSi	5507-44-8	160.287			133	0.8620 ⁹	1.4001 ²⁰	
10802	Vi nyl ethoxysilyl ether		C ₇ H ₁₄ OSi	5356-83-2	130.260			99	0.790 ⁹	1.3983 ²⁰	
10803	1-Vi nyl -4-fluorobenzene		C ₇ H ₇ F	405-99-2	122.140		-34.5	67.4 ³⁰ ; 30 ⁴	1.0220 ²⁰	1.5150 ²⁰	i H ₂ O; s Et OH, et h, bz
10804	Vi nyl formate		C ₃ H ₄ O ₂	692-45-5	72.063	visc li q	-78	46	0.985	1.3842 ²⁰	
10805	2-Vi nyl furan		C ₆ H ₆ O	1487-18-9	94.111	li q	-94	99.5	0.9445	1.4992 ¹⁹	
10806	1-Vi nyl -2-methoxybenzene		C ₈ H ₁₀ O	612-15-7	134.174	nd	29	197; 83 ¹²	1.0040 ¹⁷	1.5388 ²⁰	vs ace, bz, et h, Et OH
10807	1-Vi nyl -3-methoxybenzene		C ₈ H ₁₀ O	626-20-0	134.174			91 ¹⁵ ; 70 ⁵	0.9919 ²⁰	1.5586 ²³	i H ₂ O; s Et OH, et h, bz
10808	1-Vi nyl -4-methoxybenzene		C ₈ H ₁₀ O	637-69-4	134.174		2.0	205; 91 ¹³	1.0001 ¹³	1.5642 ¹³	i H ₂ O; s Et OH, et h, bz; sl ct c
10809	6-Vi nyl -6-methyl-1-isopropyl-3-(1-methyl-1-hydroxycyclohexyl) ether		C ₁₅ H ₂₄	5951-67-7	204.352			125 ⁸	0.8782 ²⁰	1.5130 ²⁶	vs ace, bz
10810	1-Vi nyl naphthalene		C ₁₂ H ₁₀	826-74-4	154.207			124 ¹⁵	1.0656 ²⁰	1.644 ²⁰	
10811	2-Vi nyl naphthalene		C ₁₂ H ₁₀	827-54-3	154.207		66	135 ¹⁸ ; 95 ²			i H ₂ O; s Et OH, ace, bz
10812	1-Vi nyl -3-nitrobenzene		C ₈ H ₇ NO ₂	586-39-0	149.148		-10	120 ¹¹	1.1552 ³²	1.5836 ²⁰	i H ₂ O; s Et OH, et h, bz, chl, li g, HOAc
10813	1-Vi nyl -4-nitrobenzene		C ₈ H ₇ NO ₂	100-13-0	149.148	pr (li g)	29	dec			vs Et OH, et h; s chl, HOAc, li g
10814	2-Vi nyl -5-norbornene	5-Vi nyl bicyclo[2.2.1]hept-2-ene	C ₉ H ₁₂	3048-64-4	120.191	li q	-80	139	0.841	1.481 ⁸	
10815	Vi nyl octadecanoate	Vi nyl stearate	C ₂₀ H ₃₈ O ₂	111-63-7	310.515		29	167 ²	0.8517 ²⁰		sl chl
10816	3-Vi nyl -7-oxabicyclo[4.1.0]heptane		C ₈ H ₁₂ O	106-86-5	124.180		<-100	169; 70 ²⁰	0.9581 ²⁰	1.4700 ²⁰	
10817	Vi nyl oxirane		C ₂ H ₂ O	930-22-3	70.090			68	0.9006 ²⁵	1.4168 ²⁰	s Et OH, et h, bz
10818	2-(Vi nyl oxy)ethanol	Ethylene glycol monovinyl ether	C ₄ H ₈ O ₂	764-48-7	88.106			141.6	0.9821 ²⁰	1.4564 ¹⁷	s H ₂ O, Et OH, et h, bz; i li g
10819	Vi nyl propanoate	Vi nyl propionate	C ₅ H ₁₀ O ₂	105-38-4	100.117			91.2			
10820	2-Vi nyl pyridine		C ₇ H ₇ N	100-69-6	105.138			159.5	0.9983 ²⁰	1.5495 ²⁰	sl H ₂ O; vs Et OH, et h, ace, chl
10821	3-Vi nyl pyridine		C ₇ H ₇ N	1121-55-7	105.138			162	0.9879 ²⁰	1.5530 ²⁰	sl H ₂ O; s Et OH, et h
10822	4-Vi nyl pyridine		C ₇ H ₇ N	100-43-6	105.138	red to dk-br		12 ¹⁹⁰ ; 79 ⁹³	0.9879 ²⁰	1.5449 ²⁰	s H ₂ O, Et OH, chl; sl et h
10823	1-Vi nyl -2-pyrrolidone		C ₅ H ₇ NO	88-12-0	111.141		13.5	193 ⁴⁰⁰ ; 93 ¹¹	1.04 ²⁰		
10824	Vi nyl silane		C ₂ H ₆ Si	7291-09-0	58.155	col gas	-171.6	-22.8			
10825	Vi nyl sulfide		C ₂ H ₄ S	1115-15-7	102.155	li q		8 ⁸			



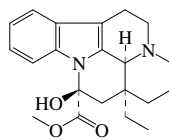
Vi ci ne



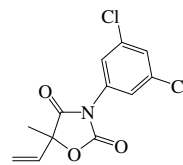
Vi darabi ne



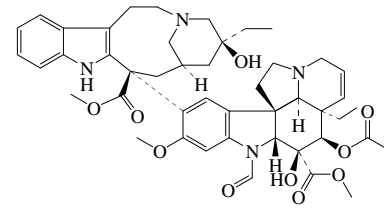
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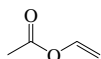
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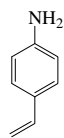
Vi ncl ozol i n



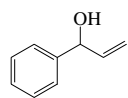
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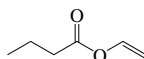
Vi nyacet at e



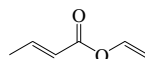
4-Vi nyl ani li i ne



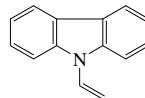
α -Vi nyl benzenemet hanol



Vi nybut anoat e



Vi nyl *trans*-2-but enoat e



9-Vi nyl -9H-carbazol e



Vi nyl cycl ohexane



1-Vi nyl cycl ohexene

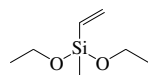


4-Vi nyl cycl ohexene



Vi nyl cycl opent ane

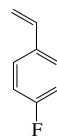
3-569



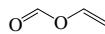
Vi nyl di et hoxymet hyl si l ane



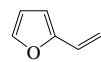
Vi nyl et hoxydi met hyl si l ane



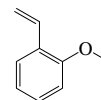
1-Vi nyl -4-f luorobenzene



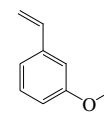
Vi nyl ormat e



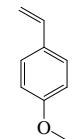
2-Vi nyl f uran



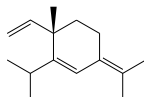
1-Vi nyl -2-met hoxybenzene



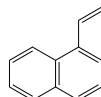
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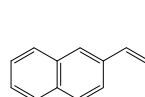
1-Vi nyl -4-met hoxybenzene



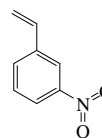
6-Vi nyl -6-met hyl -1-i sopropyl -3-(1-met hyl et hyl i dene)cycl o(6)ene,



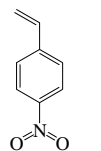
1-Vi nyl naph t al ene



2-Vi nyl naph t al ene



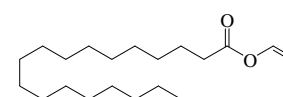
1-Vi nyl -3-ni t robenzene



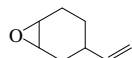
1-Vi nyl -4-ni t robenze



2-Vi nyl -5-norbornene



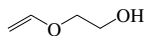
Vi nyct adecanoat e



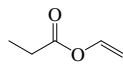
3-Vi nyl -7-oxabi cycl o(4.1.0)hept ane



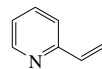
Vi nyl oxi rane



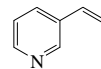
2-(Vi nyl oxy)et hanol



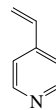
Vi nyproanoat e



2-Vi nyl pyri di ne



3-Vi nyl pyri di ne



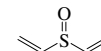
4-Vi nyl pyri di ne



1-Vi nyl -2-pyrrol i di none

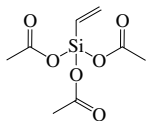


Vi nyl si l ane

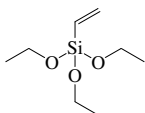


Vi nylsul f oxi de

No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10826	Vi nyl t ri acet oxy si lane	Vi nyl si lanet ri ol, t ri acet at e	$\text{C}_8\text{H}_{12}\text{O}_6\text{Si}$	C 4130-08-9	232.263			115 ⁹	1.169 ²⁰	1.4226 ²⁰	
10827	Vi nyl t ri et hoxy si lane		$\text{C}_8\text{H}_{10}\text{O}_5\text{Si}$	78-08-0	190.313			160; 62 ⁰	0.901 ²⁰	1.3960 ²⁵	s chl
10828	Vi nyl t ri met hyl si lane		$\text{C}_8\text{H}_{12}\text{Si}$	754-05-2	100.235			55	0.68 ⁹	1.3914 ²⁰	i H ₂ O
10829	Vi ol axant hi n		$\text{C}_{40}\text{H}_{56}\text{O}_4$	126-29-4	600.871	red pr (MeOH, al -et h)	208				s Et OH, et h, C ₂ S i pet h
10830	Vi qui di l		$\text{C}_{20}\text{H}_{24}\text{N}_2\text{O}_2$	84-55-9	324.417	red ye amor	60				vs et h, Et OH, chl
10831	Vi snadi ne		$\text{C}_{24}\text{H}_{24}\text{O}_7$	477-32-7	388.412	nd	85.5				i H ₂ O; s Et OH, et h
10832	Vi snagi n	4-Met hoxy-7-met hyl-5 uro[3,2-g][1]benzopyran-5-one	$\text{C}_{13}\text{H}_{10}\text{O}_4$	82-57-5	230.216	nd (w, MeOH)	144.5				sl H ₂ O, Et OH; vs chl
10833	Vi t ami n B12	Cyanocobal ami n	$\text{C}_{63}\text{H}_{98}\text{CoN}_{14}\text{O}_{14}\text{P}$	68-19-9	1355.365			>300			
10834	Vi t ami n D2		$\text{C}_{28}\text{H}_{44}\text{O}$	50-14-6	396.648	pr (ace)	116.5	sub			i H ₂ O; s Et OH, et h, ace, chl
10835	Vi t ami n D3	9,10-Secochol est a-5,7,10(19)-t ri en-3-ol, (3 β ,5Z,7E)-	$\text{C}_{27}\text{H}_{44}\text{O}$	67-97-0	384.637		84.5				i H ₂ O; s os
10836	Vi t ami n E	α -Tocopherol	$\text{C}_{55}\text{H}_{90}\text{O}_2$	59-02-9	430.706	pal e ye oi l	3.0	210	0.950 ²⁵	1.5045 ²⁵	i H ₂ O; s Et OH, et h, ace, chl
10837	Vi t ami n E acet at e		$\text{C}_{31}\text{H}_{50}\text{O}_3$	58-95-7	472.743		-27.5	184 ^{0.01}	0.9533 ²¹	1.497 ²⁰	i H ₂ O; sl Et OH; s et h, ace, chl
10838	Vi t ami n K1		$\text{C}_3\text{H}_6\text{O}_2$	84-80-0	450.696		-20	142 ^{0.001}	0.964 ²⁵	1.5250 ²⁵	i H ₂ O; s Et OH, et h, ace, bz, pet h, chl
10839	Vomi ci ne	4-Hydroxy-19-met hyl -16,19-secost rychni di ne-10,16-di one	$\text{C}_{22}\text{H}_{24}\text{N}_2\text{O}_4$	125-15-5	380.437	nd (80% al) pr (ace)	282				sl Et OH, et h, ace; vs chl; s AcOEt
10840	Warf ari n	Coumadi n	$\text{C}_{16}\text{H}_{16}\text{O}_4$	81-81-2	308.328	cry (al)	161				i H ₂ O; s Et OH, ace, di ox
10841	9H-Xant hene	10H-9-Oxaant hracene	$\text{C}_9\text{H}_{10}\text{O}$	92-83-1	182.217	ye lf (al)	100.5	311			i ₂ 0 sl Et OH, ct c; s et h, bz, chl
10842	9H-Xant hen-9-ol		$\text{C}_9\text{H}_{10}\text{O}_2$	90-46-0	198.217	nd (aq al)	125				sl H ₂ O; s Et OH, et h, chl
10843	Xant hi ne		$\text{C}_8\text{H}_8\text{N}_2\text{O}_2$	69-89-6	152.112	ye pl (w)	dec	sub			i H ₂ O
10844	Xant hone		$\text{C}_9\text{H}_8\text{O}_2$	90-47-1	196.202	nd (al)	174	351; 146 ⁶			i H ₂ O; s Et OH, et h, bz, chl; sl pet h
10845	Xant hopt eri n		$\text{C}_8\text{H}_8\text{N}_2\text{O}_2$	119-44-8	179.137	hyg ye amor or oran pow (HOAc)	>410 dec	99 ¹⁸	1.559 ²⁵		i H ₂ O; sl Et OH, et h; vs aci d, al k
10846	Xant hosi ne		$\text{C}_9\text{H}_{12}\text{N}_4\text{O}_6$	146-80-5	284.225	pr cry (w)					sl col d H ₂ O; vs hot H ₂ O; dec aci d
10847	Xant hoxy l et i n		$\text{C}_{15}\text{H}_{14}\text{O}_4$	84-99-1	258.270	pr (MeOH, pet h)	133				i H ₂ O; s Et OH, ace; sl et h; vs bz, al k
10848	Xant hyl et i n	8,8-Di met hyl-8-benzo[1,2-b:5,4-b']di pyran-2-one	$\text{C}_{14}\text{H}_{12}\text{O}_3$	553-19-5	228.243	pr (MeOH)	131.5	142 ^{0.1}			s Et OH, pet h
10849	p-Xenyl carbi mi de	4-Isocyanat o-1,1'-bi phenyl	$\text{C}_{13}\text{H}_{10}\text{NO}$	92-95-5	195.216	nd	56	dec 283			vs et h
10850	Xi benol ol		$\text{C}_8\text{H}_{15}\text{NO}_2$	81584-06-7	251.366	cry	57	135 ^{0.7}			s Et OH
10851	<i>o</i> -Xyl ene	1,2-Di met hyl benzene	C_8H_{10}	95-47-6	106.165	li q	-25.2	144.5	0.880 ²	1.5055 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz, pet h, ct c
10852	<i>m</i> -Xyl ene	1,3-Di met hyl benzene	C_8H_{10}	108-38-3	106.165	li q	-47.8	139.12	0.859 ⁶	1.4972 ¹⁰	i H ₂ O; msc Et OH, et h, ace, bz; s chl
10853	<i>p</i> -Xyl ene	1,4-Di met hyl benzene	C_8H_{10}	106-42-3	106.165	mcl pr (al)	13.25	138.37	0.856 ⁶	1.4958 ²⁰	i H ₂ O; msc Et OH, et h, ace, bz; s chl
10854	2,3-Xyl enol	2,3-Di met hyl phenol	$\text{C}_8\text{H}_8\text{O}$	526-75-0	122.164	nd (w, di l al)	72.5	216.9		1.542 ⁰	sl H ₂ O; s Et OH, et h
10855	2,4-Xyl enol	2,4-Di met hyl phenol	$\text{C}_8\text{H}_8\text{O}$	105-67-9	122.164	nd (w)	24.5	210.98	0.9650 ²⁰	1.5420 ¹⁴	sl H ₂ O; msc Et OH, et h; s ct c
10856	2,5-Xyl enol	2,5-Di met hyl phenol	$\text{C}_8\text{H}_8\text{O}$	95-87-4	122.164	nd (w), pr (al -et h)	74.8	211.1			s H ₂ O, Et OH; vs et h; sl chl
10857	2,6-Xyl enol	2,6-Di met hyl phenol	$\text{C}_8\text{H}_8\text{O}$	576-26-1	122.164	lf or nd (al)	45.8	201.07			s H ₂ O, Et OH, et h, ct c
10858	3,4-Xyl enol	3,4-Di met hyl phenol	$\text{C}_8\text{H}_8\text{O}$	95-65-8	122.164		65.1	227	0.9830 ²⁰		sl H ₂ O; s Et OH, ct c; msc et h
10859	3,5-Xyl enol	3,5-Di met hyl phenol	$\text{C}_8\text{H}_8\text{O}$	108-68-9	122.164	nd (w, pet h)	63.4	221.74	0.968 ^{0.9}		s H ₂ O, Et OH, ct c



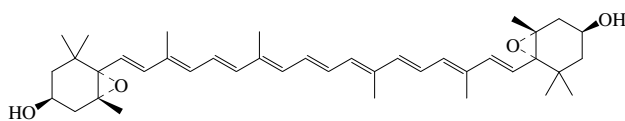
Vi nyl t ri acet oxy si l ane



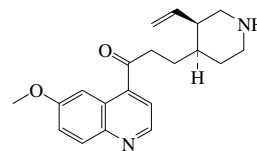
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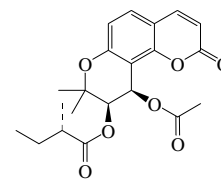
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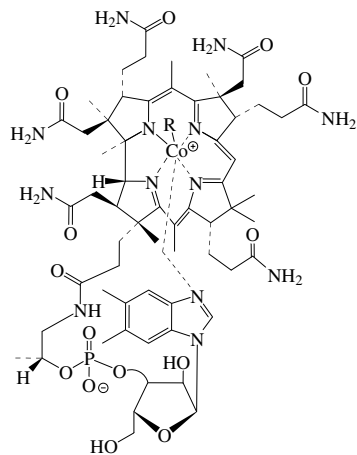
Vi olaxan ti n



Vi qui di l

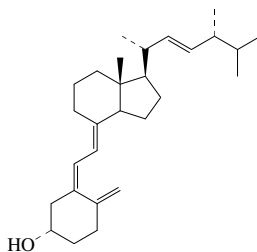


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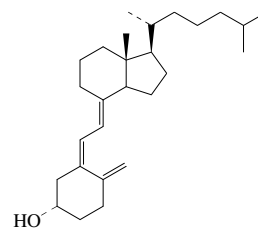


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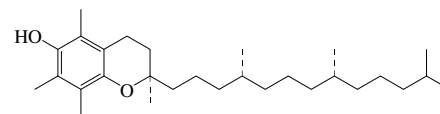
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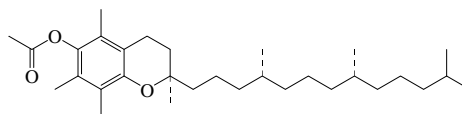
Vi t ami D2



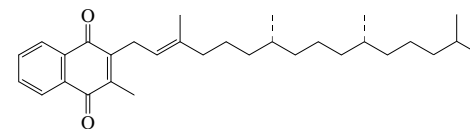
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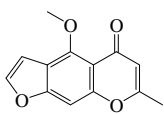
Vi t ami E



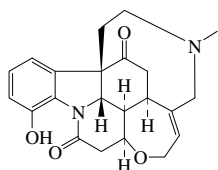
Vi t ami K acetate



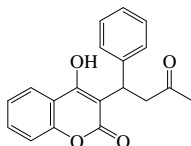
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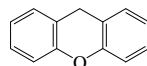
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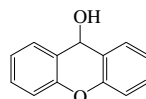
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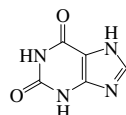
Warf ari n



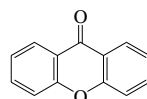
9H-Xant hene



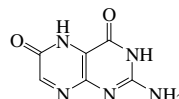
9H-Xant hen-9-ol



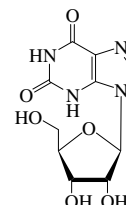
Xant hi ne



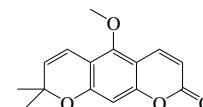
Xant hone



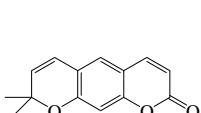
Xant hopt eri n



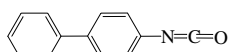
Xant hosi ne



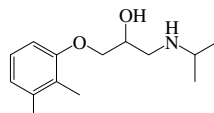
Xant hoxy l et i n



Xant hyl et i n



p-Xenyl carbi mi de



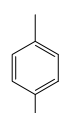
Xi benol ol



o-Xyl ene



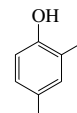
m-Xyl ene



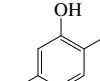
p-Xyl ene



2,3-Xyl enol



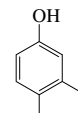
2,4-Xyl enol



2,5-Xyl enol



2,6-Xyl enol

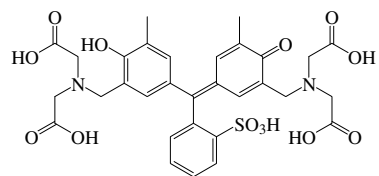


3,4-Xyl enol

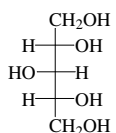


3,5-Xyl enol

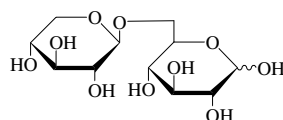
No.	Name	Synonym	Mol. Form.	CAS RN	Mol. Wt.	Physical Form	mp/°C	bp/°C	den/g cm ⁻³	n _D	Solubility
10860	Xyl enol orange		C ₃₁ H ₃₂ N ₂ O ₁₃ S	1611-35-4	672.656	dk red cry	286 dec				s H ₂ O
10861	Xyl i t ol	Xyl i t e	C ₅ H ₁₂ O ₅	87-99-0	152.146	mcl (al)	93.5	216			vs H ₂ O, py, Et OH
10862	6- <i>O</i> -β- <i>D</i> -Xyl opyranosyl <i>D</i> -glucose	Pri meverose	C ₂₀ H ₃₂ O ₁₀	26531-85-1	312.271	cry (MeOH)	210				vs H ₂ O, MeOH
10863	<i>D</i> -Xyl ose		C ₆ H ₁₀ O ₅	58-86-6	150.130	mcl nd	90.5		1.525 ⁰		vs H ₂ O; s Et OH; sl et h
10864	<i>D</i> -Xyl ul ose	<i>D</i> - <i>t</i> hree2-Pent ul ose	C ₆ H ₁₀ O ₅	551-84-8	150.130	vi sc li q					s ₂ θ
10865	<i>L</i> -Xyl ul ose	<i>L</i> - <i>t</i> hree2-Pent ul ose	C ₆ H ₁₀ O ₅	527-50-4	150.130	syrup					vs H ₂ O
10866	3,5-Xyl yl met hyl carbat e	3,5-Di met hyl phenyl met hyl carbat e	C ₁₄ H ₁₃ NO ₂	2655-14-3	179.216	cry	99				sl H ₂ O; s os
10867	Yohi mbi ne		C ₂₂ H ₂₃ N ₂ O ₃	146-48-5	354.442	nd (di l al)	241	sub 160			sl ₂ θ, bz; s Et OH, et h, chl
10868	Yohi mbi ne hydrochl ori de	Tosanpi n	C ₂₁ H ₂₇ ClN ₂ O ₃	65-19-0	390.903	ort h nd or pl (w, di l HCl)	302				vs H ₂ O
10869	Zearal enone		C ₁₈ H ₂₂ O ₅	17924-92-4	318.365	cry	164				i H ₂ O; s al k, bz, Et OH, et h
10870	Zi dovudi ne	3'-Azi do-3'-deoxyt hymi di ne	C ₁₀ H ₁₉ N ₅ O ₄	30516-87-1	267.242	cry (w)	121				
10871	Zi nc benzoat e		C ₁₀ H ₁₀ O ₄ Zn	553-72-0	307.636						sl H ₂ O
10872	Zi nc bi s(di but yl di t hi ocarbat e)		C ₁₈ H ₃₆ N ₂ S ₂ Zn	136-23-2	474.161	cry	138				
10873	Zi nc <i>N,N'</i> -et hyl enebi sdi t hi ocarbat e	Zi neb	C ₁₈ H ₃₆ N ₂ S ₂ Zn	12122-67-7	275.773		157 dec				
10874	Zi nc gl uconat e		C ₁₂ H ₂₂ O ₁₄ Zn	4468-02-4	455.704	pow					
10875	Zi nc 2,4-pent anedi oat e	Zi nc acet yl acet onat e	C ₁₀ H ₁₄ O ₄ Zn	14024-63-6	263.625						s DMSO
10876	Zi nc propanoat e		C ₁₁ H ₁₉ O ₄ Zn	557-28-8	211.550	hyg pl or nd					sl Et OH
10877	Zi ram	Zi nc, bi s(di met hyl carbat e) t hi ocarbat e	C ₁₆ H ₂₇ N ₂ S ₂ Zn	137-30-4	305.841	cry	250		1.66 ²⁵		i H ₂ O; sl bz; s chl



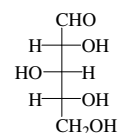
Xylenol orange



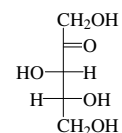
Xylitol



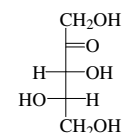
6-O-β-D-Xylopyranosyl D-glucose



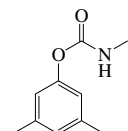
D-Xylose



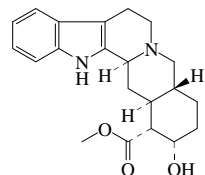
D-Xyloulose



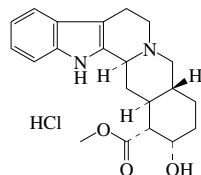
L-Xyloulose



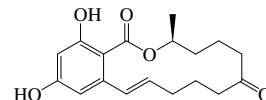
3,5-Xylylmet hyl carbamat e



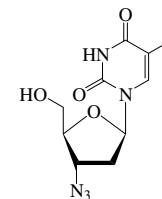
Yohimbinone



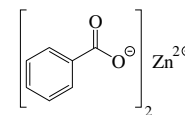
Yohimbinhydrochloride



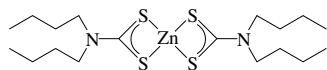
Zearalenone



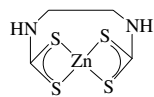
Zidovudine



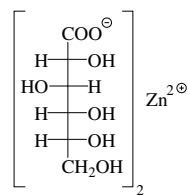
Zinbenzoate



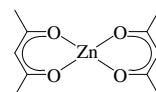
Zinbis (diethylthiophosphoramide)



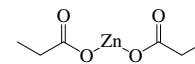
ZincoN,N'-ethylenediamine diethylthiophosphoramide



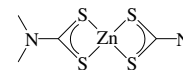
Zinoglucinate



Zin2,4-pentanedioate



Zinpropanoate



Ziram

DIAMAGNETIC SUSCEPTIBILITY OF SELECTED ORGANIC COMPOUNDS

When a material is placed in a magnetic field H , a magnetization M is induced in the material which is related to H by $M = \kappa H$, where κ is called the volume susceptibility. Since H and M have the same dimensions, κ is dimensionless. A more useful parameter is the molar susceptibility χ_m , defined by

$$\chi_m = \kappa V_m = \kappa M/\rho$$

where V_m is the molar volume of the substance, M the molar mass, and ρ the mass density. When the cgs system is used, the customary unit for χ_m is $\text{cm}^3 \text{mol}^{-1}$; the corresponding SI unit is $\text{m}^3 \text{mol}^{-1}$. Substances with no unpaired electrons are called diamagnetic; they have negative values of χ_m .

This table gives values of the diamagnetic susceptibility for about 400 common organic compounds. All values refer to room temperature and atmospheric pressure and to the physical form that is stable under these conditions. Substances are arranged by molecular formula in Hill order. A more extensive table may be found in Reference 1.

In keeping with customary practice, the molar susceptibility is given here in units appropriate to the cgs system. These values should be multiplied by 4π to obtain values for use in SI equations (where the magnetic field strength H has units of A m^{-1}).

REFERENCES

1. *Landolt-Börnstein, Numerical Data and Functional Relationships in Science and Technology, New Series, II/16, Diamagnetic Susceptibility*, Gupta, R. R., Ed., Springer-Verlag, Heidelberg, 1986.
2. Barter, C., Meisenheimer, R. G., and Stevenson, D. P., *J. Phys. Chem.* 64, 1312, 1960.
3. Broersma, S., *J. Chem. Phys.* 17, 873, 1949.

Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
CBrCl ₃	Bromotrichloromethane	73.2	C ₂ HCl ₃ O	Trichloroacetaldehyde	73.0
CBr ₄	Tetrabromomethane	93.7	C ₂ HCl ₃ O	Dichloroacetyl chloride	69.0
CClF ₃	Chlorotrifluoromethane	45.3	C ₂ HCl ₃ O ₂	Trichloroacetic acid	73.0
CClN	Cyanogen chloride	32.4	C ₂ HCl ₅	Pentachloroethane	99.1
CCl ₂ F ₂	Dichlorodifluoromethane	52.2	C ₂ HF ₃ O ₂	Trifluoroacetic acid	43.3
CCl ₂ O	Carbonyl chloride	47.9	C ₂ H ₂	Acetylene	20.8
CCl ₃ F	Trichlorofluoromethane	58.7	C ₂ H ₂ Br ₄	1,1,2,2-Tetrabromoethane	123.4
CCl ₃ NO ₂	Trichloronitromethane	75.3	C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	49.2
CCl ₄	Tetrachloromethane	66.8	C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	51.0
CHBrCl ₂	Bromodichloromethane	66.3	C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	48.9
CHBr ₃	Tribromomethane	82.6	C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	89.8
CHCl ₃	Trichloromethane	58.9	C ₂ H ₃ Cl	Chloroethylene	35.9
CHI ₃	Triiodomethane	117.1	C ₂ H ₃ ClO	Acetyl chloride	39.3
CH ₂ BrCl	Bromochloromethane	55.1	C ₂ H ₃ N	Acetonitrile	27.8
CH ₂ Br ₂	Dibromomethane	65.1	C ₂ H ₄	Ethylene	18.8
CH ₂ Cl ₂	Dichloromethane	46.6	C ₂ H ₄ Br ₂	1,2-Dibromoethane	78.9
CH ₂ I ₂	Diiodomethane	93.1	C ₂ H ₄ Cl ₂	1,1-Dichloroethane	57.4
CH ₂ N ₂	Cyanamide	24.8	C ₂ H ₄ Cl ₂	1,2-Dichloroethane	59.6
CH ₂ O	Formaldehyde	18.6	C ₂ H ₄ O	Acetaldehyde	22.2
CH ₂ O ₂	Formic acid	19.9	C ₂ H ₄ O	Ethylene oxide	30.5
CH ₃ Br	Bromomethane	42.8	C ₂ H ₄ O ₂	Acetic acid	31.8
CH ₃ Cl	Chloromethane	32.0	C ₂ H ₄ O ₂	Methyl formate	31.1
CH ₃ F	Fluoromethane	17.8	C ₂ H ₅ Br	Bromoethane	78.8
CH ₃ I	Iodomethane	57.2	C ₂ H ₅ Cl	Chloroethane	69.9
CH ₃ NO	Formamide	23.0	C ₂ H ₅ I	Iodoethane	69.1
CH ₃ NO ₂	Nitromethane	21.0	C ₂ H ₅ NO	Acetamide	33.9
CH ₄	Methane	17.4	C ₂ H ₅ NO ₂	Nitroethane	35.4
CH ₄ N ₂ O	Urea	33.5	C ₂ H ₅ NO ₂	Glycine	39.6
CH ₄ O	Methanol	21.4	C ₂ H ₆	Ethane	26.8
CH ₅ N	Methylamine	27.0	C ₂ H ₆ O	Ethanol	33.7
Cl ₄	Tetraiodomethane	136	C ₂ H ₆ O	Dimethyl ether	26.3
CN ₄ O ₈	Tetranitromethane	43.0	C ₂ H ₆ O ₂	Ethylene glycol	38.9
C ₂ ClF ₃	Chlorotrifluoroethylene	49.1	C ₂ H ₆ S	Ethanthiol	47.0
C ₂ Cl ₄	Tetrachloroethylene	81.6	C ₂ H ₆ S	Dimethyl sulfide	44.9
C ₂ Cl ₆	Hexachloroethane	112.8	C ₂ H ₈ N ₂	1,2-Ethanediamine	46.5
C ₂ HCl ₃	Trichloroethylene	65.8	C ₂ N ₂	Cyanogen	21.6

DIAMAGNETIC SUSCEPTIBILITY OF SELECTED ORGANIC COMPOUNDS (continued)

Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
C ₃ H ₄	Allene	25.3	C ₄ H ₈ O ₂	1,4-Dioxane	52.2
C ₃ H ₄ O ₂	Vinyl formate	34.7	C ₄ H ₉ Br	1-Bromobutane	77.1
C ₃ H ₅ Br	3-Bromopropene	58.6	C ₄ H ₉ Br	1-Bromo-2-methylpropane	79.9
C ₃ H ₅ Cl	2-Chloropropene	47.8	C ₄ H ₉ Cl	1-Chlorobutane	67.1
C ₃ H ₅ Cl	3-Chloropropene	47.8	C ₄ H ₉ Cl	2-Chlorobutane	67.4
C ₃ H ₅ N	Propanenitrile	38.6	C ₄ H ₉ I	1-Iodobutane	93.6
C ₃ H ₆	Propene	30.7	C ₄ H ₉ N	Pyrrolidine	54.8
C ₃ H ₆	Cyclopropane	39.2	C ₄ H ₉ NO	Morpholine	55.0
C ₃ H ₆ O	Allyl alcohol	36.7	C ₄ H ₁₀	Butane	50.3
C ₃ H ₆ O	Propanal	34.2	C ₄ H ₁₀	Isobutane	50.5
C ₃ H ₆ O	Acetone	33.8	C ₄ H ₁₀ O	1-Butanol	56.4
C ₃ H ₆ O	Methyloxirane	42.5	C ₄ H ₁₀ O	2-Butanol	57.6
C ₃ H ₆ O ₂	Propanoic acid	43.2	C ₄ H ₁₀ O	2-Methyl-1-propanol	57.6
C ₃ H ₆ O ₂	Ethyl formate	42.4	C ₄ H ₁₀ O	2-Methyl-2-propanol	56.6
C ₃ H ₇ Br	1-Bromopropane	65.6	C ₄ H ₁₀ O	Diethyl ether	55.5
C ₃ H ₇ Br	2-Bromopropane	65.1	C ₄ H ₁₀ O ₂	1,3-Butanediol	61.8
C ₃ H ₇ Cl	1-Chloropropane	56.0	C ₄ H ₁₀ O ₂	1,4-Butanediol	61.8
C ₃ H ₇ I	1-Iodopropane	84.3	C ₄ H ₁₀ S	1-Butanethiol	70.2
C ₃ H ₇ N	Allylamine	40.1	C ₄ H ₁₁ N	Butylamine	58.9
C ₃ H ₇ NO ₂	1-Nitropropane	45.0	C ₄ H ₁₁ N	Isobutylamine	59.8
C ₃ H ₇ NO ₂	2-Nitropropane	45.4	C ₄ H ₁₁ N	Diethylamine	56.8
C ₃ H ₇ NO ₂	Ethyl carbamate	57.0	C ₃ H ₄ O ₂	Furfural	47.2
C ₃ H ₈	Propane	38.6	C ₃ H ₅ N	Pyridine	48.7
C ₃ H ₈ O	1-Propanol	44.8	C ₃ H ₆ O ₂	Furfuryl alcohol	61.0
C ₃ H ₈ O	2-Propanol	45.7	C ₃ H ₇ NO ₂	Ethyl cyanoacetate	67.3
C ₃ H ₈ O ₂	1,3-Propylene glycol	50.2	C ₃ H ₈	2-Methyl-1,3-butadiene	46.0
C ₃ H ₈ O ₂	Dimethoxymethane	47.3	C ₃ H ₈ O	Cyclopentanone	51.6
C ₃ H ₈ O ₃	Glycerol	57.1	C ₃ H ₈ O ₂	Methyl methacrylate	57.3
C ₄ H ₂ O ₃	Maleic anhydride	35.8	C ₃ H ₈ O ₂	2,4-Pentanedione	54.9
C ₄ H ₄ N ₂	Pyrazine	37.8	C ₃ H ₁₀	1-Pentene	54.6
C ₄ H ₄ N ₂	Pyrimidine	43.1	C ₃ H ₁₀	2-Methyl-2-butene	54.7
C ₄ H ₄ O	Furan	43.1	C ₃ H ₁₀	Cyclopentane	56.2
C ₄ H ₄ O ₃	Succinic anhydride	47.5	C ₃ H ₁₀ O	Cyclopentanol	64.0
C ₄ H ₄ O ₄	Maleic acid	49.6	C ₃ H ₁₀ O	Pentanal	57.5
C ₄ H ₄ O ₄	Fumaric acid	49.1	C ₃ H ₁₀ O	2-Pentanone	57.5
C ₄ H ₄ S	Thiophene	57.3	C ₃ H ₁₀ O	3-Pentanone	57.7
C ₄ H ₅ N	Pyrrole	48.6	C ₃ H ₁₀ O ₂	Pentanoic acid	66.5
C ₄ H ₆	1,2-Butadiene	35.6	C ₃ H ₁₀ O ₂	3-Methylbutanoic acid	67.7
C ₄ H ₆	1,3-Butadiene	32.1	C ₃ H ₁₀ O ₂	Butyl formate	65.8
C ₄ H ₆ O ₂	Vinyl acetate	46.4	C ₃ H ₁₀ O ₂	Isobutyl formate	66.8
C ₄ H ₆ O ₃	Acetic anhydride	52.8	C ₃ H ₁₀ O ₂	Propyl acetate	65.9
C ₄ H ₆ O ₄	Succinic acid	58.0	C ₃ H ₁₀ O ₂	Isopropyl acetate	67.0
C ₄ H ₆ O ₄	Dimethyl oxalate	55.7	C ₃ H ₁₀ O ₂	Ethyl propanoate	66.3
C ₄ H ₇ N	Butanenitrile	50.4	C ₃ H ₁₀ O ₂	Tetrahydrofurfuryl alcohol	69.4
C ₄ H ₈	1-Butene	41.0	C ₃ H ₁₀ O ₃	Diethyl carbonate	75.4
C ₄ H ₈	<i>cis</i> -2-Butene	42.6	C ₃ H ₁₁ N	Piperidine	64.2
C ₄ H ₈	<i>trans</i> -2-Butene	43.3	C ₃ H ₁₂	Pentane	61.5
C ₄ H ₈	Isobutene	40.8	C ₃ H ₁₂	Isopentane	63.0
C ₄ H ₈	Cyclobutane	40.0	C ₃ H ₁₂	Neopentane	63.0
C ₄ H ₈ O	Ethyl vinyl ether	47.9	C ₃ H ₁₂ O	1-Pentanol	67.0
C ₄ H ₈ O	1,2-Epoxybutane	54.8	C ₃ H ₁₂ O	2-Pentanol	69.1
C ₄ H ₈ O	Butanal	45.9	C ₃ H ₁₂ O ₂	1,5-Pentanediol	73.5
C ₄ H ₈ O	2-Butanone	45.6	C ₃ H ₁₃ N	Pentylamine	69.3
C ₄ H ₈ O ₂	Butanoic acid	55.2	C ₆ Cl ₆	Hexachlorobenzene	147.0
C ₄ H ₈ O ₂	2-Methylpropanoic acid	56.1	C ₆ H ₄ ClNO ₂	1-Chloro-2-nitrobenzene	75.5
C ₄ H ₈ O ₂	Propyl formate	55.0	C ₆ H ₄ ClNO ₂	1-Chloro-3-nitrobenzene	77.2
C ₄ H ₈ O ₂	Ethyl acetate	54.1	C ₆ H ₄ ClNO ₂	1-Chloro-4-nitrobenzene	74.7
C ₄ H ₈ O ₂	Methyl propanoate	54.5	C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	84.4

DIAMAGNETIC SUSCEPTIBILITY OF SELECTED ORGANIC COMPOUNDS (continued)

Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	84.1	C ₆ H ₁₄ O	Dipropyl ether	79.4
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	81.7	C ₆ H ₁₄ O ₂	1,6-Hexanediol	84.3
C ₆ H ₄ O ₂	<i>p</i> -Benzoquinone	36	C ₆ H ₁₄ O ₂	1,1-Diethoxyethane	81.4
C ₆ H ₅ Br	Bromobenzene	78.4	C ₆ H ₁₄ O ₆	<i>D</i> -Glucitol	107.8
C ₆ H ₅ Cl	Chlorobenzene	69.5	C ₆ H ₁₅ N	Triethylamine	83.3
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol	77.3	C ₇ H ₅ N	Benzonitrile	65.2
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol	77.6	C ₇ H ₆ O	Benzaldehyde	60.7
C ₆ H ₅ ClO	<i>p</i> -Chlorophenol	77.7	C ₇ H ₆ O ₂	Salicylaldehyde	66.8
C ₆ H ₅ F	Fluorobenzene	58.4	C ₇ H ₆ O ₃	Salicylic acid	75
C ₆ H ₅ I	Iodobenzene	92.0	C ₇ H ₇ Br	<i>p</i> -Bromotoluene	88.7
C ₆ H ₅ NO ₂	Nitrobenzene	61.9	C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene	82.4
C ₆ H ₅ NO ₃	<i>o</i> -Nitrophenol	68.9	C ₇ H ₇ Cl	<i>m</i> -Chlorotoluene	79.7
C ₆ H ₅ NO ₃	<i>m</i> -Nitrophenol	65.9	C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene	80.3
C ₆ H ₅ NO ₃	<i>p</i> -Nitrophenol	66.9	C ₇ H ₇ Cl	(Chloromethyl)benzene	81.6
C ₆ H ₆	Benzene	54.8	C ₇ H ₇ NO	Benzamide	72.0
C ₆ H ₆ CIN	<i>o</i> -Chloroaniline	79.5	C ₇ H ₇ NO ₂	<i>o</i> -Nitrotoluene	72.2
C ₆ H ₆ CIN	<i>m</i> -Chloroaniline	76.6	C ₇ H ₇ NO ₂	<i>m</i> -Nitrotoluene	72.7
C ₆ H ₆ CIN	<i>p</i> -Chloroaniline	76.7	C ₇ H ₇ NO ₂	<i>p</i> -Nitrotoluene	73.3
C ₆ H ₆ N ₂ O ₂	<i>o</i> -Nitroaniline	67.4	C ₇ H ₈	Toluene	65.6
C ₆ H ₆ N ₂ O ₂	<i>m</i> -Nitroaniline	69.7	C ₇ H ₈ O	<i>o</i> -Cresol	73.3
C ₆ H ₆ N ₂ O ₂	<i>p</i> -Nitroaniline	68.0	C ₇ H ₈ O	<i>m</i> -Cresol	72.2
C ₆ H ₆ O	Phenol	60.6	C ₇ H ₈ O	<i>p</i> -Cresol	72.4
C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	64.7	C ₇ H ₈ O	Benzyl alcohol	71.8
C ₆ H ₆ O ₂	Pyrocatechol	68.2	C ₇ H ₈ O	Anisole	72.2
C ₆ H ₆ O ₂	Resorcinol	67.2	C ₇ H ₉ N	<i>o</i> -Methylaniline	74.9
C ₆ H ₇ N	Aniline	62.4	C ₇ H ₉ N	<i>m</i> -Methylaniline	74.6
C ₆ H ₇ N	4-Methylpyridine	59.8	C ₇ H ₉ N	<i>p</i> -Methylaniline	72.5
C ₆ H ₈	1,4-Cyclohexadiene	48.7	C ₇ H ₉ N	<i>N</i> -Methylaniline	74.1
C ₆ H ₈ N ₂	<i>o</i> -Phenylenediamine	72.5	C ₇ H ₉ N	2,4-Dimethylpyridine	71.3
C ₆ H ₈ N ₂	<i>m</i> -Phenylenediamine	70.4	C ₇ H ₉ N	2,6-Dimethylpyridine	72.5
C ₆ H ₈ N ₂	<i>p</i> -Phenylenediamine	70.7	C ₇ H ₉ NO	<i>o</i> -Methoxyaniline [<i>o</i> -Anisidine]	79.1
C ₆ H ₁₀	1,5-Hexadiene	55.1	C ₇ H ₁₂ O ₄	Diethyl malonate	92.6
C ₆ H ₁₀	1-Hexyne	64.5	C ₇ H ₁₄	1-Heptene	77.8
C ₆ H ₁₀	Cyclohexene	58.0	C ₇ H ₁₄	Cycloheptane	73.9
C ₆ H ₁₀ O	Cyclohexanone	62.0	C ₇ H ₁₄	Methylcyclohexane	78.9
C ₆ H ₁₀ O ₃	Ethyl acetoacetate	71.7	C ₇ H ₁₄ O	1-Heptanal	81.0
C ₆ H ₁₀ O ₄	Diethyl oxalate	81.7	C ₇ H ₁₄ O	2-Heptanone	80.5
C ₆ H ₁₂	1-Hexene	66.4	C ₇ H ₁₄ O	3-Heptanone	80.7
C ₆ H ₁₂	2,3-Dimethyl-2-butene	65.9	C ₇ H ₁₄ O	4-Heptanone	80.5
C ₆ H ₁₂	Cyclohexane	68	C ₇ H ₁₄ O	2,4-Dimethyl-3-pentanone	81.1
C ₆ H ₁₂	Methylcyclopentane	70.2	C ₇ H ₁₄ O ₂	Heptanoic acid	89.0
C ₆ H ₁₂ O	Hexanal	69.4	C ₇ H ₁₄ O ₂	Pentyl acetate	88.9
C ₆ H ₁₂ O	2-Hexanone	69.2	C ₇ H ₁₄ O ₂	Isopentyl acetate	89.4
C ₆ H ₁₂ O	3-Hexanone	69.0	C ₇ H ₁₄ O ₂	Butyl propanoate	89.1
C ₆ H ₁₂ O	4-Methyl-2-pentanone	69.7	C ₇ H ₁₄ O ₂	Ethyl 3-methylbutanoate	91.1
C ₆ H ₁₂ O	Cyclohexanol	73.4	C ₇ H ₁₆	Heptane	85.2
C ₆ H ₁₂ O ₂	Hexanoic acid	78.1	C ₇ H ₁₆	3-Ethylpentane	86.2
C ₆ H ₁₂ O ₂	Isopentyl formate	78.4	C ₇ H ₁₆	2,2-Dimethylpentane	87.0
C ₆ H ₁₂ O ₂	Isobutyl acetate	78.7	C ₇ H ₁₆	2,3-Dimethylpentane	87.5
C ₆ H ₁₂ O ₂	Propyl propanoate	77.7	C ₇ H ₁₆	2,4-Dimethylpentane	87.5
C ₆ H ₁₂ O ₃	Paraldehyde	86.1	C ₇ H ₁₆	3,3-Dimethylpentane	89.5
C ₆ H ₁₄	Hexane	74.1	C ₇ H ₁₆ O	1-Heptanol	91.7
C ₆ H ₁₄	2-Methylpentane	75.3	C ₇ H ₁₆ O	4-Heptanol	92.1
C ₆ H ₁₄	3-Methylpentane	75.5	C ₈ H ₆ O ₃	Phthalic anhydride	66.7
C ₆ H ₁₄	2,2-Dimethylbutane	76.2	C ₈ H ₆ O ₄	Phthalic acid	83.6
C ₆ H ₁₄	2,3-Dimethylbutane	76.2	C ₈ H ₆ O ₄	Isophthalic acid	84.6
C ₆ H ₁₄ O	1-Hexanol	79.5	C ₈ H ₆ O ₄	Terephthalic acid	83.5
C ₆ H ₁₄ O	4-Methyl-2-pentanol	80.4	C ₈ H ₇ N	Benzeneacetonitrile	76.9

DIAMAGNETIC SUSCEPTIBILITY OF SELECTED ORGANIC COMPOUNDS (continued)

Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Molecular Formula	Compound	$-\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
C ₈ H ₇ N	Indole	85.0	C ₁₀ H ₁₀ O ₂	Safrole	97.5
C ₈ H ₈	Styrene	68.2	C ₁₀ H ₁₀ O ₄	Dimethyl terephthalate	101.6
C ₈ H ₈ O	Acetophenone	72.5	C ₁₀ H ₁₄	Butylbenzene	100.7
C ₈ H ₈ O ₂	<i>o</i> -Toluic acid	84.3	C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	101.8
C ₈ H ₈ O ₂	<i>m</i> -Toluic acid	83.0	C ₁₀ H ₁₄	Isobutylbenzene	101.7
C ₈ H ₈ O ₂	<i>p</i> -Toluic acid	82.4	C ₁₀ H ₁₄	<i>p</i> -Cymene	102.8
C ₈ H ₈ O ₂	Benzeneacetic acid	82.4	C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	101.2
C ₈ H ₈ O ₂	Methyl benzoate	81.6	C ₁₀ H ₁₄ O	<i>p-tert</i> -Butylphenol	108.0
C ₈ H ₈ O ₃	Methyl salicylate	86.6	C ₁₀ H ₁₅ N	<i>N,N</i> -Diethylaniline	107.9
C ₈ H ₁₀	Ethylbenzene	77.3	C ₁₀ H ₁₆	<i>d</i> -Limonene	98.0
C ₈ H ₁₀	<i>o</i> -Xylene	77.7	C ₁₀ H ₁₆	α -Pinene	100.7
C ₈ H ₁₀	<i>m</i> -Xylene	76.4	C ₁₀ H ₁₆	β -Pinene	101.9
C ₈ H ₁₀	<i>p</i> -Xylene	77.0	C ₁₀ H ₁₆ O	Camphor, (+)	103.0
C ₈ H ₁₀ O	Phenetole	84.5	C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	107.0
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline	85.6	C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	107.6
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	85.1	C ₁₀ H ₂₂	Decane	119.5
C ₈ H ₁₁ N	2,4,6-Trimethylpyridine	83.1	C ₁₁ H ₁₀	1-Methylnaphthalene	102.9
C ₈ H ₁₄ O ₄	Ethyl succinate	105.0	C ₁₁ H ₁₀	2-Methylnaphthalene	102.7
C ₈ H ₁₆	1-Octene	88.8	C ₁₁ H ₂₄	Undecane	131.8
C ₈ H ₁₆	Cyclooctane	85.3	C ₁₂ H ₈	Acenaphthylene	111.6
C ₈ H ₁₆ O ₂	Octanoic acid	99.5	C ₁₂ H ₉ N	Carbazole	119.9
C ₈ H ₁₆ O ₂	Hexyl acetate	100.9	C ₁₂ H ₁₀	Acenaphthene	109.9
C ₈ H ₁₇ Cl	1-Chlorooctane	114.9	C ₁₂ H ₁₀	Biphenyl	103.3
C ₈ H ₁₈	Octane	96.6	C ₁₂ H ₁₀ N ₂	Azobenzene	106.8
C ₈ H ₁₈	4-Methylheptane	97.3	C ₁₂ H ₁₁ N	Diphenylamine	108.4
C ₈ H ₁₈	3-Ethylhexane	97.8	C ₁₂ H ₁₄ O ₄	Diethyl phthalate	127.5
C ₈ H ₁₈	3,4-Dimethylhexane	99.1	C ₁₂ H ₁₈	Hexamethylbenzene	122.5
C ₈ H ₁₈	2,2,4-Trimethylpentane	99.1	C ₁₂ H ₂₄ O ₂	Dodecanoic acid	113.0
C ₈ H ₁₈	2,3,4-Trimethylpentane	99.8	C ₁₃ H ₉ N	Acridine	118.8
C ₈ H ₁₈ O	1-Octanol	101.6	C ₁₃ H ₁₀ O	Benzophenone	109.6
C ₈ H ₁₉ N	Dibutylamine	103.7	C ₁₃ H ₁₂	Diphenylmethane	116.0
C ₉ H ₇ N	Quinoline	86.1	C ₁₃ H ₂₈	Tridecane	153.7
C ₉ H ₇ N	Isoquinoline	83.9	C ₁₄ H ₈ O ₂	9,10-Anthracenedione	113.0
C ₉ H ₈	Indene	83	C ₁₄ H ₁₀	Anthracene	129.8
C ₉ H ₁₀	Isopropenylbenzene	80.0	C ₁₄ H ₁₀	Phenanthrene	127.6
C ₉ H ₁₀ O ₂	Ethyl benzoate	93.8	C ₁₄ H ₁₀	Diphenylacetylene	116
C ₉ H ₁₀ O ₂	Benzyl acetate	93.2	C ₁₄ H ₁₀ O ₂	Benzil	106.8
C ₉ H ₁₂	Propylbenzene	89.1	C ₁₄ H ₁₂ O ₂	Benzyl benzoate	132.2
C ₉ H ₁₂	Isopropylbenzene [Cumene]	89.5	C ₁₄ H ₁₄	1,2-Diphenylethane	127.8
C ₉ H ₁₂	1,3,5-Trimethylbenzene [Mesitylene]	92.3	C ₁₄ H ₂₈ O ₂	Tetradecanoic acid [Myristic acid]	176.0
C ₉ H ₁₈	1-Nonene	100.1	C ₁₄ H ₃₀	Tetradecane	166.2
C ₉ H ₁₈ O	2,6-Dimethyl-4-heptanone	104.3	C ₁₆ H ₁₀	Pyrene	147
C ₉ H ₂₀	Nonane	108.1	C ₁₆ H ₃₂ O ₂	Hexadecanoic acid [Palmitic acid]	198.6
C ₁₀ H ₇ Br	1-Bromonaphthalene	123.6	C ₁₆ H ₃₄	Hexadecane	187.6
C ₁₀ H ₇ Cl	1-Chloronaphthalene	107.6	C ₁₆ H ₃₄ O	1-Hexadecanol	183.5
C ₁₀ H ₈	Naphthalene	91.6	C ₁₈ H ₁₂	Chrysene	148.0
C ₁₀ H ₈	Azulene	123.7	C ₁₈ H ₁₄	<i>o</i> -Terphenyl	150.4
C ₁₀ H ₈ O	1-Naphthol	96.2	C ₁₈ H ₁₄	<i>m</i> -Terphenyl	155.5
C ₁₀ H ₈ O	2-Naphthol	96.8	C ₁₈ H ₁₄	<i>p</i> -Terphenyl	156.0
C ₁₀ H ₆ N	1-Naphthalenamine	92.5	C ₁₈ H ₃₄ O ₂	<i>cis</i> -9-Octadecenoic acid [Oleic acid]	208.5
C ₁₀ H ₉ N	2-Naphthalenamine	98.0	C ₁₈ H ₃₆ O ₂	Octadecanoic acid [Stearic acid]	220.8
			C ₂₀ H ₁₂	Perylene	167.5

THE ELEMENTS

C. R. Hammond

One of the most striking facts about the elements is their unequal distribution and occurrence in nature. Present knowledge of the chemical composition of the universe, obtained from the study of the spectra of stars and nebulae, indicates that hydrogen is by far the most abundant element and may account for more than 90% of the atoms or about 75% of the mass of the universe. Helium atoms make up most of the remainder. All of the other elements together contribute only slightly to the total mass.

The chemical composition of the universe is undergoing continuous change. Hydrogen is being converted into helium, and helium is being changed into heavier elements. As time goes on, the ratio of heavier elements increases relative to hydrogen. Presumably, the process is not reversible.

Burbidge, Burbidge, Fowler, and Hoyle, and more recently, Peebles, Penzias, and others have studied the synthesis of elements in stars. To explain all of the features of the nuclear abundance curve — obtained by studies of the composition of the earth, meteorites, stars, etc. — it is necessary to postulate that the elements were originally formed by at least eight different processes: (1) hydrogen burning, (2) helium burning, (3) χ process, (4) e process, (5) s process, (6) r process, (7) p process, and (8) the X process. The X process is thought to account for the existence of light nuclei such as D, Li, Be, and B. Common metals such as Fe, Cr, Ni, Cu, Ti, Zn, etc. were likely produced early in the history of our galaxy. It is also probable that most of the heavy elements on earth and elsewhere in the universe were originally formed in supernovae, or in the hot interior of stars.

Studies of the solar spectrum have led to the identification of 67 elements in the sun's atmosphere; however, all elements cannot be identified with the same degree of certainty. Other elements may be present in the sun, although they have not yet been detected spectroscopically. The element helium was discovered on the sun before it was found on earth. Some elements such as scandium are relatively more plentiful in the sun and stars than here on earth.

Minerals in lunar rocks brought back from the moon on the Apollo missions consist predominantly of *plagioclase* $\{(Ca,Na)(Al,Si)O_4O_8\}$ and *pyroxene* $\{(Ca,Mg,Fe)_2Si_2O_6\}$ — two minerals common in terrestrial volcanic rock. No new elements have been found on the moon that cannot be accounted for on earth; however, three minerals, *armalcolite* $\{(Fe,Mg)Ti_2O_5\}$, *pyroxferroite* $\{CaFe_6(SiO_3)_7\}$, and *tranquillityite* $\{Fe_8(Zr,Y)Ti_3Si_3O_2\}$, are new. The oldest known terrestrial rocks are about 4 billion years old. One rock, known as the "Genesis Rock," brought back from the Apollo 15 Mission, is about 4.15 billion years old. This is only about one-half billion years younger than the supposed age of the moon and solar system. Lunar rocks appear to be relatively enriched in refractory elements such as chromium, titanium, zirconium, and the rare earths, and impoverished in volatile elements such as the alkali metals, in chlorine, and in noble metals such as nickel, platinum, and gold.

Even older than the "Genesis Rock" are *carbonaceous chondrites*, a type of meteorite that has fallen to earth and has been studied. These are some of the most primitive objects of the solar system yet found. The grains making up these objects probably condensed directly out of the gaseous nebula from which the sun and planets were born. Most of the condensation of the grains probably was completed within 50,000 years of the time the disk of the nebula was first formed — about 4.6 billion years ago. It is now thought that this type of meteorite may contain a small percentage of presolar dust grains. The relative abundances of the elements of these meteorites are about the same as the abundances found in the solar chromosphere.

The X-ray fluorescent spectrometer sent with the Viking I spacecraft to Mars shows that the Martian soil contains about 12 to 16% iron, 14 to 15% silicon, 3 to 8% calcium, 2 to 7% aluminum, and one-half to 2% titanium. The gas chromatograph — mass spectrometer on Viking II found no trace of organic compounds that should be present if life ever existed there.

F. W. Clarke and others have carefully studied the composition of rocks making up the crust of the earth. Oxygen accounts for about 47% of the crust, by weight, while silicon comprises about 28% and aluminum about 8%. These elements, plus iron, calcium, sodium, potassium, and magnesium, account for about 99% of the composition of the crust.

Many elements such as tin, copper, zinc, lead, mercury, silver, platinum, antimony, arsenic, and gold, which are so essential to our needs and civilization, are among some of the rarest elements in the earth's crust. These are made available to us only by the processes of concentration in ore bodies. Some of the so-called *rare-earth* elements have been found to be much more plentiful than originally thought and are about as abundant as uranium, mercury, lead, or bismuth. The least abundant rare-earth or *lanthanide* element, thulium, is now believed to be more plentiful on earth than silver, cadmium, gold, or iodine, for example. Rubidium, the 16th most abundant element, is more plentiful than chlorine while its compounds are little known in chemistry and commerce.

It is now thought that at least 24 elements are essential to living matter. The four most abundant in the human body are hydrogen, oxygen, carbon, and nitrogen. The seven next most common, in order of abundance, are calcium, phosphorus, chlorine, potassium, sulfur, sodium, and magnesium. Iron, copper, zinc, silicon, iodine, cobalt, manganese, molybdenum, fluorine, tin, chromium, selenium, and vanadium are needed and play a role in living matter. Boron is also thought essential for some plants, and it is possible that aluminum, nickel, and germanium may turn out to be necessary.

Ninety-one elements occur naturally on earth. Minute traces of plutonium-244 have been discovered in rocks mined in Southern California. This discovery supports the theory that heavy elements were produced during creation of the solar system. While technetium and promethium have not yet been found naturally on earth, they have been found to be present in stars. Technetium has been identified in the spectra of certain "late" type stars, and promethium lines have been identified in the spectra of a faintly visible star HR465 in Andromeda. Promethium must have been made very recently near the star's surface for no known isotope of this element has a half-life longer than 17.7 years.

It has been suggested that californium is present in certain stellar explosions known as supernovae; however, this has not been proved. At present no elements are found elsewhere in the universe that cannot be accounted for here on earth.

All atomic mass numbers from 1 to 238 are found naturally on earth except for masses 5 and 8. About 285 relatively stable and 67 naturally radioactive isotopes occur on earth totaling 352. In addition, the neutron, technetium, promethium, and the transuranic elements (lying beyond uranium) have now been produced artificially. In June 1999, scientists at the Lawrence Berkeley National Laboratory reported that they had found evidence of an isotope of Element 118 and its immediate decay products of Elements 116, 114, and 112. This sequence of events tended to reinforce the theory that was predicted since the 1970s that an "island of stability" existed for nuclei with approximately 114 protons and 184 neutrons. This "island" refers to nuclei in which the decay lasts for a period of time instead of a decay that occurs instantaneously. However, on July 27, 2001, researchers at LBNL reported that their laboratory and the facilities at the GSI Laboratory in Germany and at Japanese laboratories failed to confirm the results of their earlier experiments where the fusion of a krypton atom with a lead target resulted in Element 118, with chains of decay leading to Elements 116, 114, and 112, and on down to Element 106. Therefore, the discovery was reported to be spurious. However, with the announcement it was said that different

THE ELEMENTS (continued)

experiments at the Livermore Laboratory and Joint Institute for Nuclear Research in Dubna, Russia indicated that Element 116 had since been created directly. (See also under Elements 116 and 118.)

Laboratory processes have now extended the radioactive element mass numbers beyond 238 to about 280. Each element from atomic numbers 1 to 110 is known to have at least one radioactive isotope. As of December 2001, about 3286 isotopes and isomers were thought to be known and recognized. Many stable and radioactive isotopes are now produced and distributed by the Oak Ridge National Laboratory, Oak Ridge, Tenn., U.S.A., to customers licensed by the U.S. Department of Energy.

The nucleus of an atom is characterized by the number of protons it contains, denoted by Z , and by the number of neutrons, N . Isotopes of an element have the same value of Z , but different values of N . The *mass number* A , is the sum of Z and N . For example, Uranium-238 has a mass number of 238, and contains 92 protons and 146 neutrons.

There is evidence that the definition of chemical elements must be broadened to include the electron. Several compounds known as *electrides*, have recently been made of alkaline metal elements and electrons. A relatively stable combination of a positron and electron, known as *positronium*, has also been studied.

The well-known proton, neutron, and electron are now thought to be members of a group that includes other fundamental particles that have been discovered or hypothesized by physicists. These very elemental particles, of which all matter is made, are now thought to belong to one of two families: namely, **quarks** or **leptons**. Each of these two families consists of six particles. Also, there are four different force carriers that lead to interactions between particles. The six members or “flavors” of the quark family are called **up**, **charm**, **top**, **down**, **strange**, and **bottom**. The force carriers for the quarks are the **gluon** and the **photon**. The six members of the lepton family are the **e neutrino**, the **mu neutrino**, the **tau neutrino**, the **electron**, the **muon particle**, and the **tau particle**. The force carriers for these are the **w boson** and the **z boson**. Furthermore, it appears that each of these particles has an anti-particle that has an opposite electrical charge from the above particles.

Quarks are not found individually, but are found with other quarks arranged to form composites known as **hadrons**. There are two basic types of hadrons: **baryons**, composed of three quarks, and **mesons**, composed of a quark and an anti-quark. Examples of baryons are the neutron and the proton. Neutrons are made of two down quarks and one up quark. Protons are made of two up quarks and one down quark. An example of the meson is the **pion**. This particle is made of an up quark and a down anti-quark. Such particles are unstable and tend to decay rapidly. The anti-particle of the proton is the anti-proton. The exception to the rule is the electron, whose anti-particle is the **positron**.

In recent years a search has been made for a hypothetical particle known as the **Higgs particle** or **Higgs boson**, suggested in 1966 by Peter Higgs of the University of Edinburgh, which could possibly explain why the carriers of the “electro-weak” field (w and z bosons) have mass. The Higgs particle is thought to be responsible possibly for the mass of objects throughout the universe.

Many physicists now hold that all matter and energy in the universe is controlled by four fundamental forces: the **electromagnetic force**, **gravity**, a **weak nuclear force**, and a **strong nuclear force**. The **gluon** binds quarks together by carrying the strong nuclear force. Each of these natural forces is passed back and forth among the basic particles of matter by the force carriers mentioned above. The electromagnetic force is carried by the photon, the weak nuclear force by the **intermediate vector boson**, and the gravity by the **graviton**.

For more complete information on these fundamental particles, please consult recent articles and books on nuclear or particle physics.

The available evidence leads to the conclusion that elements 89 (actinium) through 103 (lawrencium) are chemically similar to the rare-earth or lanthanide elements (elements 57 to 71, inclusive). These elements therefore have been named *actinides* after the first member of this series. Those elements beyond uranium that have been produced artificially have the following names and symbols: neptunium, 93 (Np); plutonium, 94 (Pu); americium, 95 (Am); curium, 96 (Cm); berkelium, 97 (Bk); californium, 98 (Cf); einsteinium, 99 (Es); fermium, 100 (Fm); mendelevium, 101 (Md); nobelium, 102 (No); and lawrencium, 103 (Lr). It is now claimed that Elements 104 through 112 have been produced and identified. More recently, Elements 118, 116, and 114 were reported found (see Element 118). In August 1997, the International Union of Pure and Applied Chemistry (IUPAC) gave final approval to the following names for Elements 104 to 109: Element 104 — rutherfordium (Rf); Element 105 — dubnium (Db); Element 106 — seaborgium (Sg); Element 107 — bohrium (Bh); Element 108 — hassium (Hs); and Element 109 — meitnerium (Mt). The recently discovered elements 110, 111, 112, 114, etc. have not yet been named, but may carry temporary names as designated by the International Union of Pure and Applied Chemistry. IUPAC recommends that until the existence of a new element is proven to their satisfaction, the elements are to have names and symbols derived according to these precise and simple rules: The name is based on the digits in the element’s atomic number. Each digit is replaced with these expressions, with the end using the usual -ium suffix as follows: **0 nil, 1 un, 2 bi, 3 tri, 4 quad, 5 pent, 6 hex, 7 sept, 8 oct, 9 enn**. Double letter i’s are not used, as for example Ununbium, but would be Ununbium. The symbol used would be the first letter of the three main syllables. For example, Element 126 would be Unbihexium, with the symbol Ubh. It is thought there is a possibility of producing elements beyond Element 116 and discovering Elements 117, 115, and 113 by altering the beams of ions and the targets from those now being used.

There are many claims in the literature of the existence of various allotropic modifications of the elements, some of which are based on doubtful or incomplete evidence. Also, the physical properties of an element may change drastically by the presence of small amounts of impurities. With new methods of purification, which are now able to produce elements with 99.9999% purity, it has been necessary to restudy the properties of the elements. For example, the melting point of thorium changes by several hundred degrees by the presence of a small percentage of ThO_2 as an impurity. Ordinary commercial tungsten is brittle and can be worked only with difficulty. Pure tungsten, however, can be cut with a hacksaw, forged, spun, drawn, or extruded. In general, the value of a physical property given here applies to the pure element, when it is known.

Many of the chemical elements and their compounds are toxic and should be handled with due respect and care. In recent years there has been a greatly increased knowledge and awareness of the health hazards associated with chemicals, radioactive materials, and other agents. Anyone working with the elements and certain of their compounds should become thoroughly familiar with the proper safeguards to be taken. Information on specific hazards and recommended exposure limits may also be found in Section 16. Reference should also be made to publications such as the following:

1. *Code of Federal Regulations, Title 29, Labor*. With additions found in issues of the *Federal Register*.
2. *Code of Federal Regulations, Title 10, Energy*. With additions found in issues of the *Federal Register*. (Published by the U.S. Government Printing Office. Supt. of Documents.)
3. *Occupational Safety and Health Reporter* (latest edition with amendments and corrections), Bureau of National Affairs, Washington, D.C.

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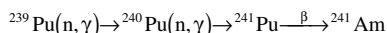
4. *Atomic Energy Law Reporter*, Commerce Clearing House, Chicago, IL.
5. *Nuclear Regulation Reporter*, Commerce Clearing House, Chicago, IL.
6. *TLVs® Threshold Limit Values for Chemical Substances and Physical Agents* is issued annually by the American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.
7. *The Sigma Aldrich Library of Regulatory and Safety Data. Vol. 3*, Robert E. Lenga and Kristine L. Volonpal, Sigma Chemical Co. and Aldrich Chemical Co., Inc. 1993.
8. *Hazardous Chemicals Desk Reference*, Richard J. Lewis, Sr., 4th ed., John Wiley & Sons, New York, Dec. 1997.
9. *Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens*, 3rd ed., Noyes Publications, 2001/2.
10. *Sax's Dangerous Properties of Industrial Materials*, Richard J. Lewis and N. Irving Sax, John Wiley & Sons, New York, 1999.
11. *World Wide Limits for Toxic and Hazardous Chemicals in Air, Water, and Soil*, Marshall Sittig, Noyes Publishers.

The prices of elements as indicated in this article are intended to be only a rough guide. Prices may vary, over time, widely with supplier, quantity, and purity.

Actinium — (Gr. *aktis, aktinos*, beam or ray), Ac; at. wt. (227); at. no. 89; m.p. 1051°C, b.p. 3200 ± 300°C (est.); sp. gr. 10.07 (calc.). Discovered by Andre Debierne in 1899 and independently by F. Giesel in 1902. Occurs naturally in association with uranium minerals. Thirty four isotopes and isomers are now recognized. All are radioactive. Actinium-227, a decay product of uranium-235, is an alpha and beta emitter with a 21.77-year half-life. Its principal decay products are thorium-227 (18.72-day half-life), radium-223 (11.4-day half-life), and a number of short-lived products including radon, bismuth, polonium, and lead isotopes. In equilibrium with its decay products, it is a powerful source of alpha rays. Actinium metal has been prepared by the reduction of actinium fluoride with lithium vapor at about 1100 to 1300°C. The chemical behavior of actinium is similar to that of the rare earths, particularly lanthanum. Purified actinium comes into equilibrium with its decay products at the end of 185 days, and then decays according to its 21.77-year half-life. It is about 150 times as active as radium, making it of value in the production of neutrons. Actinium-225, with a purity of 99%, is available from the Oak Ridge National Laboratory to holders of a permit for about \$500/millicurie, plus packing charges.

Aluminum — (*L. alumen, alum*), Al; at. wt. 26.981539(5); at. no. 13; f.p. 660.323°C; b.p. 2519°C; sp. gr. 2.6989 (20°C); valence 3. The ancient Greeks and Romans used *alum* in medicine as an astringent, and as a mordant in dyeing. In 1761 de Morveau proposed the name *alumine* for the base in alum, and Lavoisier, in 1787, thought this to be the oxide of a still undiscovered metal. Wohler is generally credited with having isolated the metal in 1827, although an impure form was prepared by Oersted two years earlier. In 1807, Davy proposed the name *aluminium* for the metal, undiscovered at that time, and later agreed to change it to *aluminum*. Shortly thereafter, the name *aluminium* was adopted to conform with the "ium" ending of most elements, and this spelling is now in use elsewhere in the world. *Aluminium* was also the accepted spelling in the U.S. until 1925, at which time the American Chemical Society officially decided to use the name *aluminum* thereafter in their publications. The method of obtaining aluminum metal by the electrolysis of alumina dissolved in *cryolite* was discovered in 1886 by Hall in the U.S. and at about the same time by Heroult in France. *Cryolite*, a natural ore found in Greenland, is no longer widely used in commercial production, but has been replaced by an artificial mixture of sodium, aluminum, and calcium fluorides. *Bauxite*, an impure hydrated oxide ore, is found in large deposits in Jamaica, Australia, Suriname, Guyana, Russia, Arkansas, and elsewhere. The Bayer process is most commonly used today to refine bauxite so it can be accommodated in the Hall-Heroult refining process, used to make most aluminum. Aluminum can now be produced from clay, but the process is not economically feasible at present. Aluminum is the most abundant metal to be found in the earth's crust (8.1%), but is never found free in nature. In addition to the minerals mentioned above, it is found in feldspars, granite, and in many other common minerals. Twenty-two isotopes and isomers are known. Natural aluminum is made of one isotope, ²⁷Al. Pure aluminum, a silvery-white metal, possesses many desirable characteristics. It is light, nontoxic, has a pleasing appearance, can easily be formed, machined, or cast, has a high thermal conductivity, and has excellent corrosion resistance. It is nonmagnetic and nonsparking, stands second among metals in the scale of malleability, and sixth in ductility. It is extensively used for kitchen utensils, outside building decoration, and in thousands of industrial applications where a strong, light, easily constructed material is needed. Although its electrical conductivity is only about 60% that of copper, it is used in electrical transmission lines because of its light weight. Pure aluminum is soft and lacks strength, but it can be alloyed with small amounts of copper, magnesium, silicon, manganese, and other elements to impart a variety of useful properties. These alloys are of vital importance in the construction of modern aircraft and rockets. Aluminum, evaporated in a vacuum, forms a highly reflective coating for both visible light and radiant heat. These coatings soon form a thin layer of the protective oxide and do not deteriorate as do silver coatings. They have found application in coatings for telescope mirrors, in making decorative paper, packages, toys, and in many other uses. The compounds of greatest importance are aluminum oxide, the sulfate, and the soluble sulfate with potassium (alum). The oxide, alumina, occurs naturally as ruby, sapphire, corundum, and emery, and is used in glassmaking and refractories. Synthetic ruby and sapphire have found application in the construction of lasers for producing coherent light. In 1852, the price of aluminum was about \$1200/kg, and just before Hall's discovery in 1886, about \$25/kg. The price rapidly dropped to 60¢ and has been as low as 33¢/kg. The price in December 2001 was about 64¢/lb or \$1.40/kg.

Americium — (the Americas), Am; at. wt. 243; at. no. 95; m.p. 1176°C; b.p. 2011°C; sp. gr. 13.67 (20°C); valence 2, 3, 4, 5, or 6. Americium was the fourth transuranium element to be discovered; the isotope ²⁴¹Am was identified by Seaborg, James, Morgan, and Ghiorso late in 1944 at the wartime Metallurgical Laboratory of the University of Chicago as the result of successive neutron capture reactions by plutonium isotopes in a nuclear reactor:



Since the isotope ²⁴¹Am can be prepared in relatively pure form by extraction as a decay product over a period of years from strongly neutron-bombarded plutonium, ²⁴¹Pu, this isotope is used for much of the chemical investigation of this element. Better suited is the isotope ²⁴³Am due to its longer half-life (7.37 × 10³ years as compared to 432.2 years for ²⁴¹Am). A mixture of the isotopes ²⁴¹Am, ²⁴²Am, and ²⁴³Am can be prepared by intense neutron irradiation of ²⁴¹Am according to the reactions ²⁴¹Am (n, γ) → ²⁴²Am (n, γ) → ²⁴³Am. Nearly isotopically pure ²⁴³Am can be prepared by a sequence of neutron bombardments and chemical separations as follows: neutron bombardment of ²⁴¹Am yields ²⁴²Pu by the reactions ²⁴¹Am (n, γ) → ²⁴²Am → ²⁴²Pu, after chemical separation the ²⁴²Pu can be transformed to ²⁴³Am via the reactions ²⁴²Pu (n, γ) → ²⁴³Pu → ²⁴³Am, and the ²⁴³Am can

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be chemically separated. Fairly pure ^{242}Pu can be prepared more simply by very intense neutron irradiation of ^{239}Pu as the result of successive neutron-capture reactions. Seventeen radioactive isotopes and isomers are now recognized. Americium metal has been prepared by reducing the trifluoride with barium vapor at 1000 to 1200°C or the dioxide by lanthanum metal. The luster of freshly prepared americium metal is white and more silvery than plutonium or neptunium prepared in the same manner. It appears to be more malleable than uranium or neptunium and tarnishes slowly in dry air at room temperature. Americium is thought to exist in two forms: an alpha form which has a double hexagonal close-packed structure and a loose-packed cubic beta form. Americium must be handled with great care to avoid personal contamination. As little as 0.03 μCi of ^{241}Am is the maximum permissible total body burden. The alpha activity from ^{241}Am is about three times that of radium. When gram quantities of ^{241}Am are handled, the intense gamma activity makes exposure a serious problem. Americium dioxide, AmO_2 , is the most important oxide. AmF_3 , AmF_4 , AmCl_3 , AmBr_3 , AmI_3 , and other compounds have been prepared. The isotope ^{241}Am has been used as a portable source for gamma radiography. It has also been used as a radioactive glass thickness gage for the flat glass industry, and as a source of ionization for smoke detectors. Americium-243 (99%) is available from the Oak Ridge National Laboratory at a cost of about \$750/g plus packing charges.

Antimony — (Gr. *anti* plus *monos* — a metal not found alone), Sb; at. wt. 121.760(1); at. no. 51; m.p. 630.63°C; b.p. 1587°C; sp. gr. 6.691 (20°C); valence 0, -3, +3, or +5. Antimony was recognized in compounds by the ancients and was known as a metal at the beginning of the 17th century and possibly much earlier. It is not abundant, but is found in over 100 mineral species. It is sometimes found native, but more frequently as the sulfide, *stibnite* (Sb_2S_3); it is also found as antimonides of the heavy metals, and as oxides. It is extracted from the sulfide by roasting to the oxide, which is reduced by salt and scrap iron; from its oxides it is also prepared by reduction with carbon. Two allotropic forms of antimony exist: the normal stable, metallic form, and the amorphous gray form. The so-called explosive antimony is an ill-defined material always containing an appreciable amount of halogen; therefore, it no longer warrants consideration as a separate allotrope. The yellow form, obtained by oxidation of *stibine*, SbH_3 , is probably impure, and is not a distinct form. Natural antimony is made of two stable isotopes, ^{121}Sb and ^{123}Sb . Forty five other radioactive isotopes and isomers are now recognized. Metallic antimony is an extremely brittle metal of a flaky, crystalline texture. It is bluish white and has a metallic luster. It is not acted on by air at room temperature, but burns brilliantly when heated with the formation of white fumes of Sb_2O_3 . It is a poor conductor of heat and electricity, and has a hardness of 3 to 3.5. Antimony, available commercially with a purity of 99.999 + %, is finding use in semiconductor technology for making infrared detectors, diodes, and Hall-effect devices. Commercial-grade antimony is widely used in alloys with percentages ranging from 1 to 20. It greatly increases the hardness and mechanical strength of lead. Batteries, antifriction alloys, type metal, small arms and tracer bullets, cable sheathing, and minor products use about half the metal produced. Compounds taking up the other half are oxides, sulfides, sodium antimonate, and antimony trichloride. These are used in manufacturing flame-proofing compounds, paints, ceramic enamels, glass, and pottery. Tartar emetic (hydrated potassium antimonyl tartate) has been used in medicine. Antimony and many of its compounds are toxic. Antimony costs about \$1.30/kg or about \$12/g (99.999%).

Argon — (Gr. *argos*, inactive), Ar; at. wt. 39.948(1); at. no. 18; m.p. -189.35°C; b.p. -185.85°C; t_c -122.28; density 1.7837 g/l. Its presence in air was suspected by Cavendish in 1785, discovered by Lord Rayleigh and Sir William Ramsay in 1894. The gas is prepared by fractionation of liquid air, the atmosphere containing 0.94% argon. The atmosphere of Mars contains 1.6% of ^{40}Ar and 5 p.p.m. of ^{36}Ar . Argon is two and one half times as soluble in water as nitrogen, having about the same solubility as oxygen. It is recognized by the characteristic lines in the red end of the spectrum. It is used in electric light bulbs and in fluorescent tubes at a pressure of about 400 Pa, and in filling photo tubes, glow tubes, etc. Argon is also used as an inert gas shield for arc welding and cutting, as a blanket for the production of titanium and other reactive elements, and as a protective atmosphere for growing silicon and germanium crystals. Argon is colorless and odorless, both as a gas and liquid. It is available in high-purity form. Commercial argon is available at a cost of about 3¢ per cubic foot. Argon is considered to be a very inert gas and is not known to form true chemical compounds, as do krypton, xenon, and radon. However, it does form a hydrate having a dissociation pressure of 105 atm at 0°C. Ion molecules such as $(\text{ArKr})^+$, $(\text{ArXe})^+$, $(\text{NeAr})^+$ have been observed spectroscopically. Argon also forms a clathrate with β -hydroquinone. This clathrate is stable and can be stored for a considerable time, but a true chemical bond does not exist. Van der Waals' forces act to hold the argon. In August 200, researchers at the University of Helsinki, Finland reported they made a new argon compound HArF by shining UV light on frozen argon that contained a small amount of HF. Naturally occurring argon is a mixture of three isotopes. Seventeen other radioactive isotopes are now known to exist. Commercial argon is priced at about \$70/300 cu. ft. or 8.5 cu. meters.

Arsenic — (L. *arsenicum*, Gr. *arsenikon*, yellow orpiment, identified with *arsenikos*, male, from the belief that metals were different sexes; Arabic, *Az-zernikh*, the orpiment from Persian *zerni-zar*, gold), As; at. wt. 74.92160(2); at. no. 33; valence -3, 0, +3 or +5. Elemental arsenic occurs in two solid modifications: yellow, and gray or metallic, with specific gravities of 1.97, and 5.73, respectively. Gray arsenic, the ordinary stable form, has a triple point of 817°C and sublimates at 614°C and has a critical temperature of 1400°C. Several other allotropic forms of arsenic are reported in the literature. It is believed that Albertus Magnus obtained the element in 1250 A.D. In 1649 Schroeder published two methods of preparing the element. It is found native, in the sulfides *realgar* and *orpiment*, as arsenides and sulfarsenides of heavy metals, as the oxide, and as arsenates. *Mispickel*, arsenopyrite, (FeSAs) is the most common mineral, from which on heating the arsenic sublimates leaving ferrous sulfide. The element is a steel gray, very brittle, crystalline, semimetallic solid; it tarnishes in air, and when heated is rapidly oxidized to arsenous oxide (As_2O_3) with the odor of garlic. Arsenic and its compounds are poisonous. Exposure to arsenic and its compounds should not exceed 0.2 mg/m³ as elemental As during an 8-h work day. These values, however, are being studied, and may be lowered. Arsenic is also used in bronzing, pyrotechny, and for hardening and improving the sphericity of shot. The most important compounds are white arsenic (As_2O_3), the sulfide, Paris green $3\text{Cu}(\text{AsO}_2)_2 \cdot \text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$, calcium arsenate, and lead arsenate; the last three have been used as agricultural insecticides and poisons. Marsh's test makes use of the formation and ready decomposition of arsine (AsH_3). Arsenic is available in high-purity form. It is finding increasing uses as a doping agent in solid-state devices such as transistors. Gallium arsenide is used as a laser material to convert electricity directly into coherent light. Natural arsenic is made of one isotope ^{75}As . Thirty other radioactive isotopes and isomers are known. Arsenic (99%) costs about \$75/50g. Purified arsenic (99.9995%) costs about \$50/g.

Astatine — (Gr. *astatos*, unstable), At; at. wt. (210); at. no. 85; m.p. 300°C (est.); valence probably 1, 3, 5, or 7. Synthesized in 1940 by D. R. Corson, K. R. MacKenzie, and E. Segre at the University of California by bombarding bismuth with alpha particles. The longest-lived isotope, ^{210}At , has a half-life of only 8.1 hours. Thirty-six other isotopes and isomers are now known. Minute quantities of ^{215}At , ^{218}At , and ^{219}At exist in equilibrium in nature with naturally occurring uranium and thorium isotopes, and traces of ^{217}At are equilibrium with ^{233}U and ^{239}Np resulting from interaction of thorium and uranium with naturally produced neutrons. The total amount of astatine present in the earth's crust, however, is probably less than 1 oz. Astatine can be produced by bombarding bismuth with energetic alpha particles to obtain the relatively long-lived $^{209-211}\text{At}$, which can be distilled

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from the target by heating it in air. Only about 0.05 μg of astatine has been prepared to date. The “time of flight” mass spectrometer has been used to confirm that this highly radioactive halogen behaves chemically very much like other halogens, particularly iodine. The interhalogen compounds AtI, AtBr, and AtCl are known to form, but it is not yet known if astatine forms diatomic astatine molecules. HAt and CH_3At (methyl astatide) have been detected. Astatine is said to be more metallic than iodine, and, like iodine, it probably accumulates in the thyroid gland. Workers at the Brookhaven National Laboratory have recently used reactive scattering in crossed molecular beams to identify and measure elementary reactions involving astatine.

Barium — (Gr. *barys*, heavy), Ba; at. wt. 137.327(7), at. no. 56; m.p. 727°C; b.p. 1897°C; sp. gr. 3.5 (20°C); valence 2. Baryta was distinguished from lime by Scheele in 1774; the element was discovered by Sir Humphrey Davy in 1808. It is found only in combination with other elements, chiefly in *barite* or *heavy spar* (sulfate) and *witherite* (carbonate) and is prepared by electrolysis of the chloride. Large deposits of barite are found in China, Germany, India, Morocco, and in the U.S. Barium is a metallic element, soft, and when pure is silvery white like lead; it belongs to the alkaline earth group, resembling calcium chemically. The metal oxidizes very easily and should be kept under petroleum or other suitable oxygen-free liquids to exclude air. It is decomposed by water or alcohol. The metal is used as a “getter” in vacuum tubes. The most important compounds are the peroxide (BaO_2), chloride, sulfate, carbonate, nitrate, and chlorate. Lithopone, a pigment containing barium sulfate and zinc sulfide, has good covering power, and does not darken in the presence of sulfides. The sulfate, as permanent white or *blanc fixe*, is also used in paint, in X-ray diagnostic work, and in glassmaking. *Barite* is extensively used as a weighting agent in oilwell drilling fluids, and also in making rubber. The carbonate has been used as a rat poison, while the nitrate and chlorate give green colors in pyrotechny. The impure sulfide phosphoresces after exposure to the light. The compounds and the metal are not expensive. Barium metal (99.2 + % pure) costs about \$3/g. All barium compounds that are water or acid soluble are poisonous. Naturally occurring barium is a mixture of seven stable isotopes. Thirty six other radioactive isotopes and isomers are known to exist.

Berkelium — (*Berkeley*, home of the University of California), Bk; at. wt. (247); at. no. 97; m.p. 1050°C; valence 3 or 4; sp. gr. 14 (est.). Berkelium, the eighth member of the actinide transition series, was discovered in December 1949 by Thompson, Ghiorso, and Seaborg, and was the fifth transuranium element synthesized. It was produced by cyclotron bombardment of milligram amounts of ^{241}Am with helium ions at Berkeley, California. The first isotope produced had a mass number of 243 and decayed with a half-life of 4.5 hours. Thirteen isotopes are now known and have been synthesized. The existence of ^{249}Bk , with a half-life of 320 days, makes it feasible to isolate berkelium in weighable amounts so that its properties can be investigated with macroscopic quantities. One of the first visible amounts of a pure berkelium compound, berkelium chloride, was produced in 1962. It weighed 3 billionth of a gram. Berkelium probably has not yet been prepared in elemental form, but it is expected to be a silvery metal, easily soluble in dilute mineral acids, and readily oxidized by air or oxygen at elevated temperatures to form the oxide. X-ray diffraction methods have been used to identify the following compounds: BkO_2 , BkO_3 , BkF_3 , BkCl , and BkOCl . As with other actinide elements, berkelium tends to accumulate in the skeletal system. The maximum permissible body burden of ^{249}Bk in the human skeleton is about 0.0004 μg . Because of its rarity, berkelium presently has no commercial or technological use. Berkelium most likely resembles terbium with respect to chemical properties. Berkelium-249 is available from O.R.N.L. at a cost of \$185/ μg plus packing charges.

Beryllium — (Gr. *beryllos*, *beryl*; also called Glucinium or Glucinum, Gr. *glykys*, sweet), Be; at. wt. 9.012182(3); at. no. 4; m.p. 1287°C; b.p. 2471°C; sp. gr. 1.848 (20°C); valence 2. Discovered as the oxide by Vauquelin in beryl and in emeralds in 1798. The metal was isolated in 1828 by Wohler and by Bussy independently by the action of potassium on beryllium chloride. Beryllium is found in some 30 mineral species, the most important of which are *bertrandite*, *beryl*, *chrysoberyl*, and *phenacite*. *Aquamarine* and *emerald* are precious forms of *beryl*. Beryllium minerals are found in the U.S., Brazil, Russia, Kazakhstan, and elsewhere. Colombia is known for its emeralds. *Beryl* ($3\text{BeO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$) and *bertrandite* ($4\text{BeO} \cdot 2\text{SiO}_2 \cdot \text{H}_2\text{O}$) are the most important commercial sources of the element and its compounds. Most of the metal is now prepared by reducing beryllium fluoride with magnesium metal. Beryllium metal did not become readily available to industry until 1957. The metal, steel gray in color, has many desirable properties. It is one of the lightest of all metals, and has one of the highest melting points of the light metals. Its modulus of elasticity is about one third greater than that of steel. It resists attack by concentrated nitric acid, has excellent thermal conductivity, and is nonmagnetic. It has a high permeability to X-rays, and when bombarded by alpha particles, as from radium or polonium, neutrons are produced in the ratio of about 30 neutrons/million alpha particles. At ordinary temperatures beryllium resists oxidation in air, although its ability to scratch glass is probably due to the formation of a thin layer of the oxide. Beryllium is used as an alloying agent in producing beryllium copper which is extensively used for springs, electrical contacts, spot-welding electrodes, and nonsparking tools. It has found application as a structural material for high-speed aircraft, missiles, spacecraft, and communication satellites. It is being used in the windshield frame, brake discs, support beams, and other structural components of the space shuttle. Because beryllium is relatively transparent to X-rays, ultra-thin Be-foil is finding use in X-ray lithography for reproduction of microminiature integrated circuits. Natural beryllium is made of ^9Be and is stable. Eight other radioactive isotopes are known.

Beryllium is used in nuclear reactors as a reflector or moderator for it has a low thermal neutron absorption cross section. It is used in gyroscopes, computer parts, and instruments where lightness, stiffness, and dimensional stability are required. The oxide has a very high melting point and is also used in nuclear work and ceramic applications. Beryllium and its salts are toxic and should be handled with the greatest of care. Beryllium and its compounds should not be tasted to verify the sweetish nature of beryllium (as did early experimenters). The metal, its alloys, and its salts can be handled safely if certain work codes are observed, but no attempt should be made to work with beryllium before becoming familiar with proper safeguards. Beryllium metal is available at a cost of about \$5/g (99.5% pure).

Bismuth — (Ger. *Weisse Masse*, white mass; later *Wisuth* and *Bisemutum*), Bi; at. wt. 208.98038(2); at. no. 83; m.p. 271.4°C; b.p. 1564°C; sp. gr. 9.747 (20°C); valence 3 or 5. In early times bismuth was confused with tin and lead. Claude Geoffroy the Younger showed it to be distinct from lead in 1753. It is a white crystalline, brittle metal with a pinkish tinge. It occurs native. The most important ores are *bismuthinite* or bismuth glance (Bi_2S_3) and *bismite* (Bi_2O_3). Peru, Japan, Mexico, Bolivia, and Canada are major bismuth producers. Much of the bismuth produced in the U.S. is obtained as a by-product in refining lead, copper, tin, silver, and gold ores. Bismuth is the most diamagnetic of all metals, and the thermal conductivity is lower than any metal, except mercury. It has a high electrical resistance, and has the highest Hall effect of any metal (i.e., greatest increase in electrical resistance when placed in a magnetic field). “Bismanol” is a permanent magnet of high coercive force, made of MnBi, by the U.S. Naval Surface Weapons Center. Bismuth expands 3.32% on solidification. This property makes bismuth alloys particularly suited to the making of sharp castings of objects subject to damage by high temperatures. With other metals such as tin, cadmium, etc., bismuth forms low-melting alloys which are extensively used for safety devices in fire detection and extinguishing systems. Bismuth is used in producing malleable irons and is finding use as a catalyst for making acrylic fibers. When bismuth is heated in air it burns with a blue flame, forming yellow fumes of the oxide. The metal is also used as a thermocouple material, and has found application as a carrier for U^{235} or U^{233} fuel in atomic reactors. Its soluble salts are characterized by forming

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insoluble basic salts on the addition of water, a property sometimes used in detection work. Bismuth oxychloride is used extensively in cosmetics. Bismuth subnitrate and subcarbonate are used in medicine. Natural bismuth contains only one isotope ^{209}Bi . Forty-four isotopes and isomers of bismuth are known. Bismuth metal (99.5%) costs about \$250/kg.

Bohrium — (Named after Niels Bohr [1885-1962], Danish atomic and nuclear physicist.) Bh; at. wt. [262], at. no. 107. Bohrium is expected to have chemical properties similar to rhenium. This element was synthesized and unambiguously identified in 1981 using the Universal Linear Accelerator (UNILAC) at the Gesellschaft für Schwerionenforschung (G.S.I.) in Darmstadt, Germany. The discovery team was led by Armbruster and Münzenberg. The reaction producing the element was proposed and applied earlier by a Dubna Group led by Oganessian in 1976. A target of ^{209}Bi was bombarded by a beam of ^{54}Cr ions. In 1983 experiments at Dubna using the 157-inch cyclotron, produced $^{262}107$ by the reaction $^{209}\text{Bi} + ^{54}\text{Cr}$. The alpha decay of ^{246}Cf , the sixth member in the decay chain of $^{262}107$, served to establish a 1-neutron reaction channel. The IUPAC adopted the name **Bohrium** with the symbol Bh for Element 107 in August 1997. Five isotopes of bohrium are now recognized. One isotope of bohrium appears to have a relatively long life of 15 seconds. Work on this relatively long-lived isotope has been performed with the 88-inch cyclotron at the Lawrence-Berkeley National Laboratory.

Boron — (Ar. *Buraq*, Pers. *Burah*), B; at. wt. 10.811(7); at. no. 5; m.p. 2075°C; b.p. 4000°C; sp. gr. of crystals 2.34, of amorphous variety 2.37; valence 3. Boron compounds have been known for thousands of years, but the element was not discovered until 1808 by Sir Humphry Davy and by Gay-Lussac and Thenard. The element is not found free in nature, but occurs as orthoboric acid usually in certain volcanic spring waters and as borates in *borax* and *colemanite*. *Ulexite*, another boron mineral, is interesting as it is nature's own version of "fiber optics." Important sources of boron are the ores *rasorite* (*kermitite*) and *tincal* (*borax ore*). Both of these ores are found in the Mojave Desert. *Tincal* is the most important source of boron from the Mojave. Extensive *borax* deposits are also found in Turkey. Boron exists naturally as 19.9% ^{10}B isotope and 80.1% ^{11}B isotope. Ten other isotopes of boron are known. High-purity crystalline boron may be prepared by the vapor phase reduction of boron trichloride or triboride with hydrogen on electrically heated filaments. The impure, or amorphous, boron, a brownish-black powder, can be obtained by heating the trioxide with magnesium powder. Boron of 99.9999% purity has been produced and is available commercially. Elemental boron has an energy band gap of 1.50 to 1.56 eV, which is higher than that of either silicon or germanium. It has interesting optical characteristics, transmitting portions of the infrared, and is a poor conductor of electricity at room temperature, but a good conductor at high temperature. Amorphous boron is used in pyrotechnic flares to provide a distinctive green color, and in rockets as an igniter. By far the most commercially important boron compound in terms of dollar sales is $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$. This pentahydrate is used in very large quantities in the manufacture of insulation fiberglass and sodium perborate bleach. Boric acid is also an important boron compound with major markets in textile fiberglass and in cellulose insulation as a flame retardant. Next in order of importance is borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) which is used principally in laundry products. Use of borax as a mild antiseptic is minor in terms of dollars and tons. Boron compounds are also extensively used in the manufacture of borosilicate glasses. The isotope boron-10 is used as a control for nuclear reactors, as a shield for nuclear radiation, and in instruments used for detecting neutrons. Boron nitride has remarkable properties and can be used to make a material as hard as diamond. The nitride also behaves like an electrical insulator but conducts heat like a metal. It also has lubricating properties similar to graphite. The hydrides are easily oxidized with considerable energy liberation, and have been studied for use as rocket fuels. Demand is increasing for boron filaments, a high-strength, lightweight material chiefly employed for advanced aerospace structures. Boron is similar to carbon in that it has a capacity to form stable covalently bonded molecular networks. Carboranes, metalboranes, phosphacarboranes, and other families comprise thousands of compounds. Crystalline boron (99.5%) costs about \$6/g. Amorphous boron (94–96%) costs about \$1.50/g. Elemental boron and the borates are not considered to be toxic, and they do not require special care in handling. However, some of the more exotic boron hydrogen compounds are definitely toxic and do require care.

Bromine — (Gr. *bromos*, stench), Br; at. wt. 79.904(1); at. no. 35; m.p. -7.2°C ; b.p. 58.8°C ; t_c 315°C ; density of gas 7.59 g/l, liquid 3.12 (20°C); valence 1, 3, 5, or 7. Discovered by Balard in 1826, but not prepared in quantity until 1860. A member of the halogen group of elements, it is obtained from natural brines from wells in Michigan and Arkansas. Little bromine is extracted today from seawater, which contains only about 85 ppm. Bromine is the only liquid nonmetallic element. It is a heavy, mobile, reddish-brown liquid, volatilizing readily at room temperature to a red vapor with a strong disagreeable odor, resembling chlorine, and having a very irritating effect on the eyes and throat; it is readily soluble in water or carbon disulfide, forming a red solution, is less active than chlorine but more so than iodine; it unites readily with many elements and has a bleaching action; when spilled on the skin it produces painful sores. It presents a serious health hazard, and maximum safety precautions should be taken when handling it. Much of the bromine output in the U.S. was used in the production of ethylene dibromide, a lead scavenger used in making gasoline antiknock compounds. Lead in gasoline, however, has been drastically reduced, due to environmental considerations. This will greatly affect future production of bromine. Bromine is also used in making fumigants, flameproofing agents, water purification compounds, dyes, medicinals, sanitizers, inorganic bromides for photography, etc. Organic bromides are also important. Natural bromine is made of two isotopes, ^{79}Br and ^{81}Br . Thirty-four isotopes and isomers are known. Bromine (99.8%) costs about \$70/kg.

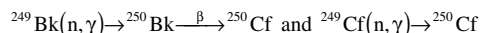
Cadmium — (L. *cadmia*; Gr. *kadmeia*—ancient name for calamine, zinc carbonate), Cd; at. wt. 112.411(8); at. no. 48; m.p. 321.07°C ; b.p. 767°C ; sp. gr. 8.65 (20°C); valence 2. Discovered by Stromeyer in 1817 from an impurity in zinc carbonate. Cadmium most often occurs in small quantities associated with zinc ores, such as *sphalerite* (ZnS). *Greenockite* (CdS) is the only mineral of any consequence bearing cadmium. Almost all cadmium is obtained as a by-product in the treatment of zinc, copper, and lead ores. It is a soft, bluish-white metal which is easily cut with a knife. It is similar in many respects to zinc. It is a component of some of the lowest melting alloys; it is used in bearing alloys with low coefficients of friction and great resistance to fatigue; it is used extensively in electroplating, which accounts for about 60% of its use. It is also used in many types of solder, for standard E.M.F. cells, for Ni-Cd batteries, and as a barrier to control atomic fission. The market for Ni-Cd batteries is expected to grow significantly in the next few years. Cadmium compounds are used in black and white television phosphors and in blue and green phosphors for color TV tubes. It forms a number of salts, of which the sulfate is most common; the sulfide is used as a yellow pigment. Cadmium and solutions of its compounds are toxic. Failure to appreciate the toxic properties of cadmium may cause workers to be unwittingly exposed to dangerous fumes. Some silver solders, for example, contain cadmium and should be handled with care. Serious toxicity problems have been found from long-term exposure and work with cadmium plating baths. Cadmium is present in certain phosphate rocks. This has raised concerns that the long-term use of certain phosphate fertilizers might pose a health hazard from levels of cadmium that might enter the food chain. In 1927 the International Conference on Weights and Measures redefined the meter in terms of the wavelength of the red cadmium spectral line (i.e. $1\text{ m} = 1,553,164.13$ wavelengths). This definition has been changed (see under

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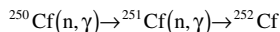
Krypton). The current price of cadmium is about 50¢/g (99.5%). It is available in high purity form for about \$550/kg. Natural cadmium is made of eight isotopes. Thirty four other isotopes and isomers are now known and recognized.

Calcium — (L. *calx*, lime), Ca; at. wt. 40.078(4); at. no. 20; m.p. 842°C; b.p. 1484°C; sp. gr. 1.55 (20°C); valence 2. Though lime was prepared by the Romans in the first century under the name *calx*, the metal was not discovered until 1808. After learning that Berzelius and Pontin prepared calcium amalgam by electrolyzing lime in mercury, Davy was able to isolate the impure metal. Calcium is a metallic element, fifth in abundance in the earth's crust, of which it forms more than 3%. It is an essential constituent of leaves, bones, teeth, and shells. Never found in nature uncombined, it occurs abundantly as *limestone* (CaCO₃), *gypsum* (CaSO₄·2H₂O), and *fluorite* (CaF₂); *apatite* is the fluorophosphate or chlorophosphate of calcium. The metal has a silvery color, is rather hard, and is prepared by electrolysis of the fused chloride to which calcium fluoride is added to lower the melting point. Chemically it is one of the alkaline earth elements; it readily forms a white coating of oxide in air, reacts with water, burns with a yellow-red flame, forming largely the oxide. The metal is used as a reducing agent in preparing other metals such as thorium, uranium, zirconium, etc., and is used as a deoxidizer, desulfurizer, and inclusion modifier for various ferrous and nonferrous alloys. It is also used as an alloying agent for aluminum, beryllium, copper, lead, and magnesium alloys, and serves as a "getter" for residual gases in vacuum tubes, etc. Its natural and prepared compounds are widely used. Quicklime (CaO), made by heating limestone and changed into slaked lime by the careful addition of water, is the great cheap base of chemical industry with countless uses. Mixed with sand it hardens as mortar and plaster by taking up carbon dioxide from the air. Calcium from limestone is an important element in Portland cement. The solubility of the carbonate in water containing carbon dioxide causes the formation of caves with stalactites and stalagmites and is responsible for hardness in water. Other important compounds are the carbide (CaC₂), chloride (CaCl₂), cyanamide (CaCN₂), hypochlorite (Ca(OCl)₂), nitrate (Ca(NO₃)₂), and sulfide (CaS). Calcium sulfide is phosphorescent after being exposed to light. Natural calcium contains six isotopes. Sixteen other radioactive isotopes are known. Metallic calcium (99.5%) costs about \$200/kg.

Californium — (State and University of California), Cf; at. wt. (251); m.p. 900°C; at. no. 98. Californium, the sixth transuranium element to be discovered, was produced by Thompson, Street, Ghioirso, and Seaborg in 1950 by bombarding microgram quantities of ²⁴²Cm with 35 MeV helium ions in the Berkeley 60-inch cyclotron. Californium (III) is the only ion stable in aqueous solutions, all attempts to reduce or oxidize californium (III) having failed. The isotope ²⁴⁹Cf results from the beta decay of ²⁴⁹Bk while the heavier isotopes are produced by intense neutron irradiation by the reactions:



followed by



The existence of the isotopes ²⁴⁹Cf, ²⁵⁰Cf, ²⁵¹Cf, and ²⁵²Cf makes it feasible to isolate californium in weighable amounts so that its properties can be investigated with macroscopic quantities. Californium-252 is a very strong neutron emitter. One microgram releases 170 million neutrons per minute, which presents biological hazards. Proper safeguards should be used in handling californium. Twenty isotopes of californium are now recognized. ²⁴⁹Cf and ²⁵²Cf have half-lives of 351 years and 900 years, respectively. In 1960 a few tenths of a microgram of californium trichloride, CfCl₃, californium oxychloride, CfOCl, and californium oxide, Cf₂O₃, were first prepared. Reduction of californium to its metallic state has not yet been accomplished. Because californium is a very efficient source of neutrons, many new uses are expected for it. It has already found use in neutron moisture gages and in well-logging (the determination of water and oil-bearing layers). It is also being used as a portable neutron source for discovery of metals such as gold or silver by on-the-spot activation analysis. ²⁵²Cf is now being offered for sale by the Oak Ridge National Laboratory (O.R.N.L.) at a cost of \$60/μg and ²⁴⁹Cf at a cost of \$185/μg plus packing charges. It has been suggested that californium may be produced in certain stellar explosions, called *supernovae*, for the radioactive decay of ²⁵⁴Cf (55-day half-life) agrees with the characteristics of the light curves of such explosions observed through telescopes. This suggestion, however, is questioned. Californium is expected to have chemical properties similar to dysprosium.

Carbon — (L. *carbo*, charcoal), C; at. wt. 12.0107(8); at. no. 6; sublimes at 3642°C; triple point (graphite-liquid-gas), 4492°C at a pressure of 101.325 kPa; sp. gr. amorphous 1.8 to 2.1, graphite 1.9 to 2.3, diamond 3.15 to 3.53 (depending on variety); gem diamond 3.513 (25°C); valence 2, 3, or 4. Carbon, an element of prehistoric discovery, is very widely distributed in nature. It is found in abundance in the sun, stars, comets, and atmospheres of most planets. Carbon in the form of microscopic diamonds is found in some meteorites. Natural diamonds are found in *kimberlite* or *lamproite* of ancient formations called "pipes," such as found in South Africa, Arkansas, and elsewhere. Diamonds are now also being recovered from the ocean floor off the Cape of Good Hope. About 30% of all industrial diamonds used in the U.S. are now made synthetically. The energy of the sun and stars can be attributed at least in part to the well-known carbon-nitrogen cycle. Carbon is found free in nature in three allotropic forms: amorphous, graphite, and diamond. A fourth form, known as "white" carbon, is now thought to exist. Graphite is one of the softest known materials while diamond is one of the hardest. Graphite exists in two forms: alpha and beta. These have identical physical properties, except for their crystal structure. Naturally occurring graphites are reported to contain as much as 30% of the rhombohedral (beta) form, whereas synthetic materials contain only the alpha form. The hexagonal alpha type can be converted to the beta by mechanical treatment, and the beta form reverts to the alpha on heating it above 1000°C. In 1969 a new allotropic form of carbon was produced during the sublimation of pyrolytic graphite at low pressures. Under free-vaporization conditions above ~2550 K, "white" carbon forms as small transparent crystals on the edges of the basal planes of graphite. The interplanar spacings of "white" carbon are identical to those of carbon form noted in the graphitic gneiss from the Ries (meteoritic) Crater of Germany. "White" carbon is a transparent birefringent material. Little information is presently available about this allotrope. Of recent interest is the discovery of all-carbon molecules, known as "buckyballs" or fullerenes, which have a number of unusual properties. These interesting molecules, consisting of 60 or 70 carbon atoms linked together, seem capable of withstanding great pressure and trapping foreign atoms inside their network of carbon. They are said to be capable of magnetism and superconductivity and have potential as a nonlinear optical material. Buckyball films are reported to remain superconductive at temperatures as high as 45 K. In combination, carbon is found as carbon dioxide in the atmosphere of the earth and dissolved in all natural waters. It is a component of great rock masses in the form of carbonates of calcium (limestone), magnesium, and iron. Coal, petroleum, and natural gas are chiefly hydrocarbons. Carbon is unique among the elements in the vast number and variety of compounds it can form. With hydrogen, oxygen, nitrogen, and other elements, it forms a very large number of compounds, carbon atom often being linked to carbon atom. There are close to ten million known carbon

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compounds, many thousands of which are vital to organic and life processes. Without carbon, the basis for life would be impossible. While it has been thought that silicon might take the place of carbon in forming a host of similar compounds, it is now not possible to form stable compounds with very long chains of silicon atoms. The atmosphere of Mars contains 96.2% CO₂. Some of the most important compounds of carbon are carbon dioxide (CO₂), carbon monoxide (CO), carbon disulfide (CS₂), chloroform (CHCl₃), carbon tetrachloride (CCl₄), methane (CH₄), ethylene (C₂H₄), acetylene (C₂H₂), benzene (C₆H₆), ethyl alcohol (C₂H₅OH), acetic acid (CH₃COOH), and their derivatives. Carbon has fifteen isotopes. Natural carbon consists of 98.89% ¹²C and 1.11% ¹³C. In 1961 the International Union of Pure and Applied Chemistry adopted the isotope carbon-12 as the basis for atomic weights. Carbon-14, an isotope with a half-life of 5715 years, has been widely used to date such materials as wood, archeological specimens, etc. A new brittle form of carbon, known as “glassy carbon”, has been developed. It can be obtained with high purity. It has a high resistance to corrosion, has good thermal stability, and is structurally impermeable to both gases and liquids. It has a randomized structure, making it useful in ultra-high technology applications, such as crystal growing, crucibles for high-temperature use, etc. Glassy carbon is available at a cost of about \$35/10gms. Fullerene powder is available at a cost of about \$55/10mg (99% C₁₀). Diamond powder (99.9%) costs about \$40/g

Cerium — (named for the asteroid *Ceres*, which was discovered in 1801 only 2 years before the element), Ce; at. wt. 140.115(4); at. no. 58; m.p. 798°C; b.p. 3424°C; sp. gr. 6.770 (25°C); valence 3 or 4. Discovered in 1803 by Klaproth and by Berzelius and Hisinger; metal prepared by Hillebrand and Norton in 1875. Cerium is the most abundant of the metals of the so-called rare earths. It is found in a number of minerals including *allanite* (also known as *orthite*), *monazite*, *bastnasite*, *cerite*, and *samarskite*. Monazite and bastnasite are presently the two most important sources of cerium. Large deposits of monazite found on the beaches of Travancore, India, in river sands in Brazil, and deposits of *allanite* in the western United States, and *bastnasite* in Southern California will supply cerium, thorium, and the other rare-earth metals for many years to come. Metallic cerium is prepared by metallothermic reduction techniques, such as by reducing cerous fluoride with calcium, or by electrolysis of molten cerous chloride or other cerous halides. The metallothermic technique is used to produce high-purity cerium. Cerium is especially interesting because of its variable electronic structure. The energy of the inner 4f level is nearly the same as that of the outer or valence electrons, and only small amounts of energy are required to change the relative occupancy of these electronic levels. This gives rise to dual valency states. For example, a volume change of about 10% occurs when cerium is subjected to high pressures or low temperatures. It appears that the valence changes from about 3 to 4 when it is cooled or compressed. The low temperature behavior of cerium is complex. Four allotropic modifications are thought to exist: cerium at room temperature and at atmospheric pressure is known as γ cerium. Upon cooling to -16°C, γ cerium changes to β cerium. The remaining γ cerium starts to change to α cerium when cooled to -172°C, and the transformation is complete at -269°C. α Cerium has a density of 8.16; δ cerium exists above 726°C. At atmospheric pressure, liquid cerium is more dense than its solid form at the melting point. Cerium is an iron-gray lustrous metal. It is malleable, and oxidizes very readily at room temperature, especially in moist air. Except for europium, cerium is the most reactive of the “rare-earth” metals. It slowly decomposes in cold water, and rapidly in hot water. Alkali solutions and dilute and concentrated acids attack the metal rapidly. The pure metal is likely to ignite if scratched with a knife. Ceric salts are orange red or yellowish; cerous salts are usually white. Cerium is a component of misch metal, which is extensively used in the manufacture of pyrophoric alloys for cigarette lighters, etc. Natural cerium is stable and contains four isotopes. Thirty-two other radioactive isotopes and isomers are known. While cerium is not radioactive, the impure commercial grade may contain traces of thorium, which is radioactive. The oxide is an important constituent of incandescent gas mantles and it is emerging as a hydrocarbon catalyst in “self-cleaning” ovens. In this application it can be incorporated into oven walls to prevent the collection of cooking residues. As ceric sulfate it finds extensive use as a volumetric oxidizing agent in quantitative analysis. Cerium compounds are used in the manufacture of glass, both as a component and as a decolorizer. The oxide is finding increased use as a glass polishing agent instead of rouge, for it is much faster than rouge in polishing glass surfaces. Cerium compounds are finding use in automobile exhaust catalysts. Cerium is also finding use in making permanent magnets. Cerium, with other rare earths, is used in carbon-arc lighting, especially in the motion picture industry. It is also finding use as an important catalyst in petroleum refining and in metallurgical and nuclear applications. In small lots, cerium costs about \$5/g (99.9%).

Cesium — (*L. caesius*, sky blue), Cs; at. wt. 132.90545(2); at. no. 55; m.p. 28.44°C; b.p. 671°C; sp. gr. 1.873 (20°C); valence 1. Cesium was discovered spectroscopically by Bunsen and Kirchhoff in 1860 in mineral water from Durkheim. Cesium, an alkali metal, occurs in *lepidolite*, *pollucite* (a hydrated silicate of aluminum and cesium), and in other sources. One of the world's richest sources of cesium is located at Bernic Lake, Manitoba. The deposits are estimated to contain 300,000 tons of pollucite, averaging 20% cesium. It can be isolated by electrolysis of the fused cyanide and by a number of other methods. Very pure, gas-free cesium can be prepared by thermal decomposition of cesium azide. The metal is characterized by a spectrum containing two bright lines in the blue along with several others in the red, yellow, and green. It is silvery white, soft, and ductile. It is the most electropositive and most alkaline element. Cesium, gallium, and mercury are the only three metals that are liquid at room temperature. Cesium reacts explosively with cold water, and reacts with ice at temperatures above -116°C. Cesium hydroxide, the strongest base known, attacks glass. Because of its great affinity for oxygen the metal is used as a “getter” in electron tubes. It is also used in photoelectric cells, as well as a catalyst in the hydrogenation of certain organic compounds. The metal has recently found application in ion propulsion systems. Cesium is used in atomic clocks, which are accurate to 5 s in 300 years. A second of time is now defined as being the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyper-fine levels of the ground state of the cesium-133 atom. Its chief compounds are the chloride and the nitrate. Cesium has 52 isotopes and isomers with masses ranging from 112 to 148. The present price of cesium is about \$50/g (99.98%) sealed in a glass ampoule.

Chlorine — (*Gr. chloros*, greenish yellow), Cl; at. wt. 35.4527(9); at. no. 17; m.p. -101.5°C; b.p. -34.04°C; t_c 143.8°C; density 3.214 g/l; sp. gr. 1.56 (-33.6°C); valence 1, 3, 5, or 7. Discovered in 1774 by Scheele, who thought it contained oxygen; named in 1810 by Davy, who insisted it was an element. In nature it is found in the combined state only, chiefly with sodium as common salt (NaCl), *carallite* (KMgCl₃·6H₂O), and *sylvite* (KCl). It is a member of the halogen (salt-forming) group of elements and is obtained from chlorides by the action of oxidizing agents and more often by electrolysis; it is a greenish-yellow gas, combining directly with nearly all elements. At 10°C one volume of water dissolves 3.10 volumes of chlorine, at 30°C only 1.77 volumes. Chlorine is widely used in making many everyday products. It is used for producing safe drinking water the world over. Even the smallest water supplies are now usually chlorinated. It is also extensively used in the production of paper products, dyestuffs, textiles, petroleum products, medicines, antiseptics, insecticides, foodstuffs, solvents, paints, plastics, and many other consumer products. Most of the chlorine produced is used in the manufacture of chlorinated compounds for sanitation, pulp bleaching, disinfectants, and textile processing. Further use is in the manufacture of chlorates, chloroform, carbon tetrachloride, and in the extraction of bromine. Organic chemistry demands much from chlorine, both as an oxidizing agent and in substitution, since it often brings desired properties in an organic compound when substituted for hydrogen, as in one form

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of synthetic rubber. Chlorine is a respiratory irritant. The gas irritates the mucous membranes and the liquid burns the skin. As little as 3.5 ppm can be detected as an odor, and 1000 ppm is likely to be fatal after a few deep breaths. It was used as a war gas in 1915. Natural chlorine contains two isotopes. Twenty other isotopes and isomers are known.

Chromium — (Gr. *chroma*, color), Cr; at. wt. 51.9961(6); at. no. 24; m.p. 1907°C; b.p. 2671°C; sp. gr. 7.18 to 7.20 (20°C); valence chiefly 2, 3, or 6. Discovered in 1797 by Vauquelin, who prepared the metal the next year, chromium is a steel-gray, lustrous, hard metal that takes a high polish. The principal ore is *chromite* (FeCr_2O_4), which is found in Zimbabwe, Russia, South Africa, Turkey, Iran, Albania, Finland, Democratic Republic of Madagascar, the Philippines, and elsewhere. The U.S. has no appreciable chromite ore reserves. The metal is usually produced by reducing the oxide with aluminum. Chromium is used to harden steel, to manufacture stainless steel, and to form many useful alloys. Much is used in plating to produce a hard, beautiful surface and to prevent corrosion. Chromium is used to give glass an emerald green color. It finds wide use as a catalyst. All compounds of chromium are colored; the most important are the chromates of sodium and potassium (K_2CrO_4) and the dichromates ($\text{K}_2\text{Cr}_2\text{O}_7$) and the potassium and ammonium chrome alums, as $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. The dichromates are used as oxidizing agents in quantitative analysis, also in tanning leather. Other compounds are of industrial value; lead chromate is chrome yellow, a valued pigment. Chromium compounds are used in the textile industry as mordants, and by the aircraft and other industries for anodizing aluminum. The refractory industry has found chromite useful for forming bricks and shapes, as it has a high melting point, moderate thermal expansion, and stability of crystalline structure. Chromium is an essential trace element for human health. Many chromium compounds, however, are acutely toxic, chronically toxic, and may be carcinogenic. They should be handled with proper safeguards. Natural chromium contains four isotopes. Twenty other isotopes are known. Chromium metal (99.95%) costs about \$1000/kg. Commercial grade chromium (99%) costs about \$75/kg.

Cobalt — (*Kobald*, from the German, goblin or evil spirit, *cobalos*, Greek, mine), Co; at. wt. 58.93320(1); at. no. 27; m.p. 1495°C; b.p. 2927°C; sp. gr. 8.9 (20°C); valence 2 or 3. Discovered by Brandt about 1735. Cobalt occurs in the mineral *cobaltite*, *smaltite*, and *erythrite*, and is often associated with nickel, silver, lead, copper, and iron ores, from which it is most frequently obtained as a by-product. It is also present in meteorites. Important ore deposits are found in Congo-Kinshasa, Australia, Zambia, Russia, Canada, and elsewhere. The U.S. Geological Survey has announced that the bottom of the north central Pacific Ocean may have cobalt-rich deposits at relatively shallow depths in waters close to the Hawaiian Islands and other U.S. Pacific territories. Cobalt is a brittle, hard metal, closely resembling iron and nickel in appearance. It has a magnetic permeability of about two thirds that of iron. Cobalt tends to exist as a mixture of two allotropes over a wide temperature range; the β -form predominates below 400°C, and the α above that temperature. The transformation is sluggish and accounts in part for the wide variation in reported data on physical properties of cobalt. It is alloyed with iron, nickel and other metals to make Alnico, an alloy of unusual magnetic strength with many important uses. Stellite alloys, containing cobalt, chromium, and tungsten, are used for high-speed, heavy-duty, high temperature cutting tools, and for dies. Cobalt is also used in other magnet steels and stainless steels, and in alloys used in jet turbines and gas turbine generators. The metal is used in electroplating because of its appearance, hardness, and resistance to oxidation. The salts have been used for centuries for the production of brilliant and permanent blue colors in porcelain, glass, pottery, tiles, and enamels. It is the principal ingredient in Sevre's and Thenard's blue. A solution of the chloride ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$) is used as sympathetic ink. The cobalt amines are of interest; the oxide and the nitrate are important. Cobalt carefully used in the form of the chloride, sulfate, acetate, or nitrate has been found effective in correcting a certain mineral deficiency disease in animals. Soils should contain 0.13 to 0.30 ppm of cobalt for proper animal nutrition. Cobalt is found in Vitamin B-12, which is essential for human nutrition. Cobalt of 99.9+% purity is priced at about \$250/kg. Cobalt-60, an artificial isotope, is an important gamma ray source, and is extensively used as a tracer and a radiotherapeutic agent. Single compact sources of Cobalt-60 vary from about \$1 to \$10/curie, depending on quantity and specific activity. Thirty isotopes and isomers of cobalt are known.

Columbium — See Niobium.

Copper — (L. *cuprum*, from the island of Cyprus), Cu; at. wt. 63.546(3); at. no. 29; f.p. 1084.62 °C; b.p. 2562°C; sp. gr. 8.96 (20°C); valence 1 or 2. The discovery of copper dates from prehistoric times. It is said to have been mined for more than 5000 years. It is one of man's most important metals. Copper is reddish colored, takes on a bright metallic luster, and is malleable, ductile, and a good conductor of heat and electricity (second only to silver in electrical conductivity). The electrical industry is one of the greatest users of copper. Copper occasionally occurs native, and is found in many minerals such as *cuprite*, *malachite*, *azurite*, *chalcocopyrite*, and *bornite*. Large copper ore deposits are found in the U.S., Chile, Zambia, Zaire, Peru, and Canada. The most important copper ores are the sulfides, oxides, and carbonates. From these, copper is obtained by smelting, leaching, and by electrolysis. Its alloys, brass and bronze, long used, are still very important; all American coins are now copper alloys; monel and gun metals also contain copper. The most important compounds are the oxide and the sulfate, blue vitriol; the latter has wide use as an agricultural poison and as an algicide in water purification. Copper compounds such as Fehling's solution are widely used in analytical chemistry in tests for sugar. High-purity copper (99.999 + %) is readily available commercially. The price of commercial copper has fluctuated widely. The price of copper in December 2001 was about \$1.50/kg. Natural copper contains two isotopes. Twenty-six other radioactive isotopes and isomers are known.

Curium — (Pierre and Marie Curie), Cm; at. wt. (247); at. no. 96; m.p. 1345°C; sp. gr. 13.51 (calc.); valence 3 and 4. Although curium follows americium in the periodic system, it was actually known before americium and was the third transuranium element to be discovered. It was identified by Seaborg, James, and Ghiorso in 1944 at the wartime Metallurgical Laboratory in Chicago as a result of helium-ion bombardment of ^{239}Pu in the Berkeley, California, 60-inch cyclotron. Visible amounts (30 μg) of ^{242}Cm , in the form of the hydroxide, were first isolated by Werner and Perlman of the University of California in 1947. In 1950, Crane, Wallmann, and Cunningham found that the magnetic susceptibility of microgram samples of CmF_3 was of the same magnitude as that of GdF_3 . This provided direct experimental evidence for assigning an electronic configuration to Cm^{+3} . In 1951, the same workers prepared curium in its elemental form for the first time. Sixteen isotopes of curium are now known. The most stable, ^{247}Cm , with a half-life of 16 million years, is so short compared to the earth's age that any primordial curium must have disappeared long ago from the natural scene. Minute amounts of curium probably exist in natural deposits of uranium, as a result of a sequence of neutron captures and β decays sustained by the very low flux of neutrons naturally present in uranium ores. The presence of natural curium, however, has never been detected. ^{242}Cm and ^{244}Cm are available in multigram quantities. ^{248}Cm has been produced only in milligram amounts. Curium is similar in some regards to gadolinium, its rare-earth homolog, but it has a more complex crystal structure. Curium is silver in color, is chemically reactive, and is more electropositive than aluminum. CmO_2 , Cm_2O_3 , CmF_3 , CmF_4 , CmCl_3 , CmBr_3 , and CmI_3 have been prepared. Most compounds of trivalent curium are faintly yellow in color. ^{242}Cm generates about three watts of thermal energy per gram. This compares to one-half watt per gram of ^{238}Pu . This suggests use for curium as a power source. ^{244}Cm is now offered for sale by the O.R.N.L. at \$185/mg plus packing charges. ^{248}Cm is available at a cost of \$160/ μg , plus packing charges,

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from the O.R.N.L. Curium absorbed into the body accumulates in the bones, and is therefore very toxic as its radiation destroys the red-cell forming mechanism. The maximum permissible total body burden of ^{244}Cm (soluble) in a human being is 0.3 μCi (microcurie).

Deuterium, an isotope of hydrogen — see Hydrogen.

Dubnium — (named after the Joint Institute of Nuclear Research in Dubna, Russia). Db; at. wt. [262]; at. no. 105. In 1967 G. N. Flerov reported that a Soviet team working at the Joint Institute for Nuclear Research at Dubna may have produced a few atoms of $^{260}\text{105}$ and $^{261}\text{105}$ by bombarding ^{243}Am with ^{22}Ne . Their evidence was based on time-coincidence measurements of alpha energies. More recently, it was reported that early in 1970 Dubna scientists synthesized Element 105 and that by the end of April 1970 “had investigated all the types of decay of the new element and had determined its chemical properties.” In late April 1970, it was announced that Ghiorso, Nurmia, Harris, K. A. Y. Eskola, and P. L. Eskola, working at the University of California at Berkeley, had positively identified Element 105. The discovery was made by bombarding a target of ^{249}Cf with a beam of 84 MeV nitrogen nuclei in the Heavy Ion Linear Accelerator (HILAC). When a ^{15}N nuclear is absorbed by a ^{249}Cf nucleus, four neutrons are emitted and a new atom of $^{260}\text{105}$ with a half-life of 1.6 s is formed. While the first atoms of Element 105 are said to have been detected conclusively on March 5, 1970, there is evidence that Element 105 had been formed in Berkeley experiments a year earlier by the method described. Ghiorso and his associates have attempted to confirm Soviet findings by more sophisticated methods without success.

In October 1971, it was announced that two new isotopes of Element 105 were synthesized with the heavy ion linear accelerator by A. Ghiorso and co-workers at Berkeley. Element $^{261}\text{105}$ was produced both by bombarding ^{250}Cf with ^{15}N and by bombarding ^{249}Bk with ^{16}O . The isotope emits 8.93-MeV α particles and decays to ^{257}Lr with a half-life of about 1.8 s. Element $^{262}\text{105}$ was produced by bombarding ^{249}Bk with ^{18}O . It emits 8.45 MeV α particles and decays to ^{258}Lr with a half-life of about 40 s. Nine isotopes of Dubnium are now recognized. Soon after the discovery the names **Hahnium** and **Joliotium**, named after Otto Hahn and Jean-Frederic Joliot and Mme. Joliot-Curie, were suggested as names for Element 105. The IUPAC in August 1997 finally resolved the issue, naming Element 105 **Dubnium** with the symbol Db. Dubnium is thought to have properties similar to tantalum.

Dysprosium — (Gr. *dysprositos*, hard to get at), Dy; at. wt. 162.50(3); at. no. 66; m.p. 1412°C; b.p. 2567°C; sp. gr. 8.551 (25°C); valence 3. Dysprosium was discovered in 1886 by Lecoq de Boisbaudran, but not isolated. Neither the oxide nor the metal was available in relatively pure form until the development of ion-exchange separation and metallographic reduction techniques by Spedding and associates about 1950. Dysprosium occurs along with other so-called rare-earth or lanthanide elements in a variety of minerals such as *xenotime*, *fergusonite*, *gadolinite*, *euxenite*, *polycrase*, and *blomstrandine*. The most important sources, however, are from *monazite* and *bastnasite*. Dysprosium can be prepared by reduction of the trifluoride with calcium. The element has a metallic, bright silver luster. It is relatively stable in air at room temperature, and is readily attacked and dissolved, with the evolution of hydrogen, by dilute and concentrated mineral acids. The metal is soft enough to be cut with a knife and can be machined without sparking if overheating is avoided. Small amounts of impurities can greatly affect its physical properties. While dysprosium has not yet found many applications, its thermal neutron absorption cross-section and high melting point suggest metallurgical uses in nuclear control applications and for alloying with special stainless steels. A dysprosium oxide-nickel cermet has found use in cooling nuclear reactor rods. This cermet absorbs neutrons readily without swelling or contracting under prolonged neutron bombardment. In combination with vanadium and other rare earths, dysprosium has been used in making laser materials. Dysprosium-cadmium chalcogenides, as sources of infrared radiation, have been used for studying chemical reactions. The cost of dysprosium metal has dropped in recent years since the development of ion-exchange and solvent extraction techniques, and the discovery of large ore bodies. Thirty two isotopes and isomers are now known. The metal costs about \$6/g (99.9% purity).

Einsteinium — (Albert Einstein [1879–1955]), Es; at. wt. (252); m.p. 860°C (est.); at. no. 99. Einsteinium, the seventh transuranic element of the actinide series to be discovered, was identified by Ghiorso and co-workers at Berkeley in December 1952 in debris from the first large thermonuclear explosion, which took place in the Pacific in November 1952. The isotope produced was the 20-day ^{253}Es isotope. In 1961, a sufficient amount of einsteinium was produced to permit separation of a macroscopic amount of ^{253}Es . This sample weighed about 0.01 μg . A special magnetic-type balance was used in making this determination. ^{253}Es so produced was used to produce mendelevium. About 3 μg of einsteinium has been produced at Oak Ridge National Laboratories by irradiating for several years kilogram quantities of ^{239}Pu in a reactor to produce ^{242}Pu . This was then fabricated into pellets of plutonium oxide and aluminum powder, and loaded into target rods for an initial 1-year irradiation at the Savannah River Plant, followed by irradiation in a HFIR (High Flux Isotopic Reactor). After 4 months in the HFIR the targets were removed for chemical separation of the einsteinium from californium. Nineteen isotopes and isomers of einsteinium are now recognized. ^{254}Es has the longest half-life (276 days). Tracer studies using ^{253}Es show that einsteinium has chemical properties typical of a heavy trivalent, actinide element. Einsteinium is extremely radioactive. Great care must be taken when handling it.

Element 93 — See Neptunium.

Element 94 — See Plutonium.

Element 95 — See Americium.

Element 96 — See Curium.

Element 97 — See Berkelium.

Element 98 — See Californium.

Element 99 — See Einsteinium.

Element 100 — See Fermium (unnilnilium).

Element 101 — See Mendelevium (unnilunium).

Element 102 — See Nobelium (unnilbium).

Element 103 — See Lawrencium (unniltrium).

Element 104 — See Rutherfordium (unnilquadium).

Element 105 — See Dubnium (unnilpentium).

Element 106 — See Seaborgium (unnilhexium).

Element 107 — See Bohrium (unnilseptium).

Element 108 — See Hassium (unniloctium).

Element 109 — See Meitnerium (unnilennium).

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Element 110 — In 1987 Oganessian, et al., at Dubna, claimed discovery of this element. Their experiments indicated the spontaneous fissioning nuclide $^{272}110$ with a half-life of 10 ms. More recently a group led by Armbruster at G.S.I. in Darmstadt, Germany, reported evidence of $^{269}110$, which was produced by bombarding lead for many days with more than 10^{18} nickel atoms. A detector searched each collision for Element 110's distinct decay sequence. On November 9, 1994, evidence of 110 was detected. Berkeley scientists, in 1991, performed similar experiments and reported evidence of 110, but this was not confirmed. Workers at Dubna have experiments underway to produce $^{273}110$ by bombarding plutonium with sulfur atoms. Other experiments at G.S.I. and elsewhere are now searching for heavier isotopes. Five isotopes of Element 110 are now recognized. Several years ago the IUPAC suggested the use of the temporary name *ununnilium*, with the symbol Uun, for Element 110 when it was found.

Element 111 — On December 20, 1994, scientists at GSI Darmstadt, Germany announced they had detected three atoms of a new element with 111 protons and 161 neutrons. This element was made by bombarding ^{83}Bi with ^{28}Ni . Signals of Element 111 appeared for less than 0.002 sec, then decayed into lighter elements including Element $^{268}109$ and Element $^{264}107$. These isotopes had not previously been observed. A name for Element 111 has not been suggested although IUPAC has suggested a temporary name of Ununium, with the symbol Uuu. Element 111 is expected to have properties similar to gold.

Element 112 — In late February 1996, Sigurd Hofmann and his collaborators at GSI Darmstadt announced their discovery of Element 112, having 112 protons and 165 neutrons, with an atomic mass of 277. This element was made by bombarding a lead target with high-energy zinc ions. A single nucleus of Element 112 was detected, which decayed after less than 0.001 sec by emitting an α particle, consisting of two protons and two neutrons. This created Element $^{110}_{273}$, which in turn decayed by emitting an α particle to form a new isotope of Element 108 and so on. Evidence indicates that nuclei with 162 neutrons are held together more strongly than nuclei with a smaller or larger number of neutrons. This suggests a narrow "peninsula" of relatively stable isotopes around Element 114. GSI scientists are experimenting to bombard targets with ions heavier than zinc to produce Elements 113 and 114. A name has not yet been suggested for Element 112, although the IUPAC suggested the temporary name of ununbium, with the symbol of Uub, when the element was discovered. Element 112 is expected to have properties similar to mercury.

Element 113 — (ununtrium) As of December 1999 this element remains undiscovered.

Element 114 — (ununquadium) Symbol Uuq. Element 114 is the first new element to be discovered since 1996. This element was found by a Russian-American team, including Livermore researchers, by bombarding a sheet of plutonium with a rare form of calcium hoping to make the atoms stick together in a new element. Radiation showed that the new element broke into smaller pieces. Data of radiation collected at the Russian Joint Institute for Nuclear Research in November and December 1998, were analyzed in January 1999. It was found that some of the heavy atoms created when 114 decayed lived up to 30 seconds, which was longer than ever seen before, for such a heavy element. This isotope decayed into a previously unknown isotope of Element 112, which itself lasted 15 minutes. That isotope, in turn, decayed to a previously undiscovered isotope of Element 108, which survived 17 minutes. Isotopes of these and those with longer life-times have been predicted for some time by theorists. It appears that these isotopes are on the edge of the "island of stability", and that some of the isotopes in this region might last long enough for studies of their nuclear behavior and for a chemical evaluation to be made. No name has yet been suggested for Element 114; however, the temporary name of ununquadium with symbol Uuq may be used.

Element 115 — (Ununpentium) Symbol Uup. As of January 2002, this element remains undiscovered.

Element 116 — (Ununhexium) Symbol Uuh. As of January 2002 it is questionable if this element has been discovered.

Element 117 — (Ununseptium) Symbol Uus. As of January 2002, this element remains undiscovered.

Element 118 — (Ununoctium) Symbol Uuo. In June 1999 it was announced that Elements 118 and 116 had been discovered at the Lawrence Berkeley National Laboratory. A lead target was bombarded for more than 10 days with roughly 1 quintillion krypton ions. The team reported that three atoms of Element 118 were made, which quickly decayed into Elements 116, 114, and elements of lower atomic mass. It was said that the isotopes of Element 118 lasted only about 200 milliseconds, while the isotope of Element 116 lasted only 1.2 milliseconds. It was hoped that these elements might be members of "an island of stability", which had long been sought. At that time it was hoped that a target of bismuth might be bombarded with krypton ions to make Element 119, which, in turn, would decay into Elements 117, 115, and 113.

On July 27, 2001 researchers at the Lawrence Berkeley Laboratory announced that their discovery of Element 118 was being retracted because workers at the GSI Laboratory in Germany and at Japanese laboratories failed to confirm their results. However, it was reported that different experiments at the Livermore Laboratory and Joint Institute for Nuclear Research in Dubna, Russia indicated that Element 116 had since been created.

Researchers at the Australian National Laboratory suggest that super-heavy elements may be more difficult to make than previously thought. Their data suggest the best way to encourage fusion in making super-heavy elements is to combine the lightest projectiles possible with the heaviest possible targets. This would minimize a so-called "quasi-fission process" in which a projectile nucleus steals protons and neutrons from a target nucleus. In this process the two nuclei are said to fly apart without every having actually combined.

Erbium — (*Ytterby*, a town in Sweden), Er; at. wt. 167.26(3); at. no. 68; m.p. 1529°C; b.p. 2868°C; sp. gr. 9.066 (25°C); valence 3, Erbium, one of the so-called rare-earth elements of the lanthanide series, is found in the minerals mentioned under dysprosium above. In 1842 Mosander separated "yttria," found in the mineral *gadolinite*, into three fractions which he called *yttria*, *erbia*, and *terbia*. The names *erbia* and *terbia* became confused in this early period. After 1860, Mosander's *terbia* was known as *erbia*, and after 1877, the earlier known *erbia* became *terbia*. The *erbia* of this period was later shown to consist of five oxides, now known as *erbia*, *scandia*, *holmia*, *thulia* and *ytterbia*. By 1905 Urbain and James independently succeeded in isolating fairly pure Er_2O_3 . Klemm and Bommer first produced reasonably pure erbium metal in 1934 by reducing the anhydrous chloride with potassium vapor. The pure metal is soft and malleable and has a bright, silvery, metallic luster. As with other rare-earth metals, its properties depend to a certain extent on the impurities present. The metal is fairly stable in air and does not oxidize as rapidly as some of the other rare-earth metals. Naturally occurring erbium is a mixture of six isotopes, all of which are stable. Twenty-seven radioactive isotopes of erbium are also recognized. Recent production techniques, using ion-exchange reactions, have resulted in much lower prices of the rare-earth metals and their compounds in recent years. The cost of 99.9% erbium metal is about \$21/g. Erbium is finding nuclear and metallurgical uses. Added to vanadium, for example, erbium lowers the hardness and improves workability. Most of the rare-earth oxides have sharp absorption bands in the visible, ultraviolet, and near infrared. This property, associated with the electronic structure, gives beautiful pastel colors to many of the rare-earth salts. Erbium oxide gives a pink color and has been used as a colorant in glasses and porcelain enamel glazes.

Europium — (Europe), Eu; at. wt. 151.964(1); at. no. 63; m.p. 822°C; b.p. 1596°C; sp. gr. 5.244 (25°C); valence 2 or 3. In 1890 Boisbaudran obtained basic fractions from samarium-gadolinium concentrates which had spark spectral lines not accounted for by samarium or gadolinium. These

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lines subsequently have been shown to belong to europium. The discovery of europium is generally credited to Demarcay, who separated the rare earth in reasonably pure form in 1901. The pure metal was not isolated until recent years. Europium is now prepared by mixing Eu_2O_3 with a 10%-excess of lanthanum metal and heating the mixture in a tantalum crucible under high vacuum. The element is collected as a silvery-white metallic deposit on the walls of the crucible. As with other rare-earth metals, except for lanthanum, europium ignites in air at about 150 to 180°C. Europium is about as hard as lead and is quite ductile. It is the most reactive of the rare-earth metals, quickly oxidizing in air. It resembles calcium in its reaction with water. *Bastnasite* and *monazite* are the principal ores containing europium. Europium has been identified spectroscopically in the sun and certain stars. Europium isotopes are good neutron absorbers and are being studied for use in nuclear control applications. Europium oxide is now widely used as a phosphor activator and europium-activated yttrium vanadate is in commercial use as the red phosphor in color TV tubes. Europium-doped plastic has been used as a laser material. With the development of ion-exchange techniques and special processes, the cost of the metal has been greatly reduced in recent years. Natural europium contains two stable isotopes. Thirty five other radioactive isotopes and isomers are known. Europium is one of the rarest and most costly of the rare-earth metals. It is priced at about \$60/g (99.9% pure).

Fermium — (Enrico Fermi [1901–1954], nuclear physicist), Fm; at. wt. [257]; at. no. 100; m.p. 1527°C. Fermium, the eighth transuranium element of the actinide series to be discovered, was identified by Ghiorso and co-workers in 1952 in the debris from a thermonuclear explosion in the Pacific in work involving the University of California Radiation Laboratory, the Argonne National Laboratory, and the Los Alamos Scientific Laboratory. The isotope produced was the 20-hour ^{255}Fm . During 1953 and early 1954, while discovery of elements 99 and 100 was withheld from publication for security reasons, a group from the Nobel Institute of Physics in Stockholm bombarded ^{238}U with ^{16}O ions, and isolated a 30-min α -emitter, which they ascribed to $^{250}\text{100}$, without claiming discovery of the element. This isotope has since been identified positively, and the 30-min half-life confirmed. The chemical properties of fermium have been studied solely with tracer amounts, and in normal aqueous media only the (III) oxidation state appears to exist. The isotope ^{254}Fm and heavier isotopes can be produced by intense neutron irradiation of lower elements such as plutonium by a process of successive neutron capture interspersed with beta decays until these mass numbers and atomic numbers are reached. Twenty isotopes and isomers of fermium are known to exist. ^{257}Fm , with a half-life of about 100.5 days, is the longest lived. ^{250}Fm , with a half-life of 30 min, has been shown to be a product of decay of Element $^{254}\text{102}$. It was by chemical identification of ^{250}Fm that production of Element 102 (nobelium) was confirmed. Fermium would probably have chemical properties resembling erbium.

Fluorine — (L. and F. *fluere*, flow, or flux), F; at. wt. 18.9984032(5); at. no. 9; m.p. -219.62°C (1 atm); b.p. -188.12°C (1 atm); t_c -129.02°C; density 1.696 g/L (0°C, 1 atm); liq. den. at b.p. 1.50 g/cm³; valence 1. In 1529, Georgius Agricola described the use of fluorspar as a flux, and as early as 1670 Schwandhard found that glass was etched when exposed to fluorspar treated with acid. Scheele and many later investigators, including Davy, Gay-Lussac, Lavoisier, and Thenard, experimented with hydrofluoric acid, some experiments ending in tragedy. The element was finally isolated in 1886 by Moisson after nearly 74 years of continuous effort. Fluorine occurs chiefly in *fluorspar* (CaF_2) and *cryolite* (Na_3AlF_6), and is in *topaz* and other minerals. It is a member of the halogen family of elements, and is obtained by electrolyzing a solution of potassium hydrogen fluoride in anhydrous hydrogen fluoride in a vessel of metal or transparent fluorspar. Modern commercial production methods are essentially variations on the procedures first used by Moisson. Fluorine is the most electronegative and reactive of all elements. It is a pale yellow, corrosive gas, which reacts with practically all organic and inorganic substances. Finely divided metals, glass, ceramics, carbon, and even water burn in fluorine with a bright flame. Until World War II, there was no commercial production of elemental fluorine. The atom bomb project and nuclear energy applications, however, made it necessary to produce large quantities. Safe handling techniques have now been developed and it is possible at present to transport liquid fluorine by the ton. Fluorine and its compounds are used in producing uranium (from the hexafluoride) and more than 100 commercial fluorochemicals, including many well-known high-temperature plastics. Hydrofluoric acid is extensively used for etching the glass of light bulbs, etc. Fluorochloro hydrocarbons have been extensively used in air conditioning and refrigeration. However, in recent years the U.S. and other countries have been phasing out ozone-depleting substances, such as the fluorochloro hydrocarbons that have been used in these applications. It has been suggested that fluorine might be substituted for hydrogen wherever it occurs in organic compounds, which could lead to an astronomical number of new fluorine compounds. The presence of fluorine as a soluble fluoride in drinking water to the extent of 2 ppm may cause mottled enamel in teeth, when used by children acquiring permanent teeth; in smaller amounts, however, fluorides are said to be beneficial and used in water supplies to prevent dental cavities. Elemental fluorine has been studied as a rocket propellant as it has an exceptionally high specific impulse value. Compounds of fluorine with rare gases have now been confirmed. Fluorides of xenon, radon, and krypton are among those known. Elemental fluorine and the fluoride ion are highly toxic. The free element has a characteristic pungent odor, detectable in concentrations as low as 20 ppb, which is below the safe working level. The recommended maximum allowable concentration for a daily 8-hour time-weighted exposure is 1 ppm. Fluorine is known to have fourteen isotopes.

Francium — (France), Fr; at. no. 87; at. wt. [223]; m.p. 27°C; valence 1. Discovered in 1939 by Mlle. Marguerite Perey of the Curie Institute, Paris. Francium, the heaviest known member of the alkali metal series, occurs as a result of an alpha disintegration of actinium. It can also be made artificially by bombarding thorium with protons. While it occurs naturally in uranium minerals, there is probably less than an ounce of francium at any time in the total crust of the earth. It has the highest equivalent weight of any element, and is the most unstable of the first 101 elements of the periodic system. Thirty-six isotopes and isomers of francium are recognized. The longest lived ^{223}Fr (Ac, K), a daughter of ^{227}Ac , has a half-life of 21.8 min. This is the only isotope of francium occurring in nature. Because all known isotopes of francium are highly unstable, knowledge of the chemical properties of this element comes from radiochemical techniques. No weighable quantity of the element has been prepared or isolated. The chemical properties of francium most closely resemble cesium. In 1996, researchers Orozco, Sprouse, and co-workers at the State University of New York, Stony Brook, reported that they had produced francium atoms by bombarding ^{18}O atoms at a gold target heated almost to its melting point. Collisions between gold and oxygen nuclei created atoms of francium-210 which had 87 protons and 123 neutrons. This team reported they had generated about 1 million francium-210 ions per second and held 1000 or more atoms at a time for about 20 secs. in a magnetic trap they had devised before the atoms decayed or escaped. Enough francium was trapped so that a video camera could capture the light given off by the atoms as they fluoresced. A cluster of about 10,000 francium atoms appeared as a glowing sphere about 1 mm in diameter. It is thought that the francium atoms could serve as miniature laboratories for probing interactions between electrons and quarks.

Gadolinium — (*gadolinite*, a mineral named for Gadolin, a Finnish chemist), Gd; at. wt. 157.25(3); at. no. 64; m.p. 1313°C; b.p. 3273°C; sp. gr. 7.901 (25°C); valence 3. Gadolinia, the oxide of gadolinium, was separated by Marignac in 1880 and Lecoq de Boisbaudran independently isolated the element from Mosander's "yttria" in 1886. The element was named for the mineral *gadolinite* from which this rare earth was originally obtained. Gadolinium is found in several other minerals, including *monazite* and *bastnasite*, which are of commercial importance. The element has been isolated

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only in recent years. With the development of ion-exchange and solvent extraction techniques, the availability and price of gadolinium and the other rare-earth metals have greatly improved. Thirty-one isotopes and isomers of gadolinium are now recognized; seven are stable and occur naturally. The metal can be prepared by the reduction of the anhydrous fluoride with metallic calcium. As with other related rare-earth metals, it is silvery white, has a metallic luster, and is malleable and ductile. At room temperature, gadolinium crystallizes in the hexagonal, close-packed α form. Upon heating to 1235°C, α gadolinium transforms into the β form, which has a body-centered cubic structure. The metal is relatively stable in dry air, but in moist air it tarnishes with the formation of a loosely adhering oxide film which spalls off and exposes more surface to oxidation. The metal reacts slowly with water and is soluble in dilute acid. Gadolinium has the highest thermal neutron capture cross-section of any known element (49,000 barns). Natural gadolinium is a mixture of seven isotopes. Two of these, ^{155}Gd and ^{157}Gd , have excellent capture characteristics, but they are present naturally in low concentrations. As a result, gadolinium has a very fast burnout rate and has limited use as a nuclear control rod material. It has been used in making gadolinium yttrium garnets, which have microwave applications. Compounds of gadolinium are used in making phosphors for color TV tubes. The metal has unusual superconductive properties. As little as 1% gadolinium has been found to improve the workability and resistance of iron, chromium, and related alloys to high temperatures and oxidation. Gadolinium ethyl sulfate has extremely low noise characteristics and may find use in duplicating the performance of amplifiers, such as the maser. The metal is ferromagnetic. Gadolinium is unique for its high magnetic moment and for its special Curie temperature (above which ferromagnetism vanishes) lying just at room temperature. This suggests uses as a magnetic component that senses hot and cold. The price of the metal is about \$5/g (99.9% purity).

Gallium — (L. *Gallia*, France; also from Latin, *gallus*, a translation of Lecoq, a cock), Ga; at. wt. 69.723(1); at. no. 31; m.p. 29.76°C; b.p. 2204°C; sp. gr. 5.904 (29.6°C) solid; sp. gr. 6.095 (29.6°C) liquid; valence 2 or 3. Predicted and described by Mendeleev as ekaaluminum, and discovered spectroscopically by Lecoq de Boisbaudran in 1875, who in the same year obtained the free metal by electrolysis of a solution of the hydroxide in KOH. Gallium is often found as a trace element in *diaspore*, *sphalerite*, *germanite*, *bauxite*, and *coal*. Some flue dusts from burning coal have been shown to contain as much as 1.5% gallium. It is the only metal, except for mercury, cesium, and rubidium, which can be liquid near room temperatures; this makes possible its use in high-temperature thermometers. It has one of the longest liquid ranges of any metal and has a low vapor pressure even at high temperatures. There is a strong tendency for gallium to supercool below its freezing point. Therefore, seeding may be necessary to initiate solidification. Ultra-pure gallium has a beautiful, silvery appearance, and the solid metal exhibits a conchoidal fracture similar to glass. The metal expands 3.1% on solidifying; therefore, it should not be stored in glass or metal containers, as they may break as the metal solidifies. Gallium wets glass or porcelain, and forms a brilliant mirror when it is painted on glass. It is widely used in doping semiconductors and producing solid-state devices such as transistors. High-purity gallium is attacked only slowly by mineral acids. Magnesium gallate containing divalent impurities such as Mn^{+2} is finding use in commercial ultraviolet activated powder phosphors. Gallium nitride has been used to produce blue light-emitting diodes. Blue LED's used in compact disc applications can be used to store a 2-hr movie, for example, on one 5-in. diameter disc. Extensive use of gallium has found recent application in the **Galex Detector Experiment** located in the Gran Sasso Underground Laboratory in Italy. This underground facility has been built by the Italian Istituto Nazionale di Fisica Nucleare in the middle of a highway tunnel through the Abruzzese mountains, about 150 km east of Rome. The experiment is shielded by a 3300-m water-equivalent of rock. In this experiment, 30.3 tons of gallium in the form of 110 tons of $\text{GaCl}_3\text{-HCl}$ solution are being used to detect solar neutrinos. The production of ^{71}Ge from gallium is being measured. Gallium arsenide is capable of converting electricity directly into coherent light. Gallium readily alloys with most metals, and has been used as a component in low-melting alloys. Its toxicity appears to be of a low order, but should be handled with care until more data are forthcoming. Natural gallium contains two stable isotopes. Twenty-six other isotopes, one of which is an isomer, are known. The metal can be supplied in ultrapure form (99.99999+%). The cost is about \$5/g (99.999%).

Germanium — (L. *Germania*, Germany), Ge; at. wt. 72.61(2); at. no. 32; m.p. 938.25°C; b.p. 2833°C; sp. gr. 5.323 (25°C); valence 2 and 4. Predicted by Mendeleev in 1871 as ekasilicon, and discovered by Winkler in 1886. The metal is found in *argyrodite*, a sulfide of germanium and silver; in *germanite*, which contains 8% of the element; in zinc ores; in coal; and in other minerals. The element is frequently obtained commercially from flue dusts of smelters processing zinc ores, and has been recovered from the by-products of combustion of certain coals. Its presence in coal insures a large reserve of the element in the years to come. Germanium can be separated from other metals by fractional distillation of its volatile tetrachloride. The tetrachloride may then be hydrolyzed to give GeO_2 ; the dioxide can be reduced with hydrogen to give the metal. Recently developed zone-refining techniques permit the production of germanium of ultra-high purity. The element is a gray-white metalloid, and in its pure state is crystalline and brittle, retaining its luster in air at room temperature. It is a very important semiconductor material. Zone-refining techniques have led to production of crystalline germanium for semiconductor use with an impurity of only one part in 10^{10} . Doped with arsenic, gallium, or other elements, it is used as a transistor element in thousands of electronic applications. Its application in fiber optics and infra-red optical systems now provides the largest use for germanium. Germanium is also finding many other applications including use as an alloying agent, as a phosphor in fluorescent lamps, and as a catalyst. Germanium and germanium oxide are transparent to the infrared and are used in infrared spectrometers and other optical equipment, including extremely sensitive infrared detectors. Germanium oxide's high index of refraction and dispersion has made it useful as a component of glasses used in wide-angle camera lenses and microscope objectives. The field of organogermanium chemistry is becoming increasingly important. Certain germanium compounds have a low mammalian toxicity, but a marked activity against certain bacteria, which makes them of interest as chemotherapeutic agents. The cost of germanium is about \$10/g (99.999% purity). Thirty isotopes and isomers are known, five of which occur naturally.

Gold — (Sanskrit *Jval*; Anglo-Saxon *gold*), Au (L. *aurum*, gold); at. wt. 196.96654(3); at. no. 79; m.p. 1064.18°C; b.p. 2856°C; sp. gr. ~19.3 (20°C); valence 1 or 3. Known and highly valued from earliest times, gold is found in nature as the free metal and in tellurides; it is very widely distributed and is almost always associated with quartz or pyrite. It occurs in veins and alluvial deposits, and is often separated from rocks and other minerals by sluicing and panning operations. About 25% of the world's gold output comes from South Africa, and about two thirds of the total U.S. production now comes from South Dakota and Nevada. The metal is recovered from its ores by cyaniding, amalgamating, and smelting processes. Refining is also frequently done by electrolysis. Gold occurs in sea water to the extent of 0.1 to 2 mg/ton, depending on the location where the sample is taken. As yet, no method has been found for recovering gold from sea water profitably. It is estimated that all the gold in the world, so far refined, could be placed in a single cube 60 ft on a side. Of all the elements, gold in its pure state is undoubtedly the most beautiful. It is metallic, having a yellow color when in a mass, but when finely divided it may be black, ruby, or purple. The Purple of Cassius is a delicate test for auric gold. It is the most malleable and ductile metal; 1 oz. of gold can be beaten out to 300 ft². It is a soft metal and is usually alloyed to give it more strength. It is a good conductor of heat and electricity, and is unaffected by air and most reagents. It is used in coinage and is a standard for monetary systems in many countries. It

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is also extensively used for jewelry, decoration, dental work, and for plating. It is used for coating certain space satellites, as it is a good reflector of infrared and is inert. Gold, like other precious metals, is measured in troy weight; when alloyed with other metals, the term *carat* is used to express the amount of gold present, 24 carats being pure gold. For many years the value of gold was set by the U.S. at \$20.67/troy ounce; in 1934 this value was fixed by law at \$35.00/troy ounce, 9/10th fine. On March 17, 1968, because of a gold crisis, a two-tiered pricing system was established whereby gold was still used to settle international accounts at the old \$35.00/troy ounce price while the price of gold on the private market would be allowed to fluctuate. Since this time, the price of gold on the free market has fluctuated widely. The price of gold on the free market reached a price of \$620/troy oz. in January 1980. More recently, the U.K. and other nations, including the I.M.F. have sold or threatened to sell a sizeable portion of their gold reserves. This has caused wide fluctuations in the price of gold. Because this has damaged the economy of some countries, a moratorium for a few years has been declared. This has tended to stabilize temporarily the price of gold. The most common gold compounds are auric chloride (AuCl_3) and chlorauric acid (HAuCl_4), the latter being used in photography for toning the silver image. Gold has forty-eight recognized isotopes and isomers; ^{198}Au , with a half-life of 2.7 days, is used for treating cancer and other diseases. Disodium aurothiomalate is administered intramuscularly as a treatment for arthritis. A mixture of one part nitric acid with three of hydrochloric acid is called *aqua regia* (because it dissolved gold, the King of Metals). Gold is available commercially with a purity of 99.999+%. For many years the temperature assigned to the freezing point of gold has been 1063.0°C; this has served as a calibration point for the International Temperature Scales (ITS-27 and ITS-48) and the International Practical Temperature Scale (IPTS-48). In 1968, a new International Practical Temperature Scale (IPTS-68) was adopted, which demanded that the freezing point of gold be changed to 1064.43°C. In 1990 a new International Temperature Scale (ITS-90) was adopted bringing the t.p. (triple point) of H_2O (t_{90} (°C)) to 0.01°C and the freezing point of gold to 1064.18°C. The specific gravity of gold has been found to vary considerably depending on temperature, how the metal is precipitated, and cold-worked. As of December 2001, gold was priced at about \$275/troy oz. (\$8.50/g).

Hafnium — (*Hafnia*, Latin name for Copenhagen), Hf; at. wt. 178.49(2); at. no. 72; m.p. 2233°C; b.p. 4603°C; sp. gr. 13.31 (20°C); valence 4. Hafnium was thought to be present in various minerals and concentrations many years prior to its discovery, in 1923, credited to D. Coster and G. von Hevesey. On the basis of the Bohr theory, the new element was expected to be associated with zirconium. It was finally identified in *zircon* from Norway, by means of X-ray spectroscopic analysis. It was named in honor of the city in which the discovery was made. Most zirconium minerals contain 1 to 5% hafnium. It was originally separated from zirconium by repeated recrystallization of the double ammonium or potassium fluorides by von Hevesey and Jantzen. Metallic hafnium was first prepared by van Arkel and deBoer by passing the vapor of the tetraiodide over a heated tungsten filament. Almost all hafnium metal now produced is made by reducing the tetrachloride with magnesium or with sodium (Kroll Process). Hafnium is a ductile metal with a brilliant silver luster. Its properties are considerably influenced by the impurities of zirconium present. Of all the elements, zirconium and hafnium are two of the most difficult to separate. Their chemistry is almost identical, however, the density of zirconium is about half that of hafnium. Very pure hafnium has been produced, with zirconium being the major impurity. Natural hafnium contains six isotopes, one of which is slightly radioactive. Hafnium has a total of 41 recognized isotopes and isomers. Because hafnium has a good absorption cross section for thermal neutrons (almost 600 times that of zirconium), has excellent mechanical properties, and is extremely corrosion resistant, it is used for reactor control rods. Such rods are used in nuclear submarines. Hafnium has been successfully alloyed with iron, titanium, niobium, tantalum, and other metals. Hafnium carbide is the most refractory binary composition known, and the nitride is the most refractory of all known metal nitrides (m.p. 3310°C). Hafnium is used in gas-filled and incandescent lamps, and is an efficient “getter” for scavenging oxygen and nitrogen. Finely divided hafnium is pyrophoric and can ignite spontaneously in air. Care should be taken when machining the metal or when handling hot sponge hafnium. At 700°C hafnium rapidly absorbs hydrogen to form the composition $\text{HfH}_{1.86}$. Hafnium is resistant to concentrated alkalis, but at elevated temperatures reacts with oxygen, nitrogen, carbon, boron, sulfur, and silicon. Halogens react directly to form tetrahalides. The price of the metal is about \$2/g. The yearly demand for hafnium in the U.S. is now in excess of 50,000 kg.

Hahnium — A name previously used for Element 105, now named *dubnium*.

Hassium — (named for the German state, Hesse) Hs, at. wt. [265]; at. no. 108. This element was first synthesized and identified in 1964 by the same G.S.I. Darmstadt Group who first identified *Bohrium* and *Meitnerium*. Presumably this element has chemical properties similar to osmium. Isotope $^{265}108$ was produced using a beam of ^{58}Fe projectiles, produced by the Universal Linear Accelerator (UNILAC) to bombard a ^{208}Pb target. Discovery of *Bohrium* and *Meitnerium* was made using detection of isotopes with odd proton and neutron numbers. Elements having even atomic numbers have been thought to be less stable against spontaneous fission than odd elements. The production of $^{265}108$ in the same reaction as was used at G.S.I. was confirmed at Dubna with detection of the seventh member of the decay chain ^{253}Es . Isotopes of *Hassium* are believed to decay by spontaneous fission, explaining why 109 was produced before 108. Isotope $^{265}108$ and $^{266}108$ are thought to decay to $^{261}106$, which in turn decay to $^{257}104$ and $^{253}102$. The IUPAC adopted the name *Hassium* after the German state of Hesse in September 1997. In June 2001 it was announced that hassium is now the heaviest element to have its chemical properties analyzed. A research team at the UNILAC heavy-ion accelerator in Darmstadt, Germany built an instrument to detect and analyze hassium. Atoms of curium-248 were collided with atoms of magnesium-26, producing about 6 atoms of hassium with a half-life of 9 sec. This was sufficiently long to obtain data showing that hassium atoms react with oxygen to form hassium oxide molecules. These condensed at a temperature consistent with the behavior of Group 8 elements. This experiment appears to confirm hassium's location under osmium in the periodic table.

Helium — (Gr. *helios*, the sun), He; at. wt. 4.002602(2); at. no. 2; m.p. below — 272.2°C (26 atm); b.p. — 268.93°C; t_c -267.96°C; density 0.1785 g/l (0°C, 1 atm); liquid density 7.62 lb/ft³ at. b.p.; valence usually 0. Evidence of the existence of helium was first obtained by Janssen during the solar eclipse of 1868 when he detected a new line in the solar spectrum; Lockyer and Frankland suggested the name *helium* for the new element; in 1895, Ramsay discovered helium in the uranium mineral *cleveite*, and it was independently discovered in cleveite by the Swedish chemists Cleve and Langlet about the same time. Rutherford and Royds in 1907 demonstrated that α particles are helium nuclei. Except for hydrogen, helium is the most abundant element found throughout the universe. Helium is extracted from natural gas; all natural gas contains at least trace quantities of helium. It has been detected spectroscopically in great abundance, especially in the hotter stars, and it is an important component in both the proton-proton reaction and the carbon cycle, which account for the energy of the sun and stars. The fusion of hydrogen into helium provides the energy of the hydrogen bomb. The helium content of the atmosphere is about 1 part in 200,000. It is present in various radioactive minerals as a decay product. Much of the world's supply of helium is obtained from wells in Texas, Colorado, and Kansas. The only other known helium extraction plants, outside the United States, in 1999 were in Poland, Russia, China, Algeria, and India. The cost of helium has fallen from \$2500/ft³ in 1915 to about 2.5¢/cu. ft. (.028 cu meters) in 1999. Helium has the lowest melting point of any element and has found wide use in cryogenic research, as its boiling point is close to absolute zero.

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Its use in the study of superconductivity is vital. Using liquid helium, Kurti and co-workers, and others, have succeeded in obtaining temperatures of a few microkelvins by the adiabatic demagnetization of copper nuclei, starting from about 0.01 K. Liquid helium (He^4) exists in two forms: He^4I and He^4II , with a sharp transition point at 2.174 K (3.83 cm Hg). He^4I (above this temperature) is a normal liquid, but He^4II (below it) is unlike any other known substance. It expands on cooling; its conductivity for heat is enormous; and neither its heat conduction nor viscosity obeys normal rules. It has other peculiar properties. Helium is the only liquid that cannot be solidified by lowering the temperature. It remains liquid down to absolute zero at ordinary pressures, but it can readily be solidified by increasing the pressure. Solid ^3He and ^4He are unusual in that both can readily be changed in volume by more than 30% by application of pressure. The specific heat of helium gas is unusually high. The density of helium vapor at the normal boiling point is also very high, with the vapor expanding greatly when heated to room temperature. Containers filled with helium gas at 5 to 10 K should be treated as though they contained liquid helium due to the large increase in pressure resulting from warming the gas to room temperature. While helium normally has a 0 valence, it seems to have a weak tendency to combine with certain other elements. Means of preparing helium difluoride have been studied, and species such as HeNe and the molecular ions He^+ and He^{++} have been investigated. Helium is widely used as an inert gas shield for arc welding; as a protective gas in growing silicon and germanium crystals, and in titanium and zirconium production; as a cooling medium for nuclear reactors, and as a gas for supersonic wind tunnels. A mixture of helium and oxygen is used as an artificial atmosphere for divers and others working under pressure. Different ratios of He/O_2 are used for different depths at which the diver is operating. Helium is extensively used for filling balloons as it is a much safer gas than hydrogen. One of the recent largest uses for helium has been for pressuring liquid fuel rockets. A Saturn booster such as used on the Apollo lunar missions required about 13 million ft^3 of helium for a firing, plus more for checkouts. Liquid helium's use in magnetic resonance imaging (MRI) continues to increase as the medical profession accepts and develops new uses for the equipment. This equipment is providing accurate diagnoses of problems where exploratory surgery has previously been required to determine problems. Another medical application that is being developed uses MRI to determine by blood analysis whether a patient has any form of cancer. Lifting gas applications are increasing. Various companies in addition to Goodyear, are now using "blimps" for advertising. The Navy and the Air Force are investigating the use of airships to provide early warning systems to detect low-flying cruise missiles. The Drug Enforcement Agency has used radar-equipped blimps to detect drug smugglers along the southern border of the U.S. In addition, NASA is currently using helium-filled balloons to sample the atmosphere in Antarctica to determine what is depleting the ozone layer that protects Earth from harmful U.V. radiation. Research on and development of materials which become superconductive at temperatures well above the boiling point of helium could have a major impact on the demand for helium. Less costly refrigerants having boiling points considerably higher could replace the present need to cool such superconductive materials to the boiling point of helium. Natural helium contains two stable isotopes ^3He and ^4He . ^3He is present in very small quantities. Six other isotopes of helium are now recognized.

Holmium — (L. *Holmia*, for Stockholm), Ho; at. wt. 164.93032(2); at. no 67; m.p. 1474°C; b.p. 2700°C; sp. gr. 8.795 (25°C); valence + 3. The spectral absorption bands of holmium were noticed in 1878 by the Swiss chemists Delafontaine and Soret, who announced the existence of an "Element X". Cleve, of Sweden, later independently discovered the element while working on erbia earth. The element is named after Cleve's native city. Pure holmia, the yellow oxide, was prepared by Homberg in 1911. Holmium occurs in *gadolinite*, *monazite*, and in other rare-earth minerals. It is commercially obtained from monazite, occurring in that mineral to the extent of about 0.05%. It has been isolated by the reduction of its anhydrous chloride or fluoride with calcium metal. Pure holmium has a metallic to bright silver luster. It is relatively soft and malleable, and is stable in dry air at room temperature, but rapidly oxidizes in moist air and at elevated temperatures. The metal has unusual magnetic properties. Few uses have yet been found for the element. The element, as with other rare earths, seems to have a low acute toxic rating. Natural holmium consists of one isotope ^{165}Ho , which is not radioactive. Holmium has 49 other isotopes known, all of which are radioactive. The price of 99.9% holmium metal is about \$20/g.

Hydrogen — (Gr. *hydro*, water, and *genes*, forming), H; at. wt. 1.00794(7); at. no. 1; m.p. -259.34°C; b.p. -252.87°C; t_c -240.18; density 0.08988 g/l; density (liquid) 70.8 g/l (-253°C); density (solid) 70.6 g/l (-262°C); valence 1. Hydrogen was prepared many years before it was recognized as a distinct substance by Cavendish in 1766. It was named by Lavoisier. Hydrogen is the most abundant of all elements in the universe, and it is thought that the heavier elements were, and still are, being built from hydrogen and helium. It has been estimated that hydrogen makes up more than 90% of all the atoms or three quarters of the mass of the universe. It is found in the sun and most stars, and plays an important part in the proton-proton reaction and carbon-nitrogen cycle, which accounts for the energy of the sun and stars. It is thought that hydrogen is a major component of the planet Jupiter and that at some depth in the planet's interior the pressure is so great that solid molecular hydrogen is converted into solid metallic hydrogen. In 1973, it was reported that a group of Russian experimenters may have produced metallic hydrogen at a pressure of 2.8 Mbar. At the transition the density changed from 1.08 to 1.3 g/cm³. Earlier, in 1972, a Livermore (California) group also reported on a similar experiment in which they observed a pressure-volume point centered at 2 Mbar. It has been predicted that metallic hydrogen may be metastable; others have predicted it would be a superconductor at room temperature. On earth, hydrogen occurs chiefly in combination with oxygen in water, but it is also present in organic matter such as living plants, petroleum, coal, etc. It is present as the free element in the atmosphere, but only to the extent of less than 1 ppm by volume. It is the lightest of all gases, and combines with other elements, sometimes explosively, to form compounds. Great quantities of hydrogen are required commercially for the fixation of nitrogen from the air in the Haber ammonia process and for the hydrogenation of fats and oils. It is also used in large quantities in methanol production, in hydrodealkylation, hydrocracking, and hydrodesulfurization. It is also used as a rocket fuel, for welding, for production of hydrochloric acid, for the reduction of metallic ores, and for filling balloons. The lifting power of 1 ft^3 of hydrogen gas is about 0.076 lb at 0°C, 760 mm pressure. Production of hydrogen in the U.S. alone now amounts to about 3 billion cubic feet per year. It is prepared by the action of steam on heated carbon, by decomposition of certain hydrocarbons with heat, by the electrolysis of water, or by the displacement from acids by certain metals. It is also produced by the action of sodium or potassium hydroxide on aluminum. Liquid hydrogen is important in cryogenics and in the study of superconductivity, as its melting point is only a 20°C above absolute zero. Hydrogen consists of three isotopes, most of which is ^1H . The ordinary isotope of hydrogen, H, is known as *protium*. In 1932, Urey announced the discovery of a stable isotope, deuterium (^2H or D) with an atomic weight of 2. Deuterium is present in natural hydrogen to the extent of 0.015%. Two years later an unstable isotope, tritium (^3H), with an atomic weight of 3 was discovered. Tritium has a half-life of about 12.32 years. Tritium atoms are also present in natural hydrogen but in much smaller proportion. Tritium is readily produced in nuclear reactors and is used in the production of the hydrogen bomb. It is also used as a radioactive agent in making luminous paints, and as a tracer. On August 27, 2001 Russian, French, and Japanese physicists working at the Joint Institute for Nuclear Research near Moscow reported they had made "super-heavy hydrogen", which had a nucleus with one proton and four neutrons. Using an accelerator, they used a beam of helium-6 nuclei to strike a hydrogen target, which resulted in the occasional production of a hydrogen-5 nucleus plus a helium-2 nucleus. These unstable particles quickly disintegrated. This resulted in two protons from the He-2, a triton, and two neutrons from the H-5 breakup. Deuterium gas is readily

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available, without permit, at about \$1/l. Heavy water, deuterium oxide (D₂O), which is used as a moderator to slow down neutrons, is available without permit at a cost of 6¢ to \$1/g, depending on quantity and purity. About 1000 tons (4,400,000 kg) of deuterium oxide (heavy water) are now in use at the Sudbury (Ontario) Neutrino Observatory. This observatory is taking data to provide new revolutionary insight into the properties of neutrinos and into the core of the sun. The heavy water is on loan from Atomic Energy of Canada, Ltd. (AECL). The observatory and detectors are located 6800 ft (2072 m) deep in the Creighton mine of the International Nickel Co., near Sudbury. The heavy water is contained in an acrylic vessel, 12 m in diameter. Neutrinos react with the heavy water to produce Cherenkov radiation. This light is then detected with 9600 photomultiplier tubes surrounding the vessel. The detector laboratory is immensely clean to reduce background radiation, which otherwise hide the very weak signals from neutrinos. Quite apart from isotopes, it has been shown that hydrogen gas under ordinary conditions is a mixture of two kinds of molecules, known as *ortho*- and *para*-hydrogen, which differ from one another by the spins of their electrons and nuclei. Normal hydrogen at room temperature contains 25% of the *para* form and 75% of the *ortho* form. The *ortho* form cannot be prepared in the pure state. Since the two forms differ in energy, the physical properties also differ. The melting and boiling points of *parahydrogen* are about 0.1°C lower than those of normal hydrogen. Consideration is being given to an entire economy based on solar- and nuclear-generated hydrogen. Located in remote regions, power plants would electrolyze sea water; the hydrogen produced would travel to distant cities by pipelines. Pollution-free hydrogen could replace natural gas, gasoline, etc., and could serve as a reducing agent in metallurgy, chemical processing, refining, etc. It could also be used to convert trash into methane and ethylene. Public acceptance, high capital investment, and the high present cost of hydrogen with respect to present fuels are but a few of the problems facing establishment of such an economy. Hydrogen is being investigated as a substitute for deep-sea diving applications below 300 m. Hydrogen is readily available from air product suppliers.

Indium — (from the brilliant indigo line in its spectrum), In; at. wt. 114.818(3); at. no. 49; m.p. 156.60°C; b.p. 2072°C; sp. gr. 7.31 (20°C); valence 1, 2, or 3. Discovered by Reich and Richter, who later isolated the metal. Indium is most frequently associated with zinc materials, and it is from these that most commercial indium is now obtained; however, it is also found in iron, lead, and copper ores. Until 1924, a gram or so constituted the world's supply of this element in isolated form. It is probably about as abundant as silver. About 4 million troy ounces of indium are now produced annually in the Free World. Canada is presently producing more than 1,000,000 troy ounces annually. The present cost of indium is about \$2 to \$10/g, depending on quantity and purity. It is available in ultrapure form. Indium is a very soft, silvery-white metal with a brilliant luster. The pure metal gives a high-pitched "cry" when bent. It wets glass, as does gallium. It has found application in making low-melting alloys; an alloy of 24% indium-76% gallium is liquid at room temperature. Indium is used in making bearing alloys, germanium transistors, rectifiers, thermistors, liquid crystal displays, high definition television, batteries, and photoconductors. It can be plated onto metal and evaporated onto glass, forming a mirror as good as that made with silver but with more resistance to atmospheric corrosion. There is evidence that indium has a low order of toxicity; however, care should be taken until further information is available. Seventy isotopes and isomers are now recognized (more than any other element). Natural indium contains two isotopes. One is stable. The other, ¹¹⁵In, comprising 95.71% of natural indium is slightly radioactive with a very long half-life.

Iodine — (Gr. *iodēs*, violet), I; at. wt. 126.90447(3); at. no. 53; m.p. 113.7°C; b.p. 184.4°C; *t_g* 546°C; density of the gas 11.27 g/l; sp. gr. solid 4.93 (20°C); valence 1, 3, 5, or 7. Discovered by Courtois in 1811. Iodine, a halogen, occurs sparingly in the form of iodides in sea water from which it is assimilated by seaweeds, in Chilean saltpeter and nitrate-bearing earth, known as *caliche* in brines from old sea deposits, and in brackish waters from oil and salt wells. Ultrapure iodine can be obtained from the reaction of potassium iodide with copper sulfate. Several other methods of isolating the element are known. Iodine is a bluish-black, lustrous solid, volatilizing at ordinary temperatures into a blue-violet gas with an irritating odor; it forms compounds with many elements, but is less active than the other halogens, which displace it from iodides. Iodine exhibits some metallic-like properties. It dissolves readily in chloroform, carbon tetrachloride, or carbon disulfide to form beautiful purple solutions. It is only slightly soluble in water. Iodine compounds are important in organic chemistry and very useful in medicine. Forty two isotopes and isomers are recognized. Only one stable isotope, ¹²⁷I is found in nature. The artificial radioisotope ¹³¹I, with a half-life of 8 days, has been used in treating the thyroid gland. The most common compounds are the iodides of sodium and potassium (KI) and the iodates (KIO₃). Lack of iodine is the cause of goiter. Iodides, and thyroxin which contains iodine, are used internally in medicine, and a solution of KI and iodine in alcohol is used for external wounds. Potassium iodide finds use in photography. The deep blue color with starch solution is characteristic of the free element. Care should be taken in handling and using iodine, as contact with the skin can cause lesions; iodine vapor is intensely irritating to the eyes and mucous membranes. Elemental iodine costs about 25 to 75¢/g depending on purity and quantity.

Iridium — (L. *iris*, rainbow), Ir; at. wt. 192.217(3); at. no. 77; m.p. 2446°C; b.p. 4428°C; sp. gr. 22.42 (17°C); valence 3 or 4. Discovered in 1803 by Tennant in the residue left when crude platinum is dissolved by aqua regia. The name iridium is appropriate, for its salts are highly colored. Iridium, a metal of the platinum family, is white, similar to platinum, but with a slight yellowish cast. It is very hard and brittle, making it very hard to machine, form, or work. It is the most corrosion-resistant metal known, and was used in making the standard meter bar of Paris, which is a 90% platinum-10% iridium alloy. This meter bar was replaced in 1960 as a fundamental unit of length (see under Krypton). Iridium is not attacked by any of the acids nor by aqua regia, but is attacked by molten salts, such as NaCl and NaCN. Iridium occurs uncombined in nature with platinum and other metals of this family in alluvial deposits. It is recovered as a by-product from the nickel mining industry. The largest reserves and production of the platinum group of metals, which includes iridium, is in South Africa, followed by Russia and Canada. The U.S. has only one active mine, located at Nye, MT. The presence of iridium has recently been used in examining the Cretaceous-Tertiary (K-T) boundary. Meteorites contain small amounts of iridium. Because iridium is found widely distributed at the K-T boundary, it has been suggested that a large meteorite or asteroid collided with the earth, killing the dinosaurs, and creating a large dust cloud and crater. Searches for such a crater point to one in the Yucatan, known as Chicxulub. Iridium has found use in making crucibles and apparatus for use at high temperatures. It is also used for electrical contacts. Its principal use is as a hardening agent for platinum. With osmium, it forms an alloy which is used for tipping pens and compass bearings. The specific gravity of iridium is only very slightly lower than that of osmium, which has been generally credited as being the heaviest known element. Calculations of the densities of iridium and osmium from the space lattices gives values of 22.65 and 22.61 g/cm³, respectively. These values may be more reliable than actual physical measurements. At present, therefore, we know that either iridium or osmium is the densest known element, but the data do not yet allow selection between the two. Natural iridium contains two stable isotopes. Forty-five other isotopes, all radioactive, are now recognized. Iridium (99.9%) costs about \$100/g.

Iron — (Anglo-Saxon, *iron*), Fe (L. *ferrum*); at. wt. 55.845(2); at. no. 26; m.p. 1538°C; b.p. 2861°C; sp. gr. 7.874 (20°C); valence 2, 3, 4, or 6. The use of iron is prehistoric. Genesis mentions that Tubal-Cain, seven generations from Adam, was "an instructor of every artificer in brass and iron." A remarkable iron pillar, dating to about A.D. 400, remains standing today in Delhi, India. This solid shaft of wrought iron is about 7 1/4 m high by 40 cm in diameter. Corrosion to the pillar has been minimal although it has been exposed to the weather since its erection. Iron is a relatively abundant

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element in the universe. It is found in the sun and many types of stars in considerable quantity. Its nuclei are very stable. It has been suggested that the iron we have here on earth may have originated in a supernova. Iron is a very difficult element to produce in ordinary nuclear reactions, such as would take place in the sun. Iron is found native as a principal component of a class of iron-nickel meteorites known as *siderites*, and is a minor constituent of the other two classes of meteorites. The core of the earth, 2150 miles in radius, is thought to be largely composed of iron with about 10% occluded hydrogen. The metal is the fourth most abundant element, by weight, making up the crust of the earth. The most common ore is *hematite* (Fe_2O_3). Magnetite (Fe_3O_4) is frequently seen as *black sands* along beaches and banks of streams. *Lodestone* is another form of magnetite. *Taconite* is becoming increasingly important as a commercial ore. Iron is a vital constituent of plant and animal life, and appears in hemoglobin. The pure metal is not often encountered in commerce, but is usually alloyed with carbon or other metals. The pure metal is very reactive chemically, and rapidly corrodes, especially in moist air or at elevated temperatures. It has four allotropic forms, or ferrites, known as α , β , γ , and δ , with transition points at 700, 928, and 1530°C. The α form is magnetic, but when transformed into the β form, the magnetism disappears although the lattice remains unchanged. The relations of these forms are peculiar. Pig iron is an alloy containing about 3% carbon with varying amounts of S, Si, Mn, and P. It is hard, brittle, fairly fusible, and is used to produce other alloys, including steel. Wrought iron contains only a few tenths of a percent of carbon, is tough, malleable, less fusible, and has usually a "fibrous" structure. Carbon steel is an alloy of iron with carbon, with small amounts of Mn, S, P, and Si. Alloy steels are carbon steels with other additives such as nickel, chromium, vanadium, etc. Iron is the cheapest and most abundant, useful, and important of all metals. Natural iron contains four isotopes and isomers. Twenty-six other isotopes and isomers, all radioactive, are now recognized.

Krypton — (Gr. *kryptos*, hidden), Kr; at. wt. 83.80(1); at. no. 36; m.p. -157.36°C ; b.p. $-153.22 \pm 0.10^\circ\text{C}$; t_c -63.74°C ; density 3.733 g/l (0°C); valence usually 0. Discovered in 1898 by Ramsay and Travers in the residue left after liquid air had nearly boiled away. Krypton is present in the air to the extent of about 1 ppm. The atmosphere of Mars has been found to contain 0.3 ppm of krypton. It is one of the "noble" gases. It is characterized by its brilliant green and orange spectral lines. Naturally occurring krypton contains six stable isotopes. Thirty other unstable isotopes and isomers are now recognized. The spectral lines of krypton are easily produced and some are very sharp. In 1960 it was internationally agreed that the fundamental unit of length, the meter, should be defined in terms of the orange-red spectral line of ^{86}Kr . This replaced the standard meter of Paris, which was defined in terms of a bar made of a platinum-iridium alloy. In October 1983 the meter, which originally was defined as being one ten millionth of a quadrant of the earth's polar circumference, was again redefined by the International Bureau of Weights and Measures as being the length of path traveled by light in a vacuum during a time interval of $1/299,792,458$ of a second. Solid krypton is a white crystalline substance with a face-centered cubic structure which is common to all the "rare gases". While krypton is generally thought of as a rare gas that normally does not combine with other elements to form compounds, it now appears that the existence of some krypton compounds is established. Krypton difluoride has been prepared in gram quantities and can be made by several methods. A higher fluoride of krypton and a salt of an oxyacid of krypton also have been reported. Molecule-ions of ArKr^+ and KrH^+ have been identified and investigated, and evidence is provided for the formation of KrXe or KrXe^+ . Krypton clathrates have been prepared with hydroquinone and phenol. ^{85}Kr has found recent application in chemical analysis. By imbedding the isotope in various solids, *kryptonates* are formed. The activity of these kryptonates is sensitive to chemical reactions at the surface. Estimates of the concentration of reactants are therefore made possible. Krypton is used in certain photographic flash lamps for high-speed photography. Uses thus far have been limited because of its high cost. Krypton gas presently costs about \$690/100 L.

Kurchatovium — See Rutherfordium.

Lanthanum — (Gr. *lanthanein*, to lie hidden), La; at. wt. 138.9055(2); at. no. 57; m.p. 918°C ; b.p. 3464°C ; sp. gr. 6.145 (25°C); valence 3. Mosander in 1839 extracted a new earth *lanthana*, from impure cerium nitrate, and recognized the new element. Lanthanum is found in rare-earth minerals such as *cerite*, *monazite*, *allanite*, and *bastnasite*. Monazite and bastnasite are principal ores in which lanthanum occurs in percentages up to 25 and 38%, respectively. Misch metal, used in making lighter flints, contains about 25% lanthanum. Lanthanum was isolated in relatively pure form in 1923. Ion-exchange and solvent extraction techniques have led to much easier isolation of the so-called "rare-earth" elements. The availability of lanthanum and other rare earths has improved greatly in recent years. The metal can be produced by reducing the anhydrous fluoride with calcium. Lanthanum is silvery white, malleable, ductile, and soft enough to be cut with a knife. It is one of the most reactive of the rare-earth metals. It oxidizes rapidly when exposed to air. Cold water attacks lanthanum slowly, and hot water attacks it much more rapidly. The metal reacts directly with elemental carbon, nitrogen, boron, selenium, silicon, phosphorus, sulfur, and with halogens. At 310°C , lanthanum changes from a hexagonal to a face-centered cubic structure, and at 865°C it again transforms into a body-centered cubic structure. Natural lanthanum is mixture of two isotopes, one of which is stable and one of which is radioactive with a very long half-life. Thirty other radioactive isotopes are recognized. Rare-earth compounds containing lanthanum are extensively used in carbon lighting applications, especially by the motion picture industry for studio lighting and projection. This application consumes about 25% of the rare-earth compounds produced. La_2O_3 improves the alkali resistance of glass, and is used in making special optical glasses. Small amounts of lanthanum, as an additive, can be used to produce nodular cast iron. There is current interest in hydrogen sponge alloys containing lanthanum. These alloys take up to 400 times their own volume of hydrogen gas, and the process is reversible. Heat energy is released every time they do so; therefore these alloys have possibilities in energy conservation systems. Lanthanum and its compounds have a low to moderate acute toxicity rating; therefore, care should be taken in handling them. The metal costs about \$2/g (99.9%).

Lawrencium — (Ernest O. Lawrence [1901–1958], inventor of the cyclotron), Lr; at. no. 103; at. mass no. [262]; valence + 3(?). This member of the 5f transition elements (actinide series) was discovered in March 1961 by A. Ghiorso, T. Sikkeland, A. E. Larsh, and R. M. Latimer. A 3- μg californium target, consisting of a mixture of isotopes of mass number 249, 250, 251, and 252, was bombarded with either ^{10}B or ^{11}B . The electrically charged transmutation nuclei recoiled with an atmosphere of helium and were collected on a thin copper conveyor tape which was then moved to place collected atoms in front of a series of solid-state detectors. The isotope of element 103 produced in this way decayed by emitting an 8.6-MeV alpha particle with a half-life of 8 s. In 1967, Flerov and associates of the Dubna Laboratory reported their inability to detect an alpha emitter with a half-life of 8 s which was assigned by the Berkeley group to $^{257}103$. This assignment has been changed to ^{258}Lr or ^{259}Lr . In 1965, the Dubna workers found a longer-lived lawrencium isotope, ^{256}Lr , with a half-life of 35 s. In 1968, Ghiorso and associates at Berkeley were able to use a few atoms of this isotope to study the oxidation behavior of lawrencium. Using solvent extraction techniques and working very rapidly, they extracted lawrencium ions from a buffered aqueous solution into an organic solvent, completing each extraction in about 30 s. It was found that lawrencium behaves differently from depositive nobelium and more like the tripositive elements earlier in the actinide series. Ten isotopes of lawrencium are now recognized.

Lead — (Anglo-Saxon *lead*), Pb (L. *plumbum*); at. wt. 207.2(1); at. no. 82; m.p. 327.46°C ; b.p. 1749°C ; sp. gr. 11.35 (20°C); valence 2 or 4. Long known, mentioned in Exodus. The alchemists believed lead to be the oldest metal and associated it with the planet Saturn. Native lead occurs in nature,

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but it is rare. Lead is obtained chiefly from *galena* (PbS) by a roasting process. *Anglesite* (PbSO₄), *cerussite* (PbCO₃), and *minim* (Pb₃O₄) are other common lead minerals. Lead is a bluish-white metal of bright luster, is very soft, highly malleable, ductile, and a poor conductor of electricity. It is very resistant to corrosion; lead pipes bearing the insignia of Roman emperors, used as drains from the baths, are still in service. It is used in containers for corrosive liquids (such as sulfuric acid) and may be toughened by the addition of a small percentage of antimony or other metals. Natural lead is a mixture of four stable isotopes: ²⁰⁴Pb (1.4%), ²⁰⁶Pb (24.1%), ²⁰⁷Pb (22.1%), and ²⁰⁸Pb (52.4%). Lead isotopes are the end products of each of the three series of naturally occurring radioactive elements: ²⁰⁶Pb for the uranium series, ²⁰⁷Pb for the actinium series, and ²⁰⁸Pb for the thorium series. Forty-three other isotopes of lead, all of which are radioactive, are recognized. Its alloys include solder, type metal, and various antifriction metals. Great quantities of lead, both as the metal and as the dioxide, are used in storage batteries. Lead is also used for cable covering, plumbing, and ammunition. The metal is very effective as a sound absorber, is used as a radiation shield around X-ray equipment and nuclear reactors, and is used to absorb vibration. Lead, alloyed with tin, is used in making organ pipes. White lead, the basic carbonate, sublimed white lead (PbSO₄), chrome yellow (PbCrO₄), red lead (Pb₃O₄), and other lead compounds are used extensively in paints, although in recent years the use of lead in paints has been drastically curtailed to eliminate or reduce health hazards. Lead oxide is used in producing fine "crystal glass" and "flint glass" of a high index of refraction for achromatic lenses. The nitrate and the acetate are soluble salts. Lead salts such as lead arsenate have been used as insecticides, but their use in recent years has been practically eliminated in favor of less harmful organic compounds. Care must be used in handling lead as it is a cumulative poison. Environmental concern with lead poisoning has resulted in a national program to eliminate the lead tetraethyl in gasoline. The U.S. Occupational Safety and Health Administration (OSHA) has recommended that industries limit airborne lead to 50 µgms/cu. meter. Lead is priced at about 90¢/kg (99.9%).

Lithium — (Gr. *lithos*, stone), Li; at. wt. 6.941(2); at. no. 3; m.p. 180.5°C; b.p. 1342°C; sp. gr. 0.534 (20°C); valence 1. Discovered by Arfvedson in 1817. Lithium is the lightest of all metals, with a density only about half that of water. It does not occur free in nature; combined it is found in small amounts in nearly all igneous rocks and in the waters of many mineral springs. *Lepidolite*, *spodumene*, *petalite*, and *amblygonite* are the more important minerals containing it. Lithium is presently being recovered from brines of Searles Lake, in California, and from Nevada, Chile, and Argentina. Large deposits of spodumene are found in North Carolina. The metal is produced electrolytically from the fused chloride. Lithium is silvery in appearance, much like Na and K, other members of the alkali metal series. It reacts with water, but not as vigorously as sodium. Lithium imparts a beautiful crimson color to a flame, but when the metal burns strongly the flame is a dazzling white. Since World War II, the production of lithium metal and its compounds has increased greatly. Because the metal has the highest specific heat of any solid element, it has found use in heat transfer applications; however, it is corrosive and requires special handling. The metal has been used as an alloying agent, is of interest in synthesis of organic compounds, and has nuclear applications. It ranks as a leading contender as a battery anode material as it has a high electrochemical potential. Lithium is used in special glasses and ceramics. The glass for the 200-inch telescope at Mt. Palomar contains lithium as a minor ingredient. Lithium chloride is one of the most hygroscopic materials known, and it, as well as lithium bromide, is used in air conditioning and industrial drying systems. Lithium stearate is used as an all-purpose and high-temperature lubricant. Other lithium compounds are used in dry cells and storage batteries. Seven isotopes of lithium are recognized. Natural lithium contains two isotopes. The metal is priced at about \$1.50/g (99.9%).

Lutetium — (Lutetia, ancient name for Paris, sometimes called *cassiopeium* by the Germans), Lu; at. wt. 174.967(1); at. no. 71; m.p. 1663°C; b.p. 3402°C; sp. gr. 9.841 (25°C); valence 3. In 1907, Urbain described a process by which Marignac's ytterbium (1879) could be separated into the two elements, ytterbium (neoytterbium) and lutetium. These elements were identical with "aldebaranium" and "cassiopeium," independently discovered by von Welsbach about the same time. Charles James of the University of New Hampshire also independently prepared the very pure oxide, *lutecia*, at this time. The spelling of the element was changed from *lutecium* to *lutetium* in 1949. Lutetium occurs in very small amounts in nearly all minerals containing yttrium, and is present in *monazite* to the extent of about 0.003%, which is a commercial source. The pure metal has been isolated only in recent years and is one of the most difficult to prepare. It can be prepared by the reduction of anhydrous LuCl₃ or LuF₃ by an alkali or alkaline earth metal. The metal is silvery white and relatively stable in air. While new techniques, including ion-exchange reactions, have been developed to separate the various rare-earth elements, lutetium is still the most costly of all rare earths. It is priced at about \$100/g (99.9%). ¹⁷⁵Lu occurs naturally (97.41%) with ¹⁷⁶Lu (2.59%), which is radioactive with a very long half-life. It is radioactive with a half-life of about 4 × 10¹⁰ years. Lutetium has 50 isotopes and isomers that are now recognized. Stable lutetium nuclides, which emit pure beta radiation after thermal neutron activation, can be used as catalysts in cracking, alkylation, hydrogenation, and polymerization. Virtually no other commercial uses have been found yet for lutetium. While lutetium, like other rare-earth metals, is thought to have a low toxicity rating, it should be handled with care until more information is available.

Magnesium — (*Magnesia*, district in Thessaly) Mg; at. wt. 24.3050(6); at. no. 12; m.p. 650°C; b.p. 1090°C; sp. gr. 1.738 (20°C); valence 2. Compounds of magnesium have long been known. Black recognized magnesium as an element in 1755. It was isolated by Davy in 1808, and prepared in coherent form by Bussy in 1831. Magnesium is the eighth most abundant element in the earth's crust. It does not occur uncombined, but is found in large deposits in the form of *magnesite*, *dolomite*, and other minerals. The metal is now principally obtained in the U.S. by electrolysis of fused magnesium chloride derived from brines, wells, and sea water. Magnesium is a light, silvery-white, and fairly tough metal. It tarnishes slightly in air, and finely divided magnesium readily ignites upon heating in air and burns with a dazzling white flame. It is used in flashlight photography, flares, and pyrotechnics, including incendiary bombs. It is one third lighter than aluminum, and in alloys is essential for airplane and missile construction. The metal improves the mechanical, fabrication, and welding characteristics of aluminum when used as an alloying agent. Magnesium is used in producing nodular graphite in cast iron, and is used as an additive to conventional propellants. It is also used as a reducing agent in the production of pure uranium and other metals from their salts. The hydroxide (*milk of magnesia*), chloride, sulfate (*Epsom salts*), and citrate are used in medicine. Dead-burned magnesite is employed for refractory purposes such as brick and liners in furnaces and converters. Calcined magnesia is also used for water treatment and in the manufacture of rubber, paper, etc. Organic magnesium compounds (Grignard's reagents) are important. Magnesium is an important element in both plant and animal life. Chlorophylls are magnesium-centered porphyrins. The adult daily requirement of magnesium is about 300 mg/day, but this is affected by various factors. Great care should be taken in handling magnesium metal, especially in the finely divided state, as serious fires can occur. Water should not be used on burning magnesium or on magnesium fires. Natural magnesium contains three isotopes. Twelve other isotopes are recognized. Magnesium metal costs about \$100/kg (99.8%).

Manganese — (*L. magnes*, magnet, from magnetic properties of pyrolusite; *It. manganese*, corrupt form of *magnesia*), Mn; at. wt. 54.938049(9); at. no. 25; m.p. 1246°C; b.p. 2061°C; sp. gr. 7.21 to 7.44, depending on allotropic form; valence 1, 2, 3, 4, 6, or 7. Recognized by Scheele, Bergman,

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and others as an element and isolated by Gahn in 1774 by reduction of the dioxide with carbon. Manganese minerals are widely distributed; oxides, silicates, and carbonates are the most common. The discovery of large quantities of manganese nodules on the floor of the oceans holds promise as a source of manganese. These nodules contain about 24% manganese together with many other elements in lesser abundance. Most manganese today is obtained from ores found in the Ukraine, Brazil, Australia, Republic of So. Africa, Gabon, China, and India. *Pyrolusite* (MnO_2) and *rhodochrosite* (MnCO_3) are among the most common manganese minerals. The metal is obtained by reduction of the oxide with sodium, magnesium, aluminum, or by electrolysis. It is gray-white, resembling iron, but is harder and very brittle. The metal is reactive chemically, and decomposes cold water slowly. Manganese is used to form many important alloys. In steel, manganese improves the rolling and forging qualities, strength, toughness, stiffness, wear resistance, hardness, and hardenability. With aluminum and antimony, especially with small amounts of copper, it forms highly ferromagnetic alloys. Manganese metal is ferromagnetic only after special treatment. The pure metal exists in four allotropic forms. The alpha form is stable at ordinary temperature; gamma manganese, which changes to alpha at ordinary temperatures, is said to be flexible, soft, easily cut, and capable of being bent. The dioxide (pyrolusite) is used as a depolarizer in dry cells, and is used to “decolorize” glass that is colored green by impurities of iron. Manganese by itself colors glass an amethyst color, and is responsible for the color of true amethyst. The dioxide is also used in the preparation of oxygen and chlorine, and in drying black paints. The permanganate is a powerful oxidizing agent and is used in quantitative analysis and in medicine. Manganese is widely distributed throughout the animal kingdom. It is an important trace element and may be essential for utilization of vitamin B_1 . Twenty-seven isotopes and isomers are known. Manganese metal (99.95%) is priced at about \$800/kg. Metal of 99.6% purity is priced at about \$80/kg.

Meitnerium — (named for Lise Meitner [1878–1968], Austrian-Swedish physicist and mathematician), Mt; at. wt. [266]; at. no. 109. On August 29, 1992, Element 109 was made and identified by physicists at the Heavy Ion Research Laboratory (G.S.I.), Darmstadt, Germany, by bombarding a target of ^{209}Bi with accelerated nuclei of ^{58}Fe . The production of Element 109 has been extremely small. It took a week of target bombardment (10^{11} nuclear encounters) to produce a single atom of 109. Oganessian and his team at Dubna in 1994 repeated the Darmstadt experiment using a tenfold irradiation dose. One fission event from seven alpha decays of 109 was observed, thus indirectly confirming the existence of isotope $^{266}109$. In August 1997, the IUPAC adopted the name *meitnerium* for this element, honoring L. Meitner. Four isotopes of *meitnerium* are now recognized.

Mendelevium — (Dmitri Mendeleev [1834–1907]), Md; at. wt. (258); at. no. 101; m.p. 827°C ; valence +2, +3. Mendelevium, the ninth transuranium element of the actinide series to be discovered, was first identified by Ghiorso, Harvey, Choppin, Thompson, and Seaborg early in 1955 as a result of the bombardment of the isotope ^{253}Es with helium ions in the Berkeley 60-inch cyclotron. The isotope produced was ^{256}Md , which has a half-life of 78 min. This first identification was notable in that ^{256}Md was synthesized on a one-atom-at-a-time basis. Nineteen isotopes and isomers are now recognized. ^{258}Md has a half-life of 51.5 days. This isotope has been produced by the bombardment of an isotope of einsteinium with ions of helium. It now appears possible that eventually enough ^{258}Md can be made so that some of its physical properties can be determined. ^{256}Md has been used to elucidate some of the chemical properties of mendelevium in aqueous solution. Experiments seem to show that the element possesses a moderately stable dipositive (II) oxidation state in addition to the tripositive (III) oxidation state, which is characteristic of actinide elements.

Mercury — (Planet *Mercury*), Hg (*hydrargyrum*, liquid silver); at. wt. 200.59(2); at. no. 80; t.p. -38.83°C ; b.p. 356.73°C ; t_c 1447°C ; sp. gr. 13.546 (20°C); valence 1 or 2. Known to ancient Chinese and Hindus; found in Egyptian tombs of 1500 B.C. Mercury is the only common metal liquid at ordinary temperatures. It only rarely occurs free in nature. The chief ore is *cinnabar* (HgS). Spain and China produce about 75% of the world's supply of the metal. The commercial unit for handling mercury is the “flask,” which weighs 76 lb (34.46 kg). The metal is obtained by heating cinnabar in a current of air and by condensing the vapor. It is a heavy, silvery-white metal; a rather poor conductor of heat, as compared with other metals, and a fair conductor of electricity. It easily forms alloys with many metals, such as gold, silver, and tin, which are called *amalgams*. Its ease in amalgamating with gold is made use of in the recovery of gold from its ores. The metal is widely used in laboratory work for making thermometers, barometers, diffusion pumps, and many other instruments. It is used in making mercury-vapor lamps and advertising signs, etc. and is used in mercury switches and other electrical apparatus. Other uses are in making pesticides, mercury cells for caustic soda and chlorine production, dental preparations, antifouling paint, batteries, and catalysts. The most important salts are mercuric chloride HgCl_2 (corrosive sublimate — a violent poison), mercurous chloride Hg_2Cl_2 (calomel, occasionally still used in medicine), mercury fulminate ($\text{Hg}(\text{ONC})_2$), a detonator widely used in explosives, and mercuric sulfide (HgS , vermilion, a high-grade paint pigment). Organic mercury compounds are important. It has been found that an electrical discharge causes mercury vapor to combine with neon, argon, krypton, and xenon. These products, held together with van der Waals' forces, correspond to HgNe , HgAr , HgKr , and HgXe . Mercury is a virulent poison and is readily absorbed through the respiratory tract, the gastrointestinal tract, or through unbroken skin. It acts as a cumulative poison and dangerous levels are readily attained in air. Air saturated with mercury vapor at 20°C contains a concentration that exceeds the toxic limit many times. The danger increases at higher temperatures. *It is therefore important that mercury be handled with care.* Containers of mercury should be securely covered and spillage should be avoided. If it is necessary to heat mercury or mercury compounds, it should be done in a well-ventilated hood. Methyl mercury is a dangerous pollutant and is now widely found in water and streams. The triple point of mercury, -38.8344°C , is a fixed point on the International Temperature Scale (ITS-90). Mercury (99.98%) is priced at about \$110/kg. Native mercury contains seven isotopes. Thirty-six other isotopes and isomers are known.

Molybdenum — (Gr. *molybdos*, lead), Mo; at. wt. 95.94(1); at. no. 42; m.p. 2623°C ; b.p. 4639°C ; sp. gr. 10.22 (20°C); valence 2, 3, 4?, 5?, or 6. Before Scheele recognized molybdenite as a distinct ore of a new element in 1778, it was confused with graphite and lead ore. The metal was prepared in an impure form in 1782 by Hjelm. Molybdenum does not occur native, but is obtained principally from *molybdenite* (MoS_2). *Wulfenite* (PbMoO_4) and *powellite* ($\text{Ca}(\text{MoW})\text{O}_4$) are also minor commercial ores. Molybdenum is also recovered as a by-product of copper and tungsten mining operations. The U.S., Canada, Chile, and China produce most of the world's molybdenum ores. The metal is prepared from the powder made by the hydrogen reduction of purified molybdic trioxide or ammonium molybdate. The metal is silvery white, very hard, but is softer and more ductile than tungsten. It has a high elastic modulus, and only tungsten and tantalum, of the more readily available metals, have higher melting points. It is a valuable alloying agent, as it contributes to the hardenability and toughness of quenched and tempered steels. It also improves the strength of steel at high temperatures. It is used in certain nickel-based alloys, such as the “Hastelloys®” which are heat-resistant and corrosion-resistant to chemical solutions. Molybdenum oxidizes at elevated temperatures. The metal has found recent application as electrodes for electrically heated glass furnaces and forehearth. The metal is also used in nuclear energy applications and for missile and aircraft parts. Molybdenum is valuable as a catalyst in the refining of petroleum. It has found application as a filament material in electronic and electrical applications. Molybdenum is an essential trace element in plant nutrition. Some lands are barren for lack of this element in the soil. Molybdenum sulfide is useful as a lubricant, especially at high temperatures where oils would

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decompose. Almost all ultra-high strength steels with minimum yield points up to 300,000 psi(lb/in.²) contain molybdenum in amounts from 0.25 to 8%. Natural molybdenum contains seven isotopes. Thirty other isotopes and isomers are known, all of which are radioactive. Molybdenum metal costs about \$1/g (99.999% purity). Molybdenum metal (99.9%) costs about \$160/kg.

Neodymium — (Gr. *neos*, new, and *didymos*, twin), Nd; at. wt. 144.24(3); at. no. 60; m.p. 1021°C; b.p. 3074°C; sp. gr. 7.008 (25°C); valence 3. In 1841, Mosander, extracted from *cerite* a new rose-colored oxide, which he believed contained a new element. He named the element *didymium*, as it was *an inseparable twin brother of lanthanum*. In 1885 von Welsbach separated didymium into two new elemental components, *neodymia* and *praseodymia*, by repeated fractionation of ammonium didymium nitrate. While the free metal is in *misch metal*, long known and used as a pyrophoric alloy for light flints, the element was not isolated in relatively pure form until 1925. Neodymium is present in *misch metal* to the extent of about 18%. It is present in the minerals *monazite* and *bastnasite*, which are principal sources of rare-earth metals. The element may be obtained by separating neodymium salts from other rare earths by ion-exchange or solvent extraction techniques, and by reducing anhydrous halides such as NdF₃ with calcium metal. Other separation techniques are possible. The metal has a bright silvery metallic luster. Neodymium is one of the more reactive rare-earth metals and quickly tarnishes in air, forming an oxide that spalls off and exposes metal to oxidation. The metal, therefore, should be kept under light mineral oil or sealed in a plastic material. Neodymium exists in two allotropic forms, with a transformation from a double hexagonal to a body-centered cubic structure taking place at 863°C. Natural neodymium is a mixture of seven isotopes, one of which has a very long half-life. Twenty seven other radioactive isotopes and isomers are recognized. Didymium, of which neodymium is a component, is used for coloring glass to make welder's goggles. By itself, neodymium colors glass delicate shades ranging from pure violet through wine-red and warm gray. Light transmitted through such glass shows unusually sharp absorption bands. The glass has been used in astronomical work to produce sharp bands by which spectral lines may be calibrated. Glass containing neodymium can be used as a laser material to produce coherent light. Neodymium salts are also used as a colorant for enamels. The element is also being used with iron and boron to produce extremely strong magnets having energy densities as high as 27 to 35 million gauss oersteds. These are the most compact magnets commercially available. The price of the metal is about \$4/g. Neodymium has a low-to-moderate acute toxic rating. As with other rare earths, neodymium should be handled with care.

Neon — (Gr. *neos*, new), Ne; at. wt. 20.1797(6); at. no. 10; t.p. -248.59°C; b.p. -246.08°C; *t_c* -228.7°C (1 atm); density of gas 0.89990 g/l (1 atm, 0°C); density of liquid at b.p. 1.207 g/cm³; valence 0. Discovered by Ramsay and Travers in 1898. Neon is a rare gaseous element present in the atmosphere to the extent of 1 part in 65,000 of air. It is obtained by liquefaction of air and separated from the other gases by fractional distillation. Natural neon is a mixture of three isotopes. Fourteen other unstable isotopes are known. It is very inert element; however, it is said to form a compound with fluorine. It is still questionable if true compounds of neon exist, but evidence is mounting in favor of their existence. The following ions are known from optical and mass spectrometric studies: Ne⁺, (NeAr)⁺, (NeH)⁺, and (HeNe)⁺. Neon also forms an unstable hydrate. In a vacuum discharge tube, neon glows reddish orange. Of all the rare gases, the discharge of neon is the most intense at ordinary voltages and currents. Neon is used in making the common neon advertising signs, which accounts for its largest use. It is also used to make high-voltage indicators, lightning arrestors, wave meter tubes, and TV tubes. Neon and helium are used in making gas lasers. Liquid neon is now commercially available and is finding important application as an economical cryogenic refrigerant. It has over 40 times more refrigerating capacity per unit volume than liquid helium and more than three times that of liquid hydrogen. It is compact, inert, and is less expensive than helium when it meets refrigeration requirements. Neon costs about \$800/80 cu. ft. (2265 l).

Neptunium — (Planet *Neptune*), Np; at. wt. (237); at. no. 93; m.p. 644°C; sp. gr. 20.25 (20°C); valence 3, 4, 5, and 6. Neptunium was the first synthetic transuranium element of the actinide series discovered; the isotope ²³⁹Np was produced by McMillan and Abelson in 1940 at Berkeley, California, as the result of bombarding uranium with cyclotron-produced neutrons. The isotope ²³⁷Np (half-life of 2.14 × 10⁶ years) is currently obtained in gram quantities as a by-product from nuclear reactors in the production of plutonium. Twenty-three isotopes and isomers of neptunium are now recognized. Trace quantities of the element are actually found in nature due to transmutation reactions in uranium ores produced by the neutrons which are present. Neptunium is prepared by the reduction of NpF₃ with barium or lithium vapor at about 1200°C. Neptunium metal has a silvery appearance, is chemically reactive, and exists in at least three structural modifications: α-neptunium, orthorhombic, density 20.25 g/cm³, β-neptunium (above 280°C), tetragonal, density (313°C) 19.36 g/cm³; γ-neptunium (above 577°C), cubic, density (600°C) 18.0 g/cm³. Neptunium has four ionic oxidation states in solution: Np⁺³ (pale purple), analogous to the rare earth ion Pm⁺³, Np⁺⁴ (yellow green); NpO⁺ (green blue); and NpO⁺⁺ (pale pink). These latter oxygenated species are in contrast to the rare earths which exhibit only simple ions of the (II), (III), and (IV) oxidation states in aqueous solution. The element forms tri- and tetrahalides such as NpF₃, NpF₄, NpCl₄, NpBr₃, NpI₃, and oxides of various compositions such as are found in the uranium-oxygen system, including Np₃O₈ and NpO₂.

Nickel — (Ger. *Nickel*, Satan or Old Nick's and from *kupfernickel*, Old Nick's copper), Ni; at. wt. 58.6934(2); at. no. 28; m.p. 1455°C; b.p. 2913°C; sp. gr. 8.902 (25°C); valence 0, 1, 2, 3. Discovered by Cronstedt in 1751 in *kupfernickel* (*niccolite*). Nickel is found as a constituent in most meteorites and often serves as one of the criteria for distinguishing a meteorite from other minerals. Iron meteorites, or *siderites*, may contain iron alloyed with from 5 to nearly 20% nickel. Nickel is obtained commercially from *pentlandite* and *pyrrhotite* of the Sudbury region of Ontario, a district that produces much of the world's nickel. It is now thought that the Sudbury deposit is the result of an ancient meteorite impact. Large deposits of nickel, cobalt, and copper have recently been developed at Voisey's Bay, Labrador. Other deposits of nickel are found in Russia, New Caledonia, Australia, Cuba, Indonesia, and elsewhere. Nickel is silvery white and takes on a high polish. It is hard, malleable, ductile, somewhat ferromagnetic, and a fair conductor of heat and electricity. It belongs to the iron-cobalt group of metals and is chiefly valuable for the alloys it forms. It is extensively used for making stainless steel and other corrosion-resistant alloys such as Invar®, Monel®, Inconel®, and the Hastelloys®. Tubing made of a copper-nickel alloy is extensively used in making desalination plants for converting sea water into fresh water. Nickel is also now used extensively in coinage and in making nickel steel for armor plate and burglar-proof vaults, and is a component in Nichrome®, Permalloy®, and constantan. Nickel added to glass gives a green color. Nickel plating is often used to provide a protective coating for other metals, and finely divided nickel is a catalyst for hydrogenating vegetable oils. It is also used in ceramics, in the manufacture of Alnico magnets, and in the Edison® storage battery. The sulfate and the oxides are important compounds. Natural nickel is a mixture of five stable isotopes; twenty-five other unstable isotopes are known. Nickel sulfide fume and dust is recognized as having carcinogenic potential. Nickel metal (99.9%) is priced at about \$2/g or less in larger quantities.

Nielsbohrium — See Bohrium.

Niobium — (*Niobe*, daughter of Tantalus), Nb; or Columbian (*Columbia*, name for America); at. wt. 92.90638(2); at. no. 41; m.p. 2477°C; b.p. 4744°C, sp. gr. 8.57 (20°C); valence 2, 3, 4?, 5. Discovered in 1801 by Hatchett in an ore sent to England more than a century before by John Winthrop

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the Younger, first governor of Connecticut. The metal was first prepared in 1864 by Blomstrand, who reduced the chloride by heating it in a hydrogen atmosphere. The name *niobium* was adopted by the International Union of Pure and Applied Chemistry in 1950 after 100 years of controversy. Many leading chemical societies and government organizations refer to it by this name. Most metallurgists, leading metal societies, and all but one of the leading U.S. commercial producers, however, still refer to the metal as “columbium”. The element is found in *niobite* (or *columbite*), *niobite-tantalite*, *pyrochlore*, and *euxenite*. Large deposits of niobium have been found associated with *carbonatites* (carbon-silicate rocks), as a constituent of *pyrochlore*. Extensive ore reserves are found in Canada, Brazil, Congo-Kinshasa, Rwanda, and Australia. The metal can be isolated from tantalum, and prepared in several ways. It is a shiny, white, soft, and ductile metal, and takes on a bluish cast when exposed to air at room temperatures for a long time. The metal starts to oxidize in air at 200°C, and when processed at even moderate temperatures must be placed in a protective atmosphere. It is used in arc-welding rods for stabilized grades of stainless steel. Thousands of pounds of niobium have been used in advance air frame systems such as were used in the Gemini space program. It has also found use in super-alloys for applications such as jet engine components, rocket subassemblies, and heat-resisting equipment. The element has superconductive properties; superconductive magnets have been made with Nb-Zr wire, which retains its superconductivity in strong magnetic fields. This type of application offers hope of direct large-scale generation of electric power. Natural niobium is composed of only one isotope, ⁹³Nb. Forty-seven other isotopes and isomers of niobium are now recognized. Niobium metal (99.9% pure) is priced at about 50¢/g.

Nitrogen — (*L. nitrum*, *Gr. nitron*, native soda; genes, *forming*, N; at. wt. 14.00674(7); at. no. 7; m.p. -210.00°C; b.p. -198.79°C; *t_c* -146.94°C; density 1.2506 g/l; sp. gr. liquid 0.808 (-195.8°C), solid 1.026 (-252°C); valence 3 or 5. Discovered by Daniel Rutherford in 1772, but Scheele, Cavendish, Priestley, and others about the same time studied “burnt or dephlogisticated air,” as air without oxygen was then called. Nitrogen makes up 78% of the air, by volume. The atmosphere of Mars, by comparison, is 2.6% nitrogen. The estimated amount of this element in our atmosphere is more than 4000 trillion tons. From this inexhaustible source it can be obtained by liquefaction and fractional distillation. Nitrogen molecules give the orange-red, blue-green, blue-violet, and deep violet shades of the aurora. The element is so inert that Lavoisier named it *azote*, meaning without life, yet its compounds are so active as to be most important in foods, poisons, fertilizers, and explosives. Nitrogen can be also easily prepared by heating a water solution of ammonium nitrite. Nitrogen, as a gas, is colorless, odorless, and a generally inert element. As a liquid it is also colorless and odorless, and is similar in appearance to water. Two allotropic forms of solid nitrogen exist, with the transition from the α to the β form taking place at -237°C. When nitrogen is heated, it combines directly with magnesium, lithium, or calcium; when mixed with oxygen and subjected to electric sparks, it forms first nitric oxide (NO) and then the dioxide (NO₂); when heated under pressure with a catalyst with hydrogen, ammonia is formed (Haber process). The ammonia thus formed is of the utmost importance as it is used in fertilizers, and it can be oxidized to nitric acid (Ostwald process). The ammonia industry is the largest consumer of nitrogen. Large amounts of gas are also used by the electronics industry, which uses the gas as a blanketing medium during production of such components as transistors, diodes, etc. Large quantities of nitrogen are used in annealing stainless steel and other steel mill products. The drug industry also uses large quantities. Nitrogen is used as a refrigerant both for the immersion freezing of food products and for transportation of foods. Liquid nitrogen is also used in missile work as a purge for components, insulators for space chambers, etc., and by the oil industry to build up great pressures in wells to force crude oil upward. Sodium and potassium nitrates are formed by the decomposition of organic matter with compounds of the metals present. In certain dry areas of the world these saltpeters are found in quantity. Ammonia, nitric acid, the nitrates, the five oxides (N₂O, NO, N₂O₃, NO₂, and N₂O₅), TNT, the cyanides, etc. are but a few of the important compounds. Nitrogen gas prices vary from 2¢ to \$2.75 per 100 ft³ (2.83 cu. meters), depending on purity, etc. Production of elemental nitrogen in the U.S. is more than 9 million short tons per year. Natural nitrogen contains two isotopes, ¹⁴N and ¹⁵N. Ten other isotopes are known.

Nobelium — (Alfred Nobel, discoverer of dynamite), No; at. wt. [259]; at. no. 102; valence +2, +3. Nobelium was unambiguously discovered and identified in April 1958 at Berkeley by A. Ghiorso, T. Sikkeland, J. R. Walton, and G. T. Seaborg, who used a new double-recoil technique. A heavy-ion linear accelerator (HILAC) was used to bombard a thin target of curium (95% ²⁴⁴Cm and 4.5% ²⁴⁶Cm) with ¹²C ions to produce ¹⁰²254 according to the ²⁴⁶Cm (¹²C, 4n) reaction. Earlier in 1957 workers of the U.S., Britain, and Sweden announced the discovery of an isotope of Element 102 with a 10-min half-life at 8.5 MeV, as a result of bombarding ²⁴⁴Cm with ¹³C nuclei. On the basis of this experiment the name *nobelium* was assigned and accepted by the Commission on Atomic Weights of the International Union of Pure and Applied Chemistry. The acceptance of the name was premature, for both Russian and American efforts now completely rule out the possibility of any isotope of Element 102 having a half-life of 10 min in the vicinity of 8.5 MeV. Early work in 1957 on the search for this element, in Russia at the Kurchatov Institute, was marred by the assignment of 8.9 ± 0.4 MeV alpha radiation with a half-life of 2 to 40 sec, which was too indefinite to support claim to discovery. Confirmatory experiments at Berkeley in 1966 have shown the existence of ²⁵⁴102 with a 55-s half-life, ²⁵²102 with a 2.3-s half-life, and ²⁵⁷102 with a 25-s half-life. Twelve isotopes are now recognized, one of which — ²⁵⁵102 has a half-life of 3.1 min. In view of the discoverer's traditional right to name an element, the Berkeley group, in 1967, suggested that the hastily given name *nobelium*, along with the symbol No, be retained.

Osmium — (*Gr. osme*, a smell), Os; at. wt. 190.23(3); at. no. 76; m.p. 3033°C; b.p. 5012°C; sp. gr. 22.57; valence 0 to +8, more usually +3, +4, +6, and +8. Discovered in 1803 by Tennant in the residue left when crude platinum is dissolved by *aqua regia*. Osmium occurs in *iridosmine* and in platinum-bearing river sands of the Urals, North America, and South America. It is also found in the nickel-bearing ores of Sudbury, Ontario, region along with other platinum metals. While the quantity of platinum metals in these ores is very small, the large tonnages of nickel ores processed make commercial recovery possible. The metal is lustrous, bluish white, extremely hard, and brittle even at high temperatures. It has the highest melting point and the lowest vapor pressure of the platinum group. The metal is very difficult to fabricate, but the powder can be sintered in a hydrogen atmosphere at a temperature of 2000°C. The solid metal is not affected by air at room temperature, but the powdered or spongy metal slowly gives off osmium tetroxide, which is a powerful oxidizing agent and has a strong smell. The tetroxide is highly toxic, and boils at 130°C (760 mm). Concentrations in air as low as 10⁻⁷ g/m³ can cause lung congestion, skin damage, or eye damage. The tetroxide has been used to detect fingerprints and to stain fatty tissue for microscope slides. The metal is almost entirely used to produce very hard alloys, with other metals of the platinum group, for fountain pen tips, instrument pivots, phonograph needles, and electrical contacts. The price of 99.9% pure osmium powder — the form usually supplied commercially — is about \$100/g, depending on quantity and supplier. Natural osmium contains seven isotopes, one of which, ¹⁸⁶Os, is radioactive with a very long half-life. Thirty four other isotopes and isomers are known, all of which are radioactive. The measured densities of iridium and osmium seem to indicate that osmium is slightly more dense than iridium, so osmium has generally been credited with being the heaviest known element. Calculations of the density from the space lattice, which may be more reliable for these elements than actual measurements, however, give a density of 22.65 for iridium compared to 22.61 for osmium. At present, therefore, we know either iridium or osmium is the heaviest element, but the data do not allow selection between the two.

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Oxygen — (Gr. *oxys*, sharp, acid, and *genes*, forming; acid former), O; at. wt. 15.9994(3); at. no. 8; t.p. -218.79°C ; t_c -118.56°C ; valence 2. For many centuries, workers occasionally realized air was composed of more than one component. The behavior of oxygen and nitrogen as components of air led to the advancement of the phlogiston theory of combustion, which captured the minds of chemists for a century. Oxygen was prepared by several workers, including Bayen and Borch, but they did not know how to collect it, did not study its properties, and did not recognize it as an elementary substance. Priestley is generally credited with its discovery, although Scheele also discovered it independently. Oxygen is the third most abundant element found in the sun, and it plays a part in the carbon-nitrogen cycle, one process thought to give the sun and stars their energy. Oxygen under excited conditions is responsible for the bright red and yellow-green colors of the aurora. Oxygen, as a gaseous element, forms 21% of the atmosphere by volume from which it can be obtained by liquefaction and fractional distillation. The atmosphere of Mars contains about 0.15% oxygen. The element and its compounds make up 49.2%, by weight, of the earth's crust. About two thirds of the human body and nine tenths of water is oxygen. In the laboratory it can be prepared by the electrolysis of water or by heating potassium chlorate with manganese dioxide as a catalyst. The gas is colorless, odorless, and tasteless. The liquid and solid forms are a pale blue color and are strongly paramagnetic. Ozone (O_3), a highly active compound, is formed by the action of an electrical discharge or ultraviolet light on oxygen. Ozone's presence in the atmosphere (amounting to the equivalent of a layer 3 mm thick at ordinary pressures and temperatures) is of vital importance in preventing harmful ultraviolet rays of the sun from reaching the earth's surface. There has been recent concern that pollutants in the atmosphere may have a detrimental effect on this ozone layer. Ozone is toxic and exposure should not exceed 0.2 mg/m^3 (8-hour time-weighted average — 40-hour work week). Undiluted ozone has a bluish color. Liquid ozone is bluish black, and solid ozone is violet-black. Oxygen is very reactive and capable of combining with most elements. It is a component of hundreds of thousands of organic compounds. It is essential for respiration of all plants and animals and for practically all combustion. In hospitals it is frequently used to aid respiration of patients. Its atomic weight was used as a standard of comparison for each of the other elements until 1961 when the International Union of Pure and Applied Chemistry adopted carbon 12 as the new basis. Oxygen has thirteen recognized isotopes. Natural oxygen is a mixture of three isotopes. Oxygen 18 occurs naturally, is stable, and is available commercially. Water (H_2O with 1.5% ^{18}O) is also available. Commercial oxygen consumption in the U.S. is estimated to be 20 million short tons per year and the demand is expected to increase substantially in the next few years. Oxygen enrichment of steel blast furnaces accounts for the greatest use of the gas. Large quantities are also used in making synthesis gas for ammonia and methanol, ethylene oxide, and for oxy-acetylene welding. Air separation plants produce about 99% of the gas, electrolysis plants about 1%. The gas costs 5¢/ft^3 ($\$1.75/\text{cu. meters}$) in small quantities.

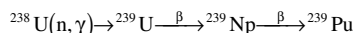
Palladium — (named after the asteroid *Pallas*, discovered about the same time; Gr. *Pallas*, goddess of wisdom), Pd. at. wt. 106.42(1) at. no. 46; m.p. 1554.9°C ; b.p. 2963°C ; sp. gr. 12.02 (20°C); valence 2, 3, or 4. Discovered in 1803 by Wollaston. Palladium is found along with platinum and other metals of the platinum group in deposits of Russia, South Africa, Canada (Ontario), and elsewhere. Natural palladium contains six stable isotopes. Twenty-nine other isotopes are recognized, all of which are radioactive. It is frequently found associated with the nickel-copper deposits such as those found in Ontario. Its separation from the platinum metals depends upon the type of ore in which it is found. It is a steel-white metal, does not tarnish in air, and is the least dense and lowest melting of the platinum group of metals. When annealed, it is soft and ductile; cold working greatly increases its strength and hardness. Palladium is attacked by nitric and sulfuric acid. At room temperatures the metal has the unusual property of absorbing up to 900 times its own volume of hydrogen, possibly forming Pd_2H . It is not yet clear if this is a true compound. Hydrogen readily diffuses through heated palladium and this provides a means of purifying the gas. Finely divided palladium is a good catalyst and is used for hydrogenation and dehydrogenation reactions. It is alloyed and used in jewelry trades. White gold is an alloy of gold decolorized by the addition of palladium. Like gold, palladium can be beaten into leaf as thin as $1/250,000$ in. The metal is used in dentistry, watchmaking, and in making surgical instruments and electrical contacts. Palladium recently has been substituted for higher priced platinum in catalytic converters by some automobile companies. This has caused a large increase in the cost of palladium. The price of the two metals are now, in 2002, about the same. Palladium, however, is less resistant to poisoning by sulfur and lead, than platinum, but it may prove useful in controlling emissions from diesel vehicles. The metal sells for about $\$350/\text{tr. oz.}$ ($\$11/\text{g}$).

Phosphorus — (Gr. *phosphoros*, light bearing; ancient name for the planet Venus when appearing before sunrise), P; at. wt. 30.973762(4); at. no. 15; m.p. (white) 44.15°C ; b.p. 280.5°C ; sp. gr. (white) 1.82 (red) 2.20, (black) 2.25 to 2.69; valence 3 or 5. Discovered in 1669 by Brand, who prepared it from urine. Phosphorus exists in four or more allotropic forms: white (or yellow), red, and black (or violet). White phosphorus has two modifications: α and β with a transition temperature at -3.8°C . Never found free in nature, it is widely distributed in combination with minerals. Twenty-one isotopes of phosphorus are recognized. *Phosphate* rock, which contains the mineral *apatite*, an impure tri-calcium phosphate, is an important source of the element. Large deposits are found in the Russia, China, Morocco, and in Florida, Tennessee, Utah, Idaho, and elsewhere. Phosphorus is an essential ingredient of all cell protoplasm, nervous tissue, and bones. Ordinary phosphorus is a waxy white solid; when pure it is colorless and transparent. It is insoluble in water, but soluble in carbon disulfide. It takes fire spontaneously in air, burning to the pentoxide. It is very poisonous, 50 mg constituting an approximate fatal dose. Exposure to white phosphorus should not exceed 0.1 mg/m^3 (8-hour time-weighted average — 40-hour work week). White phosphorus should be kept under water, as it is dangerously reactive in air, and it should be handled with forceps, as contact with the skin may cause severe burns. When exposed to sunlight or when heated in its own vapor to 250°C , it is converted to the red variety, which does not phosphoresce in air as does the white variety. This form does not ignite spontaneously and it is not as dangerous as white phosphorus. It should, however, be handled with care as it does convert to the white form at some temperatures and it emits highly toxic fumes of the oxides of phosphorus when heated. The red modification is fairly stable, sublimes with a vapor pressure of 1 atm at 417°C , and is used in the manufacture of safety matches, pyrotechnics, pesticides, incendiary shells, smoke bombs, tracer bullets, etc. White phosphorus may be made by several methods. By one process, tri-calcium phosphate, the essential ingredient of phosphate rock, is heated in the presence of carbon and silica in an electric furnace or fuel-fired furnace. Elementary phosphorus is liberated as vapor and may be collected under water. If desired, the phosphorus vapor and carbon monoxide produced by the reaction can be oxidized at once in the presence of moisture to produce phosphoric acid, an important compound in making super-phosphate fertilizers. In recent years, concentrated phosphoric acids, which may contain as much as 70 to 75% P_2O_5 content, have become of great importance to agriculture and farm production. World-wide demand for fertilizers has caused record phosphate production. Phosphates are used in the production of special glasses, such as those used for sodium lamps. Bone-ash, calcium phosphate, is also used to produce fine chinaware and to produce mono-calcium phosphate used in baking powder. Phosphorus is also important in the production of steels, phosphor bronze, and many other products. Trisodium phosphate is important as a cleaning agent, as a water softener, and for preventing boiler scale and corrosion of pipes and boiler tubes. Organic compounds of phosphorus are important. Amorphous (red) phosphorus costs about $\$70/\text{kg}$ (99%).

THE ELEMENTS (continued)

Platinum—(It. *platina*, silver), Pt; at. wt. 195.078(2); at. no. 78; m.p. 1768.4°C; b.p. 3825°C; sp. gr. 21.45 (20°C); valence 1?, 2, 3, or 4. Discovered in South America by Ulloa in 1735 and by Wood in 1741. The metal was used by pre-Columbian Indians. Platinum occurs native, accompanied by small quantities of iridium, osmium, palladium, ruthenium, and rhodium, all belonging to the same group of metals. These are found in the alluvial deposits of the Ural mountains and in Columbia. *Sperrylite* (PtAs₂), occurring with the nickel-bearing deposits of Sudbury, Ontario, is a source of a considerable amount of metal. The large production of nickel offsets there being only one part of the platinum metals in two million parts of ore. The largest supplier of the platinum group of metals is now South Africa, followed by Russia and Canada. Platinum is a beautiful silvery-white metal, when pure, and is malleable and ductile. It has a coefficient of expansion almost equal to that of soda-lime-silica glass, and is therefore used to make sealed electrodes in glass systems. The metal does not oxidize in air at any temperature, but is corroded by halogens, cyanides, sulfur, and caustic alkalis. It is insoluble in hydrochloric and nitric acid, but dissolves when they are mixed as *aqua regia*, forming chloroplatinic acid (H₂PtCl₆), an important compound. Natural platinum contains six isotopes, one of which, ¹⁹⁰Pt, is radioactive with a long half-life. Thirty-seven other radioactive isotopes and isomers are recognized. The metal is extensively used in jewelry, wire, and vessels for laboratory use, and in many valuable instruments including thermocouple elements. It is also used for electrical contacts, corrosion-resistant apparatus, and in dentistry. Platinum-cobalt alloys have magnetic properties. One such alloy made of 76.7% Pt and 23.3% Co, by weight, is an extremely powerful magnet that offers a B-H (max) almost twice that of Alnico V. Platinum resistance wires are used for constructing high-temperature electric furnaces. The metal is used for coating missile nose cones, jet engine fuel nozzles, etc., which must perform reliably for long periods of time at high temperatures. The metal, like palladium, absorbs large volumes of hydrogen, retaining it at ordinary temperatures but giving it up at red heat. In the finely divided state platinum is an excellent catalyst, having long been used in the contact process for producing sulfuric acid. It is also used as a catalyst in cracking petroleum products. There is also much current interest in the use of platinum as a catalyst in fuel cells and in its use as antipollution devices for automobiles. Platinum anodes are extensively used in cathodic protection systems for large ships and ocean-going vessels, pipelines, steel piers, etc. Pure platinum wire will glow red hot when placed in the vapor of methyl alcohol. It acts here as a catalyst, converting the alcohol to formaldehyde. This phenomenon has been used commercially to produce cigarette lighters and hand warmers. Hydrogen and oxygen explode in the presence of platinum. The price of platinum has varied widely; more than a century ago it was used to adulterate gold. It was nearly eight times as valuable as gold in 1920. The price in January 2002 was about \$430/troy oz. (\$15/g), higher than the price of gold.

Plutonium—(Planet *pluto*), Pu; at. wt. (244); at. no. 94; sp. gr. (α modification) 19.84 (25°C); m.p. 640°C; b.p. 3228°C; valence 3, 4, 5, or 6. Plutonium was the second transuranium element of the actinide series to be discovered. The isotope ²³⁸Pu was produced in 1940 by Seaborg, McMillan, Kennedy, and Wahl by deuteron bombardment of uranium in the 60-inch cyclotron at Berkeley, California. Plutonium also exists in trace quantities in naturally occurring uranium ores. It is formed in much the same manner as neptunium, by irradiation of natural uranium with the neutrons which are present. By far of greatest importance is the isotope Pu²³⁹, with a half-life of 24,100 years, produced in extensive quantities in nuclear reactors from natural uranium:



Nineteen isotopes of plutonium are now known. Plutonium has assumed the position of dominant importance among the transuranium elements because of its successful use as an explosive ingredient in nuclear weapons and the place which it holds as a key material in the development of industrial use of nuclear power. One kilogram is equivalent to about 22 million kilowatt hours of heat energy. The complete detonation of a kilogram of plutonium produces an explosion equal to about 20,000 tons of chemical explosive. Its importance depends on the nuclear property of being readily fissionable with neutrons and its availability in quantity. The world's nuclear-power reactors are now producing about 20,000 kg of plutonium/yr. By 1982 it was estimated that about 300,000 kg had accumulated. The various nuclear applications of plutonium are well known. ²³⁸Pu has been used in the Apollo lunar missions to power seismic and other equipment on the lunar surface. As with neptunium and uranium, plutonium metal can be prepared by reduction of the trifluoride with alkaline-earth metals. The metal has a silvery appearance and takes on a yellow tarnish when slightly oxidized. It is chemically reactive. A relatively large piece of plutonium is warm to the touch because of the energy given off in alpha decay. Larger pieces will produce enough heat to boil water. The metal readily dissolves in concentrated hydrochloric acid, hydroiodic acid, or perchloric acid with formation of the Pu⁺³ ion. The metal exhibits six allotropic modifications having various crystalline structures. The densities of these vary from 16.00 to 19.86 g/cm³. Plutonium also exhibits four ionic valence states in aqueous solutions: Pu⁺³ (blue lavender), Pu⁺⁴ (yellow brown), PuO⁺ (pink?), and PuO⁺² (pink orange). The ion PuO⁺ is unstable in aqueous solutions, disproportionating into Pu⁺⁴ and PuO⁺². The Pu⁺⁴ thus formed, however, oxidizes the PuO⁺ into PuO⁺², itself being reduced to Pu⁺³, giving finally Pu⁺³ and PuO⁺². Plutonium forms binary compounds with oxygen: PuO, PuO₂, and intermediate oxides of variable composition; with the halides: PuF₃, PuF₄, PuCl₃, PuBr₃, PuI₃; with carbon, nitrogen, and silicon: PuC, PuN, PuSi₂. Oxyhalides are also well known: PuOCl, PuOBr, PuOI. Because of the high rate of emission of alpha particles and the element being specifically absorbed by bone marrow, plutonium, as well as all of the other transuranium elements except neptunium, are radiological poisons and must be handled with very special equipment and precautions. Plutonium is a very dangerous radiological hazard. Precautions must also be taken to prevent the unintentional formation of a critical mass. Plutonium in liquid solution is more likely to become critical than solid plutonium. The shape of the mass must also be considered where criticality is concerned. Plutonium-239 is available to authorized users from the O.R.N.L. at a cost of about \$4.80/mg (99.9%) plus packing costs.

Polonium—(Poland, native country of Mme. Curie [1867–1934]), Po; at. wt. (209); at. no. 84; m.p. 254°C; b.p. 962°C; sp. gr. (alpha modification) 9.32; valence –2, 0, +2, +3(?), +4, and +6. Polonium was the first element discovered by Mme. Curie in 1898, while seeking the cause of radioactivity of pitchblende from Joachimsthal, Bohemia. The electroscope showed it separating with bismuth. Polonium is also called Radium F. Polonium is a very rare natural element. Uranium ores contain only about 100 µg of the element per ton. Its abundance is only about 0.2% of that of radium. In 1934, it was found that when natural bismuth (²⁰⁹Bi) was bombarded by neutrons, ²¹⁰Bi, the parent of polonium, was obtained. Milligram amounts of polonium may now be prepared this way, by using the high neutron fluxes of nuclear reactors. Polonium-210 is a low-melting, fairly volatile metal, 50% of which is vaporized in air in 45 hours at 55°C. It is an alpha emitter with a half-life of 138.39 days. A milligram emits as many alpha particles as 5 g of radium. The energy released by its decay is so large (140 W/g) that a capsule containing about half a gram reaches a temperature above 500°C. The capsule also presents a contact gamma-ray dose rate of 0.012 Gy/h. A few curies (1 curie = 3.7 × 10¹⁰ Bq) of polonium exhibit a blue glow, caused by excitation of the surrounding gas. Because almost all alpha radiation is stopped within the solid source and its container, giving up its energy,

THE ELEMENTS (continued)

polonium has attracted attention for uses as a lightweight heat source for thermoelectric power in space satellites. Thirty-eight isotopes and isomers of polonium are known, with atomic masses ranging from 192 to 218. All are radioactive. Polonium-210 is the most readily available. Isotopes of mass 209 (half-life 102 years) and mass 208 (half-life 2.9 years) can be prepared by alpha, proton, or deuteron bombardment of lead or bismuth in a cyclotron, but these are expensive to produce. Metallic polonium has been prepared from polonium hydroxide and some other polonium compounds in the presence of concentrated aqueous or anhydrous liquid ammonia. Two allotropic modifications are known to exist. Polonium is readily dissolved in dilute acids, but is only slightly soluble in alkalis. Polonium salts of organic acids char rapidly; halide amines are reduced to the metal. Polonium can be mixed or alloyed with beryllium to provide a source of neutrons. It has been used in devices for eliminating static charges in textile mills, etc.; however, beta sources are more commonly used and are less dangerous. It is also used on brushes for removing dust from photographic films. The polonium for these is carefully sealed and controlled, minimizing hazards to the user. Polonium-210 is very dangerous to handle in even milligram or microgram amounts, and special equipment and strict control is necessary. Damage arises from the complete absorption of the energy of the alpha particle into tissue. The maximum permissible body burden for ingested polonium is only 0.03 μCi , which represents a particle weighing only 6.8×10^{-12} g. Weight for weight it is about 2.5×10^{11} times as toxic as hydrocyanic acid. The maximum allowable concentration for soluble polonium compounds in air is about 2×10^{11} $\mu\text{Ci}/\text{cm}^3$. Polonium-209 is available on special order from the Oak Ridge National Laboratory at a cost of \$3600/ μCi plus packing costs..

Potassium — (English, *potash* — pot ashes; L. *kalium*, Arab. *qali*, alkali), K; at. wt. 39.0983(1); at. no. 19; m.p. 63.38°C; b.p. 759°C; sp. gr. 0.862 (20°C); valence 1. Discovered in 1807 by Davy, who obtained it from caustic potash (KOH); this was the first metal isolated by electrolysis. The metal is the seventh most abundant and makes up about 2.4% by weight of the earth's crust. Most potassium minerals are insoluble and the metal is obtained from them only with great difficulty. Certain minerals, however, such as *sylvite*, *carnallite*, *langbeinite*, and *polyhalite* are found in ancient lake and sea beds and form rather extensive deposits from which potassium and its salts can readily be obtained. Potash is mined in Germany, New Mexico, California, Utah, and elsewhere. Large deposits of potash, found at a depth of some 1000 m in Saskatchewan, promise to be important in coming years. Potassium is also found in the ocean, but is present only in relatively small amounts, compared to sodium. The greatest demand for potash has been in its use for fertilizers. Potassium is an essential constituent for plant growth and it is found in most soils. Potassium is never found free in nature, but is obtained by electrolysis of the hydroxide, much in the same manner as prepared by Davy. Thermal methods also are commonly used to produce potassium (such as by reduction of potassium compounds with CaC_2 , C, Si, or Na). It is one of the most reactive and electropositive of metals. Except for lithium, it is the lightest known metal. It is soft, easily cut with a knife, and is silvery in appearance immediately after a fresh surface is exposed. It rapidly oxidizes in air and should be preserved in a mineral oil. As with other metals of the alkali group, it decomposes in water with the evolution of hydrogen. It catches fire spontaneously on water. Potassium and its salts impart a violet color to flames. Twenty one isotopes, one of which is an isomer, of potassium are known. Ordinary potassium is composed of three isotopes, one of which is ^{40}K (0.0117%), a radioactive isotope with a half-life of 1.26×10^9 years. The radioactivity presents no appreciable hazard. An alloy of sodium and potassium (NaK) is used as a heat-transfer medium. Many potassium salts are of utmost importance, including the hydroxide, nitrate, carbonate, chloride, chlorate, bromide, iodide, cyanide, sulfate, chromate, and dichromate. Metallic potassium is available commercially for about \$1200/kg (98% purity) or \$75/g (99.95% purity).

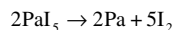
Praseodymium — (Gr. *prasios*, green, and *didymos*, twin), Pr; at. wt. 140.90765(2); at. no. 59; m.p. 931°C; b.p. 3520°C; sp. gr. 6.773; valence 3. In 1841 Mosander extracted the rare earth *didymia* from *lanthana*; in 1879, Lecoq de Boisbaudran isolated a new earth, *samarium*, from didymia obtained from the mineral *samaraskite*. Six years later, in 1885, von Welsbach separated didymia into two others, *praseodymia* and *neodymia*, which gave salts of different colors. As with other rare earths, compounds of these elements in solution have distinctive sharp spectral absorption bands or lines, some of which are only a few Angstroms wide. The element occurs along with other rare-earth elements in a variety of minerals. *Monazite* and *bastnasite* are the two principal commercial sources of the rare-earth metals. Ion-exchange and solvent extraction techniques have led to much easier isolation of the rare earths and the cost has dropped greatly in the past few years. Thirty-seven isotopes and isomers are now recognized. Praseodymium can be prepared by several methods, such as by calcium reduction of the anhydrous chloride or fluoride. Misch metal, used in making cigarette lighters, contains about 5% praseodymium metal. Praseodymium is soft, silvery, malleable, and ductile. It was prepared in relatively pure form in 1931. It is somewhat more resistant to corrosion in air than europium, lanthanum, cerium, or neodymium, but it does develop a green oxide coating that spalls off when exposed to air. As with other rare-earth metals it should be kept under a light mineral oil or sealed in plastic. The rare-earth oxides, including Pr_2O_3 , are among the most refractory substances known. Along with other rare earths, it is widely used as a core material for carbon arcs used by the motion picture industry for studio lighting and projection. Salts of praseodymium are used to color glasses and enamels; when mixed with certain other materials, praseodymium produces an intense and unusually clean yellow color in glass. Didymium glass, of which praseodymium is a component, is a colorant for welder's goggles. The metal (99.9% pure) is priced at about \$4/g.

Promethium — (*Prometheus*, who, according to mythology, stole fire from heaven), Pm; at. no. 61; at. wt. (145); m.p. 1042°C; b.p. 3000°C (est.); sp. gr. 7.264 (25°C); valence 3. In 1902 Branner predicted the existence of an element between neodymium and samarium, and this was confirmed by Moseley in 1914. Unsuccessful searches were made for this predicted element over two decades, and various investigators proposed the names "illinium", "florentium", and "cyclonium" for this element. In 1941, workers at Ohio State University irradiated neodymium and praseodymium with neutrons, deuterons, and alpha particles, resp., and produced several new radioactivities, which most likely were those of element 61. Wu and Segre, and Bethe, in 1942, confirmed the formation; however, chemical proof of the production of element 61 was lacking because of the difficulty in separating the rare earths from each other at that time. In 1945, Marinsky, Glendenin, and Coryell made the first chemical identification by use of ion-exchange chromatography. Their work was done by fission of uranium and by neutron bombardment of neodymium. These investigators named the newly discovered element. Searches for the element on earth have been fruitless, and it now appears that promethium is completely missing from the earth's crust. Promethium, however, has been reported to be in the spectrum of the star HR⁴⁶⁵ in Andromeda. This element is being formed recently near the star's surface, for no known isotope of promethium has a half-life longer than 17.7 years. Thirty five isotopes and isomers of promethium, with atomic masses from 130 to 158 are now known. Promethium-145, with a half-life of 17.7 years, is the most useful. Promethium-145 has a specific activity of 940 Ci/g. It is a soft beta emitter; although no gamma rays are emitted, X-radiation can be generated when beta particles impinge on elements of a high atomic number, and great care must be taken in handling it. Promethium salts luminesce in the dark with a pale blue or greenish glow, due to their high radioactivity. Ion-exchange methods led to the preparation of about 10 g of promethium from atomic reactor fuel processing wastes in early 1963. Little is yet generally known about the properties of metallic promethium. Two allotropic modifications exist. The element has applications as a beta source for thickness gages, and it can be absorbed by a phosphor to produce light. Light produced in this manner can be used for signs or signals

THE ELEMENTS (continued)

that require dependable operation; it can be used as a nuclear-powered battery by capturing light in photocells which convert it into electric current. Such a battery, using ^{147}Pm , would have a useful life of about 5 years. It is being used for fluorescent lighting starters and coatings for self-luminous watch dials. Promethium shows promise as a portable X-ray source, and it may become useful as a heat source to provide auxiliary power for space probes and satellites. More than 30 promethium compounds have been prepared. Most are colored. Promethium-147 is available upon special order from the Idaho National Engineering Laboratory, Idaho Falls, ID, or from the Westinghouse Hanford Co., Richland, WA.

Protactinium — (Gr. *protos*, first), Pa; at. wt. 231.03588(2); at. no. 91; m.p. 1572°C ; sp. gr. 15.37 (calc.); valence 4 or 5. The first isotope of element 91 to be discovered was ^{234}Pa , also known as UX_2 , a short-lived member of the naturally occurring ^{238}U decay series. It was identified by K. Fajans and O. H. Gohring in 1913 and they named the new element *brevium*. When the longer-lived isotope ^{231}Pa was identified by Hahn and Meitner in 1918, the name protoactinium was adopted as being more consistent with the characteristics of the most abundant isotope. Soddy, Cranson, and Fleck were also active in this work. The name *protoactinium* was shortened to *protactinium* in 1949. In 1927, Grosse prepared 2 mg of a white powder, which was shown to be Pa_2O_5 . Later, in 1934, from 0.1 g of pure Pa_2O_5 he isolated the element by two methods, one of which was by converting the oxide to an iodide and “cracking” it in a high vacuum by an electrically heated filament by the reaction



Protactinium has a bright metallic luster which it retains for some time in air. The element occurs in *pitchblende* to the extent of about 1 part ^{231}Pa to 10 million of ore. Ores from Congo-Kinshasa have about 3 ppm. Protactinium has twenty-eight isotopes and isomers, the most common of which is ^{231}Pa with a half-life of 32,500 years. A number of protactinium compounds are known, some of which are colored. The element is superconductive below 1.4 K. The element is a dangerous toxic material and requires precautions similar to those used when handling plutonium. In 1959 and 1961, it was announced that the Great Britain Atomic Energy Authority extracted by a 12-stage process 125 g of 99.9% protactinium, the world's only stock of the metal for many years to come. The extraction was made from 60 tons of waste material at a cost of about \$500,000. Protactinium is one of the rarest and most expensive naturally occurring elements.

Radium — (L. *radius*, ray), Ra; at. wt. (226); at. no. 88; m.p. 700°C ; sp. gr. 5; valence 2. Radium was discovered in 1898 by M. and Mme. Curie in the *pitchblende* or *uraninite* of North Bohemia (Czech Republic), where it occurs. There is about 1 g of radium in 7 tons of pitchblende. The element was isolated in 1911 by Mme. Curie and Debierne by the electrolysis of a solution of pure radium chloride, employing a mercury cathode; on distillation in an atmosphere of hydrogen this amalgam yielded the pure metal. Originally, radium was obtained from the rich pitchblende ore found at Joachimsthal, Bohemia. The *carnotite* sands of Colorado furnish some radium, but richer ores are found in the Republic of Congo-Kinshasa and the Great Bear Lake region of Canada. Radium is present in all uranium minerals, and could be extracted, if desired, from the extensive wastes of uranium processing. Large uranium deposits are located in Ontario, New Mexico, Utah, Australia, and elsewhere. Radium is obtained commercially as the bromide or chloride; it is doubtful if any appreciable stock of the isolated element now exists. The pure metal is brilliant white when freshly prepared, but blackens on exposure to air, probably due to formation of the nitride. It exhibits luminescence, as do its salts; it decomposes in water and is somewhat more volatile than barium. It is a member of the alkaline-earth group of metals. Radium imparts a carmine red color to a flame. Radium emits alpha, beta, and gamma rays and when mixed with beryllium produce neutrons. One gram of ^{226}Ra undergoes 3.7×10^{10} disintegrations per s. The *curie* (*Ci*) is defined as that amount of radioactivity which has the same disintegration rate as 1 g of ^{226}Ra . Thirty-six isotopes are now known; radium 226, the common isotope, has a half-life of 1599 years. One gram of radium produces about 0.0001 ml (stp) of emanation, or radon gas, per day. This is pumped from the radium and sealed in minute tubes, which are used in the treatment of cancer and other diseases. One gram of radium yields about 4186 kJ per year. Radium is used in producing self-luminous paints, neutron sources, and in medicine for the treatment of disease. Some of the more recently discovered radioisotopes, such as ^{60}Co , are now being used in place of radium. Some of these sources are much more powerful, and others are safer to use. Radium loses about 1% of its activity in 25 years, being transformed into elements of lower atomic weight. Lead is a final product of disintegration. Stored radium should be ventilated to prevent build-up of radon. Inhalation, injection, or body exposure to radium can cause cancer and other body disorders. The maximum permissible burden in the total body for ^{226}Ra is 7400 becquerel.

Radon — (from *radium*; called *niton* at first, L. *nitens*, shining), Rn; at. wt. (222); at. no. 86; m.p. -71°C ; b.p. -61.7°C ; t_c 104°C ; density of gas 9.73 g/l; sp. gr. liquid 4.4 at -62°C , solid 4; valence usually 0. The element was discovered in 1900 by Dorn, who called it *radium emanation*. In 1908 Ramsay and Gray, who named it *niton*, isolated the element and determined its density, finding it to be the heaviest known gas. It is essentially inert and occupies the last place in the zero group of gases in the Periodic Table. Since 1923, it has been called radon. Thirty-seven isotopes and isomers are known. Radon-222, coming from radium, has a half-life of 3.823 days and is an alpha emitter; Radon-220, emanating naturally from thorium and called *thoron*, has a half-life of 55.6 s and is also an alpha emitter. Radon-219 emanates from actinium and is called *actinon*. It has a half-life of 3.9 s and is also an alpha emitter. It is estimated that every square mile of soil to a depth of 6 inches contains about 1 g of radium, which releases radon in tiny amounts to the atmosphere. Radon is present in some spring waters, such as those at Hot Springs, Arkansas. On the average, one part of radon is present to 1×10^{21} part of air. At ordinary temperatures radon is a colorless gas; when cooled below the freezing point, radon exhibits a brilliant phosphorescence which becomes yellow as the temperature is lowered and orange-red at the temperature of liquid air. It has been reported that fluorine reacts with radon, forming radon fluoride. Radon clathrates have also been reported. Radon is still produced for therapeutic use by a few hospitals by pumping it from a radium source and sealing it in minute tubes, called seeds or needles, for application to patients. This practice has now been largely discontinued as hospitals can order the seeds directly from suppliers, who make up the seeds with the desired activity for the day of use. Care must be taken in handling radon, as with other radioactive materials. The main hazard is from inhalation of the element and its solid daughters, which are collected on dust in the air. Good ventilation should be provided where radium, thorium, or actinium is stored to prevent build-up of this element. Radon build-up is a health consideration in uranium mines. Recently radon build-up in homes has been a concern. Many deaths from lung cancer are caused by radon exposure. In the U.S. it is recommended that remedial action be taken if the air from radon in homes exceeds 4 pCi/l.

Rhenium — (L. *Rhenus*, Rhine), Re; at. wt. 186.207(1); at. no. 75; m.p. 3186°C ; b.p. 5596°C ; sp. gr. 21.02 (20°C); valence $-1, +1, 2, 3, 4, 5, 6, 7$. Discovery of rhenium is generally attributed to Noddack, Tacke, and Berg, who announced in 1925 they had detected the element in platinum ores and *columbite*. They also found the element in *gadolinite* and *molybdenite*. By working up 660 kg of molybdenite they were able in 1928 to extract 1 g of rhenium. The price in 1928 was \$10,000/g. Rhenium does not occur free in nature or as a compound in a distinct mineral species. It is, however, widely spread throughout the earth's crust to the extent of about 0.001 ppm. Commercial rhenium in the U.S. today is obtained from molybdenite roaster-flue dusts obtained from copper-sulfide ores mined in the vicinity of Miami, Arizona, and elsewhere in Arizona and Utah. Some molybdenites

THE ELEMENTS (continued)

contain from 0.002 to 0.2% rhenium. It is estimated that in 1999 about 16,000 kg of rhenium was being produced. The total estimated world reserves of rhenium is 11,000,000 kg. The total estimated Free World reserve of rhenium metal is 3500 tons. Natural rhenium is a mixture of two isotopes, one of which has a very long half-life. Thirty nine other unstable isotopes are recognized. Rhenium metal is prepared by reducing ammonium perrhenate with hydrogen at elevated temperatures. The element is silvery white with a metallic luster; its density is exceeded only by that of platinum, iridium, and osmium, and its melting point is exceeded only by that of tungsten and carbon. It has other useful properties. The usual commercial form of the element is a powder, but it can be consolidated by pressing and resistance-sintering in a vacuum or hydrogen atmosphere. This produces a compact shape in excess of 90% of the density of the metal. Annealed rhenium is very ductile, and can be bent, coiled, or rolled. Rhenium is used as an additive to tungsten and molybdenum-based alloys to impart useful properties. It is widely used for filaments for mass spectrographs and ion gages. Rhenium-molybdenum alloys are superconductive at 10 K. Rhenium is also used as an electrical contact material as it has good wear resistance and withstands arc corrosion. Thermocouples made of Re-W are used for measuring temperatures up to 2200°C, and rhenium wire has been used in photoflash lamps for photography. Rhenium catalysts are exceptionally resistant to poisoning from nitrogen, sulfur, and phosphorus, and are used for hydrogenation of fine chemicals, hydrocracking, reforming, and disproportionation of olefins. Rhenium has recently become especially important as a catalyst for petroleum refining and in making super-alloys for jet engines. Rhenium costs about \$16/g (99.99% pure). Little is known of its toxicity; therefore, it should be handled with care until more data are available.

Rhodium — (Gr. *rhodon*, rose), Rh; at. wt. 102.90550(3); at. no. 45; m.p. 1964°C; b.p. 3695°C; sp. gr. 12.41 (20°C); valence 2, 3, 4, 5, and 6. Wollaston discovered rhodium in 1803-4 in crude platinum ore he presumably obtained from South America. Rhodium occurs native with other platinum metals in river sands of the Urals and in North and South America. It is also found with other platinum metals in the copper-nickel sulfide ores of the Sudbury, Ontario region. Although the quantity occurring here is very small, the large tonnages of nickel processed make the recovery commercially feasible. The annual world production of rhodium in 1999 was only about 9000 kg. The metal is silvery white and at red heat slowly changes in air to the sesquioxide. At higher temperatures it converts back to the element. Rhodium has a higher melting point and lower density than platinum. Its major use is as an alloying agent to harden platinum and palladium. Such alloys are used for furnace windings, thermocouple elements, bushings for glass fiber production, electrodes for aircraft spark plugs, and laboratory crucibles. It is useful as an electrical contact material as it has a low electrical resistance, a low and stable contact resistance, and is highly resistant to corrosion. Plated rhodium, produced by electroplating or evaporation, is exceptionally hard and is used for optical instruments. It has a high reflectance and is hard and durable. Rhodium is also used for jewelry, for decoration, and as a catalyst. Fifty-two isotopes and isomers are now known. Rhodium metal (powder) costs about \$180/g (99.9%).

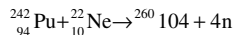
Rubidium — (L. *rubidus*, deepest red), Rb; at. wt. 85.4678(3); at. no. 37; m.p. 39.31°C; b.p. 688°C; sp. gr. (solid) 1.532 (20°C), (liquid) 1.475 (39°C); valence 1, 2, 3, 4. Discovered in 1861 by Bunsen and Kirchoff in the mineral *lepidolite* by use of the spectroscope. The element is much more abundant than was thought several years ago. It is now considered to be the 16th most abundant element in the earth's crust. Rubidium occurs in *pollucite*, *carnallite*, *leucite*, and *zinnwaldite*, which contains traces up to 1%, in the form of the oxide. It is found in lepidolite to the extent of about 1.5%, and is recovered commercially from this source. Potassium minerals, such as those found at Searles Lake, California, and potassium chloride recovered from brines in Michigan also contain the element and are commercial sources. It is also found along with cesium in the extensive deposits of *pollucite* at Bernic Lake, Manitoba. Rubidium can be liquid at room temperature. It is a soft, silvery-white metallic element of the alkali group and is the second most electropositive and alkaline element. It ignites spontaneously in air and reacts violently in water, setting fire to the liberated hydrogen. As with other alkali metals, it forms amalgams with mercury and it alloys with gold, cesium, sodium, and potassium. It colors a flame yellowish violet. Rubidium metal can be prepared by reducing rubidium chloride with calcium, and by a number of other methods. It must be kept under a dry mineral oil or in a vacuum or inert atmosphere. Thirty five isotopes and isomers of rubidium are known. Naturally occurring rubidium is made of two isotopes, ⁸⁵Rb and ⁸⁷Rb. Rubidium-87 is present to the extent of 27.83% in natural rubidium and is a beta emitter with a half-life of 4.9×10^{10} years. Ordinary rubidium is sufficiently radioactive to expose a photographic film in about 30 to 60 days. Rubidium forms four oxides: Rb₂O, Rb₂O₂, Rb₂O₃, Rb₂O₄. Because rubidium can be easily ionized, it has been considered for use in "ion engines" for space vehicles; however, cesium is somewhat more efficient for this purpose. It is also proposed for use as a working fluid for vapor turbines and for use in a thermoelectric generator using the magnetohydrodynamic principle where rubidium ions are formed by heat at high temperature and passed through a magnetic field. These conduct electricity and act like an armature of a generator thereby generating an electric current. Rubidium is used as a getter in vacuum tubes and as a photocell component. It has been used in making special glasses. RbAg₄I₅ is important, as it has the highest room conductivity of any known ionic crystal. At 20°C its conductivity is about the same as dilute sulfuric acid. This suggests use in thin film batteries and other applications. The present cost in small quantities is about \$50/g (99.8% pure).

Ruthenium — (L. *Ruthenia*, Russia), Ru; at. wt. 101.07(2); at. no. 44, m.p. 2334°C; b.p. 4150°C; sp. gr. 12.41 (20°C); valence 0, 1, 2, 3, 4, 5, 6, 7, 8. Berzelius and Osann in 1827 examined the residues left after dissolving crude platinum from the Ural mountains in *aqua regia*. While Berzelius found no unusual metals, Osann thought he found three new metals, one of which he named ruthenium. In 1844 Klaus, generally recognized as the discoverer, showed that Osann's ruthenium oxide was very impure and that it contained a new metal. Klaus obtained 6 g of ruthenium from the portion of crude platinum that is insoluble in *aqua regia*. A member of the platinum group, ruthenium occurs native with other members of the group in ores found in the Ural mountains and in North and South America. It is also found along with other platinum metals in small but commercial quantities in *pentlandite* of the Sudbury, Ontario, nickel-mining region, and in *pyroxinite* deposits of South Africa. Natural ruthenium contains seven isotopes. Twenty-eight other isotopes and isomers are known, all of which are radioactive. The metal is isolated commercially by a complex chemical process, the final stage of which is the hydrogen reduction of ammonium ruthenium chloride, which yields a powder. The powder is consolidated by powder metallurgy techniques or by argon-arc welding. Ruthenium is a hard, white metal and has four crystal modifications. It does not tarnish at room temperatures, but oxidizes in air at about 800°C. The metal is not attacked by hot or cold acids or *aqua regia*, but when potassium chlorate is added to the solution, it oxidizes explosively. It is attacked by halogens, hydroxides, etc. Ruthenium can be plated by electrodeposition or by thermal decomposition methods. The metal is one of the most effective hardeners for platinum and palladium, and is alloyed with these metals to make electrical contacts for severe wear resistance. A ruthenium-molybdenum alloy is said to be superconductive at 10.6 K. The corrosion resistance of titanium is improved a hundredfold by addition of 0.1% ruthenium. It is a versatile catalyst. Hydrogen sulfide can be split catalytically by light using an aqueous suspension of CdS particles loaded with ruthenium dioxide. It is thought this may have application to removal of H₂S from oil refining and other industrial processes. Compounds in at least eight oxidation states have been found, but of these, the +2, +3, and +4 states are the most common.

THE ELEMENTS (continued)

Ruthenium tetroxide, like osmium tetroxide, is highly toxic. In addition, it may explode. Ruthenium compounds show a marked resemblance to those of osmium. The metal is priced at about \$25/g (99.95% pure).

Rutherfordium — (named for Ernest Rutherford [1871–1937], New Zealand, Canadian, and British physicist); Rf; at. wt. [261]; at. no. 104. In 1964, workers of the Joint Nuclear Research Institute at Dubna (Russia) bombarded plutonium with accelerated 113 to 115 MeV neon ions. By measuring fission tracks in a special glass with a microscope, they detected an isotope that decays by spontaneous fission. They suggested that this isotope, which has a half-life of 0.3 ± 0.1 s, might be $^{260}_{104}\text{Pu}$, produced by the following reaction:



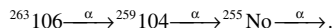
Element 104, the first *transactinide* element, is expected to have chemical properties similar to those of hafnium. It would, for example, form a relatively volatile compound with chlorine (a tetrachloride). The Soviet scientists have performed experiments aimed at chemical identification, and have attempted to show that the 0.3-s activity is more volatile than that of the relatively nonvolatile actinide trichlorides. This experiment does not fulfill the test of chemically separating the new element from all others, but it provides important evidence for evaluation. New data, reportedly issued by Soviet scientists, have reduced the half-life of the isotope they worked with from 0.3 to 0.15 s. The Dubna scientists suggest the name *kurchatovium* and symbol *Ku* for Element 104, in honor of Igor Vasilevich Kurchatov (1903–1960), late Head of Soviet Nuclear Research. The Dubna Group also has proposed the name *dubnium* for Element 104. In 1969, Ghiorso, Nurmia, Harris, K. A. Y. Eskola, and P. L. Eskola of the University of California at Berkeley reported they had positively identified two, and possibly three, isotopes of Element 104. The group also indicated that after repeated attempts so far they have been unable to produce isotope $^{260}_{104}\text{Pu}$ reported by the Dubna groups in 1964. The discoveries at Berkeley were made by bombarding a target of ^{249}Cf with ^{12}C nuclei of 71 MeV, and ^{13}C nuclei of 69 MeV. The combination of ^{12}C with ^{249}Cf followed by instant emission of four neutrons produced Element $^{257}_{104}\text{Pu}$. This isotope has a half-life of 4 to 5 s, decaying by emitting an alpha particle into ^{253}No , with a half-life of 105 s. The same reaction, except with the emission of three neutrons, was thought to have produced $^{258}_{104}\text{Pu}$ with a half-life of about 1/100 s. Element $^{259}_{104}\text{Pu}$ is formed by the merging of a ^{13}C nuclei with ^{249}Cf , followed by emission of three neutrons. This isotope has a half-life of 3 to 4 s, and decays by emitting an alpha particle into ^{255}No , which has a half-life of 185 s. Thousands of atoms of $^{257}_{104}\text{Pu}$ and $^{259}_{104}\text{Pu}$ have been detected. The Berkeley group believe their identification of $^{258}_{104}\text{Pu}$ was correct. Eleven isotopes of Element 104 have now been identified. The Berkeley group proposed for the new element the name *rutherfordium* (symbol Rf), in honor of Ernest Rutherford. This name was formally adapted by IUPAC in August 1997.

Samarium — (*Samarskite* a mineral), Sm; at. wt. 150.36(3); at. no. 62; m.p. 1074°C; b.p. 1794°C; sp. gr (α) 7.520 (25°C); valence 2 or 3. Discovered spectroscopically by its sharp absorption lines in 1879 by Lecoq de Boisbaudran in the mineral *samarskite*, named in honor of a Russian mine official, Col. Samarski. Samarium is found along with other members of the rare-earth elements in many minerals, including *monazite* and *bastnasite*, which are commercial sources. The largest producer of rare earth minerals is now China, followed by the U.S., India, and Russia. It occurs in monazite to the extent of 2.8%. While *misch metal* containing about 1% of samarium metal, has long been used, samarium has not been isolated in relatively pure form until recent years. Ion-exchange and solvent extraction techniques have recently simplified separation of the rare earths from one another; more recently, electrochemical deposition, using an electrolytic solution of lithium citrate and a mercury electrode, is said to be a simple, fast, and highly specific way to separate the rare earths. Samarium metal can be produced by reducing the oxide with barium or lanthanum. Samarium has a bright silver luster and is reasonably stable in air. Three crystal modifications of the metal exist, with transformations at 734 and 922°C. The metal ignites in air at about 150°C. Thirty-three isotopes and isomers of samarium are now recognized. Natural samarium is a mixture of seven isotopes, three of which are unstable but have long half-lives. Samarium, along with other rare earths, is used for carbon-arc lighting for the motion picture industry. The sulfide has excellent high-temperature stability and good thermoelectric efficiencies up to 1100°C. SmCo_5 has been used in making a new permanent magnet material with the highest resistance to demagnetization of any known material. It is said to have an intrinsic coercive force as high as 2200 kA/m. Samarium oxide has been used in optical glass to absorb the infrared. Samarium is used to dope calcium fluoride crystals for use in optical masers or lasers. Compounds of the metal act as sensitizers for phosphors excited in the infrared; the oxide exhibits catalytic properties in the dehydration and dehydrogenation of ethyl alcohol. It is used in infrared absorbing glass and as a neutron absorber in nuclear reactors. The metal is priced at about \$3.50/g (99.9%). Little is known of the toxicity of samarium; therefore, it should be handled carefully.

Scandium — (*L. Scandia*, Scandinavia), Sc; at. wt. 44.955910(8); at. no. 21; m.p. 1541°C; b.p. 2836°C; sp. gr. 2.989 (25°C); valence 3. On the basis of the Periodic System, Mendeleev predicted the existence of *ekaboron*, which would have an atomic weight between 40 of calcium and 48 of titanium. The element was discovered by Nilson in 1878 in the minerals *euxenite* and *gadolinite*, which had not yet been found anywhere except in Scandinavia. By processing 10 kg of euxenite and other residues of rare-earth minerals, Nilson was able to prepare about 2 g of scandium oxide of high purity. Cleve later pointed out that Nilson's scandium was identical with Mendeleev's ekaboron. Scandium is apparently a much more abundant element in the sun and certain stars than here on earth. It is about the 23rd most abundant element in the sun, compared to the 50th most abundant on earth. It is widely distributed on earth, occurring in very minute quantities in over 800 mineral species. The blue color of beryl (aquamarine variety) is said to be due to scandium. It occurs as a principal component in the rare mineral *thortveitite*, found in Scandinavia and Malagasy. It is also found in the residues remaining after the extraction of tungsten from Zinnwald *wolframite*, and in *wiikite* and *bazzite*. Most scandium is presently being recovered from *thortveitite* or is extracted as a by-product from uranium mill tailings. Metallic scandium was first prepared in 1937 by Fischer, Brunger, and Grieneisen, who electrolyzed a eutectic melt of potassium, lithium, and scandium chlorides at 700 to 800°C. Tungsten wire and a pool of molten zinc served as the electrodes in a graphite crucible. Pure scandium is now produced by reducing scandium fluoride with calcium metal. The production of the first pound of 99% pure scandium metal was announced in 1960. Scandium is a silver-white metal which develops a slightly yellowish or pinkish cast upon exposure to air. It is relatively soft, and resembles yttrium and the rare-earth metals more than it resembles aluminum or titanium. It is a very light metal and has a much higher melting point than aluminum, making it of interest to designers of spacecraft. Scandium is not attacked by a 1:1 mixture of conc. HNO_3 and 48% HF. Scandium reacts rapidly with many acids. Twenty-three isotopes and isomers of scandium are recognized. The metal is expensive, costing about \$200/g with a purity of about 99.9%. About 20 kg of scandium (as Sc_2O_3) are now being used yearly in the U.S. to produce high-intensity lights, and the radioactive isotope ^{46}Sc is used as a tracing agent in refinery crackers for crude oil, etc. Scandium iodide added to mercury vapor lamps produces a highly efficient light source resembling sunlight, which is important for indoor or night-time color TV. Little is yet known about the toxicity of scandium; therefore, it should be handled with care.

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Seaborgium — (named for Glenn T. Seaborg [1912–1999], American chemist and nuclear physicist). Sg; at. wt. [263]; at no. 106. The discovery of *Seaborgium*, Element 106, took place in 1974 almost simultaneously at the Lawrence-Berkeley Laboratory and at the Joint Institute for Nuclear Research at Dubna, Russia. The Berkeley Group, under direction of Ghiorso, used the Super-Heavy Ion Linear Accelerator (Super HILAC) as a source of heavy ^{18}O ions to bombard a 259- μg target of ^{249}Cf . This resulted in the production and positive identification of $^{263}106$, which decayed with a half-life of 0.9 ± 0.2 s by the emission of alpha particles as follows:



The Dubna Team, directed by Flerov and Organessian, produced heavy ions of ^{54}Cr with their 310-cm heavy-ion cyclotron to bombard ^{207}Pb and ^{208}Pb and found a product that decayed with a half-life of 7 ms. They assigned $^{259}106$ to this isotope. It is now thought seven isotopes of *Seaborgium* have been identified. Two of the isotopes are believed to have half-lives of about 30 s. *Seaborgium* most likely would have properties resembling tungsten. The IUPAC adopted the name *Seaborgium* in August 1997. Normally the naming of an element is not given until after the death of the person for which the element is named; however, in this case, it was named while Dr. Seaborg was still alive.

Selenium — (Gr. *Selene*, moon), Se; at. wt. 78.96(3); at. no. 34; m.p. (gray) 221°C; b.p. (gray) 685°C; sp. gr. (gray) 4.79, (vitreous) 4.28; valence -2, +4, or +6. Discovered by Berzelius in 1817, who found it associated with tellurium, named for the earth. Selenium is found in a few rare minerals, such as *crooksite* and *clausthalite*. In years past it has been obtained from flue dusts remaining from processing copper sulfide ores, but the anode muds from electrolytic copper refineries now provide the source of most of the world's selenium. Selenium is recovered by roasting the muds with soda or sulfuric acid, or by smelting them with soda and niter. Selenium exists in several allotropic forms. Three are generally recognized, but as many as six have been claimed. Selenium can be prepared with either an amorphous or crystalline structure. The color of amorphous selenium is either red, in powder form, or black, in vitreous form. Crystalline monoclinic selenium is a deep red; crystalline hexagonal selenium, the most stable variety, is a metallic gray. Natural selenium contains six stable isotopes. Twenty-nine other isotopes and isomers have been characterized. The element is a member of the sulfur family and resembles sulfur both in its various forms and in its compounds. Selenium exhibits both photovoltaic action, where light is converted directly into electricity, and photoconductive action, where the electrical resistance decreases with increased illumination. These properties make selenium useful in the production of photocells and exposure meters for photographic use, as well as solar cells. Selenium is also able to convert a.c. electricity to d.c., and is extensively used in rectifiers. Below its melting point selenium is a p-type semiconductor and is finding many uses in electronic and solid-state applications. It is used in Xerography for reproducing and copying documents, letters, etc., but recently its use in this application has been decreasing in favor of certain organic compounds. It is used by the glass industry to decolorize glass and to make ruby-colored glasses and enamels. It is also used as a photographic toner, and as an additive to stainless steel. Elemental selenium has been said to be practically nontoxic and is considered to be an essential trace element; however, hydrogen selenide and other selenium compounds are extremely toxic, and resemble arsenic in their physiological reactions. Hydrogen selenide in a concentration of 1.5 ppm is intolerable to man. Selenium occurs in some soils in amounts sufficient to produce serious effects on animals feeding on plants, such as locoweed, grown in such soils. Selenium (99.5%) is priced at about \$250/kg. It is also available in high-purity form at a cost of about \$350/kg (99.999%).

Silicon — (L. *silex, silicis*, flint), Si; at. wt. 28.0855(3); at. no. 14; m.p. 1414°C; b.p. 3265°C; sp. gr. 2.33 (25°C); valence 4. Davy in 1800 thought silica to be a compound and not an element; later in 1811, Gay Lussac and Thenard probably prepared impure amorphous silicon by heating potassium with silicon tetrafluoride. Berzelius, generally credited with the discovery, in 1824 succeeded in preparing amorphous silicon by the same general method as used earlier, but he purified the product by removing the fluosilicates by repeated washings. Deville in 1854 first prepared crystalline silicon, the second allotropic form of the element. Silicon is present in the sun and stars and is a principal component of a class of meteorites known as "aerolites". It is also a component of *tektites*, a natural glass of uncertain origin. Natural silicon contains three isotopes. Twenty-four other radioactive isotopes are recognized. Silicon makes up 25.7% of the earth's crust, by weight, and is the second most abundant element, being exceeded only by oxygen. Silicon is not found free in nature, but occurs chiefly as the oxide and as silicates. *Sand, quartz, rock crystal, amethyst, agate, flint, jasper, and opal* are some of the forms in which the oxide appears. *Granite, hornblende, asbestos, feldspar, clay mica*, etc. are but a few of the numerous silicate minerals. Silicon is prepared commercially by heating silica and carbon in an electric furnace, using carbon electrodes. Several other methods can be used for preparing the element. Amorphous silicon can be prepared as a brown powder, which can be easily melted or vaporized. Crystalline silicon has a metallic luster and grayish color. The Czochralski process is commonly used to produce single crystals of silicon used for solid-state or semiconductor devices. Hyperpure silicon can be prepared by the thermal decomposition of ultra-pure trichlorosilane in a hydrogen atmosphere, and by a vacuum float zone process. This product can be doped with boron, gallium, phosphorus, or arsenic to produce silicon for use in transistors, solar cells, rectifiers, and other solid-state devices which are used extensively in the electronics and space-age industries. Hydrogenated amorphous silicon has shown promise in producing economical cells for converting solar energy into electricity. Silicon is a relatively inert element, but it is attacked by halogens and dilute alkali. Most acids except hydrofluoric, do not affect it. Silicones are important products of silicon. They may be prepared by hydrolyzing a silicon organic chloride, such as dimethyl silicon chloride. Hydrolysis and condensation of various substituted chlorosilanes can be used to produce a very great number of polymeric products, or silicones, ranging from liquids to hard, glasslike solids with many useful properties. Elemental silicon transmits more than 95% of all wavelengths of infrared, from 1.3 to 6.7 μm . Silicon is one of man's most useful elements. In the form of sand and clay it is used to make concrete and brick; it is a useful refractory material for high-temperature work, and in the form of silicates it is used in making enamels, pottery, etc. Silica, as sand, is a principal ingredient of glass, one of the most inexpensive of materials with excellent mechanical, optical, thermal, and electrical properties. Glass can be made in a very great variety of shapes, and is used as containers, window glass, insulators, and thousands of other uses. Silicon tetrachloride can be used to iridize glass. Silicon is important in plant and animal life. Diatoms in both fresh and salt water extract silica from the water to build up their cell walls. Silica is present in ashes of plants and in the human skeleton. Silicon is an important ingredient in steel; silicon carbide is one of the most important abrasives and has been used in lasers to produce coherent light of 4560 Å. A remarkable material, first discovered in 1930, is *Aerogel*, developed and now used by NASA in their *Stardust* mission, which is expected to encounter Comet Wild 2 in 2004, returning cometary and interplanet dust to Earth in 2006. *Aerogel* is a highly insulative material that has the lowest density of any known solid. One form of *Aerogel* is 99.9% air and 0.1% SiO_2 , by volume. It is 1000 times less dense than glass. It has been called "blue smoke" or "solid smoke". A block of *Aerogel* as large as a person may weigh less than a pound and yet support the weight of 1000 lbs (455 kg). This material is expected to trap cometary particles traveling at speeds of 32 km/sec. *Aerogel* is said to be non-toxic and non-inflammable. It has high thermal insulating qualities that

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could be used in home insulation. Its light weight may have aircraft applications. Regular grade silicon (99.5%) costs about \$160/kg. Silicon (99.9999%) pure costs about \$200/kg; hyperpure silicon is available at a higher cost. Miners, stonecutters, and other engaged in work where siliceous dust is breathed in large quantities often develop a serious lung disease known as *silicosis*.

Silver — (Anglo-Saxon, *Seolfor siolfur*), Ag (L. argentum), at. wt. 107.8682(2); at. no. 47; m.p. 961.78°C; b.p. 2162°C; sp. gr. 10.50 (20°C); valence 1, 2. Silver has been known since ancient times. It is mentioned in Genesis. Slag dumps in Asia Minor and on islands in the Aegean Sea indicate that man learned to separate silver from lead as early as 3000 B.C. Silver occurs native and in ores such as *argentite* (Ag₂S) and *horn silver* (AgCl); lead, lead-zinc, copper, gold, and copper-nickel ores are principal sources. Mexico, Canada, Peru, and the U.S. are the principal silver producers in the western hemisphere. Silver is also recovered during electrolytic refining of copper. Commercial fine silver contains at least 99.9% silver. Purities of 99.999+% are available commercially. Pure silver has a brilliant white metallic luster. It is a little harder than gold and is very ductile and malleable, being exceeded only by gold and perhaps palladium. Pure silver has the highest electrical and thermal conductivity of all metals, and possesses the lowest contact resistance. It is stable in pure air and water, but tarnishes when exposed to ozone, hydrogen sulfide, or air containing sulfur. The alloys of silver are important. Sterling silver is used for jewelry, silverware, etc. where appearance is paramount. This alloy contains 92.5% silver, the remainder being copper or some other metal. Silver is of utmost importance in photography, about 30% of the U.S. industrial consumption going into this application. It is used for dental alloys. Silver is used in making solder and brazing alloys, electrical contacts, and high capacity silver-zinc and silver-cadmium batteries. Silver paints are used for making printed circuits. It is used in mirror production and may be deposited on glass or metals by chemical deposition, electrodeposition, or by evaporation. When freshly deposited, it is the best reflector of visible light known, but is rapidly tarnishes and loses much of its reflectance. It is a poor reflector of ultraviolet. Silver fulminate (Ag₂C₂N₂O₂), a powerful explosive, is sometimes formed during the silvering process. Silver iodide is used in seeding clouds to produce rain. Silver chloride has interesting optical properties as it can be made transparent; it also is a cement for glass. Silver nitrate, or *lunar caustic*, the most important silver compound, is used extensively in photography. While silver itself is not considered to be toxic, most of its salts are poisonous. Natural silver contains two stable isotopes. Fifty-six other radioactive isotopes and isomers are known. Silver compounds can be absorbed in the circulatory system and reduced silver deposited in the various tissues of the body. A condition, known as *argyria*, results with a greyish pigmentation of the skin and mucous membranes. Silver has germicidal effects and kills many lower organisms effectively without harm to higher animals. Silver for centuries has been used traditionally for coinage by many countries of the world. In recent times, however, consumption of silver has at times greatly exceeded the output. In 1939, the price of silver was fixed by the U.S. Treasury at 71¢/troy oz., and at 90.5¢/troy oz. in 1946. In November 1961 the U.S. Treasury suspended sales of nonmonetized silver, and the price stabilized for a time at about \$1.29, the melt-down value of silver U.S. coins. The Coinage Act of 1965 authorized a change in the metallic composition of the three U.S. subsidiary denominations to clad or composite type coins. This was the first change in U.S. coinage since the monetary system was established in 1792. Clad dimes and quarters are made of an outer layer of 75% Cu and 25% Ni bonded to a central core of pure Cu. The composition of the one- and five-cent pieces remains unchanged. One-cent coins are 95% Cu and 5% Zn. Five-cent coins are 75% Cu and 25% Ni. Old silver dollars are 90% Ag and 10% Cu. Earlier subsidiary coins of 90% Ag and 10% Cu officially were to circulate alongside the clad coins; however, in practice they have largely disappeared (Gresham's Law), as the value of the silver is now greater than their exchange value. Silver coins of other countries have largely been replaced with coins made of other metals. On June 24, 1968, the U.S. Government ceased to redeem U.S. Silver Certificates with silver. Since that time, the price of silver has fluctuated widely. As of January 2002, the price of silver was about \$4.10/troy oz. (13¢/g); however the price has fluctuated considerably due to market instability. The price of silver in 2001 was only about four times the cost of the metal about 150 years ago. This has largely been caused by Central Banks disposing of some of their silver reserves and the development of more productive mines with better refining methods. Also, silver has been displaced by other metals or processes, such as digital photography.

Sodium — (English, *soda*; Medieval Latin, *sodanum*, headache remedy), Na (L. natrium); at. wt. 22.989770(2); at. no. 11; m.p. 97.80°C; b.p. 883°C; sp. gr. 0.971 (20°C); valence 1. Long recognized in compounds, sodium was first isolated by Davy in 1807 by electrolysis of caustic soda. Sodium is present in fair abundance in the sun and stars. The D lines of sodium are among the most prominent in the solar spectrum. Sodium is the sixth most abundant element on earth, comprising about 2.6% of the earth's crust; it is the most abundant of the alkali group of metals of which it is a member. The most common compound is sodium chloride, but it occurs in many other minerals, such as *soda niter*, *cryolite*, *amphibole*, *zeolite*, *sodalite*, etc. It is a very reactive element and is never found free in nature. It is now obtained commercially by the electrolysis of absolutely dry fused sodium chloride. This method is much cheaper than that of electrolyzing sodium hydroxide, as was used several years ago. Sodium is a soft, bright, silvery metal which floats on water, decomposing it with the evolution of hydrogen and the formation of the hydroxide. It may or may not ignite spontaneously on water, depending on the amount of oxide and metal exposed to the water. It normally does not ignite in air at temperatures below 115°C. Sodium should be handled with respect, as it can be dangerous when improperly handled. Metallic sodium is vital in the manufacture of sodamide and esters, and in the preparation of organic compounds. The metal may be used to improve the structure of certain alloys, to descale metal, to purify molten metals, and as a heat transfer agent. An alloy of sodium with potassium, NaK, is also an important heat transfer agent. Sodium compounds are important to the paper, glass, soap, textile, petroleum, chemical, and metal industries. Soap is generally a sodium salt of certain fatty acids. The importance of common salt to animal nutrition has been recognized since prehistoric times. Among the many compounds that are of the greatest industrial importance are common salt (NaCl), soda ash (Na₂CO₃), baking soda (NaHCO₃), caustic soda (NaOH), Chile saltpeter (NaNO₃), di- and tri-sodium phosphates, sodium thiosulfate (hypo, Na₂S₂O₃ · 5H₂O), and borax (Na₂B₄O₇ · 10H₂O). Seventeen isotopes of sodium are recognized. Metallic sodium is priced at about \$575/kg (99.95%). On a volume basis, it is the cheapest of all metals. Sodium metal should be handled with great care. It should be kept in an inert atmosphere and contact with water and other substances with which sodium reacts should be avoided.

Strontium — (*Strontian*, town in Scotland), Sr; at. wt. 87.62(1); at. no. 38; m.p. 777°C; b.p. 1382°C; sp. gr. 2.54; valence 2. Isolated by Davy by electrolysis in 1808; however, Adair Crawford in 1790 recognized a new mineral (strontianite) as differing from other barium minerals (baryta). Strontium is found chiefly as *celestite* (SrSO₄) and *strontianite* (SrCO₃). *Celestite* is found in Mexico, Turkey, Iran, Spain, Algeria, and in the U.K. The U.S. has no active *celestite* mines. The metal can be prepared by electrolysis of the fused chloride mixed with potassium chloride, or is made by reducing strontium oxide with aluminum in a vacuum at a temperature at which strontium distills off. Three allotropic forms of the metal exist, with transition points at 235 and 540°C. Strontium is softer than calcium and decomposes water more vigorously. It does not absorb nitrogen below 380°C. It should be kept under mineral oil to prevent oxidation. Freshly cut strontium has a silvery appearance, but rapidly turns a yellowish color with the formation of the oxide. The finely divided metal ignites spontaneously in air. Volatile strontium salts impart a beautiful crimson color to flames, and these salts are used in pyrotechnics and in the production of flares. Natural strontium is a mixture of four stable isotopes. Thirty-two other unstable

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isotopes and isomers are known to exist. Of greatest importance is ^{90}Sr with a half-life of 29 years. It is a product of nuclear fallout and presents a health problem. This isotope is one of the best long-lived high-energy beta emitters known, and is used in SNAP (Systems for Nuclear Auxiliary Power) devices. These devices hold promise for use in space vehicles, remote weather stations, navigational buoys, etc., where a lightweight, long-lived, nuclear-electric power source is needed. The major use for strontium at present is in producing glass for color television picture tubes. All color TV and cathode ray tubes sold in the U.S. are required by law to contain strontium in the face plate glass to block X-ray emission. Strontium also improves the brilliance of the glass and the quality of the picture. It has also found use in producing ferrite magnets and in refining zinc. Strontium titanate is an interesting optical material as it has an extremely high refractive index and an optical dispersion greater than that of diamond. It has been used as a gemstone, but it is very soft. It does not occur naturally. Strontium metal (99% pure) costs about \$220/kg.

Sulfur — (Sanskrit, *sulvere*; L. *sulphurium*), S; at. wt. 32.066(6); at. no. 16; m.p. 115.21°C; b.p. 444.60°C; t_c 1041°C; sp. gr. (rhombohedral) 2.07, (monoclinic) 1.957 (20°C); valence 2, 4, or 6. Known to the ancients; referred to in Genesis as *brimstone*. Sulfur is found in meteorites. A dark area near the crater Aristarchus on the moon has been studied by R. W. Wood with ultraviolet light. This study suggests strongly that it is a sulfur deposit. Sulfur occurs native in the vicinity of volcanoes and hot springs. It is widely distributed in nature as *iron pyrites, galena, sphalerite, cinnabar, stibnite, gypsum, Epsom salts, celestite, barite*, etc. Sulfur is commercially recovered from wells sunk into the salt domes along the Gulf Coast of the U.S. It is obtained from these wells by the Frasch process, which forces heated water into the wells to melt the sulfur, which is then brought to the surface. Sulfur also occurs in natural gas and petroleum crudes and must be removed from these products. Formerly this was done chemically, which wasted the sulfur. New processes now permit recovery, and these sources promise to be very important. Large amounts of sulfur are being recovered from Alberta gas fields. Sulfur is a pale yellow, odorless, brittle solid, which is insoluble in water but soluble in carbon disulfide. In every state, whether gas, liquid or solid, elemental sulfur occurs in more than one allotropic form or modification; these present a confusing multitude of forms whose relations are not yet fully understood. Amorphous or "plastic" sulfur is obtained by fast cooling of the crystalline form. X-ray studies indicate that amorphous sulfur may have a helical structure with eight atoms per spiral. Crystalline sulfur seems to be made of rings, each containing eight sulfur atoms, which fit together to give a normal X-ray pattern. Twenty-one isotopes of sulfur are now recognized. Four occur in natural sulfur, none of which is radioactive. A finely divided form of sulfur, known as *flowers of sulfur*, is obtained by sublimation. Sulfur readily forms sulfides with many elements. Sulfur is a component of black gunpowder, and is used in the vulcanization of natural rubber and a fungicide. It is also used extensively in making phosphatic fertilizers. A tremendous tonnage is used to produce sulfuric acid, the most important manufactured chemical. It is used in making sulfite paper and other papers, as a fumigant, and in the bleaching of dried fruits. The element is a good electrical insulator. Organic compounds containing sulfur are very important. Calcium sulfate, ammonium sulfate, carbon disulfide, sulfur dioxide, and hydrogen sulfide are but a few of the many other important compounds of sulfur. Sulfur is essential to life. It is a minor constituent of fats, body fluids, and skeletal minerals. Carbon disulfide, hydrogen sulfide, and sulfur dioxide should be handled carefully. Hydrogen sulfide in small concentrations can be metabolized, but in higher concentrations it quickly can cause death by respiratory paralysis. It is insidious in that it quickly deadens the sense of smell. Sulfur dioxide is a dangerous component in atmospheric air pollution. In 1975, University of Pennsylvania scientists reported synthesis of polymeric sulfur nitride, which has the properties of a metal, although it contains no metal atoms. The material has unusual optical and electrical properties. Sulfur (99.999%) costs about \$575/kg.

Tantalum — (Gr. *Tantalos*, mythological character, father of *Niobe*), Ta; at. wt. 180.9479(1); at. no. 73; m.p. 3017°C; b.p. 5458°C; sp. gr. 16.654; valence 2?, 3, 4?, or 5. Discovered in 1802 by Ekeberg, but many chemists thought niobium and tantalum were identical elements until Rose, in 1844, and Marignac, in 1866, showed that niobic and tantallic acids were two different acids. The early investigators only isolated the impure metal. The first relatively pure ductile tantalum was produced by von Bolton in 1903. Tantalum occurs principally in the mineral *columbite-tantalite* (Fe, Mn)(Nb, Ta)₂O₆. Tantalum ores are found in Australia, Brazil, Rwanda, Zimbabwe, Congo-Kinshasa, Nigeria, and Canada. Separation of tantalum from niobium requires several complicated steps. Several methods are used to commercially produce the element, including electrolysis of molten potassium fluorotantalate, reduction of potassium fluorotantalate with sodium, or reacting tantalum carbide with tantalum oxide. Thirty-four isotopes and isomers of tantalum are known to exist. Natural tantalum contains two isotopes, one of which is radioactive with a very long half-life. Tantalum is a gray, heavy, and very hard metal. When pure, it is ductile and can be drawn into fine wire, which is used as a filament for evaporating metals such as aluminum. Tantalum is almost completely immune to chemical attack at temperatures below 150°C, and is attacked only by hydrofluoric acid, acidic solutions containing the fluoride ion, and free sulfur trioxide. Alkalis attack it only slowly. At high temperatures, tantalum becomes much more reactive. The element has a melting point exceeded only by tungsten and rhenium. Tantalum is used to make a variety of alloys with desirable properties such as high melting point, high strength, good ductility, etc. Scientists at Los Alamos have produced a tantalum carbide graphite composite material, which is said to be one of the hardest materials ever made. The compound has a melting point of 3738°C. Tantalum has good "gettering" ability at high temperatures, and tantalum oxide films are stable and have good rectifying and dielectric properties. Tantalum is used to make electrolytic capacitors and vacuum furnace parts, which account for about 60% of its use. The metal is also widely used to fabricate chemical process equipment, nuclear reactors, and aircraft and missile parts. Tantalum is completely immune to body liquids and is a nonirritating metal. It has, therefore, found wide use in making surgical appliances. Tantalum oxide is used to make special glass with high index of refraction for camera lenses. The metal has many other uses. The price of (99.9%) tantalum is about \$2/g.

Technetium — (Gr. *technetos*, artificial), Tc; at. wt. (98); at. no. 43; m.p. 2157°C; b.p. 4265°C; sp. gr. 11.50 (calc.); valence 0, +2, +4, +5, +6, and +7. Element 43 was predicted on the basis of the periodic table, and was erroneously reported as having been discovered in 1925, at which time it was named *masurium*. The element was actually discovered by Perrier and Segre in Italy in 1937. It was found in a sample of molybdenum, which was bombarded by deuterons in the Berkeley cyclotron, and which E. Lawrence sent to these investigators. Technetium was the first element to be produced artificially. Since its discovery, searches for the element in terrestrial materials have been made without success. If it does exist, the concentration must be very small. Technetium has been found in the spectrum of S-, M-, and N-type stars, and its presence in stellar matter is leading to new theories of the production of heavy elements in the stars. Forty-three isotopes and isomers of technetium, with atomic masses ranging from 86 to 113, are known. ^{97}Tc has a half-life of 2.6×10^6 years. ^{98}Tc has a half-life of 4.2×10^6 years. The isomeric isotope $^{95\text{m}}\text{Tc}$, with a half-life of 61 days, is useful for tracer work, as it produces energetic gamma rays. Technetium metal has been produced in kilogram quantities. The metal was first prepared by passing hydrogen gas at 1100°C over Tc₂S₇. It is now conveniently prepared by the reduction of ammonium pertechnetate with hydrogen. Technetium is a silvery-gray metal that tarnishes slowly in moist air. Until 1960, technetium was available only in small amounts and the price was as high as \$2800/g. ^{99}Tc is now commercially available to holders of O.R.N.L. permits at a price of \$83/g plus packing charges. ^{99}Tc is available at a cost of \$1.56/μCi. The chemistry of technetium is said to be similar to that of rhenium. Technetium dissolves in nitric acid, aqua regia, and conc.

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sulfuric acid, but is not soluble in hydrochloric acid of any strength. The element is a remarkable corrosion inhibitor for steel. It is reported that mild carbon steels may be effectively protected by as little as 55 ppm of KTcO_4 in aerated distilled water at temperatures up to 250°C. This corrosion protection is limited to closed systems, since technetium is radioactive and must be confined. ^{99}Tc has a specific activity of 6.2×10^8 Bq/g. Activity of this level must not be allowed to spread. ^{99}Tc is a contamination hazard and should be handled in a glove box. The metal is an excellent superconductor at 11°K and below.

Tellurium — (*L. tellus*, earth), Te; at. wt. 127.60(3); at. no. 52; m.p. 449.51°C; b.p. 988°C; sp. gr. 6.24 (20°C); valence 2, 4, or 6. Discovered by Muller von Reichenstein in 1782; named by Klaproth, who isolated it in 1798. Tellurium is occasionally found native, but is more often found as the telluride of gold (*calaverite*), and combined with other metals. It is recovered commercially from the anode muds produced during the electrolytic refining of blister copper. The U.S., Canada, Peru, and Japan are the largest Free World producers of the element. Crystalline tellurium has a silvery-white appearance, and when pure exhibits a metallic luster. It is brittle and easily pulverized. Amorphous tellurium is formed by precipitating tellurium from a solution of telluric or tellurous acid. Whether this form is truly amorphous, or made of minute crystals, is open to question. Tellurium is a p-type semiconductor, and shows greater conductivity in certain directions, depending on alignment of the atoms. Its conductivity increases slightly with exposure to light. It can be doped with silver, copper, gold, tin, or other elements. In air, tellurium burns with a greenish-blue flame, forming the dioxide. Molten tellurium corrodes iron, copper, and stainless steel. Tellurium and its compounds are probably toxic and should be handled with care. Workmen exposed to as little as 0.01 mg/m³ of air, or less, develop “tellurium breath,” which has a garlic-like odor. Forty two isotopes and isomers of tellurium are known, with atomic masses ranging from 106 to 138. Natural tellurium consists of eight isotopes, two of which are radioactive with very long half-lives. Tellurium improves the machinability of copper and stainless steel, and its addition to lead decreases the corrosive action of sulfuric acid on lead and improves its strength and hardness. Tellurium catalysts are used in the oxidation of organic compounds and are used in hydrogenation and halogenation reactions. Tellurium is also used in electronic and semi-conductor devices. It is also used as a basic ingredient in blasting caps, and is added to cast iron for chill control. Tellurium is used in ceramics. Bismuth telluride has been used in thermoelectric devices. Tellurium costs about 50¢/g, with a purity of about 99.5%. The metal with a purity of 99.9999% costs about \$5/g.

Terbium — (*Ytterby*, village in Sweden), Tb; at. wt. 158.92534(2); at. no. 65; m.p. 1356°C; b.p. 3230°C; sp. gr. 8.230; valence 3, 4. Discovered by Mosander in 1843. Terbium is a member of the lanthanide or “rare earth” group of elements. It is found in *cerite*, *gadolinite*, and other minerals along with other rare earths. It is recovered commercially from *monazite* in which it is present to the extent of 0.03%, from *xenotime*, and from *euxenite*, a complex oxide containing 1% of more of terbium. Terbium has been isolated only in recent years with the development of ion-exchange techniques for separating the rare-earth elements. As with other rare earths, it can be produced by reducing the anhydrous chloride or fluoride with calcium metal in a tantalum crucible. Calcium and tantalum impurities can be removed by vacuum remelting. Other methods of isolation are possible. Terbium is reasonably stable in air. It is a silver-gray metal, and is malleable, ductile, and soft enough to be cut with a knife. Two crystal modifications exist, with a transformation temperature of 1289°C. Forty-two isotopes and isomers are recognized. The oxide is a chocolate or dark maroon color. Sodium terbium borate is used as a laser material and emits coherent light at 0.546 μm . Terbium is used to dope calcium fluoride, calcium tungstate, and strontium molybdate, used in solid-state devices. The oxide has potential application as an activator for green phosphors used in color TV tubes. It can be used with ZrO_2 as a crystal stabilizer of fuel cells which operate at elevated temperature. Few other uses have been found. The element is priced at about \$40/g (99.9%). Little is known of the toxicity of terbium. It should be handled with care as with other lanthanide elements.

Thallium — (*Gr. thallos*, a green shoot or twig), Tl; at. wt. 204.3833(2); at. no. 81; m.p. 304°C; b.p. 1473°C; sp. gr. 11.85 (20°C); valence 1, or 3. Thallium was discovered spectroscopically in 1861 by Crookes. The element was named after the beautiful green spectral line, which identified the element. The metal was isolated both by Crookes and Lamy in 1862 about the same time. Thallium occurs in *crooksite*, *lorandite*, and *hutchinsonite*. It is also present in *pyrites* and is recovered from the roasting of this ore in connection with the production of sulfuric acid. It is also obtained from the smelting of lead and zinc ores. Extraction is somewhat complex and depends on the source of the thallium. Manganese nodules, found on the ocean floor, contain thallium. When freshly exposed to air, thallium exhibits a metallic luster, but soon develops a bluish-gray tinge, resembling lead in appearance. A heavy oxide builds up on thallium if left in air, and in the presence of water the hydroxide is formed. The metal is very soft and malleable. It can be cut with a knife. Forty-seven isotopes of thallium, with atomic masses ranging from 179 to 210 are recognized. Natural thallium is a mixture of two isotopes. The element and its compounds are toxic and should be handled carefully. Contact of the metal with skin is dangerous, and when melting the metal adequate ventilation should be provided. Thallium is suspected of carcinogenic potential for man. Thallium sulfate has been widely employed as a rodenticide and ant killer. It is odorless and tasteless, giving no warning of its presence. Its use, however, has been prohibited in the U.S. since 1975 as a household insecticide and rodenticide. The electrical conductivity of thallium sulfide changes with exposure to infrared light, and this compound is used in photocells. Thallium bromide-iodide crystals have been used as infrared optical materials. Thallium has been used, with sulfur or selenium and arsenic, to produce low melting glasses which become fluid between 125 and 150°C. These glasses have properties at room temperatures similar to ordinary glasses and are said to be durable and insoluble in water. Thallium oxide has been used to produce glasses with a high index of refraction. Thallium has been used in treating ringworm and other skin infections; however, its use has been limited because of the narrow margin between toxicity and therapeutic benefits. A mercury-thallium alloy, which forms a eutectic at 8.5% thallium, is reported to freeze at -60°C, some 20° below the freezing point of mercury. Thallium metal (99.999%) costs about \$2/g.

Thorium — (*Thor*, Scandinavian god of war), Th; at. wt. 232.0381(1); at. no. 90; m.p. 1750°C; b.p. 4788°C; sp. gr. 11.72; valence +2(?), +3(?), +4. Discovered by Berzelius in 1828. Thorium occurs in *thorite* (ThSiO_4) and in *thorianite* ($\text{ThO}_2 + \text{UO}_2$). Large deposits of thorium minerals have been reported in New England and elsewhere, but these have not yet been exploited. Thorium is now thought to be about three times as abundant as uranium and about as abundant as lead or molybdenum. The metal is a source of nuclear power. There is probably more energy available for use from thorium in the minerals of the earth's crust than from both uranium and fossil fuels. Any sizable demand for thorium as a nuclear fuel is still several years in the future. Work has been done in developing thorium cycle converter-reactor systems. Several prototypes, including the HTGR (high-temperature gas-cooled reactor) and MSRE (molten salt converter reactor experiment), have operated. While the HTGR reactors are efficient, they are not expected to become important commercially for many years because of certain operating difficulties. Thorium is recovered commercially from the mineral *monazite*, which contains from 3 to 9% ThO_2 along with rare-earth minerals. Much of the internal heat the earth produces has been attributed to thorium and uranium. Several methods are available for producing thorium metal: it can be obtained by reducing thorium oxide with calcium, by electrolysis of anhydrous thorium chloride in a fused mixture of sodium and potassium chlorides, by calcium reduction of thorium tetrachloride mixed with anhydrous zinc chloride, and by reduction of thorium tetrachloride with an alkali metal. Thorium was originally assigned a position in Group IV

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of the periodic table. Because of its atomic weight, valence, etc., it is now considered to be the second member of the *actinide* series of elements. When pure, thorium is a silvery-white metal which is air-stable and retains its luster for several months. When contaminated with the oxide, thorium slowly tarnishes in air, becoming gray and finally black. The physical properties of thorium are greatly influenced by the degree of contamination with the oxide. The purest specimens often contain several tenths of a percent of the oxide. High-purity thorium has been made. Pure thorium is soft, very ductile, and can be cold-rolled, swaged, and drawn. Thorium is dimorphic, changing at 1400°C from a cubic to a body-centered cubic structure. Thorium oxide has a melting point of 3300°C, which is the highest of all oxides. Only a few elements, such as tungsten, and a few compounds, such as tantalum carbide, have higher melting points. Thorium is slowly attacked by water, but does not dissolve readily in most common acids, except hydrochloric. Powdered thorium metal is often pyrophoric and should be carefully handled. When heated in air, thorium turnings ignite and burn brilliantly with a white light. The principal use of thorium has been in the preparation of the Welsbach mantle, used for portable gas lights. These mantles, consisting of thorium oxide with about 1% cerium oxide and other ingredients, glow with a dazzling light when heated in a gas flame. Thorium is an important alloying element in magnesium, imparting high strength and creep resistance at elevated temperatures. Because thorium has a low work-function and high electron emission, it is used to coat tungsten wire used in electronic equipment. The oxide is also used to control the grain size of tungsten used for electric lamps; it is also used for high-temperature laboratory crucibles. Glasses containing thorium oxide have a high refractive index and low dispersion. Consequently, they find application in high quality lenses for cameras and scientific instruments. Thorium oxide has also found use as a catalyst in the conversion of ammonia to nitric acid, in petroleum cracking, and in producing sulfuric acid. Thorium has not found many uses due to its radioactive nature and its handling and disposal problems. Thirty isotopes of thorium are known with atomic masses ranging from 210 to 237. All are unstable. ²³²Th occurs naturally and has a half-life of 1.4×10^{10} years. It is an alpha emitter. ²³²Th goes through six alpha and four beta decay steps before becoming the stable isotope ²⁰⁸Pb. ²³²Th is sufficiently radioactive to expose a photographic plate in a few hours. Thorium disintegrates with the production of "thoron" (²²⁰Rn), which is an alpha emitter and presents a radiation hazard. Good ventilation of areas where thorium is stored or handled is therefore essential. Thorium metal (99.8%) costs about \$25/g.

Thulium — (*Thule*, the earliest name for Scandinavia), Tm; at. wt. 168.93421(3); at. no. 69; m.p. 1545°C; b.p. 1950°C; sp. gr. 9.321 (25°C); valence 3. Discovered in 1879 by Cleve. Thulium occurs in small quantities along with other rare earths in a number of minerals. It is obtained commercially from *monazite*, which contains about 0.007% of the element. Thulium is the least abundant of the rare earth elements, but with new sources recently discovered, it is now considered to be about as rare as silver, gold, or cadmium. Ion-exchange and solvent extraction techniques have recently permitted much easier separation of the rare earths, with much lower costs. Only a few years ago, thulium metal was not obtainable at any cost; in 1996 the oxide cost \$20/g. Thulium metal powder now costs \$70/g (99.9%). Thulium can be isolated by reduction of the oxide with lanthanum metal or by calcium reduction of the anhydrous fluoride. The pure metal has a bright, silvery luster. It is reasonably stable in air, but the metal should be protected from moisture in a closed container. The element is silver-gray, soft, malleable, and ductile, and can be cut with a knife. Forty-one isotopes and isomers are known, with atomic masses ranging from 146 to 176. Natural thulium, which is 100% ¹⁶⁹Tm, is stable. Because of the relatively high price of the metal, thulium has not yet found many practical applications. ¹⁶⁹Tm bombarded in a nuclear reactor can be used as a radiation source in portable X-ray equipment. ¹⁷¹Tm is potentially useful as an energy source. Natural thulium also has possible use in *ferrites* (ceramic magnetic materials) used in microwave equipment. As with other lanthanides, thulium has a low-to-moderate acute toxic rating. It should be handled with care.

Tin — (anglo-Saxon, *tin*), Sn (L. *stannum*); at. wt. 118.710(7); at. no. 50; m.p. 231.93°C; b.p. 2602°C; sp. gr. (gray) 5.75, (white) 7.31; valence 2, 4. Known to the ancients. Tin is found chiefly in *cassiterite* (SnO₂). Most of the world's supply comes from China, Indonesia, Peru, Brazil, and Bolivia. The U.S. produces almost none, although occurrences have been found in Alaska and Colorado. Tin is obtained by reducing the ore with coal in a reverberatory furnace. Ordinary tin is composed of ten stable isotopes; thirty-six unstable isotopes and isomers are also known. Ordinary tin is a silver-white metal, is malleable, somewhat ductile, and has a highly crystalline structure. Due to the breaking of these crystals, a "tin cry" is heard when a bar is bent. The element has two allotropic forms at normal pressure. On warming, gray, or α tin, with a cubic structure, changes at 13.2°C into white, or β tin, the ordinary form of the metal. White tin has a tetragonal structure. When tin is cooled below 13.2°C, it changes slowly from white to gray. This change is affected by impurities such as aluminum and zinc, and can be prevented by small additions of antimony or bismuth. This change from the α to β form is called the tin pest. Tin-lead alloys are used to make organ pipes. There are few if any uses for gray tin. Tin takes a high polish and is used to coat other metals to prevent corrosion or other chemical action. Such tin plate over steel is used in the so-called tin can for preserving food. Alloys of tin are very important. Soft solder, type metal, fusible metal, pewter, bronze, bell metal, Babbitt metal, White metal, die casting alloy, and phosphor bronze are some of the important alloys using tin. Tin resists distilled sea and soft tap water, but is attacked by strong acids, alkalis, and acid salts. Oxygen in solution accelerates the attack. When heated in air, tin forms SnO₂, which is feebly acid, forming stannate salts with basic oxides. The most important salt is the chloride (SnCl₂ · H₂O), which is used as a reducing agent and as a mordant in calico printing. Tin salts sprayed onto glass are used to produce electrically conductive coatings. These have been used for panel lighting and for frost-free windshields. Most window glass is now made by floating molten glass on molten tin (float glass) to produce a flat surface (Pilkington process). Of recent interest is a crystalline tin-niobium alloy that is superconductive at very low temperatures. This promises to be important in the construction of superconductive magnets that generate enormous field strengths but use practically no power. Such magnets, made of tin-niobium wire, weigh but a few pounds and produce magnetic fields that, when started with a small battery, are comparable to that of a 100 ton electromagnet operated continuously with a large power supply. The small amount of tin found in canned foods is quite harmless. The agreed limit of tin content in U.S. foods is 300 mg/kg. The trialkyl and triaryl tin compounds are used as biocides and must be handled carefully. Over the past 25 years the price of commercial tin has varied from 50¢/lb (\$1.10/kg) to its present price of about \$6/kg in January 2002. Tin (99.99% pure) costs about \$260/kg.

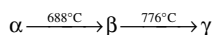
Titanium — (*L. Titans*, the first sons of the Earth, myth.), Ti; at. wt. 47.867(1); at. no. 22; m.p. 1668°C; b.p. 3287°C; sp. gr. 4.54; valence 2, 3, or 4. Discovered by Gregor in 1791; named by Klaproth in 1795. Impure titanium was prepared by Nilson and Pettersson in 1887; however, the pure metal (99.9%) was not made until 1910 by Hunter by heating TiCl₄ with sodium in a steel bomb. Titanium is present in meteorites and in the sun. Rocks obtained during the Apollo 17 lunar mission showed presence of 12.1% TiO₂. Analyses of rocks obtained during earlier Apollo missions show lower percentages. Titanium oxide bands are prominent in the spectra of M-type stars. The element is the ninth most abundant in the crust of the earth. Titanium is almost always present in igneous rocks and in the sediments derived from them. It occurs in the minerals *rutile*, *ilmenite*, and *sphene*, and is present in titanates and in many iron ores. Deposits of ilmenite and rutile are found in Florida, California, Tennessee, and New York. Australia, Norway, Malaysia, India, and China are also large suppliers of titanium minerals. Titanium is present in the ash of coal, in plants, and in the human body. The metal was a laboratory curiosity until Kroll, in 1946, showed that titanium could be produced commercially by reducing titanium

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tetrachloride with magnesium. This method is largely used for producing the metal today. The metal can be purified by decomposing the iodide. Titanium, when pure, is a lustrous, white metal. It has a low density, good strength, is easily fabricated, and has excellent corrosion resistance. It is ductile only when it is free of oxygen. The metal burns in air and is the only element that burns in nitrogen. Titanium is resistant to dilute sulfuric and hydrochloric acid, most organic acids, moist chlorine gas, and chloride solutions. Natural titanium consists of five isotopes with atomic masses from 46 to 50. All are stable. Eighteen other unstable isotopes are known. The metal is dimorphic. The hexagonal α form changes to the cubic β form very slowly at about 880°C. The metal combines with oxygen at red heat, and with chlorine at 550°C. Titanium is important as an alloying agent with aluminum, molybdenum, manganese, iron, and other metals. Alloys of titanium are principally used for aircraft and missiles where lightweight strength and ability to withstand extremes of temperature are important. Titanium is as strong as steel, but 45% lighter. It is 60% heavier than aluminum, but twice as strong. Titanium has potential use in desalination plants for converting sea water into fresh water. The metal has excellent resistance to sea water and is used for propeller shafts, rigging, and other parts of ships exposed to salt water. A titanium anode coated with platinum has been used to provide cathodic protection from corrosion by salt water. Titanium metal is considered to be physiologically inert; however, titanium powder may be a carcinogenic hazard. When pure, titanium dioxide is relatively clear and has an extremely high index of refraction with an optical dispersion higher than diamond. It is produced artificially for use as a gemstone, but it is relatively soft. Star sapphires and rubies exhibit their asterism as a result of the presence of TiO_2 . Titanium dioxide is extensively used for both house paint and artist's paint, as it is permanent and has good covering power. Titanium oxide pigment accounts for the largest use of the element. Titanium paint is an excellent reflector of infrared, and is extensively used in solar observatories where heat causes poor seeing conditions. Titanium tetrachloride is used to iridize glass. This compound fumes strongly in air and has been used to produce smoke screens. The price of titanium metal (99.9%) is about \$1100/kg.

Tungsten — (Swedish, *tung sten*, heavy stone); also known as *wolfram* (from *wolframite*, said to be named from *wolf rahm* or *spumi lupi*, because the ore interfered with the smelting of tin and was supposed to devour the tin), W; at. wt. 183.84(1); at. no. 74; m.p. 3422°C; b.p. 5555°C; sp. gr. 19.3 (20°C); valence 2, 3, 4, 5, or 6. In 1779 Peter Woulfe examined the mineral now known as *wolframite* and concluded it must contain a new substance. Scheele, in 1781, found that a new acid could be made from *tung sten* (a name first applied about 1758 to a mineral now known as *scheelite*). Scheele and Berman suggested the possibility of obtaining a new metal by reducing this acid. The de Elhuyar brothers found an acid in *wolframite* in 1783 that was identical to the acid of *tungsten* (tungstic acid) of Scheele, and in that year they succeeded in obtaining the element by reduction of this acid with charcoal. Tungsten occurs in *wolframite*, $(\text{Fe, Mn})\text{WO}_4$; *scheelite*, CaWO_4 ; *huebnerite*, MnWO_4 ; and *ferberite*, FeWO_4 . Important deposits of tungsten occur in California, Colorado, Bolivia, Russia, and Portugal. China is reported to have about 75% of the world's tungsten resources. Natural tungsten contains five stable isotopes. Thirty two other unstable isotopes and isomers are recognized. The metal is obtained commercially by reducing tungsten oxide with hydrogen or carbon. Pure tungsten is a steel-gray to tin-white metal. Very pure tungsten can be cut with a hacksaw, and can be forged, spun, drawn, and extruded. The impure metal is brittle and can be worked only with difficulty. Tungsten has the highest melting point of all metals, and at temperatures over 1650°C has the highest tensile strength. The metal oxidizes in air and must be protected at elevated temperatures. It has excellent corrosion resistance and is attacked only slightly by most mineral acids. The thermal expansion is about the same as borosilicate glass, which makes the metal useful for glass-to-metal seals. Tungsten and its alloys are used extensively for filaments for electric lamps, electron and television tubes, and for metal evaporation work; for electrical contact points for automobile distributors; X-ray targets; windings and heating elements for electrical furnaces; and for numerous spacecraft and high-temperature applications. High-speed tool steels, Hastelloy®, Stellite®, and many other alloys contain tungsten. Tungsten carbide is of great importance to the metal-working, mining, and petroleum industries. Calcium and magnesium tungstates are widely used in fluorescent lighting; other salts of tungsten are used in the chemical and tanning industries. Tungsten disulfide is a dry, high-temperature lubricant, stable to 500°C. Tungsten bronzes and other tungsten compounds are used in paints. Zirconium tungstate has found recent applications (see under Zirconium). Tungsten powder (99.999%) costs about \$2900/kg.

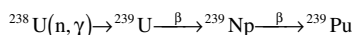
Uranium — (Planet *Uranus*), U; at. wt. 238.0289(1); at. no. 92; m.p. 1135°C; b.p. 4131°C; sp. gr. ~18.95; valence 2, 3, 4, 5, or 6. Yellow-colored glass, containing more than 1% uranium oxide and dating back to 79 A.D., has been found near Naples, Italy. Klaproth recognized an unknown element in *pitchblende* and attempted to isolate the metal in 1789. The metal apparently was first isolated in 1841 by Peligot, who reduced the anhydrous chloride with potassium. Uranium is not as rare as it was once thought. It is now considered to be more plentiful than mercury, antimony, silver, or cadmium, and is about as abundant as molybdenum or arsenic. It occurs in numerous minerals such as *pitchblende*, *uraninite*, *carnotite*, *autunite*, *uranophane*, *davidite*, and *tobernite*. It is also found in *phosphate rock*, *lignite*, *monazite sands*, and can be recovered commercially from these sources. Large deposits of uranium ore occur in Utah, Colorado, New Mexico, Canada, and elsewhere. Uranium can be made by reducing uranium halides with alkali or alkaline earth metals or by reducing uranium oxides by calcium, aluminum, or carbon at high temperatures. The metal can also be produced by electrolysis of KUF_5 or UF_4 , dissolved in a molten mixture of CaCl_2 and NaCl . High-purity uranium can be prepared by the thermal decomposition of uranium halides on a hot filament. Uranium exhibits three crystallographic modifications as follows:



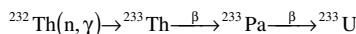
Uranium is a heavy, silvery-white metal which is pyrophoric when finely divided. It is a little softer than steel, and is attacked by cold water in a finely divided state. It is malleable, ductile, and slightly paramagnetic. In air, the metal becomes coated with a layer of oxide. Acids dissolve the metal, but it is unaffected by alkalis. Uranium has twenty three isotopes, one of which is an isomer and all of which are radioactive. Naturally occurring uranium contains 99.2745% by weight ^{238}U , 0.720% ^{235}U , and 0.0055% ^{234}U . Studies show that the percentage weight of ^{235}U in natural uranium varies by as much as 0.1%, depending on the source. The U.S.D.O.E. has adopted the value of 0.711% as being their "official" percentage of ^{235}U in natural uranium. Natural uranium is sufficiently radioactive to expose a photographic plate in an hour or so. Much of the internal heat of the earth is thought to be attributable to the presence of uranium and thorium. ^{238}U with a half-life of 4.46×10^9 years, has been used to estimate the age of igneous rocks. The origin of uranium, the highest member of the naturally occurring elements — except perhaps for traces of neptunium or plutonium — is not clearly understood, although it has been thought that uranium might be a decay product of elements of higher atomic weight, which may have once been present on earth or elsewhere in the universe. These original elements may have been formed as a result of a primordial "creation," known as "the big bang," in a supernova, or in some other stellar processes. The fact that recent studies show that most trans-uranic elements are extremely rare with very short half-lives indicates that it may be necessary to find some alternative explanation for the very large quantities of radioactive uranium we find on earth. Studies of meteorites from other parts of the solar system show a relatively low radioactive content, compared to terrestrial rocks. Uranium is of great

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importance as a nuclear fuel. ^{238}U can be converted into fissionable plutonium by the following reactions:



This nuclear conversion can be brought about in “breeder” reactors where it is possible to produce more new fissionable material than the fissionable material used in maintaining the chain reaction. ^{235}U is of even greater importance, for it is the key to the utilization of uranium. ^{235}U , while occurring in natural uranium to the extent of only 0.72%, is so fissionable with slow neutrons that a self-sustaining fission chain reaction can be made to occur in a reactor constructed from natural uranium and a suitable moderator, such as heavy water or graphite, alone. ^{235}U can be concentrated by gaseous diffusion and other physical processes, if desired, and used directly as a nuclear fuel, instead of natural uranium, or used as an explosive. Natural uranium, slightly enriched with ^{235}U by a small percentage, is used to fuel nuclear power reactors for the generation of electricity. Natural thorium can be irradiated with neutrons as follows to produce the important isotope ^{233}U .



While thorium itself is not fissionable, ^{233}U is, and in this way may be used as a nuclear fuel. One pound of completely fissioned uranium has the fuel value of over 1500 tons of coal. The uses of nuclear fuels to generate electrical power, to make isotopes for peaceful purposes, and to make explosives are well known. The estimated world-wide production of the 437 nuclear power reactors in operation in 1998 amounted to about 352,000 Megawatt hours. In 1998 the U.S. had about 107 commercial reactors with an output of about 100,000 Megawatt-hours. Some nuclear-powered electric generating plants have recently been closed because of safety concerns. There are also serious problems with nuclear waste disposal that have not been completely resolved. Uranium in the U.S.A. is controlled by the U.S. Nuclear Regulatory Commission, under the Department of Energy. Uses are being found for the large quantities of “depleted” uranium, now available, where uranium-235 has been lowered to about 0.2%. Depleted uranium has been used for inertial guidance devices, gyrocompasses, counterweights for aircraft control surfaces, ballast for missile reentry vehicles, and as a shielding material for tanks, etc. Concerns, however, have been raised over its low radioactive properties. Uranium metal is used for X-ray targets for production of high-energy X-rays. The nitrate has been used as photographic toner, and the acetate is used in analytical chemistry. Crystals of uranium nitrate are triboluminescent. Uranium salts have also been used for producing yellow “vaseline” glass and glazes. Uranium and its compounds are highly toxic, both from a chemical and radiological standpoint. Finely divided uranium metal, being pyrophoric, presents a fire hazard. The maximum permissible total body burden of natural uranium (based on radiotoxicity) is 0.2 μCi for soluble compounds. Recently, the natural presence of uranium and thorium in many soils has become of concern to homeowners because of the generation of radon and its daughters (see under Radon). Uranium metal is available commercially at a cost of about \$6/g (99.7%) in air-tight glass under argon.

Unnilnilium etc. — See under the opening paragraphs of this article and also under Elements 110 to 118.

Vanadium — (Scandinavian goddess, *Vanadis*), V; at. wt. 50.9415(1); at. no. 23; m.p. 1910°C; b.p. 3407°C; sp. gr. 6.11 (18.7°C); valence 2, 3, 4, or 5. Vanadium was first discovered by del Rio in 1801. Unfortunately, a French chemist incorrectly declared del Rio’s new element was only impure chromium; del Rio thought himself to be mistaken and accepted the French chemist’s statement. The element was rediscovered in 1830 by Sefstrom, who named the element in honor of the Scandinavian goddess *Vanadis* because of its beautiful multicolored compounds. It was isolated in nearly pure form by Roscoe, in 1867, who reduced the chloride with hydrogen. Vanadium of 99.3 to 99.8% purity was not produced until 1927. Vanadium is found in about 65 different minerals among which are *carnotite*, *roscoelite*, *vanadinite*, and *patronite* important sources of the metal. Vanadium is also found in phosphate rock and certain iron ores, and is present in some crude oils in the form of organic complexes. It is also found in small percentages in meteorites. Commercial production from petroleum ash holds promise as an important source of the element. China, South Africa, and Russia supply much of the world’s vanadium ores. High-purity ductile vanadium can be obtained by reduction of vanadium trichloride with magnesium or with magnesium-sodium mixtures. Much of the vanadium metal being produced is now made by calcium reduction of V_2O_5 in a pressure vessel, an adaptation of a process developed by McKechnie and Seybolt. Natural vanadium is a mixture of two isotopes, ^{50}V (0.25%) and ^{51}V (99.75%). ^{50}V is slightly radioactive, having a long half-life. Twenty other unstable isotopes are recognized. Pure vanadium is a bright white metal, and is soft and ductile. It has good corrosion resistance to alkalis, sulfuric and hydrochloric acid, and salt water, but the metal oxidizes readily above 660°C. The metal has good structural strength and a low fission neutron cross section, making it useful in nuclear applications. Vanadium is used in producing rust resistant, spring, and highspeed tool steels. It is an important carbide stabilizer in making steels. About 80% of the vanadium now produced is used as ferrovanadium or as a steel additive. Vanadium foil is used as a bonding agent in cladding titanium to steel. Vanadium pentoxide is used in ceramics and as a catalyst. It is also used in producing a superconductive magnet with a field of 175,000 gauss. Vanadium and its compounds are toxic and should be handled with care. Ductile vanadium is commercially available. Vanadium metal (99.7%) costs about \$3/g.

Wolfram — see Tungsten.

Xenon — (Gr. *xenon*, stranger), Xe; at. wt. 131.29(2); at. no. 54; m.p. -111.79°C; b.p. -108.12°C; t_c 16.62°C; density (gas) 5.887 ± 0.009 g/l, sp. gr (liquid) 3.52 (-109°C); valence usually 0. Discovered by Ramsay and Travers in 1898 in the residue left after evaporating liquid air components. Xenon is a member of the so-called noble or “inert” gases. It is present in the atmosphere to the extent of about one part in twenty million. Xenon is present in the Martian atmosphere to the extent of 0.08 ppm. The element is found in the gases evolved from certain mineral springs, and is commercially obtained by extraction from liquid air. Natural xenon is composed of nine stable isotopes. In addition to these, thirty five unstable isotopes and isomers have been characterized. Before 1962, it had generally been assumed that xenon and other noble gases were unable to form compounds. Evidence has been mounting in the past few years that xenon, as well as other members of the zero valence elements, do form compounds. Among the “compounds” of xenon now reported are xenon hydrate, sodium perxenate, xenon deuterate, difluoride, tetrafluoride, hexafluoride, and XePtF_6 and XeRhF_6 . Xenon trioxide, which is highly explosive, has been prepared. More than 80 xenon compounds have been made with xenon chemically bonded to fluorine and oxygen. Some xenon compounds are colored. Metallic xenon has been produced, using several hundred kilobars of pressure. Xenon in a vacuum tube produces a beautiful blue glow when excited by an electrical discharge. The gas is used in making electron tubes, stroboscopic lamps, bactericidal lamps, and lamps used to excite ruby lasers for generating coherent light. Xenon is used in the atomic energy field in bubble chambers, probes, and other applications where its high molecular weight is of value. The perxenates are used in analytical chemistry as oxidizing agents. ^{133}Xe and ^{135}Xe

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are produced by neutron irradiation in air cooled nuclear reactors. ^{133}Xe has useful applications as a radioisotope. The element is available in sealed glass containers for about \$20/l of gas at standard pressure. Xenon is not toxic, but its compounds are highly toxic because of their strong oxidizing characteristics.

Ytterbium — (Ytterby, village in Sweden), Yb; at. wt. 173.04(3); at. no. 70; m.p. 819°C; b.p. 1196°C; sp. gr. (α) 6.903 (β) 6.966; valence 2, 3. Marignac in 1878 discovered a new component, which he called *ytterbia*, in the earth then known as *erbia*. In 1907, Urbain separated ytterbia into two components, which he called *neoytterbia* and *lutecia*. The elements in these earths are now known as *ytterbium* and *lutetium*, respectively. These elements are identical with *aldebaranium* and *cassiopeium*, discovered independently and at about the same time by von Welsbach. Ytterbium occurs along with other rare earths in a number of rare minerals. It is commercially recovered principally from *monazite sand*, which contains about 0.03%. Ion-exchange and solvent extraction techniques developed in recent years have greatly simplified the separation of the rare earths from one another. The element was first prepared by Klemm and Bonner in 1937 by reducing ytterbium trichloride with potassium. Their metal was mixed, however, with KCl. Daane, Dennison, and Spedding prepared a much purer form in 1953 from which the chemical and physical properties of the element could be determined. Ytterbium has a bright silvery luster, is soft, malleable, and quite ductile. While the element is fairly stable, it should be kept in closed containers to protect it from air and moisture. Ytterbium is readily attacked and dissolved by dilute and concentrated mineral acids and reacts slowly with water. Ytterbium has three allotropic forms with transformation points at -13° and 795°C . The beta form is a room-temperature, face-centered, cubic modification, while the high-temperature gamma form is a body-centered cubic form. Another body-centered cubic phase has recently been found to be stable at high pressures at room temperatures. The beta form ordinarily has metallic-type conductivity, but becomes a semiconductor when the pressure is increased above 16,000 atm. The electrical resistance increases tenfold as the pressure is increased to 39,000 atm and drops to about 80% of its standard temperature-pressure resistivity at a pressure of 40,000 atm. Natural ytterbium is a mixture of seven stable isotopes. Twenty six other unstable isotopes and isomers are known. Ytterbium metal has possible use in improving the grain refinement, strength, and other mechanical properties of stainless steel. One isotope is reported to have been used as a radiation source as a substitute for a portable X-ray machine where electricity is unavailable. Few other uses have been found. Ytterbium metal is available with a purity of about 99.9% for about \$10/g. Ytterbium has a low acute toxic rating, but may present a carcinogenic hazard.

Yttrium — (Ytterby, village in Sweden near Vauxholm), Y; at. wt. 88.90585(2); at. no. 39; m.p. 1522°C; b.p. 3345°C; sp. gr. 4.469 (25°C); valence 3. *Yttria*, which is an earth containing yttrium, was discovered by Gadolin in 1794. *Ytterby* is the site of a quarry which yielded many unusually minerals containing rare earths and other elements. This small town, near Stockholm, bears the honor of giving names to *erbitum*, *terbitum*, and *ytterbitum* as well as *yttrium*. In 1843 Mosander showed that yttria could be resolved into the oxides (or earths) of three elements. The name yttria was reserved for the most basic one; the others were named *erbia* and *terbia*. Yttrium occurs in nearly all of the rare-earth minerals. Analysis of lunar rock samples obtained during the Apollo missions show a relatively high yttrium content. It is recovered commercially from *monazite sand*, which contains about 3%, and from *bastnasite*, which contains about 0.2%. Wohler obtained the impure element in 1828 by reduction of the anhydrous chloride with potassium. The metal is now produced commercially by reduction of the fluoride with calcium metal. It can also be prepared by other techniques. Yttrium has a silver-metallic luster and is relatively stable in air. Turnings of the metal, however, ignite in air if their temperature exceeds 400°C, and finely divided yttrium is very unstable in air. Yttrium oxide is one of the most important compounds of yttrium and accounts for the largest use. It is widely used in making YVO_4 europium, and Y_2O_3 europium phosphors to give the red color in color television tubes. Many hundreds of thousands of pounds are now used in this application. Yttrium oxide also is used to produce yttrium-iron-garnets, which are very effective microwave filters. Yttrium iron, aluminum, and gadolinium garnets, with formulas such as $\text{Y}_3\text{Fe}_5\text{O}_{12}$ and $\text{Y}_3\text{Al}_5\text{O}_{12}$, have interesting magnetic properties. Yttrium iron garnet is also exceptionally efficient as both a transmitter and transducer of acoustic energy. Yttrium aluminum garnet, with a hardness of 8.5, is also finding use as a gemstone (simulated diamond). Small amounts of yttrium (0.1 to 0.2%) can be used to reduce the grain size in chromium, molybdenum, zirconium, and titanium, and to increase strength of aluminum and magnesium alloys. Alloys with other useful properties can be obtained by using yttrium as an additive. The metal can be used as a deoxidizer for vanadium and other nonferrous metals. The metal has a low cross section for nuclear capture. ^{90}Y , one of the isotopes of yttrium, exists in equilibrium with its parent ^{90}Sr , a product of atomic explosions. Yttrium has been considered for use as a nodulizer for producing nodular cast iron, in which the graphite forms compact nodules instead of the usual flakes. Such iron has increased ductility. Yttrium is also finding application in laser systems and as a catalyst for ethylene polymerization. It has also potential use in ceramic and glass formulas, as the oxide has a high melting point and imparts shock resistance and low expansion characteristics to glass. Natural yttrium contains but one isotope, ^{89}Y . Forty-three other unstable isotopes and isomers have been characterized. Yttrium metal of 99.9% purity is commercially available at a cost of about \$5/g.

Zinc — (Ger. *Zink*, of obscure origin), Zn; at. wt. 65.39(2); at. no. 30; m.p. 419.53°C; b.p. 907°C; sp. gr. 7.133 (25°C); valence 2. Centuries before zinc was recognized as a distinct element, zinc ores were used for making brass. Tubal-Cain, seven generations from Adam, is mentioned as being an "instructor in every artificer in brass and iron." An alloy containing 87% zinc has been found in prehistoric ruins in Transylvania. Metallic zinc was produced in the 13th century A.D. in India by reducing calamine with organic substances such as wool. The metal was rediscovered in Europe by Marggraf in 1746, who showed that it could be obtained by reducing *calamine* with charcoal. The principal ores of zinc are *sphalerite* or *blende* (sulfide), *smithsonite* (carbonate), *calamine* (silicate), and *franklinite* (zinc, manganese, iron oxide). Canada, Japan, Belgium, Germany, and The Netherlands are suppliers of zinc ores. Zinc is also mined in Alaska, Tennessee, Missouri, and elsewhere in the U.S. Zinc can be obtained by roasting its ores to form the oxide and by reduction of the oxide with coal or carbon, with subsequent distillation of the metal. Other methods of extraction are possible. Naturally occurring zinc contains five stable isotopes. Twenty-five other unstable isotopes and isomers are recognized. Zinc is a bluish-white, lustrous metal. It is brittle at ordinary temperatures but malleable at 100 to 150°C. It is a fair conductor of electricity, and burns in air at high red heat with evolution of white clouds of the oxide. The metal is employed to form numerous alloys with other metals. Brass, nickel silver, typewriter metal, commercial bronze, spring brass, German silver, soft solder, and aluminum solder are some of the more important alloys. Large quantities of zinc are used to produce die castings, used extensively by the automotive, electrical, and hardware industries. An alloy called *Prestal*®, consisting of 78% zinc and 22% aluminum is reported to be almost as strong as steel but as easy to mold as plastic. It is said to be so plastic that it can be molded into form by relatively inexpensive die casts made of ceramics and cement. It exhibits superplasticity. Zinc is also extensively used to galvanize other metals such as iron to prevent corrosion. Neither zinc nor zirconium is ferromagnetic; but ZrZn_2 exhibits ferromagnetism at temperatures below 35 K. Zinc oxide is a unique and very useful material to modern civilization. It is widely used in the manufacture of paints, rubber products, cosmetics, pharmaceuticals, floor coverings, plastics, printing inks, soap, storage batteries, textiles, electrical equipment, and other products. It has unusual electrical, thermal, optical, and solid-state properties that have not yet been fully investigated. Lithopone, a mixture of zinc sulfide and barium sulfate,

THE ELEMENTS (continued)

is an important pigment. Zinc sulfide is used in making luminous dials, X-ray and TV screens, and fluorescent lights. The chloride and chromate are also important compounds. Zinc is an essential element in the growth of human beings and animals. Tests show that zinc-deficient animals require 50% more food to gain the same weight as an animal supplied with sufficient zinc. Zinc is not considered to be toxic, but when freshly formed ZnO is inhaled a disorder known as the *oxide shakes* or *zinc chills* sometimes occurs. It is recommended that where zinc oxide is encountered good ventilation be provided. The commercial price of zinc in January 2002 was roughly 40¢/lb (\$90 kg). Zinc metal with a purity of 99.9999% is priced at about \$5/g.

Zirconium — (Syriac, *zargun*, color of gold), Zr; at. wt. 91.224(2); at. no. 40; m.p. 1855°C; b.p. 4409°C; sp. gr. 6.506 (20°C); valence +2, +3, and +4. The name *zircon* may have originated from the Syriac word *zargono*, which describes the color of certain gemstones now known as *zircon*, *jargon*, *hyacinth*, *jacinth*, or *ligure*. This mineral, or its variations, is mentioned in biblical writings. These minerals were not known to contain this element until Klaproth, in 1789, analyzed a *jargon* from Sri Lanka and found a new earth, which Werner named zircon (*silex circonius*), and Klaproth called *Zirkonerde* (*zirconia*). The impure metal was first isolated by Berzelius in 1824 by heating a mixture of potassium and potassium zirconium fluoride in a small iron tube. Pure zirconium was first prepared in 1914. Very pure zirconium was first produced in 1925 by van Arkel and de Boer by an iodide decomposition process they developed. Zirconium is found in abundance in S-type stars, and has been identified in the sun and meteorites. Analyses of lunar rock samples obtained during the various Apollo missions to the moon show a surprisingly high zirconium oxide content, compared with terrestrial rocks. Naturally occurring zirconium contains five isotopes. Thirty-one other radioactive isotopes and isomers are known to exist. *Zircon*, ZrSiO₄, the principal ore, is found in deposits in Florida, South Carolina, Australia, South Africa, and elsewhere. *Baddeleyite*, found in Brazil, is an important zirconium mineral. It is principally pure ZrO₂ in crystalline form having a hafnium content of about 1%. Zirconium also occurs in some 30 other recognized mineral species. Zirconium is produced commercially by reduction of the chloride with magnesium (the Kroll Process), and by other methods. It is a grayish-white lustrous metal. When finely divided, the metal may ignite spontaneously in air, especially at elevated temperatures. The solid metal is much more difficult to ignite. The inherent toxicity of zirconium compounds is low. Hafnium is invariably found in zirconium ores, and the separation is difficult. Commercial-grade zirconium contains from 1 to 3% hafnium. Zirconium has a low absorption cross section for neutrons, and is therefore used for nuclear energy applications, such as for cladding fuel elements. Commercial nuclear power generation now takes more than 90% of zirconium metal production. Reactors of the size now being made may use as much as a half-million lineal feet of zirconium alloy tubing. Reactor-grade zirconium is essentially free of hafnium. *Zircaloy*® is an important alloy developed specifically for nuclear applications. Zirconium is exceptionally resistant to corrosion by many common acids and alkalis, by sea water, and by other agents. It is used extensively by the chemical industry where corrosive agents are employed. Zirconium is used as a getter in vacuum tubes, as an alloying agent in steel, in surgical appliances, photoflash bulbs, explosive primers, rayon spinnerets, lamp filaments, etc. It is used in poison ivy lotions in the form of the carbonate as it combines with *urushiol*. With niobium, zirconium is superconductive at low temperatures and is used to make superconductive magnets, which offer hope of direct large-scale generation of electric power. Alloyed with zinc, zirconium becomes magnetic at temperatures below 35 K. Zirconium oxide (zircon) has a high index of refraction and is used as a gem material. The impure oxide, zirconia, is used for laboratory crucibles that will withstand heat shock, for linings of metallurgical furnaces, and by the glass and ceramic industries as a refractory material. Its use as a refractory material accounts for a large share of all zirconium consumed. Zirconium tungstate is an unusual material that shrinks, rather than expands, when heated. While this compound has been known for more than 30 years, it is only now that it is being studied to determine the nature of this unusual behavior. A few other compounds are known to possess this property, but they tend to shrink in one direction, while they stretch out in others in order to maintain an overall volume. Zirconium tungstate shrinks in all directions over a wide temperature range of from near absolute zero to +777°C. This material is being considered for use in very small computer chips, which are subject to severe temperature changes. It is also being considered for use in composite materials where thermal expansion may be a problem. Zirconium of about 99.5% purity is available at a cost of about \$2000/kg or about \$4/g.

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS

The compounds in this table were selected on the basis of their laboratory and industrial importance, as well as their value in illustrating trends in the variation of physical properties with position in the periodic table. An effort has been made to include the most frequently encountered inorganic substances; a limited number of organometallics are also covered. Many, if not most, of the compounds that are solids at ambient temperature can exist in more than one crystalline modification. The information given here applies to the most stable or common crystalline form. In cases where two or more forms are of practical importance, separate entries will be found in the table.

Compounds are arranged primarily in alphabetical order by the most commonly used name. However, adjustments are made in many instances in order to bring closely related compounds together. For example, hydrides of elements such as boron, silicon, and germanium are grouped together immediately following the entry for the parent element, since they would otherwise be scattered throughout the table. Likewise, the oxoacids of an element are given in one group whenever a strict alphabetical order would separate them (e.g., sulfuric acid and fluorosulfuric acid). The Formula Index following the table provides another means of locating a compound. There is also an index to CAS Registry Numbers.

The following data fields appear in the table:

- **Name:** Systematic name for the substance. The valence state of a metallic element is indicated by a Roman numeral, e.g., copper in the +1 state is written as copper(I) rather than cuprous, iron in the +3 state is iron(III) rather than ferric.
- **Formula:** The simplest descriptive formula is given, but this does not necessarily specify the actual structure of the compound. For example, aluminum chloride is designated as AlCl_3 , even though a more accurate representation of the structure in the solid phase (and, under some conditions, in the gas phase) is Al_2Cl_6 . A few exceptions are made, such as the use of Hg_2^{+2} for the mercury(I) ion.
- **CAS Registry Number:** Chemical Abstracts Service Registry Number. An asterisk (*) following the CAS RN for a hydrate indicates that the number refers to the anhydrous compound. In most cases the generic CAS RN for the compound is given rather than the number for a specific crystalline form or mineral.
- **Mol. Weight:** Molecular weight (relative molar mass) as calculated with the 1997 IUPAC Recommended Atomic Weights. The number of decimal places corresponds to the number of places in the atomic weight of the least accurately known element (e.g., one place for lead compounds, two places for compounds of selenium, germanium, etc.); a maximum of three places is given. For compounds of radioactive elements for which IUPAC makes no recommendation, the mass number of the isotope with longest half-life is used, and the result is rounded to the nearest integer.
- **Physical Form:** The crystal system is given, when available, for compounds that are solid at room temperature, together with color and other descriptive features. Abbreviations are listed below.
- **mp:** Normal melting point in °C. The notation "tp" indicates the temperature at which solid, liquid, and gas are in equilibrium at a pressure greater than one atmosphere (i.e., the normal melting point does not exist). When available, the triple point pressure is listed.
- **bp:** Normal boiling point in °C (referred to 101.325 kPa or 760 mmHg pressure). The notation "sp" following the number indicates the temperature where the pressure of the vapor in equilibrium with the solid reaches as 101.325 kPa. See Reference 8, p. 23, for further discussion of sublimation points and triple points. A notation "sublimes" without a temperature being given indicates that there is a perceptible sublimation pressure above the solid at ambient temperatures.
- **Density:** Density values for solids and liquids are always in units of grams per cubic centimeter and can be assumed to refer to temperatures near room temperature unless otherwise stated. Values for gases are the calculated ideal gas densities in grams per liter at 25°C and 101.325 kPa; the unit is always specified for a gas value.
- **Aqueous Solubility:** Solubility is expressed as the number of grams of the compound (excluding any water of hydration) that will dissolve in 100 g of water. The temperature in °C is given as a superscript. Solubility at other temperatures can be found for many compounds in the table "Aqueous Solubility of Inorganic Compounds at Various Temperatures" in Section 8.
- **Qualitative Solubility:** Qualitative information on the solubility in other solvents (and in water, if quantitative data are unavailable) is given here. The abbreviations are:
 - i insoluble
 - sl slightly soluble
 - s soluble
 - vs very soluble

Data were taken from a wide variety of reliable sources, including monographs, treatises, review articles, evaluated compilations and databases, and in some cases the primary literature. Some of the most useful references for the properties covered here are listed below.

List of Abbreviations

Ac	acetyl	brn	brown	dec	decomposes
ace	acetone	bz	benzene	dil	dilute
acid	acid solutions	chl	chloroform	diox	dioxane
alk	alkaline solutions	col	colorless	eth	ethyl ether
amorp	amorphous	conc	concentrated	EtOH	ethanol
anh	anhydrous	cry	crystals, crystalline	exp	explodes, explosive
aq	aqueous	cub	cubic	flam	flammable
blk	black	cyhex	cyclohexane	gl	glass, glassy

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (CONTINUED)

List of Abbreviations (continued)

grn	green	peth	petroleum ether	temp	temperature
hc	hydrocarbon solvents	pow	powder	tetr	tetragonal
hex	hexagonal	prec	precipitate	thf	tetrahydrofuran
hp	heptane	pur	purple	tol	toluene
hex	hexane	py	pyridine	tp	triple point
hyd	hydrate	reac	reacts with	trans	transition, transformation
hyg	hygroscopic	refrac	refractory	tricl	triclinic
i	insoluble in	rhom	rhombohedral	trig	trigonal
liq	liquid	s	soluble in	unstab	unstable
MeOH	methanol	silv	silvery	viol	violet
mono	monoclinic	sl	slightly soluble in	visc	viscous
octahed	octahedral	soln	solution	vs	very soluble in
oran	orange	sp	sublimation point	wh	white
orth	orthorhombic	stab	stable	xyl	xylene
os	organic solvents	subl	sublimes	yel	yellow

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No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1	Actinium	Ac	7440-34-8	227	silv metl cub	1051	3198	10		
2	Actinium bromide	AcBr ₃	33689-81-5	467	wh hex cry		800 subl	5.85		s H ₂ O
3	Actinium chloride	AcCl ₃	22986-54-5	333	wh hex cry		960 subl	4.81		
4	Actinium fluoride	AcF ₃	33689-80-4	284	wh hex cry			7.88		i H ₂ O
5	Actinium iodide	AcI ₃	33689-82-6	608	wh cry					s H ₂ O
6	Actinium oxide	Ac ₂ O ₃	12002-61-8	502	wh hex cry	1977		9.19		i H ₂ O
7	Aluminum	Al	7429-90-5	26.982	silv-wh metl cub cry	660.32	2519	2.70		i H ₂ O; s acid, ak
8	Aluminum ammonium sulfate	ANH ₄ (SO ₄) ₂	7784-25-0	237.148	wh powder					slH ₂ O; i EDH
9	Aluminum ammonium sulfate dodecahydrate	ANH ₄ (SO ₄) ₂ · 12H ₂ O	7784-26-1	453.331	colcry or powder	94.5	>280 dec	1.65		s H ₂ O; i EDH
10	Aluminum antimonide	ASb	25152-52-7	148.742	cub cry	1065		4.26		
11	Aluminum arsenide	AA _s	22831-42-1	101.903	oran cub cry; hyg	1740		3.76		
12	Aluminum borate	2Al ₂ O ₃ · B ₂ O ₃	11121-16-7	273.543	needles	≈1050				i H ₂ O
13	Aluminum boride	AB ₂	12041-50-8	48.604	powder	>920 dec		3.19		s dilHCl
14	Aluminum borohydride	A(BH ₄) ₃	16962-07-5	71.510	f am lq	-64.5	44.5			react H ₂ O
15	Aluminum bromate nonahydrate	A(BrO ₃) ₃ · 9H ₂ O	11126-81-1*	572.826	wh hyg cry	62	>100 dec			s H ₂ O
16	Aluminum bromide	ABr ₃	7727-15-3	266.694	wh-yelmonocry; hyg	97.5	255	3.2		react H ₂ O; s bz, bl
17	Aluminum bromide hexahydrate	ABr ₃ · 6H ₂ O	7784-11-4	374.785	colyelhycry	93		2.54		s H ₂ O, EDH, CS ₂
18	Aluminum carbide	Al ₄ C ₃	1299-86-1	143.958	yelhex cry	2100	>2200 dec	2.36		react H ₂ O
19	Aluminum chloride nonahydrate	A(CD ₃) ₃ · 9H ₂ O	15477-33-5	439.472	hyg cry					vs H ₂ O; s EDH
20	Aluminum chloride	AlCl ₃	7446-70-0	133.340	wh hex cry or powder; hyg	192.6	180 sp	2.48	45.1 ²⁵	s bz, ct, chl
21	Aluminum chloride hexahydrate	AlCl ₃ · 6H ₂ O	7784-13-6	241.431	colhyg cry	100 dec		2.398	45.1 ²⁵	s EDH, eh
22	Aluminum diacetate	A(OH)(C ₂ H ₃ O ₂) ₂	142-03-0	162.078	wh amorp powder					i H ₂ O
23	Aluminum ethanoate	A(C ₂ H ₃ O ₂) ₃	555-75-9	162.163	lq, condenses b wh sold	140				react H ₂ O; slxyl
24	Aluminum fluoride	AF ₃	7784-18-1	83.977	wh hex cry	≈2250 p (220 MPa)	1276 sp	3.10	0.50 ²⁵	
25	Aluminum fluoride monohydrate	AF ₃ · H ₂ O	32287-65-3	101.992	orb cry			2.17	0.50 ²⁵	
26	Aluminum fluoride trihydrate	AF ₃ · 3H ₂ O	15098-87-0	138.023	wh hyg cry			1.914	0.50 ²⁵	
27	Aluminum hexafluorosilicate nonahydrate	Al ₂ (SiF ₆) ₃ · 9H ₂ O	17099-70-6	642.329	hex prisms	>500 dec				s H ₂ O
28	Aluminum hydride	AH ₃	7784-21-6	30.006	colhex cry	>150 dec				react H ₂ O
29	Aluminum hydroxide	A(OH) ₃	21645-51-2	78.004	wh amorp powder			2.42		i H ₂ O; s ak, acid
30	Aluminum hydroxychloride	Al ₂ (OH) ₃ Cl · 2H ₂ O	1327-41-9	210.483	glsold					s H ₂ O
31	Aluminum hypophosphite	A(H ₂ PO ₂) ₃	7784-22-7	221.948	cry powder	220 dec				i H ₂ O; s ak, acid
32	Aluminum iodide	Al ₃ I	7784-23-8	407.695	wh leaf ts	188.28	382	3.98		react H ₂ O
33	Aluminum iodide hexahydrate	Al ₃ I · 6H ₂ O	10090-53-6	515.786	yelhyg cry powder					vs H ₂ O; s EDH, eh
34	Aluminum isocyanate	A(C ₂ H ₃ O ₃) ₃	18917-91-4	294.192	powder					vs H ₂ O
35	Aluminum nitrate	A(NO ₃) ₃	13473-90-0	212.997	wh hyg sold	dec			68.9 ²⁵	vs EDH; slace
36	Aluminum nitrate nonahydrate	A(NO ₃) ₃ · 9H ₂ O	7784-27-2	375.134	wh hyg mono cry	73	135 dec	1.72	68.9 ²⁵	vs EDH; i pyr
37	Aluminum nitride	AN	24304-00-5	40.989	blue-wh hex cry	3000		3.255		react H ₂ O
38	Aluminum oxide	A(C ₁₈ H ₃₃ O ₂) ₃	688-37-9	871.342	yelsold					i H ₂ O; s EDH, bz
39	Aluminum phosphate	AP ₄	7784-30-7	121.953	wh rhomb plets	>1460		2.56		i H ₂ O; slacid
40	Aluminum metaphosphate	A(PO ₃) ₃	32823-06-6	263.898	colpowder; et	≈1525		2.78		i H ₂ O
41	Aluminum oxide (corundum)	Al ₂ O ₃	1344-28-1	101.961	wh powder; hex	2053	≈3000	3.97		i H ₂ O, os; slak
42	Aluminum oxyhydroxide	AO(OH)	14457-84-2	59.989	ortho cry			3.44		i H ₂ O; s acid, ak
43	Aluminum palmitate	A(C ₁₅ H ₃₁ COO) ₃	555-35-1	793.230	wh-yel powder					i H ₂ O, EDH; s pch
44	Aluminum perchlorate nonahydrate	A(CD ₄) ₃ · 9H ₂ O	14452-39-2	487.470	wh hyg cry	82 dec		2.0	182.4 ⁹	
45	Aluminum phosphide	AP	20859-73-8	57.956	grn or yelcub cry	2550		2.40		react H ₂ O

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
46	Aluminum selenide	Al ₂ Se ₃	1302-82-5	290.84	yellow powder	960		3.437		react H ₂ O
47	Aluminum silicate	Al ₂ SiO ₅	12183-80-1	162.046	gray-grn cry			3.145		
48	Aluminum silicate dihydrate	Al ₂ O ₃ · 2SiO ₂ · 2H ₂ O	1332-58-7	258.161	wh-yellow powder; ticl			2.59		i H ₂ O, acid, alk
49	Aluminum stearate	Al(C ₁₈ H ₃₅ O ₂) ₃	637-12-7	877.390	wh powder	115		1.070		i H ₂ O, EDH, eth; s alk
50	Aluminum sulfide	Al ₂ (SO ₄) ₃	10043-01-3	342.154	wh cry	1040 dec			38.5 ²⁵	i EDH
51	Aluminum sulfide octadecahydrate	Al ₂ (SO ₄) ₃ · 18H ₂ O	7784-31-8	666.429	colorless cry	86 dec		1.69	38.5 ²⁵	
52	Aluminum sulfide	Al ₂ S ₃	1302-81-4	150.161	yellow powder	1100		2.02		
53	Aluminum telluride	Al ₂ Te ₃	12043-29-7	436.76	gray-bk hex cry	≈895		4.5		
54	Aluminum thiocyanate	Al(SCN) ₃	538-17-0	201.232	yellow powder					s H ₂ O; i EDH, eth
55	Americium	Am	7440-35-9	243	silv metal hex or cub	1176	2011	12		s acid
56	Americium(III) oxide	Am ₂ O ₃	12254-64-7	534	tan hex cry			11.77		s acid
57	Americium(III) bromide	AmBr ₃	14933-38-1	483	wh orth cry			6.85		s H ₂ O
58	Americium(III) chloride	AmCl ₃	13464-46-5	349	pink hex cry	500		5.87		
59	Americium(III) fluoride	AmF ₃	13708-80-0	300	pink hex cry	1393		9.53		
60	Americium(III) iodide	AmI ₃	13813-47-3	624	yellow cry	≈950		6.9		
61	Americium(IV) fluoride	AmF ₄	15947-41-8	319	tan monocry			7.23		
62	Americium(IV) oxide	AmO ₂	12005-67-3	275	bk cub cry	>1000 dec		11.68		s acid
63	Ammonia	NH ₃	7664-41-7	17.031	col gas	-77.73	-33.33	0.696 g/L		vs H ₂ O; s EDH, eth
64	Ammonium acetate	NH ₄ C ₂ H ₃ O ₂	631-61-8	77.083	wh hyg cry	114		1.073	148 ⁴	s EDH; slace
65	Ammonium azide	NH ₄ N ₃	12164-94-2	60.059	ortho cry; f lam	160	exp	1.346	20.2 ³⁰	
66	Ammonium benzoate	NH ₄ C ₆ H ₅ O ₂	1863-63-4	139.152	wh cry or powder	198		1.26		s H ₂ O; sl EDH
67	Ammonium hydrogen maleate	NH ₄ C ₄ H ₄ O ₅	5972-71-4	151.118	ortho cry	160		1.15		s H ₂ O; sl EDH
68	Ammonium borate tetrahydrate	(NH ₄) ₂ B ₄ O ₇ · 4H ₂ O	12228-87-4	263.377	bt cry					s H ₂ O; i EDH
69	Ammonium bromate	NH ₄ BrO ₃	13843-59-9	145.941	col hex cry	exp				vs H ₂ O
70	Ammonium bromide	NH ₄ Br	12124-97-9	97.943	wh hyg bt cry	542 dec	396 sp	2.429	78.3 ²⁵	s EDH, ace; sl eth
71	Ammonium caprylate	NH ₄ C ₈ H ₁₅ O ₂	5972-76-9	161.243	hyg monocry	≈75				react H ₂ O; s EDH; i chl bz
72	Ammonium carbamate	NH ₂ COONH ₄	1111-78-0	78.071	cry powder					vs H ₂ O; s EDH
73	Ammonium carbonate	(NH ₄) ₂ CO ₃	506-87-6	96.086	col cry powder	58 dec			100 ¹⁵	
74	Ammonium cerium(III) sulfate tetrahydrate	NH ₄ Ce(SO ₄) ₂ · 4H ₂ O	21995-38-0*	422.343	monocry					s H ₂ O
75	Ammonium cerium(IV) nitrate	(NH ₄) ₂ Ce(NO ₃) ₆	16774-21-3	548.223	red-oran cry					vs H ₂ O
76	Ammonium chloride	NH ₄ Cl	10192-29-7	101.490	wh cry	102 exp		1.80	28.7 ⁰	
77	Ammonium chloride	NH ₄ Cl	12125-02-9	53.492	col cub cry	520 p (dec)	338 sp	1.519	39.5 ²⁵	
78	Ammonium chromate	(NH ₄) ₂ CrO ₄	7788-98-9	152.071	yellow cry	185 dec		1.90	37 ²⁵	slace, MeOH; i EDH
79	Ammonium chromic sulfate dodecahydrate	NH ₄ Cr(SO ₄) ₂ · 12H ₂ O	10022-47-6	478.345	blue-violet cry	94 dec		1.72		s H ₂ O; sl EDH
80	Ammonium cobalt(II) phosphate	CoNH ₄ PO ₄	14590-13-7	171.943	red-violet powder (hyd)					i H ₂ O; s acid
81	Ammonium cobalt(II) sulfate hexahydrate	(NH ₄) ₂ Co(SO ₄) ₂ · 6H ₂ O	13586-38-4	395.229	red monocry prisms			1.90		s H ₂ O; i EDH
82	Ammonium copper(II) chloride	CuCl ₂ · 2NH ₄ Cl	10060-13-6*	241.434	yellow orth cry					s H ₂ O
83	Ammonium copper(II) chloride dihydrate	CuCl ₂ · 2NH ₄ Cl · 2H ₂ O	10060-13-6	277.464	blue-grn bt cry	110 dec		1.993		s H ₂ O, EDH
84	Ammonium cyanide	NH ₄ CN	12211-52-8	44.056	col bt cry	dec		1.10		vs H ₂ O
85	Ammonium dichromate	(NH ₄) ₂ Cr ₂ O ₇	7789-09-5	252.065	orange-red monocry; hyg	180 dec		2.155	35.6 ²⁰	
86	Ammonium dihydrogen arsenate	NH ₄ H ₂ AsO ₄	13462-93-6	158.975	bt cry	300 dec		2.311	52.7 ²⁵	
87	Ammonium dihydrogen phosphate	NH ₄ H ₂ PO ₄	7722-76-1	115.026	wh bt cry	190		1.80	40.4 ²⁵	sl EDH; i ace
88	Ammonium dithiocarbamate	NH ₄ NH ₂ CSS	513-74-6	110.204	yellow orth cry	99 dec		1.45		s H ₂ O
89	Ammonium ferric chromate	NH ₄ Fe(CrO ₄) ₂	7789-08-4	305.871	red powder					i H ₂ O
90	Ammonium ferric oxalate trihydrate	(NH ₄) ₃ Fe(C ₂ O ₄) ₃ · 3H ₂ O	13268-42-3	428.063	grn monocry; hyg	≈160 dec		1.780		vs H ₂ O; i EDH

91	Ammonium ferric sulfate dodecahydrate	$\text{NH}_4\text{Fe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	10138-04-2	482.194	colb violcry	≈ 37	1.71		vs H_2O ; i EOH
92	Ammonium ferricyanide trihydrate	$(\text{NH}_4)_3\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$	14221-48-8*	320.111	red cry				s H_2O ; i EOH
93	Ammonium ferrocyanide trihydrate	$(\text{NH}_4)_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$	14481-29-9*	338.149	yelcry	dec			s H_2O ; i EOH
94	Ammonium ferrous sulfate hexahydrate	$(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	10045-89-3	392.141	blue-grn monoclcry	≈ 100 dec	1.86		s H_2O ; i EOH
95	Ammonium fluoride	NH_4F	12125-01-8	37.037	wh hex cry; hyg	dec	1.015	83.5 ²⁵	slEOH
96	Ammonium tetrafluoroborate	NH_4BF_4	13826-83-0	104.844	wh powder; orth	487 dec	1.871	25 ²⁰	
97	Ammonium fluorosulfonate	$\text{NH}_4\text{SO}_3\text{F}$	13446-08-7	117.101	colneedls	245			s H_2O , EOH, MeOH
98	Ammonium formate	NH_4CHO_2	540-69-2	63.057	hyg cry	116	1.27	143 ²⁰	s EOH
99	Ammonium hexachloroiridate(IV)	$(\text{NH}_4)_2\text{IrCl}_6$	16940-92-4	441.010	bk cry powder	dec	2.856	1.09 ²⁵	
100	Ammonium hexachlorosulfate(IV)	$(\text{NH}_4)_2\text{O}_2\text{S}_6$	12125-08-5	439.02	red cry or powder		2.93		s H_2O , EOH
101	Ammonium hexachloropalladate(IV)	$(\text{NH}_4)_2\text{PdCl}_6$	19168-23-1	355.21	red-brn hyg cry	dec	2.418		
102	Ammonium hexabromoplatinate(IV)	$(\text{NH}_4)_2\text{PtBr}_6$	17363-02-9	710.58	powder	145 dec		0.59 ²⁰	
103	Ammonium hexachloroplatinate(IV)	$(\text{NH}_4)_2\text{PtCl}_6$	16919-58-7	443.87	red-oran cub cry	380 dec	3.065	0.5 ²⁰	i EOH
104	Ammonium hexafluoroaluminum	$(\text{NH}_4)_3\text{AlF}_6$	7784-19-2	195.087	cub cry		1.78		s H_2O
105	Ammonium hexafluorogallate	$(\text{NH}_4)_3\text{GaF}_6$	14639-94-2	237.828	colcub cry	>200 dec	2.10		
106	Ammonium hexafluorogermanate	$(\text{NH}_4)_3\text{GeF}_6$	16962-47-3	222.68	wh cry	380	2.564		s H_2O ; i EOH
107	Ammonium hexafluorophosphate	NH_4PF_6	16941-11-0	163.003	wh cub cry	58 dec	2.180		vs H_2O ; s ace, EOH, MeOH
108	Ammonium hexafluorosilicate	$(\text{NH}_4)_3\text{SiF}_6$	16919-19-0	178.153	wh cub or tig cry	dec	2.011	22.7 ²⁵	i EOH, ace
109	Ammonium hexafluorozirconate(IV)	$(\text{NH}_4)_2\text{ZrF}_6$	16919-31-6	241.291	wh hex cry		1.154		s H_2O
110	Ammonium hydrogen arsenate	$(\text{NH}_4)_2\text{HAsO}_4$	7784-44-3	176.004	wh powder		1.99		s H_2O
111	Ammonium hydrogen borate trihydrate	$\text{NH}_4\text{HB}_3\text{O}_7 \cdot 3\text{H}_2\text{O}$	10135-84-9	228.332	colcry		≈ 2.5		s H_2O
112	Ammonium hydrogen carbonate	NH_4HCO_3	1066-33-7	79.056	color wh prisms	107 dec	1.586	24.8 ²⁵	i EOH, bz
113	Ammonium hydrogen citrate	$(\text{NH}_4)_3\text{HC}_6\text{H}_5\text{O}_7$	3012-65-5	226.184	colcry		1.48		vs H_2O ; slEOH
114	Ammonium hydrogen fluoride	NH_4HF_2	1341-49-7	57.044	wh orth cry	125	240 dec	1.50	60.2 ²⁰
115	Ammonium hydrogen oxalate monohydrate	$\text{NH}_4\text{HC}_2\text{O}_4 \cdot \text{H}_2\text{O}$	5972-72-5*	125.081	colrhomb cry	dec	1.56		sl H_2O , EOH
116	Ammonium hydrogen phosphate	$(\text{NH}_4)_2\text{HPO}_4$	7783-28-0	132.055	wh cry	155 dec	1.619	69.5 ²⁵	i EOH, ace
117	Ammonium hydrogen selenate	NH_4HSeO_4	10294-60-7	162.01	rhomb cry	dec	2.162		
118	Ammonium hydrogen sulfate	NH_4HSO_4	7803-63-6	115.111	wh hyg cry	147	1.78	100 ²⁰	i EOH, ace, py
119	Ammonium hydrogen sulfide	NH_4HS	12124-99-1	51.113	wh t or orth cry	dec	1.17	128 ⁰	slace; i bz, eh
120	Ammonium hydrogen sulfite	NH_4HSO_3	10192-30-0	99.111	colcry	dec	2.03	71.8 ⁰	
121	Ammonium hydrogen tartrate	$\text{NH}_4\text{C}_4\text{H}_4\text{O}_6$	3095-65-6	167.117	wh cry		1.68		sl H_2O ; s ak; i EOH
122	Ammonium hydroxide	NH_4OH	1336-21-6	35.046	exists only in soln				
123	Ammonium hypophosphite	$\text{NH}_4\text{H}_2\text{PO}_2$	7803-65-8	83.028	wh hyg cry	dec			vs H_2O ; slEOH; i ace
124	Ammonium iodate	NH_4IO_3	13446-09-8	192.941	wh powder	150	3.3	3.84 ²⁵	
125	Ammonium iodide	NH_4I	12027-06-4	144.943	wh t cry; hyg	551 dec	405 sp	2.514	178 ²⁵
126	Ammonium isocyanate	$\text{NH}_4\text{C}_2\text{H}_3\text{O}_3$	52003-58-4	107.108	colcry	92			s H_2O , EOH; slMeOH; i ace, eh
127	Ammonium manganate hexahydrate	$(\text{NH}_4)_6\text{W}_2\text{O}_{24} \cdot 6\text{H}_2\text{O}$	12028-48-7	1887.19	wh cry				s H_2O ; i EOH
128	Ammonium metavanadate	NH_4VO_3	7803-55-6	116.979	wh-yelcry	200 dec	2.326	4.8 ²⁰	
129	Ammonium molybdate(VI) trihydrate	$(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$	12054-85-2	1235.86	color grn-yelcry	90 dec	2.498	43	i EOH
130	Ammonium molybdophosphate	$(\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3$	54723-94-3*	1876.35	yelcry pow	dec		0.02	s ak; i acid
131	Ammonium nickelchloride hexahydrate	$\text{NH}_4\text{NiCl}_6 \cdot 6\text{H}_2\text{O}$	16122-03-5*	291.181	grn hyg cry		1.65		s H_2O
132	Ammonium nickelsulfate hexahydrate	$(\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	7785-20-8	394.989	blue-grn cry	dec	1.923		sl H_2O ; i EOH
133	Ammonium nitrate	NH_4NO_3	6484-52-2	80.043	wh hyg cry; orth	210 dec	1.72	213 ²⁵	slMeOH
134	Ammonium nitrite	NH_4NO_2	13446-48-5	64.044	wh-yelcry	60 exp	1.69	221 ²⁵	i eh
135	Ammonium nitroferrocyanide	$(\text{NH}_4)_2\text{Fe}(\text{CN})_5\text{NO}$	14402-70-1	252.016	red-brn cry				s H_2O , EOH
136	Ammonium oxalate	$\text{NH}_4\text{C}_2\text{O}_4$	544-60-5	299.493	yelbrn past	21			s H_2O ; slace
137	Ammonium oxalate	$(\text{NH}_4)_2\text{C}_2\text{O}_4$	1113-38-8	124.096	colsol		1.5	5.20 ²⁵	
138	Ammonium oxalate monohydrate	$(\text{NH}_4)_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$	6009-70-7	142.110	wh orth cry	dec	1.50	5.20 ²⁵	slEOH

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
139	Ammonium pahitè	NH ₄ C ₁₆ H ₃₁ CO ₂	593-26-0	273.455	yelwh powder	22				s H ₂ O; slbz, xyl i ace, EDH, ct
140	Ammonium pentaborat ètahydrat	NH ₄ B ₅ O ₃ · 4H ₂ O	12007-89-5	272.150	wh cry				7.03 ¹⁸	
141	Ammonium pentàchbrozinat	(NH ₄) ₂ ZnCl ₆	14639-98-6	296.77	hyg orh cry			1.81		vs H ₂ O
142	Ammonium perchbrat	NH ₄ CO ₄	7790-98-9	117.490	wh orh cry	dec, exp		1.95	24.5 ²⁵	s MeOH; slEDH, ace; i eh
143	Ammonium permanganat	NH ₄ MnO ₄	13446-10-1	136.975	purp rhomb cry	70 dec		2.22	7.9 ¹⁵	
144	Ammonium peroxydisuf at	(NH ₄) ₂ S ₂ O ₈	7727-54-0	228.204	monocry or wh powder	dec		1.982	83.5 ²⁵	
145	Ammonium perrhenat	NH ₄ ReO ₄	13598-65-7	268.244	colpowder			3.97	6.23 ²⁰	
146	Ammonium fosfat èt thydrat	(NH ₄) ₂ PO ₄ · 3H ₂ O	10361-65-6*	203.133	wh prisms				25.0 ²⁵	i ace
147	Ammonium fosfat èt, dibasic, monohydrat	(NH ₄) ₂ HPO ₃ · H ₂ O	51503-61-8	134.071	hyg cry					s H ₂ O
148	Ammonium fosfomolybdat monohydrat	(NH ₄) ₃ PO ₄ · 12MoO ₃ · H ₂ O	54723-94-3	1894.36	yelcry or powder	dec			0.02	
149	Ammonium fosphotungst èt dihydrat	(NH ₄) ₃ PO ₄ · 12WO ₃ · 2H ₂ O	1311-90-6	2967.18	cry powder					slH ₂ O
150	Ammonium picrat	NH ₄ C ₆ H ₂ N ₂ O ₇	131-74-8	246.135	yelorth cry	exp		1.72		slH ₂ O
151	Ammonium salcyat	NH ₄ C ₇ H ₅ O ₃	528-94-9	155.151	wh cry powder					vs H ₂ O; s EDH
152	Ammonium seènat	(NH ₄) ₂ SeO ₄	7783-21-3	179.04	wh monocry	dec		2.194	117 ²⁵	i EDH, ace
153	Ammonium seènit	(NH ₄) ₂ SeO ₃	7783-19-9	163.04	wh or red hyg cry	dec			121 ²⁵	
154	Ammonium starat	NH ₄ C ₁₈ H ₃₅ O ₂	1002-89-7	301.509	yelwh powder	22		0.89		slH ₂ O, bz; s EDH, MeOH; i ace
155	Ammonium suf amat	NH ₄ NH ₂ SO ₃	7773-06-0	114.125	wh hyg cry	131	160 dec			vs H ₂ O; slEDH
156	Ammonium suf at	(NH ₄) ₂ SO ₄	7783-20-2	132.141	wh or brn orh cry	280 dec		1.77	76.4 ²⁵	i EDH, ace
157	Ammonium suf ide	(NH ₄) ₂ S	12135-76-1	68.143	yeloran cry	≈0 dec				s H ₂ O, EDH, ak
158	Ammonium suf ite	(NH ₄) ₂ SO ₃	17026-44-7	116.141	wh hyg cry				64.2 ²⁵	
159	Ammonium suf ite monohydrat	(NH ₄) ₂ SO ₃ · H ₂ O	7783-11-1	134.156	colcry	dec		1.41	64.2 ²⁵	i EDH, ace
160	Ammonium artat	(NH ₄) ₂ C ₄ H ₄ O ₆	3164-29-2	184.147	wh cry	dec		1.601		s H ₂ O
161	Ammonium èlurat	(NH ₄) ₂ TeO ₄	13453-06-0	227.68	wh powder	dec		3.024		
162	Ammonium ètachbroaluminat	NH ₄ AlCl ₄	7784-14-7	186.832	wh hyg sold	304				s H ₂ O, eh
163	Ammonium ètachbroplnat(II)	(NH ₄) ₂ PCl ₄	13820-41-2	372.97	red cry	dec		2.936		s H ₂ O; i EDH
164	Ammonium ètachbrozinat	(NH ₄) ₂ ZnCl ₄	14639-97-5	243.28	wh orh pàès; hyg	150 dec		1.879		vs H ₂ O
165	Ammonium ètatiotungst èt	(NH ₄) ₂ WS ₄	13862-78-7	348.18	oran cry	dec		2.71		s H ₂ O
166	Ammonium tiocyanat	NH ₄ SCN	1762-95-4	76.122	colhyg cry	≈149	dec	1.30	181 ²⁵	vs EDH; s ace; i chl
167	Ammonium biosuf at	(NH ₄) ₂ S ₂ O ₃	7783-18-8	148.207	wh cry	150 dec		1.678		vs H ₂ O; i EDH, eh
168	Ammonium itanium oxat monohydrat	(NH ₄) ₂ TiO(C ₂ O ₄) ₂ · H ₂ O	10580-03-7	293.996	hyg cry					vs H ₂ O
169	Ammonium tungst èt(VI)	(NH ₄) ₁₀ W ₁₂ O ₄₁	11120-25-5	3042.44	cry pow			2.3		s H ₂ O; i EDH
170	Ammonium uranat èt(VI)	(NH ₄) ₂ U ₂ O ₇	7783-22-4	624.131	red-yelamorp powder					i H ₂ O, ak; s acid
171	Ammonium uranium f fluoride	UO ₂ (NH ₄) ₂ F ₅	18433-40-4	419.135	grn-yel monocry					s H ₂ O; i EDH
172	Ammonium valrat	NH ₄ C ₄ H ₉ CO ₂	42739-38-8	119.163	hyg cry	108				vs H ₂ O, EDH; s eh
173	Ammonium zirconiycarbonat dihydrat	(NH ₄) ₃ ZrOH(CO ₃) ₂ · 2H ₂ O	12616-24-9*	362.404	prisms; unsat					s H ₂ O
174	Antimony	Sb	7440-36-0	121.760	silv metl hex	630.63	1587	6.68		i dilacid
175	Stbine	SbH ₃	7803-52-3	124.784	colgas; f àm	-88	-17	5.100 g/L		slH ₂ O; s EDH
176	Antimony arsenide	SbAs	12322-34-8	196.682	hex cry	≈680		6.0		
177	Antimony(III) bromide	SbBr ₃	7789-61-9	361.472	yelorth cry; hyg	96.6	280	4.35		reac H ₂ O; s ace, bz, chl
178	Antimony(III) chloride	SbCl ₃	10025-91-9	228.118	colorh cry; hyg	73.4	220.3	3.14	987 ²⁵	s acid, EDH, bz, ace
179	Antimony(III) fluoride	SbF ₃	7783-56-4	178.755	wh orh cry; hyg	292	≈345	4.38	492 ²⁵	
180	Antimony(III) iodide	SbI ₃	7790-44-5	502.473	red rhomb cry	168	401	4.92		reac H ₂ O; s EDH, ace; i ct
181	Antimony(III) oxide (senarmonitè)	Sb ₂ O ₃	1309-64-4	291.518	colcub cry	570 fans	1425	5.58		slH ₂ O; i os
182	Antimony(III) oxide (valènititè)	Sb ₂ O ₃	1309-64-4	291.518	wh orh cry	655	1425	5.7		slH ₂ O; i os

183	Antimony(III) oxychloride	SbOCl	7791-08-4	173.212	wh momo cry	170	dec			react H ₂ O; i EDH, eh	
184	Antimony(III) selenide	Sb ₂ Se ₃	1315-05-5	480.40	grn orth cry	611		5.81		slH ₂ O	
185	Antimony(III) sulfide	Sb ₂ (SO ₄) ₃	7446-32-4	531.711	wh cry powder; hyg		dec	3.62		slH ₂ O	
186	Antimony(III) sulfide	Sb ₂ S ₃	1345-04-6	339.718	gray-bk orth cry	550		4.562		i H ₂ O; s conc HCl	
187	Antimony(III) telluride	Sb ₂ Te ₃	1327-50-0	626.32	gray cry	620		6.5			
188	Antimony(III,V) oxide	Sb ₂ O ₄	1332-81-6	307.518	yellow cry			6.64			
189	Antimony(V) chloride	SbCl ₅	7647-18-9	299.024	color yell liq	4	140	dec	2.34	react H ₂ O; s chl ct	
190	Antimony(V) fluoride	SbF ₅	7783-70-2	216.752	hyg visc liq	8.3	141		3.10	react H ₂ O	
191	Antimony(V) dichlorotrifluoride	SbCl ₂ F ₃	7791-16-4	249.660	visc liq					react H ₂ O	
192	Antimony(V) oxide	Sb ₂ O ₅	1314-60-9	323.517	yellow powder; cub		dec	3.78	0.3 ²⁰		
193	Antimony(V) sulfide	Sb ₂ S ₅	1315-04-4	403.850	orange-yellow powder		75	dec	4.120	i H ₂ O; s acid, ak	
194	Argon	Ar	7440-37-1	39.948	colgas	-189.36	p (69 kPa)	-185.85	1.633	g/L	slH ₂ O
195	Arsenic (gray)	As	7440-38-2	74.922	gray metal rhomb	817	p (3.70 MPa)	603	sp	5.75	i H ₂ O
196	Arsine	AsH ₃	7784-42-1	77.946	colgas	-116		-62.5	3.186	g/L	slH ₂ O
197	Diarsine	As ₂ H ₄	15942-63-9	153.875	unstable liq			≈100			
198	Arsenic acid	H ₃ AsO ₄	7778-39-4	141.944	exists only in soln						
199	Arsenic acid hemihydrate	H ₃ AsO ₄ · 0.5H ₂ O	7778-39-4*	150.951	wh hyg cry	35.5		≈2		vs H ₂ O, EDH	
200	Arsenious acid	H ₃ AsO ₃	13464-58-9	125.944	exists only in soln						
201	Arsenic diiodide	As ₂ I ₄	13770-56-4	657.461	red cry	137				react H ₂ O; s os	
202	Arsenic hemiselenide	As ₂ Se	1303-35-1	228.80	bk cry					i H ₂ O, os; dec acid, ak	
203	Arsenic sulfide	As ₂ S ₄	12279-90-2	427.950	red monocry	320		565	3.5	i H ₂ O; slbz; s ak	
204	Arsenic(III) bromide	AsBr ₃	7784-33-0	314.634	yellow cry; hyg	31.1		221	3.40	react H ₂ O; s hc, ct; vs eh, bz	
205	Arsenic(III) chloride	AsCl ₃	7784-34-1	181.280	coll liq	-16		130	2.150	react H ₂ O; vs chl ct, eh	
206	Arsenic(III) fluoride	AsF ₃	7784-35-2	131.917	coll liq	-5.9		57.8	2.7	react H ₂ O; s EDH, eh, bz	
207	Arsenic(III) iodide	AsI ₃	7784-45-4	455.635	red hex cry	140.9		424	4.73	slH ₂ O, EDH, eh; s bz, bl	
208	Arsenic(III) oxide (arsenolite)	As ₂ O ₃	1327-53-3	197.841	wh cub cry	274		460	3.86	2.05 ²⁵	
209	Arsenic(III) oxide (claudette)	As ₂ O ₃	1327-53-3	197.841	wh monocry	313		460	3.74	2.05 ²⁵	
210	Arsenic(III) selenide	As ₂ Se ₃	1303-36-2	386.72	brn-bk sold	260			4.75	i H ₂ O; s ak	
211	Arsenic(III) sulfide	As ₂ S ₃	1303-33-9	246.041	yellow monocry	310		707	3.46	i H ₂ O; s ak	
212	Arsenic(III) telluride	As ₂ Te ₃	12044-54-1	532.64	bk monocry	621			6.50		
213	Arsenic(V) chloride	AsCl ₅	22441-45-8	252.186	stable at bw temp		≈-50	dec			
214	Arsenic(V) fluoride	AsF ₅	7784-36-3	169.914	colgas	-79.8		-52.8	6.945	g/L	react H ₂ O; s EDH, bz, eh
215	Arsenic(V) oxide	As ₂ O ₅	1303-28-2	229.840	wh amorp powder	315			4.32	65.8 ²⁰	vs EDH
216	Arsenic(V) selenide	As ₂ Se ₅	1303-37-3	544.64	bk sold		dec			i H ₂ O, EDH, eh; s ak	
217	Arsenic(V) sulfide	As ₂ S ₅	1303-34-0	310.173	brn-yellow amorp sold		dec			i H ₂ O; s ak	
218	Triethylarsenite	As(OC ₂ H ₅) ₃	3141-12-6	210.103	liq			166	1.21		
219	Astatine	At	7440-68-8	210	cry	302				s HNO ₃ , os	
220	Barium	Ba	7440-39-3	137.327	silv-yellow metal cub	727		1897	3.62		react H ₂ O; slEDH
221	Barium acetate	Ba(C ₂ H ₃ O ₂) ₂	543-80-6	255.416	wh powder				2.47	79.2 ²⁵	
222	Barium acetate monohydrate	Ba(C ₂ H ₃ O ₂) ₂ · H ₂ O	5908-64-5	273.431	wh cry	110	dec		2.19	79.2 ²⁵	slEDH
223	Barium aluminate	BaAl ₂ O ₄	12004-04-5	255.288	hex cry	1827					
224	Barium azide	Ba(N ₃) ₂	18810-58-7	221.367	monocry; exp		≈120	dec	2.936	17.3 ²⁰	slEDH; i eh
225	Barium bromate monohydrate	Ba(BrO ₃) ₂ · H ₂ O	10326-26-8	411.147	wh monocry	260	dec		3.99	0.831 ²⁵	i EDH
226	Barium bromide	BaBr ₂	10553-31-8	297.135	wh orth cry	857		1835	4.781	100 ²⁵	
227	Barium bromide dihydrate	BaBr ₂ · 2H ₂ O	7791-28-8	333.166	wh cry	75	dec		3.7	100 ²⁵	s MeOH; i EDH, ace, diox
228	Barium carbide	BaC ₂	50813-65-5	161.348	gray bt cry		dec		3.74		react H ₂ O
229	Barium carbonate	BaCO ₃	513-77-9	197.336	wh orth cry	1555			4.2865	0.0014 ²⁰	s acid

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
230	Barium chbrat	Ba(CD ₃) ₂	13477-00-4	304.228	wh cry	414			37.9 ²⁵	slEDH, ace
231	Barium chbrat monohydrat	Ba(CD ₃) ₂ · H ₂ O	10294-38-9	322.244	wh monocry	120 dec		3.179	37.9 ²⁵	s acid; slEDH, ace
232	Barium chbride	BaCl ₂	10361-37-2	208.232	wh orth cry; hyg	962	1560	3.9	37.0 ²⁵	
233	Barium chbride dihydrat	BaCl ₂ · 2H ₂ O	10326-27-9	244.263	wh monocry	≈120 dec		3.097	37.0 ²⁵	i EDH
234	Barium chromat(V)	Ba ₃ (CrO ₄) ₂	12345-14-1	643.968	grn-bk hex cry			5.25		s H ₂ O
235	Barium chromat(VI)	BaCrO ₄	10294-40-3	253.321	yelorth cry	1380		4.50	0.00026 ²⁰	reac acid
236	Barium citat monohydrat	Ba ₃ (C ₆ H ₅ O ₇) ₂ · H ₂ O	512-25-4*	808.195	gray-wh cry					s H ₂ O, acid
237	Barium copper ytium oxide	BaCuY ₂ O ₅	82642-06-6	458.682	grn cry; notsuperconductor					
238	Barium copper ytium oxide	Ba ₂ Cu ₃ YO ₇	109064-29-1	666.194	bk solid; HT superconductor					
239	Barium copper ytium oxide	Ba ₂ Cu ₄ YO ₈	114104-80-2	745.739	HT superconductor					
240	Barium copper ytium oxide	Ba ₃ Cu ₇ Y ₂ O ₁₅	124365-83-9	1411.933	HT superconductor					
241	Barium cyanide	Ba(CN) ₂	542-62-1	189.361	wh cry powder					vs H ₂ O; s EDH
242	Barium dichromat dihydrat	BaCr ₂ O ₇ · 2H ₂ O	10031-16-0	389.346	brn-red needls	dec				reac H ₂ O
243	Barium dithionat dihydrat	BaS ₂ O ₆ · 2H ₂ O	13845-17-5	333.486	wh cry	140 dec		4.54	22.1 ²⁰	slEDH
244	Barium ferrocyanide hexahydrat	Ba ₂ Fe(CN) ₆ · 6H ₂ O	13821-06-2*	594.694	yelmonocry	80 dec				i H ₂ O, EDH
245	Barium fluoride	BaF ₂	7787-32-8	175.324	wh cub cry	1368	2260	4.893	0.161 ²⁵	
246	Barium formate	Ba(CHO ₂) ₂	541-43-5	227.362	cry			3.21		s H ₂ O; i EDH
247	Barium hexaboride	BaB ₆	12046-08-1	202.193	bk cub cry	2070		4.36		i H ₂ O; s acid; i EDH
248	Barium hexafluorosilicat	BaSiF ₆	17125-80-3	279.403	wh orth needls	300 dec		4.29		i H ₂ O, EDH; slacid
249	Barium hydride	BaH ₂	13477-09-3	139.343	gray orth cry	1200		4.16		reac H ₂ O
250	Barium hydrogen phosphat	BaHPO ₄	10048-98-3	233.306	wh cry powder	400 dec		4.16	0.015 ²⁰	s dilacid
251	Barium hydrosulfide	Ba(HS) ₂	25417-81-6	203.475	yelhyg cry					s H ₂ O
252	Barium hydrosulfide tetrahydrat	Ba(HS) ₂ · 4H ₂ O	12230-74-9	275.536	yelrhomb cry	50 dec				s H ₂ O
253	Barium hydroxide	Ba(OH) ₂	17194-00-2	171.342	wh powder	408			4.91 ²⁵	
254	Barium hydroxide monohydrat	Ba(OH) ₂ · H ₂ O	22326-55-2	189.357	wh powder			3.743	4.91 ²⁵	s acid
255	Barium hydroxide octahydrat	Ba(OH) ₂ · 8H ₂ O	12230-71-6	315.464	wh monocry	78 dec		2.18	4.91 ²⁵	
256	Barium hypophosphite monohydrat	Ba(H ₂ PO ₂) ₂ · H ₂ O	14871-79-5*	285.320	monocpabts			2.90		s H ₂ O; i EDH
257	Barium iodat	Ba(IO ₃) ₂	10567-69-8	487.132	wh cry powder	476 dec		5.23	0.0396 ²⁵	
258	Barium iodat monohydrat	Ba(IO ₃) ₂ · H ₂ O	7787-34-0	505.148	cry	130 dec		5.00	0.0396 ²⁵	s acid; i EDH
259	Barium iodide	BaI ₂	13718-50-8	391.136	wh orth cry	711		5.15	221 ²⁵	
260	Barium iodide dihydrat	BaI ₂ · 2H ₂ O	7787-33-9	427.167	colcry	740 dec		5.0	221 ²⁵	s EDH, ace
261	Barium manganat(VI)	BaMnO ₄	7787-35-1	256.263	grn-gray hyg cry			4.85	0.00041 ²⁰	
262	Barium metaborat monohydrat	Ba(BO ₂) ₂ · H ₂ O	26124-86-7	240.962	wh powder	>900		3.3		slH ₂ O
263	Barium molybdatt	BaMoO ₄	7787-37-3	297.27	wh powder	1450		4.975	0.0021 ²⁰	
264	Barium niobat	Ba(NbO ₃) ₂	12009-14-2	419.136	yelorth cry	1455		5.44		i H ₂ O
265	Barium nitat	Ba(NO ₃) ₂	10022-31-8	261.336	wh cub cry	590		3.24	10.3 ²⁵	slEDH, ace
266	Barium nitide	Ba ₃ N ₂	12047-79-9	439.994	yelbrn cry	>500 dec		4.78		reac H ₂ O
267	Barium nitrite	Ba(NO ₂) ₂	13465-94-6	229.338	colhex cry	267		3.234	79.5 ²⁵	
268	Barium nitrite monohydrat	Ba(NO ₂) ₂ · H ₂ O	7787-38-4	247.353	yelwh hex cry	217 dec		3.18	79.5 ²⁵	i EDH
269	Barium oxat	BaC ₂ O ₄	516-02-9	225.346	wh powder	400 dec		2.658	0.0075	
270	Barium oxat monohydrat	BaC ₂ O ₄ · H ₂ O	13463-22-4	243.361	wh cry powder			2.66	0.0075 ²⁰	s acid
271	Barium oxide	BaO	1304-28-5	153.326	wh-yelpowder; cub and hex	1972		5.72(cub)	1.5 ²⁰	s dilacid, EDH; i ace
272	Barium perchbrat	Ba(CD ₄) ₂	13465-95-7	336.227	colhex cry	505		3.20	312 ²⁵	vs EDH
273	Barium perchbrat trihydrat	Ba(CD ₄) ₂ · 3H ₂ O	10294-39-0	390.273	colcry			2.74	312 ²⁵	s MeOH; slEDH, ace; i et
274	Barium permanganat	Ba(MnO ₄) ₂	7787-36-2	375.198	brn-violcry	200 dec		3.77	62.5 ²⁰	reac EDH

275	Barium peroxide	BaO ₂	1304-29-6	169.326	gray-wh et cry	450 dec	4.96	0.091 ²⁰	reac dilacid
276	Barium metaphosphat	Ba(PO ₃) ₂	13466-20-1	295.271	wh powder	1560			i H ₂ O; slacid
277	Barium potassium chromat	BaK ₂ (CrO ₄) ₂	27133-66-0	447.511	yelhex cry		3.63		vs H ₂ O
278	Barium pyrophosphat	Ba ₂ P ₂ O ₇	13466-21-2	448.597	wh powder	1430	3.9	0.0088 ²⁰	s acid
279	Barium selenat	BaSeO ₄	7787-41-9	280.29	wh rhomb cry	dec	4.75	0.015 ²⁰	
280	Barium selenide	BaSe	1304-39-8	216.29	cub cry powder	1780	5.02		reac H ₂ O
281	Barium selenit	BaSeO ₃	13718-59-7	264.29	sold				i H ₂ O
282	Barium disilicat	BaSi ₂ O ₅	12650-28-1	273.495	wh orth cry	1420	3.70		
283	Barium measilicat	BaSiO ₃	13255-26-0	213.411	colrhomb powder	1605	4.40		i H ₂ O; s acid
284	Barium silicide	BaSi ₂	1304-40-1	193.498	gray lumps	1180			reac H ₂ O
285	Barium sodium niobat	Ba ₂ Na(NbO ₃) ₅	12323-03-4	1002.167	wh orth cry	1437	5.40		i H ₂ O
286	Barium stannat	BaSnO ₃	12009-18-6	304.035	cub cry		7.24		slH ₂ O
287	Barium stannat tetrahydrat	BaSnO ₃ · 3H ₂ O	12009-18-6*	358.081	wh cry powder				slH ₂ O; s acid
288	Barium stearat	Ba(C ₁₈ H ₃₅ O ₂) ₂	6865-35-6	704.266	wh powder	160	1.145		i H ₂ O, EDH
289	Barium sulfat	BaSO ₄	7727-43-7	233.391	wh orth cry	1580	4.49	0.00031 ²⁰	i EDH
290	Barium sulfid	BaS	21109-95-5	169.393	colcub cry or gray powder	2229	4.3	8.94 ²⁵	
291	Barium sulfid	BaSO ₃	7787-39-5	217.391	wh monocry	dec	4.44	0.0011 ²⁵	i EDH
292	Barium tartat	BaC ₄ H ₄ O ₆	5908-81-6	285.398	wh cry		2.98		s H ₂ O; i EDH
293	Barium tetacyanoplatinat(II) tetrahydrat	BaPt(CN) ₄ · 4H ₂ O	13755-32-3	508.54	yelpowder or cry		2.076		slH ₂ O; i EDH
294	Barium tetaiodomercurat(II)	BaHgI ₄	10048-99-4	845.54	yehred hyg cry				vs H ₂ O, EDH
295	Barium thiocyanat	Ba(SCN) ₂	2092-17-3	253.493	hyg cry			167 ²⁵	s ace, MeOH, EDH
296	Barium thiocyanat dihydrat	Ba(SCN) ₂ · 2H ₂ O	2092-17-3*	289.524	hyg wh cry			167 ²⁵	s EDH
297	Barium thiocyanat tetrahydrat	Ba(SCN) ₂ · 3H ₂ O	68016-36-4	307.539	wh needbs; hyg		2.286	167 ²⁵	s EDH
298	Barium tiosulfat	BaS ₂ O ₃	35112-53-9	249.457	wh cry powder	220 dec		0.2 ²⁰	i EDH
299	Barium tiosulfat monohydrat	BaS ₂ O ₃ · H ₂ O	7787-40-8	267.473	wh cry powder	dec	3.5	0.2	i EDH
300	Barium titanat	BaTiO ₃	12047-27-7	233.192	wh et cry	1625	6.02		i H ₂ O
301	Barium tungstat	BaWO ₄	7787-42-0	385.17	wh et cry	1475	1730	5.04	0.0016 ²⁰
302	Barium uranium oxide	BaU ₂ O ₇	10380-31-1	725.381	oran-yelpowder				i H ₂ O; s acid
303	Barium orthovanadat	Ba ₃ (VO ₄) ₂	39416-30-3	641.859	hex cry	707	5.14		
304	Barium zirconat	BaZrO ₃	12009-21-1	276.549	gray-wh cub cry	2500	5.52		i H ₂ O, ak; slacid
305	Berkelium (α form)	Bk	7440-40-6	247	hex	1050	14.78		
306	Berkelium (β form)	Bk	7440-40-6	247	cub cry	986	13.25		
307	Beryllium	Be	7440-41-7	9.012	hex	1287	2471	1.85	s acid, ak
308	Beryllium acetat	Be(C ₂ H ₃ O ₂) ₂	543-81-7	127.101	wh cry	60 dec			i H ₂ O, EDH
309	Beryllium 2,4-pentanedioat	Be(CH ₃ COCHCOCH ₃) ₂	10210-64-7	207.228	monocry powder	108	270	1.168	i H ₂ O; vs EDH, eh
310	Beryllium aluminat	BeAl ₂ O ₄	12004-06-7	126.973	orth cry			3.65	
311	Beryllium aluminum measilicat	Be ₃ Al ₂ (SiO ₃) ₆	1302-52-9	537.502	color grn-yelcry; hex			2.64	
312	Beryllium basic acetat	Be ₄ O(C ₂ H ₃ O ₂) ₆	1332-52-1	406.312	wh cry	285	330	1.25	i H ₂ O; s eh, os
313	Beryllium boride	BeB ₂	12228-40-9	30.634	ref rac sold	>1970			
314	Beryllium borohydride	Be(BH ₄) ₂	17440-85-6	36.682	sold	125 dec	subl		reac H ₂ O
315	Beryllium bromide	BeBr ₂	7787-46-4	168.820	orth cry; hyg	508	520	3.465	vs H ₂ O; s EDH, pyr
316	Beryllium carbide	Be ₂ C	506-66-1	30.035	red cub cry	>2100 dec		1.90	reac H ₂ O
317	Beryllium carbonat tetrahydrat	BeCO ₃ · 4H ₂ O	60883-64-9	93.085	wh sold	100 dec		0.36 ⁹	
318	Beryllium carbonat, basic	Be ₃ (OH) ₂ (CO ₃) ₂	66104-24-3	181.069	wh pow				i H ₂ O; s acid, ak
319	Beryllium chbride	BeCl ₂	7787-47-5	79.917	wh-yelorth cry; hyg	415	482	1.90	71.5 ²⁵
320	Beryllium fluoride	BeF ₂	7787-49-7	47.009	et cry or gl hyg	552	1169	2.1	vs H ₂ O; slEDH
321	Beryllium formiat	Be(CHO ₂) ₂	1111-71-3	99.047	powder	>250 dec			reac H ₂ O; i os
322	Beryllium hydride	BeH ₂	7787-52-2	11.028	wh amorp sold	250 dec		0.65	reac H ₂ O; i eh, bl

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
323	Beryllium hydrogen phosphatē	BeHPO ₄	13598-15-7	104.991	cry					i H ₂ O
324	Beryllium hydroxide	Be(OH) ₂	13327-32-7	43.027	wh powder or cry	≈200 dec		1.92		sl H ₂ O, ak; s acid
325	Beryllium iodide	BeI ₂	7787-53-3	262.821	hyg needles	470	487	4.32		reac H ₂ O; s EDH
326	Beryllium nitatē trihydratē	Be(NO ₃) ₂ · 3H ₂ O	13597-99-4	187.068	yelwh hyg cry	≈30	dec		107 ²⁰	s EDH
327	Beryllium nitide	Be ₃ N ₂	1304-54-7	55.050	gray ref rac cry; cub	2200		2.71		reac acid, ak
328	Beryllium oxide	BeO	1304-56-9	25.011	wh hex cry	2577		3.01		i H ₂ O; slacid, ak
329	Beryllium perchbratē tetahydratē	Be(CO ₃) ₂ · 4H ₂ O	7787-48-6	279.974	hyg cry	250 dec			198 ²⁵	
330	Beryllium sēbnatē tetahydratē	BeSeO ₄ · 4H ₂ O	10039-31-3	224.03	orb cry	100 dec		2.03		vs H ₂ O
331	Beryllium sulfatē	BeSO ₄	13510-49-1	105.076	coltē cry; hyg	1127		2.5	41.3 ²⁵	
332	Beryllium sulfatē tetahydratē	BeSO ₄ · 4H ₂ O	7787-56-6	177.137	coltē cry	≈100 dec		1.71	41.3 ²⁵	i EDH
333	Beryllium sulfide	BeS	13598-22-6	41.078	colcub cry	dec		2.36		reac hotH ₂ O
334	Bismuh	Bi	7440-69-9	208.980	gray-wh sof metal	271.40	1564	9.79		s acid
335	Bismuh arsenatē	BiAsO ₄	13702-38-0	347.900	wh mono cry			7.14		i H ₂ O; slconc HNO ₃
336	Bismuh basic carbonatē	(BiO) ₂ CO ₃	5892-10-4	509.969	wh powder			6.86		i H ₂ O; s acid
337	Bismuh tribromide	BiBr ₃	7787-58-8	448.692	yelcub cry	218	453	5.72		reac H ₂ O; s dilacid, ace; i EDH
338	Bismuh tichbride	BiCl ₃	7787-60-2	315.338	yelwh cub cry; hyg	230	447	4.75		reac H ₂ O; s acid, EDH, ace
339	Bismuh citatē	BiC ₆ H ₅ O ₇	813-93-4	398.080	wh powder			3.458		i H ₂ O; slEDH
340	Bismuh trifluoride	BiF ₃	7787-61-3	265.975	wh-gray cub cry	725	900	8.3		i H ₂ O
341	Bismuh pēntē fluoride	BiF ₅	7787-62-4	303.972	wh tē needles; hyg	154	230	5.55		reac H ₂ O
342	Bismuh hydride	BiH ₃	18288-22-7	212.004	colgas; unstable	-67	≈17	8.665 g/L		
343	Bismuh hydroxide	Bi(OH) ₃	10361-43-0	260.002	wh-yelamorp powder			4.962		i H ₂ O; s acid
344	Bismuh triiodide	BiI ₃	7787-64-6	589.693	bk hex cry	408.6	542	5.778	0.00078 ²⁰	s EDH
345	Bismuh hexafluoro-2,4-pentanedioatē	Bi(CF ₃ COCHCOCF ₃) ₂		830.132	pow	96				
346	Bismuh molybdatē	Bi ₂ (MoO ₄) ₃	51898-99-8	897.77	monocry			5.95		
347	Bismuh nitatē pentahydratē	Bi(NO ₃) ₃ · 5H ₂ O	10035-06-0	485.071	coltlicry; hyg	≈75 dec		2.83		reac H ₂ O; s ace; i EDH
348	Bismuh oxatē	Bi(C ₁₀ H ₁₅ O ₂) ₃	52951-38-9	1053.340	sof tye+brn sold					i H ₂ O; s et; slbz
349	Bismuh oxatē	Bi ₂ (C ₂ O ₄) ₃	6591-55-5	682.018	wh powder					i H ₂ O, EDH; s dilacid
350	Bismuh oxide	Bi ₂ O ₃	1304-76-3	465.959	yelmonocry or powder	817	1890	8.9		i H ₂ O; s acid
351	Bismuh oxybromide	BiOBr	7787-57-7	304.883	coltē cry			8.08		i H ₂ O, EDH; s acid
352	Bismuh oxychloride	BiOCl	7787-59-9	260.432	wh tē cry			7.72		i H ₂ O
353	Bismuh oxyiodide	BiOI	7787-63-5	351.883	red tē cry	>300 dec		7.92		i H ₂ O, EDH, chl s HCl
354	Bismuh oxynitatē	BiONO ₃	10361-46-3	286.985	wh powder	260 dec		4.93		i H ₂ O, EDH; s acid
355	Bismuh phosphatē	BiPO ₄	10049-01-1	303.951	monocry			6.32		slH ₂ O, dilacid; i EDH
356	Bismuh potassium iodide	K ₂ BiI ₇	41944-01-8	1253.704	red cry					reac H ₂ O; s ak iodide soh
357	Bismuh sēbnide	Bi ₂ Se ₃	12068-69-8	654.84	bk hex cry	710 dec		7.5		i H ₂ O
358	Bismuh sēbnatē pentahydratē	Bi ₂ (SnO ₃) ₃ · 5H ₂ O	12777-45-6	1008.162	wh cry					i H ₂ O
359	Bismuh subnitatē	Bi ₂ O(OH) ₃ (NO ₃) ₄	1304-85-4	1461.987	hyg cry pow	260 dec		4.928		i H ₂ O, EDH; s dilacid
360	Bismuh sulfatē	Bi ₂ (SO ₄) ₃	7787-68-0	706.152	wh needles or powder	405 dec		5.08		reac H ₂ O, EDH
361	Bismuh sulfide	Bi ₂ S ₃	1345-07-9	514.159	bk-brn orb cry	850		6.78		i H ₂ O; s acid
362	Bismuh teluride	Bi ₂ Te ₃	1304-82-1	800.76	gray hex plāts	580		7.74		i H ₂ O; s EDH
363	Bismuh tetroxide	Bi ₂ O ₄	12048-50-9	481.959	red-oran powder	305		5.6		reac H ₂ O
364	Bismuh titanatē	Bi ₂ (TiO ₄) ₃	12048-51-0	1171.516	wh orb cry			7.85		
365	Bismuh tungstatē	Bi ₂ (WO ₄) ₃	13595-87-4	1161.47	wh pow					
366	Bismuh vanadatē	BiVO ₄	14059-33-7	323.920	orb cry	tans 500		6.25		i H ₂ O; s acid
367	Boron	B	7440-42-8	10.811	bk rhomb cry	2075	4000	2.34		i H ₂ O

368	Diborane	B ₂ H ₆	19287-45-7	27.670	colgas; f am	-165.5	-92.4	1.131 g/L		reac H ₂ O
369	Tetaborane(10)	B ₄ H ₁₀	18283-93-7	53.323	colgas	-121	18	2.180 g/L		reac H ₂ O
370	Pentaborane(9)	B ₅ H ₉	19624-22-7	63.126	f am lq	-46.6	60	0.60		reac hotH ₂ O
371	Pentaborane(11)	B ₅ H ₁₁	18433-84-6	65.142	collq; unsabbe	-122	65			reac H ₂ O
372	Hexaborane(10)	B ₆ H ₁₀	23777-80-2	74.945	collq	-62.3	108 dec	0.67		reac hotH ₂ O
373	Hexaborane(12)	B ₆ H ₁₂	12008-19-4	76.961	collq; unsabbe	-82.3	≈80			reac H ₂ O
374	Nonaborane(15)	B ₉ H ₁₅	19465-30-6	112.418	collq	2.6				
375	Decaborane(14)	B ₁₀ H ₁₄	17702-41-9	122.221	wh orth cry	99.6	≈213	0.94		slH ₂ O; s EDH, bz, CS ₂ , ct
376	Borane carbonyl	BH ₃ CO	13205-44-2	41.845	colgas	-137	-64	1.710 g/L		reac H ₂ O
377	Borazine	B ₃ N ₃ H ₆	6569-51-3	80.501	collq	-58	53	0.824		reac H ₂ O
378	Boric acid (orthoboric acid)	H ₃ BO ₃	10043-35-3	61.833	coltictcry	170.9		1.5	5.80 ²⁵	slEDH
379	Metaboric acid (α form)	HBO ₂	13460-50-9	43.818	colorth cry; hyg	176		1.784		s H ₂ O
380	Metaboric acid (β form)	HBO ₂	13460-50-9	43.818	colmonoclcry; hyg	201		2.045		s H ₂ O
381	Metaboric acid (γ form)	HBO ₂	13460-50-9	43.818	colcub cry	236		2.487		s H ₂ O
382	Tetrafluoroboric acid	BF ₄	16872-11-0	87.813	collq		130 dec	≈1.8		vs H ₂ O, EOH
383	Boron arsenide	BA _s	12005-69-5	85.733	cub cry		920 dec	5.22		
384	Boron tribromide	BBr ₃	10294-33-4	250.523	collq; hyg	-45	91	2.6		reac H ₂ O, EDH
385	Boron carbide	B ₄ C	12069-32-8	55.255	hard bk cry	2350	>3500	2.50		i H ₂ O, acid
386	Boron trichloride	BCl ₃	10294-34-5	117.169	collq or gas	-107	12.65	4.789 g/L		reac H ₂ O, EDH
387	Tetrachlorodiborane	B ₂ Cl ₄	13701-67-2	163.433	collq; f am	-92.6	65			reac H ₂ O
388	Boron trifluoride	BF ₃	7637-07-2	67.806	colgas	-126.8	-101	2.772 g/L		s H ₂ O
389	Tetrafluorodiborane	B ₂ F ₄	13965-73-6	97.616	colgas; f am	-56	-34	3.990 g/L		reac H ₂ O
390	Boron triiodide	BI ₃	13517-10-7	391.524	wh needles	49.7	209.5	3.35		i H ₂ O
391	Boron nitride	BN	10043-11-5	24.818	wh powder; hex or cub cry	2966		2.18		i H ₂ O, acid
392	Boron oxide	B ₂ O ₃	1303-86-2	69.620	colglor hex cry; hyg	450		2.55	2.2 ²⁰	s EDH
393	Boron phosphide	BP	20205-91-8	41.785	red cub cry or powder		1125 dec			reac H ₂ O, acid
394	Boron sulfide	B ₂ S ₃	12007-33-9	117.820	yelamorp sold		sof fns ≈320	≈1.7		
395	Bromine	Br ₂	7726-95-6	159.808	red lq	-7.2	58.8	3.1028		slH ₂ O
396	Bromic acid	HBrO ₃	7789-31-3	128.910	sabbe only in aq soh					s H ₂ O
397	Bromine oxide	Br ₂ O	21308-80-5	175.807	brn sold	-17.5 dec				
398	Bromine dioxide	BrO ₂	21255-83-4	111.903	unsabbe yelcry	≈0 dec				
399	Bromine azide	BrN ₃	13973-87-0	121.924	red cry; exp	≈45	exp			
400	Bromine chloride	BrCl	13863-41-7	115.357	unsabbe red-brn gas	≈-66	≈5 dec	4.715 g/L		reac H ₂ O; s eth, CS ₂
401	Bromine fluoride	BrF	13863-59-7	98.902	unsabbe red-brn gas	≈-33	≈20 dec	4.043 g/L		
402	Bromine trifluoride	BrF ₃	7787-71-5	136.899	colhyg lq	8.77	125.8	2.803		reac H ₂ O
403	Bromine pentafluoride	BrF ₅	7789-30-2	174.896	collq	-60.5	40.76	2.460		reac H ₂ O (exp)
404	Bromyl fluoride	BrO ₂ F	22585-64-4	130.901	collq	-9	50 dec			reac H ₂ O
405	Cadmium	Cd	7440-43-9	112.411	silv-wh metal	321.07		767	8.69	i H ₂ O; reac acid
406	Cadmium acetate	Cd(C ₂ H ₃ O ₂) ₂	543-90-8	230.500	colcry	255		2.34		s H ₂ O, EDH
407	Cadmium acetate dihydrate	Cd(C ₂ H ₃ O ₂) ₂ · 2H ₂ O	5743-04-4	266.529	wh cry	130 dec		2.01		vs H ₂ O; s EDH
408	Cadmium antimonide	CdSb	12014-29-8	234.171	orth cry	456		6.92		
409	Cadmium arsenide	Cd ₃ As ₂	12006-15-4	487.076	gray bt cry	721		6.25		
410	Cadmium azide	Cd(N ₃) ₂	14215-29-3	196.451	yel-wh orth cry; exp	exp		3.24		
411	Cadmium bromide	CdBr ₂	7789-42-6	272.219	wh hex powder or flakes; hyg	568	844	5.19	115 ²⁵	slace, eth
412	Cadmium bromide tetrahydrate	CdBr ₂ · 4H ₂ O	13464-92-1	344.281	wh-yelcry				115 ²⁵	s ace, EDH
413	Cadmium carbonate	CdCO ₃	513-78-0	172.420	wh hex cry	500 dec		4.258		i H ₂ O; s acid
414	Cadmium chloride dihydrate	Cd(CO ₃) ₂ · 2H ₂ O	22750-54-5*	315.343	colhyg cry	80 dec		2.28	2.64 ⁰	
415	Cadmium chloride	CdCl ₂	10108-64-2	183.316	rhombr cry; hyg	564	960	4.08	120 ²⁵	s ace; slEDH; i eth

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
416	Cadmium chloride hemipentahydrate	CdCl ₂ · 2.5H ₂ O	7790-78-5	228.354	wh rhomb tablets			3.327	120 ²⁵	s ace
417	Cadmium chloride monohydrate	CdCl ₂ · H ₂ O	34330-64-8	201.331	wh cry				120 ²⁵	
418	Cadmium chromate	CdCrO ₄	14312-00-6	228.405	yellow cry			4.5		i H ₂ O
419	Cadmium cyanide	Cd(CN) ₂	542-83-6	164.445	wh cub cry			2.23	1.7 ¹⁵	
420	Cadmium 2-ethylhexanoate	Cd(C ₈ H ₁₅ O ₂) ₂	2420-98-6	398.818	pow					
421	Cadmium fluoride	CdF ₂	7790-79-6	150.408	cub cry	1110	1748	6.33	4.36 ²⁵	s acid; i EDH
422	Cadmium hydroxide	Cd(OH) ₂	21041-95-2	146.426	wh tig or hex cry	130 dec		4.79	0.00015 ²⁰	s dilacid
423	Cadmium iodate	Cd(IO ₃) ₂	7790-81-0	462.216	wh powder			6.48	0.091 ²⁵	s HNO ₃
424	Cadmium iodide	CdI ₂	7790-80-9	366.220	hex flakes	387	742	5.64	86.2 ²⁵	s EDH, et, ace
425	Cadmium metasilicate	CdSiO ₃	13477-19-5	188.495	grn monocry	1252		5.10		
426	Cadmium molybdate	CdMoO ₄	13972-68-4	272.35	collet cry	≈900 dec		5.4		i H ₂ O; s acid
427	Cadmium niobate	Cd ₂ Nb ₂ O ₇	12187-14-3	522.631	cub cry	≈1410		6.28		i H ₂ O
428	Cadmium nitrate	Cd(NO ₃) ₂	10325-94-7	236.420	wh cub cry; hyg	350		3.6	156 ²⁵	s EDH
429	Cadmium nitrate tetrahydrate	Cd(NO ₃) ₂ · 4H ₂ O	10022-68-1	308.482	colorh cry; hyg	59.5		2.45	156 ²⁵	s EDH, ace
430	Cadmium oxalate	CdC ₂ O ₄	814-88-0	200.430	wh sold			3.32	0.0060 ²⁵	
431	Cadmium oxalate trihydrate	CdC ₂ O ₄ · 3H ₂ O	20712-42-9	254.476	wh amorp powder	340 dec			0.0060 ²⁵	i EDH; s dilacid
432	Cadmium oxide	CdO	1306-19-0	128.410	brn cub cry		1559 sp	8.15		i H ₂ O; s dilacid
433	Cadmium perchlorate hexahydrate	Cd(ClO ₄) ₂ · 6H ₂ O	10326-28-0	419.403	wh hex cry			2.37	191.5 ²⁵	
434	Cadmium phosphate	Cd ₃ (PO ₄) ₂	13477-17-3	527.176	pow	≈1500				i H ₂ O
435	Cadmium phosphide	Cd ₃ P ₂	12014-28-7	399.181	gr bt needles	700		5.96		s dilHCl
436	Cadmium selenate dihydrate	CdSeO ₄ · 2H ₂ O	10060-09-0	291.40	orth cry	100 dec		3.62	70.5 ²⁵	
437	Cadmium selenide	CdSe	1306-24-7	191.37	wh cub cry	1240		5.81		i H ₂ O
438	Cadmium sulfate	CdSO ₄	10124-36-4	208.475	colorh cry	1000		4.69	76.7 ²⁵	i EDH
439	Cadmium sulfate monohydrate	CdSO ₄ · H ₂ O	7790-84-3	226.490	monocry	105		3.79	76.7 ²⁵	
440	Cadmium sulfate octahydrate	CdSO ₄ · 8H ₂ O	15244-35-6	352.597	col monocry	40 dec		3.08	76.7 ²⁵	
441	Cadmium sulfide	CdS	1306-23-6	144.477	yellow cub cry	1750		4.83		i H ₂ O; s acid
442	Cadmium telluride	CdTe	1306-25-8	240.01	brn-bk cub cry	1042		6.2		i H ₂ O, dilacid
443	Cadmium tetrafluoroborate	Cd(BF ₄) ₂	14486-19-2	286.020	cohyg liq			1.6		vs H ₂ O, EDH
444	Cadmium titanate	CdTiO ₃	12014-14-1	208.276	orth cry			6.5		
445	Cadmium tungstate	CdWO ₄	7790-85-4	360.25	wh monocry			8.0		i H ₂ O, acid; s NH ₄ OH
446	Calcium	Ca	7440-70-2	40.078	silv-wh metl	842	1484	1.54		reac H ₂ O; i bz
447	Calcium acetate	Ca(C ₂ H ₃ O ₂) ₂	62-54-4	158.167	wh hyg cry	160 dec		1.50		s H ₂ O; slEDH
448	Calcium acetate monohydrate	Ca(C ₂ H ₃ O ₂) ₂ · H ₂ O	5743-26-0	176.182	wh needles or powder	≈150 dec				s H ₂ O; slEDH
449	Calcium aluminate	CaAl ₂ O ₄	12042-68-1	158.039	wh monocry	1605		2.98		reac H ₂ O
450	Calcium aluminate (β form)	Ca ₃ Al ₂ O ₆	12042-78-3	270.193	wh cub cry; ref r	1535		3.04		i H ₂ O
451	Calcium arsenate	Ca ₃ (AsO ₄) ₂	7778-44-1	398.072	wh powder	dec		3.6	0.0036 ²⁰	s dilacid
452	Calcium arsenite	CaAsO ₃	52740-16-6	162.998	wh pow					slH ₂ O; s acid
453	Calcium boride	CaB ₆	12007-99-7	104.944	ref rac sold	2235		2.49		
454	Calcium bromide	CaBr ₂	7789-41-5	199.886	rhomb cry; hyg	742	1815	3.38	156 ²⁵	s EDH, ace
455	Calcium bromide hexahydrate	CaBr ₂ · 6H ₂ O	13477-28-6	307.977	wh hyg powder	38 dec		2.29	156 ²⁵	
456	Calcium carbide	CaC ₂	75-20-7	64.099	gray-bk orth cry	2300		2.22		reac H ₂ O
457	Calcium carbonate (aragonite)	CaCO ₃	471-34-1	100.087	wh orth cry or powder	825 dec		2.83	0.00066 ²⁰	s dilacid
458	Calcium carbonate (calcite)	CaCO ₃	471-34-1	100.087	wh hex cry or powder	1330		2.71	0.00066 ²⁰	s dilacid
459	Calcium chloride	Ca(ClO ₃) ₂	10137-74-3	206.979	wh cry	340			197 ²⁵	
460	Calcium chloride dihydrate	Ca(ClO ₃) ₂ · 2H ₂ O	10035-05-9	243.010	wh monocry; hyg	100 dec		2.711	197 ²⁵	s EDH

461	Cabium chbride	CaCl ₂	10043-52-4	110.983	wh cub cry or powder; hyg	775	1935.5	2.15	81.3 ²⁵	vs EOH
462	Cabium chbride dihydrat	CaCl ₂ · 2H ₂ O	10035-04-8	147.014	hyg f lkes or powder	175 dec		1.85	81.3 ²⁵	vs EOH
463	Cabium chbride hexahydrat	CaCl ₂ · 6H ₂ O	7774-34-7	219.074	wh hex cry; hyg	30 dec		1.71	81.3 ²⁵	
464	Cabium chbride monohydrat	CaCl ₂ · H ₂ O	13477-29-7	128.998	wh hyg cry	260 dec		2.24	81.3 ²⁵	s EOH
465	Cabium chromat dihydrat	CaCrO ₄ · 2H ₂ O	13765-19-0	192.102	yel/orh cry			2.50	13.2 ²⁰	
466	Cabium cyanamide	CaCN ₂	156-62-7	80.102	colhex cry	≈1340	subl	2.29		reac H ₂ O
467	Cabium cyanide	Ca(CN) ₂	592-01-8	92.112	wh rhomb cry; hyg					s H ₂ O, EOH
468	Cabium dichromat trihydrat	CaCr ₂ O ₇ · 3H ₂ O	14307-33-6*	310.112	red-oran cry	100 dec		2.37		vs H ₂ O; reac EOH; i eh, ct
469	Cabium 2-ethyhexanoat	Ca(C ₆ H ₁₃ O ₂) ₂	136-51-6	326.485	pow					
470	Cabium f lorida	CaF ₂	7789-75-5	78.075	wh cub cry or powder	1418	2533.4	3.18	0.0016 ²⁵	slacid
471	Cabium f ormat	Ca(CHO ₂) ₂	544-17-2	130.113	orh cry	300 dec		2.02	16.6 ²⁰	i EOH
472	Cabium hexaf luro-2,4-pentnedioat	Ca(CF ₃ COCHCOCF ₃) ₂	121012-90-6	454.180	pow	135				
473	Cabium hexaf luorosilicat dihydrat	CaSiF ₆ · 2H ₂ O	16925-39-6	218.185	collet cry			2.25	0.52 ²⁰	i ace; reac hotH ₂ O
474	Cabium hydride	CaH ₂	7789-78-8	42.094	gray orh cry or powder	1000		1.7		reac H ₂ O, EOH
475	Cabium hydrogen fosphat	CaHPO ₄	7757-93-9	136.057	wh ticl cry	dec		2.92	0.02 ²⁵	i EOH
476	Cabium hydrogen fosphat dihydrat	CaHPO ₄ · 2H ₂ O	7789-77-7	172.088	monocry	≈100 dec		2.31	0.02 ²⁵	i EOH; s dilacid
477	Cabium hydroxide	Ca(OH) ₂	1305-62-0	74.093	sof thex cry			≈2.2	0.16 ²⁰	s acid
478	Cabium hypochbrit	Ca(OC) ₂	7778-54-3	142.982	pow	100		2.350		
479	Cabium hypofosphit	Ca(H ₂ PO ₂) ₂	7789-79-9	170.055	wh monocry	300 dec				s H ₂ O; i EOH
480	Cabium iodat	Ca(IO ₃) ₂	7789-80-2	389.883	wh monocry			4.52	0.306 ²⁵	s HNO ₃ ; i EOH
481	Cabium iodide	CaI ₂	10102-68-8	293.887	hyg hex cry	783		3.96	215 ²⁵	s MeOH, EOH, ace; i eh
482	Cabium iodide hexahydrat	CaI ₂ · 6H ₂ O	71626-98-7	401.978	wh hex needes or powder	42 dec		2.55	215 ²⁵	vs EOH
483	Cabium metborat	Ca(BO ₃) ₂	13701-64-9	125.698	pow				0.13 ²⁰	
484	Cabium moybdat	CaMoO ₄	7789-82-4	200.02	wh et cry	965 dec		4.35	0.0011 ²⁰	i EOH; s conc acid
485	Cabium nitat	Ca(NO ₃) ₂	10124-37-5	164.087	wh cub cry; hyg	561		2.5	144 ²⁵	s EOH, MeOH, ace
486	Cabium nitat tetahydrat	Ca(NO ₃) ₂ · 4H ₂ O	13477-34-4	236.149	wh cry	≈40 dec		1.82	144 ²⁵	s EOH, ace
487	Cabium nitide	Ca ₃ N ₂	12013-82-0	148.247	red-brn cub cry	1195		2.67		s H ₂ O, acid; i EOH
488	Cabium nitit	Ca(NO ₂) ₂	13780-06-8	132.089	wh-yelhex cry; hyg			2.23	94.6 ²⁵	slEOH
489	Cabium oxat	CaC ₂ O ₄	563-72-4	128.097	wh cry powder			2.2	0.00061 ²⁰	
490	Cabium oxat monohydrat	CaC ₂ O ₄ · H ₂ O	5794-28-5	146.112	cub cry	200 dec		2.2	0.00061 ²⁰	s dilacid
491	Cabium oxide	CaO	1305-78-8	56.077	gray-wh cub cry	2898		3.34		reac H ₂ O; s acid
492	Cabium oxide silcat	Ca ₃ OSiO ₄	12168-85-3	228.317	ref rac sold	2150				
493	Cabium 2,4-pentnedioat	Ca(CH ₃ COCHCOCCH ₃) ₂	19372-44-2	238.294	cry	175 dec				
494	Cabium perchbrat	Ca(CD ₄) ₂	13477-36-6	238.978	wh cry	270 dec		2.65	188 ²⁵	s EOH
495	Cabium permanganat	Ca(MnO ₄) ₂	10118-76-0	277.949	purp hyg cry			2.4	331 ²⁰	reac EOH
496	Cabium peroxide	CaO ₂	1305-79-9	72.077	wh-yel et cry; hyg	≈200 dec		2.9		slH ₂ O; s acid
497	Cabium fosphat	Ca ₃ (PO ₄) ₂	7758-87-4	310.177	wh amorp powder	1670		3.14	0.00012 ²⁰	i EOH; s dilacid
498	Cabium dihydrogen fosphat monohydrat	Ca(H ₂ PO ₄) ₂ · H ₂ O	10031-30-8	252.068	colticlpbes	100 dec		2.220		slH ₂ O; s dilacid
499	Cabium fosphide	Ca ₃ P ₂	1305-99-3	182.182	red-brn hyg cry	≈1600		2.51		reac H ₂ O; i EOH, eh
500	Cabium propanoat	Ca(C ₃ H ₅ O ₂) ₂	4075-81-4	186.219	mono cry, pow					s H ₂ O; slMeOH, EOH; i ace, bz
501	Cabium pyrofosphat	Ca ₂ P ₂ O ₇	7790-76-3	254.099	wh powder	1353		3.09		i H ₂ O; s dilacid
502	Cabium sebnat dihydrat	CaSeO ₄ · 2H ₂ O	7790-74-1	219.07	wh monocry			2.75	8.3 ¹⁸	
503	Cabium sebnide	CaSe	1305-84-6	119.04	wh-brn cub cry	1400 dec		3.8		reac H ₂ O
504	Cabium metasilicat	CaSiO ₃	1344-95-2	116.162	wh monocry	1540		2.92		i H ₂ O
505	Cabium silcide	CaSi ₂	12013-56-8	96.249	gray hex cry	1040		2.50		i colH ₂ O; reac hotH ₂ O; s acid
506	Cabium silcide	CaSi	12013-55-7	68.164	orh cry	1324		2.39		
507	Cabium sbrat	Ca(C ₁₈ H ₃₆ O ₂) ₂	1592-23-0	607.017	granulr pow	180				i H ₂ O, EOH

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
508	Barium sulfate	CaSO ₄	7778-18-9	136.142	orth cry	1460		2.96	0.205 ²⁴	
509	Barium sulfate dihydrate	CaSO ₄ · 2H ₂ O	10101-41-4	172.172	monocry or powder	150 dec		2.32	0.205 ²⁰	i os
510	Barium sulfate hemihydrate	CaSO ₄ · 0.5H ₂ O	10034-76-1	145.149	wh powder				0.205 ²⁵	
511	Barium sulfide	CaS	20548-54-3	72.144	wh-yel cub cry; hyg	2524		2.59		s H ₂ O; i EOH
512	Barium sulfide dihydrate	CaSO ₃ · 2H ₂ O	10257-55-3	156.173	wh powder				0.0070 ²⁵	s EOH; s acid
513	Barium telluride	CaTe	12013-57-9	167.68	wh cub cry	1600 dec		4.87		
514	Barium tetrahydroaluminate	Ca(AH ₄) ₂	16941-10-9	102.105	gray powder; fam					reac H ₂ O; s hf; i eh, bz
515	Barium thiocyanate tetrahydrate	Ca(SCN) ₂ · 4H ₂ O	2092-16-2	228.306	hygr cry	160 dec				vs H ₂ O; s EOH, ace
516	Barium thiosulfate hexahydrate	CaS ₂ O ₃ · 6H ₂ O	10124-41-1	260.300	tlc cry	45 dec		1.87		s H ₂ O; i EOH
517	Barium titanate	CaTiO ₃	12049-50-2	135.943	cub cry	1980		3.98		
518	Barium tungstate	CaWO ₄	7790-75-2	287.92	wh lt cry	1620		6.06	0.2 ¹⁸	s hot acid
519	Barium zirconate	CaZrO ₃	12013-47-7	179.300	pow	2550				
520	Californium	Cf	7440-71-3	251	hex or cub metal	900		15.1		
521	Carbon (diamond)	C	7782-40-3	12.011	col cub cry	4440 (12.4 GPa)		3.513		i H ₂ O
522	Carbon (graphite)	C	7782-42-5	12.011	soft blk hex cry	4489 p (10.3 MPa)	3825 sp	2.2		i H ₂ O
523	Carbon (fubrene-C ₆₀)	C ₆₀	99685-96-8	720.642	yel needles or plates	>280				s os
524	Carbon (fubrene-C ₇₀)	C ₇₀	115383-22-7	840.749	red-brn solid	>280				s bz, bl
525	Carbon fubrene fluoride	C ₆₀ F ₆₀	134929-59-2	1860.546	col plates	287				vs ace; s hf; i chl
526	Carbon monoxide	CO	630-08-0	28.010	col gas	-205.02	-191.5	1.145 g/L		s H ₂ O; s chl EOH
527	Carbon dioxide	CO ₂	124-38-9	44.010	col gas	-56.56 p	-78.4 sp	1.799 g/L		s H ₂ O
528	Carbon diselenide	CSe ₂	506-80-9	169.93	yel liq	-43.7	125.5	2.6626		i H ₂ O; vs ct, bl
529	Carbon disulfide	CS ₂	75-15-0	76.143	color yel liq	-112.1	46	1.2555		i H ₂ O; vs EOH, bz, os
530	Carbon oxyselenide	COSe	1603-84-5	106.97	col gas; unsable	-124.4	-21.7	4.372 g/L		reac H ₂ O
531	Carbon oxysulfide	COS	463-58-1	60.076	col gas	-138.8	-50	2.456 g/L		s H ₂ O, EOH
532	Carbon sulfide selenide	CSSe	5951-19-9	123.04	yel liq	-85	84.5	1.99		i H ₂ O
533	Carbon sulfide telluride	CSTe	10340-06-4	171.68	red-yel liq; unsable	-54	20 dec			reac H ₂ O
534	Carbon suboxide	C ₃ O ₂	504-64-3	68.031	col gas	-111.3	6.8	2.781 g/L		reac H ₂ O
535	Carbon subsulfide	C ₃ S ₂	627-34-9	100.164	red liq	-1	90 dec	1.27		reac H ₂ O
536	Carbonyl bromide	COBr ₂	593-95-3	187.818	col liq		64.5	2.5		reac H ₂ O
537	Carbonyl chloride	COCl ₂	75-44-5	98.915	col gas	-127.78	8	4.043 g/L		s H ₂ O; s bz, bl
538	Carbonyl fluoride	COF ₂	353-50-4	66.007	col gas	-111.26	-84.57	2.698 g/L		reac H ₂ O
539	Cyanogen	C ₂ N ₂	460-19-5	52.034	col gas	-27.83	-21.1	2.127 g/L		s H ₂ O, eh; s EOH
540	Cyanogen bromide	BrCN	506-68-3	105.922	wh hyg needles	52	61.5	2.005		s H ₂ O, EOH, eh
541	Cyanogen chloride	CCN	506-77-4	61.470	col gas	-6.55	13	2.513 g/L		s H ₂ O, EOH, eh
542	Cyanogen fluoride	FCN	1495-50-7	45.016	col gas	-82	-46	1.840 g/L		
543	Cyanogen iodide	ICN	506-78-5	152.922	col needles	146.7		1.84		s H ₂ O, EOH, eh
544	Cerium	Ce	7440-45-1	140.116	silv metal cub or hex	798	3443	6.770		s dil acid
545	Cerium boride	CeB ₆	12008-02-5	204.982	blue ref rac solid; hex	2550		4.87		i H ₂ O, HCl
546	Cerium carbide	CeC ₂	12012-32-7	164.137	red hex cry	2250		5.47		reac H ₂ O
547	Cerium nitride	CeN	25764-08-3	154.123	ref rac cub cry	2557		7.89		
548	Cerium silicide	CeSi ₂	12014-85-6	196.287	et cry	1620		5.31		i H ₂ O
549	Cerium(II) hydride	CeH ₂	13569-50-1	142.132	cub cry			5.45		reac H ₂ O
550	Cerium(II) iodide	CeI ₂	19139-47-0	393.925	bronze cry	808				
551	Cerium(II) sulfide	CeS	12014-82-3	172.182	yel cub cry	2445		5.9		
552	Cerium(III) bromide	CeBr ₃	14457-87-5	379.828	wh hex cry; hyg	733	1457			s H ₂ O

553	Cerium(III) bromide heptahydrate	CeBr ₃ · 7H ₂ O	7789-56-2	505.935	col hyg needles	732				s H ₂ O, EDH
554	Cerium(III) carbide	Ce ₂ C ₃	12115-63-8	316.264	yel brn cub cry	1505		6.9		
555	Cerium(III) carbonate hydrate	Ce ₂ (CO ₃) ₃ · 5H ₂ O	72520-94-6	550.335	wh powder					i H ₂ O; s dil acid
556	Cerium(III) chloride	CeCl ₃	7790-86-5	246.474	wh hex cry	817		3.97		s H ₂ O, EDH
557	Cerium(III) chloride heptahydrate	CeCl ₃ · 7H ₂ O	18618-55-8	372.581	yel orh cry; hyg	90 dec				vs H ₂ O, EDH
558	Cerium(III) fluoride	CeF ₃	7758-88-5	197.111	wh hex cry; hyg	1430		6.157		i H ₂ O
559	Cerium(III) iodide	CeI ₃	7790-87-6	520.829	yel orh cry; hyg	766				s H ₂ O
560	Cerium(III) iodide nonahydrate	CeI ₃ · 9H ₂ O	7790-87-6*	682.967	wh-red cry					vs H ₂ O; s EDH
561	Cerium(III) nitrate hexahydrate	Ce(NO ₃) ₃ · 6H ₂ O	10108-73-3*	434.222	col red cry	150 dec			176 ²⁵	s ace
562	Cerium(III) oxide	Ce ₂ O ₃	1345-13-7	328.230	yel grn cub cry	2210	3730	6.2		i H ₂ O; s acid
563	Cerium(III) sulfate octahydrate	Ce ₂ (SO ₄) ₃ · 8H ₂ O	13454-94-9	712.545	wh orh cry	≈250 dec		2.87		s H ₂ O
564	Cerium(III) sulfide	Ce ₂ S ₃	12014-93-6	376.430	red cub cry	2450		5.02		i H ₂ O
565	Cerium(IV) fluoride	CeF ₄	10060-10-3	216.110	wh hyg powder	≈600 dec		4.77		i H ₂ O
566	Cerium(IV) oxide	CeO ₂	1306-38-3	172.115	wh-yel powder; cub	2400		7.65		i H ₂ O, dil acid
567	Cerium(IV) sulfate tetrahydrate	Ce(SO ₄) ₂ · 4H ₂ O	10294-42-5	404.305	yel oran orh cry	180 dec		3.91	9.66 ²⁰	
568	Cesium	Cs	7440-46-2	132.905	silv-wh metal	28.5	671	1.93		reac H ₂ O
569	Cesium acetate	CsC ₂ H ₃ O ₂	3396-11-0	191.949	hyg lumps	194			10 ¹¹	
570	Cesium amide	CsNH ₂	22205-57-8	148.928	wh et cry			3.70		
571	Cesium azide	CsN ₃	22750-57-8	174.925	hyg et cry; exp	326		≈3.5	22 ⁴⁰	
572	Cesium bromate	CsBrO ₃	13454-75-6	260.807	col hex cry			4.11	3.83 ²⁵	
573	Cesium bromide	CsBr	7787-69-1	212.809	wh cub cry; hyg	636	≈1300	4.43	123 ²⁵	s EDH; i ace
574	Cesium carbonate	Cs ₂ CO ₃	534-17-8	325.820	wh monocry; hyg	792		4.24	261 ¹⁵	s EDH, et
575	Cesium chloride	CsCl	13763-67-2	216.356	col hex cry			3.57	7.78 ²⁵	
576	Cesium chloride	CsCl	7647-17-8	168.358	wh cub cry; hyg	645	1297	3.988	191 ²⁵	s EDH
577	Cesium cyanide	CsCN	21159-32-0	158.923	wh cub cry; hyg	350		3.34		vs H ₂ O
578	Cesium fluoride	CsF	13400-13-0	151.903	wh cub cry; hyg	703		4.64	573 ²⁵	s MeOH; i diox, py
579	Cesium formate	CsCHO ₂	3495-36-1	177.923	wh cry			1.017		vs H ₂ O
580	Cesium hydride	CsH	58724-12-2	133.913	wh cub cry; f am	≈170 dec		3.42		reac H ₂ O
581	Cesium hydrogen carbonate	CsHCO ₃	15519-28-5	193.922	rhom cry	175 dec			209 ¹⁵	s EDH
582	Cesium hydrogen fluoride	CsHF ₂	12280-52-3	171.910	et cry	170		3.86		
583	Cesium hydrogen sulfate	CsHSO ₄	7789-16-4	229.977	col rhom prisms	dec		3.352		s H ₂ O
584	Cesium hydroxide	CsOH	21351-79-1	149.912	wh-yel hyg cry	342.3		3.68	300 ³⁰	s EDH
585	Cesium iodate	CsIO ₃	13454-81-4	307.807	wh mono cry			4.85	2.6 ²⁵	
586	Cesium iodide	CsI	7789-17-5	259.809	col cub cry; hyg	621	≈1280	4.51	84.8 ²⁵	s EDH, MeOH, ace
587	Cesium metaborate	CsBO ₂	92141-86-1	175.715	cub cry	732		≈3.7		
588	Cesium nitrate	CsNO ₃	7789-18-6	194.910	wh hex or cub cry	414		3.66	27.9 ²⁵	s ace; sl EDH
589	Cesium oxide	Cs ₂ O	20281-00-9	281.810	yel oran hex cry	490		4.65		vs H ₂ O
590	Cesium superoxide	CsO ₂	12018-61-0	164.904	yel et cry	432		3.77		reac H ₂ O
591	Cesium perchlorate	CsClO ₄	13454-84-7	232.356	wh orh cry; hyg	250		3.327	2.00 ²⁵	
592	Cesium periodate	CsIO ₄	13478-04-1	323.807	wh rhom prisms			4.26	2.2 ¹⁵	
593	Cesium sulfate	Cs ₂ SO ₄	10294-54-9	361.875	wh orh cry or hex prisms; hyg	1005		4.24	182 ²⁵	i EDH, ace, py
594	Cesium sulfide tetrahydrate	Cs ₂ S · 4H ₂ O	12214-16-3	369.939	wh hyg cry					vs H ₂ O
595	Chlorine	Cl ₂	7782-50-5	70.905	grn-yel gas	-101.5	-34.04	2.898 g/L		sl H ₂ O
596	Hypochlorous acid	HOCl	7790-92-3	52.460	grn-yel sabl only in aq soln					s H ₂ O
597	Perchloric acid	HClO ₄	7601-90-3	100.459	col hyg liq	-112	≈90 dec	1.77		s H ₂ O
598	Chlorine monoxide	Cl ₂ O	7791-21-1	86.904	yel brn gas	-120.6	2.2	3.552 g/L		vs H ₂ O
599	Chlorine dioxide	ClO ₂	10049-04-4	67.452	oran-grn gas	-59	11	2.757 g/L		sl H ₂ O
600	Chlorine trioxide	Cl ₂ O ₃	17496-59-2	118.903	dark brn solid	exp <25				

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
601	Chlorine hexoxide	Cl ₂ O ₆	12442-63-6	166.901	red liq	3.5	≈200			reac H ₂ O
602	Chlorine heptoxide	Cl ₂ O ₇	10294-48-1	182.901	colorliq liq; exp	-91.5	82	1.9		reac H ₂ O
603	Chlorine fluoride	ClF	7790-89-8	54.451	colgas	-155.6	-101.1	2.226 g/L		reac H ₂ O
604	Chlorine trifluoride	ClF ₃	7790-91-2	92.448	gas	-76.34	11.75	3.779 g/L		reac H ₂ O
605	Chlorine trifluoride oxide	ClF ₃ O	30708-80-6	108.447	colliq	-42	29			reac H ₂ O
606	Chlorine pentafluoride	ClF ₅	13637-63-3	130.445	colgas	-103	-13.1	5.332 g/L		
607	Chlorine difluoride	Cl ₂ F ₂	13637-83-7	86.450	colgas	-15	-6	3.534 g/L		reac H ₂ O
608	Chlorine difluoride	Cl ₂ F ₃	38680-84-1	124.447	colgas	-81	-22	5.087 g/L		reac H ₂ O
609	Perchlorine fluoride	Cl ₄ F	7616-94-6	102.449	colgas	-147	-46.75	4.187 g/L		
610	Chlorine perchlorate	ClO ₄ Cl	27218-16-2	134.903	unstable liq	-117	≈25 dec	1.81 ^o		
611	Chromium	Cr	7440-47-3	51.996	blue-wh metal cub	1907	2671	7.15		reac dilacid
612	Chromium antimonide	CrSb	12053-12-2	173.756	hex cry	1110		7.11		
613	Chromium arsenide	Cr ₂ As	12254-85-2	178.914	et cry			7.04		
614	Chromium boride	CrB	12006-79-0	62.807	ref rac orth cry	2100		6.1		
615	Chromium boride	CrB ₂	12007-16-8	73.618	ref rac solid; hex	2200		5.22		
616	Chromium boride	Cr ₅ B ₃	12007-38-4	292.414	et cry	1900		6.10		
617	Chromium carbide	Cr ₃ C ₂	12012-35-0	180.009	gray orth cry	1895		6.68		
618	Chromium carbonyl	Cr(CO) ₆	13007-92-6	220.056	colorth cry	130 dec	subl	1.77		i H ₂ O, EOH; s et, chl
619	Chromium nitride	Cr ₂ N	12053-27-9	117.999	hex cry	1650		6.8		
620	Chromium nitride	CrN	24094-93-7	66.003	gray cub cry	1080 dec		5.9		
621	Chromium phosphide	CrP	26342-61-0	82.970	orth cry			5.25		
622	Chromium selenide	CrSe	12053-13-3	130.96	hex cry	≈1500		6.1		
623	Chromium silicide	Cr ₅ Si	12018-36-9	184.074	cub cry	1770		6.4		
624	Chromium silicide	CrSi ₂	12018-09-6	108.167	gray hex cry	1490		4.91		
625	Chromium(II) acetate monohydrate	Cr(C ₂ H ₃ O ₂) ₂ · H ₂ O	628-52-4*	188.100	red monocry			1.79		s H ₂ O
626	Chromium(II) bromide	CrBr ₂	10049-25-9	211.804	wh monocry; aq soh blue	842		4.236		s H ₂ O, EOH
627	Chromium(II) chloride	CrCl ₂	10049-05-5	122.901	hyg needles; aq soh blue	814	1300	2.88		s H ₂ O
628	Chromium(II) chloride tetrahydrate	Cr(H ₂ O) ₄ Cl ₂ · 4H ₂ O	13931-94-7	267.023	blue hyg cry	51 dec				s H ₂ O
629	Chromium(II) fluoride	CrF ₂	10049-10-2	89.993	blue-grn monocry	894		3.79		s H ₂ O; i EOH
630	Chromium(II) iodide	CrI ₂	13478-28-9	305.805	red-brn cry; hyg	868		5.1		
631	Chromium(II) oxalate monohydrate	CrC ₂ O ₄ · H ₂ O	814-90-4*	158.030	yelgrn powder			2.468		s H ₂ O
632	Chromium(II) sulfate pentahydrate	CrSO ₄ · 5H ₂ O	13825-86-0	238.136	blue cry				21 ^o	s dilacid; sl EOH; i ace
633	Chromium(II,III) oxide	Cr ₅ O ₄	12018-34-7	219.986	cub cry			6.1		
634	Chromium(III) acetate	Cr(C ₂ H ₃ O ₂) ₃	1066-30-4	229.127	btgrn pwd					s H ₂ O
635	Chromium(III) acetate hexahydrate	Cr(C ₂ H ₃ O ₂) ₃ · 6H ₂ O	1066-30-4*	337.220	blue needles					s H ₂ O
636	Chromium(III) bromide	CrBr ₃	10031-25-1	291.708	dark grn hex cry	1130		4.68		s hotH ₂ O
637	Chromium(III) bromide hexahydrate (β)	Cr(H ₂ O) ₆ Br ₃	10031-25-1*	399.799	violhyg cry					s H ₂ O; i EOH, eh
638	Chromium(III) bromide hexahydrate (α)	CrBr ₃ (H ₂ O) ₄ · 2H ₂ O	18721-05-6	399.799	grn hyg cry					s H ₂ O, EOH
639	Chromium(III) chloride	CrCl ₃	10025-73-7	158.354	purp hex plets	1152	1300 dec	2.87		s H ₂ O
640	Chromium(III) chloride hexahydrate	[CrCl ₂ (H ₂ O) ₄]Cl · 2H ₂ O	10060-12-5	266.445	grn monocry; hyg					s H ₂ O, EOH; sl ace; i eh
641	Chromium(III) fluoride	CrF ₃	7788-97-8	108.991	grn needles	1400		3.8		i H ₂ O, EOH
642	Chromium(III) fluoride trihydrate	CrF ₃ · 3H ₂ O	16671-27-5	163.037	grn hex cry			2.2		s H ₂ O
643	Chromium(III) hydroxide trihydrate	Cr(OH) ₃ · 3H ₂ O	1308-14-1	157.063	blue-grn powder					i H ₂ O; s acid
644	Chromium(III) iodide	CrI ₃	13569-75-0	432.709	dark grn hex cry	500 dec		5.32		s H ₂ O
645	Chromium(III) nitrate	Cr(NO ₃) ₃	13548-38-4	238.011	grn hyg powder	>60 dec				vs H ₂ O

646	Chromium(III) nitrate nonahydrate	$\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	7789-02-8	400.148	grn-bk monocry	66.3	>100 dec	1.80		vs H_2O
647	Chromium(III) oxide	Cr_2O_3	1308-38-9	151.990	grn hex cry	2329	≈3000	5.22		i H_2O ; EDH; slacid, ak
648	Chromium(III) 2,4-pentanedioate	$\text{Cr}(\text{CH}_3\text{COCHCOCH}_3)_3$	21679-31-2	349.320	red monocry	208	345	1.34		i H_2O ; s bz
649	Chromium(III) phosphate	CrPO_4	7789-04-0	146.967	blue orth cry	>1800		4.6		i H_2O ; acid, aqua regia
650	Chromium(III) phosphate hemiheptahydrate	$\text{CrPO}_4 \cdot 3.5\text{H}_2\text{O}$	84359-31-9	210.021	blue-grn powder			2.15		i H_2O ; s acid
651	Chromium(III) phosphate hexahydrate	$\text{CrPO}_4 \cdot 6\text{H}_2\text{O}$	84359-31-9	255.059	violcry	>500 dec		2.121		i H_2O ; s acid, ak
652	Chromium(III) potassium sulfate dodecahydrate	$\text{CrK}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	7788-99-0	499.405	violbk cub cry	89 dec		1.83		s H_2O ; i EDH
653	Chromium(III) sulfate	$\text{Cr}_2(\text{SO}_4)_3$	10101-53-8	392.183	red-brn hex cry			3.1	64 ²⁵	vs acid
654	Chromium(III) sulfide	Cr_2S_3	12018-22-3	200.190	brn-bk hex cry			3.8		
655	Chromium(III) telluride	Cr_2Te_3	12053-39-3	486.79	hex cry	≈1300		7.0		
656	Chromium(IV) chloride	CrCl_4	15597-88-3	193.807	gas, stable at high temp		>600 dec	7.922 g/L		
657	Chromium(IV) fluoride	CrF_4	10049-11-3	127.990	grn cry	277				
658	Chromium(IV) oxide	CrO_2	12018-01-8	83.995	brn-bk et powder	≈400 dec		4.89		i H_2O ; s acid
659	Chromium(V) fluoride	CrF_5	14884-42-5	146.988	red orth cry	34	117			
660	Chromium(VI) fluoride	CrF_6	13843-28-2	165.986	yellow; stable at low temp	-100 dec				
661	Chromium(VI) oxide	CrO_3	1333-82-0	99.994	red orth cry	197	≈250 dec	2.7	169 ²⁵	
662	Chromic acid	H_2CrO_4	7738-94-5	118.010	aq soln only					s H_2O
663	Chromylchloride	CrO_2Cl_2	14977-61-8	154.900	red liq	-96.5	117	1.91		reac H_2O ; s ct, chl bz
664	Cobalt	Co	7440-48-4	58.933	gray metal hex or cub	1495	2927	8.86		s dilacid
665	Cobaltantimonide	CoSb	12052-42-5	180.693	hex cry	1202		8.8		
666	Cobaltarsenic sulfide	CoAsS	12254-82-9	165.921	silv-wh solid			≈6.1		
667	Cobaltarsenide	CoAs	27016-73-5	133.855	orth cry	1180		8.22		
668	Cobaltarsenide	CoAs ₂	12044-42-7	208.776	monocry			7.2		
669	Cobaltarsenide	CoAs ₃	12256-04-1	283.698	cub cry	942		6.84		
670	Cobaltboride	Co ₂ B	12045-01-1	128.677	ref rac solid	1280		8.1		
671	Cobaltboride	CoB	12006-77-8	69.744	ref rac solid	1460		7.25		reac H_2O , HNO_3
672	Cobaltcarbonyl	$\text{Co}_2(\text{CO})_8$	10210-68-1	341.947	oran cry	51 dec		1.78		i H_2O ; s EDH, eth, CS ₂
673	Cobaltphosphide	Co ₂ P	12134-02-0	148.840	gray needles	1386		6.4		i H_2O ; s HNO_3
674	Cobalt silicide	CoSi ₂	12017-12-8	115.104	gray cub cry	1326		4.9		s hotHCl
675	Cobalt disulfide	CoS ₂	12013-10-4	123.065	cub cry			4.3		
676	Cobalt dodecacarbonyl	$\text{Co}_4(\text{CO})_{12}$	17786-31-1	571.854	bk cry	60 dec		2.09		
677	Cobalt(II) acetate	$\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2$	71-48-7	177.022	pink cry					vs H_2O ; s EDH
678	Cobalt(II) acetate tetrahydrate	$\text{Co}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$	6147-53-1	249.082	red monocry			1.705		s H_2O , EDH, dilacid
679	Cobalt(II) aluminate	CoAl_2O_4	13820-62-7	176.894	blue cub cry			4.37		i H_2O
680	Cobalt(II) arsenate octahydrate	$\text{Co}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$	24719-19-5	598.760	red monoc/needles	400 dec	1000 dec	3.0		i H_2O ; s dilacid
681	Cobalt(II) bromate hexahydrate	$\text{Co}(\text{BrO}_3)_2 \cdot 6\text{H}_2\text{O}$	13476-01-2	422.829	violcry			≈2.5		vs H_2O
682	Cobalt(II) bromide	CoBr ₂	7789-43-7	218.741	grn hex cry; hyg	678		4.91	113.2 ²⁰	s MeOH, EDH, ace
683	Cobalt(II) bromide hexahydrate	$\text{CoBr}_2 \cdot 6\text{H}_2\text{O}$	13762-12-4	326.832	red hyg cry	47 dec	100 dec	2.46	113.2	
684	Cobalt(II) carbonate	CoCO_3	513-79-1	118.942	pink rhomb cry			4.2	0.00014 ²⁰	i EDH
685	Cobalt(II) chloride	CoCl_2	7646-79-9	129.838	blue hyg etf etf	740	1049	3.36	56.2 ²⁵	s EDH, eth, ace, py
686	Cobalt(II) chloride dihydrate	$\text{CoCl}_2 \cdot 2\text{H}_2\text{O}$	16544-92-6	165.869	viol/blue cry			2.477	56.2 ²⁵	
687	Cobalt(II) chloride hexahydrate	$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$	7791-13-1	237.929	pink-red monocry	87 dec		1.924	56.2 ²⁵	s EDH, ace, eth
688	Cobalt(II) chromate	CoCrO_4	24613-38-5	174.927	yellowish orth cry			≈4.0		i H_2O ; s acid
689	Cobalt(II) chromite	CoCr_2O_4	13455-25-9	226.923	blue-grn cub cry			5.14		i H_2O , conc acid
690	Cobalt(II) cyanide	$\text{Co}(\text{CN})_2$	542-84-7	110.967	blue hyg cry			1.872		i H_2O
691	Cobalt(II) cyanide dihydrate	$\text{Co}(\text{CN})_2 \cdot 2\text{H}_2\text{O}$	20427-11-6	146.998	pink-brn needles					i H_2O , acid
692	Cobalt(II) ferricyanide	$\text{Co}_3[\text{Fe}(\text{CN})_6]_2$	14049-81-1	600.699	red needles					i H_2O , HCl; s NH_4OH

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
693	Coba(II) fluoride	CoF ₂	10026-17-2	96.930	red et cry	1127	≈1400	4.46	1.4 ²⁵	s acid
694	Coba(II) fluoride tetrahydrat	CoF ₂ · 4H ₂ O	13817-37-3	168.992	red orth cry	dec		2.22	1.4 ²⁵	
695	Coba(II) formate dihydrat	Co(CHO ₂) ₂ · 2H ₂ O	6424-20-0	184.998	red cry powder	140 dec		2.13	5.03 ²⁰	i EOH
696	Coba(II) hexaf luoro-2,4-pentanedioat	Co(CF ₃ COCHOCF ₃) ₂	19648-83-0	473.035	pow	197				
697	Coba(II) hexaf luorosilicat hexahydrat	CoSiF ₆ · 6H ₂ O	12021-68-0	309.100	paë red cry			2.087	76.8 ²²	
698	Coba(II) hydroxide	Co(OH) ₂	21041-93-0	92.948	blue-grn cry	≈160 dec		3.60		s H ₂ O; s acid
699	Coba(II) iodat	Co(IO ₃) ₂	13455-28-2	408.738	bk-violneedbs	200 dec		5.09	0.46 ²⁰	
700	Coba(II) iodide	CoI ₂	15238-00-3	312.742	bk hex cry; hyg	520		5.60	203 ²⁵	
701	Coba(II) iodide hexahydrat	CoI ₂ · 6H ₂ O	15238-00-3*	420.833	red hex prisms	130 dec		2.90	203 ²⁵	s EOH, eh, ace
702	Coba(II) titanat	CoTiO ₃	12017-01-5	154.798	grn rhomb cry			5.0		
703	Coba(II) molybdät	CoMoO ₄	13762-14-6	218.87	bk monoclcry	1040		4.7		
704	Coba(II) nitat	Co(NO ₃) ₂	10141-05-6	182.942	paë red powder	100 dec		2.49	103 ²⁵	
705	Coba(II) nitat hexahydrat	Co(NO ₃) ₂ · 6H ₂ O	10026-22-9	291.034	red monoclcry; hyg	≈55		1.88	103 ²⁵	s EOH
706	Coba(II) oxat	CoC ₂ O ₄	814-89-1	146.952	pink powder	250 dec		3.02	0.0037 ²⁰	s acid, NH ₄ OH
707	Coba(II) oxat dihydrat	CoC ₂ O ₄ · 2H ₂ O	5965-38-8	182.982	pink needbs	dec			0.0037	slacid; s NH ₄ OH
708	Coba(II) oxide	CoO	1307-96-6	74.932	gray cub cry	1830		6.44		i H ₂ O; s acid
709	Coba(II) perchbrat	Co(CD ₄) ₂	13455-31-7	257.833	red needbs			3.33	113 ²⁵	i EOH, ace
710	Coba(II) phosphat octahydrat	Co ₃ (PO ₄) ₂ · 8H ₂ O	10294-50-5	510.865	pink amorp powder			2.77		i H ₂ O; s acid
711	Coba(II) potassium suf at hexahydrat	CoK ₂ (SO ₄) ₂ · 6H ₂ O	10026-20-7	437.349	red monoclcry	75 dec		2.22		vs H ₂ O
712	Coba(II) selenat pentahydrat	CoSeO ₄ · 5H ₂ O	14590-19-3	291.97	red ticlcry	dec		2.51	55 ¹⁵	
713	Coba(II) selenide	CoSe	1307-99-9	137.89	yelhex cry	1055		7.65		i H ₂ O, ak; s aqua regia
714	Coba(II) selenit dihydrat	CoSeO ₃ · 2H ₂ O	19034-13-0	221.92	blue-red powder					i H ₂ O
715	Coba(II) orthosilicat	Co ₂ SiO ₄	12017-08-2	209.950	red-violorth cry	1345		4.63		i H ₂ O; s dilHCl
716	Coba(II) stannat	Co ₂ SnO ₄	12139-93-4	300.574	grn-blue cub cry			6.30		i H ₂ O; s ak
717	Coba(II) suf at	CoSO ₄	10124-43-3	154.997	red orth cry	>700		3.71	38.3 ²⁵	
718	Coba(II) suf at heptahydrat	CoSO ₄ · 7H ₂ O	10026-24-1	281.103	pink monoclcry	41 dec		2.03	38.3 ²⁵	slEOH, MeOH
719	Coba(II) suf at monohydrat	CoSO ₄ · H ₂ O	13455-34-0	173.012	red monoclcry			3.08	38.3 ²⁵	
720	Coba(II) suf ide	CoS	1317-42-6	90.999	bk amorp powder	1182		5.45		i H ₂ O; s acid
721	Coba(II) teluride	CoTe	12017-13-9	186.53	hex cry			≈8.8		
722	Coba(II) thiocyanat	Co(SCN) ₂	3017-60-5	175.099	yelbrn pow				103 ²⁵	s EOH, MeOH, ace, eh
723	Coba(II) thiocyanat trihydrat	Co(SCN) ₂ · 3H ₂ O	97126-35-7	229.145	violrhomb cry				103 ²⁵	s EOH, eh, ace
724	Coba(II) tungstät	CoWO ₄	12640-47-0	306.77	blue monoclcry			≈7.8		i H ₂ O; s hotconc acid
725	Coba(II,III) oxide	Co ₃ O ₄	1308-06-1	240.798	bk cub cry	900 dec		6.11		i H ₂ O; s acid, ak
726	Coba(III) acetat	Co(C ₂ H ₃ O ₂) ₃	917-69-1	236.064	grn hyg cry	100 dec				s H ₂ O, EOH
727	Coba(III) ammonium etanodiammine	NH ₄ [Co(NH ₃) ₂ (NO ₂) ₄]	13600-89-0	295.054	red-brn orth cry			1.97		s H ₂ O
728	Coba(III) fluoride	CoF ₃	10026-18-3	115.928	brn hex cry	927		3.88		reac H ₂ O
729	Coba(III) hexammine chbride	Co(NH ₃) ₆ Cl ₃	10534-89-1	267.474	red monoclcry			1.71		s H ₂ O; i EOH
730	Coba(III) hydroxide	Co(OH) ₃	1307-86-4	109.955	brn powder	dec		≈4		i H ₂ O; s acid
731	Coba(III) nitat	Co(NO ₃) ₃	15520-84-0	244.948	grn cub cry; hyg			≈3.0		s H ₂ O; reac os
732	Coba(III) oxide	Co ₂ O ₃	1308-04-9	165.864	gray-bk powder	895 dec		5.18		i H ₂ O; s conc acid
733	Coba(III) oxide monohydrat	Co ₂ O ₃ · H ₂ O	12016-80-7	183.880	brn-bk hex cry	150 dec				i H ₂ O; s acid
734	Coba(III) potassium nitit sesquihydrat	CoK ₃ (NO ₂) ₆ · 1.5H ₂ O	13782-01-9*	479.284	yelcub cry			2.6		slH ₂ O; reac acid; i EOH
735	Coba(III) suf ide	Co ₂ S ₃	1332-71-4	214.064	bk cub cry			4.8		reac acid
736	Coba(III) titanat	Co ₂ TiO ₄	12017-38-8	229.731	grn-bk cub cry			5.1		s conc HCl
737	Copper	Cu	7440-50-8	63.546	red metl cub	1084.62	2562	8.96		slidilacid

738	Copper(II) 2,4-pentanedioate	$\text{Cu}(\text{C}_5\text{H}_7\text{O}_4)_2$	13395-16-9	261.762	blue powder	284 dec	subl			sH_2O ; s chl
739	Copper nitride	Cu_3N	1308-80-1	204.645	cub cry	300 dec		5.84		
740	Copper(II) 2-ethylhexanoate	$\text{Cu}(\text{C}_8\text{H}_{15}\text{O}_2)_2$	149-11-1	349.953	pow	252 dec				
741	Copper phosphide	Cu_3P_2	12019-11-3	125.494	monocry	≈ 900		4.20		
742	Copper silicide	Cu_5Si	12159-07-8	345.816	sold	825				
743	Copper(I) acetate	$\text{CuC}_2\text{H}_3\text{O}_2$	598-54-9	122.590	colcry	dec	subl			reac H_2O
744	Copper(I) acetylide	Cu_2C_2	1117-94-8	151.113	red amorp powder; exp					
745	Copper(I) azide	CuN_3	14336-80-2	105.566	et cry; exp					
746	Copper(I) bromide	CuBr	7787-70-4	143.450	wh cub cry; hyg	497	1345	4.98	0.0012 ²⁰	i ace
747	Copper(I) chloride	CuCl	7758-89-6	98.999	wh cub cry	430	≈ 1400	4.14	0.0047 ²⁰	i EDH, ace
748	Copper(I) cyanide	CuCN	544-92-3	89.564	wh powder or grn orth cry	474	dec	2.9		i H_2O , EDH; s KCN soh
749	Copper(I) fluoride	CuF	13478-41-6	82.544	cub cry			7.1		
750	Copper(I) hydride	CuH	13517-00-5	64.554	red-brn sold	60 dec				
751	Copper(I) iodide	CuI	7681-65-4	190.450	wh cub cry	606	≈ 1290	5.67	0.000020 ²⁰	i dilacid
752	Copper(I) mercury iodide	Cu_2HgI_4	13876-85-2	835.30	red cry powder	tans ≈ 60 (brn)				i H_2O , EDH
753	Copper(I) oxide	Cu_2O	1317-39-1	143.091	red-brn cub cry	1235	1800 dec	6.0		i H_2O
754	Copper(I) selenide	Cu_2Se	20405-64-5	206.05	blue-bk et cry	1113		6.84		i H_2O ; s acid
755	Copper(I) sulfide	Cu_2S	22205-45-4	159.158	blue-bk orth cry	≈ 1100		5.6		i H_2O ; slacid
756	Copper(I) sulfate monohydrate	$\text{Cu}_2\text{SO}_4 \cdot \text{H}_2\text{O}$		225.172	cry			3.83		sH_2O ; s HCl
757	Copper(I) sulfate hemihydrate	$\text{Cu}_2\text{SO}_4 \cdot 0.5\text{H}_2\text{O}$	13982-53-1*	216.164	wh-yelhex cry					sH_2O ; s acid, ak; i EDH, eh
758	Copper(I) telluride	Cu_2Te	12019-52-2	254.69	blue hex cry	1127		4.6		
759	Copper(I) thiocyanate	CuSCN	1111-67-7	121.630	wh-yelamorp powder	1084		2.85		i H_2O , dilacid, EDH, ace; s eh
760	Copper(II) sulfate dihydrate	$\text{Cu}_2\text{SO}_4 \cdot \text{CuSO}_4 \cdot 2\text{H}_2\text{O}$	13814-81-8	386.797	red prisms or powder					i H_2O , EDH; s HCl
761	Copper(II) acetate	$\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$	142-71-2	181.635	blue-grn hyg powder					
762	Copper(II) acetate mearsenite	$\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{Cu}(\text{AsO}_2)_2$	12002-03-8	1013.795	grn cry powder					i H_2O ; reac acid
763	Copper(II) acetate monohydrate	$\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot \text{H}_2\text{O}$	6046-93-1	199.650	grn monocry	115	240 dec	1.88		s H_2O , EDH; slch
764	Copper(II) acetylide	Cu_2C_2	12540-13-5	87.567	brn-bk sold; exp	exp 100				
765	Copper(II) arsenate	$\text{Cu}_3(\text{AsO}_4)_2$	10103-61-4	468.476	blue-grn cry					i H_2O , EDH; s dilacid
766	Copper(II) arsenite	CuHAsO_3	10290-12-7	187.474	yelgrn powder					i H_2O , EDH; s acid
767	Copper(II) azide	$\text{Cu}(\text{N}_3)_2$	14215-30-6	147.586	brn orth cry; exp			≈ 2.6		
768	Copper(II) basic acetate	$\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot \text{CuO} \cdot 6\text{H}_2\text{O}$	52503-64-7	369.271	blue-grn cry or powder					sH_2O , EDH; s dilacid, NH_4OH
769	Copper(II) borate	$\text{Cu}(\text{BO}_3)_2$	39290-85-2	149.166	blue-grn powder			3.859		i H_2O ; s acid
770	Copper(II) bromide	CuBr_2	7789-45-9	223.354	bk monocry; hyg	498	900	4.710	126 ²⁵	s EDH, ace; i bz, eh
771	Copper(II) butanoate monohydrate	$\text{Cu}(\text{C}_4\text{H}_7\text{O}_2)_2 \cdot \text{H}_2\text{O}$	540-16-9	255.756	grn monoclates					s H_2O , diox, bz; slEOH
772	Copper(II) carbonate hydroxide	$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$	12069-69-1	221.116	grn monocry	200 dec		4.0		i H_2O , EDH; s dilacid
773	Copper(II) chloride hexahydrate	$\text{Cu}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$	14721-21-2	338.539	blue-grn hyg cry	65	100 dec		164 ¹⁸	vs EDH
774	Copper(II) chloride	CuCl_2	7447-39-4	134.451	yelbrn monocry; hyg	630 dec		3.4	75.7 ²⁵	s EDH, ace
775	Copper(II) chloride dihydrate	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$	10125-13-0	170.482	grn-blue orth cry; hyg	100 dec		2.51	75.7 ²⁰	vs EDH, MeOH; s ace; i eh
776	Copper(II) chloride hydroxide	$\text{Cu}_2(\text{OH})_2\text{Cl}$	1332-65-6	213.567	paë grn cry					i H_2O ; s acid
777	Copper(II) chromate	CuCrO_4	13548-42-0	179.540	red-brn cry					i H_2O ; s EDH
778	Copper(II) chromite	CuCr_2O_4	12018-10-9	231.536	gray-bk et cry			5.4		i H_2O , dilacid
779	Copper(II) citrate hemipentahydrate	$\text{Cu}_2\text{C}_6\text{H}_7\text{O}_7 \cdot 2.5\text{H}_2\text{O}$	10402-15-0	360.221	blue-grn cry	100 dec				sH_2O ; s dilacid
780	Copper(II) cyanide	$\text{Cu}(\text{CN})_2$	14763-77-0	115.580	grn powder					i H_2O ; s acid, ak
781	Copper(II) cyclohexanecarboxylate	$\text{Cu}(\text{C}_{10}\text{H}_{17}\text{O}_2)_2$	2218-80-6	402.028	pow	126 dec				
782	Copper(II) dichromate dihydrate	$\text{CuCr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$	13675-47-3	315.565	red-brn tictcry			2.286		vs H_2O
783	Copper(II) ethanoate	$\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$	2850-65-9	153.667	blue hyg sold	120 dec				i os
784	Copper(II) ethylenediacetate	$\text{Cu}(\text{C}_2\text{H}_3\text{CO}_2\text{CHCOCH}_3)_2$	14284-06-1	321.813	pow	192				s EDH
785	Copper(II) ferrocyanide	$\text{Cu}_2\text{Fe}(\text{CN})_6$	13601-13-3	339.041	red-br cub cry or powder			2.2		i H_2O , acid, os

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
786	Copper(II) ferrous sulfide	CuFeS ₂	1308-56-1	183.523	yellow cry	950		4.2		i H ₂ O, HCl s HNO ₃
787	Copper(II) fluoride	CuF ₂	7789-19-7	101.543	wh monocry	836	1676	4.23	0.075 ²⁵	
788	Copper(II) fluoride dihydrate	CuF ₂ · 2H ₂ O	13454-88-1	137.574	blue monocry	130 dec		2.934	0.075 ²⁵	
789	Copper(II) formate	Cu(CHO ₂) ₂	544-19-4	153.581	blue cry				12.5 ²⁰	i os
790	Copper(II) formate tetrahydrate	Cu(CHO ₂) ₂ · 4H ₂ O	5893-61-8	225.641	blue monocry				12.5	slEDH; i os
791	Copper(II) hexafluoro-2,4-pentanedioate	Cu(CF ₃ COCHCOCF ₃) ₂	14781-45-4	477.648	cry	98	220 dec			s MeOH, ace, bl
792	Copper(II) hexafluorosilicate tetrahydrate	CuSiF ₆ · 4H ₂ O	12062-24-7	277.684	blue monocry	dec		2.56	99.7 ¹⁷	slEDH
793	Copper(II) hydroxide	Cu(OH) ₂	20427-59-2	97.561	blue-grn powder			3.37		i H ₂ O; s acid, conc ak
794	Copper(II) iodate	Cu(IO ₃) ₂	13454-89-2	413.351	grn mono cry	dec		5.241	0.15 ²⁰	s dilacid
795	Copper(II) iodate monohydrate	Cu(IO ₃) ₂ · H ₂ O	13454-90-5	431.367	blue tlcry	248 dec		4.872	0.15 ²⁰	s dilH ₂ SO ₄
796	Copper(II) molybdate	CuMoO ₄	13767-34-5	223.48	grn cry	≈500		3.4	0.038	
797	Copper(II) nitrate	Cu(NO ₃) ₂	3251-23-8	187.555	blue-grn orth cry; hyg	255	subl		145 ²⁵	s diox; reac eth
798	Copper(II) nitrate hexahydrate	Cu(NO ₃) ₂ · 6H ₂ O	13478-38-1	295.647	blue rhomb cry; hyg			2.07	145 ²⁵	s EDH
799	Copper(II) nitrate trihydrate	Cu(NO ₃) ₂ · 3H ₂ O	10031-43-3	241.602	blue rhomb cry	114	170 dec	2.32	145 ²⁵	vs EDH
800	Copper(II) oxalate	Cu(C ₁₈ H ₃₀ O ₂) ₂	1120-44-1	626.453	blue-grn solid					i H ₂ O; slEDH; s eth
801	Copper(II) oxalate	CuC ₂ O ₄	814-91-5	151.565	blue-wh powder	310 dec			0.0026 ²⁰	i EDH, eth; s NH ₄ OH
802	Copper(II) oxalate hemihydrate	CuC ₂ O ₄ · 0.5H ₂ O	814-91-5*	144.573	blue-wh cry	200 dec			0.0026 ²⁰	s NH ₄ OH
803	Copper(II) oxide	CuO	1317-38-0	79.545	bk powder or monocry	1446		6.31		i H ₂ O, EDH; s dilacid
804	Copper(II) perchlorate	Cu(ClO ₄) ₂	13770-18-8	262.446	grn hyg cry	130 dec			146 ³⁰	s eth, diox; i bz, ct
805	Copper(II) perchlorate hexahydrate	Cu(ClO ₄) ₂ · 6H ₂ O	10294-46-9	370.538	blue monocry; hyg	82	120 dec	2.22	146 ³⁰	vs EDH, HOAc, ace; sleh
806	Copper(II) phosphate	Cu ₃ (PO ₄) ₂	7798-23-4	380.581	blue-grn tlcry					i H ₂ O; s acid, NH ₄ OH
807	Copper(II) phosphate trihydrate	Cu ₃ (PO ₄) ₂ · 3H ₂ O	10031-48-8	434.627	blue-grn orth cry					i H ₂ O; s acid, NH ₄ OH
808	Copper(II) selenate pentahydrate	CuSeO ₄ · 5H ₂ O	10031-45-5	296.58	blue tlcry	80 dec		2.56	27.4 ²⁵	s acid, NH ₄ OH; slace; i EDH
809	Copper(II) selenide	CuSe	1317-41-5	142.51	blue-bk needles or plates	550 dec		5.99		reac acid
810	Copper(II) selenite dihydrate	CuSeO ₃ · 2H ₂ O	15168-20-4	226.54	blue orth cry			3.31		i H ₂ O; s acid, NH ₄ OH
811	Copper(II) selenate	Cu(C ₁₈ H ₃₀ O ₂) ₂	660-60-6	630.485	blue-grn amorp powder	≈250				i H ₂ O, EDH, eth; s py
812	Copper(II) sulfate	CuSO ₄	7758-98-7	159.610	wh-grn amorp powder or rhomb cry	560 dec		3.60	22.0 ²⁵	i EDH
813	Copper(II) sulfate pentahydrate	CuSO ₄ · 5H ₂ O	7758-99-8	249.686	blue tlcry	110 dec		2.286	22.0 ²⁵	s MeOH; slEDH
814	Copper(II) sulfate basic	Cu ₃ (OH) ₂ SO ₄	1332-14-5	354.731	grn rhomb cry			3.88		i H ₂ O
815	Copper(II) sulfide	CuS	1317-40-4	95.612	bk hex cry	tans 507		4.76		i H ₂ O, EDH, dilacid, ak
816	Copper(II) tetrathionate trihydrate	CuC ₄ H ₄ O ₆ · 3H ₂ O	815-82-7	265.663	blue-grn powder					slH ₂ O; s acid, ak
817	Copper(II) telluride	CuTe	12019-23-7	191.15	yellow cry	tans ≈400		7.09		
818	Copper(II) tetrafluoroborate	Cu(BF ₄) ₂	14735-84-3	237.155	solid					s H ₂ O
819	Copper(II) tungstate	CuWO ₄	13587-35-4	311.38	yellow powder			7.5		
820	Copper(II) tungstate dihydrate	CuWO ₄ · 2H ₂ O	13587-35-4*	347.41	grn powder					i H ₂ O; slHOAc; reac conc acid
821	Copper(II) vanadate	Cu(VO ₃) ₂	12789-09-2	261.425	pow					
822	Curium	Cm	7440-51-9	247	silv metal hex or cub	1345	≈3100	13.51		
823	Dysprosium	Dy	7429-91-6	162.50	silv metal hex	1412	2567	8.55		s dilacid
824	Dysprosium boride	DyB ₄	12310-43-9	205.74	et cry	2500		6.98		
825	Dysprosium nitride	DyN	12019-88-4	176.51	cub cry			9.93		
826	Dysprosium silicide	DySi ₂	12133-07-2	218.67	orth cry			5.2		
827	Dysprosium(II) chloride	DyCl ₂	13767-31-2	233.41	bk cry	721 dec				reac H ₂ O
828	Dysprosium(II) iodide	DyI ₂	36377-94-3	416.31	purp cry	659				reac H ₂ O
829	Dysprosium(III) bromide	DyBr ₃	14456-48-5	402.21	wh hyg cry	879				s H ₂ O
830	Dysprosium(III) chloride	DyCl ₃	10025-74-8	268.86	yellow cry	680		3.67		s H ₂ O

831	Dysprosium(III) fluoride	DyF ₃	13569-80-7	219.50	grn cry	1154			
832	Dysprosium(III) hydride	DyH ₃	13537-09-2	165.52	hex cry		7.1		
833	Dysprosium(III) iodide	DyI ₃	15474-63-2	543.21	grn cry	978			
834	Dysprosium(III) nitrate pentahydrate	Dy(NO ₃) ₃ · 5H ₂ O	10143-38-1*	438.59	yel cry	88.6		208.4 ²⁵	
835	Dysprosium(III) oxide	Dy ₂ O ₃	1308-87-8	373.00	wh cub cry	2228	3900	7.81	s acid
836	Dysprosium(III) sulfide	Dy ₂ S ₃	12133-10-7	421.20	red-brn monocry			6.08	
837	Einsteinium	Es	7429-92-7	252	metl cub	860			
838	Erbium	Er	7440-52-0	167.26	silv metl hex	1529	2868	9.07	i H ₂ O; s acid
839	Erbium boride	ErB ₄	12310-44-0	210.50	et cry	2450		7.0	
840	Erbium bromide	ErBr ₃	13536-73-7	406.97	viol hyg cry	923			s H ₂ O
841	Erbium chloride	ErCl ₃	10138-41-7	273.62	viol monocry; hyg	776		4.1	s H ₂ O
842	Erbium chloride hexahydrate	ErCl ₃ · 6H ₂ O	10025-75-9	381.71	pink hyg cry	dec			s H ₂ O; sl EDH
843	Erbium fluoride	ErF ₃	13760-83-3	224.26	pink orth cry	1147		7.8	i H ₂ O
844	Erbium hydride	ErH ₃	13550-53-3	170.28	hex cry			≈7.6	
845	Erbium iodide	ErI ₃	13813-42-8	547.97	viol hex cry; hyg	1014		≈5.5	s H ₂ O
846	Erbium nitrate pentahydrate	Er(NO ₃) ₃ · 5H ₂ O	10168-80-6*	443.35	red cry	130 dec		240.8 ²⁵	s EDH, ace
847	Erbium nitride	ErN	12020-21-2	181.27	cub cry			10.6	
848	Erbium oxide	Er ₂ O ₃	12061-16-4	382.52	pink powder	2344	3920	8.64	i H ₂ O; s acid
849	Erbium silicide	ErSi ₂	12020-28-9	223.43	orth cry			7.26	
850	Erbium sulfate	Er ₂ (SO ₄) ₃	13478-49-4	622.71	hyg powder	dec		3.68	13 ²⁰
851	Erbium sulfate octahydrate	Er ₂ (SO ₄) ₃ · 8H ₂ O	10031-52-4	766.83	pink monocry	dec		3.20	13 ²⁰
852	Erbium sulfide	Er ₂ S ₃	12159-66-9	430.72	red-brn monocry	1730		6.07	
853	Erbium telluride	Er ₂ Te ₃	12020-39-2	717.32	orth cry	1213		7.11	
854	Europium	Eu	7440-53-1	151.964	soft silv metl cub	822	1529	5.24	reac H ₂ O
855	Europium boride	EuB ₆	12008-05-8	216.830	cub cry	≈2600		4.91	
856	Europium nitride	EuN	12020-58-5	165.971	cub cry			8.7	
857	Europium silicide	EuSi ₂	12434-24-1	208.135	et cry	1500		5.46	
858	Europium(II) bromide	EuBr ₂	13780-48-8	311.772	wh cry	683			s H ₂ O
859	Europium(II) chloride	EuCl ₂	13769-20-5	222.869	wh orth cry	731		4.9	s H ₂ O
860	Europium(II) fluoride	EuF ₂	14077-39-5	189.961	grn-yel cub cry	≈1380		6.5	
861	Europium(II) iodide	EuI ₂	22015-35-6	405.773	grn cry	580			s H ₂ O
862	Europium(II) selenide	EuSe	12020-66-5	230.92	brn cub cry			6.45	
863	Europium(II) sulfate	EuSO ₄	10031-54-6	248.028	colorl cry			4.99	i H ₂ O
864	Europium(II) sulfide	EuS	12020-65-4	184.030	cub cry			5.7	
865	Europium(II) telluride	EuTe	12020-69-8	279.56	bk cub cry	1526		6.48	
866	Europium(III) bromide	EuBr ₃	13759-88-1	391.676	gray cry	dec			s H ₂ O
867	Europium(III) chloride	EuCl ₃	10025-76-0	258.322	grn-yel needls	623		4.89	
868	Europium(III) chloride hexahydrate	EuCl ₃ · 6H ₂ O	13759-92-7	366.413	wh-yel hyg cry	850		4.89	s H ₂ O
869	Europium(III) fluoride	EuF ₃	13765-25-8	208.959	wh hyg cry	1276			i H ₂ O
870	Europium(III) nitrate hexahydrate	Eu(NO ₃) ₃ · 6H ₂ O	10031-53-5	446.070	wh-pink hyg cry	85 dec		193 ²⁵	
871	Europium(III) oxide	Eu ₂ O ₃	1308-96-9	351.926	pink powder	2291	3790	7.42	i H ₂ O; s acid
872	Europium(III) sulfate	Eu ₂ (SO ₄) ₃	13537-15-0	592.119	paë pink cry			4.99	2.1 ²⁰
873	Europium(III) sulfate octahydrate	Eu ₂ (SO ₄) ₃ · 8H ₂ O	10031-52-4	736.241	pink cry	375 dec			2.1 ²⁰
874	Fermium	Fm	7440-72-4	257	metl	1527			
875	Fluorine	F ₂	7782-41-4	37.997	paë yel gas	-219.67 p	-188.12	1.553 g/L	reac H ₂ O
876	Fluorine monoxide	F ₂ O	7783-41-7	53.996	col gas	-223.8	-144.75	2.207 g/L	sl H ₂ O
877	Fluorine dioxide	F ₂ O ₂	7783-44-0	69.996	gas, stabl only at bw temp	-154	-57	2.861 g/L	
878	Fluorine nitrate	FN ₃	7789-26-6	81.003	col gas	-175	-46	3.311 g/L	reac H ₂ O, EDH, et; s ace

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
879	Fluorine perchlorate	FOCl ₃	10049-03-3	118.449	colgas; exp	-167.3	-16	4.841 g/L		reac H ₂ O
880	Francium	Fr	7440-73-5	223	shortlived akal metl	27				
881	Gadolinium	Gd	7440-54-2	157.25	silv metl hex	1313	3273	7.90		s dilacid
882	Gadolinium boride	GdB ₆	12008-06-9	222.12	bk-brn cub cry	2510		5.31		
883	Gadolinium nitride	GdN	25764-15-2	171.26	cub cry			9.10		
884	Gadolinium silicide	GdSi ₂	12134-75-7	213.42	orth cry			5.9		
885	Gadolinium(II) iodide	GdI ₂	13814-72-7	411.06	bronze cry	831				
886	Gadolinium(II) selenide	GdSe	12024-81-6	236.21	cub cry	2170		8.1		
887	Gadolinium(III) bromide	GdBr ₃	13818-75-2	396.96	wh monoclcry; hyg	770		4.56		
888	Gadolinium(III) chloride	GdCl ₃	10138-52-0	263.61	wh monoclcry; hyg	609		4.52		s H ₂ O
889	Gadolinium(III) chloride hexahydrate	GdCl ₃ · 6H ₂ O	19423-81-5	371.70	colhyg cry			2.424		s H ₂ O
890	Gadolinium(III) fluoride	GdF ₃	13765-26-9	214.25	wh cry	1231				
891	Gadolinium(III) iodide	GdI ₃	13572-98-0	537.96	yelcry	925				
892	Gadolinium(III) nitrate hexahydrate	Gd(NO ₃) ₃ · 6H ₂ O	19598-90-4	451.36	hyg tlcry	91 dec		2.33	190 ²⁵	s EDH
893	Gadolinium(III) nitrate pentahydrate	Gd(NO ₃) ₃ · 5H ₂ O	52788-53-1	433.34	wh cry	92 dec		2.41	190 ²⁵	
894	Gadolinium(III) oxide	Gd ₂ O ₃	12064-62-9	362.50	wh hyg powder	2339	3900	7.07		i H ₂ O; s acid
895	Gadolinium(III) sulfate octahydrate	Gd ₂ (SO ₄) ₃ · 8H ₂ O	13450-87-8	746.81	colmonoclcry	400 dec		4.14	2.3 ²⁰	
896	Gadolinium(III) sulfide	Gd ₂ S ₃	12134-77-9	410.70	yelcub cry			6.1		
897	Gadolinium(III) telluride	Gd ₂ Te ₃	12160-99-5	697.30	orth cry	1255		7.7		
898	Galum	Ga	7440-55-3	69.723	silv lq or gray orth cry	29.771 p	2204	5.91		reac ak
899	Galum antimonide	GaSb	12064-03-8	191.483	cub cry	712		5.6137		
900	Galum arsenide	GaAs	1303-00-0	144.645	gray cub cry	1238		5.3176		
901	Galum nitride	GaN	25617-97-4	83.730	gray hex cry	>2500		6.1		
902	Galum phosphide	GaP	12063-98-8	100.697	yelcub cry	1457		4.138		
903	Galum suboxide	Ga ₂ O	12024-20-3	155.445	brn powder	>660	>800 dec	4.77		
904	Galum(II) chloride	GaCl ₂	24597-12-4	140.628	wh orth cry	172.4	535	2.74		
905	Galum(II) selenide	GaSe	12024-11-2	148.68	hex cry	960		5.03		
906	Galum(II) sulfide	GaS	12024-10-1	101.789	hex cry	965		3.86		
907	Galum(II) telluride	GaTe	12024-14-5	197.32	monoclcry	824		5.44		
908	Galum(III) 2,4-pentanedioate	Ga(CH ₃ COCHCOCH ₃) ₃	14405-43-7	367.047	wh powder	193	subl	1.42		
909	Galum(III) bromide	GaBr ₃	13450-88-9	309.435	wh orth cry	121.5	279	3.69		
910	Galum(III) chloride	GaCl ₃	13450-90-3	176.081	colneedes or glsold	77.9	201	2.47		
911	Galum(III) fluoride	GaF ₃	7783-51-9	126.718	wh powder or colneedes	>1000		4.47		i H ₂ O
912	Galum(III) fluoride trihydrate	GaF ₃ · 3H ₂ O	22886-66-4	180.764	wh cry	>140 dec				slH ₂ O
913	Galum(III) hydride	GaH ₃	13572-93-5	72.747	visc lq	-15	≈0 dec			
914	Galum(III) hydroxide	Ga(OH) ₃	12023-99-3	120.745	unstable prec					
915	Galum(III) iodide	GaI ₃	13450-91-4	450.436	monoclcry	212	340	4.5		
916	Galum(III) nitrate	Ga(NO ₃) ₃	13494-90-1	255.738	wh cry powder					s H ₂ O, EDH, eh
917	Galum(III) oxide	Ga ₂ O ₃	12024-21-4	187.444	wh cry	1806		≈6.0		s hotacid
918	Galum(III) oxide hydroxide	GaOOH	20665-52-5	102.730	orth cry			5.23		
919	Galum(III) selenide	Ga ₂ Se ₃	12024-24-7	376.33	cub cry	937		4.92		
920	Galum(III) sulfate	Ga ₂ (SO ₄) ₃	13494-91-2	427.637	hex cry					
921	Galum(III) sulfate octadecahydrate	Ga ₂ (SO ₄) ₃ · 18H ₂ O	13780-42-2	751.912	octahed cry					s H ₂ O, EDH
922	Galum(III) sulfide	Ga ₂ S ₃	12024-22-5	235.644	monoclcry	1090		3.7		
923	Galum(III) telluride	Ga ₂ Te ₃	12024-27-0	522.25	cub cry	790		5.57		

924	Germanium	Ge	7440-56-4	72.61	gray-wh cub cry	938.25	2833	5.3234	i H ₂ O, dilacid, ak
925	Germane	GeH ₄	7782-65-2	76.64	colgas; f am	-165	-88.1	3.133 g/L	i H ₂ O
926	Digermane	Ge ₂ H ₆	13818-89-8	151.27	collq; f am	-109	29	1.98 ¹⁰⁹	
927	Trigermane	Ge ₃ H ₈	14691-44-2	225.89	collq	-105.6	110.5	2.20 ¹⁰⁵	i H ₂ O
928	Tetagermane	Ge ₄ H ₁₀	14691-47-5	300.52	collq		176.9		i H ₂ O
929	Pentagermane	Ge ₅ H ₁₂	15587-39-0	375.15	collq		234		i H ₂ O
930	Bromogermane	GeH ₃ Br	13569-43-2	155.54	collq	-32	52	2.34	reac H ₂ O
931	Chbrogermane	GeH ₃ Cl	13637-65-5	111.09	collq	-52	28	1.75	reac H ₂ O
932	Chbrotif luorogermane	GeF ₂ Cl	14188-40-0	165.06	gas	-66.2	-20.3	6.747 g/L	
933	Dibromogermane	GeH ₂ Br ₂	13769-36-3	234.43	collq	-15	89	2.80	reac H ₂ O
934	Dichbrogermane	GeH ₂ Cl ₂	15230-48-5	145.53	collq	-68	69.5	1.90	reac H ₂ O
935	Dichbrodif luorogermane	GeF ₂ Cl ₂	24422-21-7	181.51	colgas	-51.8	-2.8	7.419 g/L	
936	Fluorogermane	GeH ₃ F	13537-30-9	94.63	colgas			3.868 g/L	reac H ₂ O
937	Iodogermane	GeH ₃ I	13573-02-9	202.54	lq	-15	=90		reac H ₂ O
938	Tribromogermane	GeHBr ₃	14779-70-5	313.33	collq	-25	dec		reac H ₂ O
939	Trichbrogermane	GeHCl ₃	1184-65-2	179.98	lq	-71	75.3	1.93	reac H ₂ O
940	Trichbrof luorogermane	GeCl ₃ F	24422-20-6	197.97	lq	-49.8	37.5		
941	Methygermane	GeH ₃ CH ₃	1449-65-6	90.67	colgas	-158	-23	3.706 g/L	
942	Germanium(II) bromide	GeBr ₂	24415-00-7	232.42	yelmonoelcry	122	150 dec		reac H ₂ O
943	Germanium(II) chbride	GeCl ₂	10060-11-4	143.51	wh-yelhyg powder	dec			reac H ₂ O; s eh, bz
944	Germanium(II) f luoride	GeF ₂	13940-63-1	110.61	wh orth cry; hyg	110	130 dec	3.64	reac H ₂ O
945	Germanium(II) iodide	GeI ₂	13573-08-5	326.42	oran-yelhex cry	550 dec		5.4	reac H ₂ O
946	Germanium(II) oxide	GeO	20619-16-3	88.61	bk sold	700 dec			
947	Germanium(II) setnide	GeSe	12065-10-0	151.57	gray orth cry or brn powder	667		5.6	
948	Germanium(II) suf ide	GeS	12025-32-0	104.68	gray orth cry	615		4.1	
949	Germanium(II) telride	GeTe	12025-39-7	200.21	cub cry	725		6.16	i H ₂ O; s conc HNO ₃
950	Germanium(IV) bromide	GeBr ₄	13450-92-5	392.23	wh cry		186.35	3.132	reac H ₂ O
951	Germanium(IV) chbride	GeCl ₄	10038-98-9	214.42	collq	-51.50	86.55	1.88	reac H ₂ O; s bz, eh, EDH, ct
952	Germanium(IV) f luoride	GeF ₄	7783-58-6	148.60	colgas	-15 p	-36.5 sp	6.074 g/L	reac H ₂ O
953	Germanium(IV) iodide	GeI ₄	13450-95-8	580.23	red-oran cub cry	146	377	4.322	reac H ₂ O
954	Germanium(IV) nitide	Ge ₃ N ₄	12065-36-0	273.86	orth cry	900 dec			i H ₂ O, acid, aqua regia
955	Germanium(IV) oxide	GeO ₂	1310-53-8	104.61	wh hex cry	1115		4.25	i H ₂ O
956	Germanium(IV) setnide	GeSe ₂	12065-11-1	230.53	yeh-oran orth cry	707 dec		4.56	
957	Germanium(IV) suf ide	GeS ₂	12025-34-2	136.74	bk orth cry	530		3.01	
958	Gold	Au	7440-57-5	196.967	sof tyelmebl	1064.18	2856	19.3	s aqua regia
959	Bromoauric acid pentahydrat	HAuBr ₄ · 5H ₂ O	17083-68-0	607.667	red-brn hyg cry	27			s H ₂ O, EDH
960	Chbroauric acid tetahydrat	HAuCl ₄ · 4H ₂ O	16903-35-8	411.847	yelmonoelcry; hyg			≈3.9	vs H ₂ O, EDH; s eh
961	Gold(I) bromide	AuBr	10294-27-6	276.871	yelgray bt cry	165 dec		8.20	i H ₂ O
962	Gold(I) chbride	AuCl	10294-29-8	232.420	yelorth cry	289 dec		7.6	0.000031 ²⁰
963	Gold(I) cyanide	AuCN	506-65-0	222.985	yelhex cry	dec		7.2	i H ₂ O, EDH, eh, dilacid
964	Gold(I) iodide	AuI	10294-31-2	323.871	yel-grn powder; bt	120 dec		8.25	i H ₂ O; s CN soh
965	Gold(I) suf ide	Au ₂ S	1303-60-2	425.999	brn-bk cub cry; unstab	240 dec		≈11	i H ₂ O, acid; s aqua regia
966	Gold(III) bromide	AuBr ₃	10294-28-7	436.679	red-br monoelcry	≈160 dec			s H ₂ O, EDH
967	Gold(III) chbride	AuCl ₃	13453-07-1	303.325	red monoelcry	>160 dec		4.7	68 ²⁰
968	Gold(III) cyanide trihydrat	Au(CN) ₃ · 3H ₂ O	535-37-5*	329.065	wh hyg cry	50 dec			vs H ₂ O; s EDH
969	Gold(III) f luoride	AuF ₃	14720-21-9	253.962	oran-yelhex cry	>300	subl	6.75	
970	Gold(III) hydroxide	Au(OH) ₃	1303-52-2	247.989	brn powder	≈100 dec			i H ₂ O; s acid
971	Gold(III) iodide	AuI ₃	31032-13-0	577.680	unstab grn powder	20 dec			

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
972	Gold(III) oxide	Au ₂ O ₃	1303-58-8	441.931	brn powder	≈150 dec				i H ₂ O; s acid
973	Gold(III) selenate	Au ₂ (SeO ₄) ₃	10294-32-3	822.81	yel cry					i H ₂ O; s acid
974	Gold(III) selenide	Au ₂ Se ₃	1303-62-4	630.81	bk amorp sold	dec		4.65		s aqua regia
975	Gold(III) sulfide	Au ₂ S ₃	1303-61-3	490.131	unstabl bk powder	200 dec				
976	Hafnium	Hf	7440-58-6	178.49	gray metl hex	2233	4603	13.3		s HF
977	Hafnium boride	HfB ₂	12007-23-7	200.11	gray hex cry	3100		10.5		
978	Hafnium(IV) bromide	HfBr ₄	13777-22-5	498.11	wh cub cry	424 p	323 sp	4.90		
979	Hafnium carbide	HfC	12069-85-1	190.50	ref rac cub cry	≈3000		12.2		
980	Hafnium(IV) chloride	HfCl ₄	13499-05-3	320.30	wh monocry	432 p	317 sp			reac H ₂ O
981	Hafnium fluoride	HfF ₆	13709-52-9	254.48	wh monocry	>970	970 sp	7.1		
982	Hafnium hydride	HfH ₂	12770-26-2	180.51	ref rac tet cry			11.4		
983	Hafnium iodide	HfI ₄	13777-23-6	686.11	yeloran cub cry	449 p	394 sp	5.6		
984	Hafnium nitride	HfN	25817-87-2	192.50	yelbrn cub cry	3305		13.8		
985	Hafnium oxide	HfO ₂	12055-23-1	210.49	wh cub cry	2774		9.68		i H ₂ O
986	Hafnium oxychloride octahydrate	HfOCl ₂ · 8H ₂ O	14456-34-9	409.52	wh tet cry	dec				s H ₂ O
987	Hafnium phosphide	HfP	12325-59-6	209.46	hex cry			9.78		
988	Hafnium selenide	HfSe ₃	12162-21-9	336.41	brn hex cry			7.46		
989	Hafnium orthosilicate	HfSiO ₄	13870-13-8	270.57	tet cry			7.0		
990	Hafnium silicide	HfSi ₂	12401-56-8	234.66	gray orth cry	≈1700		7.6		
991	Hafnium sulfate	Hf(SO ₄) ₂	15823-43-5	370.62	wh cry	>500 dec				
992	Hafnium sulfide	HfS ₂	18855-94-2	242.62	purp-brn hex cry			6.03		
993	Helium	He	7440-59-7	4.003	colgas		-268.93	0.164 g/L		sH ₂ O; i EDH
994	Holmium	Ho	7440-60-0	164.930	silv metl hex	1474	2700	8.80		s dilacid
995	Holmium bromide	HoBr ₃	13825-76-8	404.642	yelhyg cry	919	1470			
996	Holmium chloride	HoCl ₃	10138-62-2	271.288	yelmonocry; hyg	718	1500	3.7		s H ₂ O
997	Holmium fluoride	HoF ₃	13760-78-6	221.925	pink-yelorth cry; hyg	1143	>2200	7.664		s H ₂ O
998	Holmium iodide	HoI ₃	13813-41-7	545.643	yelhex cry	994		5.4		
999	Holmium nitride	HoN	12029-81-1	178.937	cub cry			10.6		
1000	Holmium oxide	Ho ₂ O ₃	12055-62-8	377.859	yelcub cry	2330	3900	8.41		s acid
1001	Holmium silicide	HoSi ₂	12136-24-2	221.101	hex cry			7.1		
1002	Holmium sulfide	Ho ₂ S ₃	12162-59-3	426.059	yeloran monocry			5.92		
1003	Hydrazine	N ₂ H ₄	302-01-2	32.045	coloiq liq	1.4	113.55	1.0036		vs H ₂ O, EDH, MeOH
1004	Hydrazine hydrate	N ₂ H ₄ · H ₂ O	7803-57-8	50.060	fuming liq	-51.7	119	1.030		vs H ₂ O, EDH; i chl eth
1005	Hydrazine hydrobromide	N ₂ H ₄ · HBr	13775-80-9	112.957	wh monocry flakes	84	≈190 dec	2.3		s H ₂ O, EDH
1006	Hydrazine hydrochloride	N ₂ H ₄ · HCl	2644-70-4	68.506	wh orth cry	89	240 dec	1.5		s H ₂ O; i os
1007	Hydrazine dihydrochloride	N ₂ H ₄ · 2HCl	5341-61-7	104.966	wh orth cry	198 dec		1.42		s H ₂ O; slEDH
1008	Hydrazine hydroiodide	N ₂ H ₄ · HI	10039-55-1	159.957	hyg cry	125				s H ₂ O
1009	Hydrazine nitrate	N ₂ H ₄ · HNO ₃	13464-97-6	95.058	monocry; exp	70				vs H ₂ O
1010	Hydrazine sulfate	N ₂ H ₄ · H ₂ SO ₄	10034-93-2	130.125	colorth cry	254		1.378		sH ₂ O; i EDH
1011	Hydrazoic acid	HN ₃	7782-79-8	43.028	collq; exp	-80	35.7			s H ₂ O
1012	Hydroxyamine	H ₂ NOH	7803-49-8	33.030	wh orth flakes or needles	33.1	58	1.21		vs H ₂ O, MeOH
1013	Hydroxyamine sulfate	(H ₂ NOH) ₂ · H ₂ SO ₄	10039-54-0	164.139	cry	170				vs H ₂ O
1014	Hydrogen	H ₂	1333-74-0	2.016	colgas; fam	-259.34	-252.87	0.082 g/L		sH ₂ O
1015	Hydrogen bromide	HBr	10035-10-6	80.912	colgas	-86.80	-66.38	3.307 g/L		vs H ₂ O; s EDH
1016	Hydrogen chloride	HCl	7647-01-0	36.461	colgas	-114.17	-85	1.490 g/L		vs H ₂ O

1017	Hydrogen chloride dihydrate	HCl · 2H ₂ O	13465-05-9	72.492	collq	-17.7		1.46	
1018	Hydrogen cyanide	HCN	74-90-8	27.026	collq	-13.29	26	0.684	vs H ₂ O, EDH; slch
1019	Hydrogen fluoride	HF	7664-39-3	20.006	colgas	-83.35	20	0.818 g/L	vs H ₂ O, EDH; slch
1020	Hydrogen iodide	HI	10034-85-2	127.912	color yelgas	-50.76	-35.55	5.228 g/L	vs H ₂ O; s os
1021	Hydrogen peroxide	H ₂ O ₂	7722-84-1	34.015	collq	-0.43	150.2	1.44	vs H ₂ O
1022	Hydrogen selenide	H ₂ Se	7783-07-5	80.98	colgas; f am	-65.73	-41.25	3.310 g/L	s H ₂ O
1023	Hydrogen sulfide	H ₂ S	7783-06-4	34.082	colgas; f am	-85.5	-59.55	1.393 g/L	s H ₂ O
1024	Hydrogen disulfide	H ₂ S ₂	13465-07-1	66.148	collq		70.7	1.334	
1025	Hydrogen telluride	H ₂ Te	7783-09-7	129.62	colgas	-49	-2	5.298 g/L	s H ₂ O, EDH, ak
1026	Indium	In	7440-74-6	114.818	soft wh metal	156.60	2072	7.31	s acid
1027	Indium antimonide	InSb	1312-41-0	236.578	bk cub cry	525		5.7747	
1028	Indium arsenide	InAs	1303-11-3	189.740	gray cub cry	942		5.67	i acid
1029	Indium nitride	InN	25617-98-5	128.825	hex cry	1100		6.88	
1030	Indium phosphide	InP	22398-80-7	145.792	bk cub cry	1062		4.81	slacid
1031	Indium(I) bromide	InBr	14280-53-6	194.722	oran-red orth cry	290	656	4.96	reac H ₂ O
1032	Indium(I) chloride	InCl	13465-10-6	150.271	yelcub cry	211	608	4.19	reac H ₂ O
1033	Indium(I) iodide	InI	13966-94-4	241.722	orth cry	364.4	712	5.32	
1034	Indium(II) bromide	InBr ₂	21264-43-7	274.626	orth cry			4.22	reac H ₂ O
1035	Indium(II) chloride	InCl ₂	13465-11-7	185.723	colorh cry	235		3.64	reac H ₂ O
1036	Indium(II) sulfide	InS	12030-14-7	146.884	red-brn orth cry	692		5.2	
1037	Indium(III) bromide	InBr ₃	13465-09-3	354.530	hyg yelwh monocry	420		4.74	414 ²⁰
1038	Indium(III) chloride	InCl ₃	10025-82-8	221.176	yelmonocry; hyg	583		4.0	195.1 ²² s EDH
1039	Indium(III) fluoride	InF ₃	7783-52-0	171.813	wh hex cry; hyg	1170	>1200	4.39	slH ₂ O; s dilacid
1040	Indium(III) fluoride trihydrate	InF ₃ · 3H ₂ O	14166-78-0	225.859	wh cry	100 dec			s H ₂ O
1041	Indium(III) hydroxide	In(OH) ₃	20661-21-6	165.840	cub cry			4.4	
1042	Indium(III) iodide	InI ₃	13510-35-5	495.531	yelred monocry; hyg	207		4.69	1308 ²²
1043	Indium(III) oxide	In ₂ O ₃	1312-43-2	277.634	yelcub cry	1912		7.18	i H ₂ O; s hotacid
1044	Indium(III) perchlorate octahydrate	In(ClO ₄) ₃ · 8H ₂ O	13465-15-1	557.291	wh cry	≈80	200 dec		
1045	Indium(III) phosphate	InPO ₄	14693-82-4	209.789	wh orth cry			4.9	i H ₂ O
1046	Indium(III) selenide	In ₂ Se ₃	1312-42-1	466.52	bk hex cry	660		5.8	
1047	Indium(III) sulfate	In ₂ (SO ₄) ₃	13464-82-9	517.827	hyg wh powder			3.44	117 ²⁰
1048	Indium(III) sulfide	In ₂ S ₃	12030-24-9	325.834	oran cub cry	1050		4.45	
1049	Indium(III) telluride	In ₂ Te ₃	1312-45-4	612.44	bk cub cry	667		5.75	
1050	Iodine	I ₂	7553-56-2	253.809	blue-bk plates	113.7	184.4	4.933	0.03 ²⁰ s bz, EDH, eh, ct, chl
1051	Iodic acid	HIO ₃	7782-68-5	175.910	colorh cry	110 dec		4.63	308 ²⁵ i EDH, eh
1052	Periodic acid dihydrate	HIO ₄ · 2H ₂ O	10450-60-9	227.940	monocry hyg cry	122 dec			s H ₂ O, EDH; slch
1053	Iodine tetroxide	I ₂ O ₄	12399-08-5	317.807	yelcry	85 dec		4.2	slH ₂ O
1054	Iodine pentoxide	I ₂ O ₅	12029-98-0	333.806	hyg wh cry	≈300 dec		4.98	253.4 ²⁰ i EDH, eh, CS ₂
1055	Iodine nonaoxide	I ₂ O ₉	73560-00-6	651.613	hyg yelpowder	75 dec			
1056	Iodine bromide	IBr	7789-33-5	206.808	bk orth cry	40	116 dec	4.3	s H ₂ O, EDH, eh
1057	Iodine chloride	ICl	7790-99-0	162.357	red cry or oily liq	27.39	100 dec	3.24	reac H ₂ O; s EDH
1058	Iodine trichloride	ICl ₃	865-44-1	233.262	yelticrcry; hyg	101 p (16 atm)	64 sp dec	3.2	reac H ₂ O; s EDH, bz
1059	Iodine fluoride	IF	13873-84-2	145.902	disproportionates at room temp				
1060	Iodine trifluoride	IF ₃	22520-96-3	183.899	yelsolid, stable at low temp	-28 dec			
1061	Iodine pentafluoride	IF ₅	7783-66-6	221.896	yelliq	9.43	100.5	3.19	reac H ₂ O
1062	Iodine heptafluoride	IF ₇	16921-96-3	259.893	colgas	6.5 p	4.8 sp	10.62 g/L	s H ₂ O
1063	Iridium	Ir	7439-88-5	192.217	silv-wh metal cub	2446	4428	22.5	s aqua regia
1064	Iridium(III) sulfide	Ir ₂ S ₃	12136-42-4	480.632	orth cry			10.2	

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1065	Iridium(III) bromide	IrBr ₃	10049-24-8	431.929	red-brn monocry			6.82		i H ₂ O, acid, ak
1066	Iridium(III) bromide tetrahydrate	IrBr ₃ · 4H ₂ O	10049-24-8*	503.991	grn-brn cry					s H ₂ O; i EOH
1067	Iridium(III) chloride	IrCl ₃	10025-83-9	298.575	brn monocry	763 dec				i H ₂ O, acid, ak
1068	Iridium(III) fluoride	IrF ₃	23370-59-4	249.212	bk hex cry	250 dec		5.30		i H ₂ O, dilacid
1069	Iridium(III) iodide	IrI ₃	7790-41-2	572.930	dark brn monocry			≈8.0		i H ₂ O, acid, bz, chl s ak
1070	Iridium(III) oxide	Ir ₂ O ₃	1312-46-5	432.432	blue-bk cry	1000 dec				i H ₂ O; slhotHCl
1071	Iridium(IV) chloride	IrCl ₄	10025-97-5	334.028	brn hyg sold	≈700 dec				s H ₂ O, EOH
1072	Iridium(IV) oxide	IrO ₂	12030-49-8	224.216	brn bt cry	1100 dec		11.7		
1073	Iridium(IV) sulfide	IrS ₂	12030-51-2	256.349	orb cry			9.3		
1074	Iridium(VI) fluoride	IrF ₆	7783-75-7	306.207	yelcub cry; hyg	44	53.6	4.8		reac H ₂ O
1075	Iron	Fe	7439-89-6	55.845	silv-wh or gray met	1538	2861	7.87		s dilacid
1076	Ferrocene	Fe(C ₅ H ₅) ₂	102-54-5	186.031	oran needles	172.5	249			i H ₂ O; s EOH, eh, bz, dilHNO ₃
1077	Iron pentacarbonyl	Fe(CO) ₅	13463-40-6	195.896	yellowy liq; f am	-20	103	1.490		i H ₂ O; s eh, bz, ace
1078	Iron nonacarbonyl	Fe ₂ (CO) ₉	15321-51-4	363.781	oran-yelcry	100 dec		2.85		
1079	Iron dodecacarbonyl	Fe ₃ (CO) ₁₂	12088-65-2	503.656	bk cry	140		2.00		
1080	Iron hydrocarbonyl	FeH ₂ (CO) ₄	17440-90-3	169.902	collq; unsable	-70	dec			s ak
1081	Iron arsenide	FeAs	12044-16-5	130.767	gray orb cry	1030		7.85		
1082	Iron boride	FeB	12006-84-7	66.656	ref r sold; orb	1650		≈7		
1083	Iron boride	Fe ₂ B	12006-86-9	122.501	ref r sold; bt	1389		7.3		
1084	Iron carbide	Fe ₃ C	12011-67-5	179.546	gray cub cry	1227		7.694		
1085	Iron phosphide	FeP	26508-33-8	86.819	rhomb cry			6.07		
1086	Iron phosphide	Fe ₂ P	1310-43-6	142.664	gray hex needles	1370		6.8		i H ₂ O, dilacid, ak
1087	Iron phosphide	Fe ₃ P	12023-53-9	198.509	gray sold	1100		6.74		i H ₂ O
1088	Iron disulfide	FeS ₂	1317-66-4	119.977	bk cub cry	>600 dec		5.02		i H ₂ O
1089	Iron silicide	FeSi	12022-95-6	83.931	gray cub cry	1410		6.1		
1090	Iron silicide	FeSi ₂	12022-99-0	112.016	gray bt cry	1220		4.74		
1091	Iron(II) aluminate	Fe(AlO ₂) ₂	12068-49-4	173.806	bk cub cry			4.3		
1092	Iron(II) arsenate	Fe ₃ (AsO ₄) ₂	10102-50-8	445.373	grn pow					i H ₂ O
1093	Iron(II) arsenate hexahydrate	Fe ₃ (AsO ₄) ₂ · 6H ₂ O	10102-50-8*	553.465	grn amorp pow	dec				i H ₂ O; s acid
1094	Iron(II) bromide	FeBr ₂	7789-46-0	215.653	yelbrn hex cry; hyg	691	dec	4.636	120 ²⁵	vs EOH
1095	Iron(II) bromide hexahydrate	FeBr ₂ · 6H ₂ O	13463-12-2	323.744	grn hyg cry	27 dec		4.64	120 ²⁵	s EOH
1096	Iron(II) carbonate	FeCO ₃	563-71-3	115.854	gray-brn hex cry			3.9	0.000062 ²⁰	
1097	Iron(II) chloride	FeCl ₂	7758-94-3	126.750	wh hex cry; hyg	677	1023	3.16	65.0 ²⁵	vs EOH, ace; slbz
1098	Iron(II) chloride dihydrate	FeCl ₂ · 2H ₂ O	16399-77-2	162.781	wh-grn monocry	120 dec		2.39	65.0 ²⁵	
1099	Iron(II) chloride tetrahydrate	FeCl ₂ · 4H ₂ O	13478-10-9	198.812	grn monocry	105 dec		1.93	65.0 ²⁵	s EOH
1100	Iron(II) chromite	FeCr ₂ O ₄	1308-31-2	223.835	bk cub cry			5.0		
1101	Iron(II) fluoride	FeF ₂	7789-28-8	93.842	wh bt cry	1100		4.09		slH ₂ O; s dilHF; i EOH, eh
1102	Iron(II) fluoride tetrahydrate	FeF ₂ · 4H ₂ O	13940-89-1	165.904	colhex cry			2.20		
1103	Iron(II) hydroxide	Fe(OH) ₂	18624-44-7	89.860	wh-grn hex cry			3.4	0.000052 ²⁰	
1104	Iron(II) iodide	FeI ₂	7783-86-0	309.654	red-violhex cry; hyg	587		5.3		s H ₂ O, EOH, eh
1105	Iron(II) iodide tetrahydrate	FeI ₂ · 4H ₂ O	7783-86-0*	381.716	bk hyg haf bt	90 dec		2.87		s H ₂ O, EOH
1106	Iron(II) molybdate	FeMoO ₄	13718-70-2	215.78	brn-yelmonocry	1115		5.6		i H ₂ O
1107	Iron(II) nitrate	Fe(NO ₃) ₂	14013-86-6	179.854	grn sold				87.5 ²⁵	
1108	Iron(II) nitrate hexahydrate	Fe(NO ₃) ₂ · 6H ₂ O	14013-86-6*	287.946	grn sold	60 dec			87.5 ²⁵	
1109	Iron(II) oxalate dihydrate	FeC ₂ O ₄ · 2H ₂ O	6047-25-2	179.894	yelcry	150 dec		2.28	0.078 ²⁵	s acid

1110	Iron(II) oxide	FeO	1345-25-1	71.844	bk cub cry	1377	6.0		i H ₂ O; ak; s acid
1111	Iron(II) perchlorate	Fe(ClO ₄) ₂	13933-23-8	254.745	grn-wh hyg needs	>100 dec		210 ²⁵	
1112	Iron(II) phosphate octahydrate	Fe ₃ (PO ₄) ₂ · 8H ₂ O	14940-41-1	501.600	gray-blue monocry; hyg		2.58		i H ₂ O; s acid
1113	Iron(II) selenide	FeSe	1310-32-3	134.81	bk hex cry		6.7		i H ₂ O
1114	Iron(II) orthosilicate	Fe ₂ SiO ₄	10179-73-4	203.774	brn orth cry		4.30		
1115	Iron(II) sulfate	FeSO ₄	7720-78-7	151.909	wh orth cry; hyg		3.65	29.5 ²⁵	
1116	Iron(II) sulfate monohydrate	FeSO ₄ · H ₂ O	17375-41-6	169.924	wh-yelmonocry	300 dec	3.0	29.5 ²⁵	
1117	Iron(II) sulfate heptahydrate	FeSO ₄ · 7H ₂ O	7782-63-0	278.015	blue-grn monocry	≈60 dec	1.895	29.5 ²⁵	i EOH
1118	Iron(II) sulfide	FeS	1317-37-9	87.911	colhex or tet cry; hyg	1188	dec	4.7	i H ₂ O; reac acid
1119	Iron(II) tannate	Fe(TaO ₃) ₂		513.737	brn tet cry			7.33	
1120	Iron(II) tartrate	FeC ₄ H ₄ O ₆		203.916	wh cry			0.88	vs acid; s NH ₄ OH
1121	Iron(II) telluride	FeTe	12125-63-2	183.45	tet cry	914		6.8	
1122	Iron(II) thiocyanate trihydrate	Fe(SCN) ₂ · 3H ₂ O	6010-09-9	226.057	grn monocry				s H ₂ O, EOH, eh
1123	Iron(II) titanate	FeTiO ₃	12168-52-4	151.710	bk rhomb cry	≈1470		4.72	
1124	Iron(II) tungstate	FeWO ₄	13870-24-1	303.68	monocry			7.51	
1125	Iron(II,III) oxide	Fe ₃ O ₄	1317-61-9	231.533	bk cub cry or amorp powder	1597		5.17	i H ₂ O; s acid
1126	Iron(III) acetate, basic	FeOH(C ₂ H ₃ O ₂) ₂	10450-55-2	190.941	brn-red amorp powder				i H ₂ O; s EOH, acid
1127	Iron(III) 2,4-pentanedioate	Fe(CH ₃ COCHCOCH ₃) ₃	14024-18-1	353.169	red-oran cry	179		5.24	sH ₂ O; s os
1128	Iron(III) arsenate dihydrate	FeAsO ₄ · 2H ₂ O	10102-49-5	230.795	grn-brn powder	dec		3.18	i H ₂ O; s dilacid
1129	Iron(III) bromide	FeBr ₃	10031-26-2	295.557	dark red hex cry; hyg	dec		4.5	455 ²⁵ s EOH, eh
1130	Iron(III) chloride	FeCl ₃	7705-08-0	162.203	grn hex cry; hyg	304	≈316	2.90	91.2 ²⁵ s EOH, eh, ace
1131	Iron(III) chloride hexahydrate	FeCl ₃ · 6H ₂ O	10025-77-1	270.294	yel-oran monocry; hyg	37 dec		1.82	91.2 ²⁵ s EOH, eh, ace
1132	Iron(III) chromate	Fe ₂ (CrO ₄) ₃	10294-52-7	459.671	yelpowder				i H ₂ O, EOH; s acid
1133	Iron(III) citrate pentahydrate	FeC ₆ H ₄ O ₇ · 5H ₂ O	3522-50-7	335.021	red-brn cry				s H ₂ O; i EOH
1134	Iron(III) dichromate	Fe ₂ (Cr ₂ O ₇) ₃	10294-53-8	759.654	red-brn sold				s H ₂ O, acid
1135	Iron(III) ferrocyanide	Fe ₄ [Fe(CN) ₆] ₃	14038-43-8	859.229	dark blue powder		1.80		i H ₂ O, dilacid, os
1136	Iron(III) fluoride	FeF ₃	7783-50-8	112.840	grn hex cry	>1000		3.87	5.92 ²⁵ i EOH, eh, bz
1137	Iron(III) fluoride trihydrate	FeF ₃ · 3H ₂ O	15469-38-2	166.886	yel-brn tet cry			2.3	5.92 ²⁵
1138	Iron(III) formate	Fe(CHO ₂) ₃	555-76-0	190.897	red-yelcry pow				s H ₂ O; s EOH
1139	Iron(III) hydroxide	Fe(OH) ₃	1309-33-7	106.867	yelmonocry			3.12	
1140	Iron(III) hydroxide oxide	FeO(OH)	20344-49-4	88.852	red-brn orth cry			4.26	i H ₂ O; s acid
1141	Iron(III) nitrate	Fe(NO ₃) ₃	10421-48-4	241.860	cry				82.5 ²⁰
1142	Iron(III) nitrate hexahydrate	Fe(NO ₃) ₃ · 6H ₂ O	13476-08-9	349.951	violcub cry	35 dec			82.5 ²⁰
1143	Iron(III) nitrate nonahydrate	Fe(NO ₃) ₃ · 9H ₂ O	7782-61-8	403.997	violgray hyg cry	47 dec		1.68	82.5 ²⁰ vs EOH, ace
1144	Iron(III) oxalate	Fe ₂ (C ₂ O ₄) ₃	19469-07-9	375.747	yelamorp powder	100 dec			s H ₂ O, acid; i ak
1145	Iron(III) oxide	Fe ₂ O ₃	1309-37-1	159.688	red-brn hex cry	1565		5.25	i H ₂ O; s acid
1146	Iron(III) phosphate dihydrate	FePO ₄ · 2H ₂ O	10045-86-0	186.847	gray-wh orth cry			2.87	i H ₂ O; s HCl
1147	Iron(III) pyrophosphate nonahydrate	Fe ₄ (P ₂ O ₇) ₃ · 9H ₂ O	10058-44-3	907.348	yelpowder				i H ₂ O; s acid
1148	Iron(III) hypophosphite	Fe(H ₂ PO ₂) ₃	7783-84-8	250.811	wh-gray powder				i H ₂ O
1149	Iron(III) sodium pyrophosphate	FeNaP ₂ O ₇	10045-87-1	252.778	wh pow			1.5	i H ₂ O; s HCl
1150	Iron(III) sulfate	Fe ₂ (SO ₄) ₃	10028-22-5	399.881	gray-wh rhomb cry; hyg			3.10	440 ²⁰ s EOH; i ace
1151	Iron(III) sulfate nonahydrate	Fe ₂ (SO ₄) ₃ · 9H ₂ O	13520-56-4	562.018	yelhex cry	400 dec		2.1	440 ²⁰
1152	Iron(III) thiocyanate monohydrate	Fe(SCN) ₃ · H ₂ O	4119-52-2	248.110	red hyg cry	dec			s H ₂ O, EOH, ace; i bl chl
1153	Iron(III) metavanadate	Fe(VO ₃) ₃	65842-03-7	352.665	gray-brn powder				i H ₂ O, EOH; s acid
1154	Krypton	Kr	7439-90-9	83.80	colgas	-157.38 b (73.2 kPa)	-153.22	3.425 g/L	sH ₂ O
1155	Krypton difluoride	KrF ₂	13773-81-4	121.80	coltet cry	≈25 dec		3.24	reac H ₂ O
1156	Lanthanum	La	7439-91-0	138.906	silv metal hex	918	3464	6.15	s dilacid
1157	Lanthanum boride	LaB ₆	12008-21-8	203.772	bk cub cry; ref rac	2715		4.76	

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1158	Lanthanum bromide	LaBr ₃	13536-79-3	378.618	wh hex cry; hyg	788		5.1		s H ₂ O
1159	Lanthanum carbide	LaC ₂	12071-15-7	162.927	et cry	2360		5.29		
1160	Lanthanum carbonate octahydrate	La ₂ (CO ₃) ₃ · 8H ₂ O	6487-39-4	601.960	wh cry powder			2.6		i H ₂ O; s dilacid
1161	Lanthanum chloride	LaCl ₃	10099-58-8	245.264	wh hex cry; hyg	859		3.84	95.7 ²⁵	
1162	Lanthanum chloride heptahydrate	LaCl ₃ · 7H ₂ O	20211-76-1	371.371	wh tlcry; hyg	91 dec			95.7 ²⁵	s EOH
1163	Lanthanum fluoride	LaF ₃	13709-38-1	195.901	wh hex cry; hyg	1493		5.9		i H ₂ O, acid
1164	Lanthanum hydride	LaH ₃	13864-01-2	141.930	bk cub cry			5.36		
1165	Lanthanum hydroxide	La(OH) ₃	14507-19-8	189.928	wh amorp sold	dec			0.000020 ²⁰	
1166	Lanthanum iodate	La(IO ₃) ₃	13870-19-4	663.614	colcry				1.7	
1167	Lanthanum iodide	LaI ₃	13813-22-4	519.619	wh orh cry; hyg	778		5.6		s H ₂ O
1168	Lanthanum nitrate hexahydrate	La(NO ₃) ₃ · 6H ₂ O	10277-43-7	433.012	wh hyg tlcry	≈40 dec			200 ²⁵	vs EOH; s ace
1169	Lanthanum nitride	LaN	25764-10-7	152.913	cub cry			6.73		
1170	Lanthanum oxide	La ₂ O ₃	1312-81-8	325.809	wh amorp powder	2304	3620	6.51		i H ₂ O; s dilacid
1171	Lanthanum silicide	LaSi ₂	12056-90-5	195.077	gray et cry			5.0		
1172	Lanthanum sulfate nonahydrate	La ₂ (SO ₄) ₃ · 9H ₂ O	10294-62-9	728.139	hex cry			2.82	2.7 ²⁰	i EOH
1173	Lanthanum sulfide	La ₂ S ₃	12031-49-1	374.009	red cub cry	2110		4.9		
1174	Lanthanum sulfide	LaS	12031-30-0	170.972	yelcub cry	2300		5.61		
1175	Lawrencium	Lr	22537-19-5	262	metal	1627				
1176	Lead	Pb	7439-92-1	207.2	soft silv-gray metal cub	327.46	1749	11.3		s conc acid
1177	Lead(II) acetate	Pb(C ₂ H ₃ O ₂) ₂	301-04-2	325.3	wh cry	280	dec	3.25	44.3 ²⁰	
1178	Lead(II) acetate trihydrate	Pb(C ₂ H ₃ O ₂) ₂ · 3H ₂ O	6080-56-4	427.3	colcry	75 dec		2.55		vs H ₂ O; slEOH
1179	Lead(II) acetate, basic	Pb(C ₂ H ₃ O ₂) ₂ · 2Pb(OH) ₂	1335-32-6	807.7	wh pow	dec			6.3 ⁰	
1180	Lead(II) antimonate	Pb ₃ (SbO ₄) ₂	13510-89-9	993.1	oran-yelpowder			6.58		i H ₂ O, dilacid
1181	Lead(II) arsenate	Pb ₃ (AsO ₄) ₂	3687-31-8	899.4	wh cry	1042 dec		5.8		i H ₂ O; s HNO ₃
1182	Lead(II) arsenite	Pb(AsO ₂) ₂	10031-13-7	421.0	wh powder			5.85		i H ₂ O; s dilHNO ₃
1183	Lead(II) azide	Pb(N ₃) ₂	13424-46-9	291.2	colorb needles; exp	exp ≈350		4.7	0.023 ¹⁸	vs HOAc
1184	Lead(II) borate monohydrate	Pb(BO ₂) ₂ · H ₂ O	10214-39-8	310.8	wh powder	500 dec		5.6		i H ₂ O; s dilHNO ₃
1185	Lead(II) bromate monohydrate	Pb(BrO ₃) ₂ · H ₂ O	10031-21-7	481.0	colcry	≈180 dec		5.53	1.33 ²⁰	
1186	Lead(II) bromide	PbBr ₂	10031-22-8	367.0	wh orh cry	371	892	6.69	0.975 ²⁵	i EOH
1187	Lead(II) butanoate	Pb(C ₄ H ₇ O ₂) ₂	819-73-8	381.4	colsold	≈90				i H ₂ O; s dilHNO ₃
1188	Lead(II) carbonate	PbCO ₃	598-63-0	267.2	colorb cry	≈315 dec		6.6		i H ₂ O
1189	Lead(II) carbonate, basic	Pb(OH) ₂ · 2PbCO ₃	1319-46-6	775.6	wh hex cry	400 dec		≈6.5		i H ₂ O, EOH; s acid
1190	Lead(II) chloride	Pb(ClO ₃) ₂	10294-47-0	374.1	colhyg cry	230 dec		3.9	144 ¹⁶	vs EOH
1191	Lead(II) chloride	PbCl ₂	7758-95-4	278.1	wh orh needles or powder	501	951	5.98	1.08 ²⁵	s ak
1192	Lead(II) chloride fluoride	PbClF	13847-57-9	261.7	et cry			7.05	0.035 ²⁰	
1193	Lead(II) chromate	PbCrO ₄	7758-97-6	323.2	yel-oran monocry	844		6.12	0.00017 ²⁰	s ak, dilacid
1194	Lead(II) chromate(VI) oxide	PbCrO ₄ · PbO	18454-12-1	546.4	red powder					i H ₂ O
1195	Lead(II) citrate trihydrate	Pb ₃ (C ₆ H ₇ O ₇) ₂ · 3H ₂ O	512-26-5	1053.8	wh cry powder					s H ₂ O; slEOH
1196	Lead(II) cyanide	Pb(CN) ₂	592-05-2	259.2	wh-yelpowder					slH ₂ O; reac acid
1197	Lead(II) 2-ethylhexanoate	Pb(C ₇ H ₁₅ CO ₂) ₂	301-08-6	493.6	visc liq			1.56		
1198	Lead(II) fluoride	PbF ₂	7783-46-2	245.2	wh orh cry	830	1293	8.44	0.0670 ²⁵	
1199	Lead(II) fluoroborate	Pb(BF ₄) ₂	13814-96-5	380.8	subl only in aq sol					s H ₂ O
1200	Lead(II) formate	Pb(CHO ₂) ₂	811-54-1	297.2	wh prisms or needles	190 dec		4.63	1.6 ¹⁶	i EOH
1201	Lead(II) hexafluoro-2,4-pentanedioate	Pb(CF ₃ COCH ₂ COCF ₃) ₂	19648-88-5	621.3	cry	155	210			
1202	Lead(II) hydrogen arsenate	PbHAsO ₄	7784-40-9	347.1	wh monocry	280 dec		5.943		i H ₂ O; s HNO ₃ , ak

1203	Lead(II) hydrogen phosphatē	PbHPO ₄	15845-52-0	303.2	wh monocry	dec	5.66			
1204	Lead(II) hydroxide	Pb(OH) ₂	19783-14-3	241.2	wh powder	145 dec	7.59	0.00012 ²⁰	s acid	
1205	Lead(II) iodatē	Pb(IO ₃) ₂	25659-31-8	557.0	wh orth cry		6.50	0.0025 ²⁵		
1206	Lead(II) iodide	PbI ₂	10101-63-0	461.0	yelhex cry or powder	410	872 dec	6.16	0.076 ²⁵	i EOH
1207	Lead(II) acetatē	Pb(C ₂ H ₃ O ₂) ₂	18917-82-3	385.3	wh cry powder				s H ₂ O, hot EOH	
1208	Lead(II) molybdatē	PbMoO ₄	10190-55-3	367.1	yelēt cry	≈1060		6.7	i H ₂ O; s HNO ₃ , NaOH	
1209	Lead(II) niobatē	Pb(NbO ₃) ₂	12034-88-7	489.0	rhomb or et cry	1343		6.6	i H ₂ O	
1210	Lead(II) nitatē	Pb(NO ₃) ₂	10099-74-8	331.2	colcub cry	470		4.53	59.7 ²⁵	sl EOH
1211	Lead(II) oxatē	Pb(C ₁₈ H ₃₅ O ₂) ₂	1120-46-3	770.1	wax-like sold					i H ₂ O; s EOH, bz, eh
1212	Lead(II) oxalatē	PbC ₂ O ₄	814-93-7	295.2	wh powder	300 dec		5.28	0.00025 ²⁰	s diiHNO ₃
1213	Lead(II) oxide (lharġe)	PbO	1317-36-8	223.2	red et cry	tans b massicot 489		9.35		i H ₂ O, EOH; s diiHNO ₃
1214	Lead(II) oxide (massicot)	PbO	1317-36-8	223.2	yelorth cry	897		9.64		i H ₂ O, EOH; s diiHNO ₃
1215	Lead(II) oxide hydratē	3PbO · H ₂ O	1311-11-1	687.6	wh powder			7.41		i H ₂ O; s dilacid
1216	Lead(II) 2,4-pentanedioatē	Pb(CH ₃ COCHCOCH ₃) ₂	15282-88-9	405.4	cry	143				
1217	Lead(II) perchbratē	Pb(CD ₄) ₂	13453-62-8	406.1	wh cry				441 ²⁵	
1218	Lead(II) perchbratē trihydratē	Pb(CD ₄) ₂ · 3H ₂ O	13637-76-8	460.1	wh cry	100 dec		2.6	441 ²⁵	s EOH
1219	Lead(II) phosphatē	Pb ₃ (PO ₄) ₂	7446-27-7	811.5	wh hex cry	1014		7.01		i H ₂ O, EOH
1220	Lead(II) hypophosphitē	Pb(H ₂ PO ₂) ₂	10294-58-3	337.2	hyg cry powder	dec				sl H ₂ O; i EOH
1221	Lead(II) metasilcatē	PbSiO ₃	10099-76-0	283.3	wh monocry powder	764		6.49		i H ₂ O, os
1222	Lead(II) orthosilcatē	Pb ₂ SiO ₄	13566-17-1	506.5	monocry	743		7.60		
1223	Lead(II) hexaf luorosilcatē dihydratē	PbSiF ₆ · 2H ₂ O	1310-03-8	385.3	colcry	dec				vs H ₂ O
1224	Lead(II) sēbnatē	PbSeO ₄	7446-15-3	350.2	orth cry			6.37	0.013 ²⁵	s conc acid
1225	Lead(II) sēbnide	PbSe	12069-00-0	286.2	gray cub cry	1078		8.1		i H ₂ O; s HNO ₃
1226	Lead(II) sēbnitē	PbSeO ₃	7488-51-9	334.2	wh monocry	≈500		7.0		i H ₂ O
1227	Lead(II) sodium biosulfatē	Na ₂ Pb(S ₂ O ₃) ₃	10101-94-7	635.6	wh cry					sl H ₂ O
1228	Lead(II) staratē	Pb(C ₁₈ H ₃₅ O ₂) ₂	1072-35-1	774.1	wh powder	≈100		1.4		i H ₂ O; s hot EOH
1229	Lead(II) sulfatē	PbSO ₄	7446-14-2	303.3	orth cry	1087		6.29	0.0044 ²⁵	i acid; slak
1230	Lead(II) sulf ide	PbS	1314-87-0	239.3	bk powder or silv cub cry	1113		7.60		i H ₂ O; s acid
1231	Lead(II) sulf itē	PbSO ₃	7446-10-8	287.3	wh powder	dec				i H ₂ O; s HNO ₃
1232	Lead(II) antatē	Pb(TaO ₃) ₂	12065-68-8	665.1	orth cry			7.9		i H ₂ O
1233	Lead(II) teluride	PbTe	1314-91-6	334.8	gray cub cry	924		8.164		i H ₂ O, acid
1234	Lead(II) thiocyanatē	Pb(SCN) ₂	592-87-0	323.4	wh-yel powder			3.82	0.05 ²⁰	
1235	Lead(II) thiosulfatē	PbS ₂ O ₃	13478-50-7	319.3	wh cry	dec		5.18		i H ₂ O; s acid
1236	Lead(II) titanatē	PbTiO ₃	12060-00-3	303.1	yelēt cry			7.9		i H ₂ O; reac HCl
1237	Lead(II) tungstatē (sbzite)	PbWO ₄	7759-01-5	455.0	yelēt cry	1130		8.24	0.03 ²⁰	s ak
1238	Lead(II) tungstatē (raspite)	PbWO ₄	7759-01-5	455.0	monocry	tans 400		8.46	0.03 ²⁰	s ak
1239	Lead(II) metavanadatē	Pb(VO ₃) ₂	10099-79-3	405.1	yel powder					i H ₂ O; reac HNO ₃
1240	Lead(II) zirconatē	PbZrO ₃	12060-01-4	346.4	colorh cry			≈8		i H ₂ O, ak; s acid
1241	Lead(II,IV) oxide	Pb ₂ O ₃	1314-27-8	462.4	bk monocry or red amorp powder	530 dec		10.05		i H ₂ O; s ak; reac conc HCl
1242	Lead(II,II,IV) oxide	Pb ₃ O ₄	1314-41-6	685.6	red et cry	830		8.92		i H ₂ O, EOH; s hot HCl
1243	Lead(IV) acetatē	Pb(C ₂ H ₃ O ₂) ₄	546-67-8	443.4	colmonocry	≈175		2.23		reac H ₂ O, EOH; s bz, chl
1244	Lead(IV) bromide	PbBr ₄	13701-91-2	526.8	unsabbē lq					
1245	Lead(IV) chbride	PbCl ₄	13463-30-4	349.0	yeloily lq	-15	≈50 dec			
1246	Lead(IV) fluoride	PbF ₄	7783-59-7	283.2	wh et cry; hyg	≈600		6.7		
1247	Lead(IV) oxide	PbO ₂	1309-60-0	239.2	red et cry or brn powder	290 dec		9.64		
1248	Lithium	Li	7439-93-2	6.941	soft silv-wh meal	180.50	1342	0.534		reac H ₂ O
1249	Lithium acetatē	LiC ₂ H ₃ O ₂	546-89-4	65.985	cry	286			45.0 ²⁵	vs EOH

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1250	Lithium acetate dihydrate	LiC ₂ H ₃ O ₂ · 2H ₂ O	6108-17-4	102.016	wh rhomb cry	58 dec		1.3	45.0 ²⁵	s EOH
1251	Lithium aluminum hydride	LiAlH ₄	16853-85-3	37.955	gray-wh monoclcry	>125 dec		0.917		reac H ₂ O, EOH; s eh, hf
1252	Lithium amide	LiNH ₂	7782-89-0	22.964	et cry	380		1.18		reac H ₂ O
1253	Lithium arsenate	Li ₃ AsO ₄	13478-14-3	159.743	colorh cry			3.07		slH ₂ O; s HOAc
1254	Lithium azide	LiN ₃	19597-69-4	48.961	hyg monoclcry; exp			1.83		vs H ₂ O
1255	Lithium metaborate	LiBO ₂	13453-69-5	49.751	wh monoclcry; hyg	849		2.18		vs H ₂ O; s EOH
1256	Lithium borohydride	LiBH ₄	16949-15-8	21.784	wh-gray orth cry or powder	268	380 dec	0.66		s ak, eh, hf
1257	Lithium bromide	LiBr	7550-35-8	86.845	wh cub cry; hyg	552	≈1300	3.464	181 ²⁵	s EOH, eh
1258	Lithium carbonate	Li ₂ CO ₃	554-13-2	73.891	wh monoclcry	723	1300 dec	2.11	1.30 ²⁵	s acid; i EOH
1259	Lithium chloride	LiCl	13453-71-9	90.392	colhyg rhom needles	127.6	300 dec	1.119	459 ²⁵	vs EOH; slace
1260	Lithium chloride	LiCl	7447-41-8	42.394	wh cub cry or powder; hyg	610	1383	2.07	84.5 ²⁵	s EOH, ace, py
1261	Lithium chromate dihydrate	Li ₂ CrO ₄ · 2H ₂ O	7789-01-7	165.906	yellowh cry; hyg	75 dec		2.15		vs H ₂ O; s EOH
1262	Lithium dichromate dihydrate	Li ₂ Cr ₂ O ₇ · 2H ₂ O	10022-48-7	265.901	yellowh cry	130 dec		2.34		vs H ₂ O
1263	Lithium dihydrogen phosphate	LiH ₂ PO ₄	13453-80-0	103.928	colhyg cry	>100		2.461	126 ⁰	
1264	Lithium ferrosilicon	LiFeSi	64082-35-5	90.872	dark brick cry					reac H ₂ O
1265	Lithium fluoride	LiF	7789-24-4	25.939	wh cub cry or powder	848.2	1673	2.640	0.134 ²⁵	s acid
1266	Lithium formate monohydrate	Li(CHO ₂) · H ₂ O	6108-23-2	69.974	colwh cry			1.46		s H ₂ O
1267	Lithium hydride	LiH	7580-67-8	7.949	gray cub cry or powder; hyg	688.7		0.78		reac H ₂ O, EOH
1268	Lithium hydroxide	LiOH	1310-65-2	23.948	collet cry	471.1	1626	1.45	12.5 ²⁵	slEOH
1269	Lithium hydroxide monohydrate	LiOH · H ₂ O	1310-66-3	41.964	wh monoclcry or powder			1.51	12.5 ²⁵	slEOH
1270	Lithium iodate	LiIO ₃	13765-03-2	181.843	wh hyg hex cry			4.502	77.9 ²⁵	i EOH
1271	Lithium iodide	LiI	10377-51-2	133.845	wh cub cry; hyg	469	1171	4.06	165 ²⁵	
1272	Lithium iodide trihydrate	LiI · 3H ₂ O	7790-22-9	187.891	wh hyg cry	73		2.38	165 ²⁵	vs EOH, ace
1273	Lithium niobate	LiNbO ₃	12031-63-9	147.845	wh hex cry	≈1240		4.30		
1274	Lithium nitrate	LiNO ₃	7790-69-4	68.946	colhex cry; hyg	253		2.38	102 ²⁵	s EOH
1275	Lithium nitride	Li ₃ N	26134-62-3	34.830	red hex cry	813		1.27		reac H ₂ O
1276	Lithium nitrite monohydrate	LiNO ₂ · H ₂ O	13568-33-7*	70.962	colneedles	>100		1.615	139.5 ²⁵	vs EOH
1277	Lithium phosphate	Li ₃ PO ₄	10377-52-3	115.794	wh orth cry	1205		2.46	0.027 ²⁵	
1278	Lithium oxide	Li ₂ O	12057-24-8	29.881	wh cub cry	1570		2.013		
1279	Lithium perchlorate	LiClO ₄	7791-03-9	106.392	wh orth cry or powder	236	430 dec	2.428	58.7 ²⁵	s EOH, ace, eh
1280	Lithium peroxide	Li ₂ O ₂	12031-80-0	45.881	wh hex cry			2.31		s H ₂ O; i EOH
1281	Lithium selenate monohydrate	Li ₂ SeO ₄ · H ₂ O	7790-71-8	174.86	monoclcry			2.56		vs H ₂ O
1282	Lithium silicate	Li ₂ SiO ₃	10102-24-6	89.966	wh orth needles	1201		2.52		i colH ₂ O; reac dilacid
1283	Lithium sulfate	Li ₂ SO ₄	10377-48-7	109.946	wh monoclcry; hyg	859		2.21	34.2 ²⁵	
1284	Lithium sulfate monohydrate	Li ₂ SO ₄ · H ₂ O	10102-25-7	127.961	colcry	130 dec		2.06	34.2 ²⁵	slEOH
1285	Lithium sulfide	Li ₂ S	12136-58-2	45.948	wh cub cry; hyg	1372		1.64		
1286	Lithium thiocyanate	LiSCN	556-65-0	65.025	wh hyg cry				120 ²⁵	
1287	Lutetium	Lu	7439-94-3	174.967	silv metal hex	1663	3402	9.84		s dilacid
1288	Lutetium boride	LuB ₄	12688-52-7	218.211	et cry	2600		≈7.0		
1289	Lutetium bromide	LuBr ₃	14456-53-2	414.679	wh hyg cry	1025				vs H ₂ O
1290	Lutetium chloride	LuCl ₃	10099-66-8	281.325	wh monoclcry; hyg	925		3.98		s H ₂ O
1291	Lutetium fluoride	LuF ₃	13760-81-1	231.962	orth cry	1182	2200	8.3		i H ₂ O
1292	Lutetium iodide	LuI ₃	13813-45-1	555.680	brn hex cry; hyg	1050		≈5.6		vs H ₂ O
1293	Lutetium nitride	LuN	12125-25-6	188.974	cub cry			11.6		
1294	Lutetium oxide	Lu ₂ O ₃	12032-20-1	397.932	wh cub cry or powder	2427	3980	9.41		

1295	Lutetium sulfide octahydrate	$\text{Lu}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$	13473-77-3	782.247	wh cry					vs H_2O
1296	Lutetium sulfide	Lu_2S_3	12163-20-1	446.132	gray rhomb cry	1750	dec		6.26	
1297	Lutetium telluride	Lu_2Te_3	12163-22-3	732.73	orb cry				7.8	
1298	Magnesium	Mg	7439-95-4	24.305	silv-wh metal	650	1090		1.74	s dilacid
1299	Magnesium acetate	$\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2$	142-72-3	142.394	wh orb/mcl cry	323	dec		1.50	65.6 ²⁵
1300	Magnesium acetate tetrahydrate	$\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$	16674-78-5	214.454	colmonocry; hyg	80	dec		1.45	65.6 ²⁵ vs EDH
1301	Magnesium amide	$\text{Mg}(\text{NH}_2)_2$	7803-54-5	56.350	wh powder; f am		dec		1.39	react H_2O
1302	Magnesium antimonide	Mg_3Sb_2	12057-75-9	316.435	hex cry	1245			3.99	
1303	Magnesium boride	MgB_2	12007-25-9	45.927	hex cry	800	dec		2.57	
1304	Magnesium bromate hexahydrate	$\text{Mg}(\text{BrO}_3)_2 \cdot 6\text{H}_2\text{O}$	7789-36-8	388.201	colcub cry	200	dec		2.29	98 ²⁵
1305	Magnesium bromide	MgBr_2	7789-48-2	184.113	wh hex cry; hyg	711			3.72	102 ²⁵
1306	Magnesium bromide hexahydrate	$\text{MgBr}_2 \cdot 6\text{H}_2\text{O}$	13446-53-2	292.204	colmonocry	165	dec		2.0	102 ²⁵ s EDH
1307	Magnesium carbonate	MgCO_3	546-93-0	84.314	wh hex cry	990			3.05	0.18 ²⁰ i EDH; s acid
1308	Magnesium chlorate hexahydrate	$\text{Mg}(\text{ClO}_3)_2 \cdot 6\text{H}_2\text{O}$	13446-19-0	299.298	wh hyg cry	≈35	dec		1.80	142 ²⁵ slEDH
1309	Magnesium chloride	MgCl_2	7786-30-3	95.210	wh hex leaf bb; hyg	714	1412		2.325	56.0 ²⁵
1310	Magnesium chloride hexahydrate	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$	7791-18-6	203.301	wh hyg cry	≈100	dec		1.56	56.0 ²⁵ s EDH
1311	Magnesium chromate heptahydrate	$\text{MgCrO}_4 \cdot 7\text{H}_2\text{O}$	13423-61-5*	266.405	yelrhomb cry				1.695	54.8 ²⁵
1312	Magnesium fluoride	MgF_2	7783-40-6	62.302	wh lt cry	1263	2227		3.148	0.013 ²⁵
1313	Magnesium formate dihydrate	$\text{Mg}(\text{CHO}_2)_2 \cdot 2\text{H}_2\text{O}$	6150-82-9	150.370	wh cry		dec			s H_2O ; i EDH
1314	Magnesium germanide	Mg_2Ge	1310-52-7	121.22	cub cry	1117			3.09	
1315	Magnesium hydride	MgH_2	7693-27-8	26.321	wh lt cry	327			1.45	react H_2O
1316	Magnesium hydrogen phosphate trihydrate	$\text{MgHPO}_4 \cdot 3\text{H}_2\text{O}$	7757-86-0	174.331	wh powder	550	dec		2.13	sl H_2O ; s dilacid
1317	Magnesium hydroxide	$\text{Mg}(\text{OH})_2$	1309-42-8	58.320	wh hex cry	350			2.37	0.00069 ²⁰ s dilacid
1318	Magnesium iodate tetrahydrate	$\text{Mg}(\text{IO}_3)_2 \cdot 4\text{H}_2\text{O}$	7790-32-1*	446.172	colmono cry	210	dec		3.3	11.1 ²⁵
1319	Magnesium iodide	MgI_2	10377-58-9	278.114	wh hex cry; hyg	634			4.43	146 ²⁵
1320	Magnesium iodide octahydrate	$\text{MgI}_2 \cdot 8\text{H}_2\text{O}$	7790-31-0	422.236	wh orb cry; hyg	41	dec		2.10	146 ²⁵ s EDH
1321	Magnesium nitrate	$\text{Mg}(\text{NO}_3)_2$	10377-60-3	148.314	wh cub cry				≈2.3	71.2 ²⁵
1322	Magnesium nitrate dihydrate	$\text{Mg}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$	15750-45-5	184.345	wh cry	≈100	dec		1.45	71.2 ²⁵ s EDH
1323	Magnesium nitrate hexahydrate	$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	13446-18-9	256.406	colmonocry; hyg	≈95	dec		1.46	71.2 ²⁵ s EDH
1324	Magnesium nitride	Mg_3N_2	12057-71-5	100.928	yelcub cry	≈1500	dec		2.71	
1325	Magnesium nitrite trihydrate	$\text{Mg}(\text{NO}_2)_2 \cdot 3\text{H}_2\text{O}$	15070-34-5	170.362	wh hyg prisms	100	dec			129.9 ²⁵ s EDH
1326	Magnesium oxalate	MgC_2O_4	547-66-0	112.324	wh pdw					0.038 ²⁵
1327	Magnesium oxalate dihydrate	$\text{MgC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	6150-88-5	148.354	wh powder					0.038 ²⁵ i EDH; s dilacid
1328	Magnesium oxide	MgO	1309-48-4	40.304	wh cub cry	2825	3600		3.6	sl H_2O ; i EDH
1329	Magnesium perchlorate	$\text{Mg}(\text{ClO}_4)_2$	10034-81-8	223.205	wh hyg powder	250	dec		2.2	100 ²⁵
1330	Magnesium perchlorate hexahydrate	$\text{Mg}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$	13446-19-0	331.297	wh hyg cry	190	dec		1.98	100 ²⁵ s EDH
1331	Magnesium permanganate hexahydrate	$\text{Mg}(\text{MnO}_4)_2 \cdot 6\text{H}_2\text{O}$	10377-62-5	370.268	blue-bk cry		dec		2.18	H_2O
1332	Magnesium peroxide	MgO_2	1335-26-8	56.304	wh cub cry	100	dec		≈3.0	i H_2O ; s dilacid
1333	Magnesium phosphate pentahydrate	$\text{Mg}_3(\text{PO}_4)_2 \cdot 5\text{H}_2\text{O}$	7757-87-1*	352.934	wh cry	400	dec			0.00009 ²⁰ s dilacid
1334	Magnesium phosphate octahydrate	$\text{Mg}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$	13446-23-6	406.980	wh monocry				2.17	0.00009 ²⁰ s acid
1335	Magnesium pyrophosphate trihydrate	$\text{Mg}_2\text{P}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$	10102-34-8	276.600	wh powder	100	dec		2.56	i H_2O ; s acid
1336	Magnesium phosphide	Mg_3P_2	12057-74-8	134.863	yelcub cry				2.06	react H_2O
1337	Magnesium selenate hexahydrate	$\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$	13446-28-1	275.35	wh monocry				1.928	55.5 ²⁵
1338	Magnesium selenide	MgSe	1313-04-8	103.27	brn cub cry				4.2	react H_2O
1339	Magnesium selenite hexahydrate	$\text{MgSeO}_3 \cdot 6\text{H}_2\text{O}$	15593-61-0	259.36	colhex cry				2.09	i H_2O ; s dilacid
1340	Magnesium silicate	MgSiO_3	13776-74-4	100.389	wh monocry	≈1550	dec		3.19	i H_2O ; slHF
1341	Magnesium orthosilicate	Mg_2SiO_4	26686-77-1	140.694	wh orb cry	1897			3.21	i H_2O
1342	Magnesium tetrasilicate	$\text{Mg}_2\text{Si}_3\text{O}_8$	14987-04-3	260.862	wh pow					i H_2O ; EDH

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1343	Magnesium hexafluorosilicate hexahydrate	MgSiF ₆ · 6H ₂ O	60950-56-3	274.472	wh cry	120 dec		1.79	39.3 ¹⁸	i EOH
1344	Magnesium silicide	Mg ₂ Si	22831-39-6	76.696	gray cub cry	1102		1.99		reac H ₂ O
1345	Magnesium stannide	Mg ₂ Sn	1313-08-2	167.320	blue cub cry	771		3.60		s H ₂ O, dilHCl
1346	Magnesium sulfate	MgSO ₄	7487-88-9	120.369	colorh cry	1127		2.66	35.7 ²⁵	
1347	Magnesium sulfate monohydrate	MgSO ₄ · H ₂ O	14168-73-1	138.384	colmonoclcry	150 dec		2.57	35.7 ²⁵	
1348	Magnesium sulfate heptahydrate	MgSO ₄ · 7H ₂ O	10034-99-8	246.475	colorh cry	150 dec		1.67	35.7 ²⁵	s EOH
1349	Magnesium sulfide	MgS	12032-36-9	56.371	red-brn cub cry	2226		2.68		reac H ₂ O
1350	Magnesium sulfate trihydrate	MgSO ₄ · 3H ₂ O	19086-20-5	158.415	colorh cry			2.12	0.79 ²⁵	
1351	Magnesium sulfate hexahydrate	MgSO ₄ · 6H ₂ O	13446-29-2	212.461	wh hex cry	200 dec		1.72	0.79 ²⁵	i EOH
1352	Magnesium biosulfate hexahydrate	Mg ₂ O ₃ · 6H ₂ O	13446-30-5	244.527	colcry	170 dec		1.82	93 ²⁵	i EOH
1353	Magnesium titanate	MgTiO ₃	1312-99-8	120.170	colhex cry	1565		3.85		
1354	Magnesium tungstate	MgWO ₄	13573-11-0	272.14	wh monoclcry			6.89	0.016 ²⁰	i EOH
1355	Manganese	Mn	7439-96-5	54.938	hard gray metal	1246	2061	7.3		s dilacids
1356	Manganese antimonide	MnSb	12032-82-5	176.698	hex cry	840		6.9		
1357	Manganese antimonide	Mn ₂ Sb	12032-97-2	231.636	bt cry	948		7.0		
1358	Manganese boride	MnB	12045-15-7	65.749	orb cry	1890		6.45		
1359	Manganese boride	MnB ₂	12228-50-1	76.560	hex cry	1827		5.3		
1360	Manganese boride	Mn ₂ B	12045-16-8	120.687	red-brn bt cry	1580		7.20		
1361	Manganese carbide	Mn ₃ C	12266-65-8	176.825	ref rac sold	1520		6.89		
1362	Manganese carbonyl	Mn ₂ (CO) ₁₀	10170-69-1	389.977	yelmonoclcry	154		1.75		i H ₂ O; s os
1363	Manganese phosphide	MnP	12032-78-9	85.912	orb cry	1147		5.49		
1364	Manganese phosphide	Mn ₂ P	12333-54-9	140.850	hex cry	1327		6.0		
1365	Manganese(II) acetate tetrahydrate	Mn(C ₂ H ₃ O ₂) ₂ · 4H ₂ O	6156-78-1	245.087	red monoclcry	80		1.59		s H ₂ O, EDH
1366	Manganese(II) tetraborate octahydrate	MnB ₄ O ₇ · 8H ₂ O	12228-91-0	354.300	red sold					i H ₂ O, EDH; s dilacid
1367	Manganese(II) bromide	MnBr ₂	13446-03-2	214.746	pink hex cry	698		4.385	151 ²⁵	
1368	Manganese(II) bromide tetrahydrate	MnBr ₂ · 4H ₂ O	10031-20-6	286.808	red hyg cry	64 dec			151 ²⁵	
1369	Manganese(II) carbonate	MnCO ₃	598-62-9	114.947	pink hex cry	>200 dec		3.70	0.00008 ²⁰	s dilacid
1370	Manganese(II) chloride	MnCl ₂	7773-01-5	125.843	pink tig cry; hyg	650	1190	2.977	77.3 ²⁵	s py, EDH; i et
1371	Manganese(II) chloride tetrahydrate	MnCl ₂ · 4H ₂ O	13446-34-9	197.905	red monoclcry; hyg	87.5		1.913	77.3 ²⁵	s EDH; i et
1372	Manganese(II) dihydrogen phosphate dihydrate	Mn(H ₂ PO ₄) ₂ · 2H ₂ O	18718-07-5	284.944	colhyg cry					s H ₂ O; i EOH
1373	Manganese(II) fluoride	MnF ₂	7782-64-1	92.935	red bt cry	930		3.98	1.02 ²⁵	i EOH
1374	Manganese(II) hydroxide	Mn(OH) ₂	18933-05-6	88.953	pink hex cry	dec		3.26	0.00034 ²⁰	
1375	Manganese(II) iodide	MnI ₂	7790-33-2	308.747	wh hex cry; hyg	638		5.04		s H ₂ O, EDH
1376	Manganese(II) iodide tetrahydrate	MnI ₂ · 4H ₂ O	7790-33-2*	380.809	red cry					vs H ₂ O; s EDH
1377	Manganese(II) molybdate	MnMoO ₄	14013-15-1	214.88	yelmonoclcry			4.05		
1378	Manganese(II) nitrate	Mn(NO ₃) ₂	10377-93-2	178.948	colorh cry; hyg			2.2	161 ²⁵	s diox, hf
1379	Manganese(II) nitrate hexahydrate	Mn(NO ₃) ₂ · 6H ₂ O	10377-66-9	287.040	rose monoclcry	28 dec		1.8	161 ²⁵	vs EDH
1380	Manganese(II) nitrate tetrahydrate	Mn(NO ₃) ₂ · 4H ₂ O	20694-39-7	251.010	pink hyg cry	37.1 dec		2.13	161 ²⁵	s EDH
1381	Manganese(II) oxalate dihydrate	MnC ₂ O ₄ · 2H ₂ O	6556-16-7	178.987	wh cry powder	150 dec		2.45	0.032 ²⁰	s acid
1382	Manganese(II) oxide	MnO	1344-43-0	70.937	gr cub cry or powder	1839		5.37		i H ₂ O; s acid
1383	Manganese(II) perchlorate hexahydrate	Mn(ClO ₄) ₂ · 6H ₂ O	15364-94-0	361.930	pink hex cry			2.10		
1384	Manganese(II) pyrophosphate	Mn ₂ P ₂ O ₇	53731-35-4	283.819	wh monoclcry	1196		3.71		i H ₂ O
1385	Manganese(II) metasilicate	MnSiO ₃	7759-00-4	131.022	red orb cry	1291		3.48		i H ₂ O
1386	Manganese(II) orthosilicate	Mn ₂ SiO ₄	13568-32-6	201.960	orb cry			4.11		i H ₂ O
1387	Manganese(II) selenide	MnSe	1313-22-0	133.90	gray cub cry	1460		5.45		i H ₂ O

1388	Manganese(II) sulfat	MnSO ₄	7785-87-7	151.002	wh orth cry	700	850 dec	3.25	63.7 ²⁵	
1389	Manganese(II) sulfat monohydrat	MnSO ₄ · H ₂ O	10034-96-5	169.017	red monoclcry			2.95	63.7 ²⁵	i EDH
1390	Manganese(II) sulfat tetrahydrat	MnSO ₄ · 4H ₂ O	10101-68-5	223.063	red monoclcry	38 dec		2.26	63.7 ²⁵	i EDH
1391	Manganese(II) sulfid (α f orm)	MnS	18820-29-6	87.004	grn cub cry	1610		4.0		i H ₂ O; s dilacid
1392	Manganese(II) sulfid (β f orm)	MnS	18820-29-6	87.004	red cub cry			3.3		i H ₂ O; s dilacid
1393	Manganese(II) sulfid (γ f orm)	MnS	18820-29-6	87.004	red hex cry			≈3.3		i H ₂ O; s dilacid
1394	Manganese(II) telurid	MnTe	12032-88-1	182.54	hex cry	≈1150		6.0		
1395	Manganese(II) titanat	MnTiO ₃	12032-74-5	150.803	red hex cry	1360		4.55		
1396	Manganese(II) tungstt	MnWO ₄	13918-22-4	302.78	wh monoclcry			7.2	0.0054 ²⁰	
1397	Manganese(II,III) oxid	Mn ₂ O ₃	1317-35-7	228.812	brn tt cry	1567		4.84		i H ₂ O; s HCl
1398	Manganese(III) fluorid	MnF ₃	7783-53-1	111.933	red monoclcry; hyg	>600 dec		3.54		reac H ₂ O
1399	Manganese(III) hydroxid	MnO(OH)	1332-63-4	87.945	bk monoclcry	250 dec		≈4.3		i H ₂ O
1400	Manganese(III) oxid	Mn ₂ O ₃	1317-34-6	157.874	bk cub cry	1080 dec		≈5.0		i H ₂ O
1401	Manganese(IV) oxid	MnO ₂	1313-13-9	86.937	bk tt cry	535 dec		5.08		i H ₂ O, HNO ₃
1402	Manganese(VII) oxid	Mn ₂ O ₇	12057-92-0	221.872	grn oil exp	5.9	95 exp	2.40		vs H ₂ O
1403	Mendelevium	Md	7440-11-1	258	Metal	827				
1404	Mercury	Hg	7439-97-6	200.59	heavy silv liq	-38.837 p	356.73	13.5336		i H ₂ O
1405	Mercury(I) acetat	Hg ₂ (C ₂ H ₃ O ₂) ₂	631-60-7	519.27	colscabs	dec				slH ₂ O; i EDH, eh
1406	Mercury(I) bromat	Hg ₂ (BrO ₃) ₂	13465-33-3	656.98	colcry	dec				i H ₂ O; slacid
1407	Mercury(I) bromid	Hg ₂ Br ₂	15385-58-7	560.99	wh tt cry or powder	407		7.307		i H ₂ O, EDH, eh
1408	Mercury(I) carbonat	Hg ₂ CO ₃	6824-78-8	461.19	yelbrn cry	130 dec			0.0000045	i EDH
1409	Mercury(I) chbrat	Hg ₂ (CO ₃) ₂	10294-44-7	568.08	wh rhom cry	≈250 dec		6.409		slH ₂ O; s EDH
1410	Mercury(I) chlrid	Hg ₂ Cl ₂	10112-91-1	472.09	wh tt cry	525 p	383 sp	7.16	0.0004 ²⁵	i EDH, eh
1411	Mercury(I) fluorid	Hg ₂ F ₂	13967-25-4	439.18	yelcub cry	570 dec	subl	8.73		reac H ₂ O
1412	Mercury(I) iodid	Hg ₂ I ₂	15385-57-6	654.99	yelamorp powder	290		7.70		i H ₂ O, EDH, eh
1413	Mercury(I) nitat	Hg ₂ (NO ₃) ₂	10415-75-5	525.19	cry					slH ₂ O
1414	Mercury(I) nitat dihydrat	Hg ₂ (NO ₃) ₂ · 2H ₂ O	7782-86-7	561.22	colcry	70 dec		4.8		slH ₂ O
1415	Mercury(I) nitit	Hg ₂ (NO ₂) ₂	13492-25-6	493.19	yelcry	100 dec		7.3		reac H ₂ O
1416	Mercury(I) oxalat	Hg ₂ C ₂ O ₄	2949-11-3	489.20	cry					i H ₂ O; slHNO ₃
1417	Mercury(I) oxid	Hg ₂ O	15829-53-5	417.18	prob mixture of HgO+Hg	100 dec		9.8		i H ₂ O; s HNO ₃
1418	Mercury(I) perchbrat tetrahydrat	Hg ₂ (CO ₃) ₂ · 4H ₂ O	65202-12-2	672.14	cry	64			44 ²⁵	
1419	Mercury(I) sulfat	Hg ₂ SO ₄	7783-36-0	497.24	wh-yelcry powder			7.56	0.051 ²⁵	s dilHNO ₃
1420	Mercury(I) thiocyanat	Hg ₂ (SCN) ₂	517.35	colpow	dec				0.03 ²⁵	s HCl KCNS
1421	Mercury(I) tungstt	Hg ₂ WO ₄	38705-19-0	649.02	yelamorp sold	dec				i H ₂ O, EDH
1422	Mercury(II) acetat	Hg(C ₂ H ₃ O ₂) ₂	1600-27-7	318.68	wh-yelcry or powder	179 dec		3.28	25 ¹⁰	s EDH
1423	Mercury(II) amid chlrid	Hg(NH ₂)Cl	10124-48-8	252.07	wh sold		subl	5.38		i H ₂ O, EDH; s warm acid
1424	Mercury(II) bromat	Hg(BrO ₃) ₂	26522-91-8	456.39	cry	130 dec			0.15	s acid
1425	Mercury(II) bromid	HgBr ₂	7789-47-1	360.40	wh rhomb cry or powder	236	322	6.05	0.61 ²⁵	slchl s EDH, MeOH
1426	Mercury(II) chbrat	Hg(CO ₃) ₂	367.49	wh needls	dec			4.998	25	
1427	Mercury(II) chlrid	HgCl ₂	7487-94-7	271.50	wh orth cry	276	304	5.6	7.31 ²⁵	slbz; s EDH, MeOH, ace, eh
1428	Mercury(II) chromat	HgCrO ₄	13444-75-2	316.58	red monoclcry			6.06		slH ₂ O
1429	Mercury(II) cyanid	Hg(CN) ₂	592-04-1	252.62	coltt cry	320 dec		4.00	11.4 ²⁵	s EDH; sleh
1430	Mercury(II) dichromat	HgCr ₂ O ₇	7789-10-8	416.58	red cry powder					i H ₂ O; s acid
1431	Mercury(II) fluorid	HgF ₂	7783-39-3	238.59	wh cub cry; hyg	645 dec		8.95		reac H ₂ O
1432	Mercury(II) fulminat	Hg(CNO) ₂	628-86-4	284.62	gray cry	exp		4.42		slH ₂ O; s EDH, NH ₄ OH
1433	Mercury(II) hydrogen arsenat	HgHAsO ₄	7784-37-4	340.52	yelpowder					i H ₂ O; s acid
1434	Mercury(II) iodat	Hg(IO ₃) ₂	7783-32-6	550.40	wh powder	175 dec				i H ₂ O
1435	Mercury(II) iodid	HgI ₂	7774-29-0	454.40	red tt cry or powder	259	354	6.28	0.0055 ²⁵	slEDH, ace, eh

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1436	Mercury(II) nitrate	Hg(NO ₃) ₂	10045-94-0	324.60	col hyg cry	79		4.3		s H ₂ O; i EOH
1437	Mercury(II) nitrate dihydrate	Hg(NO ₃) ₂ · 2H ₂ O	10045-94-0*	360.63	monocry			4.78		s H ₂ O
1438	Mercury(II) nitrate monohydrate	Hg(NO ₃) ₂ · H ₂ O	7783-34-8	342.62	wh-yel hyg cry			4.3		s H ₂ O, dil acid
1439	Mercury(II) oxalate	HgC ₂ O ₄	3444-13-1	288.61	pwd	165 dec				i H ₂ O
1440	Mercury(II) oxide	HgO	21908-53-2	216.59	red or yel orth cry	500 dec		11.14		i H ₂ O, EOH; s dil acid
1441	Mercury(II) oxide sulfite	(Hg ₂ O ₂)SO ₄	1312-03-4	729.83	yelpow					i H ₂ O; s acid
1442	Mercury(II) oxycyanide	Hg(CN) ₂ · HgO	1335-31-5	469.21	wh orth cry	exp		4.44	11.4 ²⁵	
1443	Mercury(II) perchlorate trihydrate	Hg(ClO ₄) ₂ · 3H ₂ O	7616-83-3	453.54	cry					
1444	Mercury(II) phosphate	Hg ₃ (PO ₄) ₂	7782-66-3	791.71	wh-yel powder					i H ₂ O, EOH; s acid
1445	Mercury(II) selenide	HgSe	20601-83-6	279.55	gray cub cry		subl	8.21		i H ₂ O
1446	Mercury(II) sulfate	HgSO ₄	7783-35-9	296.65	wh monocry			6.47		reac H ₂ O
1447	Mercury(II) sulfide (black)	HgS	1344-48-5	232.66	bk cub cry or powder	850		7.70		i H ₂ O; s acid, EOH
1448	Mercury(II) sulfide (red)	HgS	1344-48-5	232.66	red hex cry	tans b bk HgS 344		8.17		i H ₂ O, acid; s aqua regia
1449	Mercury(II) telluride	HgTe	12068-90-5	328.19	gray cub cry	673		8.63		
1450	Mercury(II) thiocyanate	Hg(SCN) ₂	592-85-8	316.76	monocry	≈165 dec		3.71	0.070 ²⁵	s dil HCl
1451	Mercury(II) tungstate	HgWO ₄	37913-38-5	448.43	yel cry	dec				i H ₂ O, EOH
1452	Molybdenum	Mo	7439-98-7	95.94	gray-bk metal cub	2623	4639	10.2		i H ₂ O, dil acid, ak
1453	Molybdenum boride	Mo ₂ B	12006-99-4	202.69	ref rac bk cry	2000		9.2		
1454	Molybdenum boride	Mo ₂ B ₃	12007-97-5	245.94	ref rac hex cry	1600		≈7.2		
1455	Molybdenum carbide	MoC	12011-97-1	107.95	ref rac solid; cub	2577				
1456	Molybdenum carbide	Mo ₂ C	12069-89-5	203.89	gray orth cry	2687		9.18		
1457	Molybdenum hexacarbonyl	Mo(CO) ₆	13939-06-5	264.00	wh orth cry	148	155 dec	1.96		i H ₂ O; s bz; sleh
1458	Molybdenum nitride	MoN	12033-19-1	109.95	hex cry	1750		9.20		
1459	Molybdenum nitride	Mo ₂ N	12033-31-7	205.89	gray cub cry	790 dec		9.46		
1460	Molybdenum phosphide	MoP	12163-69-8	126.91	bk hex cry			7.34		
1461	Molybdenum silicide	MoSi ₂	12136-78-6	152.11	gray bk cry	≈1900		6.2		i H ₂ O; s HF
1462	Molybdenum(II) bromide	MoBr ₂	13446-56-5	255.75	yel-red cry	900 dec				
1463	Molybdenum(II) chloride	MoCl ₂	13478-17-6	166.85	yel cry	530 dec				
1464	Molybdenum(II) iodide	MoI ₂	14055-74-4	349.75	bk hyg cry			5.278		
1465	Molybdenum(III) bromide	MoBr ₃	13446-57-6	335.65	grn hex cry	977		4.89		i H ₂ O
1466	Molybdenum(III) chloride	MoCl ₃	13478-18-7	202.30	dark red monocry	1027		3.74		i H ₂ O
1467	Molybdenum(III) fluoride	MoF ₃	20193-58-2	152.94	brn hex cry	>600		4.64		i H ₂ O
1468	Molybdenum(III) iodide	MoI ₃	14055-75-5	476.65	bk solid	927				i H ₂ O
1469	Molybdenum(III) oxide	Mo ₂ O ₃	1313-29-7	239.88	gray-bk powder					i H ₂ O; sl acid
1470	Molybdenum(IV) bromide	MoBr ₄	13520-59-7	415.56	bk cry	dec				reac H ₂ O
1471	Molybdenum(IV) chloride	MoCl ₄	13320-71-3	237.75	bk cry	>170 dec				reac H ₂ O
1472	Molybdenum(IV) fluoride	MoF ₄	23412-45-5	171.93	grn cry	dec				reac H ₂ O
1473	Molybdenum(IV) oxide	MoO ₂	18868-43-4	127.94	brn-violet cry	≈1100 dec		6.47		s H ₂ O
1474	Molybdenum(IV) selenide	MoSe ₂	12058-18-3	253.86	gray hex cry	>1200		6.90		
1475	Molybdenum(IV) sulfide	MoS ₂	1317-33-5	160.07	bk powder or hex cry	1750		5.06		i H ₂ O; s conc acid
1476	Molybdenum(IV) telluride	MoTe ₂	12058-20-7	351.14	gray hex cry			7.7		
1477	Molybdenum(V) chloride	MoCl ₅	10241-05-1	273.20	gr-bk monocry; hyg	194	268	2.93		s EOH, eh
1478	Molybdenum(V) fluoride	MoF ₅	13819-84-6	190.93	yel monocry	67	213.6	3.5		
1479	Molybdenum(V) oxytetrachloride	MoOCl ₃	13814-74-9	218.30	bk monocry	297	subl			reac H ₂ O
1480	Molybdenum(VI) acid monohydrate	H ₂ MoO ₄ · H ₂ O	7782-91-4	179.97	wh powder			3.1		s H ₂ O; s ak

1481	Molybdenum(VI) fluoride	MoF ₆	7783-77-9	209.93	wh cub cry or collq; hyg	17.5	34.0	2.54		reac H ₂ O
1482	Molybdenum(VI) oxytetrafluoride	MoOF ₄	14459-59-7	187.93	volatile solid	98	186.0			
1483	Molybdenum(VI) oxytetrachloride	MoOCl ₄	13814-75-0	253.75	grn hyg powder	101				
1484	Molybdenum(VI) dioxidichloride	MoO ₂ Cl ₂	13637-68-8	198.84	yellow solid	≈175		3.31		reac H ₂ O
1485	Molybdenum(VI) oxide	MoO ₃	1313-27-5	143.94	wh-yellow rhomb cry	801	1155	4.70	0.14 ²⁰	s conc acid
1486	Molybdenum(VI) metaphosphate	Mo(PO ₃) ₆	133863-98-6	569.77	yellow powder			3.28		i H ₂ O, acid
1487	Neodymium	Nd	7440-00-8	144.24	silv metal hex	1021	3074	7.01		
1488	Neodymium boride	NdB ₆	12008-23-0	209.11	bk cub cry	2610		4.93		
1489	Neodymium bromide	NdBr ₃	13536-80-6	383.95	viol or h cry; hyg	682	1540	5.3		s H ₂ O
1490	Neodymium chloride	NdCl ₃	10024-93-8	250.60	viol hex cry	758	1600	4.13	100 ²⁵	vs EDH; i et, chl
1491	Neodymium chloride hexahydrate	NdCl ₃ · 6H ₂ O	13477-89-9	358.69	purp cry	124 dec		2.3	100 ²⁵	s EDH
1492	Neodymium fluoride	NdF ₃	13709-42-7	201.24	viol hex cry; hyg	1377	2300	6.51		i H ₂ O
1493	Neodymium iodide	NdI ₃	13813-24-6	524.95	grn orth cry; hyg	784		5.85		s H ₂ O
1494	Neodymium nitrate	Nd(NO ₃) ₃	10045-95-1	330.26	viol hyg. cry				152 ²⁵	s EDH
1495	Neodymium nitrate hexahydrate	Nd(NO ₃) ₃ · 6H ₂ O	14517-29-4	438.35	purp hyg cry				152 ²⁵	s EDH, ace
1496	Neodymium nitride	NdN	25764-11-8	158.25	bk cub cry			7.69		
1497	Neodymium oxide	Nd ₂ O ₃	1313-97-9	336.48	blue hex cry; hyg	2233	3760	7.24		i H ₂ O; s dilacid
1498	Neodymium sulfate	Nd ₂ (SO ₄) ₃	13477-91-3	576.67	pink needles	≈700 dec			7.1 ²⁰	
1499	Nickel(II) perchlorate hexahydrate	Ni(ClO ₄) ₂ · 6H ₂ O	13637-71-3*	365.685	grn hex needles	140			158.8 ²⁵	s EDH, ace
1500	Neodymium sulfide	Nd ₂ S ₃	12035-32-4	384.68	orth cry	2207		5.46		
1501	Nickel(II) phosphate octahydrate	Ni ₃ (PO ₄) ₂ · 8H ₂ O	10381-36-9*	510.145	grn plates					s acid
1502	Nickel(II) selenate hexahydrate	NiSeO ₄ · 6H ₂ O	15060-62-5*	309.74	grn br cry			2.314	35.5 ²⁰	
1503	Neodymium telluride	Nd ₂ Te ₃	12035-35-7	671.28	gray orth cry	1377		7.0		
1504	Neon	Ne	7440-01-9	20.180	col gas	-248.61 b (43 kPa)	-246.08	0.825 g/L		sl H ₂ O
1505	Neptunium	Np	7439-99-8	237	silv metal	644		20.2		s HCl
1506	Neptunium(IV) oxide	NpO ₂	12035-79-9	269	grn cub cry	2547		11.1		
1507	Nickel	Ni	7440-02-0	58.693	wh metal cub	1455	2913	8.90		i H ₂ O; s dilacid
1508	Nickel antimonide	NiSb	12035-52-8	180.453	hex cry	1147		8.74		
1509	Nickel arsenide	NiAs	27016-75-7	133.615	hex cry	967		7.77		
1510	Nickel boride	Ni ₃ B	12007-02-2	186.891	ref rac sold	1156		8.17		
1511	Nickel boride	NiB	12007-00-0	69.504	grn ref rac sold	1035		7.13		
1512	Nickel boride	Ni ₂ B	12007-01-1	128.198	ref rac sold	1125		7.90		
1513	Nickel carbonyl	Ni(CO) ₄	13463-39-3	170.734	collq	-19.3	43 (exp =60)	1.31		i H ₂ O; s EDH, bz, ace, ct
1514	Nickel phosphide	Ni ₃ P	12035-64-2	148.361	hex cry	1100		7.33		
1515	Nickel silicide	Ni ₂ Si	12059-14-2	145.473	orth cry	1255		7.40		
1516	Nickel silicide	NiSi ₂	12201-89-7	114.864	cub cry	993		4.83		
1517	Nickel(II) ammonium sulfate hexahydrate	Ni(NH ₄) ₂ (SO ₄) ₂ · 6H ₂ O	15699-18-0	394.989	blue-grn cry			1.923	6.5 ²⁰	i EDH
1518	Nickel(II) arsenate octahydrate	Ni ₃ (AsO ₄) ₂ · 8H ₂ O	7784-48-7	598.040	yellow powder	dec		4.98		i H ₂ O; s acid
1519	Nickel(II) bromide	NiBr ₂	13462-88-9	218.501	yellow cry; hyg	963	subl	5.10	131 ²⁰	
1520	Nickel(II) bromide trihydrate	NiBr ₂ · 3H ₂ O	13462-88-9*	272.547	yellow hyg cry	200 dec				vs H ₂ O; s EDH, et
1521	Nickel(II) carbonate	NiCO ₃	3333-67-3	118.702	grn rhomb cry			4.39	0.0043 ²⁰	s dilacid
1522	Nickel(II) chloride	NiCl ₂	7718-54-9	129.598	yellow cry; hyg	1009 b	985 sp	3.51	67.5 ²⁵	s EDH
1523	Nickel(II) chloride hexahydrate	NiCl ₂ · 6H ₂ O	7791-20-0	237.689	grn monocry				67.5 ²⁵	s EDH
1524	Nickel(II) cyanide tetrahydrate	Ni(CN) ₂ · 4H ₂ O	13477-95-7	182.789	grn plates	200 dec				i H ₂ O; s dilacid; s NH ₄ OH
1525	Nickel(II) fluoride	NiF ₂	10028-18-9	96.690	yellow cry	1474		4.7	2.56 ²⁵	i EDH, et
1526	Nickel(II) hydroxide	Ni(OH) ₂	12054-48-7	92.708	grn hex cry	230 dec		4.1	0.00015 ²⁰	
1527	Nickel(II) hydroxide monohydrate	Ni(OH) ₂ · H ₂ O	36897-37-7	110.723	grn powder				0.00015 ²⁰	s dilacid
1528	Nickel(II) iodate	Ni(IO ₃) ₂	13477-98-0	408.498	yellow needles			5.07	1.1 ³⁰	

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1529	Nicke(II) iodide	NiI ₂	13462-90-3	312.502	bk hex cry; hyg	780	subl	5.22	154 ²⁵	
1530	Nicke(II) iodide hexahydrat	NiI ₂ · 6H ₂ O	7790-34-3	420.593	grn monoclcry; hyg				154 ²⁵	vs EOH
1531	Nicke(II) nitat	Ni(NO ₃) ₂	13138-45-9	182.702	grn cry				99.2 ²⁵	s EOH
1532	Nicke(II) nitat hexahydrat	Ni(NO ₃) ₂ · 6H ₂ O	13478-00-7	290.794	grn monoclcry; hyg	56 dec		2.05	99.2 ²⁵	s EDH
1533	Nicke(II) oxide	NiO	1313-99-1	74.692	grn cub cry	1955		6.72		i H ₂ O; s acid
1534	Nicke(II) selenide	NiSe	1314-05-2	137.65	yelgrn hex cry	980		7.2		
1535	Nicke(II) sulfat	NiSO ₄	7786-81-4	154.757	grn-yel orth cry	840 dec		4.01	40.4 ²⁵	
1536	Nicke(II) sulfat heptahydrat	NiSO ₄ · 7H ₂ O	10101-98-1	280.863	grn orth cry			1.98	40.4 ²⁵	s EDH
1537	Nicke(II) sulfat hexahydrat	NiSO ₄ · 6H ₂ O	10101-97-0	262.848	blue-grn et cry	≈100 dec		2.07	40.4 ²⁵	sl EDH
1538	Nicke(II) sulfide	NiS	16812-54-7	90.759	yel hex cry	976		5.5		i H ₂ O
1539	Nicke(II) thiocyanat	Ni(SCN) ₂	13689-92-4	174.859	grn pwd				55.0 ²⁵	
1540	Nicke(II) titanat	NiTiO ₃	12035-39-1	154.558	brn hex cry			5.0		
1541	Nicke(II,III) sulfide	Ni ₃ S ₄	12137-12-1	304.344	cub cry	995		4.77		
1542	Nicke(III) oxide	Ni ₂ O ₃	1314-06-3	165.385	gray-bk cub cry	≈600 dec				i H ₂ O; s hotacid
1543	Nicke(III) sulfide	Ni ₃ S ₂	12035-72-2	240.212	hex cry	787		5.87		
1544	Niobium	Nb	7440-03-1	92.906	gray metl cub	2477	4744	8.57		i acid
1545	Niobium boride	NbB	12045-19-1	103.717	gray orth cry	2270		7.5		
1546	Niobium boride	NbB ₂	12007-29-3	114.528	gray hex cry	3050		6.97		
1547	Niobium carbide	NbC	12069-94-2	104.917	gray cub cry	3608	4300	7.82		i H ₂ O, acid
1548	Niobium carbide	Nb ₂ C	12011-99-3	197.824	ref rac hex cry	3080		7.8		i H ₂ O
1549	Niobium nitride	NbN	24621-21-4	106.913	gray cry; cub	2300		8.47		i HCl acid
1550	Niobium phosphide	NbP	12034-66-1	123.880	et cry			6.5		
1551	Niobium silicide	NbSi ₂	12034-80-9	149.077	gray hex cry	1950		5.7		
1552	Niobium(II) oxide	NbO	12034-57-0	108.905	gray cub cry	1936		7.30		
1553	Niobium(III) bromide	NbBr ₃	15752-41-7	332.618	dark brn sold		subl			
1554	Niobium(III) chloride	NbCl ₃	13569-59-0	199.264	bk sold					
1555	Niobium(III) fluoride	NbF ₃	15195-53-6	149.901	blue cub cry			4.2		
1556	Niobium(IV) chloride	NbCl ₄	13569-70-5	234.717	violbk monoclcry		275 subl	3.2		
1557	Niobium(IV) fluoride	NbF ₄	13842-88-1	168.900	bk et cry; hyg	>350 dec		4.01		
1558	Niobium(IV) iodide	NbI ₄	13870-21-8	600.524	gray orth cry	503		5.6		
1559	Niobium(IV) oxide	NbO ₂	12034-59-2	124.905	wh et cry or powder	1901		5.9		
1560	Niobium(IV) selenide	NbSe ₂	12034-77-4	250.83	gray hex cry	>1300		6.3		
1561	Niobium(IV) sulfide	NbS ₂	12136-97-9	157.038	bk rhomb cry			4.4		
1562	Niobium(IV) telluride	NbTe ₂	12034-83-2	348.11	hex cry			7.6		
1563	Niobium(V) bromide	NbBr ₅	13478-45-0	492.426	oran orth cry	254	360	4.36		s H ₂ O, EOH
1564	Niobium(V) chloride	NbCl ₅	10026-12-7	270.170	yel monoclcry; hyg	204.7	254.0	2.78		reac H ₂ O; s HCl ct
1565	Niobium(V) fluoride	NbF ₅	7783-68-8	187.898	col monoclcry; hyg	80	229	2.70		reac H ₂ O; sl CS ₂ , chl
1566	Niobium(V) iodide	NbI ₅	13779-92-5	727.428	yelbk monoclcry	≈200 dec		5.32		
1567	Niobium(V) oxide	Nb ₂ O ₅	1313-96-8	265.810	wh orth cry	1512		4.6		i H ₂ O; s HF
1568	Niobium(V) oxybromide	NbOBr ₃	14459-75-7	348.617	yelbrn cry	≈320 dec	subl			
1569	Niobium(V) oxychloride	NbOCl ₃	13597-20-1	215.263	wh et cry		subl	3.72		
1570	Niobium(V) dioxyfluoride	NbO ₂ F	15195-33-2	143.903	wh cub cry			4.0		
1571	Nitrogen	N ₂	7727-37-9	28.013	col gas	-210.00	-195.79	1.145 g/L		sl H ₂ O; i EOH
1572	Nitamide	NO ₂ NH ₂	7782-94-7	62.028	unsstab wh cry	72 dec				s H ₂ O, EOH, ace, et; i chl
1573	Nitric acid	HNO ₃	7697-37-2	63.013	collq; hyg	-41.6	83	1.55		vs H ₂ O

1574	Nitous acid	HNO ₂	7782-77-6	47.014	sbble only in soh					
1575	Nitous oxide	N ₂ O	10024-97-2	44.012	colgas	-90.8	-88.48	1.799 g/L	slH ₂ O; s EDH, eh	
1576	Nitic oxide	NO	10102-43-9	30.006	colgas	-163.6	-151.74	1.226 g/L	slH ₂ O	
1577	Nitrogen dioxide	NO ₂	10102-44-0	46.006	brn gas; equilwih N ₂ O ₄		see N ₂ O ₄	1.880 g/L	reac H ₂ O	
1578	Nitrogen trioxide	N ₂ O ₃	10544-73-7	76.011	blue sold or lq (bw tmp)	-101.1	≈3 dec	1.4 ²	reac H ₂ O	
1579	Nitrogen tetroxide	N ₂ O ₄	10544-72-6	92.011	coliq; equilwih NO ₂	-9.3		21.15	1.45 ²⁰	reac H ₂ O
1580	Nitrogen pentoxide	N ₂ O ₅	10102-03-1	108.010	colhex cry			33 sp	2.0	s chl slct
1581	Nitrogen tribromide	NBr ₃	15162-90-0	253.719	unsable sold	exp -100				
1582	Nitrogen trichloride	NCl ₃	10025-85-1	120.365	yellowiq; exp	-40	71	1.653		i H ₂ O; s CS ₂ , bz, ct
1583	Nitrogen trifluoride	NF ₃	7783-54-2	71.002	colgas	-206.79	-128.75	2.902 g/L		i H ₂ O
1584	Nitrogen triiodide	NI ₃	13444-85-4	394.720	unsable bk cry; exp					
1585	Nitrogen trichloride difluoride	NCF ₂	13637-87-1	87.457	colgas	-195	-67	3.575 g/L		
1586	Chloramine	NH ₂ Cl	10599-90-3	51.476	yellowiq	-66				s H ₂ O, EDH, eh; slbz, CCl ₄
1587	Fluoramine	NH ₂ F	15861-05-9	35.021	unsable gas			1.431 g/L		
1588	Difluoramine	NHF ₂	10405-27-3	53.012	colgas	-116	-23	2.167 g/L		
1589	cis-Difluorodiazine	N ₂ F ₂	13812-43-6	66.010	colgas	<-195	-105.75	2.698 g/L		
1590	trans-Difluorodiazine	N ₂ F ₂	13776-62-0	66.010	colgas	-172	-111.45	2.698 g/L		
1591	Tetrafluorohydrazine	N ₂ F ₄	10036-47-2	104.007	colgas	-164.5	-74	4.251 g/L		
1592	Nitrosylbromide	NOBr	13444-87-6	109.910	red gas	-56	≈0	4.492 g/L		reac H ₂ O
1593	Nitrosylchloride	NOCl	2696-92-6	65.459	yellow gas	-59.6	-5.5	2.676 g/L		reac H ₂ O
1594	Nitrosyl fluoride	NOF	7789-25-5	49.004	colgas	-132.5	-59.9	2.003 g/L		
1595	Trifluoramine oxide	NOF ₃	13847-65-9	87.001	colgas	-161	-87.5	3.556 g/L		
1596	Nitrylchloride	NO ₂ Cl	13444-90-1	81.459	colgas	-145	-15	3.330 g/L		
1597	Nitryl fluoride	NO ₂ F	10022-50-1	65.004	colgas	-166	-72.4	2.657 g/L		reac H ₂ O
1598	Nitrogen selenide	N ₂ Se ₄	12033-88-4	371.87	red monoclcr; hyg	exp		4.2		i H ₂ O, eh, EDH; slbz, CS ₂
1599	Nobelium	No	10028-14-5	259	metl	827				
1600	Osmium	Os	7440-04-2	190.23	blue-wh metl hex	3033	5012	22.59		s aqua regia
1601	Osmium carbonyl	Os ₃ (CO) ₁₂	15696-40-9	906.81	yellow cry			3.48		
1602	Osmium(III) bromide	OsBr ₃	59201-51-3	429.94	dark gray cry	340 dec				
1603	Osmium(III) chloride	OsCl ₃	13444-93-4	296.59	gray cub cry	>450 dec				i H ₂ O; s HNO ₃
1604	Osmium(IV) chloride	OsCl ₄	10026-01-4	332.04	red-bk orth cry		450 sp	4.38		reac H ₂ O
1605	Osmium(IV) fluoride	OsF ₄	54120-05-7	266.22	yellow cry	230				
1606	Osmium(IV) oxide	OsO ₂	12036-02-1	222.23	yellow-bk cry			11.4		i H ₂ O, acid
1607	Osmium(V) fluoride	OsF ₅	31576-40-6	285.22	blue cry	70	225.9			reac H ₂ O
1608	Osmium(VI) fluoride	OsF ₆	13768-38-2	304.22	yellow cub cry	33.2	47.5	4.1		reac H ₂ O
1609	Osmium(VIII) oxide	OsO ₄	20816-12-0	254.23	yellow monoclcr	41	135	5.1	6.44 ²⁰	
1610	Oxygen	O ₂	7782-44-7	31.999	colgas	-218.79	-182.95	1.308 g/L		slH ₂ O, EDH, os
1611	Ozone	O ₃	10028-15-6	47.998	blue gas	-193	-111.35	1.962 g/L		slH ₂ O
1612	Palladium	Pd	7440-05-3	106.42	silv-wh metl cub	1554.9	2963	12.0		s aqua regia
1613	Palladium(II) sulfide	PdS	12125-22-3	138.49	gray bk cry			6.7		
1614	Palladium(II) bromide	PdBr ₂	13444-94-5	266.23	red-bk monoclcr; hyg	250 dec		≈5.2		i H ₂ O
1615	Palladium(II) chloride	PdCl ₂	7647-10-1	177.33	red rhomb cry; hyg	679		4.0		s H ₂ O, EDH, ace
1616	Palladium(II) fluoride	PdF ₂	13444-96-7	144.42	viol bk cry; hyg	952		5.76		reac H ₂ O
1617	Palladium(II) iodide	PdI ₂	7790-38-7	360.23	bk cry	360 dec		6.0		i H ₂ O, EDH, eh
1618	Palladium(II) nitrate	Pd(NO ₃) ₂	10102-05-3	230.43	brn hyg cry	dec				slH ₂ O; s dilHNO ₃
1619	Palladium(II) oxide	PdO	1314-08-5	122.42	grn-bk bk cry	750 dec		8.3		i H ₂ O, acid; slaqua regia
1620	Phosphorus (white)	P	7723-14-0	30.974	colwaxlike cub cry	44.15	280.5	1.823		i H ₂ O; slbz, EDH, chl s CS ₂
1621	Phosphorus (red)	P	7723-14-0	30.974	red-violamorp powder	590 p	431 sp	2.16		i H ₂ O, os

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1622	Phosphorus (black)	P	7723-14-0	30.974	bk orth cry or amorp sold	610		2.69		i os
1623	Phosphine	PH ₃	7803-51-2	33.998	colgas; f am	-133.8	-87.75	1.390 g/L		i H ₂ O; sl EOH, eh
1624	Diphosphine	P ₂ H ₄	13445-50-6	65.980	collq	-99	63.5 dec			reac H ₂ O
1625	Diphosphorus tetrachloride	P ₂ Cl ₄	13497-91-1	203.759	coloiy lq	-28	≈180 dec			
1626	Diphosphorus tetrafluoride	P ₂ F ₄	13824-74-3	137.942	colgas	-86.5	-6.2	5.638 g/L		
1627	Diphosphorus tetraiodide	P ₂ I ₄	13455-00-0	569.566	red ticl needles	125.5	dec	3.89		
1628	Phosphonium chloride	PH ₄ Cl	24567-53-1	70.459	gas		-27 sp	2.880 g/L		reac H ₂ O
1629	Phosphonium iodide	PH ₄ I	12125-09-6	161.910	collet cry	18.5	62.5	2.86		reac H ₂ O, EOH
1630	Phosphoric acid (orthophosphoric acid)	H ₃ PO ₄	7664-38-2	97.995	colvisc lq	42.4	407		548 ²⁰	s EOH
1631	Phosphonic acid (phosphorous acid)	H ₃ PO ₃	13598-36-2	81.996	wh hyg cry	74.4	200	1.65	309 ⁰	vs EOH
1632	Phosphinic acid (hypophosphorous acid)	HPH ₂ O ₂	6303-21-5	65.997	hyg cry or coloiy lq	26.5	130	1.49		vs H ₂ O, EOH, eh
1633	Metaphosphoric acid	HPO ₃	37267-86-0	79.980	glsold; hyg					sl H ₂ O; s EOH
1634	Hypophosphoric acid	H ₄ P ₂ O ₆	7803-60-3	161.976	colorth cry	73 dec				vs H ₂ O
1635	Diphosphoric acid (pyrophosphoric acid)	H ₄ P ₂ O ₇	2466-09-3	177.975	wh cry	71.5			709 ²³	
1636	Difluorophosphoric acid	HPO ₂ F ₂	13779-41-4	101.978	collq	≈-94	110 dec	1.583		reac H ₂ O
1637	Hexafluorophosphoric acid	HPF ₆	16940-81-1	145.972	coloiy lq	25 dec				reac H ₂ O
1638	Fluorophosphonic acid	H ₂ PFO ₃	13537-32-1	99.986	colvisc lq	<-70		1.82		vs H ₂ O
1639	Phosphorus nitride	P ₃ N ₅	12136-91-3	162.955	yel-brn sold	800 dec				i H ₂ O; s os
1640	Phosphorus sesquisulfide	P ₄ S ₃	1314-85-8	220.093	yel-grn orth cry	172.5	407	2.03		i H ₂ O; s bz; vs CS ₂
1641	Phosphorus heptasulfide	P ₄ S ₇	12037-82-0	348.357	paë yel-monocry	312	523	2.19		sl CS ₂
1642	Phosphonitric chloride trimer	(PNCl ₂) ₃	940-71-6	347.657	wh hyg cry	128.8		1.98		reac H ₂ O
1643	Phosphorus(III) bromide	PBr ₃	7789-60-8	270.686	collq	-41.5	173.2	2.8		reac H ₂ O, EOH; s ace, CS ₂
1644	Phosphorus(III) dibromide fluoride	PBr ₂ F	15597-39-4	209.780	collq	-115	78.5			
1645	Phosphorus(III) bromide difluoride	PBrF ₂	15597-40-7	148.875	colgas	-133.8	-16.1	6.085 g/L		
1646	Phosphorus(III) chloride	PCl ₃	7719-12-2	137.332	collq	-93.6	76.1	1.574		reac H ₂ O, EOH; s bz, chl, eh
1647	Phosphorus(III) dichloride fluoride	PCl ₂ F	15597-63-4	120.877	colgas	-144	13.85	4.941 g/L		
1648	Phosphorus(III) chloride difluoride	PCF ₂	14335-40-1	104.424	colgas	-164.8	-47.3	4.268 g/L		
1649	Phosphorus(III) fluoride	PF ₃	7783-55-3	87.969	colgas	-151.5	-101.8	3.596 g/L		reac H ₂ O
1650	Phosphorus(III) iodide	PI ₃	13455-01-1	411.687	red-oran hex cry; hyg	61.2	227 dec	4.18		reac H ₂ O; s EOH
1651	Phosphorus(III) oxide	P ₂ O ₃	1314-24-5	109.946	colmonocry or lq	23.8	173	2.13		reac H ₂ O
1652	Tetraphosphorus(III) hexoxide	P ₄ O ₆	12440-00-5	219.891	sof twh cry	23.8	175.4			
1653	Phosphorus(III) selenide	P ₂ Se ₃	1314-86-9	298.83	oran-red cry	245	≈380	1.31		reac H ₂ O; s bz, ct, CS ₂ , ace
1654	Phosphorus(III) sulfide	P ₂ S ₃	12165-69-4	158.146	yelsold	290	490			reac H ₂ O; s EOH, eh, CS ₂
1655	Phosphorus(V) bromide	PBr ₅	7789-69-7	430.494	yelorth cry, Donnay	≈100 dec		3.61		reac H ₂ O, EOH; s CS ₂ , ct
1656	Phosphorus(V) tetrabromide fluoride	PBr ₄ F		369.588	paë yel cry	87 dec				
1657	Phosphorus(V) dibromide trifluoride	PBr ₂ F ₃	13445-58-4	247.777	yel-red lq	-20	15 dec			
1658	Phosphorus(V) chloride	PCl ₅	10026-13-8	208.238	wh-yellet cry; hyg	167 p	160 sp	2.1		reac H ₂ O; s CS ₂ , ct
1659	Phosphorus(V) tetrachloride fluoride	PCl ₄ F	13498-11-8	191.783	collq	-59	30 dec			
1660	Phosphorus(V) tetrachloride difluoride	PCl ₃ F ₂	158704-27-9	175.329	collq	-63				
1661	Phosphorus(V) dichloride trifluoride	PCl ₂ F ₃	13454-99-4	158.874	colgas	-125	7.1	6.494 g/L		
1662	Phosphorus(V) chloride tetrafluoride	PCF ₄		142.421	colgas	-132	-43.4	5.821 g/L		
1663	Phosphorus(V) fluoride	PF ₅	7647-19-0	125.966	colgas	-93.8	-84.6	5.149 g/L		reac H ₂ O
1664	Phosphorus(V) oxide	P ₂ O ₅	1314-56-3	141.945	wh orth cry; hyg	562	605	2.30		reac H ₂ O, EOH
1665	Phosphorus(V) selenide	P ₂ Se ₅	1314-82-5	456.75	bk-purp amorp sold					reac hotH ₂ O, ct; i CS ₂
1666	Phosphorus(V) sulfide	P ₂ S ₅	1314-80-3	222.278	grn-yelhyg cry	285	515	2.03		reac H ₂ O; s CS ₂

1667	Phosphonic difluoride	POF ₂ H	14939-34-5	85.978	voilet lq	>-120	≈60 (gas unsbb)		
1668	Phosphoric tribromide (phosphoryl bromide)	POBr ₃	7789-59-5	286.685	faintoran ptes	55	191.7	2.822	reac H ₂ O; s bz, eh, chl
1669	Phosphoric dibromide chloride	POBr ₂ Cl	13550-31-7	242.234	yelsold	31	165		
1670	Phosphoric dibromide fluoride	POBr ₂ F	14014-19-8	225.779	collq	-117.2	110.1		
1671	Phosphoric bromide dichloride	POBrCl ₂	13455-03-3	197.782	collq	11	136.5	2.104 ¹⁴	
1672	Phosphoric bromide difluoride	POBrF ₂	14014-18-7	164.874	collq	-84.8	31.6		
1673	Phosphoric bromide chlorofluoride	POBrCF	14518-81-1	181.328	collq		79		
1674	Phosphoric trichloride (phosphoryl chloride)	POCl ₃	10025-87-3	153.331	collq	1.18	105.5	1.645	reac H ₂ O, EOH
1675	Phosphoric dichloride fluoride	POCl ₂ F	13769-76-1	136.876	collq	-80.1	52.9		
1676	Phosphoric chloride difluoride	POCF ₂	13769-75-0	120.423	colgas	-96.4	3.1	4.922 g/L	
1677	Phosphoric trifluoride (phosphoryl fluoride)	POF ₃	13478-20-1	103.968	colgas	-39.1 p	-39.7 sp	4.250 g/L	reac H ₂ O
1678	Phosphoric triiodide (phosphoryliodide)	POI ₃	13455-04-4	427.686	violcry	53			
1679	Phosphorothioic tribromide	PSBr ₃	3931-89-3	302.752	yelcry	37.8	212 dec	2.85	
1680	Phosphorothioic dibromide fluoride	PSBr ₂ F	13706-10-0	241.846	yellq	-75.2	125.3		
1681	Phosphorothioic bromide difluoride	PSBrF ₂	13706-09-7	180.941	yellq	-136.9	35.5		
1682	Phosphorothioic trichloride	PSCl ₃	3982-91-0	169.398	fuming lq	-36.2	125	1.635	reac H ₂ O; s bz, ct, chl CS ₂
1683	Phosphorothioic dichloride fluoride	PSCl ₂ F	155698-29-6	152.943	collq	-96.0	64.7		
1684	Phosphorothioic chloride difluoride	PSCF ₂	2524-02-9	136.490	colgas	-155.2	6.3	5.579 g/L	
1685	Phosphorothioic trifluoride	PSF ₃	2404-52-6	120.035	colgas	-148.8	-52.25	4.906 g/L	
1686	Phosphorothioic triiodide	PSI ₃	63972-04-3	443.753	yelcry	48	dec		
1687	Platinum	Pt	7440-06-4	195.08	silv-gray metl cub	1768.4	3825	21.5	i acid; s aqua regia
1688	Platinum(II) bromide	PBr ₂	13455-12-4	354.89	red-brn powder	250 dec		6.65	i H ₂ O
1689	Platinum(II) chloride	PCl ₂	10025-65-7	265.98	grn hex cry	581 dec		6.0	i H ₂ O, EOH, eh; s HCl
1690	Platinum(II) iodide	PI ₂	7790-39-8	448.89	bk powder	325 dec		6.4	i H ₂ O
1691	Platinum(II) oxide	PO	12035-82-4	211.08	bk let cry	325 dec		14.1	i H ₂ O, EOH; s aqua regia
1692	Platinum(II) sulfide	PS	12038-20-9	227.14	let cry			10.25	
1693	Platinum(III) bromide	PBr ₃	25985-07-3	434.79	grn-bk cry	200 dec			
1694	Platinum(III) chloride	PCl ₃	25909-39-1	301.44	grn-bk cry	435 dec		5.26	
1695	Platinum(IV) bromide	PBr ₄	68938-92-1	514.69	brn-bk cry	180 dec		0.41 ²⁰	sl EOH, eh
1696	Platinum(IV) chloride	PCl ₄	37773-49-2	336.89	red-brn cub cry	327 dec		4.30	142 ²⁵
1697	Platinum(IV) chloride hexahydrate	PCl ₄ · 5H ₂ O	13454-96-1	426.97	red cry			2.43	s H ₂ O, EOH
1698	Platinum(IV) fluoride	PF ₄	13455-15-7	271.07	red cry	600			
1699	Platinum(IV) iodide	PI ₄	7790-46-7	702.70	brn-bk powder	130 dec			s H ₂ O
1700	Platinum(IV) oxide	PO ₂	1314-15-4	227.08	bk hex cry	450		11.8	i H ₂ O; s conc acid, dilak
1701	Platinum(IV) sulfide	PS ₂	12038-21-0	259.21	hex cry			7.85	
1702	Platinum(VI) fluoride	PF ₆	13693-05-5	309.07	red cub cry	61.3	69.1	≈4.0	
1703	cis-Diamminedichloroplatinum	P(NH ₃) ₂ Cl ₂	15663-27-1	300.04	yelsold	270 dec		0.253 ²⁵	
1704	trans-Diamminedichloroplatinum	P(NH ₃) ₂ Cl ₂	14913-33-8	300.04	paet yelsold	270 dec		0.036 ²⁵	s DMF, DMSO
1705	Hexachloroplatinic acid hexahydrate	H ₂ PtCl ₆ · 6H ₂ O	16941-12-1	517.90	brn-yelgh cry	60		2.43	140 ¹⁶
1706	Platinum silicide	PSi	12137-83-6	223.16	orth cry	1229		12.4	
1707	Plutonium	Pu	7440-07-5	244	silv-wh metl monocl	640	3228	19.7	
1708	Plutonium nitride	PuN	12033-54-4	258	gray cub cry	2550		14.4	
1709	Plutonium(II) oxide	PuO	12035-83-5	260	cub cry			14.0	
1710	Plutonium(III) bromide	PuBr ₃	15752-46-2	484	grn orth cry	681		6.75	s H ₂ O
1711	Plutonium(III) chloride	PuCl ₃	13569-62-5	350	grn hex cry	760		5.71	s H ₂ O
1712	Plutonium(III) fluoride	PuF ₃	13842-83-6	301	purp hex cry	1396		9.33	i H ₂ O; slacid

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1713	Plutonium(III) iodide	PuI ₃	13813-46-2	625	grn orth cry; hyg	777		6.92		s H ₂ O
1714	Plutonium(III) oxide	Pu ₂ O ₃	12036-34-9	536	bk cub cry			10.5		
1715	Plutonium(IV) fluoride	PuF ₄	13709-56-3	320	red-brn monocry	1027		7.1		
1716	Plutonium(IV) oxide	PuO ₂	12059-95-9	276	yelbrn cub cry	2400		11.5		
1717	Plutonium(VI) fluoride	PuF ₆	13693-06-6	358	red-brn orth cry	52		5.08		
1718	Polonium	Po	7440-08-6	209	silv metal cub	254	962	9.20		
1719	Polonium(IV) chloride	PoCl ₄	10026-02-5	351	yelhyg cry	≈300	390			s H ₂ O, EOH, ace
1720	Polonium(IV) oxide	PoO ₂	7446-06-2	241	yelcub cry	500 dec		8.9		
1721	Potassium	K	7440-09-7	39.098	soft tsilv-wh metal cub	63.5	759	0.89		react H ₂ O
1722	Potassium acetate	KC ₂ H ₃ O ₂	127-08-2	98.142	wh hyg cry	309		1.57	269 ²⁵	s EOH; i eh
1723	Potassium aluminate trihydrate	K ₂ Al ₂ O ₄ · 3H ₂ O	12003-63-3*	250.204	wh orth cry			2.13		vs H ₂ O; i EOH
1724	Potassium aluminum silicate	KAlSi ₃ O ₈	1327-44-2	278.332	colmonocry			2.56		i H ₂ O
1725	Potassium aluminum sulfate	KAl(SO ₄) ₂	10043-67-1	258.207	wh hyg powder				5.9 ²⁰	
1726	Potassium aluminum sulfate dodecahydrate	KAl(SO ₄) ₂ · 12H ₂ O	7784-24-9	474.391	colcry	≈100 dec		1.72	5.9 ²⁰	
1727	Potassium amide	KNH ₂	17242-52-3	55.121	wh/yelgrn hyg cry	335				react H ₂ O, EOH
1728	Potassium arsenate	K ₃ AsO ₄	13464-36-3	256.215	colcry			2.8	125 ²⁵	
1729	Potassium arsenite	KAsO ₂	13464-35-2	146.019	wh hyg pow					s H ₂ O; sl EOH
1730	Potassium azide	KN ₃	20762-60-1	81.118	bt cry; exp			2.04	49.7 ¹⁷	
1731	Potassium borohydride	KBH ₄	13762-51-1	53.941	wh cub cry	≈500 dec		1.11		s H ₂ O
1732	Potassium bromate	KBrO ₃	7758-01-2	167.000	wh hex cry	434 dec		3.27	8.17 ²⁵	i EOH
1733	Potassium bromide	KBr	7758-02-3	119.002	colcub cry; hyg	734	1435	2.74	67.8 ²⁵	sl EOH
1734	Potassium carbonate	K ₂ CO ₃	584-08-7	138.206	wh monocry; hyg	898	dec	2.29	111 ²⁵	i EOH
1735	Potassium carbonate sesquihydrate	K ₂ CO ₃ · 1.5H ₂ O	6381-79-9	165.229	granular cry				111 ²⁰	
1736	Potassium chlorate	KClO ₃	3811-04-9	122.549	wh monocry	368	dec	2.32	8.61 ²⁵	
1737	Potassium chloride	KCl	7447-40-7	74.551	wh cub cry	771		1.988	35.5 ²⁵	i eh, ace
1738	Potassium chromate	K ₂ CrO ₄	7789-00-6	194.191	yelorth cry	975		2.73	65.0 ²⁵	
1739	Potassium cyanate	KCNO	590-28-3	81.115	wh bt cry	≈700 dec		2.05	75 ²⁵	sl EOH
1740	Potassium cyanide	KCN	151-50-8	65.116	wh cub cry; hyg	634		1.55	69.9 ²⁰	sl EOH
1741	Potassium dichromate	K ₂ Cr ₂ O ₇	7778-50-9	294.185	oran-red tictcry	398	≈500 dec	2.68	15.1 ²⁵	
1742	Potassium dihydrogen arsenate	KH ₂ AsO ₄	7784-41-0	180.034	colcry	288		2.87	19 ⁶	i EOH
1743	Potassium dihydrogen phosphate	KH ₂ PO ₄	7778-77-0	136.085	wh bt cry	253		2.34	25.0 ²⁵	sl EOH
1744	Potassium ferricyanide	K ₃ Fe(CN) ₆	13746-66-2	329.244	red cry	dec		1.89	48.8 ²⁵	
1745	Potassium ferrocyanide trihydrate	K ₄ Fe(CN) ₆ · 3H ₂ O	14459-95-1	422.388	yelmonocry	60 dec		1.85	36.0 ²⁵	i EOH, eh
1746	Potassium fluoride	KF	7789-23-3	58.096	wh cub cry	858	1502	2.48	102 ²⁵	
1747	Potassium fluoride dihydrate	KF · 2H ₂ O	13455-21-5	94.127	monocry	41 dec		2.5	102 ²⁵	
1748	Potassium fluoroborate	KBF ₄	14075-53-7	125.903	colorh cry	530		2.505	0.55 ²⁵	sl EOH
1749	Potassium fluorotantalate	K ₂ TaF ₇	16924-00-8	392.134	colcry	730		5.24	0.5 ⁰	
1750	Potassium formate	KCHO ₂	590-29-4	84.116	colhyg cry	167		1.91	331 ¹⁸	
1751	Potassium hexachloroarsate(IV)	K ₂ OsCl ₆	16871-60-6	481.14	red cub cry					vs H ₂ O; sl EOH
1752	Potassium hexachloroplatinate	K ₂ PtCl ₆	16921-30-5	485.99	yeloran cub cry	250 dec		3.50	0.77 ²⁰	i EOH
1753	Potassium hexacyanocobaltate	K ₃ Co(CN) ₆	13963-58-1	332.332	yelmonocry	dec		1.91		vs H ₂ O; i EOH
1754	Potassium hexafluoromanganate(IV)	K ₂ MnF ₆	16962-31-5	247.125	yelhex cry					react H ₂ O
1755	Potassium hexafluorosilicate	K ₂ SiF ₆	16871-90-2	220.273	wh cry	dec		2.27	0.084 ²⁰	i EOH
1756	Potassium hexafluorozirconate(IV)	K ₂ ZrF ₆	16923-95-8	283.411	colmono cry			3.48	0.78 ²	
1757	Potassium hydride	KH	7693-26-7	40.106	cub cry			1.43		react H ₂ O

1758	Potassium hydrogen arsenate	K_2HAsO_4	21093-83-4	218.125	col mono prisms	300 dec		18.7 ⁶	i EDH	
1759	Potassium hydrogen arsenite	$KAsO_2 \cdot HAsO_2$	10124-50-2	253.947	wh hyg powder				s H ₂ O	
1760	Potassium hydrogen carbonate	$KHCO_3$	298-14-6	100.115	col monocry	≈100 dec	2.17	36.2 ²⁵	i EDH	
1761	Potassium hydrogen fluoride	KHF_2	7789-29-9	78.103	col let cry	238.9	2.37	39.2 ²⁰	i EDH	
1762	Potassium hydrogen phosphate	K_2HPO_4	7758-11-4	174.176	wh hyg cry	dec		168 ²⁵	s EDH	
1763	Potassium hydrogen phosphite	K_2HPO_3	13492-26-7	158.177	wh hyg powder	dec		170 ²⁰	i EDH	
1764	Potassium hydrogen selenite	$KHSeO_3$	7782-70-9	167.06	hyg orth cry	>100 dec			s H ₂ O; sl EDH	
1765	Potassium hydrogen sulfite	$KHSO_4$	7646-93-7	136.170	wh monocry; hyg	≈200	2.32	50.6 ²⁵		
1766	Potassium hydrogen sulfide	KHS	1310-61-8	72.172	wh hex cry; hyg	≈450	1.69		s H ₂ O, EDH	
1767	Potassium hydrogen sulfide hemihydrate	$KHS \cdot 0.5H_2O$	1310-61-8*	81.179	wh-yel hyg cry	≈175	1.7		vs H ₂ O, EDH	
1768	Potassium hydrogen sulfate	$KHSO_4$	7773-03-7	120.170	wh cry powder	190 dec		49 ²⁰	i EDH	
1769	Potassium hydrogen tartrate	$KHC_4H_4O_6$	868-14-4	188.177	wh cry		1.98	0.57 ²⁰	s acid, aq; i EDH	
1770	Potassium hydroxide	KOH	1310-58-3	56.105	wh rhomb cry; hyg	406	1327	2.044	121 ²⁵	s EDH; s MeOH
1771	Potassium hypophosphite	KH_2PO_2	7782-87-8	104.087	wh hyg cry	dec			vs H ₂ O; s EDH	
1772	Potassium iodate	KIO_3	7758-05-6	214.001	wh monocry	560 dec		3.89	9.22 ²⁵	
1773	Potassium iodide	KI	7681-11-0	166.003	col cub cry	681	1323	3.12	148 ²⁵	sl EDH
1774	Potassium iron(III) oxalate trihydrate	$K_3Fe(C_2O_4)_3 \cdot 3H_2O$	491.243	491.243	grn mono cry	100	230 dec	2.133	4.7 ⁰	i EDH
1775	Potassium manganate	K_2MnO_4	10294-64-1	197.133	grn cry	190 dec			s H ₂ O; reac HCl	
1776	Potassium metarsenate	$KAsO_3$	19197-73-0	162.018	wh sold	660				
1777	Potassium metabisulfite	$K_2S_2O_5$	16731-55-8	222.326	wh powder	≈150 dec		2.3	49.5 ²⁵	reac acid; i EDH
1778	Potassium metaborate	KBO_2	13709-94-9	81.908	wh hex cry			≈2.3		
1779	Potassium molybdate	K_2MoO_4	13446-49-6	238.14	wh hyg cry	919		2.3	183 ²⁵	i EDH
1780	Potassium niobate	$KNbO_3$	12030-85-2	180.002	wh rhomb cry	≈1100		4.64		i H ₂ O
1781	Potassium nitrate	KNO_3	7757-79-1	101.103	col rhomb cry or powder	337	400 dec	2.11	38.3 ²⁵	i EDH
1782	Potassium nitrite	KNO_2	7758-09-0	85.104	wh hyg cry	441	537 exp	1.915	312 ²⁵	sl EDH
1783	Potassium oxalate	$K_2C_2O_4$	583-52-8	166.216	wh pwd					sl H ₂ O
1784	Potassium oxalate monohydrate	$K_2C_2O_4 \cdot H_2O$	6487-48-5	184.231	col cry	160 dec		2.13	36.4 ²⁰	
1785	Potassium oxide	K_2O	12136-45-7	94.196	gray cub cry	350 dec		2.35		s H ₂ O, EDH, eh
1786	Potassium perbromate	$KBrO_4$	22207-96-1	183.000	wh cry	275 dec			4.21 ²⁵	
1787	Potassium perchlorate	$KClO_4$	7778-74-7	138.549	col orth cry; hyg	525		2.52	2.08 ²⁵	
1788	Potassium periodate	KIO_4	7790-21-8	230.001	col let cry	582	exp	3.618	0.51 ²⁵	
1789	Potassium permanganate	$KMnO_4$	7722-64-7	158.034	purp orth cry	dec		2.7	7.60 ²⁵	reac EDH
1790	Potassium peroxide	K_2O_2	17014-71-0	110.196	yel amorp sold	490				reac H ₂ O
1791	Potassium persulfate	$K_2S_2O_8$	7727-21-1	270.324	col cry	≈100 dec		2.48	4.7 ²⁰	
1792	Potassium phosphate	K_3PO_4	7778-53-2	212.266	wh orth cry; hyg	1340		2.564	106 ²⁵	i EDH
1793	Potassium pyrophosphate trihydrate	$K_4P_2O_7 \cdot 3H_2O$	7320-34-5*	384.383	col hyg cry	1090		2.33		vs H ₂ O; i EDH
1794	Potassium pyrosulfate	$K_2S_2O_7$	7790-62-7	254.325	col needles	≈325		2.28		s H ₂ O
1795	Potassium selenate	K_2SeO_4	7790-59-2	221.16	wh powder			3.07	114 ²⁵	
1796	Potassium selenide	K_2Se	1312-74-9	157.16	red cub cry; hyg	800		2.29		s H ₂ O
1797	Potassium selenite	K_2SeO_3	10431-47-7	205.16	wh hyg cry	875 dec			217 ²⁵	sl EDH
1798	Potassium silver cyanide	$KAg(CN)_2$	506-61-6	199.000	wh cry					s H ₂ O
1799	Potassium stannate trihydrate	$K_2SnO_3 \cdot 3H_2O$	12142-33-5*	298.951	col cry			3.20		vs H ₂ O; i EDH
1800	Potassium sulfate	K_2SO_4	7778-80-5	174.261	wh orth cry	1069		2.66	12.0 ²⁵	i EDH
1801	Potassium sulfide	K_2S	1312-73-8	110.263	red-yel cub cry; hyg	948		1.74		s H ₂ O, EDH; i eh
1802	Potassium sulfide pentahydrate	$K_2S \cdot 5H_2O$	37248-34-3	200.339	col rhomb cry	60				vs H ₂ O, EDH; i eh
1803	Potassium sulfite	K_2SO_3	10117-38-1	158.261	col hex cry				106 ²⁵	sl EDH
1804	Potassium sulfite dihydrate	$K_2SO_3 \cdot 2H_2O$	7790-56-9	194.292	wh monocry	dec			107 ²⁰	sl EDH; dec dil acid
1805	Potassium superoxide	KO_2	12030-88-5	71.097	yel let cry; hyg	380		2.16		reac H ₂ O

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1806	Potassium tetrab(VI) trihydrate	K ₂ TeO ₄ · 3H ₂ O	15571-91-2*	323.84	wh cry powder					s H ₂ O
1807	Potassium tetrat	K ₂ TeO ₃	7790-58-1	253.80	wh hyg cry	≈460 dec				vs H ₂ O
1808	Potassium tetraborate pentahydrate	K ₂ B ₄ O ₇ · 5H ₂ O	1332-77-0	323.513	wh cry powder			16.5 ³⁰		slEDH
1809	Potassium tetrachloroaurate dihydrate	KAuCl ₄ · 2H ₂ O	13682-61-6	413.907	yelmonocry					s H ₂ O; EDH, eh
1810	Potassium tetrachloroplatinate	K ₂ PtCl ₄	10025-99-7	415.09	pink-red tt cry	500 dec		3.38		s H ₂ O; i EDH
1811	Potassium tetracyanoplatinate(II) trihydrate	K ₂ Pt(CN) ₄ · 3H ₂ O	562-76-5*	431.39	colrhomb prisms					s H ₂ O
1812	Potassium tetaiodomercurate(II)	K ₂ HgI ₄	7783-33-7	786.40	yelhyg cry			4.29		vs H ₂ O; s EDH, eh, ace
1813	Potassium thiocyanate	KSCN	333-20-0	97.182	coltt cry; hyg	173	500 dec	1.88	238 ²⁵	s EDH
1814	Potassium tiosulfate	K ₂ S ₂ O ₃	10294-66-3	190.327	colhyg cry				165 ²⁵	i EDH
1815	Potassium titanate	K ₂ TiO ₃	12030-97-6	174.062	wh orth cry	1515		3.1		reac H ₂ O
1816	Potassium triiodide monohydrate	KI ₃ · H ₂ O	7790-42-3	437.827	brn monocry; hyg	225 dec		3.5		s H ₂ O; reac EDH, eh
1817	Potassium thiocarbonate	K ₂ CS ₃	26750-66-3	186.406	yelred hyg cry					vs H ₂ O
1818	Potassium tungstate	K ₂ WO ₄	7790-60-5	326.04	hyg cry	921		3.12		vs H ₂ O; i EDH
1819	Potassium uranate	K ₂ U ₂ O ₇	7790-63-8	666.251	oran cub cry			6.12		i H ₂ O; s acid
1820	Praseodymium	Pr	7440-10-0	140.908	silv metal hex	931	3520	6.77		
1821	Praseodymium boride	PrB ₅	12008-27-4	205.774	bk cub cry	2610		4.84		
1822	Praseodymium bromide	PrBr ₃	13536-53-3	380.620	grn hex cry; hyg	693		5.28		s H ₂ O
1823	Praseodymium chloride	PrCl ₃	10361-79-2	247.266	grn hex needles; hyg	786		4.0	96.1 ²⁵	s EDH
1824	Praseodymium chloride heptahydrate	PrCl ₃ · 7H ₂ O	10025-90-8	373.373	grn cry	110 dec			96.1 ²⁵	s EDH
1825	Praseodymium fluoride	PrF ₃	13709-46-1	197.903	grn hex cry	1395		6.3		
1826	Praseodymium iodide	PrI ₃	13813-23-5	521.621	orth hyg cry	737		≈5.8		s H ₂ O
1827	Praseodymium nitrate	Pr(NO ₃) ₃	10361-80-5	326.923	pat grn hyg cry				165 ²⁵	s EDH
1828	Praseodymium nitrate hexahydrate	Pr(NO ₃) ₃ · 6H ₂ O	15878-77-0	435.014	grn needles				165 ²⁵	s EDH, ace
1829	Praseodymium nitride	PrN	25764-09-4	154.915	cub cry			7.46		
1830	Praseodymium oxide	Pr ₂ O ₃	12036-32-7	329.813	wh hex cry	2183	3760	6.9		
1831	Praseodymium silicide	PrSi ₂	12066-83-0	197.079	tt cry	1712		5.46		
1832	Praseodymium sulfide	Pr ₂ S ₃	12038-13-0	378.013	cub cry	1765		5.1		
1833	Praseodymium tetrat	Pr ₂ Te ₃	12038-12-9	664.62	cub cry	1500		≈7.0		
1834	Promethium	Pm	7440-12-2	145	silv metal hex	1042	3000	7.26		
1835	Protactinium	Pa	7440-13-3	231.036	shiny metal tt or cub	1572		15.4		
1836	Protactinium(V) chloride	PaCl ₅	13760-41-3	408.300	yelmonocry	306		3.74		
1837	Radium	Ra	7440-14-4	226	wh metal cub	700		5		
1838	Radium bromide	RaBr ₂	10031-23-9	386	wh orth cry	728		5.79	70.6 ²⁰	s EDH
1839	Radium chloride	RaCl ₂	10025-66-8	297	wh orth cry	1000		4.9	24.5 ²⁰	s EDH
1840	Radium fluoride	RaF ₂	20610-49-5	264	wh cub cry			6.7		
1841	Radium nitrate	Ra(NO ₃) ₂	10213-12-4	350	cry				13.9	
1842	Radium sulfate	RaSO ₄	7446-16-4	322	wh cry					i H ₂ O, acid
1843	Radon	Rn	10043-92-2	222	colgas	-71	-61.7	9.074 g/L		slH ₂ O
1844	Rhenium	Re	7440-15-5	186.207	silv-gray metal	3186	5596	20.8		i HCl
1845	Perrhenic acid	HReO ₄	13768-11-1	251.213	exists only in soln					vs H ₂ O, os
1846	Rhenium carbonyl	Re ₂ (CO) ₁₀	14285-68-8	652.515	yelwh cry	170 dec		2.87		s os
1847	Rhenium(III) bromide	ReBr ₃	13569-49-8	425.919	red-brn monocry		500 subl	6.10		s ace, MeOH, EDH
1848	Rhenium(III) chloride	ReCl ₃	13569-63-6	292.565	red-bk hyg cry	500 dec		4.81		s H ₂ O
1849	Rhenium(III) iodide	ReI ₃	15622-42-1	566.920	bk solid	dec				
1850	Rhenium(IV) chloride	ReCl ₄	13569-71-6	328.018	purp-bk cry; hyg	300 dec		4.9		

1851	Rhenium(IV) fluoride	ReF ₄	15192-42-4	262.201	blue-ét cry		>300 subl	7.49	
1852	Rhenium(IV) oxide	ReO ₂	12036-09-8	218.206	gray orth cry	900 dec		11.4	
1853	Rhenium(IV) sulfide	ReS ₂	12038-63-0	250.339	black cry			7.6	
1854	Rhenium(IV) telluride	ReTe ₂	12067-00-4	441.41	orth cry			8.50	
1855	Rhenium(V) bromide	ReBr ₅	30937-53-2	585.727	brn sold	110 dec			
1856	Rhenium(V) chloride	ReCl ₅	39368-69-9	363.471	brn-bk sold	220		4.9	reac H ₂ O
1857	Rhenium(V) fluoride	ReF ₅	30937-52-1	281.199	yel-grn sold	48	221.3		
1858	Rhenium(V) oxide	Re ₂ O ₅	12165-05-8	452.411	blue-bk ét cry			≈7	
1859	Rhenium(VI) chloride	ReCl ₆	31234-26-1	398.923	red-grn sold	29			
1860	Rhenium(VI) dioxide fluoride	ReO ₂ F ₂	81155-18-2	256.203	col cry	156			
1861	Rhenium(VI) fluoride	ReF ₆	10049-17-9	300.197	yellow or cub cry	18.5	33.8	4.06(cry)	s HNO ₃
1862	Rhenium(VI) oxide	ReO ₃	1314-28-9	234.205	redcub cry	400 dec		6.9	i H ₂ O, acid, ak
1863	Rhenium(VI) oxytetrachloride	ReOCl ₄	13814-76-1	344.017	brn cry	29.3	223		reac H ₂ O
1864	Rhenium(VI) oxytetrafluoride	ReOF ₄	17026-29-8	278.200	blue sold	108	171.7		
1865	Rhenium(VII) fluoride	ReF ₇	17029-21-9	319.196	yellow cub cry	48.3	73.7	4.32	
1866	Rhenium(VII) oxide	Re ₂ O ₇	1314-68-7	484.410	yellow hyg cry	297	360	6.10	s H ₂ O, EDH, eh, diox, py
1867	Rhenium(VII) tetrochloride	ReO ₂ Cl ₄	7791-09-5	269.658	coliq	4.5	128	3.87	reac H ₂ O
1868	Rhenium(VII) tetrafluoride	ReO ₂ F ₄	42246-24-2	253.203	yellow sold	147	164		
1869	Rhenium(VII) dioxyl fluoride	ReO ₂ F ₃	57246-89-6	275.201	yellow sold	90	185.4		reac H ₂ O
1870	Rhenium(VII) oxypent fluoride	ReOF ₅	23377-53-9	297.198	cream sold	43.8	73.0		
1871	Rhenium(VII) sulfide	Re ₂ S ₇	12038-67-4	596.876	brn-bk ét cry			4.87	i H ₂ O
1872	Rhodium	Rh	7440-16-6	102.906	silv-wh metal cub	1964	3695	12.4	i acid, aqua regia
1873	Rhodium carbonyl chloride	[Rh(CO) ₂ Cl] ₂	14523-22-9	388.757	red-oran cry	124			s os
1874	Rhodium dodecacarbonyl	Rh ₄ (CO) ₁₂	19584-30-6	747.743	red hyg cry			2.52	reac H ₂ O
1875	Rhodium(III) chloride	RhCl ₃	10049-07-7	209.264	red monocry		717	5.38	i H ₂ O; s ak
1876	Rhodium(III) fluoride	RhF ₃	60804-25-3	159.901	red hex cry			5.4	
1877	Rhodium(III) iodide	RhI ₃	15492-38-3	483.619	bk monocry; hyg			6.4	
1878	Rhodium(III) oxide	Rh ₂ O ₃	12036-35-0	253.809	gray hex cry	1100 dec		8.2	
1879	Rhodium(III) sulfate	Rh ₂ (SO ₄) ₃	10489-46-0	494.002	red-yellow sold	>500 dec			
1880	Rhodium(IV) oxide	RhO ₂	12137-27-8	134.905	bk ét cry			7.2	
1881	Rhodium(VI) fluoride	RhF ₆	13693-07-7	216.896	bk cub cry	≈70		3.1	
1882	Rubidium	Rb	7440-17-7	85.468	soft silv metal cub	39.30	688	1.53	reac H ₂ O
1883	Rubidium acetate	RbC ₂ H ₃ O ₂	563-67-7	144.512	wh hyg cry	246			vs H ₂ O
1884	Rubidium aluminum sulfate	RbAl(SO ₄) ₂	13530-57-9	304.577	hex cry			≈3.1	1.60 ²⁰ i EDH
1885	Rubidium aluminum sulfate dodecahydrate	RbAl(SO ₄) ₂ · 12H ₂ O	7784-29-4	520.761	col cub cry	≈100 dec		≈1.9	s H ₂ O; i EDH
1886	Rubidium azide	RbN ₃	22756-36-1	127.488	ét cry; exp	317		2.79	107 ¹⁶
1887	Rubidium bromate	RbBrO ₃	13446-70-3	213.370	cub cry	430		3.68	2.95 ²⁵
1888	Rubidium bromide	RbBr	7789-39-1	165.372	wh cub cry; hyg	682	1340	3.35	116 ²⁵
1889	Rubidium carbonate	Rb ₂ CO ₃	584-09-8	230.945	col monocry; hyg	837			223 ²⁰
1890	Rubidium chlorate	RbClO ₃	13446-71-4	168.919	col cry			3.19	6.63 ²⁵
1891	Rubidium chloride	RbCl	7791-11-9	120.921	wh cub cry; hyg	715	1390	2.76	93.9 ²⁵ sil EDH
1892	Rubidium chromate	Rb ₂ CrO ₄	13446-72-5	286.930	yellow cry			3.518	76.2 ²⁵
1893	Rubidium cyanide	RbCN	19073-56-4	111.486	wh cub cry			2.3	s H ₂ O; i EDH, eh
1894	Rubidium fluoride	RbF	13446-74-7	104.466	wh cub cry; hyg	833	1410	3.2	300 ²⁰ i EDH
1895	Rubidium hydrogen fluoride	RbHF ₂	12280-64-7	124.473	ét cry	188		3.3	
1896	Rubidium formate	RbCHO ₂	3495-35-0	130.486	wh hyg cry	dec			
1897	Rubidium hydride	RbH	13446-75-8	86.476	wh cub cry; f km	≈170 dec		2.60	reac H ₂ O
1898	Rubidium hydrogen carbonate	RbHCO ₃	19088-74-5	146.485	wh rhomb cry	175 dec			116 ²⁰

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1899	Rubidium hydrogen sulfide	RbHSO ₄	15587-72-1	182.540	col monocry	208		2.9		s H ₂ O
1900	Rubidium hydroxide	RbOH	1310-82-3	102.475	gray-wh orth cry; hyg	382		3.2	173 ³⁰	s EDH
1901	Rubidium iodate	RbIO ₃	13446-76-9	260.370	mono or cub cry	dec		4.33	2.44 ²⁵	vs HCl
1902	Rubidium iodide	RbI	7790-29-6	212.372	wh cub cry	642	1300	3.55	165 ²⁵	s EDH
1903	Rubidium nitrate	RbNO ₃	13126-12-0	147.473	wh hex cry; hyg	305		3.11	65.0 ²⁵	
1904	Rubidium oxide	Rb ₂ O	18088-11-4	186.935	yellow cub cry; hyg	400 dec		4.0		react H ₂ O
1905	Rubidium perchlorate	RbClO ₄	13510-42-4	184.919	wh hyg cry	281	600 dec	2.8	1.5 ²⁵	
1906	Rubidium peroxide	Rb ₂ O ₂	23611-30-5	202.935	wh orth cry			3.8		react H ₂ O
1907	Rubidium selenide	Rb ₂ Se	31052-43-4	249.90	wh cub cry	733		3.22		react H ₂ O
1908	Rubidium sulfate	Rb ₂ SO ₄	7488-54-2	267.000	wh orth cry	1050		3.6	50.8 ²⁵	
1909	Rubidium sulfide	Rb ₂ S	31083-74-6	203.002	wh cub cry	425		2.91		s H ₂ O
1910	Rubidium superoxide	RbO ₂	12137-25-6	117.467	bt cry	412		≈3.0		
1911	Ruthenium	Ru	7440-18-8	101.07	silv-wh metal hex	2334	4150	12.1		i acid, aqua regia
1912	Ruthenium dodecacarbonyl	Ru ₃ (CO) ₁₂	15243-33-1	639.33	oran cry	150 dec				
1913	Ruthenium(III) 2,4-pentanedioate	Ru(CH ₃ COCHCOCH ₃) ₃	14284-93-6	398.39	red-brn cry	230				
1914	Ruthenium(III) bromide	RuBr ₃	14014-88-1	340.78	brn hex cry	>400 dec		5.3		
1915	Ruthenium(III) chloride	RuCl ₃	10049-08-8	207.43	brn hex cry	>500 dec		3.1		i H ₂ O; s EDH
1916	Ruthenium(III) fluoride	RuF ₃	51621-05-7	158.07	brn rhomb cry	>600 dec		5.36		
1917	Ruthenium(III) iodide	RuI ₃	13896-65-6	481.78	bk hex cry			6.0		
1918	Ruthenium(IV) fluoride	RuF ₄	71500-16-8	177.06	yel cry					react H ₂ O
1919	Ruthenium(IV) oxide	RuO ₂	12036-10-1	133.07	gray-bk bt cry			7.05		i H ₂ O, acid
1920	Ruthenium(V) fluoride	RuF ₅	14521-18-7	196.06	grn monocry	86.5	227	3.90		
1921	Ruthenium(VI) fluoride	RuF ₆	13693-08-8	215.06	dark brn orth cry	54		3.54		react H ₂ O
1922	Ruthenium(VIII) oxide	RuO ₄	20427-56-9	165.07	yel monocry prisms	25.4	40	3.29	171 ⁰	vs ct; react EDH
1923	Samarium	Sm	7440-19-9	150.36	silv metal rhomb	1074	1794	7.52		
1924	Samarium boride	SmB ₆	12008-29-6	215.23	ref rac sold	2580		5.07		
1925	Samarium silicide	SmSi ₂	12300-22-0	206.53	orth cry			5.14		
1926	Samarium(II) bromide	SmBr ₂	50801-97-3	310.17	brn cry	669				react H ₂ O
1927	Samarium(II) chloride	SmCl ₂	13874-75-4	221.27	brn cry	855		3.69		react H ₂ O
1928	Samarium(II) fluoride	SmF ₂	15192-17-3	188.36	purp cry					react H ₂ O
1929	Samarium(II) iodide	SmI ₂	32248-43-4	404.17	grn cry	520				react H ₂ O
1930	Samarium(III) bromide	SmBr ₃	13759-87-0	390.07	yel cry	640				react H ₂ O
1931	Samarium(III) chloride	SmCl ₃	10361-82-7	256.72	yel cry	682		4.46	93.8 ²⁵	
1932	Samarium(III) chloride hexahydrate	SmCl ₃ · 6H ₂ O	13465-55-9	364.81	yel cry	dec		2.38	93.8 ²⁵	
1933	Samarium(III) fluoride	SmF ₃	13765-24-7	207.36	wh cry	1306				react H ₂ O
1934	Samarium(III) iodide	SmI ₃	13813-25-7	531.07	oran cry	850				react H ₂ O
1935	Samarium(III) nitrate	Sm(NO ₃) ₃	10361-83-8	336.38	yel-wh hyg sold				144 ²⁵	s EDH
1936	Samarium(III) nitrate hexahydrate	Sm(NO ₃) ₃ · 6H ₂ O	13759-83-6	444.47	pañ yel cry	78				s H ₂ O, MeOH, ace
1937	Samarium(III) oxide	Sm ₂ O ₃	12060-58-1	348.72	yel-wh cub cry	2269	3780	7.6		
1938	Samarium(III) sulfate octahydrate	Sm ₂ (SO ₄) ₃ · 8H ₂ O	13465-58-2	733.03	yel cry			2.93	2.67 ²⁰	
1939	Samarium(III) sulfide	Sm ₂ S ₃	12067-22-0	396.92	gray-brn cub cry	1720		5.87		
1940	Samarium(III) telluride	Sm ₂ Te ₃	12040-00-5	683.52	orth cry			7.31		
1941	Scandium	Sc	7440-20-2	44.956	silv metal hex	1541	2836	2.99		
1942	Scandium boride	ScB ₂	12007-34-0	66.578	ref rac sold	2250		3.17		
1943	Scandium bromide	ScBr ₃	13465-59-3	284.668	wh hyg cry	969		9.33		s H ₂ O

1944	Scandium chloride	ScCl ₃	10361-84-9	151.314	wh hyg cry	967		2.4		s H ₂ O; i EDH
1945	Scandium fluoride	ScF ₃	13709-47-2	101.951	wh powder	1515				sH ₂ O
1946	Scandium hydroxide	Sc(OH) ₃	17674-34-9	95.978	colamorp sol					i H ₂ O; s dilacid
1947	Scandium nitrate	Sc(NO ₃) ₃	13465-60-6	230.971	wh cry				169 ²⁵	s EDH
1948	Scandium oxide	Sc ₂ O ₃	12060-08-1	137.910	wh cub cry	2485		3.864		s conc acid
1949	Scandium sulfide	Sc ₂ S ₃	12166-29-9	186.110	yellow cry	1775				2.91
1950	Scandium selenide	Sc ₂ Se ₃	12166-44-8	472.71	bk hex cry					5.29
1951	Selenium (α form)	Se	7782-49-2	78.96	red monocry	221	685	4.39		i H ₂ O, EDH; slch
1952	Selenium (gray)	Se	7782-49-2	78.96	gray metallic cry; hex	220.5	685	4.81		i H ₂ O, CS ₂
1953	Selenium (vitreous)	Se	7782-49-2	78.96	bk amorp sold		tans b gray Se 180	685	4.28	i H ₂ O; slCS ₂
1954	Selenic acid	H ₂ SeO ₄	7783-08-6	144.97	wh hyg sold	58		260 dec	2.95	vs H ₂ O; reac EDH
1955	Selenous acid	H ₂ SeO ₃	7783-00-8	128.97	wh hyg cry		70 dec		3.0	vs H ₂ O; s EDH
1956	Selenium dioxide	SeO ₂	7446-08-4	110.96	wh et needles or powder	340 p		315 sp	3.95	264 ²² s EDH, MeOH; slace
1957	Selenium trioxide	SeO ₃	13768-86-0	126.96	wh et cry; hyg	118		subl	3.44	s H ₂ O, os
1958	Selenium bromide	Se ₂ Br ₂	7789-52-8	317.73	red liq			225 dec	3.60	reac H ₂ O; s CS ₂ , chl
1959	Selenium chloride	Se ₂ Cl ₂	10025-68-0	228.83	yellow oily liq	-85		130 dec	2.774	reac H ₂ O; s CS ₂ , bz, ct, chl
1960	Selenium tetrabromide	SeBr ₄	7789-65-3	398.58	oran-red cry	123				reac H ₂ O; s CS ₂ , chl
1961	Selenium tetrachloride	SeCl ₄	10026-03-6	220.77	wh-yellow cry	305 p		191.4 sp	2.6	reac H ₂ O
1962	Selenium tetrafluoride	SeF ₄	13465-66-2	154.95	collq	-10		106	2.75	reac H ₂ O; vs EDH, eh
1963	Selenium hexafluoride	SeF ₆	7783-79-1	192.95	colgas	-34.6 p		-46.6 sp	7.887 g/L	i H ₂ O
1964	Selenium oxybromide	SeOBr ₂	7789-51-7	254.77	red-yellow sold	41.6		220 dec	3.38	reac H ₂ O; s CS ₂ , bz, ct
1965	Selenium oxychloride	SeOCl ₂	7791-23-3	165.86	color yell liq	8.5		177	2.44	reac H ₂ O; s ct, chl, bz, bl
1966	Selenium oxyfluoride	SeOF ₂	7783-43-9	132.96	collq	15		125	2.8	reac H ₂ O
1967	Selenium dioxide fluoride	SeO ₂ F ₂	14984-81-7	148.96	colgas	-99.5		-8.4	6.089 g/L	reac H ₂ O
1968	Selenium sulfide	SeS ₂	7488-56-4	143.09	red-yellow cry	100				i H ₂ O; s acid
1969	Selenium sulfide	Se ₂ S ₆	75926-26-0	350.32	oran needles	121.5			2.44	s CS ₂ ; slbz
1970	Selenium sulfide	Se ₄ S ₄	75926-28-2	444.10	red cry	113 dec			3.29	s bz; slCS ₂
1971	Selenium sulfide	Se ₆ S ₂	75926-30-6	537.89	oran cry	121.5				s CS ₂
1972	Silicon	Si	7440-21-3	28.086	gray cry or brn amorp sold	1414		3265	2.3290	i H ₂ O, acid; s ak
1973	Silane	SiH ₄	7803-62-5	32.118	colgas; f am	-185		-111.9	1.313 g/L	reac H ₂ O; i EDH, bz
1974	Disilane	Si ₂ H ₆	1590-87-0	62.219	colgas; f am	-132.5		-14.3	2.543 g/L	reac H ₂ O, ct, chl s EDH, bz
1975	Trisilane	Si ₃ H ₈	7783-26-8	92.321	f am liq	-117.4		52.9	0.739	reac H ₂ O
1976	Tetrasilane	Si ₄ H ₁₀	7783-29-1	122.421	collq; f am	-89.9		108.1	0.792	reac H ₂ O
1977	2-Silyltetrasilane	Si ₄ H ₁₀	13597-87-0	122.421	collq	-99.4		101.7	0.792	reac H ₂ O
1978	Pentasilane	Si ₅ H ₁₂	14868-53-2	152.523	collq	-72.8		153.2	0.827	reac H ₂ O
1979	2-Silylpentasilane	Si ₅ H ₁₂	14868-54-3	152.523	collq	-109.9		146.2	0.820	reac H ₂ O
1980	2,2-Disilylpentasilane	Si ₅ H ₁₂	15947-57-6	152.523	collq	-57.8		134.3	0.815	reac H ₂ O
1981	Hexasilane	Si ₆ H ₁₄	14693-61-9	182.624	collq	-44.7		193.6	0.847	reac H ₂ O
1982	2-Silylhexasilane	Si ₆ H ₁₄	14868-55-4	182.624	collq	-78.4		185.2	0.840	
1983	3-Silylhexasilane	Si ₆ H ₁₄	14868-55-4	182.624	collq	-69		179.5	0.843	reac H ₂ O
1984	Heptasilane	Si ₇ H ₁₆	14693-65-3	212.726	collq	-30.1		226.8	0.859	reac H ₂ O
1985	Cyclohexasilane	Si ₆ H ₁₀	289-22-5	150.507	collq	-10.5		194.3	0.963	reac H ₂ O
1986	Cyclohexasilane	Si ₆ H ₁₂	291-59-8	180.608	collq	16.5		226		reac H ₂ O
1987	Bromosilane	SiH ₃ Br	13465-73-1	111.014	colgas	-94		1.9	4.538 g/L	
1988	Bromotrichlorosilane	SiCl ₃ Br	13465-74-2	214.348	collq	-62		80.3	1.826	reac H ₂ O
1989	Chlorosilane	SiH ₃ Cl	13465-78-6	66.563	colgas	-118		-30.4	2.721 g/L	
1990	Chlorotrichlorosilane	SiCl ₃ Cl	14049-36-6	120.534	colgas	-138		-70.0	4.927 g/L	reac H ₂ O
1991	Dibromodichlorosilane	SiBr ₂ Cl ₂	13465-75-3	258.799	collq	-45.5		104	2.172	reac H ₂ O

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
1992	Dibromosilane	SiH ₂ Br ₂	13768-94-0	189.910	lq	-70.1	66			
1993	Dichlorosilane	SiH ₂ Cl ₂	4109-96-0	101.007	colgas; f am	-122	8.3	4.129 g/L		reac H ₂ O
1994	Dichlorodifluorosilane	SiCl ₂ F ₂	18356-71-3	136.988	colgas	-44		5.599 g/L		reac H ₂ O
1995	Difluorosilane	SiH ₂ F ₂	13824-36-7	68.099	colgas	-122	-77.8	2.783 g/L		
1996	Diiodosilane	SiH ₂ I ₂	13760-02-6	283.911	collq	-1	150			
1997	Fluorosilane	SiH ₃ F	13537-33-2	50.108	colgas		-98.6	2.048 g/L		
1998	Iodosilane	SiH ₃ I	13598-42-0	158.014	collq	-57	45.6			
1999	Tetabromosilane	SiBr ₄	7789-66-4	347.702	colfuming lq	5.39	154	2.8		reac H ₂ O
2000	Tetrachlorosilane	SiCl ₄	10026-04-7	169.897	colfuming lq	-68.74	57.65	1.5		reac H ₂ O
2001	Tetrafluorosilane	SiF ₄	7783-61-1	104.080	colgas	-90.2	-86	4.254 g/L		reac H ₂ O
2002	Tetraiodosilane	SiI ₄	13465-84-4	535.704	wh powder	120.5	287.35	4.1		
2003	Tribromosilane	SiHBr ₃	7789-57-3	268.806	f am lq	-73	109	2.7		reac H ₂ O
2004	Tribromochlorosilane	SiBr ₂ Cl	13465-76-4	303.251	collq	-20.8	127	2.497		reac H ₂ O
2005	Trichlorosilane	SiHCl ₃	10025-78-2	135.452	fuming lq	-128.2	33	1.331		reac H ₂ O
2006	Trichlorodifluorosilane	SiCl ₃ F	14965-52-7	153.442	colgas		12.25	6.272 g/L		
2007	Trichloroiodosilane	SiCl ₃ I	13465-85-5	261.348	collq	-60	113.5			reac H ₂ O
2008	Trifluorosilane	SiHF ₃	13465-71-9	86.089	colgas	-131	-95	3.519 g/L		
2009	Triiodosilane	SiI ₃	13465-72-0	409.807	lq	8	220 dec			
2010	Disiloxane	(SiH ₃) ₂ O	13597-73-4	78.218	gas	-144	-15.2	3.197 g/L		
2011	Metasilicic acid	H ₂ SiO ₃	7699-41-4	78.100	wh amorp powder					i H ₂ O; s HF
2012	Orthosilicic acid	H ₄ SiO ₄	10193-36-9	96.116	exists only in soln					
2013	Fluorosilicic acid	H ₂ SiF ₆	16961-83-4	144.092	stable only in aq soln					s H ₂ O
2014	Silicon carbide (hexagona)	SiC	409-21-2	40.097	hard grn-black hex cry	2830		3.16		i H ₂ O, EDH
2015	Silicon nitride	Si ₃ N ₄	12033-89-5	140.284	gray ref rac solid; hex	1900		3.17		
2016	Silicon monoxide	SiO	10097-28-6	44.085	bk cub cry; stable >1200			2.18		
2017	Silicon dioxide (α-quartz)	SiO ₂	14808-60-7	60.085	colhex cry	tans b bea quartz 573	2950	2.648		i H ₂ O, acid; s HF
2018	Silicon dioxide (β-quartz)	SiO ₂	14808-60-7	60.085	colhex cry	tans b tidymite 867	2950	2.533 ³⁰⁰		i H ₂ O, acid; s HF
2019	Silicon dioxide (tridymite)	SiO ₂	15468-32-3	60.085	colhex cry	tans cristobalite 1470	2950	2.265		i H ₂ O, acid; s HF
2020	Silicon dioxide (cristobalite)	SiO ₂	14464-46-1	60.085	colhex cry	1722	2950	2.334		i H ₂ O, acid; s HF
2021	Silicon dioxide (vitreous)	SiO ₂	60676-86-0	60.085	colamorp solid	≈1700	2950	2.196		i H ₂ O, acid; s HF
2022	Silicon monosulfide	SiS	12504-41-5	60.152	yel-red hyg powder	≈900	940	1.85		reac H ₂ O
2023	Silicon disulfide	SiS ₂	13759-10-9	92.218	wh rhomb cry	1090	subl	2.04		reac H ₂ O, EDH; i bz
2024	Silver	Ag	7440-22-4	107.868	silv metal cub	961.78	2162	10.5		
2025	Silver azide	AgN ₃	13863-88-2	149.888	orth cry; exp	exp ≈250		4.9	0.00081 ²⁰	
2026	Silver subfluoride	Ag ₂ F	1302-01-8	234.734	yelhex cry	100 dec		8.6		reac H ₂ O
2027	Silver(I) acetate	AgC ₂ H ₃ O ₂	563-63-3	166.912	wh needles or powder	dec		3.26	1.04 ²⁰	
2028	Silver(I) acetylide	Ag ₂ C ₂	7659-31-6	239.757	wh powder; exp					
2029	Silver(I) arsenate	Ag ₃ AsO ₄	13510-44-6	462.524	red cub cry	dec		6.657	0.00085	s NH ₄ OH
2030	Silver(I) acetylide	AgC ₂ H	13092-75-6	132.897	wh powder; exp					
2031	Silver(I) bromate	AgBrO ₃	7783-89-3	235.770	wh tet cry	360 dec		5.21	0.193 ²⁵	
2032	Silver(I) bromide	AgBr	7785-23-1	187.772	yelcub cry	432	1502	6.47	0.000014 ²⁵	i acid
2033	Silver(I) carbonate	Ag ₂ CO ₃	534-16-7	275.745	yelmonoclcry	218		6.077	0.0036 ²⁰	s acid
2034	Silver(I) chborate	AgCD ₃	7783-92-8	191.319	wh tet cry	230	270 dec	4.430	17.6 ²⁵	slEDH
2035	Silver(I) chloride	AgCl	7783-90-6	143.321	wh cub cry	455	1547	5.56	0.00019 ²⁵	
2036	Silver(I) chloride	AgCD ₂	7783-91-7	175.320	yelcry	105 exp			0.55 ²⁵	

2037	Silver(I) chromate	Ag ₂ CrO ₄	7784-01-2	331.730	brn-red monocry		5.625	0.000014 ⁰		
2038	Silver(I) citate	Ag ₃ C ₆ H ₅ O ₇	126-45-4	512.705	wh cry powder				i H ₂ O; s HNO ₃	
2039	Silver(I) cyanide	AgCN	506-64-9	133.886	wh-gray hex cry	320 dec	3.95	0.0000011	i EDH, dilacid	
2040	Silver(I) dichromate	Ag ₂ Cr ₂ O ₇	7784-02-3	431.724	red cry		4.770		slH ₂ O	
2041	Silver(I) diethylthiocarbamate	Ag(C ₂ H ₅) ₂ NCS ₂	1470-61-7	256.140	pow	173			s py	
2042	Silver(I) fluoride	AgF	7775-41-9	126.866	yelbrn cub cry; hyg	435	1159	5.852	172 ²⁰	
2043	Silver(I) hexafluoroantimonate	AgSbF ₆	26042-64-8	343.618	pow					
2044	Silver(I) hexafluoroarsenate	AgAsF ₆	12005-82-2	296.780	pow					
2045	Silver(I) hexafluorophosphate	AgPF ₆	26042-63-7	252.832	pow	102 dec				
2046	Silver(I) hydrogen fluoride	AgHF ₂	12249-52-4	146.873	hyg cry	dec				
2047	Silver(I) iodate	AgIO ₃	7783-97-3	282.770	wh orth cry	>200	5.53	0.053 ²⁵		
2048	Silver(I) iodide	AgI	7783-96-2	234.772	yelpowder; hex	558	1506	5.68	0.000003	i acid
2049	Silver(I) iactate monohydrate	AgC ₂ H ₃ O ₃ · H ₂ O	128-00-7	214.954	gray cry powder					slH ₂ O, EDH
2050	Silver(I) metaphosphate	AgPO ₃	13465-96-8	186.840	grn glass	490	6.37			i H ₂ O; s HNO ₃ , NH ₄ OH
2051	Silver(I) molybdate	Ag ₂ MoO ₄	13765-74-7	375.67	yelcub cry	483	6.18			slH ₂ O
2052	Silver(I) nitrate	AgNO ₃	7761-88-8	169.873	colrhomb cry	212	440 dec	4.35	234 ²⁵	slEDH, ace
2053	Silver(I) nitrite	AgNO ₂	7783-99-5	153.874	yelneedbs	140 dec	4.453	0.415 ²⁵		i EDH; reac acid
2054	Silver(I) oxalate	Ag ₂ C ₂ O ₄	533-51-7	303.755	wh cry powder	exp 140	5.03	0.0043 ²⁰		
2055	Silver(I) oxide	Ag ₂ O	20667-12-3	231.735	brn-bk cub cry	≈200 dec	7.2	0.0025		i EDH; s acid, ak
2056	Silver(I) perchlorate	AgClO ₄	7783-93-9	207.319	colcub cry; hyg	486 dec	2.806	558 ²⁵		s bz, py, os
2057	Silver(I) perchlorate monohydrate	AgClO ₄ · H ₂ O	14242-05-8	225.334	hyg wh cry	43 dec		558 ²⁵		
2058	Silver(I) permanganate	AgMnO ₄	7783-98-4	226.804	violmonocry	dec	4.49	0.91 ¹⁸		reac EDH
2059	Silver(I) phosphate	Ag ₃ PO ₄	7784-09-0	418.576	yelpowder	849	6.37	0.0064		sl/dilacid
2060	Silver(I) picrate monohydrate	AgC ₆ H ₂ N ₂ O ₇ · H ₂ O	146-84-9	353.979	yelcry					slH ₂ O, EDH; i chl eth
2061	Silver(I) selenate	Ag ₂ SeO ₄	7784-07-8	358.69	orth cry		5.72	0.118 ²⁰		
2062	Silver(I) selenide	Ag ₂ Se	1302-09-6	294.70	gray hex needles	880	8.216			i H ₂ O
2063	Silver(I) selenite	Ag ₂ SeO ₃	7784-05-6	342.69	needbs	530	>550 dec	5.930		slH ₂ O; s acid
2064	Silver(I) sulfite	Ag ₂ SO ₃	10294-26-5	311.800	colcry or powder	652	5.45	0.84 ²⁵		
2065	Silver(I) sulfide	Ag ₂ S	21548-73-2	247.802	gray-bk orth powder	825	7.23			i H ₂ O; s acid
2066	Silver(I) sulfate	Ag ₂ SO ₄	13465-98-0	295.800	wh cry	100 dec		0.00046 ²⁰		s acid, NH ₄ OH
2067	Silver(I) telluride	Ag ₂ Te	12002-99-2	343.34	bk orth cry	955	8.4			
2068	Silver(I) tetraiodomercurate(II)	Ag ₂ HgI ₄	7784-03-4	923.94	yelct cry	tans b red cub ≈40	6.1			i H ₂ O, dilacid
2069	Silver(I) thiocyanate	AgSCN	1701-93-5	165.952	wh powder	dec				i H ₂ O
2070	Silver(I) thiosulfate	Ag ₂ S ₂ O ₃	23149-52-2	327.866	wh cry	dec				slH ₂ O; s NH ₄ OH
2071	Silver(II) oxide	AgO	1301-96-8	123.867	gray powder; monoclor cub	>100 dec	7.5	0.0027 ²⁵		s ak; reac acid
2072	Silver(II) tungstate	Ag ₂ WO ₄	13465-93-5	463.57	yelcry	620		0.015		s HNO ₃ , NH ₄ OH
2073	Silver(II) fluoride	AgF ₂	7783-95-1	145.865	wh or gray hyg cry	690	4.58			reac H ₂ O
2074	Silver(II) oxide (Ag ₂ O ₂)	Ag ₂ O ₂	25455-73-6	247.735	gray-bk cub cry	>100	7.44			i H ₂ O; s acid, NH ₄ OH
2075	Sodium	Na	7440-23-5	22.990	soft tsiv met cub	97.80	883	0.97		reac H ₂ O
2076	Sodium acetate	NaC ₂ H ₃ O ₂	127-09-3	82.034	colcry	328.2	1.528	50.4 ²⁵		
2077	Sodium acetate trihydrate	NaC ₂ H ₃ O ₂ · 3H ₂ O	6131-90-4	136.079	colcry	58 dec	1.45	50.4 ²⁵		slEDH
2078	Sodium aluminate	NaAlO ₂	1302-42-7	81.971	wh orth cry; hyg	1650	4.63			vs H ₂ O; i EDH
2079	Sodium aluminum hydride	NaAlH ₄	13770-96-2	54.004	wh hyg sold	174 dec	1.24			i eth; s tlf
2080	Sodium aluminum sulfate dodecahydrate	NaAl(SO ₄) ₂ · 12H ₂ O	10102-71-3	458.283	colcry	≈60	1.61	39.7 ²⁰		i EDH
2081	Sodium amide	NaNH ₂	7782-92-5	39.013	wh-grn orth cry	210	500 dec	1.39		reac H ₂ O
2082	Sodium ammonium phosphate tetrahydrate	NaNH ₄ HPO ₄ · 4H ₂ O	13011-54-6	209.069	monocry	≈80 dec	1.54			s H ₂ O; i EDH
2083	Sodium arsenite	NaAsO ₂	7784-46-5	129.911	wh-gray hyg powder		1.87			vs H ₂ O; i EDH
2084	Sodium azide	NaN ₃	26628-22-8	65.010	colhex cry	300 dec	1.846	40.8 ²⁰		slEDH; i eth

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
2085	Sodium borohydride	NaBH ₄	16940-66-2	37.833	wh cub cry; hyg	≈400 dec		1.07	55 ²⁰	reac EDH
2086	Sodium bromat	NaBrO ₃	7789-38-0	150.892	colcub cry	381		3.34	39.4 ²⁵	i EDH
2087	Sodium bromide	NaBr	7647-15-6	102.894	wh cub cry	747	1390	3.200	94.6 ²⁵	s EDH
2088	Sodium bromide dihydrat	NaBr · 2H ₂ O	13466-08-5	138.925	wh cry	36 dec		2.18	94.6 ²⁵	slEDH
2089	Sodium carbonat	Na ₂ CO ₃	497-19-8	105.989	wh hyg powder	858.1		2.54	30.7 ²⁵	i EDH
2090	Sodium carbonat decahydrat	Na ₂ CO ₃ · 10H ₂ O	6132-02-1	286.142	colcry	34 dec		1.46	30.7 ²⁵	i EDH
2091	Sodium carbonat monohydrat	Na ₂ CO ₃ · H ₂ O	5968-11-6	124.005	colrth cry	100 dec		2.25	30.7 ²⁵	i EDH
2092	Sodium chbrat	NaCD ₃	7775-09-9	106.441	colcub cry	248	>300 dec	2.5	100 ²⁵	slEDH
2093	Sodium chbride	NaCl	7647-14-5	58.443	colcub cry	800.7	1465	2.17	36.0 ²⁵	slEDH
2094	Sodium chbrië	NaCD ₂	7758-19-2	90.442	wh hyg cry	≈180 dec			64 ¹⁷	
2095	Sodium chromat	Na ₂ CrO ₄	7775-11-3	161.974	yelrth cry	792		2.72	87.6 ²⁵	slEDH
2096	Sodium chromat tetrahydrat	Na ₂ CrO ₄ · 4H ₂ O	10034-82-9	234.035	yelhyg cry	dec			87.6 ²⁵	slEDH
2097	Sodium citat dihydrat	Na ₃ C ₆ H ₅ O ₇ · 2H ₂ O	6132-04-3	294.099	wh cry	150 dec				vs H ₂ O; i EDH, eh
2098	Sodium cyanat	NaCNO	917-61-3	65.007	colneedles	550		1.89		s H ₂ O; slEDH; i eh
2099	Sodium cyanide	NaCN	143-33-9	49.008	wh cub cry; hyg	563		1.6	58.2 ²⁰	slEDH
2100	Sodium cyanoborohydride	NaBH ₃ (CN)	25895-60-7	62.843	wh hyg powder	240 dec		1.12		vs H ₂ O; s trif; slEDH; i bz, eh
2101	Sodium dichromat	Na ₂ Cr ₂ O ₇	10588-01-9	261.968	red hyg cry	357	400 dec		187 ²⁵	
2102	Sodium dihydrogen phosphat	NaH ₂ PO ₄	7558-80-7	119.977	colmono cry	200 dec			94.9 ²⁵	
2103	Sodium dihydrogen phosphat monohydrat	NaH ₂ PO ₄ · H ₂ O	10049-21-5	137.993	wh hyg cry	100 dec			94.9 ²⁵	i EDH
2104	Sodium dihydrogen phosphat dihydrat	NaH ₂ PO ₄ · 2H ₂ O	13472-35-0	156.008	colrth cry	60 dec		1.91	94.9 ²⁵	i EDH
2105	Sodium dihydrogen hypophosphat hexahydrat	Na ₂ H ₂ P ₂ O ₆ · 6H ₂ O	7782-95-8*	314.031	mono plets	110 dec		1.849	2.0 ²⁵	i EDH
2106	Sodium dihydrogen pyrophosphat	Na ₂ H ₂ P ₂ O ₇	7758-16-9	221.939	wh powder	220 dec		≈1.9		s H ₂ O
2107	Sodium ditionat	Na ₂ S ₂ O ₄	7775-14-6	174.110	gray-wh pow	52 dec			24.1 ²⁰	slEDH
2108	Sodium ditionat dihydrat	Na ₂ S ₂ O ₄ · 2H ₂ O	7631-94-9*	242.139	colrth cry	110 dec		2.19	15.1 ²⁰	i EDH
2109	Sodium etanonat	NaC ₂ H ₃ O	141-52-6	68.050	wh-yelhyg pow					reac H ₂ O; s EDH
2110	Sodium ferricyanide monohydrat	Na ₃ Fe(CN) ₆ · H ₂ O	14217-21-1*	298.933	red hyg cry					s H ₂ O; i EDH
2111	Sodium ferrocyanide decahydrat	Na ₄ Fe(CN) ₆ · 10H ₂ O	13601-19-9	484.061	yelmonoclcry	≈50 dec		1.46	20 ²⁰	i os
2112	Sodium f luoride	NaF	7681-49-4	41.988	colcub or let cry	996	1704	2.78	4.13 ²⁵	i EDH
2113	Sodium tetrafluoroborat	NaBF ₄	13755-29-8	109.795	wh orth prisms	384		2.47	108 ²⁰	slEDH
2114	Sodium f luorophosphat	Na ₂ PO ₃ F	10163-15-2	143.950	pow					
2115	Sodium format	NaCHO ₂	141-53-7	68.008	wh hyg cry	257.3	dec	1.92	94.9 ²⁵	slEDH
2116	Sodium germanat	Na ₂ GeO ₃	12025-19-3	166.59	wh mono hyg cry	1083		3.31		
2117	Sodium hexabromoplatnat(IV) hexahydrat	Na ₂ PBr ₆ · 6H ₂ O	39277-13-9	828.57	cry					
2118	Sodium hexachloridat(IV) hexahydrat	Na ₂ IrCl ₆ · 6H ₂ O	19567-78-3	559.004	cry	600 dec				
2119	Sodium hexachloroplatnat(IV)	Na ₂ PCI ₆	16923-58-3	453.77	yelhyg cry				53 ¹⁶	s EDH
2120	Sodium hexachloroplatnat(IV) hexahydrat	Na ₂ PCI ₆ · 6H ₂ O	16923-58-3	561.87	yelcry	110 dec		2.50	53 ¹⁶	s EDH; i eh
2121	Sodium hexafluoroaluminat	Na ₃ AF ₆	13775-53-6	209.941	colmonoclcry; tans cub 560	1009		2.97		i H ₂ O
2122	Sodium hexafluoroantimonat	NaSbF ₆	16925-25-0	258.740	wh cub cry			3.375	129 ²⁰	s EDH, ace
2123	Sodium hexafluorophosphat monohydrat	NaPF ₆ · H ₂ O	20644-15-9	185.969	colrth cry			2.369	103 ⁰	s EDH, MeOH, ace
2124	Sodium hexafluorosilicat	Na ₂ SIF ₆	16893-85-9	188.056	wh hex cry	dec		2.7	0.67 ²⁰	i EDH
2125	Sodium hexanitocobalt(III)	Na ₃ Co(NO ₂) ₆	14649-73-1	403.935	yelbrn cry pow					vs H ₂ O; slEDH
2126	Sodium hydride	NaH	7646-69-7	23.998	silv cub cry; f am	425 dec		1.39		reac H ₂ O, EDH
2127	Sodium hydrogen arsenat	Na ₂ HAsO ₄	7778-43-0	185.908	wh pow	≈195 dec			51 ²⁰	slEDH
2128	Sodium hydrogen arsenat heptahydrat	Na ₂ HAsO ₄ · 7H ₂ O	10048-95-0	312.014	wh monoclcry	≈50 dec		1.87	51 ²⁰	slEDH
2129	Sodium hydrogen carbonat	NaHCO ₃	144-55-8	84.007	wh monoclcry	≈50 dec		2.20	10.3 ²⁵	i EDH

2130	Sodium hydrogen fluoride	NaHF_2	1333-83-1	61.995	wh hex cry	>160 dec	2.08	3.25 ²⁰			
2131	Sodium hydrogen phosphat	Na_2HPO_4	7558-79-4	141.959	wh hyg powder		1.7	11.8 ²⁵			
2132	Sodium hydrogen phosphat dodecahydrat	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$	10039-32-4	358.143	colcry	≈35 dec	≈1.5	11.8 ²⁵	i EOH		
2133	Sodium hydrogen phosphat heptahydrat	$\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$	7782-85-6	268.066	colcry		≈1.7	11.8 ²⁵	i EOH		
2134	Sodium hydrogen sulfat	NaHSO_4	7681-38-1	120.062	wh hyg cry	≈315	2.43	28.5 ²⁵			
2135	Sodium hydrogen sulfat monohydrat	$\text{NaHSO}_4 \cdot \text{H}_2\text{O}$	10034-88-5	138.077	wh monocry		2.10	28.5 ²⁵	reac EOH		
2136	Sodium hydrogen sulfid	NaHS	16721-80-5	56.064	colrhomb cry	350	1.79		s H_2O , EOH, eh		
2137	Sodium hydrogen sulfid dihydrat	$\text{NaHS} \cdot 2\text{H}_2\text{O}$	16721-80-5	92.095	yelhyg needbs	55 dec			vs H_2O , EOH, eh		
2138	Sodium hydrogen sulfid	NaHSO_3	7631-90-5	104.062	wh cry		1.48		s H_2O ; slEOH		
2139	Sodium hydroxide	NaOH	1310-73-2	39.997	wh orth cry; hyg		323	1388	2.13	100 ²⁵	s EOH, MeOH
2140	Sodium hypochlorit	NaClO	7681-52-9	74.442	stabl in aq soln	anh f orm exp				79.9 ²⁵	
2141	Sodium hypochlorit pentahydrat	$\text{NaOCl} \cdot 5\text{H}_2\text{O}$	10022-70-5	164.518	pat grn orth cry	18	1.6				s H_2O
2142	Sodium iodat	NaIO_3	7681-55-2	197.892	wh orth cry	dec	4.28	9.47 ²⁵			i EOH
2143	Sodium iodide	NaI	7681-82-5	149.894	wh cub cry; hyg	660	1304	3.67		184 ²⁵	s EOH, ace
2144	Sodium bismutat	NaBiO_3	12232-99-4	279.968	yelbrn hyg cry						i cold H_2O , reac acid
2145	Sodium metabisulfid	$\text{Na}_2\text{S}_2\text{O}_5$	7681-57-4	190.109	wh cry					66.7 ²⁵	slEOH
2146	Sodium metaborat	NaBO_2	7775-19-1	65.800	wh hex cry	966	1434	2.46			s H_2O
2147	Sodium metasilicat	Na_2SiO_3	6834-92-0	122.064	wh amorp sold; hyg	1089		2.61			s cold H_2O ; reac hot H_2O
2148	Sodium molybdat	Na_2MoO_4	7631-95-0	205.92	colcub cry	687		≈3.5		65.0 ²⁵	
2149	Sodium molybdat dihydrat	$\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$	10102-40-6	241.95	cry powder	100 dec		≈3.5		65.0 ²⁵	
2150	Sodium niobat	NaNbO_3	12034-09-2	163.894	rhomb cry	1422		4.55			i H_2O
2151	Sodium nitat	NaNO_3	7631-99-4	84.995	colhex cry; hyg	307		2.26		91.2 ²⁵	slEOH, MeOH
2152	Sodium nitrit	NaNO_2	7632-00-0	68.996	wh orth cry; hyg	271	>320 dec	2.17		84.8 ²⁵	slEOH; reac acid
2153	Sodium nitoprussid dihydrat	$\text{Na}_2[\text{Fe}(\text{CN})_2\text{NO}] \cdot 2\text{H}_2\text{O}$	13755-38-9	297.949	red cry			1.72		40 ¹⁶	slEOH
2154	Sodium orthovanadat	Na_3VO_4	13721-39-6	183.909	colhex prisms	860					s H_2O ; i EOH
2155	Sodium oxalat	$\text{Na}_2\text{C}_2\text{O}_4$	62-76-0	133.999	wh powder	≈250 dec		2.34		3.61 ²⁵	i EOH
2156	Sodium oxid	Na_2O	1313-59-3	61.979	wh amorp powder	1132 dec		2.27			reac H_2O
2157	Sodium perborat tetrahydrat	$\text{NaBO}_3 \cdot 4\text{H}_2\text{O}$	7632-04-4	153.861	wh cry	60 dec					reac H_2O
2158	Sodium perchlorat	NaClO_4	7601-89-0	122.441	wh orth cry; hyg	480 dec		2.52		205 ²⁵	
2159	Sodium perchlorat monohydrat	$\text{NaClO}_4 \cdot \text{H}_2\text{O}$	7791-07-3	140.456	wh hyg cry	≈130 dec		2.02		205 ²⁵	
2160	Sodium periodat	NaIO_4	7790-28-5	213.892	wh et cry	≈300 dec		3.86		14.4 ²⁵	s acid
2161	Sodium periodat trihydrat	$\text{NaIO}_4 \cdot 3\text{H}_2\text{O}$	13472-31-6	267.938	wh hex cry	175 dec		3.22		14.4 ²⁵	
2162	Sodium permanganat trihydrat	$\text{NaMnO}_4 \cdot 3\text{H}_2\text{O}$	10101-50-5*	195.972	red-bk hyg cry	170 dec		2.47		144 ²⁰	reac EOH
2163	Sodium peroxid	Na_2O_2	1313-60-6	77.979	yelhyg powder	675		2.805			reac H_2O
2164	Sodium perrhenat	NaReO_4	13472-33-8	273.195	cry	300		5.39			
2165	Sodium persulfat	$\text{Na}_2\text{S}_2\text{O}_8$	7775-27-1	238.107	wh hyg cry						vs H_2O ; reac EOH
2166	Sodium phosphat dodecahydrat	$\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$	10101-89-0	380.124	colhex cry	≈75		1.62		14.4 ²⁵	i EOH
2167	Chlornatd trisodium phosphat	$\text{Na}_3\text{PO}_4 \cdot \text{NaOCl}$	56802-99-4	238.383	wh cry					25 ²⁵	
2168	Sodium phosphinat	NaH_2PO_2	7681-53-0	87.979	wh cry					100 ²⁵	
2169	Sodium phosphinat monohydrat	$\text{NaH}_2\text{PO}_2 \cdot \text{H}_2\text{O}$	10039-56-2	105.994	colhyg cry	310 dec				100 ²⁵	s EOH
2170	Sodium potassium tetrat tetrahydrat	$\text{NaKC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$	304-59-6	282.220	wh cry	≈70 dec	anh at130	1.79			vs H_2O ; i EOH
2171	Sodium pyrophosphat	$\text{Na}_2\text{P}_2\text{O}_7$	7722-88-5	265.902	colcry	988		2.53		7.09 ²⁵	
2172	Sodium selenat	Na_2SeO_4	13410-01-0	188.94	colorth cry					58.5 ²⁵	
2173	Sodium selenat decahydrat	$\text{Na}_2\text{SeO}_4 \cdot 10\text{H}_2\text{O}$	10102-23-5	369.09	wh cry			1.61		58.5 ²⁵	
2174	Sodium selenid	Na_2Se	1313-85-5	124.94	amorp sold	>875		2.62			reac H_2O
2175	Sodium selenit	Na_2SeO_3	10102-18-8	172.94	wh et cry					89.8 ²⁵	i EOH

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
2176	Sodium starat	NaC ₁₈ H ₃₅ O ₂	822-16-2	306.460	wh pow					sH ₂ O, EOH; vs hotH ₂ O
2177	Sodium succinat hexahydrat	Na ₂ C ₄ H ₄ O ₄ · 6H ₂ O	150-90-3	270.144	cry pow	120 dec			20	i EOH
2178	Sodium suf at	Na ₂ SO ₄	7757-82-6	142.044	wh orth cry or powder	884		2.7	28.1 ²⁵	i EOH
2179	Sodium suf at decahydrat	Na ₂ SO ₄ · 10H ₂ O	7727-73-3	322.197	colmonocry	32 dec		1.46	28.1 ²⁵	i EOH
2180	Sodium suf ide	Na ₂ S	1313-82-2	78.046	wh cub cry; hyg	1172		1.856	20.6 ²⁵	slEOH; i eh
2181	Sodium suf ide nonahydrat	Na ₂ S · 9H ₂ O	1313-84-4	240.184	wh-yelhyg cry	≈50 dec		1.43	20.6 ²⁵	slEOH; i eh
2182	Sodium suf ide penthydrat	Na ₂ S · 5H ₂ O	1313-83-3	168.122	colorth cry	120 dec		1.58	20.6 ²⁵	s EOH; i eh
2183	Sodium suf it	Na ₂ SO ₃	7757-83-7	126.044	wh hex cry	dec		2.63	30.7 ²⁵	i EOH
2184	Sodium suf it heptahydrat	Na ₂ SO ₃ · 7H ₂ O	10102-15-5	252.151	wh monocry; unsat			1.56	30.7 ²⁵	slEOH
2185	Sodium superoxide	NaO ₂	12034-12-7	54.989	yelcub cry	552		2.2		reac H ₂ O
2186	Sodium telurat	Na ₂ TeO ₄	10101-83-4	237.58	wh powder				0.8	
2187	Sodium telurit	Na ₂ TeO ₃	10102-20-2	221.58	wh rhomb prisms					sH ₂ O
2188	Sodium etaborat	Na ₂ B ₄ O ₇	1330-43-4	201.220	colglsold; hyg	743	1575	2.4	3.17 ²⁵	slMeOH
2189	Sodium etaborat decahydrat	Na ₂ B ₄ O ₇ · 10H ₂ O	1303-96-4	381.373	wh monocry	75 dec		1.73	3.17 ²⁵	i EOH
2190	Sodium etaborat penthydrat	Na ₂ B ₄ O ₇ · 5H ₂ O	12045-88-4	291.296	hex cry	dec		1.88	3.17 ²⁵	
2191	Sodium etaborat etahydrat	Na ₂ B ₄ O ₇ · 4H ₂ O	12045-87-3	273.281	wh monocry			1.95	3.17 ²⁵	
2192	Sodium etachbroalminat	NaAlCl ₄	7784-16-9	191.783	orth cry			2.01		s H ₂ O
2193	Sodium etachbroaurat(III) dihydrat	NaAuCl ₄ · 2H ₂ O	13874-02-7	397.799	oran-yelrhomb cry	100 dec			150 ¹⁰	s EOH, eh
2194	Sodium etachbropaladat(II) tihydrat	Na ₂ PdCl ₄ · 3H ₂ O	13820-53-6	348.26	brn-red hyg cry					vs H ₂ O; s EOH
2195	Sodium etachbropaladat(II) etahydrat	Na ₂ PdCl ₄ · 4H ₂ O	10026-00-3	454.93	red prisms	100				s H ₂ O, EOH
2196	Sodium etaf fluoroberyll	Na ₂ BeF ₄	13871-27-7	130.986	orth cry	575		2.47		sH ₂ O
2197	Sodium tiocyanat	NaSCN	540-72-7	81.074	colhyg cry	287			151 ²⁵	
2198	Sodium tiophosphat dodecahydrat	Na ₃ PO ₃ S · 12H ₂ O	10101-88-9	396.191	hex hyg taf ts	60				vs hotH ₂ O
2199	Sodium tiosuf at	Na ₂ S ₂ O ₃	7772-98-7	158.110	colmono cry	100 dec		1.69	76.4 ²⁵	i EOH
2200	Sodium tiosuf at penthydrat	Na ₂ S ₂ O ₃ · 5H ₂ O	10102-17-7	248.186	colcry	≈50 dec		1.69	76.4 ²⁵	i EOH
2201	Sodium timefphosphat	Na ₃ (PO ₃) ₃	7785-84-4	305.885	wh cry			2.49	22	
2202	Sodium timefphosphat hexahydrat	Na ₃ (PO ₃) ₃ · 6H ₂ O	7785-84-4	413.976	trichrom hyg prisms	53		1.786	22	i EOH
2203	Sodium tipolyphosphat	Na ₆ P ₃ O ₁₀	7758-29-4	367.864	wh hyg pow	622			20 ²⁵	
2204	Sodium tungstat	Na ₂ WO ₄	13472-45-2	293.82	wh rhomb cry	695		4.18	74.2 ²⁵	
2205	Sodium tungstat dihydrat	Na ₂ WO ₄ · 2H ₂ O	10213-10-2	329.85	wh orth cry	100 dec		3.25	74.2 ²⁵	i EOH
2206	Sodium uranat(VI) monohydrat	Na ₂ U ₂ O ₇ · H ₂ O	13721-34-1	652.049	yel.pow					i H ₂ O; s acid
2207	Sodium vanadat(V)	NaVO ₃	13718-26-8	121.930	colmono prisms	630			21 ²⁵	
2208	Sodium vanadat(V) etahydrat	NaVO ₃ · 4H ₂ O	13718-26-8	193.992	yelwh cry pow				21 ²⁵	
2209	Stontium	Sr	7440-24-6	87.62	silv-wh mef cub	777	1382	2.64		reac H ₂ O; s EOH
2210	Stontium arsenit etahydrat	Sr(AsO ₂) ₂ · 4H ₂ O	10378-48-0	373.52	wh pow					sH ₂ O, EOH; soldilacid
2211	Stontium bromat monohydrat	Sr(BrO ₃) ₂ · H ₂ O	14519-18-7	361.44	yelhyg mono cry	120 dec		3.773	39.0 ²⁵	
2212	Stontium bromide	SrBr ₂	10476-81-0	247.43	wh et cry	657		4.216	107 ²⁵	
2213	Stontium bromide hexahydrat	SrBr ₂ · 6H ₂ O	7789-53-9	355.52	colhyg cry	88 dec			107 ²⁵	s EOH; i eh
2214	Stontium carbide	SrC ₂	12071-29-3	111.64	bk et cry	>1700		3.19		i H ₂ O
2215	Stontium carbonat	SrCO ₃	1633-05-2	147.63	wh orth cry; hyg	1494		3.5	0.00034 ²⁰	s dilacid
2216	Stontium chbrat	Sr(CD ₃) ₂	7791-10-8	254.52	colcry	120 dec		3.15	176 ²⁵	slEOH
2217	Stontium chbride	SrCl ₂	10476-85-4	158.53	wh cub cry; hyg	874	1250	3.052	54.7 ²⁵	
2218	Stontium chbride hexahydrat	SrCl ₂ · 6H ₂ O	10025-70-4	266.62	colhyg cry	100 dec		1.96	54.7 ²⁵	s EOH
2219	Stontium chromat	SrCrO ₄	7789-06-2	203.61	yelmonocry	dec		3.9	0.106 ²⁰	s dilacid
2220	Stontium cyanide dihydrat	Sr(CN) ₂ · 4H ₂ O		211.72	wh hyg cry	dec				vs H ₂ O

2221	Strontium ferrocyanide pentahydrate	SrFe(CN) ₆ · 5H ₂ O	569.80	yel mono cry				50	
2222	Strontium fluoride	SrF ₂	7783-48-4	125.62	wh cub cry or powder	1477	2460	4.24	0.021 ²⁵ s dil acid
2223	Strontium formate	Sr(CHO ₂) ₂	592-89-2	177.66	wh cry	71.9		2.693	9.1 ⁰
2224	Strontium formate dihydrate	Sr(CHO ₂) ₂ · 2H ₂ O	6160-34-5	213.69	colorh cry	100	dec	2.25	9.1 ³⁷ i EOH, eh
2225	Strontium hexaboride	SrB ₆	12046-54-7	152.49	bk cub cry	2235		3.39	i H ₂ O; s HNO ₃
2226	Strontium hydride	SrH ₂	13598-33-9	89.64	orth cry	1050		3.26	reac H ₂ O
2227	Strontium hydroxide	Sr(OH) ₂	18480-07-4	121.64	colorh cry; hyg	535	710 dec	3.625	2.25 ²⁵
2228	Strontium iodate	Sr(IO ₃) ₂	13470-01-4	437.43	tiel cry			5.045	0.165 ²⁵
2229	Strontium iodide	SrI ₂	10476-86-5	341.43	wh hyg cry	538	1773 dec	4.55	177 ²⁵
2230	Strontium iodide hexahydrate	SrI ₂ · 6H ₂ O	73796-25-5	449.52	wh-yel hex cry; hyg	120	dec	4.4	177 ²⁵ s EDH
2231	Strontium niobate	SrNb ₂ O ₆	12034-89-8	369.43	monocry	1225		5.11	i H ₂ O
2232	Strontium nitrate	Sr(NO ₃) ₂	10042-76-9	211.63	wh cub cry	570	645	2.99	80.2 ²⁵ sl EOH, ace
2233	Strontium nitride	Sr ₃ N ₂	12033-82-8	290.87	ref rac sold	1200			reac H ₂ O; s HCl
2234	Strontium nitrite	Sr(NO ₂) ₂	13470-06-9	179.63	wh-yel hyg needles	240	dec	2.8	72.1 ³⁰
2235	Strontium oxide	SrO	1314-11-0	103.62	col cub cry	2531		5.1	reac H ₂ O
2236	Strontium perchlorate	Sr(ClO ₄) ₂	13450-97-0	286.52	col hyg cry				306 ²⁵ s EDH, MeOH
2237	Strontium permanganate trihydrate	Sr(MnO ₄) ₂ · 3H ₂ O		379.54	pur cub cry	175	dec	2.75	250 ¹⁸
2238	Strontium peroxide	SrO ₂	1314-18-7	119.62	wh et cry; unstable	215	dec	4.78	reac H ₂ O
2239	Strontium phosphate	Sr ₃ (PO ₄) ₂	7446-28-8	452.80	wh powder				0.000011 ²⁰ s acid
2240	Strontium selenate	SrSeO ₄	7446-21-1	230.58	orth cry			4.25	0.115 ²⁰ s hot HCl
2241	Strontium selenide	SrSe	1315-07-7	166.58	wh cub cry	1600		4.54	
2242	Strontium orthosilicate	Sr ₂ SiO ₄	13597-55-2	267.32	orth cry			4.5	
2243	Strontium silicide	SrSi ₂	12138-28-2	143.79	silv-gray cub cry	1100		3.35	
2244	Strontium sulfate	SrSO ₄	7759-02-6	183.68	wh orth cry	1606		3.96	0.0135 ²⁵ i EOH; sl acid
2245	Strontium sulfide	SrS	1314-96-1	119.69	gray cub cry	2226		3.70	sl H ₂ O; s acid
2246	Strontium sulfite	SrSO ₃	13451-02-0	167.68	col cry	dec			0.0015 ²⁵ s H ₂ SO ₄ , HCl
2247	Strontium telluride	SrTe	12040-08-3	215.22	wh cub cry			4.83	
2248	Strontium tiosulfate pentahydrate	SrS ₂ O ₃ · 5H ₂ O	15123-90-7	289.83	mono needles	100	dec	2.17	36.3 ²⁵ i EOH
2249	Strontium titanate	SrTiO ₃	12060-59-2	183.49	wh cub cry	2080		5.1	i H ₂ O
2250	Strontium tungstate	SrWO ₄	13451-05-3	335.46	col et cry	dec		6.187	0.14 ¹⁵ i EOH
2251	Sulfur (rhombic)	S	7704-34-9	32.066	yel orth cry	95.3 (trans b monoc)	444.60	2.07	i H ₂ O; sl EOH, bz, eh; s CS ₂
2252	Sulfur (monoclinic)	S	7704-34-9	32.066	yel monocl needles, stable	95.3-120	444.60	2.07	i H ₂ O; sl EOH, bz, eh; s CS ₂
2253	Sulfuric acid	H ₂ SO ₄	7664-93-9	98.080	col oily liq	10.31	337	1.8	vs H ₂ O
2254	Peroxydisulfuric acid	H ₂ SO ₅	7722-86-3	114.079	wh cry; unstable	45	dec		vs H ₂ O
2255	Nitrosylsulfuric acid	HNOSO ₄	7782-78-7	127.078	prisms	73	dec		reac H ₂ O; s H ₂ SO ₄
2256	Chlorosulfuric acid	SO ₂ (OH)Cl	7790-94-5	116.525	col yell liq	-80	152	1.75	reac H ₂ O; s py
2257	Fluorosulfuric acid	SO ₂ (OH)F	7789-21-1	100.070	col liq	-89	163	1.726	reac H ₂ O
2258	Sulfurous acid	H ₂ SO ₃	7782-99-2	82.080	exists only in soln				soln of SO ₂ in H ₂ O
2259	Sulfamic acid	H ₂ NSO ₃ H	5329-14-6	97.095	orth cry	≈205	dec	2.15	14.7 ⁰ sl ace; i eh
2260	Sulfur dioxide	SO ₂	7446-09-5	64.065	col gas	-75.5	-10.05	2.619 g/L	s H ₂ O, EDH, eh, chl
2261	Sulfur trioxide	SO ₃	7446-11-9	80.064	col liq	16.8	45	1.92	reac H ₂ O
2262	Sulfur bromide	SSBr ₂	13172-31-1	223.940	red oily liq	-46	>25 dec	2.63	reac H ₂ O
2263	Sulfur chloride	SSCl ₂	10025-67-9	135.037	yel-red oily liq	-77	137	1.69	reac H ₂ O; s EOH, bz, eh, ct
2264	Sulfur fluoride	SSF ₂	16860-99-4	102.129	col gas	-164.6	-10.6	4.174 g/L	reac H ₂ O
2265	Sulfur tetrafluoride	FSSF	13709-35-8	102.129	col gas	-133	15	4.174 g/L	reac H ₂ O
2266	Sulfur dichloride	SCl ₂	10545-99-0	102.971	red visc liq	-122	59.6	1.62	reac H ₂ O
2267	Sulfur tetrafluoride	SF ₄	7783-60-0	108.060	col gas	-125	-40.45	4.417 g/L	reac H ₂ O

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
2268	Sulfur hexafluoride	SF ₆	2551-62-4	146.056	colgas	-50.7 p	-63.8 sp	5.970 g/L		slH ₂ O; s EDH
2269	Sulfur pentabromide	SF ₅ Br	15607-89-3	206.962	colgas	-79	3.1	8.459 g/L		
2270	Sulfur pentachloride	SF ₅ Cl	13780-57-9	162.511	colgas	-64	-19.05	6.642 g/L		
2271	Sulfur decafluoride	S ₂ F ₁₀	5714-22-7	254.116	lq	-52.7	30; dec 150	2.08		i H ₂ O
2272	Sulfurylamide	(NH ₂) ₂ SO ₂	7803-58-9	96.110	orth plets	93	250 dec			vs H ₂ O; slEDH
2273	Sulfurylchloride	SO ₂ Cl ₂	7791-25-5	134.970	collq	-51	69.4	1.680		reac H ₂ O; s bz, bl eth
2274	Sulfuryl fluoride	SO ₂ F ₂	2699-79-8	102.062	colgas	-135.8	-55.4	4.172 g/L		slH ₂ O, EDH; s bl ct
2275	Pyrosulfurylchloride	S ₂ O ₅ Cl ₂	7791-27-7	215.034	colf uming lq	-37	151	1.837		reac H ₂ O
2276	Thionylbromide	SOBr ₂	507-16-4	207.873	yellq	-50	140			reac H ₂ O
2277	Thionylchloride	SOCl ₂	7719-09-7	118.970	yelf uming lq	-101	75.6	1.631		reac H ₂ O; s bz, ct, chl
2278	Thionyl fluoride	SOF ₂	7783-42-8	86.062	colgas	-129.5	-43.8	3.518 g/L		reac H ₂ O; s bz, eth
2279	Sulfur fluoride hypofluorite	F ₂ SOF	15179-32-5	162.055	colgas	-86	-35.1	6.624 g/L		
2280	Tantalum	Ta	7440-25-7	180.948	gray metl cub	3017	5458	16.4		reac HF
2281	Tantalum aluminide	TaAl ₃	12004-76-1	261.893	gray ref rac powder	≈1400		7.02		i H ₂ O, acid, ak
2282	Tantalum boride	TaB	12007-07-7	191.759	ref rac orth cry	2040		14.2		
2283	Tantalum boride	TaB ₂	12007-35-1	202.570	bk hex cry	3140		11.2		i H ₂ O, acid, ak
2284	Tantalum carbide	TaC	12070-06-3	192.959	gold-brown powder; cub	3880	4780	14.3		s HF-HNO ₃ mixture
2285	Tantalum carbide	Ta ₃ C	12070-07-4	373.907	ref rac hex cry	3327		15.1		
2286	Tantalum nitride	TaN	12033-62-4	194.955	bk hex cry	3090		13.7		i H ₂ O; slaque regia; reac ak
2287	Tantalum silicide	TaSi ₂	12039-79-1	237.119	gray powder	2200		9.14		
2288	Tantalum(IV) oxide	TaO ₂	12036-14-5	212.947	et cry			10.0		
2289	Tantalum(IV) selenide	TaSe ₂	12039-55-3	338.87	hex cry			6.7		
2290	Tantalum(IV) sulfide	TaS ₂	12143-72-5	245.080	bk hex cry	>3000		6.86		i H ₂ O
2291	Tantalum(IV) telluride	TaTe ₂	12067-66-2	436.15	monocry			9.4		
2292	Tantalum(V) bromide	TaBr ₅	13451-11-1	580.468	yelcry powder	265	349	4.99		
2293	Tantalum(V) chloride	TaCl ₅	7721-01-9	358.212	yelmonocry; hyg	216	239.35	3.68		reac H ₂ O; s EDH
2294	Tantalum(V) fluoride	TaF ₅	7783-71-3	275.940	wh monocry; hyg	95.1	229.2	5.0		s H ₂ O, eth; slCS ₂ , ct
2295	Tantalum(V) iodide	TaI ₅	14693-81-3	815.470	bk hex cry; hyg	496	543	5.80		
2296	Tantalum(V) oxide	Ta ₂ O ₅	1314-61-0	441.893	wh rhomb cry or powder	1784		8.2		i H ₂ O, EDH, acid; s HF
2297	Technetium	Tc	7440-26-8	98	hex cry	2157	4265	11		
2298	Technetium(V) fluoride	TcF ₅	31052-14-9	193	yelsold	50	dec			
2299	Technetium(VI) fluoride	TcF ₆	13842-93-8	212	yelcub cry	37.4	55.3	3.0		
2300	Tellurium	Te	13494-80-9	127.60	gray-wh rhomb cry	449.51	988	6.24		i H ₂ O, bz, CS ₂
2301	Telluric(VI) acid	H ₆ TeO ₆	7803-68-1	229.64	wh monocry	136		3.07	50.1 ³⁰	
2302	Tellurous acid	H ₂ TeO ₃	10049-23-7	177.61	wh cry	40 dec		3.0		slH ₂ O; s dilacid, ak
2303	Tellurium dioxide	TeO ₂	7446-07-3	159.60	wh orth cry	733	1245	5.9		i H ₂ O; s ak, acid
2304	Tellurium trioxide	TeO ₃	13451-18-8	175.60	yeloran cry	430		5.07		i H ₂ O
2305	Tellurium dibromide	TeBr ₂	7789-54-0	287.41	grn-brn hyg cry	210	339			reac H ₂ O; s eth; slchl
2306	Tellurium dichloride	TeCl ₂	10025-71-5	198.51	bk amorp sold; hyg	208	328	6.9		reac H ₂ O; i ct
2307	Tellurium tetrabromide	TeBr ₄	10031-27-3	447.22	yeloran monocry	388	≈420 dec	4.3		reac H ₂ O; s eth
2308	Tellurium tetrachloride	TeCl ₄	10026-07-0	269.41	wh monocry; hyg	224	387	3.0		reac H ₂ O; s EDH, bl
2309	Tellurium tetrafluoride	TeF ₄	15192-26-4	203.59	colcry	129	195 dec			reac H ₂ O
2310	Tellurium tetraiodide	TeI ₄	7790-48-9	635.22	bk orth cry	280		5.05		reac H ₂ O; slace
2311	Tellurium hexafluoride	TeF ₆	7783-80-4	241.59	colgas	-37.6 p	-38.9 sp	9.875 g/L		reac H ₂ O
2312	Terbium	Tb	7440-27-9	158.925	silv metl hex	1356	3230	8.23		

2313	Terbium chbride	TbCl ₃	10042-88-3	265.283	wh orth cry; hyg	588		4.35		s H ₂ O
2314	Terbium chbride hexahydrat	TbCl ₃ · 6H ₂ O	13798-24-8	373.374	hyg cry			4.35		vs H ₂ O
2315	Terbium iodide	TbI ₃	13813-40-6	539.638	hex cry; hyg	957		≈5.2		s H ₂ O
2316	Terbium nitat	Tb(NO ₃) ₃	10043-27-3	344.940	pink hyg sold				157 ²⁵	s EOH
2317	Terbium nitat hexahydrat	Tb(NO ₃) ₃ · 6H ₂ O	13451-19-9	453.031	colneedles	89				s H ₂ O, EOH, ace
2318	Terbium nitide	TbN	12033-64-6	172.932	cub cry			9.55		
2319	Terbium oxide	Tb ₂ O ₃	12036-41-8	365.849	wh cub cry	2303		7.91		
2320	Terbium silicide	TbSi ₂	12039-80-4	215.096	orth cry			6.66		
2321	Terbium suf ide	Tb ₂ S ₃	12138-11-3	414.049	cub cry			6.35		
2322	Thalum	Tl	7440-28-0	204.383	sof tble-wh metl	304	1473	11.8		i H ₂ O; reac acid
2323	Thalum(I) acetat	Tl ₂ H ₃ O ₂	563-68-8	263.427	hyg wh cry	131		3.68		s H ₂ O, EOH
2324	Thalum(I) bromat	TlBr ₃	14550-84-6	332.285	colneedles	120 dec			0.49 ³⁰	s EOH
2325	Thalum(I) bromide	TlBr	7789-40-4	284.287	yelcub cry	460	819	7.5	0.059 ³⁰	
2326	Thalum(I) carbonat	Tl ₂ CO ₃	6533-73-9	468.776	wh monoclcry	272		7.11	4.69 ³⁰	i EOH
2327	Thalum(I) chbrat	TlCl ₃	13453-30-0	287.834	colhex cry			5.5	3.92 ²⁰	
2328	Thalum(I) chbride	TlCl	7791-12-0	239.836	wh cub cry	430	720	7.0	0.33 ²⁰	i EOH
2329	Thalum(I) chromat	Tl ₂ CrO ₄		524.761	yelcry				0.003 ²⁰	slacid, ak
2330	Thalum(I) cyanide	TlCN	13453-34-4	230.401	wh hex patts			6.523		s H ₂ O, acid, EOH
2331	Thalum(I) etanoat	Tl ₂ H ₃ O	20398-06-5	249.443	cbudy lq	-3	130 dec	3.49		reac H ₂ O
2332	Thalum(I) fluoride	TlF	7789-27-7	223.381	wh orth cry	326	826	8.36	245 ²⁵	
2333	Thalum(I) formiat	TlCHO ₂	992-98-3	249.401	hyg colneedles	101		4.97		vs H ₂ O; s MeOH
2334	Thalum(I) hexaf luorophosphat	TlPF ₆	60969-19-9	349.347	wh cub cry			4.6		
2335	Thalum(I) hydroxide	TlOH	12026-06-1	221.390	yelneedles	139 dec		7.44	34.3 ¹⁸	
2336	Thalum(I) iodat	TlIO ₃	14767-09-0	379.285	wh needles				0.058	slHNO ₃
2337	Thalum(I) iodide	TlI	7790-30-9	331.287	yelcry powder	441.7	824	7.1	0.0085 ²⁰	i EOH
2338	Thalum(I) molybdat	Tl ₂ MoO ₄	34128-09-1	568.71	yelwh cub cry					i H ₂ O
2339	Thalum(I) nitat	TlNO ₃	10102-45-1	266.388	wh cry	206	450 dec	5.55	9.55 ²⁰	i EOH
2340	Thalum(I) nitide	TlNO ₂	13826-63-6	250.389	cub cry			5.7	32.1 ²⁵	
2341	Thalum(I) oxat	Tl ₂ C ₂ O ₄	30737-24-7	496.786	wh powder			6.31	1.83 ²⁰	
2342	Thalum(I) oxide	Tl ₂ O	1314-12-1	424.766	bk rhomb cry; hyg	579	≈1080	9.52		s H ₂ O, EOH
2343	Thalum(I) perchbrat	TlCl ₄	13453-40-2	303.834	colorth cry			4.8	19.7 ³⁰	
2344	Thalum(I) selenat	Tl ₂ SeO ₄	7446-22-2	551.73	orth cry	>400		6.875	2.8 ²⁰	i EOH, eh
2345	Thalum(I) selenide	Tl ₂ Se	15572-25-5	487.73	gray patts	340				i H ₂ O, acid
2346	Thalum(I) suf at	Tl ₂ SO ₄	7446-18-6	504.831	wh rhomb prisms	632		6.77	5.47 ²⁵	
2347	Thalum(I) suf ide	Tl ₂ S	1314-97-2	440.833	blue-bk cry	448	1367	8.39	0.02 ²⁰	slak; s acid
2348	Thalum(III) bromide etahydrat	TlBr ₃ · 4H ₂ O	13701-90-1	516.157	yelorth cry			3.65		s H ₂ O, EOH
2349	Thalum(III) chbride	TlCl ₃	13453-32-2	310.741	monoclcry	155		4.7		vs H ₂ O, EOH, eh
2350	Thalum(III) chbride etahydrat	TlCl ₃ · 4H ₂ O	13453-32-2*	382.803	orth cry			3.00		s H ₂ O
2351	Thalum(III) fluoride	TlF ₃	7783-57-5	261.378	wh orth cry; hyg	550 dec		8.65		reac H ₂ O
2352	Thalum(III) nitat	Tl(NO ₃) ₃	13746-98-0	390.398	colcry					reac H ₂ O
2353	Thalum(III) oxide	Tl ₂ O ₃	1314-32-5	456.765	brn cub cry	834		10.2		i H ₂ O; reac acid
2354	Thalum(III) suf at	Tl ₂ (SO ₄) ₃	16222-66-5	696.958	colfaf ts					reac H ₂ O
2355	Thalum selenide	TlSe	12039-52-0	283.34	bk sold	330				i H ₂ O, acid
2356	Thorium	Th	7440-29-1	232.038	sof tgray-wh metl cub	1750	4788	11.7		s acid
2357	Thorium hydride	ThH ₂	16689-88-6	234.054	et cry			9.5		
2358	Thorium boride	ThB ₆	12229-63-9	296.904	ref rac sold	2450		6.99		
2359	Thorium(IV) bromide	ThBr ₄	13453-49-1	551.654	wh hyg cry	679			65 ²⁰	
2360	Thorium carbide	ThC	12012-16-7	244.049	cub cry	2500		10.6		reac H ₂ O

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
2361	Thorium dicarbide	ThC ₂	12071-31-7	256.059	yelmonocry	≈2650		9.0		reac H ₂ O
2362	Thorium(IV) chloride	ThCl ₄	10026-08-1	373.849	gray-wh et needs; hyg	770	921	4.59		s H ₂ O, EDH
2363	Thorium(IV) fluoride	ThF ₄	13709-59-6	308.032	wh monocry; hyg	1110	1680	6.1		
2364	Thorium(IV) iodide	ThI ₄	7790-49-0	739.656	wh-yelmonocry	570	837			
2365	Thorium(IV) nitrate tetrahydrate	Th(NO ₃) ₄ · 4H ₂ O	33088-16-3	552.119	wh hyg cry	500 dec			191 ²⁰	s EDH
2366	Thorium nitride	ThN	12033-65-7	246.045	ref rac cub cry	2820		11.6		reac H ₂ O
2367	Thorium(IV) oxide	ThO ₂	1314-20-1	264.037	wh cub cry	3390	4400	10.0		i H ₂ O, ak; slacid
2368	Thorium(IV) selenide	ThSe ₂	60763-24-8	389.96	orb cry			8.5		
2369	Thorium orthosilicate	ThSiO ₄	14553-44-7	324.122	brn et cry			6.7		
2370	Thorium silicide	ThSi ₂	12067-54-8	288.209	et cry	1850		7.9		
2371	Thorium(IV) sulfate nonahydrate	Th(SO ₄) ₂ · 9H ₂ O	10381-37-0	586.303	wh monocry	dec		2.8	4.2 ²⁰	
2372	Thorium(IV) sulfide	ThS ₂	12138-07-7	296.170	dark brn cry	1905		7.30		i H ₂ O; s acid
2373	Thulium	Tm	7440-30-4	168.934	silv metl hex	1545	1950	9.32		s dilacid
2374	Thulium bromide	TmBr ₃	14456-51-0	408.646	wh hyg cry	954				s H ₂ O
2375	Thulium chloride	TmCl ₃	13537-18-3	275.292	yelhyg cry	824				s H ₂ O
2376	Thulium chloride heptahydrate	TmCl ₃ · 7H ₂ O	13778-39-7	401.399	hyg cry					s H ₂ O, EDH
2377	Thulium fluoride	TmF ₃	13760-79-7	225.929	wh cry	1158				s H ₂ O
2378	Thulium iodide	TmI ₃	13813-43-9	549.647	yelhyg cry	1021				
2379	Thulium nitrate	Tm(NO ₃) ₃	14985-19-4	354.949	grn hyg sold				212 ²⁵	s EDH
2380	Thulium nitrate pentahydrate	Tm(NO ₃) ₃ · 5H ₂ O	36548-87-5	445.025	grn hyg cry					s H ₂ O, EDH, ace
2381	Thulium oxide	Tm ₂ O ₃	12036-44-1	385.866	grn-wh cub cry	2341	3945	8.6		slacid
2382	Tin (gray)	Sn	7440-31-5	118.710	cub cry	tans b wh Sn 13.2	2602	5.769		
2383	Tin (white)	Sn	7440-31-5	118.710	silv et cry	231.93	2602	7.265		
2384	Stannane	SnH ₄	2406-52-2	122.742	unsabbl colgas	-146	-51.8	5.017 g/L		
2385	Methylstannane	SnH ₃ CH ₃	1631-78-3	136.769	colgas		0	5.590 g/L		reac H ₂ O
2386	Tin(II) acetate	Sn(C ₂ H ₃ O ₂) ₂	638-39-1	236.799	wh orb cry	183	subl	2.31		s dilHCl
2387	Tin(II) bromide	SnBr ₂	10031-24-0	278.518	yelpowder	215	639	5.12	85 ⁰	s EDH, eh, ace
2388	Tin(II) chloride	SnCl ₂	7772-99-8	189.615	wh orb cry	247.1	623	3.90	178 ¹⁰	s EDH, ace, eh; i xyl
2389	Tin(II) chloride dihydrate	SnCl ₂ · 2H ₂ O	10025-69-1	225.646	wh monocry	37 dec		2.71	178 ¹⁰	s EDH, NaOH; vs HCl
2390	Tin(II) fluoride	SnF ₂	7783-47-3	156.707	wh monocry; hyg	213	850	4.57		s H ₂ O; i EDH, eh, chl
2391	Tin(II) hexafluorozirconate	SnZrF ₆	12419-43-1	323.924	cry			4.21		s H ₂ O
2392	Tin(II) hydroxide	Sn(OH) ₂	12026-24-3	152.725	wh amorp sold					
2393	Tin(II) iodide	SnI ₂	10294-70-9	372.519	red-oran powder	320	714	5.28	0.98 ²⁰	s bz, chl CS ₂
2394	Tin(II) oxalate	SnC ₂ O ₄	814-94-8	206.729	wh powder	280 dec		3.56		i H ₂ O; s dilHCl
2395	Tin(II) oxide	SnO	21651-19-4	134.709	blue-bk et cry	1080 dec		6.45		i H ₂ O, EDH; s acid
2396	Tin(II) pyrophosphate	Sn ₂ P ₂ O ₇	15578-26-4	411.363	wh amorp powder	400 dec		4.009		i H ₂ O; s conc acid
2397	Tin(II) selenide	SnSe	1315-06-6	197.67	gray orb cry	861		6.18		i H ₂ O; s aqua regia
2398	Tin(II) sulfate	SnSO ₄	7488-55-3	214.774	wh orb cry	378 dec		4.15	18.8 ¹⁹	
2399	Tin(II) sulfide	SnS	1314-95-0	150.776	gray orb cry	880	1210	5.08		i H ₂ O; s conc acid
2400	Tin(II) selenate	SnC ₂ H ₄ O ₆	815-85-0	266.781	wh cry powder					s H ₂ O, dilHCl
2401	Tin(II) telluride	SnTe	12040-02-7	246.31	gray cub cry	790		6.5		
2402	Tin(IV) bromide	SnBr ₄	7789-67-5	438.326	wh cry	29.1	205	3.34		vs H ₂ O; s EDH
2403	Tin(IV) chloride	SnCl ₄	7646-78-8	260.521	colf uming liq	-34.07	114.15	2.234		reac H ₂ O; s EDH, ct, bz, ace
2404	Tin(IV) chloride pentahydrate	SnCl ₄ · 5H ₂ O	10026-06-9	350.597	wh-yelcry	56 dec		2.04		vs H ₂ O; s EDH
2405	Tin(IV) chromate	Sn(CrO ₄) ₂	38455-77-5	350.697	brn-yelcry powder	dec				s H ₂ O

2406	Tin(IV) fluoride	SnF ₄	7783-62-2	194.704	wh et cry		705	subl	4.78	reac H ₂ O	
2407	Tin(IV) iodide	SnI ₄	7790-47-8	626.328	yel-brn cub cry		143	364.35	4.46	reac H ₂ O; s EDH, bz, chl eh	
2408	Tin(IV) oxide	SnO ₂	18282-10-5	150.709	gray et cry		1630		6.85	i H ₂ O, EDH; s hotconc ak	
2409	Tin(IV) selenide	SnSe ₂	20770-09-6	276.63	red-brn cry		650		≈5.0	i H ₂ O; s ak, conc acid	
2410	Tin(IV) selenite	Sn(SeO ₃) ₂	7446-25-5	372.63	cry powder					i H ₂ O; s hotHCl	
2411	Tin(IV) sulfide	SnS ₂	1315-01-1	182.842	gold-yel hex cry		600	dec	4.5	i H ₂ O; s ak, aqua regia	
2412	Titanium	Ti	7440-32-6	47.867	gray metal hex		1668	3287	4.506		
2413	Titanium hydride	TiH ₂	7704-98-5	49.883	gray-bk powder		≈450	dec	3.75	i H ₂ O	
2414	Titanium boride	TiB ₂	12045-63-5	69.489	gray ref rac solid; hex		3225		4.38		
2415	Titanium carbide	TiC	12070-08-5	59.878	cub cry		3067		4.93	i H ₂ O; s HNO ₃	
2416	Titanium nitride	TiN	25583-20-4	61.874	yel-brn cub cry		2950		5.21	i H ₂ O; s aqua regia	
2417	Titanium phosphide	TiP	12037-65-9	78.841	gray hex cry		1990		4.08		
2418	Titanium silicide	TiSi ₂	12039-83-7	104.038	bk orth cry		1500		4.0	i H ₂ O, acid, ak; s HF	
2419	Titanium(II) bromide	TiBr ₂	13783-04-5	207.675	bk powder				4.0	reac H ₂ O	
2420	Titanium(II) chloride	TiCl ₂	10049-06-6	118.772	bk hex cryc		1035	1500	3.13	reac H ₂ O; s EDH; i chl eh	
2421	Titanium(II) iodide	TiI ₂	13783-07-8	301.676	bk hex cry				5.02	reac H ₂ O	
2422	Titanium(II) oxide	TiO	12137-20-1	63.866	cub cry		1750		4.95		
2423	Titanium(II) sulfide	TiS	12039-07-5	79.933	brn hex cry		1780		3.85	s conc acid	
2424	Titanium(III) bromide	TiBr ₃	13135-31-4	287.579	blue-bk hex cry					s H ₂ O	
2425	Titanium(III) chloride	TiCl ₃	7705-07-9	154.225	red-viol hex cry; hyg		425	dec	960	2.64	reac H ₂ O
2426	Titanium(III) fluoride	TiF ₃	13470-08-1	104.862	viol hex cry		1200	1400	2.98	i H ₂ O, dilacid, ak	
2427	Titanium(III) oxide	Ti ₂ O ₃	1344-54-3	143.732	viol hex cry		1842		4.486	s hotHF	
2428	Titanium(III) sulfate	Ti ₂ (SO ₄) ₃	10343-61-0	383.925	grn cry					i H ₂ O, EDH; s dilHCl	
2429	Titanium(III) sulfide	Ti ₂ S ₃	12039-16-6	191.932	bk hex cry				3.56		
2430	Titanium(III,IV) oxide	Ti ₃ O ₅	12065-65-5	223.598	bk monoclcry		1777		4.24		
2431	Titanium(IV) bromide	TiBr ₄	7789-68-6	367.483	yel-oran cub cry; hyg		39		3.37	reac H ₂ O	
2432	Titanium(IV) chloride	TiCl ₄	7550-45-0	189.678	color yellq		-24.12	136.45	1.73	reac H ₂ O; s EDH	
2433	Titanium(IV) fluoride	TiF ₄	7783-63-3	123.861	wh hyg powder		284	subl	2.798	reac H ₂ O; s EDH, py	
2434	Titanium(IV) iodide	TiI ₄	7720-83-4	555.485	red hyg powder		150	377	4.3	reac H ₂ O	
2435	Titanium(IV) oxide	TiO ₂	13463-67-7	79.866	wh et cry		1843		4.23	i H ₂ O, dilacid; s conc acid	
2436	Titanium(IV) oxysulfate monohydrate	TiOSO ₄ · H ₂ O	13825-74-6*	177.945	colorl cry				2.71	reac H ₂ O	
2437	Titanium(IV) sulfate	Ti(SO ₄) ₂	13693-11-3	239.994	wh-yel hyg cry		150	dec		s H ₂ O	
2438	Titanium(IV) sulfide	TiS ₂	12039-13-3	111.999	yel-brn hex cry; hyg				3.37	s H ₂ SO ₄	
2439	Tungsten	W	7440-33-7	183.84	gray-wh metal cub		3422	5555	19.3		
2440	Tungstic acid	H ₂ WO ₄	7783-03-1	249.85	yelamporp powder		100	dec	5.5	i H ₂ O, acid; s ak	
2441	Tungsten boride	W ₂ B	12007-10-2	378.49	ref rac bk powder		2670		16.0	i H ₂ O	
2442	Tungsten boride	WB	12007-09-9	194.65	bk ref rac powder		2665		15.2	i H ₂ O	
2443	Tungsten boride	W ₂ B ₅	12007-98-6	421.74	ref rac solid		2365		11.0	i H ₂ O	
2444	Tungsten carbide	W ₂ C	12070-13-2	379.69	ref rac hex cry		≈2800		14.8	i H ₂ O	
2445	Tungsten carbide	WC	12070-12-1	195.85	gray hex cry		2785		15.6	i H ₂ O; s HNO ₃ /HF	
2446	Tungsten carbonyl	W(CO) ₆	14040-11-0	351.90	wh cry		170	dec	subl	2.65	i H ₂ O; s os
2447	Tungsten nitride	WN ₂	60922-26-1	211.85	hex cry		600	dec		7.7	
2448	Tungsten nitride	W ₂ N	12033-72-6	381.69	gray cub cry			dec		17.8	
2449	Tungsten silicide	WSi ₂	12039-88-2	240.01	blue-gray et cry		2160		9.3	i H ₂ O	
2450	Tungsten silicide	W ₅ Si ₃	12039-95-1	1003.46	blue-gray ref rac solid		2320		14.4		
2451	Tungsten(II) bromide	WBr ₂	13470-10-5	343.65	yelpowder		400	dec			
2452	Tungsten(II) chloride	WCl ₂	13470-12-7	254.75	yelsolid		>500	dec		s H ₂ O	
2453	Tungsten(II) iodide	WI ₂	13470-17-2	437.65	oran cry				6.79		

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
2454	Tungsten(III) bromide	WBr ₃	15163-24-3	423.55	bk hex cry	>80 dec				i H ₂ O
2455	Tungsten(III) chloride	WCl ₃	20193-56-0	290.20	red sold	550 dec	subl			reac H ₂ O
2456	Tungsten(IV) bromide	WBr ₄	14055-81-3	503.46	bk orb cry		240 subl			reac H ₂ O
2457	Tungsten(IV) chloride	WCl ₄	13470-13-8	325.65	bk hyg powder	450 dec		4.62		reac H ₂ O
2458	Tungsten(IV) fluoride	WF ₄	13766-47-7	259.83	red-brn cry	>800 dec				
2459	Tungsten(IV) iodide	WI ₄	14055-84-6	691.46	bk powder	dec				reac H ₂ O; s EDH; i eh chl
2460	Tungsten(IV) oxide	WO ₂	12036-22-5	215.84	blue monocry	≈1500 dec		10.8		i H ₂ O, os
2461	Tungsten(IV) selenide	WSe ₂	12067-46-8	341.76	gray hex cry			9.2		
2462	Tungsten(IV) sulfide	WS ₂	12138-09-9	247.97	gray hex cry	1250 dec		7.6		i H ₂ O, HCl ak
2463	Tungsten(IV) telluride	WTe ₂	12067-76-4	439.04	gray orb cry	1020		9.43		
2464	Tungsten(V) bromide	WBr ₅	13470-11-6	583.36	brn-bk hyg sold	286	333			
2465	Tungsten(V) chloride	WCl ₅	13470-14-9	361.10	bk hyg cry	242	286			reac H ₂ O
2466	Tungsten(V) ethoxide	W(C ₂ H ₅ O) ₅	62571-53-3	409.14	pow		105(0.05 mmHg)			s EAc
2467	Tungsten(V) fluoride	WF ₅	19357-83-6	278.83	yelsold	>80 dec				
2468	Tungsten(V) oxytetrabromide	WOBBr ₄	20213-56-3	439.55	dark brn tt cry			≈5.9		
2469	Tungsten(V) oxytrichloride	WOCl ₃	14249-98-0	306.20	grn tt cry			≈4.6		
2470	Tungsten(VI) bromide	WBr ₆	13701-86-5	663.26	blue-bk cry	309				
2471	Tungsten(VI) chloride	WCl ₆	13283-01-7	396.56	purp hex cry; hyg	275	346.75	3.52		s EDH, os
2472	Tungsten(VI) dioxylbromide	WO ₂ Br ₂	13520-75-7	375.65	red cry		440 subl			
2473	Tungsten(VI) dioxylchloride	WO ₂ Cl ₂	13520-76-8	286.74	yelorb cry	265		4.67		i H ₂ O
2474	Tungsten(VI) dioxyl iodide	WO ₂ I ₂	14447-89-3	469.65	grn monocry	400 dec		6.39		
2475	Tungsten(VI) fluoride	WF ₆	7783-82-6	297.83	colgas	2.3	17.1	12.17 g/L		reac H ₂ O
2476	Tungsten(VI) oxide	WO ₃	1314-35-8	231.84	yelpowder	1472		7.2		i H ₂ O; slacid; s ak
2477	Tungsten(VI) oxytetrabromide	WOBBr ₄	13520-77-9	519.46	red tt cry	277	327	≈5.5		reac H ₂ O
2478	Tungsten(VI) oxytetrachloride	WOCl ₄	13520-78-0	341.65	red hyg cry	211	227.55	11.92		reac H ₂ O; s bz, CS ₂
2479	Tungsten(VI) oxytetrafluoride	WOF ₄	13520-79-1	275.83	wh monocry	106	185.9	5.07		reac H ₂ O
2480	Tungsten(VI) sulfide	WS ₃	12125-19-8	280.04	brn powder					slH ₂ O; s ak
2481	Uranium	U	7440-61-1	238.029	silv-wh orb cry	1135	4131	19.1		
2482	Uranium boride	UB ₂	12007-36-2	259.651	ref rac sold	2430		12.7		
2483	Uranium boride	UB ₃	12007-84-0	281.273	ref rac sold	2530		9.32		i H ₂ O
2484	Uranium carbide	UC	12070-09-6	250.040	gray cub cry	2790				
2485	Uranium carbide	UC ₂	12071-33-9	262.050	gray tt cry	2350	4370	11.3		reac H ₂ O; slEDH
2486	Uranium carbide	U ₂ C ₃	12076-62-9	512.090	gray cub cry	≈1700 dec		12.7		
2487	Uranium nitride	UN	25658-43-9	252.036	gray cub cry	2805		14.3		i H ₂ O
2488	Uranium nitride	U ₂ N ₃	12033-83-9	518.078	cub cry	dec		11.3		
2489	Uranium(III) bromide	UBr ₃	13470-19-4	477.741	red hyg cry	727				s H ₂ O
2490	Uranium(III) chloride	UCl ₃	10025-93-1	344.387	grn hyg cry	837		5.51		vs H ₂ O; i bz, ct
2491	Uranium(III) fluoride	UF ₃	13775-06-9	295.024	bk hex cry	dec		8.9		i H ₂ O; s acid
2492	Uranium(III) hydride	UH ₃	13598-56-6	241.053	gray-bk cub cry			11.1		
2493	Uranium(III) iodide	UI ₃	13775-18-3	618.742	bk hyg cry	766				s H ₂ O
2494	Uranium(IV) bromide	UBr ₄	13470-20-7	557.645	brn hyg cry	519				s H ₂ O, EDH
2495	Uranium(IV) chloride	UCl ₄	10026-10-5	379.840	grn ocched cry	590	791	4.72		reac H ₂ O; s EDH
2496	Uranium(IV) fluoride	UF ₄	10049-14-6	314.023	grn monocry	1036	1417	6.7	0.01 ²⁵	s conc acid, ak
2497	Uranium(IV) iodide	UI ₄	13470-22-9	745.647	bk hyg cry	506				s H ₂ O, EDH
2498	Uranium(IV) oxide	UO ₂	1344-57-6	270.028	brn cub cry	2827		10.97		i H ₂ O, dilacid; s conc acid

2499	Uranium(IV,V) oxide	U ₂ O ₉	12037-15-9	1096.111	cub cry				11.2		
2500	Uranium(V) bromide	UBr ₅	13775-16-1	637.549	brn hyg cry					reac H ₂ O	
2501	Uranium(V) chloride	UCl ₅	13470-21-8	415.293	brn hyg cry		287			reac H ₂ O	
2502	Uranium(V) fluoride	UF ₅	13775-07-0	333.021	pbk blue bt cry; hyg		348		5.81	s H ₂ O	
2503	Uranium(V,Vl) oxide	U ₃ O ₈	1344-59-8	842.082	grn-bk orth cry		1300 dec		8.38		
2504	Uranium(Vl) chloride	UCl ₆	13763-23-0	450.745	green hex cry		177		3.6		
2505	Uranium(Vl) fluoride	UF ₆	7783-81-5	352.019	wh monoclsold		64.0 p	56.5 sp	5.09	reac H ₂ O; s ct, chl	
2506	Uranium(Vl) oxide	UO ₃	1344-58-7	286.027	oran-yelcry				≈7.3	i H ₂ O; s acid	
2507	Uranium(Vl) oxide monohydrate	UO ₃ · H ₂ O	12326-21-5	304.043	yelorth cry		570 dec		7.05		
2508	Uranium peroxide dihydrate	UO ₄ · 2H ₂ O	19525-15-6	338.057	yelhyg cry		115 dec			i H ₂ O	
2509	Uranylchloride	UO ₂ Cl ₂	7791-26-6	340.933	yelorth cry; hyg		577			vs H ₂ O; s EDH, ace; i bz	
2510	Uranyl fluoride	UO ₂ F ₂	13536-84-0	308.025	yelhyg sold				64.4 ²⁰	i bz	
2511	Uranyl nitrate	UO ₂ (NO ₃) ₂	10102-06-4	394.037	yelcry				127 ²⁵	s et	
2512	Uranyl nitrate hexahydrate	UO ₂ (NO ₃) ₂ · 6H ₂ O	13520-83-7	502.129	yelorth cry; hyg		60	118 dec	2.81	127 ²⁵	s EDH, et
2513	Uranyl sulfate	UO ₂ SO ₄	1314-64-3	366.091	yelcry						
2514	Uranyl sulfate trihydrate	UO ₂ SO ₄ · 3H ₂ O	20910-28-5	420.138	yelcry				3.28	152 ¹⁶	s/EDH
2515	Vanadium	V	7440-62-2	50.942	gray-wh metl cub		1910	3407	6.0		i H ₂ O; s acid
2516	Vanadium boride	VB	12045-27-1	61.753	ref rac sold		2250				i H ₂ O
2517	Vanadium boride	VB ₂	12007-37-3	72.564	ref rac sold		2450				
2518	Vanadium carbide	VC	12070-10-9	62.953	ref rac bk cry; cub		2810		5.77		i H ₂ O
2519	Vanadium carbide	V ₂ C	12012-17-8	113.894	hex cry		2167				
2520	Vanadium carbonyl	V(CO) ₆	20644-87-5	219.002	blue-grn cry; f am		60 dec				subl
2521	Vanadium nitride	VN	24646-85-3	64.949	bk powder; cub		2050		6.13		i H ₂ O; s aqua regia
2522	Vanadium silicide	VS ₂	12039-87-1	107.113	metalc prisms				4.42		s HF
2523	Vanadium silicide	V ₃ Si	12039-76-8	180.911	cub cry		1935		5.70		
2524	Vanadium(II) bromide	VBr ₂	14890-41-6	210.750	oran-brn hex cry			800 subl	4.58		reac H ₂ O
2525	Vanadium(II) chloride	VCl ₂	10580-52-6	121.847	grn hex pbts		≈1350	910 subl	3.23		reac H ₂ O; s EDH, et
2526	Vanadium(II) fluoride	VF ₂	13842-80-3	88.939	blue hyg cry						reac H ₂ O
2527	Vanadium(II) iodide	VI ₂	15513-84-5	304.751	red-violhex cry			800 subl	5.44		reac H ₂ O
2528	Vanadium(II) oxide	VO	12035-98-2	66.941	grn cry		1789		5.758		s acid
2529	Vanadium(II) sulfate heptahydrate	VSO ₄ · 7H ₂ O	36907-42-3	273.112	violcry						
2530	Vanadium(III) 2,4-pentanedioate	V(CH ₃ COCHCOCH ₃) ₃	13476-99-8	348.266	brn cry		≈185	subl	≈1.0		s MeOH, ace, bz chl
2531	Vanadium(III) bromide	VBr ₃	13470-26-3	290.654	gray-brn hyg cry				4.00		reac H ₂ O
2532	Vanadium(III) chloride	VCl ₃	7718-98-1	157.300	red-violhex cry; hyg		500 dec		3.00		reac H ₂ O; s EDH, et
2533	Vanadium(III) fluoride	VF ₃	10049-12-4	107.937	yelgrn hex cry		≈1400	subl	3.363		i H ₂ O, EDH
2534	Vanadium(III) fluoride trihydrate	VF ₃ · 3H ₂ O	10049-12-4*	161.983	grn rhomb cry		≈100 dec				s/H ₂ O
2535	Vanadium(III) iodide	VI ₃	15513-94-7	431.655	brn-bk rhomb cry; hyg				5.21		reac H ₂ O
2536	Vanadium(III) oxide	V ₂ O ₃	1314-34-7	149.881	bk powder		2067		4.87		i H ₂ O
2537	Vanadium(III) sulfate	V ₂ (SO ₄) ₃	13701-70-7	390.074	yelpowder			≈400 dec			s/H ₂ O
2538	Vanadium(III) sulfide	V ₂ S ₃	1315-03-3	198.081	grn-bk powder		dec		4.7		i H ₂ O; s hotHCl
2539	Vanadium(IV) bromide	VBr ₄	13595-30-7	370.558	unsabb magenta cry		-23 dec				
2540	Vanadium(IV) chloride	VCl ₄	7632-51-1	192.753	unsabb red lq		-25.7	148	1.816		reac H ₂ O; s EDH, et
2541	Vanadium(IV) fluoride	VF ₄	10049-16-8	126.936	grn hyg powder		325 dec	subl	3.15		vs H ₂ O
2542	Vanadium(IV) oxide	VO ₂	12036-21-4	82.941	blue-bk powder		1967		4.339		i H ₂ O; s acid, ak
2543	Vanadium(V) fluoride	VF ₅	7783-72-4	145.934	collq		19.5	48.3	2.50		reac H ₂ O
2544	Vanadium(V) oxide	V ₂ O ₅	1314-62-1	181.880	yelbrn orth cry		670	1800 dec	3.35	0.07 ²⁵	s conc acid, ak; i EDH
2545	Vanadyl bromide	VOBr	13520-88-2	146.845	violcry		480 dec				
2546	Vanadyl chloride	VOCl	13520-87-1	102.394	brn orth cry			127	1.72		

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
2547	Vanadyl dibromide	VOBr ₂	13520-89-3	226.749	yelbrn cry	180 dec				
2548	Vanadyl dichloride	VOCl ₂	10213-09-9	137.846	grn hyg cry	380 dec		2.88		reac H ₂ O; s EOH
2549	Vanadyl difluoride	VOF ₂	13814-83-0	104.938	yelcry					
2550	Vanadylseelenite hydrate	VOSeO ₃ · H ₂ O	133578-89-9	211.92	grn ticl plates			3.506		
2551	Vanadylsulfate dihydrate	VOSO ₄ · 2H ₂ O	27774-13-6	199.036	blue cry powder					s H ₂ O
2552	Vanadyltitanium bromide	VOBr ₃	13520-90-6	306.653	deep red lq		180 dec			reac H ₂ O
2553	Vanadyltitanium chloride	VOCl ₃	7727-18-6	173.299	fuming red lq	-79	127	1.829		reac H ₂ O; s MeOH, eth, ace
2554	Vanadyltitanium fluoride	VOF ₃	13709-31-4	123.936	yelhyg powder	300	480	2.459		reac H ₂ O
2555	Water	H ₂ O	7732-18-5	18.015	collq	0.00	100.0	0.9970		s EOH, MeOH, ace
2556	Xenon	Xe	7440-63-3	131.29	colgas	-111.79 b (81.6 kPa)	-108.12	5.366 g/L		s H ₂ O
2557	Xenon trioxide	XeO ₃	13776-58-4	179.29	colorl cry	exp ≈25		4.55		s H ₂ O
2558	Xenon tetroxide	XeO ₄	12340-14-6	195.29	yelsold; exp	-35.9	≈0 dec			
2559	Xenon difluoride	XeF ₂	13709-36-9	169.29	collet cry	129.03 b	114.35 sp	4.32		s H ₂ O
2560	Xenon tetrafluoride	XeF ₄	13709-61-0	207.28	colmonocry	117.10 b	115.75 sp	4.04		reac H ₂ O
2561	Xenon hexafluoride	XeF ₆	13693-09-9	245.28	colmonocry	49.5	75.6	3.56		reac H ₂ O
2562	Xenon dioxydifluoride	XeO ₂ F ₂	13875-06-4	201.29	colorl cry	30.8 exp		4.10		
2563	Xenon oxytetrafluoride	XeOF ₄	13774-85-1	223.28	collq	-46.2		3.17 ^o		reac H ₂ O
2564	Xenon fluoride hexafluoroantimonate	XeFRuF ₆	22527-13-5	365.35	yelgrn monocry	110		3.78		
2565	Xenon fluoride undecafluoroantimonate	XeFSb ₂ F ₁₁	15364-10-0	602.79	yelmonocry	63		3.69		
2566	Xenon fluoride hexafluoroarsenate	Xe ₂ F ₃ AsF ₆	50432-32-1	508.49	yelgrn monocry	99		3.62		reac H ₂ O
2567	Xenon fluoride hexafluoroantimonate	XeF ₃ SbF ₆	39797-63-2	424.04	yelgrn monocry	≈110		3.92		
2568	Xenon trifluoride undecafluoroantimonate	XeF ₃ Sb ₂ F ₁₁	35718-37-7	640.79	yelgrn ticl cry	82		3.98		
2569	Xenon pentafluoride hexafluoroarsenate	XeF ₅ AsF ₆	20328-94-3	415.19	wh monocry	130.5		3.51		
2570	Xenon pentafluoride hexafluoroantimonate	XeF ₅ RuF ₆	39796-98-0	441.34	grn orh cry	152		3.79		
2571	Ytterbium	Yb	7440-64-4	173.04	silv metl cub	819	1196	6.90		s dilacid
2572	Ytterbium silicide	YbSi ₂	12039-89-3	229.21	hex cry			7.54		
2573	Ytterbium(II) bromide	YbBr ₂	25502-05-0	332.85	yelcry	673				reac H ₂ O
2574	Ytterbium(II) chloride	YbCl ₂	13874-77-6	243.95	grn cry	721		5.27		reac H ₂ O
2575	Ytterbium(II) iodide	YbI ₂	19357-86-9	426.85	bk cry	772				reac H ₂ O
2576	Ytterbium(III) chloride	YbCl ₃	10361-91-8	279.40	wh hyg powder	875				s H ₂ O
2577	Ytterbium(III) chloride hexahydrate	YbCl ₃ · 6H ₂ O	19423-87-1	387.49	grn hyg cry	150 dec		2.57		vs H ₂ O
2578	Ytterbium(III) fluoride	YbF ₃	13760-80-0	230.04	wh cry	1157		8.2		i H ₂ O
2579	Ytterbium(III) nitrate	Yb(NO ₃) ₃	13768-67-7	359.06	colhyg sold				239 ²⁵	s EOH
2580	Ytterbium(III) oxide	Yb ₂ O ₃	1314-37-0	394.08	colcub cry	2355	4070	9.2		s dilacid
2581	Ytterbium(III) sulfate octahydrate	Yb ₂ (SO ₄) ₃ · 8H ₂ O	10034-98-7	778.39	colcry			3.3	38.4 ²⁰	
2582	Ytium	Y	7440-65-5	88.906	silv metl hex	1522	3345	4.47		reac H ₂ O; s dilacid
2583	Ytium aluminum oxide	Y ₂ Al ₂ O ₁₂	12005-21-9	593.619	grn cub cry			≈4.5		
2584	Ytium antimonide	YSb	12186-97-9	210.666	cub cry	2310		5.97		
2585	Ytium arsenide	YAs	12255-48-0	163.828	cub cry			5.59		
2586	Ytium boride	YB ₃	12008-32-1	153.772	ref rac sold	2600		3.72		
2587	Ytium bromide	YBr ₃	13469-98-2	328.618	colhyg cry	904			83.3 ³⁰	
2588	Ytium carbide	YC ₂	12071-35-1	112.927	ref rac sold	≈2400		4.13		
2589	Ytium carbonate trihydrate	Y ₂ (CO ₃) ₃ · 3H ₂ O	5970-44-5	411.885	red-brn powder					i H ₂ O; s dilacid
2590	Ytium chloride	YCl ₃	10361-92-9	195.264	wh monocry; hyg	721		2.61	75.1 ²⁰	
2591	Ytium fluoride	YF ₃	13709-49-4	145.901	wh hyg powder	≈1150		4.0		i H ₂ O

2592	Ytium nitat	$Y(NO_3)_3$	10361-93-0	274.921	wh hyg sold				149 ²⁵	s EDH
2593	Ytium nitat etahydrat	$Y(NO_3)_3 \cdot 4H_2O$	13773-69-8	346.982	red-wh prisms		2.68		149 ²⁵	
2594	Ytium nitat hexahydrat	$Y(NO_3)_3 \cdot 6H_2O$	13494-98-9	383.012	hyg cry				149 ²⁵	
2595	Ytium oxide	Y_2O_3	1314-36-9	225.810	wh cry; cub	2438		5.03		s dilacid
2596	Ytium phosphide	YP	12294-01-8	119.880	cub cry			≈4.4		
2597	Ytium suf at ocayhydrat	$Y_2(SO_4)_3 \cdot 8H_2O$	7446-33-5	610.125	red monocry			2.6	7.47 ¹⁶	
2598	Ytium suf ide	Y_2S_3	12039-19-9	274.010	yelcub cry	1925		3.87		
2599	Zinc	Zn	7440-66-6	65.39	blue-wh metal hex	419.53	907	7.14		s acid, ak
2600	Zinc acetat dihydrat	$Zn(C_2H_3O_2)_2 \cdot 2H_2O$	5970-45-6	219.51	wh powder	237 dec		1.735	30.0 ²⁰	s EDH
2601	Zinc ammonium suf at	$Zn(NH_4)_2(SO_4)_2$	7783-24-6	293.59	wh cry				9.2 ²⁰	
2602	Zinc antimonide	ZnSb	12039-35-9	187.15	silv-wh orth cry	565		6.33		reac H ₂ O
2603	Zinc arsenat	$Zn_3(AsO_4)_2$	13464-44-3	474.01	wh powder				0.000078 ²⁰	s acid, ak
2604	Zinc arsenat ocayhydrat	$Zn_3(AsO_4)_2 \cdot 8H_2O$	13464-45-4	618.13	wh monocry			3.33	0.000078 ²⁰	s acid, ak
2605	Zinc arsenide	Zn_3As_2	12006-40-5	346.01	pow	1015		5.528		
2606	Zinc arsenit	$Zn(AsO_2)_2$	10326-24-6	279.23	colpowder					i H ₂ O; s acid
2607	Zinc borat	$3ZnO \cdot 2B_2O_3$	27043-84-1	383.41	wh amorp powder			3.64		sH ₂ O; s dilacid
2608	Zinc borat hemihydrat	$2ZnO \cdot 3B_2O_3 \cdot 3.5H_2O$	12513-27-8	434.69	wh cry	980		4.22		i H ₂ O
2609	Zinc borat pentahydrat	$2ZnO \cdot 3B_2O_3 \cdot 5H_2O$	12536-65-1	461.72	wh pow			3.64	0.007 ²⁵	sHCl
2610	Zinc bromat hexahydrat	$Zn(BrO_3)_2 \cdot 6H_2O$	13517-27-6	429.29	wh hyg sold	100		2.57		vs H ₂ O
2611	Zinc bromide	ZnBr ₂	7699-45-8	225.20	wh hex cry; hyg	394	697	4.5	488 ²⁵	vs EDH; s eh
2612	Zinc caprylat	$Zn(C_8H_{15}O_2)_2$	557-09-5	351.80	wh hyg cry	136				sH ₂ O
2613	Zinc carbonat	ZnCO ₃	3486-35-9	125.40	wh rhomb cry	140 dec		4.4	0.000091 ²⁰	s dilacid, ak
2614	Zinc carbonat hydroxide	$3Zn(OH)_2 \cdot 2ZnCO_3$	12070-69-8	549.01	wh pow					
2615	Zinc chbrat	$Zn(CD_3)_2$	10361-95-2	232.29	yelhyg cry	60 dec		2.15	200 ²⁰	
2616	Zinc chlride	ZnCl ₂	7646-85-7	136.29	wh hyg cry	290	732	2.907	408 ²⁵	s EDH, ace
2617	Zinc chromat	ZnCrO ₄	13530-65-9	181.38	yelprisms	316		3.40	3.08	s acid; i ace
2618	Zinc chromit	ZnCr ₂ O ₄	12018-19-8	233.38	grn cub cry			5.29		
2619	Zinc citat dihydrat	$Zn_3(C_6H_5O_7)_2 \cdot 2H_2O$	546-46-3	610.40	colpowder					sH ₂ O; s dilacid, ak
2620	Zinc cyanide	Zn(CN) ₂	557-21-1	117.42	wh powder			1.852	0.00047 ²⁰	reac acid
2621	Zinc ditionat	ZnS ₂ O ₄	7779-86-4	193.52	wh amorp sold	200 dec			40 ²⁰	
2622	Zinc f luoride	ZnF ₂	7783-49-5	103.39	wh et needles; hyg	872	1500	4.9	1.55 ²⁵	
2623	Zinc f luoride etahydrat	$ZnF_2 \cdot 4H_2O$	13986-18-0	175.45	wh orth cry			2.30	1.55 ²⁵	
2624	Zinc f luoroborat hexahydrat	$Zn(BF_4)_2 \cdot 6H_2O$	27860-83-9	347.09	hex cry			2.12		vs H ₂ O; s EDH
2625	Zinc f ormat dihydrat	$Zn(CHO_2)_2 \cdot 2H_2O$	5970-62-7	191.46	wh cry			2.207	5.2 ²⁰	i EDH
2626	Zinc hexaf luorosilcat hexahydrat	$ZnSiF_6 \cdot 6H_2O$	16871-71-9	315.56	wh cry					s H ₂ O
2627	Zinc hydroxide	Zn(OH) ₂	20427-58-1	99.41	colorth cry	125 dec		3.05	0.000042 ²⁰	
2628	Zinc iodat	Zn(IO ₃) ₂	7790-37-6	415.20	wh cry powder				0.64 ²⁵	
2629	Zinc iodide	ZnI ₂	10139-47-6	319.20	wh hyg cry	446	625	4.74	438 ²⁵	s EDH, eh
2630	Zinc iurat	$Zn(C_{12}H_{23}O_5)_2$	2452-01-9	464.01	wh powder	128				sH ₂ O
2631	Zinc molybdat	ZnMoO ₄	13767-32-3	225.33	wh et cry	>700		4.3		i H ₂ O
2632	Zinc nitat	$Zn(NO_3)_2$	7779-88-6	189.40	wh powder				120 ²⁵	
2633	Zinc nitat hexahydrat	$Zn(NO_3)_2 \cdot 6H_2O$	10196-18-6	297.49	colorth cry	36 dec		2.067	120 ²⁵	vs EDH
2634	Zinc nitide	Zn ₃ N ₂	1313-49-1	224.18	blue-gray cub cry	700 dec		6.22		i H ₂ O
2635	Zinc nitit	$Zn(NO_2)_2$	10102-02-0	157.40	hyg sold					reac H ₂ O
2636	Zinc obat	$Zn(C_{18}H_{33}O_2)_2$	557-07-3	628.30	wh powder	70 dec				i H ₂ O; s EDH, eh, bz
2637	Zinc oxat	ZnC ₂ O ₄	547-68-2	153.41	wh pwd				0.0026 ²⁵	
2638	Zinc oxat dihydrat	$ZnC_2O_4 \cdot 2H_2O$	4255-07-6	189.44	wh powder	100 dec		2.56	0.0026 ²⁵	s dilacid
2639	Zinc oxide	ZnO	1314-13-2	81.39	wh powder; hex	1974		5.6		i H ₂ O; s dilacid

No.	Name	Formula	CAS Reg No.	Mol. Weight	Physical Form	mp/°C	bp/°C	Density /g cm ⁻³	Solubility g/100 g H ₂ O	Qualitative Solubility
2640	Zinc 2,4-pentanedioate	Zn(CH ₃ COCHCOCH ₃) ₂	14024-63-6	263.61	cry	137 dec				sH ₂ O; s EDH
2641	Zinc perchlorate hexahydrate	Zn(ClO ₄) ₂ · 6H ₂ O	10025-64-6	372.38	wh cub cry; hyg	106 dec		2.2	121.3 ²⁵	s EDH
2642	Zinc permanganate hexahydrate	Zn(MnO ₄) ₂ · 6H ₂ O	23414-72-4	411.35	bk orb cry; hyg			2.45		s H ₂ O; reac EDH
2643	Zinc peroxide	ZnO ₂	1314-22-3	97.39	yelwh powder	>150 dec	212 exp	1.57		i H ₂ O; reac acid, EDH, ace
2644	Zinc phosphite	Zn ₃ (PO ₃) ₂	7779-90-0	386.11	wh monocry	900		4.0		i H ₂ O
2645	Zinc phosphate tetrahydrate	Zn ₃ (PO ₄) ₂ · 4H ₂ O	7543-51-3	458.17	colorh cry			3.04		i H ₂ O, EDH; s dilacid, ak
2646	Zinc phosphide	Zn ₃ P ₂	1314-84-7	258.12	gray bf cry	1160		4.55		i H ₂ O, EDH; reac acid; s bz
2647	Zinc pyrophosphate	Zn ₂ P ₂ O ₇	7446-26-6	304.72	wh cry powder			3.75		i H ₂ O; s dilacid
2648	Zinc selenate pentahydrate	ZnSeO ₄ · 5H ₂ O	13597-54-1	298.42	tielcry	50 dec		2.59	63.4 ²⁵	
2649	Zinc selenide	ZnSe	1315-09-9	144.35	yelred cub cry	>1100	subl	5.65		i H ₂ O; s dilacid
2650	Zinc orthosilicate	Zn ₂ SiO ₄	13597-65-4	222.86	wh hex cry	1509		4.1		i H ₂ O, dilacid
2651	Zinc selenite	ZnSeO ₃	13597-46-1	192.35	wh pow					
2652	Zinc stearate	Zn(C ₁₈ H ₃₅ O ₂) ₂	557-05-1	632.33	wh powder	130		1.095		i H ₂ O, EDH, eh; s bz
2653	Zinc sulfate	ZnSO ₄	7733-02-0	161.45	colorh cry	680 dec		3.8	57.7 ²⁵	
2654	Zinc sulfate monohydrate	ZnSO ₄ · H ₂ O	7446-19-7	179.47	wh monocry	238 dec		3.20	57.7 ²⁵	i EOH
2655	Zinc sulfate heptahydrate	ZnSO ₄ · 7H ₂ O	7446-20-0	287.56	colorh cry	100 dec		1.97	57.7 ²⁵	i EOH
2656	Zinc sulfide (sphalerite)	ZnS	1314-98-3	97.46	gray-wh cub cry	1700		4.04		i H ₂ O, EDH; s dilacid
2657	Zinc sulfide (wurzite)	ZnS	1314-98-3	97.46	wh hex cry	1700		4.09		i H ₂ O; s dilacid
2658	Zinc sulfite dihydrate	ZnSO ₃ · 2H ₂ O	7488-52-0	181.49	wh powder	200 dec			0.224 ²⁵	i EOH
2659	Zinc telluride	ZnTe	1315-11-3	192.99	red cub cry	1239		5.9		i H ₂ O
2660	Zinc thiocyanate	Zn(SCN) ₂	557-42-6	181.56	wh hyg cry					sH ₂ O; s EDH
2661	Zirconium	Zr	7440-67-7	91.224	gray-wh metal hex	1855	4409	6.52		s hotconc acid
2662	Zirconium boride	ZrB ₂	12045-64-6	112.846	gray ref rac sold; hex	3245		6.17		
2663	Zirconium carbide	ZrC	12020-14-3	103.235	gray ref rac sold; cub	3532		6.73		s HF
2664	Zirconium(II) chloride	ZrCl ₂	13762-26-0	162.129	bk cry	772 dec		3.16		reac H ₂ O
2665	Zirconium(II) hydride	ZrH ₂	7704-99-6	93.240	gray bf cry	800 dec		5.6		i H ₂ O
2666	Zirconium(IV) bromide	ZrBr ₄	13777-25-8	410.840	wh cub cry	450 p	360 sp	3.98		
2667	Zirconium(IV) chloride	ZrCl ₄	10026-11-6	233.035	wh monocry; hyg	437 p	331 sp	2.80		reac H ₂ O; s EDH, eh
2668	Zirconium(IV) fluoride	ZrF ₄	7783-64-4	167.218	wh monocry	932 p	912 sp	4.43	1.5 ²⁵	
2669	Zirconium(IV) hydroxide	Zr(OH) ₄	14475-63-9	159.254	wh amorp powder	dec		3.25		i H ₂ O; s acid
2670	Zirconium(IV) iodide	ZrI ₄	13986-26-0	598.842	oran cub cry; hyg	499 p	431 sp	4.85		vs H ₂ O
2671	Zirconium(IV) nitrate pentahydrate	Zr(NO ₃) ₄ · 5H ₂ O	13746-89-9	429.320	wh hyg cry	100 dec				vs H ₂ O; s EDH
2672	Zirconium(IV) oxide	ZrO ₂	1314-23-4	123.223	wh amorp powder	2709		5.68		i H ₂ O; slacid
2673	Zirconium(IV) orthosilicate	ZrSiO ₄	10101-52-7	183.308	wh bf cry	1540 dec		4.6		i H ₂ O, acid
2674	Zirconium(IV) sulfate	Zr(SO ₄) ₂	14644-61-2	283.351	wh hyg cry	410 dec		3.22		s H ₂ O; slEDH
2675	Zirconium(IV) sulfate tetrahydrate	Zr(SO ₄) ₂ · 4H ₂ O	7446-31-3	355.413	wh bf cry	100 dec		2.80		vs H ₂ O
2676	Zirconium(IV) sulfide	ZrS ₂	12039-15-5	155.356	red-brn hex cry	1480		3.82		i H ₂ O
2677	Zirconium nitride	ZrN	25658-42-8	105.231	yelcub cry	2960		7.09		s conc HF; stdilacid
2678	Zirconium phosphide	ZrP ₂	12037-80-8	153.172	orb cry			≈5.1		
2679	Zirconium silicide	ZrSi ₂	12039-90-6	147.395	gray powder	1620		4.88		i H ₂ O, aqua regia; s HF
2680	Zirconylchloride	ZrOCl ₂	7699-43-6	178.128	wh sold	250 dec				s H ₂ O, EDH
2681	Zirconylchloride octahydrate	ZrOCl ₂ · 8H ₂ O	13520-92-8	322.251	bf cry	400 dec		1.91		vs H ₂ O, EOH

PHYSICAL PROPERTIES OF THE RARE EARTH METALS

K.A. Gschneidner, Jr.

Table 1
Data for the Trivalent Ions of the Rare Earth Elements

Rare earth	Symbol	Atomic no.	Atomic wt. ^a	Electronic configuration for R ³⁺				Spectroscopic ground state symbol
				No. 4f electrons	S	L	J	
Scandium	Sc	21	44.955910	0	—	—	—	—
Yttrium	Y	39	88.90585	0	—	—	—	—
Lanthanum	La	57	138.9055	0	—	—	—	—
Cerium	Ce	58	140.115	1	1/2	3	5/2	² F _{5/2}
Praseodymium	Pr	59	140.90765	2	1	5	4	³ H ₄
Neodymium	Nd	60	144.24	3	3/2	6	9/2	⁴ I _{9/2}
Promethium	Pm	61	(145)	4	2	6	4	⁵ L ₄
Samarium	Sm	62	150.36	5	5/2	5	5/2	⁶ H _{5/2}
Europium	Eu	63	151.965	6	3	3	0	⁷ F ₀
Gadolinium	Gd	64	157.25	7	7/2	0	7/2	⁸ S _{7/2}
Terbium	Tb	65	158.92534	8	3	3	6	⁷ F ₆
Dysprosium	Dy	66	162.50	9	5/2	5	15/2	⁶ H _{15/2}
Holmium	Ho	67	164.93032	10	2	6	8	⁵ I ₈
Erbium	Er	68	167.26	11	3/2	6	15/2	⁴ I _{15/2}
Thulium	Tm	69	168.93421	12	1	5	6	³ H ₆
Ytterbium	Yb	70	173.04	13	1/2	3	7/2	² F _{7/2}
Lutetium	Lu	71	174.967	14	—	—	—	—

Note: For additional information, see Goldschmidt, Z.B., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978; DeLaeter, J.R., and Heumann, K.G., *J. Phys. Chem. Ref. Data*, 20, 1313, 1991; *Pure Appl. Chem.*, 66, 2423, 1994.

^a 1993 standard atomic weights.

Table 2
Crystallographic Data for the Rare Earth Metals at 24°C (297 K) or Below

Rare earth metal	Crystal structure ^a	Lattice constants(Å)			Metallic radius CN = 12 (Å)	Atomic volume (cm ³ /mol)	Density (g/cm ³)
		a ₀	b ₀	c ₀			
αSc	hcp	3.3088	—	5.2680	1.6406	15.039	2.989
αY	hcp	3.6482	—	5.7318	1.8012	19.893	4.469
αLa	dhcp	3.7740	—	12.171	1.8791	22.602	6.146
αCe ^b	fcc	4.85 ^b	—	—	1.72 ^b	17.2 ^b	8.16 ^b
βCe	dhcp	3.6810	—	11.857	1.8321	20.947	6.689
γCe ^c	fcc	5.1610	—	—	1.8247	20.696	6.770
αPr	dhcp	3.6721	—	11.8326	1.8279	20.803	6.773
αNd	dhcp	3.6582	—	11.7966	1.8214	20.583	7.008
αPm	dhcp	3.65	—	11.65	1.811	20.24	7.264
αSm	rhom ^d	3.6290 ^d	—	26.207	1.8041	20.000	7.520
Eu	bcc	4.5827	—	—	2.0418	28.979	5.244
αGd	hcp	3.6336	—	5.7810	1.8013	19.903	7.901
α'Tb ^e	ortho	3.605 ^e	6.244 ^e	5.706 ^e	1.784 ^e	19.34 ^e	8.219 ^e
αTb	hcp	3.6055	—	5.6966	1.7833	19.310	8.230
α'Dy ^f	ortho	3.595 ^f	6.184 ^f	5.678 ^f	1.774 ^f	19.00 ^f	8.551 ^f
αDy	hcp	3.5915	—	5.6501	1.7740	19.004	8.551
Ho	hcp	3.5778	—	5.6178	1.7661	18.752	8.795

PHYSICAL PROPERTIES OF THE RARE EARTH METALS (continued)

Table 2
Crystallographic Data for the Rare Earth Metals at 24°C (297 K) or Below (continued)

Rare earth metal	Crystal structure ^a	Lattice constants(Å)			Metallic radius CN = 12 (Å)	Atomic volume (cm ³ /mol)	Density (g/cm ³)
		a_0	b_0	c_0			
Er	hcp	3.5592	—	5.5850	1.7566	18.449	9.066
Tm	hcp	3.5375	—	5.5540	1.7462	18.124	9.321
α Yb ^g	hcp	3.8799 ^g	—	6.3859 ^g	1.9451 ^g	25.067 ^g	6.903 ^g
β Yb	fcc	5.4848	—	—	1.9392	24.841	6.966
Lu	hcp	3.5052	—	5.5494	1.7349	17.779	9.841

Note: For additional information, see Gschneidner, K.A., Jr. and Calderwood, F.W., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 8, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1986; Gschneidner, K.A., Jr., Pecharsky, V.K., Cho, Jaephil and Martin, S.W., *Scripta Mater.*, 1996, to be published.

^a hcp = hexagonal close-packed; P6₃/mmc, hP2, A3, Mg-type; dhcp = double-c hexagonal close-packed; P6₃/mmc, hP4, A3', α La-type; fcc = face-centered cubic; Fm $\bar{3}$ m, cF4, A1, Cu-type; rhomb = rhombohedral; R $\bar{3}$ m, hR3, α Sm-type; bcc = body-centered cubic; Im $\bar{3}$ m, cI2, A2, W-type; ortho = orthorhombic; Cmcm, oC4, α' Dy-type.

^b At 77 K (–196°C).

^c Equilibrium room temperature (standard state) phase.

^d Rhombohedral is the primitive cell. Lattice parameters given are for the nonprimitive hexagonal cell.

^d At 220 K (–53°C).

^f At 86 K (–187°C).

^g At 23°C.

Table 3
Crystallographic Data for Rare Earth Metals at High Temperature

Rare earth metal	Structure	Lattice parameter (Å)	Temp. (°C)	Metallic radius		Atomic volume (cm ³ /mol)	Density (g/cm ³)
				CN = 8 (Å)	CN = 12 (Å)		
β Sc	bcc	3.73 (est.)	1337	1.62	1.66	15.6	2.88
β Y	bcc	4.10 ^a	1478	1.78	1.83	20.8	4.28
β La	fcc	5.303	325	—	1.875	22.45	6.187
γ La	bcc	4.26	887	1.84	1.90	23.3	5.97
δ Ce	bcc	4.12	757	1.78	1.84	21.1	6.65
β Pr	bcc	4.13	821	1.79	1.84	21.2	6.64
β Nd	bcc	4.13	883	1.79	1.84	21.2	6.80
β Pm	bcc	4.10 (est.)	890	1.78	1.83	20.8	6.99
β Sm	hcp	$a = 3.6630$ $c = 5.8448$	450 ^b	—	1.8176	20.450	7.353
γ Sm	bcc	4.10 (est.)	922	1.77	1.82	20.8	7.25
β Gd	bcc	4.06	1265	1.76	1.81	20.2	7.80
β Tb	bcc	4.07 ^a	1289	1.76	1.81	20.3	7.82
β Dy	bcc	4.03 ^a	1381	1.75	1.80	19.7	8.23
γ Yb	bcc	4.44	763 ^c	1.92	1.98	26.4	6.57

Note: The rare earths Eu, Ho, Er, Tm, and Lu are monomorphic. For additional information, see Gschneidner, K.A., Jr. and Calderwood, F.W., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 8, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1986, 1.

^a Determined by extrapolation to 0% solute of a vs. composition data for R-Mg alloys at 24°C and corrected for thermal expansion to temperature given.

^b The hcp phase was stabilized by impurities and the temperature of measurement was below the equilibrium transition temperature (see Table 4).

^c The bcc phase was stabilized by impurities and the temperature of measurement was below the equilibrium transition temperature (see Table 4).

PHYSICAL PROPERTIES OF THE RARE EARTH METALS (continued)

Table 4
High Temperature Transition Temperatures and Melting Point of Rare Earth Metals

Rare earth metal	Transition I ($\alpha - \beta$) ^a		Transition II ($\beta - \gamma$) ^a		Melting point (°C)
	Temp. (°C)	Phases	Temp. (°C)	Phases	
Sc	1337	hcp 1 bcc	—	—	1541
Y	1478	hcp 1 bcc	—	—	1522
La ^b	310	dhcp → fcc	865	fcc 1 bcc	918
Ce ^{c,d}	139	dhcp → fcc ($\beta - \gamma$)	726	fcc 1 bcc ($\gamma - \delta$)	798
Pr	795	dhcp 1 bcc	—	—	931
Nd	863	dhcp 1 bcc	—	—	1021
Pm	890	dhcp 1 bcc	—	—	1042
Sm ^e	734	rhom → hcp	922	hcp 1 bcc	1074
Eu	—	—	—	—	822
Gd	1235	hcp 1 bcc	—	—	1313
Tb	1289	hcp 1 bcc	—	—	1356
Dy	1381	hcp 1 bcc	—	—	1412
Ho	—	—	—	—	1474
Er	—	—	—	—	1529
Tm	—	—	—	—	1545
Yb	795	fcc 1 bcc ($\beta - \gamma$)	—	—	819
Lu	—	—	—	—	1663

Note: For additional information, see Gschneidner, K.A., Jr. and Calderwood, F.W., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 8, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1986; Gschneidner, K.A., Jr., Pecharsky, V.K., Cho, Jaephil and Martin, S.W., *Scripta Mater.*, 34, 1717, 1996.

- ^a For all the transformations listed, unless otherwise noted.
- ^b On cooling, fcc → dhcp ($\beta \rightarrow \alpha$), 260°C.
- ^c The β 1 γ equilibrium transition temperature is $10 \pm 5^\circ\text{C}$.
- ^d On cooling, fcc → dhcp ($\gamma \rightarrow \beta$), -16°C.
- ^e On cooling, hcp → rhomb ($\beta \rightarrow \alpha$), 727°C.

Table 5
Low Temperature Transition Temperatures of the Rare Earth Metals

Rare earth metal	Cooling			Rare earth metal	Heating		
	Transformation	°C	K		Transformation	°C	K
Ce	$\gamma \rightarrow \beta^a$	-16	257	Ce	$\alpha \rightarrow \beta$	-148	125
	$\gamma \rightarrow \alpha$	-172	101		$\alpha \rightarrow \beta + \gamma$	-104	169
	$\beta \rightarrow \alpha$	-228	45		$\beta \rightarrow \gamma^a$	139	412
Tb	$\alpha \rightarrow \alpha'$	-53	220	Yb	$\alpha \rightarrow \beta$	7	280
Dy	$\alpha \rightarrow \alpha'$	-187	86				
Yb	$\beta \rightarrow \alpha$	-13	260				

Note: For additional information, see Beaudry, B.J. and Gschneidner, K.A., Jr., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 173. Koskenmaki, D.C. and Gschneidner, K.A., Jr., 1978, in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 337. Gschneidner, K.A., Jr., Pecharsky, V.K., Cho, Jaephil and Martin, S.W., *Scripta Mater.*, 34, 1717, 1996.

- ^a The β 1 γ equilibrium transition temperature is $10 \pm 5^\circ\text{C}$ ($283 \pm 5\text{K}$).

PHYSICAL PROPERTIES OF THE RARE EARTH METALS (continued)

Table 6
Heat Capacity, Standard Entropy, Heats of Transformation, and Fusion of the Rare Earth Metals

Rare earth metal	Heat capacity at 298 K (J/mol K)	Standard entropy S_{298}° (J/mol K)	Heat of transformation (kJ/mol)				Heat of fusion (kJ/mol)
			trans. 1	ΔH_{tr}^1	trans. 2	ΔH_{tr}^2	
Sc	25.5	34.6	α 1 β	4.00	—	—	14.1
Y	26.5	44.4	α 1 β	4.99	—	—	11.4
La	27.1	56.9	α 1 β	0.36	β 1 γ	3.12	6.20
Ce	26.9	72.0	β 1 γ	0.05	γ 1 δ	2.99	5.46
Pr	27.2	73.2	α 1 β	3.17	—	—	6.89
Nd	27.5	71.5	α 1 β	3.03	—	—	7.14
Pm	27.3 ^a	71.6 ^a	α 1 β	3.0 ^a	—	—	7.7 ^a
Sm	29.5	69.6	α 1 β	0.2 ^a	β 1 γ	3.11	8.62
Eu	27.7	77.8	—	—	—	—	9.21
Gd	37.0	68.1	α 1 β	3.91	—	—	10.0
Tb	28.9	73.2	α 1 β	5.02	—	—	10.79
Dy	27.7	75.6	α 1 β	4.16	—	—	11.06
Ho	27.2	75.3	—	—	—	—	17.0 ^a
Er	28.1	73.2	—	—	—	—	19.9
Tm	27.0	74.0	—	—	—	—	16.8
Yb	26.7	59.9	β 1 γ	1.75	—	—	7.66
Lu	26.9	51.0	—	—	—	—	22 ^a

Note: For additional information, see Hultgren, R., Desai, P.D., Hawkins, D.T., Gleiser, M., Kelley, K.K., and Wagman, D.D., *Selected Values of the Thermodynamic Properties of the Elements*, ASM International, Metals Park, Ohio, 1973; Wagman, D.D., Evans, W.H., Parker, V.B., Schumm, R.H., Halow, I., Bailey, S.M., Churney, K.L., and Nuttall, R.L., *The NBS Tables of Chemical Thermodynamic Properties, J. Phys. Chem. Ref. Data*, Vol. 11, Suppl 2, 1982; Amitin, E.B., Bessergenev, W.G., Kovalevskaya, Yu. A., and Paukov, I.E., *J. Chem. Thermodyn.*, 15, 181, 1983; Amitin, E.B., Bessergenev, W.G., Kovalevskaya, Yu. A., and Paukov, I.E., *J. Chem. Thermodyn.*, 15, 181, 1983.

^a Estimated.

Table 7
Vapor Pressures, Boiling Points, and Heats of Sublimation of Rare Earth Metals

Rare earth metal	Temperature in °C ^a for a vapor pressure of				Boiling point ^a (°C)	Heat of sublimation at 25°C (kJ/mol)
	10 ⁻⁸ atm (0.001 Pa)	10 ⁻⁶ atm (0.101 Pa)	10 ⁻⁴ atm (10.1 Pa)	10 ⁻² atm (1013 Pa)		
Sc	1036	1243	1533	1999	2836	377.8
Y	1222	1460	1812	2360	3345	424.7
La	1301	1566	1938	2506	3464	431.0
Ce	1290	1554	1926	2487	3443	422.6
Pr	1083	1333	1701	2305	3520	355.6
Nd	955	1175	1500	2029	3074	327.6
Pm	—	—	—	—	3000 ^b	348 ^b
Sm	508	642	835	1150	1794	206.7
Eu	399	515	685	964	1529	175.3
Gd	1167	1408	1760	2306	3273	397.5
Tb	1124	1354	1698	2237	3230	388.7
Dy	804	988	1252	1685	2567	290.4
Ho	845	1036	1313	1771	2700	300.8
Er	908	1113	1405	1896	2868	317.1
Tm	599	748	964	1300	1950	232.2
Yb	301	400	541	776	1196	152.1
Lu	1241	1483	1832	2387	3402	427.6

Note: For additional information, see Hultgren, R., Desai, P.D., Hawkins, D.T., Gleiser, M., Kelley, K.K., and Wagman, D.D., *Selected Values of the Thermodynamic Properties of the Elements*, ASM International, Metals Park, Ohio, 1973 and Beaudry, B.J. and Gschneidner, K.A., Jr., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 173.

^a International Temperature Scale of 1990 (ITS-90) values.

^b Estimated.

Table 8
Magnetic Properties of the Rare Earth Metals

Rare earth metal	$\chi_A \times 10^6$ at 298 K (emu/mol)	Effective magnetic moment				Easy axis	Néel temp. T_N (K)		Curie temp. T_C (K)	θ_p (K)		
		Paramagnetic at ~298 K		Ferromagnetic at ~0 K			Hex sites	Cubic sites		|c	⊥c	Polycryst. or avg.
		Theory ^a	Obs.	Theory ^b	Obs.							
αSc	295.2	—	—	—	—	—	—	—	—	—	—	
αY	187.7	—	—	—	—	—	—	—	—	—	—	
αLa	95.9	—	—	—	—	—	—	—	—	—	—	
βLa	105	—	—	—	—	—	—	—	—	—	—	
γCe	2,270	2.54	2.52	2.14	—	—	14.4	—	—	—	-50	
βCe	2,500	2.54	2.61	2.14	—	—	13.7	12.5	—	—	-41	
αPr	5,530	3.58	3.56	3.20	2.7 ^c	a	0.03	—	—	—	0	
αNd	5,930	3.62	3.45	3.27	2.2 ^c	b	19.9	7.5	—	0	5	3.3
αPm	—	2.68	—	2.40	—	—	—	—	—	—	—	
αSm	1,278 ^d	0.85	1.74	0.71	0.5 ^c	a	109	14.0	—	—	—	—
Eu	30,900	7.94	8.48	7.0	5.9	<110>	—	90.4	—	—	—	100
αGd	185,000 ^e	7.94	7.98	7.0	7.63	30° to c	—	—	293.4	317	317	317
αTb	170,000	9.72	9.77	—	—	—	230.0	—	—	195	239	224
α'Tb	—	—	—	9.0	9.34	b	—	—	219.5	—	—	—
αDy	98,000	10.64	10.83	—	—	—	180.2	—	—	121	169	153
α'Dy	—	—	—	10.0	10.33	a	—	—	90.5 ^g	—	—	—
Ho	72,900	10.60	11.2	10.0	10.34	b	132	—	19.5	73.0	88.0	83.0
Er	48,000	9.58	9.9	9.0	9.1	30° to c	85	—	18.7	61.7	32.5	42.2
Tm	24,700	7.56	7.61	7.0	7.14	c	58	—	32.0	41.0	-17.0	2.3
βYb	67 ^d	—	—	—	—	—	—	—	—	—	—	—
Lu	182.9	—	—	—	—	—	—	—	—	—	—	—

Note: For additional information, see McEwen, K.A., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 411 and Legvold, S., in *Ferromagnetic Materials*, Vol. 1, Wohlfarth, E.P., Ed., North-Holland Physics, Amsterdam, 1980, 183; Pecharsky, V.K., Gschneidner, K.A., Jr. and Fort, D., *Phys. Rev. B*, 47, 5063, 1993; Pecharsky, V.K., Gschneidner, K.A., Jr. and Fort, D., 1996, to be published; Steward, A.M. and Collocott, S.J., *J. Phys.: Condens. Matter*, 1, 677, 1988.

^a $g[J(J+1)]^{1/2}$.

^b gJ .

^c At 38 T and 4.2 K.

^d At 290 K.

^e At 350 K.

^g On cooling $T_C = 89.6$ K and on warming $T_C = 91.5$ K.

Table 9
Room Temperature Coefficient of Thermal Expansion, Thermal Conductivity, Electrical Resistance, and Hall Coefficient

Rare earth metal	Expansion $\alpha_i \times 10^6$ ($^{\circ}\text{C}^{-1}$)			Thermal conductivity (W/cm-K)	Electrical resistance ($\mu\Omega\text{-cm}$)			Hall coefficient ($R_i \times 10^{12}$) (V-cm/A-Oe)		
	α_a	α_c	α_{poly}		ρ_a	ρ_c	ρ_{poly}	R_a	R_c	R_{poly}
αSc	7.6	15.3	10.2	0.158	70.9	26.9	56.2 ^a	—	—	-0.13
αY	6.0	19.7	10.6	0.172	72.5	35.5	59.6	-0.27	-1.6	—
aLa	4.5	27.2	12.1	0.134	—	—	61.5	—	—	-0.35
bCe	—	—	—	—	—	—	82.8	—	—	—
γCe	6.3	—	6.3	0.113	—	—	74.4	—	—	+1.81
αPr	4.5	11.2	6.7	0.125	—	—	70.0	—	—	+0.709
αNd	7.6	13.5	9.6	0.165	—	—	64.3	—	—	+0.971
αPm	9 ^b	16 ^b	11 ^b	0.15 ^b	—	—	75 ^b	—	—	—
αSm	9.6	19.0	12.7	0.133	—	—	94.0	—	—	-0.21
Eu	35.0	—	35.0	0.139 ^b	—	—	90.0	—	—	+24.4
αGd	9.1 ^c	10.0 ^c	9.4 ^c	0.105	135.1	121.7	131.0	-10	-54	-4.48 ^d
αTb	9.3	12.4	10.3	0.111	123.5	101.5	115.0	-1.0	-3.7	—
αDy	7.1	15.6	9.9	0.107	111.0	76.6	92.6	-0.3	-3.7	—
Ho	7.0	19.5	11.2	0.162	101.5	60.5	81.4	+0.2	-3.2	—
Er	7.9	20.9	12.2	0.145	94.5	60.3	86.0	+0.3	-3.6	—
Tm	8.8	22.2	13.3	0.169	88.0	47.2	67.6	—	—	-1.8
βYb	26.3	—	26.3	0.385	—	—	25.0	—	—	+3.77
Lu	4.8	20.0	9.9	0.164	76.6	34.7	58.2	+0.45	-2.6	-0.535

Note: For additional information, see Beaudry, B. J. and Gschneidner, K.A., Jr., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 173 and McEwen, K.A., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 411.

^a Calculated from single crystal values.

^b Estimated.

^c At 100°C.

^d At 77°C.

PHYSICAL PROPERTIES OF THE RARE EARTH METALS (continued)

Table 10

Electronic Specific Heat Constant (γ), Electron-Electron (Coulomb) Coupling Constant (μ^*), Electron-Phonon Coupling Constant (λ), Debye Temperature at 0 K (θ_D), and Superconducting Transition Temperature

Rare earth metal	γ (mJ/mol·K ²)	μ^*	λ	θ_D (K) from		Superconducting temperature (K)
				Heat capacity	Elastic constants	
α Sc	10.334	0.16	0.30	345.3	—	0.050 ^a
α Y	7.878	0.15	0.30	244.4	258	1.3 ^b
α La	9.45	0.08	0.76	150	154	5.10
β La	11.5	—	—	140	—	6.00
α Ce	12.8	—	—	179	—	0.022 ^c
α Pr	20	—	1.07 ^d	155 ^e	153	—
α Nd	f	—	0.86 ^d	157 ^e	163	—
α Pm	—	—	—	159 ^e	—	—
α Sm	8.1 ± 1.5 ^g	—	0.81 ^d	162 ^{e,f}	169	—
Eu	f	—	—	f	118	—
α Gd	4.48	—	0.30	169	182	—
α' Tb	3.71	—	0.34 ^d	169.6	177	—
α' Dy	4.9	—	0.32 ^d	192	183	—
Ho	2.1	—	0.30 ^d	175 ^e	190	—
Er	8.7	—	0.33 ^d	176.9	188	—
Tm	f	—	0.36 ^d	179 ^e	200	—
α Yb	3.30	—	—	117.6	118	—
β Yb	8.36	—	—	109	—	—
Lu	8.194	0.14	0.31	183.2	185	0.022 ^h

Note: For additional information, see Sundström, L.J., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr., and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 379, Scott, T., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 591, Probst, C. and Wittig, J., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 749, and Tsang, T.-W.E., Gschneidner, K.A., Jr., Schmidt, F.A., and Thome, D.K., *Phys. Rev.*, B, 31, 235, 1985. Collocott, S.J., Hill, R.W. and Stewart, A.M., *J. Phys. F*, 18, L223, 1988. Hill, R.W. and Gschneidner, K.A., Jr., *J. Phys. F*, 18, 2545, 1988. Skriver, H.L. and Mertig, I., *Phys. Rev. B*, 41, 6553, 1990. Collocott, S.J. and Stewart, A.M., *J. Phys.: Condens. Matter*, 4, 6743, 1992. Pecharsky, V.K., Gschneidner, K.A., Jr. and Fort, D., *Phys. Rev. B*, 47, 5063, 1993.

^a At 18.6 GPa.

^b At 11 GPa.

^c At 2.2 GPa.

^d Calculated value.

^e Estimated.

^f Heat capacity results have been reported, but the resultant γ and θ_D values are unreliable because of the presence of impurities and/or there was no reliable procedure or model to correct for the magnetic contribution to the heat capacity.

^g Based on the values reported for the purer Sm sample (IV).

^h At 4.5 GPa.

PHYSICAL PROPERTIES OF THE RARE EARTH METALS (continued)

Table 11
Room Temperature Elastic Moduli and Mechanical Properties

Rare earth metal	Elastic moduli (GPa)				Mechanical properties (MPa)				Recryst. temp. (°C)
	Young's (elastic) modulus	Shear modulus	Bulk modulus	Poisson's ratio	Yield strength 0.2% offset	Ultimate tensile strength	Uniform elongation (%)	Reduction in area (%)	
Sc	74.4	29.1	56.6	0.279	173 ^a	255 ^a	5.0 ^a	8.0 ^a	550
Y	63.5	25.6	41.2	0.243	42	129	34.0	—	550
αLa	36.6	14.3	27.9	0.280	126 ^a	130	7.9 ^a	—	300
βCe	—	—	—	—	86	138	—	24.0	—
γCe	33.6	13.5	21.5	0.24	28	117	22.0	30.0	325
αPr	37.3	14.8	28.8	0.281	73	147	15.4	67.0	400
αNd	41.4	16.3	31.8	0.281	71	164	25.0	72.0	400
αPm	46 ^b	18 ^b	33 ^b	0.28 ^b	—	—	—	—	400 ^b
αSm	49.7	19.5	37.8	0.274	68	156	17.0	29.5	440
Eu	18.2	7.9	8.3	0.152	—	—	—	—	300
αGd	54.8	21.8	37.9	0.259	15	118	37.0	56.0	500
αTb	55.7	22.1	38.7	0.261	—	—	—	—	500
αDy	61.4	24.7	40.5	0.247	43	139	30.0	30.0	550
Ho	64.8	26.3	40.2	0.231	—	—	—	—	520
Er	69.9	28.3	44.4	0.237	60	136	11.5	11.9	520
Tm	74.0	30.5	44.5	0.213	—	—	—	—	600
βYb	23.9	9.9	30.5	0.207	7	58	43.0	92.0	300
Lu	68.6	27.2	47.6	0.261	—	—	—	—	600

Note: For additional information, see Scott, T., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 1, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1978, 591.

^a Value is questionable.

^b Estimated.

Table 12
Liquid Metal Properties Near the Melting Point

Rare earth metal	Density (g/cm ³)	Surface tension (N/m)	Viscosity (centipoise)	Heat capacity (J/mol K)	Thermal conductivity (W/cm K)	Magnetic susceptibility $\chi \times 10^4$ (emu/mol)	Electrical resistivity ($\mu\Omega \cdot \text{cm}$)	$\Delta V_{L \rightarrow s}^a$ (%)	Spectral emittance at $\lambda = 645 \text{ nm}$	
									ϵ (%)	Temp. range (°C)
Sc	2.80	0.954	—	44.2 ^b	—	—	—	—	—	—
Y	4.24	0.871	—	43.1	—	—	—	—	36.8	1522–1647
La	5.96	0.718	2.65	34.3	0.238	1.20	133	–0.6	25.4	920–1287
Ce	6.68	0.706	3.20	37.7	0.210	9.37	130	+1.1	32.2	877–1547
Pr	6.59	0.707	2.85	43.0	0.251	17.3	139	–0.02	28.4	931–1537
Nd	6.72	0.687	—	48.8	0.195	18.7	151	–0.9	39.4	1021–1567
Pm	6.9 ^b	0.680 ^b	—	50 ^b	—	—	160 ^b	—	—	—
Sm	7.16	0.431	—	50.2 ^b	—	18.3	182	–3.6	43.7	1075
Eu	4.87	0.264	—	38.1	—	97	242	–4.8	—	—
Gd	7.4	0.664	—	37.2	0.149	67	195	–2.0	34.2	1313–1600
Tb	7.65	0.669	—	46.5	—	82	193	–3.1	—	—
Dy	8.2	0.648	—	49.9	0.187	95	210	–4.5	29.7	1412–1437
Ho	8.34	0.650	—	43.9	—	88	221	–7.4	—	—
Er	8.6	0.637	—	38.7	—	69	226	–9.0	37.2	1529–1587
Tm	9.0 ^b	—	—	41.4	—	41	235 ^b	–6.9	—	—
Yb	6.21	0.320	2.67	36.8	—	—	113	–5.1	—	—
Lu	9.3	0.940	—	47.9 ^b	—	—	224	–3.6	—	—

Note: For additional information, see Van Zytveld, J., in *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 12, Gschneidner, K.A., Jr. and Eyring, L., Eds., North-Holland Physics, Amsterdam, 1989, 357. Stretz, L.A. and Bautista, R.G., in *Temperature, Its Measurement and Control in Science and Industry*, Vol. 4, part I, H.H. Plumb, Ed., Instrument Society of America, Pittsburgh, 1972, 489. King, T.S., Baria, D.N., and Bautista, R.G., *Met. Trans. B*, 7, 411, 1976. Baria, D.N., King, T.S., and Bautista, R.G., *Met. Trans. B*, 7, 577, 1976.

^a Volume change on freezing.

^b Estimated.

PHYSICAL PROPERTIES OF THE RARE EARTH METALS (continued)

Table 13
Ionization Potentials (Electronvolts)

Rare earth	I	II	III	IV	V
	Neutral atom	Singly ionized	Doubly ionized	Triply ionized	Quadruply ionized
Sc	6.56144	12.79967	24.75666	73.4894	91.65
Y	6.217	12.24	20.52	60.597	77.0
La	5.5770	11.060	19.1773	49.95	61.6
Ce	5.5387	10.85	20.198	36.758	65.55
Pr	5.464	10.55	21.624	38.98	57.53
Nd	5.5250	10.73	22.1	40.41	—
Pm	5.554	10.90	22.3	41.1	—
Sm	5.6437	11.07	23.4	41.4	—
Eu	5.6704	11.241	24.92	42.7	—
Gd	6.1500	12.09	20.63	44.0	—
Tb	5.8639	11.52	21.91	39.79	—
Dy	5.9389	11.67	22.8	41.47	—
Ho	6.0216	11.80	22.84	42.5	—
Er	6.1078	11.93	22.74	42.7	—
Tm	6.18431	12.05	23.68	42.7	—
Yb	6.25416	12.1761	25.05	43.56	—
Lu	5.42585	13.9	20.9594	45.25	66.8

Note: For references, see the table "Ionization Potentials of Atoms and Atomic Ions" in Section 10.

Table 14
Effective Ionic Radii (Å)^a

Rare earth ion	R ²⁺		R ³⁺			R ⁴⁺	
	CN = 6	CN = 8	CN = 6	CN = 8	CN = 12	CN = 6	CN = 8
Sc	—	—	0.745	0.87	1.116	—	—
Y	—	—	0.900	1.015	1.220	—	—
La	—	—	1.045	1.18	1.320	—	—
Ce	—	—	1.010	1.14	1.290	0.80	0.97
Pr	—	—	0.997	1.14	1.286	0.78	0.96
Nd	—	—	0.983	1.12	1.276	—	—
Pm	—	—	0.97	1.10	1.267	—	—
Sm	1.19	1.27	0.958	1.09	1.260	—	—
Eu	1.17	1.25	0.947	1.07	1.252	—	—
Gd	—	—	0.938	1.06	1.246	—	—
Tb	—	—	0.923	1.04	1.236	0.76	0.88
Dy	—	—	0.912	1.03	1.228	—	—
Ho	—	—	0.901	1.02	1.221	—	—
Er	—	—	0.890	1.00	1.214	—	—
Tm	—	—	0.880	0.99	1.207	—	—
Yb	1.00	1.07	0.868	0.98	1.199	—	—
Lu	—	—	0.861	0.97	1.194	—	—

Note: For additional information, see Shannon, R.D. and Prewitt, C.T., *Acta Cryst.*, 25, 925, 1969 and Shannon, R.D. and Prewitt, C.T., *Acta Cryst.*, 26, 1046, 1970.

^a Radius of O²⁻ is 1.40 Å for a coordination number (CN) of 6.

MELTING, BOILING, AND CRITICAL TEMPERATURES OF THE ELEMENTS

This table summarizes the melting point t_m , normal boiling point t_b , and critical temperature t_c (on the ITS-90 scale) for the elements for which data are available. A “tp” after a value indicates a solid-liquid-gas triple point, and “sp” indicates a sublimation point, where the vapor pressure of the solid phase reaches 101.325 kPa (1 atm). Transition temperatures between allotropic forms are included for several elements. References may be found in the tables *Physical Constants of Inorganic Compounds* and *Critical Constants*.

Name	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$t_c/^\circ\text{C}$	Name	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$t_c/^\circ\text{C}$
Actinium	1051	3198		Molybdenum	2623	4639	
Aluminum	660.32	2519		Neodymium	1021	3074	
Americium	1176	2011		Neon	-248.59	-246.08	-228.7
Antimony	630.63	1587		Neptunium	644		
Argon	-189.35	-185.85	-122.28	Nickel	1455	2913	
Arsenic (gray)	817 tp (3.70 MPa)	603 sp	1400	Niobium	2477	4744	
Astatine	302			Nitrogen	-210.00	-195.79	-146.94
Barium	727	1897		Nobelium	827		
Berkelium (α form)	1050			Osmium	3033	5012	
Berkelium (β form)	986			Oxygen	-218.79	-182.95	-118.56
Beryllium	1287	2471		Palladium	1554.9	2963	
Bismuth	271.40	1564		Phosphorus (white)	44.15	280.5	721
Boron	2075	4000		Phosphorus (red)	590 tp	431 sp	721
Bromine	-7.2	58.8	315	Phosphorus (black)	610		
Cadmium	321.07	767		Platinum	1768.4	3825	
Calcium	842	1484		Plutonium	640	3228	
Californium	900			Polonium	254	962	
Carbon (graphite)	4489 tp (10.3 MPa)	3825 sp		Potassium	63.5	759	1950
Carbon (diamond)	4440 (12.4 GPa)			Praseodymium	931	3520	
Cerium	798	3443		Promethium	1042	3000	
Cesium	28.5	671	1665	Protactinium	1572		
Chlorine	-101.5	-34.04	143.8	Radium	700		
Chromium	1907	2671		Radon	-71	-61.7	104
Cobalt	1495	2927		Rhenium	3186	5596	
Copper	1084.62	2562		Rhodium	1964	3695	
Curium	1345	\approx 3100		Rubidium	39.30	688	1820
Dysprosium	1412	2567		Ruthenium	2334	4150	
Einsteinium	860			Samarium	1074	1794	
Erbium	1529	2868		Scandium	1541	2836	
Europium	822	1529		Selenium (vitreous)	180 (trans to gray)	685	
Fermium	1527			Selenium (gray)	220.5	685	1493
Fluorine	-219.67 tp	-188.12	-129.02	Silicon	1414	3265	
Francium	27			Silver	961.78	2162	
Gadolinium	1313	3273		Sodium	97.80	883	2300
Gallium	29.771 tp	2204		Strontium	777	1382	
Germanium	938.25	2833		Sulfur (rhombohedral)	95.3 (trans to mono)	444.60	1041
Gold	1064.18	2856		Sulfur (monoclinic)	119.6	444.60	1041
Hafnium	2233	4603		Tantalum	3017	5458	
Helium		-268.93	-267.96	Technetium	2157	4265	
Holmium	1474	2700		Tellurium	449.51	988	
Hydrogen	-259.34	-252.87	-240.18	Terbium	1356	3230	
Indium	156.60	2072		Thallium	304	1473	
Iodine	113.7	184.4	546	Thorium	1750	4788	
Iridium	2446	4428		Thulium	1545	1950	
Iron	1538	2861		Tin (gray)	13.2 (trans to white)	2602	
Krypton	-157.38 tp (73.2 kPa)	-153.22	-63.74	Tin (white)	231.93	2602	
Lanthanum	918	3464		Titanium	1668	3287	
Lawrencium	1627			Tungsten	3422	5555	
Lead	327.46	1749		Uranium	1135	4131	
Lithium	180.50	1342	2950	Vanadium	1910	3407	
Lutetium	1663	3402		Xenon	-111.79 tp (81.6 kPa)	-108.12	16.62
Magnesium	650	1090		Ytterbium	819	1196	
Manganese	1246	2061		Yttrium	1522	3345	
Mendelevium	827			Zinc	419.53	907	
Mercury	-38.837 tp	356.73	1477	Zirconium	1855	4409	

HEAT CAPACITY OF THE ELEMENTS AT 25°C

This table gives the specific heat capacity (c_p) in J/g K and the molar heat capacity (C_p) in J/mol K at a temperature of 25°C and a pressure of 100 kPa (1 bar or 0.987 standard atmospheres) for all the elements for which reliable data are available.

Name	c_p J/g K	C_p J/mol K	Name	c_p J/g K	C_p J/mol K
Actinium	0.120	27.2	Molybdenum	0.251	24.06
Aluminum	0.897	24.200	Neodymium	0.190	27.45
Antimony	0.207	25.23	Neon	1.030	20.786
Argon	0.520	20.786	Nickel	0.444	26.07
Arsenic	0.329	24.64	Niobium	0.265	24.60
Barium	0.204	28.07	Nitrogen (N ₂)	1.040	29.124
Beryllium	1.825	16.443	Osmium	0.130	24.7
Bismuth	0.122	25.52	Oxygen (O ₂)	0.918	29.378
Boron	1.026	11.087	Palladium	0.246	25.98
Bromine (Br ₂)	0.226	36.057	Phosphorus (white)	0.769	23.824
Cadmium	0.232	26.020	Platinum	0.133	25.86
Calcium	0.647	25.929	Potassium	0.757	29.600
Carbon (graphite)	0.709	8.517	Praseodymium	0.193	27.20
Cerium	0.192	26.94	Radon	0.094	20.786
Cesium	0.242	32.210	Rhenium	0.137	25.48
Chlorine (Cl ₂)	0.479	33.949	Rhodium	0.243	24.98
Chromium	0.449	23.35	Rubidium	0.363	31.060
Cobalt	0.421	24.81	Ruthenium	0.238	24.06
Copper	0.385	24.440	Samarium	0.197	29.54
Dysprosium	0.170	27.7	Scandium	0.568	25.52
Erbium	0.168	28.12	Selenium	0.321	25.363
Europium	0.182	27.66	Silicon	0.705	19.789
Fluorine (F ₂)	0.824	31.304	Silver	0.235	25.350
Gadolinium	0.236	37.03	Sodium	1.228	28.230
Gallium	0.371	25.86	Strontium	0.301	26.4
Germanium	0.320	23.222	Sulfur (rhombic)	0.710	22.75
Gold	0.129	25.418	Tantalum	0.140	25.36
Hafnium	0.144	25.73	Tellurium	0.202	25.73
Helium	5.193	20.786	Terbium	0.182	28.91
Holmium	0.165	27.15	Thallium	0.129	26.32
Hydrogen (H ₂)	14.304	28.836	Thorium	0.113	26.230
Indium	0.233	26.74	Thulium	0.160	27.03
Iodine (I ₂)	0.145	36.888	Tin (white)	0.228	27.112
Iridium	0.131	25.10	Titanium	0.523	25.060
Iron	0.449	25.10	Tungsten	0.132	24.27
Krypton	0.248	20.786	Uranium	0.116	27.665
Lanthanum	0.195	27.11	Vanadium	0.489	24.89
Lead	0.129	26.650	Xenon	0.158	20.786
Lithium	3.582	24.860	Ytterbium	0.155	26.74
Lutetium	0.154	26.86	Yttrium	0.298	26.53
Magnesium	1.023	24.869	Zinc	0.388	25.390
Manganese	0.479	26.32	Zirconium	0.278	25.36
Mercury	0.140	27.983			

VAPOR PRESSURE OF THE METALLIC ELEMENTS

C. B. Alcock

This table gives coefficients in an equation for the vapor pressure of 65 metallic elements in both the solid and liquid state. Vapor pressures in the range 10^{-10} to 10^2 Pa (10^{-15} to 10^{-3} atm) are covered. The equation is:

$$\text{for } p \text{ in pascals: } \log(p/\text{Pa}) = 5.006 + A + BT^{-1} + C\log T + DT^{-3}$$

$$\text{for } p \text{ in atmospheres: } \log(p/\text{atm}) = A + BT^{-1} + C\log T + DT^{-3}, \text{ where } T \text{ is the temperature in K}$$

This equation reproduces the observed vapor pressures to an accuracy of $\pm 5\%$ or better. Reprinted with permission of the publisher, Pergamon Press.

REFERENCE

Alcock, C. B., Itkin, V. P., and Horrigan, M. K., *Canadian Metallurgical Quarterly*, 23, 309, 1984.

Element, state	A	B	C	D	Temperature range
Li sol	5.667	-8310			298-m.p.
Li liq	5.055	-8023			m.p.-1000
Na sol	5.298	-5603			298-m.p.
Na liq	4.704	-5377			m.p.-700
K sol	4.961	-4646			298-m.p.
K liq	4.402	-4453			m.p.-600
Rb sol	4.857	-4215			298-m.p.
Rb liq	4.312	-4040			m.p.-550
Cs sol	4.711	-3999			298-m.p.
Cs liq	4.165	-3830			m.p.-550
Be sol	8.042	-17020	-0.4440		298-m.p.
Be liq	5.786	-15731			m.p.-1800
Mg sol	8.489	-7813	-0.8253		298-m.p.
Ca sol	10.127	-9517	-1.4030		298-m.p.
Sr sol	9.226	-8572	-1.1926		298-m.p.
Ba sol	12.405	-9690	-2.2890		298-m.p.
Ba liq	4.007	-8163			m.p.-1200
Al sol	9.459	-17342	-0.7927		298-m.p.
Al liq	5.911	-16211			m.p.-1800
Ga sol	6.657	-14208			298-m.p.
Ga liq	6.754	-13984	-0.3413		m.p.-1600
In sol	5.991	-12548			298-m.p.
In liq	5.374	-12276			m.p.-1500
Tl sol	5.971	-9447			298-m.p.
Tl liq	5.259	-9037			m.p.-1100
Sn sol	6.036	-15710			298-m.p.
Sn liq	5.262	-15332			m.p.-1850
Pb sol	5.643	-10143			298-m.p.
Pb liq	4.911	-9701			m.p.-1200
Sc sol	6.650	-19721	0.2885	-0.3663	298-m.p.
Sc liq	5.795	-17681			m.p.-2000
Y sol	9.735	-22306	-0.8705		298-m.p.
Y liq	5.795	-20341			m.p.-2300
La sol	7.463	-22551	-0.3142		298-m.p.
La liq	5.911	-21855			m.p.-2450
Ti sol	11.925	-24991	-1.3376		298-m.p.
Ti liq	6.358	-22747			m.p.-2400
Zr sol	10.008	-31512	-0.7890		298-m.p.
Zr liq	6.806	-30295			m.p.-2500
Hf sol	9.445	-32482	-0.6735		298-m.p.
V sol	9.744	-27132	-0.5501		298-m.p.

VAPOR PRESSURE OF THE METALLIC ELEMENTS (continued)

Element, state	A	B	C	D	Temperature range
V liq	6.929	-25011			m.p.-2500
Nb sol	8.822	-37818	-0.2575		298-2500
Ta sol	16.807	-41346	-3.2152	0.7437	248-2500
Cr sol	6.800	-20733	0.4391	-0.4094	298-2000
Mo sol	11.529	-34626	-1.1331		298-2500
W sol	2.945	-44094	1.3677		298-2350
W sol	-54.527	-57687	-12.2231		2200-2500
Mn sol	12.805	-15097	-1.7896		298-m.p.
Re sol	11.543	-40726	-1.1629		298-2500
Fe sol	7.100	-21723	0.4536	-0.5846	298-m.p.
Fe liq	6.347	-19574			m.p.-2100
Ru sol	9.755	-34154	-0.4723		298-m.p.
Os sol	9.419	-41198	-0.3896		298-2500
Co sol	10.976	-22576	-1.0280		298-m.p.
Co liq	6.488	-20578			m.p.-2150
Rh sol	10.168	-29010	-0.7068		298-m.p.
Rh liq	6.802	-26792			m.p.-2500
Ir sol	10.506	-35099	-0.7500		298-2500
Ni sol	10.557	-22606	-0.8717		298-m.p.
Ni liq	6.666	-20765			m.p.-2150
Pd sol	9.502	-19813	-0.9258		298-m.p.
Pd liq	5.426	-17899			m.p.-2100
Pt sol	4.882	-29387	1.1039	-0.4527	298-m.p.
Pt liq	6.386	-26856			m.p.-2500
Cu sol	9.123	-17748	-0.7317		298-m.p.
Cu liq	5.849	-16415			m.p.-1850
Ag sol	9.127	-14999	-0.7845		298-m.p.
Ag liq	5.752	-13827			m.p.-1600
Au sol	9.152	-19343	-0.7479		298-m.p.
Au liq	5.832	-18024			m.p.-2050
Zn sol	6.102	-6776			298-m.p.
Zn liq	5.378	-6286			m.p.-750
Cd sol	5.939	-5799			298-m.p.
Cd liq	5.242	-5392			m.p.-650
Hg liq	5.116	-3190			298-400
Ce sol	6.139	-21752			298-m.p.
Ce liq	5.611	-21200			m.p.-2450
Pr sol	8.859	-18720	-0.9512		298-m.p.
Pr liq	4.772	-17315			m.p.-2200
Nd sol	8.996	-17264	-0.9519		298-m.p.
Nd liq	4.912	-15824			m.p.-2000
Sm sol	9.988	-11034	-1.3287		298-m.p.
Eu sol	9.240	-9459	-1.1661		298-m.p.
Gd sol	8.344	-20861	-0.5775		298-m.p.
Gd liq	5.557	-19389			m.p.-2250
Tb sol	9.510	-20457	-0.9247		298-m.p.
Tb liq	5.411	-18639			m.p.-2200
Dy sol	9.579	-15336	-1.1114		298-m.p.
Ho sol	9.785	-15899	-1.1753		298-m.p.
Er sol	9.916	-16642	-1.2154		298-m.p.
Er liq	4.668	-14380			m.p.-1900
Tm sol	8.882	-12270	-0.9564		298-1400
Yb sol	9.111	-8111	-1.0849		298-900
Lu sol	8.793	-22423	-0.6200		298-m.p.
Lu liq	5.648	-20302			m.p.-2350
Th sol	8.668	-31483	-0.5288		298-m.p.
Th liq	-18.453	-24569	6.6473		m.p.-2500
Pa sol	10.552	-34869	-1.0075		298-m.p.

VAPOR PRESSURE OF THE METALLIC ELEMENTS (continued)

Element, state	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	Temperature range
Pa liq	6.177	-32874			m.p.-2500
U sol	0.770	-27729	2.6982	-1.5471	298-m.p.
U liq	20.735	-28776	-4.0962		m.p.-2500
Np sol	19.643	-24886	-3.9991		298-m.p.
Np liq	10.076	-23378	-1.3250		m.p.-2500
Pu sol	26.160	-19162	-6.6675		298-600
Pu sol	18.858	-18460	-4.4720		500-m.p.
Pu liq	3.666	-16658			m.p.-2450
Am sol	11.311	-15059	-1.3449		298-m.p.
Cm sol	8.369	-20364	-0.5770		298-m.p.
Cm liq	5.223	-18292			m.p.-2200

DENSITY OF MOLTEN ELEMENTS AND REPRESENTATIVE SALTS

This table lists the liquid density at the melting point, ρ_m , for elements that are solid at room temperature, as well as for some representative salts of these elements. Densities at higher temperatures (up to the t_{\max} given in the last column) may be estimated from the equation

$$\rho(t) = \rho_m - k(t - t_m)$$

where t_m is the melting point and k is given in the fifth column of the table. If a value of t_{\max} is not given, the equation should not be used to extrapolate more than about 20°C beyond the melting point.

Data for the elements were selected from the primary literature; the assistance of Gernot Lang in compiling these data is gratefully acknowledged. The molten salt data were derived from Reference 1.

REFERENCE

1. Janz, G. J., Thermodynamic and Transport Properties of Molten Salts: Correlation Equations for Critically Evaluated Density, Surface Tension, Electrical Conductance, and Viscosity Data, *J. Phys. Chem. Ref. Data*, 17, Suppl. 2, 1988.
2. Nasch, P. M., and Steinemann, S. G., *Phys. Chem. Liq.*, 29, 43, 1995.

Formula	Name	$t_m/^\circ\text{C}$	$\rho_m/\text{g cm}^{-3}$	$k/\text{g cm}^{-3} \text{ }^\circ\text{C}^{-1}$	t_{\max}
Ag	Silver	961.78	9.320	0.0009	1500
AgBr	Silver(I) bromide	432	5.577	0.001035	667
AgCl	Silver(I) chloride	455	4.83	0.00094	627
AgI	Silver(I) iodide	558	5.58	0.00101	802
AgNO ₃	Silver(I) nitrate	212	3.970	0.001098	360
Ag ₂ SO ₄	Silver(I) sulfate	652	4.84	0.001089	770
Al	Aluminum	660.32	2.375	0.000233	1340
AlBr ₃	Aluminum bromide	97.5	2.647	0.002435	267
AlCl ₃	Aluminum chloride	192.6	1.302	0.002711	296
AlI ₃	Aluminum iodide	188.32	3.223	0.0025	240
As	Arsenic	817	5.22	0.000544	
Au	Gold	1064.18	17.31	0.001343	1200
B	Boron	2075	2.08		
Ba	Barium	727	3.338	0.000299	1550
BaBr ₂	Barium bromide	857	3.991	0.000924	900
BaCl ₂	Barium chloride	962	3.174	0.000681	1081
BaF ₂	Barium fluoride	1368	4.14	0.000999	1727
BaI ₂	Barium iodide	711	4.26	0.000977	975
Be	Beryllium	1287	1.690	0.00011	
BeCl ₂	Beryllium chloride	415	1.54	0.0011	473
BeF ₂	Beryllium fluoride	552	1.96	0.000015	850
Bi	Bismuth	271.40	10.05	0.00135	800
BiBr ₃	Bismuth bromide	218	4.76	0.002637	927
BiCl ₃	Bismuth chloride	230	3.916	0.0023	350
Ca	Calcium	842	1.378	0.000230	1484
CaBr ₂	Calcium bromide	742	3.111	0.0005	791
CaCl ₂	Calcium chloride	775	2.085	0.000422	950
CaF ₂	Calcium fluoride	1418	2.52	0.000391	2027
CaI ₂	Calcium iodide	783	3.443	0.000751	1028
Cd	Cadmium	321.07	7.996	0.001218	500
CdBr ₂	Cadmium bromide	568	4.075	0.00108	720
CdCl ₂	Cadmium chloride	564	3.392	0.00082	807
CdI ₂	Cadmium iodide	387	4.396	0.001117	700
Ce	Cerium	799	6.55	0.000710	1460
CeCl ₃	Cerium(III) chloride	817	3.25	0.00092	950
CeF ₃	Cerium(III) fluoride	1430	4.659	0.000936	1927
Co	Cobalt	1495	7.75	0.00165	1580
Cr	Chromium	1907	6.3	0.0011	2100
Cs	Cesium	28.44	1.843	0.000556	510
CsBr	Cesium bromide	636	3.133	0.001223	860
CsCl	Cesium chloride	645	2.79	0.001065	906
CsF	Cesium fluoride	703	3.649	0.001282	912
CsI	Cesium iodide	621	3.197	0.001183	907

DENSITY OF MOLTEN ELEMENTS AND REPRESENTATIVE SALTS (continued)

Formula	Name	$t_m/^\circ\text{C}$	$\rho_m/\text{g cm}^{-3}$	$k/\text{g cm}^{-3} \text{ }^\circ\text{C}^{-1}$	t_{max}
CsNO ₃	Cesium nitrate	414	2.820	0.001166	491
Cs ₂ SO ₄	Cesium sulfate	1005	3.1	0.00095	1530
Cu	Copper	1084.62	8.02	0.000609	1630
CuCl	Copper(I) chloride	430	3.692	0.00076	585
Dy	Dysprosium	1411	8.37	0.00143	1540
DyCl ₃	Dysprosium(III) chloride	680	3.62	0.00068	987
Er	Erbium	1529	8.86	0.00157	1700
Eu	Europium	822	5.13	0.0028	980
Fe	Iron	1538	6.98	0.000572	1680
FeCl ₂	Iron(II) chloride	677	2.348	0.000555	877
Ga	Gallium	29.76	6.08	0.00062	400
GaBr ₃	Gallium(III) bromide	121.5	3.116	0.00246	135
GaCl ₃	Gallium(III) chloride	77.9	2.053	0.002083	141
GaI ₃	Gallium(III) iodide	212	3.630	0.002377	252
Gd	Gadolinium	1314	7.4		
GdCl ₃	Gadolinium(III) chloride	609	3.56	0.000671	1007
GdI ₃	Gadolinium(III) iodide	925	4.12	0.000908	1032
Ge	Germanium	938.25	5.60	0.00055	1600
Hf	Hafnium	2233	12		
HgBr ₂	Mercury(II) bromide	236	5.126	0.003233	319
HgCl ₂	Mercury(II) chloride	276	4.368	0.002862	304
HgI ₂	Mercury(II) iodide	259	5.222	0.003235	354
Ho	Holmium	1472	8.34		
In	Indium	156.60	7.02	0.000836	500
InBr ₃	Indium(III) bromide	420	3.121	0.0015	528
InCl ₃	Indium(III) chloride	583	2.140	0.0021	666
InI ₃	Indium(III) iodide	207	3.820	0.0015	360
Ir	Iridium	2446	19		
K	Potassium	63.38	0.828	0.000232	500
KBr	Potassium bromide	734	2.127	0.000825	930
KCl	Potassium chloride	771	1.527	0.000583	939
KF	Potassium fluoride	858	1.910	0.000651	1037
KI	Potassium iodide	681	2.448	0.000956	904
KNO ₃	Potassium nitrate	337	1.865	0.000723	457
La	Lanthanum	920	5.94	0.00061	1600
LaBr ₃	Lanthanum bromide	788	4.933	0.000096	912
LaCl ₃	Lanthanum chloride	859	3.209	0.000777	973
LaF ₃	Lanthanum fluoride	1493	4.589	0.000682	2177
LaI ₃	Lanthanum iodide	778	4.29	0.001110	907
Li	Lithium	180.5	0.512	0.00052	285
LiBr	Lithium bromide	552	2.528	0.000652	739
LiCl	Lithium chloride	610	1.502	0.000432	781
LiF	Lithium fluoride	848.2	1.81	0.000490	1047
LiI	Lithium iodide	469	3.109	0.000917	667
LiNO ₃	Lithium nitrate	253	1.781	0.000546	441
Li ₂ SO ₄	Lithium sulfate	859	2.003	0.000407	1214
Lu	Lutetium	1663	9.3		
Mg	Magnesium	650	1.584	0.000234	900
MgBr ₂	Magnesium bromide	711	2.62	0.000478	935
MgCl ₂	Magnesium chloride	714	1.68	0.000271	826
MgI ₂	Magnesium iodide	634	3.05	0.000651	888
Mn	Manganese	1246	5.95	0.00105	1590
MnCl ₂	Manganese(II) chloride	650	2.353	0.000437	850
Mo	Molybdenum	2623	9.33		
Na	Sodium	97.80	0.927	0.00023	600
NaBr	Sodium bromide	747	2.342	0.000816	945
Na ₂ CO ₃	Sodium carbonate	858.1	1.972	0.000448	1004
NaCl	Sodium chloride	800.7	1.556	0.000543	1027
NaF	Sodium fluoride	996	1.948	0.000636	1097
NaI	Sodium iodide	660	2.742	0.000949	912

DENSITY OF MOLTEN ELEMENTS AND REPRESENTATIVE SALTS (continued)

Formula	Name	$t_m/^\circ\text{C}$	$\rho_m/\text{g cm}^{-3}$	$k/\text{g cm}^{-3} \text{ }^\circ\text{C}^{-1}$	t_{max}
NaNO ₃	Sodium nitrate	307	1.90	0.000715	370
Na ₂ SO ₄	Sodium sulfate	884	2.069	0.000483	1077
Nd	Neodymium	1016	6.89	0.00076	1350
Ni	Nickel	1455	7.81	0.000726	1700
NiCl ₂	Nickel(II) chloride	1009	2.653	0.00066	1057
Os	Osmium	3033	20		
Pb	Lead	327.46	10.66	0.00122	700
PbBr ₂	Lead(II) bromide	371	5.73	0.00165	600
PbCl ₂	Lead(II) chloride	501	4.951	0.0015	710
PbI ₂	Lead(II) iodide	410	5.691	0.001594	697
Pd	Palladium	1554.9	10.38	0.001169	1700
Pr	Praseodymium	931	6.50	0.00093	1460
PrCl ₃	Praseodymium chloride	786	3.23	0.00074	977
Pt	Platinum	1768.4	19.77	0.0024	2200
Pu	Plutonium	640	16.63	0.001419	950
Rb	Rubidium	39.31	1.46	0.000451	800
RbBr	Rubidium bromide	682	2.715	0.001072	907
Rb ₂ CO ₃	Rubidium carbonate	837	2.84	0.000640	1007
RbCl	Rubidium chloride	715	2.248	0.000883	923
RbF	Rubidium fluoride	833	2.87	0.00102	1067
RbI	Rubidium iodide	642	2.904	0.001143	902
RbNO ₃	Rubidium nitrate	305	2.519	0.001068	417
Rb ₂ SO ₄	Rubidium sulfate	1050	2.56	0.000665	1545
Re	Rhenium	3186	18.9		
Rh	Rhodium	1964	10.7	0.000895	2200
Ru	Ruthenium	2334	10.65		
S	Sulfur	115.21	1.819	0.00080	160
Sb	Antimony	630.63	6.53	0.00067	745
SbCl ₃	Antimony(III) chloride	73.4	2.681	0.002293	77
SbCl ₅	Antimony(V) chloride	4	2.37	0.001869	77
SbI ₃	Antimony(III) iodide	168	4.171	0.002483	322
Sc	Scandium	1541	2.80		
Se	Selenium	221	3.99		
Si	Silicon	1414	2.57	0.000936	1500
Sm	Samarium	1072	7.16		
Sn	Tin	231.93	6.99	0.000601	1200
SnCl ₂	Tin(II) chloride	247	3.36	0.001253	480
SnCl ₄	Tin(IV) chloride	-33	2.37	0.002687	138
Sr	Strontium	777	6.980		
SrBr ₂	Strontium bromide	657	3.70	0.000745	1004
SrCl ₂	Strontium chloride	874	2.727	0.000578	1037
SrF ₂	Strontium fluoride	1477	3.470	0.000751	1927
SrI ₂	Strontium iodide	538	4.085	0.000885	1026
Ta	Tantalum	3017	15		
TaCl ₅	Tantalum(V) chloride	216	2.700	0.004316	457
Tb	Terbium	1359	7.65		
Te	Tellurium	449.51	5.70	0.00035	600
ThCl ₄	Thorium chloride	770	3.363	0.0014	847
ThF ₄	Thorium fluoride	1110	6.058	0.000759	1378
Ti	Titanium	1668	4.11		
TiCl ₄	Titanium(IV) chloride	-25	1.807	0.001735	137
Tl	Thallium	304	11.22	0.00144	600
TlBr	Thallium(I) bromide	460	5.98	0.001755	647
TlCl	Thallium(I) chloride	430	5.628	0.0018	642
TlI	Thallium(I) iodide	441.8	6.15	0.001761	737
TlNO ₃	Thallium(I) nitrate	206	4.91	0.001873	279
Tl ₂ SO ₄	Thallium(I) sulfate	632	5.62	0.00130	927
Tm	Thulium	1545	8.56	0.00050	1675
U	Uranium	1135	17.3		
UCl ₃	Uranium(III) chloride	837	4.84	0.007943	1057

DENSITY OF MOLTEN ELEMENTS AND REPRESENTATIVE SALTS (continued)

Formula	Name	$t_m/^\circ\text{C}$	$\rho_m/\text{g cm}^{-3}$	$k/\text{g cm}^{-3} \text{ }^\circ\text{C}^{-1}$	t_{max}
UCl ₄	Uranium(IV) chloride	590	3.572	0.001945	667
UF ₄	Uranium(IV) fluoride	1036	6.485	0.000992	1341
V	Vanadium	1910	5.5		
W	Tungsten	3422	17.6		
Y	Yttrium	1526	4.24		
YCl ₃	Yttrium chloride	721	2.510	0.0005	845
Yb	Ytterbium	824	6.21		
Zn	Zinc	419.53	6.57	0.0011	700
ZnBr ₂	Zinc bromide	394	3.47	0.000959	602
ZnCl ₂	Zinc chloride	290	2.54	0.00053	557
ZnI ₂	Zinc iodide	446	3.878	0.00136	588
ZnSO ₄	Zinc sulfate	680	3.14	0.00047	987
Zr	Zirconium	1855	5.8		
ZrCl ₄	Zirconium chloride	437	1.643	0.007464	492

MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS AND INORGANIC COMPOUNDS

When a material is placed in a magnetic field H , a magnetization (magnetic moment per unit volume) M is induced in the material which is related to H by $M = \kappa H$, where κ is called the volume susceptibility. Since H and M have the same dimensions, κ is dimensionless. A more useful parameter is the molar susceptibility χ_m , defined by

$$\chi_m = \kappa V_m = \kappa M/\rho$$

where V_m is the molar volume of the substance, M the molar mass, and ρ the mass density. When the cgs system is used, the customary units for χ_m are $\text{cm}^3 \text{mol}^{-1}$; the corresponding SI units are $\text{m}^3 \text{mol}^{-1}$.

Substances that have no unpaired electron orbital or spin angular momentum generally have negative values of χ_m and are called diamagnetic. Their molar susceptibility varies only slightly with temperature. Substances with unpaired electrons, which are termed paramagnetic, have positive χ_m and show a much stronger temperature dependence, varying roughly as $1/T$. The net susceptibility of a paramagnetic substance is the sum of the paramagnetic and diamagnetic contributions, but the former almost always dominates.

This table gives values of χ_m for the elements and selected inorganic compounds. All values refer to nominal room temperature (285 to 300 K) unless otherwise indicated. When the physical state (s = solid, l = liquid, g = gas, aq = aqueous solution) is not given, the most common crystalline form is understood. An entry of "Ferro," indicates a ferromagnetic substance.

Substances are arranged in alphabetical order by the most common name, except that compounds such as hydrides, oxides, and acids are grouped with the parent element (the same ordering used in the table "Physical Constants of Inorganic Compounds").

In keeping with customary practice, the molar susceptibility is given here in units appropriate to the cgs system. These values should be multiplied by 4π to obtain values for use in SI equations (where the magnetic field strength H has units of A m^{-1}).

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Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
Aluminum	Al	+16.5	Arsenic (yellow)	As	-23.2
Aluminum trifluoride	AlF ₃	-13.9	Arsine (g)	AsH ₃	-35.2
Aluminum oxide	Al ₂ O ₃	-37	Arsenic(III) bromide	AsBr ₃	-106
Aluminum sulfate	Al ₂ (SO ₄) ₃	-93	Arsenic(III) chloride	AsCl ₃	-72.5
Ammonia (g)	NH ₃	-16.3	Arsenic(III) iodide	AsI ₃	-142.2
Ammonia (aq)	NH ₃	-18.3	Arsenic(III) oxide	As ₂ O ₃	-30.34
Ammonium acetate	NH ₄ C ₂ H ₃ O ₂	-41.1	Arsenic(III) sulfide	As ₂ S ₃	-70
Ammonium bromide	NH ₄ Br	-47	Barium	Ba	+20.6
Ammonium carbonate	(NH ₄) ₂ CO ₃	-42.5	Barium bromide	BaBr ₂	-92
Ammonium chlorate	NH ₄ ClO ₃	-42.1	Barium bromide dihydrate	BaBr ₂ ·2H ₂ O	-119.3
Ammonium chloride	NH ₄ Cl	-36.7	Barium carbonate	BaCO ₃	-58.9
Ammonium fluoride	NH ₄ F	-23	Barium chloride	BaCl ₂	-72.6
Ammonium iodate	NH ₄ IO ₃	-62.3	Barium chloride dihydrate	BaCl ₂ ·2H ₂ O	-100
Ammonium iodide	NH ₄ I	-66	Barium fluoride	BaF ₂	-51
Ammonium nitrate	NH ₄ NO ₃	-33	Barium hydroxide	Ba(OH) ₂	-53.2
Ammonium sulfate	(NH ₄) ₂ SO ₄	-67	Barium iodate	Ba(IO ₃) ₂	-122.5
Ammonium thiocyanate	NH ₄ SCN	-48.1	Barium iodide	BaI ₂	-124.4
Antimony	Sb	-99	Barium iodide dihydrate	BaI ₂ ·2H ₂ O	-163
Stibine (g)	SbH ₃	-34.6	Barium nitrate	Ba(NO ₃) ₂	-66.5
Antimony(III) bromide	SbBr ₃	-111.4	Barium oxide	BaO	-29.1
Antimony(III) chloride	SbCl ₃	-86.7	Barium peroxide	BaO ₂	-40.6
Antimony(III) fluoride	SbF ₃	-46	Barium sulfate	BaSO ₄	-65.8
Antimony(III) iodide	SbI ₃	-147.2	Beryllium	Be	-9.0
Antimony(III) oxide	Sb ₂ O ₃	-69.4	Beryllium chloride	BeCl ₂	-26.5
Antimony(III) sulfide	Sb ₂ S ₃	-86	Beryllium hydroxide	Be(OH) ₂	-23.1
Antimony(V) chloride	SbCl ₅	-120.5	Beryllium oxide	BeO	-11.9
Argon (g)	Ar	-19.32	Beryllium sulfate	BeSO ₄	-37
Arsenic (gray)	As	-5.6	Bismuth	Bi	-280.1

MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS AND INORGANIC COMPOUNDS (continued)

Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
Bismuth tribromide	BiBr ₃	-147	Cesium	Cs	+29
Bismuth trichloride	BiCl ₃	-26.5	Cesium bromate	CsBrO ₃	-75.1
Bismuth fluoride	BiF ₃	-61.2	Cesium bromide	CsBr	-67.2
Bismuth hydroxide	Bi(OH) ₃	-65.8	Cesium carbonate	Cs ₂ CO ₃	-103.6
Bismuth triiodide	BiI ₃	-200.5	Cesium chlorate	CsClO ₃	-65
Bismuth nitrate pentahydrate	Bi(NO ₃) ₃ ·5H ₂ O	-159	Cesium chloride	CsCl	-56.7
Bismuth oxide	Bi ₂ O ₃	-83	Cesium fluoride	CsF	-44.5
Bismuth phosphate	BiPO ₄	-77	Cesium iodide	CsI	-82.6
Bismuth sulfate	Bi ₂ (SO ₄) ₃	-199	Cesium superoxide	CsO ₂	+1534
Bismuth sulfide	Bi ₂ S ₃	-123	Cesium sulfate	Cs ₂ SO ₄	-116
Boron	B	-6.7	Chlorine (l)	Cl ₂	-40.4
Diborane (g)	B ₂ H ₆	-21.0	Chlorine trifluoride (g)	ClF ₃	-26.5
Boric acid (orthoboric acid)	H ₃ BO ₃	-34.1	Chromium	Cr	+167
Boron trichloride	BCl ₃	-59.9	Chromium(II) chloride	CrCl ₂	+7230
Boron oxide	B ₂ O ₃	-38.7	Chromium(III) chloride	CrCl ₃	+6350
Bromine (l)	Br ₂	-56.4	Chromium(III) fluoride	CrF ₃	+4370
Bromine (g)	Br ₂	-73.5	Chromium(III) oxide	Cr ₂ O ₃	+1960
Bromine trifluoride	BrF ₃	-33.9	Chromium(III) sulfate	Cr ₂ (SO ₄) ₃	+11800
Bromine pentafluoride	BrF ₅	-45.1	Chromium(VI) oxide	CrO ₃	+40
Cadmium	Cd	-19.7	Cobalt	Co	Ferro.
Cadmium bromide	CdBr ₂	-87.3	Cobalt(II) bromide	CoBr ₂	+13000
Cadmium bromide tetrahydrate	CdBr ₂ ·4H ₂ O	-131.5	Cobalt(II) chloride	CoCl ₂	+12660
Cadmium carbonate	CdCO ₃	-46.7	Cobalt(II) chloride hexahydrate	CoCl ₂ ·6H ₂ O	+9710
Cadmium chloride	CdCl ₂	-68.7	Cobalt(II) cyanide	Co(CN) ₂	+3825
Cadmium chromate	CdCrO ₄	-16.8	Cobalt(II) fluoride	CoF ₂	+9490
Cadmium cyanide	Cd(CN) ₂	-54	Cobalt(II) iodide	CoI ₂	+10760
Cadmium fluoride	CdF ₂	-40.6	Cobalt(II) sulfate	CoSO ₄	+10000
Cadmium hydroxide	Cd(OH) ₂	-41	Cobalt(II) sulfide	CoS	+225
Cadmium iodate	Cd(IO ₃) ₂	-108.4	Cobalt(II,III) oxide	Co ₃ O ₄	+7380
Cadmium iodide	CdI ₂	-117.2	Cobalt(III) fluoride	CoF ₃	+1900
Cadmium nitrate	Cd(NO ₃) ₂	-55.1	Cobalt(III) oxide	Co ₂ O ₃	+4560
Cadmium nitrate tetrahydrate	Cd(NO ₃) ₂ ·4H ₂ O	-140	Copper	Cu	-5.46
Cadmium oxide	CdO	-30	Copper(I) bromide	CuBr	-49
Cadmium sulfate	CdSO ₄	-59.2	Copper(I) chloride	CuCl	-40
Cadmium sulfide	CdS	-50	Copper(I) cyanide	CuCN	-24
Calcium	Ca	+40	Copper(I) iodide	CuI	-63
Calcium bromide	CaBr ₂	-73.8	Copper(I) oxide	Cu ₂ O	-20
Calcium carbonate	CaCO ₃	-38.2	Copper(II) bromide	CuBr ₂	+685
Calcium chloride	CaCl ₂	-54.7	Copper(II) chloride	CuCl ₂	+1080
Calcium fluoride	CaF ₂	-28	Copper(II) chloride dihydrate	CuCl ₂ ·2H ₂ O	+1420
Calcium hydroxide	Ca(OH) ₂	-22	Copper(II) fluoride	CuF ₂	+1050
Calcium iodate	Ca(IO ₃) ₂	-101.4	Copper(II) fluoride dihydrate	CuF ₂ ·2H ₂ O	+1600
Calcium iodide	CaI ₂	-109	Copper(II) hydroxide	Cu(OH) ₂	+1170
Calcium oxide	CaO	-15.0	Copper(II) nitrate trihydrate	Cu(NO ₃) ₂ ·3H ₂ O	+1570
Calcium sulfate	CaSO ₄	-49.7	Copper(II) nitrate hexahydrate	Cu(NO ₃) ₂ ·6H ₂ O	+1625
Calcium sulfate dihydrate	CaSO ₄ ·2H ₂ O	-74	Copper(II) oxide	CuO	+238
Carbon (diamond)	C	-5.9	Copper(II) sulfate	CuSO ₄	+1330
Carbon (graphite)	C	-6.0	Copper(II) sulfate pentahydrate	CuSO ₄ ·5H ₂ O	+1460
Carbon monoxide (g)	CO	-9.8	Copper(II) sulfide	CuS	-2.0
Carbon dioxide (g)	CO ₂	-21.0	Dysprosium (α)	Dy	+98000
Cerium (β)	Ce	+2500	Dysprosium(III) oxide	Dy ₂ O ₃	+89600
Cerium(II) sulfide	CeS	+2110	Dysprosium(III) sulfide	Dy ₂ S ₃	+95200
Cerium(III) chloride	CeCl ₃	+2490	Erbium	Er	+48000
Cerium(III) fluoride	CeF ₃	+2190	Erbium oxide	Er ₂ O ₃	+73920
Cerium(III) sulfide	Ce ₂ S ₃	+5080	Erbium sulfate octahydrate	Er ₂ (SO ₄) ₃ ·8H ₂ O	+74600
Cerium(IV) oxide	CeO ₂	+26	Erbium sulfide	Er ₂ S ₃	+77200
Cerium(IV) sulfate tetrahydrate	Ce(SO ₄) ₂ ·4H ₂ O	-97			

MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS AND INORGANIC COMPOUNDS (continued)

Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
Europium	Eu	+30900	Iodic acid	HIO ₃	-48
Europium(II) bromide	EuBr ₂	+26800	Iodine pentoxide	I ₂ O ₅	-79.4
Europium(II) chloride	EuCl ₂	+26500	Iodine chloride	ICl	-54.6
Europium(II) fluoride	EuF ₂	+23750	Iodine trichloride	ICl ₃	-90.2
Europium(II) iodide	EuI ₂	+26000	Iodine pentafluoride	IF ₅	-58.1
Europium(II) sulfide	EuS	+23800	Iridium	Ir	+25
Europium(III) oxide	Eu ₂ O ₃	+10100	Iridium(III) chloride	IrCl ₃	-14.4
Europium(III) sulfate	Eu ₂ (SO ₄) ₃	+10400	Iridium(IV) oxide	IrO ₂	+224
Gadolinium (350 K)	Gd	+185000	Iron	Fe	Ferro.
Gadolinium(III) chloride	GdCl ₃	+27930	Iron(II) bromide	FeBr ₂	+13600
Gadolinium(III) oxide	Gd ₂ O ₃	+53200	Iron(II) carbonate	FeCO ₃	+11300
Gadolinium(III) sulfate octahydrate	Gd ₂ (SO ₄) ₃ ·8H ₂ O	+53280	Iron(II) chloride	FeCl ₂	+14750
Gadolinium(III) sulfide	Gd ₂ S ₃	+55500	Iron(II) chloride tetrahydrate	FeCl ₂ ·4H ₂ O	+12900
Gallium	Ga	-21.6	Iron(II) fluoride	FeF ₂	+9500
Gallium suboxide	Ga ₂ O	-34	Iron(II) iodide	FeI ₂	+13600
Gallium(II) sulfide	GaS	-23	Iron(II) oxide	FeO	+7200
Gallium(III) chloride	GaCl ₃	-63	Iron(II) sulfate	FeSO ₄	+12400
Gallium(III) sulfide	Ga ₂ S ₃	-80	Iron(II) sulfate monohydrate	FeSO ₄ ·H ₂ O	+10500
Germanium	Ge	-11.6	Iron(II) sulfate heptahydrate	FeSO ₄ ·7H ₂ O	+11200
Germane (g)	GeH ₄	-29.7	Iron(II) sulfide	FeS	+1074
Germanium(II) oxide	GeO	-28.8	Iron(III) chloride	FeCl ₃	+13450
Germanium(II) sulfide	GeS	-40.9	Iron(III) chloride hexahydrate	FeCl ₃ ·6H ₂ O	+15250
Germanium(IV) chloride	GeCl ₄	-72	Iron(III) fluoride	FeF ₃	+13760
Germanium(IV) fluoride	GeF ₄	-50	Iron(III) fluoride trihydrate	FeF ₃ ·3H ₂ O	+7870
Germanium(IV) iodide	GeI ₄	-171	Iron(III) nitrate nonahydrate	Fe(NO ₃) ₃ ·9H ₂ O	+15200
Germanium(IV) oxide	GeO ₂	-34.3	Krypton (g)	Kr	-29.0
Germanium(IV) sulfide	GeS ₂	-53.9	Lanthanum (α)	La	+95.9
Gold	Au	-28	Lanthanum oxide	La ₂ O ₃	-78
Gold(I) bromide	AuBr	-61	Lanthanum sulfate nonahydrate	La ₂ (SO ₄) ₃ ·9H ₂ O	-262
Gold(I) chloride	AuCl	-67	Lanthanum sulfide	La ₂ S ₃	-37
Gold(I) iodide	AuI	-91	Lead	Pb	-23
Gold(III) chloride	AuCl ₃	-112	Lead(II) acetate	Pb(C ₂ H ₃ O ₂) ₂	-89.1
Hafnium	Hf	+71	Lead(II) bromide	PbBr ₂	-90.6
Hafnium oxide	HfO ₂	-23	Lead(II) carbonate	PbCO ₃	-61.2
Helium (g)	He	-2.02	Lead(II) chloride	PbCl ₂	-73.8
Holmium	Ho	+72900	Lead(II) chromate	PbCrO ₄	-18
Holmium oxide	Ho ₂ O ₃	+88100	Lead(II) fluoride	PbF ₂	-58.1
Hydrazine (l)	N ₂ H ₄	-201	Lead(II) iodate	Pb(IO ₃) ₂	-131
Hydrogen (l, 20.3 K)	H ₂	-5.44	Lead(II) iodide	PbI ₂	-126.5
Hydrogen (g)	H ₂	-3.99	Lead(II) nitrate	Pb(NO ₃) ₂	-74
Hydrogen chloride (l)	HCl	-22.6	Lead(II) oxide	PbO	-42
Hydrogen chloride (aq)	HCl	-22	Lead(II) phosphate	Pb ₃ (PO ₄) ₂	-182
Hydrogen fluoride (l)	HF	-8.6	Lead(II) sulfate	PbSO ₄	-69.7
Hydrogen fluoride (aq)	HF	-9.3	Lead(II) sulfide	PbS	-83.6
Hydrogen iodide (s, 195 K)	HI	-47.3	Lithium	Li	+14.2
Hydrogen iodide (l, 233 K)	HI	-48.3	Lithium bromide	LiBr	-34.3
Hydrogen iodide (aq)	HI	-50.2	Lithium carbonate	Li ₂ CO ₃	-27
Hydrogen peroxide (l)	H ₂ O ₂	-17.3	Lithium chloride	LiCl	-24.3
Hydrogen sulfide (g)	H ₂ S	-25.5	Lithium fluoride	LiF	-10.1
Indium	In	-10.2	Lithium hydride	LiH	-4.6
Indium(I) chloride	InCl	-30	Lithium hydroxide (aq)	LiOH	-12.3
Indium(II) chloride	InCl ₂	-56	Lithium iodide	LiI	-50
Indium(II) sulfide	InS	-28	Lithium sulfate	Li ₂ SO ₄	-41.6
Indium(III) bromide	InBr ₃	-107	Lutetium	Lu	+182.9
Indium(III) chloride	InCl ₃	-86	Magnesium	Mg	+13.1
Indium(III) oxide	In ₂ O ₃	-56	Magnesium bromide	MgBr ₂	-72
Indium(III) sulfide	In ₂ S ₃	-98	Magnesium carbonate	MgCO ₃	-32.4
Iodine	I ₂	-90	Magnesium chloride	MgCl ₂	-47.4

MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS AND INORGANIC COMPOUNDS (continued)

Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
Magnesium fluoride	MgF ₂	-22.7	Molybdenum(VI) fluoride	MoF ₆	-26.0
Magnesium hydroxide	Mg(OH) ₂	-22.1	Molybdenum(VI) oxide	MoO ₃	+3
Magnesium iodide	MgI ₂	-111	Neodymium (α)	Nd	+5930
Magnesium oxide	MgO	-10.2	Neodymium fluoride	NdF ₃	+4980
Magnesium sulfate	MgSO ₄	-42	Neodymium oxide	Nd ₂ O ₃	+10200
Magnesium sulfate monohydrate	MgSO ₄ ·H ₂ O	-61	Neodymium sulfate	Nd ₂ (SO ₄) ₃	+9990
Magnesium sulfate heptahydrate	MgSO ₄ ·7H ₂ O	-135.7	Neodymium sulfide	Nd ₂ S ₃	+5550
Manganese	Mn	+511	Neon (g)	Ne	-6.96
Manganese(II) bromide	MnBr ₂	+13900	Neptunium	Np	+575
Manganese(II) carbonate	MnCO ₃	+11400	Nickel	Ni	Ferro.
Manganese(II) chloride	MnCl ₂	+14350	Nickel(II) bromide	NiBr ₂	+5600
Manganese(II) chloride tetrahydrate	MnCl ₂ ·4H ₂ O	+14600	Nickel(II) chloride	NiCl ₂	+6145
Manganese(II) fluoride	MnF ₂	+10700	Nickel(II) chloride hexahydrate	NiCl ₂ ·6H ₂ O	+4240
Manganese(II) hydroxide	Mn(OH) ₂	+13500	Nickel(II) fluoride	NiF ₂	+2410
Manganese(II) iodide	MnI ₂	+14400	Nickel(II) hydroxide	Ni(OH) ₂	+4500
Manganese(II) oxide	MnO	+4850	Nickel(II) iodide	NiI ₂	+3875
Manganese(II) sulfate	MnSO ₄	+13660	Nickel(II) nitrate hexahydrate	Ni(NO ₃) ₂ ·6H ₂ O	+4300
Manganese(II) sulfate monohydrate	MnSO ₄ ·H ₂ O	+14200	Nickel(II) oxide	NiO	+660
Manganese(II) sulfate tetrahydrate	MnSO ₄ ·4H ₂ O	+14600	Nickel(II) sulfate	NiSO ₄	+4005
Manganese(II) sulfide (α form)	MnS	+5630	Nickel(II) sulfide	NiS	+190
Manganese(II) sulfide (β form)	MnS	+3850	Nickel(III) sulfide	Ni ₃ S ₂	+1030
Manganese(II,III) oxide	Mn ₃ O ₄	+12400	Niobium	Nb	+208
Manganese(III) fluoride	MnF ₃	+10500	Niobium(V) oxide	Nb ₂ O ₅	-10
Manganese(III) oxide	Mn ₂ O ₃	+14100	Nitrogen (g)	N ₂	-12.0
Manganese(IV) oxide	MnO ₂	+2280	Nitric acid (l)	HNO ₃	-19.9
Mercury (s, 234 K)	Hg	-24.1	Nitrous oxide (g)	N ₂ O	-18.9
Mercury (l)	Hg	-33.5	Nitric oxide (s, 90 K)	NO	+19.8
Mercury(I) bromide	Hg ₂ Br ₂	-105	Nitric oxide (l, 118 K)	NO	+114.2
Mercury(I) chloride	Hg ₂ Cl ₂	-120	Nitric oxide (g)	NO	+1461
Mercury(I) fluoride	Hg ₂ F ₂	-106	Nitrogen dioxide (g, 408 K)	NO ₂	+150
Mercury(I) iodide	Hg ₂ I ₂	-166	Nitrogen trioxide (g)	N ₂ O ₃	-16
Mercury(I) nitrate	Hg ₂ (NO ₃) ₂	-121	Nitrogen tetroxide (g)	N ₂ O ₄	-23.0
Mercury(I) oxide	Hg ₂ O	-76.3	Osmium	Os	+11
Mercury(I) sulfate	Hg ₂ SO ₄	-123	Oxygen (s, 54 K)	O ₂	+10200
Mercury(II) bromide	HgBr ₂	-94.2	Oxygen (l, 90 K)	O ₂	+7699
Mercury(II) chloride	HgCl ₂	-82	Oxygen (g)	O ₂	+3449
Mercury(II) cyanide	Hg(CN) ₂	-67	Ozone (l)	O ₃	+6.7
Mercury(II) fluoride	HgF ₂	-57.3	Palladium	Pd	+540
Mercury(II) iodide	HgI ₂	-165	Palladium(II) chloride	PdCl ₂	-38
Mercury(II) nitrate	Hg(NO ₃) ₂	-74	Phosphorus (white)	P	-26.66
Mercury(II) oxide	HgO	-46	Phosphorus (red)	P	-20.77
Mercury(II) sulfate	HgSO ₄	-78.1	Phosphine (g)	PH ₃	-26.2
Mercury(II) sulfide	HgS	-55.4	Phosphoric acid (aq)	H ₃ PO ₄	-43.8
Mercury(II) thiocyanate	Hg(SCN) ₂	-96.5	Phosphorous acid (aq)	H ₃ PO ₃	-42.5
Molybdenum	Mo	+72	Phosphorus(III) chloride (l)	PCl ₃	-63.4
Molybdenum(III) bromide	MoBr ₃	+525	Platinum	Pt	+193
Molybdenum(III) chloride	MoCl ₃	+43	Platinum(II) chloride	PtCl ₂	-54
Molybdenum(III) oxide	Mo ₂ O ₃	-42.0	Platinum(III) chloride	PtCl ₃	-66.7
Molybdenum(IV) bromide	MoBr ₄	+520	Platinum(IV) chloride	PtCl ₄	-93
Molybdenum(IV) chloride	MoCl ₄	+1750	Platinum(IV) fluoride	PtF ₄	+445
Molybdenum(IV) oxide	MoO ₂	+41	Plutonium	Pu	+525
Molybdenum(V) chloride	MoCl ₅	+990	Plutonium(IV) fluoride	PuF ₄	+1760
			Plutonium(IV) oxide	PuO ₂	+730
			Plutonium(VI) fluoride	PuF ₆	+173
			Potassium	K	+20.8
			Potassium bromate	KBrO ₃	-52.6
			Potassium bromide	KBr	-49.1
			Potassium carbonate	K ₂ CO ₃	-59

MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS AND INORGANIC COMPOUNDS (continued)

Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
Potassium chlorate	KClO ₃	-42.8	Silane (g)	SiH ₄	-20.4
Potassium chloride	KCl	-38.8	Disilane (g)	Si ₂ H ₆	-37.3
Potassium chromate	K ₂ CrO ₄	-3.9	Tetramethylsilane (l)	(CH ₃) ₄ Si	-74.80
Potassium cyanide	KCN	-37	Tetraethylsilane (l)	(C ₂ H ₅) ₄ Si	-120.2
Potassium ferricyanide	K ₃ Fe(CN) ₆	+2290	Tetrabromosilane (l)	SiBr ₄	-126
Potassium ferrocyanide trihydrate	K ₄ Fe(CN) ₆ ·3H ₂ O	-172.3	Tetrachlorosilane (l)	SiCl ₄	-87.5
Potassium fluoride	KF	-23.6	Silicon carbide	SiC	-12.8
Potassium hydrogen sulfate	KHSO ₄	-49.8	Silicon dioxide	SiO ₂	-29.6
Potassium hydroxide (aq)	KOH	-22	Silver	Ag	-19.5
Potassium iodate	KIO ₃	-63.1	Silver(I) bromide	AgBr	-61
Potassium iodide	KI	-63.8	Silver(I) carbonate	Ag ₂ CO ₃	-80.90
Potassium nitrate	KNO ₃	-33.7	Silver(I) chloride	AgCl	-49
Potassium nitrite	KNO ₂	-23.3	Silver(I) chromate	Ag ₂ CrO ₄	-40
Potassium permanganate	KMnO ₄	+20	Silver(I) cyanide	AgCN	-43.2
Potassium sulfate	K ₂ SO ₄	-67	Silver(I) fluoride	AgF	-36.5
Potassium sulfide	K ₂ S	-60	Silver(I) iodide	AgI	-80
Potassium superoxide	KO ₂	+3230	Silver(I) nitrate	AgNO ₃	-45.7
Potassium thiocyanate	KSCN	-48	Silver(I) nitrite	AgNO ₂	-42
Praseodymium (α)	Pr	+5530	Silver(I) oxide	Ag ₂ O	-134
Praseodymium chloride	PrCl ₃	+44.5	Silver(I) phosphate	Ag ₃ PO ₄	-120
Praseodymium oxide	Pr ₂ O ₃	+8994	Silver(I) sulfate	Ag ₂ SO ₄	-92.90
Praseodymium sulfide	Pr ₂ S ₃	+10770	Silver(I) thiocyanate	AgSCN	-61.8
Protactinium	Pa	+277	Silver(II) oxide	AgO	-19.6
Rhenium	Re	+67	Sodium	Na	+16
Rhenium(IV) oxide	ReO ₂	+44	Sodium acetate	NaC ₂ H ₃ O ₂	-37.6
Rhenium(IV) sulfide	ReS ₂	+38	Sodium bromate	NaBrO ₃	-44.2
Rhenium(V) chloride	ReCl ₅	+1225	Sodium bromide	NaBr	-41
Rhenium(VI) oxide	ReO ₃	+16	Sodium carbonate	Na ₂ CO ₃	-41
Rhenium(VII) oxide	Re ₂ O ₇	-16	Sodium chlorate	NaClO ₃	-34.7
Rhodium	Rh	+102	Sodium chloride	NaCl	-30.2
Rhodium(III) chloride	RhCl ₃	-7.5	Sodium dichromate	Na ₂ Cr ₂ O ₇	+55
Rhodium(III) oxide	Rh ₂ O ₃	+104	Sodium fluoride	NaF	-15.6
Rubidium	Rb	+17	Sodium hydrogen phosphate	Na ₂ HPO ₄	-56.6
Rubidium bromide	RbBr	-56.4	Sodium hydroxide (aq)	NaOH	-15.8
Rubidium carbonate	Rb ₂ CO ₃	-75.4	Sodium iodate	NaIO ₃	-53
Rubidium chloride	RbCl	-46	Sodium iodide	NaI	-57
Rubidium fluoride	RbF	-31.9	Sodium nitrate	NaNO ₃	-25.6
Rubidium iodide	RbI	-72.2	Sodium nitrite	NaNO ₂	-14.5
Rubidium nitrate	RbNO ₃	-41	Sodium oxide	Na ₂ O	-19.8
Rubidium sulfate	Rb ₂ SO ₄	-88.4	Sodium peroxide	Na ₂ O ₂	-28.10
Rubidium superoxide	RbO ₂	+1527	Sodium sulfate	Na ₂ SO ₄	-52
Ruthenium	Ru	+39	Sodium sulfate decahydrate	Na ₂ SO ₄ ·10H ₂ O	-184
Ruthenium(III) chloride	RuCl ₃	+1998	Sodium sulfide	Na ₂ S	-39
Ruthenium(IV) oxide	RuO ₂	+162	Sodium tetraborate	Na ₂ B ₄ O ₇	-85
Samarium (α)	Sm	+1278	Strontium	Sr	+92
Samarium(II) bromide	SmBr ₂	+5337	Strontium bromide	SrBr ₂	-86.6
Samarium(III) bromide	SmBr ₃	+972	Strontium bromide hexahydrate	SrBr ₂ ·6H ₂ O	-160
Samarium(III) oxide	Sm ₂ O ₃	+1988	Strontium carbonate	SrCO ₃	-47
Samarium(III) sulfate octahydrate	Sm ₂ (SO ₄) ₃ ·8H ₂ O	+1710	Strontium chlorate	Sr(ClO ₃) ₂	-73
Samarium(III) sulfide	Sm ₂ S ₃	+3300	Strontium chloride	SrCl ₂	-61.5
Scandium (α)	Sc	+295.2	Strontium chloride hexahydrate	SrCl ₂ ·6H ₂ O	-145
Selenium	Se	-25	Strontium chromate	SrCrO ₄	-5.1
Selenium dioxide	SeO ₂	-27.2	Strontium fluoride	SrF ₂	-37.2
Selenium bromide	Se ₂ Br ₂	-113	Strontium hydroxide	Sr(OH) ₂	-40
Selenium chloride (l)	Se ₂ Cl ₂	-94.8	Strontium iodate	Sr(IO ₃) ₂	-108
Selenium hexafluoride (g)	SeF ₆	-51	Strontium iodide	SrI ₂	-112
Silicon	Si	-3.12	Strontium nitrate	Sr(NO ₃) ₂	-57.2

MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS AND INORGANIC COMPOUNDS (continued)

Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$	Name	Formula	$\chi_m/10^{-6} \text{ cm}^3 \text{ mol}^{-1}$
Strontium oxide	SrO	-35	Tungsten	W	+53
Strontium peroxide	SrO ₂	-32.3	Tungsten carbide	WC	+10
Strontium sulfate	SrSO ₄	-57.9	Tungsten(II) chloride	WCl ₂	-25
Sulfur (rhombic)	S	-15.5	Tungsten(IV) oxide	WO ₂	+57
Sulfur (monoclinic)	S	-14.9	Tungsten(IV) sulfide	WS ₂	+5850
Sulfuric acid (l)	H ₂ SO ₄	-39	Tungsten(V) bromide	WBr ₅	+270
Sulfur dioxide (g)	SO ₂	-18.2	Tungsten(V) chloride	WCl ₅	+387
Sulfur trioxide (l)	SO ₃	-28.54	Tungsten(VI) chloride	WCl ₆	-71
Sulfur chloride (l)	SSCl ₂	-62.2	Tungsten(VI) fluoride (g)	WF ₆	-53
Sulfur dichloride (l)	SCl ₂	-49.4	Tungsten(VI) oxide	WO ₃	-15.8
Sulfur hexafluoride (g)	SF ₆	-44	Uranium	U	+409
Thionyl chloride (l)	SOCl ₂	-44.3	Uranium(III) bromide	UBr ₃	+4740
Tantalum	Ta	+154	Uranium(III) chloride	UCl ₃	+3460
Tantalum(V) chloride	TaCl ₅	+140	Uranium(III) hydride	UH ₃	+6244
Tantalum(V) oxide	Ta ₂ O ₅	-32	Uranium(III) iodide	UI ₃	+4460
Technetium	Tc	+115	Uranium(IV) bromide	UBr ₄	+3530
Tellurium	Te	-38	Uranium(IV) chloride	UCl ₄	+3680
Tellurium dibromide	TeBr ₂	-106	Uranium(IV) fluoride	UF ₄	+3530
Tellurium dichloride	TeCl ₂	-94	Uranium(IV) oxide	UO ₂	+2360
Tellurium hexafluoride (g)	TeF ₆	-66	Uranium(VI) fluoride	UF ₆	+43
Terbium (α)	Tb	+170000	Uranium(VI) oxide	UO ₃	+128
Terbium oxide	Tb ₂ O ₃	+78340	Vanadium	V	+285
Thallium	Tl	-50	Vanadium(II) bromide	VBr ₂	+3230
Thallium(I) bromate	TlBrO ₃	-75.9	Vanadium(II) chloride	VCl ₂	+2410
Thallium(I) bromide	TlBr	-63.9	Vanadium(III) bromide	VBr ₃	+2910
Thallium(I) carbonate	Tl ₂ CO ₃	-101.6	Vanadium(III) chloride	VCl ₃	+3030
Thallium(I) chlorate	TlClO ₃	-65.5	Vanadium(III) fluoride	VF ₃	+2757
Thallium(I) chloride	TlCl	-57.8	Vanadium(III) oxide	V ₂ O ₃	+1976
Thallium(I) chromate	Tl ₂ CrO ₄	-39.3	Vanadium(III) sulfide	V ₂ S ₃	+1560
Thallium(I) cyanide	TlCN	-49	Vanadium(IV) chloride	VCl ₄	+1215
Thallium(I) fluoride	TlF	-44.4	Vanadium(IV) oxide	VO ₂	+99
Thallium(I) iodate	TlIO ₃	-86.8	Vanadium(V) oxide	V ₂ O ₅	+128
Thallium(I) iodide	TlI	-82.2	Water (s, 273 K)	H ₂ O	-12.63
Thallium(I) nitrate	TlNO ₃	-56.5	Water (l, 293 K)	H ₂ O	-12.96
Thallium(I) nitrite	TlNO ₂	-50.8	Water (l, 373 K)	H ₂ O	-13.09
Thallium(I) sulfate	Tl ₂ SO ₄	-112.6	Water (g, 373 K))	H ₂ O	-13.1
Thallium(I) sulfide	Tl ₂ S	-88.8	Xenon (g)	Xe	-45.5
Thorium	Th	+97	Ytterbium (β)	Yb	+67
Thorium(IV) oxide	ThO ₂	-16	Yttrium (α)	Y	+187.7
Thulium	Tm	+24700	Yttrium oxide	Y ₂ O ₃	+44.4
Thulium oxide	Tm ₂ O ₃	+51444	Yttrium sulfide	Y ₂ S ₃	+100
Tin (gray)	Sn	-37.4	Zinc	Zn	-9.15
Tin(II) chloride	SnCl ₂	-69	Zinc carbonate	ZnCO ₃	-34
Tin(II) chloride dihydrate	SnCl ₂ ·2H ₂ O	-91.4	Zinc chloride	ZnCl ₂	-55.33
Tin(II) oxide	SnO	-19	Zinc cyanide	Zn(CN) ₂	-46
Tin(IV) bromide	SnBr ₄	-149	Zinc fluoride	ZnF ₂	-34.3
Tin(IV) chloride (l)	SnCl ₄	-115	Zinc hydroxide	Zn(OH) ₂	-67
Tin(IV) oxide	SnO ₂	-41	Zinc iodide	ZnI ₂	-108
Titanium	Ti	+151	Zinc oxide	ZnO	-27.2
Titanium(II) bromide	TiBr ₂	+720	Zinc phosphate	Zn ₃ (PO ₄) ₂	-141
Titanium(II) chloride	TiCl ₂	+484	Zinc sulfate	ZnSO ₄	-47.8
Titanium(II) iodide	TiI ₂	+1790	Zinc sulfate monohydrate	ZnSO ₄ ·H ₂ O	-63
Titanium(II) sulfide	TiS	+432	Zinc sulfate heptahydrate	ZnSO ₄ ·7H ₂ O	-138
Titanium(III) bromide	TiBr ₃	+660	Zinc sulfide	ZnS	-25
Titanium(III) chloride	TiCl ₃	+1110	Zirconium	Zr	+120
Titanium(III) fluoride	TiF ₃	+1300	Zirconium carbide	ZrC	-26
Titanium(III) oxide	Ti ₂ O ₃	+132	Zirconium nitrate	Zr(NO ₃) ₄ ·5H ₂ O	-77
Titanium(IV) chloride	TiCl ₄	-54	pentahydrate		
Titanium(IV) oxide	TiO ₂	+5.9	Zirconium(IV) oxide	ZrO ₂	-13.8

INDEX OF REFRACTION OF INORGANIC LIQUIDS

This table gives the index of refraction n of several inorganic substances in the liquid state at specified temperatures. The measurements refer to ambient atmospheric pressure except for substances whose normal boiling points are greater than the indicated temperature; in this case the pressure is the saturated vapor pressure of the substance. All values refer to a wavelength of 589 nm unless otherwise indicated. Entries are arranged in alphabetical order by chemical formula as normally written.

Data on the index of refraction at other temperatures and wavelengths may be found in Reference 1.

REFERENCES

1. Wohlfarth, C., and Wohlfarth, B., *Landolt-Börnstein, Numerical Data and Functional Relationships in Science and Technology, New Series, III/38A*, Martienssen, W., Editor, Springer-Verlag, Heidelberg, 1996.
2. Francis, A.W., *J. Chem. Eng. Data*, 5, 534, 1960.

Formula	Name	$t/^\circ\text{C}$	n
Ar	Argon	-188	1.2312
AsCl ₃	Arsenic(III) chloride	16	1.604
BBr ₃	Boron tribromide	16	1.312
BrF ₃	Bromine trifluoride	25	1.4536
BrF ₅	Bromine pentafluoride	25	1.3529
Br ₂	Bromine	15	1.659
COS	Carbon oxysulfide	25	1.3506
CO ₂	Carbon dioxide	24	1.6630
CS ₂	Carbon disulfide	20	1.62774
C ₃ O ₂	Carbon suboxide	0	1.453
Cl ₂	Chlorine	20	1.3834
CrO ₂ Cl ₂	Chromyl chloride	23	1.524
Fe(CO) ₅	Iron pentacarbonyl	14	1.523
GeBr ₄	Germanium(IV) bromide	26	1.6269
GeCl ₄	Germanium(IV) chloride	25	1.4614
HBr	Hydrogen bromide	10	1.325
HCN	Hydrogen cyanide	20	1.26136
HCl	Hydrogen chloride	18	1.3287 ^a
HClO ₄	Perchloric acid	50	1.3819
HF	Hydrogen fluoride	25	1.1574
HI	Hydrogen iodide	16	1.466
HNO ₃	Nitric acid	25	1.393
H ₂	Hydrogen	-253	1.1096
H ₂ O	Water	20	1.33336
H ₂ O ₂	Hydrogen peroxide	28	1.4061
H ₂ S	Hydrogen sulfide	-80	1.460
		20	1.3682
H ₂ SO ₄	Sulfuric acid	20	1.4183
H ₂ S ₂	Hydrogen disulfide	20	1.630
He	Helium	-269	1.02451 ^c
Kr	Krypton	-157	1.3032 ^c
NH ₃	Ammonia	-77	1.3944 ^b
		20	1.3327
NO	Nitric oxide	-90	1.330
N ₂	Nitrogen	-196	1.19876 ^b
N ₂ H ₄	Hydrazine	22	1.470
N ₂ O	Nitrous oxide	25	1.238
O ₂	Oxygen	-183	1.2243 ^c
PBr ₃	Phosphorus(III) bromide	25	1.687
PCl ₃	Phosphorus(III) chloride	21	1.5122
PH ₃	Phosphine	17	1.317
P ₂ O ₃	Phosphorus(III) oxide	27	1.540
S	Sulfur	125	1.9170
SCL ₂	Sulfur dichloride	14	1.557
SF ₆	Sulfur hexafluoride	25	1.167
SOCl ₂	Thionyl chloride	10	1.527
SO ₂	Sulfur dioxide	25	1.3396
SO ₂ Cl ₂	Sulfuryl chloride	12	1.444

INDEX OF REFRACTION OF INORGANIC LIQUIDS (continued)

Formula	Name	<i>t</i> /°C	<i>n</i>
SO ₃	Sulfur trioxide	20	1.40965
SSCl ₂	Sulfur chloride	20	1.671
SbCl ₅	Antimony(V) chloride	22	1.5925
SiBr ₄	Tetrabromosilane	31	1.5685
SiCl ₄	Tetrachlorosilane	25	1.41156
SnBr ₄	Tin(IV) bromide	31	1.6628
SnCl ₄	Tin(IV) chloride	25	1.5086
TiCl ₄	Titanium(IV) chloride	18	1.6076
Xe	Xenon	-112	1.3918 ^c

^a At 581 nm

^b At 578 nm

^c At 546 nm

PHYSICAL AND OPTICAL PROPERTIES OF MINERALS

The chemical formula, crystal system, density, hardness, and index of refraction of some common minerals are given in this table. Entries are arranged alphabetically by mineral name. The columns are:

- **Formula:** Chemical formula for a typical sample of the mineral. Composition often varies considerably with the origin of the sample.
- **Crystal system:** tricl = triclinic; monocl = monoclinic; orth = orthorhombic; tetr = tetragonal; hex = hexagonal; rhomb = rhombohedral; cub = cubic.
- **Density:** Typical density in g/cm³. Individual samples may vary by a few percent.
- **Hardness:** On the Mohs' scale (range of 1 to 10, with talc = 1 and diamond = 10).
- **Index of refraction:** Values are given for the three coordinate axes in the order of least, intermediate, and greatest index. For cubic crystals there is only a single value. See Reference 1 for details on the axis systems. Variations of several percent, depending on the origin and exact composition of the sample, are common.

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2. Carmichael, R.S., *Practical Handbook of Physical Properties of Rocks and Minerals*, CRC Press, Boca Raton, FL, 1989.
3. Donnay, J.D.H., and Ondik, H.M., *Crystal Data Determinative Tables, Third Edition, Volume 2, Inorganic Compounds*, Joint Committee on Powder Diffraction Standards, Swarthmore, PA, 1973.

Name	Formula	Crystal system	Density g/cm ³	Hardness	Index of refraction		
					n_α	n_β	n_γ
Acanthite	Ag ₂ S	orth	7.2	2.3			
Actinolite	Ca ₂ (Mg,Fe) ₅ Si ₈ O ₂₂ (OH,F) ₂	monocl	3.23	5.5	1.624	1.655	1.664
Aegirine	NaFe(SiO ₃) ₂	monocl	3.58	6	1.763	1.800	1.815
Akermanite	Ca ₂ MgSi ₂ O ₇	tetr	2.94	5.5	1.632	1.640	
Alabandite	MnS	cub	4.0	3.8			
Albite	NaAlSi ₃ O ₈	tricl	2.63	6.3	1.527	1.531	1.538
Allanite	(Ca,Mn,Ce,La,Y,Th) ₂ (Fe,Ti)(Al,Fe)O-OH(Si ₂ O ₇)(SiO ₄)	monocl	3.8	5.8	1.75	1.78	1.80
Allemontite	SbAs	hex	6.0	3.5			
Almandine	Fe ₃ Al ₂ Si ₃ O ₁₂	cub	4.32	6.8	1.830		
Altaite	PbTe	cub	8.16	3			
Aluminite	Al ₂ (SO ₄)(OH) ₄ ·7H ₂ O	monocl	1.74	1.5	1.459	1.464	1.470
Alunite	(K,Na)Al ₃ (SO ₄) ₂ (OH) ₆	rhomb	2.8	3.8	1.572	1.592	
Alunogen	Al ₂ (SO ₄) ₃ ·18H ₂ O	monocl	1.69	1.8	1.467	1.47	1.478
Amblygonite	(Li,Na)Al(PO ₄)(F,OH)	tricl	3.1	5.8	1.591	1.604	1.613
Analcite	NaAlSi ₂ O ₆ ·H ₂ O	cub	2.27	5.5	1.486		
Anatase	TiO ₂	tetr	4.23	5.8	2.488	2.561	
Andalusite	Al ₂ OSiO ₄	orth	3.15	7.5	1.635	1.639	1.644
Andesine	NaAlSi ₃ O ₈ CaAl ₂ Si ₂ O ₈	tricl	2.67	6.3	1.550	1.553	1.557
Andorite	PbAgSb ₃ S ₆	rhomb	5.35	3.3			
Andradite	Ca ₃ (Fe,Ti) ₂ Si ₃ O ₁₂	cub	3.86	6.8	1.887		
Anglesite	PbSO ₄	orth	6.29	2.8	1.877	1.883	1.894
Anhydrite	CaSO ₄	orth	2.96	3.5	1.570	1.575	1.614
Ankerite	Ca(Fe,Mg,Mn)(CO ₃) ₂	rhomb	3.0	3.8	1.529	1.720	
Anorthite	CaAl ₂ Si ₂ O ₈	tricl	2.76	6.3	1.577	1.585	1.590
Anorthoclase	(Na,K)AlSi ₃ O ₈	tricl	2.58	6	1.523	1.528	1.529
Anthophyllite	(Mg,Fe) ₇ Si ₈ O ₂₂ (OH,F) ₂	rhomb	3.21	5.8	1.645	1.658	1.668
Apatite	Ca ₅ (PO ₄) ₃ (OH,F,Cl)	hex	3.2	5	1.645	1.648	
Apophyllite	KFCa ₄ Si ₈ O ₂₀ ·8H ₂ O	tetr	2.35	4.8	1.535	1.536	
Aragonite	CaCO ₃	orth	2.83	3.5	1.531	1.680	1.686
Arcanite	K ₂ SO ₄	orth	2.66		1.494	1.494	1.497
Argentite	Ag ₂ S	orth	7.2	2.3			
Arsenolite	As ₂ O ₃	cub	3.86	1.5	1.755		
Arsenopyrite	FeAsS	monocl	6.1	5.8			
Atacamite	Cu ₂ (OH) ₃ Cl	rhomb	3.76	3.3	1.831	1.861	1.880
Augelite	Al ₂ (PO ₄)(OH) ₃	monocl	2.70	4.8	1.574	1.576	1.588
Augite	(Ca,Mg,Fe,Ti,Al) ₂ (Si,Al) ₂ O ₆	monocl	3.38	6	1.703	1.707	1.738
Autunite	Ca(UO ₂) ₂ (PO ₄) ₂ ·10H ₂ O	tetr	3.2	2.3	1.553	1.577	
Axinite	(Ca,Mn,Fe) ₃ Al ₂ BO ₃ Si ₄ O ₁₂ (OH)	tricl	3.31	6.8	1.684	1.691	1.694

PHYSICAL AND OPTICAL PROPERTIES OF MINERALS (continued)

Name	Formula	Crystal system	Density g/cm ³	Hardness	Index of refraction		
					<i>n</i> _α	<i>n</i> _β	<i>n</i> _γ
Azurite	Cu ₃ (OH) ₂ (CO ₃) ₂	monocl	3.77	3.8	1.730	1.758	1.838
Baddeleyite	ZrO ₂	monocl	5.7	6.5	2.13	2.19	2.20
Barite	BaSO ₄	orth	4.49	3.3	1.636	1.637	1.648
Benitoite	BaTi(SiO ₃) ₃	rhomb	3.65	6.3	1.757	1.804	
Bertrandite	Be ₃ Si ₂ O ₇ (OH) ₂	rhomb	2.6	6	1.589	1.602	1.613
Beryl	Be ₃ Al ₂ (SiO ₃) ₆	hex	2.64	7.8	1.582	1.589	
Beryllonite	NaBe(PO) ₄	monocl	2.81	5.8	1.552	1.558	1.561
Biotite	K(Mg,Fe) ₃ AlSi ₃ O ₁₀ (OH,F) ₂	monocl	3.0	2.8	1.595	1.651	1.651
Bismuthinite	Bi ₂ S ₃	orth	6.78	2			
Bixbyite	(Mn,Fe) ₂ O ₃	cub	4.95	6.3			
Bloedite	Na ₂ Mg(SO ₄) ₂ ·4H ₂ O	monocl	2.25	2.8	1.483	1.486	1.487
Boehmite	AlO(OH)	orth	3.44	3.8	1.64	1.65	1.66
Boracite	Mg ₃ B ₇ O ₁₃ Cl	rhomb	2.94	7.3	1.66	1.66	1.67
Borax	Na ₂ B ₄ O ₇ ·10H ₂ O	monocl	1.73	2.3	1.447	1.469	1.472
Bornite	Cu ₅ FeS ₄	cub	5.07	3			
Boulangierite	Pb ₅ Sb ₄ S ₁₁	monocl	6.1	2.8			
Bournonite	PbCuSbS ₃	rhomb	5.83	2.8			
Braggite	PtS	tetr	10.2				
Braunite	(Mn,Si) ₂ O ₃	tetr	4.78	6.3			
Bravoite	(Ni,Fe)S ₂	cub	4.62	5.8			
Breithauptite	NiSb	hex	≈8.7	5.5			
Brochantite	Cu ₄ (SO ₄)(OH) ₆	monocl	3.79	3.8	1.728	1.771	1.800
Bromyrite	AgBr	cub	6.47	2.5	2.253		
Brookite	TiO ₂	orth	4.23	5.8	2.583	2.584	2.700
Brucite	Mg(OH) ₂	hex	2.37	2.5	1.575	1.59	
Bunsenite	NiO	cub	6.72	5.5			
Cacoxenite	Fe ₄ (PO ₄) ₃ (OH) ₃ ·12H ₂ O	hex	2.3	3.5	1.580	1.646	
Calcite	CaCO ₃	hex	2.71	3	1.486	1.658	
Caledonite	Cu ₂ Pb ₅ (SO ₄) ₃ (CO ₃)(OH) ₆	rhomb	5.76	2.8	1.818	1.866	1.909
Calomel	Hg ₂ Cl ₂	tetr	7.16	1.5	1.973	2.656	
Cancrinite	(Na,Ca,K) ₇ [Al ₆ Si ₆ O ₂₄] (CO ₃ ,SO ₄ ,Cl,OH) ₂ ·H ₂ O	hex	2.42	5.5	1.495	1.509	
Carnalite	KMgCl ₃ ·6H ₂ O	rhomb	1.60	2.5	1.466	1.475	1.494
Carnotite	K ₂ (UO ₂) ₂ (VO ₄) ₂ ·3H ₂ O	rhomb		1.5	1.75	1.92	1.95
Cassiterite	SnO ₂	tetr	6.85	6.5	2.006	2.097	
Celestine	SrSO ₄	orth	3.96	3.3	1.622	1.624	1.631
Celsian	BaAl ₂ Si ₂ O ₈	monocl	3.25	6.3	1.583	1.588	1.594
Cerargyrite	AgCl	cub	5.56	2.5	2.071		
Cerussite	PbCO ₃	orth	6.6	3.3	1.804	2.076	2.079
Cervantite	Sb ₂ O ₄	orth	6.64	4.5			
Chabazite	Ca[Al ₂ Si ₄ O ₁₂]·6H ₂ O	trig	2.08	4.5	1.482		
Chalcanthite	CuSO ₄ ·5H ₂ O	tricl	2.29	2.5	1.514	1.537	1.543
Chalcocite	Cu ₂ S	orth	5.6	2.8			
Chalcopyrite	CuFeS ₂	tetr	4.2	3.8			
Chiolite	Na ₅ Al ₃ F ₁₄	tetr	3.00	3.8	1.342	1.349	
Chlorite	(Mg,Al,Fe) ₁₂ (Si,Al) ₈ O ₂₀ (OH) ₁₆	monocl	3.0	2.5	1.61	1.62	1.62
Chloritoid	FeAl ₄ O ₂ (SiO ₄) ₂ (OH) ₄	monocl	3.66	6.5	1.717	1.721	1.726
Chondrodite	Mg(OH,F) ₂ ·2Mg ₂ SiO ₄	monocl	3.21	6.5	1.604	1.615	1.634
Chromite	FeCr ₂ O ₄	cub	5.0	5.5	2.16		
Chrysoberyl	BeAl ₂ O ₄	orth	3.65	8.5	1.746	1.748	1.756
Chrysocolla	CuSiO ₃ ·2H ₂ O	rhomb	2.4	2	1.575	1.597	1.598
Cinnabar	HgS	hex	8.17	2.3	2.814	3.143	
Claudetite	As ₂ O ₃	monocl	3.74	2.5	1.87	1.92	2.01
Clinohumite	Mg(OH,F) ₂ ·4Mg ₂ SiO ₄	monocl	3.21	6	1.633	1.647	1.668
Clinozoisite	Ca ₂ Al ₃ Si ₃ O ₁₂ (OH)	monocl	3.30	6.5	1.693	1.700	1.712
Cobaltite	CoAsS	cub	≈6.1	5.5			
Colemanite	Ca ₂ B ₆ O ₁₁ ·5H ₂ O	monocl	2.42	4.5	1.586	1.592	1.614
Columbite	(Fe,Mn)(Nb,Ta) ₂ O ₆	rhomb	5.20	6			
Connellite	Cu ₁₉ (SO ₄)Cl ₄ (OH) ₃₂ ·3H ₂ O	hex	3.36	3	1.731	1.752	

PHYSICAL AND OPTICAL PROPERTIES OF MINERALS (continued)

Name	Formula	Crystal system	Density g/cm ³	Hardness	Index of refraction		
					<i>n</i> _α	<i>n</i> _β	<i>n</i> _γ
Copiapite	(Fe,Mg)Fe ₄ (SO ₄) ₆ (OH) ₂ ·20H ₂ O	tricl	2.13	2.8	1.52	1.54	1.59
Coquimbite	Fe ₂ (SO ₄) ₃ ·9H ₂ O	hex	2.1	2.5	1.54	1.56	
Cordierite	Al ₃ (Mg,Fe) ₂ Si ₅ AlO ₁₈	rhomb	2.66	7	1.540	1.549	1.553
Corundum	Al ₂ O ₃	hex	3.97	9	1.761	1.769	
Cotunnite	PbCl ₂	orth	5.98	2.5	2.199	2.217	2.260
Covellite	CuS	hex	4.8	1.8			
Cristobalite	SiO ₂	hex	2.33	6.5	1.484	1.487	
Crocoite	PbCrO ₄	monocl	6.12	2.8	2.29	2.36	2.66
Cryolite	Na ₃ AlF ₆	monocl	2.97	2.5	1.338	1.338	1.339
Cryolithionite	Na ₃ Li ₃ Al ₂ F ₁₂	cub	2.77	2.8	1.340		
Cubanite	CuFe ₂ S ₃	rhomb	4.11	3.5			
Cumingtonite	(Mg,Fe) ₇ Si ₈ O ₂₂ (OH) ₂	monocl	3.4	5.5	1.650	1.660	1.676
Cuprite	Cu ₂ O	cub	6.0	3.8			
Danburite	CaSi ₂ B ₂ O ₈	rhomb	3.0	7	1.63	1.63	1.63
Datolite	CaBSiO ₄ (OH)	monocl	2.98	5.3	1.624	1.652	1.668
Daubreelite	Cr ₂ FeS ₄	cub	3.81				
Derbylite	Fe ₆ Ti ₆ Sb ₂ O ₂₃	rhomb	4.53	5	2.45	2.45	2.51
Diamond	C	cub	3.51	10	2.418		
Diaspore	AlO(OH)	orth	3.4	6.8	1.694	1.715	1.741
Digenite	Cu ₂₋₃ S	cub	5.55	2.8			
Diopside	CaMgSi ₂ O ₆	monocl	3.30	6	1.680	1.687	1.708
Diopase	CuSiO ₂ (OH) ₂	rhomb	3.5	5	1.65	1.70	
Dolomite	CaMg(CO ₃) ₂	rhomb	2.86	3.5	1.500	1.679	
Douglasite	K ₂ FeCl ₄ ·2H ₂ O	orth	2.16		1.488	1.500	
Dyscrasite	Ag ₃ Sb	rhomb	9.74	3.8			
Eddingtonite	BaAl ₂ Si ₃ O ₁₀ ·4H ₂ O	rhomb	2.8		1.541	1.553	1.557
Eglestonite	Hg ₄ OCl ₂	cub	8.4	2.5	2.49		
Emplectite	CuBiS ₂	rhomb	6.38	2			
Enargite	Cu ₃ AsS ₄	rhomb	4.5	3			
Enstatite	MgSiO ₃	monocl	3.19	5.5	1.656	1.662	1.669
Epidote	Ca ₂ Al ₂ (Al,Fe)OH(SiO ₄) ₃	monocl	3.44	6	1.733	1.755	1.765
Epsomite	MgSO ₄ ·7H ₂ O	orth	1.67	2.3	1.433	1.455	1.461
Erythrite	(Co,Ni) ₃ (AsO ₄) ₂ ·8H ₂ O	monocl	3.06	2	1.626	1.661	1.699
Eucairite	CuAgSe	orth	7.7	2.5			
Euclase	BeAlSiO ₄ (OH)	monocl	3.1	7.5	1.651	1.655	1.671
Eudialite	(Na,Ca,Ce) ₅ (Fe,Mn)(Zr,Ti)(Si ₃ O ₉) ₂ (OH,Cl)	hex	3.0	5.5	1.623	1.600	1.615
Eulytite	Bi ₄ Si ₃ O ₁₂	cub	6.6	4.5	2.05		
Euxenite	(Y,Ca,Ce,U,Th)(Nb,Ta,Ti) ₂ O ₆	rhomb	5.5	6	2.2		
Fayalite	Fe ₂ SiO ₄	orth	4.30	6.5	1.827	1.869	1.879
Ferberite	FeWO ₄	monocl	7.51	4.3			
Fergussonite	(Y,Er,Ce,Fe)(Nb,Ta,Ti)O ₄	tetr	5.7	6	2.1		
Fluorite	CaF ₂	cub	3.18	4	1.434		
Forsterite	Mg ₂ SiO ₄	orth	3.21	7	1.635	1.651	1.670
Franklinite	ZnFe ₂ O ₄	cub	5.21	6	2.36		
Gahnite	ZnAl ₂ O ₄	cub	4.62	7.8	1.805		
Galaxite	MnAl ₂ O ₄	cub	4.04	7.8	1.92		
Galena	PbS	cub	7.60	2.5	3.91		
Galenabismuthite	PbBi ₂ S ₄	rhomb	7.04	3			
Ganomalite	(Ca,Pb) ₁₀ (OH,Cl) ₂ (Si ₂ O ₇) ₃	hex	5.6	3.5	1.910	1.945	
Gaylussite	Na ₂ Ca(CO ₃) ₂ ·5H ₂ O	monocl	1.99	2.8	1.444	1.516	1.523
Gehlenite	Ca ₂ Al ₂ SiO ₇	tetr	3.04	5.5	1.658	1.669	
Geikielite	MgTiO ₃	hex	3.85	5.5	1.95	2.31	
Gibbsite	Al(OH) ₃	monocl	2.42	3	1.57	1.57	1.59
Glauberite	Na ₂ Ca(SO ₄) ₂	monocl	2.80	2.8	1.515	1.535	1.536
Glauconite	(K,Na,Ca) _{1.6} (Fe,Al,Mg) _{4.0} Si _{7.3} Al _{0.7} O ₂₀ (OH) ₄	monocl	2.7	2	1.60	1.63	1.63
Glaucofanite	Na ₂ Mg ₃ Al ₂ Si ₈ O ₂₂ (OH) ₂	monocl	3.19	6	1.634	1.645	1.648
Gmelinite	(Ca,Na ₂)[Al ₂ Si ₄ O ₁₂]·6H ₂ O	hex	2.10	4.5	1.477	1.485	

PHYSICAL AND OPTICAL PROPERTIES OF MINERALS (continued)

Name	Formula	Crystal system	Density g/cm ³	Hardness	Index of refraction		
					<i>n</i> _α	<i>n</i> _β	<i>n</i> _γ
Goethite	FeO(OH)	orth	4.3	5.3	2.268	2.401	2.457
Goslarite	ZnSO ₄ ·7H ₂ O	orth	1.97	2.3	1.457	1.480	1.484
Greenockite	CdS	cub	4.8	3.3	2.506	2.529	
Grossularite	Ca ₃ Al ₂ Si ₃ O ₁₂	cub	3.59	6.8	1.734		
Gummite	UO ₃ ·H ₂ O	orth	7.05	3.8			
Gypsum	CaSO ₄ ·2H ₂ O	monocl	2.32	2	1.520	1.525	1.530
Halite	NaCl	cub	2.17	2	1.544		
Hamburgite	Be ₂ (OH)(BO ₃)	rhomb	2.36	7.5	1.56	1.59	1.63
Hanksite	Na ₂₂ K(SO ₄) ₉ (CO ₃) ₂ Cl	hex	2.56	3.3	1.461	1.481	
Harmotome	Ba[Al ₂ Si ₆ O ₁₆]·6H ₂ O	monocl	4.45	4.5	1.506	1.507	1.511
Hausmannite	Mn ₃ O ₄	tetr	4.84	5.5	2.15	2.46	
Häuyne	(Na,Ca) ₄₋₈ Al ₆ Si ₆ O ₂₄ (SO ₄ ,S) ₁₋₂	cub	2.47	5.8	1.502		
Hedenbergite	CaFeSi ₂ O ₆	monocl	3.53	6	1.721	1.727	1.746
Helvite	Mn ₄ Be ₃ Si ₃ O ₁₂ S	cub	3.32	6	1.739		
Hematite	Fe ₂ O ₃	hex	5.25	6	2.91	3.19	
Hemimorphite	Zn ₄ Si ₂ O ₇ (OH) ₂ ·H ₂ O	rhomb	3.45	5	1.614	1.617	1.636
Hercynite	Fe(AlO ₂) ₂	cub	4.3	7.8	1.835		
Herderite	CaBe(PO ₄)(Fe,OH)	monocl	2.98	5.3	1.592	1.612	1.621
Hessite	Ag ₂ Te	orth	8.4	2.5			
Heulandite	(Ca,Na ₂ ,K ₂)[Al ₂ Si ₇ O ₁₈]·6H ₂ O	monocl	2.2	3.8	1.498	1.498	1.506
Hopeite	Zn ₃ (PO ₄) ₂ ·4H ₂ O	orth	3.0	3.2	1.58	1.59	1.59
Hornblende	Ca ₂ (Mg,Fe) ₄ Al(Si ₇ AlO ₂₂)(OH) ₂	monocl	3.24	5.5	1.67	1.67	1.69
Huebnerite	MnWO ₄	monocl	7.2	4.3	2.17	2.22	2.32
Humite	Mg(OH,F) ₂ ·3Mg ₂ SiO ₄	orth	3.3	6	1.625	1.636	1.657
Huntite	Mg ₃ Ca(CO ₃) ₄	trig	2.70				
Hydrogrossularite	Ca ₃ Al ₂ Si ₂ O ₈ (SiO ₄) _{1-m} (OH) _{4m}	cub	3.4	6.8	1.70		
Hydromagnesite	3MgCO ₃ ·Mg(OH) ₂ ·3H ₂ O	monocl	2.24	3.5	1.523	1.527	1.545
Illite	KAl ₄ [Si ₇ AlO ₂₀](OH) ₄	monocl	2.8	1.5	1.56	1.59	1.59
Ilmenite	FeTiO ₃	rhomb	4.72	5.5			
Iodyrite	AgI	hex	5.68	1.5	2.21	2.22	
Jacobsite	MnFe ₂ O ₄	cub	4.87	7.8	2.3		
Jadeite	NaAlSi ₂ O ₆	monocl	3.34	6	1.649	1.654	1.663
Jamesonite	Pb ₄ FeSb ₆ S ₁₄	monocl	5.63	2.5			
Jarosite	KFe ₃ (SO ₄) ₂ (OH) ₆	rhomb	3.09	3	1.715	1.820	
Kainite	KMg(SO ₄)Cl·3H ₂ O	monocl	2.15	2.8	1.494	1.505	1.516
Kaliophyllite	KAlSiO ₄	hex	2.61	6	1.532	1.537	
Kaolinite	Al ₄ Si ₄ O ₁₀ (OH) ₈	tricl	2.65	2.3	1.549	1.564	1.565
Kernite	Na ₂ B ₄ O ₇ ·4H ₂ O	monocl	1.95	2.5	1.454	1.472	1.488
Kieserite	MgSO ₄ ·H ₂ O	monocl	2.57	3.5	1.520	1.533	1.584
Kyanite	Al ₂ OSiO ₄	tricl	3.59	6.3	1.715	1.722	1.731
Lanarkite	Pb ₂ (SO ₄)O	monocl	6.92	2.3	1.928	2.007	2.036
Lanthanite	(La,Ce) ₂ (CO ₃) ₃ ·8H ₂ O	rhomb	2.72	2.8	1.52	1.587	1.613
Laumontite	Ca ₄ [Al ₈ Si ₁₆ O ₄₈]·16H ₂ O	monocl	2.3	3.3	1.508	1.517	1.519
Laurionite	Pb(OH)Cl	rhomb	6.24	3.3	2.08	2.12	2.16
Lawsonite	CaAl ₂ (OH) ₂ Si ₂ O ₇ ·H ₂ O	rhomb	3.08	6	1.655	1.675	1.685
Lazulite	(Mg,Fe)Al ₂ (PO ₄) ₂ (OH) ₂	monocl	3.23	5.8	1.615	1.64	1.650
Lazurite	Na ₄ SSi ₃ Al ₃ O ₁₂	cub	2.42	5.3	1.500		
Leadhillite	Pb ₄ (SO ₄)(CO ₃) ₂ (OH) ₂	monocl	6.55	2.8	1.87	2.00	2.01
Lepidocrocite	FeO(OH)	orth	4.26	5	1.94	2.20	2.51
Lepidolite	K ₂ (Li,Al) ₅₋₆ [Si ₆₋₇ Al ₂₋₁ O ₂₀](OH,F) ₄	monocl	2.85	3.3	1.536	1.565	1.566
Leucite	KAlSi ₂ O ₆	tetr	2.49	5.8	1.510		
Levyne	(Ca,Na ₂)Al ₂ Si ₄ O ₁₂ ·6H ₂ O	rhomb	2.10	4.5	1.496	1.501	
Litharge	PbO	tetr	9.35	2	2.535	2.665	
Loellingite	FeAs ₂	rhomb	7.40	5.3			
Maghemite	Fe ₂ O ₃	cub	4.88	7.8	2.63		
Magnesite	MgCO ₃	hex	3.05	4	1.536	1.741	
Magnetite	Fe ₃ O ₄	cub	5.17	6	2.42		
Malachite	Cu ₂ (OH) ₂ (CO ₃)	monocl	4.05	3.8	1.655	1.875	1.909
Manganite	MnO(OH)	monocl	≈4.3	4	2.25	2.25	2.53

PHYSICAL AND OPTICAL PROPERTIES OF MINERALS (continued)

Name	Formula	Crystal system	Density g/cm ³	Hardness	Index of refraction		
					<i>n</i> _α	<i>n</i> _β	<i>n</i> _γ
Manganosite	MnO	cub	5.37	5.5			
Marcasite	FeS ₂	cub	5.02	6.3			
Marialite	Na ₄ Al ₃ Si ₉ O ₂₄ Cl	tetr	2.56	5.5	1.541	1.548	
Marshite	CuI	cub	5.67	2.5	2.346		
Mascagnite	(NH ₄) ₂ SO ₄	orth	1.77	2.3	1.520	1.523	1.533
Matlockite	PbClF	tetr	7.05	2.8	2.006	2.145	
Meionite	Ca ₄ Al ₆ Si ₆ O ₂₄ CO ₃	tetr	2.78	5.5	1.559	1.595	
Melanterite	FeSO ₄ ·7H ₂ O	monocl	1.89	2	1.47	1.48	1.49
Melilite	(Ca,Na) ₂ (Mg,Fe,Al,Si) ₃ O ₇	tetr	3.00	5.5	1.639	1.645	
Mellite	Al ₂ C ₁₂ O ₁₂ ·18H ₂ O	tetr	1.64	2.3	1.511	1.539	
Mendipite	Pb ₂ O ₂ Cl ₂	rhomb	7.24	2.5	2.24	2.27	2.31
Mesolite	Na ₂ Ca ₂ (Al ₂ Si ₃ O ₁₀) ₃ ·8H ₂ O	orth	2.26	5	1.506		
Metacinnabar	HgS	cub	7.70	3			
Microcline	KAlSi ₃ O ₈	monocl	2.56	6.3	1.522	1.526	1.530
Miersite	AgI	hex	5.68	2.5	2.20		
Millerite	NiS	hex	5.5	3.3			
Mimetite	Pb ₅ (AsO ₄ ·PO ₄) ₃ Cl	hex	7.24	3.8	2.128	2.147	
Minium	Pb ₃ O ₄	tetr	8.9	2.5			
Mirabilite	Na ₂ SO ₄ ·10H ₂ O	monocl	1.46	1.8	1.394	1.396	1.398
Moissanite	SiC	hex	3.16	9.5	2.648	2.691	
Molybdenite	MoS ₂	hex	5.06	1.3			
Monazite	(Ce,La,Th)PO ₄	monocl	5.2	5	1.787	1.789	1.840
Monetite	CaHPO ₄	tricl	2.92	3.5	1.587	1.61	1.640
Monticellite	Ca(Mg,Fe)SiO ₄	orth	3.18	5.5	1.647	1.655	1.664
Montmorillonite	(0.5Ca,Na) _{0.7} (Al,Mg,Fe) ₄ [(Si,Al) ₈ O ₂₀](OH) ₄ · <i>n</i> H ₂ O	monocl	2.5	1.5	1.55	1.57	1.57
Montroydite	HgO	orth	11.14	2.5	2.37	2.50	2.65
Mordenite	(Na,K,Ca)[Al ₂ Si ₁₀ O ₂₄]·7H ₂ O	orth	2.13	3.5	1.478	1.480	1.482
Muscovite	KAl ₂ Si ₃ AlO ₁₀ (OH,F) ₂	monocl	2.83	2.8	1.563	1.596	1.602
Nantokite	CuCl	cub	4.14	2.5	1.930		
Natrolite	Na ₂ Al ₂ Si ₃ O ₁₀ ·2H ₂ O	orth	2.23	5	1.478	1.481	1.491
Nepheline	Na ₃ KAl ₄ Si ₄ O ₁₆	hex	2.61	5.8	1.534	1.538	
Newberyite	MgHPO ₄ ·3H ₂ O	orth	2.13	3.3	1.514	1.517	1.533
Niccolite	NiAs	hex	7.77	5.3			
Norbergite	Mg(OH,F) ₂ ·Mg ₂ SiO ₄	orth	3.21	6.5	1.565	1.573	1.592
Nosean	Na ₈ Al ₆ Si ₆ O ₂₄ SO ₄	cub	2.35	5.5	1.495		
Oldhamite	CaS	cub	2.59	4	2.137		
Oligoclase	([NaSi] _{0.9-0.7} [CaAl] _{0.1-0.3})AlSi ₂ O ₈	tricl	2.64	6.3	1.539	1.543	1.547
Olivenite	Cu ₂ (AsO ₄)(OH)	rhomb	4.2	3	1.77	1.80	1.85
Olivine	(Mg,Fe)SiO ₄	rhomb	3.81	6.8	1.73	1.76	1.78
Opal	SiO ₂ · <i>n</i> H ₂ O	amorp	1.9	5	1.44		
Orpiment	As ₂ S ₃	monocl	3.46	1.8	2.40	2.81	3.02
Orthoclase	KAlSi ₃ O ₈	monocl	2.56	6	1.523	1.527	1.531
Orthopyroxene	(Mg,Fe)SiO ₃	rhomb	3.6	5.5	1.709	1.712	1.723
Paragonite	NaAl ₂ Si ₃ AlO ₁₀ (OH) ₂	monocl	2.85	2.5	1.572	1.602	1.605
Parisite	(Ce,La,Na)FCO ₃ ·CaCO ₃	hex	4.42	4.5	1.672	1.771	
Pectolite	Ca ₂ NaH(SiO ₃) ₃	tricl	2.88	4.8	1.603	1.610	1.639
Penfieldite	Pb ₄ Cl ₆ (OH) ₂	hex	6.6		2.13	2.21	
Pentlandite	(Fe,Ni) ₉ S ₈	cub	4.8	3.8			
Percylite	PbCuCl ₂ (OH) ₂	cub		2.5	2.05		
Periclase	MgO	cub	3.6	5.5	1.735		
Perovskite	CaTiO ₃	cub	3.98	5.5	2.34		
Petalite	LiAlSi ₄ O ₁₀	monocl	2.42	6.5	1.506	1.511	1.519
Pharmacosiderite	Fe ₃ (AsO ₄) ₂ (OH) ₃ ·5H ₂ O	cub	2.80	2.5	1.690		
Phenakite	Be ₂ SiO ₄	rhomb	2.98	7.5	1.654	1.670	
Phillipsite	K(Ca _{0.5} ,Na) ₂ [Al ₃ Si ₅ O ₁₆]·6H ₂ O	monocl	2.2	4.3	1.494	1.497	1.505
Phlogopite	KMg ₃ AlSi ₃ O ₁₀ (OH,F) ₂	monocl	2.83	2.3	1.560	1.597	1.598
Phosgenite	Pb ₂ (CO ₃)Cl ₂	tetr	6.13	2.5	2.118	2.145	
Piemontite	Ca ₂ (Mn,Fe,Al) ₃ O(Si ₂ O ₇)(SiO ₄)(OH)	monocl	3.49	6	1.762	1.773	1.796

PHYSICAL AND OPTICAL PROPERTIES OF MINERALS (continued)

Name	Formula	Crystal system	Density g/cm ³	Hardness	Index of refraction		
					<i>n</i> _α	<i>n</i> _β	<i>n</i> _γ
Pigeonite	(Mg,Fe,Ca)(Mg,Fe)Si ₂ O ₆	monocl	3.38	6	1.702	1.703	1.728
Pollucite	CsAlSi ₂ O ₆	tetr	2.9	6.5	1.517		
Polybasite	(Ag,Cu) ₁₆ Sb ₂ S ₁₁	monocl	6.1	2.5			
Powellite	Ca(Mo,W)O ₄	tetr	4.35	3.8	1.971	1.980	
Prehnite	Ca ₂ Al ₂ Si ₃ O ₁₀ (OH) ₂	rhomb	2.93	6.3	1.622	1.628	1.648
Proustite	Ag ₃ AsS ₃	rhomb	5.57	2.3	2.792	3.088	
Pseudobrookite	Fe ₂ TiO ₅	rhomb	4.36	6	2.38	2.39	2.42
Psilomelane	BaMn ₉ O ₁₆ (OH) ₄	rhomb	4.71	5.5			
Pumpellyite	Ca ₂ Al ₂ (Al,Fe,Mg)[Si ₂ (O,OH) ₇ (SiO ₄)(OH,O) ₃	monocl	3.21	5.5	1.688	1.695	1.705
Pyrargyrite	Ag ₃ SbS ₃	rhomb	5.85	2.5	2.88	3.08	
Pyrite	FeS ₂	cub	5.02	6.3			
Pyrochlore	NaCaNb ₂ O ₆ F	cub	5.3	5.3			
Pyrochroite	Mn(OH) ₂	hex	3.26	2.5	1.68	1.72	
Pyrolusite	MnO ₂	tetr	5.08	6.3			
Pyromorphite	Pb ₅ (PO ₄ ,AsO ₄) ₃ Cl	hex	7.04	3.8	2.048	2.058	
Pyrope	Mg ₃ Al ₂ Si ₃ O ₁₂	cub	3.58	6.8	1.714		
Pyrophyllite	Al ₂ Si ₄ O ₁₀ (OH) ₂	monocl	2.78	1.5	1.545	1.579	1.599
Pyrrhotite	Fe ₇ S ₈	hex	4.62	4			
Quartz	SiO ₂	hex	2.65	7	1.544	1.553	
Rammelsbergite	NiAs ₂	orth	7.1	5.8			
Raspite	PbWO ₄	monocl	8.46	2.8	1.27	1.27	1.30
Realgar	As ₄ S ₄	monocl	3.5	1.8	2.538	2.684	2.704
Rhodochrosite	MnCO ₃	hex	3.70	3.8	1.597	1.816	
Rhodonite	(Mn,Fe,Ca)SiO ₃	orth	3.48	6	1.725	1.729	1.737
Riebeckite	Na ₂ Fe ₅ (Si ₈ O ₂₂)(OH) ₂	monocl	3.3	5	1.675	1.683	1.694
Rutile	TiO ₂	tetr	4.23	6.2	2.609	2.900	
Safflorite	(Co,Fe)As ₂	rhomb	7.3	4.8			
Samarskite	(Y,Er,Ce,U,Ca,Fe,Pb,Th)(Nb,Ta,Ti,Sn) ₂ O ₆	rhomb	5.69	5.5	2.200		
Sapphirine	(Mg,Fe) ₂ Al ₄ O ₆ SiO ₄	monocl	3.49	7.5	1.709	1.712	1.715
Scapolite	(Na,Ca) ₄ Al ₃ (Al,Si) ₃ Si ₆ O ₂₄ (Cl,F,OH,CO ₃ ,SO ₄)	tetr	2.64	5.5	1.551	1.573	
Scheelite	CaWO ₄	tetr	6.06	4.8	1.920	1.936	
Scolecite	CaAl ₂ Si ₃ O ₁₀ ·3H ₂ O	monocl	2.27	5	1.510	1.518	1.519
Scorodite	Fe(AsO ₄)·2H ₂ O	rhomb	3.28	3.8	1.784	1.795	1.814
Sellaite	MgF ₂	tetr	3.15	5	1.378	1.390	
Senarmontite	Sb ₂ O ₃	cub	5.58	2.3	2.087		
Serpentine	Mg ₃ Si ₂ O ₅ (OH) ₄	monocl	2.55	3	1.55	1.56	1.56
Siderite	FeCO ₃	hex	3.9	4.3	1.635	1.875	
Sillimanite	Al ₂ OSiO ₄	rhomb	3.25	7	1.658	1.660	1.660
Skutterudite	(Co,Ni)As ₃	cub	6.8	5.8			
Smithsonite	ZnCO ₃	rhomb	4.4	4.3	1.621	1.848	
Sodalite	Na ₈ Al ₆ Si ₆ O ₂₄ Cl ₂	cub	2.30	5.8	1.485		
Sperryllite	PtAs ₂	cub	10.58	6.5			
Spessartite	Mn ₃ Al ₂ Si ₃ O ₁₂	cub	4.19	6.8	1.800		
Sphalerite	ZnS	cub	4.0	3.8	2.369		
Sphene	CaTiSiO ₄ (O,OH,F)	monocl	3.50	5	1.90	1.95	2.03
Spinel	MgAl ₂ O ₄	cub	3.55	7.8	1.719		
Spodumene	LiAlSi ₂ O ₆	monocl	3.13	6.8	1.656	1.662	1.671
Stannite	Cu ₂ FeSn ₄	tetr	4.4	4			
Staurolite	(Fe,Mg,Zn) ₂ (Al,Fe,Ti) ₉ O ₆ [(Si,Al) ₄ l ₄ (O,OH) ₂	monocl	3.79	7.5	1.743	1.747	1.755
Stercorite	Na(NH ₄)H(PO ₄)·4H ₂ O	tricl	1.62	2	1.439	1.442	1.469
Stibiotantalite	Sb(Ta,Nb)O ₄	rhomb	6.6	5.5	2.38	2.41	2.46
Stibnite	Sb ₂ S ₃	orth	4.56	2			
Stilbite	NaCa ₂ [Al ₅ Si ₁₃ O ₃₆]·14H ₂ O	monocl	2.2	3.8	1.492	1.499	1.503

PHYSICAL AND OPTICAL PROPERTIES OF MINERALS (continued)

Name	Formula	Crystal system	Density g/cm ³	Hardness	Index of refraction		
					n_{α}	n_{β}	n_{γ}
Stilpnomelane	(K,Na,Ca) _{0.6} (Fe,Mg) ₆ Si ₈ Al(O,OH) ₂₇ ·2H ₂ O	monocl	2.8	3.5	1.585	1.665	1.665
Stolzite	PbWO ₄	tetr	8.2	2.8	2.19	2.27	
Strengite	FePO ₄ ·2H ₂ O	orth	2.87	4	1.707	1.719	1.741
Strontianite	SrCO ₃	orth	3.5	3.5	1.518	1.666	1.668
Struvite	Mg(NH ₄)(PO ₄)·6H ₂ O	rhomb	1.71	2	1.495	1.496	1.504
Sulfur	S	orth	2.07	2	1.958	2.038	2.245
Sylvanite	(Ag,Au)Te ₂	monocl	8.16	1.8			
Sylvite	KCl	cub	1.99	2	1.490		
Talc	Mg ₃ Si ₄ O ₁₀ (OH) ₂	monocl	2.71	1	1.545	1.592	1.595
Tantalite	(Fe,Mn)(Ta,Nb) ₂ O ₆	rhomb	7.95	6.5	2.26	2.32	2.43
Tapiolite	FeTa ₂ O ₆	tetr	7.9	6.3	2.27	2.42	
Tellurobismuthite	Bi ₂ Te ₃	hex	7.74	1.8			
Terlinguaite	Hg ₂ OCl	monocl	8.73	2.5	2.35	2.64	2.66
Tetrahedrite	(Cu,Fe) ₁₂ Sb ₄ S ₁₃	cub	4.9	3.8			
Thenardite	Na ₂ SO ₄	orth	2.7	2.8	1.468	1.475	1.483
Thermonatrite	Na ₂ CO ₃ ·H ₂ O	orth	2.25	1.3	1.420	1.506	1.524
Thomsenolite	NaCaAlF ₆ ·H ₂ O	monocl	2.98	2	1.407	1.414	1.415
Thorianite	ThO ₂	cub	10.0	6.5	2.200		
Thorite	ThSiO ₄	tetr	6.7	4.8	1.8		
Topaz	Al ₂ SiO ₄ (OH,F) ₂	rhomb	3.53	8	1.618	1.620	1.627
Torbernite	Cu(UO ₂) ₂ (PO ₄) ₂ ·8H ₂ O	tetr	3.22	2.3	1.582	1.592	
Tourmaline	Na(Mg,Fe,Mn,Li,Al) ₃ Al ₆ Si ₆ O ₁₈ (BO ₃) ₃	rhomb	3.14	7	1.62	1.65	
Tremolite	Ca ₂ Mg ₅ Si ₈ O ₂₂ (OH,F) ₂	monocl	3.0	5.5	1.599	1.612	1.622
Trevorite	NiFe ₂ O ₄	cub	5.33	7.8	2.3		
Tridymite	SiO ₂	hex	2.27	7	1.475	1.476	1.479
Triphyllite-Lithiophyllite	Li(Fe,Mn)PO ₄	rhomb	3.46	4.5	1.68	1.68	1.69
Troegerite	(UO ₂) ₃ (AsO ₄) ₂ ·12H ₂ O	tetr		2.5	1.59	1.630	
Troilite	FeS	hex	4.7	4			
Trona	Na ₃ H(CO ₃) ₂ ·2H ₂ O	monocl	2.14	2.8	1.412	1.492	1.540
Turquoise	Cu(Al,Fe) ₆ (PO ₄) ₄ (OH) ₈ ·4H ₂ O	tricl	2.9	5.3	1.70	1.73	1.75
Ullmannite	NiSbS	cub	6.65	5.3			
Uraninite	UO ₂	cub	11.0	5.5			
Uvarovite	Ca ₃ Cr ₂ Si ₃ O ₁₂	cub	3.83	6.8	1.865		
Valentinite	Sb ₂ O ₃	orth	5.7	2.8	2.18	2.35	2.35
Vanadinite	Pb ₅ (VO ₄) ₃ Cl	hex	6.8	2.9	2.350	2.416	
Variseite-Strengite	(Al,Fe)(PO ₄)·2H ₂ O	rhomb	2.72	4	1.635	1.654	1.668
Vaterite	CaCO ₃	hex	2.71		1.550	1.645	
Vermiculite	(Mg,Ca) _{0.7} (Mg,Fe,Al) ₆ [(Al,Si) ₈ O ₂₀](OH) ₄ ·8H ₂ O	monocl	2.3	1.5	1.542	1.556	1.556
Vesuvianite	Ca ₁₀ (Mg,Fe) ₂ Al ₄ (Si ₂ O ₇) ₂ (SiO ₄) ₅ (OH,F) ₄	tetr	3.33	6.5	1.72	1.73	
Villiaumite	NaF	cub	2.78	2.3	1.327		
Vivianite	Fe ₃ (PO ₄) ₂ ·8H ₂ O	monocl	2.58	1.8	1.598	1.629	1.652
Wagnerite	Mg ₂ (PO ₄)F	monocl	3.15	5.3	1.568	1.572	1.582
Wavellite	Al ₃ (OH) ₃ (PO ₄) ₂ ·5H ₂ O	rhomb	2.36	3.6	1.527	1.535	1.553
Whewellite	CaC ₂ O ₄ ·H ₂ O	cub	2.2	2.8	1.491	1.554	1.650
Willemite	Zn ₂ SiO ₄	hex	4.1	5.5	1.691	1.719	
Witherite	BaCO ₃	orth	4.29	3.5	1.529	1.676	1.677
Wolframite	(Fe,Mn)WO ₄	monocl	7.3	4.3	2.26	2.32	2.42
Wollastonite	CaSiO ₃	monocl	2.92	4.8	1.628	1.639	1.642
Wulfenite	PbMoO ₄	tetr	6.7	2.9	2.283	2.403	
Wurtzite	ZnS	hex	4.09	3.8	2.356	2.378	
Xenotime	YPO ₄	tetr	4.8	4.5	1.721	1.816	
Zeunerite	Cu(UO ₂) ₂ (AsO ₄) ₂ ·10H ₂ O	tetr			1.606		
Zincite	ZnO	hex	5.6	4	2.013	2.029	
Zircon	ZrSiO ₄	tetr	4.6	7.5	1.94	1.99	
Zoisite	Ca ₂ Al ₃ Si ₃ O ₁₂ (OH)	rhomb	3.26	6	1.695	1.699	1.711

CRYSTALLOGRAPHIC DATA ON MINERALS

This table contains x-ray crystallographic data on about 400 common minerals, as well as selected crystalline elements. Entries are arranged alphabetically by mineral name. The columns are:

Name: Common name of the mineral.

Formula: Chemical formula for a typical sample of the mineral. Composition often varies considerably with the origin of the sample.

Crystal system: triclinic; monoclinic; orthorhombic; tetragonal; hexagonal; rhombohedral; cubic.

Structure type: Prototype for the structural arrangement of the crystallographic cell.

Z: Number of formula units per the unit cell.

a, b, c : Lengths of the cell edges in Å ($1 \text{ Å} = 10^{-8} \text{ cm}$).

α, β, γ : Angles between cell axes.

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Name	Formula	Crystal system	Structure type	Z	<i>a</i> /Å	<i>b</i> /Å	<i>c</i> /Å	α	β	γ
Acanthite	Ag ₂ S	monocl		4	4.228	6.928	7.862		99.58°	
Acmite(Aegirine)	NaFe(SiO ₃) ₂	monocl	diopside	4	9.658	8.795	5.294		107.42°	
Akermanite	Ca ₂ MgSi ₂ O ₇	tetr	melilite	2	7.8435		5.010			
Alabandite	MnS	cubic	rocksalt	4	5.223					
Almandine(Almandite)	Fe ₃ Al ₂ Si ₃ O ₁₂	cubic	garnet	8	11.526					
Altaite	PbTe	cubic	rocksalt	4	6.4606					
Aluminum	Al	cubic	copper	4	4.049					
Alunite	KAl ₃ (SO ₄) ₂ (OH) ₆	rhomb		3	6.982		17.32			
Analcite	NaAlSi ₂ O ₆ ·H ₂ O	cubic		16	13.733					
Anatase	TiO ₂	tetr		4	3.785		9.514			
Andalusite	Al ₂ OSiO ₄	orth		4	7.7959	7.8983	5.5583			
Andradite	Ca ₃ Fe ₂ Si ₃ O ₁₂	cubic	garnet	8	12.048					
Anglesite	PbSO ₄	orth	barite	4	8.480	5.398	6.958			
Anhydrite	CaSO ₄	orth	anhydrite	4	6.991	6.996	6.238			
Annite	KFe ₃ [AlSi ₃ O ₁₀](OH) ₂	monocl	1Mmica	2	10.29	9.33	5.39		105.1°	
Anorthite	CaAl ₂ Si ₂ O ₈	tricl	primitivecell	8	8.177	12.877	14.169	93.17°	115.85°	91.22°
Anthophyllite	Mg ₇ Si ₈ O ₂₂ (OH) ₂	orth		4	18.61	18.01	5.24			
Antimony	Sb	rhomb	arsenic	6	4.2996		11.2516			
Aragonite	CaCO ₃	orth	aragonite	4	5.741	7.968	4.959			
Arcanite	K ₂ SO ₄	orth	arcanite	4	5.772	10.072	7.483			
Argentite	Ag ₂ S	cubic		2	4.870					
Argentopyrite	AgFe ₂ S ₃	orth		4	6.64	11.47	6.45			
Arsenic	As	rhomb	arsenic	6	3.760		10.555			
Arsenolite	As ₂ O ₃	cubic	diamond	16	11.074					
Arsenopyrite	FeAsS	tricl		4	5.760	5.690	5.785	90.00°	112.23°	90.00°
Azurite	Cu ₃ (OH) ₂ (CO ₃) ₂	monocl		2	5.008	5.844	10.336		92.45°	
Baddeleyite	ZrO ₂	monocl	baddeleyite	4	5.1454	5.2075	5.3107		99.23°	
Banalsite	BaNa ₂ Al ₄ Si ₄ O ₁₆	orth		4	8.50	9.97	16.72			
Barite	BaSO ₄	orth	barite	4	8.878	5.450	7.152			
Berlinite	AlPO ₄	hex	α -quartz	3	4.942		10.97			
Beryl	Be ₃ Al ₂ (SiO ₃) ₆	hex	beryl	2	9.215		9.192			
Berzelianite	Cu ₂ Se	cubic		4	5.85					
Bismite	Bi ₂ O ₃	monocl	pseudo-orth	4	7.48	8.14	5.83		112.9°	
Bismuth	Bi	rhomb	arsenic	6	4.5367		11.8383			
Bismuthinite	Bi ₂ S ₃	orth	stibnite	4	11.150	11.300	3.981			
Bixbyite	Mn ₂ O ₃	cubic	thalliumtrioxide	16	9.411					
Boehmite	AlO(OH)	orth	lepidocrocite	4	2.868	12.227	3.700			
Borax	Na ₂ B ₄ O ₇ ·10H ₂ O	monocl		4	11.858	10.674	12.197		106.68°	
Bornite(metastable)	Cu ₅ FeS ₄	cubic		8	10.94					
Breithauptite	NiSb	hex	niccolite	2	3.942		5.155			
Brochantite	Cu ₄ SO ₄ (OH) ₆	monocl		4	13.066	9.85	6.022		103.27°	
Bromargyrite	AgBr	cubic	rocksalt	4	5.7745					
Bromellite	BeO	hex	zincite	2	2.6979		4.3772			
Brookite	TiO ₂	orth		8	5.456	9.182	5.143			
Brucite	Mg(OH) ₂	hex	cadmiumiodide	1	3.147		4.769			

Name	Formula	Crystal system	Structure type	Z	<i>a</i> /Å	<i>b</i> /Å	<i>c</i> /Å	α	β	γ
Bunsenite	NiO	cubic	rocksalt	4	4.177					
Bustamite	CaMn(SiO ₃) ₂	tricl		6	7.736	7.157	13.824	90.52°	94.58°	103.87°
Cadmiumtelluride	CdTe	cubic	sphalerite	4	6.4805					
Cadmoselite	CdSe	hex	zincite	2	4.2977		7.0021			
Calcite	CaCO ₃	rhom	calcite	6	4.9899		17.064			
Calomel	Hg ₂ Cl ₂	tetr		4	4.478		10.910			
Carbonate-apatite	Ca ₁₀ (PO ₄) ₆ CO ₃ ·H ₂ O	hex	apatite	1	9.436		6.883			
Cassiterite	SnO ₂	tetr	rutile	2	4.738		3.188			
Cattierite	CoS ₂	cubic	pyrite	4	5.5345					
Celestite	SrSO ₄	orth	barite	4	8.359	5.352	6.866			
Celsian	BaAl ₂ Si ₂ O ₈	monocl		8	8.627	13.045	14.408		115.20°	
Cerianite	CeO ₂	cubic	fluorite	4	5.4110					
Cerussite	PbCO ₃	orth	aragonite	4	6.152	8.436	5.195			
Cervantite	Sb ₂ O ₄	orth		4	5.424	11.76	4.804			
Chalcanthite	CuSO ₄ ·5H ₂ O	tricl		2	6.1045	10.72	5.949	97.57°	107.28°	77.43°
Chalcocite	Cu ₂ S	orth		96	11.881	27.323	13.491			
Chalcopyrite	CuFeS ₂	tetr		4	5.2988		10.434			
Chlorapatite	Ca ₅ (PO ₄) ₃ Cl	hex	apatite	2	9.629		6.777			
Chlorargyrite	AgCl	cubic	rocksalt	4	5.5491					
Chloritoid	FeAl ₄ O ₂ (SiO ₄) ₂ (OH) ₄	monocl		8	9.48	5.48	18.18		101.77°	
Chloromagnesite	MgCl ₂	rhom		3	3.632		17.795			
Chondrodite	2Mg ₂ SiO ₄ ·MgF ₂	monocl		2	7.89	4.743	10.29		109.03°	
Chrysoberyl	BeAl ₂ O ₄	orth	olivine	4	5.4756	9.4041	4.4267			
Cinnabar	HgS	hex	cinnabar	3	4.149		9.495			
Claudeteite	As ₂ O ₃	monocl		4	5.339	12.984	4.5405		94.27°	
Clausthalite	PbSe	cubic	rocksalt	4	6.1255					
Clinoenstatite	MgSiO ₃	monocl		8	9.620	8.825	5.188		108.33°	
Clinoferrosilite	FeSiO ₃	monocl		8	9.7085	9.0872	5.2284		108.43°	
Clinohumite	4Mg ₂ SiO ₄ ·MgF ₂	monocl		2	13.68	4.75	10.27		100.83°	
Clinozoisite	Ca ₂ Al ₃ (SiO ₄) ₃ OH	monocl		2	8.887	5.581	10.14		115.93°	
Cobaltolivine	Co ₂ SiO ₄	orth	olivine	4	4.782	10.301	6.003			
Cobaltoxide	CoO	cubic	rocksalt	4	4.260					
Cobaltsulfide	CoS	cubic	sphalerite	4	5.339					
Cobalttitanate	CoTiO ₃	rhom	ilmenite	6	5.066		13.918			
Cobaltcalcite	CoCO ₃	rhom	calcite	6	4.6581		14.958			
Cobaltite	CoAsS	cubic	NiSbS	4	5.60					
Coesite	SiO ₂	monocl		16	7.152	12.379	7.152		120.00°	
Coffinite	USiO ₄	tetr	zircon	4	6.995		6.263			
Colemanite	Ca ₂ B ₆ O ₁₁ ·5H ₂ O	monocl		4	8.743	11.264	6.102		110.12°	
Coloradoite	HgTe	cubic	sphalerite	4	6.4600					
Cooperite	PtS	tetr		2	3.4699		6.1098			
Copper	Cu	cubic	face-centeredcubic	4	3.6150					
Corundum	Al ₂ O ₃	rhom	corundum	6	4.7591		12.9894			
Cotunnite	PbCl ₂	orth		4	4.535	7.62	9.05			
Covellite	CuS	hex		6	3.792		16.34			

Name	Formula	Crystal system	Structure type	Z	a/Å	b/Å	c/Å	α	β	γ
Cristobalite(α)	SiO ₂	tetr		4	4.971		6.918			
Cristobalite(β)	SiO ₂	cubic		8	7.1382					
Cryolite	Na ₃ AlF ₆	monocl		2	5.40	5.60	7.776		90.18°	
Cubanite	CuFe ₂ S ₃	orth		4	6.46	11.12	6.23			
Cummingtonite	(Mg,Fe,Mn) ₇ (Si ₄ O ₁₁) ₂ (OH) ₂	monocl	tremolite	2	9.522	18.223	5.332		101.92°	
Cuprite	Cu ₂ O	cubic		2	4.2696					
Danburite	CaB ₂ Si ₂ O ₈	orth		4	8.04	8.77	7.74			
Datolite	CaBSiO ₄ (OH)	monocl		4	9.62	7.60	4.84		90.15°	
Daubreeite	FeCr ₂ S ₄	cubic	spinel	8	9.966					
Diamond	C	cubic	diamond	8	3.5670					
Diaspore	AlO(OH)	orth		4	4.401	9.421	2.845			
Dickite	Al ₂ Si ₂ O ₅ (OH) ₄	monocl		4	5.150	8.940	14.736		103.58°	
Digenite	Cu _{1.79} S	cubic	deformedfluorite	4	5.5695					
Diopside	CaMg(SiO ₃) ₂	monocl	diopside	4	9.743	8.923	5.251		105.93°	
Diopase	CuSiO ₂ (OH) ₂	rhomb	phenacite	18	14.61		7.80			
Dolerophanite	Cu ₂ O(SO ₄)	monocl		4	8.334	6.312	7.628		108.4°	
Dolomite	CaMg(CO ₃) ₂	rhomb	calcite	3	4.8079		16.010			
Dravite	NaMg ₃ Al ₆ B ₃ Si ₆ O ₂₇ (OH) ₄	rhomb	tourmaline	3	15.942		7.224			
Elbaite	NaLiAl _{7.67} B ₃ Si ₆ O ₂₇ (OH) ₄	rhomb	tourmaline	3	15.842		7.009			
Enargite	Cu ₃ AsS ₄	orth		2	6.426	7.422	6.144			
Enstatite	MgSiO ₃	orth		16	8.829	18.22	5.192			
Epidote	Ca ₂ Al ₂ (Al,Fe)OH(SiO ₄) ₃	monocl		2	8.89	5.63	10.19		115.40°	
Epsomite	MgSO ₄ ·7H ₂ O	orth		4	11.86	11.99	6.858			
Eskolaite	Cr ₂ O ₃	rhomb	corundum	6	4.9607		13.599			
Eucairite	AgCuSe	orth		10	4.105	20.35	6.31			
Euclase	AlBeSiO ₄ (OH)	monocl		4	4.763	14.29	4.618		100.25°	
Famatimite	Cu ₃ SbS ₄	tetr		2	5.384		10.770			
Fayalite	Fe ₂ SiO ₄	orth	olivine	4	4.817	10.477	6.105			
Fe-Cordierite	Fe ₂ Al ₃ (AlSi ₅ O ₁₈)	orth	cordierite	4	9.726	17.065	9.287			
Fe-Gehlenite	Ca ₂ Fe ₂ SiO ₇	tetr	melilite	2	7.54		4.855			
Fe-Indialite	Fe ₂ Al ₃ (AlSi ₅ O ₁₈)	hex	beryl	2	9.860		9.285			
Fe-Leucite	KFeSi ₂ O ₆	tetr		16	13.205		13.970			
Fe-Microcline	KFeSi ₃ O ₈	tricl		4	8.68	13.10	7.340	90.75°	116.05°	86.23°
Fe-Sanidine	KFeSi ₃ O ₈	monocl		4	8.689	13.12	7.319		116.10°	
Fe-Skutterudite	FeAs _{2.95}	cubic		8	8.1814					
Ferberite	FeWO ₄	monocl	wolframite	2	4.732	5.708	4.965		90.00°	
Ferriannite	KFe ₃ [FeSi ₃ O ₁₀](OH) ₂	monocl		2	5.430	9.404	10.341		100.07°	
Ferroselite	FeSe ₂	orth	marcasite	2	4.801	5.778	3.587			
Ferrotremolite	Ca ₂ Fe ₅ [Si ₈ O ₂₂](OH) ₂	monocl	tremolite	2	9.97	18.34	5.30		104.50°	
Fluor-edenite	NaCa ₂ Mg ₅ [AlSi ₇ O ₂₂]F ₂	monocl	tremolite	2	9.847	18.00	5.282		104.83°	
Fluor-humite	3Mg ₂ SiO ₄ ·MgF ₂	orth		4	10.243	20.72	4.735			
Fluor-norbergite	Mg ₂ SiO ₄ ·MgF ₂	orth		4	8.727	10.271	4.709			
Fluor-phlogopite	KMg ₃ [AlSi ₃ O ₁₀]F ₂	monocl	1Mmica	2	5.299	9.188	10.135		99.92°	
Fluor-richterite	Na ₂ CaMg ₅ [Si ₈ O ₂₂]F ₂	monocl	tremolite	2	9.823	17.96	5.268		104.33°	
Fluor-tremolite	Ca ₂ Mg ₅ [Si ₈ O ₂₂]F ₂	monocl	tremolite	2	9.781	18.01	5.267		104.52°	

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CRYSTALLOGRAPHIC DATA ON MINERAL(S) (continued)

Name	Formula	Crystal system	Structure type	Z	<i>a</i> /Å	<i>b</i> /Å	<i>c</i> /Å	α	β	γ
Fluorapatite	Ca ₅ (PO ₄) ₃ F	hex	apatite	2	9.3684		6.8841			
Fluorite	CaF ₂	cubic	fluorite	4	5.4638					
Forsterite	Mg ₂ SiO ₄	orth	olivine	4	4.758	10.214	5.984			
Frohbergite	FeTe ₂	orth	marcasite	2	5.265	6.265	3.869			
Gahnite	ZnAl ₂ O ₄	cubic	spinel	8	8.0848					
Galaxite	MnAl ₂ O ₄	cubic	spinel	8	8.258					
Galena	PbS	cubic	rocksalt	4	5.9360					
Galliumoxide	Ga ₂ O ₃	rhomb	corundum	6	4.9793		13.429			
Gehlenite	Ca ₂ Al ₂ SiO ₇	tetr	melilite	2	7.690		5.0675			
Geikielite	MgTiO ₃	rhomb	ilmenite	6	5.054		13.898			
Gerhardite	Cu ₂ (NO ₃)(OH) ₃	orth		4	6.075	13.812	5.592			
Gersdorffite	NiAsS	cubic		4	5.693					
Gibbsite	Al(OH) ₃	monocl		8	9.719	5.0705	8.6412		94.57°	
Glauchroite	CaMnSiO ₄	orth	olivine	4	4.944	11.19	6.529			
Glaucodot	(Co,Fe)AsS	orth		24	6.64	28.39	5.64			
GlaucofaniteI	Na ₂ Mg ₃ Al ₂ [Si ₈ O ₂₂](OH) ₂	monocl	tremolite	2	9.748	17.915	5.273		102.78°	
GlaucofaniteII	Na ₂ Mg ₃ Al ₂ [Si ₈ O ₂₂](OH) ₂	monocl	tremolite	2	9.663	17.696	5.277		103.67°	
Goethite	FeO(OH)	orth		4	4.596	9.957	3.021			
Gold	Au	cubic	face-centeredcubic	4	4.0786					
Goldmanite	Ca ₃ V ₂ Si ₃ O ₁₂	cubic	garnet	8	12.070					
Goslarite	ZnSO ₄ ·7H ₂ O	orth	epsomite	4	11.779	12.050	6.822			
Graphite	C	hex	graphite	4	2.4612		6.7079			
Greenockite	CdS	hex	zincite	2	4.1354		6.7120			
Greigite	Fe ₃ S ₄	cubic	spinel	8	9.876					
Grossularite	Ca ₃ Al ₂ Si ₃ O ₁₂	cubic	garnet	8	11.851					
Grunerite	Fe ₇ [Si ₈ O ₂₂](OH) ₂	monocl	tremolite	2	9.572	18.44	5.342		101.77°	
Gudmundite	FeSbS	monocl		8	10.00	5.93	6.73		90.00°	
Gypsum	CaSO ₄ ·2H ₂ O	monocl		4	5.68	15.18	6.29		113.83°	
Hafnia	HfO ₂	monocl	baddeleyite	4	5.1156	5.1722	5.2948		99.18°	
Halite	NaCl	cubic	rocksalt	4	5.6402					
Hambegite	Be ₂ (OH,F)BO ₃	orth		8	9.755	12.201	4.426			
Hardystonite	Ca ₂ ZnSi ₂ O ₇	tetr	melilite	2	7.87		5.01			
Hauerite	MnS ₂	cubic	pyrite	4	6.1014					
Hausmannite	Mn ₃ O ₄	tetr		8	8.136		9.422			
Hawleyite	CdS	cubic	sphalerite	4	5.833					
Heazlewoodite	Ni ₃ S ₂	rhomb		3	5.746		7.134			
Hedenbergite	CaFe(SiO ₃) ₂	monocl	diopside	4	9.854	9.024	5.263		104.23°	
Hematite	Fe ₂ O ₃	rhomb	corundum	6	5.025		13.735			
Hemimorphite	Zn ₄ (OH) ₂ Si ₂ O ₇ ·H ₂ O	orth		2	8.370	10.719	5.120			
Hercynite	Fe(AlO ₂) ₂	cubic	spinel	8	8.150					
Herzenbergite	SnS	orth	germaniumsulfide	4	4.328	11.190	3.978			
Hessite	Ag ₂ Te	monocl		4	8.13	4.48	8.09		111.9°	
Hexahydrate	MgSO ₄ ·6H ₂ O	monocl		8	10.110	7.212	24.41		98.30°	
Highalbite(Analbite)	NaAlSi ₃ O ₈	tricl		4	8.160	12.870	7.106	93.54°	116.36°	90.19°
Highargentite	Ag ₂ S	cubic		4	6.269					

Name	Formula	Crystal system	Structure type	Z	<i>a</i> /Å	<i>b</i> /Å	<i>c</i> /Å	α	β	γ
Highbornite	Cu ₅ FeS ₄	cubic		1	5.50					
Highcarnegeite	NaAlSiO ₄	cubic		4	7.325					
Highchalcocite	Cu ₂ S	hex		2	3.961		6.722			
Highclinoenstatite	MgSiO ₃	tricl		8	10.000	8.934	5.170	88.27°	70.03°	91.01°
Highdigenite	Cu ₂ S	cubic		4	5.725					
Highgermania	GeO ₂	hex	α -quartz	3	4.987		5.652			
Highleucite	KAlSi ₂ O ₆	cubic		16	13.43					
Highnaumanite	Ag ₂ Se	cubic		2	4.993					
Highsanidine	KAlSi ₃ O ₈	monocl		4	8.615	13.031	7.177		115.98°	
Huebnerite	MnWO ₄	monocl	wolframite	2	4.834	5.758	4.999		91.18°	
Huntite	Mg ₃ Ca(CO ₃) ₄	rhomb	calcite	3	9.498		7.816			
Hydroxylapatite	Ca ₅ (PO ₄) ₃ OH	hex	apatite	2	9.418		6.883			
Ice	H ₂ O	hex		4	4.5212		7.3666			
Ilmenite	FeTiO ₃	rhomb	ilmenite	6	5.093		14.055			
Indialite(Cordierite)	Mg ₂ Al ₃ (AlSi ₅ O ₁₈)	hex	beryl	2	9.7698		9.3517			
Iodargyrite	AgI	hex	zincite	2	4.5955		7.5005			
Iron (α)	Fe	cubic	body-centeredcubic	2	2.8664					
Jacobsite	MnFe ₂ O ₄	cubic	spinel	8	8.499					
Jadeite	NaAl(SiO ₃) ₂	monocl	diopside	4	9.409	8.564	5.220		107.50°	
Jalpaite	Ag _{1.55} Cu _{0.45} S	tetr		16	8.673		11.756			
Johannsenite	CaMn(SiO ₃) ₂	monocl	diopside	4	9.83	9.04	5.27		105.00°	
Kaliophilite	KAlSiO ₄	hex		54	26.930		8.522			
Kalsilite	KAlSiO ₄	hex		2	5.1597		8.7032			
Kaolinite	Al ₂ Si ₂ O ₅ (OH) ₄	tricl		2	5.155	8.959	7.407	91.68°	104.87°	89.93°
Karelianite	V ₂ O ₃	rhomb	corundum	6	4.952		14.002			
Keatite	SiO ₂	tetr		12	7.456		8.604			
Kernite	Na ₂ B ₄ O ₇ ·4H ₂ O	monocl		4	7.022	9.151	15.676		108.83°	
Kerschsteinite	CaFeSiO ₄	orth	olivine	4	4.886	11.146	6.434			
Klockmannite	CuSe	hex	deformedcovellite	78	14.206		17.25			
Knebelite	MnFeSiO ₄	orth	olivine	4	4.854	10.602	6.162			
Kyanite	Al ₂ OSiO ₄	tricl		4	7.123	7.848	5.564	89.92°	101.25°	105.97°
Larnite	Ca ₂ SiO ₄	monocl		4	5.48	6.76	9.28		94.55°	
Laurite	RuS ₂	cubic	pyrite	4	5.60					
Lawrencite	FeCl ₂	rhomb		3	3.593		17.58			
Lawsonite	CaAl ₂ Si ₂ O ₇ (OH) ₂ ·H ₂ O	orth		4	8.787	5.836	13.123			
Lead	Pb	cubic	face-centeredcubic	4	4.9505					
Leonhardtite	MgSO ₄ ·4H ₂ O	monocl		4	5.922	13.604	7.905		90.85°	
Lepidocrocite	FeO(OH)	orth		4	3.868	12.525	3.066			
Lepidolite	K ₂ Al ₃ Li ₂ AlSi ₇ O ₂₀ (OH) ₄	monocl	2M2mica	2	9.2	5.3	20.0		98.00°	
Leucite	KAlSi ₂ O ₆	tetr		16	13.074		13.738			
Lime	CaO	cubic	rocksalt	4	4.8108					
Limeolivine	Ca ₂ SiO ₄	orth	olivine	4	5.091	11.371	6.782			
Linnaeite	Co ₃ S ₄	cubic	spinel	8	9.401					
Litharge	PbO	tetr		2	3.9759		5.023			
Loellingite	FeAs ₂	orth	marcasite	2	5.300	5.981	2.882			

Name	Formula	Crystal system	Structure type	Z	<i>a</i> /Å	<i>b</i> /Å	<i>c</i> /Å	α	β	γ
Lowalbite	NaAlSi ₃ O ₈	tricl		4	8.139	12.788	7.160	94.27°	116.57°	87.68°
Lowbornite	Cu ₅ FeS ₄	tetr		16	10.94		21.88			
Lowcordierite	Mg ₂ Al ₃ (AlSi ₅ O ₁₈)	orth		4	9.721	17.062	9.339			
Lowgermania	GeO ₂	tetr	rutile	2	4.3963		2.8626			
Lownepheline	NaAlSiO ₄	hex		8	9.986		8.330			
Luzonite	Cu ₃ AsS ₄	tetr		2	5.289		10.440			
Mackinawite	FeS	tetr		2	3.675		5.030			
Magnesioriebeckite	Na ₂ Mg ₃ Fe ₂ [Si ₈ O ₂₂](OH) ₂	monocl	tremolite	2	9.733	17.946	5.299		103.30°	
Magnesite	MgCO ₃	rhomb	calcite	6	4.6330		15.016			
Magnetite	Fe ₃ O ₄	cubic	spinel	8	8.3940					
Malachite	Cu ₂ (OH) ₂ CO ₃	monocl		4	9.502	11.974	3.240		98.75°	
Maldonite	Au ₂ Bi	cubic		8	7.958					
Manganesesulfide(γ)	MnS	hex	zincite	2	3.976		6.432			
Manganesesulfide(β)	MnS	cubic	sphalerite	4	5.611					
Manganosite	MnO	cubic	rocksalt	4	4.4448					
Marcasite	FeS ₂	orth	marcasite	2	4.443	5.423	3.3876			
Margarite	CaAl ₂ [AlSi ₂ O ₁₀](OH) ₂	monocl	2Mmica	4	5.13	8.92	19.50		95.00°	
Marialite	Na ₄ Al ₃ Si ₉ O ₂₄ Cl	tetr		2	12.064		7.514			
Marshite	CuI	cubic	sphalerite	4	6.0507					
Mascagnite	(NH ₄) ₂ SO ₄	orth	arcanite	4	7.782	5.993	10.636			
Massicot	PbO	orth		4	5.489	4.755	5.891			
Matlockite	PbClF	tetr		2	4.106		7.23			
Maucherite	Ni ₁₁ As ₈	tetr		4	6.870		21.81			
Meionite	Ca ₄ Al ₆ Si ₆ O ₂₄ CO ₃	tetr		2	12.174		7.652			
Melanophlogite	SiO ₂	cubic	clathratetype	46	13.402					
Melanterite	FeSO ₄ ·7H ₂ O	monocl		4	14.072	6.503	11.041		105.57°	
Melonite	NiTe ₂	hex	cadmiumiodide	1	3.869		5.308			
Metacinnabar	HgS	cubic	sphalerite	4	5.8517					
Miargyrite	AgSbS ₂	monocl		8	12.862	4.111	13.220		98.63°	
Microcline	KAlSi ₃ O ₈	tricl		4	8.582	12.964	7.222	90.62°	115.92°	87.68°
Miersite	AgI	cubic	sphalerite	4	6.4963					
Millerite	NiS	rhomb		9	9.616		3.152			
Minium	Pb ₃ O ₄	tetr		4	8.815		6.565			
Minnesotaite	Fe ₃ Si ₄ O ₁₀ (OH) ₂	monocl		4	5.4	9.42	19.4		100.00°	
Mirabilite	Na ₂ SO ₄ ·10H ₂ O	monocl		4	11.51	10.38	12.83		107.75°	
Mn-Indialite	Mn ₂ Al ₃ (AlSi ₅ O ₁₈)	hex	beryl	2	9.925		9.297			
Molybdenite	MoS ₂	hex	molybdenite	2	3.1604		12.295			
Molybdenum	Mo	cubic		2	3.1653					
Molybdite	MoO ₃	orth		4	3.962	13.858	3.697			
Monteponite	CdO	cubic	rocksalt	4	4.6953					
Monticellite	CaMgSiO ₄	orth	olivine	4	4.827	11.084	6.376			
Montroydite	HgO	orth		4	6.608	5.518	3.519			
Mullite(2:1)	2Al ₂ O ₃ ·SiO ₂	orth		6	7.5788	7.6909	2.8883			
Mullite(3:2)	3Al ₂ O ₃ ·2SiO ₂	orth		3	7.557	7.6876	2.8842			
Muscovite	KAl ₂ AlSi ₃ O ₁₀ (OH) ₂	monocl	2M2mica	4	5.203	8.995	20.030		94.47°	

Name	Formula	Crystal system	Structure type	Z	a/Å	b/Å	c/Å	α	β	γ
Nacrite	Al ₂ Si ₂ O ₅ (OH) ₄	monocl		4	8.909	5.146	15.697		113.70°	
Nantokite	CuCl	cubic	sphalerite	4	5.416					
Natroalunite	NaAl ₃ (SO ₄) ₂ (OH) ₆	rhomb		3	6.974		16.69			
Natrolite	Na ₂ Al ₂ Si ₃ O ₁₀ ·2H ₂ O	orth		8	18.30	18.63	6.60			
Neighborite	NaMgF ₃	orth	perovskite	4	5.363	7.676	5.503			
Ni-Skutterudite	NiAs _{2.95}	cubic		8	8.3300					
Niccolite	NiAs	hex	niccolite	2	3.618		5.034			
Nickel	Ni	cubic	face-centeredcubic	4	3.5238					
Nickelcarbonate	NiCO ₃	rhomb	calcite	6	4.5975		14.723			
Nickelolivine	Ni ₂ SiO ₄	orth	olivine	4	4.727	10.121	5.915			
Nickelselenide	NiSe ₂	cubic	pyrite	4	5.9604					
Niter	KNO ₃	orth	aragonite	4	6.431	9.164	5.414			
Norsethite	BaMg(CO ₃) ₂	rhomb	calcite	3	5.020		16.75			
Oldhamite	CaS	cubic	rocksalt	4	5.689					
Orpiment	As ₂ S ₃	monocl		4	11.49	9.59	4.25		90.45°	
Orthoclase	KAlSi ₃ O ₈	monocl		4	8.562	12.996	7.193		116.02°	
Orthoferrosilite	FeSiO ₃	orth	enstatite	16	9.080	18.431	5.238			
Otavite	CdCO ₃	rhomb	calcite	6	4.9204		16.298			
Paracelsian	BaAl ₂ Si ₂ O ₈	monocl		4	8.58	9.583	9.08		90.00°	
Paragonite	NaAl ₂ AlSi ₃ O ₁₀ (OH) ₂	monocl	2M1mica	4	5.13	8.89	19.32		95.17°	
Pararammelsbergite	NiAs ₂	orth		8	5.75	5.82	11.428			
Paratellurite	TeO ₂	tetr		4	4.810		7.613			
Parawollastonite	CaSiO ₃	monocl		12	15.417	7.321	7.066		95.40°	
Pectolite	Ca ₂ NaH(SiO ₃) ₃	tricl		2	7.99	7.04	7.02	90.05°	95.27°	102.47°
Pentlandite	Fe _{5.25} Ni _{3.75} S ₈	cubic		4	10.196					
Pentlandite	Fe _{4.75} Ni _{5.25} S ₈	cubic		4	10.095					
Periclase	MgO	cubic	rocksalt	4	4.2117					
Perovskite	CaTiO ₃	orth	perovskite	4	5.3670	7.6438	5.4439			
Petalite	LiAlSi ₄ O ₁₀	monocl		2	11.32	5.14	7.62		105.90°	
Petzite	Ag ₃ AuTe ₂	cubic		8	10.38					
Phenacite	Be ₂ SiO ₄	rhomb	phenacite	18	12.472		8.252			
Phlogopite	KMg ₃ AlSi ₃ O ₁₀ (OH) ₂	monocl	1Mmica	2	5.326	9.210	10.311		100.17°	
Picrochromite	MgCr ₂ O ₄	cubic	spinel	8	8.333					
Piemontite	Ca ₂ Al _{1.5} Mn _{1.5} (SiO ₄) ₃ OH	monocl		2	8.95	5.70	9.41		115.70°	
Platinum	Pt	cubic	face-centeredcubic	4	3.9231					
Polymidite	Ni ₃ S ₄	cubic	spinel	8	9.480					
Portlandite	Ca(OH) ₂	hex	cadmiumiodide	1	3.5933		4.9086			
Powellite	CaMoO ₄	tetr	scheelite	4	5.226		11.43			
Protoenstatite	MgSiO ₃	orth		8	9.25	8.74	5.32			
Proustite	Ag ₃ AsS ₃	rhomb		6	10.816		8.6948			
Pseudowollastonite	CaSiO ₃	tricl		24	6.90	11.78	19.65	90.00°	90.80°	90.00°
Pyrrargyrite	Ag ₃ SbS ₃	rhomb		6	11.052		8.7177			
Pyrite	FeS ₂	cubic	pyrite	4	5.4175					
Pyrolusite	MnO ₂	tetr	rutile	2	4.388		2.865			
Pyrope	Mg ₃ Al ₂ Si ₃ O ₁₂	cubic	garnet	8	11.459					

CRYSTALLOGRAPHIC DATA ON MINERALS (continued)

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Name	Formula	Crystal system	Structure type	Z	a/Å	b/Å	c/Å	α	β	γ
Pyrophanite	MnTiO ₃	rhomb	ilmenite	6	5.155		14.18			
Pyrophyllite	Al ₂ Si ₄ O ₁₀ (OH) ₂	monocl	2M1 mica	4	5.14	8.90	18.55		99.92°	
Pyroxmangite	MnFe(SiO ₃) ₂	tricl		7	7.56	17.45	6.67	84.00°	94.30°	113.70°
Pyrrhotite	Fe _{0.980} S	hex	defectniccolite	2	3.446		5.848			
Pyrrhotite	Fe _{0.885} S	hex	defectniccolite	2	3.440		5.709			
Quartz(α)	SiO ₂	hex		3	4.9136		5.4051			
Quartz(β)	SiO ₂	hex		3	4.999		5.4592			
Rammelsbergite	NiAs ₂	orth	marcasite	2	4.757	5.797	3.542			
Realgar	AsS	monocl		16	9.29	13.53	6.57		106.55°	
Retgersite	NiSO ₄ ·4H ₂ O	tetr		4	6.782		18.28			
Rhodochrosite	MnCO ₃	rhomb	calcite	6	4.7771		15.664			
Rhodonite	MnSiO ₃	tricl		10	7.682	11.818	6.707	92.36°	93.95°	105.66°
Riebeckite	Na ₂ Fe ₅ FSi ₈ O ₂₂ (OH) ₂	monocl	tremolite	2	9.729	18.065	5.334		103.31°	
Rutile	TiO ₂	tetr		2	4.5937		2.9618			
Safflorite	Co _{0.5} Fe _{0.5} As ₂	orth	marcasite	2	5.231	5.953	2.962			
Sanmartinite	ZnWO ₄	monocl	wolframite	2	4.691	5.720	4.925		89.36°	
Sapphirine	Mg ₂ Al ₄ O ₆ SiO ₄	monocl		8	9.96	28.60	9.85		110.5°	
Scacchite	MnCl ₂	rhomb		3	3.711		17.59			
Scheelite	CaWO ₄	tetr	scheelite	4	5.242		11.372			
Schorl	NaFe ₃ Al ₆ B ₃ Si ₆ O ₂₇ (OH) ₄	rhomb	tourmaline	3	16.032		7.149			
Selenium	Se	hex		3	4.3642		4.9588			
Selenolite	SeO ₂	tetr		8	8.35		5.05			
Sellaite	MgF ₂	tetr	rutile	2	4.621		3.050			
Senarmontite	Sb ₂ O ₃	cubic	arsenitrioxide	16	11.152					
Shandite	Ni ₃ Pb ₂ S ₂	rhomb		3	5.576		13.658			
Shortite	Na ₂ Ca ₂ (CO ₃) ₃	orth		2	4.961	11.03	7.12			
Siderite	FeCO ₃	rhomb	calcite	6	4.6887		15.373			
Silicon	Si	cubic	diamond	8	5.4305					
Sillimanite	Al ₂ OSiO ₄	orth		4	7.4843	7.6730	5.7711			
Silver	Ag	cubic	face-centeredcubic	4	4.0862					
SilvertellurideI	Ag ₂ Te	cubic		2	5.29					
SilvertellurideII	Ag ₂ Te	cubic		4	6.585					
Smithsonite	ZnCO ₃	rhomb	calcite	6	4.6528		15.025			
Sodanite	NaNO ₃	rhomb	calcite	6	5.0696		16.829			
Sodiummelilite	NaCaAlSi ₂ O ₇	tetr	melilite	2	8.511		4.809			
Sperrylite	PtAs ₂	cubic	pyrite	4	5.968					
Spessartite	Mn ₃ Al ₂ Si ₃ O ₁₂	cubic	garnet	8	11.621					
Sphalerite	ZnS	cubic	sphalerite	4	5.4093					
Sphene	CaTiSiO ₅	monocl		4	7.07	8.72	6.56		113.95°	
Spinel	MgAl ₂ O ₄	cubic	spinel	8	8.080					
Spodumene	LiAl(SiO ₃) ₂	monocl	diopside	4	9.451	8.387	5.208		110.07°	
Spodumene(β)	LiAl(SiO ₃) ₂	tetr		4	7.5332		9.1540			
Staurolite	Fe ₂ Al ₉ Si ₄ O ₂₂ (OH) ₂	monocl		2	7.90	16.65	5.63		90.00°	
Sternbergite	AgFe ₂ S ₃	orth		8	11.60	12.675	6.63			
Stibnite	Sb ₂ S ₃	orth	stibnite	4	11.229	11.310	3.8389			

Name	Formula	Crystal system	Structure type	Z	a/Å	b/Å	c/Å	α	β	γ
Stilleite	ZnSe	cubic	sphalerite	4	5.6685					
Stishovite	SiO ₂	tetr	rutile	2	4.1790		2.6649			
Stolzite	PbWO ₄	tetr	scheelite	4	5.4616		12.046			
Stromeyerite	Ag _{0.93} Cu _{1.07} S	orth		4	4.066	6.628	7.972			
Strontianite	SrCO ₃	orth	aragonite	4	6.029	8.414	5.107			
Sulfur(monoclinic)	S	monocl	S8ringmolecules	48	11.04	10.98	10.92		96.73 °	
Sulfur(orthorhombic)	S	orth	S8ringmolecules	128	10.4646	12.8660	24.4860			
Sulfur(rhombohedral)	S	rhomb	S6ringmolecules	18	10.818		4.280			
Sylvite	KCl	cubic	rocksalt	4	6.2931					
Syngenite	K ₂ Ca(SO ₄) ₂ ·H ₂ O	monocl		2	9.775	7.156	6.251		104.00°	
Syntheticanorthite	CaAl ₂ Si ₂ O ₈	hex		2	5.10		14.72			
Syntheticanorthite	CaAl ₂ Si ₂ O ₈	orth		2	8.22	8.60	4.83			
Talc	Mg ₃ Si ₄ O ₁₀ (OH) ₂	monocl	2M1mica	4	5.287	9.158	18.95		99.50 °	
Tantalum	Ta	cubic	tungsten	2	3.3058					
Teallite	PbSnS ₂	orth	germaniumsulfide	2	4.266	11.419	4.090			
Tellurite	TeO ₂	orth	tellurite	8	5.607	12.034	5.463			
Tellurium	Te	hex	selenium	3	4.4570		5.9290			
Tellurobismuthite	Bi ₂ Te ₃	rhomb		3	4.3835		30.487			
Tennantite	Cu ₁₂ As ₄ S ₁₃	cubic	tetrahedrite	2	10.190					
Tenorite	CuO	monocl		4	4.684	3.425	5.129		99.47°	
Tephroite	Mn ₂ SiO ₄	orth	olivine	4	4.871	10.636	6.232			
Tetrahedrite	Cu ₁₂ Sb ₄ S ₁₃	cubic	tetrahedrite	2	10.327					
Thenardite	Na ₂ SO ₄	orth	thenardite	8	5.863	12.304	9.821			
Thorianite	ThO ₂	cubic	fluorite	4	5.5952					
Thorite	ThSiO ₄	tetr	zircon	4	7.143		6.327			
Tiemannite	HgSe	cubic	sphalerite	4	6.0853					
Tin	Sn	tetr		4	5.8315		3.1813			
Titanium	Ti	hex		2	2.953		4.729			
Titanium(III)oxide	Ti ₂ O ₃	rhomb	corundum	6	5.149		13.642			
Topaz	Al ₂ SiO ₄ (OH,F) ₂	orth		4	8.394	8.792	4.649			
Tremolite	Ca ₂ Mg ₅ Si ₈ O ₂₂ (OH) ₂	monocl	tremolite	2	9.840	18.052	5.275		104.70°	
Trevorite	NiFe ₂ O ₄	cubic	spinel	8	8.339					
Tridymite(β)	SiO ₂	hex		4	5.0463		8.2563			
Trogtalite	CoSe ₂	cubic	pyrite	4	5.8588					
Troilite	FeS	hex	niccolite	2	3.446		5.877			
Tschermakite	CaAl ₂ SiO ₆	monocl	diopside	4	9.615	8.661	5.272		106.12°	
Tungsten	W	cubic		2	3.1653					
Tungstenite	WS ₂	hex	molybdenite	2	3.154		12.362			
Turquoise	CuAl ₆ (PO ₄) ₄ (OH) ₈ ·4H ₂ O	tricl		1	7.424	7.629	9.910	68.61°	69.71°	65.08°
Umangite	Cu ₃ Se ₂	tetr		2	6.402		4.276			
Uraninite	UO ₂	cubic	fluorite	4	5.4682					
Ureyite	NaCr(SiO ₃) ₂	monocl	diopside	4	9.550	8.712	5.273		107.44°	
Uvarovite	Ca ₃ Cr ₂ Si ₃ O ₁₂	cubic	garnet	8	11.999					
Uvite	CaMg ₄ Al ₅ B ₃ Si ₆ O ₂₇ (OH) ₄	rhomb	tourmaline	3	15.86		7.19			
Vaesite	NiS ₂	cubic	pyrite	4	5.6873					

Name	Formula	Crystal system	Structure type	Z	<i>a</i> /Å	<i>b</i> /Å	<i>c</i> /Å	α	β	γ
Valentinite	Sb ₂ O ₃	orth	antimonytrioxide	4	4.914	12.468	5.421			
Vanhoffite	MgSO ₄ ·3Na ₂ SO ₄	monocl		2	9.797	9.217	8.199		113.50°	
Vaterite	CaCO ₃	hex		6	7.135		8.524			
Villiaumite	NaF	cubic	rocksalt	4	4.6342					
Violarite	FeNi ₂ S ₄	cubic	spinel	8	9.464					
Willemite	Zn ₂ SiO ₄	rhomb	phenacite	18	13.94		9.309			
Witherite	BaCO ₃	orth	aragonite	4	6.430	8.904	5.314			
Wolframite	Fe _{0.5} Mn _{0.5} WO ₄	monocl	wolframite	2	4.782	5.731	4.982		90.57°	
Wollastonite	CaSiO ₃	tricl		6	7.94	7.32	7.07	90.03°	95.37°	103.43°
Wulfenite	PbMoO ₄	tetr	scheelite	4	5.435		12.110			
Wurtzite	ZnS	hex	zincite	2	3.8230		6.2565			
Wustite	Fe _{0.953} O	cubic	defectrocksalt	4	4.3088					
Xenotime	YPO ₄	tetr	zircon	4	6.885		5.982			
Zinc	Zn	hex	hexagonalclosepack	2	2.665		4.947			
Zinctelluride	ZnTe	cubic	sphalerite	4	6.1020					
Zincite	ZnO	hex	zincite	2	3.2495		5.2069			
Zinkosite	ZnSO ₄	orth	barite	4	8.588	6.740	4.770			
Zircon	ZrSiO ₄	tetr	zircon	4	6.604		5.979			
Zoisite	Ca ₂ Al ₃ (SiO ₄) ₃ OH	orth		4	16.15	5.581	10.06			

CODATA KEY VALUES FOR THERMODYNAMICS

The Committee on Data for Science and Technology (CODATA) has conducted a project to establish internationally agreed values for the thermodynamic properties of key chemical substances. This table presents the final results of the project. Use of these recommended, internally consistent values is encouraged in the analysis of thermodynamic measurements, data reduction, and preparation of other thermodynamic tables.

The table includes the standard enthalpy of formation at 298.15 K, the entropy at 298.15 K, and the quantity $H^\circ(298.15\text{ K}) - H^\circ(0)$. A value of 0 in the $\Delta_f H^\circ$ column for an element indicates the reference state for that element. The standard state pressure is 100000 Pa (1 bar). See the reference for information on the dependence of gas-phase entropy on the choice of standard state pressure.

Substances are listed in alphabetical order of their chemical formulas when written in the most common form.

The table is reprinted with permission of CODATA.

REFERENCE

Cox, J. D., Wagman, D. D., and Medvedev, V. A., *CODATA Key Values for Thermodynamics*, Hemisphere Publishing Corp., New York, 1989.

Substance	State	$\Delta_f H^\circ(298.15\text{ K})$	$S^\circ(298.15\text{ K})$	$H^\circ(298.15\text{ K}) - H^\circ(0)$
		$\text{kJ}\cdot\text{mol}^{-1}$	$\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$	$\text{kJ}\cdot\text{mol}^{-1}$
Ag	cr	0	42.55 ± 0.20	5.745 ± 0.020
Ag	g	284.9 ± 0.8	172.997 ± 0.004	6.197 ± 0.001
Ag ⁺	aq	105.79 ± 0.08	73.45 ± 0.40	
AgCl	cr	-127.01 ± 0.05	96.25 ± 0.20	12.033 ± 0.020
Al	cr	0	28.30 ± 0.10	4.540 ± 0.020
Al	g	330.0 ± 4.0	164.554 ± 0.004	6.919 ± 0.001
Al ³⁺	aq	-538.4 ± 1.5	-325 ± 10	
AlF ₃	cr	-1510.4 ± 1.3	66.5 ± 0.5	11.62 ± 0.04
Al ₂ O ₃	cr, corundum	-1675.7 ± 1.3	50.92 ± 0.10	10.016 ± 0.020
Ar	g	0	154.846 ± 0.003	6.197 ± 0.001
B	cr, rhombic	0	5.90 ± 0.08	1.222 ± 0.008
B	g	565 ± 5	153.436 ± 0.015	6.316 ± 0.002
BF ₃	g	-1136.0 ± 0.8	254.42 ± 0.20	11.650 ± 0.020
B ₂ O ₃	cr	-1273.5 ± 1.4	53.97 ± 0.30	9.301 ± 0.040
Be	cr	0	9.50 ± 0.08	1.950 ± 0.020
Be	g	324 ± 5	136.275 ± 0.003	6.197 ± 0.001
BeO	cr	-609.4 ± 2.5	13.77 ± 0.04	2.837 ± 0.008
Br	g	111.87 ± 0.12	175.018 ± 0.004	6.197 ± 0.001
Br ⁻	aq	-121.41 ± 0.15	82.55 ± 0.20	
Br ₂	l	0	152.21 ± 0.30	24.52 ± 0.01
Br ₂	g	30.91 ± 0.11	245.468 ± 0.005	9.725 ± 0.001
C	cr, graphite	0	5.74 ± 0.10	1.050 ± 0.020
C	g	716.68 ± 0.45	158.100 ± 0.003	6.536 ± 0.001
CO	g	-110.53 ± 0.17	197.660 ± 0.004	8.671 ± 0.001
CO ₂	g	-393.51 ± 0.13	213.785 ± 0.010	9.365 ± 0.003
CO ₂	aq, undissoc.	-413.26 ± 0.20	119.36 ± 0.60	
CO ₃ ²⁻	aq	-675.23 ± 0.25	-50.0 ± 1.0	
Ca	cr	0	41.59 ± 0.40	5.736 ± 0.040
Ca	g	177.8 ± 0.8	154.887 ± 0.004	6.197 ± 0.001
Ca ²⁺	aq	-543.0 ± 1.0	-56.2 ± 1.0	
CaO	cr	-634.92 ± 0.90	38.1 ± 0.4	6.75 ± 0.06
Cd	cr	0	51.80 ± 0.15	6.247 ± 0.015
Cd	g	111.80 ± 0.20	167.749 ± 0.004	6.197 ± 0.001
Cd ²⁺	aq	-75.92 ± 0.60	-72.8 ± 1.5	
CdO	cr	-258.35 ± 0.40	54.8 ± 1.5	8.41 ± 0.08
CdSO ₄ ·8/3H ₂ O	cr	-1729.30 ± 0.80	229.65 ± 0.40	35.56 ± 0.04
Cl	g	121.301 ± 0.008	165.190 ± 0.004	6.272 ± 0.001
Cl ⁻	aq	-167.080 ± 0.10	56.60 ± 0.20	
ClO ₄ ⁻	aq	-128.10 ± 0.40	184.0 ± 1.5	
Cl ₂	g	0	223.081 ± 0.010	9.181 ± 0.001
Cs	cr	0	85.23 ± 0.40	7.711 ± 0.020
Cs	g	76.5 ± 1.0	175.601 ± 0.003	6.197 ± 0.001
Cs ⁺	aq	-258.00 ± 0.50	132.1 ± 0.5	

CODATA KEY VALUES FOR THERMODYNAMICS (continued)

Substance	State	$\Delta_f H^\circ$ (298.15 K)	S° (298.15 K)	H° (298.15 K)– H° (0)
		$\text{kJ}\cdot\text{mol}^{-1}$	$\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$	$\text{kJ}\cdot\text{mol}^{-1}$
Cu	cr	0	33.15 ± 0.08	5.004 ± 0.008
Cu	g	337.4 ± 1.2	166.398 ± 0.004	6.197 ± 0.001
Cu ⁺²	aq	64.9 ± 1.0	-98 ± 4	
CuSO ₄	cr	-771.4 ± 1.2	109.2 ± 0.4	16.86 ± 0.08
F	g	79.38 ± 0.30	158.751 ± 0.004	6.518 ± 0.001
F ⁻	aq	-335.35 ± 0.65	-13.8 ± 0.8	
F ₂	g	0	202.791 ± 0.005	8.825 ± 0.001
Ge	cr	0	31.09 ± 0.15	4.636 ± 0.020
Ge	g	372 ± 3	167.904 ± 0.005	7.398 ± 0.001
GeF ₄	g	-1190.20 ± 0.50	301.9 ± 1.0	17.29 ± 0.10
GeO ₂	cr, tetragonal	-580.0 ± 1.0	39.71 ± 0.15	7.230 ± 0.020
H	g	217.998 ± 0.006	114.717 ± 0.002	6.197 ± 0.001
H ⁺	aq	0	0	
HBr	g	-36.29 ± 0.16	198.700 ± 0.004	8.648 ± 0.001
HCO ₃ ⁻	aq	-689.93 ± 0.20	98.4 ± 0.5	
HCl	g	-92.31 ± 0.10	186.902 ± 0.005	8.640 ± 0.001
HF	g	-273.30 ± 0.70	173.779 ± 0.003	8.599 ± 0.001
HI	g	26.50 ± 0.10	206.590 ± 0.004	8.657 ± 0.001
HPO ₄ ⁻²	aq	-1299.0 ± 1.5	-33.5 ± 1.5	
HS ⁻	aq	-16.3 ± 1.5	67 ± 5	
HSO ₄ ⁻	aq	-886.9 ± 1.0	131.7 ± 3.0	
H ₂	g	0	130.680 ± 0.003	8.468 ± 0.001
H ₂ O	l	-285.830 ± 0.040	69.95 ± 0.03	13.273 ± 0.020
H ₂ O	g	-241.826 ± 0.040	188.835 ± 0.010	9.905 ± 0.005
H ₂ PO ₄ ⁻	aq	-1302.6 ± 1.5	92.5 ± 1.5	
H ₂ S	g	-20.6 ± 0.5	205.81 ± 0.05	9.957 ± 0.010
H ₂ S	aq, undissoc.	-38.6 ± 1.5	126 ± 5	
H ₃ BO ₃	cr	-1094.8 ± 0.8	89.95 ± 0.60	13.52 ± 0.04
H ₃ BO ₃	aq, undissoc.	-1072.8 ± 0.8	162.4 ± 0.6	
He	g	0	126.153 ± 0.002	6.197 ± 0.001
Hg	l	0	75.90 ± 0.12	9.342 ± 0.008
Hg	g	61.38 ± 0.04	174.971 ± 0.005	6.197 ± 0.001
Hg ⁺²	aq	170.21 ± 0.20	-36.19 ± 0.80	
HgO	cr, red	-90.79 ± 0.12	70.25 ± 0.30	9.117 ± 0.025
Hg ₂ ⁺²	aq	166.87 ± 0.50	65.74 ± 0.80	
Hg ₂ Cl ₂	cr	-265.37 ± 0.40	191.6 ± 0.8	23.35 ± 0.20
Hg ₂ SO ₄	cr	-743.09 ± 0.40	200.70 ± 0.20	26.070 ± 0.030
I	g	106.76 ± 0.04	180.787 ± 0.004	6.197 ± 0.001
I ⁻	aq	-56.78 ± 0.05	106.45 ± 0.30	
I ₂	cr	0	116.14 ± 0.30	13.196 ± 0.040
I ₂	g	62.42 ± 0.08	260.687 ± 0.005	10.116 ± 0.001
K	cr	0	64.68 ± 0.20	7.088 ± 0.020
K	g	89.0 ± 0.8	160.341 ± 0.003	6.197 ± 0.001
K ⁺	aq	-252.14 ± 0.08	101.20 ± 0.20	
Kr	g	0	164.085 ± 0.003	6.197 ± 0.001
Li	cr	0	29.12 ± 0.20	4.632 ± 0.040
Li	g	159.3 ± 1.0	138.782 ± 0.010	6.197 ± 0.001
Li ⁺	aq	-278.47 ± 0.08	12.24 ± 0.15	
Mg	cr	0	32.67 ± 0.10	4.998 ± 0.030
Mg	g	147.1 ± 0.8	148.648 ± 0.003	6.197 ± 0.001
Mg ⁺²	aq	-467.0 ± 0.6	-137 ± 4	
MgF ₂	cr	-1124.2 ± 1.2	57.2 ± 0.5	9.91 ± 0.06
MgO	cr	-601.60 ± 0.30	26.95 ± 0.15	5.160 ± 0.020
N	g	472.68 ± 0.40	153.301 ± 0.003	6.197 ± 0.001
NH ₃	g	-45.94 ± 0.35	192.77 ± 0.05	10.043 ± 0.010
NH ₄ ⁺	aq	-133.26 ± 0.25	111.17 ± 0.40	
NO ₃ ⁻	aq	-206.85 ± 0.40	146.70 ± 0.40	

CODATA KEY VALUES FOR THERMODYNAMICS (continued)

Substance	State	$\Delta_f H^\circ$ (298.15 K)	S° (298.15 K)	H° (298.15 K)– H° (0)
		$\text{kJ}\cdot\text{mol}^{-1}$	$\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$	$\text{kJ}\cdot\text{mol}^{-1}$
N ₂	g	0	191.609 ± 0.004	8.670 ± 0.001
Na	cr	0	51.30 ± 0.20	6.460 ± 0.020
Na	g	107.5 ± 0.7	153.718 ± 0.003	6.197 ± 0.001
Na ⁺	aq	-240.34 ± 0.06	58.45 ± 0.15	
Ne	g	0	146.328 ± 0.003	6.197 ± 0.001
O	g	249.18 ± 0.10	161.059 ± 0.003	6.725 ± 0.001
OH ⁻	aq	-230.015 ± 0.040	-10.90 ± 0.20	
O ₂	g	0	205.152 ± 0.005	8.680 ± 0.002
P	cr, white	0	41.09 ± 0.25	5.360 ± 0.015
P	g	316.5 ± 1.0	163.199 ± 0.003	6.197 ± 0.001
P ₂	g	144.0 ± 2.0	218.123 ± 0.004	8.904 ± 0.001
P ₄	g	58.9 ± 0.3	280.01 ± 0.50	14.10 ± 0.20
Pb	cr	0	64.80 ± 0.30	6.870 ± 0.030
Pb	g	195.2 ± 0.8	175.375 ± 0.005	6.197 ± 0.001
Pb ⁺²	aq	0.92 ± 0.25	18.5 ± 1.0	
PbSO ₄	cr	-919.97 ± 0.40	148.50 ± 0.60	20.050 ± 0.040
Rb	cr	0	76.78 ± 0.30	7.489 ± 0.020
Rb	g	80.9 ± 0.8	170.094 ± 0.003	6.197 ± 0.001
Rb ⁺	aq	-251.12 ± 0.10	121.75 ± 0.25	
S	cr, rhombic	0	32.054 ± 0.050	4.412 ± 0.006
S	g	277.17 ± 0.15	167.829 ± 0.006	6.657 ± 0.001
SO ₂	g	-296.81 ± 0.20	248.223 ± 0.050	10.549 ± 0.010
SO ₄ ⁻²	aq	-909.34 ± 0.40	18.50 ± 0.40	
S ₂	g	128.60 ± 0.30	228.167 ± 0.010	9.132 ± 0.002
Si	cr	0	18.81 ± 0.08	3.217 ± 0.008
Si	g	450 ± 8	167.981 ± 0.004	7.550 ± 0.001
SiF ₄	g	-1615.0 ± 0.8	282.76 ± 0.50	15.36 ± 0.05
SiO ₂	cr, alpha quartz	-910.7 ± 1.0	41.46 ± 0.20	6.916 ± 0.020
Sn	cr, white	0	51.18 ± 0.08	6.323 ± 0.008
Sn	g	301.2 ± 1.5	168.492 ± 0.004	6.215 ± 0.001
Sn ⁺²	aq	-8.9 ± 1.0	-16.7 ± 4.0	
SnO	cr, tetragonal	-280.71 ± 0.20	57.17 ± 0.30	8.736 ± 0.020
SnO ₂	cr, tetragonal	-577.63 ± 0.20	49.04 ± 0.10	8.384 ± 0.020
Th	cr	0	51.8 ± 0.5	6.35 ± 0.05
Th	g	602 ± 6	190.17 ± 0.05	6.197 ± 0.003
ThO ₂	cr	-1226.4 ± 3.5	65.23 ± 0.20	10.560 ± 0.020
Ti	cr	0	30.72 ± 0.10	4.824 ± 0.015
Ti	g	473 ± 3	180.298 ± 0.010	7.539 ± 0.002
TiCl ₄	g	-763.2 ± 3.0	353.2 ± 4.0	21.5 ± 0.5
TiO ₂	cr, rutile	-944.0 ± 0.8	50.62 ± 0.30	8.68 ± 0.05
U	cr	0	50.20 ± 0.20	6.364 ± 0.020
U	g	533 ± 8	199.79 ± 0.10	6.499 ± 0.020
UO ₂	cr	-1085.0 ± 1.0	77.03 ± 0.20	11.280 ± 0.020
UO ₂ ⁺²	aq	-1019.0 ± 1.5	-98.2 ± 3.0	
UO ₃	cr, gamma	-1223.8 ± 1.2	96.11 ± 0.40	14.585 ± 0.050
U ₃ O ₈	cr	-3574.8 ± 2.5	282.55 ± 0.50	42.74 ± 0.10
Xe	g	0	169.685 ± 0.003	6.197 ± 0.001
Zn	cr	0	41.63 ± 0.15	5.657 ± 0.020
Zn	g	130.40 ± 0.40	160.990 ± 0.004	6.197 ± 0.001
Zn ⁺²	aq	-153.39 ± 0.20	-109.8 ± 0.5	
ZnO	cr	-350.46 ± 0.27	43.65 ± 0.40	6.933 ± 0.040

STANDARD THERMODYNAMIC PROPERTIES OF CHEMICAL SUBSTANCES

This table gives the standard state chemical thermodynamic properties of about 2500 individual substances in the crystalline, liquid, and gaseous states. Substances are listed by molecular formula in a modified Hill order; all substances not containing carbon appear first, followed by those that contain carbon. The properties tabulated are:

$\Delta_f H^\circ$	Standard molar enthalpy (heat) of formation at 298.15 K in kJ/mol
$\Delta_f G^\circ$	Standard molar Gibbs energy of formation at 298.15 K in kJ/mol
S°	Standard molar entropy at 298.15 K in J/mol K
C_p	Molar heat capacity at constant pressure at 298.15 K in J/mol K

The standard state pressure is 100 kPa (1 bar). The standard states are defined for different phases by:

- The standard state of a pure gaseous substance is that of the substance as a (hypothetical) ideal gas at the standard state pressure.
- The standard state of a pure liquid substance is that of the liquid under the standard state pressure.
- The standard state of a pure crystalline substance is that of the crystalline substance under the standard state pressure.

An entry of 0.0 for $\Delta_f H^\circ$ for an element indicates the reference state of that element. See References 1 and 2 for further information on reference states. A blank means no value is available.

The data are derived from the sources listed in the references, from other papers appearing in the *Journal of Physical and Chemical Reference Data*, and from the primary research literature. We are indebted to M. V. Korobov for providing data on fullerene compounds.

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Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
Substances not containing carbon:													
Ac	Actinium	0.0		56.5	27.2					406.0	366.0	188.1	20.8
Ag	Silver	0.0		42.6	25.4					284.9	246.0	173.0	20.8
AgBr	Silver(I) bromide	-100.4	-96.9	107.1	52.4								
AgBrO ₃	Silver(I) bromate	-10.5		71.3	151.9								
AgCl	Silver(I) chloride	-127.0	-109.8	96.3	50.8								
AgClO ₃	Silver(I) chlorate	-30.3	64.5	142.0									
AgClO ₄	Silver(I) perchlorate	-31.1											
AgF	Silver(I) fluoride	-204.6											
AgF ₂	Silver(II) fluoride	-360.0											
AgI	Silver(I) iodide	-61.8	-66.2	115.5	56.8								
AgIO ₃	Silver(I) iodate	-171.1	-93.7	149.4	102.9								
AgNO ₃	Silver(I) nitrate	-124.4	-33.4	140.9	93.1								
Ag ₂	Disilver									410.0	358.8	257.1	37.0
Ag ₂ CrO ₄	Silver(I) chromate	-731.7	-641.8	217.6	142.3								
Ag ₂ O	Silver(I) oxide	-31.1	-11.2	121.3	65.9								
Ag ₂ O ₂	Silver(II) oxide	-24.3	27.6	117.0	88.0								
Ag ₂ O ₃	Silver(III) oxide	33.9	121.4	100.0									
Ag ₂ O ₄ S	Silver(I) sulfate	-715.9	-618.4	200.4	131.4								
Ag ₂ S	Silver(I) sulfide (argentite)	-32.6	-40.7	144.0	76.5								
Al	Aluminum	0.0		28.3	24.4					330.0	289.4	164.6	21.4
AlB ₃ H ₁₂	Aluminum borohydride					-16.3	145.0	289.1	194.6	13.0	147.0	379.2	
AlBr	Aluminum monobromide									-4.0	-42.0	239.5	35.6
AlBr ₃	Aluminum bromide	-527.2		180.2	100.6					-425.1			
AlCl	Aluminum monochloride									-47.7	-74.1	228.1	35.0
AlCl ₂	Aluminum dichloride									-331.0			
AlCl ₃	Aluminum chloride	-704.2	-628.8	109.3	91.1					-583.2			
AlF	Aluminum monofluoride									-258.2	-283.7	215.0	31.9
AlF ₃	Aluminum fluoride	-1510.4	-1431.1	66.5	75.1					-1204.6	-1188.2	277.1	62.6
AlF ₄ Na	Sodium tetrafluoroaluminate									-1869.0	-1827.5	345.7	105.9
AlH	Aluminum monohydride									259.2	231.2	187.9	29.4
AlH ₃	Aluminum hydride	-46.0		30.0	40.2								
AlH ₄ K	Potassium aluminum hydride	-183.7											
AlH ₄ Li	Lithium aluminum hydride	-116.3	-44.7	78.7	83.2								
AlH ₄ Na	Sodium aluminum hydride	-15.5											
AlI	Aluminum monoiodide									65.5			36.0
AlI ₃	Aluminum iodide	-313.8	-300.8	159.0	98.7					-207.5			
AlN	Aluminum nitride	-318.0	-287.0	20.2	30.1								
AlO	Aluminum monoxide									91.2	65.3	218.4	30.9
AlO ₄ P	Aluminum phosphate	-1733.8	-1617.9	90.8	93.2								
AlP	Aluminum phosphide	-166.5											

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
AlS	Aluminum monosulfide									200.9	150.1	230.6	33.4
Al ₂	Dialuminum									485.9	433.3	233.2	36.4
Al ₂ Br ₆	Aluminum hexabromide									-970.7			
Al ₂ Cl ₆	Aluminum hexachloride									-1290.8	-1220.4	490.0	
Al ₂ F ₆	Aluminum hexafluoride									-2628.0			
Al ₂ I ₆	Aluminum hexaiodide									-516.7			
Al ₂ O	Aluminum oxide (Al ₂ O)									-130.0	-159.0	259.4	45.7
Al ₂ O ₃	Aluminum oxide (corundum)	-1675.7	-1582.3	50.9	79.0								
Al ₂ S ₃	Aluminum sulfide	-724.0		116.9	105.1								
Am	Americium	0.0											
Ar	Argon									0.0		154.8	20.8
As	Arsenic (gray)	0.0		35.1	24.6					302.5	261.0	174.2	20.8
As	Arsenic (yellow)	14.6											
AsBr ₃	Arsenic(III) bromide	-197.5								-130.0	-159.0	363.9	79.2
AsCl ₃	Arsenic(III) chloride					-305.0	-259.4	216.3		-261.5	-248.9	327.2	75.7
AsF ₃	Arsenic(III) fluoride					-821.3	-774.2	181.2	126.6	-785.8	-770.8	289.1	65.6
AsGa	Gallium arsenide	-71.0	-67.8	64.2	46.2								
AsH ₃	Arsine									66.4	68.9	222.8	38.1
AsH ₃ O ₄	Arsenic acid	-906.3											
AsI ₃	Arsenic(III) iodide	-58.2	-59.4	213.1	105.8							388.3	80.6
AsIn	Indium arsenide	-58.6	-53.6	75.7	47.8								
AsO	Arsenic monoxide									70.0			
As ₂	Diarsenic									222.2	171.9	239.4	35.0
As ₂ O ₃	Arsenic(V) oxide	-924.9	-782.3	105.4	116.5								
As ₂ S ₃	Arsenic(III) sulfide	-169.0	-168.6	163.6	116.3								
At	Astatine	0.0											
Au	Gold	0.0		47.4	25.4					366.1	326.3	180.5	20.8
AuBr	Gold(I) bromide	-14.0											
AuBr ₃	Gold(III) bromide	-53.3											
AuCl	Gold(I) chloride	-34.7											
AuCl ₃	Gold(III) chloride	-117.6											
AuF ₃	Gold(III) fluoride	-363.6											
AuH	Gold hydride									295.0	265.7	211.2	29.2
AuI	Gold(I) iodide	0.0											
Au ₂	Digold									515.1			36.9
B	Boron (β -rhombohedral)	0.0		5.9	11.1					565.0	521.0	153.4	20.8
BBr	Bromoborane(1)									238.1	195.4	225.0	32.9
BBr ₃	Boron tribromide					-239.7	-238.5	229.7		-205.6	-232.5	324.2	67.8
BCl	Chloroborane(1)									149.5	120.9	213.2	31.7
BClO	Chloroxyborane									-314.0			
BCl ₃	Boron trichloride					-427.2	-387.4	206.3	106.7	-403.8	-388.7	290.1	62.7
BCsO ₂	Cesium metaborate	-972.0	-915.0	104.4	80.6								
BF	Fluoroborane(1)									-122.2	-149.8	200.5	29.6

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
BaO	Barium oxide	-548.0	-520.3	72.1	47.3					-112.0			
BaO ₄ S	Barium sulfate	-1473.2	-1362.2	132.2	101.8								
BaS	Barium sulfide	-460.0	-456.0	78.2	49.4								
Be	Beryllium	0.0		9.5	16.4					324.0	286.6	136.3	20.8
BeBr ₂	Beryllium bromide	-353.5		108.0	69.4								
BeCl ₂	Beryllium chloride	-490.4	-445.6	75.8	62.4								
BeF ₂	Beryllium fluoride	-1026.8	-979.4	53.4	51.8								
BeH ₂ O ₂	Beryllium hydroxide	-902.5	-815.0	45.5	62.1								
BeI ₂	Beryllium iodide	-192.5		121.0	71.1								
BeO	Beryllium oxide	-609.4	-580.1	13.8	25.6								
BeO ₄ S	Beryllium sulfate	-1205.2	-1093.8	77.9	85.7								
BeS	Beryllium sulfide	-234.3		34.0	34.0								
Bi	Bismuth	0.0		56.7	25.5					207.1	168.2	187.0	20.8
BiClO	Bismuth oxychloride	-366.9	-322.1	120.5									
BiCl ₃	Bismuth trichloride	-379.1	-315.0	177.0	105.0					-265.7	-256.0	358.9	79.7
BiH ₃ O ₃	Bismuth hydroxide	-711.3											
BiI ₃	Bismuth triiodide		-175.3										
Bi ₂	Dibismuth									219.7			36.9
Bi ₂ O ₃	Bismuth oxide	-573.9	-493.7	151.5	113.5								
Bi ₂ O ₁₂ S ₃	Bismuth sulfate	-2544.3											
Bi ₂ S ₃	Bismuth sulfide	-143.1	-140.6	200.4	122.2								
Bk	Berkelium	0.0											
Br	Bromine (atomic)									111.9	82.4	175.0	20.8
BrCl	Bromine chloride									14.6	-1.0	240.1	35.0
BrCl ₃ Si	Bromotrichlorosilane											350.1	90.9
BrCs	Cesium bromide	-405.8	-391.4	113.1	52.9								
BrCu	Copper(I) bromide	-104.6	-100.8	96.1	54.7								
BrF	Bromine fluoride									-93.8	-109.2	229.0	33.0
BrF ₃	Bromine trifluoride					-300.8	-240.5	178.2	124.6	-255.6	-229.4	292.5	66.6
BrF ₅	Bromine pentafluoride					-458.6	-351.8	225.1		-428.9	-350.6	320.2	99.6
BrGe	Germanium monobromide									235.6			37.1
BrGeH ₃	Bromogermane											274.8	56.4
BrH	Hydrogen bromide									-36.3	-53.4	198.7	29.1
BrHSi	Bromosilylene									-464.4			
BrH ₃ Si	Bromosilane											262.4	52.8
BrH ₂ N	Ammonium bromide	-270.8	-175.2	113.0	96.0								
BrI	Iodine bromide									40.8	3.7	258.8	36.4
BrIn	Indium(I) bromide	-175.3	-169.0	113.0						-56.9	-94.3	259.5	36.7
BrK	Potassium bromide	-393.8	-380.7	95.9	52.3								
BrKO ₃	Potassium bromate	-360.2	-271.2	149.2	105.2								
BrKO ₄	Potassium perbromate	-287.9	-174.4	170.1	120.2								
BrLi	Lithium bromide	-351.2	-342.0	74.3									
BrNO	Nitrosyl bromide									82.2	82.4	273.7	45.5

BrNa	Sodium bromide	-361.1	-349.0	86.8	51.4				-143.1	-177.1	241.2	36.3
BrNaO ₃	Sodium bromate	-334.1	-242.6	128.9								
BrO	Bromine monoxide								125.8	109.6	233.0	34.2
BrO ₂	Bromine dioxide								152.0	155.0	271.1	45.4
BrRb	Rubidium bromide	-394.6	-381.8	110.0	52.8							
BrSi	Bromosilyldyne								209.0			38.6
BrTl	Thallium(I) bromide	-173.2	-167.4	120.5					-37.7			
Br ₂	Bromine					0.0	152.2	75.7	30.9	3.1	245.5	36.0
Br ₂ Ca	Calcium bromide	-682.8	-663.6	130.0								
Br ₂ Cd	Cadmium bromide	-316.2	-296.3	137.2	76.7							
Br ₂ Co	Cobalt(II) bromide	-220.9			79.5							
Br ₂ Cr	Chromium(II) bromide	-302.1										
Br ₂ Cu	Copper(II) bromide	-141.8										
Br ₂ Fe	Iron(II) bromide	-249.8	-238.1	140.6								
Br ₂ H ₂ Si	Dibromosilane										309.7	65.5
Br ₂ Hg	Mercury(II) bromide	-170.7	-153.1	172.0								
Br ₂ Hg ₂	Mercury(I) bromide	-206.9	-181.1	218.0								
Br ₂ Mg	Magnesium bromide	-524.3	-503.8	117.2								
Br ₂ Mn	Manganese(II) bromide	-384.9										
Br ₂ Ni	Nickel(II) bromide	-212.1										
Br ₂ Pb	Lead(II) bromide	-278.7	-261.9	161.5	80.1							
Br ₂ Pt	Platinum(II) bromide	-82.0										
Br ₂ S ₂	Sulfur bromide					-13.0						
Br ₂ Se	Selenium dibromide								-21.0			
Br ₂ Sn	Tin(II) bromide	-243.5										
Br ₂ Sr	Strontium bromide	-717.6	-697.1	135.1	75.3							
Br ₂ Ti	Titanium(II) bromide	-402.0										
Br ₂ Zn	Zinc bromide	-328.7	-312.1	138.5								
Br ₃ Ce	Cerium(III) bromide	-891.4										
Br ₃ ClSi	Tribromochlorosilane										377.1	95.3
Br ₃ Dy	Dysprosium(III) bromide	-836.2										
Br ₃ Fe	Iron(III) bromide	-268.2										
Br ₃ Ga	Gallium(III) bromide	-386.6	-359.8	180.0								
Br ₃ HSi	Tribromosilane					-355.6	-336.4	248.1	-317.6	-328.5	348.6	80.8
Br ₃ In	Indium(III) bromide	-428.9							-282.0			
Br ₃ OP	Phosphoric tribromide	-458.6									359.8	89.9
Br ₃ P	Phosphorus(III) bromide					-184.5	-175.7	240.2	-139.3	-162.8	348.1	76.0
Br ₃ Pt	Platinum(III) bromide	-120.9										
Br ₃ Re	Rhenium(III) bromide	-167.0										
Br ₃ Ru	Ruthenium(III) bromide	-138.0										
Br ₃ Sb	Antimony(III) bromide	-259.4	-239.3	207.1					-194.6	-223.9	372.9	80.2
Br ₃ Sc	Scandium bromide	-743.1										
Br ₃ Ti	Titanium(III) bromide	-548.5	-523.8	176.6	101.7							
Br ₄ Ge	Germanium(IV) bromide					-347.7	-331.4	280.7	-300.0	-318.0	396.2	101.8
Br ₄ Pa	Protactinium(IV) bromide	-824.0	-787.8	234.0								
Br ₄ Pt	Platinum(IV) bromide	-156.5										

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
Br ₄ Si	Tetrabromosilane					-457.3	-443.9	277.8		-415.5	-431.8	377.9	97.1
Br ₄ Sn	Tin(IV) bromide	-377.4	-350.2	264.4						-314.6	-331.4	411.9	103.4
Br ₄ Te	Tellurium tetrabromide	-190.4											
Br ₄ Ti	Titanium(IV) bromide	-616.7	-589.5	243.5	131.5					-549.4	-568.2	398.4	100.8
Br ₄ V	Vanadium(IV) bromide									-336.8			
Br ₄ Zr	Zirconium(IV) bromide	-760.7											
Br ₅ P	Phosphorus(V) bromide	-269.9											
Br ₅ Ta	Tantalum(V) bromide	-598.3											
Br ₆ W	Tungsten(VI) bromide	-348.5											
Ca	Calcium	0.0		41.6	25.9					177.8	144.0	154.9	20.8
CaCl ₂	Calcium chloride	-795.4	-748.8	108.4	72.9								
CaF ₂	Calcium fluoride	-1228.0	-1175.6	68.5	67.0								
CaH ₂	Calcium hydride	-181.5	-142.5	41.4	41.0								
CaH ₂ O ₂	Calcium hydroxide	-985.2	-897.5	83.4	87.5								
CaI ₂	Calcium iodide	-533.5	-528.9	142.0									
CaN ₂ O ₆	Calcium nitrate	-938.2	-742.8	193.2	149.4								
CaO	Calcium oxide	-634.9	-603.3	38.1	42.0								
CaO ₄ S	Calcium sulfate	-1434.5	-1322.0	106.5	99.7								
CaS	Calcium sulfide	-482.4	-477.4	56.5	47.4								
Ca ₃ O ₈ P ₂	Calcium phosphate	-4120.8	-3884.7	236.0	227.8								
Cd	Cadmium	0.0		51.8	26.0					111.8		167.7	20.8
CdCl ₂	Cadmium chloride	-391.5	-343.9	115.3	74.7								
CdF ₂	Cadmium fluoride	-700.4	-647.7	77.4									
CdH ₂ O ₂	Cadmium hydroxide	-560.7	-473.6	96.0									
CdI ₂	Cadmium iodide	-203.3	-201.4	161.1	80.0								
CdO	Cadmium oxide	-258.4	-228.7	54.8	43.4								
CdO ₄ S	Cadmium sulfate	-933.3	-822.7	123.0	99.6								
CdS	Cadmium sulfide	-161.9	-156.5	64.9									
CdTe	Cadmium telluride	-92.5	-92.0	100.0									
Ce	Cerium (γ , fcc)	0.0		72.0	26.9					423.0	385.0	191.8	23.1
CeCl ₃	Cerium(III) chloride	-1060.5	-984.8	151.0	87.4								
CeI ₃	Cerium(III) iodide	-669.3											
CeO ₂	Cerium(IV) oxide	-1088.7	-1024.6	62.3	61.6								
CeS	Cerium(II) sulfide	-459.4	-451.5	78.2	50.0								
Ce ₂ O ₃	Cerium(III) oxide	-1796.2	-1706.2	150.6	114.6								
Cf	Californium	0.0											
Cl	Chlorine (atomic)									121.3	105.3	165.2	21.8
ClCs	Cesium chloride	-443.0	-414.5	101.2	52.5								
ClCsO ₄	Cesium perchlorate	-443.1	-314.3	175.1	108.3								
ClCu	Copper(I) chloride	-137.2	-119.9	86.2	48.5								
ClF	Chlorine fluoride									-50.3	-51.8	217.9	32.1
ClFO ₃	Perchloryl fluoride									-23.8	48.2	279.0	64.9
ClF ₃	Chlorine trifluoride					-189.5				-163.2	-123.0	281.6	63.9

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
Cl ₂ O ₂ U	Uranyl chloride	-1243.9	-1146.4	150.5	107.9								
Cl ₂ Pb	Lead(II) chloride	-359.4	-314.1	136.0									
Cl ₂ Pt	Platinum(II) chloride	-123.4											
Cl ₂ S	Sulfur dichloride					-50.0							
Cl ₂ S ₂	Sulfur chloride					-59.4							
Cl ₂ Sn	Tin(II) chloride	-325.1											
Cl ₂ Sr	Strontium chloride	-828.9	-781.1	114.9	75.6								
Cl ₂ Ti	Titanium(II) chloride	-513.8	-464.4	87.4	69.8								
Cl ₂ Zn	Zinc chloride	-415.1	-369.4	111.5	71.3					-266.1			
Cl ₂ Zr	Zirconium(II) chloride	-502.0											
Cl ₃ Cr	Chromium(III) chloride	-556.5	-486.1	123.0	91.8								
Cl ₃ Dy	Dysprosium(III) chloride	-1000.0											
Cl ₃ Er	Erbium chloride	-998.7			100.0								
Cl ₃ Eu	Europium(III) chloride	-936.0											
Cl ₃ Fe	Iron(III) chloride	-399.5	-334.0	142.3	96.7								
Cl ₃ Ga	Gallium(III) chloride	-524.7	-454.8	142.0									
Cl ₃ Gd	Gadolinium(III) chloride	-1008.0			88.0								
Cl ₃ HfSi	Trichlorosilane					-539.3	-482.5	227.6		-513.0	-482.0	313.9	75.8
Cl ₃ Ho	Holmium chloride	-1005.4			88.0								
Cl ₃ In	Indium(III) chloride	-537.2								-374.0			
Cl ₃ Ir	Iridium(III) chloride	-245.6											
Cl ₃ La	Lanthanum chloride	-1072.2			108.8								
Cl ₃ Lu	Lutetium chloride	-945.6								-649.0			
Cl ₃ N	Nitrogen trichloride					230.0							
Cl ₃ Nd	Neodymium chloride	-1041.0			113.0								
Cl ₃ OP	Phosphoric trichloride					-597.1	-520.8	222.5	138.8	-558.5	-512.9	325.5	84.9
Cl ₃ OV	Vanadyl trichloride					-734.7	-668.5	244.3		-695.6	-659.3	344.3	89.9
Cl ₃ Os	Osmium(III) chloride	-190.4											
Cl ₃ P	Phosphorus(III) chloride					-319.7	-272.3	217.1		-287.0	-267.8	311.8	71.8
Cl ₃ Pr	Praseodymium chloride	-1056.9			100.0								
Cl ₃ Pt	Platinum(III) chloride	-182.0											
Cl ₃ Re	Rhenium(III) chloride	-264.0	-188.0	123.8	92.4								
Cl ₃ Rh	Rhodium(III) chloride	-299.2											
Cl ₃ Ru	Ruthenium(III) chloride	-205.0											
Cl ₃ Sb	Antimony(III) chloride	-382.2	-323.7	184.1	107.9								
Cl ₃ Sc	Scandium chloride	-925.1											
Cl ₃ Sm	Samarium(III) chloride	-1025.9											
Cl ₃ Tb	Terbium chloride	-997.0											
Cl ₃ Ti	Titanium(III) chloride	-720.9	-653.5	139.7	97.2								
Cl ₃ Tl	Thallium(III) chloride	-315.1											
Cl ₃ Tm	Thulium chloride	-986.6											
Cl ₃ U	Uranium(III) chloride	-866.5	-799.1	159.0	102.5								
Cl ₃ V	Vanadium(III) chloride	-580.7	-511.2	131.0	93.2								

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
CsH	Cesium hydride	-54.2											
CsHO	Cesium hydroxide	-416.2	-371.8	104.2	69.9					-256.0	-256.5	254.8	49.7
CsHO ₄ S	Cesium hydrogen sulfate	-1158.1											
CsH ₂ N	Cesium amide	-118.4											
CsI	Cesium iodide	-346.6	-340.6	123.1	52.8								
CsNO ₃	Cesium nitrate	-506.0	-406.5	155.2									
CsO ₂	Cesium superoxide	-286.2											
Cs ₂ O	Cesium oxide	-345.8	-308.1	146.9	76.0								
Cs ₂ O ₃ S	Cesium sulfite	-1134.7											
Cs ₂ O ₄ S	Cesium sulfate	-1443.0	-1323.6	211.9	134.9								
Cs ₂ S	Cesium sulfide	-359.8											
Cu	Copper	0.0		33.2	24.4					337.4	297.7	166.4	20.8
CuF ₂	Copper(II) fluoride	-542.7											
CuH ₂ O ₂	Copper(II) hydroxide	-449.8											
CuI	Copper(I) iodide	-67.8	-69.5	96.7	54.1								
CuN ₂ O ₆	Copper(II) nitrate	-302.9											
CuO	Copper(II) oxide	-157.3	-129.7	42.6	42.3								
CuO ₄ S	Copper(II) sulfate	-771.4	-662.2	109.2									
CuO ₄ W	Copper(II) tungstate	-1105.0											
CuS	Copper(II) sulfide	-53.1	-53.6	66.5	47.8								
CuSe	Copper(II) selenide	-39.5											
Cu ₂	Dicopper									484.2	431.9	241.6	36.6
Cu ₂ O	Copper(I) oxide	-168.6	-146.0	93.1	63.6								
Cu ₂ S	Copper(I) sulfide	-79.5	-86.2	120.9	76.3								
Dy	Dysprosium	0.0		75.6	27.7					290.4	254.4	196.6	20.8
DyI ₃	Dysprosium(III) iodide	-620.5											
Dy ₂ O ₃	Dysprosium(III) oxide	-1863.1	-1771.5	149.8	116.3								
Er	Erbium	0.0		73.2	28.1					317.1	280.7	195.6	20.8
ErF ₃	Erbium fluoride	-1711.0											
Er ₂ O ₃	Erbium oxide	-1897.9	-1808.7	155.6	108.5								
Es	Einsteinium	0.0											
Eu	Europium	0.0		77.8	27.7					175.3	142.2	188.8	20.8
Eu ₂ O ₃	Europium(III) oxide	-1651.4	-1556.8	146.0	122.2								
Eu ₃ O ₄	Europium(II,III) oxide	-2272.0	-2142.0	205.0									
F	Fluorine (atomic)									79.4	62.3	158.8	22.7
FGa	Gallium monofluoride									-251.9			33.3
FGe	Germanium monofluoride									-33.4			34.7
FGeH ₃	Fluorogermane											252.8	51.6
FH	Hydrogen fluoride					-299.8				-273.3	-275.4	173.8	
FH ₃ Si	Fluorosilane											238.4	47.4
FH ₄ N	Ammonium fluoride	-464.0	-348.7	72.0	65.3								
FI	Iodine fluoride									-95.7	-118.5	236.2	33.4
FI _n	Indium(I) fluoride									-203.4			

FK	Potassium fluoride	-567.3	-537.8	66.6	49.0				
FLi	Lithium fluoride	-616.0	-587.7	35.7	41.6				
FNO	Nitrosyl fluoride					-66.5	-51.0	248.1	41.3
FNO ₂	Nitryl fluoride							260.4	49.8
FNS	Thionitrosyl fluoride (NSF)							259.8	44.1
FNa	Sodium fluoride	-576.6	-546.3	51.1	46.9				
FO	Fluorine oxide					109.0	105.3	216.4	32.0
FO ₂	Fluorine superoxide (FOO)					25.4	39.4	259.5	44.5
FRb	Rubidium fluoride	-557.7							
FSi	Fluorosilylydyne					7.1	-24.3	225.8	32.6
FTl	Thallium(I) fluoride	-324.7				-182.4			
F ₂	Fluorine					0.0		202.8	31.3
F ₂ Fe	Iron(II) fluoride	-711.3	-668.6	87.0	68.1				
F ₂ HK	Potassium hydrogen fluoride	-927.7	-859.7	104.3	76.9				
F ₂ HN	Difluoramine							252.8	43.4
F ₂ HNa	Sodium hydrogen fluoride	-920.3	-852.2	90.9	75.0				
F ₂ HRb	Rubidium hydrogen fluoride	-922.6	-855.6	120.1	79.4				
F ₂ Mg	Magnesium fluoride	-1124.2	-1071.1	57.2	61.6				
F ₂ N	Difluoroamidogen					43.1	57.8	249.9	41.0
F ₂ N ₂	<i>cis</i> -Difluorodiazine					69.5			
F ₂ N ₂	<i>trans</i> -Difluorodiazine					82.0			
F ₂ Ni	Nickel(II) fluoride	-651.4	-604.1	73.6	64.1				
F ₂ O	Fluorine monoxide					24.5	41.8	247.5	43.3
F ₂ OS	Thionyl fluoride							278.7	56.8
F ₂ O ₂	Fluorine dioxide					19.2	58.2	277.2	62.1
F ₂ O ₂ S	Sulfuryl fluoride							284.0	66.0
F ₂ O ₂ U	Uranyl fluoride	-1653.5	-1557.4	135.6	103.2				
F ₂ Pb	Lead(II) fluoride	-664.0	-617.1	110.5					
F ₂ Si	Difluorosilylene					-619.0	-628.0	252.7	43.9
F ₂ Sr	Strontium fluoride	-1216.3	-1164.8	82.1	70.0				
F ₂ Zn	Zinc fluoride	-764.4	-713.3	73.7	65.7				
F ₃ Ga	Gallium(III) fluoride	-1163.0	-1085.3	84.0					
F ₃ Gd	Gadolinium(III) fluoride					-1297.0			
F ₃ HSi	Trifluorosilane							271.9	60.5
F ₃ Ho	Holmium fluoride	-1707.0							
F ₃ N	Nitrogen trifluoride					-132.1	-90.6	260.8	53.4
F ₃ Nd	Neodymium fluoride	-1657.0							
F ₃ OP	Phosphoric trifluoride					-1254.3	-1205.8	285.4	68.8
F ₃ P	Phosphorus(III) fluoride					-958.4	-936.9	273.1	58.7
F ₃ Sb	Antimony(III) fluoride	-915.5							
F ₃ Sc	Scandium fluoride	-1629.2	-1555.6	92.0		-1247.0	-1234.0	300.5	67.8
F ₃ Sm	Samarium(III) fluoride	-1778.0							
F ₃ Th	Thorium(III) fluoride					-1166.1	-1160.6	339.2	73.3
F ₃ U	Uranium(III) fluoride	-1502.1	-1433.4	123.4	95.1	-1058.5	-1051.9	331.9	74.3
F ₃ Y	Yttrium fluoride	-1718.8	-1644.7	100.0		-1288.7	-1277.8	311.8	70.3
F ₄ Ge	Germanium(IV) fluoride					-1190.2	-1150.0	301.9	

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
F ₄ Hf	Hafnium fluoride	-1930.5	-1830.4	113.0						-1669.8			
F ₄ N ₂	Tetrafluorohydrazine									-8.4	79.9	301.2	79.2
F ₄ Pb	Lead(IV) fluoride	-941.8											
F ₄ S	Sulfur tetrafluoride									-763.2	-722.0	299.6	77.6
F ₄ Si	Tetrafluorosilane									-1615.0	-1572.8	282.8	73.6
F ₄ Th	Thorium(IV) fluoride	-2097.8	-2003.4	142.0	110.7					-1759.0	-1724.0	341.7	93.0
F ₄ U	Uranium(IV) fluoride	-1914.2	-1823.3	151.7	116.0					-1598.7	-1572.7	368.0	91.2
F ₄ V	Vanadium(IV) fluoride	-1403.3											
F ₄ Xe	Xenon tetrafluoride	-261.5											
F ₄ Zr	Zirconium(IV) fluoride	-1911.3	-1809.9	104.6	103.7								
F ₅ I	Iodine pentafluoride					-864.8				-822.5	-751.7	327.7	99.2
F ₅ Nb	Niobium(V) fluoride	-1813.8	-1699.0	160.2	134.7					-1739.7	-1673.6	321.9	97.1
F ₅ P	Phosphorus(V) fluoride									-1594.4	-1520.7	300.8	84.8
F ₅ Ta	Tantalum(V) fluoride	-1903.6											
F ₅ V	Vanadium(V) fluoride					-1480.3	-1373.1	175.7		-1433.9	-1369.8	320.9	98.6
F ₆ H ₈ N ₂ Si	Ammonium hexafluorosilicate	-2681.7	-2365.3	280.2	228.1								
F ₆ Ir	Iridium(VI) fluoride	-579.7	-461.6	247.7						-544.0	-460.0	357.8	121.1
F ₆ K ₂ Si	Potassium hexafluorosilicate	-2956.0	-2798.6	226.0									
F ₆ Mo	Molybdenum(VI) fluoride					-1585.5	-1473.0	259.7	169.8	-1557.7	-1472.2	350.5	120.6
F ₆ Na ₂ Si	Sodium hexafluorosilicate	-2909.6	-2754.2	207.1	187.1								
F ₆ Os	Osmium(VI) fluoride			246.0								358.1	120.8
F ₆ Pt	Platinum(VI) fluoride			235.6								348.3	122.8
F ₆ S	Sulfur hexafluoride									-1220.5	-1116.5	291.5	97.0
F ₆ Se	Selenium hexafluoride									-1117.0	-1017.0	313.9	110.5
F ₆ Si ₂	Hexafluorodisilane	-2427.0	-2299.7	219.1	129.5					-2383.3	-2307.3	391.0	129.9
F ₆ Te	Tellurium hexafluoride									-1318.0			
F ₆ U	Uranium(VI) fluoride	-2197.0	-2068.5	227.6	166.8					-2147.4	-2063.7	377.9	129.6
F ₆ W	Tungsten(VI) fluoride					-1747.7	-1631.4	251.5		-1721.7	-1632.1	341.1	119.0
Fe	Iron	0.0		27.3	25.1					416.3	370.7	180.5	25.7
FeI ₂	Iron(II) iodide	-113.0											
FeI ₃	Iron(III) iodide									71.0			
FeMoO ₄	Iron(II) molybdate	-1075.0	-975.0	129.3	118.5								
FeO	Iron(II) oxide	-272.0											
FeO ₄ S	Iron(II) sulfate	-928.4	-820.8	107.5	100.6								
FeO ₄ W	Iron(II) tungstate	-1155.0	-1054.0	131.8	114.6								
FeS	Iron(II) sulfide	-100.0	-100.4	60.3	50.5								
FeS ₂	Iron disulfide	-178.2	-166.9	52.9	62.2								
Fe ₂ O ₃	Iron(III) oxide	-824.2	-742.2	87.4	103.9								
Fe ₂ O ₄ Si	Iron(II) orthosilicate	-1479.9	-1379.0	145.2	132.9								
Fe ₃ O ₄	Iron(II,III) oxide	-1118.4	-1015.4	146.4	143.4								
Fm	Fermium	0.0											
Fr	Francium	0.0		95.4									
Ga	Gallium	0.0	0.0	40.8	26.1	5.6				272.0	233.7	169.0	25.3

GaH ₃ O ₃	Gallium(III) hydroxide	-964.4	-831.3	100.0					
GaI ₃	Gallium(III) iodide	-238.9		205.0	100.0				
GaN	Gallium nitride	-110.5							
GaO	Gallium monoxide					279.5	253.5	231.1	32.1
GaP	Gallium phosphide	-88.0							
GaSb	Gallium antimonide	-41.8	-38.9	76.1	48.5				
Ga ₂	Digallium					438.5			
Ga ₂ O	Gallium suboxide	-356.0							
Ga ₂ O ₃	Gallium(III) oxide	-1089.1	-998.3	85.0	92.1				
Gd	Gadolinium	0.0		68.1	37.0	397.5	359.8	194.3	27.5
Gd ₂ O ₃	Gadolinium(III) oxide	-1819.6			106.7				
Ge	Germanium	0.0		31.1	23.3	372.0	331.2	167.9	30.7
GeH ₄ I	Iodogermane							283.2	57.5
GeH ₄	Germane					90.8	113.4	217.1	45.0
GeI ₄	Germanium(IV) iodide	-141.8	-144.3	271.1		-56.9	-106.3	428.9	104.1
GeO	Germanium(II) oxide	-261.9	-237.2	50.0		-46.2	-73.2	224.3	30.9
GeO ₂	Germanium(IV) oxide	-580.0	-521.4	39.7	52.1				
GeP	Germanium phosphide	-21.0	-17.0	63.0					
GeS	Germanium(II) sulfide	-69.0	-71.5	71.0		92.0	42.0	234.0	33.7
GeTe	Germanium(II) telluride	20.0							
Ge ₂	Digermanium					473.1	416.3	252.8	35.6
Ge ₂ H ₆	Digermane					162.3			
Ge ₃ H ₈	Trigermane					193.7			
H	Hydrogen (atomic)					218.0	203.3	114.7	20.8
HI	Hydrogen iodide					26.5	1.7	206.6	29.2
HIO ₃	Iodic acid	-230.1							
HK	Potassium hydride	-57.7							
HKO	Potassium hydroxide	-424.6	-379.4	81.2	68.9	-232.0	-229.7	238.3	49.2
HKO ₂ S	Potassium hydrogen sulfate	-1160.6	-1031.3	138.1					
HLi	Lithium hydride	-90.5	-68.3	20.0	27.9				
HLiO	Lithium hydroxide	-487.5	-441.5	42.8	49.6				
HN	Imidogen					-229.0	-234.2	214.4	46.0
HNO ₂	Nitrous acid					351.5	345.6	181.2	29.2
HNO ₃	Nitric acid					-79.5	-46.0	254.1	45.6
HN ₃	Hydrazoic acid					-174.1	-80.7	155.6	109.9
						264.0	327.3	140.6	
HNa	Sodium hydride	-56.3	-33.5	40.0	36.4				
HNaO	Sodium hydroxide	-425.8	-379.7	64.4	59.5				
HNaO ₂ S	Sodium hydrogen sulfate	-1125.5	-992.8	113.0		-191.0	-193.9	229.0	48.0
HNa ₂ O ₄ P	Sodium hydrogen phosphate	-1748.1	-1608.2	150.5	135.3				
HO	Hydroxyl					39.0	34.2	183.7	29.9
HORb	Rubidium hydroxide	-418.8	-373.9	94.0	69.0	-238.0	-239.1	248.5	49.5
HOTl	Thallium(I) hydroxide	-238.9	-195.8	88.0					
HO ₂	Hydroperoxy					10.5	22.6	229.0	34.9
HO ₂ P	Metaphosphoric acid	-948.5							
HO ₂ RbS	Rubidium hydrogen sulfate	-1159.0							
HO ₂ Re	Perrhenic acid	-762.3	-656.4	158.2					

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
HRb	Rubidium hydride	-52.3											
HS	Mercapto									142.7	113.3	195.7	32.3
HSi	Silylidyne									361.0			
HTa ₂	Tantalum hydride	-32.6	-69.0	79.1	90.8								
H ₂	Hydrogen									0.0		130.7	28.8
H ₂ KN	Potassium amide	-128.9											
H ₂ KO ₄ P	Potassium dihydrogen phosphate	-1568.3	-1415.9	134.9	116.6								
H ₂ LiN	Lithium amide	-179.5											
H ₂ Mg	Magnesium hydride	-75.3	-35.9	31.1	35.4								
H ₂ MgO ₂	Magnesium hydroxide	-924.5	-833.5	63.2	77.0								
H ₂ N	Amidogen									184.9	194.6	195.0	33.9
H ₂ NNa	Sodium amide	-123.8	-64.0	76.9	66.2								
H ₂ NRb	Rubidium amide	-113.0											
H ₂ N ₂ O ₂	Nitramide	-89.5											
H ₂ NiO ₂	Nickel(II) hydroxide	-529.7	-447.2	88.0									
H ₂ O	Water					-285.8	-237.1	70.0	75.3	-241.8	-228.6	188.8	33.6
H ₂ O ₂	Hydrogen peroxide					-187.8	-120.4	109.6	89.1	-136.3	-105.6	232.7	43.1
H ₂ O ₂ Sn	Tin(II) hydroxide	-561.1	-491.6	155.0									
H ₂ O ₂ Sr	Strontium hydroxide	-959.0											
H ₂ O ₂ Zn	Zinc hydroxide	-641.9	-553.5	81.2									
H ₂ O ₃ Si	Metasilicic acid	-1188.7	-1092.4	134.0									
H ₂ O ₄ S	Sulfuric acid					-814.0	-690.0	156.9	138.9				
H ₂ O ₄ Se	Selenic acid	-530.1											
H ₂ S	Hydrogen sulfide									-20.6	-33.4	205.8	34.2
H ₂ S ₂	Hydrogen disulfide					-18.1			84.1	15.5			51.5
H ₂ Se	Hydrogen selenide									29.7	15.9	219.0	34.7
H ₂ Sr	Strontium hydride	-180.3											
H ₂ Te	Hydrogen telluride									99.6			
H ₂ Th	Thorium hydride	-139.7	-100.0	50.7	36.7								
H ₂ Zr	Zirconium(II) hydride	-169.0	-128.8	35.0	31.0								
H ₃ Si	Iodosilane											270.9	54.4
H ₃ N	Ammonia									-45.9	-16.4	192.8	35.1
H ₃ NO	Hydroxylamine	-114.2											
H ₃ O ₂ P	Phosphinic acid	-604.6				-595.4							
H ₃ O ₃ P	Phosphonic acid	-964.4											
H ₃ O ₄ P	Phosphoric acid	-1284.4	-1124.3	110.5	106.1	-1271.7	-1123.6	150.8	145.0				
H ₃ P	Phosphine									5.4	13.5	210.2	37.1
H ₃ Sb	Stibine									145.1	147.8	232.8	41.1
H ₃ U	Uranium(III) hydride	-127.2	-72.8	63.7	49.3								
H ₄ IN	Ammonium iodide	-201.4	-112.5	117.0									
H ₄ N ₂	Hydrazine					50.6	149.3	121.2	98.9	95.4	159.4	238.5	48.4
H ₄ N ₂ O ₂	Ammonium nitrite	-256.5											
H ₄ N ₂ O ₃	Ammonium nitrate	-365.6	-183.9	151.1	139.3								

H ₃ N ₃	Ammonium azide	115.5	274.2	112.5								
H ₂ O ₂ Si	Orthosilicic acid	-1481.1	-1332.9	192.0								
H ₄ O ₇ P ₂	Diphosphoric acid	-2241.0				-2231.7						
H ₄ P ₂	Diphosphine					-5.0			20.9			
H ₄ Si	Silane								34.3	56.9	204.6	42.8
H ₄ Sn	Stannane								162.8	188.3	227.7	49.0
H ₃ NO	Ammonium hydroxide					-361.2	-254.0	165.6	154.9			
H ₃ NO ₃ S	Ammonium hydrogen sulfite	-768.6										
H ₃ NO ₃ S	Ammonium hydrogen sulfate	-1027.0										
H ₂ Si ₂	Disilane								80.3	127.3	272.7	80.8
H ₈ N ₂ O ₄ S	Ammonium sulfate	-1180.9	-901.7	220.1	187.5							
H ₃ Si ₃	Trisilane					92.5			120.9			
H ₃ N ₂ O ₄ P	Ammonium hydrogen phosphate	-1566.9				188.0						
H ₁₂ N ₃ O ₄ P	Ammonium phosphate	-1671.9										
He	Helium								0.0		126.2	20.8
Hf	Hafnium	0.0		43.6	25.7				619.2	576.5	186.9	20.8
HfO ₂	Hafnium oxide	-1144.7	-1088.2	59.3	60.3							
Hg	Mercury					0.0	75.9	28.0	61.4	31.8	175.0	20.8
HgI ₂	Mercury(II) iodide	-105.4	-101.7	180.0								
HgO	Mercury(II) oxide	-90.8	-58.5	70.3	44.1							
HgO ₂ S	Mercury(II) sulfate	-707.5										
HgS	Mercury(II) sulfide (red)	-58.2	-50.6	82.4	48.4							
HgTe	Mercury(II) telluride	-42.0										
Hg ₂	Dimercury								108.8	68.2	288.1	37.4
Hg ₂ I ₂	Mercury(I) iodide	-121.3	-111.0	233.5								
Hg ₂ O ₂ S	Mercury(I) sulfate	-743.1	-625.8	200.7	132.0							
Ho	Holmium	0.0		75.3	27.2				300.8	264.8	195.6	20.8
Ho ₂ O ₃	Holmium oxide	-1880.7	-1791.1	158.2	115.0							
I	Iodine (atomic)								106.8	70.2	180.8	20.8
IIn	Indium(I) iodide	-116.3	-120.5	130.0					7.5	-37.7	267.3	36.8
IK	Potassium iodide	-327.9	-324.9	106.3	52.9							
IKO ₃	Potassium iodate	-501.4	-418.4	151.5	106.5							
IKO ₄	Potassium periodate	-467.2	-361.4	175.7								
ILi	Lithium iodide	-270.4	-270.3	86.8	51.0							
INa	Sodium iodide	-287.8	-286.1	98.5	52.1							
INaO ₃	Sodium iodate	-481.8									92.0	
INaO ₄	Sodium periodate	-429.3	-323.0	163.0								
IO	Iodine monoxide								126.0	102.5	239.6	32.9
IRb	Rubidium iodide	-333.8	-328.9	118.4	53.2							
ITl	Thallium(I) iodide	-123.8	-125.4	127.6					7.1			
I ₂	Iodine (rhombic)	0.0		116.1	54.4				62.4	19.3	260.7	36.9
I ₂ Mg	Magnesium iodide	-364.0	-358.2	129.7								
I ₂ Ni	Nickel(II) iodide	-78.2										
I ₂ Pb	Lead(II) iodide	-175.5	-173.6	174.9	77.4							
I ₂ Sn	Tin(II) iodide	-143.5										
I ₂ Sr	Strontium iodide	-558.1									81.6	

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
I ₂ Zn	Zinc iodide	-208.0	-209.0	161.1									
I ₃ In	Indium(III) iodide	-238.0								-120.5			
I ₃ La	Lanthanum iodide	-668.9											
I ₃ Lu	Lutetium iodide	-548.0											
I ₃ P	Phosphorus(III) iodide	-45.6									374.4	78.4	
I ₃ Ru	Ruthenium(III) iodide	-65.7											
I ₃ Sb	Antimony(III) iodide	-100.4											
I ₄ Pt	Platinum(IV) iodide	-72.8											
I ₄ Si	Tetraiodosilane	-189.5											
I ₄ Sn	Tin(IV) iodide				84.9						446.1	105.4	
I ₄ Ti	Titanium(IV) iodide	-375.7	-371.5	249.4	125.7					-277.8			
I ₄ V	Vanadium(IV) iodide									-122.6			
I ₄ Zr	Zirconium(IV) iodide	-481.6											
In	Indium	0.0		57.8	26.7					243.3	208.7	173.8	20.8
InO	Indium monoxide									387.0	364.4	236.5	32.6
InP	Indium phosphide	-88.7	-77.0	59.8	45.4								
InS	Indium(II) sulfide	-138.1	-131.8	67.0						238.0			
InSb	Indium antimonide	-30.5	-25.5	86.2	49.5					344.3			
In ₂	Diindium									380.9			
In ₂ O ₃	Indium(III) oxide	-925.8	-830.7	104.2	92.0								
In ₂ S ₃	Indium(III) sulfide	-427.0	-412.5	163.6	118.0								
In ₂ Te ₅	Indium(IV) telluride	-175.3											
Ir	Iridium	0.0		35.5	25.1					665.3	617.9	193.6	20.8
IrO ₃	Iridium(IV) oxide	-274.1			57.3								
IrS ₂	Iridium(IV) sulfide	-138.0											
Ir ₂ S ₃	Iridium(III) sulfide	-234.0											
K	Potassium	0.0		64.7	29.6					89.0	60.5	160.3	20.8
KMnO ₄	Potassium permanganate	-837.2	-737.6	171.7	117.6								
KNO ₂	Potassium nitrite	-369.8	-306.6	152.1	107.4								
KNO ₃	Potassium nitrate	-494.6	-394.9	133.1	96.4								
KNa	Potassium sodium					6.3							
KO ₂	Potassium superoxide	-284.9	-239.4	116.7	77.5								
K ₂	Dipotassium									123.7	87.5	249.7	37.9
K ₂ O	Potassium oxide	-361.5											
K ₂ O ₂	Potassium peroxide	-494.1	-425.1	102.1									
K ₂ O ₄ S	Potassium sulfate	-1437.8	-1321.4	175.6	131.5								
K ₂ S	Potassium sulfide	-380.7	-364.0	105.0									
K ₃ O ₄ P	Potassium phosphate	-1950.2											
Kr	Krypton									0.0		164.1	20.8
La	Lanthanum	0.0		56.9	27.1					431.0	393.6	182.4	22.8
LaS	Lanthanum monosulfide	-456.0	-451.5	73.2	59.0								
La ₂ O ₃	Lanthanum oxide	-1793.7	-1705.8	127.3	108.8								
Li	Lithium	0.0		29.1	24.8					159.3	126.6	138.8	20.8

LiNO ₂	Lithium nitrite	-372.4	-302.0	96.0					
LiNO ₃	Lithium nitrate	-483.1	-381.1	90.0					
Li ₂	Dilithium					215.9	174.4	197.0	36.1
Li ₂ O	Lithium oxide	-597.9	-561.2	37.6	54.1				
Li ₂ O ₂	Lithium peroxide	-634.3							
Li ₂ O ₃ Si	Lithium metasilicate	-1648.1	-1557.2	79.8	99.1				
Li ₂ O ₃ S	Lithium sulfate	-1436.5	-1321.7	115.1	117.6				
Li ₂ S	Lithium sulfide	-441.4							
Li ₃ O ₄ P	Lithium phosphate	-2095.8							
Lr	Lawrencium	0.0							
Lu	Lutetium	0.0		51.0	26.9	427.6	387.8	184.8	20.9
Lu ₂ O ₃	Lutetium oxide	-1878.2	-1789.0	110.0	101.8				
Md	Mendelevium	0.0							
Mg	Magnesium	0.0		32.7	24.9	147.1	112.5	148.6	20.8
MgN ₂ O ₆	Magnesium nitrate	-790.7	-589.4	164.0	141.9				
MgO	Magnesium oxide	-601.6	-569.3	27.0	37.2				
MgO ₃ S	Magnesium sulfate	-1284.9	-1170.6	91.6	96.5				
MgO ₃ Se	Magnesium selenate	-968.5							
MgS	Magnesium sulfide	-346.0	-341.8	50.3	45.6				
Mg ₂	Dimagnesium					287.7			
Mg ₂ O ₃ Si	Magnesium orthosilicate	-2174.0	-2055.1	95.1	118.5				
Mn	Manganese	0.0		32.0	26.3	280.7	238.5	173.7	20.8
MnN ₂ O ₆	Manganese(II) nitrate	-576.3							
MnNaO ₄	Sodium permanganate	-1156.0							
MnO	Manganese(II) oxide	-385.2	-362.9	59.7	45.4				
MnO ₂	Manganese(IV) oxide	-520.0	-465.1	53.1	54.1				
MnO ₃ Si	Manganese(II) metasilicate	-1320.9	-1240.5	89.1	86.4				
MnS	Manganese(II) sulfide (α form)	-214.2	-218.4	78.2	50.0				
MnSe	Manganese(II) selenide	-106.7	-111.7	90.8	51.0				
Mn ₂ O ₃	Manganese(III) oxide	-959.0	-881.1	110.5	107.7				
Mn ₂ O ₃ Si	Manganese(II) orthosilicate	-1730.5	-1632.1	163.2	129.9				
Mn ₃ O ₄	Manganese(II,III) oxide	-1387.8	-1283.2	155.6	139.7				
Mo	Molybdenum	0.0		28.7	24.1	658.1	612.5	182.0	20.8
MoNa ₂ O ₄	Sodium molybdate	-1468.1	-1354.3	159.7	141.7				
MoO ₂	Molybdenum(IV) oxide	-588.9	-533.0	46.3	56.0				
MoO ₃	Molybdenum(VI) oxide	-745.1	-668.0	77.7	75.0				
MoO ₄ Pb	Lead(II) molybdate	-1051.9	-951.4	166.1	119.7				
MoS ₂	Molybdenum(IV) sulfide	-235.1	-225.9	62.6	63.6				
Mo ₂ Si	Molybdenum silicide	-125.2	-125.7	106.3	93.1				
N	Nitrogen (atomic)					472.7	455.5	153.3	20.8
NNaO ₂	Sodium nitrite	-358.7	-284.6	103.8					
NNaO ₃	Sodium nitrate	-467.9	-367.0	116.5	92.9				
NO	Nitric oxide					91.3	87.6	210.8	29.9
NO ₂	Nitrogen dioxide					33.2	51.3	240.1	37.2
NO ₂ Rb	Rubidium nitrite	-367.4	-306.2	172.0					
NO ₃ Rb	Rubidium nitrate	-495.1	-395.8	147.3	102.1				

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
NO ₃ Tl	Thallium(I) nitrate	-243.9	-152.4	160.7	99.5								
NP	Phosphorus nitride	-63.0								171.5	149.4	211.1	29.7
N ₂	Nitrogen									0.0		191.6	29.1
N ₂ O	Nitrous oxide									81.6	103.7	220.0	38.6
N ₂ O ₃	Nitrogen trioxide					50.3				86.6	142.4	314.7	72.7
N ₂ O ₄	Nitrogen tetroxide					-19.5	97.5	209.2	142.7	11.1	99.8	304.4	79.2
N ₂ O ₄ Sr	Strontium nitrite	-762.3											
N ₂ O ₅	Nitrogen pentoxide	-43.1	113.9	178.2	143.1					13.3	117.1	355.7	95.3
N ₂ O ₆ Pb	Lead(II) nitrate	-451.9											
N ₂ O ₆ Ra	Radium nitrate	-992.0	-796.1	222.0									
N ₂ O ₆ Sr	Strontium nitrate	-978.2	-780.0	194.6	149.9								
N ₂ O ₆ Zn	Zinc nitrate	-483.7											
N ₃ Na	Sodium azide	21.7	93.8	96.9	76.6								
N ₃ Si ₃	Silicon nitride	-743.5	-642.6	101.3									
Na	Sodium	0.0		51.3	28.2					107.5	77.0	153.7	20.8
NaO ₂	Sodium superoxide	-260.2	-218.4	115.9	72.1								
Na ₂	Disodium									142.1	103.9	230.2	37.6
Na ₂ O	Sodium oxide	-414.2	-375.5	75.1	69.1								
Na ₂ O ₂	Sodium peroxide	-510.9	-447.7	95.0	89.2								
Na ₂ O ₃ S	Sodium sulfite	-1100.8	-1012.5	145.9	120.3								
Na ₂ O ₃ Si	Sodium metasilicate	-1554.9	-1462.8	113.9									
Na ₂ O ₄ S	Sodium sulfate	-1387.1	-1270.2	149.6	128.2								
Na ₂ S	Sodium sulfide	-364.8	-349.8	83.7									
Nb	Niobium	0.0		36.4	24.6					725.9	681.1	186.3	30.2
NbO	Niobium(II) oxide	-405.8	-378.6	48.1	41.3								
NbO ₂	Niobium(IV) oxide	-796.2	-740.5	54.5	57.5								
Nb ₂ O ₅	Niobium(V) oxide	-1899.5	-1766.0	137.2	132.1								
Nd	Neodymium	0.0		71.5	27.5					327.6	292.4	189.4	22.1
Nd ₂ O ₃	Neodymium oxide	-1807.9	-1720.8	158.6	111.3								
Ne	Neon									0.0		146.3	20.8
Ni	Nickel	0.0		29.9	26.1					429.7	384.5	182.2	23.4
NiO ₄ S	Nickel(II) sulfate	-872.9	-759.7	92.0	138.0								
NiS	Nickel(II) sulfide	-82.0	-79.5	53.0	47.1								
Ni ₂ O ₃	Nickel(III) oxide	-489.5											
No	Nobelium	0.0											
O	Oxygen (atomic)									249.2	231.7	161.1	21.9
OP	Phosphorus monoxide									-28.5	-51.9	222.8	31.8
OPb	Lead(II) oxide (massicot)	-217.3	-187.9	68.7	45.8								
OPb	Lead(II) oxide (litharge)	-219.0	-188.9	66.5	45.8								
OPd	Palladium(II) oxide	-85.4			31.4					348.9	325.9	218.0	
ORa	Radium oxide	-523.0											
ORb ₂	Rubidium oxide	-339.0											
ORh	Rhodium monoxide									385.0			

OS	Sulfur monoxide					6.3	-19.9	222.0	30.2			
OSe	Selenium monoxide					53.4	26.8	234.0	31.3			
OSi	Silicon monoxide					-99.6	-126.4	211.6	29.9			
OSn	Tin(II) oxide	-280.7	-251.9	57.2	44.3	15.1	-8.4	232.1	31.6			
OSr	Strontium oxide	-592.0	-561.9	54.4	45.0	1.5						
OTi	Titanium(II) oxide	-519.7	-495.0	50.0	40.0							
OTl ₂	Thallium(I) oxide	-178.7	-147.3	126.0								
OU	Uranium(II) oxide					21.0						
OV	Vanadium(II) oxide	-431.8	-404.2	38.9	45.4							
OZn	Zinc oxide	-350.5	-320.5	43.7	40.3							
O ₂	Oxygen					0.0		205.2	29.4			
O ₂ P	Phosphorus dioxide					-279.9	-281.6	252.1	39.5			
O ₂ Pb	Lead(IV) oxide	-277.4	-217.3	68.6	64.6							
O ₂ Rb	Rubidium superoxide	-278.7										
O ₂ Rb ₂	Rubidium peroxide	-472.0										
O ₂ Ru	Ruthenium(IV) oxide	-305.0										
O ₂ S	Sulfur dioxide					-320.5		-296.8	-300.1	248.2	39.9	
O ₂ Se	Selenium dioxide	-225.4										
O ₂ Si	Silicon dioxide (α -quartz)	-910.7	-856.3	41.5	44.4			-322.0				
O ₂ Sn	Tin(IV) oxide	-577.6	-515.8	49.0	52.6							
O ₂ Te	Tellurium dioxide	-322.6	-270.3	79.5								
O ₂ Th	Thorium(IV) oxide	-1226.4	-1169.2	65.2	61.8							
O ₂ Ti	Titanium(IV) oxide	-944.0	-888.8	50.6	55.0							
O ₂ U	Uranium(IV) oxide	-1085.0	-1031.8	77.0	63.6			-465.7	-471.5	274.6	51.4	
O ₂ W	Tungsten(IV) oxide	-589.7	-533.9	50.5	56.1							
O ₂ Zr	Zirconium(IV) oxide	-1100.6	-1042.8	50.4	56.2							
O ₃	Ozone					142.7	163.2	238.9	39.2			
O ₃ PbS	Lead(II) sulfite	-669.9										
O ₃ PbSi	Lead(II) metasilicate	-1145.7	-1062.1	109.6	90.0							
O ₃ Pr ₂	Praseodymium oxide	-1809.6								117.4		
O ₃ Rh ₂	Rhodium(III) oxide	-343.0								103.8		
O ₃ S	Sulfur trioxide	-454.5	-374.2	70.7		-441.0	-373.8	113.8	-395.7	-371.1	256.8	50.7
O ₃ Sc ₂	Scandium oxide	-1908.8	-1819.4	77.0	94.2							
O ₃ SiSr	Strontium metasilicate	-1633.9	-1549.7	96.7	88.5							
O ₃ Sm ₂	Samarium(III) oxide	-1823.0	-1734.6	151.0	114.5							
O ₃ Tb ₂	Terbium oxide	-1865.2									115.9	
O ₃ Ti ₂	Titanium(III) oxide	-1520.9	-1434.2	78.8	97.4							
O ₃ Tm ₂	Thulium oxide	-1888.7	-1794.5	139.7	116.7							
O ₃ U	Uranium(VI) oxide	-1223.8	-1145.7	96.1	81.7							
O ₃ V ₂	Vanadium(III) oxide	-1218.8	-1139.3	98.3	103.2							
O ₃ W	Tungsten(VI) oxide	-842.9	-764.0	75.9	73.8							
O ₃ Y ₂	Yttrium oxide	-1905.3	-1816.6	99.1	102.5							
O ₃ Yb ₂	Ytterbium(III) oxide	-1814.6	-1726.7	133.1	115.4							
O ₄ Os	Osmium(VIII) oxide	-394.1	-304.9	143.9				-337.2	-292.8	293.8	74.1	
O ₄ PbS	Lead(II) sulfate	-920.0	-813.0	148.5	103.2							
O ₄ PbSe	Lead(II) selenate	-609.2	-504.9	167.8								

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
O ₄ Pb ₂ Si	Lead(II) orthosilicate	-1363.1	-1252.6	186.6	137.2								
O ₄ Pb ₃	Lead(II,II,IV) oxide	-718.4	-601.2	211.3	146.9								
O ₄ RaS	Radium sulfate	-1471.1	-1365.6	138.0									
O ₄ Rb ₂ S	Rubidium sulfate	-1435.6	-1316.9	197.4	134.1								
O ₄ Ru	Ruthenium(VIII) oxide	-239.3	-152.2	146.4									
O ₄ SSr	Strontium sulfate	-1453.1	-1340.9	117.0									
O ₄ STl ₂	Thallium(I) sulfate	-931.8	-830.4	230.5									
O ₄ SZn	Zinc sulfate	-982.8	-871.5	110.5	99.2								
O ₄ SiSr ₂	Strontium orthosilicate	-2304.5	-2191.1	153.1	134.3								
O ₄ SiZn ₂	Zinc orthosilicate	-1636.7	-1523.2	131.4	123.3								
O ₄ SiZr	Zirconium(IV) orthosilicate	-2033.4	-1919.1	84.1	98.7								
O ₄ TiZr	Zirconium titanate	-2024.1	-1915.8	116.7	114.0								
O ₅ Sb ₂	Antimony(V) oxide	-971.9	-829.2	125.1									
O ₅ Ta ₂	Tantalum(V) oxide	-2046.0	-1911.2	143.1	135.1								
O ₅ Ti ₃	Titanium(III,IV) oxide	-2459.4	-2317.4	129.3	154.8								
O ₅ V ₂	Vanadium(V) oxide	-1550.6	-1419.5	131.0	127.7								
O ₅ V ₃	Vanadium(III,IV) oxide	-1933.0	-1803.0	163.0									
O ₇ Re ₂	Rhenium(VII) oxide	-1240.1	-1066.0	207.1	166.1					-1100.0	-994.0	452.0	
O ₇ U ₃	Uranium(IV,VI) oxide	-3427.1	-3242.9	250.5	215.5								
O ₈ S ₂ Zr	Zirconium(IV) sulfate	-2217.1			172.0								
O ₈ U ₃	Uranium(V,VI) oxide	-3574.8	-3369.5	282.6	238.4								
O ₈ U ₄	Uranium(IV,V) oxide	-4510.4	-4275.1	334.1	293.3								
Os	Osmium	0.0		32.6	24.7					791.0	745.0	192.6	20.8
P	Phosphorus (white)	0.0		41.1	23.8					316.5	280.1	163.2	20.8
P	Phosphorus (red)	-17.6		22.8	21.2								
P	Phosphorus (black)	-39.3											
P ₂	Diphosphorus									144.0	103.5	218.1	32.1
P ₄	Tetraphosphorus									58.9	24.4	280.0	67.2
Pa	Protactinium	0.0		51.9						607.0	563.0	198.1	22.9
Pb	Lead	0.0		64.8	26.4					195.2	162.2	175.4	20.8
PbS	Lead(II) sulfide	-100.4	-98.7	91.2	49.5								
PbSe	Lead(II) selenide	-102.9	-101.7	102.5	50.2								
PbTe	Lead(II) telluride	-70.7	-69.5	110.0	50.5								
Pd	Palladium	0.0		37.6	26.0					378.2	339.7	167.1	20.8
PdS	Palladium(II) sulfide	-75.0	-67.0	46.0									
Pm	Promethium	0.0										187.1	24.3
Po	Polonium	0.0											
Pr	Praseodymium	0.0		73.2	27.2					355.6	320.9	189.8	21.4
Pt	Platinum	0.0		41.6	25.9					565.3	520.5	192.4	25.5
PtS	Platinum(II) sulfide	-81.6	-76.1	55.1	43.4								
PtS ₂	Platinum(IV) sulfide	-108.8	-99.6	74.7	65.9								
Pu	Plutonium	0.0											
Ra	Radium	0.0		71.0						159.0	130.0	176.5	20.8

Rb	Rubidium	0.0		76.8	31.1		80.9	53.1	170.1	20.8
Re	Rhenium	0.0		36.9	25.5		769.9	724.6	188.9	20.8
Rh	Rhodium	0.0		31.5	25.0		556.9	510.8	185.8	21.0
Rn	Radon						0.0		176.2	20.8
Ru	Ruthenium	0.0		28.5	24.1		642.7	595.8	186.5	21.5
S	Sulfur (rhombic)	0.0		32.1	22.6		277.2	236.7	167.8	23.7
S	Sulfur (monoclinic)	0.3								
SSi	Silicon monosulfide						112.5	60.9	223.7	32.3
SSn	Tin(II) sulfide	-100.0	-98.3	77.0	49.3					
SSr	Strontium sulfide	-472.4	-467.8	68.2	48.7					
STl ₂	Thallium(I) sulfide	-97.1	-93.7	151.0						
SZn	Zinc sulfide (wurtzite)	-192.6								
SZn	Zinc sulfide (sphalerite)	-206.0	-201.3	57.7	46.0					
S ₂	Disulfur						128.6	79.7	228.2	32.5
Sb	Antimony	0.0		45.7	25.2		262.3	222.1	180.3	20.8
Sb ₂	Diantimony						235.6	187.0	254.9	36.4
Sc	Scandium	0.0		34.6	25.5		377.8	336.0	174.8	22.1
Se	Selenium (gray)	0.0		42.4	25.4		227.1	187.0	176.7	20.8
Se	Selenium (α form)	6.7					227.1			
Se	Selenium (vitreous)	5.0					227.1			
SeSr	Strontium selenide	-385.8								
SeTl ₂	Thallium(I) selenide	-59.0	-59.0	172.0						
SeZn	Zinc selenide	-163.0	-163.0	84.0						
Se ₂	Diselenium						146.0	96.2	252.0	35.4
Si	Silicon	0.0		18.8	20.0		450.0	405.5	168.0	22.3
Si ₂	Disilicon						594.0	536.0	229.9	34.4
Sm	Samarium	0.0		69.6	29.5		206.7	172.8	183.0	30.4
Sn	Tin (white)	0.0		51.2	27.0		301.2	266.2	168.5	21.3
Sn	Tin (gray)	-2.1	0.1	44.1	25.8					
Sr	Strontium	0.0		55.0	26.8		164.4	130.9	164.6	20.8
Ta	Tantalum	0.0		41.5	25.4		782.0	739.3	185.2	20.9
Tb	Terbium	0.0		73.2	28.9		388.7	349.7	203.6	24.6
Tc	Technetium	0.0					678.0		181.1	20.8
Te	Tellurium	0.0		49.7	25.7		196.7	157.1	182.7	20.8
Te ₂	Ditellurium						168.2	118.0	268.1	36.7
Th	Thorium	0.0		51.8	27.3		602.0	560.7	190.2	20.8
Ti	Titanium	0.0		30.7	25.0		473.0	428.4	180.3	24.4
Tl	Thallium	0.0		64.2	26.3		182.2	147.4	181.0	20.8
Tm	Thulium	0.0		74.0	27.0		232.2	197.5	190.1	20.8
U	Uranium	0.0		50.2	27.7		533.0	488.4	199.8	23.7
V	Vanadium	0.0		28.9	24.9		514.2	754.4	182.3	26.0
W	Tungsten	0.0		32.6	24.3		849.4	807.1	174.0	21.3
Xe	Xenon						0.0		169.7	20.8
Y	Yttrium	0.0		44.4	26.5		421.3	381.1	179.5	25.9
Yb	Ytterbium	0.0		59.9	26.7		152.3	118.4	173.1	20.8
Zn	Zinc	0.0		41.6	25.4		130.4	94.8	161.0	20.8
Zr	Zirconium	0.0		39.0	25.4		608.8	566.5	181.4	26.7

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
Substances containing carbon:													
C	Carbon (graphite)	0.0		5.7	8.5					716.7	671.3	158.1	20.8
C	Carbon (diamond)	1.9	2.9	2.4	6.1								
CAgN	Silver(I) cyanide	146.0	156.9	107.2	66.7								
CAg ₂ O ₃	Silver(I) carbonate	-505.8	-436.8	167.4	112.3								
CBaO ₃	Barium carbonate	-1213.0	-1134.4	112.1	86.0								
CBeO ₃	Beryllium carbonate	-1025.0		52.0	65.0								
CBrClF ₂	Bromochlorodifluoromethane											318.5	74.6
CBrCl ₂ F	Bromodichlorofluoromethane											330.6	80.0
CBrCl ₃	Bromotrichloromethane									-41.1			85.3
CBrF ₃	Bromotrifluoromethane									-648.3			69.3
CBrN	Cyanogen bromide	140.5								186.2	165.3	248.3	46.9
CBrN ₃ O ₆	Bromotrinitromethane					32.5				80.3			
CBr ₂ ClF	Dibromochlorofluoromethane											342.8	82.4
CBr ₂ Cl ₂	Dibromodichloromethane											347.8	87.1
CBr ₂ F ₂	Dibromodifluoromethane											325.3	77.0
CBr ₂ O	Carbonyl bromide					-127.2				-96.2	-110.9	309.1	61.8
CBr ₃ Cl	Tribromochloromethane											357.8	89.4
CBr ₃ F	Tribromofluoromethane											345.9	84.4
CBr ₄	Tetrabromomethane	29.4	47.7	212.5	144.3					83.9	67.0	358.1	91.2
CCaO ₃	Calcium carbonate (calcite)	-1207.6	-1129.1	91.7	83.5								
CCaO ₃	Calcium carbonate (aragonite)	-1207.8	-1128.2	88.0	82.3								
CCdO ₃	Cadmium carbonate	-750.6	-669.4	92.5									
CClFO	Carbonyl chloride fluoride											276.7	52.4
CClF ₃	Chlorotrifluoromethane									-706.3			66.9
CClN	Cyanogen chloride					112.1				138.0	131.0	236.2	45.0
CClN ₃ O ₆	Chlorotrinitromethane					-27.1				18.4			
CCl ₂ F ₂	Dichlorodifluoromethane									-477.4	-439.4	300.8	72.3
CCl ₂ O	Carbonyl chloride									-219.1	-204.9	283.5	57.7
CCl ₃	Trichloromethyl									59.0			
CCl ₃ F	Trichlorofluoromethane					-301.3	-236.8	225.4	121.6	-268.3			78.1
CCl ₄	Tetrachloromethane					-128.2			130.7	-95.7			83.3
CCoO ₃	Cobalt(II) carbonate	-713.0											
CCs ₂ O ₃	Cesium carbonate	-1139.7	-1054.3	204.5	123.9								
CCuN	Copper(I) cyanide	96.2	111.3	84.5									
CFN	Cyanogen fluoride											224.7	41.8
CF ₂ O	Carbonyl fluoride									-639.8			46.8
CF ₃	Trifluoromethyl									-477.0	-464.0	264.5	49.6
CF ₃ I	Trifluoroiodomethane									-587.8		307.4	70.9
CF ₄	Tetrafluoromethane									-933.6		261.6	61.1
CFeO ₃	Iron(II) carbonate	-740.6	-666.7	92.9	82.1								

CFe ₃	Iron carbide	25.1	20.1	104.6	105.9								
CH	Methyldiyne											595.8	
CHBrClF	Bromochlorofluoromethane												304.3 63.2
CHBrCl ₂	Bromodichloromethane												316.4 67.4
CHBrF ₂	Bromodifluoromethane										-424.9		295.1 58.7
CHBr ₂ Cl	Chlorodibromomethane												327.7 69.2
CHBr ₂ F	Dibromofluoromethane												316.8 65.1
CHBr ₃	Tribromomethane					-22.3	-5.0	220.9	130.7	23.8	8.0		330.9 71.2
CHClF ₂	Chlorodifluoromethane											-482.6	280.9 55.9
CHCl ₂ F	Dichlorofluoromethane												293.1 60.9
CHCl ₃	Trichloromethane					-134.1	-73.7	201.7	114.2	-102.7	6.0		295.7 65.7
CHCsO ₃	Cesium hydrogen carbonate	-966.1											
CHFO	Formyl fluoride												246.6 39.9
CHF ₃	Trifluoromethane												-695.4 259.7 51.0
CHI ₃	Triiodomethane	-181.1										251.0	356.2 75.0
CHKO ₂	Potassium formate	-679.7											
CHKO ₃	Potassium hydrogen carbonate	-963.2	-863.5	115.5									
CHN	Hydrogen cyanide					108.9	125.0	112.8	70.6	135.1	124.7		201.8 35.9
CHNO	Isocyanic acid (HNCO)												238.0 44.9
CHNS	Isothiocyanic acid											127.6 113.0	247.8 46.9
CHN ₃ O ₆	Trinitromethane					-32.8							435.6 134.1
CHNaO ₂	Sodium formate	-666.5	-599.9	103.8	82.7								
CHNaO ₃	Sodium hydrogen carbonate	-950.8	-851.0	101.7	87.6								
CHO	Oxomethyl (HCO)											43.1 28.0	224.7 34.6
CH ₂	Methylene											390.4 372.9	194.9 33.8
CH ₂ BrCl	Bromochloromethane												287.6 52.7
CH ₂ BrF	Bromofluoromethane												276.3 49.2
CH ₂ Br ₂	Dibromomethane												293.2 54.7
CH ₂ ClF	Chlorofluoromethane												264.4 47.0
CH ₂ Cl ₂	Dichloromethane					-124.2		177.8	101.2	-95.4			270.2 51.0
CH ₂ F ₂	Difluoromethane												-452.3 246.7 42.9
CH ₂ I ₂	Diiodomethane					68.5	90.4	174.1	134.0	119.5	95.8		309.7 57.7
CH ₂ N ₂	Diazomethane												242.9 52.5
CH ₂ N ₂	Cyanamide	58.8											
CH ₂ N ₂ O ₄	Dinitromethane					-104.9							-61.5 358.1 86.4
CH ₂ O	Formaldehyde												-108.6 -102.5 218.8 35.4
(CH ₂ O) _x	Paraformaldehyde	-177.6											
CH ₂ O ₂	Formic acid					-425.0	-361.4	129.0	99.0	-378.7			
CH ₂ S ₃	Trithiocarbonic acid					24.0							
CH ₃	Methyl											145.7 147.9	194.2 38.7
CH ₃ BO	Borane carbonyl												-111.2 -92.9 249.4 59.5
CH ₃ Br	Bromomethane					-59.8							-35.4 -26.3 246.4 42.4
CH ₃ Cl	Chloromethane												-81.9 234.6 40.8
CH ₃ Cl ₃ Si	Methyltrichlorosilane							262.8	163.1	-528.9			351.1 102.4
CH ₃ F	Fluoromethane												222.9 37.5
CH ₃ I	Iodomethane					-13.6		163.2	126.0	14.4			254.1 44.1

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
CH ₃ NO	Formamide					-254.0				-193.9			
CH ₃ NO ₂	Nitromethane					-112.6	-14.4	171.8	106.6	-80.8		282.9	55.5
CH ₃ NO ₂	Methyl nitrite									-66.1			
CH ₃ NO ₃	Methyl nitrate					-156.3	-43.4	217.1	157.3	-122.0		305.8	76.6
CH ₄	Methane									-74.6	-50.5	186.3	35.7
CH ₅ N ₂	Ammonium cyanide	0.4			134.0								
CH ₄ N ₂ O	Urea	-333.1								-245.8			
CH ₄ N ₂ S	Thiourea	-89.1								22.9			
CH ₄ N ₄ O ₂	Nitroguanidine	-92.4											
CH ₄ O	Methanol					-239.2	-166.6	126.8	81.1	-201.0	-162.3	239.9	44.1
CH ₃ S	Methanethiol					-46.7	-7.7	169.2	90.5	-22.9	-9.3	255.2	50.3
CH ₃ N	Methylamine					-47.3	35.7	150.2	102.1	-22.5	32.7	242.9	50.1
CH ₅ NO ₃	Ammonium hydrogen carbonate	-849.4	-665.9	120.9									
CH ₅ N ₃	Guanidine	-56.0											
CH ₅ N ₃ S	Hydrazinecarbothioamide	24.7											
CH ₅ N ₄ O ₂	3-Amino-1-nitroguanidine	22.1											
CH ₆ ClN	Methylamine hydrochloride	-298.1											
CH ₆ N ₂	Methylhydrazine					54.2	180.0	165.9	134.9	94.7	187.0	278.8	71.1
CH ₆ Si	Methylsilane											256.5	65.9
CHg ₂ O ₃	Mercury(I) carbonate	-553.5	-468.1	180.0									
ClN	Cyanogen iodide	166.2	185.0	96.2						225.5	196.6	256.8	48.3
Cl ₄	Tetraiodomethane	-392.9								474.0		391.9	95.9
CKN	Potassium cyanide	-113.0	-101.9	128.5	66.3								
CKNS	Potassium thiocyanate	-200.2	-178.3	124.3	88.5								
CK ₂ O ₃	Potassium carbonate	-1151.0	-1063.5	155.5	114.4								
CLi ₂ O ₃	Lithium carbonate	-1215.9	-1132.1	90.4	99.1								
CMgO ₃	Magnesium carbonate	-1095.8	-1012.1	65.7	75.5								
CMnO ₃	Manganese(II) carbonate	-894.1	-816.7	85.8	81.5								
CN	Cyanide									437.6	407.5	202.6	29.2
CNNa	Sodium cyanide	-87.5	-76.4	115.6	70.4								
CNNaO	Sodium cyanate	-405.4	-358.1	96.7	86.6								
CN ₄ O ₆	Tetranitromethane					38.4				82.4		503.7	176.1
CNa ₂ O ₃	Sodium carbonate	-1130.7	-1044.4	135.0	112.3								
CO	Carbon monoxide									-110.5	-137.2	197.7	29.1
COS	Carbon oxysulfide									-142.0	-169.2	231.6	41.5
CO ₂	Carbon dioxide									-393.5	-394.4	213.8	37.1
CO ₃ Pb	Lead(II) carbonate	-699.1	-625.5	131.0	87.4								
CO ₃ Rb ₂	Rubidium carbonate	-1136.0	-1051.0	181.3	117.6								
CO ₃ Sr	Strontium carbonate	-1220.1	-1140.1	97.1	81.4								
CO ₃ Tl ₂	Thallium(I) carbonate	-700.0	-614.6	155.2									
CO ₃ Zn	Zinc carbonate	-812.8	-731.5	82.4	79.7								
CS	Carbon monosulfide									234.0	184.0	210.6	29.8
CS ₂	Carbon disulfide					89.0	64.6	151.3	76.4	116.7	67.1	237.8	45.4

CSe ₂	Carbon diselenide					164.8					
CSi	Silicon carbide (cubic)	-65.3	-62.8	16.6	26.9						
CSi	Silicon carbide (hexagonal)	-62.8	-60.2	16.5	26.7						
C ₂	Dicarbon							831.9	775.9	199.4	43.2
C ₂ BrF ₅	Bromopentafluoroethane							-1064.4			
C ₂ Br ₂ ClF ₃	1,2-Dibromo-1-chloro-1,2,2-trifluoroethane					-691.7				-656.6	
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane					-817.7				-789.1	
C ₂ Br ₄	Tetrabromoethene									387.1	102.7
C ₂ Br ₆	Hexabromoethane									441.9	139.3
C ₂ Ca	Calcium carbide		-59.8	-64.9	70.0	62.7					
C ₂ CaN ₂	Calcium cyanide		-184.5								
C ₂ CaO ₄	Calcium oxalate		-1360.6								
C ₂ ClF ₃	Chlorotrifluoroethene					-522.7			-505.5	-523.8	322.1 83.9
C ₂ ClF ₅	Chloropentafluoroethane								-1118.8		184.2
C ₂ Cl ₂ F ₄	1,2-Dichloro-1,1,2,2-tetrafluoroethane					-960.2		111.7	-937.0		
C ₂ Cl ₂ O ₂	Oxalyl chloride					-367.6				-335.8	
C ₂ Cl ₃ F ₃	1,1,2-Trichloro-1,2,2-trifluoroethane					-745.0			170.1	-716.8	
C ₂ Cl ₃ N	Trichloroacetonitrile										336.6 96.1
C ₂ Cl ₄	Tetrachloroethene					-50.6	3.0	266.9	143.4	-10.9	
C ₂ Cl ₄ F ₂	1,1,1,2-Tetrachloro-2,2-difluoroethane									-489.9	-407.0 382.9 123.4
C ₂ Cl ₄ F ₂	1,1,2,2-Tetrachloro-1,2-difluoroethane								173.6		
C ₂ Cl ₄ O	Trichloroacetyl chloride					-280.8				-239.8	
C ₂ Cl ₆	Hexachloroethane		-202.8		237.3	198.2				-143.6	
C ₂ F ₃ N	Trifluoroacetonitrile									-497.9	298.1 77.9
C ₂ F ₄	Tetrafluoroethene		-820.5							-658.9	300.1 80.5
C ₂ F ₆	Hexafluoroethane									-1344.2	332.3 106.7
C ₂ HBr	Bromoacetylene										253.7 55.7
C ₂ HBrClF ₃	1-Bromo-2-chloro-1,1,2-trifluoroethane					-675.3				-644.8	
C ₂ HBrClF ₃	2-Bromo-2-chloro-1,1,1-trifluoroethane					-720.0				-690.4	
C ₂ HCl	Chloroacetylene										242.0 54.3
C ₂ HClF ₂	1-Chloro-2,2-difluoroethene									-315.5	-289.1 303.0 72.1
C ₂ HCl ₂ F	1,1-Dichloro-2-fluoroethene										313.9 76.5
C ₂ HCl ₂ F ₃	2,2-Dichloro-1,1,1-trifluoroethane										352.8 102.5
C ₂ HCl ₃	Trichloroethene					-43.6		228.4	124.4	-9.0	324.8 80.3
C ₂ HCl ₃ O	Trichloroacetaldehyde					-234.5				151.0	-196.6
C ₂ HCl ₃ O	Dichloroacetyl chloride					-280.4					-241.0
C ₂ HCl ₃ O ₂	Trichloroacetic acid		-503.3								
C ₂ HCl ₅	Pentachloroethane					-187.6				173.8	-142.0
C ₂ HF	Fluoroacetylene										231.7 52.4
C ₂ HF ₃	Trifluoroethene									-490.5	
C ₂ HF ₃ O ₂	Trifluoroacetic acid					-1069.9				-1031.4	
C ₂ HF ₅	Pentafluoroethane									-1100.4	
C ₂ H ₂	Acetylene									227.4	209.9 200.9 44.0
C ₂ H ₂ BrF ₃	2-Bromo-1,1,1-trifluoroethane									-694.5	
C ₂ H ₂ Br ₂	<i>cis</i> -1,2-Dibromoethene										311.3 68.8
C ₂ H ₂ Br ₂	<i>trans</i> -1,2-Dibromoethene										313.5 70.3

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₂ H ₂ Br ₂ Cl ₂	1,2-Dibromo-1,2-dichloroethane									-36.9			
C ₂ H ₂ Br ₄	1,1,2,2-Tetrabromoethane								165.7				
C ₂ H ₂ ClF ₃	2-Chloro-1,1,1-trifluoroethane											326.5	89.1
C ₂ H ₂ Cl ₂	1,1-Dichloroethene					-23.9	24.1	201.5	111.3	2.8	25.4	289.0	67.1
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethene					-26.4		198.4	116.4	4.6		289.6	65.1
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethene					-24.3	27.3	195.9	116.8	5.0	28.6	290.0	66.7
C ₂ H ₂ Cl ₂ O	Chloroacetyl chloride					-283.7				-244.8			
C ₂ H ₂ Cl ₂ O ₂	Dichloroacetic acid					-496.3							
C ₂ H ₂ Cl ₃ NO	2,2,2-Trichloroacetamide	-358.0											
C ₂ H ₂ Cl ₄	1,1,1,2-Tetrachloroethane											356.0	102.7
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane					-195.0		246.9	162.3	-149.2		362.8	100.8
C ₂ H ₂ F ₂	1,1-Difluoroethene									-335.0		266.2	60.1
C ₂ H ₂ F ₂	<i>cis</i> -1,2-Difluoroethene											268.3	58.2
C ₂ H ₂ F ₃ I	1,1,1-Trifluoro-2-iodoethane										-644.5		
C ₂ H ₂ I ₂	<i>cis</i> -1,2-Diiodoethene										-207.4		
C ₂ H ₂ O	Ketene					-67.9				-47.5	-48.3	247.6	51.8
C ₂ H ₂ O ₂	Glyoxal									-212.0	-189.7	272.5	60.6
C ₂ H ₂ O ₄	Oxalic acid	-829.9		109.8	91.0					-731.8	-662.7	320.6	86.2
C ₂ H ₂ O ₄ Sr	Strontium formate	-1393.3											
C ₂ H ₂ S	Thiirene									300.0	275.8	255.3	54.7
C ₂ H ₃ Br	Bromoethene									79.2	81.8	275.8	55.5
C ₂ H ₃ BrO	Acetyl bromide					-223.5				-190.4			
C ₂ H ₃ BrO ₂	Bromoacetic acid									-383.5	-338.3	337.0	80.5
C ₂ H ₃ Cl	Chloroethene	-94.1			59.4	14.6				37.2	53.6	264.0	53.7
C ₂ H ₃ ClF ₂	1-Chloro-1,1-difluoroethane											307.2	82.5
C ₂ H ₃ ClO	Acetyl chloride					-272.9	-208.0	200.8	117.0	-242.8	-205.8	295.1	67.8
C ₂ H ₃ ClO ₂	Chloroacetic acid	-509.7								-427.6	-368.5	325.9	78.8
C ₂ H ₃ Cl ₂ F	1,1-Dichloro-1-fluoroethane											320.2	88.7
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane					-177.4		227.4	144.3	-144.4		323.1	93.3
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane					-190.8		232.6	150.9	-151.3		337.2	89.0
C ₂ H ₃ F	Fluoroethene									-138.8			
C ₂ H ₃ FO	Acetyl fluoride					-467.2				-442.1			
C ₂ H ₃ F ₃	1,1,1-Trifluoroethane									-744.6		279.9	78.2
C ₂ H ₃ F ₃	1,1,2-Trifluoroethane									-730.7			
C ₂ H ₃ F ₃ O	2,2,2-Trifluoroethanol					-932.4				-888.4			
C ₂ H ₃ I	Iodoethene											285.0	57.9
C ₂ H ₃ O	Acetyl iodide					-163.5				-126.4			
C ₂ H ₃ KO ₂	Potassium acetate	-723.0											
C ₂ H ₃ N	Acetonitrile					40.6	86.5	149.6	91.5	74.0	91.9	243.4	52.2
C ₂ H ₃ N	Isocyanomethane					130.8	159.5	159.0		163.5	165.7	246.9	52.9
C ₂ H ₃ NO	Methyl isocyanate					-92.0							
C ₂ H ₃ NO ₂	Nitroethene									33.3		300.5	73.7
C ₂ H ₃ NO ₃	Oxamic acid	-661.2								-552.3			

C ₂ H ₃ NS	Methyl isothiocyanate	79.4								
C ₂ H ₃ NaO ₂	Sodium acetate	-708.8	-607.2	123.0	79.9					
C ₂ H ₄	Ethylene							52.4	68.4	219.3 42.9
C ₂ H ₄ BrCl	1-Bromo-2-chloroethane						130.1			
C ₂ H ₄ Br ₂	1,1-Dibromoethane					-66.2				327.7 80.8
C ₂ H ₄ Br ₂	1,2-Dibromoethane					-79.2	223.3	136.0	-37.5	
C ₂ H ₄ ClF	1-Chloro-1-fluoroethane								-313.4	
C ₂ H ₄ Cl ₂	1,1-Dichloroethane					-158.4	-73.8	211.8	126.3	-127.7 -70.8 305.1 76.2
C ₂ H ₄ Cl ₂	1,2-Dichloroethane					-166.8			128.4	-126.4 308.4 78.7
C ₂ H ₄ F ₂	1,1-Difluoroethane									-497.0 282.5 67.8
C ₂ H ₄ I ₂	1,2-Diiodoethane	9.3								75.0
C ₂ H ₄ N ₂ O ₂	Oxamide	-504.4								-387.1
C ₂ H ₄ N ₂ O ₂	Ethanedial dioxime	-90.5								
C ₂ H ₄ N ₂ O ₄	1,1-Dinitroethane					-148.2				
C ₂ H ₄ N ₂ O ₄	1,2-Dinitroethane					-165.2				
C ₂ H ₄ N ₂ S ₂	Ethanedithioamide	-20.8								83.0
C ₂ H ₄ N ₄	1 <i>H</i> -1,2,4-Triazol-3-amine	76.8								
C ₂ H ₄ O	Acetaldehyde					-192.2	-127.6	160.2	89.0	-166.2 -133.0 263.8 55.3
C ₂ H ₄ O	Oxirane					-78.0	-11.8	153.9	88.0	-52.6 -13.0 242.5 47.9
C ₂ H ₄ OS	Thioacetic acid					-216.9				-175.1
C ₂ H ₄ O ₂	Acetic acid					-484.3	-389.9	159.8	123.3	-432.2 -374.2 283.5 63.4
C ₂ H ₄ O ₂	Methyl formate					-386.1			119.1	-357.4 285.3 64.4
C ₂ H ₄ O ₃	Peroxyacetic acid									
C ₂ H ₄ O ₃	Glycolic acid									-583.0 -504.9 318.6 87.1
C ₂ H ₄ S	Thiirane					51.6				82.0 96.8 255.2 53.3
C ₂ H ₄ Si	Ethynylsilane									269.4 72.6
C ₂ H ₅ Br	Bromoethane					-90.5	-25.8	198.7	100.8	-61.9 -23.9 286.7 64.5
C ₂ H ₅ Cl	Chloroethane					-136.8	-59.3	190.8	104.3	-112.1 -60.4 276.0 62.8
C ₂ H ₅ ClO	2-Chloroethanol					-295.4				
C ₂ H ₅ F	Fluoroethane									264.5 58.6
C ₂ H ₅ I	Iodoethane					-40.0	14.7	211.7	115.1	-8.1 19.2 306.0 66.9
C ₂ H ₅ N	Ethyleneimine					91.9				126.5
C ₂ H ₅ NO	Acetamide	-317.0	115.0	91.3						-238.3
C ₂ H ₅ NO	<i>N</i> -Methylformamide								123.8	
C ₂ H ₅ NO ₂	Nitroethane					-143.9			134.4	-103.8 320.5 79.0
C ₂ H ₅ NO ₂	Glycine	-528.5								-392.1
C ₂ H ₅ NO ₃	2-Nitroethanol					-350.7				
C ₂ H ₅ NO ₃	Ethyl nitrate					-190.4				-154.1
C ₂ H ₅ NS	Thioacetamide	-71.7								11.4
C ₂ H ₆	Ethane									-84.0 -32.0 229.2 52.5
C ₂ H ₆ Cd	Dimethyl cadmium					63.6	139.0	201.9	132.0	101.6 146.9 303.0
C ₂ H ₆ Hg	Dimethyl mercury					59.8	140.3	209.0		94.4 146.1 306.0 83.3
C ₂ H ₆ N ₂ O	<i>N</i> -Methylurea	-332.8								
C ₂ H ₆ N ₂ O ₂	1,2-Hydrazinedicarboxamide	-498.7								
C ₂ H ₆ N ₄ O ₂	Oxaly dihydrazide	-295.2								
C ₂ H ₆ O	Ethanol					-277.6	-174.8	160.7	112.3	-234.8 -167.9 281.6 65.6

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₂ H ₆ O	Dimethyl ether					-203.3				-184.1	-112.6	266.4	64.4
C ₂ H ₆ OS	Dimethyl sulfoxide					-204.2	-99.9	188.3	153.0	-151.3			
C ₂ H ₄ O ₂	Ethylene glycol					-460.0		163.2	148.6	-392.2		303.8	82.7
C ₂ H ₆ O ₂ S	Dimethyl sulfone	-450.1	-302.4	142.0						-373.1	-272.7	310.6	100.0
C ₂ H ₆ O ₃ S	Dimethyl sulfite					-523.6				-483.4			
C ₂ H ₆ O ₄ S	Dimethyl sulfate					-735.5				-687.0			
C ₂ H ₆ S	Ethanethiol					-73.6	-5.5	207.0	117.9	-46.1	-4.8	296.2	72.7
C ₂ H ₆ S	Dimethyl sulfide					-65.3		196.4	118.1	-37.4		286.0	74.1
C ₂ H ₆ S ₂	1,2-Ethanedithiol					-54.3				-9.7			
C ₂ H ₆ S ₂	Dimethyl disulfide					-62.6		235.4	146.1	-24.7			
C ₂ H ₄ Zn	Dimethyl zinc					23.4		201.6	129.2	53.0			
C ₂ H ₇ N	Ethylamine					-74.1			130.0	-47.5	36.3	283.8	71.5
C ₂ H ₇ N	Dimethylamine					-43.9	70.0	182.3	137.7	-18.8	68.5	273.1	70.7
C ₂ H ₇ NO	Ethanolamine								195.5				
C ₂ H ₆ ClN	Dimethylamine hydrochloride	-289.3											
C ₂ H ₈ N ₂	1,2-Ethanediamine					-63.0			172.6	-18.0			
C ₂ H ₈ N ₂	1,1-Dimethylhydrazine					48.9	206.4	198.0	164.1	84.1			
C ₂ H ₈ N ₂	1,2-Dimethylhydrazine					52.7				92.2			
C ₂ H ₈ N ₂ O ₄	Ammonium oxalate	-1123.0			226.0								
C ₂ HgO ₄	Mercury(II) oxalate	-678.2											
C ₂ I ₂	Diiodoacetylene										313.1	70.3	
C ₂ I ₄	Tetraiodoethene	305.0											
C ₂ K ₂ O ₄	Potassium oxalate	-1346.0											
C ₂ MgO ₄	Magnesium oxalate	-1269.0											
C ₂ N ₂	Cyanogen					285.9				306.7		241.9	56.8
C ₂ N ₄ O ₆	Trinitroacetone					183.7							
C ₂ Na ₂ O ₄	Sodium oxalate									-1318.0			
C ₂ O ₄ Pb	Lead(II) oxalate	-851.4	-750.1	146.0	105.4								
C ₃ F ₈	Perfluoropropane									-1783.2			
C ₃ H ₃ N ₂	Malononitrile	186.4								265.5			
C ₃ H ₂ O ₂	2-Propynoic acid					-193.2							
C ₃ H ₂ O ₃	1,3-Dioxol-2-one					-459.9				-418.6			
C ₃ H ₃ Cl ₃	1,2,3-Trichloropropene					-101.8							
C ₃ H ₃ F ₃	3,3,3-Trifluoropropene									-614.2			
C ₃ H ₃ N	Acrylonitrile					147.1				180.6			
C ₃ H ₃ NO	Oxazole					-48.0				-15.5			
C ₃ H ₃ NO	Isoxazole					42.1				78.6			
C ₃ H ₄	Allene									190.5			
C ₃ H ₄	Propyne									184.9			
C ₃ H ₄	Cyclopropene									277.1			
C ₃ H ₄ Cl ₂	2,3-Dichloropropene					-73.3							
C ₃ H ₄ Cl ₄	1,1,1,3-Tetrachloropropane					-208.7							
C ₃ H ₄ Cl ₄	1,2,2,3-Tetrachloropropane					-251.8							

C ₂ H ₂ F ₄ O	2,2,3,3-Tetrafluoro-1-propanol			-1114.9				-1061.3	
C ₃ H ₄ N ₂	1 <i>H</i> -Pyrazole			105.4				179.4	
C ₃ H ₄ N ₂	Imidazole	49.8						132.9	
C ₃ H ₄ O	Acrolein								71.3
C ₃ H ₄ O ₂	1,2-Propanedione			-309.1				-271.0	
C ₃ H ₄ O ₂	Acrylic acid			-383.8			145.7		
C ₃ H ₄ O ₂	2-Oxetanone			-329.9	175.3		122.1	-282.9	
C ₃ H ₄ O ₃	Ethylene carbonate			-571.5			133.9	-508.4	
C ₃ H ₃ Br	<i>cis</i> -1-Bromopropene			7.9				40.8	
C ₃ H ₃ Br	3-Bromopropene			12.2				45.2	
C ₃ H ₃ BrO	Bromoacetone							-181.0	
C ₃ H ₃ Cl	2-Chloropropene							-21.0	
C ₃ H ₃ Cl	3-Chloropropene						125.1		
C ₃ H ₃ ClO	Epichlorohydrin			-148.4			131.6	-107.8	
C ₃ H ₃ ClO ₂	2-Chloropropanoic acid			-522.5				-475.8	
C ₃ H ₃ ClO ₂	3-Chloropropanoic acid	-549.3							
C ₃ H ₃ ClO ₂	Ethyl chloroformate			-505.3				-462.9	
C ₃ H ₃ ClO ₂	Methyl chloroacetate			-487.0				-444.0	
C ₃ H ₂ Cl ₃	1,2,3-Trichloropropane			-230.6			183.6	-182.9	
C ₃ H ₂ I	3-Iodopropene			53.7				91.5	
C ₃ H ₂ I	Iodoacetone							-130.5	
C ₃ H ₂ I ₂ O ₂	3-Iodopropanoic acid	-460.0							
C ₃ H ₃ N	Propanenitrile			15.5			119.3	51.7	
C ₃ H ₃ N	2-Propyn-1-amine			205.7					
C ₃ H ₃ N	Ethyl isocyanide			108.6				141.7	
C ₃ H ₃ NO	Acrylamide	-212.1	110.6	-224.0				-130.2	
C ₃ H ₃ NO ₃	Nitroacetone			-278.6					
C ₃ H ₃ NO ₄	Methyl nitroacetate			-464.0					
C ₃ H ₃ N ₃ O ₉	Trinitroglycerol			-370.9				-279.1	545.9 234.2
C ₃ H ₆	Propene			4.0				20.0	
C ₃ H ₆	Cyclopropane			35.2				53.3	104.5 237.5 55.6
C ₃ H ₆ Br ₂	1,2-Dibromopropane			-113.6				-71.6	
C ₃ H ₆ Cl ₂	1,2-Dichloropropane, (±)			-198.8			149.1	-162.8	
C ₃ H ₆ Cl ₂	1,3-Dichloropropane			-199.9				-159.2	
C ₃ H ₆ Cl ₂	2,2-Dichloropropane			-205.8				-173.2	
C ₃ H ₆ Cl ₂ O	2,3-Dichloro-1-propanol			-381.5				-316.3	
C ₃ H ₆ Cl ₂ O	1,3-Dichloro-2-propanol			-385.3				-318.4	
C ₃ H ₆ I ₂	1,2-Diiodopropane							35.6	
C ₃ H ₆ I ₂	1,3-Diiodopropane			-9.0					
C ₃ H ₆ N ₂ O ₂	Propanediamide	-546.1							
C ₃ H ₆ N ₂ O ₂	<i>N</i> -(Aminocarbonyl)acetamide	-544.2						-441.2	
C ₃ H ₆ N ₂ O ₄	1,1-Dinitropropane			-163.2				-100.7	
C ₃ H ₆ N ₂ O ₄	1,3-Dinitropropane			-207.1					
C ₃ H ₆ N ₂ O ₄	2,2-Dinitropropane			-181.2					
C ₃ H ₆ N ₆ O ₆	Hexahydro-1,3,5-trinitro-1,3,5-triazine							192.0	482.4 230.2
C ₃ H ₆ O	Allyl alcohol			-171.8			138.9	-124.5	

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₃ H ₆ O	Propanal					-215.6				-185.6		304.5	80.7
C ₃ H ₆ O	Acetone					-248.4		199.8	126.3	-217.1	-152.7	295.3	74.5
C ₃ H ₆ O	Methyloxirane					-123.0		196.5	120.4	-94.7		286.9	72.6
C ₃ H ₆ O	Oxetane					-110.8				-80.5			
C ₃ H ₆ O ₂	Propanoic acid					-510.7		191.0	152.8	-455.7			
C ₃ H ₆ O ₂	Ethyl formate								149.3				
C ₃ H ₆ O ₂	Methyl acetate					-445.9			141.9	-413.3		324.4	86.0
C ₃ H ₆ O ₂	1,3-Dioxolane					-333.5			118.0	-298.0			
C ₃ H ₆ O ₂ S	Thiolactic acid					-468.4							
C ₃ H ₆ O ₃	1,3,5-Trioxane	-522.5		133.0	111.4					-465.9			
C ₃ H ₆ S	Thietane					24.7		184.9		60.6	107.1	285.0	68.3
C ₃ H ₆ S	Methylthiirane					11.3				45.8			
C ₃ H ₆ S ₂	1,2-Dithiolane									0.0	47.7	313.5	86.5
C ₃ H ₆ S ₂	1,3-Dithiolane									10.0	54.7	323.3	84.7
C ₃ H ₆ S ₃	1,3,5-Trithiane									80.0	130.4	336.4	111.3
C ₃ H ₇ Br	1-Bromopropane					-121.9				-87.0			
C ₃ H ₇ Br	2-Bromopropane					-130.5				-99.4			
C ₃ H ₇ Cl	1-Chloropropane					-160.5				-131.9			
C ₃ H ₇ Cl	2-Chloropropane					-172.3				-144.9			
C ₃ H ₇ ClO ₂	3-Chloro-1,2-propanediol					-525.3							
C ₃ H ₇ ClO ₂	2-Chloro-1,3-propanediol					-517.5							
C ₃ H ₇ F	1-Fluoropropane									-285.9			
C ₃ H ₇ F	2-Fluoropropane									-293.5			
C ₃ H ₇ I	1-Iodopropane					-66.0				-30.0			
C ₃ H ₇ I	2-Iodopropane					-74.8				-40.3			
C ₃ H ₇ N	Allylamine					-10.0							
C ₃ H ₇ N	Cyclopropylamine					45.8		187.7	147.1	77.0			
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide					-239.3			150.6	-192.4			
C ₃ H ₇ NO	Propanamide	-338.2								-259.0			
C ₃ H ₇ NO ₂	1-Nitropropane					-167.2				-124.3		350.0	104.1
C ₃ H ₇ NO ₂	2-Nitropropane					-180.3			170.3	-138.9			
C ₃ H ₇ NO ₂	Ethyl carbamate	-517.1			156.4	-497.3				-446.3			
C ₃ H ₇ NO ₂	<i>DL</i> -Alanine	-563.6											
C ₃ H ₇ NO ₂	<i>D</i> -Alanine	-561.2											
C ₃ H ₇ NO ₂	<i>L</i> -Alanine	-604.0								-465.9			
C ₃ H ₇ NO ₂	β -Alanine	-558.0								-424.0			
C ₃ H ₇ NO ₂	Sarcosine	-513.3								-367.3			
C ₃ H ₇ NO ₂ S	<i>L</i> -Cysteine	-534.1											
C ₃ H ₇ NO ₃	Propyl nitrate					-214.5				-174.1		362.6	123.2
C ₃ H ₇ NO ₃	Isopropyl nitrate					-229.7				-191.0			
C ₃ H ₇ NO ₃	<i>DL</i> -Serine	-739.0											
C ₃ H ₇ NO ₃	<i>L</i> -Serine	-732.7											
C ₃ H ₈	Propane					-120.9				-103.8	-23.4	270.3	73.6

C ₂ H ₅ N ₂ O	<i>N</i> -Ethylurea	-357.8							
C ₃ H ₈ N ₂ O	<i>N,N</i> -Dimethylurea	-319.1							
C ₃ H ₈ N ₂ O	<i>N,N</i> -Dimethylurea	-312.1							
C ₃ H ₈ N ₂ O ₃	Oxymethurea	-717.0							
C ₃ H ₈ O	1-Propanol		-302.6		193.6	143.9	-255.1		322.6 85.6
C ₃ H ₈ O	2-Propanol		-318.1		181.1	156.5	-272.6		309.2 89.3
C ₃ H ₈ O	Ethyl methyl ether						-216.4		309.2 93.3
C ₃ H ₈ O ₂	1,2-Propylene glycol		-501.0			190.8	-429.8		
C ₃ H ₈ O ₂	1,3-Propylene glycol		-480.8				-408.0		
C ₃ H ₈ O ₂	Ethylene glycol monomethyl ether					171.1			
C ₃ H ₈ O ₂	Dimethoxymethane		-377.8		244.0	162.0	-348.5		
C ₃ H ₈ O ₃	Glycerol		-669.6		206.3	218.9	-577.9		
C ₃ H ₈ S	1-Propanethiol		-99.9		242.5	144.6	-67.8		
C ₃ H ₈ S	2-Propanethiol		-105.9		233.5	145.3	-76.2		
C ₃ H ₈ S	Ethyl methyl sulfide		-91.6		239.1	144.6	-59.6		
C ₃ H ₈ S ₂	1,3-Propanedithiol		-79.4				-29.8		
C ₃ H ₇ Al	Trimethyl aluminum		-136.4	-9.9	209.4	155.6	-74.1		
C ₃ H ₇ B	Trimethylborane		-143.1	-32.1	238.9		-124.3	-35.9	314.7 88.5
C ₃ H ₇ BO ₃	Trimethyl borate					189.9			
C ₃ H ₇ ClSi	Trimethylchlorosilane		-382.8	-246.4	278.2		-352.8	-243.5	369.1
C ₃ H ₇ N	Propylamine		-101.5			164.1	-70.1	39.9	325.4 91.2
C ₃ H ₇ N	Isopropylamine		-112.3		218.3	163.8	-83.7	32.2	312.2 97.5
C ₃ H ₇ N	Trimethylamine		-45.7		208.5	137.9	-23.6		287.1 91.8
C ₃ H ₁₀ ClN	Propylamine hydrochloride	-354.7							
C ₃ H ₁₀ ClN	Trimethylamine hydrochloride	-282.9							
C ₃ H ₁₀ N ₂	1,2-Propanediamine, (±)		-97.8				-53.6		
C ₃ H ₁₀ Si	Trimethylsilane								331.0 117.9
C ₃ H ₁₂ BN	Trimethylamine borane	-142.5	70.7	187.0					
C ₃ H ₁₂ BN	Aminetrimethylboron	-284.1	-79.3	218.0					
C ₄ Cl ₆	Hexachloro-1,3-butadiene		-24.5						
C ₄ F ₈	Perfluorocyclobutane						-1542.6		
C ₄ F ₁₀	Perfluorobutane					127.2			
C ₄ H ₂ N ₂	<i>trans</i> -2-Butenedinitrile	268.2					340.2		
C ₄ H ₂ O ₃	Maleic anhydride	-469.8					-398.3		
C ₄ H ₂ O ₄	2-Butyenedioic acid	-577.3							
C ₄ H ₃ NO ₃	2-Nitrofuran	-104.1					-28.8		
C ₄ H ₄ BrNO ₂	<i>N</i> -Bromosuccinimide	-335.9							
C ₄ H ₄ ClNO ₂	<i>N</i> -Chlorosuccinimide	-357.9							
C ₄ H ₄ N ₂	Succinonitrile		139.7		191.6	145.6	209.7		
C ₄ H ₄ N ₂	Pyrazine	139.8					196.1		
C ₄ H ₄ N ₂	Pyrimidine		145.9				195.7		
C ₄ H ₄ N ₂	Pyridazine		224.9				278.3		
C ₄ H ₄ N ₂ O ₂	Uracil	-429.4	120.5				-302.9		
C ₄ H ₄ N ₂ O ₃	Barbituric acid	-634.7							
C ₄ H ₄ O	Furan		-62.3		177.0	114.8	-34.8		267.2 65.4
C ₄ H ₄ O ₂	Diketene		-233.1				-190.3		

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₄ H ₄ O ₃	Succinic anhydride	-608.6								-527.9			
C ₄ H ₄ O ₄	Maleic acid	-789.4		160.8	137.0					-679.4			
C ₄ H ₄ O ₄	Fumaric acid	-811.7		168.0	142.0					-675.8			
C ₄ H ₄ S	Thiophene					80.2		181.2	123.8	114.9	126.1	278.8	72.8
C ₄ H ₅ N	<i>trans</i> -2-Butenenitrile					95.1				134.3			
C ₄ H ₅ N	3-Butenenitrile					117.8				159.7			
C ₄ H ₅ N	2-Methylacrylonitrile								126.3				
C ₄ H ₅ N	Pyrrole					63.1		156.4	127.7	108.2			
C ₄ H ₅ N	Cyclopropanecarbonitrile					140.8				182.8			
C ₄ H ₅ NO ₂	Succinimide	-459.0								-375.4			
C ₄ H ₅ NS	4-Methylthiazole					67.9				111.8			
C ₄ H ₅ N ₃ O	Cytosine	-221.3			132.6								
C ₄ H ₆	1,2-Butadiene					138.6				162.3			
C ₄ H ₆	1,3-Butadiene					88.5		199.0	123.6	110.0			
C ₄ H ₆	1-Butyne					141.4				165.2			
C ₄ H ₆	2-Butyne					119.1				145.7			
C ₄ H ₆	Cyclobutene									156.7			
C ₄ H ₆ N ₂ O ₂	2,5-Piperazinedione	-446.5											
C ₄ H ₆ O	Divinyl ether					-39.8				-13.6			
C ₄ H ₆ O	<i>trans</i> -2-Butenal					-138.7				-100.6			
C ₄ H ₆ O ₂	<i>trans</i> -2-Butenoic acid												
C ₄ H ₆ O ₂	Methacrylic acid								161.1				
C ₄ H ₆ O ₂	Vinyl acetate					-349.2				-314.4			
C ₄ H ₆ O ₂	Methyl acrylate					-362.2		239.5	158.8	-333.0			
C ₄ H ₆ O ₂	γ -Butyrolactone					-420.9			141.4	-366.5			
C ₄ H ₆ O ₃	Acetic anhydride					-624.4				-572.5			
C ₄ H ₆ O ₃	Propylene carbonate					-613.2			218.6	-582.5			
C ₄ H ₆ O ₄	Succinic acid	-940.5		167.3	153.1					-823.0			
C ₄ H ₆ O ₄	Dimethyl oxalate	-756.3								-708.9			
C ₄ H ₆ S	2,3-Dihydrothiophene					52.9				90.7	133.5	303.5	79.8
C ₄ H ₆ S	2,5-Dihydrothiophene					47.0				86.9	131.6	297.1	83.3
C ₄ H ₇ ClO	2-Chloroethyl vinyl ether					-208.1				-170.1			
C ₄ H ₇ ClO ₂	2-Chlorobutanoic acid					-575.5							
C ₄ H ₇ ClO ₂	3-Chlorobutanoic acid					-556.3							
C ₄ H ₇ ClO ₂	4-Chlorobutanoic acid					-566.3							
C ₄ H ₇ ClO ₂	Propyl chlorocarbonate					-533.4				-492.7			
C ₄ H ₇ N	Butanenitrile					-5.8				33.6			
C ₄ H ₇ N	2-Methylpropanenitrile					-13.8				23.4			
C ₄ H ₇ NO	Acetone cyanohydrin					-120.9							
C ₄ H ₇ NO	2-Pyrrolidone					-286.2							
C ₄ H ₇ NO	2-Methyl-2-oxazoline					-169.5				-130.5			
C ₄ H ₇ NO ₄	Iminodiacetic acid	-932.6											
C ₄ H ₇ NO ₄	Ethyl nitroacetate					-487.1							

C ₄ H ₇ NO ₄	<i>L</i> -Aspartic acid	-973.3						
C ₄ H ₇ N ₃ O	Creatinine	-238.5						
C ₄ H ₈	1-Butene	-20.8	227.0	118.0	0.1			
C ₄ H ₈	<i>cis</i> -2-Butene	-29.8	219.9	127.0	-7.1			
C ₄ H ₈	<i>trans</i> -2-Butene	-33.3			-11.4			
C ₄ H ₈	Isobutene	-37.5			-16.9			
C ₄ H ₈	Cyclobutane	3.7			27.7			
C ₄ H ₈	Methylcyclopropane	1.7						
C ₄ H ₈ Br ₂	1,2-Dibromobutane	-142.1			-91.6			
C ₄ H ₈ Br ₂	1,3-Dibromobutane	-148.0						
C ₄ H ₈ Br ₂	1,4-Dibromobutane	-140.3			-87.8			
C ₄ H ₈ Br ₂	2,3-Dibromobutane	-139.6			-102.0			
C ₄ H ₈ Br ₂	1,2-Dibromo-2-methylpropane	-156.6			-113.3			
C ₄ H ₈ Cl ₂	1,3-Dichlorobutane	-237.3			-195.0			
C ₄ H ₈ Cl ₂	1,4-Dichlorobutane	-229.8			-183.4			
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether			220.9				
C ₄ H ₉ I ₂	1,4-Diiodobutane	-30.0						
C ₄ H ₈ N ₂ O ₂	Succinamide	-581.2						
C ₄ H ₈ N ₂ O ₂	Dimethylglyoxime	-199.7						
C ₄ H ₈ N ₂ O ₃	<i>L</i> -Asparagine	-789.4						
C ₄ H ₈ N ₂ O ₃	<i>N</i> -Glycylglycine	-747.7						
C ₄ H ₈ N ₂ O ₄	1,4-Dinitrobutane	-237.5						
C ₄ H ₈ N ₄ O ₈	Cyclotetramethylenetetranitramine				187.9	568.8	275.5	
C ₄ H ₈ O	Ethyl vinyl ether	-167.4			-140.8			
C ₄ H ₈ O	1,2-Epoxybutane	-168.9	230.9	147.0				
C ₄ H ₈ O	Butanal	-239.2	246.6	163.7	-204.8	343.7	103.4	
C ₄ H ₈ O	Isobutanal	-247.3			-215.7			
C ₄ H ₈ O	2-Butanone	-273.3	239.1	158.7	-238.5	339.9	101.7	
C ₄ H ₈ O	Tetrahydrofuran	-216.2	204.3	124.0	-184.1	302.4	76.3	
C ₄ H ₈ OS	<i>S</i> -Ethyl thioacetate	-268.2			-228.1			
C ₄ H ₈ O ₂	Butanoic acid	-533.8	222.2	178.6	-475.9			
C ₄ H ₈ O ₂	2-Methylpropanoic acid			173.0				
C ₄ H ₈ O ₂	Propyl formate	-500.3			-462.7			
C ₄ H ₈ O ₂	Ethyl acetate	-479.3	257.7	170.7	-443.6			
C ₄ H ₈ O ₂	Methyl propanoate			171.2				
C ₄ H ₈ O ₂	1,3-Dioxane	-379.7		143.9	-340.6			
C ₄ H ₈ O ₂	1,4-Dioxane	-353.9	270.2	152.1	-315.3			
C ₄ H ₈ O ₂	2-Methyl-1,3-dioxolane	-386.9			-352.0			
C ₄ H ₈ O ₂ S	Sulfolane			180.0				
C ₄ H ₈ S	Tetrahydrothiophene	-72.9			-34.1	45.8	309.6	92.5
C ₄ H ₈ S ₂	1,3-Dithiane				-10.0	72.4	333.5	110.4
C ₄ H ₈ S ₂	1,4-Dithiane				0.0	84.5	326.2	109.7
C ₄ H ₉ Br	1-Bromobutane	-143.8			-107.1			
C ₄ H ₉ Br	2-Bromobutane, (±)	-154.9			-120.3			
C ₄ H ₉ Br	2-Bromo-2-methylpropane	-164.4			-132.4			
C ₄ H ₉ Cl	1-Chlorobutane	-188.1			-154.4			

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₄ H ₉ Cl	2-Chlorobutane					-192.8				-161.1			
C ₄ H ₉ Cl	1-Chloro-2-methylpropane					-191.1				-159.3			
C ₄ H ₉ Cl	2-Chloro-2-methylpropane					-211.3				-182.2			
C ₄ H ₉ ClO	2-Chloroethyl ethyl ether					-335.6				-301.3			
C ₄ H ₉ I	1-Iodo-2-methylpropane								162.3				
C ₄ H ₉ I	2-Iodo-2-methylpropane					-107.5				-72.1			
C ₄ H ₉ N	Cyclobutanamine					5.6				41.2			
C ₄ H ₉ N	Pyrrolidine					-41.1		204.1	156.6	-3.6			
C ₄ H ₉ NO	Butanamide					-346.9				-282.0			
C ₄ H ₉ NO	<i>N</i> -Methylpropanamide								179.0				
C ₄ H ₉ NO	2-Methylpropanamide	-368.6								-282.6			
C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide					-278.3			175.6	-228.0			
C ₄ H ₉ NO	Morpholine								164.8				
C ₄ H ₉ NO ₂	1-Nitrobutane					-192.5				-143.9	369.9	115.1	
C ₄ H ₉ NO ₂	2-Nitroisobutane					-217.2				-177.1			
C ₄ H ₉ NO ₂	Propyl carbamate	-552.6								-471.4			
C ₄ H ₉ NO ₂	4-Aminobutanoic acid	-581.0								-441.0			
C ₄ H ₉ NO ₃	3-Nitro-2-butanol					-390.0							
C ₄ H ₉ NO ₃	2-Methyl-2-nitro-1-propanol	-410.1											
C ₄ H ₉ NO ₃	<i>DL</i> -Threonine	-758.8											
C ₄ H ₉ NO ₃	<i>L</i> -Threonine	-807.2											
C ₄ H ₉ N ₃ O ₂	Creatine	-537.2											
C ₄ H ₁₀	Butane					-147.3			140.9	-125.7			
C ₄ H ₁₀	Isobutane					-154.2				-134.2			
C ₄ H ₁₀ Hg	Diethyl mercury					30.1			182.8	75.3			
C ₄ H ₁₀ N ₂	Piperazine	-45.6											
C ₄ H ₁₀ N ₂ O	Trimethylurea	-330.5											
C ₄ H ₁₀ N ₂ O ₂	<i>N</i> -Nitrodiethylamine					-106.2				-53.0			
C ₄ H ₁₀ N ₂ O ₄	<i>L</i> -Asparagine, monohydrate	-1086.6											
C ₄ H ₁₀ O	1-Butanol					-327.3		225.8	177.2	-274.9			
C ₄ H ₁₀ O	2-Butanol					-342.6		214.9	196.9	-292.8	359.5	112.7	
C ₄ H ₁₀ O	2-Methyl-1-propanol					-334.7		214.7	181.5	-283.8			
C ₄ H ₁₀ O	2-Methyl-2-propanol					-359.2		193.3	218.6	-312.5	326.7	113.6	
C ₄ H ₁₀ O	Diethyl ether					-279.5		172.4	175.6	-252.1	342.7	119.5	
C ₄ H ₁₀ O	Methyl propyl ether					-266.0		262.9	165.4	-238.1			
C ₄ H ₁₀ O	Isopropyl methyl ether					-278.8		253.8	161.9	-252.0			
C ₄ H ₁₀ OS	Diethyl sulfoxide					-268.0				-205.6			
C ₄ H ₁₀ O ₂	1,2-Butanediol, (\pm)					-523.6							
C ₄ H ₁₀ O ₂	1,3-Butanediol					-501.0				-433.2			
C ₄ H ₁₀ O ₂	1,4-Butanediol					-505.3		223.4	200.1	-428.7			
C ₄ H ₁₀ O ₂	2,3-Butanediol					-541.5			213.0	-482.3			
C ₄ H ₁₀ O ₂	2-Methyl-1,2-propanediol					-539.7							
C ₄ H ₁₀ O ₂	Ethylene glycol monoethyl ether								210.8				

C ₂ H ₁₀ O ₂	Ethylene glycol dimethyl ether									193.3																		
C ₄ H ₁₀ O ₂	Dimethylacetal										-389.7																	
C ₄ H ₁₀ O ₂	<i>tert</i> -Butyl hydroperoxide										-245.9																	
C ₄ H ₁₀ O ₃	Diethylene glycol									244.8	-571.2																	
C ₄ H ₁₀ O ₃ S	Diethyl sulfite										-552.2																	
C ₄ H ₁₀ O ₄ S	Diethyl sulfate										-756.3																	
C ₄ H ₁₀ S	1-Butanethiol									171.2	-88.0																	
C ₄ H ₁₀ S	2-Butanethiol										-96.9																	
C ₄ H ₁₀ S	2-Methyl-1-propanethiol										-97.3																	
C ₄ H ₁₀ S	2-Methyl-2-propanethiol										-109.6																	
C ₄ H ₁₀ S	Diethyl sulfide									269.3	171.4	-83.5	368.1	117.0														
C ₄ H ₁₀ S	Methyl propyl sulfide											-82.2																
C ₄ H ₁₀ S	Isopropyl methyl sulfide											-90.5																
C ₄ H ₁₀ S ₂	1,4-Butanedithiol											-50.6																
C ₄ H ₁₀ S ₂	Diethyl disulfide											-79.4																
C ₄ H ₁₁ N	Butylamine											-91.9																
C ₄ H ₁₁ N	<i>sec</i> -Butylamine											-104.6																
C ₄ H ₁₁ N	<i>tert</i> -Butylamine											-121.0																
C ₄ H ₁₁ N	Isobutylamine											-98.7																
C ₄ H ₁₁ N	Diethylamine											-72.2																
C ₄ H ₁₁ NO	<i>N,N</i> -Dimethylethanolamine											-203.6																
C ₄ H ₁₁ NO ₂	Diethanolamine	-493.8		233.5								-397.1																
C ₄ H ₁₁ NO ₃	Tris(hydroxymethyl)methylamine	-717.8																										
C ₄ H ₁₂ BrN	Tetramethylammonium bromide	-251.0																										
C ₄ H ₁₂ ClN	Diethylamine hydrochloride	-358.6																										
C ₄ H ₁₂ ClN	Tetramethylammonium chloride	-276.4																										
C ₄ H ₁₂ IN	Tetramethylammonium iodide	-203.9																										
C ₄ H ₁₂ N ₂	2-Methyl-1,2-propanediamine											-133.9	-90.3															
C ₄ H ₁₂ Pb	Tetramethyl lead											97.9	135.9															
C ₄ H ₁₂ Si	Tetramethylsilane											-264.0	-100.0	277.3	204.1	-239.1	-99.9	359.0	143.9									
C ₄ H ₁₂ Sn	Tetramethylstannane											-52.3							-18.8									
C ₄ H ₁₃ N ₃	Bis(2-aminoethyl)amine																			254.0								
C ₄ N ₂	2-Butynedinitrile												500.4								529.2							
C ₄ NiO ₄	Nickel carbonyl												-633.0	-588.2	313.4	204.6	-602.9	-587.2	410.6		145.2							
C ₅ FeO ₅	Iron pentacarbonyl												-774.0	-705.3	338.1	240.6												
C ₆ H ₂ F ₆ O ₂	Hexafluoroacetylacetone	-2286.7																										
C ₆ H ₃ NO ₅	5-Nitro-2-furancarboxylic acid	-516.8																										
C ₉ H ₄ N ₄	1 <i>H</i> -Purine	169.4																										
C ₇ H ₄ N ₄ O	Hypoxanthine	-110.8		145.6	134.5																							
C ₅ H ₄ N ₄ O ₂	Xanthine	-379.6		161.1	151.3																							
C ₇ H ₂ N ₄ O ₃	Uric acid	-618.8		173.2	166.1																							
C ₅ H ₄ O ₂	Furfural																					-201.6	163.2	-151.0				
C ₅ H ₄ O ₃	2-Furancarboxylic acid	-498.4																						-390.0				
C ₅ H ₄ O ₃	3-Methyl-2,5-furandione																								-504.5	-447.2		
C ₅ H ₅ F ₃ O ₂	1,1,1-Trifluoro-2,4-pentanedione																								-1040.2	-993.3		
C ₅ H ₅ N	Pyridine																									100.2	132.7	140.4

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₅ H ₅ NO	1 <i>H</i> -Pyrrole-2-carboxaldehyde	-106.4											
C ₅ H ₅ N ₅	Adenine	96.9			147.0					205.7			
C ₅ H ₅ N ₅ O	Guanine	-183.9											
C ₅ H ₆	<i>cis</i> -3-Penten-1-yne					226.5							
C ₅ H ₆	<i>trans</i> -3-Penten-1-yne					228.2							
C ₅ H ₆	1,3-Cyclopentadiene					105.9				134.3			
C ₅ H ₆ N ₂ O ₂	Thymine	-462.8			150.8					-328.7			
C ₅ H ₆ O ₂	Furfuryl alcohol					-276.2			204.0	-211.8			
C ₅ H ₆ O ₄	<i>trans</i> -1-Propene-1,2-dicarboxylic acid	-824.4											
C ₅ H ₆ S	2-Methylthiophene					44.6		218.5	149.8	83.5			
C ₅ H ₆ S	3-Methylthiophene					43.1				82.5			
C ₅ H ₇ N	<i>trans</i> -3-Pentenenitrile					80.9				125.7			
C ₅ H ₇ N	Cyclobutanecarbonitrile					103.0				147.4			
C ₅ H ₇ N	1-Methylpyrrole					62.4				103.1			
C ₅ H ₇ N	2-Methylpyrrole					23.3				74.0			
C ₅ H ₇ N	3-Methylpyrrole					20.5				70.2			
C ₅ H ₇ NO ₂	Ethyl cyanoacetate								220.2				
C ₅ H ₈	1,2-Pentadiene									140.7			
C ₅ H ₈	<i>cis</i> -1,3-Pentadiene									81.4			
C ₅ H ₈	<i>trans</i> -1,3-Pentadiene									76.1			
C ₅ H ₈	1,4-Pentadiene									105.7			
C ₅ H ₈	2,3-Pentadiene									133.1			
C ₅ H ₈	3-Methyl-1,2-butadiene					101.2							
C ₅ H ₈	2-Methyl-1,3-butadiene					48.2		229.3	152.6	75.5			
C ₅ H ₈	Cyclopentene					4.3		201.2	122.4	34.0			
C ₅ H ₈	Spiropentane					157.5		193.7	134.5	185.2			
C ₅ H ₈	Methylenecyclobutane					93.8				121.6			
C ₅ H ₈ N ₄ O ₁₂	Pentaerythritol tetranitrate	-538.6								-387.0		614.7	294.8
C ₅ H ₈ O	Cyclopentanone					-235.9				-192.1			
C ₅ H ₈ O ₂	4-Pentenoic acid	-430.6											
C ₅ H ₈ O ₂	Allyl acetate								184.1				
C ₅ H ₈ O ₂	Ethyl acrylate					-370.6				-354.2			
C ₅ H ₈ O ₂	Methyl <i>trans</i> -2-butenate					-382.9				-341.9			
C ₅ H ₈ O ₂	Methyl methacrylate								191.2				
C ₅ H ₈ O ₂	2,4-Pentanedione					-423.8				-382.0			
C ₅ H ₈ O ₂	Dihydro-4-methyl-2(3 <i>H</i>)-furanone					-461.3				-406.5			
C ₅ H ₈ O ₂	Tetrahydro-2 <i>H</i> -pyran-2-one					-436.7				-379.6			
C ₅ H ₈ O ₃	Methyl acetoacetate					-623.2							
C ₅ H ₈ O ₄	Glutaric acid	-960.0											
C ₅ H ₉ ClO ₂	Propyl chloroacetate					-515.5				-467.0			
C ₅ H ₉ N	Pentanenitrile					-33.1				10.5			
C ₅ H ₉ N	2,2-Dimethylpropanenitrile					-39.8		232.0	179.4	-2.3			
C ₅ H ₉ N	1,2,5,6-Tetrahydropyridine					33.5							

C ₅ H ₉ NO	2-Piperidinone	-306.6				
C ₅ H ₉ NO	<i>N</i> -Methyl-2-pyrrolidone		-262.2		307.8	
C ₅ H ₉ NO ₂	<i>L</i> -Proline	-515.2				-366.2
C ₅ H ₉ NO ₄	<i>D</i> -Glutamic acid	-1005.3				
C ₅ H ₉ NO ₄	<i>L</i> -Glutamic acid	-1009.7				
C ₅ H ₁₀	1-Pentene		-46.9	262.6	154.0	-21.1
C ₅ H ₁₀	<i>cis</i> -2-Pentene		-53.7	258.6	151.7	-27.6
C ₅ H ₁₀	<i>trans</i> -2-Pentene		-58.2	256.5	157.0	-31.9
C ₅ H ₁₀	2-Methyl-1-butene		-61.1	254.0	157.2	-35.2
C ₅ H ₁₀	3-Methyl-1-butene		-51.5	253.3	156.1	-27.5
C ₅ H ₁₀	2-Methyl-2-butene		-68.6	251.0	152.8	-41.7
C ₅ H ₁₀	Cyclopentane		-105.1	204.5	128.8	-76.4
C ₅ H ₁₀	Methylcyclobutane		-44.5			
C ₅ H ₁₀	Ethylcyclopropane		-24.8			
C ₅ H ₁₀	1,1-Dimethylcyclopropane		-33.3			-8.2
C ₅ H ₁₀	<i>cis</i> -1,2-Dimethylcyclopropane		-26.3			
C ₅ H ₁₀	<i>trans</i> -1,2-Dimethylcyclopropane		-30.7			
C ₅ H ₁₀ Br ₂	2,3-Dibromo-2-methylbutane					-137.6
C ₅ H ₁₀ N ₂ O	<i>N</i> -Nitrosopiperidine		-31.1			16.6
C ₅ H ₁₀ N ₂ O ₂	<i>N</i> -Nitropiperidine		-93.0			-44.5
C ₅ H ₁₀ N ₂ O ₃	<i>L</i> -Glutamine	-826.4				
C ₅ H ₁₀ O	Cyclopentanol		-300.1	204.1	182.5	-242.5
C ₅ H ₁₀ O	Pentanal		-267.2			-228.4
C ₅ H ₁₀ O	2-Pentanone		-297.3		184.1	-258.8
C ₅ H ₁₀ O	3-Pentanone		-296.5	266.0	190.9	-257.9
C ₅ H ₁₀ O	3-Methyl-2-butanone		-299.5	268.5	179.9	-262.6
C ₅ H ₁₀ O	3,3-Dimethylloxetane		-182.2			-148.2
C ₅ H ₁₀ O	Tetrahydropyran		-258.3			-223.4
C ₅ H ₁₀ OS	<i>S</i> -Propyl thioacetate		-294.5			-250.4
C ₅ H ₁₀ O ₂	Pentanoic acid		-559.4	259.8	210.3	-491.9
C ₅ H ₁₀ O ₂	2-Methylbutanoic acid		-554.5			
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid		-561.6			-510.0
C ₅ H ₁₀ O ₂	2,2-Dimethylpropanoic acid	-564.5				-491.3
C ₅ H ₁₀ O ₂	Butyl formate				200.2	
C ₅ H ₁₀ O ₂	Propyl acetate				196.2	
C ₅ H ₁₀ O ₂	Isopropyl acetate		-518.9		199.4	-481.6
C ₅ H ₁₀ O ₂	Ethyl propanoate		-502.7			-463.4
C ₅ H ₁₀ O ₂	Methyl butanoate				198.2	
C ₅ H ₁₀ O ₂	(Ethoxymethyl)oxirane		-296.5			
C ₅ H ₁₀ O ₂	4-Methyl-1,3-dioxane	-416.1				-376.9
C ₅ H ₁₀ O ₂	<i>cis</i> -1,2-Cyclopentanediol	-485.0				
C ₅ H ₁₀ O ₂	<i>trans</i> -1,2-Cyclopentanediol	-490.1				
C ₅ H ₁₀ O ₂	Tetrahydrofurfuryl alcohol		-435.7			-369.1
C ₅ H ₁₀ O ₃	Diethyl carbonate		-681.5			-637.9
C ₅ H ₁₀ O ₃	Ethylene glycol monomethyl ether acetate				310.0	
C ₅ H ₁₀ O ₃	Ethyl lactate				254.0	

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₃ H ₁₀ O ₄	Glycerol 1-acetate, (DL)					-909.2							
C ₅ H ₁₀ O ₅	D-Ribose	-1047.2											
C ₅ H ₁₀ O ₅	D-Xylose	-1057.8											
C ₅ H ₁₀ O ₅	α -D-Arabinopyranose	-1057.9											
C ₆ H ₁₀ S	Thiacyclohexane					-106.3		218.2	163.3	-63.5	53.1	323.0	109.7
C ₆ H ₁₀ S	Cyclopentanethiol					-89.5		256.9	165.2	-48.1			
C ₆ H ₁₁ Br	1-Bromopentane					-170.2				-128.9			
C ₆ H ₁₁ Cl	1-Chloropentane					-213.2				-174.9			
C ₆ H ₁₁ Cl	1-Chloro-3-methylbutane					-216.0				-179.7			
C ₆ H ₁₁ Cl	2-Chloro-2-methylbutane					-235.7				-202.2			
C ₆ H ₁₁ Cl	2-Chloro-3-methylbutane					-226.6				-185.1			
C ₆ H ₁₁ N	Cyclopentylamine					-95.1		241.0	181.2	-54.9			
C ₆ H ₁₁ N	Piperidine					-86.4		210.0	179.9	-47.1			
C ₆ H ₁₁ NO	Pentanamide	-379.5								-290.2			
C ₆ H ₁₁ NO	2,2-Dimethylpropanamide	-399.7								-313.1			
C ₆ H ₁₁ NO ₂	1-Nitropentane					-215.4				-164.4		390.9	137.1
C ₆ H ₁₁ NO ₂	DL-Valine	-628.9											
C ₆ H ₁₁ NO ₂	L-Valine	-617.9								-455.1			
C ₆ H ₁₁ NO ₂	5-Aminopentanoic acid	-604.1								-460.0			
C ₆ H ₁₁ NO ₂ S	L-Methionine	-577.5								-413.5			
C ₆ H ₁₁ NO ₄	2-Ethyl-2-nitro-1,3-propanediol	-606.4											
C ₆ H ₁₂	Pentane					-173.5			167.2	-146.9			
C ₆ H ₁₂	Isopentane					-178.4		260.4	164.8	-153.6			
C ₆ H ₁₂	Neopentane					-190.2				-168.0			
C ₆ H ₁₂ N ₂ O	Butylurea	-419.5											
C ₆ H ₁₂ N ₂ O	tert-Butylurea	-417.4											
C ₆ H ₁₂ N ₂ O	N,N-Diethylurea	-372.2											
C ₆ H ₁₂ N ₂ O	Tetramethylurea	-262.2											
C ₆ H ₁₂ N ₂ S	Tetramethylthiourea	-38.1								44.9			
C ₆ H ₁₂ O	1-Pentanol					-351.6			208.1	-294.6			
C ₆ H ₁₂ O	2-Pentanol					-365.2				-311.0			
C ₆ H ₁₂ O	3-Pentanol					-368.9			239.7	-314.9			
C ₆ H ₁₂ O	2-Methyl-1-butanol, (\pm)					-356.6				-301.4			
C ₆ H ₁₂ O	3-Methyl-1-butanol					-356.4				-300.7			
C ₆ H ₁₂ O	2-Methyl-2-butanol					-379.5			247.1	-329.3			
C ₆ H ₁₂ O	3-Methyl-2-butanol, (\pm)					-366.6				-313.5			
C ₆ H ₁₂ O	2,2-Dimethyl-1-propanol					-399.4							
C ₆ H ₁₂ O	Butyl methyl ether					-290.6		295.3	192.7	-258.1			
C ₆ H ₁₂ O	Methyl tert-butyl ether					-313.6		265.3	187.5	-283.7			
C ₆ H ₁₂ O	Ethyl propyl ether					-303.6		295.0	197.2	-272.0			
C ₆ H ₁₂ O ₂	1,5-Pentanediol									-450.8			
C ₆ H ₁₂ O ₂	2,2-Dimethyl-1,3-propanediol	-551.2											
C ₆ H ₁₂ O ₂	Diethoxymethane					-450.5				-414.7			

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₆ H ₅ Br	Bromobenzene					60.9		219.2	154.3				
C ₆ H ₅ Cl	Chlorobenzene					11.1			150.1	52.0			
C ₆ H ₅ ClO	2-Chlorophenol								188.7				
C ₆ H ₅ ClO	3-Chlorophenol	-206.4				-189.3							
C ₆ H ₅ ClO	4-Chlorophenol	-197.7				-181.3							
C ₆ H ₅ Cl ₂ N	3,4-Dichloroaniline	-89.1											
C ₆ H ₅ F	Fluorobenzene					-150.6		205.9	146.4	-115.9			
C ₆ H ₅ I	Iodobenzene					117.2		205.4	158.7	164.9			
C ₆ H ₅ NO ₂	Nitrobenzene					12.5			185.8	68.5	348.8	120.4	
C ₆ H ₅ NO ₂	3-Pyridinecarboxylic acid	-344.9								-221.5			
C ₆ H ₅ NO ₃	2-Nitrophenol	-202.4											
C ₆ H ₅ N ₃	1 <i>H</i> -Benzotriazole	236.5								335.5			
C ₆ H ₅ N ₃ O ₄	2,3-Dinitroaniline	-11.7											
C ₆ H ₅ N ₃ O ₄	2,4-Dinitroaniline	-67.8											
C ₆ H ₅ N ₃ O ₄	2,5-Dinitroaniline	-44.3											
C ₆ H ₅ N ₃ O ₄	2,6-Dinitroaniline	-50.6											
C ₆ H ₅ N ₃ O ₄	3,5-Dinitroaniline	-38.9											
C ₆ H ₆	1,5-Hexadiyne					384.2							
C ₆ H ₆	Benzene					49.1	124.5	173.4	136.0	82.9	129.7	269.2	82.4
C ₆ H ₆ ClN	2-Chloroaniline					-4.6							
C ₆ H ₆ ClN	3-Chloroaniline					-20.3			198.7				
C ₆ H ₆ ClN	4-Chloroaniline	-33.3			147.3								
C ₆ H ₆ N ₂ O ₂	2-Nitroaniline	-26.1			166.0	-9.4				63.8			
C ₆ H ₆ N ₂ O ₂	3-Nitroaniline	-38.3			158.8	-14.4				58.4			
C ₆ H ₆ N ₂ O ₂	4-Nitroaniline	-42.0			167.0	-20.7				58.8			
C ₆ H ₆ O	Phenol	-165.1		144.0	127.4					-96.4			
C ₆ H ₆ O	2-Vinylfuran					-10.3				27.8			
C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	-364.5			136.0					-265.3			
C ₆ H ₆ O ₂	Pyrocatechol	-354.1								-267.5			
C ₆ H ₆ O ₂	Resorcinol	-368.0								-274.7			
C ₆ H ₆ O ₃	1,2,3-Benzenetriol	-551.1								-434.2			
C ₆ H ₆ O ₃	1,2,4-Benzenetriol	-563.8								-444.0			
C ₆ H ₆ O ₃	1,3,5-Benzenetriol	-584.6								-452.9			
C ₆ H ₆ O ₃	3,4-Dimethyl-2,5-furandione	-581.4											
C ₆ H ₆ O ₆	<i>cis</i> -1-Propene-1,2,3-tricarboxylic acid	-1224.4											
C ₆ H ₆ O ₆	<i>trans</i> -1-Propene-1,2,3-tricarboxylic acid	-1232.7											
C ₆ H ₆ S	Benzenethiol					63.7		222.8	173.2	111.3			
C ₆ H ₇ N	Aniline					31.6			191.9	87.5	-7.0	317.9	107.9
C ₆ H ₇ N	2-Methylpyridine					56.7			158.6	99.2			
C ₆ H ₇ N	3-Methylpyridine					61.9		216.3	158.7	106.4			
C ₆ H ₇ N	4-Methylpyridine					59.2		209.1	159.0	103.8			
C ₆ H ₇ N	1-Cyclopentene carbonitrile					111.5				156.5			
C ₆ H ₈ N ₂	Adiponitrile					85.1			128.7	149.5			

C ₆ H ₈ N ₂	1,2-Benzenediamine	-0.3			
C ₆ H ₈ N ₂	1,3-Benzenediamine	-7.8	154.5	159.6	
C ₆ H ₈ N ₂	1,4-Benzenediamine	3.0			
C ₆ H ₈ N ₂	Phenylhydrazine			141.0	217.0 202.9
C ₆ H ₈ N ₂ S	Bis(2-cyanoethyl) sulfide			96.3	
C ₆ H ₈ O ₄	Dimethyl maleate				263.2
C ₆ H ₈ O ₆	L-Ascorbic acid	-1164.6			
C ₆ H ₈ O ₇	Citric acid	-1543.8			
C ₆ H ₉ Cl ₃ O ₂	Butyl trichloroacetate			-545.8	-492.3
C ₆ H ₉ Cl ₃ O ₂	Isobutyl trichloroacetate			-553.4	-500.2
C ₆ H ₉ N	Cyclopentanecarbonitrile			0.7	44.1
C ₆ H ₉ N	2,4-Dimethylpyrrole	-422.3			
C ₆ H ₉ N	2,5-Dimethylpyrrole			-16.7	39.8
C ₆ H ₉ NO ₃	Triacetamide			-610.5	-550.1
C ₆ H ₉ NO ₃	Nitrilotriacetic acid	-1311.9			
C ₆ H ₉ N ₃ O ₂	L-Histidine	-466.7			
C ₆ H ₁₀	1,5-Hexadiene			54.1	84.2
C ₆ H ₁₀	3,3-Dimethyl-1-butene			78.4	
C ₆ H ₁₀	Cyclohexene	-38.5	214.6	148.3	-5.0
C ₆ H ₁₀	1-Methylcyclopentene	-36.4			-3.8
C ₆ H ₁₀	3-Methylcyclopentene	-23.7			7.4
C ₆ H ₁₀	4-Methylcyclopentene	-17.6			14.6
C ₆ H ₁₀ Cl ₂ O ₂	Butyl dichloroacetate			-550.1	-497.8
C ₆ H ₁₀ O	Cyclohexanone	-271.2			182.2 -226.1
C ₆ H ₁₀ O	2-Methylcyclopentanone	-265.2			
C ₆ H ₁₀ O	Mesityl oxide				212.5
C ₆ H ₁₀ O ₂	Ethyl <i>trans</i> -2-butenolate	-420.0			-375.6
C ₆ H ₁₀ O ₂	Methyl cyclobutanecarboxylate	-395.0			-350.2
C ₆ H ₁₀ O ₃	Ethyl acetoacetate				248.0
C ₆ H ₁₀ O ₃	Propanoic anhydride			-679.1	-626.5
C ₆ H ₁₀ O ₄	Adipic acid	-994.3			
C ₆ H ₁₀ O ₄	Diethyl oxalate			-805.5	-742.0
C ₆ H ₁₀ O ₄	Ethylene glycol diacetate				310.0
C ₆ H ₁₁ Cl	Chlorocyclohexane	-207.2			-163.7
C ₆ H ₁₁ ClO ₂	Ethyl 4-chlorobutanoate	-566.5			-513.8
C ₆ H ₁₁ ClO ₂	Propyl 3-chloropropanoate	-537.6			-485.7
C ₆ H ₁₁ ClO ₂	Butyl chloroacetate			-538.4	-487.4
C ₆ H ₁₁ NO	Caprolactam	-329.4	156.8		-239.6
C ₆ H ₁₁ NO	1-Methyl-2-piperidinone			-293.0	
C ₆ H ₁₂	1-Hexene	-74.2	295.2	183.3	-43.5
C ₆ H ₁₂	<i>cis</i> -2-Hexene	-83.9			-52.3
C ₆ H ₁₂	<i>trans</i> -2-Hexene	-85.5			-53.9
C ₆ H ₁₂	<i>cis</i> -3-Hexene	-78.9			-47.6
C ₆ H ₁₂	<i>trans</i> -3-Hexene	-86.1			-54.4
C ₆ H ₁₂	2-Methyl-1-pentene	-90.0			-59.4
C ₆ H ₁₂	3-Methyl-1-pentene	-78.2			-49.5

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₆ H ₁₂	4-Methyl-1-pentene					-80.0				-51.3			
C ₆ H ₁₂	2-Methyl-2-pentene					-98.5				-66.9			
C ₆ H ₁₂	3-Methyl- <i>cis</i> -2-pentene					-94.5				-62.3			
C ₆ H ₁₂	3-Methyl- <i>trans</i> -2-pentene					-94.6				-63.1			
C ₆ H ₁₂	4-Methyl- <i>cis</i> -2-pentene					-87.0				-57.5			
C ₆ H ₁₂	4-Methyl- <i>trans</i> -2-pentene					-91.6				-61.5			
C ₆ H ₁₂	2-Ethyl-1-butene					-87.1				-56.0			
C ₆ H ₁₂	2,3-Dimethyl-1-butene					-93.2				-62.4			
C ₆ H ₁₂	3,3-Dimethyl-1-butene					-87.5				-60.3			
C ₆ H ₁₂	2,3-Dimethyl-2-butene					-101.4		270.2	174.7	-68.1			
C ₆ H ₁₂	Cyclohexane					-156.4			154.9	-123.4			
C ₆ H ₁₂	Methylcyclopentane					-137.9				-106.2			
C ₆ H ₁₂	Ethylcyclobutane					-59.0				-27.5			
C ₆ H ₁₂	1,1,2-Trimethylcyclopropane					-96.2							
C ₆ H ₁₂ N ₂ O ₄ S ₂	<i>L</i> -Cystine	-1032.7											
C ₆ H ₁₂ N ₂ S ₄	Thiram	40.2			301.7								
C ₆ H ₁₂ O	Butyl vinyl ether					-218.8			232.0	-182.6			
C ₆ H ₁₂ O	Hexanal							280.3	210.4				
C ₆ H ₁₂ O	2-Hexanone					-322.0			213.3	-278.9			
C ₆ H ₁₂ O	3-Hexanone					-320.2		305.3	216.9	-277.6			
C ₆ H ₁₂ O	4-Methyl-2-pentanone								213.3				
C ₆ H ₁₂ O	2-Methyl-3-pentanone					-325.9				-286.0			
C ₆ H ₁₂ O	3,3-Dimethyl-2-butanone					-328.6				-290.6			
C ₆ H ₁₂ O	Cyclohexanol					-348.2			208.2	-286.2			
C ₆ H ₁₂ O	<i>cis</i> -2-Methylcyclopentanol					-345.5							
C ₆ H ₁₂ O ₂	Hexanoic acid					-583.8				-511.9			
C ₆ H ₁₂ O ₂	Butyl acetate					-529.2			227.8	-485.3			
C ₆ H ₁₂ O ₂	<i>tert</i> -Butyl acetate					-554.5			231.0	-516.5			
C ₆ H ₁₂ O ₂	Isobutyl acetate								233.8				
C ₆ H ₁₂ O ₂	Ethyl butanoate								228.0				
C ₆ H ₁₂ O ₂	Methyl pentanoate					-514.2			229.3	-471.1			
C ₆ H ₁₂ O ₂	Methyl 2,2-dimethylpropanoate					-530.0			257.9	-491.2			
C ₆ H ₁₂ O ₂	Diacetone alcohol								221.3				
C ₆ H ₁₂ O ₃	Ethylene glycol monoethyl ether acetate								376.0				
C ₆ H ₁₂ O ₃	Paraldehyde					-673.1				-631.7			
C ₆ H ₁₂ O ₆	β - <i>D</i> -Fructose	-1265.6											
C ₆ H ₁₂ O ₆	<i>D</i> -Galactose	-1286.3											
C ₆ H ₁₂ O ₆	α - <i>D</i> -Glucose	-1273.3											
C ₆ H ₁₂ O ₆	<i>D</i> -Mannose	-1263.0											
C ₆ H ₁₂ O ₆	<i>L</i> -Sorbosose	-1271.5											
C ₆ H ₁₂ S	Thiophane									-65.8	79.4	363.5	131.3
C ₆ H ₁₂ S	Cyclohexanethiol					-140.7		255.6	192.6	-96.2			
C ₆ H ₁₂ S	Cyclopentyl methyl sulfide					-109.8				-64.7			

C ₆ H ₁₃ Br	1-Bromohexane				-194.2	453.0	203.5	-148.3
C ₆ H ₁₃ Cl	2-Chlorohexane				-246.1			-204.3
C ₆ H ₁₃ N	Cyclohexylamine				-147.6			-104.0
C ₈ H ₁₃ N	2-Methylpiperidine, (±)				-124.9			-84.4
C ₆ H ₁₃ NO	Hexanamide				-397.9			-324.2
C ₆ H ₁₃ NO	<i>N</i> -Butylacetamide				-380.9			-305.9
C ₇ H ₁₃ NO ₂	<i>DL</i> -Leucine	-640.6						
C ₆ H ₁₃ NO ₂	<i>D</i> -Leucine	-637.3						
C ₇ H ₁₃ NO ₂	<i>L</i> -Leucine	-637.4	200.1					-486.8
C ₆ H ₁₃ NO ₂	<i>DL</i> -Isoleucine	-635.3						
C ₆ H ₁₃ NO ₂	<i>L</i> -Isoleucine	-637.8						
C ₆ H ₁₃ NO ₂	<i>L</i> -Norleucine	-639.1						
C ₆ H ₁₃ NO ₂	6-Aminohexanoic acid	-637.3						
C ₆ H ₁₄	Hexane				-198.7		195.6	-166.9
C ₆ H ₁₄	2-Methylpentane				-204.6	290.6	193.7	-174.6
C ₆ H ₁₄	3-Methylpentane				-202.4	292.5	190.7	-171.9
C ₆ H ₁₄	2,2-Dimethylbutane				-213.8	272.5	191.9	-185.9
C ₆ H ₁₄	2,3-Dimethylbutane				-207.4	287.8	189.7	-178.1
C ₆ H ₁₄ N ₂	Azopropane				11.5			51.3
C ₆ H ₁₄ N ₂ O ₂	<i>DL</i> -Lysine	-678.7						
C ₆ H ₁₄ N ₄ O ₂	<i>D</i> -Arginine	-623.5	250.6	232.0				
C ₆ H ₁₄ O	1-Hexanol				-377.5	287.4	240.4	-315.9
C ₆ H ₁₄ O	2-Hexanol				-392.0			-333.5
C ₆ H ₁₄ O	3-Hexanol				-392.4		286.2	
C ₆ H ₁₄ O	2-Methyl-1-pentanol						248.0	
C ₆ H ₁₄ O	3-Methyl-2-pentanol						275.9	
C ₆ H ₁₄ O	4-Methyl-2-pentanol				-394.7		273.0	
C ₆ H ₁₄ O	2-Methyl-3-pentanol				-396.4			
C ₆ H ₁₄ O	3-Methyl-3-pentanol						293.4	
C ₆ H ₁₄ O	Dipropyl ether				-328.8	323.9	221.6	-293.0
C ₆ H ₁₄ O	Diisopropyl ether				-351.5		216.8	-319.2
C ₆ H ₁₄ O	Butyl ethyl ether						159.0	
C ₆ H ₁₄ O	<i>tert</i> -Butyl ethyl ether							-313.9
C ₆ H ₁₄ OS	Dipropyl sulfoxide				-329.4			-254.9
C ₆ H ₁₄ O ₂	1,2-Hexanediol				-577.1			-490.1
C ₆ H ₁₄ O ₂	1,6-Hexanediol	-569.9			-548.6			-461.2
C ₆ H ₁₄ O ₂	2-Methyl-2,4-pentanediol						336.0	
C ₆ H ₁₄ O ₂	Ethylene glycol monobutyl ether						281.0	
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane				-491.4			-453.5
C ₆ H ₁₄ O ₂	Ethylene glycol diethyl ether				-451.4		259.4	-408.1
C ₆ H ₁₄ O ₃	Diethylene glycol monoethyl ether						301.0	
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether						274.1	
C ₆ H ₁₄ O ₃	Trimethylolpropane	-750.9						
C ₆ H ₁₄ O ₄	Triethylene glycol				-804.3			-725.0
C ₆ H ₁₄ O ₂ S	Dipropyl sulfate				-859.0			-792.0
C ₆ H ₁₄ O ₆	Galactitol				-1317.0			

Molecular Formula	Name	Crystal				Liquid				Gas				
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	
C ₆ H ₁₄ O ₆	D-Mannitol					-1314.5								
C ₆ H ₁₄ S	1-Hexanethiol					-175.7					-129.9			
C ₆ H ₁₄ S	2-Methyl-2-pentanethiol					-188.3					-148.3			
C ₆ H ₁₄ S	2,3-Dimethyl-2-butanethiol					-187.1					-147.9			
C ₆ H ₁₄ S	Diisopropyl sulfide					-181.6		313.0	232.0		-142.0			
C ₆ H ₁₄ S	Butyl ethyl sulfide					-172.3					-127.8			
C ₆ H ₁₄ S	Methyl pentyl sulfide					-167.1					-121.8			
C ₆ H ₁₄ S ₂	Dipropyl disulfide					-171.5					-118.3			
C ₆ H ₁₅ B	Triethylborane					-194.6	9.4	336.7	241.2		-157.7	16.1	437.8	
C ₆ H ₁₅ N	Dipropylamine					-156.1					-116.0			
C ₆ H ₁₅ N	Diisopropylamine					-178.5					-143.8			
C ₆ H ₁₅ N	Triethylamine					-127.7			219.9		-92.7			
C ₆ H ₁₅ NO	2-Diethylaminoethanol					-305.9								
C ₆ H ₁₅ NO ₃	Triethanolamine	-664.2			389.0						-558.3			
C ₆ H ₁₆ N ₂	1,6-Hexanediamine	-205.0												
C ₆ H ₁₆ N ₃ OP	Hexamethylphosphoric triamide								321.0					
C ₆ H ₁₈ OSi ₂	Hexamethyldisiloxane					-815.0	-541.5	433.8	311.4		-777.7	-534.5	535.0	238.5
C ₆ MoO ₆	Molybdenum hexacarbonyl	-982.8	-877.7	325.9	242.3						-912.1	-856.0	490.0	205.0
C ₆ N ₄	Tetracyanoethene	623.8									705.0			
C ₇ F ₈	Perfluorotoluene					-1311.1		355.5	262.3					
C ₇ F ₁₄	Perfluoromethylcyclohexane					-2931.1			353.1		-2897.2			
C ₇ F ₁₆	Perfluoroheptane					-3420.0		561.8	419.0		-3383.6			
C ₇ H ₅ F ₅	2,3,4,5,6-Pentafluorotoluene					-883.8		306.4	225.8		-842.7			
C ₇ H ₅ Cl ₃ O	3-Chlorobenzoyl chloride					-189.7								
C ₇ H ₅ N ₂ O ₆	3,5-Dinitrobenzoic acid	-409.8												
C ₇ H ₅ ClO	Benzoyl chloride					-158.0					-103.2			
C ₇ H ₅ ClO ₂	2-Chlorobenzoic acid	-404.5									-325.0			
C ₇ H ₅ ClO ₂	3-Chlorobenzoic acid	-424.3									-342.3			
C ₇ H ₅ ClO ₂	4-Chlorobenzoic acid	-428.9			163.2						-341.0			
C ₇ H ₅ F ₃	(Trifluoromethyl)benzene								188.4					
C ₇ H ₅ N	Benzonitrile					163.2		209.1	165.2		215.7			
C ₇ H ₅ NO	Benzoxazole	-24.2									44.8			
C ₇ H ₅ NO ₄	2-Nitrobenzoic acid	-378.8												
C ₇ H ₅ NO ₄	3-Nitrobenzoic acid	-394.7												
C ₇ H ₅ NO ₄	4-Nitrobenzoic acid	-392.2												
C ₇ H ₅ N ₃ O ₆	2,4,6-Trinitrotoluene	-63.2			243.3									
C ₇ H ₆ N ₂	1 <i>H</i> -Benzimidazole	79.5									181.7			
C ₇ H ₆ N ₂	1 <i>H</i> -Indazole	151.9									243.0			
C ₇ H ₆ N ₂ O ₄	1-Methyl-2,4-dinitrobenzene	-66.4									33.2			
C ₇ H ₆ O	Benzaldehyde					-87.0		221.2	172.0		-36.7			
C ₇ H ₆ O ₂	Benzoic acid	-385.2		167.6	146.8						-294.0			
C ₇ H ₆ O ₂	Salicylaldehyde								222.0					
C ₇ H ₆ O ₂	3-(2-Furanyl)-2-propenal	-182.0									-105.9			

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₇ H ₁₃ ClO ₂	Isobutyl 2-chloropropanoate					-603.1				-549.6			
C ₇ H ₁₃ ClO ₂	Butyl 3-chloropropanoate					-557.9				-502.3			
C ₇ H ₁₃ ClO ₂	Isobutyl 3-chloropropanoate					-572.6				-517.3			
C ₇ H ₁₃ ClO ₂	Propyl 2-chlorobutanoate					-630.7				-578.4			
C ₇ H ₁₃ N	Heptanenitrile					-82.8				-31.0			
C ₇ H ₁₄	1-Heptene					-97.9		327.6	211.8	-62.3			
C ₇ H ₁₄	<i>cis</i> -2-Heptene					-105.1							
C ₇ H ₁₄	<i>trans</i> -2-Heptene					-109.5							
C ₇ H ₁₄	<i>cis</i> -3-Heptene					-104.3							
C ₇ H ₁₄	<i>trans</i> -3-Heptene					-109.3							
C ₇ H ₁₄	5-Methyl-1-hexene					-100.0				-65.7			
C ₇ H ₁₄	<i>cis</i> -3-Methyl-3-hexene					-115.9				-79.4			
C ₇ H ₁₄	<i>trans</i> -3-Methyl-3-hexene					-112.7				-76.8			
C ₇ H ₁₄	2,4-Dimethyl-1-pentene					-117.0				-83.8			
C ₇ H ₁₄	4,4-Dimethyl-1-pentene					-110.6				-81.6			
C ₇ H ₁₄	2,4-Dimethyl-2-pentene					-123.1				-88.7			
C ₇ H ₁₄	<i>cis</i> -4,4-Dimethyl-2-pentene					-105.3				-72.6			
C ₇ H ₁₄	<i>trans</i> -4,4-Dimethyl-2-pentene					-121.7				-88.8			
C ₇ H ₁₄	2-Ethyl-3-methyl-1-butene					-114.1				-79.5			
C ₇ H ₁₄	2,3,3-Trimethyl-1-butene					-117.7				-85.5			
C ₇ H ₁₄	Cycloheptane					-156.6				-118.1			
C ₇ H ₁₄	Methylcyclohexane					-190.1			184.8	-154.7			
C ₇ H ₁₄	Ethylcyclopentane					-163.4		279.9		-126.9			
C ₇ H ₁₄	1,1-Dimethylcyclopentane					-172.1				-138.2			
C ₇ H ₁₄	<i>cis</i> -1,2-Dimethylcyclopentane					-165.3		269.2		-129.5			
C ₇ H ₁₄	<i>trans</i> -1,2-Dimethylcyclopentane					-171.2				-136.6			
C ₇ H ₁₄	<i>cis</i> -1,3-Dimethylcyclopentane					-170.1				-135.8			
C ₇ H ₁₄	<i>trans</i> -1,3-Dimethylcyclopentane					-168.1				-133.6			
C ₇ H ₁₄	1,1,2,2-Tetramethylcyclopropane					-119.8							
C ₇ H ₁₄ Br ₂	1,2-Dibromoheptane					-212.3				-157.9			
C ₇ H ₁₄ O	1-Heptanal					-311.5		335.4	230.1	-263.8			
C ₇ H ₁₄ O	2-Heptanone								232.6				
C ₇ H ₁₄ O	3-Heptanone									-297.1			
C ₇ H ₁₄ O	4-Heptanone									-298.3			
C ₇ H ₁₄ O	2,2-Dimethyl-3-pentanone					-356.1				-313.6			
C ₇ H ₁₄ O	2,4-Dimethyl-3-pentanone					-352.9		318.0	233.7	-311.3			
C ₇ H ₁₄ O	<i>cis</i> -2-Methylcyclohexanol					-390.2				-327.0			
C ₇ H ₁₄ O	<i>trans</i> -2-Methylcyclohexanol, (±)					-415.7				-352.5			
C ₇ H ₁₄ O	<i>cis</i> -3-Methylcyclohexanol, (±)					-416.1				-350.9			
C ₇ H ₁₄ O	<i>trans</i> -3-Methylcyclohexanol, (±)					-394.4				-329.1			
C ₇ H ₁₄ O	<i>cis</i> -4-Methylcyclohexanol					-413.2				-347.5			
C ₇ H ₁₄ O	<i>trans</i> -4-Methylcyclohexanol					-433.3				-367.2			
C ₇ H ₁₄ O ₂	Heptanoic acid					-610.2			265.4	-536.2			

C ₇ H ₁₄ O ₂	Pentyl acetate				261.0	
C ₇ H ₁₄ O ₂	Isopentyl acetate				248.5	
C ₇ H ₁₄ O ₂	Ethyl pentanoate			-553.0		-505.9
C ₇ H ₁₄ O ₂	Ethyl 3-methylbutanoate			-571.0		-527.0
C ₇ H ₁₄ O ₂	Ethyl 2,2-dimethylpropanoate			-577.2		-536.0
C ₇ H ₁₄ O ₂	Methyl hexanoate			-540.2		-492.2
C ₇ H ₁₄ O ₆	α-Methylglucoside	-1233.3				
C ₇ H ₁₅ Br	1-Bromoheptane			-218.4		-167.8
C ₇ H ₁₆	Heptane			-224.2		224.7 -187.6
C ₇ H ₁₆	2-Methylhexane			-229.5	323.3	222.9 -194.5
C ₇ H ₁₆	3-Methylhexane			-226.4		-191.3
C ₇ H ₁₆	3-Ethylpentane			-224.9	314.5	219.6 -189.5
C ₇ H ₁₆	2,2-Dimethylpentane			-238.3	300.3	221.1 -205.7
C ₇ H ₁₆	2,3-Dimethylpentane			-233.1		-198.7
C ₇ H ₁₆	2,4-Dimethylpentane			-234.6	303.2	224.2 -201.6
C ₇ H ₁₆	3,3-Dimethylpentane			-234.2		-201.0
C ₇ H ₁₆	2,2,3-Trimethylbutane			-236.5	292.2	213.5 -204.4
C ₇ H ₁₆ O	1-Heptanol			-403.3		272.1 -336.5
C ₇ H ₁₆ O	<i>tert</i> -Butyl isopropyl ether			-392.8		-358.1
C ₇ H ₁₆ O ₂	1,7-Heptanediol			-574.2		
C ₇ H ₁₆ O ₂	2,2-Diethoxypropane			-538.9		-506.9
C ₇ H ₁₆ S	1-Heptanethiol			-200.5		-149.9
C ₈ H ₄ O ₃	Phthalic anhydride	-460.1	180.0	160.0		-371.4
C ₈ H ₈ NO ₂	1 <i>H</i> -Indole-2,3-dione	-268.2				
C ₈ H ₆ O ₄	Phthalic acid	-782.0	207.9	188.1		
C ₈ H ₆ O ₄	Isophthalic acid	-803.0				-696.3
C ₈ H ₆ O ₄	Terephthalic acid	-816.1				-717.9
C ₈ H ₆ S	Benzo[<i>b</i>]thiophene	100.6				166.3
C ₈ H ₇ N	1 <i>H</i> -Indole	86.6				156.5
C ₈ H ₈	Styrene			103.8		182.0 147.9
C ₈ H ₈ O	Phenyl vinyl ether			-26.2		22.7
C ₈ H ₈ O	Acetophenone			-142.5		-86.7
C ₈ H ₈ O ₂	<i>o</i> -Toluic acid	-416.5		174.9		
C ₈ H ₈ O ₂	<i>m</i> -Toluic acid	-426.1		163.6		
C ₈ H ₈ O ₂	<i>p</i> -Toluic acid	-429.2		169.0		
C ₈ H ₈ O ₂	Methyl benzoate			-343.5		221.3 -287.9
C ₈ H ₈ O ₃	Methyl salicylate					249.0
C ₈ H ₉ NO	Acetanilide	-209.4		179.3		
C ₈ H ₁₀	1,7-Octadiyne			334.4		
C ₈ H ₁₀	Ethylbenzene			-12.3		183.2 29.9
C ₈ H ₁₀	<i>o</i> -Xylene			-24.4		186.1 19.1
C ₈ H ₁₀	<i>m</i> -Xylene			-25.4		183.0 17.3
C ₈ H ₁₀	<i>p</i> -Xylene			-24.4		181.5 18.0
C ₈ H ₁₀ O	2-Ethylphenol			-208.8		-145.2
C ₈ H ₁₀ O	3-Ethylphenol			-214.3		-146.1
C ₈ H ₁₀ O	4-Ethylphenol	-224.4		206.9		-144.1

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₈ H ₁₀ O	2,3-Xylenol	-241.1								-157.2			
C ₈ H ₁₀ O	2,4-Xylenol					-228.7				-163.8			
C ₈ H ₁₀ O	2,5-Xylenol	-246.6								-161.6			
C ₈ H ₁₀ O	2,6-Xylenol	-237.4								-162.1			
C ₈ H ₁₀ O	3,4-Xylenol	-242.3								-157.3			
C ₈ H ₁₀ O	3,5-Xylenol	-244.4								-162.4			
C ₈ H ₁₀ O	Benzeneethanol								252.6				
C ₈ H ₁₀ O	Ethoxybenzene					-152.6			228.5	-101.6			
C ₈ H ₁₀ O ₂	1,2-Dimethoxybenzene					-290.3				-223.3			
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline					8.2				56.3			
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline					46.0				100.5			
C ₈ H ₁₁ N	2,4-Dimethylaniline					-39.2							
C ₈ H ₁₁ N	2,5-Dimethylaniline					-38.9							
C ₈ H ₁₁ N	2,6-Dimethylaniline								238.9				
C ₈ H ₁₂	1-Octen-3-yne					140.7							
C ₈ H ₁₂	<i>cis</i> -1,2-Divinylcyclobutane					124.3				166.5			
C ₈ H ₁₂	<i>trans</i> -1,2-Divinylcyclobutane					101.3				143.5			
C ₈ H ₁₂ N ₄	2,2'-Azobis[isobutyronitrile]	228.9											
C ₈ H ₁₂ O ₂	2,2,4,4-Tetramethyl-1,3-cyclobutanedione	-379.9								-307.6			
C ₈ H ₁₄	Ethylidenecyclohexane					-103.5				-59.5			
C ₈ H ₁₄	Allylcyclopentane					-64.5				-24.1			
C ₈ H ₁₄ ClN ₅	Atrazine	-125.4											
C ₈ H ₁₄ O ₃	Butanoic anhydride								283.7				
C ₈ H ₁₅ ClO ₂	3-Methylbutyl 2-chloropropanoate					-627.3				-575.0			
C ₈ H ₁₅ ClO ₂	3-Methylbutyl 3-chloropropanoate					-593.4				-539.4			
C ₈ H ₁₅ N	Octanenitrile					-107.3				-50.5			
C ₈ H ₁₆	1-Octene					-124.5			241.0	-81.3			
C ₈ H ₁₆	<i>cis</i> -2-Octene					-135.7			239.0				
C ₈ H ₁₆	<i>trans</i> -2-Octene					-135.7			239.0				
C ₈ H ₁₆	<i>cis</i> -2,2-Dimethyl-3-hexene					-126.4				-89.3			
C ₈ H ₁₆	<i>trans</i> -2,2-Dimethyl-3-hexene					-144.9				-107.7			
C ₈ H ₁₆	3-Ethyl-2-methyl-1-pentene					-137.9				-100.3			
C ₈ H ₁₆	2,4,4-Trimethyl-1-pentene					-145.9				-110.5			
C ₈ H ₁₆	2,4,4-Trimethyl-2-pentene					-142.4				-104.9			
C ₈ H ₁₆	Cyclooctane					-167.7				-124.4			
C ₈ H ₁₆	Ethylcyclohexane					-212.1		280.9	211.8	-171.5			
C ₈ H ₁₆	1,1-Dimethylcyclohexane					-218.7		267.2	209.2	-180.9			
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane					-211.8		274.1	210.2	-172.1			
C ₈ H ₁₆	<i>trans</i> -1,2-Dimethylcyclohexane					-218.2		273.2	209.4	-179.9			
C ₈ H ₁₆	<i>cis</i> -1,3-Dimethylcyclohexane					-222.9		272.6	209.4	-184.6			
C ₈ H ₁₆	<i>trans</i> -1,3-Dimethylcyclohexane					-215.7		276.3	212.8	-176.5			
C ₈ H ₁₆	<i>cis</i> -1,4-Dimethylcyclohexane					-215.6		271.1	212.1	-176.6			
C ₈ H ₁₆	<i>trans</i> -1,4-Dimethylcyclohexane					-222.4		268.0	210.2	-184.5			

C ₈ H ₁₆	Propylcyclopentane				-188.8	310.8	216.3	-147.7
C ₈ H ₁₆	1-Ethyl-1-methylcyclopentane				-193.8			
C ₈ H ₁₆	<i>cis</i> -1-Ethyl-2-methylcyclopentane				-190.8			
C ₈ H ₁₆	<i>trans</i> -1-Ethyl-2-methylcyclopentane				-195.1			-156.2
C ₈ H ₁₆	<i>cis</i> -1-Ethyl-3-methylcyclopentane				-194.4			
C ₈ H ₁₆	<i>trans</i> -1-Ethyl-3-methylcyclopentane				-196.0			
C ₈ H ₁₆ O	Octanal							-291.9
								365.4
C ₈ H ₁₆ O	2-Ethylhexanal				-348.5			-299.6
C ₈ H ₁₆ O	2-Octanone						273.3	
C ₈ H ₁₆ O	2,2,4-Trimethyl-3-pentanone				-381.6			-338.3
C ₈ H ₁₆ O ₂	Octanoic acid				-636.0		297.9	-554.3
C ₈ H ₁₆ O ₂	2-Ethylhexanoic acid				-635.1			-559.5
C ₈ H ₁₆ O ₂	Hexyl acetate						282.8	
C ₈ H ₁₆ O ₂	Isobutyl isobutanoate				-587.4			-542.9
C ₈ H ₁₆ O ₂	Propyl pentanoate				-583.0			-533.6
C ₈ H ₁₆ O ₂	Isopropyl pentanoate				-592.2			-544.9
C ₈ H ₁₆ O ₂	Methyl heptanoate				-567.1		285.1	-515.5
C ₈ H ₁₇ Br	1-Bromooctane				-245.1			-189.3
C ₈ H ₁₇ Cl	1-Chlorooctane				-291.3			-238.9
C ₈ H ₁₇ NO	Octanamide	-473.2						-362.7
C ₈ H ₁₈	Octane				-250.1		254.6	-208.5
C ₈ H ₁₈	2-Methylheptane				-255.0	356.4	252.0	-215.3
C ₈ H ₁₈	3-Methylheptane, (S)				-252.3	362.6	250.2	-212.5
C ₈ H ₁₈	4-Methylheptane				-251.6		251.1	-211.9
C ₈ H ₁₈	3-Ethylhexane				-250.4			-210.7
C ₈ H ₁₈	2,2-Dimethylhexane				-261.9			-224.5
C ₈ H ₁₈	2,3-Dimethylhexane				-252.6			-213.8
C ₈ H ₁₈	2,4-Dimethylhexane				-257.0			-219.2
C ₈ H ₁₈	2,5-Dimethylhexane				-260.4		249.2	-222.5
C ₈ H ₁₈	3,3-Dimethylhexane				-257.5		246.6	-219.9
C ₈ H ₁₈	3,4-Dimethylhexane				-251.8			-212.8
C ₈ H ₁₈	3-Ethyl-2-methylpentane				-249.6			-211.0
C ₈ H ₁₈	3-Ethyl-3-methylpentane				-252.8			-214.8
C ₈ H ₁₈	2,2,3-Trimethylpentane				-256.9			-220.0
C ₈ H ₁₈	2,2,4-Trimethylpentane				-259.2		239.1	-224.0
C ₈ H ₁₈	2,3,3-Trimethylpentane				-253.5		245.6	-216.3
C ₈ H ₁₈	2,3,4-Trimethylpentane				-255.0	329.3	247.3	-217.3
C ₈ H ₁₈	2,2,3,3-Tetramethylbutane	-269.0	273.7	239.2				-226.0
C ₈ H ₁₈ N ₂	Azobutane				-40.1			9.2
C ₈ H ₁₈ O	1-Octanol				-426.5		305.2	-355.6
C ₈ H ₁₈ O	2-Octanol						330.1	
C ₈ H ₁₈ O	2-Ethyl-1-hexanol				-432.8	347.0	317.5	-365.3
C ₈ H ₁₈ O	Dibutyl ether				-377.9		278.2	-332.8
C ₈ H ₁₈ O	Di- <i>sec</i> -butyl ether				-401.5			-360.6
C ₈ H ₁₈ O	Di- <i>tert</i> -butyl ether				-399.6		276.1	-362.0
C ₈ H ₁₈ O	<i>tert</i> -Butyl isobutyl ether				-409.1			-369.0

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₈ H ₁₈ O ₂	1,8-Octanediol	-626.6											
C ₈ H ₁₈ O ₂	2,5-Dimethyl-2,5-hexanediol	-681.7											
C ₈ H ₁₈ O ₃	Diethylene glycol monobutyl ether								354.9				
C ₈ H ₁₈ O ₃	Diethylene glycol diethyl ether								341.4				
C ₈ H ₁₈ O ₃ S	Dibutyl sulfite					-693.1					-625.3		
C ₈ H ₁₈ O ₅	Tetraethylene glycol					-981.7			428.8		-883.0		
C ₈ H ₁₈ S	Dibutyl sulfide					-220.7		405.1	284.3		-167.7		
C ₈ H ₁₈ S	Di- <i>sec</i> -butyl sulfide					-220.7					-167.7		
C ₈ H ₁₈ S	Di- <i>tert</i> -butyl sulfide					-232.6					-188.8		
C ₈ H ₁₈ S	Diisobutyl sulfide					-229.2					-180.5		
C ₈ H ₁₈ S ₂	Dibutyl disulfide					-222.9					-160.6		
C ₈ H ₁₈ S ₂	Di- <i>tert</i> -butyl disulfide					-255.2					-201.0		
C ₈ H ₁₉ N	Dibutylamine					-206.0			292.9		-156.6		
C ₈ H ₁₉ N	Diisobutylamine					-218.5					-179.2		
C ₈ H ₂₀ BrN	Tetraethylammonium bromide	-342.7											
C ₈ H ₂₀ O ₂ Si	Ethyl silicate							533.1	364.4				
C ₈ H ₂₀ Pb	Tetraethyl lead					52.7		464.6	307.4	109.6			
C ₈ H ₂₀ Si	Tetraethylsilane								298.1				
C ₈ H ₈ N ₂ O ₂	Toluene-2,4-diisocyanate								287.8				
C ₉ H ₇ N	Quinoline					141.2					200.5		
C ₉ H ₇ N	Isoquinoline					144.3		216.0	196.2	204.6			
C ₉ H ₇ NO	2-Quinolinol	-144.9									-25.5		
C ₉ H ₇ NO	8-Quinolinol	82.1											
C ₉ H ₈	Indene					110.6		215.3	186.9	163.4			
C ₉ H ₈ O ₄	2-(Acetyloxy)benzoic acid	-815.6											
C ₉ H ₁₀	Cyclopropylbenzene					100.3					150.5		
C ₉ H ₁₀	Indan					11.5		234.4	190.2	60.3			
C ₉ H ₁₀ Cl ₂ N ₂ O	Diuron	-329.0											
C ₉ H ₁₀ N ₂	2,2'-Dipyrrylmethane	126.2											
C ₉ H ₁₀ O ₂	Ethyl benzoate								246.0				
C ₉ H ₁₀ O ₂	Benzyl acetate								148.5				
C ₉ H ₁₁ NO ₂	L-Phenylalanine	-466.9		213.6	203.0						-312.9		
C ₉ H ₁₁ NO ₃	L-Tyrosine	-685.1		214.0	216.4								
C ₉ H ₁₂	Propylbenzene					-38.3		287.8	214.7	7.9			
C ₉ H ₁₂	Isopropylbenzene					-41.1			210.7	4.0			
C ₉ H ₁₂	2-Ethyltoluene					-46.4				1.3			
C ₉ H ₁₂	3-Ethyltoluene					-48.7				-1.8			
C ₉ H ₁₂	4-Ethyltoluene					-49.8				-3.2			
C ₉ H ₁₂	1,2,3-Trimethylbenzene					-58.5		267.9	216.4	-9.5			
C ₉ H ₁₂	1,2,4-Trimethylbenzene					-61.8			215.0	-13.8			
C ₉ H ₁₂	1,3,5-Trimethylbenzene					-63.4			209.3	-15.9			
C ₉ H ₁₂ O	2-Isopropylphenol					-233.7				-182.2			
C ₉ H ₁₂ O	3-Isopropylphenol					-252.5				-196.0			

C ₉ H ₁₂ O	4-Isopropylphenol		-265.9			-209.4
C ₉ H ₁₂ O ₂	Isopropylbenzene hydroperoxide		-148.3			-78.4
C ₉ H ₁₃ NO ₂	Ethyl 3,5-dimethylpyrrole-2-carboxylate	-474.5				
C ₉ H ₁₃ NO ₂	Ethyl 2,4-dimethylpyrrole-3-carboxylate	-463.2				
C ₉ H ₁₃ NO ₂	Ethyl 2,5-dimethylpyrrole-3-carboxylate	-478.7				
C ₉ H ₁₃ NO ₂	Ethyl 4,5-dimethylpyrrole-3-carboxylate	-470.3				
C ₉ H ₁₄ O	Isophorone				253.5	
C ₉ H ₁₄ O ₆	Triacetin		-1330.8	458.3	384.7	-1245.0
C ₉ H ₁₅ N	3-Ethyl-2,4,5-trimethylpyrrole	-89.2				
C ₉ H ₁₆	1-Nonyne		16.3			62.3
C ₉ H ₁₆ O ₄	Nonanedioic acid	-1054.3				
C ₉ H ₁₇ NO	2,2,6,6-Tetramethyl-4-piperidinone	-334.2				-273.4
C ₉ H ₁₈	Propylcyclohexane		-237.4	311.9	242.0	-192.3
C ₉ H ₁₈	1 α ,3 α ,5 β -1,3,5-Trimethylcyclohexane					-212.1
C ₉ H ₁₈ O	2-Nonanone		-397.2			-340.7
C ₉ H ₁₈ O	5-Nonanone		-398.2	401.4	303.6	-344.9
C ₉ H ₁₈ O	2,6-Dimethyl-4-heptanone		-408.5		297.3	-357.6
C ₉ H ₁₈ O ₂	Nonanoic acid		-659.7		362.4	-577.3
C ₉ H ₁₈ O ₂	Butyl pentanoate	-613.3				-560.2
C ₉ H ₁₈ O ₂	sec-Butyl pentanoate		-624.2			-573.2
C ₉ H ₁₈ O ₂	Isobutyl pentanoate		-620.0			-568.6
C ₉ H ₁₈ O ₂	Methyl octanoate		-590.3			-533.9
C ₉ H ₁₉ N	<i>N</i> -Butylpiperidine		-171.8			
C ₉ H ₁₉ N	2,2,6,6-Tetramethylpiperidine		-206.9			-159.9
C ₉ H ₂₀	Nonane		-274.7		284.4	-228.2
C ₉ H ₂₀	2,2-Dimethylheptane		-288.1			
C ₉ H ₂₀	2,2,3-Trimethylhexane		-282.7			
C ₉ H ₂₀	2,2,4-Trimethylhexane		-282.8			
C ₉ H ₂₀	2,2,5-Trimethylhexane		-293.3			
C ₉ H ₂₀	2,3,3-Trimethylhexane		-281.1			
C ₉ H ₂₀	2,3,5-Trimethylhexane		-284.0			-242.6
C ₉ H ₂₀	2,4,4-Trimethylhexane		-280.2			
C ₉ H ₂₀	3,3,4-Trimethylhexane		-277.5			
C ₉ H ₂₀	3,3-Diethylpentane		-275.4		278.2	-233.3
C ₉ H ₂₀	3-Ethyl-2,2-dimethylpentane		-272.7			
C ₉ H ₂₀	3-Ethyl-2,4-dimethylpentane		-269.7			
C ₉ H ₂₀	2,2,3,3-Tetramethylpentane		-278.3		271.5	-237.1
C ₉ H ₂₀	2,2,3,4-Tetramethylpentane		-277.7			-236.9
C ₉ H ₂₀	2,2,4,4-Tetramethylpentane		-280.0		266.3	-241.6
C ₉ H ₂₀	2,3,3,4-Tetramethylpentane		-277.9			-236.1
C ₉ H ₂₀ N ₂ O	Tetraethylurea	-403.0				
C ₉ H ₂₀ O	1-Nonanol		-453.4			-376.5
C ₉ H ₂₀ O ₂	1,9-Nonanediol	-657.6				
C ₉ H ₂₁ N	Tripropylamine		-207.1			-161.0
C ₁₀ H ₆ N ₂	2-Quinolinecarbonitrile	246.5				
C ₁₀ H ₆ N ₂	3-Quinolinecarbonitrile	242.3				

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₁₀ H ₆ N ₂ O ₄	1,5-Dinitronaphthalene	29.8											
C ₁₀ H ₆ N ₂ O ₄	1,8-Dinitronaphthalene	39.7											
C ₁₀ H ₇ Cl	1-Chloronaphthalene					54.6			212.6	119.8			
C ₁₀ H ₇ Cl	2-Chloronaphthalene	55.4								137.4			
C ₁₀ H ₇ I	1-Iodonaphthalene					161.5				233.8			
C ₁₀ H ₇ I	2-Iodonaphthalene	144.3								235.1			
C ₁₀ H ₇ NO ₂	1-Nitronaphthalene	42.6								111.2			
C ₁₀ H ₈	Naphthalene	78.5	201.6	167.4	165.7					150.6	224.1	333.1	131.9
C ₁₀ H ₈	Azulene	212.3								289.1			
C ₁₀ H ₈ O	1-Naphthol	-121.5			166.9					-30.4			
C ₁₀ H ₈ O	2-Naphthol					-124.1				-29.9			
C ₁₀ H ₉ N	1-Naphthylamine	67.8								132.8			
C ₁₀ H ₉ N	2-Naphthylamine	60.2								134.3			
C ₁₀ H ₁₀	1,2-Dihydronaphthalene					71.6							
C ₁₀ H ₁₀	1,4-Dihydronaphthalene					84.2							
C ₁₀ H ₁₀ O	1-Tetralone	-209.6											
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate								303.1				
C ₁₀ H ₁₀ O ₄	Dimethyl isophthalate	-730.9											
C ₁₀ H ₁₀ O ₄	Dimethyl terephthalate	-732.6			261.1								
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene					-29.2			217.5	26.0			
C ₁₀ H ₁₄	Butylbenzene					-63.2		321.2	243.4	-11.8			
C ₁₀ H ₁₄	<i>sec</i> -Butylbenzene, (\pm)					-66.4				-18.4			
C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene					-71.9				-23.0			
C ₁₀ H ₁₄	Isobutylbenzene					-69.8				-21.9			
C ₁₀ H ₁₄	1-Isopropyl-2-methylbenzene					-73.3							
C ₁₀ H ₁₄	1-Isopropyl-3-methylbenzene					-78.6							
C ₁₀ H ₁₄	1-Isopropyl-4-methylbenzene					-78.0			236.4				
C ₁₀ H ₁₄	<i>o</i> -Diethylbenzene					-68.5							
C ₁₀ H ₁₄	<i>m</i> -Diethylbenzene					-73.5							
C ₁₀ H ₁₄	<i>p</i> -Diethylbenzene					-72.8							
C ₁₀ H ₁₄	3-Ethyl-1,2-dimethylbenzene					-80.5							
C ₁₀ H ₁₄	4-Ethyl-1,2-dimethylbenzene					-86.0							
C ₁₀ H ₁₄	2-Ethyl-1,3-dimethylbenzene					-80.1							
C ₁₀ H ₁₄	2-Ethyl-1,4-dimethylbenzene					-84.8							
C ₁₀ H ₁₄	1-Ethyl-2,4-dimethylbenzene					-84.1							
C ₁₀ H ₁₄	1-Ethyl-3,5-dimethylbenzene					-87.8							
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	-119.9		245.6	215.1								
C ₁₀ H ₁₄ O	Thymol	-309.7								-218.5			
C ₁₀ H ₁₆	Dipentene					-50.8			249.4	-2.6			
C ₁₀ H ₁₆	α -Limonene					-54.5			249.0				
C ₁₀ H ₁₆	α -Pinene					-16.4				28.3			
C ₁₀ H ₁₆	β -Pinene					-7.7				38.7			
C ₁₀ H ₁₆	α -Terpinene									-20.6			

C ₁₀ H ₁₆	β-Myrcene				14.5			
C ₁₀ H ₁₆	<i>cis, cis</i> -2,6-Dimethyl-2,4,6-octatriene				-24.0			
C ₁₀ H ₁₆ N ₂ O ₈	Ethylenediaminetetraacetic acid	-1759.5						
C ₁₀ H ₁₆ O	Camphor, (±)	-319.4		271.2				-267.5
C ₁₀ H ₁₈	1,1'-Bicyclopentyl				-178.9			
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene				-219.4	265.0	232.0	-169.2
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene				-230.6	264.9	228.5	-182.1
C ₁₀ H ₁₈ O ₄	Sebacic acid	-1082.6						-921.9
C ₁₀ H ₁₉ N	Decanenitrile				-158.4			-91.5
C ₁₀ H ₂₀	1-Decene				-173.8	425.0	300.8	-123.3
C ₁₀ H ₂₀	<i>cis</i> -1,2-Di- <i>tert</i> -butylethene				-163.6			
C ₁₀ H ₂₀	Butylcyclohexane				-263.1	345.0	271.0	-213.7
C ₁₀ H ₂₀ O ₂	Decanoic acid	-713.7			-684.3			-594.9
C ₁₀ H ₂₀ O ₂	Methyl nonanoate				-616.2			-554.2
C ₁₀ H ₂₁ NO ₂	1-Nitrodecane				-351.5			
C ₁₀ H ₂₂	Decane				-300.9		314.4	-249.5
C ₁₀ H ₂₂	2-Methylnonane				-309.8	420.1	313.3	-260.2
C ₁₀ H ₂₂	5-Methylnonane				-307.9	423.8	314.4	-258.6
C ₁₀ H ₂₂ O	1-Decanol				-478.1		370.6	-396.6
C ₁₀ H ₂₂ O	Dipentyl ether						250.0	
C ₁₀ H ₂₂ O	Diisopentyl ether						379.0	
C ₁₀ H ₂₂ O ₂	1,10-Decanediol	-678.9						
C ₁₀ H ₂₂ O ₂	Ethylene glycol dibutyl ether						350.0	
C ₁₀ H ₂₂ S	1-Decanethiol	-309.9			-276.5	476.1	350.4	-211.5
C ₁₀ H ₂₂ S	Dipentyl sulfide				-266.4			-204.9
C ₁₀ H ₂₂ S	Diisopentyl sulfide				-281.8			-221.5
C ₁₀ H ₂₃ N	Octyldimethylamine				-232.8			
C ₁₁ H ₈ O ₂	1-Naphthalenecarboxylic acid	-333.5						-223.1
C ₁₁ H ₈ O ₂	2-Naphthalenecarboxylic acid	-346.1						-232.5
C ₁₁ H ₁₀	1-Methylnaphthalene				56.3	254.8	224.4	
C ₁₁ H ₁₀	2-Methylnaphthalene	44.9	220.0	196.0				106.7
C ₁₁ H ₁₂ N ₂ O ₂	<i>L</i> -Tryptophan	-415.3	251.0	238.1				
C ₁₁ H ₁₄	1,1-Dimethylindan				-53.6			-1.6
C ₁₁ H ₁₆	1- <i>tert</i> -Butyl-3-methylbenzene				-109.7			
C ₁₁ H ₁₆	1- <i>tert</i> -Butyl-4-methylbenzene				-109.7			-57.0
C ₁₁ H ₁₆	Pentamethylbenzene	-144.6						-67.2
C ₁₁ H ₂₀	Spiro[5.5]undecane				-244.5			-188.3
C ₁₁ H ₂₂	1-Undecene						344.9	
C ₁₁ H ₂₂ O ₂	Methyl decanoate				-640.5			-573.8
C ₁₁ H ₂₄	Undecane				-327.2		344.9	-270.8
C ₁₁ H ₂₄ O	1-Undecanol				-504.8			
C ₁₂ F ₂₇ N	Tris(perfluorobutyl)amine						418.4	
C ₁₂ H ₈	Acenaphthylene	186.7		166.4				259.7
C ₁₂ H ₈ N ₂	Phenazine	237.0						328.8
C ₁₂ H ₈ O	Dibenzofuran	-5.3						83.4
C ₁₂ H ₈ S	Dibenzothiophene	120.0						205.1

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₁₂ H ₈ S ₂	Thianthrene	182.0								286.0			
C ₁₂ H ₉ N	Carbazole	101.7								200.7			
C ₁₂ H ₁₀	Acenaphthene	70.3		188.9	190.4					156.0			
C ₁₂ H ₁₀	Biphenyl	99.4		209.4	198.4					181.4			
C ₁₂ H ₁₀ N ₂ O	<i>trans</i> -Azoxybenzene	243.4								342.0			
C ₁₂ H ₁₀ N ₂ O	<i>N</i> -Nitrosodiphenylamine	227.2											
C ₁₂ H ₁₀ O	Diphenyl ether	-32.1		233.9	216.6	-14.9				52.0			
C ₁₂ H ₁₀ O ₂	1-Naphthaleneacetic acid	-359.2											
C ₁₂ H ₁₀ O ₂	2-Naphthaleneacetic acid	-371.9											
C ₁₂ H ₁₁ N	Diphenylamine	130.2								219.3			
C ₁₂ H ₁₁ N	2-Aminobiphenyl	93.8								184.4			
C ₁₂ H ₁₁ N	4-Aminobiphenyl	81.0											
C ₁₂ H ₁₂ N ₂	<i>p</i> -Benzidine	70.7											
C ₁₂ H ₁₄ O ₄	Diethyl phthalate					-776.6		425.1	366.1	-688.4			
C ₁₂ H ₁₆	Cyclohexylbenzene					-76.6				-16.7			
C ₁₂ H ₁₇ NO ₄	Diethyl 3,5-dimethylpyrrole-2,4-dicarboxylate	-916.7											
C ₁₂ H ₁₈	3,9-Dodecadiyne					197.8							
C ₁₂ H ₁₈	5,7-Dodecadiyne					181.5							
C ₁₂ H ₁₈	1- <i>tert</i> -Butyl-3,5-dimethylbenzene					-146.5							
C ₁₂ H ₁₈	Hexamethylbenzene	-162.4		306.3	245.6					-77.4			
C ₁₂ H ₂₂	Cyclohexylcyclohexane					-273.7				-215.7			
C ₁₂ H ₂₂ O ₄	Dodecanedioic acid	-1130.0								-976.9			
C ₁₂ H ₂₂ O ₁₁	Sucrose	-2226.1											
C ₁₂ H ₂₂ O ₁₁	β - <i>D</i> -Lactose	-2236.7											
C ₁₂ H ₂₄	1-Dodecene					-226.2		484.8	360.7	-165.4			
C ₁₂ H ₂₄ O ₂	Dodecanoic acid	-774.6			404.3	-737.9				-642.0			
C ₁₂ H ₂₄ O ₂	Methyl undecanoate					-665.2				-593.8			
C ₁₂ H ₂₄ O ₁₂	α -Lactose monohydrate	-2484.1											
C ₁₂ H ₂₅ Br	1-Bromododecane					-344.7				-269.9			
C ₁₂ H ₂₅ Cl	1-Chlorododecane					-392.3				-321.1			
C ₁₂ H ₂₆	Dodecane					-350.9			375.8	-289.4			
C ₁₂ H ₂₆ O	1-Dodecanol					-528.5			438.1	-436.6			
C ₁₂ H ₂₆ O ₃	Diethylene glycol dibutyl ether								452.0				
C ₁₂ H ₂₇ N	Tributylamine					-281.6							
C ₁₂ H ₂₇ O ₃ P	Tributyl phosphate								379.4				
C ₁₃ H ₈ O ₂	Xanthone	-191.5											
C ₁₃ H ₉ N	Acridine	179.4								273.9			
C ₁₃ H ₉ N	Phenanthridine	141.9								240.5			
C ₁₃ H ₉ N	Benzo[<i>f</i>]quinoline	150.6								233.7			
C ₁₃ H ₁₀	9 <i>H</i> -Fluorene	89.9		207.3	203.1					175.0			173.1
C ₁₃ H ₁₀ N ₂	9-Acridinamine	159.2											
C ₁₃ H ₁₀ O	Benzophenone	-34.5			224.8					54.9			
C ₁₃ H ₁₁ N	9-Methyl-9 <i>H</i> -carbazole	105.5								201.0			

C ₁₃ H ₁₂	Diphenylmethane	71.5	239.3	89.7	139.0
C ₁₃ H ₁₃ N	<i>N</i> -Benzylaniline	101.4			
C ₁₃ H ₁₄ N ₂	4,4'-Diaminodiphenylmethane		270.9		
C ₁₃ H ₂₄ O ₄	Tridecanedioic acid	-1148.3			
C ₁₃ H ₂₆	1-Tridecene				391.8
C ₁₃ H ₂₆ O ₂	Methyl dodecanoate			-693.0	-614.9
C ₁₃ H ₂₈	Tridecane				406.7
C ₁₃ H ₂₈ O	1-Tridecanol	-599.4			
C ₁₄ H ₈ O ₂	9,10-Anthracenedione	-188.5			-75.7
C ₁₄ H ₈ O ₂	9,10-Phenanthrenedione	-154.7			-46.6
C ₁₄ H ₈ O ₄	1,4-Dihydroxy-9,10-anthracenedione	-595.8			-471.7
C ₁₄ H ₁₀	Anthracene	129.2	207.5	210.5	230.9
C ₁₄ H ₁₀	Phenanthrene	116.2	215.1	220.6	207.5
C ₁₄ H ₁₀	Diphenylacetylene	312.4		225.9	
C ₁₄ H ₁₀ O ₂	Benzil	-153.9			-55.5
C ₁₄ H ₁₀ O ₄	Benzoyl peroxide	-369.4			-281.7
C ₁₄ H ₁₂	<i>cis</i> -Stilbene			183.3	252.3
C ₁₄ H ₁₂	<i>trans</i> -Stilbene	136.9			236.1
C ₁₄ H ₁₄	1,1-Diphenylethane			48.7	
C ₁₄ H ₁₄	1,2-Diphenylethane	51.5			142.9
C ₁₄ H ₂₂	1,3-Di- <i>tert</i> -butylbenzene			-188.8	
C ₁₄ H ₂₂	1,4-Di- <i>tert</i> -butylbenzene	-212.0			
C ₁₄ H ₂₃ N ₃ O ₁₀	Pentetic acid	-2225.2			
C ₁₄ H ₂₇ N	Tetradecanenitrile			-260.2	-174.9
C ₁₄ H ₂₈ O ₂	Tetradecanoic acid	-833.5	432.0	-788.8	-693.7
C ₁₄ H ₂₈ O ₂	Methyl tridecanoate			-717.9	-635.3
C ₁₄ H ₃₀ O	1-Tetradecanol	-629.6	388.0	-580.6	
C ₁₅ H ₁₆ O ₂	2,2-Bis(4-hydroxyphenyl)propane	-368.6			
C ₁₅ H ₂₄	1,3-Di- <i>tert</i> -butyl-5-methylbenzene	-245.8			
C ₁₅ H ₂₄ O	2,6-Di- <i>tert</i> -butyl-4-methylphenol	-410.0			-296.9
C ₁₅ H ₃₀	Decylcyclopentane			-367.3	
C ₁₅ H ₃₀ O ₂	Pentadecanoic acid	-861.7	443.3	-811.7	-699.0
C ₁₅ H ₃₀ O ₂	Methyl tetradecanoate			-743.9	-656.9
C ₁₅ H ₃₂ O	1-Pentadecanol	-658.2			
C ₁₆ H ₁₀	Fluoranthene	189.9	230.6	230.2	289.0
C ₁₆ H ₁₀	Pyrene	125.5	224.9	229.7	225.7
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate			-842.6	-750.9
C ₁₆ H ₂₂ O ₁₁	α - <i>D</i> -Glucose pentaacetate	-2249.4			
C ₁₆ H ₂₂ O ₁₁	β - <i>D</i> -Glucose pentaacetate	-2232.6			
C ₁₆ H ₂₆	Decylbenzene			-218.3	-138.6
C ₁₆ H ₃₂	1-Hexadecene			-328.7	587.9 488.9 -248.4
C ₁₆ H ₃₂ O ₂	Hexadecanoic acid	-891.5	452.4	460.7	-838.1 -737.1
C ₁₆ H ₃₂ O ₂	Methyl pentadecanoate			-771.0	-680.0
C ₁₆ H ₃₃ Br	1-Bromohexadecane			-444.5	-350.2
C ₁₆ H ₃₄	Hexadecane			-456.1	501.6 -374.8
C ₁₆ H ₃₄ O	1-Hexadecanol	-686.5	422.0		-517.0

Molecular Formula	Name	Crystal				Liquid				Gas			
		$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K	$\Delta_f H^\circ$ kJ/mol	$\Delta_f G^\circ$ kJ/mol	S° J/mol K	C_p J/mol K
C ₁₆ H ₃₆ I _N	Tetrabutylammonium iodide	-498.6											
C ₁₇ H ₃₄ O ₂	Heptadecanoic acid	-924.4			475.7	-865.6							
C ₁₈ H ₁₂	Benz[a]anthracene	170.8								293.0			
C ₁₈ H ₁₂	Chrysene	145.3								269.8			
C ₁₈ H ₁₄	<i>o</i> -Terphenyl			298.8	274.8			337.1	369.1				
C ₁₈ H ₁₄	<i>p</i> -Terphenyl	163.0		285.6	278.7					279.0			
C ₁₈ H ₁₅ N	Triphenylamine	234.7								326.8			
C ₁₈ H ₁₅ O ₄ P	Triphenyl phosphate			397.5	356.2								
C ₁₈ H ₁₅ P	Triphenylphosphine				312.5								
C ₁₈ H ₃₀	1,3,5-Tri- <i>tert</i> -butylbenzene	-320.0											
C ₁₈ H ₃₄ O ₂	Oleic acid								577.0				
C ₁₈ H ₃₄ O ₄	Dibutyl sebacate								619.0				
C ₁₈ H ₃₆ O ₂	Stearic acid	-947.7			501.5	-884.7				-781.2			
C ₁₈ H ₃₇ Cl	1-Chlorooctadecane					-544.1				-446.0			
C ₁₈ H ₃₈	Octadecane	-567.4		480.2	485.6					-414.6			
C ₁₈ H ₃₉ N	Trihexylamine					-433.0							
C ₁₉ H ₁₆ O	Triphenylmethanol	-2.5											
C ₁₉ H ₃₆ O ₂	Methyl oleate					-734.5				-649.9			
C ₁₉ H ₃₆ O ₂	Methyl <i>trans</i> -9-octadecenoate					-737.0							
C ₂₀ H ₁₂	Perylene	182.8		264.6	274.9								
C ₂₀ H ₁₂	Benzo[a]pyrene												254.8
C ₂₀ H ₁₄ O ₄	Diphenyl phthalate	-489.2											
C ₂₀ H ₃₈ O ₂	Ethyl oleate					-775.8							
C ₂₀ H ₃₈ O ₂	Ethyl <i>trans</i> -9-octadecenoate					-773.3							
C ₂₀ H ₄₀ O ₂	Eicosanoic acid	-1011.9			545.1	-940.0				-812.4			
C ₂₁ H ₂₁ O ₄ P	Tri- <i>o</i> -cresyl phosphate			570.0	578.0								
C ₂₂ H ₁₄	Dibenz[a,h]anthracene												283.9
C ₂₂ H ₄₂ O ₂	<i>trans</i> -13-Docosenoic acid	-960.7											
C ₂₂ H ₄₂ O ₂	Butyl oleate					-816.9							
C ₂₂ H ₄₄ O ₂	Butyl stearate												
C ₂₄ H ₃₈ O ₄	Bis(2-ethylhexyl) phthalate								704.7				
C ₂₄ H ₅₁ N	Trioctylamine					-585.0							
C ₂₆ H ₁₈	9,10-Diphenylanthracene	308.7								465.6			
C ₂₆ H ₅₄	5-Butyldocosane					-713.5				-587.6			
C ₂₆ H ₅₄	11-Butyldocosane					-716.0				-593.4			
C ₂₈ H ₁₈	9,9'-Bianthracene	326.2								454.3			
C ₃₁ H ₆₄	11-Decylheneicosane					-848.0				-705.8			
C ₃₂ H ₆₆	Dotriacontane					-968.3				-697.2			
C ₆₀	Carbon (fullerene-C ₆₀)	2327.0	2302.0	426.0	520.0					2502.0	2442.0	544.0	512.0
C ₇₀	Carbon (fullerene-C ₇₀)	2555.0	2537.0	464.0	650.0					2755.0	2692.0	614.0	585.0

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE

L. V. Gurvich, V. S. Iorish, V. S. Yungman, and O. V. Dorofeeva

The thermodynamic properties $C_p^\circ(T)$, $S^\circ(T)$, $H^\circ(T) - H^\circ(T_r)$, $-[G^\circ(T) - H^\circ(T_r)]/T$ and formation properties $\Delta_f H^\circ(T)$, $\Delta_f G^\circ(T)$, $\log K_f^\circ(T)$ are tabulated as functions of temperature in the range 298.15 to 1500 K for 80 substances in the standard state. The reference temperature, T_r , is equal to 298.15 K. The standard state pressure is taken as 1 bar (100,000 Pa). The tables are presented in the JANAF Thermochemical Tables format (Reference 2). The numerical data are extracted from IVTANTHERMO databases except for C_2H_4O , C_3H_6O , C_6H_6 , C_6H_6O , $C_{10}H_8$, and CH_5N , which are based upon TRC Tables. See the references for information on standard states and other details.

REFERENCES

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2. Chase, M. W., et al., *JANAF Thermochemical Tables*, 3rd ed., *J. Phys. Chem. Ref. Data*, 14, Suppl. 1, 1985.

Order of Listing of Tables

No.	Formula	Name	State	No.	Formula	Name	State
1	Ar	Argon	g	41	CuCl ₂	Copper dichloride	cr, l
2	Br	Bromine	g	42	CuCl ₂	Copper dichloride	g
3	Br ₂	Dibromine	g	43	F	Fluorine	g
4	BrH	Hydrogen bromide	g	44	F ₂	Difluorine	g
5	C	Carbon (graphite)	cr	45	FH	Hydrogen fluoride	g
6	C	Carbon (diamond)	cr	46	Ge	Germanium	cr, l
7	C ₂	Dicarbon	g	47	Ge	Germanium	g
8	C ₃	Tricarbon	g	48	GeO ₂	Germanium dioxide	cr, l
9	CO	Carbon oxide	g	49	GeCl ₄	Germanium tetrachloride	g
10	CO ₂	Carbon dioxide	g	50	H	Hydrogen	g
11	CH ₄	Methane	g	51	H ₂	Dihydrogen	g
12	C ₂ H ₂	Acetylene	g	52	HO	Hydroxyl	g
13	C ₂ H ₄	Ethylene	g	53	H ₂ O	Water	l
14	C ₂ H ₆	Ethane	g	54	H ₂ O	Water	g
15	C ₃ H ₆	Cyclopropane	g	55	I	Iodine	g
16	C ₃ H ₈	Propane	g	56	I ₂	Diiodine	cr, l
17	C ₆ H ₆	Benzene	l	57	I ₂	Diiodine	g
18	C ₆ H ₆	Benzene	g	58	IH	Hydrogen iodide	g
19	C ₁₀ H ₈	Naphthalene	cr, l	59	K	Potassium	cr, l
20	C ₁₀ H ₈	Naphthalene	g	60	K	Potassium	g
21	CH ₂ O	Formaldehyde	g	61	K ₂ O	Dipotassium oxide	cr, l
22	CH ₄ O	Methanol	g	62	KOH	Potassium hydroxide	cr, l
23	C ₂ H ₄ O	Acetaldehyde	g	63	KOH	Potassium hydroxide	g
24	C ₂ H ₆ O	Ethanol	g	64	KCl	Potassium chloride	cr, l
25	C ₂ H ₄ O ₂	Acetic acid	g	65	KCl	Potassium chloride	g
26	C ₃ H ₆ O	Acetone	g	66	N ₂	Dinitrogen	g
27	C ₆ H ₆ O	Phenol	g	67	NO	Nitric oxide	g
28	CF ₄	Carbon tetrafluoride	g	68	NO ₂	Nitrogen dioxide	g
29	CHF ₃	Trifluoromethane	g	69	NH ₃	Ammonia	g
30	CClF ₃	Chlorotrifluoromethane	g	70	O	Oxygen	g
31	CCl ₂ F ₂	Dichlorodifluoromethane	g	71	O ₂	Dioxygen	g
32	CHClF ₂	Chlorodifluoromethane	g	72	S	Sulfur	cr, l
33	CH ₅ N	Methylamine	g	73	S	Sulfur	g
34	Cl	Chlorine	g	74	S ₂	Disulfur	g
35	Cl ₂	Dichlorine	g	75	S ₈	Octasulfur	g
36	ClH	Hydrogen chloride	g	76	SO ₂	Sulfur dioxide	g
37	Cu	Copper	cr, l	77	Si	Silicon	cr
38	Cu	Copper	g	78	Si	Silicon	g
39	CuO	Copper oxide	cr	79	SiO ₂	Silicon dioxide	cr
40	Cu ₂ O	Dicopper oxide	cr	80	SiCl ₄	Silicon tetrachloride	g

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_p))/T$	$H^\circ - H^\circ(T_p)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
1. ARGON Ar (g)							
298.15	20.786	154.845	154.845	0.000	0.000	0.000	0.000
300	20.786	154.973	154.845	0.038	0.000	0.000	0.000
400	20.786	160.953	155.660	2.117	0.000	0.000	0.000
500	20.786	165.591	157.200	4.196	0.000	0.000	0.000
600	20.786	169.381	158.924	6.274	0.000	0.000	0.000
700	20.786	172.585	160.653	8.353	0.000	0.000	0.000
800	20.786	175.361	162.322	10.431	0.000	0.000	0.000
900	20.786	177.809	163.909	12.510	0.000	0.000	0.000
1000	20.786	179.999	165.410	14.589	0.000	0.000	0.000
1100	20.786	181.980	166.828	16.667	0.000	0.000	0.000
1200	20.786	183.789	168.167	18.746	0.000	0.000	0.000
1300	20.786	185.453	169.434	20.824	0.000	0.000	0.000
1400	20.786	186.993	170.634	22.903	0.000	0.000	0.000
1500	20.786	188.427	171.773	24.982	0.000	0.000	0.000
2. BROMINE Br (g)							
298.15	20.786	175.017	175.017	0.000	111.870	82.379	-14.432
300	20.786	175.146	175.018	0.038	111.838	82.196	-14.311
400	20.787	181.126	175.833	2.117	96.677	75.460	-9.854
500	20.798	185.765	177.373	4.196	96.910	70.129	-7.326
600	20.833	189.559	179.097	6.277	97.131	64.752	-5.637
700	20.908	192.776	180.827	8.364	97.348	59.338	-4.428
800	21.027	195.575	182.499	10.461	97.568	53.893	-3.519
900	21.184	198.061	184.093	12.571	97.796	48.420	-2.810
1000	21.365	200.302	185.604	14.698	98.036	42.921	-2.242
1100	21.559	202.347	187.034	16.844	98.291	37.397	-1.776
1200	21.752	204.231	188.390	19.010	98.560	31.850	-1.386
1300	21.937	205.980	189.676	21.195	98.844	26.279	-1.056
1400	22.107	207.612	190.900	23.397	99.141	20.686	-0.772
1500	22.258	209.142	192.065	25.615	99.449	15.072	-0.525
3. DIBROMINE Br₂ (g)							
298.15	36.057	245.467	245.467	0.000	30.910	3.105	-0.544
300	36.074	245.690	245.468	0.067	30.836	2.933	-0.511
332.25	36.340	249.387	245.671	1.235			
400	36.729	256.169	246.892	3.711	0.000	pressure = 1 bar	0.000
500	37.082	264.406	249.600	7.403	0.000	0.000	0.000
600	37.305	271.188	252.650	11.123	0.000	0.000	0.000
700	37.464	276.951	255.720	14.862	0.000	0.000	0.000
800	37.590	281.962	258.694	18.615	0.000	0.000	0.000
900	37.697	286.396	261.530	22.379	0.000	0.000	0.000
1000	37.793	290.373	264.219	26.154	0.000	0.000	0.000
1100	37.883	293.979	266.763	29.938	0.000	0.000	0.000
1200	37.970	297.279	269.170	33.730	0.000	0.000	0.000
1300	38.060	300.322	271.451	37.532	0.000	0.000	0.000
1400	38.158	303.146	273.615	41.343	0.000	0.000	0.000
1500	38.264	305.782	275.673	45.164	0.000	0.000	0.000
4. HYDROGEN BROMIDE HBr (g)							
298.15	29.141	198.697	198.697	0.000	-36.290	-53.360	9.348
300	29.141	198.878	198.698	0.054	-36.333	-53.466	9.309
400	29.220	207.269	199.842	2.971	-52.109	-55.940	7.305
500	29.454	213.811	202.005	5.903	-52.484	-56.854	5.939
600	29.872	219.216	204.436	8.868	-52.844	-57.694	5.023
700	30.431	223.861	206.886	11.882	-53.168	-58.476	4.363
800	31.063	227.965	209.269	14.957	-53.446	-59.214	3.866

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
4. HYDROGEN BROMIDE HBr (g) (continued)							
900	31.709	231.661	211.555	18.095	-53.677	-59.921	3.478
1000	32.335	235.035	213.737	21.298	-53.864	-60.604	3.166
1100	32.919	238.145	215.816	24.561	-54.012	-61.271	2.909
1200	33.454	241.032	217.799	27.880	-54.129	-61.925	2.696
1300	33.938	243.729	219.691	31.250	-54.220	-62.571	2.514
1400	34.374	246.261	221.499	34.666	-54.291	-63.211	2.358
1500	34.766	248.646	223.230	38.123	-54.348	-63.846	2.223
5. CARBON (GRAPHITE) C (cr; graphite)							
298.15	8.536	5.740	5.740	0.000	0.000	0.000	0.000
300	8.610	5.793	5.740	0.016	0.000	0.000	0.000
400	11.974	8.757	6.122	1.054	0.000	0.000	0.000
500	14.537	11.715	6.946	2.385	0.000	0.000	0.000
600	16.607	14.555	7.979	3.945	0.000	0.000	0.000
700	18.306	17.247	9.113	5.694	0.000	0.000	0.000
800	19.699	19.785	10.290	7.596	0.000	0.000	0.000
900	20.832	22.173	11.479	9.625	0.000	0.000	0.000
1000	21.739	24.417	12.662	11.755	0.000	0.000	0.000
1100	22.452	26.524	13.827	13.966	0.000	0.000	0.000
1200	23.000	28.502	14.968	16.240	0.000	0.000	0.000
1300	23.409	30.360	16.082	18.562	0.000	0.000	0.000
1400	23.707	32.106	17.164	20.918	0.000	0.000	0.000
1500	23.919	33.749	18.216	23.300	0.000	0.000	0.000
6. CARBON (DIAMOND) C (cr; diamond)							
298.15	6.109	2.362	2.362	0.000	1.850	2.857	-0.501
300	6.201	2.400	2.362	0.011	1.846	2.863	-0.499
400	10.321	4.783	2.659	0.850	1.645	3.235	-0.422
500	13.404	7.431	3.347	2.042	1.507	3.649	-0.381
600	15.885	10.102	4.251	3.511	1.415	4.087	-0.356
700	17.930	12.709	5.274	5.205	1.361	4.537	-0.339
800	19.619	15.217	6.361	7.085	1.338	4.993	-0.326
900	21.006	17.611	7.479	9.118	1.343	5.450	-0.316
1000	22.129	19.884	8.607	11.277	1.372	5.905	-0.308
1100	23.020	22.037	9.731	13.536	1.420	6.356	-0.302
1200	23.709	24.071	10.842	15.874	1.484	6.802	-0.296
1300	24.222	25.990	11.934	18.272	1.561	7.242	-0.291
1400	24.585	27.799	13.003	20.714	1.646	7.675	-0.286
1500	24.824	29.504	14.047	23.185	1.735	8.103	-0.282
7. DICARBON C₂ (g)							
298.15	43.548	197.095	197.095	0.000	830.457	775.116	-135.795
300	43.575	197.365	197.096	0.081	830.506	774.772	-134.898
400	42.169	209.809	198.802	4.403	832.751	755.833	-98.700
500	39.529	218.924	201.959	8.483	834.170	736.423	-76.933
600	37.837	225.966	205.395	12.342	834.909	716.795	-62.402
700	36.984	231.726	208.758	16.078	835.148	697.085	-52.016
800	36.621	236.637	211.943	19.755	835.020	677.366	-44.227
900	36.524	240.943	214.931	23.411	834.618	657.681	-38.170
1000	36.569	244.793	217.728	27.065	834.012	638.052	-33.328
1100	36.696	248.284	220.349	30.728	833.252	618.492	-29.369
1200	36.874	251.484	222.812	34.406	832.383	599.006	-26.074
1300	37.089	254.444	225.133	38.104	831.437	579.596	-23.288
1400	37.329	257.201	227.326	41.824	830.445	560.261	-20.903
1500	37.589	259.785	229.405	45.570	829.427	540.997	-18.839

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
8. TRICARBON C_3 (g)							
298.15	42.202	237.611	237.611	0.000	839.958	774.249	-135.643
300	42.218	237.872	237.611	0.078	839.989	773.841	-134.736
400	43.383	250.164	239.280	4.354	841.149	751.592	-98.147
500	44.883	260.003	242.471	8.766	841.570	729.141	-76.172
600	46.406	268.322	246.104	13.331	841.453	706.659	-61.519
700	47.796	275.582	249.807	18.042	840.919	684.230	-51.057
800	48.997	282.045	253.440	22.884	840.053	661.901	-43.217
900	50.006	287.876	256.948	27.835	838.919	639.698	-37.127
1000	50.844	293.189	260.310	32.879	837.572	617.633	-32.261
1100	51.535	298.069	263.524	37.999	836.059	595.711	-28.288
1200	52.106	302.578	266.593	43.182	834.420	573.933	-24.982
1300	52.579	306.768	269.524	48.417	832.690	552.295	-22.191
1400	52.974	310.679	272.326	53.695	830.899	530.793	-19.804
1500	53.307	314.346	275.006	59.010	829.068	509.421	-17.739
9. CARBON OXIDE CO (g)							
298.15	29.141	197.658	197.658	0.000	-110.530	-137.168	24.031
300	29.142	197.838	197.659	0.054	-110.519	-137.333	23.912
400	29.340	206.243	198.803	2.976	-110.121	-146.341	19.110
500	29.792	212.834	200.973	5.930	-110.027	-155.412	16.236
600	30.440	218.321	203.419	8.941	-110.157	-164.480	14.319
700	31.170	223.067	205.895	12.021	-110.453	-173.513	12.948
800	31.898	227.277	208.309	15.175	-110.870	-182.494	11.915
900	32.573	231.074	210.631	18.399	-111.378	-191.417	11.109
1000	33.178	234.538	212.851	21.687	-111.952	-200.281	10.461
1100	33.709	237.726	214.969	25.032	-112.573	-209.084	9.928
1200	34.169	240.679	216.990	28.426	-113.228	-217.829	9.482
1300	34.568	243.430	218.920	31.864	-113.904	-226.518	9.101
1400	34.914	246.005	220.763	35.338	-114.594	-235.155	8.774
1500	35.213	248.424	222.527	38.845	-115.291	-243.742	8.488
10. CARBON DIOXIDE CO_2 (g)							
298.15	37.135	213.783	213.783	0.000	-393.510	-394.373	69.092
300	37.220	214.013	213.784	0.069	-393.511	-394.379	68.667
400	41.328	225.305	215.296	4.004	-393.586	-394.656	51.536
500	44.627	234.895	218.280	8.307	-393.672	-394.914	41.256
600	47.327	243.278	221.762	12.909	-393.791	-395.152	34.401
700	49.569	250.747	225.379	17.758	-393.946	-395.367	29.502
800	51.442	257.492	228.978	22.811	-394.133	-395.558	25.827
900	53.008	263.644	232.493	28.036	-394.343	-395.724	22.967
1000	54.320	269.299	235.895	33.404	-394.568	-395.865	20.678
1100	55.423	274.529	239.172	38.893	-394.801	-395.984	18.803
1200	56.354	279.393	242.324	44.483	-395.035	-396.081	17.241
1300	57.144	283.936	245.352	50.159	-395.265	-396.159	15.918
1400	57.818	288.196	248.261	55.908	-395.488	-396.219	14.783
1500	58.397	292.205	251.059	61.719	-395.702	-396.264	13.799
11. METHANE CH_4 (g)							
298.15	35.695	186.369	186.369	0.000	-74.600	-50.530	8.853
300	35.765	186.590	186.370	0.066	-74.656	-50.381	8.772
400	40.631	197.501	187.825	3.871	-77.703	-41.827	5.462
500	46.627	207.202	190.744	8.229	-80.520	-32.525	3.398
600	52.742	216.246	194.248	13.199	-82.969	-22.690	1.975
700	58.603	224.821	198.008	18.769	-85.023	-12.476	0.931
800	64.084	233.008	201.875	24.907	-86.693	-1.993	0.130

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_f))/T$	$H^\circ - H^\circ(T_f)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
11. METHANE CH₄ (g) (continued)							
900	69.137	240.852	205.773	31.571	-88.006	8.677	-0.504
1000	73.746	248.379	209.660	38.719	-88.996	19.475	-1.017
1100	77.919	255.607	213.511	46.306	-89.698	30.358	-1.442
1200	81.682	262.551	217.310	54.289	-90.145	41.294	-1.797
1300	85.067	269.225	221.048	62.630	-90.367	52.258	-2.100
1400	88.112	275.643	224.720	71.291	-90.390	63.231	-2.359
1500	90.856	281.817	228.322	80.242	-90.237	74.200	-2.584
12. ACETYLENE C₂H₂ (g)							
298.15	44.036	200.927	200.927	0.000	227.400	209.879	-36.769
300	44.174	201.199	200.927	0.082	227.397	209.770	-36.524
400	50.388	214.814	202.741	4.829	227.161	203.928	-26.630
500	54.751	226.552	206.357	10.097	226.846	198.154	-20.701
600	58.121	236.842	210.598	15.747	226.445	192.452	-16.754
700	60.970	246.021	215.014	21.704	225.968	186.823	-13.941
800	63.511	254.331	219.418	27.931	225.436	181.267	-11.835
900	65.831	261.947	223.726	34.399	224.873	175.779	-10.202
1000	67.960	268.995	227.905	41.090	224.300	170.355	-8.898
1100	69.909	275.565	231.942	47.985	223.734	164.988	-7.835
1200	71.686	281.725	235.837	55.067	223.189	159.672	-6.950
1300	73.299	287.528	239.592	62.317	222.676	154.400	-6.204
1400	74.758	293.014	243.214	69.721	222.203	149.166	-5.565
1500	76.077	298.218	246.709	77.264	221.774	143.964	-5.013
13. ETHYLENE C₂H₄ (g)							
298.15	42.883	219.316	219.316	0.000	52.400	68.358	-11.976
300	43.059	219.582	219.317	0.079	52.341	68.457	-11.919
400	53.045	233.327	221.124	4.881	49.254	74.302	-9.703
500	62.479	246.198	224.864	10.667	46.533	80.887	-8.450
600	70.673	258.332	229.441	17.335	44.221	87.982	-7.659
700	77.733	269.770	234.393	24.764	42.278	95.434	-7.121
800	83.868	280.559	239.496	32.851	40.655	103.142	-6.734
900	89.234	290.754	244.630	41.512	39.310	111.036	-6.444
1000	93.939	300.405	249.730	50.675	38.205	119.067	-6.219
1100	98.061	309.556	254.756	60.280	37.310	127.198	-6.040
1200	101.670	318.247	259.688	70.271	36.596	135.402	-5.894
1300	104.829	326.512	264.513	80.599	36.041	143.660	-5.772
1400	107.594	334.384	269.225	91.223	35.623	151.955	-5.669
1500	110.018	341.892	273.821	102.107	35.327	160.275	-5.581
14. ETHANE C₂H₆ (g)							
298.15	52.487	229.161	229.161	0.000	-84.000	-32.015	5.609
300	52.711	229.487	229.162	0.097	-84.094	-31.692	5.518
400	65.459	246.378	231.379	5.999	-88.988	-13.473	1.759
500	77.941	262.344	235.989	13.177	-93.238	5.912	-0.618
600	89.188	277.568	241.660	21.545	-96.779	26.086	-2.271
700	99.136	292.080	247.835	30.972	-99.663	46.800	-3.492
800	107.936	305.904	254.236	41.334	-101.963	67.887	-4.433
900	115.709	319.075	260.715	52.525	-103.754	89.231	-5.179
1000	122.552	331.628	267.183	64.445	-105.105	110.750	-5.785
1100	128.553	343.597	273.590	77.007	-106.082	132.385	-6.286
1200	133.804	355.012	279.904	90.131	-106.741	154.096	-6.708
1300	138.391	365.908	286.103	103.746	-107.131	175.850	-7.066
1400	142.399	376.314	292.178	117.790	-107.292	197.625	-7.373
1500	145.905	386.260	298.121	132.209	-107.260	219.404	-7.640

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
15. CYCLOPROPANE C_3H_6 (g)							
298.15	55.571	237.488	237.488	0.000	53.300	104.514	-18.310
300	55.941	237.832	237.489	0.103	53.195	104.832	-18.253
400	76.052	256.695	239.924	6.708	47.967	122.857	-16.043
500	93.859	275.637	245.177	15.230	43.730	142.091	-14.844
600	108.542	294.092	251.801	25.374	40.405	162.089	-14.111
700	120.682	311.763	259.115	36.854	37.825	182.583	-13.624
800	130.910	328.564	266.755	49.447	35.854	203.404	-13.281
900	139.658	344.501	274.516	62.987	34.384	224.441	-13.026
1000	147.207	359.616	282.277	77.339	33.334	245.618	-12.830
1100	153.749	373.961	289.965	92.395	32.640	266.883	-12.673
1200	159.432	387.588	297.538	108.060	32.249	288.197	-12.545
1300	164.378	400.549	304.967	124.257	32.119	309.533	-12.437
1400	168.689	412.892	312.239	140.915	32.215	330.870	-12.345
1500	172.453	424.662	319.344	157.976	32.507	352.193	-12.264
16. PROPANE C_3H_8 (g)							
298.15	73.597	270.313	270.313	0.000	-103.847	-23.458	4.110
300	73.931	270.769	270.314	0.136	-103.972	-22.959	3.997
400	94.014	294.739	273.447	8.517	-110.33	15.029	-0.657
500	112.591	317.768	280.025	18.872	-115.658	34.507	-3.605
600	128.700	339.753	288.162	30.955	-119.973	64.961	-5.655
700	142.674	360.668	297.039	44.540	-123.384	96.065	-7.168
800	154.766	380.528	306.245	59.427	-126.016	127.603	-8.331
900	165.352	399.381	315.555	75.444	-127.982	159.430	-9.253
1000	174.598	417.293	324.841	92.452	-129.380	191.444	-10.000
1100	182.673	434.321	334.026	110.325	-130.296	223.574	-10.617
1200	189.745	450.526	343.064	128.954	-130.802	255.770	-11.133
1300	195.853	465.961	351.929	148.241	-130.961	287.993	-11.572
1400	201.209	480.675	360.604	168.100	-130.829	320.217	-11.947
1500	205.895	494.721	369.080	188.460	-130.445	352.422	-12.272
17. BENZENE C_6H_6 (l)							
298.15	135.950	173.450	173.450	0.000	49.080	124.521	-21.815
300	136.312	174.292	173.453	.252	49.077	124.989	-21.762
400	161.793	216.837	179.082	15.102	48.978	150.320	-19.630
500	207.599	257.048	190.639	33.204	50.330	175.559	-18.340
18. BENZENE C_6H_6 (g)							
298.15	82.430	269.190	269.190	0.000	82.880	129.750	-22.731
300	83.020	269.700	269.190	0.153	82.780	130.040	-22.641
400	113.510	297.840	272.823	10.007	77.780	146.570	-19.140
500	139.340	326.050	280.658	22.696	73.740	164.260	-17.160
600	160.090	353.360	290.517	37.706	70.490	182.680	-15.903
700	176.790	379.330	301.360	54.579	67.910	201.590	-15.042
800	190.460	403.860	312.658	72.962	65.910	220.820	-14.418
900	201.840	426.970	324.084	92.597	64.410	240.280	-13.945
1000	211.430	448.740	335.473	113.267	63.340	259.890	-13.575
1100	219.580	469.280	346.710	134.827	62.620	277.640	-13.184
1200	226.540	488.690	357.743	157.137	62.200	299.320	-13.029
1300	232.520	507.070	368.534	180.097	62.000	319.090	-12.821
1400	237.680	524.490	379.056	203.607	61.990	338.870	-12.643
1500	242.140	541.040	389.302	227.607	62.110	358.640	-12.489

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
19. NAPHTHALENE $C_{10}H_8$ (cr, l)							
298.15	165.720	167.390	167.390	0.000	78.530	201.585	-35.316
300	167.001	168.419	167.393	0.308	78.466	202.349	-35.232
353.43	208.722	198.948	169.833	10.290	96.099	224.543	-33.186
PHASE TRANSITION: $\Delta_{\text{trs}} H = 18.980$ kJ/mol, $\Delta_{\text{trs}} S = 53.702$ J/K·mol, cr-l							
353.43	217.200	252.650	169.833	29.270	96.099	224.543	-33.186
400	241.577	280.916	181.124	39.917	96.067	241.475	-31.533
470	276.409	322.712	199.114	58.091	97.012	266.859	-29.658
20. NAPHTHALENE $C_{10}H_8$ (g)							
298.15	131.920	333.150	333.150	0.000	150.580	224.100	-39.260
300	132.840	333.970	333.157	0.244	150.450	224.560	-39.098
400	180.070	378.800	338.950	15.940	144.190	250.270	-32.681
500	219.740	423.400	351.400	36.000	139.220	277.340	-28.973
600	251.530	466.380	367.007	59.624	135.350	305.330	-26.581
700	277.010	507.140	384.146	86.096	132.330	333.950	-24.919
800	297.730	545.520	401.935	114.868	130.050	362.920	-23.696
900	314.850	581.610	419.918	145.523	128.430	392.150	-22.759
1000	329.170	615.550	437.806	177.744	127.510	421.700	-22.027
1100	341.240	647.500	455.426	211.281	127.100	450.630	-21.398
1200	351.500	677.650	472.707	245.932	126.960	480.450	-20.913
1300	360.260	706.130	489.568	281.531	127.060	509.770	-20.482
1400	367.780	733.110	506.009	317.941	127.390	539.740	-20.137
1500	374.270	758.720	522.019	355.051	127.920	568.940	-19.812
21. FORMALDEHYDE H_2CO (g)							
298.15	35.387	218.760	218.760	0.000	-108.700	-102.667	17.987
300	35.443	218.979	218.761	0.066	-108.731	-102.630	17.869
400	39.240	229.665	220.192	3.789	-110.438	-100.340	13.103
500	43.736	238.900	223.028	7.936	-112.073	-97.623	10.198
600	48.181	247.270	226.381	12.534	-113.545	-94.592	8.235
700	52.280	255.011	229.924	17.560	-114.833	-91.328	6.815
800	55.941	262.236	233.517	22.975	-115.942	-87.893	5.739
900	59.156	269.014	237.088	28.734	-116.889	-84.328	4.894
1000	61.951	275.395	240.603	34.792	-117.696	-80.666	4.213
1100	64.368	281.416	244.042	41.111	-118.382	-76.929	3.653
1200	66.453	287.108	247.396	47.655	-118.966	-73.134	3.183
1300	68.251	292.500	250.660	54.392	-119.463	-69.294	2.784
1400	69.803	297.616	253.833	61.297	-119.887	-65.418	2.441
1500	71.146	302.479	256.915	68.346	-120.249	-61.514	2.142
22. METHANOL CH_3OH (g)							
298.15	44.101	239.865	239.865	0.000	-201.000	-162.298	28.434
300	44.219	240.139	239.866	0.082	-201.068	-162.057	28.216
400	51.713	253.845	241.685	4.864	-204.622	-148.509	19.393
500	59.800	266.257	245.374	10.442	-207.750	-134.109	14.010
600	67.294	277.835	249.830	16.803	-210.387	-119.125	10.371
700	73.958	288.719	254.616	23.873	-212.570	-103.737	7.741
800	79.838	298.987	259.526	31.569	-214.350	-88.063	5.750
900	85.025	308.696	264.455	39.817	-215.782	-72.188	4.190
1000	89.597	317.896	269.343	48.553	-216.916	-56.170	2.934
1100	93.624	326.629	274.158	57.718	-217.794	-40.050	1.902
1200	97.165	334.930	278.879	67.262	-218.457	-23.861	1.039
1300	100.277	342.833	283.497	77.137	-218.936	-7.624	0.306
1400	103.014	350.367	288.007	87.304	-219.261	8.644	-0.322
1500	105.422	357.558	292.405	97.729	-219.456	24.930	-0.868

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
23. ACETALDEHYDE C₂H₄O (g)							
298.15	55.318	263.840	263.840	0.000	-166.190	-133.010	23.302
300	55.510	264.180	263.837	0.103	-166.250	-132.800	23.122
400	66.282	281.620	266.147	6.189	-169.530	-121.130	15.818
500	76.675	297.540	270.850	13.345	-172.420	-108.700	11.356
600	85.942	312.360	276.550	21.486	-174.870	-95.720	8.334
700	94.035	326.230	282.667	30.494	-176.910	-82.350	6.145
800	101.070	339.260	288.938	40.258	-178.570	-68.730	4.487
900	107.190	351.520	295.189	50.698	-179.880	-54.920	3.187
1000	112.490	363.100	301.431	61.669	-180.850	-40.930	2.138
1100	117.080	374.040	307.537	73.153	-181.560	-27.010	1.283
1200	121.060	384.400	313.512	85.065	-182.070	-12.860	0.560
1300	124.500	394.230	319.350	97.344	-182.420	1.240	-0.050
1400	127.490	403.570	325.031	109.954	-182.640	15.470	-0.577
1500	130.090	412.460	330.571	122.834	-182.750	29.580	-1.030
24. ETHANOL C₂H₅OH (g)							
298.15	65.652	281.622	281.622	0.000	-234.800	-167.874	29.410
300	65.926	282.029	281.623	0.122	-234.897	-167.458	29.157
400	81.169	303.076	284.390	7.474	-239.826	-144.216	18.832
500	95.400	322.750	290.115	16.318	-243.940	-119.820	12.517
600	107.656	341.257	297.112	26.487	-247.260	-94.672	8.242
700	118.129	358.659	304.674	37.790	-249.895	-69.023	5.151
800	127.171	375.038	312.456	50.065	-251.951	-43.038	2.810
900	135.049	390.482	320.276	63.185	-253.515	-16.825	0.976
1000	141.934	405.075	328.033	77.042	-254.662	9.539	-0.498
1100	147.958	418.892	335.670	91.543	-255.454	36.000	-1.709
1200	153.232	431.997	343.156	106.609	-255.947	62.520	-2.721
1300	157.849	444.448	350.473	122.168	-256.184	89.070	-3.579
1400	161.896	456.298	357.612	138.160	-256.206	115.630	-4.314
1500	165.447	467.591	364.571	154.531	-256.044	142.185	-4.951
25. ACETIC ACID C₂H₄O₂ (g)							
298.15	63.438	283.470	283.470	0.000	-432.249	-374.254	65.567
300	63.739	283.863	283.471	0.118	-432.324	-373.893	65.100
400	79.665	304.404	286.164	7.296	-436.006	-353.840	46.206
500	93.926	323.751	291.765	15.993	-438.875	-332.950	34.783
600	106.181	341.988	298.631	26.014	-440.993	-311.554	27.123
700	116.627	359.162	306.064	37.169	-442.466	-289.856	21.629
800	125.501	375.331	313.722	49.287	-443.395	-267.985	17.497
900	132.989	390.558	321.422	62.223	-443.873	-246.026	14.279
1000	139.257	404.904	329.060	75.844	-443.982	-224.034	11.702
1100	144.462	418.429	336.576	90.039	-443.798	-202.046	9.594
1200	148.760	431.189	343.933	104.707	-443.385	-180.086	7.839
1300	152.302	443.240	351.113	119.765	-442.795	-158.167	6.355
1400	155.220	454.637	358.105	135.146	-442.071	-136.299	5.085
1500	157.631	465.432	364.903	150.793	-441.247	-114.486	3.987
26. ACETONE C₃H₆O (g)							
298.15	74.517	295.349	295.349	0.000	-217.150	-152.716	26.757
300	74.810	295.809	295.349	0.138	-217.233	-152.339	26.521
400	91.755	319.658	298.498	8.464	-222.212	-129.913	16.962
500	107.864	341.916	304.988	18.464	-226.522	-106.315	11.107
600	122.047	362.836	312.873	29.978	-230.120	-81.923	7.133
700	134.306	382.627	321.470	42.810	-233.049	-56.986	4.252
800	144.934	401.246	330.265	56.785	-235.350	-31.673	2.068

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_f))/T$	$H^\circ - H^\circ(T_f)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
26. ACETONE C₃H₆O (g) (continued)							
900	154.097	418.860	339.141	71.747	-237.149	-6.109	0.353
1000	162.046	435.513	347.950	87.563	-238.404	19.707	-1.030
1100	168.908	451.286	356.617	104.136	-239.283	45.396	-2.157
1200	174.891	466.265	365.155	121.332	-239.827	71.463	-3.110
1300	180.079	480.491	373.513	139.072	-240.120	97.362	-3.912
1400	184.556	493.963	381.596	157.314	-240.203	123.470	-4.607
1500	188.447	506.850	389.533	175.975	-240.120	149.369	-5.202
27. PHENOL C₆H₆O (g)							
298.15	103.220	314.810	314.810	0.000	-96.400	-32.630	5.720
300	103.860	315.450	314.810	0.192	-96.490	-32.230	5.610
400	135.790	349.820	319.278	12.217	-100.870	-10.180	1.330
500	161.910	383.040	328.736	27.152	-104.240	12.970	-1.360
600	182.480	414.450	340.430	44.412	-106.810	36.650	-3.190
700	198.840	443.860	353.134	63.508	-108.800	60.750	-4.530
800	212.140	471.310	366.211	84.079	-110.300	85.020	-5.550
900	223.190	496.950	379.327	105.861	-111.370	109.590	-6.360
1000	232.490	520.960	392.302	128.658	-111.990	134.280	-7.010
1100	240.410	543.500	405.033	152.314	-112.280	158.620	-7.530
1200	247.200	564.720	417.468	176.703	-112.390	183.350	-7.980
1300	253.060	584.740	429.568	201.723	-112.330	208.070	-8.360
1400	258.120	603.680	441.331	227.288	-112.120	233.050	-8.700
1500	262.520	621.650	452.767	253.325	-111.780	257.540	-8.970
28. CARBON TETRAFLUORIDE CF₄ (g)							
298.15	61.050	261.455	261.455	0.000	-933.200	-888.518	155.663
300	61.284	261.833	261.456	0.113	-933.219	-888.240	154.654
400	72.399	281.057	264.001	6.822	-933.986	-873.120	114.016
500	80.713	298.153	269.155	14.499	-934.372	-857.852	89.618
600	86.783	313.434	275.284	22.890	-934.490	-842.533	73.348
700	91.212	327.162	281.732	31.801	-934.431	-827.210	61.726
800	94.479	339.566	288.199	41.094	-934.261	-811.903	53.011
900	96.929	350.842	294.542	50.670	-934.024	-796.622	46.234
1000	98.798	361.156	300.695	60.460	-933.745	-781.369	40.814
1100	100.250	370.643	306.629	70.416	-933.442	-766.146	36.381
1200	101.396	379.417	312.334	80.500	-933.125	-750.952	32.688
1300	102.314	387.571	317.811	90.687	-932.800	-735.784	29.564
1400	103.059	395.181	323.069	100.957	-932.470	-720.641	26.887
1500	103.671	402.313	328.116	111.295	-932.137	-705.522	24.568
29. TRIFLUOROMETHANE CHF₃ (g)							
298.15	51.069	259.675	259.675	0.000	-696.700	-662.237	116.020
300	51.258	259.991	259.676	0.095	-696.735	-662.023	115.267
400	61.148	276.113	261.807	5.722	-698.427	-650.186	84.905
500	69.631	290.700	266.149	12.275	-699.715	-637.969	66.647
600	76.453	304.022	271.368	19.593	-700.634	-625.528	54.456
700	81.868	316.230	276.917	27.519	-701.253	-612.957	45.739
800	86.201	327.455	282.542	35.930	-701.636	-600.315	39.196
900	89.719	337.818	288.116	44.732	-701.832	-587.636	34.105
1000	92.617	347.426	293.572	53.854	-701.879	-574.944	30.032
1100	95.038	356.370	298.879	63.240	-701.805	-562.253	26.699
1200	97.084	364.730	304.022	72.849	-701.629	-549.574	23.922
1300	98.833	372.571	308.997	82.647	-701.368	-536.913	21.573
1400	100.344	379.952	313.804	92.607	-701.033	-524.274	19.561
1500	101.660	386.921	318.449	102.709	-700.635	-511.662	17.817

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_f))/T$	$H^\circ - H^\circ(T_f)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
30. CHLOROTRIFLUOROMETHANE CClF_3 (g)							
298.15	66.886	285.419	285.419	0.000	-707.800	-667.238	116.896
300	67.111	285.834	285.421	0.124	-707.810	-666.986	116.131
400	77.528	306.646	288.187	7.383	-708.153	-653.316	85.313
500	85.013	324.797	293.734	15.532	-708.170	-639.599	66.818
600	90.329	340.794	300.271	24.314	-707.975	-625.901	54.489
700	94.132	355.020	307.096	33.547	-707.654	-612.246	45.686
800	96.899	367.780	313.897	43.106	-707.264	-598.642	39.087
900	98.951	379.317	320.536	52.903	-706.837	-585.090	33.957
1000	100.507	389.827	326.947	62.880	-706.396	-571.586	29.856
1100	101.708	399.465	333.108	72.993	-705.950	-558.126	26.503
1200	102.651	408.357	339.013	83.213	-705.505	-544.707	23.710
1300	103.404	416.604	344.668	93.517	-705.064	-531.326	21.349
1400	104.012	424.290	350.084	103.889	-704.628	-517.977	19.326
1500	104.512	431.484	355.273	114.316	-704.196	-504.660	17.574
31. DICHLORODIFLUOROMETHANE CCl_2F_2 (g)							
298.15	72.476	300.903	300.903	0.000	-486.000	-447.030	78.317
300	72.691	301.352	300.905	0.134	-486.002	-446.788	77.792
400	82.408	323.682	303.883	7.919	-485.945	-433.716	56.637
500	89.063	342.833	309.804	16.514	-485.618	-420.692	43.949
600	93.635	359.500	316.729	25.663	-485.136	-407.751	35.497
700	96.832	374.189	323.909	35.196	-484.576	-394.897	29.467
800	99.121	387.276	331.027	44.999	-483.984	-382.126	24.950
900	100.801	399.053	337.942	55.000	-483.388	-369.429	21.441
1000	102.062	409.742	344.596	65.146	-482.800	-356.799	18.637
1100	103.030	419.517	350.969	75.402	-482.226	-344.227	16.346
1200	103.786	428.515	357.061	85.745	-481.667	-331.706	14.439
1300	104.388	436.847	362.882	96.154	-481.121	-319.232	12.827
1400	104.874	444.602	368.445	106.618	-480.588	-306.799	11.447
1500	105.270	451.851	373.767	117.126	-480.065	-294.404	10.252
32. CHLORODIFLUOROMETHANE CHClF_2 (g)							
298.15	55.853	280.915	280.915	0.000	-475.000	-443.845	77.759
300	56.039	281.261	280.916	0.104	-475.028	-443.652	77.246
400	65.395	298.701	283.231	6.188	-476.390	-432.978	56.540
500	73.008	314.145	287.898	13.123	-477.398	-422.001	44.086
600	78.940	328.003	293.448	20.733	-478.103	-410.851	35.767
700	83.551	340.533	299.294	28.867	-478.574	-399.603	29.818
800	87.185	351.936	305.172	37.411	-478.870	-388.299	25.353
900	90.100	362.379	310.956	46.280	-479.031	-376.967	21.878
1000	92.475	371.999	316.586	55.413	-479.090	-365.622	19.098
1100	94.433	380.908	322.033	64.761	-479.068	-354.276	16.823
1200	96.066	389.196	327.289	74.289	-478.982	-342.935	14.927
1300	97.438	396.941	332.352	83.966	-478.843	-331.603	13.324
1400	98.601	404.206	337.228	93.769	-478.661	-320.283	11.950
1500	99.593	411.044	341.923	103.681	-478.443	-308.978	10.759
33. METHYLAMINE CH_5N (g)							
298.15	50.053	242.881	242.881	0.000	-22.529	32.734	-5.735
300	50.227	243.196	242.893	0.091	-22.614	33.077	-5.759
400	60.171	258.986	244.975	5.604	-26.846	52.294	-6.829
500	70.057	273.486	249.244	12.121	-30.431	72.510	-7.575
600	78.929	287.063	254.431	19.579	-33.364	93.382	-8.129
700	86.711	299.826	260.008	27.873	-35.712	114.702	-8.559
800	93.545	311.865	265.749	36.893	-37.548	136.316	-8.900

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
33. METHYLAMINE CH₅N (g) (continued)							
900	99.573	323.239	271.511	46.555	-38.949	158.138	-9.178
1000	104.886	334.006	277.220	56.786	-39.967	180.098	-9.407
1100	109.576	344.233	282.861	67.509	-40.681	201.822	-9.584
1200	113.708	353.944	288.374	78.685	-41.136	224.240	-9.761
1300	117.341	363.190	293.775	90.239	-41.376	246.364	-9.899
1400	120.542	372.012	299.061	102.131	-41.451	268.504	-10.018
1500	123.353	380.426	304.209	114.326	-41.381	290.639	-10.121
34. CHLORINE Cl (g)							
298.15	21.838	165.190	165.190	0.000	121.302	105.306	-18.449
300	21.852	165.325	165.190	0.040	121.311	105.207	-18.318
400	22.467	171.703	166.055	2.259	121.795	99.766	-13.028
500	22.744	176.752	167.708	4.522	122.272	94.203	-9.841
600	22.781	180.905	169.571	6.800	122.734	88.546	-7.709
700	22.692	184.411	171.448	9.074	123.172	82.813	-6.179
800	22.549	187.432	173.261	11.337	123.585	77.019	-5.029
900	22.389	190.079	174.986	13.584	123.971	71.175	-4.131
1000	22.233	192.430	176.615	15.815	124.334	65.289	-3.410
1100	22.089	194.542	178.150	18.031	124.675	59.368	-2.819
1200	21.959	196.458	179.597	20.233	124.996	53.416	-2.325
1300	21.843	198.211	180.963	22.423	125.299	47.439	-1.906
1400	21.742	199.826	182.253	24.602	125.587	41.439	-1.546
1500	21.652	201.323	183.475	26.772	125.861	35.418	-1.233
35. DICHLORINE Cl₂ (g)							
298.15	33.949	223.079	223.079	0.000	0.000	0.000	0.000
300	33.981	223.290	223.080	0.063	0.000	0.000	0.000
400	35.296	233.263	224.431	3.533	0.000	0.000	0.000
500	36.064	241.229	227.021	7.104	0.000	0.000	0.000
600	36.547	247.850	229.956	10.736	0.000	0.000	0.000
700	36.874	253.510	232.926	14.408	0.000	0.000	0.000
800	37.111	258.450	235.815	18.108	0.000	0.000	0.000
900	37.294	262.832	238.578	21.829	0.000	0.000	0.000
1000	37.442	266.769	241.203	25.566	0.000	0.000	0.000
1100	37.567	270.343	243.692	29.316	0.000	0.000	0.000
1200	37.678	273.617	246.052	33.079	0.000	0.000	0.000
1300	37.778	276.637	248.290	36.851	0.000	0.000	0.000
1400	37.872	279.440	250.416	40.634	0.000	0.000	0.000
1500	37.961	282.056	252.439	44.426	0.000	0.000	0.000
36. HYDROGEN CHLORIDE HCl (g)							
298.15	29.136	186.902	186.902	0.000	-92.310	-95.298	16.696
300	29.137	187.082	186.902	0.054	-92.314	-95.317	16.596
400	29.175	195.468	188.045	2.969	-92.587	-96.278	12.573
500	29.304	201.990	190.206	5.892	-92.911	-97.164	10.151
600	29.576	207.354	192.630	8.835	-93.249	-97.983	8.530
700	29.988	211.943	195.069	11.812	-93.577	-98.746	7.368
800	30.500	215.980	197.435	14.836	-93.879	-99.464	6.494
900	31.063	219.604	199.700	17.913	-94.149	-100.145	5.812
1000	31.639	222.907	201.858	21.049	-94.384	-100.798	5.265
1100	32.201	225.949	203.912	24.241	-94.587	-101.430	4.816
1200	32.734	228.774	205.867	27.488	-94.760	-102.044	4.442
1300	33.229	231.414	207.732	30.786	-94.908	-102.645	4.124
1400	33.684	233.893	209.513	34.132	-95.035	-103.235	3.852
1500	34.100	236.232	211.217	37.522	-95.146	-103.817	3.615

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
37. COPPER Cu (cr, l)							
298.15	24.440	33.150	33.150	0.000	0.000	0.000	0.000
300	24.460	33.301	33.150	0.045	0.000	0.000	0.000
400	25.339	40.467	34.122	2.538	0.000	0.000	0.000
500	25.966	46.192	35.982	5.105	0.000	0.000	0.000
600	26.479	50.973	38.093	7.728	0.000	0.000	0.000
700	26.953	55.090	40.234	10.399	0.000	0.000	0.000
800	27.448	58.721	42.322	13.119	0.000	0.000	0.000
900	28.014	61.986	44.328	15.891	0.000	0.000	0.000
1000	28.700	64.971	46.245	18.726	0.000	0.000	0.000
1100	29.553	67.745	48.075	21.637	0.000	0.000	0.000
1200	30.617	70.361	49.824	24.644	0.000	0.000	0.000
1300	31.940	72.862	51.501	27.769	0.000	0.000	0.000
1358	32.844	74.275	52.443	29.647	0.000	0.000	0.000
	PHASE TRANSITION: $\Delta_{\text{trs}} H = 13.141$ kJ/mol, $\Delta_{\text{trs}} S = 9.676$ J/K·mol, cr-l						
1358	32.800	83.951	52.443	42.788	0.000	0.000	0.000
1400	32.800	84.950	53.403	44.166	0.000	0.000	0.000
1500	32.800	87.213	55.583	47.446	0.000	0.000	0.000
38. COPPER Cu (g)							
298.15	20.786	166.397	166.397	0.000	337.600	297.873	-52.185
300	20.786	166.525	166.397	0.038	337.594	297.626	-51.821
400	20.786	172.505	167.213	2.117	337.179	284.364	-37.134
500	20.786	177.143	168.752	4.196	336.691	271.215	-28.333
600	20.786	180.933	170.476	6.274	336.147	258.170	-22.475
700	20.786	184.137	172.205	8.353	335.554	245.221	-18.298
800	20.786	186.913	173.874	10.431	334.913	232.359	-15.171
900	20.786	189.361	175.461	12.510	334.219	219.581	-12.744
1000	20.786	191.551	176.963	14.589	333.463	206.883	-10.806
1100	20.788	193.532	178.380	16.667	332.631	194.265	-9.225
1200	20.793	195.341	179.719	18.746	331.703	181.726	-7.910
1300	20.803	197.006	180.986	20.826	330.657	169.270	-6.801
1400	20.823	198.548	182.186	22.907	316.342	157.305	-5.869
1500	20.856	199.986	183.325	24.991	315.146	145.987	-5.084
39. COPPER OXIDE CuO (cr)							
298.15	42.300	42.740	42.740	0.000	-162.000	-134.277	23.524
300	42.417	43.002	42.741	0.078	-161.994	-134.105	23.349
400	46.783	55.878	44.467	4.564	-161.487	-124.876	16.307
500	49.190	66.596	47.852	9.372	-160.775	-115.803	12.098
600	50.827	75.717	51.755	14.377	-159.973	-106.883	9.305
700	52.099	83.651	55.757	19.526	-159.124	-98.102	7.320
800	53.178	90.680	59.691	24.791	-158.247	-89.444	5.840
900	54.144	97.000	63.491	30.158	-157.356	-80.897	4.695
1000	55.040	102.751	67.134	35.617	-156.462	-72.450	3.784
1100	55.890	108.037	70.615	41.164	-155.582	-64.091	3.043
1200	56.709	112.936	73.941	46.794	-154.733	-55.812	2.429
1300	57.507	117.507	77.118	52.505	-153.940	-47.601	1.913
1400	58.288	121.797	80.158	58.295	-166.354	-39.043	1.457
1500	59.057	125.845	83.070	64.163	-165.589	-29.975	1.044
40. DICOPPER OXIDE Cu₂O (cr)							
298.15	62.600	92.550	92.550	0.000	-173.100	-150.344	26.339
300	62.721	92.938	92.551	0.116	-173.102	-150.203	26.152
400	67.587	111.712	95.078	6.654	-173.036	-142.572	18.618
500	70.784	127.155	99.995	13.580	-172.772	-134.984	14.101

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
40. DICOPPER OXIDE Cu₂O (cr) (continued)							
600	73.323	140.291	105.643	20.789	-172.389	-127.460	11.096
700	75.552	151.764	111.429	28.235	-171.914	-120.009	8.955
800	77.616	161.989	117.121	35.894	-171.363	-112.631	7.354
900	79.584	171.245	122.629	43.755	-170.750	-105.325	6.113
1000	81.492	179.729	127.920	51.809	-170.097	-98.091	5.124
1100	83.360	187.584	132.992	60.052	-169.431	-90.922	4.317
1200	85.202	194.917	137.850	68.480	-168.791	-83.814	3.648
1300	87.026	201.808	142.507	77.092	-168.223	-76.756	3.084
1400	88.836	208.324	146.978	85.885	-194.030	-68.926	2.572
1500	90.636	214.515	151.276	94.858	-193.438	-60.010	2.090
41. COPPER DICHLORIDE CuCl₂ (cr, l)							
298.15	71.880	108.070	108.070	0.000	-218.000	-173.826	30.453
300	71.998	108.515	108.071	0.133	-217.975	-173.552	30.218
400	76.338	129.899	110.957	7.577	-216.494	-158.962	20.758
500	78.654	147.204	116.532	15.336	-214.873	-144.765	15.123
600	80.175	161.687	122.884	23.282	-213.182	-130.901	11.396
675	81.056	171.183	127.732	29.329	-211.185	-120.693	9.340
PHASE TRANSITION: $\Delta_{\text{trs}} H = 0.700$ kJ/mol, $\Delta_{\text{trs}} S = 1.037$ J/K·mol, crII-crI							
675	82.400	172.220	127.732	30.029	-211.185	-120.693	9.340
700	82.400	175.216	129.375	32.089	-210.719	-117.350	8.757
800	82.400	186.219	135.808	40.329	-208.898	-104.137	6.799
871	82.400	193.226	140.207	46.179	-192.649	-94.893	5.691
PHASE TRANSITION: $\Delta_{\text{trs}} H = 15.001$ kJ/mol, $\Delta_{\text{trs}} S = 17.221$ J/K·mol, crI-l							
871	100.000	210.447	140.207	61.180	-192.649	-94.893	5.691
900	100.000	213.723	142.523	64.080	-191.640	-91.655	5.319
1000	100.000	224.259	150.179	74.080	-188.212	-80.730	4.217
1100	100.000	233.790	157.353	84.080	-184.873	-70.144	3.331
1130.75	100.000	236.547	159.470	87.155	-183.867	-66.951	3.093
42. COPPER DICHLORIDE CuCl₂ (g)							
298.15	56.814	278.418	278.418	0.000	-43.268	-49.883	8.739
300	56.869	278.769	278.419	0.105	-43.271	-49.924	8.692
400	58.992	295.456	280.679	5.911	-43.428	-52.119	6.806
500	60.111	308.752	285.010	11.871	-43.606	-54.271	5.670
600	60.761	319.774	289.911	17.918	-43.814	-56.385	4.909
700	61.168	329.173	294.865	24.015	-44.060	-58.462	4.362
800	61.439	337.360	299.677	30.147	-44.349	-60.500	3.950
900	61.630	344.608	304.274	36.301	-44.688	-62.499	3.627
1000	61.776	351.109	308.638	42.471	-45.088	-64.457	3.367
1100	61.900	357.003	312.771	48.655	-45.566	-66.372	3.152
1200	62.022	362.394	316.685	54.851	-46.139	-68.239	2.970
1300	62.159	367.364	320.395	61.060	-46.829	-70.053	2.815
1400	62.325	371.976	323.916	67.284	-60.784	-71.404	2.664
1500	62.531	376.283	327.265	73.526	-61.613	-72.133	2.512
43. FLUORINE F (g)							
298.15	22.746	158.750	158.750	0.000	79.380	62.280	-10.911
300	22.742	158.891	158.750	0.042	79.393	62.173	-10.825
400	22.432	165.394	159.639	2.302	80.043	56.332	-7.356
500	22.100	170.363	161.307	4.528	80.587	50.340	-5.259
600	21.832	174.368	163.161	6.724	81.046	44.246	-3.852
700	21.629	177.717	165.008	8.897	81.442	38.081	-2.842
800	21.475	180.595	166.780	11.052	81.792	31.862	-2.080
900	21.357	183.117	168.458	13.193	82.106	25.601	-1.486

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
43. FLUORINE F (g) (continued)							
1000	21.266	185.362	170.039	15.324	82.391	19.308	-1.009
1100	21.194	187.386	171.525	17.447	82.654	12.986	-0.617
1200	21.137	189.227	172.925	19.563	82.897	6.642	-0.289
1300	21.091	190.917	174.245	21.675	83.123	0.278	-0.011
1400	21.054	192.479	175.492	23.782	83.335	-6.103	0.228
1500	21.022	193.930	176.673	25.886	83.533	-12.498	0.435
44. DIFLUORINE F₂ (g)							
298.15	31.304	202.790	202.790	0.000	0.000	0.000	0.000
300	31.337	202.984	202.790	0.058	0.000	0.000	0.000
400	32.995	212.233	204.040	3.277	0.000	0.000	0.000
500	34.258	219.739	206.453	6.643	0.000	0.000	0.000
600	35.171	226.070	209.208	10.117	0.000	0.000	0.000
700	35.839	231.545	212.017	13.669	0.000	0.000	0.000
800	36.343	236.365	214.765	17.279	0.000	0.000	0.000
900	36.740	240.669	217.409	20.934	0.000	0.000	0.000
1000	37.065	244.557	219.932	24.625	0.000	0.000	0.000
1100	37.342	248.103	222.334	28.346	0.000	0.000	0.000
1200	37.588	251.363	224.619	32.093	0.000	0.000	0.000
1300	37.811	254.381	226.794	35.863	0.000	0.000	0.000
1400	38.019	257.191	228.866	39.654	0.000	0.000	0.000
1500	38.214	259.820	230.843	43.466	0.000	0.000	0.000
45. HYDROGEN FLUORIDE HF (g)							
298.15	29.137	173.776	173.776	0.000	-273.300	-275.399	48.248
300	29.137	173.956	173.776	0.054	-273.302	-275.412	47.953
400	29.149	182.340	174.919	2.968	-273.450	-276.096	36.054
500	29.172	188.846	177.078	5.884	-273.679	-276.733	28.910
600	29.230	194.169	179.496	8.804	-273.961	-277.318	24.142
700	29.350	198.683	181.923	11.732	-274.277	-277.852	20.733
800	29.549	202.614	184.269	14.676	-274.614	-278.340	18.174
900	29.827	206.110	186.505	17.645	-274.961	-278.785	16.180
1000	30.169	209.270	188.626	20.644	-275.309	-279.191	14.583
1100	30.558	212.163	190.636	23.680	-275.652	-279.563	13.275
1200	30.974	214.840	192.543	26.756	-275.988	-279.904	12.184
1300	31.403	217.336	194.355	29.875	-276.315	-280.217	11.259
1400	31.831	219.679	196.081	33.037	-276.631	-280.505	10.466
1500	32.250	221.889	197.729	36.241	-276.937	-280.771	9.777
46. GERMANIUM Ge (cr, l)							
298.15	23.222	31.090	31.090	0.000	0.000	0.000	0.000
300	23.249	31.234	31.090	0.043	0.000	0.000	0.000
400	24.310	38.083	32.017	2.426	0.000	0.000	0.000
500	24.962	43.582	33.798	4.892	0.000	0.000	0.000
600	25.452	48.178	35.822	7.414	0.000	0.000	0.000
700	25.867	52.133	37.876	9.980	0.000	0.000	0.000
800	26.240	55.612	39.880	12.586	0.000	0.000	0.000
900	26.591	58.723	41.804	15.227	0.000	0.000	0.000
1000	26.926	61.542	43.639	17.903	0.000	0.000	0.000
1100	27.252	64.124	45.386	20.612	0.000	0.000	0.000
1200	27.571	66.509	47.048	23.353	0.000	0.000	0.000
1211.4	27.608	66.770	47.232	23.668	0.000	0.000	0.000
PHASE TRANSITION: $\Delta_{\text{trs}} H = 37.030$ kJ/mol, $\Delta_{\text{trs}} S = 30.568$ J/K·mol, cr-l							
1211.4	27.600	97.338	47.232	60.698	0.000	0.000	0.000
1300	27.600	99.286	50.714	63.143	0.000	0.000	0.000

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
46. GERMANIUM Ge (cr, l) (continued)							
1400	27.600	101.331	54.258	65.903	0.000	0.000	0.000
1500	27.600	103.236	57.460	68.663	0.000	0.000	0.000
47. GERMANIUM Ge (g)							
298.15	30.733	167.903	167.903	0.000	367.800	327.009	-57.290
300	30.757	168.094	167.904	0.057	367.814	326.756	-56.893
400	31.071	177.025	169.119	3.162	368.536	312.959	-40.868
500	30.360	183.893	171.415	6.239	369.147	298.991	-31.235
600	29.265	189.334	173.965	9.222	369.608	284.914	-24.804
700	28.102	193.758	176.487	12.090	369.910	270.773	-20.205
800	27.029	197.439	178.882	14.845	370.060	256.598	-16.754
900	26.108	200.567	181.122	17.501	370.073	242.414	-14.069
1000	25.349	203.277	183.205	20.072	369.969	228.234	-11.922
1100	24.741	205.664	185.141	22.575	369.763	214.069	-10.165
1200	24.264	207.795	186.941	25.025	369.471	199.928	-8.703
1300	23.898	209.722	188.621	27.432	332.088	188.521	-7.575
1400	23.624	211.483	190.192	29.807	331.704	177.492	-6.622
1500	23.426	213.105	191.666	32.159	331.296	166.491	-5.798
48. GERMANIUM DIOXIDE GeO₂ (cr, l)							
298.15	50.166	39.710	39.710	0.000	-580.200	-521.605	91.382
300	50.475	40.021	39.711	0.093	-580.204	-521.242	90.755
400	61.281	56.248	41.850	5.759	-579.893	-501.610	65.503
500	66.273	70.519	46.191	12.164	-579.013	-482.134	50.368
600	69.089	82.872	51.299	18.943	-577.915	-462.859	40.295
700	70.974	93.671	56.597	25.952	-576.729	-443.776	33.115
800	72.449	103.247	61.841	33.125	-575.498	-424.866	27.741
900	73.764	111.857	66.928	40.436	-574.235	-406.113	23.570
1000	75.049	119.696	71.819	47.877	-572.934	-387.502	20.241
1100	76.378	126.910	76.504	55.447	-571.582	-369.024	17.523
1200	77.796	133.616	80.987	63.155	-570.166	-350.671	15.264
1300	79.332	139.903	85.279	71.010	-605.685	-329.732	13.249
1308	79.460	140.390	85.615	71.646	-584.059	-328.034	13.100
PHASE TRANSITION: $\Delta_{\text{trs}} H = 21.500$ kJ/mol, $\Delta_{\text{trs}} S = 16.437$ J/K·mol, crII-crI							
1308	80.075	156.827	85.615	93.146	-584.059	-328.034	13.100
1388	81.297	161.617	89.858	99.601	-565.504	-312.415	11.757
PHASE TRANSITION: $\Delta_{\text{trs}} H = 17.200$ kJ/mol, $\Delta_{\text{trs}} S = 12.392$ J/K·mol, crI-l							
1388	78.500	174.009	89.858	116.801	-565.504	-312.415	11.757
1400	78.500	174.685	90.582	117.743	-565.328	-310.228	11.575
1500	78.500	180.100	96.372	125.593	-563.882	-292.057	10.170
49. GERMANIUM TETRACHLORIDE GeCl₄ (g)							
298.15	95.918	348.393	348.393	0.000	-500.000	-461.582	80.866
300	96.041	348.987	348.395	0.178	-499.991	-461.343	80.326
400	100.750	377.342	352.229	10.045	-499.447	-448.540	58.573
500	103.206	400.114	359.604	20.255	-498.845	-435.882	45.536
600	104.624	419.067	367.980	30.652	-498.234	-423.347	36.855
700	105.509	435.266	376.463	41.162	-497.634	-410.914	30.662
800	106.096	449.396	384.715	51.744	-497.057	-398.565	26.023
900	106.504	461.917	392.611	62.375	-496.509	-386.287	22.419
1000	106.799	473.155	400.113	73.041	-495.993	-374.068	19.539
1100	107.020	483.344	407.224	83.733	-495.512	-361.899	17.185
1200	107.189	492.664	413.961	94.444	-495.067	-349.772	15.225
1300	107.320	501.249	420.349	105.169	-531.677	-334.973	13.459
1400	107.425	509.206	426.416	115.907	-531.265	-319.857	11.934
1500	107.509	516.621	432.185	126.654	-530.861	-304.771	10.613

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_f))/T$	$H^\circ - H^\circ(T_f)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
50. HYDROGEN H (g)							
298.15	20.786	114.716	114.716	0.000	217.998	203.276	-35.613
300	20.786	114.845	114.716	0.038	218.010	203.185	-35.377
400	20.786	120.824	115.532	2.117	218.635	198.149	-25.875
500	20.786	125.463	117.071	4.196	219.253	192.956	-20.158
600	20.786	129.252	118.795	6.274	219.867	187.639	-16.335
700	20.786	132.457	120.524	8.353	220.476	182.219	-13.597
800	20.786	135.232	122.193	10.431	221.079	176.712	-11.538
900	20.786	137.680	123.780	12.510	221.670	171.131	-9.932
1000	20.786	139.870	125.282	14.589	222.247	165.485	-8.644
1100	20.786	141.852	126.700	16.667	222.806	159.781	-7.587
1200	20.786	143.660	128.039	18.746	223.345	154.028	-6.705
1300	20.786	145.324	129.305	20.824	223.864	148.230	-5.956
1400	20.786	146.864	130.505	22.903	224.360	142.393	-5.313
1500	20.786	148.298	131.644	24.982	224.835	136.522	-4.754
51. DIHYDROGEN H₂ (g)							
298.15	28.836	130.680	130.680	0.000	0.000	0.000	0.000
300	28.849	130.858	130.680	0.053	0.000	0.000	0.000
400	29.181	139.217	131.818	2.960	0.000	0.000	0.000
500	29.260	145.738	133.974	5.882	0.000	0.000	0.000
600	29.327	151.078	136.393	8.811	0.000	0.000	0.000
700	29.440	155.607	138.822	11.749	0.000	0.000	0.000
800	29.623	159.549	141.172	14.702	0.000	0.000	0.000
900	29.880	163.052	143.412	17.676	0.000	0.000	0.000
1000	30.204	166.217	145.537	20.680	0.000	0.000	0.000
1100	30.580	169.113	147.550	23.719	0.000	0.000	0.000
1200	30.991	171.791	149.460	26.797	0.000	0.000	0.000
1300	31.422	174.288	151.275	29.918	0.000	0.000	0.000
1400	31.860	176.633	153.003	33.082	0.000	0.000	0.000
1500	32.296	178.846	154.653	36.290	0.000	0.000	0.000
52. HYDROXYL OH (g)							
298.15	29.886	183.737	183.737	0.000	39.349	34.631	-6.067
300	29.879	183.922	183.738	0.055	39.350	34.602	-6.025
400	29.604	192.476	184.906	3.028	39.384	33.012	-4.311
500	29.495	199.067	187.104	5.982	39.347	31.422	-3.283
600	29.513	204.445	189.560	8.931	39.252	29.845	-2.598
700	29.655	209.003	192.020	11.888	39.113	28.287	-2.111
800	29.914	212.979	194.396	14.866	38.945	26.752	-1.747
900	30.265	216.522	196.661	17.874	38.763	25.239	-1.465
1000	30.682	219.731	198.810	20.921	38.577	23.746	-1.240
1100	31.135	222.677	200.848	24.012	38.393	22.272	-1.058
1200	31.603	225.406	202.782	27.149	38.215	20.814	-0.906
1300	32.069	227.954	204.621	30.332	38.046	19.371	-0.778
1400	32.522	230.347	206.374	33.562	37.886	17.941	-0.669
1500	32.956	232.606	208.048	36.836	37.735	16.521	-0.575
53. WATER H₂O (l)							
298.15	75.300	69.950	69.950	0.000	-285.830	-237.141	41.546
300	75.281	70.416	69.951	0.139	-285.771	-236.839	41.237
373.21	76.079	86.896	71.715	5.666	-283.454	-225.160	31.513
54. WATER H₂O (g)							
298.15	33.598	188.832	188.832	0.000	-241.826	-228.582	40.046

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
54. WATER H₂O (g) (continued)							
300	33.606	189.040	188.833	0.062	-241.844	-228.500	39.785
400	34.283	198.791	190.158	3.453	-242.845	-223.900	29.238
500	35.259	206.542	192.685	6.929	-243.822	-219.050	22.884
600	36.371	213.067	195.552	10.509	-244.751	-214.008	18.631
700	37.557	218.762	198.469	14.205	-245.620	-208.814	15.582
800	38.800	223.858	201.329	18.023	-246.424	-203.501	13.287
900	40.084	228.501	204.094	21.966	-247.158	-198.091	11.497
1000	41.385	232.792	206.752	26.040	-247.820	-192.603	10.060
1100	42.675	236.797	209.303	30.243	-248.410	-187.052	8.882
1200	43.932	240.565	211.753	34.574	-248.933	-181.450	7.898
1300	45.138	244.129	214.108	39.028	-249.392	-175.807	7.064
1400	46.281	247.516	216.374	43.599	-249.792	-170.132	6.348
1500	47.356	250.746	218.559	48.282	-250.139	-164.429	5.726
55. IODINE I (g)							
298.15	20.786	180.787	180.787	0.000	106.760	70.172	-12.294
300	20.786	180.915	180.787	0.038	106.748	69.945	-12.178
400	20.786	186.895	181.602	2.117	97.974	58.060	-7.582
500	20.786	191.533	183.142	4.196	75.988	50.202	-5.244
600	20.786	195.323	184.866	6.274	76.190	45.025	-3.920
700	20.786	198.527	186.594	8.353	76.385	39.816	-2.971
800	20.787	201.303	188.263	10.432	76.574	34.579	-2.258
900	20.789	203.751	189.851	12.510	76.757	29.319	-1.702
1000	20.795	205.942	191.352	14.589	76.936	24.038	-1.256
1100	20.806	207.924	192.770	16.669	77.109	18.740	-0.890
1200	20.824	209.735	194.110	18.751	77.277	13.426	-0.584
1300	20.851	211.403	195.377	20.835	77.440	8.098	-0.325
1400	20.889	212.950	196.577	22.921	77.596	2.758	-0.103
1500	20.936	214.392	197.717	25.013	77.745	-2.592	0.090
56. DIIODINE I₂ (cr, l)							
298.15	54.440	116.139	116.139	0.000	0.000	0.000	0.000
300	54.518	116.476	116.140	0.101	0.000	0.000	0.000
386.75	61.531	131.039	117.884	5.088	0.000	0.000	0.000
		PHASE TRANSITION: $\Delta_{\text{trs}} H = 15.665$ kJ/mol, $\Delta_{\text{trs}} S = 40.504$ J/K·mol, cr-l					
386.75	79.555	171.543	117.884	20.753	0.000	0.000	0.000
400	79.555	174.223	119.706	21.807	0.000	0.000	0.000
457.67	79.555	184.938	127.266	26.395	0.000	0.000	0.000
57. DIIODINE I₂ (g)							
298.15	36.887	260.685	260.685	0.000	62.420	19.324	-3.385
300	36.897	260.913	260.685	0.068	62.387	19.056	-3.318
400	37.256	271.584	262.138	3.778	44.391	5.447	-0.711
457.67	37.385	276.610	263.652	5.931		pressure = 1 bar	
500	37.464	279.921	264.891	7.515	0.000	0.000	0.000
600	37.613	286.765	267.983	11.269	0.000	0.000	0.000
700	37.735	292.573	271.092	15.037	0.000	0.000	0.000
800	37.847	297.619	274.099	18.816	0.000	0.000	0.000
900	37.956	302.083	276.965	22.606	0.000	0.000	0.000
1000	38.070	306.088	279.681	26.407	0.000	0.000	0.000
1100	38.196	309.722	282.249	30.220	0.000	0.000	0.000
1200	38.341	313.052	284.679	34.047	0.000	0.000	0.000
1300	38.514	316.127	286.981	37.890	0.000	0.000	0.000
1400	38.719	318.989	289.166	41.751	0.000	0.000	0.000
1500	38.959	321.668	291.245	45.635	0.000	0.000	0.000

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
58. HYDROGEN IODIDE HI (g)							
298.15	29.157	206.589	206.589	0.000	26.500	1.700	-0.298
300	29.158	206.769	206.589	0.054	26.477	1.546	-0.269
400	29.329	215.176	207.734	2.977	17.093	-6.289	0.821
500	29.738	221.760	209.904	5.928	-5.481	-9.946	1.039
600	30.351	227.233	212.348	8.931	-5.819	-10.806	0.941
700	31.070	231.965	214.820	12.002	-6.101	-11.614	0.867
800	31.807	236.162	217.230	15.145	-6.323	-12.386	0.809
900	32.511	239.950	219.548	18.362	-6.489	-13.133	0.762
1000	33.156	243.409	221.763	21.646	-6.608	-13.865	0.724
1100	33.735	246.597	223.878	24.991	-6.689	-14.586	0.693
1200	34.249	249.555	225.896	28.391	-6.741	-15.302	0.666
1300	34.703	252.314	227.823	31.839	-6.775	-16.014	0.643
1400	35.106	254.901	229.666	35.330	-6.797	-16.723	0.624
1500	35.463	257.336	231.430	38.858	-6.814	-17.432	0.607
59. POTASSIUM K (cr, l)							
298.15	29.600	64.680	64.680	0.000	0.000	0.000	0.000
300	29.671	64.863	64.681	0.055	0.000	0.000	0.000
336.86	32.130	68.422	64.896	1.188	0.000	0.000	0.000
		PHASE TRANSITION: $\Delta_{\text{trs}} H = 2.321$ kJ/mol, $\Delta_{\text{trs}} S = 6.891$ J/K·mol, cr-l					
336.86	32.129	75.313	64.896	3.509	0.000	0.000	0.000
400	31.552	80.784	66.986	5.519	0.000	0.000	0.000
500	30.741	87.734	70.469	8.632	0.000	0.000	0.000
600	30.158	93.283	73.824	11.675	0.000	0.000	0.000
700	29.851	97.905	76.943	14.673	0.000	0.000	0.000
800	29.838	101.887	79.818	17.655	0.000	0.000	0.000
900	30.130	105.415	82.470	20.651	0.000	0.000	0.000
1000	30.730	108.618	84.927	23.691	0.000	0.000	0.000
1039.4	31.053	109.812	85.847	24.908	0.000	0.000	0.000
60. POTASSIUM K (g)							
298.15	20.786	160.340	160.340	0.000	89.000	60.479	-10.596
300	20.786	160.468	160.340	0.038	88.984	60.302	-10.499
400	20.786	166.448	161.155	2.117	85.598	51.332	-6.703
500	20.786	171.086	162.695	4.196	84.563	42.887	-4.480
600	20.786	174.876	164.419	6.274	83.599	34.643	-3.016
700	20.786	178.080	166.148	8.353	82.680	26.557	-1.982
800	20.786	180.856	167.817	10.431	81.776	18.601	-1.215
900	20.786	183.304	169.404	12.510	80.859	10.759	-0.624
1000	20.786	185.494	170.905	14.589	79.897	3.021	-0.158
1039.4	20.786	186.297	171.474	15.408			
		pressure = 1 bar					
1100	20.786	187.475	172.323	16.667	0.000	0.000	0.000
1200	20.786	189.284	173.662	18.746	0.000	0.000	0.000
1300	20.789	190.948	174.929	20.825	0.000	0.000	0.000
1400	20.793	192.489	176.129	22.904	0.000	0.000	0.000
1500	20.801	193.923	177.268	24.983	0.000	0.000	0.000
61. DIPOTASSIUM OXIDE K₂O (cr, l)							
298.15	72.000	96.000	96.000	0.000	-361.700	-321.171	56.267
300	72.130	96.446	96.001	0.133	-361.704	-320.920	55.876
400	79.154	118.158	98.914	7.698	-366.554	-306.416	40.013
500	86.178	136.575	104.647	15.964	-366.043	-291.423	30.444
590	92.500	151.348	110.662	24.005	-364.204	-278.079	24.619
		PHASE TRANSITION: $\Delta_{\text{trs}} H = 0.700$ kJ/mol, $\Delta_{\text{trs}} S = 1.186$ J/K·mol, crIII-crII					

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_f))/T$	$H^\circ - H^\circ(T_f)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
61. DIPOTASSIUM OXIDE K_2O (cr, l) (continued)							
590	100.000	152.534	110.662	24.705	-364.204	-278.079	24.619
600	100.000	154.215	111.374	25.705	-363.968	-276.621	24.082
645	100.000	161.447	114.618	30.205	-358.901	-270.109	21.874
PHASE TRANSITION: $\Delta_{trs} H = 4.000$ kJ/mol, $\Delta_{trs} S = 6.202$ J/K·mol, crI-crI							
645	100.000	167.649	114.618	34.205	-358.901	-270.109	21.874
700	100.000	175.832	119.111	39.705	-357.592	-262.592	19.595
800	100.000	189.185	127.054	49.705	-355.224	-249.183	16.270
900	100.000	200.963	134.625	59.705	-352.919	-236.067	13.701
1000	100.000	211.499	141.794	69.705	-350.732	-223.202	11.659
1013	100.000	212.791	142.697	71.005	-323.459	-221.546	11.424
PHASE TRANSITION: $\Delta_{trs} H = 27.000$ kJ/mol, $\Delta_{trs} S = 26.654$ J/K·mol, crI-l							
1013	100.000	239.444	142.697	98.005	-323.459	-221.546	11.424
1100	100.000	247.684	150.679	106.705	-479.439	-203.633	9.670
1200	100.000	256.385	159.131	116.705	-475.371	-178.740	7.780
1300	100.000	264.389	166.924	126.705	-471.321	-154.185	6.195
1400	100.000	271.800	174.154	136.705	-467.287	-129.941	4.848
1500	100.000	278.699	180.896	146.705	-463.268	-105.986	3.691
62. POTASSIUM HYDROXIDE KOH (cr, l)							
298.15	64.900	78.870	78.870	0.000	-424.580	-378.747	66.354
300	65.038	79.272	78.871	0.120	-424.569	-378.463	65.895
400	72.519	99.007	81.512	6.998	-426.094	-362.765	47.372
500	80.000	115.993	86.745	14.624	-424.572	-347.093	36.260
520	81.496	119.159	87.931	16.239	-417.725	-344.002	34.555
PHASE TRANSITION: $\Delta_{trs} H = 6.450$ kJ/mol, $\Delta_{trs} S = 12.404$ J/K·mol, crII-crI							
520	79.000	131.563	87.931	22.689	-417.725	-344.002	34.555
600	79.000	142.868	94.520	29.009	-416.274	-332.766	28.969
678	79.000	152.523	100.649	35.171	-405.464	-321.998	24.807
PHASE TRANSITION: $\Delta_{trs} H = 9.400$ kJ/mol, $\Delta_{trs} S = 13.865$ J/K·mol, crI-l							
678	83.000	166.388	100.649	44.571	-405.464	-321.998	24.807
700	83.000	169.038	102.757	46.397	-404.981	-319.297	23.826
800	83.000	180.121	111.750	54.697	-402.808	-307.206	20.058
900	83.000	189.897	119.901	62.997	-400.694	-295.383	17.143
1000	83.000	198.642	127.345	71.297	-398.668	-283.791	14.824
1100	83.000	206.553	134.192	79.597	-475.618	-267.780	12.716
1200	83.000	213.775	140.527	87.897	-472.711	-249.014	10.839
1300	83.000	220.418	146.421	96.197	-469.843	-230.490	9.261
1400	83.000	226.569	151.929	104.497	-467.011	-212.184	7.917
1500	83.000	232.296	157.098	112.797	-464.217	-194.080	6.758
63. POTASSIUM HYDROXIDE KOH (g)							
298.15	49.184	238.283	238.283	0.000	-227.989	-229.685	40.239
300	49.236	238.588	238.284	0.091	-228.007	-229.696	39.993
400	51.178	253.053	240.243	5.124	-231.377	-229.667	29.991
500	52.178	264.591	243.998	10.296	-232.309	-229.129	23.937
600	52.804	274.163	248.251	15.547	-233.145	-228.413	19.885
700	53.296	282.340	252.551	20.853	-233.934	-227.562	16.981
800	53.758	289.487	256.730	26.206	-234.708	-226.599	14.795
900	54.229	295.846	260.730	31.605	-235.495	-225.538	13.090
1000	54.713	301.585	264.533	37.052	-236.322	-224.388	11.721
1100	55.203	306.823	268.143	42.548	-316.077	-218.535	10.377
1200	55.686	311.647	271.570	48.092	-315.925	-209.674	9.127
1300	56.153	316.122	274.827	53.684	-315.764	-200.826	8.069
1400	56.598	320.300	277.927	59.322	-315.595	-191.991	7.163
1500	57.016	324.220	280.884	65.003	-315.420	-183.169	6.378

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_f))/T$	$H^\circ - H^\circ(T_f)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
64. POTASSIUM CHLORIDE KCl (cr, l)							
298.15	51.300	82.570	82.570	0.000	-436.490	-408.568	71.579
300	51.333	82.887	82.571	0.095	-436.481	-408.395	71.107
400	52.977	97.886	84.605	5.312	-438.463	-398.651	52.058
500	54.448	109.867	88.498	10.685	-437.990	-388.749	40.612
600	55.885	119.921	92.919	16.201	-437.332	-378.960	32.991
700	57.425	128.649	97.413	21.865	-436.502	-369.295	27.557
800	59.205	136.430	101.812	27.694	-435.505	-359.760	23.490
900	61.361	143.523	106.058	33.719	-434.337	-350.360	20.334
1000	64.032	150.121	110.138	39.983	-432.981	-341.100	17.817
1044	65.405	152.908	111.882	42.830	-485.450	-336.720	16.847
PHASE TRANSITION: $\Delta_{\text{trs}} H = 26.320$ kJ/mol, $\Delta_{\text{trs}} S = 25.210$ J/K·mol, cr-l							
1044	72.000	178.118	111.882	69.150	-485.450	-336.720	16.847
1100	72.000	181.880	115.351	73.182	-483.633	-328.790	15.613
1200	72.000	188.145	121.160	80.382	-480.393	-314.856	13.705
1300	72.000	193.908	126.537	87.582	-477.158	-301.192	12.102
1400	72.000	199.244	131.542	94.782	-473.928	-287.778	10.737
1500	72.000	204.211	136.223	101.982	-470.704	-274.594	9.562
65. POTASSIUM CHLORIDE KCl (g)							
298.15	36.505	239.091	239.091	0.000	-214.575	-233.320	40.876
300	36.518	239.317	239.092	0.068	-214.594	-233.436	40.644
400	37.066	249.904	240.532	3.749	-218.112	-239.107	31.224
500	37.384	258.212	243.267	7.473	-219.287	-244.219	25.513
600	37.597	265.048	246.344	11.222	-220.396	-249.100	21.686
700	37.769	270.857	249.441	14.991	-221.461	-253.799	18.938
800	37.907	275.910	252.441	18.775	-222.509	-258.347	16.868
900	38.041	280.382	255.302	22.572	-223.568	-262.764	15.250
1000	38.162	284.397	258.014	26.383	-224.667	-267.061	13.950
1100	38.279	288.039	260.581	30.205	-304.696	-266.627	12.661
1200	38.401	291.375	263.010	34.039	-304.821	-263.161	11.455
1300	38.518	294.454	265.312	37.885	-304.941	-259.684	10.434
1400	38.639	297.313	267.496	41.743	-305.053	-256.199	9.559
1500	38.761	299.983	269.574	45.613	-305.159	-252.706	8.800
66. DINITROGEN N₂ (g)							
298.15	29.124	191.608	191.608	0.000	0.000	0.000	0.000
300	29.125	191.788	191.608	0.054	0.000	0.000	0.000
400	29.249	200.180	192.752	2.971	0.000	0.000	0.000
500	29.580	206.738	194.916	5.911	0.000	0.000	0.000
600	30.109	212.175	197.352	8.894	0.000	0.000	0.000
700	30.754	216.864	199.812	11.936	0.000	0.000	0.000
800	31.433	221.015	202.208	15.046	0.000	0.000	0.000
900	32.090	224.756	204.509	18.222	0.000	0.000	0.000
1000	32.696	228.169	206.706	21.462	0.000	0.000	0.000
1100	33.241	231.311	208.802	24.759	0.000	0.000	0.000
1200	33.723	234.224	210.801	28.108	0.000	0.000	0.000
1300	34.147	236.941	212.708	31.502	0.000	0.000	0.000
1400	34.517	239.485	214.531	34.936	0.000	0.000	0.000
1500	34.842	241.878	216.275	38.404	0.000	0.000	0.000
67. NITRIC OXIDE NO (g)							
298.15	29.862	210.745	210.745	0.000	91.277	87.590	-15.345
300	29.858	210.930	210.746	0.055	91.278	87.567	-15.247
400	29.954	219.519	211.916	3.041	91.320	86.323	-11.272
500	30.493	226.255	214.133	6.061	91.340	85.071	-8.887

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_f))/T$	$H^\circ - H^\circ(T_f)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
67. NITRIC OXIDE NO (g) (continued)							
600	31.243	231.879	216.635	9.147	91.354	83.816	-7.297
700	32.031	236.754	219.168	12.310	91.369	82.558	-6.160
800	32.770	241.081	221.642	15.551	91.386	81.298	-5.308
900	33.425	244.979	224.022	18.862	91.405	80.036	-4.645
1000	33.990	248.531	226.298	22.233	91.426	78.772	-4.115
1100	34.473	251.794	228.469	25.657	91.445	77.505	-3.680
1200	34.883	254.811	230.540	29.125	91.464	76.237	-3.318
1300	35.234	257.618	232.516	32.632	91.481	74.967	-3.012
1400	35.533	260.240	234.404	36.170	91.495	73.697	-2.750
1500	35.792	262.700	236.209	39.737	91.506	72.425	-2.522
68. NITROGEN DIOXIDE NO₂ (g)							
298.15	37.178	240.166	240.166	0.000	34.193	52.316	-9.165
300	37.236	240.397	240.167	0.069	34.181	52.429	-9.129
400	40.513	251.554	241.666	3.955	33.637	58.600	-7.652
500	43.664	260.939	244.605	8.167	33.319	64.882	-6.778
600	46.383	269.147	248.026	12.673	33.174	71.211	-6.199
700	48.612	276.471	251.575	17.427	33.151	77.553	-5.787
800	50.405	283.083	255.107	22.381	33.213	83.893	-5.478
900	51.844	289.106	258.555	27.496	33.334	90.221	-5.236
1000	53.007	294.631	261.891	32.741	33.495	96.534	-5.042
1100	53.956	299.729	265.102	38.090	33.686	102.828	-4.883
1200	54.741	304.459	268.187	43.526	33.898	109.105	-4.749
1300	55.399	308.867	271.148	49.034	34.124	115.363	-4.635
1400	55.960	312.994	273.992	54.603	34.360	121.603	-4.537
1500	56.446	316.871	276.722	60.224	34.604	127.827	-4.451
69. AMMONIA NH₃ (g)							
298.15	35.630	192.768	192.768	0.000	-45.940	-16.407	2.874
300	35.678	192.989	192.769	0.066	-45.981	-16.223	2.825
400	38.674	203.647	194.202	3.778	-48.087	-5.980	0.781
500	41.994	212.633	197.011	7.811	-49.908	4.764	-0.498
600	45.229	220.578	200.289	12.174	-51.430	15.846	-1.379
700	48.269	227.781	203.709	16.850	-52.682	27.161	-2.027
800	51.112	234.414	207.138	21.821	-53.695	38.639	-2.523
900	53.769	240.589	210.516	27.066	-54.499	50.231	-2.915
1000	56.244	246.384	213.816	32.569	-55.122	61.903	-3.233
1100	58.535	251.854	217.027	38.309	-55.589	73.629	-3.496
1200	60.644	257.039	220.147	44.270	-55.920	85.392	-3.717
1300	62.576	261.970	223.176	50.432	-56.136	97.177	-3.905
1400	64.339	266.673	226.117	56.779	-56.251	108.975	-4.066
1500	65.945	271.168	228.971	63.295	-56.282	120.779	-4.206
70. OXYGEN O (g)							
298.15	21.911	161.058	161.058	0.000	249.180	231.743	-40.600
300	21.901	161.194	161.059	0.041	249.193	231.635	-40.331
400	21.482	167.430	161.912	2.207	249.874	225.677	-29.470
500	21.257	172.197	163.511	4.343	250.481	219.556	-22.937
600	21.124	176.060	165.290	6.462	251.019	213.319	-18.571
700	21.040	179.310	167.067	8.570	251.500	206.997	-15.446
800	20.984	182.115	168.777	10.671	251.932	200.610	-13.098
900	20.944	184.584	170.399	12.767	252.325	194.171	-11.269
1000	20.915	186.789	171.930	14.860	252.686	187.689	-9.804
1100	20.893	188.782	173.372	16.950	253.022	181.173	-8.603
1200	20.877	190.599	174.733	19.039	253.335	174.628	-7.601
1300	20.864	192.270	176.019	21.126	253.630	168.057	-6.753

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ-H^\circ(T_r))/T$	$H^\circ-H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
70. OXYGEN O (g) (continued)							
1400	20.853	193.815	177.236	23.212	253.908	161.463	-6.024
1500	20.845	195.254	178.389	25.296	254.171	154.851	-5.392
71. DIOXYGEN O₂ (g)							
298.15	29.378	205.148	205.148	0.000	0.000	0.000	0.000
300	29.387	205.330	205.148	0.054	0.000	0.000	0.000
400	30.109	213.873	206.308	3.026	0.000	0.000	0.000
500	31.094	220.695	208.525	6.085	0.000	0.000	0.000
600	32.095	226.454	211.045	9.245	0.000	0.000	0.000
700	32.987	231.470	213.612	12.500	0.000	0.000	0.000
800	33.741	235.925	216.128	15.838	0.000	0.000	0.000
900	34.365	239.937	218.554	19.244	0.000	0.000	0.000
1000	34.881	243.585	220.878	22.707	0.000	0.000	0.000
1100	35.314	246.930	223.096	26.217	0.000	0.000	0.000
1200	35.683	250.019	225.213	29.768	0.000	0.000	0.000
1300	36.006	252.888	227.233	33.352	0.000	0.000	0.000
1400	36.297	255.568	229.162	36.968	0.000	0.000	0.000
1500	36.567	258.081	231.007	40.611	0.000	0.000	0.000
72. SULFUR S (cr, I)							
298.15	22.690	32.070	32.070	0.000	0.000	0.000	0.000
300	22.737	32.210	32.070	0.042	0.000	0.000	0.000
368.3	24.237	37.030	32.554	1.649	0.000	0.000	0.000
PHASE TRANSITION: $\Delta_{\text{trs}} H = 0.401$ kJ/mol, $\Delta_{\text{trs}} S = 1.089$ J/K·mol, crII-crI							
368.3	24.773	38.119	32.553	2.050	0.000	0.000	0.000
388.36	25.180	39.444	32.875	2.551	0.000	0.000	0.000
PHASE TRANSITION: $\Delta_{\text{trs}} H = 1.722$ kJ/mol, $\Delta_{\text{trs}} S = 4.431$ J/K·mol, crI-I							
388.36	31.710	43.875	32.872	4.273	0.000	0.000	0.000
400	32.369	44.824	33.206	4.647	0.000	0.000	0.000
500	38.026	53.578	36.411	8.584	0.000	0.000	0.000
600	34.371	60.116	39.842	12.164	0.000	0.000	0.000
700	32.451	65.278	43.120	15.511	0.000	0.000	0.000
800	32.000	69.557	46.163	18.715	0.000	0.000	0.000
882.38	32.000	72.693	48.496	21.351	0.000	0.000	0.000
73. SULFUR S (g)							
298.15	23.673	167.828	167.828	0.000	277.180	236.704	-41.469
300	23.669	167.974	167.828	0.044	277.182	236.453	-41.170
400	23.233	174.730	168.752	2.391	274.924	222.962	-29.115
500	22.741	179.860	170.482	4.689	273.286	210.145	-21.953
600	22.338	183.969	172.398	6.942	271.958	197.646	-17.206
700	22.031	187.388	174.302	9.160	270.829	185.352	-13.831
800	21.800	190.314	176.125	11.351	269.816	173.210	-11.309
900	21.624	192.871	177.847	13.522	215.723	162.258	-9.417
1000	21.489	195.142	179.465	15.677	216.018	156.301	-8.164
1100	21.386	197.185	180.985	17.821	216.284	150.317	-7.138
1200	21.307	199.043	182.413	19.955	216.525	144.309	-6.282
1300	21.249	200.746	183.759	22.083	216.743	138.282	-5.556
1400	21.209	202.319	185.029	24.206	216.940	132.239	-4.934
1500	21.186	203.781	186.231	26.325	217.119	126.182	-4.394
74. DISULFUR S₂ (g)							
298.15	32.505	228.165	228.165	0.000	128.600	79.696	-13.962
300	32.540	228.366	228.165	0.060	128.576	79.393	-13.823
400	34.108	237.956	229.462	3.398	122.703	63.380	-8.276
500	35.133	245.686	231.959	6.863	118.296	49.031	-5.122

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ - H^\circ(T_r))/T$	$H^\circ - H^\circ(T_r)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
74. DISULFUR S₂ (g) (continued)							
600	35.815	252.156	234.800	10.413	114.685	35.530	-3.093
700	36.305	257.715	237.686	14.020	111.599	22.588	-1.685
800	36.697	262.589	240.501	17.671	108.841	10.060	-0.657
882.38	36.985	266.200	242.734	20.706		pressure = 1 bar	
900	37.045	266.932	243.201	21.358	0.000	0.000	0.000
1000	37.377	270.852	245.773	25.079	0.000	0.000	0.000
1100	37.704	274.430	248.218	28.833	0.000	0.000	0.000
1200	38.030	277.725	250.541	32.620	0.000	0.000	0.000
1300	38.353	280.781	252.751	36.439	0.000	0.000	0.000
1400	38.669	283.635	254.856	40.290	0.000	0.000	0.000
1500	38.976	286.314	256.865	44.173	0.000	0.000	0.000
75. OCTASULFUR S₈ (g)							
298.15	156.500	432.536	432.536	0.000	101.277	48.810	-8.551
300	156.768	433.505	432.539	0.290	101.231	48.484	-8.442
400	167.125	480.190	438.834	16.542	80.642	32.003	-4.179
500	173.181	518.176	451.022	33.577	66.185	21.409	-2.237
600	177.936	550.180	464.951	51.137	55.101	13.549	-1.180
700	182.441	577.948	479.152	69.157	46.349	7.343	-0.548
800	186.764	602.596	493.071	87.620	39.177	2.263	-0.148
900	190.595	624.821	506.495	106.494	-392.062	6.554	-0.380
1000	193.618	645.067	519.355	125.712	-387.728	50.614	-2.644
1100	195.684	663.625	531.639	145.185	-383.272	94.233	-4.475
1200	196.825	680.707	543.359	164.817	-378.786	137.444	-5.983
1300	197.195	696.480	554.539	184.524	-374.356	180.283	-7.244
1400	196.988	711.089	565.206	204.237	-370.048	222.785	-8.312
1500	196.396	724.662	575.389	223.909	-365.905	264.984	-9.227
76. SULFUR DIOXIDE SO₂ (g)							
298.15	39.842	248.219	248.219	0.000	-296.810	-300.090	52.574
300	39.909	248.466	248.220	0.074	-296.833	-300.110	52.253
400	43.427	260.435	249.828	4.243	-300.240	-300.935	39.298
500	46.490	270.465	252.978	8.744	-302.735	-300.831	31.427
600	48.938	279.167	256.634	13.520	-304.699	-300.258	26.139
700	50.829	286.859	260.413	18.513	-306.308	-299.386	22.340
800	52.282	293.746	264.157	23.671	-307.691	-298.302	19.477
900	53.407	299.971	267.796	28.958	-302.075	-295.987	17.178
1000	54.290	305.646	271.301	34.345	-302.012	-288.647	15.077
1100	54.993	310.855	274.664	39.810	-301.934	-281.314	13.358
1200	55.564	315.665	277.882	45.339	-301.849	-273.989	11.926
1300	56.033	320.131	280.963	50.920	-301.763	-266.671	10.715
1400	56.426	324.299	283.911	56.543	-301.680	-259.359	9.677
1500	56.759	328.203	286.735	62.203	-301.605	-252.053	8.777
77. SILICON Si (cr)							
298.15	19.789	18.810	18.810	0.000	0.000	0.000	0.000
300	19.855	18.933	18.810	0.037	0.000	0.000	0.000
400	22.301	25.023	19.624	2.160	0.000	0.000	0.000
500	23.610	30.152	21.231	4.461	0.000	0.000	0.000
600	24.472	34.537	23.092	6.867	0.000	0.000	0.000
700	25.124	38.361	25.006	9.348	0.000	0.000	0.000
800	25.662	41.752	26.891	11.888	0.000	0.000	0.000
900	26.135	44.802	28.715	14.478	0.000	0.000	0.000
1000	26.568	47.578	30.464	17.114	0.000	0.000	0.000
1100	26.974	50.130	32.138	19.791	0.000	0.000	0.000
1200	27.362	52.493	33.737	22.508	0.000	0.000	0.000

THERMODYNAMIC PROPERTIES AS A FUNCTION OF TEMPERATURE (continued)

T/K	J/K·mol			kJ/mol			Log K_f
	C_p°	S°	$-(G^\circ-H^\circ(T_p))/T$	$H^\circ-H^\circ(T_p)$	$\Delta_f H^\circ$	$\Delta_f G^\circ$	
77. SILICON Si (cr) (continued)							
1300	27.737	54.698	35.265	25.263	0.000	0.000	0.000
1400	28.103	56.767	36.728	28.055	0.000	0.000	0.000
1500	28.462	58.719	38.130	30.883	0.000	0.000	0.000
78. SILICON Si (g)							
298.15	22.251	167.980	167.980	0.000	450.000	405.525	-71.045
300	22.234	168.117	167.980	0.041	450.004	405.249	-70.559
400	21.613	174.416	168.843	2.229	450.070	390.312	-50.969
500	21.316	179.204	170.456	4.374	449.913	375.388	-39.216
600	21.153	183.074	172.246	6.497	449.630	360.508	-31.385
700	21.057	186.327	174.032	8.607	449.259	345.682	-25.795
800	21.000	189.135	175.748	10.709	448.821	330.915	-21.606
900	20.971	191.606	177.375	12.808	448.329	316.205	-18.352
1000	20.968	193.815	178.911	14.904	447.791	301.553	-15.751
1100	20.989	195.815	180.358	17.002	447.211	286.957	-13.626
1200	21.033	197.643	181.723	19.103	446.595	272.416	-11.858
1300	21.099	199.329	183.014	21.209	445.946	257.927	-10.364
1400	21.183	200.895	184.236	23.323	445.268	243.489	-9.085
1500	21.282	202.360	185.396	25.446	444.563	229.101	-7.978
79. SILICON DIOXIDE SiO₂ (cr)							
298.15	44.602	41.460	41.460	0.000	-910.700	-856.288	150.016
300	44.712	41.736	41.461	0.083	-910.708	-855.951	149.032
400	53.477	55.744	43.311	4.973	-910.912	-837.651	109.385
500	60.533	68.505	47.094	10.705	-910.540	-819.369	85.598
600	64.452	79.919	51.633	16.971	-909.841	-801.197	69.749
700	68.234	90.114	56.414	23.590	-908.958	-783.157	58.439
800	76.224	99.674	61.226	30.758	-907.668	-765.265	49.966
848	82.967	104.298	63.533	34.569	-906.310	-756.747	46.613
PHASE TRANSITION: $\Delta_{\text{trs}} H = 0.411$ kJ/mol, $\Delta_{\text{trs}} S = 0.484$ J/K·mol, crII-crII'							
848	67.446	104.782	63.532	34.980	-906.310	-756.747	46.613
900	67.953	108.811	66.033	38.500	-905.922	-747.587	43.388
1000	68.941	116.021	70.676	45.345	-905.176	-730.034	38.133
1100	69.940	122.639	75.104	52.289	-904.420	-712.557	33.836
1200	70.947	128.768	79.323	59.333	-903.382	-695.148	30.259
PHASE TRANSITION: $\Delta_{\text{trs}} H = 2.261$ kJ/mol, $\Delta_{\text{trs}} S = 1.883$ J/K·mol, crII'-crI							
1200	71.199	130.651	79.323	61.594	-901.382	-695.148	30.259
1300	71.743	136.372	83.494	68.742	-900.574	-677.994	27.242
1400	72.249	141.707	87.463	75.941	-899.782	-660.903	24.658
1500	72.739	146.709	91.248	83.191	-899.004	-643.867	22.421
80. SILICON TETRACHLORIDE SiCl₄ (g)							
298.15	90.404	331.446	331.446	0.000	-662.200	-622.390	109.039
300	90.562	332.006	331.448	0.167	-662.195	-622.143	108.323
400	96.893	359.019	335.088	9.572	-661.853	-608.841	79.505
500	100.449	381.058	342.147	19.456	-661.413	-595.637	62.225
600	102.587	399.576	350.216	29.616	-660.924	-582.527	50.713
700	103.954	415.500	358.432	39.948	-660.417	-569.501	42.496
800	104.875	429.445	366.455	50.392	-659.912	-556.548	36.338
900	105.523	441.837	374.155	60.914	-659.422	-543.657	31.553
1000	105.995	452.981	381.490	71.491	-658.954	-530.819	27.727
1100	106.349	463.101	388.456	82.109	-658.515	-518.027	24.599
1200	106.620	472.366	395.068	92.758	-658.107	-505.274	21.994
1300	106.834	480.909	401.347	103.431	-657.735	-492.553	19.791
1400	107.003	488.833	407.316	114.123	-657.400	-479.860	17.904
1500	107.141	496.220	413.000	124.830	-657.104	-467.189	16.269

THERMODYNAMIC PROPERTIES OF AQUEOUS SYSTEMS

This table contains standard state thermodynamic properties of ions and neutral species in aqueous solution. It includes enthalpy and Gibbs energy of formation, entropy, and heat capacity, and thus serves as a companion to the preceding table, "Standard Thermodynamic Properties of Chemical Substances". The standard state is the hypothetical ideal solution with molality $m = 1$ mol/kg (mean ionic molality m_{\pm} in the case of a species which is assumed to dissociate at infinite dilution). Further details on conventions may be found in Reference 1.

Cations are listed by formula in the first part of the table, followed by anions and finally neutral species. All values refer to standard conditions of 25°C and 100 kPa pressure.

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2. Zemaitis, J. F., Clark, D. M., Rafal, M., and Scrivner, N. C., *Handbook of Aqueous Electrolyte Thermodynamics*, American Institute of Chemical Engineers, New York, 1986.

Species	$\Delta_f H^\circ /$ kJ mol ⁻¹	$\Delta_f G^\circ /$ kJ mol ⁻¹	$S^\circ /$ J mol ⁻¹ K ⁻¹	$C_p /$ J mol ⁻¹ K ⁻¹	Species	$\Delta_f H^\circ /$ kJ mol ⁻¹	$\Delta_f G^\circ /$ kJ mol ⁻¹	$S^\circ /$ J mol ⁻¹ K ⁻¹	$C_p /$ J mol ⁻¹ K ⁻¹
Cations					InOH ⁺²	-370.3	-313.0	-88.0	
Ag ⁺	105.6	77.1	72.7	21.8	In(OH) ₂ ⁺	-619.0	-525.0	25.0	
Al ⁺³	-531.0	-485.0	-321.7		K ⁺	-252.4	-283.3	102.5	21.8
AlOH ⁺²		-694.1			La ⁺³	-707.1	-683.7	-217.6	-13.0
Ba ⁺²	-537.6	-560.8	9.6		Li ⁺	-278.5	-293.3	13.4	68.6
BaOH ⁺		-730.5			Lu ⁺³	-665.0	-628.0	-264.0	25.0
Be ⁺²	-382.8	-379.7	-129.7		LuF ⁺²		-931.4		
Bi ⁺³		82.8			Mg ⁺²	-466.9	-454.8	-138.1	
BiOH ⁺²		-146.4			MgOH ⁺		-626.7		
Ca ⁺²	-542.8	-553.6	-53.1		Mn ⁺²	-220.8	-228.1	-73.6	50.0
CaOH ⁺		-718.4			MnOH ⁺	-450.6	-405.0	-17.0	
Cd ⁺²	-75.9	-77.6	-73.2		NH ₄ ⁺	-132.5	-79.3	113.4	79.9
CdOH ⁺		-261.1			N ₂ H ₅ ⁺	-7.5	82.5	151.0	70.3
Ce ⁺³	-696.2	-672.0	-205.0		Na ⁺	-240.1	-261.9	59.0	46.4
Ce ⁺⁴	-537.2	-503.8	-301.0		Nd ⁺³	-696.2	-671.6	-206.7	-21.0
Co ⁺²	-58.2	-54.4	-113.0		Ni ⁺²	-54.0	-45.6	-128.9	
Co ⁺³	92.0	134.0	-305.0		NiOH ⁺	-287.9	-227.6	-71.0	
Cr ⁺²	-143.5				PH ₄ ⁺		92.1		
Cs ⁺	-258.3	-292.0	133.1	-10.5	Pa ⁺⁴	-619.0			
Cu ⁺	71.7	50.0	40.6		Pb ⁺²	-1.7	-24.4	10.5	
Cu ⁺²	64.8	65.5	-99.6		PbOH ⁺		-226.3		
Dy ⁺³	-699.0	-665.0	-231.0	21.0	Pd ⁺²	149.0	176.5	-184.0	
Er ⁺³	-705.4	-669.1	-244.3	21.0	Po ⁺²		71.0		
Eu ⁺²	-527.0	-540.2	-8.0		Po ⁺⁴		293.0		
Eu ⁺³	-605.0	-574.1	-222.0	8.0	Pr ⁺³	-704.6	-679.1	-209.0	-29.0
Fe ⁺²	-89.1	-78.9	-137.7		Pt ⁺²		254.8		
Fe ⁺³	-48.5	-4.7	-315.9		Ra ⁺²	-527.6	-561.5	54.0	
FeOH ⁺	-324.7	-277.4	-29.0		Rb ⁺	-251.2	-284.0	121.5	
FeOH ⁺²	-290.8	-229.4	-142.0		Re ⁺		-33.0		
Fe(OH) ₂ ⁺		-438.0			Sc ⁺³	-614.2	-586.6	-255.0	
Ga ⁺²		-88.0			ScOH ⁺²	-861.5	-801.2	-134.0	
Ga ⁺³	-211.7	-159.0	-331.0		Sm ⁺²		-497.5		
GaOH ⁺²		-380.3			Sm ⁺³	-691.6	-666.6	-211.7	-21.0
Ga(OH) ₂ ⁺		-597.4			Sn ⁺²	-8.8	-27.2	-17.0	
Gd ⁺³	-686.0	-661.0	-205.9		SnOH ⁺	-286.2	-254.8	50.0	
H ⁺	0	0	0	0	Sr ⁺²	-545.8	-559.5	-32.6	
Hg ⁺²	171.1	164.4	-32.2		SrOH ⁺		-721.3		
Hg ₂ ⁺²	172.4	153.5	84.5		Tb ⁺³	-682.8	-651.9	-226.0	17.0
HgOH ⁺	-84.5	-52.3	71.0		Te(OH) ₃ ⁺	-608.4	-496.1	111.7	
Ho ⁺³	-705.0	-673.7	-226.8	17.0	Th ⁺⁴	-769.0	-705.1	-422.6	
In ⁺		-12.1			Th(OH) ₃ ⁺	-1030.1	-920.5	-343.0	
In ⁺²		-50.7			Th(OH) ₂ ⁺²	-1282.4	-1140.9	-218.0	
In ⁺³	-105.0	-98.0	-151.0		Tl ⁺	5.4	-32.4	125.5	
					Tl ⁺³	196.6	214.6	-192.0	

THERMODYNAMIC PROPERTIES OF AQUEOUS SYSTEMS (continued)

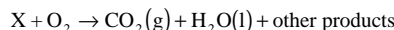
Species	$\Delta_f H^\circ$ kJ mol ⁻¹	$\Delta_f G^\circ$ kJ mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p J mol ⁻¹ K ⁻¹	Species	$\Delta_f H^\circ$ kJ mol ⁻¹	$\Delta_f G^\circ$ kJ mol ⁻¹	S° J mol ⁻¹ K ⁻¹	C_p J mol ⁻¹ K ⁻¹
CHOONH ₄	-558.1	-430.4	205.0	-7.9	GdCl ₃	-1188.0	-1059.0	-36.8	-410.0
CHOONa	-665.7	-612.9	151.0	-41.4	HBr	-121.6	-104.0	82.4	-141.8
CHOORb	-676.7	-635.1	213.0		HCN	150.6	172.4	94.1	
CH ₂ ClCOOH	-501.3				HCl	-167.2	-131.2	56.5	-136.4
CH ₃ COOCs	-744.3	-661.3	219.7		HF	-332.6	-278.8	-13.8	-106.7
CH ₃ COOH	-486.0	-369.3	86.6	-6.3	HI	-55.2	-51.6	111.3	-142.3
CH ₃ COOK	-738.4	-652.6	189.1	15.5	HNO ₃	-207.4	-111.3	146.4	-86.6
CH ₃ COONH ₄	-618.5	-448.6	200.0	73.6	HSCN	76.4	92.7	144.3	-40.2
CH ₃ COONa	-726.1	-631.2	145.6	40.2	H ₂ SO ₄	-909.3	-744.5	20.1	-293.0
CH ₃ COORb	-737.2	-653.3	207.9		HoCl ₃	-1206.7	-1067.3	-57.7	-393.0
(COOH) ₂	-825.1	-673.9	45.6		KBr	-373.9	-387.2	184.9	-120.1
(CH ₃) ₃ N	-76.0	93.1	133.5		KCl	-419.5	-414.5	159.0	-114.6
CaBr ₂	-785.9	-761.5	111.7		KF	-585.0	-562.1	88.7	-84.9
CaCO ₃	-1220.0	-1081.4	-110.0		KHCO ₃	-944.4	-870.0	193.7	
CaCl ₂	-877.1	-816.0	59.8		KHSO ₄	-1139.7	-1039.2	234.3	-63.0
CaF ₂	-1208.1	-1111.2	-80.8		KI	-307.6	-334.9	213.8	-120.5
CaI ₂	-653.2	-656.7	169.5		KNO ₃	-459.7	-394.5	248.9	-64.9
Ca(NO ₃) ₂	-957.6	-776.1	239.7		K ₂ CO ₃	-1181.9	-1094.4	148.1	
CaSO ₄	-1452.1	-1298.1	-33.1		K ₂ S	-471.5	-480.7	190.4	
CdBr ₂	-319.0	-285.5	91.6		K ₂ SO ₄	-1414.0	-1311.1	225.1	-251.0
CdCl ₂	-410.2	-340.1	39.7		K ₂ Se		-437.2		
CdF ₂	-741.2	-635.2	-100.8		LaCl ₃	-1208.8	-1077.3	-50.0	-423.0
CdI ₂	-186.3	-180.8	149.4		LiBr	-400.0	-397.3	95.8	-73.2
Cd(NO ₃) ₂	-490.6	-300.1	219.7		LiCl	-445.6	-424.6	69.9	-67.8
CdSO ₄	-985.2	-822.1	-53.1		LiF	-611.1	-571.9	-0.4	-38.1
CeCl ₃	-1197.5	-1065.6	-38.0		LiI	-333.7	-344.8	124.7	-73.6
CoBr ₂	-301.2	-262.3	50.0		LiNO ₃	-485.9	-404.5	160.2	-18.0
CoCl ₂	-392.5	-316.7			Li ₂ CO ₃	-1234.1	-1114.6	-29.7	
CoI ₂	-168.6	-157.7	109.0		Li ₂ SO ₄	-1466.2	-1331.2	47.3	-155.6
Co(NO ₃) ₂	-472.8	-276.9	180.0		LuCl ₃	-1167.0	-1021.0	-96.0	-385.0
CoSO ₄	-967.3	-799.1	-92.0		MgBr ₂	-709.9	-662.7	26.8	
CsBr	-379.8	-396.0	215.5		MgCl ₂	-801.2	-717.1	-25.1	
CsCl	-425.4	-423.2	189.5	-146.9	MgI ₂		-577.2	84.5	
CsF	-590.9	-570.8	119.2		Mg(NO ₃) ₂	-881.6	-677.3	154.8	
CsHCO ₃	-950.3	-878.8	224.3		MgSO ₄	-1376.1	-1199.5	-118.0	
CsHSO ₄	-1145.6	-1047.9	264.8		MnBr ₂	-464.0			
CsI	-313.5	-343.6	244.3	-152.7	MnCl ₂	-555.1	-490.8	38.9	-222.0
CsNO ₃	-465.6	-403.3	279.5	-99.0	MnI ₂	-331.0			
Cs ₂ CO ₃	-1193.7	-1111.9	209.2		Mn(NO ₃) ₂	-635.5	-450.9	218.0	-121.0
Cs ₂ S	-483.7	-498.3	251.0		MnSO ₄	-1130.1	-972.7	-53.6	-243.0
Cs ₂ SO ₄	-1425.8	-1328.6	286.2		NH ₄ Br	-254.1	-183.3	195.8	-61.9
Cs ₂ Se		-454.8			NH ₄ BrO ₃	-199.6	-60.7	275.1	
Cu(NO ₃) ₂	-350.0	-157.0	193.3		NH ₄ CN	18.0	93.0	207.5	
CuSO ₄	-844.5	-679.0	-79.5		NH ₄ Cl	-299.7	-210.5	169.9	-56.5
DyCl ₃	-1197.0	-1059.0	-61.9	-389.0	NH ₄ ClO ₃	-236.5	-87.3	275.7	
ErCl ₃	-1207.1	-1062.7	-75.3	-389.0	NH ₄ ClO ₄	-261.8	-87.8	295.4	
EuCl ₂	-862.0				NH ₄ F	-465.1	-358.1	99.6	-26.8
EuCl ₃	-1106.2	-967.7	-54.0	-402.0	NH ₄ HCO ₃	-824.5	-666.1	204.6	
FeBr ₂	-332.2	-286.8	27.2		NH ₄ HS	-150.2	-67.2	176.1	
FeBr ₃	-413.4	-316.7	-68.6		NH ₄ HSO ₃	-758.7	-607.0	253.1	
FeCl ₂	-423.4	-341.3	-24.7		NH ₄ HSO ₄	-1019.9	-835.2	245.2	-3.8
FeCl ₃	-550.2	-398.3	-146.4		NH ₄ HSeO ₄	-714.2	-531.6	262.8	
FeF ₂	-754.4	-636.5	-165.3		NH ₄ H ₂ AsO ₃	-847.3	-666.4	223.8	
FeF ₃	-1046.4	-840.9	-357.3		NH ₄ H ₂ AsO ₄	-1042.1	-832.5	230.5	
FeI ₂	-199.6	-182.1	84.9		NH ₄ H ₂ PO ₄	-1428.8	-1209.6	203.8	
FeI ₃	-214.2	-159.4	18.0		NH ₄ H ₃ P ₂ O ₇	-2409.1	-2102.6	326.0	
Fe(NO ₃) ₃	-670.7	-338.3	123.4		NH ₄ I	-187.7	-130.9	224.7	-62.3
FeSO ₄	-998.3	-823.4	-117.6		NH ₄ IO ₃	-354.0	-207.4	231.8	
Fe ₂ (SO ₄) ₃	-2825.0	-2242.8	-571.5		NH ₄ NO ₂	-237.2	-111.6	236.4	-17.6

THERMODYNAMIC PROPERTIES OF AQUEOUS SYSTEMS (continued)

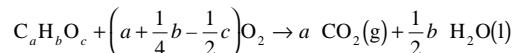
Species	$\Delta_f H^\circ /$ kJ mol ⁻¹	$\Delta_f G^\circ /$ kJ mol ⁻¹	$S^\circ /$ J mol ⁻¹ K ⁻¹	$C_p /$ J mol ⁻¹ K ⁻¹	Species	$\Delta_f H^\circ /$ kJ mol ⁻¹	$\Delta_f G^\circ /$ kJ mol ⁻¹	$S^\circ /$ J mol ⁻¹ K ⁻¹	$C_p /$ J mol ⁻¹ K ⁻¹
NH ₄ NO ₃	-339.9	-190.6	259.8	-6.7	RaSO ₄	-1436.8	-1306.2	75.0	
NH ₄ OH	-362.5	-236.5	102.5	-68.6	RbBr	-372.7	-387.9	203.9	
NH ₄ SCN	-56.1	13.4	257.7	39.7	RbCl	-418.3	-415.2	178.0	
(NH ₄) ₂ CO ₃	-942.2	-686.4	169.9		RbF	-583.8	-562.8	107.5	
(NH ₄) ₂ CrO ₄	-1146.2	-886.4	277.0		RbHCO ₃	-943.2	-870.8	212.7	
(NH ₄) ₂ Cr ₂ O ₇	-1755.2	-1459.5	488.7		RbHSO ₄	-1138.5	-1039.9	253.1	
(NH ₄) ₂ HAsO ₄	-1171.4	-873.2	225.1		RbI	-306.4	-335.6	232.6	
(NH ₄) ₂ HPO ₄	-1557.2	-1247.8	193.3		RbNO ₃	-458.5	-395.2	267.8	
(NH ₄) ₂ S	-231.8	-72.6	212.1		Rb ₂ CO ₃	-1179.5	-1095.8	186.2	
(NH ₄) ₂ SO ₃	-900.4	-645.0	197.5		Rb ₂ S	-469.4	-482.0	228.4	
(NH ₄) ₂ SO ₄	-1174.3	-903.1	246.9	-133.1	Rb ₂ SO ₄	-1411.6	-1312.5	263.2	
(NH ₄) ₂ SeO ₄	-864.0	-599.8	280.7		SmCl ₃	-1193.3	-1060.2	-42.7	-431.0
(NH ₄) ₃ PO ₄	-1674.9	-1256.6	117.0		SrBr ₂	-788.9	-767.4	132.2	
NaBr	-361.7	-365.8	141.4	-95.4	SrCO ₃	-1222.9	-1087.3	-89.5	
NaCl	-407.3	-393.1	115.5	-90.0	SrCl ₂	-880.1	-821.9	80.3	
NaF	-572.8	-540.7	45.2	-60.2	SrI ₂	-656.2	-662.6	190.0	
NaHCO ₃	-932.1	-848.7	150.2		Sr(NO ₃) ₂	-960.5	-782.0	260.2	
NaHSO ₄	-1127.5	-1017.8	190.8	-38.0	SrSO ₄	-1455.1	-1304.0	-12.6	
NaI	-295.3	-313.5	170.3	-95.8	TbCl ₃	-1184.1	-1045.5	-59.0	-393.0
NaNO ₃	-447.5	-373.2	205.4	-40.2	TbBr	-116.2	-136.4	207.9	
Na ₂ CO ₃	-1157.4	-1051.6	61.1		TbBr ₃	-168.2	-97.1	54.0	
Na ₂ S	-447.3	-438.1	103.3		TlCl	-161.8	-163.6	182.0	
Na ₂ SO ₄	-1389.5	-1268.4	138.1	-201.0	TlCl ₃	-305.0	-179.0	-23.0	
Na ₂ Se		-394.6			TlF	-327.3	-311.2	111.7	
NdCl ₃	-1197.9	-1065.6	-37.7	-431.0	TlI	-49.8	-84.0	236.8	
NiBr ₂	-297.1	-253.6	36.0		TlNO ₃	-202.0	-143.7	272.0	
NiCl ₂	-388.3	-307.9	-15.1		Tl ₂ SO ₄	-898.6	-809.3	271.1	
NiF ₂	-719.2	-603.3	-156.5		TmCl ₃	-1199.1	-1055.6	-75.0	-385.0
NiI ₂	-164.4	-149.0	93.7		UCl ₄	-1259.8	-1056.8	-184.0	
Ni(NO ₃) ₂	-468.6	-268.5	164.0		UO ₂ CO ₃	-1696.6	-1481.5	-154.4	
NiSO ₄	-963.2	-790.3	-108.8		UO ₂ (NO ₃) ₂	-1434.3	-1176.0	195.4	
PbBr ₂	-244.8	-232.3	175.3		UO ₂ SO ₄	-1928.8	-1698.2	-77.4	
PbCl ₂	-336.0	-286.9	123.4		YbCl ₃	-1176.1	-1037.6	-71.0	-385.0
PbF ₂	-666.9	-582.0	-17.2		ZnBr ₂	-397.0	-355.0	52.7	-238.0
PbI ₂	-112.1	-127.6	233.0		ZnCl ₂	-488.2	-409.5	0.8	-226.0
Pb(NO ₃) ₂	-416.3	-246.9	303.3		ZnF ₂	-819.1	-704.6	-139.7	-167.0
PrCl ₃	-1206.2	-1072.7	-42.0	-439.0	ZnI ₂	-264.3	-250.2	110.5	-238.0
RaCl ₂	-861.9	-823.8	167.0		Zn(NO ₃) ₂	-568.6	-369.6	180.7	-126.0
Ra(NO ₃) ₂	-942.2	-784.0	347.0		ZnSO ₄	-1063.2	-891.6	-92.0	-247.0

HEAT OF COMBUSTION

The heat of combustion of a substance at 25°C can be calculated from the enthalpy of formation ($\Delta_f H^\circ$) data in the table "Standard Thermodynamic Properties of Chemical Substances" in this Section. We can write the general combustion reaction as



For a compound containing only carbon, hydrogen, and oxygen, the reaction is simply



and the standard heat of combustion $\Delta_c H^\circ$, which is defined as the negative of the enthalpy change for the reaction (i.e., the heat released in the combustion process), is given by

$$\begin{aligned} \Delta_c H^\circ &= -a\Delta_f H^\circ(CO_2, g) - \frac{1}{2}b \Delta_f H^\circ(H_2O, l) + \Delta_f H^\circ(C_a H_b O_c) \\ &= 393.51 a + 142.915 b + \Delta_f H^\circ(C_a H_b O_c) \end{aligned}$$

This equation applies if the reactants start in their standard states (25°C and one atmosphere pressure) and the products return to the same conditions. The same equation applies to a compound containing another element if that element ends in its standard reference state (e.g., nitrogen, if the product is N_2); in general, however, the exact products containing the other elements must be known in order to calculate the heat of combustion.

The following table gives the standard heat of combustion calculated in this manner for a few representative substances.

Molecular formula	Name	$\Delta_c H^\circ / \text{kJ mol}^{-1}$	Molecular formula	Name	$\Delta_c H^\circ / \text{kJ mol}^{-1}$
Inorganic substances					
C	Carbon (graphite)	393.5	C_3H_8O	1-Propanol (l)	2021.3
CO	Carbon monoxide (g)	283.0	$C_3H_8O_3$	Glycerol (l)	1655.4
H_2	Hydrogen (g)	285.8	$C_4H_{10}O$	Diethyl ether (l)	2723.9
H_3N	Ammonia (g)	382.8	$C_5H_{12}O$	1-Pentanol (l)	3330.9
H_4N_2	Hydrazine (g)	667.1	C_6H_6O	Phenol (s)	3053.5
N_2O	Nitrous oxide (g)	82.1	Carbonyl compounds		
Hydrocarbons			CH_2O	Formaldehyde (g)	570.7
CH_4	Methane (g)	890.8	C_2H_2O	Ketene (g)	1025.4
C_2H_2	Acetylene (g)	1301.1	C_2H_4O	Acetaldehyde (l)	1166.9
C_2H_4	Ethylene (g)	1411.2	C_3H_6O	Acetone (l)	1789.9
C_2H_6	Ethane (g)	1560.7	C_3H_6O	Propanal (l)	1822.7
C_3H_6	Propylene (g)	2058.0	C_4H_8O	2-Butanone (l)	2444.1
C_3H_6	Cyclopropane (g)	2091.3	Acids and esters		
C_3H_8	Propane (g)	2219.2	CH_2O_2	Formic acid (l)	254.6
C_4H_6	1,3-Butadiene (g)	2541.5	$C_2H_4O_2$	Acetic acid (l)	874.2
C_4H_{10}	Butane (g)	2877.6	$C_2H_4O_2$	Methyl formate (l)	972.6
C_5H_{12}	Pentane (l)	3509.0	$C_3H_6O_2$	Methyl acetate (l)	1592.2
C_6H_6	Benzene (l)	3267.6	$C_4H_8O_2$	Ethyl acetate (l)	2238.1
C_6H_{12}	Cyclohexane (l)	3919.6	$C_7H_6O_2$	Benzoic acid (s)	3226.9
C_6H_{14}	Hexane (l)	4163.2	Nitrogen compounds		
C_7H_8	Toluene (l)	3910.3	CHN	Hydrogen cyanide (g)	671.5
C_7H_{16}	Heptane (l)	4817.0	CH_3NO_2	Nitromethane (l)	709.2
$C_{10}H_8$	Naphthalene (s)	5156.3	CH_5N	Methylamine (g)	1085.6
Alcohols and ethers			C_2H_3N	Acetonitrile (l)	1247.2
CH_4O	Methanol (l)	726.1	C_2H_5NO	Acetamide (s)	1184.6
C_2H_6O	Ethanol (l)	1366.8	C_3H_9N	Trimethylamine (g)	2443.1
C_2H_6O	Dimethyl ether (g)	1460.4	C_5H_5N	Pyridine (l)	2782.3
$C_2H_6O_2$	Ethylene glycol (l)	1189.2	C_6H_7N	Aniline (l)	3392.8

MOLAR CONDUCTIVITY OF AQUEOUS HF, HCl, HBr, AND HI

The molar conductivity Λ of an electrolyte solution is defined as the conductivity divided by amount-of-substance concentration. The customary unit is $\text{S cm}^2\text{mol}^{-1}$ (i.e., $\Omega^{-1} \text{cm}^2\text{mol}^{-1}$). The first part of this table gives the molar conductivity of the hydrohalogen acids at 25°C as a function of the concentration in mol/L. The second part gives the temperature dependence of Λ for HCl and HBr. More extensive tables and mathematical representations may be found in the reference.

REFERENCE

Hamer, W.J., and DeWane, H.J., *Electrolytic Conductance and the Conductances of the Hydrohalogen Acids in Water*, Natl. Stand. Ref. Data Sys.-Natl. Bur. Standards (U.S.), No. 33, 1970.

$c/\text{mol L}^{-1}$	HF	HCl	HBr	HI	$c/\text{mol L}^{-1}$	HF	HCl	HBr	HI
Inf. dil.	405.1	426.1	427.7	426.4	3.5		218.3	217.5	215.4
0.0001		424.5	425.9	424.6	4.0		200.0	199.4	195.1
0.0005		422.6	424.3	423.0	4.5		183.1	182.4	176.8
0.001		421.2	422.9	421.7	5.0		167.4	166.5	160.4
0.005	128.1	415.7	417.6	416.4	5.5		152.9	151.8	145.5
0.01	96.1	411.9	413.7	412.8	6.0		139.7	138.2	131.7
0.05	50.1	398.9	400.4	400.8	6.5		127.7	125.7	118.6
0.10	39.1	391.1	391.9	394.0	7.0		116.9	114.2	105.7
0.5	26.3	360.7	361.9	369.8	7.5		107.0	103.8	
1.0	24.3	332.2	334.5	343.9	8.0		98.2	94.4	
1.5		305.8	307.6	316.4	8.5		90.3	85.8	
2.0		281.4	281.7	288.9	9.0		83.1		
2.5		258.9	257.8	262.5	9.5		76.6		
3.0		237.6	236.8	237.9	10.0		70.7		

$c/\text{mol L}^{-1}$	-20°C	-10°C	0°C	10°C	20°C	30°C	40°C	50°C
HCl								
0.5			228.7	283.0	336.4	386.8	436.9	482.4
1.0			211.7	261.6	312.2	359.0	402.9	445.3
1.5			196.2	241.5	287.5	331.1	371.6	410.8
2.0			182.0	222.7	262.9	303.3	342.4	378.2
2.5		131.7	168.5	205.1	239.8	277.0	315.2	347.6
3.0		120.8	154.6	188.5	219.3	253.3	289.3	319.0
3.5	85.5	111.3	139.6	172.2	201.6	232.9	263.9	292.1
4.0	79.3	102.7	129.2	158.1	185.6	214.2	242.2	268.2
4.5	73.7	94.9	119.5	145.4	170.6	196.6	222.5	246.7
5.0	68.5	87.8	110.3	133.5	156.6	180.2	204.1	226.5
5.5	63.6	81.1	101.7	122.5	143.6	165.0	187.1	207.7
6.0	58.9	74.9	93.7	112.3	131.5	151.0	171.3	190.3
6.5	54.4	69.1	86.2	103.0	120.4	138.2	156.9	174.3
7.0	50.2	63.7	79.3	94.4	110.2	126.4	143.3	159.7
7.5	46.3	58.6	73.0	86.5	100.9	115.7	131.6	146.2
8.0	42.7	54.0	67.1	79.4	92.4	106.1	120.6	134.0
8.5	39.4	49.8	61.7	72.9	84.7	97.3	110.7	123.0
9.0	36.4	45.9	56.8	67.1	77.8	89.4	101.7	112.9
9.5	33.6	42.3	52.3	61.8	71.5	82.3	93.6	103.9
10.0	31.2	39.1	48.2	57.0	65.8	75.9	86.3	95.7
10.5	28.9	36.1	44.5	52.7	60.7	70.1	79.6	88.4
11.0	26.8	33.4	41.1	48.8	56.1	64.9	73.6	81.7
11.5	24.9	31.0	38.0	45.3	51.9	60.1	68.0	75.6
12.0	23.1	28.7	35.3	42.0	48.0	55.6	62.8	70.0
12.5	21.4	26.7	32.7	39.0	44.4	51.4	57.9	64.8

MOLAR CONDUCTIVITY OF AQUEOUS HF, HCl, HBr, AND HI (continued)

$c/\text{mol L}^{-1}$	-20°C	-10°C	0°C	10°C	20°C	30°C	40°C	50°C
				HBr				
0.5			240.9	295.9	347.0	398.9	453.6	496.8
1.0			229.6	276.0	329.0	380.4	418.6	465.2
1.5			209.5	254.9	298.9	340.6	381.8	421.4
2.0		150.8	188.6	231.3	271.8	314.1	350.5	387.4
2.5		136.8	171.7	208.3	244.8	281.7	316.0	349.1
3.0		125.7	157.2	189.5	222.2	255.0	287.8	318.6
3.5		116.1	144.1	174.6	203.2	234.4	263.7	291.9
4.0	84.0	107.5	132.3	160.2	186.8	214.2	239.7	266.9
4.5	78.0	99.0	123.0	146.4	171.2	195.1	218.8	242.6
5.0	72.3	91.4	112.6	134.0	155.7	178.2	199.6	221.3
5.5	67.0	84.2	103.1	122.7	142.1	162.8	181.4	201.8
6.0	61.8	77.2	94.3	112.0	129.6	148.0	165.4	183.4
6.5	56.8	70.7	86.0	102.0	118.0	134.1	150.5	166.3
7.0	51.9	64.6	78.4	92.6	107.1	121.4	136.3	150.8

STANDARD KCl SOLUTIONS FOR CALIBRATING CONDUCTIVITY CELLS

This table presents recommended electrolytic conductivity (κ) values for aqueous potassium chloride solutions with molalities of 0.01 mol/kg, 0.1 mol/kg and 1.0 mol/kg at temperatures from 0°C to 50°C. The values, which are based on measurements at the National Institute of Standards and Technology, provide primary standards for the calibration of conductivity cells. The measurements at 0.01 and 0.1 molal are described in Reference 1, while those at 1.0 molal are in Reference 2. Temperatures are given on the ITS-90 scale. The uncertainty in the conductivity is about 0.03% for the 0.01 molal values and about 0.04% for the 0.1 and 1.0 molal values. The conductivity of water saturated with atmospheric CO₂ is given in the last column. These values were subtracted from the original measurements to give the values in the second, third, and fourth columns. All κ values are given in units of 10⁻⁴ S/m (numerically equal to $\mu\text{S}/\text{cm}$).

The assistance of Kenneth W. Pratt is appreciated.

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<i>t</i> /°C	10 ⁴ $\kappa/\text{S m}^{-1}$			
	0.01 m KCl	0.1 m KCl	1.0 m KCl	H ₂ O (CO ₂ sat.)
0	772.92	7 116.85	63 488	0.58
5	890.96	8 183.70	72 030	0.68
10	1 013.95	9 291.72	80 844	0.79
15	1 141.45	10 437.1	89 900	0.89
18	1 219.93	11 140.6	—	0.95
20	1 273.03	11 615.9	99 170	0.99
25	1 408.23	12 824.6	108 620	1.10
30	1 546.63	14 059.2	118 240	1.20
35	1 687.79	15 316.0	127 970	1.30
40	1 831.27	16 591.0	137 810	1.40
45	1 976.62	17 880.6	147 720	1.51
50	2 123.43	19 180.9	157 670	1.61

EQUIVALENT CONDUCTIVITY OF ELECTROLYTES IN AQUEOUS SOLUTION

Petr Vanýsek

This table gives the equivalent (molar) conductivity Λ at 25°C for some common electrolytes in aqueous solution at concentrations up to 0.1 mol/L. The units of Λ are $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$.

For very dilute solutions, the equivalent conductivity for any electrolyte of concentration c can be approximately calculated using the Debye-Hückel-Onsager equation, which can be written for a symmetrical (equal charge on cation and anion) electrolyte as

$$\Lambda = \Lambda^\circ - (A + B\Lambda^\circ)c^{1/2}$$

For a solution at 25°C and both cation and anion with charge ± 1 , the constants are $A = 60.20$ and $B = 0.229$. Λ° can be found from the next table, "Ionic Conductivity and Diffusion at Infinite Dilution". The equation is reliable for $c < 0.001 \text{ mol/L}$; with higher concentration the error increases.

Compound	Infinite dilution Λ°	Concentration (mol/L)						
		0.0005	0.001	0.005	0.01	0.02	0.05	0.1
		Λ						
AgNO ₃	133.29	131.29	130.45	127.14	124.70	121.35	115.18	109.09
1/2BaCl ₂	139.91	135.89	134.27	127.96	123.88	119.03	111.42	105.14
1/2CaCl ₂	135.77	131.86	130.30	124.19	120.30	115.59	108.42	102.41
1/2Ca(OH) ₂	258	—	—	233	226	214	—	—
1/2CuSO ₄	133.6	121.6	115.20	94.02	83.08	72.16	59.02	50.55
HCl	425.95	422.53	421.15	415.59	411.80	407.04	398.89	391.13
KBr	151.9	149.8	148.9	146.02	143.36	140.41	135.61	131.32
KCl	149.79	147.74	146.88	143.48	141.20	138.27	133.30	128.90
KClO ₄	139.97	138.69	137.80	134.09	131.39	127.86	121.56	115.14
1/3K ₃ Fe(CN) ₆	174.5	166.4	163.1	150.7	—	—	—	—
1/4K ₄ Fe(CN) ₆	184	—	167.16	146.02	134.76	122.76	107.65	97.82
KHCO ₃	117.94	116.04	115.28	112.18	110.03	107.17	—	—
KI	150.31	148.2	143.32	144.30	142.11	139.38	134.90	131.05
KIO ₄	127.86	125.74	124.88	121.18	118.45	114.08	106.67	98.2
KNO ₃	144.89	142.70	141.77	138.41	132.75	132.34	126.25	120.34
KMnO ₄	134.8	132.7	131.9	—	126.5	—	—	113
KOH	271.5	—	234	230	228	—	219	213
KReO ₄	128.20	126.03	125.12	121.31	118.49	114.49	106.40	97.40
1/3LaCl ₃	145.9	139.6	137.0	127.5	121.8	115.3	106.2	99.1
LiCl	114.97	113.09	112.34	109.35	107.27	104.60	100.06	95.81
LiClO ₄	105.93	104.13	103.39	100.52	98.56	96.13	92.15	88.52
1/2MgCl ₂	129.34	125.55	124.15	118.25	114.49	109.99	103.03	97.05
NH ₄ Cl	149.6	147.5	146.7	134.4	141.21	138.25	133.22	128.69
NaCl	126.39	124.44	123.68	120.59	118.45	115.70	111.01	106.69
NaClO ₄	117.42	115.58	114.82	111.70	109.54	106.91	102.35	98.38
NaI	126.88	125.30	124.19	121.19	119.18	116.64	112.73	108.73
NaOOCCH ₃	91.0	89.2	88.5	85.68	83.72	81.20	76.88	72.76
NaOH	247.7	245.5	244.6	240.7	237.9	—	—	—
Na picrate	80.45	78.7	78.6	75.7	73.7	—	66.3	61.8
1/2Na ₂ SO ₄	129.8	125.68	124.09	117.09	112.38	106.73	97.70	89.94
1/2SrCl ₂	135.73	131.84	130.27	124.18	120.23	115.48	108.20	102.14
1/2ZnSO ₄	132.7	121.3	114.47	95.44	84.87	74.20	61.17	52.61

IONIC CONDUCTIVITY AND DIFFUSION AT INFINITE DILUTION

Petr Vanýsek

This table gives the molar (equivalent) conductivity λ for common ions at infinite dilution. All values refer to aqueous solutions at 25°C. It also lists the diffusion coefficient D of the ion in dilute aqueous solution, which is related to λ through the equation

$$D = \left(RT / F^2 \right) (\lambda / |z|)$$

where R is the molar gas constant, T the temperature, F the Faraday constant, and z the charge on the ion. The variation with temperature is fairly sharp; for typical ions, λ and D increase by 2 to 3% per degree as the temperature increases from 25°C.

The diffusion coefficient for a salt, D_{salt} , may be calculated from the D_+ and D_- values of the constituent ions by the relation

$$D_{\text{salt}} = \frac{(z_+ + |z_-|) D_+ D_-}{z_+ D_+ + |z_-| D_-}$$

For solutions of simple, pure electrolytes (one positive and one negative ionic species), such as NaCl, equivalent ionic conductivity Λ° , which is the conductivity per unit concentration of charge, is defined as

$$\Lambda^\circ = \lambda_+ + \lambda_-$$

where λ_+ and λ_- are equivalent ionic conductivities of the cation and anion. The more general formula is

$$\Lambda^\circ = \nu_+ \lambda_+ + \nu_- \lambda_-$$

where ν_+ and ν_- refer to the number of moles of cations and anions to which one mole of the electrolyte gives a rise in the solution.

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Ion	λ $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	D $10^{-5} \text{ cm}^2 \text{ s}^{-1}$	Ion	λ $10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	D $10^{-5} \text{ cm}^2 \text{ s}^{-1}$
Inorganic Cations					
Ag ⁺	61.9	1.648	1/3Ho ³⁺	66.3	0.589
1/3Al ³⁺	61	0.541	K ⁺	73.48	1.957
1/2Ba ²⁺	63.6	0.847	1/3La ³⁺	69.7	0.619
1/2Be ²⁺	45	0.599	Li ⁺	38.66	1.029
1/2Ca ²⁺	59.47	0.792	1/2Mg ²⁺	53.0	0.706
1/2Cd ²⁺	54	0.719	1/2Mn ²⁺	53.5	0.712
1/3Ce ³⁺	69.8	0.620	NH ₄ ⁺	73.5	1.957
1/2Co ²⁺	55	0.732	N ₂ H ₅ ⁺	59	1.571
1/3[Co(NH ₃) ₆] ³⁺	101.9	0.904	Na ⁺	50.08	1.334
1/3[Co(en) ₃] ³⁺	74.7	0.663	1/3Nd ³⁺	69.4	0.616
1/6[Co ₂ (trien) ₃] ⁶⁺	69	0.306	1/2Ni ²⁺	49.6	0.661
1/3Cr ³⁺	67	0.595	1/4[Ni ₂ (trien) ₃] ⁴⁺	52	0.346
Cs ⁺	77.2	2.056	1/2Pb ²⁺	71	0.945
1/2Cu ²⁺	53.6	0.714	1/3Pr ³⁺	69.5	0.617
D ⁺	249.9	6.655	1/2Ra ²⁺	66.8	0.889
1/3Dy ³⁺	65.6	0.582	Rb ⁺	77.8	2.072
1/3Er ³⁺	65.9	0.585	1/3Sc ³⁺	64.7	0.574
1/3Eu ³⁺	67.8	0.602	1/3Sm ³⁺	68.5	0.608
1/2Fe ²⁺	54	0.719	1/2Sr ²⁺	59.4	0.791
1/3Fe ³⁺	68	0.604	Tl ⁺	74.7	1.989
1/3Gd ³⁺	67.3	0.597	1/3Tm ³⁺	65.4	0.581
H ⁺	349.65	9.311	1/2UO ₂ ²⁺	32	0.426
1/2Hg ²⁺	68.6	0.913	1/3Y ³⁺	62	0.550
1/2Hg ²⁺	63.6	0.847	1/3Yb ³⁺	65.6	0.582
			1/2Zn ²⁺	52.8	0.703

IONIC CONDUCTIVITY AND DIFFUSION AT INFINITE DILUTION (continued)

Ion	λ 10 ⁻⁴ m ² S mol ⁻¹	D 10 ⁻⁵ cm ² s ⁻¹	Ion	λ 10 ⁻⁴ m ² S mol ⁻¹	D 10 ⁻⁵ cm ² s ⁻¹
Inorganic Anions			1/2SeO ₄ ²⁻	75.7	1.008
Au(CN) ₂ ⁻	50	1.331	1/2WO ₄ ²⁻	69	0.919
Au(CN) ₄ ⁻	36	0.959	Organic Cations		
B(C ₆ H ₅) ₄ ⁻	21	0.559	Benzyltrimethylammonium ⁺	34.6	0.921
Br ⁻	78.1	2.080	Isobutylammonium ⁺	38	1.012
Br ₃ ⁻	43	1.145	Butyltrimethylammonium ⁺	33.6	0.895
BrO ₃ ⁻	55.7	1.483	Decylpyridinium ⁺	29.5	0.786
CN ⁻	78	2.077	Decyltrimethylammonium ⁺	24.4	0.650
CNO ⁻	64.6	1.720	Diethylammonium ⁺	42.0	1.118
1/2CO ₃ ²⁻	69.3	0.923	Dimethylammonium ⁺	51.8	1.379
Cl ⁻	76.31	2.032	Dipropylammonium ⁺	30.1	0.802
ClO ₂ ⁻	52	1.385	Dodecylammonium ⁺	23.8	0.634
ClO ₃ ⁻	64.6	1.720	Dodecyltrimethylammonium ⁺	22.6	0.602
ClO ₄ ⁻	67.3	1.792	Ethanolammonium ⁺	42.2	1.124
1/3[Co(CN) ₆] ³⁻	98.9	0.878	Ethylammonium ⁺	47.2	1.257
1/2CrO ₄ ²⁻	85	1.132	Ethyltrimethylammonium ⁺	40.5	1.078
F ⁻	55.4	1.475	Hexadecyltrimethylammonium ⁺	20.9	0.557
1/4[Fe(CN) ₆] ⁴⁻	110.4	0.735	Hexyltrimethylammonium ⁺	29.6	0.788
1/3[Fe(CN) ₆] ³⁻	100.9	0.896	Histidyl ⁺	23.0	0.612
H ₂ AsO ₄ ⁻	34	0.905	Hydroxyethyltrimethylarsonium ⁺	39.4	1.049
HCO ₃ ⁻	44.5	1.185	Methylammonium ⁺	58.7	1.563
HF ₂ ⁻	75	1.997	Octadecylpyridinium ⁺	20	0.533
1/2HPO ₄ ²⁻	57	0.759	Octadecyltributylammonium ⁺	16.6	0.442
H ₂ PO ₄ ⁻	36	0.959	Octadecyltriethylammonium ⁺	17.9	0.477
H ₂ PO ₂ ⁻	46	1.225	Octadecyltrimethylammonium ⁺	19.9	0.530
HS ⁻	65	1.731	Octadecyltripropylammonium ⁺	17.2	0.458
HSO ₃ ⁻	58	1.545	Octyltrimethylammonium ⁺	26.5	0.706
HSO ₄ ⁻	52	1.385	Pentylammonium ⁺	37	0.985
H ₂ SbO ₄ ⁻	31	0.825	Piperidinium ⁺	37.2	0.991
I ⁻	76.8	2.045	Propylammonium ⁺	40.8	1.086
IO ₃ ⁻	40.5	1.078	Pyridinium ⁺	24.3	0.647
IO ₄ ⁻	54.5	1.451	Tetrabutylammonium ⁺	19.5	0.519
MnO ₄ ⁻	61.3	1.632	Tetradecyltrimethylammonium ⁺	21.5	0.573
1/2MoO ₄ ²⁻	74.5	1.984	Tetraethylammonium ⁺	32.6	0.868
N(CN) ₂ ⁻	54.5	1.451	Tetramethylammonium ⁺	44.9	1.196
NO ₂ ⁻	71.8	1.912	Tetraisopentylammonium ⁺	17.9	0.477
NO ₃ ⁻	71.42	1.902	Tetrapentylammonium ⁺	17.5	0.466
NH ₂ SO ₃ ⁻	48.3	1.286	Tetrapropylammonium ⁺	23.4	0.623
N ₃ ⁻	69	1.837	Triethylammonium ⁺	34.3	0.913
OCN ⁻	64.6	1.720	Triethylsulfonium ⁺	36.1	0.961
OD ⁻	119	3.169	Trimethylammonium ⁺	47.23	1.258
OH ⁻	198	5.273	Trimethylhexylammonium ⁺	34.6	0.921
PF ₆ ⁻	56.9	1.515	Trimethylsulfonium ⁺	51.4	1.369
1/2PO ₃ F ₂ ²⁻	63.3	0.843	Tripropylammonium ⁺	26.1	0.695
1/3PO ₄ ³⁻	92.8	0.824	Organic Anions		
1/4P ₂ O ₇ ⁴⁻	96	0.639	Acetate ⁻	40.9	1.089
1/3P ₃ O ₃ ³⁻	83.6	0.742	<i>p</i> -Anisate ⁻	29.0	0.772
1/5P ₃ O ₁₀ ⁵⁻	109	0.581	1/2Azelaate ²⁻	40.6	0.541
ReO ₄ ⁻	54.9	1.462	Benzoate ⁻	32.4	0.863
SCN ⁻	66	1.758	Bromoacetate ⁻	39.2	1.044
1/2SO ₃ ²⁻	72	0.959	Bromobenzoate ⁻	30	0.799
1/2SO ₄ ²⁻	80.0	1.065	Butyrate ⁻	32.6	0.868
1/2S ₂ O ₃ ²⁻	85.0	1.132	Chloroacetate ⁻	39.8	1.060
1/2S ₂ O ₄ ²⁻	66.5	0.885	<i>m</i> -Chlorobenzoate ⁻	31	0.825
1/2S ₂ O ₆ ²⁻	93	1.238	<i>o</i> -Chlorobenzoate ⁻	30.2	0.804
1/2S ₂ O ₈ ²⁻	86	1.145			
Sb(OH) ₆ ⁻	31.9	0.849			
SeCN ⁻	64.7	1.723			

IONIC CONDUCTIVITY AND DIFFUSION AT INFINITE DILUTION (continued)

Ion	λ	D	Ion	λ	D
	$10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	$10^{-5} \text{ cm}^2 \text{ s}^{-1}$		$10^{-4} \text{ m}^2 \text{ S mol}^{-1}$	$10^{-5} \text{ cm}^2 \text{ s}^{-1}$
1/3Citrate ³⁻	70.2	0.623	Iodoacetate ⁻	40.6	1.081
Crotonate ⁻	33.2	0.884	Lactate ⁻	38.8	1.033
Cyanoacetate ⁻	43.4	1.156	1/2Malate ²⁻	58.8	0.783
Cyclohexane carboxylate ⁻	28.7	0.764	1/2Maleate ²⁻	61.9	0.824
1/2 1,1-Cyclopropanedicarboxylate ²⁻	53.4	0.711	1/2Malonate ²⁻	63.5	0.845
Decylsulfate ⁻	26	0.692	Methylsulfate ⁻	48.8	1.299
Dichloroacetate ⁻	38.3	1.020	Naphthylacetate ⁻	28.4	0.756
1/2Diethylbarbiturate ²⁻	26.3	0.350	1/2Oxalate ²⁻	74.11	0.987
Dihydrogencitrate ⁻	30	0.799	Octylsulfate ⁻	29	0.772
1/2Dimethylmalonate ²⁻	49.4	0.658	Phenylacetate ⁻	30.6	0.815
3,5-Dinitrobenzoate ⁻	28.3	0.754	1/2o-Phthalate ²⁻	52.3	0.696
Dodecylsulfate ⁻	24	0.639	1/2m-Phthalate ²⁻	54.7	0.728
Ethylmalonate ⁻	49.3	1.313	Picrate ⁻	30.37	0.809
Ethylsulfate ⁻	39.6	1.055	Pivalate ⁻	31.9	0.849
Fluoroacetate ⁻	44.4	1.182	Propionate ⁻	35.8	0.953
Fluorobenzoate ⁻	33	0.879	Propylsulfate ⁻	37.1	0.988
Formate ⁻	54.6	1.454	Salicylate ⁻	36	0.959
1/2Fumarate ²⁻	61.8	0.823	1/2Suberate ²⁻	36	0.479
1/2Glutarate ²⁻	52.6	0.700	1/2Succinate ²⁻	58.8	0.783
Hydrogenoxalate ⁻	40.2	1.070	p-Sulfonate	29.3	0.780
Isovalerate ⁻	32.7	0.871	1/2Tartarate ²⁻	59.6	0.794
			Trichloroacetate ⁻	35	0.932

ACTIVITY COEFFICIENTS OF ACIDS, BASES, AND SALTS
Petr Vanýsek

This table gives mean activity coefficients at 25°C for molalities in the range 0.1 to 1.0. See the following table for definitions, references, and data over a wider concentration range.

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
AgNO ₃	0.734	0.657	0.606	0.567	0.536	0.509	0.485	0.464	0.446	0.429
AlCl ₃	0.337	0.305	0.302	0.313	0.331	0.356	0.388	0.429	0.479	0.539
Al ₂ (SO ₄) ₃	0.035	0.0225	0.0176	0.0153	0.0143	0.014	0.0142	0.0149	0.0159	0.0175
BaCl ₂	0.500	0.444	0.419	0.405	0.397	0.391	0.391	0.391	0.392	0.395
BeSO ₄	0.150	0.109	0.0885	0.0769	0.0692	0.0639	0.0600	0.0570	0.0546	0.0530
CaCl ₂	0.518	0.472	0.455	0.448	0.448	0.453	0.460	0.470	0.484	0.500
CdCl ₂	0.2280	0.1638	0.1329	0.1139	0.1006	0.0905	0.0827	0.0765	0.0713	0.0669
Cd(NO ₃) ₂	0.513	0.464	0.442	0.430	0.425	0.423	0.423	0.425	0.428	0.433
CdSO ₄	0.150	0.103	0.0822	0.0699	0.0615	0.0553	0.0505	0.0468	0.0438	0.0415
CoCl ₂	0.522	0.479	0.463	0.459	0.462	0.470	0.479	0.492	0.511	0.531
CrCl ₃	0.331	0.298	0.294	0.300	0.314	0.335	0.362	0.397	0.436	0.481
Cr(NO ₃) ₃	0.319	0.285	0.279	0.281	0.291	0.304	0.322	0.344	0.371	0.401
Cr ₂ (SO ₄) ₃	0.0458	0.0300	0.0238	0.0207	0.0190	0.0182	0.0181	0.0185	0.0194	0.0208
CsBr	0.754	0.694	0.654	0.626	0.603	0.586	0.571	0.558	0.547	0.538
CsCl	0.756	0.694	0.656	0.628	0.606	0.589	0.575	0.563	0.553	0.544
CsI	0.754	0.692	0.651	0.621	0.599	0.581	0.567	0.554	0.543	0.533
CsNO ₃	0.733	0.655	0.602	0.561	0.528	0.501	0.478	0.458	0.439	0.422
CsOH	0.795	0.761	0.744	0.739	0.739	0.742	0.748	0.754	0.762	0.771
CsOAc	0.799	0.771	0.761	0.759	0.762	0.768	0.776	0.783	0.792	0.802
Cs ₂ SO ₄	0.456	0.382	0.338	0.311	0.291	0.274	0.262	0.251	0.242	0.235
CuCl ₂	0.508	0.455	0.429	0.417	0.411	0.409	0.409	0.410	0.413	0.417
Cu(NO ₃) ₂	0.511	0.460	0.439	0.429	0.426	0.427	0.431	0.437	0.445	0.455
CuSO ₄	0.150	0.104	0.0829	0.0704	0.0620	0.0559	0.0512	0.0475	0.0446	0.0423
FeCl ₂	0.5185	0.473	0.454	0.448	0.450	0.454	0.463	0.473	0.488	0.506
HBr	0.805	0.782	0.777	0.781	0.789	0.801	0.815	0.832	0.850	0.871
HCl	0.796	0.767	0.756	0.755	0.757	0.763	0.772	0.783	0.795	0.809
HClO ₄	0.803	0.778	0.768	0.766	0.769	0.776	0.785	0.795	0.808	0.823
HI	0.818	0.807	0.811	0.823	0.839	0.860	0.883	0.908	0.935	0.963
HNO ₃	0.791	0.754	0.735	0.725	0.720	0.717	0.717	0.718	0.721	0.724
H ₂ SO ₄	0.2655	0.2090	0.1826	—	0.1557	—	0.1417	—	—	0.1316
KBr	0.772	0.722	0.693	0.673	0.657	0.646	0.636	0.629	0.622	0.617
KCl	0.770	0.718	0.688	0.666	0.649	0.637	0.626	0.618	0.610	0.604
KClO ₃	0.749	0.681	0.635	0.599	0.568	0.541	0.518	—	—	—
K ₂ CrO ₄	0.456	0.382	0.340	0.313	0.292	0.276	0.263	0.253	0.243	0.235
KF	0.775	0.727	0.700	0.682	0.670	0.661	0.654	0.650	0.646	0.645
K ₃ Fe(CN) ₆	0.268	0.212	0.184	0.167	0.155	0.146	0.140	0.135	0.131	0.128
K ₄ Fe(CN) ₆	0.139	0.0993	0.0808	0.0693	0.0614	0.0556	0.0512	0.0479	0.0454	—
KH ₂ PO ₄	0.731	0.653	0.602	0.561	0.529	0.501	0.477	0.456	0.438	0.421
KI	0.778	0.733	0.707	0.689	0.676	0.667	0.660	0.654	0.649	0.645
KNO ₃	0.739	0.663	0.614	0.576	0.545	0.519	0.496	0.476	0.459	0.443
KOAc	0.796	0.766	0.754	0.750	0.751	0.754	0.759	0.766	0.774	0.783
KOH	0.798	0.760	0.742	0.734	0.732	0.733	0.736	0.742	0.749	0.756
KSCN	0.769	0.716	0.685	0.663	0.646	0.633	0.623	0.614	0.606	0.599
K ₂ SO ₄	0.441	0.360	0.316	0.286	0.264	0.246	0.232	—	—	—
LiBr	0.796	0.766	0.756	0.752	0.753	0.758	0.767	0.777	0.789	0.803
LiCl	0.790	0.757	0.744	0.740	0.739	0.743	0.748	0.755	0.764	0.774
LiClO ₄	0.812	0.794	0.792	0.798	0.808	0.820	0.834	0.852	0.869	0.887
LiI	0.815	0.802	0.804	0.813	0.824	0.838	0.852	0.870	0.888	0.910
LiNO ₃	0.788	0.752	0.736	0.728	0.726	0.727	0.729	0.733	0.737	0.743
LiOH	0.760	0.702	0.665	0.638	0.617	0.599	0.585	0.573	0.563	0.554
LiOAc	0.784	0.742	0.721	0.709	0.700	0.691	0.689	0.688	0.688	0.689
Li ₂ SO ₄	0.468	0.398	0.361	0.337	0.319	0.307	0.297	0.289	0.282	0.277
MgCl ₂	0.529	0.489	0.477	0.475	0.481	0.491	0.506	0.522	0.544	0.570
MgSO ₄	0.150	0.107	0.0874	0.0756	0.0675	0.0616	0.0571	0.0536	0.0508	0.0485
MnCl ₂	0.516	0.469	0.450	0.442	0.440	0.443	0.448	0.455	0.466	0.479
MnSO ₄	0.150	0.105	0.0848	0.0725	0.0640	0.0578	0.0530	0.0493	0.0463	0.0439

ACTIVITY COEFFICIENTS OF ACIDS, BASES, AND SALTS (continued)

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
NH ₄ Cl	0.770	0.718	0.687	0.665	0.649	0.636	0.625	0.617	0.609	0.603
NH ₄ NO ₃	0.740	0.677	0.636	0.606	0.582	0.562	0.545	0.530	0.516	0.504
(NH ₄) ₂ SO ₄	0.439	0.356	0.311	0.280	0.257	0.240	0.226	0.214	0.205	0.196
NaBr	0.782	0.741	0.719	0.704	0.697	0.692	0.689	0.687	0.687	0.687
NaCl	0.778	0.735	0.710	0.693	0.681	0.673	0.667	0.662	0.659	0.657
NaClO ₃	0.772	0.720	0.688	0.664	0.645	0.630	0.617	0.606	0.597	0.589
NaClO ₄	0.775	0.729	0.701	0.683	0.668	0.656	0.648	0.641	0.635	0.629
Na ₂ CrO ₄	0.464	0.394	0.353	0.327	0.307	0.292	0.280	0.269	0.261	0.253
NaF	0.765	0.710	0.676	0.651	0.632	0.616	0.603	0.592	0.582	0.573
NaH ₂ PO ₄	0.744	0.675	0.629	0.593	0.563	0.539	0.517	0.499	0.483	0.468
NaI	0.787	0.751	0.735	0.727	0.723	0.723	0.724	0.727	0.731	0.736
NaNO ₃	0.762	0.703	0.666	0.638	0.617	0.599	0.583	0.570	0.558	0.548
NaOAc	0.791	0.757	0.744	0.737	0.735	0.736	0.740	0.745	0.752	0.757
NaOH	0.766	0.727	0.708	0.697	0.690	0.685	0.681	0.679	0.678	0.678
NaSCN	0.787	0.750	—	0.720	0.715	0.712	0.710	0.710	0.711	0.712
Na ₂ SO ₄	0.445	0.365	0.320	0.289	0.266	0.248	0.233	0.221	0.210	0.201
NiCl ₂	0.522	0.479	0.463	0.460	0.464	0.471	0.482	0.496	0.515	0.563
NiSO ₄	0.150	0.105	0.0841	0.0713	0.0627	0.0562	0.0515	0.0478	0.0448	0.0425
Pb(NO ₃) ₂	0.395	0.308	0.260	0.228	0.205	0.187	0.172	0.160	0.150	0.141
RbBr	0.763	0.706	0.673	0.650	0.632	0.617	0.605	0.595	0.586	0.578
RbCl	0.764	0.709	0.675	0.652	0.634	0.620	0.608	0.599	0.590	0.583
RbI	0.762	0.705	0.671	0.647	0.629	0.614	0.602	0.591	0.583	0.575
RbNO ₃	0.734	0.658	0.606	0.565	0.534	0.508	0.485	0.465	0.446	0.430
RbOAc	0.796	0.767	0.756	0.753	0.755	0.759	0.766	0.773	0.782	0.792
Rb ₂ SO ₄	0.451	0.374	0.331	0.301	0.279	0.263	0.249	0.238	0.228	0.219
SrCl ₂	0.511	0.462	0.442	0.433	0.430	0.431	0.434	0.441	0.449	0.461
TlClO ₄	0.730	0.652	0.599	0.559	0.527	—	—	—	—	—
TlNO ₃	0.702	0.606	0.545	0.500	—	—	—	—	—	—
UO ₂ Cl ₂	0.544	0.510	0.520	0.505	0.517	0.532	0.549	0.571	0.595	0.620
UO ₂ SO ₄	0.150	0.102	0.0807	0.0689	0.0611	0.0566	0.0515	0.0483	0.0458	0.0439
ZnCl ₂	0.515	0.462	0.432	0.411	0.394	0.380	0.369	0.357	0.348	0.339
Zn(NO ₃) ₂	0.531	0.489	0.474	0.469	0.473	0.480	0.489	0.501	0.518	0.535
ZnSO ₄	0.150	0.140	0.0835	0.0714	0.0630	0.0569	0.0523	0.0487	0.0458	0.0435

MEAN ACTIVITY COEFFICIENTS OF ELECTROLYTES AS A FUNCTION OF CONCENTRATION

The mean activity coefficient γ of an electrolyte $X_a Y_b$ is defined as

$$\gamma = (\gamma_+^a \gamma_-^b)^{1/(a+b)}$$

where γ_+ and γ_- are activity coefficients of the individual ions (which cannot be directly measured). This table gives the mean activity coefficients of about 100 electrolytes in aqueous solution as a function of concentration, expressed in molality terms. All values refer to a temperature of 25°C. Substances are arranged in alphabetical order by formula.

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Mean Activity Coefficient at 25°C

<i>m</i> /mol kg ⁻¹	AgNO ₃	BaBr ₂	BaCl ₂	BaI ₂	CaBr ₂	CaCl ₂	CaI ₂
0.001	0.964	0.881	0.887	0.890	0.890	0.888	0.890
0.002	0.950	0.850	0.849	0.853	0.853	0.851	0.853
0.005	0.924	0.785	0.782	0.792	0.791	0.787	0.791
0.010	0.896	0.727	0.721	0.737	0.735	0.727	0.736
0.020	0.859	0.661	0.653	0.678	0.674	0.664	0.677
0.050	0.794	0.573	0.559	0.600	0.594	0.577	0.600
0.100	0.732	0.517	0.492	0.551	0.540	0.517	0.552
0.200	0.656	0.463	0.436	0.520	0.502	0.469	0.524
0.500	0.536	0.435	0.391	0.536	0.500	0.444	0.554
1.000	0.430	0.470	0.393	0.664	0.604	0.495	0.729
2.000	0.316	0.654		1.242	1.125	0.784	
5.000	0.181				18.7	5.907	
10.000	0.108					43.1	
15.000	0.085						

<i>m</i> /mol kg ⁻¹	Cd(NO ₂) ₂	Cd(NO ₃) ₂	CoBr ₂	CoCl ₂	CoI ₂	Co(NO ₃) ₂	CsBr
0.001	0.881	0.888	0.890	0.889	0.887	0.888	0.965
0.002	0.837	0.851	0.854	0.852	0.849	0.850	0.951
0.005	0.759	0.787	0.794	0.789	0.783	0.786	0.925
0.010	0.681	0.728	0.740	0.732	0.724	0.728	0.898
0.020	0.589	0.664	0.681	0.670	0.661	0.663	0.864
0.050	0.451	0.576	0.605	0.586	0.582	0.576	0.806
0.100	0.344	0.515	0.556	0.528	0.540	0.516	0.752
0.200	0.247	0.465	0.523	0.483	0.527	0.469	0.691
0.500	0.148	0.428	0.538	0.465	0.596	0.446	0.605
1.000	0.098	0.437	0.685	0.532	0.845	0.492	0.540
2.000	0.069	0.517	1.421	0.864	2.287	0.722	0.485
5.000	0.054		13.9		55.3	3.338	0.454
10.000					196		

<i>m</i> /mol kg ⁻¹	CsCl	CsF	CsI	CsNO ₃	CsOH	Cs ₂ SO ₄	CuBr ₂
0.001	0.965	0.965	0.965	0.964	0.966	0.885	0.889
0.002	0.951	0.952	0.951	0.951	0.953	0.845	0.853
0.005	0.925	0.929	0.925	0.924	0.930	0.775	0.791
0.010	0.898	0.905	0.898	0.897	0.906	0.709	0.735
0.020	0.864	0.876	0.863	0.860	0.878	0.634	0.674
0.050	0.805	0.830	0.804	0.796	0.836	0.526	0.594
0.100	0.751	0.792	0.749	0.733	0.802	0.444	0.541

**MEAN ACTIVITY COEFFICIENTS OF ELECTROLYTES AS A FUNCTION
OF CONCENTRATION (continued)**

<i>m/mol kg⁻¹</i>	CsCl	CsF	CsI	CsNO₃	CsOH	Cs₂SO₄	CuBr₂
0.200	0.691	0.755	0.688	0.655	0.772	0.369	0.504
0.500	0.607	0.721	0.601	0.529	0.755	0.285	0.503
1.000	0.546	0.726	0.534	0.421	0.782	0.233	0.591
2.000	0.496	0.803	0.470				0.859
5.000	0.474						
10.000	0.508						

<i>m/mol kg⁻¹</i>	CuCl₂	Cu(ClO₄)₂	Cu(NO₃)₂	FeCl₂	HBr	HCl	HClO₄
0.001	0.887	0.890	0.888	0.888	0.966	0.965	0.966
0.002	0.849	0.854	0.851	0.850	0.953	0.952	0.953
0.005	0.783	0.795	0.787	0.785	0.930	0.929	0.929
0.010	0.722	0.741	0.729	0.725	0.907	0.905	0.906
0.020	0.654	0.685	0.664	0.659	0.879	0.876	0.878
0.050	0.561	0.613	0.577	0.570	0.837	0.832	0.836
0.100	0.495	0.572	0.516	0.509	0.806	0.797	0.803
0.200	0.441	0.553	0.466	0.462	0.783	0.768	0.776
0.500	0.401	0.617	0.431	0.443	0.790	0.759	0.769
1.000	0.405	0.892	0.456	0.500	0.872	0.811	0.826
2.000	0.453	2.445	0.615	0.782	1.167	1.009	1.055
5.000	0.601		2.083		3.800	2.380	3.100
10.000					33.4	10.4	30.8
15.000							323

<i>m/mol kg⁻¹</i>	HF	HI	HNO₃	H₂SO₄	KBr	KCNS	KCl
0.001	0.551	0.966	0.965	0.804	0.965	0.965	0.965
0.002	0.429	0.953	0.952	0.740	0.952	0.951	0.951
0.005	0.302	0.931	0.929	0.634	0.927	0.927	0.927
0.010	0.225	0.909	0.905	0.542	0.902	0.901	0.901
0.020	0.163	0.884	0.875	0.445	0.870	0.869	0.869
0.050	0.106	0.847	0.829	0.325	0.817	0.815	0.816
0.100	0.0766	0.823	0.792	0.251	0.771	0.768	0.768
0.200	0.0550	0.811	0.756	0.195	0.772	0.716	0.717
0.500	0.0352	0.845	0.725	0.146	0.658	0.647	0.649
1.000	0.0249	0.969	0.730	0.125	0.617	0.598	0.604
2.000	0.0175	1.363	0.788	0.119	0.593	0.556	0.573
5.000	0.0110	4.760	1.063	0.197	0.626	0.525	0.593
10.000	0.0085	49.100	1.644	0.527			
15.000	0.0077		2.212	1.077			
20.000	0.0075		2.607	1.701			

<i>m/mol kg⁻¹</i>	KClO₃	K₂CrO₄	KF	KH₂PO₄[*]	K₂HPO₄^{**}	KI	KNO₃
0.001	0.965	0.886	0.965	0.964	0.886	0.965	0.964
0.002	0.951	0.847	0.952	0.950	0.847	0.952	0.950
0.005	0.926	0.779	0.927	0.924	0.779	0.927	0.924
0.010	0.899	0.715	0.902	0.896	0.715	0.902	0.896
0.020	0.865	0.643	0.870	0.859	0.643	0.871	0.860
0.050	0.805	0.539	0.818	0.793	0.538	0.820	0.797
0.100	0.749	0.460	0.773	0.730	0.457	0.776	0.735
0.200	0.681	0.385	0.726	0.652	0.379	0.731	0.662
0.500	0.569	0.296	0.670	0.529	0.283	0.676	0.546
1.000		0.239	0.645	0.422		0.646	0.444

**MEAN ACTIVITY COEFFICIENTS OF ELECTROLYTES AS A FUNCTION
OF CONCENTRATION (continued)**

<i>m</i> /mol kg ⁻¹	KClO ₃	K ₂ CrO ₄	KF	KH ₂ PO ₄ *	K ₂ HPO ₄ **	KI	KNO ₃
2.000		0.199	0.658			0.638	0.332
5.000			0.871				
10.000			1.715				
15.000			3.120				

<i>m</i> /mol kg ⁻¹	KOH	K ₂ SO ₄	LiBr	LiCl	LiClO ₄	LiI	LiNO ₃
0.001	0.965	0.885	0.965	0.965	0.966	0.966	0.965
0.002	0.952	0.844	0.952	0.952	0.953	0.953	0.952
0.005	0.927	0.772	0.929	0.928	0.931	0.930	0.928
0.010	0.902	0.704	0.905	0.904	0.908	0.908	0.904
0.020	0.871	0.625	0.877	0.874	0.882	0.882	0.874
0.050	0.821	0.511	0.832	0.827	0.843	0.843	0.827
0.100	0.779	0.424	0.797	0.789	0.815	0.817	0.788
0.200	0.740	0.343	0.767	0.756	0.795	0.802	0.753
0.500	0.710	0.251	0.754	0.739	0.806	0.824	0.726
1.000	0.733		0.803	0.775	0.887	0.912	0.743
2.000	0.860		1.012	0.924	1.161	1.197	0.837
5.000	1.697		2.696	2.000			1.298
10.000	6.110		20.0	9.600			2.500
15.000	19.9		147	30.9			3.960
20.000	46.4		486				4.970

<i>m</i> /mol kg ⁻¹	LiOH	Li ₂ SO ₄	MgBr ₂	MgCl ₂	MgI ₂	MnBr ₂	MnCl ₂
0.001	0.964	0.887	0.889	0.889	0.889	0.889	0.888
0.002	0.950	0.847	0.852	0.852	0.853	0.853	0.850
0.005	0.923	0.780	0.790	0.790	0.791	0.791	0.786
0.010	0.895	0.716	0.733	0.734	0.736	0.735	0.727
0.020	0.858	0.645	0.672	0.672	0.677	0.674	0.662
0.050	0.794	0.544	0.593	0.590	0.602	0.595	0.574
0.100	0.735	0.469	0.543	0.535	0.556	0.543	0.513
0.200	0.668	0.400	0.512	0.493	0.535	0.508	0.464
0.500	0.579	0.325	0.540	0.485	0.594	0.519	0.437
1.000	0.522	0.284	0.715	0.577	0.858	0.650	0.477
2.000	0.484	0.270	1.590	1.065	2.326	1.224	0.661
5.000	0.493		36.1	14.40	109.8	6.697	1.539

<i>m</i> /mol kg ⁻¹	Mn(ClO ₄) ₂	NH ₄ Cl	NH ₄ ClO ₄	(NH ₄) ₂ HPO ₄ **	NH ₄ NO ₃	NaBr	NaBrO ₃
0.001	0.892	0.965	0.964	0.882	0.964	0.965	0.965
0.002	0.858	0.952	0.950	0.839	0.951	0.952	0.951
0.005	0.801	0.927	0.924	0.763	0.925	0.928	0.926
0.010	0.752	0.901	0.895	0.688	0.897	0.903	0.900
0.020	0.700	0.869	0.859	0.600	0.862	0.873	0.867
0.050	0.637	0.816	0.794	0.469	0.801	0.824	0.811
0.100	0.604	0.769	0.734	0.367	0.744	0.783	0.759
0.200	0.596	0.718	0.663	0.273	0.678	0.742	0.698
0.500	0.686	0.649	0.560	0.171	0.582	0.697	0.605
1.000	1.030	0.603	0.479	0.114	0.502	0.687	0.528
2.000	3.072	0.569	0.399	0.074	0.419	0.730	0.449
5.000		0.563			0.303	1.083	
10.000					0.220		
15.000					0.179		
20.000					0.154		

**MEAN ACTIVITY COEFFICIENTS OF ELECTROLYTES AS A FUNCTION
OF CONCENTRATION (continued)**

<i>m</i> /mol kg ⁻¹	Na ₂ CO ₃	NaCl	NaClO ₃	NaClO ₄	Na ₂ CrO ₄	NaF	Na ₂ HPO ₄ *
0.001	0.887	0.965	0.965	0.965	0.887	0.965	0.887
0.002	0.847	0.952	0.952	0.952	0.849	0.951	0.848
0.005	0.780	0.928	0.927	0.928	0.783	0.926	0.780
0.010	0.716	0.903	0.902	0.903	0.722	0.901	0.717
0.020	0.644	0.872	0.870	0.872	0.653	0.868	0.644
0.050	0.541	0.822	0.818	0.821	0.554	0.813	0.539
0.100	0.462	0.779	0.771	0.777	0.479	0.764	0.456
0.200	0.385	0.734	0.719	0.729	0.406	0.710	0.373
0.500	0.292	0.681	0.646	0.668	0.318	0.633	0.266
1.000	0.229	0.657	0.590	0.630	0.261	0.573	0.191
2.000	0.182	0.668	0.537	0.608	0.231		0.133
5.000		0.874		0.648			

<i>m</i> /mol kg ⁻¹	NaI	NaNO ₃	NaOH	Na ₂ SO ₃	Na ₂ SO ₄	Na ₂ WO ₄	NiBr ₂
0.001	0.965	0.965	0.965	0.887	0.886	0.886	0.889
0.002	0.952	0.951	0.952	0.847	0.846	0.846	0.853
0.005	0.928	0.926	0.927	0.779	0.777	0.777	0.791
0.010	0.904	0.900	0.902	0.716	0.712	0.712	0.735
0.020	0.874	0.866	0.870	0.644	0.637	0.638	0.675
0.050	0.827	0.810	0.819	0.540	0.529	0.534	0.596
0.100	0.789	0.759	0.775	0.462	0.446	0.457	0.546
0.200	0.753	0.701	0.731	0.386	0.366	0.388	0.514
0.500	0.722	0.617	0.685	0.296	0.268	0.320	0.535
1.000	0.734	0.550	0.674	0.237	0.204	0.291	0.692
2.000	0.823	0.480	0.714	0.196	0.155	0.291	1.476
5.000	1.402	0.388	1.076				
10.000	4.011	0.329	3.258				
15.000			9.796				
20.000			19.410				

<i>m</i> /mol kg ⁻¹	NiCl ₂	Ni(ClO ₄) ₂	Ni(NO ₃) ₂	Pb(ClO ₄) ₂	Pb(NO ₃) ₂	RbBr	RbCl
0.001	0.889	0.891	0.889	0.889	0.882	0.965	0.965
0.002	0.852	0.855	0.851	0.851	0.840	0.951	0.951
0.005	0.789	0.797	0.787	0.787	0.764	0.926	0.926
0.010	0.732	0.745	0.730	0.729	0.690	0.900	0.900
0.020	0.669	0.690	0.666	0.666	0.604	0.866	0.867
0.050	0.584	0.621	0.581	0.580	0.476	0.811	0.811
0.100	0.527	0.582	0.524	0.522	0.379	0.760	0.761
0.200	0.482	0.567	0.481	0.476	0.291	0.705	0.707
0.500	0.465	0.639	0.467	0.458	0.195	0.630	0.633
1.000	0.538	0.946	0.528	0.516	0.136	0.578	0.583
2.000	0.915	2.812	0.797	0.799		0.535	0.546
5.000	4.785			4.043		0.514	0.544
10.000				33.8			

<i>m</i> /mol kg ⁻¹	RbF	RbI	RbNO ₃	Rb ₂ SO ₄	SrBr ₂	SrCl ₂	SrI ₂
0.001	0.965	0.965	0.964	0.886	0.889	0.888	0.890
0.002	0.952	0.951	0.950	0.845	0.852	0.850	0.854
0.005	0.927	0.926	0.924	0.776	0.790	0.785	0.793
0.010	0.902	0.900	0.896	0.710	0.734	0.725	0.740
0.020	0.871	0.866	0.859	0.635	0.673	0.659	0.681

**MEAN ACTIVITY COEFFICIENTS OF ELECTROLYTES AS A FUNCTION
OF CONCENTRATION (continued)**

<i>m/mol kg⁻¹</i>	RbF	RbI	RbNO₃	Rb₂SO₄	SrBr₂	SrCl₂	SrI₂
0.050	0.821	0.810	0.795	0.526	0.591	0.569	0.606
0.100	0.780	0.759	0.733	0.443	0.535	0.506	0.557
0.200	0.739	0.703	0.657	0.365	0.492	0.455	0.526
0.500	0.701	0.627	0.536	0.274	0.476	0.421	0.542
1.000	0.697	0.574	0.430	0.217	0.545	0.451	0.686
2.000	0.724	0.532	0.320		0.921	0.650	
5.000		0.517					

<i>m/mol kg⁻¹</i>	UO₂Cl₂	UO₂(NO₃)₂	ZnBr₂	ZnCl₂	ZnI₂
0.001	0.888	0.888	0.890	0.887	0.893
0.002	0.851	0.849	0.854	0.847	0.859
0.005	0.787	0.784	0.794	0.781	0.804
0.010	0.729	0.726	0.741	0.719	0.757
0.020	0.666	0.663	0.683	0.652	0.708
0.050	0.583	0.583	0.606	0.561	0.644
0.100	0.529	0.535	0.553	0.499	0.601
0.200	0.493	0.509	0.515	0.447	0.574
0.500	0.501	0.532	0.516	0.384	0.635
1.000	0.601	0.673	0.558	0.330	0.836
2.000	0.948	1.223	0.578	0.283	1.062
5.000		3.020	0.788	0.342	1.546
10.000			2.317	0.876	4.698
15.000			5.381	1.914	
20.000			7.965	2.968	

* The anion is H₂PO₄⁻.

** The anion is HPO₄⁻².

ENTHALPY OF DILUTION OF ACIDS

The quantity given in this table is $-\Delta_{\text{dil}}H$, the negative of the enthalpy (heat) of dilution to infinite dilution for aqueous solutions of several common acids; i.e., the negative of the enthalpy change when a solution of molality m at a temperature of 25°C is diluted with an infinite amount of water. The tabulated numbers thus represent the heat produced (or, if the value is negative, the heat absorbed) when the acid is diluted. The initial molality m is given in the first column. The second column gives the dilution ratio, which is the number of moles of water that must be added to one mole of the acid to produce a solution of the molality in the first column.

REFERENCE

Parker, V. B., *Thermal Properties of Aqueous Uni-Univalent Electrolytes*, Natl. Stand. Ref. Data Ser. - Natl. Bur. Stand. (U.S.) 2, U.S. Government Printing Office, 1965.

$-\Delta_{\text{dil}}H$ in kJ/mol at 25°C

m	Dil. ratio	HF	HCl	HClO ₄	HBr	HI	HNO ₃	CH ₂ O ₂	C ₂ H ₄ O ₂
55.506	1.0		45.61		48.83		19.73	0.046	2.167
20	2.775	14.88	19.87	13.81	19.92	21.71	9.498	0.038	2.075
15	3.700	14.34	15.40	7.920	14.29	14.02	6.883	0.109	1.962
10	5.551	13.87	10.24	2.013	8.694	7.615	3.933	0.205	1.824
9	6.167	13.81	9.213	1.280	7.719	6.569	3.368	0.230	1.782
8	6.938	13.77	8.201	0.611	6.786	5.607	2.791	0.255	1.724
7	7.929	13.73	7.217	0.046	5.925	4.728	2.251	0.272	1.648
6	9.251	13.69	6.268	-0.351	5.004	3.975	1.749	0.280	1.540
5.5506	10	13.66	5.841	-0.490	4.590	3.577	1.540	0.285	1.477
5	11.10	13.62	5.318	-0.628	4.113	3.197	1.310	0.289	1.393
4.5	12.33	13.58	4.899	-0.732	3.711	2.828	1.109	0.289	1.310
4	13.88	13.53	4.402	-0.787	3.330	2.460	0.958	0.289	1.218
3.5	15.86	13.47	3.958	-0.820	2.966	2.105	0.791	0.289	1.121
3	18.50	13.45	3.506	-0.782	2.611	1.787	0.665	0.289	1.025
2.5	22.20	13.43	3.063	-0.724	2.301	1.527	0.582	0.285	0.912
2	27.75	13.40	2.623	-0.623	1.996	1.318	0.527	0.276	0.803
1.5	37.00	13.36	2.167	-0.431	1.665	1.125	0.506	0.259	0.678
1	55.51	13.30	1.695	-0.201	1.314	0.933	0.506	0.226	0.544
0.5551	100	13.22	1.234	0.050	0.983	0.736	0.502	0.184	0.423
0.5	111.0	13.20	1.172	0.075	0.941	0.711	0.498	0.176	0.406
0.2	277.5	13.09	0.761	0.247	0.649	0.536	0.439	0.146	0.331
0.1	555.1	12.80	0.556	0.272	0.498	0.439	0.372	0.134	0.289
0.0925	600	12.79	0.540	0.272	0.481	0.427	0.368	0.134	0.285
0.0793	700	12.70	0.502	0.272	0.452	0.402	0.351	0.134	0.285
0.0694	800	12.61	0.473	0.268	0.427	0.385	0.339	0.130	0.280
0.0617	900	12.50	0.448	0.264	0.406	0.368	0.326	0.126	0.276
0.05551	1000	12.42	0.427	0.259	0.385	0.351	0.318	0.121	0.272
0.05	1110	12.24	0.406	0.259	0.372	0.339	0.305	0.121	0.272
0.02775	2000	11.29	0.310	0.226	0.285	0.264	0.247	0.117	0.264
0.01850	3000	10.66	0.251	0.197	0.234	0.218	0.213	0.117	0.259
0.01388	4000	10.25	0.226	0.180	0.205	0.192	0.192	0.113	0.259
0.01110	5000	9.874	0.197	0.167	0.184	0.172	0.176	0.109	0.255
0.00555	10000	8.912	0.142	0.126	0.130	0.121	0.130	0.105	0.243
0.00278	20000	7.531	0.105	0.092	0.092	0.084	0.096	0.096	0.230
0.00111	50000	5.439	0.067	0.059	0.054	0.050	0.063	0.084	0.222
0.000555	100000	3.766	0.042	0.042	0.038	0.038	0.046	0.054	0.209
0.000111	500000	1.255	0.021	0.021	0.021	0.021	0.021	0.038	0.167
0	∞	0	0	0	0	0	0	0	0

ENTHALPY OF SOLUTION OF ELECTROLYTES

This table gives the molar enthalpy (heat) of solution at infinite dilution for some common uni-univalent electrolytes. This is the enthalpy change when 1 mol of solute in its standard state is dissolved in an infinite amount of water. Values are given in kilojoules per mole at 25°C.

REFERENCE

Parker, V. B., *Thermal Properties of Uni-Univalent Electrolytes*, Natl. Stand. Ref. Data Series — Natl. Bur. Stand.(U.S.), No.2, 1965.

Solute	State	$\Delta_{\text{sol}} H^\circ$ kJ/mol	Solute	State	$\Delta_{\text{sol}} H^\circ$ kJ/mol	Solute	State	$\Delta_{\text{sol}} H^\circ$ kJ/mol
HF	g	-61.50	LiBr · 2H ₂ O	c	-9.41	KCl	c	17.22
HCl	g	-74.84	LiBrO ₃	c	1.42	KClO ₃	c	41.38
HClO ₄	l	-88.76	LiI	c	-63.30	KClO ₄	c	51.04
HClO ₄ · H ₂ O	c	-32.95	LiI · H ₂ O	c	-29.66	KBr	c	19.87
HBr	g	-85.14	LiI · 2H ₂ O	c	-14.77	KBrO ₃	c	41.13
HI	g	-81.67	LiI · 3H ₂ O	c	0.59	KI	c	20.33
HIO ₃	c	8.79	LiNO ₂	c	-11.00	KIO ₃	c	27.74
HNO ₃	l	-33.28	LiNO ₂ · H ₂ O	c	7.03	KNO ₂	c	13.35
HCOOH	l	-0.86	LiNO ₃	c	-2.51	KNO ₃	c	34.89
CH ₃ COOH	l	-1.51				KC ₂ H ₃ O ₂	c	-15.33
			NaOH	c	-44.51	KCN	c	11.72
NH ₃	g	-30.50	NaOH · H ₂ O	c	-21.41	KCNO	c	20.25
NH ₄ Cl	c	14.78	NaF	c	0.91	KCNS	c	24.23
NH ₄ ClO ₄	c	33.47	NaCl	c	3.88	KMnO ₄	c	43.56
NH ₄ Br	c	16.78	NaClO ₂	c	0.33			
NH ₄ I	c	13.72	NaClO ₂ · 3H ₂ O	c	28.58	RbOH	c	-62.34
NH ₄ IO ₃	c	31.80	NaClO ₃	c	21.72	RbOH · H ₂ O	c	-17.99
NH ₄ NO ₂	c	19.25	NaClO ₄	c	13.88	RbOH · 2H ₂ O	c	0.88
NH ₄ NO ₃	c	25.69	NaClO ₄ · H ₂ O	c	22.51	RbF	c	-26.11
NH ₄ C ₂ H ₃ O ₂	c	-2.38	NaBr	c	-0.60	RbF · H ₂ O	c	-0.42
NH ₄ CN	c	17.57	NaBr · 2H ₂ O	c	18.64	RbF · 1.5H ₂ O	c	1.34
NH ₄ CNS	c	22.59	NaBrO ₃	c	26.90	RbCl	c	17.28
CH ₃ NH ₃ Cl	c	5.77	NaI	c	-7.53	RbClO ₃	c	47.74
(CH ₃) ₃ NHCl	c	1.46	NaI · 2H ₂ O	c	16.13	RbClO ₄	c	56.74
N(CH ₃) ₄ Cl	c	4.08	NaIO ₃	c	20.29	RbBr	c	21.88
N(CH ₃) ₄ Br	c	24.27	NaNO ₂	c	13.89	RbBrO ₃	c	48.95
N(CH ₃) ₄ I	c	42.07	NaNO ₃	c	20.50	RbI	c	25.10
			NaC ₂ H ₃ O ₂	c	-17.32	RbNO ₃	c	36.48
AgClO ₄	c	7.36	NaC ₂ H ₃ O ₂ · 3H ₂ O	c	19.66			
AgNO ₂	c	36.94	NaCN	c	1.21	CsOH	c	-71.55
AgNO ₃	c	22.59	NaCN · 0.5H ₂ O	c	3.31	CsOH · H ₂ O	c	-20.50
			NaCN · 2H ₂ O	c	18.58	CsF	c	-36.86
LiOH	c	-23.56	NaCNO	c	19.20	CsF · H ₂ O	c	-10.46
LiOH · H ₂ O	c	-6.69	NaCNS	c	6.83	CsF · 1.5H ₂ O	c	-5.44
LiF	c	4.73				CsCl	c	17.78
LiCl	c	-37.03	KOH	c	-57.61	CsClO ₄	c	55.44
LiCl · H ₂ O	c	-19.08	KOH · H ₂ O	c	-14.64	CsBr	c	25.98
LiClO ₄	c	-26.55	KOH · 1.5H ₂ O	c	-10.46	CsBrO ₃	c	50.46
LiClO ₄ · 3H ₂ O	c	32.61	KF	c	-17.73	CsI	c	33.35
LiBr	c	-48.83	KF · 2H ₂ O	c	6.97	CsNO ₃	c	40.00
LiBr · H ₂ O	c	-23.26						

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING

The present compilation of kinetic data represents the 12th evaluation prepared by the NASA Panel for Data Evaluation. The Panel was established in 1977 by the NASA Upper Atmosphere Research Program Office for the purpose of providing a critical tabulation of the latest kinetic and photochemical data for use by modelers in computer simulations of stratospheric chemistry. The recommended rate data and cross sections are based on laboratory measurements. The major use of theoretical extrapolation of data is in connection with three-body reactions, in which the required pressure or temperature dependence is sometimes unavailable from laboratory measurements, and can be estimated by use of appropriate theoretical treatment. In the case of important rate constants for which no experimental data are available, the panel may provide estimates of rate constant parameters based on analogy to similar reactions for which data are available.

Rate constants are expressed in the form $k(T) = A \exp(-E/RT)$, where A is the pre-exponential factor, E the activation energy, R the gas constant, and T the absolute temperature. Uncertainties are expressed by the factor f , e.g., a value of 4.2×10^{-10} with $f = 2$ indicates that the true value is believed to lie between 2.1×10^{-10} and 8.4×10^{-10} . The value of f at other temperatures may be calculated from $f(298)$, given in the last column, by:

$$f(T) = f(298) \exp[(\Delta E/R)(1/T - 1/298)],$$

where $\Delta E/R$ is the uncertainty in E/R .

Table 1 covers rate constant data on second order reactions, grouped by class, while Table 2 covers association reactions. Relevant equilibrium constant data are given in Table 3. All concentrations are measured in molecules cm^{-3} . Notes on each reaction, as well as related photochemical data, may be found in the reference.

The assistance of Robert Hampson is gratefully acknowledged.

REFERENCE

DeMore, W. B., Sander, S. P., Golden, D. M., Hampson, R. F., Kurylo, M. J., Howard, C. J., Ravishankara, A. R., Kolb, C. E., and Molina, M. J., *Chemical Kinetics and Photochemical Data for use in Atmospheric Modeling. Evaluation Number 12*, Jet Propulsion Laboratory Publication 97-4, Pasadena CA, 1997.

The report is also available at the World Wide Web site <<http://remus.jpl.nasa.gov/pub/jpl97>>.

Table 1. Rate Constants for Second Order Reactions

Reaction	A $\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	E/R K	k (298 K) $\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	$f(298)$
O_x Reactions				
$\text{O} + \text{O}_3 \rightarrow \text{O}_2 + \text{O}_2$	8.0×10^{-12}	2060 ± 250	8.0×10^{-15}	1.15
O(¹D) Reactions				
$\text{O}(^1\text{D}) + \text{O}_2 \rightarrow \text{O} + \text{O}_2$	3.2×10^{-11}	$-(70 \pm 100)$	4.0×10^{-11}	1.2
$\text{O}(^1\text{D}) + \text{O}_3 \rightarrow \text{O}_2 + \text{O}_2$	1.2×10^{-10}	0 ± 100	1.2×10^{-10}	1.3
$\rightarrow \text{O}_2 + \text{O} + \text{O}$	1.2×10^{-10}	0 ± 100	1.2×10^{-10}	1.3
$\text{O}(^1\text{D}) + \text{H}_2 \rightarrow \text{OH} + \text{H}$	1.1×10^{-10}	0 ± 100	1.1×10^{-10}	1.1
$\text{O}(^1\text{D}) + \text{H}_2\text{O} \rightarrow \text{OH} + \text{OH}$	2.2×10^{-10}	0 ± 100	2.2×10^{-10}	1.2
$\text{O}(^1\text{D}) + \text{N}_2 \rightarrow \text{O} + \text{N}_2$	1.8×10^{-11}	$-(110 \pm 100)$	2.6×10^{-11}	1.2
$\text{O}(^1\text{D}) + \text{N}_2\text{O} \rightarrow \text{N}_2 + \text{O}_2$	4.9×10^{-11}	0 ± 100	4.9×10^{-11}	1.3
$\rightarrow \text{NO} + \text{NO}$	6.7×10^{-11}	0 ± 100	6.7×10^{-11}	1.3
$\text{O}(^1\text{D}) + \text{NH}_3 \rightarrow \text{OH} + \text{NH}_2$	2.5×10^{-10}	0 ± 100	2.5×10^{-10}	1.3
$\text{O}(^1\text{D}) + \text{CO}_2 \rightarrow \text{O} + \text{CO}_2$	7.4×10^{-11}	$-(120 \pm 100)$	1.1×10^{-10}	1.2
$\text{O}(^1\text{D}) + \text{CH}_4 \rightarrow \text{products}$	1.5×10^{-10}	0 ± 100	1.5×10^{-10}	1.2
$\text{O}(^1\text{D}) + \text{HCl} \rightarrow \text{products}$	1.5×10^{-10}	0 ± 100	1.5×10^{-10}	1.2
$\text{O}(^1\text{D}) + \text{HF} \rightarrow \text{OH} + \text{F}$	1.4×10^{-10}	0 ± 100	1.4×10^{-10}	2.0
$\text{O}(^1\text{D}) + \text{HBr} \rightarrow \text{products}$	1.5×10^{-10}	0 ± 100	1.5×10^{-10}	2.0
$\text{O}(^1\text{D}) + \text{Cl}_2 \rightarrow \text{products}$	2.8×10^{-10}	0 ± 100	2.8×10^{-10}	2.0
$\text{O}(^1\text{D}) + \text{CCl}_2\text{O} \rightarrow \text{products}$	3.6×10^{-10}	0 ± 100	3.6×10^{-10}	2.0
$\text{O}(^1\text{D}) + \text{CClFO} \rightarrow \text{products}$	1.9×10^{-10}	0 ± 100	1.9×10^{-10}	2.0
$\text{O}(^1\text{D}) + \text{CF}_2\text{O} \rightarrow \text{products}$	7.4×10^{-11}	0 ± 100	7.4×10^{-11}	2.0
$\text{O}(^1\text{D}) + \text{CCl}_4 \rightarrow \text{products}$ (CFC-10)	3.3×10^{-10}	0 ± 100	3.3×10^{-10}	1.2
$\text{O}(^1\text{D}) + \text{CH}_3\text{Br} \rightarrow \text{products}$	1.8×10^{-10}	0 ± 100	1.8×10^{-10}	1.3
$\text{O}(^1\text{D}) + \text{CH}_2\text{Br}_2 \rightarrow \text{products}$	2.7×10^{-10}	0 ± 100	2.7×10^{-10}	1.3
$\text{O}(^1\text{D}) + \text{CHBr}_3 \rightarrow \text{products}$	6.6×10^{-10}	0 ± 100	6.6×10^{-10}	1.5
$\text{O}(^1\text{D}) + \text{CH}_3\text{F} \rightarrow \text{products}$ (HFC-41)	1.5×10^{-10}	0 ± 100	1.5×10^{-10}	1.2

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm³ molecule⁻¹ s⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm³ molecule⁻¹ s⁻¹	<i>f</i>(298)
O(¹ D) + CH ₂ F ₂ → products (HFC-32)	5.1x10 ⁻¹¹	0±100	5.1x10 ⁻¹¹	1.3
O(¹ D) + CHF ₃ → products (HFC-23)	9.1x10 ⁻¹²	0±100	9.1x10 ⁻¹²	1.2
O(¹ D) + CHCl ₂ F → products (HCFC-21)	1.9x10 ⁻¹⁰	0±100	1.9x10 ⁻¹⁰	1.3
O(¹ D) + CHClF ₂ → products (HCFC-22)	1.0x10 ⁻¹⁰	0±100	1.0x10 ⁻¹⁰	1.2
O(¹ D) + CCl ₃ F → products (CFC-11)	2.3x10 ⁻¹⁰	0±100	2.3x10 ⁻¹⁰	1.2
O(¹ D) + CCl ₂ F ₂ → products (CFC-12)	1.4x10 ⁻¹⁰	0±100	1.4x10 ⁻¹⁰	1.3
O(¹ D) + CClF ₃ → products (CFC-13)	8.7x10 ⁻¹¹	0±100	8.7x10 ⁻¹¹	1.3
O(¹ D) + CClBrF ₂ → products (Halon-1211)	1.5x10 ⁻¹⁰	0±100	1.5x10 ⁻¹⁰	1.3
O(¹ D) + CBr ₂ F ₂ → products (Halon-1202)	2.2x10 ⁻¹⁰	0±100	2.2x10 ⁻¹⁰	1.3
O(¹ D) + CBrF ₃ → products (Halon-1301)	1.0x10 ⁻¹⁰	0±100	1.0x10 ⁻¹⁰	1.3
O(¹ D) + CF ₄ → CF ₄ + O (CFC-14)	-	-	2.0x10 ⁻¹⁴	1.5
O(¹ D) + CH ₃ CH ₂ F → products (HFC-161)	2.6x10 ⁻¹⁰	0±100	2.6x10 ⁻¹⁰	1.3
O(¹ D) + CH ₃ CHF ₂ → products (HFC-152a)	2.0x10 ⁻¹⁰	0±100	2.0x10 ⁻¹⁰	1.3
O(¹ D) + CH ₃ CCl ₂ F → products (HCFC-141b)	2.6x10 ⁻¹⁰	0±100	2.6x10 ⁻¹⁰	1.3
O(¹ D) + CH ₃ CClF ₂ → products (HCFC-142b)	2.2x10 ⁻¹⁰	0±100	2.2x10 ⁻¹⁰	1.3
O(¹ D) + CH ₃ CF ₃ → products (HFC-143a)	1.0x10 ⁻¹⁰	0±100	1.0x10 ⁻¹⁰	3.0
O(¹ D) + CH ₂ ClCClF ₂ → products (HCFC-132b)	1.6x10 ⁻¹⁰	0±100	1.6x10 ⁻¹⁰	2.0
O(¹ D) + CH ₂ ClCF ₃ → products (HCFC-133a)	1.2x10 ⁻¹⁰	0±100	1.2x10 ⁻¹⁰	1.3
O(¹ D) + CH ₂ FCF ₃ → products (HFC-134a)	4.9x10 ⁻¹¹	0±100	4.9x10 ⁻¹¹	1.3
O(¹ D) + CHCl ₂ CF ₃ → products (HCFC-123)	2.0x10 ⁻¹⁰	0±100	2.0x10 ⁻¹⁰	1.3
O(¹ D) + CHClFCF ₃ → products (HCFC-124)	8.6x10 ⁻¹¹	0±100	8.6x10 ⁻¹¹	1.3
O(¹ D) + CHF ₂ CF ₃ → products (HFC-125)	1.2x10 ⁻¹⁰	0±100	1.2x10 ⁻¹⁰	2.0
O(¹ D) + CCl ₃ CF ₃ → products (CFC-113a)	2x10 ⁻¹⁰	0±100	2x10 ⁻¹⁰	2.0
O(¹ D) + CCl ₂ FCClF ₂ → products (CFC-113)	2x10 ⁻¹⁰	0±100	2x10 ⁻¹⁰	2.0
O(¹ D) + CCl ₂ FCF ₃ → products (CFC-114a)	1x10 ⁻¹⁰	0±100	1x10 ⁻¹⁰	2.0
O(¹ D) + CClF ₂ CClF ₂ → products (CFC-114)	1.3x10 ⁻¹⁰	0±100	1.3x10 ⁻¹⁰	1.3
O(¹ D) + CClF ₂ CF ₃ → products (CFC-115)	5x10 ⁻¹¹	0±100	5x10 ⁻¹¹	1.3
O(¹ D) + CBrF ₂ CBrF ₂ → products (Halon-2402)	1.6x10 ⁻¹⁰	0±100	1.6x10 ⁻¹⁰	1.3

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
O(¹ D) + CF ₃ CF ₃ → O + CF ₃ CF ₃ (CFC-116)	-	-	1.5x10 ⁻¹³	1.5
O(¹ D) + CHF ₂ CF ₂ CF ₂ CHF ₂ → products (HFC-338pcc)	1.8x10 ⁻¹¹	0±100	1.8x10 ⁻¹¹	1.5
O(¹ D) + c-C ₄ F ₈ → products	-	-	8x10 ⁻¹³	1.3
O(¹ D) + CF ₃ CHFCHF ₂ CF ₃ → products (HFC-43-10mee)	2.1x10 ⁻¹⁰	0±100	2.1x10 ⁻¹⁰	4
O(¹ D) + C ₅ F ₁₂ → products (CFC-41-12)	-	-	3.9x10 ⁻¹³	2
O(¹ D) + C ₆ F ₁₄ → products (CFC-51-14)	-	-	1x10 ⁻¹²	2
O(¹ D) + 1,2-(CF ₃) ₂ c-C ₄ F ₆ → products	-	-	2.8x10 ⁻¹³	2
O(¹ D) + SF ₆ → products	-	-	1.8x10 ⁻¹⁴	1.5
Singlet O₂ Reactions				
O ₂ (¹ Δ) + O → products	-	-	<2x10 ⁻¹⁶	-
O ₂ (¹ Δ) + O ₂ → products	3.6x10 ⁻¹⁸	220±100	1.7x10 ⁻¹⁸	1.2
O ₂ (¹ Δ) + O ₃ → O + 2O ₂	5.2x10 ⁻¹¹	2840±500	3.8x10 ⁻¹⁵	1.2
O ₂ (¹ Δ) + H ₂ O → products	-	-	4.8x10 ⁻¹⁸	1.5
O ₂ (¹ Δ) + N → NO + O	-	-	<9x10 ⁻¹⁷	-
O ₂ (¹ Δ) + N ₂ → products	-	-	<10 ⁻²⁰	-
O ₂ (¹ Δ) + CO ₂ → products	-	-	<2x10 ⁻²⁰	-
O ₂ (¹ Σ) + O → products	-	-	8x10 ⁻¹⁴	5.0
O ₂ (¹ Σ) + O ₂ → products	-	-	3.9x10 ⁻¹⁷	1.5
O ₂ (¹ Σ) + O ₃ → products	2.2x10 ⁻¹¹	0±200	2.2x10 ⁻¹¹	1.2
O ₂ (¹ Σ) + H ₂ O → products	-	-	5.4x10 ⁻¹²	1.3
O ₂ (¹ Σ) + N → products	-	-	<10 ⁻¹³	-
O ₂ (¹ Σ) + N ₂ → products	2.1x10 ⁻¹⁵	0±200	2.1x10 ⁻¹⁵	1.2
O ₂ (¹ Σ) + CO ₂ → products	4.2x10 ⁻¹³	0±200	4.2x10 ⁻¹³	1.2
HO_x Reactions				
O + OH → O ₂ + H	2.2x10 ⁻¹¹	-(120±100)	3.3x10 ⁻¹¹	1.2
O + HO ₂ → OH + O ₂	3.0x10 ⁻¹¹	-(200±100)	5.9x10 ⁻¹¹	1.2
O + H ₂ O ₂ → OH + HO ₂	1.4x10 ⁻¹²	2000±1000	1.7x10 ⁻¹⁵	2.0
H + O ₃ → OH + O ₂	1.4x10 ⁻¹⁰	470±200	2.9x10 ⁻¹¹	1.25
H + HO ₂ → products	8.1x10 ⁻¹¹	0±100	8.1x10 ⁻¹¹	1.3
OH + O ₃ → HO ₂ + O ₂	1.6x10 ⁻¹²	940±300	6.8x10 ⁻¹⁴	1.3
OH + H ₂ → H ₂ O + H	5.5x10 ⁻¹²	2000±100	6.7x10 ⁻¹⁵	1.1
OH + HD → products	5.0x10 ⁻¹²	2130±200	4.0x10 ⁻¹⁵	1.2
OH + OH → H ₂ O + O	4.2x10 ⁻¹²	240±240	1.9x10 ⁻¹²	1.4
OH + HO ₂ → H ₂ O + O ₂	4.8x10 ⁻¹¹	-(250±200)	1.1x10 ⁻¹⁰	1.3
OH + H ₂ O ₂ → H ₂ O + HO ₂	2.9x10 ⁻¹²	160±100	1.7x10 ⁻¹²	1.2
HO ₂ + O ₃ → OH + 2O ₂	1.1x10 ⁻¹⁴	500±	2.0x10 ⁻¹⁵	1.3
HO ₂ + HO ₂ → H ₂ O ₂ + O ₂	2.3x10 ⁻¹³	-(600±200)	1.7x10 ⁻¹²	1.3
H ₂ O ₂ + O ₂	1.7x10 ⁻³³ [M]	-(1000±400)	4.9x10 ⁻³² [M]	1.3
NO_x Reactions				
O + NO ₂ → NO + O ₂	6.5x10 ⁻¹²	-(120±120)	9.7x10 ⁻¹²	1.1
O + NO ₃ → O ₂ + NO ₂	1.0x10 ⁻¹¹	0±150	1.0x10 ⁻¹¹	1.5
O + N ₂ O ₅ → products	-	-	<3.0x10 ⁻¹⁶	-
O + HNO ₃ → OH + NO ₃	-	-	<3.0x10 ⁻¹⁷	-
O + HO ₂ NO ₂ → products	7.8x10 ⁻¹¹	3400±750	8.6x10 ⁻¹⁶	3.0

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
H + NO ₂ → OH + NO	4.0x10 ⁻¹⁰	340±300	1.3x10 ⁻¹⁰	1.3
OH + NO ₃ → products			2.2x10 ⁻¹¹	1.5
OH + HONO → H ₂ O + NO ₂	1.8x10 ⁻¹¹	390±	4.5x10 ⁻¹²	1.5
OH + HNO ₃ → H ₂ O + NO ₃	See reference	1.3		
OH + HO ₂ NO ₂ → products	1.3x10 ⁻¹²	-(380±)	4.6x10 ⁻¹²	1.5
OH + NH ₃ → H ₂ O + NH ₂	1.7x10 ⁻¹²	710±200	1.6x10 ⁻¹³	1.2
HO ₂ + NO → NO ₂ + OH	3.5x10 ⁻¹²	-(250±50)	8.1x10 ⁻¹²	1.15
HO ₂ + NO ₂ → HONO + O ₂	See reference			
HO ₂ + NO ₃ → products			3.5x10 ⁻¹²	1.5
HO ₂ + NH ₂ → products			3.4x10 ⁻¹¹	2.0
N + O ₂ → NO + O	1.5x10 ⁻¹¹	3600±400	8.5x10 ⁻¹⁷	1.25
N + O ₃ → NO + O ₂			<2.0x10 ⁻¹⁶	
N + NO → N ₂ + O	2.1x10 ⁻¹¹	-(100±100)	3.0x10 ⁻¹¹	1.3
N + NO ₂ → N ₂ O + O	5.8x10 ⁻¹²	-(220±100)	1.2x10 ⁻¹¹	1.5
NO + O ₃ → NO ₂ + O ₂	2.0x10 ⁻¹²	1400±200	1.8x10 ⁻¹⁴	1.1
NO + NO ₃ → 2NO ₂	1.5x10 ⁻¹¹	-(170±100)	2.6x10 ⁻¹¹	1.3
NO ₂ + O ₃ → NO ₃ + O ₂	1.2x10 ⁻¹³	2450±150	3.2x10 ⁻¹⁷	1.15
NO ₂ + NO ₃ → NO + NO ₂ + O ₂	See reference			
NO ₃ + NO ₃ → 2NO ₂ + O ₂	8.5x10 ⁻¹³	2450±500	2.3x10 ⁻¹⁶	1.5
NH ₂ + O ₂ → products			<6.0x10 ⁻²¹	
NH ₂ + O ₃ → products	4.3x10 ⁻¹²	930±500	1.9x10 ⁻¹³	3.0
NH ₂ + NO → products	4.0x10 ⁻¹²	-(450±150)	1.8x10 ⁻¹¹	1.3
NH ₂ + NO ₂ → products	2.1x10 ⁻¹²	-(650±250)	1.9x10 ⁻¹¹	3.0
NH + NO → products	4.9x10 ⁻¹¹	0±300	4.9x10 ⁻¹¹	1.5
NH + NO ₂ → products	3.5x10 ⁻¹³	-(1140±500)	1.6x10 ⁻¹¹	2.0
O ₃ + HNO ₂ → O ₂ + HNO ₃			<5.0x10 ⁻¹⁹	
N ₂ O ₅ + H ₂ O → 2HNO ₃			<2.0x10 ⁻²¹	
N ₂ (A,ν) + O ₂ → products			2.5x10 ⁻¹² , ν=0	1.5
N ₂ (A,ν) + O ₃ → products			4.1x10 ⁻¹¹ , ν=0	2.0
Reactions of Organic Compounds				
O + CH ₃ → products	1.1x10 ⁻¹⁰	0±250	1.1x10 ⁻¹⁰	1.3
O + HCN → products	1.0x10 ⁻¹¹	4000±1000	1.5x10 ⁻¹⁷	10
O + C ₂ H ₂ → products	3.0x10 ⁻¹¹	1600±250	1.4x10 ⁻¹³	1.3
O + H ₂ CO → products	3.4x10 ⁻¹¹	1600±250	1.6x10 ⁻¹³	1.25
O + CH ₃ CHO → CH ₃ CO + OH	1.8x10 ⁻¹¹	1100±200	4.5x10 ⁻¹³	1.25
O ₃ + C ₂ H ₂ → products	1.0x10 ⁻¹⁴	4100±500	1.0x10 ⁻²⁰	3
O ₃ + C ₂ H ₄ → products	1.2x10 ⁻¹⁴	2630±100	1.7x10 ⁻¹⁸	1.25
O ₃ + C ₃ H ₆ → products	6.5x10 ⁻¹⁵	1900±200	1.1x10 ⁻¹⁷	1.2
OH + CO → Products	1.5x10 ⁻¹³ x (1+0.6 <i>P</i> _{atm})	0±300	1.5x10 ⁻¹³ x (1+0.6 <i>P</i> _{atm})	1.3
OH + CH ₄ → CH ₃ + H ₂ O	2.45x10 ⁻¹²	1775±100	6.3x10 ⁻¹⁵	1.1
OH + ¹³ CH ₄ → ¹³ CH ₃ + H ₂ O	See reference			
OH + CH ₃ D → products	3.5x10 ⁻¹²	1950 ± 200	5.0x10 ⁻¹⁵	1.15
OH + H ₂ CO → H ₂ O + HCO	1.0x10 ⁻¹¹	0±200	1.0x10 ⁻¹¹	1.25
OH + CH ₃ OH → products	6.7x10 ⁻¹²	600±300	8.9x10 ⁻¹³	1.2
OH + CH ₃ OOH → Products	3.8x10 ⁻¹²	-(200±200)	7.4x10 ⁻¹²	1.5
OH + HC(O)OH → products	4.0x10 ⁻¹³	0±200	4.0x10 ⁻¹³	1.3
OH + HCN → products	1.2x10 ⁻¹³	400±150	3.1x10 ⁻¹⁴	3
OH + C ₂ H ₆ → H ₂ O + C ₂ H ₅	8.7 x 10 ⁻¹²	1070±100	2.4x10 ⁻¹³	1.1
OH + C ₃ H ₈ → H ₂ O + C ₃ H ₇	1.0 x 10 ⁻¹¹	660±100	1.1x10 ⁻¹²	1.2
OH + CH ₃ CHO → CH ₃ CO + H ₂ O	5.6x10 ⁻¹²	-(270±200)	1.4x10 ⁻¹¹	1.2
OH + C ₂ H ₅ OH → products	7.0x10 ⁻¹²	235±100	3.2x10 ⁻¹²	1.3
OH + CH ₃ C(O)OH → products	4.0x10 ⁻¹³	-(200±400)	8.0x10 ⁻¹³	1.3

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
OH + CH ₃ C(O)CH ₃ → CH ₃ C(O)CH ₂ + H ₂ O	2.2 x 10 ⁻¹²	685±100	2.2x10 ⁻¹³	1.15
OH + CH ₃ CN → products	7.8x10 ⁻¹³	1050±200	2.3x10 ⁻¹⁴	1.5
OH + CH ₃ ONO ₂ → products	5.0x10 ⁻¹³	890±500	2.4x10 ⁻¹⁴	3
OH + CH ₃ C(O)O ₂ NO ₂ (PAN) → products			<4 x 10 ⁻¹⁴	
OH + C ₂ H ₅ ONO ₂ → products	8.2x10 ⁻¹³	450±300	1.8x10 ⁻¹³	3
HO ₂ + CH ₂ O → adduct	6.7x10 ⁻¹⁵	-(600±600)	5.0x10 ⁻¹⁴	5
HO ₂ + CH ₃ O ₂ → CH ₃ OOH + O ₂	3.8x10 ⁻¹³	-(800±400)	5.6x10 ⁻¹²	2
HO ₂ + C ₂ H ₅ O ₂ → C ₂ H ₅ OOH + O ₂	7.5x10 ⁻¹³	-(700±250)	8.0x10 ⁻¹²	1.5
HO ₂ + CH ₃ C(O)O ₂ → products	4.5x10 ⁻¹³	-(1000±600)	1.3x10 ⁻¹¹	2
NO ₃ + CO → products			<4.0x10 ⁻¹⁹	
NO ₃ + CH ₂ O → products			5.8x10 ⁻¹⁶	1.3
NO ₃ + CH ₃ CHO → products	1.4x10 ⁻¹²	1900±300	2.4x10 ⁻¹⁵	1.3
CH ₃ + O ₂ → products			<3.0x10 ⁻¹⁶	
CH ₃ + O ₃ → products	5.4x10 ⁻¹²	220±150	2.6x10 ⁻¹²	2
HCO + O ₂ → CO + HO ₂	3.5x10 ⁻¹²	-(140±140)	5.5x10 ⁻¹²	1.3
CH ₂ OH + O ₂ → CH ₂ O + HO ₂	9.1x10 ⁻¹²	0±200	9.1x10 ⁻¹²	1.3
CH ₃ O + O ₂ → CH ₂ O + HO ₂	3.9x10 ⁻¹⁴	900±300	1.9x10 ⁻¹⁵	1.5
CH ₃ O + NO → CH ₂ O + HNO	See reference			
CH ₃ O + NO ₂ → CH ₂ O + HONO	1.1 x 10 ⁻¹¹	1200±600	2.0 x 10 ⁻¹³	5
CH ₃ O ₂ + O ₃ → products			<3.0x10 ⁻¹⁷	
CH ₃ O ₂ + CH ₃ O ₂ → products	2.5x10 ⁻¹³	-(190±190)	4.7x10 ⁻¹³	1.5
CH ₃ O ₂ + NO → CH ₃ O + NO ₂	3.0x10 ⁻¹²	-(280±60)	7.7x10 ⁻¹²	1.15
CH ₃ O ₂ + CH ₃ C(O)O ₂ → products	1.3x10 ⁻¹²	-(640±200)	1.1x10 ⁻¹¹	1.5
C ₂ H ₅ + O ₂ → C ₂ H ₄ + HO ₂			<2.0x10 ⁻¹⁴	
C ₂ H ₅ O + O ₂ → CH ₃ CHO + HO ₂	6.3 x 10 ⁻¹⁴	550±200	1.0x10 ⁻¹⁴	1.5
C ₂ H ₅ O ₂ + C ₂ H ₅ O ₂ → products	6.8x10 ⁻¹⁴	0±300	6.8x10 ⁻¹⁴	2
C ₂ H ₅ O ₂ + NO → products	2.6x10 ⁻¹²	-(365±150)	8.7x10 ⁻¹²	1.2
CH ₃ C(O)O ₂ + CH ₃ C(O)O ₂ → products	2.9x10 ⁻¹²	-(500±150)	1.5x10 ⁻¹¹	1.5
CH ₃ C(O)O ₂ + NO → products	5.3x10 ⁻¹²	-(360±150)	1.8x10 ⁻¹¹	1.4
FO_x Reactions				
O + FO → F + O ₂	2.7x10 ⁻¹¹	0±250	2.7x10 ⁻¹¹	3.0
O + FO ₂ → FO + O ₂	5.0x10 ⁻¹¹	0±250	5.0x10 ⁻¹¹	5.0
OH + CH ₃ F → CH ₂ F + H ₂ O (HFC-41)	3.0x10 ⁻¹²	1500±300	2.0x10 ⁻¹⁴	1.1
OH + CH ₂ F ₂ → CHF ₂ + H ₂ O (HFC-32)	1.9x10 ⁻¹²	1550±200	1.0x10 ⁻¹⁴	1.2
OH + CHF ₃ → CF ₃ + H ₂ O (HFC-23)	1.0x10 ⁻¹²	2440±200	2.8x10 ⁻¹⁶	1.3
OH + CF ₃ OH → CF ₃ O + H ₂ O			<2x10 ⁻¹⁷	
OH + CH ₃ CH ₂ F → products (HFC-161)	7.0x10 ⁻¹²	1100±300	1.7x10 ⁻¹³	1.4
OH + CH ₃ CHF ₂ → products (HFC-152a)	2.4x10 ⁻¹²	1260±200	3.5x10 ⁻¹⁴	1.2
OH + CH ₂ FCH ₂ F → CHFCH ₂ F + H ₂ O (HFC-152)	1.7x10 ⁻¹¹	1500±500	1.1x10 ⁻¹³	2.0
OH + CH ₃ CF ₃ → CH ₂ CF ₃ + H ₂ O (HFC-143a)	1.8x10 ⁻¹²	2170±150	1.2x10 ⁻¹⁵	1.1
OH + CH ₂ FCHF ₂ → products (HFC-143)	4.0x10 ⁻¹²	1650±300	1.6x10 ⁻¹⁴	1.5
OH + CH ₂ FCF ₃ → CHF ₂ CF ₃ + H ₂ O (HFC-134a)	1.5x10 ⁻¹²	1750±200	4.2x10 ⁻¹⁵	1.1

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
OH + CHF ₂ CHF ₂ → CF ₂ CHF ₂ (HFC-134) + H ₂ O	1.6x10 ⁻¹²	1680±300	5.7x10 ⁻¹⁵	2.0
OH + CHF ₂ CF ₃ → CF ₂ CF ₃ + H ₂ O (HFC-125)	5.6x10 ⁻¹³	1700±300	1.9x10 ⁻¹⁵	1.3
OH + CH ₃ OCHF ₂ → products (HFOC-152a)	6.0x10 ⁻¹²	1530±150	3.5x10 ⁻¹⁴	1.2
OH + CF ₃ OCH ₃ → CF ₃ OCH ₂ + H ₂ O (HFOC-143a)	1.5x10 ⁻¹²	1450±150	1.2x10 ⁻¹⁴	1.1
OH + CF ₂ HOCHF ₂ H → CF ₂ OCF ₂ H (HFOC-134) + H ₂ O	1.9x10 ⁻¹²	2000±150	2.3x10 ⁻¹⁵	1.2
OH + CF ₃ OCHF ₂ → CF ₃ OCF ₂ + H ₂ O (HFOC-125)	4.7x10 ⁻¹³	2100±300	4.1x10 ⁻¹⁶	1.2
OH + CF ₃ CH ₂ CH ₃ → products (HFC-263fb)	-	-	4.2x10 ⁻¹⁴	1.5
OH + CH ₂ FCF ₂ CHF ₂ → products (HFC-245ca)	2.4x10 ⁻¹²	1660±150	9.1x10 ⁻¹⁵	1.3
OH + CHF ₂ CHFCHF ₂ → products (HFC-245ea)	-	-	1.6x10 ⁻¹⁴	2.0
OH + CF ₃ CHFCH ₂ F → products (HFC-245eb)	-	-	1.5x10 ⁻¹⁴	2.0
OH + CHF ₂ CH ₂ CF ₃ → products (HFC-245fa)	6.1x10 ⁻¹³	1330±150	7.0x10 ⁻¹⁵	1.2
OH + CF ₃ CF ₂ CH ₂ F → CF ₃ CF ₂ CHF (HFC-236cb) + H ₂ O	1.5x10 ⁻¹²	1750±500	4.2x10 ⁻¹⁵	2.0
OH + CF ₃ CHFCHF ₂ → products (HFC-236ea)	1.1x10 ⁻¹²	1590±150	5.3x10 ⁻¹⁵	1.1
OH + CF ₃ CH ₂ CF ₃ → CF ₃ CHCF ₃ (HFC-236fa) + H ₂ O	1.3x10 ⁻¹²	2480±150	3.2x10 ⁻¹⁶	1.1
OH + CF ₃ CHFCF ₃ → CF ₃ CF ₂ CF ₃ +H ₂ O (HFC-227ea)	5.0x10 ⁻¹³	1700±300	1.7x10 ⁻¹⁵	1.1
OH + CHF ₂ OCH ₂ CF ₃ → products (HFOC-245fa)	2.6x10 ⁻¹²	1610±150	1.2x10 ⁻¹⁴	2.0
OH + CF ₃ CH ₂ CF ₂ CH ₃ → products (HFC-365mfc)	2.0x10 ⁻¹²	1750±200	5.7x10 ⁻¹⁵	1.3
OH + CF ₃ CH ₂ CH ₂ CF ₃ → products (HFC-356mff)	3.0x10 ⁻¹²	1800±300	7.1x10 ⁻¹⁵	1.3
OH + CF ₃ CF ₂ CH ₂ CH ₂ F → products (HFC-356mcf)	1.7x10 ⁻¹²	1110±200	4.2x10 ⁻¹⁴	2.0
OH + CHF ₂ CF ₂ CF ₂ CF ₂ H → products (HFC-338pcc)	7.8x10 ⁻¹³	1530±200	4.6x10 ⁻¹⁵	1.5
OH + CF ₃ CH ₂ CF ₂ CH ₂ CF ₃ → products (HFC-458mfcf)	1.2x10 ⁻¹²	1830±200	2.6x10 ⁻¹⁵	2.0
OH + CF ₃ CHFCHF ₂ CF ₃ → products (HFC-43-10mee)	5.2x10 ⁻¹³	1500±300	3.4x10 ⁻¹⁵	1.3
OH + CF ₃ CF ₂ CH ₂ CH ₂ CF ₂ CF ₃ → (HFC-55-10-meff) products	-	-	8.3x10 ⁻¹⁵	1.5
F + O ₃ → FO + O ₂	2.2x10 ⁻¹¹	230±200	1.0x10 ⁻¹¹	1.5
F + H ₂ → HF + H	1.4x10 ⁻¹⁰	500±200	2.6x10 ⁻¹¹	1.2
F + H ₂ O → HF + OH	1.4x10 ⁻¹¹	0±200	1.4x10 ⁻¹¹	1.3
F + HNO ₃ → HF + NO ₃	6.0x10 ⁻¹²	-(400±200)	2.3x10 ⁻¹¹	1.3
F + CH ₄ → HF + CH ₃	1.6x10 ⁻¹⁰	260±200	6.7x10 ⁻¹¹	1.4
FO + O ₃ → products			<1 x 10 ⁻¹⁴	
FO + NO → NO ₂ + F	8.2x10 ⁻¹²	-(300±200)	2.2x10 ⁻¹¹	1.5
FO + FO → 2 F + O ₂	1.0x10 ⁻¹¹	0±250	1.0x10 ⁻¹¹	1.5
FO ₂ + O ₃ → products			<3.4x10 ⁻¹⁶	
FO ₂ + NO → FNO + O ₂	7.5x10 ⁻¹²	690±400	7.5x10 ⁻¹³	2.0

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
FO ₂ + NO ₂ → products	3.8x10 ⁻¹¹	2040±500	4.0x10 ⁻¹⁴	2.0
FO ₂ + CO → products			<5.1x10 ⁻¹⁶	
FO ₂ + CH ₄ → products			<2x10 ⁻¹⁶	
CF ₃ O + O ₂ → FO ₂ + CF ₂ O	<3 x 10 ⁻¹¹	5000	<1.5 x 10 ⁻¹⁸	
CF ₃ O + O ₃ → CF ₃ O ₂ + O ₂	2 x 10 ⁻¹²	1400±600	1.8 x 10 ⁻¹⁴	1.3
CF ₃ O + H ₂ O → OH + CF ₃ OH	3 x 10 ⁻¹²	>3600	<2 x 10 ⁻¹⁷	
CF ₃ O + NO → CF ₂ O + FNO	3.7 x 10 ⁻¹¹	-(110±70)	5.4 x 10 ⁻¹¹	1.2
CF ₃ O + NO ₂ → products	See reference			
CF ₃ O + CO → products			<2 x 10 ⁻¹⁵	
CF ₃ O + CH ₄ → CH ₃ + CF ₃ OH	2.6 x 10 ⁻¹²	1420±200	2.2 x 10 ⁻¹⁴	1.1
CF ₃ O + C ₂ H ₆ → C ₂ H ₅ + CF ₃ OH	4.9 x 10 ⁻¹²	400±100	1.3 x 10 ⁻¹²	1.2
CF ₃ O ₂ + O ₃ → CF ₃ O + 2O ₂			<3 x 10 ⁻¹⁵	
CF ₃ O ₂ + CO → CF ₃ O + CO ₂			<5 x 10 ⁻¹⁶	
CF ₃ O ₂ + NO → CF ₃ O + NO ₂	5.4 x 10 ⁻¹²	-(320±150)	1.6 x 10 ⁻¹¹	1.1
ClO_x Reactions				
O + ClO → Cl + O ₂	3.0x10 ⁻¹¹	-(70±70)	3.8x10 ⁻¹¹	1.2
O + OClO → ClO + O ₂	2.4x10 ⁻¹²	960±300	1.0x10 ⁻¹³	2.0
O + Cl ₂ O → ClO + ClO	2.7x10 ⁻¹¹	530±150	4.5x10 ⁻¹²	1.3
O + HCl → OH + Cl	1.0x10 ⁻¹¹	3300±350	1.5x10 ⁻¹⁶	2.0
O + HOCl → OH + ClO	1.7x10 ⁻¹³	0±300	1.7x10 ⁻¹³	3.0
O + ClONO ₂ → products	2.9x10 ⁻¹²	800±200	2.0x10 ⁻¹³	1.5
O ₃ + OClO → products	2.1x10 ⁻¹²	4700±1000	3.0x10 ⁻¹⁹	2.5
O ₃ + Cl ₂ O ₂ → products	-	-	<1.0x10 ⁻¹⁹	-
OH + Cl ₂ → HOCl + Cl	1.4x10 ⁻¹²	900±400	6.7x10 ⁻¹⁴	1.2
OH + ClO → products	1.1x10 ⁻¹¹	-(120±150)	1.7x10 ⁻¹¹	1.5
OH + OClO → HOCl + O ₂	4.5x10 ⁻¹³	-(800±200)	6.8x10 ⁻¹²	2.0
OH + HCl → H ₂ O + Cl	2.6x10 ⁻¹²	350±100	8.0x10 ⁻¹³	1.2
OH + HOCl → H ₂ O + ClO	3.0x10 ⁻¹²	500±500	5.0x10 ⁻¹³	3.0
OH + ClNO ₂ → HOCl + NO ₂	2.4x10 ⁻¹²	1250±300	3.6x10 ⁻¹⁴	2.0
OH + ClONO ₂ → products	1.2x10 ⁻¹²	330±200	3.9x10 ⁻¹³	1.5
OH + CH ₃ Cl → CH ₂ Cl + H ₂ O	4.0x10 ⁻¹²	1400±250	3.6x10 ⁻¹⁴	1.2
OH + CH ₂ Cl ₂ → CHCl ₂ + H ₂ O	3.8x10 ⁻¹²	1050±150	1.1x10 ⁻¹³	1.4
OH + CHCl ₃ → CCl ₃ + H ₂ O	2.0x10 ⁻¹²	900±150	1.0x10 ⁻¹³	1.2
OH + CCl ₄ → products	~1.0x10 ⁻¹²	>2300	<5.0x10 ⁻¹⁶	-
OH + CFCl ₃ → products				
(CFC-11)	~1.0x10 ⁻¹²	>3700	<5.0x10 ⁻¹⁸	-
OH + CF ₂ Cl ₂ → products				
(CFC-12)	~1.0x10 ⁻¹²	>3600	<6.0x10 ⁻¹⁸	-
OH + CH ₂ ClF → CHClF + H ₂ O				
(HCFC-31)	2.8x10 ⁻¹²	1270±200	3.9x10 ⁻¹⁴	1.2
OH + CHFCl ₂ → CFCl ₂ + H ₂ O				
(HCFC-21)	1.7x10 ⁻¹²	1250±150	2.6x10 ⁻¹⁴	1.2
OH + CHF ₂ Cl → CF ₂ Cl + H ₂ O				
(HCFC-22)	1.0x10 ⁻¹²	1600±150	4.7x10 ⁻¹⁵	1.1
OH + CH ₃ OCl → products	2.4x10 ⁻¹²	360±200	7.2x10 ⁻¹³	3.0
OH + CH ₃ CCl ₃ → CH ₂ CCl ₃ + H ₂ O				
(HCC-140)	1.8x10 ⁻¹²	1550±150	1.0x10 ⁻¹⁴	1.1
OH + C ₂ HCl ₃ → products	4.9x10 ⁻¹³	-(450±200)	2.2x10 ⁻¹²	1.25
OH + C ₂ Cl ₄ → products	9.4x10 ⁻¹²	1200±200	1.7x10 ⁻¹³	1.25
OH + CCl ₃ CHO → H ₂ O + CCl ₃ CO	8.2x10 ⁻¹²	600±300	1.1x10 ⁻¹²	1.5
OH + CH ₃ CFCl ₂ → CH ₂ CFCl ₂ + H ₂ O				
(HCFC-141b)	1.7x10 ⁻¹²	1700±150	5.7x10 ⁻¹⁵	1.2
OH + CH ₃ CF ₂ Cl → CH ₂ CF ₂ Cl + H ₂ O				
(HCFC-142b)	1.3x10 ⁻¹²	1800±150	3.1x10 ⁻¹⁵	1.2

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
OH + CH ₂ ClCF ₂ Cl → CHClCF ₂ Cl (HCFC-132b) + H ₂ O	3.6x10 ⁻¹²	1600±400	1.7x10 ⁻¹⁴	2.0
OH + CHCl ₂ CF ₂ Cl → CCl ₂ CF ₂ Cl (HCFC-122) + H ₂ O	1.0x10 ⁻¹²	900±150	4.9x10 ⁻¹⁴	1.2
OH + CHFClCFCl ₂ → CFCICFCl ₂ (HCFC-122a) + H ₂ O	1.0x10 ⁻¹²	1250±150	1.5x10 ⁻¹⁴	1.1
OH + CH ₂ ClCF ₃ → CHClCF ₃ + H ₂ O (HCFC-133a)	5.2x10 ⁻¹³	1100±300	1.3x10 ⁻¹⁴	1.3
OH + CHCl ₂ CF ₃ → CCl ₂ CF ₃ + H ₂ O (HCFC-123)	7.0x10 ⁻¹³	900±150	3.4x10 ⁻¹⁴	1.2
OH + CHFClCF ₂ Cl → CFCICF ₂ Cl (HCFC-123a) + H ₂ O	9.2x10 ⁻¹³	1280±150	1.3x10 ⁻¹⁴	1.2
OH + CHFClCF ₃ → CFCICF ₃ + H ₂ O (HCFC-124)	8.0x10 ⁻¹³	1350±150	8.6x10 ⁻¹⁵	1.2
OH + CH ₃ CF ₂ CFCl ₂ → products (HCFC-243cc)	7.7x10 ⁻¹³	1700±300	2.6x10 ⁻¹⁵	2.0
OH + CF ₃ CF ₂ CHCl ₂ → products (HCFC-225ca)	1.0x10 ⁻¹²	1100±200	2.5x10 ⁻¹⁴	1.3
OH + CF ₂ ClCF ₂ CHFCI → products (HCFC-225cb)	5.5x10 ⁻¹³	1250±200	8.3x10 ⁻¹⁵	1.3
HO ₂ + Cl → HCl + O ₂	1.8x10 ⁻¹¹	-(170±200)	3.2x10 ⁻¹¹	1.5
→ OH + ClO	4.1x10 ⁻¹¹	450±200	9.1x10 ⁻¹²	2.0
HO ₂ + ClO → HOCl + O ₂	4.8x10 ⁻¹³	-(700±)	5.0x10 ⁻¹²	1.4
H ₂ O + ClONO ₂ → products	-	-	<2.0x10 ⁻²¹	-
NO + OCIO → NO ₂ + ClO	2.5x10 ⁻¹²	600±300	3.4x10 ⁻¹³	2.0
NO + Cl ₂ O ₂ → products	-	-	<2.0x10 ⁻¹⁴	-
NO ₃ + HCl → HNO ₃ + Cl	-	-	<5.0x10 ⁻¹⁷	-
HO ₂ NO ₂ + HCl → products	-	-	<1.0x10 ⁻²¹	-
Cl + O ₃ → ClO + O ₂	2.9x10 ⁻¹¹	260±100	1.2x10 ⁻¹¹	1.15
Cl + H ₂ → HCl + H	3.7x10 ⁻¹¹	2300±200	1.6x10 ⁻¹⁴	1.25
Cl + H ₂ O ₂ → HCl + HO ₂	1.1x10 ⁻¹¹	980±500	4.1x10 ⁻¹³	1.5
Cl + NO ₃ → ClO + NO ₂	2.4x10 ⁻¹¹	0±400	2.4x10 ⁻¹¹	1.5
Cl + N ₂ O → ClO + N ₂	See reference	-	-	-
Cl + HNO ₃ → products	-	-	<2.0x10 ⁻¹⁶	-
Cl + CH ₄ → HCl + CH ₃	1.1x10 ⁻¹¹	1400±150	1.0x10 ⁻¹³	1.1
Cl + CH ₃ D → products	-	-	7.4x10 ⁻¹⁴	2.0
Cl + H ₂ CO → HCl + HCO	8.1x10 ⁻¹¹	30±100	7.3x10 ⁻¹¹	1.15
Cl + CH ₃ O ₂ → products	-	-	1.6x10 ⁻¹⁰	1.5
Cl + CH ₃ OH → CH ₂ OH + HCl	5.4x10 ⁻¹¹	0±250	5.4x10 ⁻¹¹	1.5
Cl + C ₂ H ₆ → HCl + C ₂ H ₅	7.7x10 ⁻¹¹	90±90	5.7x10 ⁻¹¹	1.1
Cl + C ₂ H ₅ O ₂ → ClO + C ₂ H ₅ O	-	-	7.4x10 ⁻¹¹	2.0
→ HCl + C ₂ H ₄ O ₂	-	-	7.7x10 ⁻¹¹	2.0
Cl + CH ₃ CN → products	1.6x10 ⁻¹¹	2140±300	1.2x10 ⁻¹⁴	2.0
Cl + CH ₃ CO ₃ NO ₂ → products	-	-	<1x10 ⁻¹⁴	-
Cl + C ₃ H ₈ → HCl + C ₃ H ₇	1.2x10 ⁻¹⁰	-(40±250)	1.4x10 ⁻¹⁰	1.3
Cl + OCIO → ClO + ClO	3.4x10 ⁻¹¹	-(160±200)	5.8x10 ⁻¹¹	1.25
Cl + ClOO → Cl ₂ + O ₂	2.3x10 ⁻¹⁰	0±250	2.3x10 ⁻¹⁰	3.0
→ ClO + ClO	1.2x10 ⁻¹¹	0±250	1.2x10 ⁻¹¹	3.0
Cl + Cl ₂ O → Cl ₂ + ClO	6.2x10 ⁻¹¹	-(130±130)	9.6x10 ⁻¹¹	1.2
Cl + Cl ₂ O ₂ → products	-	-	1.0x10 ⁻¹⁰	2.0
Cl + HOCl → products	2.5x10 ⁻¹²	130±250	1.6x10 ⁻¹²	1.5
Cl + ClNO → NO + Cl ₂	5.8x10 ⁻¹¹	-(100±200)	8.1x10 ⁻¹¹	1.5
Cl + ClONO ₂ → products	6.5x10 ⁻¹²	-(135±50)	1.0x10 ⁻¹¹	1.2
Cl + CH ₃ Cl → CH ₂ Cl + HCl	3.2x10 ⁻¹¹	1250±200	4.8x10 ⁻¹³	1.2
Cl + CH ₂ Cl ₂ → HCl + CHCl ₂	3.1x10 ⁻¹¹	1350±500	3.3x10 ⁻¹³	1.5
Cl + CHCl ₃ → HCl + CCl ₃	8.2x10 ⁻¹²	1325±300	9.6x10 ⁻¹⁴	1.3

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
Cl + CH ₃ F → HCl + CH ₂ F (HFC-41)	2.0x10 ⁻¹¹	1200±500	3.5x10 ⁻¹³	1.3
Cl + CH ₂ F ₂ → HCl + CHF ₂ (HFC-32)	1.2x10 ⁻¹¹	1630±500	5.0x10 ⁻¹⁴	1.5
Cl + CF ₃ H → HCl + CF ₃ (HFC-23)	-	-	3.0x10 ⁻¹⁸	5.0
Cl + CH ₂ FCI → HCl + CHFCl (HCFC-31)	1.2x10 ⁻¹¹	1390±500	1.1x10 ⁻¹³	2.0
Cl + CHFCl ₂ → HCl + CFCl ₂ (HCFC-21)	5.5x10 ⁻¹²	1675±200	2.0x10 ⁻¹⁴	1.3
Cl + CHF ₂ Cl → HCl + CF ₂ Cl (HCFC-22)	5.9x10 ⁻¹²	2430±200	1.7x10 ⁻¹⁵	1.3
Cl + CH ₃ CCl ₃ → CH ₂ CCl ₃ + HCl	2.8x10 ⁻¹²	1790±400	7.0x10 ⁻¹⁵	2.0
Cl + CH ₃ CH ₂ F → HCl + CH ₃ CHF (HFC-161)	1.8x10 ⁻¹¹	290±500	6.8x10 ⁻¹²	3.0
→ HCl + CH ₂ CH ₂ F	1.4x10 ⁻¹¹	880±500	7.3x10 ⁻¹³	3.0
Cl + CH ₃ CHF ₂ → HCl + CH ₃ CF ₂ (HFC-152a)	6.4x10 ⁻¹²	950±500	2.6x10 ⁻¹³	1.3
→ HCl + CH ₂ CHF ₂	7.2x10 ⁻¹²	2390±500	2.4x10 ⁻¹⁵	3.0
Cl + CH ₂ FCH ₂ F → HCl + CHFCH ₂ F (HFC-152)	2.6x10 ⁻¹¹	1060±500	7.5x10 ⁻¹³	3.0
Cl + CH ₃ CFCl ₂ → HCl + CH ₂ CFCl ₂ (HCFC-141b)	1.8x10 ⁻¹²	2000±300	2.2x10 ⁻¹⁵	1.2
Cl + CH ₃ CF ₂ Cl → HCl + CH ₂ CF ₂ Cl (HCFC-142b)	1.4x10 ⁻¹²	2420±500	4.2x10 ⁻¹⁶	1.2
Cl + CH ₃ CF ₃ → HCl + CH ₂ CF ₃ (HFC-143a)	1.2x10 ⁻¹¹	3880±500	2.6x10 ⁻¹⁷	5.0
Cl + CH ₂ FCHF ₂ → HCl + CH ₂ FCF ₂ (HFC-143)	5.5x10 ⁻¹²	1610±500	2.5x10 ⁻¹⁴	3.0
→ HCl + CHFCHF ₂	7.7x10 ⁻¹²	1720±500	2.4x10 ⁻¹⁴	3.0
Cl + CH ₂ ClCF ₃ → HCl + CHClCF ₃ (HCFC-133a)	1.8x10 ⁻¹²	1710±500	5.9x10 ⁻¹⁵	3.0
Cl + CH ₂ FCF ₃ → HCl + CHF ₂ CF ₃ (HFC-134a)	-	-	1.5x10 ⁻¹⁵	1.2
Cl + CHF ₂ CHF ₂ → HCl + CF ₂ CHF ₂ (HCF-134)	7.5x10 ⁻¹²	2430±500	2.2x10 ⁻¹⁵	1.5
Cl + CHCl ₂ CF ₃ → HCl + CCl ₂ CF ₃ (HCFC-123)	4.4x10 ⁻¹²	1750±500	1.2x10 ⁻¹⁴	1.3
Cl + CHFClCF ₃ → HCl + CFClCF ₃ (HCFC-124)	1.1x10 ⁻¹²	1800±500	2.7x10 ⁻¹⁵	1.3
Cl + CHF ₂ CF ₃ → HCl + CF ₂ CF ₃ (HFC-125)	-	-	2.4x10 ⁻¹⁶	1.3
ClO + O ₃ → ClOO + O ₂	-	-	<1.4x10 ⁻¹⁷	-
→ OClO + O ₂	1.0x10 ⁻¹²	>4000	<1.0x10 ⁻¹⁸	-
ClO + H ₂ → products	~1.0x10 ⁻¹²	>4800	<1.0x10 ⁻¹⁹	-
ClO + NO → NO ₂ + Cl	6.4x10 ⁻¹²	-(290±100)	1.7x10 ⁻¹¹	1.15
ClO + NO ₃ → ClOO + NO ₂	4.7x10 ⁻¹³	0±400	4.7x10 ⁻¹³	1.5
ClO + N ₂ O → products	~1.0x10 ⁻¹²	>4300	<6.0x10 ⁻¹⁹	-
ClO + CO → products	~1.0x10 ⁻¹²	>3700	<4.0x10 ⁻¹⁸	-
ClO + CH ₄ → products	~1.0x10 ⁻¹²	>3700	<4.0x10 ⁻¹⁸	-
ClO + H ₂ CO → products	~1.0x10 ⁻¹²	>2100	<1.0x10 ⁻¹⁵	-
ClO + CH ₃ O ₂ → products	3.3x10 ⁻¹²	115±115	2.2x10 ⁻¹²	1.5
ClO + ClO → Cl ₂ + O ₂	1.0x10 ⁻¹²	1590±300	4.8x10 ⁻¹⁵	1.5
→ ClOO + Cl	3.0x10 ⁻¹¹	2450±500	8.0x10 ⁻¹⁵	1.5
→ OClO + Cl	3.5x10 ⁻¹³	1370±300	3.5x10 ⁻¹⁵	1.5
HCl + ClONO ₂ → products	-	-	<1.0x10 ⁻²⁰	-

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
CH ₂ ClO + O ₂ → CHClO + HO ₂	-	-	6 x 10 ⁻¹⁴	5
CH ₂ ClO ₂ + HO ₂ →				
CH ₂ ClO ₂ H + O ₂	3.3 x 10 ⁻¹³	-(820±200)	5.2 x 10 ⁻¹²	1.5
CH ₂ ClO ₂ + NO → CH ₂ ClO + NO ₂	7 x 10 ⁻¹²	-(300±200)	1.9 x 10 ⁻¹¹	1.5
CCl ₃ O ₂ + NO → CCl ₂ O + NO ₂ + Cl	7.3 x 10 ⁻¹²	-(270±200)	1.8 x 10 ⁻¹¹	1.3
CCl ₂ FO ₂ + NO → CClFO +				
NO ₂ + Cl	4.5 x 10 ⁻¹²	-(350±200)	1.5 x 10 ⁻¹¹	1.3
CClF ₂ O ₂ + NO → CF ₂ O +				
NO ₂ + Cl	3.8 x 10 ⁻¹²	-(400±200)	1.5 x 10 ⁻¹¹	1.2
BrO_x Reactions				
O + BrO → Br + O ₂	1.9x10 ⁻¹¹	-(230±150)	4.1x10 ⁻¹¹	1.5
O + HBr → OH + Br	5.8x10 ⁻¹²	1500±200	3.8x10 ⁻¹⁴	1.3
O + HOBr → OH + BrO	1.2x10 ⁻¹⁰	430±300	2.8x10 ⁻¹¹	3.0
OH + Br ₂ → HOBr + Br	4.2x10 ⁻¹¹	0±600	4.2x10 ⁻¹¹	1.3
OH + BrO → products	-	-	7.5x10 ⁻¹¹	3.0
OH + HBr → H ₂ O + Br	1.1x10 ⁻¹¹	0±250	1.1x10 ⁻¹¹	1.2
OH + CH ₃ Br → CH ₂ Br + H ₂ O	4.0x10 ⁻¹²	1470±150	2.9x10 ⁻¹⁴	1.1
OH + CH ₂ Br ₂ → CHBr ₂ + H ₂ O	2.4x10 ⁻¹²	900±300	1.2x10 ⁻¹³	1.1
OH + CHBr ₃ → CBr ₃ + H ₂ O	1.6x10 ⁻¹²	710±200	1.5x10 ⁻¹³	2.0
OH + CHF ₂ Br → CF ₂ Br + H ₂ O	1.1x10 ⁻¹²	1400±200	1.0x10 ⁻¹⁴	1.1
OH + CH ₂ ClBr → CHClBr + H ₂ O	2.3x10 ⁻¹²	930±150	1.0x10 ⁻¹³	1.2
OH + CF ₂ ClBr → products	-	-	<1.5x10 ⁻¹⁶	-
OH + CF ₂ Br ₂ → products	-	-	<5.0x10 ⁻¹⁶	-
OH + CF ₃ Br → products	-	-	<1.2x10 ⁻¹⁶	-
OH + CH ₂ BrCF ₃ → CHBrCF ₃ + H ₂ O	1.4x10 ⁻¹²	1340±200	1.6x10 ⁻¹⁴	1.3
OH + CHFBrCF ₃ → CFBrCF ₃	7.2x10 ⁻¹³	1110±150	1.8x10 ⁻¹⁴	1.5
OH + CHClBrCF ₃ → CClBrCF ₃ + H ₂ O	1.3x10 ⁻¹²	995±150	4.5x10 ⁻¹⁴	1.5
OH + CF ₂ BrCHFCl → CF ₂ BrCFCl + H ₂ O	9.3x10 ⁻¹³	1250±150	1.4x10 ⁻¹⁴	1.5
OH + CF ₂ BrCF ₂ Br → products	-	-	<1.5x10 ⁻¹⁶	-
HO ₂ + Br → HBr + O ₂	1.5x10 ⁻¹¹	600±600	2.0x10 ⁻¹²	2.0
HO ₂ + BrO → products	3.4x10 ⁻¹²	-(540±200)	2.1x10 ⁻¹¹	1.5
NO ₃ + HBr → HNO ₃ + Br	-	-	<1.0x10 ⁻¹⁶	-
Cl + CH ₂ ClBr → HCl + CHClBr	4.3x10 ⁻¹¹	1370±500	4.3x10 ⁻¹³	3.0
Cl + CH ₃ Br → HCl + CH ₂ Br	1.5x10 ⁻¹¹	1060±100	4.3x10 ⁻¹³	1.2
Cl + CH ₂ Br ₂ → HCl + CHBr ₂	6.4x10 ⁻¹²	810±100	4.2x10 ⁻¹³	1.2
Br + O ₃ → BrO + O ₂	1.7x10 ⁻¹¹	800±200	1.2x10 ⁻¹²	1.2
Br + H ₂ O ₂ → HBr + HO ₂	1.0x10 ⁻¹¹	>3000	<5.0x10 ⁻¹⁶	-
Br + NO ₃ → BrO + NO ₂	-	-	1.6x10 ⁻¹¹	2.0
Br + H ₂ CO → HBr + HCO	1.7x10 ⁻¹¹	800±200	1.1x10 ⁻¹²	1.3
Br + OClO → BrO + ClO	2.6x10 ⁻¹¹	1300±300	3.4x10 ⁻¹³	2.0
Br + Cl ₂ O → BrCl + ClO	2.1x10 ⁻¹¹	470±150	4.3x10 ⁻¹²	1.3
Br + Cl ₂ O ₂ → products	-	-	3.0x10 ⁻¹²	2.0
BrO + O ₃ → products	~1.0x10 ⁻¹²	>3200	<2.0x10 ⁻¹⁷	-
BrO + NO → NO ₂ + Br	8.8x10 ⁻¹²	-(260±130)	2.1x10 ⁻¹¹	1.15
BrO + NO ₃ → products	-	-	1.0x10 ⁻¹²	3.0
BrO + ClO → Br + OClO	1.6x10 ⁻¹²	-(430±200)	6.8x10 ⁻¹²	1.25
→ Br + ClOO	2.9x10 ⁻¹²	-(220±200)	6.1x10 ⁻¹²	1.25
→ BrCl + O ₂	5.8x10 ⁻¹³	-(170±200)	1.0x10 ⁻¹²	1.25
BrO + BrO → products	1.5x10 ⁻¹²	-(230±150)	3.2x10 ⁻¹²	1.15
CH ₂ BrO ₂ + NO → CH ₂ O +				
NO ₂ + Br	4x10 ⁻¹²	-(300±200)	1.1 x 10 ⁻¹¹	1.5

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
IO_x Reactions				
O + I ₂ → IO + I	1.4x10 ⁻¹⁰	0±250	1.4x10 ⁻¹⁰	1.4
O + IO → O ₂ + I			1.2x10 ⁻¹⁰	2.0
OH + I ₂ → HOI + I			1.8x10 ⁻¹⁰	2.0
OH + HI → H ₂ O + I			3.0x10 ⁻¹¹	2.0
OH + CH ₃ I → H ₂ O + CH ₂ I	3.1x10 ⁻¹²	1120±500	7.2x10 ⁻¹⁴	3.0
OH + CF ₃ I → HOI + CF ₃			3.1x10 ⁻¹⁴	5.0
HO ₂ + I → HI + O ₂	1.5x10 ⁻¹¹	1090±500	3.8x10 ⁻¹³	2.0
HO ₂ + IO → HOI + O ₂			8.4x10 ⁻¹¹	1.5
NO ₃ + HI → HNO ₃ + I	See reference			
I + O ₃ → IO + O ₂	2.3x10 ⁻¹¹	870±200	1.2x10 ⁻¹²	1.2
I + BrO → IO + Br	-	-	1.2x10 ⁻¹¹	2.0
IO + NO → I + NO ₂	9.1x10 ⁻¹²	-(240±150)	2.0x10 ⁻¹¹	1.2
IO + ClO → products	5.1x10 ⁻¹²	-(280±200)	1.3x10 ⁻¹¹	2.0
IO + BrO → products	-	-	6.9x10 ⁻¹¹	1.5
IO + IO → products	1.5x10 ⁻¹¹	-(500±500)	8.0x10 ⁻¹¹	1.5
INO + INO → I ₂ + 2NO	8.4x10 ⁻¹¹	2620±600	1.3x10 ⁻¹⁴	2.5
INO ₂ + INO ₂ → I ₂ + 2NO ₂	2.9x10 ⁻¹¹	2600±1000	4.7x10 ⁻¹⁵	3.0
SO_x Reactions				
O + SH → SO + H	-	-	1.6x10 ⁻¹⁰	5.0
O + CS → CO + S	2.7x10 ⁻¹⁰	760±250	2.1x10 ⁻¹¹	1.1
O + H ₂ S → OH + SH	9.2x10 ⁻¹²	1800±550	2.2x10 ⁻¹⁴	1.7
O + OCS → CO + SO	2.1x10 ⁻¹¹	2200±150	1.3x10 ⁻¹⁴	1.2
O + CS ₂ → CS + SO	3.2x10 ⁻¹¹	650±150	3.6x10 ⁻¹²	1.2
O + CH ₃ SCH ₃ → CH ₃ SO + CH ₃	1.3x10 ⁻¹¹	-(410±100)	5.0x10 ⁻¹¹	1.1
O + CH ₃ SSCH ₃ → CH ₃ SO + CH ₃ S	5.5x10 ⁻¹¹	-(250±100)	1.3x10 ⁻¹⁰	1.3
O ₃ + H ₂ S → products	-	-	<2.0x10 ⁻²⁰	-
O ₃ + CH ₃ SCH ₃ → products	-	-	<1.0x10 ⁻¹⁸	-
O ₃ + SO ₂ → SO ₃ + O ₂	3.0x10 ⁻¹²	>7000	<2.0x10 ⁻²²	-
OH + H ₂ S → SH + H ₂ O	6.0x10 ⁻¹²	75±75	4.7x10 ⁻¹²	1.2
OH + OCS → products	1.1x10 ⁻¹³	1200±500	1.9x10 ⁻¹⁵	2.0
OH + CS ₂ → products	See reference	-	-	-
OH + CH ₃ SH → CH ₃ S + H ₂ O	9.9x10 ⁻¹²	-(360±100)	3.3x10 ⁻¹¹	1.2
OH + CH ₃ SCH ₃ → H ₂ O + CH ₂ SCH ₃	1.2x10 ⁻¹¹	260±100	5.0x10 ⁻¹²	1.15
OH + CH ₃ SSCH ₃ → products	6.0x10 ⁻¹¹	-(400±200)	2.3x10 ⁻¹⁰	1.2
OH + S → H + SO	-	-	6.6x10 ⁻¹¹	3.0
OH + SO → H + SO ₂	-	-	8.6x10 ⁻¹¹	2.0
HO ₂ + H ₂ S → products	-	-	<3.0x10 ⁻¹⁵	-
HO ₂ + CH ₃ SH → products	-	-	<4.0x10 ⁻¹⁵	-
HO ₂ + CH ₃ SCH ₃ → products	-	-	<5.0x10 ⁻¹⁵	-
HO ₂ + SO ₂ → products	-	-	<1.0x10 ⁻¹⁸	-
NO ₂ + SO ₂ → products	-	-	<2.0x10 ⁻²⁶	-
NO ₃ + H ₂ S → products	-	-	<8.0x10 ⁻¹⁶	-
NO ₃ + OCS → products	-	-	<1.0x10 ⁻¹⁶	-
NO ₃ + CS ₂ → products	-	-	<4.0x10 ⁻¹⁶	-
NO ₃ + CH ₃ SH → products	4.4x10 ⁻¹³	-(210±210)	8.9x10 ⁻¹³	1.25
NO ₃ + CH ₃ SCH ₃ → CH ₃ SCH ₂ + HNO ₃	1.9x10 ⁻¹³	-(500±200)	1.0x10 ⁻¹²	1.2
NO ₃ + CH ₃ SSCH ₃ → products	1.3x10 ⁻¹²	270±270	5.3x10 ⁻¹³	1.4
NO ₃ + SO ₂ → products	-	-	<7.0x10 ⁻²¹	-
N ₂ O ₅ + CH ₃ SCH ₃ → products	-	-	<1.0x10 ⁻¹⁷	-
CH ₃ O ₂ + SO ₂ → products	-	-	<5.0x10 ⁻¹⁷	-
F + CH ₃ SCH ₃ → products	-	-	2.4x10 ⁻¹⁰	2.0

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
Cl + H ₂ S → HCl + SH	3.7x10 ⁻¹¹	-(210±100)	7.4x10 ⁻¹¹	1.25
Cl + OCS → products	-	-	<1.0x10 ⁻¹⁶	-
Cl + CS ₂ → products	-	-	<4.0x10 ⁻¹⁵	-
Cl + CH ₃ SH → CH ₃ S + HCl	1.2x10 ⁻¹⁰	-(150±50)	2.0x10 ⁻¹⁰	1.25
Cl + CH ₃ SCH ₃ → products	See reference	-	-	-
ClO + OCS → products	-	-	<2.0x10 ⁻¹⁶	-
ClO + CH ₃ SCH ₃ → products	-	-	9.5x10 ⁻¹⁵	2.0
ClO + SO → Cl + SO ₂	2.8x10 ⁻¹¹	0±50	2.8x10 ⁻¹¹	1.3
ClO + SO ₂ → Cl + SO ₃	-	-	<4.0x10 ⁻¹⁸	-
Br + H ₂ S → HBr + SH	1.4x10 ⁻¹¹	2750±300	1.4x10 ⁻¹⁵	2.0
Br + CH ₃ SH → CH ₃ S + HBr	9.2x10 ⁻¹²	390±100	2.5x10 ⁻¹²	2.0
Br + CH ₃ SCH ₃ → products	See reference	-	-	-
BrO + CH ₃ SCH ₃ → products	1.5x10 ⁻¹⁴	-(850±200)	2.6x10 ⁻¹³	1.3
BrO + SO → Br + SO ₂	-	-	5.7x10 ⁻¹¹	1.4
IO + CH ₃ SH → products	-	-	6.6x10 ⁻¹⁶	2.0
IO + CH ₃ SCH ₃ → products	-	-	1.2x10 ⁻¹⁴	1.5
S + O ₂ → SO + O	2.3x10 ⁻¹²	0±200	2.3x10 ⁻¹²	1.2
S + O ₃ → SO + O ₂	-	-	1.2x10 ⁻¹¹	2.0
SO + O ₂ → SO ₂ + O	2.6x10 ⁻¹³	2400±500	8.4x10 ⁻¹⁷	2.0
SO + O ₃ → SO ₂ + O ₂	3.6x10 ⁻¹²	1100±200	9.0x10 ⁻¹⁴	1.2
SO + NO ₂ → SO ₂ + NO	1.4x10 ⁻¹¹	0±50	1.4x10 ⁻¹¹	1.2
SO + OCIO → SO ₂ + ClO	-	-	1.9x10 ⁻¹²	3.0
SO ₃ + H ₂ O → products	See reference	-	-	-
SO ₃ + NO ₂ → products	-	-	1.0x10 ⁻¹⁹	10.0
SH + O ₂ → OH + SO	-	-	<4.0x10 ⁻¹⁹	-
SH + O ₃ → HSO + O ₂	9.0x10 ⁻¹²	280±200	3.5x10 ⁻¹²	1.3
SH + H ₂ O ₂ → products	-	-	<5.0x10 ⁻¹⁵	-
SH + NO ₂ → HSO + NO	2.9x10 ⁻¹¹	-(240±50)	6.5x10 ⁻¹¹	1.2
SH + Cl ₂ → ClSH + Cl	1.7x10 ⁻¹¹	690±200	1.7x10 ⁻¹²	2.0
SH + BrCl → products	2.3x10 ⁻¹¹	-(350±200)	7.4x10 ⁻¹¹	2.0
SH + Br ₂ → BrSH + Br	6.0x10 ⁻¹¹	-(160±160)	1.0x10 ⁻¹⁰	2.0
SH + F ₂ → FSH + F	4.3x10 ⁻¹¹	1390±200	4.0x10 ⁻¹³	2.0
HSO + O ₂ → products	-	-	<2.0x10 ⁻¹⁷	-
HSO + O ₃ → products	-	-	1.0x10 ⁻¹³	1.3
HSO + NO → products	-	-	<1.0x10 ⁻¹⁵	-
HSO + NO ₂ → HSO ₂ + NO	-	-	9.6x10 ⁻¹²	2.0
HSO ₂ + O ₂ → HO ₂ + SO ₂	-	-	3.0x10 ⁻¹³	3.0
HOSO ₂ + O ₂ → HO ₂ + SO ₃	1.3x10 ⁻¹²	330±200	4.4x10 ⁻¹³	1.2
CS + O ₂ → OCS + O	-	-	2.9x10 ⁻¹⁹	2.0
CS + O ₃ → OCS + O ₂	-	-	3.0x10 ⁻¹⁶	3.0
CS + NO ₂ → OCS + NO	-	-	7.6x10 ⁻¹⁷	3.0
CH ₃ S + O ₂ → products	-	-	<3.0x10 ⁻¹⁸	-
CH ₃ S + O ₃ → products	2.0x10 ⁻¹²	-(290±100)	5.3x10 ⁻¹²	1.15
CH ₃ S + NO → products	-	-	<1.0x10 ⁻¹³	-
CH ₃ S + NO ₂ → CH ₃ SO + NO	2.1x10 ⁻¹¹	-(320±100)	6.1x10 ⁻¹¹	1.15
CH ₂ SH + O ₂ → products	-	-	6.5x10 ⁻¹²	2.0
CH ₂ SH + O ₃ → products	-	-	3.5x10 ⁻¹¹	2.0
CH ₂ SH + NO → products	-	-	1.9x10 ⁻¹¹	2.0
CH ₂ SH + NO ₂ → products	-	-	5.2x10 ⁻¹¹	2.0
CH ₃ SO + O ₃ → products	-	-	6.0x10 ⁻¹³	1.5
CH ₃ SO + NO ₂ → CH ₃ SO ₂ + NO	-	-	1.2x10 ⁻¹¹	1.4
CH ₃ SOO + O ₃ → products	-	-	<8.0x10 ⁻¹³	-
CH ₃ SOO + NO → products	1.1x10 ⁻¹¹	0±100	1.1x10 ⁻¹¹	2.0
CH ₃ SO ₂ + NO ₂ → products	2.2x10 ⁻¹¹	0±100	2.2x10 ⁻¹¹	2.0
CH ₃ SCH ₂ + NO ₃ → products	-	-	3.0 x 10 ⁻¹⁰	2.0
CH ₃ SCH ₂ O ₂ + NO → CH ₃ SCH ₂ O + NO ₂	-	-	1.9 x 10 ⁻¹¹	2.0

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 1. Rate Constants for Second Order Reactions (continued)

Reaction	<i>A</i> cm ³ molecule ⁻¹ s ⁻¹	<i>E/R</i> K	<i>k</i> (298 K) cm ³ molecule ⁻¹ s ⁻¹	<i>f</i> (298)
CH ₃ SS + O ₃ → products			4.6x10 ⁻¹³	2.0
CH ₃ SS + NO ₂ → products			1.8x10 ⁻¹¹	2.0
CH ₃ SSO + NO ₂ → products			4.5x10 ⁻¹²	2.0
Metal Reactions				
Na + O ₃ → NaO + O ₂	1.0x10 ⁻⁹	95±50	7.3x10 ⁻¹⁰	1.2
→ NaO ₂ + O	-	-	<4.0x10 ⁻¹¹	-
Na + N ₂ O → NaO + N ₂	2.8x10 ⁻¹⁰	1600±400	1.3x10 ⁻¹²	1.2
Na + Cl ₂ → NaCl + Cl	7.3x10 ⁻¹⁰	0±200	7.3x10 ⁻¹⁰	1.3
NaO + O → Na + O ₂	3.7x10 ⁻¹⁰	0±400	3.7x10 ⁻¹⁰	3.0
NaO + O ₃ → NaO ₂ + O ₂	1.1x10 ⁻⁹	570±300	1.6x10 ⁻¹⁰	1.5
→ Na + 2O ₂	6.0x10 ⁻¹¹	0±800	6.0x10 ⁻¹¹	3.0
NaO + H ₂ → NaOH + H	2.6x10 ⁻¹¹	0±600	2.6x10 ⁻¹¹	2.0
NaO + H ₂ O → NaOH + OH	2.2x10 ⁻¹⁰	0±400	2.2x10 ⁻¹⁰	2.0
NaO + NO → Na + NO ₂	1.5x10 ⁻¹⁰	0±400	1.5x10 ⁻¹⁰	4.0
NaO + HCl → products	2.8x10 ⁻¹⁰	0±400	2.8x10 ⁻¹⁰	3.0
NaO ₂ + O → NaO + O ₂	2.2x10 ⁻¹¹	0±600	2.2x10 ⁻¹¹	5.0
NaO ₂ + NO → NaO + NO ₂	-	-	<10 ⁻¹⁴	-
NaO ₂ + HCl → products	2.3x10 ⁻¹⁰	0±400	2.3x10 ⁻¹⁰	3.0
NaOH + HCl → NaCl + H ₂ O	2.8x10 ⁻¹⁰	0±400	2.8x10 ⁻¹⁰	3.0

Table 2. Rate Constants for Association Reactions

The values quoted are suitable for air as the third body, M. The integer in parentheses is the power of ten.

Reaction	Low pressure limit		High pressure limit	
	$k_0(T) = k_0(300) (T/300)^{-n}$ cm ⁶ molecule ⁻² s ⁻¹	<i>n</i>	$k_\infty(T) = k_\infty(300) (T/300)^{-m}$ cm ³ molecule ⁻¹ s ⁻¹	<i>m</i>
<i>O_x Reactions</i>				
O + O ₂ → O ₃	(6.0±0.5) (-34)	2.3±0.5	-	-
<i>O(¹D) Reactions</i>				
O(¹ D) + N ₂ → N ₂ O	(3.5±3.0) (-37)	0.6	-	-
<i>HO_x Reactions</i>				
H + O ₂ → HO ₂	(5.7±0.5) (-32)	1.6±0.5	(7.5±4.0) (-11)	0±1.0
OH + OH → H ₂ O ₂	(6.2±1.2) (-31)	1.0	(2.6±1.0) (-11)	0±0.5
<i>NO_x Reactions</i>				
O + NO → NO ₂	(9.0±2.0) (-32)	1.5±0.3	(3.0±1.0) (-11)	0±1.0
O + NO ₂ → NO ₃	(9.0±1.0) (-32)	2.0±1.0	(2.2±0.3) (-11)	0±1.0
OH + NO → HONO	(7.0±1.0) (-31)	2.6±0.3	(3.6±1.0) (-11)	0.1±0.5
OH + NO ₂ → HNO ₃	(2.5±0.1) (-30)	4.4±0.3	(1.6±0.2) (-11)	1.7±0.2
HO ₂ + NO ₂ → HO ₂ NO ₂	(1.8±0.3) (-31)	3.2±0.4	(4.7±1.0) (-12)	1.4±1.4
NO ₂ + NO ₃ → N ₂ O ₅	(2.2±0.5) (-30)	3.9±1.0	(1.5±0.8) (-12)	0.7±0.4
NO ₃ → NO + O ₂	See reference			
<i>Hydrocarbon Reactions</i>				
CH ₃ + O ₂ → CH ₃ O ₂	(4.5±1.5) (-31)	3.0±1.0	(1.8±0.2) (-12)	1.7±1.7
C ₂ H ₅ + O ₂ → C ₂ H ₅ O ₂	(1.5±1.0) (-28)	3.0±1.0	(8.0±1.0) (-12)	0±1.0
OH + C ₂ H ₂ → HOCHCH	(5.5±2.0) (-30)	0.0±0.2	(8.3±1.0) (-13)	-2
OH + C ₂ H ₄ → HOCH ₂ CH ₂	(1.0±0.6) (-28)	0.8±2.0	(8.8±0.9) (-12)	0

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 2. Rate Constants for Association Reactions (continued)

The values quoted are suitable for air as the third body, M. The integer in parentheses is the power of ten.

Reaction	Low pressure limit		High pressure limit	
	$k_0(T) = k_0(300) (T/300)^{-n} \text{ cm}^6 \text{ molecule}^{-2} \text{ s}^{-1}$	n	$k_\infty(T) = k_\infty(300) (T/300)^{-m} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	m
CH ₃ O + NO → CH ₃ ONO	(1.4±0.5) (-29)	3.8±1.0	(3.6±1.6) (-11)	0.6±1.0
CH ₃ O + NO ₂ → CH ₃ ONO ₂	(1.1±0.4) (-28)	4.0±2.0	(1.6±0.5) (-11)	1.0±1.0
C ₂ H ₅ O + NO → C ₂ H ₅ ONO	(2.8±1.0) (-27)	4.0±2.0	(5.0±1.0) (-11)	1.0±1.0
C ₂ H ₅ O + NO ₂ → C ₂ H ₅ ONO ₂	(2.0±1.0) (-27)	4.0±2.0	(2.8±0.4) (-11)	1.0±1.0
CH ₃ O ₂ + NO ₂ → CH ₃ O ₂ NO ₂	(1.5±0.8) (-30)	4.0±2.0	(6.5±3.2) (-12)	2.0±2.0
CH ₃ C(O)O ₂ + NO ₂ → CH ₃ C(O)O ₂ NO ₂	(9.7±3.8) (-29)	5.6±2.8	(9.3±0.4) (-12)	1.5±0.3
<i>FO_x Reactions</i>				
F + O ₂ → FO ₂	(4.4±0.4) (-33)	1.2±0.5	-	-
F + NO → FNO	(1.8±0.3) (-31)	1.0±10	(2.8±1.4) (-10)	0.0±1.0
F + NO ₂ → FNO ₂	(6.3±3.0) (-32)	2.0±2.0	(2.6±1.3) (-10)	0.0±1.0
FO + NO ₂ → FONO ₂	(2.6±2.0) (-31)	1.3±1.3	(2.0±1.0) (-11)	1.5±1.5
CF ₃ + O ₂ → CF ₃ O ₂	(3.0±0.3) (-29)	4.0±2.0	(4.0±1.0) (-12)	1.0±1.0
CF ₃ O + NO ₂ → CF ₃ ONO ₂	See reference			
CF ₃ O ₂ + NO ₂ → CF ₃ O ₂ NO ₂	(2.2±0.5) (-29)	5.0±1.0	(6.0±1.0) (-12)	2.5±1.0
CF ₃ O + CO → CF ₃ OCO	(2.5±0.2) (-31)	-	(6.8±0.4) (-14)	-1.2
CF ₃ O → CF ₂ O + F	See reference			
<i>ClO_x Reactions</i>				
Cl + O ₂ → ClOO	(2.7±1.0) (-33)	1.5±0.5	-	-
Cl + NO → ClNO	(9.0±2.0) (-32)	1.6±0.5	-	-
Cl + NO ₂ → ClONO → ClONO ₂	(1.3±0.2) (-30)	2.0±1.0	(1.0±0.5) (-10)	1.0±1.0
Cl + CO → ClCO	(1.8±0.3) (-31)	2.0±1.0	(1.0±0.5) (-10)	1.0±1.0
Cl + C ₂ H ₂ → ClC ₂ H ₂	(1.3±0.5) (-33)	3.8±0.5	-	-
Cl + C ₂ H ₄ → ClC ₂ H ₄	((5.9±1.0) (-30)	2.1±1.0	(2.1±0.4) (-10)	1.0±0.5
Cl + C ₂ H ₆ → ClC ₂ H ₆	(1.6±1) (-29)	3.3±1.0	(3.1±2) (-10)	1.0±0.5
Cl + C ₂ Cl ₄ → C ₂ Cl ₅	(1.4±0.6) (-28)	8.5±1.0	(4.0±1.0) (-11)	1.2±0.5
ClO + NO ₂ → ClONO ₂	(1.8±0.3) (-31)	3.4±1.0	(1.5±0.7) (-11)	1.9±1.9
ClO + NO ₃ → O ₂ ClONO ₂	See reference			
ClO + ClO → Cl ₂ O ₂	(2.2±0.4) (-32)	3.1±0.5	(3.5±2) (-12)	1.0±1.0
ClO + OClO → Cl ₂ O ₃	(6.2±1.0) (-32)	4.7±0.6	(2.4±1.2) (-11)	0±1.0
OClO + O → ClO ₃	(1.9±0.5) (-31)	1.1±1.0	(3.1±0.8) (-11)	0±1.0
CH ₂ Cl + O ₂ → CH ₂ ClO ₂	(1.9±0.1) (-30)	3.2±0.2	(2.9±0.2) (-12)	1.2±0.6
CHCl ₂ + O ₂ → CHCl ₂ O ₂	(1.3±0.1) (-30)	4.0±0.2	(2.8±0.2) (-12)	1.4±0.6
CCl ₃ + O ₂ → CCl ₃ O ₂	(6.9±0.2) (-31)	6.4±0.3	(2.4±0.2) (-12)	2.1±0.6
CFCl ₂ + O ₂ → CFCl ₂ O ₂	(5.0±0.8) (-30)	4.0±2.0	(6.0±1.0) (-12)	1.0±1.0
CF ₂ Cl + O ₂ → CF ₂ ClO ₂	(3.0±1.5) (-30)	4.0±2.0	(3±2) (-12)	1.0±1.0
CCl ₃ O ₂ + NO ₂ → CCl ₃ O ₂ NO ₂	(5.0±1.0) (-29)	5.0±1.0	(6.0±1.0) (-12)	2.5±1.0
CFCl ₂ O ₂ + NO ₂ → CFCl ₂ O ₂ NO ₂	(3.5±0.5) (-29)	5.0±1.0	(6.0±1.0) (-12)	2.5±1.0
CF ₂ ClO ₂ + NO ₂ → CF ₂ ClO ₂ NO ₂	(3.3±0.7) (-29)	6.7±1.3	(4.1±1.9) (-12)	2.8±0.7
<i>BrO_x Reactions</i>				
Br + NO ₂ → BrNO ₂	(4.2±0.8) (-31)	2.4±0.5	(2.7±0.5) (-11)	0±1.0
BrO + NO ₂ → BrONO ₂	(5.2±0.6) (-31)	3.2±0.8	(6.9±1.0) (-12)	2.9±1.0
<i>IO_x Reactions</i>				
I + NO → INO	(1.8±0.5) (-32)	1.0±0.5	(1.7±1.0) (-11)	0±1.0
I + NO ₂ → INO ₂	(3.0±1.5) (-31)	1.0±1.0	(6.6±5.0) (-11)	0±1.0
IO + NO ₂ → IONO ₂	(5.9±2.0) (-31)	3.5±1.0	(9.0±1.0) (-12)	1.5±1.0

CHEMICAL KINETIC DATA FOR STRATOSPHERIC MODELING (continued)

Table 2. Rate Constants for Association Reactions (continued)

The values quoted are suitable for air as the third body, M. The integer in parentheses is the power of ten.

Reaction	Low pressure limit		High pressure limit	
	$k_0(T) = k_0(300) (T/300)^{-n} \text{ cm}^6 \text{ molecule}^{-2} \text{ s}^{-1}$	n	$k_\infty(T) = k_\infty(300) (T/300)^{-m} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	m
<i>SO_x Reactions</i>				
HS + NO → HSNO	(2.4±0.4) (-31)	3.0±1.0	(2.7±0.5) (-11)	0
CH ₃ S + NO → CH ₃ SNO	(3.2±0.4) (-29)	4.0±1.0	(3.9±0.6) (-11)	2.7±1.0
O + SO ₂ → SO ₃	(1.3±)(-33)	-3.6±0.7		
OH + SO ₂ → HOSO ₂	(3.0±1.0) (-31)	3.3±1.5	(1.5±0.5) (-12)	0
CH ₃ SCH ₂ + O ₂ → CH ₃ SCH ₂ O ₂	See reference			
SO ₃ + NH ₃ → H ₃ NSO ₃	(3.9±0.8) (-30)	3.0±3.0	(4.7±1.3) (-11)	0±1.0
<i>Metal Reactions</i>				
Na + O ₂ → NaO ₂	(3.2±0.3) (-30)	1.4±0.3	(6.0±2.0) (-10)	0±1.0
NaO + O ₂ → NaO ₃	(3.5±0.7) (-30)	2.0±2.0	(5.7±3.0) (-10)	0±1.0
NaO + CO ₂ → NaCO ₃	(8.7±2.6) (-28)	2.0±2.0	(6.5±3.0) (-10)	0±1.0
NaOH + CO ₂ → NaHCO ₃	(1.3±0.3) (-28)	2.0±2.0	(6.8±4.0) (-10)	0±1.0

Table 3. Equilibrium Constants

$K(T)/\text{cm}^3 \text{ molecule}^{-1} = A \exp(B/T) \quad [200 < T/K < 300]$

Reaction	$A/\text{cm}^3 \text{ molecule}^{-1}$	B/K	$K(298 \text{ K})$	$f(298 \text{ K})$
HO ₂ + NO ₂ → HO ₂ NO ₂	2.1x10 ⁻²⁷	10900±1000	1.6x10 ⁻¹¹	5
NO + NO ₂ → N ₂ O ₃	3.3x10 ⁻²⁷	4667±100	2.1x10 ⁻²⁰	2
NO ₂ + NO ₂ → N ₂ O ₄	5.2x10 ⁻²⁹	6643±250	2.5x10 ⁻¹⁹	2
NO ₂ + NO ₃ → N ₂ O ₅	2.7x10 ⁻²⁷	11000±500	2.9x10 ⁻¹¹	1.3
CH ₃ O ₂ + NO ₂ → CH ₃ O ₂ NO ₂	1.3x10 ⁻²⁸	11200±1000	2.7x10 ⁻¹²	2
CH ₃ C(O)O ₂ + NO ₂ → CH ₃ C(O)O ₂ NO ₂	9.0x10 ⁻²⁹	14000±200	2.3x10 ⁻⁸	2
F + O ₂ → FOO	3.2x10 ⁻²⁵	6100±1200	2.5x10 ⁻¹⁶	1.0
Cl + O ₂ → ClOO	5.7x10 ⁻²⁵	2500±750	2.5x10 ⁻²¹	2
Cl + CO → ClCO	1.6x10 ⁻²⁵	4000±500	1.1x10 ⁻¹⁹	5
ClO + O ₂ → ClO-O ₂	2.9x10 ⁻²⁶	<3700	<7.2x10 ⁻²¹	-
ClO + ClO → Cl ₂ O ₂	1.3x10 ⁻²⁷	8744±850	7.2x10 ⁻¹⁵	1.5
ClO + OClO → Cl ₂ O ₃	1.1x10 ⁻²⁴	5455±300	9.8x10 ⁻¹⁷	3
OCIO + NO ₃ → O ₂ ClONO ₂	1x10 ⁻²⁸	9300±1000	3.6x10 ⁻¹⁵	5
OH + CS ₂ → CS ₂ OH	4.5x10 ⁻²⁵	5140±500	1.4x10 ⁻¹⁷	1.4
CH ₃ S + O ₂ → CH ₃ SO ₂	1.8x10 ⁻²⁷	5545±300	2.2x10 ⁻¹⁹	1.4

KINETIC DATA FOR COMBUSTION MODELLING

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The following tables present evaluated rate constants and other chemical kinetic data required for modelling the combustion of hydrocarbons. The compilation was prepared as part of the project "Kinetics and Mechanisms of Chemical Processes in Combustion", which is one of the projects in the third European Community Energy Research and Development Program. The tables are reprinted from the *Journal of Physical and Chemical Reference Data* by permission of the authors and the American Institute of Physics.

Table 1 lists all the reactions studied and gives the recommended rate constant k for every bimolecular reaction, as well as the applicable temperature range and the associated error limits. Where more than one set of products is possible, rate constants or branching ratios are given for all channels considered feasible. The data for decomposition reactions and combination reactions are given in Tables 2 and 3, respectively. The reference includes a detailed data sheet for each reaction listed here, covering the thermodynamic data, kinetic measurements, and reliability assessments.

REFERENCE

Baulch, D. L., et al., *J. Phys. Chem. Ref. Data*, 21, 411-734, 1992.

Table 1
BIMOLECULAR REACTIONS

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
<i>O Atom Reactions</i>			
$\text{O} + \text{H}_2 \rightarrow \text{OH} + \text{H}$	$8.5 \times 10^{-20} T^{2.67} \exp(-3160/T)$	300-2500	± 0.5 at 300 K falling to ± 0.2 for $T > 500$ K
$\text{O} + \text{OH} \rightarrow \text{O}_2 + \text{H}$	$2.0 \times 10^{-11} \exp(112/T)$ $2.4 \times 10^{-11} \exp(-353/T)$	220-500 1000-2000	± 0.2 ± 0.1
$\text{O} + \text{HO}_2 \rightarrow \text{OH} + \text{O}_2$	5.3×10^{-11}	300-1000	± 0.3 at 300 K rising to ± 0.5 at 1000 K.
$\text{O} + \text{H}_2\text{O}_2 \rightarrow \text{OH} + \text{HO}_2$	$1.1 \times 10^{-12} \exp(-2000/T)$	300-500	± 0.3
$\text{O} + \text{NH}_3 \rightarrow \text{OH} + \text{NH}_2$	$1.6 \times 10^{-11} \exp(-3670/T)$	500-2500	± 0.5
$\text{O} + \text{CH} \rightarrow \text{CO} + \text{H}$ $\quad \quad \quad \rightarrow \text{CHO}^+ + e$	6.6×10^{-11} $4.2 \times 10^{-13} \exp(-850/T)$	300-2000 300-2500	± 0.5 ± 0.5
$\text{O} + {}^3\text{CH}_2 \rightarrow \text{CO} + 2\text{H}$] $\quad \quad \quad \rightarrow \text{CO} + \text{H}_2$]	2×10^{-10} $k_1/k_2 = 0.6 \pm 0.3$ over whole range	300-2500	± 0.2 at 300 K rising to ± 0.7 at 2500 K.
$\text{O} + \text{CH}_3 \rightarrow \text{HCHO} + \text{H}$	1.4×10^{-10}	300-2500	± 0.2
$\text{O} + \text{CH}_4 \rightarrow \text{OH} + \text{CH}_3$	$1.5 \times 10^{-15} T^{1.56} \exp(-4270/T)$	300-2500	± 0.3 at 300 K falling to ± 0.15 at 2500 K.
$\text{O} + \text{CHO} \rightarrow \text{OH} + \text{CO}$ $\quad \quad \quad \rightarrow \text{CO}_2 + \text{H}$	5.0×10^{-11} 5.0×10^{-11}	300-2500 300-2500	± 0.3 ± 0.3
$\text{O} + \text{HCHO} \rightarrow \text{OH} + \text{CHO}$	$6.9 \times 10^{-13} T^{0.57} \exp(-1390/T)$	250-2200	± 0.1 at 250 K rising to ± 0.3 at 2200 K.
$\text{O} + \text{CH}_3\text{O} \rightarrow \text{O}_2 + \text{CH}_3$] $\quad \quad \quad \rightarrow \text{OH} + \text{HCHO}$]	2.5×10^{-11} $k_2/k_1 = (0.12 \pm 0.1)$ at 300 K	300-1000	± 0.3 at 300 K rising to ± 0.7 at 1000 K.
$\text{O} + \text{CN} \rightarrow \text{CO} + \text{N}({}^4\text{S})$] $\quad \quad \quad \rightarrow \text{CO} + \text{N}({}^2\text{D})$]	1.7×10^{-11}	300-5000	± 0.2 at 300 K rising to ± 0.6 at 5000 K.
$\text{O} + \text{NCO} \rightarrow \text{NO} + \text{CO}$] $\quad \quad \quad \rightarrow \text{O}_2 + \text{CN}$]	7.0×10^{-11}	1450-2600	± 0.8

KINETIC DATA FOR COMBUSTION MODELLING (continued)

Table 1
BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
$\text{O} + \text{HCN} \rightarrow \text{NCO} + \text{H}$ $\rightarrow \text{CO} + \text{NH}$ $\rightarrow \text{OH} + \text{CN}$]	$2.3 \times 10^{-18} T^{2.1} \exp(-3075/T)$	450-2500	± 0.2 at 450 K rising to ± 0.3 at 2500 K.
$\text{O} + \text{CH}_3\text{OOH} \rightarrow \text{OH} + \text{CH}_2\text{COOH}$ $\rightarrow \text{OH} + \text{CH}_3\text{O}_2$]	$6.9 \times 10^{-13} T^{0.57} \exp(-1390/T)$ [estimate]	250-2200	± 0.1 at 250 K rising to ± 0.3 at 2200 K.
$\text{O} + \text{C}_2\text{H} \rightarrow \text{CO} + \text{CH}$	1.7×10^{-11}	300-2500	± 1.0
$\text{O} + \text{C}_2\text{H}_2 \rightarrow \text{CO} + {}^3\text{CH}_2$ $\rightarrow \text{CHCO} + \text{H}$]	$3.6 \times 10^{-20} T^{2.8} \exp(-250/T)$ $k_1/k_2 = 0.5 \pm 0.3$ over whole range.	300-2500	± 0.2
$\text{O} + \text{C}_2\text{H}_3 \rightarrow \text{OH} + \text{C}_2\text{H}_2$ $\rightarrow \text{CO} + \text{CH}_3$ $\rightarrow \text{HCO} + \text{CH}_2$]	5×10^{-11}	300-2000	± 0.5
$\text{O} + \text{C}_2\text{H}_4 \rightarrow \text{CH}_2\text{CHO} + \text{H}$ $\rightarrow \text{HCO} + \text{CH}_3$ $\rightarrow \text{HCHO} + \text{CH}_2$ $\rightarrow \text{CH}_2\text{CO} + \text{H}_2$]	$5.75 \times 10^{-18} T^{2.08}$ $k_1/k_2 = 0.35 \pm 0.05$ at $p > 3$ Torr $k_2/k_3 = 0.6 \pm 0.10$	300-2000 over whole temperature range	± 0.1 for $T < 1000$ K rising to ± 0.3 at 2000 K.
$\text{O} + \text{C}_2\text{H}_5 \rightarrow \text{CH}_3\text{CHO} + \text{H}$ $\rightarrow \text{HCHO} + \text{CH}_3$]	1.1×10^{-10} $k_2/k_3 = 0.17 \pm 0.2$ at 300 K	300-2500	± 0.3 from 300 to 1000 K ± 0.5 from 1000 to 2500 K
$\text{O} + \text{C}_2\text{H}_6 \rightarrow \text{OH} + \text{C}_2\text{H}_5$	$1.66 \times 10^{-15} T^{1.5} \exp(-2920/T)$	300-1200	± 0.3 at 300 K falling to ± 0.15 at 1200 K.
$\text{O} + \text{CHCO} \rightarrow 2\text{CO} + \text{H}$	1.6×10^{-10}	300-2500	± 0.3
$\text{O} + \text{CH}_2\text{CO} \rightarrow \text{CH}_2\text{O} + \text{CO}$ $\rightarrow \text{HCO} + \text{H} + \text{CO}$ $\rightarrow \text{HCO} + \text{HCO}$]	$3.8 \times 10^{-12} \exp(-680/T)$	230-500	± 0.3
$\text{O} + \text{CH}_3\text{CHO} \rightarrow \text{OH} + \text{CH}_3\text{CO}$ $\rightarrow \text{OH} + \text{CH}_2\text{CHO}$]	$9.7 \times 10^{-12} \exp(-910/T)$	300-1500	± 0.05 at 300 K rising to ± 0.5 at 1500 K.
$\text{O} + \text{C}_2\text{H}_5\text{OOH} \rightarrow \text{OH} + \text{C}_2\text{H}_4\text{OOH}$ $\rightarrow \text{OH} + \text{C}_2\text{H}_5\text{OO}$]	$6.9 \times 10^{-13} T^{0.57} \exp(-1390/T)$ [estimate]	250-2200	± 0.1 at 150 K rising to ± 0.3 at 2200 K.
$\text{O} + \text{C}_6\text{H}_6 \rightarrow \text{OH} + \text{C}_6\text{H}_5$ $\rightarrow \text{C}_6\text{H}_5\text{OH}$]	$1.2 \times 10^{-22} T^{3.7} \exp(-570/T)$	300-1000	± 0.5
$\text{O} + \text{C}_6\text{H}_5\text{CH}_2 \rightarrow \text{HCO} + \text{C}_6\text{H}_6$ $\rightarrow \text{C}_6\text{H}_5\text{CH} + \text{H}$ $\rightarrow \text{CH}_2\text{O} + \text{C}_6\text{H}_5$]	5.5×10^{-10} No recommendation	300	± 0.3
$\text{O} + \text{C}_6\text{H}_5\text{CH}_3 \rightarrow \text{products}$	$5.3 \times 10^{-15} T^{1.21} \exp(-1260/T)$	300-2800	± 0.1 at 300 K rising to ± 0.4 at 2800 K
$\text{O} + p\text{-C}_6\text{H}_4(\text{CH}_3)_2 \rightarrow \text{products}$	$2.6 \times 10^{-11} \exp(-1409/T)$	300-600	± 0.3
$\text{O} + \text{C}_6\text{H}_5\text{C}_2\text{H}_5 \rightarrow \text{products}$	1.0×10^{-13}	298	± 0.3
<i>O₂ Reactions</i>			
$\text{O}_2 + \text{CH}_4 \rightarrow \text{HO}_2 + \text{CH}_3$	$6.6 \times 10^{-11} \exp(-28630/T)$	500-2000	± 0.5 at 500 K rising to ± 1.0 at 2000 K.

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
$\text{O}_2 + \text{C}_2\text{H}_6 \rightarrow \text{HO}_2 + \text{C}_2\text{H}_5$	$1.0 \times 10^{-10} \exp(-26100/T)$	500-2000	± 0.5 at 500 K rising to ± 1.0 at 2000 K
$\text{O}_2 + \text{HCHO} \rightarrow \text{HO}_2 + \text{HCO}$	$1.0 \times 10^{-10} \exp(-20460/T)$	700-1000	± 0.5
$\text{O}_2 + \text{CH}_3\text{CHO} \rightarrow \text{HO}_2 + \text{CH}_3\text{CO}$	$5.0 \times 10^{-11} \exp(-19700/T)$	600-1100	± 0.5 at 600 K rising to ± 1.0 at 1100 K.
<i>H Atom Reactions</i>			
$\text{H} + \text{O}_2 \rightarrow \text{OH} + \text{O}$	$3.3 \times 10^{-10} \exp(-8460/T)$	300-2500	± 0.1 at 300 K rising to ± 0.2 at 2500 K.
$\text{H} + \text{O}_2 + \text{Ar} \rightarrow \text{HO}_2 + \text{Ar}$	See Table 3		
$\text{H} + \text{O}_2 + \text{H}_2 \rightarrow \text{HO}_2 + \text{H}_2$	See Table 3		
$\text{H} + \text{O}_2 + \text{N}_2 \rightarrow \text{HO}_2 + \text{N}_2$	See Table 3		
$\text{H} + \text{O}_2 + \text{H}_2\text{O} \rightarrow \text{HO}_2 + \text{H}_2\text{O}$	See Table 3		
$\text{H} + \text{H} + \text{Ar} \rightarrow \text{H}_2 + \text{Ar}$	See Table 3		
$\text{H} + \text{H} + \text{H}_2 \rightarrow \text{H}_2 + \text{H}_2$	See Table 3		
$\text{H} + \text{OH} + \text{H}_2\text{O} \rightarrow \text{H}_2\text{O} + \text{H}_2\text{O}$	See Table 3		
$\text{H} + \text{OH} + \text{Ar} \rightarrow \text{H}_2\text{O} + \text{Ar}$	See Table 3		
$\text{H} + \text{HO} + \text{N}_2 \rightarrow \text{H}_2\text{O} + \text{N}_2$	See Table 3		
$\text{H} + \text{HO}_2 \rightarrow \text{H}_2 + \text{O}_2$	$7.1 \times 10^{-11} \exp(-710/T)$	300-1000	± 0.3
$\rightarrow 2 \text{OH}$	$2.8 \times 10^{-10} \exp(-440/T)$	300-1000	± 0.3
$\rightarrow \text{H}_2\text{O} + \text{O}$	$5.0 \times 10^{-11} \exp(-866/T)$	300-1000	± 0.3
$\text{H} + \text{H}_2\text{O} \rightarrow \text{OH} + \text{H}_2$	$7.5 \times 10^{-16} T^{1.6} \exp(-9270/T)$	300-2500	± 0.2
$\text{H} + \text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{HO}_2$	$2.8 \times 10^{-12} \exp(-1890/T)$	300-1000	± 0.3
$\rightarrow \text{OH} + \text{H}_2\text{O}$	$1.7 \times 10^{-11} \exp(-1800/T)$	300-1000	± 0.3
$\text{H} + \text{NH} \rightarrow \text{H}_2 + \text{N}$	1.7×10^{-11}	1500-2500	± 1.0
$\text{H} + \text{NH}_2 \rightarrow \text{H}_2 + \text{NH}$	1.0×10^{-11}	2000-3000	± 1.0
$\text{H} + {}^3\text{CH}_2 \rightarrow \text{H}_2 + \text{CH}$	$1.0 \times 10^{-11} \exp(900/T)$	300-3000	± 0.7
$\text{H} + \text{CH}_3 \rightarrow \text{H}_2 + {}^1\text{CH}_2$	$1.0 \times 10^{-10} \exp(-7600/T)$	300-2500	± 1.0
$\rightarrow \text{CH}_4$	See Table 3		
$\text{H} + \text{CH}_4 \rightarrow \text{H}_2 + \text{CH}_3$	$2.2 \times 10^{-20} T^{3.0} \exp(-4045/T)$	300-2500	± 0.2
$\text{H} + \text{CHO} \rightarrow \text{H}_2 + \text{CO}$	1.5×10^{-10}	300-2500	± 0.3
$\text{H} + \text{HCHO} \rightarrow \text{H}_2 + \text{HCO}$	$3.8 \times 10^{-14} T^{1.05} \exp(-1650/T)$	300-2200	± 0.1 at 300 K rising to ± 0.5 at 2200 K
$\text{H} + \text{CH}_3\text{O} \rightarrow \text{H}_2 + \text{HCHO}$	3.0×10^{-11}	300-1000	± 0.5
$\text{H} + \text{HNCO} \rightarrow \text{NH}_2 + \text{CO}$	No recommendation		
$\rightarrow \text{H}_2 + \text{NCO}$	$3.4 \times 10^{-10} T^{-0.27} \exp(-10190/T)$	500-1000	± 1.0
$\text{H} + \text{NCO} \rightarrow \text{NH} + \text{CO}$	8.7×10^{-11}	1400-1500	± 0.5
$\rightarrow \text{HCN} + \text{O}$			

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
$\text{H} + \text{C}_2\text{H}_2 \rightarrow \text{H}_2 + \text{C}_2\text{H}$ $\quad \quad \quad \rightarrow \text{C}_2\text{H}_3$	$1.0 \times 10^{-10} \exp(-14000/T)$ See Table 3	1000–3000	± 1.0
$\text{H} + \text{C}_2\text{H}_3 \rightarrow \text{H}_2 + \text{C}_2\text{H}_2$ $\quad \quad \quad \rightarrow \text{C}_2\text{H}_4$	2.0×10^{-11} See Table 3	300–2500	± 0.5
$\text{H} + \text{C}_2\text{H}_4 \rightarrow \text{C}_2\text{H}_3 + \text{H}_2$ $\quad \quad \quad \rightarrow \text{C}_2\text{H}_5$	$9.0 \times 10^{-10} \exp(-7500/T)$ See Table 3	700–2000	± 0.5
$\text{H} + \text{C}_2\text{H}_5 \rightarrow 2\text{CH}_3$ $\quad \quad \quad \rightarrow \text{C}_2\text{H}_6$	6.0×10^{-11} See Table 3	300–2000	± 0.3
$\text{H} + \text{C}_2\text{H}_6 \rightarrow \text{H}_2 + \text{C}_2\text{H}_5$	$2.4 \times 10^{-15} T^{1.5} \exp(-3730/T)$	300–2000	± 0.15 at 300 K rising to ± 0.3 at 2000 K
$\text{H} + \text{CHCO} \rightarrow \text{CH}_2 + \text{CO}$ $\quad \quad \quad \rightarrow \text{H}_2 + \text{C}_2\text{O}$ $\quad \quad \quad \rightarrow \text{HCCOH}$]	2.5×10^{-10}	300–2500	± 0.4
$\text{H} + \text{CH}_2\text{CO} \rightarrow \text{CH}_3 + \text{CO}$ $\quad \quad \quad \rightarrow \text{CH}_2\text{CHO}$	$3.0 \times 10^{-11} \exp(-1700/T)$ k_2/k very small	200–2000	± 0.5 at 200 K rising to ± 1.0 at 2000 K.
$\text{H} + \text{CH}_3\text{CHO} \rightarrow \text{H}_2 + \text{CH}_3\text{CO}$ $\quad \quad \quad \rightarrow \text{H}_2 + \text{CH}_2\text{CHO}$]	$6.8 \times 10^{-15} T^{1.16} \exp(-1210/T)$	300–2000	± 0.1 at 300 rising to ± 0.4 at 2000 K.
$\text{H} + \text{C}_6\text{H}_5 + \text{M} \rightarrow \text{C}_6\text{H}_6 + \text{M}$	See Table 3		
$\text{H} + \text{C}_6\text{H}_6 \rightarrow \text{H}_2 + \text{C}_6\text{H}_5$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_7$	No recommendation See Table 3		
$\text{H} + \text{C}_6\text{H}_5\text{O} + \text{M} \rightarrow \text{C}_6\text{H}_5\text{OH} + \text{M}$	See Table 3		
$\text{H} + \text{C}_6\text{H}_5\text{OH} \rightarrow \text{C}_6\text{H}_5\text{O} + \text{H}_2$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_6 + \text{OH}$	$1.9 \times 10^{-10} \exp(-6240/T)$ $3.7 \times 10^{-11} \exp(-3990/T)$	1000–1150 1000–1150	± 0.3 ± 0.3
$\text{H} + \text{C}_6\text{H}_5\text{CH}_2 + \text{M} \rightarrow \text{C}_6\text{H}_5\text{CH}_3 + \text{M}$	See Table 3		
$\text{H} + \text{C}_6\text{H}_5\text{CH}_3 \rightarrow \text{H}_2 + \text{C}_6\text{H}_5\text{CH}_2$ $\quad \quad \quad \rightarrow \text{H}_2 + \text{C}_6\text{H}_4\text{CH}_3$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_6 + \text{CH}_3$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_6\text{CH}_3$	$6.6 \times 10^{-22} T^{3.44} \exp(-1570/T)$ No recommendation No recommendation See Table 3	600–2800	± 0.3 at 600 K rising to ± 0.5 at 2800 K.
$\text{H} + p\text{-C}_6\text{H}_4(\text{CH}_3)_2 \rightarrow \text{products}$	5.8×10^{-13}	298	± 0.1
$\text{H} + \text{C}_6\text{H}_5\text{C}_2\text{H}_5 \rightarrow \text{H}_2 + \text{C}_6\text{H}_5\text{C}_2\text{H}_4$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_6\text{C}_2\text{H}_5$	2.4×10^{-12} See Table 3	773	± 0.1
<i>H₂ Reactions</i>			
$\text{H}_2 + \text{Ar} \rightarrow 2\text{H} + \text{Ar}$	See Table 2		
$\text{H}_2 + \text{H}_2 \rightarrow 2\text{H} + \text{H}_2$	See Table 2		
<i>OH Radical Reactions</i>			
$\text{OH} + \text{H}_2 \rightarrow \text{H}_2\text{O} + \text{H}$	$1.7 \times 10^{-16} T^{1.6} \exp(-1660/T)$	300–2500	± 0.1 at 300 K rising to ± 0.3 at 2500 K
$\text{OH} + \text{OH} \rightarrow \text{H}_2\text{O} + \text{O}$	$2.5 \times 10^{-15} T^{1.14} \exp(-50/T)$	250–2500	± 0.2
$\text{OH} + \text{OH} + \text{M} \rightarrow \text{H}_2\text{O}_2 + \text{M}$	See Table 3		

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
$\text{OH} + \text{HO}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$	$4.8 \times 10^{-11} \exp(250/T)$	300–2000	± 0.2 at 300 K rising to ± 0.5 at 2000 K.
$\text{OH} + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{HO}_2$	$1.3 \times 10^{-11} \exp(-670/T)$	300–1000	± 0.2
$\text{OH} + \text{NH} \rightarrow \text{NO} + \text{H}_2$ $\quad \quad \quad \rightarrow \text{H}_2\text{O} + \text{N}$]	8.0×10^{-11}	300–1000	± 0.5
$\text{OH} + \text{NH}_2 \rightarrow \text{O} + \text{NH}_3$ $\quad \quad \quad \rightarrow \text{H}_2\text{O} + \text{NH}$	$3.3 \times 10^{-14} T^{0.405} \exp(-250/T)$ No recommendation	500–2500	± 0.5
$\text{OH} + \text{CO} \rightarrow \text{H} + \text{CO}_2$	$1.05 \times 10^{-17} T^{1.5} \exp(250/T)$	300–2000	± 0.2 at 300 K rising to ± 0.5 at 2000 K.
$\text{OH} + \text{CH}_3 \rightarrow \text{H} + \text{CH}_2\text{OH}$ $\quad \quad \quad \rightarrow \text{H} + \text{CH}_3\text{O}$] $\quad \quad \quad \rightarrow \text{H}_2\text{O} + {}^1\text{CH}_2$ $\quad \quad \quad \rightarrow \text{CH}_3\text{OH}$	6.0×10^{-11} See Table 3	300–2000	± 0.7
$\text{OH} + \text{CH}_4 \rightarrow \text{H}_2\text{O} + \text{CH}_3$	$2.6 \times 10^{-17} T^{1.83} \exp(-1400/T)$	250–2500	± 0.07 at 250 K rising to ± 0.15 at 1200 K.
$\text{OH} + \text{CHO} \rightarrow \text{H}_2\text{O} + \text{CO}$	1.7×10^{-10}	300–2500	± 0.3
$\text{OH} + \text{HCHO} \rightarrow \text{H}_2\text{O} + \text{CHO}$	$5.7 \times 10^{-15} T^{1.18} \exp(225/T)$	300–3000	± 0.1 at 300 K rising to ± 0.7 at 3000 K.
$\text{OH} + \text{CN} \rightarrow \text{O} + \text{HCN}$] $\quad \quad \quad \rightarrow \text{NCO} + \text{H}$]	1.0×10^{-10}	1500–3000	± 0.5
$\text{OH} + \text{HCN} \rightarrow \text{H}_2\text{O} + \text{CN}$ $\quad \quad \quad \rightarrow \text{HOCN} + \text{H}$] $\quad \quad \quad \rightarrow \text{HNCO} + \text{H}$]	$1.5 \times 10^{-11} \exp(-5400/T)$ No recommendation	1500–2500	± 0.5
$\text{OH} + \text{CH}_3\text{OOH} \rightarrow \text{H}_2\text{O} + \text{CH}_3\text{OO}$ $\quad \quad \quad \rightarrow \text{H}_2\text{O} + \text{CH}_2\text{OOH}$	$1.2 \times 10^{-12} \exp(130/T)$ $1.8 \times 10^{-12} \exp(220/T)$	300–1000 300–1000	± 0.2 at 300 K rising to ± 0.4 at 1000 K ± 0.1 at 300 K rising to ± 0.3 at 1000 K.
$\text{OH} + \text{C}_2\text{H}_2 \rightarrow \text{H}_2\text{O} + \text{C}_2\text{H}$] $\quad \quad \quad \rightarrow \text{H} + \text{CH}_2\text{CO}$] $\quad \quad \quad \rightarrow \text{C}_2\text{H}_2\text{OH}$	$1.0 \times 10^{-10} \exp(-6500/T)$ See Table 3	1000–2000	± 1.0
$\text{OH} + \text{C}_2\text{H}_4 \rightarrow \text{H}_2\text{O} + \text{C}_2\text{H}_3$	$3.4 \times 10^{-11} \exp(-2990/T)$	650–1500	± 0.5
$\text{OH} + \text{C}_2\text{H}_6 \rightarrow \text{H}_2\text{O} + \text{C}_2\text{H}_5$	$1.2 \times 10^{-17} T^{2.0} \exp(-435/T)$	250–2000	± 0.07 at 250 K rising to ± 0.15 at 2000 K.
$\text{OH} + \text{CH}_2\text{CO} \rightarrow \text{CH}_2\text{OH} + \text{CO}$] $\quad \quad \quad \rightarrow \text{H}_2\text{CO} + \text{HCO}$]	1.7×10^{-11}	300–2000	± 1.0
$\text{OH} + \text{CH}_3\text{CHO} \rightarrow \text{H}_2\text{O} + \text{CH}_3\text{CO}$] $\quad \quad \quad \rightarrow \text{H}_2\text{O} + \text{CH}_2\text{CHO}$]	$3.9 \times 10^{-14} T^{0.73} \exp(560/T)$	250–1200	± 0.1 at 250 K rising to ± 0.3 at 1200 K.
$\text{OH} + \text{C}_2\text{H}_5\text{OOH} \rightarrow \text{H}_2\text{O} + \text{C}_2\text{H}_5\text{OO}$] $\quad \quad \quad \rightarrow \text{H}_2\text{O} + \text{C}_2\text{H}_4\text{OOH}$]	$3.0 \times 10^{-12} \exp(190/T)$ [estimate]	250–1000	± 0.3 at 250 K rising to ± 0.7 at 1000 K.

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
OH + C ₆ H ₆ → H ₂ O + C ₆ H ₅	$2.7 \times 10^{-16} T^{1.42} \exp(-730/T)$	400–1500	± 0.3
→ H + C ₆ H ₅ OH	$2.2 \times 10^{-11} \exp(-5330/T)$	1000–1150	± 0.3
→ C ₆ H ₆ OH	See Table 3		
OH + C ₆ H ₅ OH → C ₆ H ₅ (OH) ₂	See Table 3		
→ H ₂ O + C ₆ H ₅ O	1.0×10^{-11}	1000–1150	± 0.5
→ H ₂ O + C ₆ H ₄ OH			
OH + C ₆ H ₅ CH ₃ → H ₂ O + C ₆ H ₅ CH ₂	$8.6 \cdot 10^{-15} T \exp(-1440/T)$	400–1200	± 0.5 at 400 K reducing to ± 0.3 at 1200 K.
See Table 3			
OH + <i>p</i> -C ₆ H ₄ (CH ₃) ₂ → C ₆ H ₄ CH ₂ CH ₃ + H ₂ O	$6.4 \times 10^{-11} \exp(-1440/T)$	500–960	± 0.1
→ <i>p</i> -C ₆ H ₄ (CH ₃) ₂ OH	See Table 3		
OH + C ₆ H ₅ C ₂ H ₅ → HOC ₆ H ₅ C ₂ H ₅	See Table 3		
→ H ₂ O + C ₆ H ₅ C ₂ H ₄	8.7×10^{-12}	773	± 0.1
→ H ₂ O + C ₆ H ₄ C ₂ H ₅			
<i>H₂O Reactions</i>			
H ₂ O + M → H + OH + M	See Table 2		
<i>HO₂ Radical Reactions</i>			
HO ₂ + HO ₂ → H ₂ O ₂ + O ₂	$3.1 \times 10^{-12} \exp(-775/T)$	550–1250	± 0.15 at 550 K rising to ± 0.3 at 1250 K.
HO ₂ + NH ₂ → NH ₃ + O ₂	2.6×10^{-11}	300–400	± 0.4
→ HNO + H ₂ O			
HO ₂ + CH ₃ → OH + CH ₃ O	3×10^{-11}	300–2500	± 0.7
→ O ₂ + CH ₄	No recommendation		
HO ₂ + CH ₄ → H ₂ O ₂ + CH ₃	$1.5 \times 10^{-11} \exp(-12400/T)$	600–1000	± 0.2 at 600 K rising to ± 0.3 at 1000 K.
HO ₂ + HCHO → H ₂ O ₂ + CHO	$5.0 \times 10^{-12} \exp(-6580/T)$	600–1000	± 0.5
HO ₂ + C ₂ H ₄ → OH + C ₂ H ₄ O	$3.7 \times 10^{-12} \exp(-8650/T)$	600–900	± 0.15 at 600 K rising to ± 0.25 at 900 K.
HO ₂ + C ₂ H ₆ → H ₂ O ₂ + C ₂ H ₅	$2.2 \times 10^{-11} \exp(-10300/T)$	500–1000	± 0.2 at 500 K rising to ± 0.3 at 1000 K.
HO ₂ + CH ₃ CHO → H ₂ O ₂ + CH ₃ CO	$5.0 \times 10^{-12} \exp(-6000/T)$	900–1200	± 0.7
<i>H₂O₂ Reactions</i>			
H ₂ O ₂ + M → 2OH + M	See Table 2		
<i>N Atom Reactions</i>			
N + CN → N ₂ + C	3×10^{-10}	300–2500	± 1.0
N + NCO → NO + CN	No recommendation		
→ N ₂ + CO	3.3×10^{-11}	1700	± 0.5

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
<i>NH Radical Reactions</i>			
$\text{NH} + \text{O}_2 \rightarrow \text{NO} + \text{OH}$ $\quad \rightarrow \text{NO}_2 + \text{H}$ $\quad \rightarrow \text{HNO} + \text{O}$	$1.26 \times 10^{-13} \exp(-770/T)$	270-550	± 0.2 at 270 K rising to ± 0.5 at 550 K.
$\text{NH} + \text{NO} \rightarrow \text{N}_2\text{O} + \text{H}$ $\quad \rightarrow \text{HN}_2 + \text{O}$ $\quad \rightarrow \text{N}_2 + \text{OH}$	5.0×10^{-11}	270-380	± 0.2
<i>NH₂ Radical Reactions</i>			
$\text{NH}_2 + \text{O}_2 \rightarrow \text{products}$	$< 3 \times 10^{-18}$	298	
$\text{NH}_2 + \text{NO} \rightarrow \text{N}_2 + \text{H}_2\text{O}$ $\quad \rightarrow \text{N}_2 + \text{H} + \text{OH}$ $\quad \rightarrow \text{N}_2\text{H} + \text{OH}$ $\quad \rightarrow \text{N}_2\text{O} + \text{H}_2$	$1.8 \times 10^{-12} \exp(650/T)$ $(k_2 + k_3)/k \approx 0.12$ at 298 K.	220-2000	± 0.5
<i>¹C₂ and ³C₂ Radical Reactions</i>			
	See data sheets.		
<i>CH Radical Reactions</i>			
$\text{CH} + \text{O}_2 \rightarrow \text{CHO} + \text{O}$ $\quad \rightarrow \text{CO} + \text{OH}$	5.5×10^{-11}	300-2000	± 0.3 at 300 K rising to ± 0.5 at 2000 K.
$\text{CH} + \text{H}_2 \rightarrow \text{CH}_2 + \text{H}$ $\quad \rightarrow \text{CH}_3$	$2.4 \times 10^{-10} \exp(-1760/T)$	300-1000	± 0.3
$\text{CH} + \text{H}_2\text{O} \rightarrow \text{products}$	$9.5 \times 10^{-12} \exp(380/T)$	300-1000	± 1.0
$\text{CH} + \text{CO} \rightarrow \text{products}$	$4.6 \times 10^{-13} \exp(860/T)$	300-1000	± 1.0
$\text{CH} + \text{CO}_2 \rightarrow \text{products}$	$5.7 \times 10^{-12} \exp(-345/T)$	300-1000	± 1.0
$\text{CH} + \text{CH}_4 \rightarrow \text{products}$	$5.0 \times 10^{-11} \exp(200/T)$	200-700	± 1.0
$\text{CH} + \text{C}_2\text{H}_2 \rightarrow \text{products}$	$3.5 \times 10^{-10} \exp(61/T)$	200-700	± 1.0
$\text{CH} + \text{C}_2\text{H}_4 \rightarrow \text{products}$	$2.2 \times 10^{-10} \exp(173/T)$	200-700	± 1.0
$\text{CH} + \text{C}_2\text{H}_6 \rightarrow \text{products}$	$1.8 \times 10^{-10} \exp(132/T)$	200-700	± 1.0
$\text{CH} + \text{C}_3\text{H}_8 \rightarrow \text{products}$	$1.9 \times 10^{-10} \exp(240/T)$	300-700	± 1.0
$\text{CH} + n\text{-C}_4\text{H}_{10} \rightarrow \text{products}$	$4.4 \times 10^{-10} \exp(28/T)$	250-700	± 1.0
$\text{CH} + i\text{-C}_4\text{H}_{10} \rightarrow \text{products}$	$2.0 \times 10^{-10} \exp(240/T)$	300-700	± 1.0
$\text{CH} + \text{neo-C}_5\text{H}_{12} \rightarrow \text{products}$	$1.6 \times 10^{-10} \exp(340/T)$	300-700	± 1.0
$\text{CH} + \text{CH}_3\text{C}_2\text{H} \rightarrow \text{products}$	No recommendation		
$\text{CH} + \text{CH}_2\text{O} \rightarrow \text{products}$	$1.6 \times 10^{-10} \exp(260/T)$	300-700	± 1.0

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
<i>³CH₂ Radical Reactions</i>			
$\left. \begin{array}{l} {}^3\text{CH}_2 + \text{O}_2 \rightarrow \text{CO} + \text{H} + \text{OH} \\ \rightarrow \text{CO}_2 + \text{H} + \text{H} \\ \rightarrow \text{CO} + \text{H}_2\text{O} \\ \rightarrow \text{CO}_2 + \text{H}_2 \\ \rightarrow \text{HCHO} + \text{O} \end{array} \right\}$	$4.1 \times 10^{-11} \exp(-750/T)$	300-1000	± 0.3 at 300 K rising to ± 0.5 at 1000 K.
$\left. \begin{array}{l} {}^3\text{CH}_2 + {}^3\text{CH}_2 \rightarrow \text{C}_2\text{H}_2 + \text{H}_2 \\ \rightarrow \text{C}_2\text{H}_2 + 2\text{H} \end{array} \right\}$	$2.0 \times 10^{-10} \exp(-400/T)$ $k_2/k = 0.9 \pm 0.1$ over range 300-3000 K.	300-3000	± 0.5
${}^3\text{CH}_2 + \text{CH}_3 \rightarrow \text{C}_2\text{H}_4 + \text{H}$	7.0×10^{-11}	300-3000	± 0.3 at 300 K rising to ± 0.5 at 3000 K.
${}^3\text{CH}_2 + \text{C}_2\text{H}_2 \rightarrow \text{C}_3\text{H}_4$	See Table 3		
$\left. \begin{array}{l} {}^3\text{CH}_2 + \text{C}_2\text{H}_4 \rightarrow \text{C}_3\text{H}_6 \\ \rightarrow \text{c-C}_3\text{H}_6 \\ \rightarrow \text{CH}_2\text{CHCH}_2 + \text{H} \end{array} \right\}$	See Table 3		
<i>¹CH₂ Radical Reactions</i>			
${}^1\text{CH}_2 + \text{Ar} \rightarrow {}^3\text{CH}_2 + \text{Ar}$	6.0×10^{-12}	300-2000	± 0.3
${}^1\text{CH}_2 + \text{N}_2 \rightarrow {}^3\text{CH}_2 + \text{N}_2$	1.0×10^{-11}	300-2000	± 0.3
${}^1\text{CH}_2 + \text{CH}_4 \rightarrow {}^3\text{CH}_2 + \text{CH}_4$	1.2×10^{-11}	300-2000	± 0.4
${}^1\text{CH}_2 + \text{C}_2\text{H}_2 \rightarrow {}^3\text{CH}_2 + \text{C}_2\text{H}_2$	8.0×10^{-11}	300-2000	± 0.4
${}^1\text{CH}_2 + \text{C}_2\text{H}_4 \rightarrow {}^3\text{CH}_2 + \text{C}_2\text{H}_4$	2.3×10^{-11}	300-2000	± 0.4
${}^1\text{CH}_2 + \text{C}_2\text{H}_6 \rightarrow {}^3\text{CH}_2 + \text{C}_2\text{H}_6$	3.6×10^{-11}	300-2000	± 0.4
$\left. \begin{array}{l} {}^1\text{CH}_2 + \text{O}_2 \rightarrow \text{CO} + \text{H} + \text{OH} \\ \rightarrow \text{CO}_2 + \text{H}_2 \\ \rightarrow \text{CO} + \text{H}_2\text{O} \\ \rightarrow {}^3\text{CH}_2 + \text{O}_2 \end{array} \right\}$	5.2×10^{-11}	300-1000	± 0.3 at 300 K rising to ± 0.5 at 1000 K
${}^1\text{CH}_2 + \text{H}_2 \rightarrow \text{CH}_3 + \text{H}$	1.2×10^{-10}	300-1000	± 0.1 at 300 K rising to ± 0.3 at 1000 K
$\left. \begin{array}{l} {}^1\text{CH}_2 + \text{C}_2\text{H}_2 \rightarrow \text{CH}_2\text{CCH}_2 \\ \rightarrow \text{CH}_3\text{CCH} \\ \rightarrow \text{CH}_2\text{CCH} + \text{H} \\ \rightarrow {}^3\text{CH}_2 + \text{C}_2\text{H}_2 \end{array} \right\}$	See Table 3		
	See earlier entry		
$\left. \begin{array}{l} {}^1\text{CH}_2 + \text{C}_2\text{H}_4 \rightarrow \text{C}_3\text{H}_6 \\ \rightarrow {}^3\text{CH}_2 + \text{C}_2\text{H}_4 \end{array} \right\}$	See Table 3		
	See earlier entry		
<i>CH₃ Radical Reactions</i>			
$\text{CH}_3 + \text{M} \rightarrow \text{CH}_2 + \text{H} + \text{M}$	See Table 2		
$\left. \begin{array}{l} \text{CH}_3 + \text{O}_2 \rightarrow \text{CH}_3\text{O} + \text{O} \\ \rightarrow \text{HCHO} + \text{OH} \\ \rightarrow \text{CH}_3\text{O}_2 \end{array} \right\}$	$2.2 \times 10^{-10} \exp(-15800/T)$ $5.5 \times 10^{-13} \exp(-4500/T)$ See Table 3	300-2500 1000-2500	± 0.5 ± 0.5

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
$\text{CH}_3 + \text{H}_2 \rightarrow \text{CH}_4 + \text{H}$	$1.14 \times 10^{-20} T^{2.74} \exp(-4740/T)$	300-2500	± 0.15 in the range 300-700 K. ± 0.3 in the range 700-2500 K.
$\text{CH}_3 + \text{CH}_3 \rightarrow \text{C}_2\text{H}_5 + \text{H}$ $\rightarrow \text{C}_2\text{H}_4 + \text{H}_2$ $\rightarrow \text{C}_2\text{H}_6$	$5 \times 10^{-11} \exp(-6800/T)$ No recommendation (see data sheets) See Table 3	1300-2500	± 0.6
$\text{CH}_3 + \text{HCHO} \rightarrow \text{CH}_4 + \text{HCO}$	$6.8 \times 10^{-12} \exp(-4450/T)$	300-1000	± 0.3
$\text{CH}_3 + \text{C}_2\text{H}_2 + \text{M} \rightarrow \text{C}_3\text{H}_3 + \text{M}$ $\rightarrow \text{CH}_4 + \text{C}_2\text{H}$	See Table 3 No recommendation		
$\text{CH}_3 + \text{C}_2\text{H}_4 \rightarrow \text{CH}_4 + \text{C}_2\text{H}_3$ $\rightarrow n\text{-C}_3\text{H}_7$	$6.9 \times 10^{-12} \exp(-5600/T)$ See Table 3	400-3000	± 0.5
$\text{CH}_3 + \text{C}_2\text{H}_5 \rightarrow \text{CH}_4 + \text{C}_2\text{H}_4$ $\rightarrow \text{C}_3\text{H}_6$	1.9×10^{-12} See Table 3	300-800	± 0.4
$\text{CH}_3 + \text{C}_2\text{H}_6 \rightarrow \text{CH}_4 + \text{C}_2\text{H}_5$	$2.5 \times 10^{-31} T^{6.0} \exp(-3043/T)$	300-1500	± 0.1 at 300 K rising to ± 0.2 at 1500 K.
$\text{CH}_3 + \text{CH}_3\text{CHO} \rightarrow \text{CH}_4 + \text{CH}_3\text{CO}$ $\rightarrow \text{CH}_4 + \text{CH}_2\text{CHO}$	$3.3 \times 10^{-30} T^{5.64} \exp(-1240/T)$ No recommendation (see data sheets)	300-1250	± 0.3
<i>CH₄ Reactions</i>			
$\text{CH}_4 + \text{M} \rightarrow \text{CH}_3 + \text{H} + \text{M}$	See Table 2		
<i>CHO Radical Reactions</i>			
$\text{CHO} + \text{O}_2 \rightarrow \text{CO} + \text{HO}_2$ $\rightarrow \text{OH} + \text{CO}_2$ $\rightarrow \text{HCO}_3$]	5.0×10^{-12}	300-2500	± 0.3
$\text{CHO} + \text{CHO} \rightarrow \text{HCHO} + \text{CO}$	5.0×10^{-11}	300	± 0.3
<i>HCHO Reactions</i>			
$\text{HCHO} + \text{M} \rightarrow \text{H} + \text{CHO} + \text{M}$ $\rightarrow \text{H}_2 + \text{CO} + \text{M}$]	See Table 2		
<i>CH₂OH Reactions</i>			
$\text{CH}_2\text{OH} + \text{O}_2 \rightarrow \text{CH}_2\text{O} + \text{HO}_2$	$2.6 \times 10^{-9} T^{-1.0} +$ $1.2 \times 10^{-10} \exp(-1800/T)$	300-1200	± 0.1 at 300 K rising to ± 0.3 at 1200 K.
<i>CH₃O Radical Reactions</i>			
$\text{CH}_3\text{O} + \text{M} \rightarrow \text{HCHO} + \text{H} + \text{M}$	See Table 2		
$\text{CH}_3\text{O} + \text{O}_2 \rightarrow \text{HCHO} + \text{HO}_2$	$6.7 \times 10^{-14} \exp(-1070/T)$	300-1000	± 0.2 at 500 K rising to ± 0.3 at 300 K and 1000 K.

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
<i>CH₃OOH Reactions</i>			
$\text{CH}_3\text{OOH} + \text{M} \rightarrow \text{CH}_3\text{O} + \text{OH} + \text{M}$	See Table 2		
<i>CN Radical Reactions</i>			
$\text{CN} + \text{O}_2 \rightarrow \text{NCO} + \text{O}$	$1.1 \times 10^{-11} \exp(205/T)$	300–2500	± 0.25 at 300 K rising to ± 0.5 at 2500 K.
$\text{CN} + \text{H}_2\text{O} \rightarrow \text{HCN} + \text{OH}$ $\quad \quad \quad \rightarrow \text{HOCN} + \text{H}$]	$1.3 \times 10^{-11} \exp(-3750/T)$	500–3000	± 0.3 at 500 K rising to ± 0.5 at 3000 K.
$\text{CN} + \text{CH}_4 \rightarrow \text{HCN} + \text{CH}_3$	$1.5 \times 10^{-11} \exp(-940/T)$	260–400	± 0.3
<i>NCO Radical Reactions</i>			
$\text{NCO} + \text{M} \rightarrow \text{N} + \text{CO} + \text{M}$	See Table 2		
$\text{NCO} + \text{NO} \rightarrow \text{N}_2\text{O} + \text{CO}$ $\quad \quad \quad \rightarrow \text{N}_2 + \text{CO}_2$ $\quad \quad \quad \rightarrow \text{N}_2 + \text{CO} + \text{O}$]	$1.7 \times 10^{-11} \exp(200/T)$	300–600	± 0.5
<i>C₂H Radical Reactions</i>			
$\text{C}_2\text{H} + \text{O}_2 \rightarrow \text{CO}_2 + \text{CH}$ $\quad \quad \quad \rightarrow 2\text{CO} + \text{H}$ $\quad \quad \quad \rightarrow \text{C}_2\text{HO} + \text{O}$ $\quad \quad \quad \rightarrow \text{CO} + \text{HCO}$]	3.0×10^{-11}	300	± 0.5
$\text{C}_2\text{H} + \text{H}_2 \rightarrow \text{C}_2\text{H}_2 + \text{H}$	$2.5 \times 10^{-11} \exp(-1560/T)$	300–2500	± 0.3 at 300 K rising to ± 0.7 at 2500 K
$\text{C}_2\text{H} + \text{C}_2\text{H}_2 \rightarrow \text{C}_4\text{H}_2 + \text{H}$	5.0×10^{-11}	300–2700	± 0.3
$\text{C}_2\text{H} + \text{CH}_4 \rightarrow \text{products}$	2.0×10^{-12}	298	± 1
$\text{C}_2\text{H} + \text{C}_2\text{H}_6 \rightarrow \text{products}$	No recommendation		
<i>C₂H₃ Radical Reactions</i>			
$\text{C}_2\text{H}_3 + \text{M} \rightarrow \text{C}_2\text{H}_2 + \text{H} + \text{M}$	See Table 2		
$\text{C}_2\text{H}_3 + \text{O}_2 \rightarrow \text{HCHO} + \text{CHO}$	9.0×10^{-12}	300–2000	± 0.3 at 300 K rising to ± 0.5 at 2000 K
<i>C₂H₅ Radical Reactions</i>			
$\text{C}_2\text{H}_5 + \text{O}_2 \rightarrow \text{C}_2\text{H}_4 + \text{HO}_2$	$1.7 \times 10^{-14} \exp(1100/T)$	600–1200	± 0.3
$\text{C}_2\text{H}_5 + \text{C}_2\text{H}_5 \rightarrow \text{C}_2\text{H}_6 + \text{C}_2\text{H}_4$ $\quad \quad \quad \rightarrow n\text{-C}_4\text{H}_{10}$	2.4×10^{-12} See Table 3	300–1200	± 0.4
<i>C₂H₆ Reactions</i>			
$\text{C}_2\text{H}_6 + \text{M} \rightarrow \text{CH}_3 + \text{CH}_3 + \text{M}$	See Table 2		

KINETIC DATA FOR COMBUSTION MODELLING (continued)

**Table 1
BIMOLECULAR REACTIONS (continued)**

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
<i>CHCO Reactions</i>			
$\text{CHCO} + \text{O}_2 \rightarrow \text{CO}_2 + \text{HCO}$ $\quad \rightarrow 2\text{CO} + \text{OH}$ $\quad \rightarrow \text{C}_2\text{O} + \text{HO}_2$ $\quad \rightarrow \text{CHO}_2\text{CO}$	$2.7 \times 10^{-12} \exp(430/T)$ M = He, 2 Torr	300-550	± 0.7
<i>CH₂CHO Radical Reactions</i>			
$\text{CH}_2\text{CHO} + \text{O}_2 \rightarrow \text{HO}_2 + \text{CH}_2\text{CHO}$ $\quad \rightarrow \text{HCHO} + \text{CO} + \text{OH}$ $\quad \rightarrow \text{O}_2\text{CH}_2\text{CHO}$	$k_\infty = 2.6 \times 10^{-13}$ $k_2 = 3.0 \times 10^{-14}$	250-1000 300	± 0.2 ± 0.3
<i>CH₃CO Radical Reactions</i>			
$\text{CH}_3\text{CO} + \text{O}_2 + \text{M} \rightarrow \text{CH}_3\text{CO}_3 + \text{M}$	See Table 3		
<i>CH₃CHO Reactions</i>			
$\text{CH}_3\text{CHO} + \text{M} \rightarrow \text{CH}_3 + \text{HCO} + \text{M}$	See Table 2		
<i>C₂H₅O Reactions</i>			
$\text{C}_2\text{H}_5\text{O} + \text{M} \rightarrow \text{HCHO} + \text{CH}_3 + \text{M}$ $\quad \rightarrow \text{CH}_3\text{CHO} + \text{H} + \text{M}$	See Table 2		
$\text{C}_2\text{H}_5\text{O} + \text{O}_2 \rightarrow \text{CH}_3\text{CHO} + \text{HO}_2$	$1.0 \times 10^{-13} \exp(-830/T)$	300-1000	± 0.3 at 300 K rising to ± 0.5 at 1000 K
<i>C₂H₅OOH Reactions</i>			
$\text{C}_2\text{H}_5\text{OOH} + \text{M} \rightarrow \text{C}_2\text{H}_5\text{O} + \text{OH} + \text{M}$	See Table 2		
<i>C₆H₅ Radical Reactions</i>			
$\text{C}_6\text{H}_5 + \text{M} \rightarrow \text{C}_2\text{H}_2 + \text{C}_4\text{H}_3 + \text{M}$ $\quad \rightarrow \text{C}_2\text{H}_3 + \text{C}_4\text{H}_2 + \text{M}$ $\quad \rightarrow \text{linear-C}_6\text{H}_5 + \text{M}$	See Table 2		
<i>C₆H₆ Reactions</i>			
$\text{C}_6\text{H}_6 + \text{M} \rightarrow \text{C}_6\text{H}_5 + \text{H} + \text{M}$ $\quad \rightarrow \text{C}_4\text{H}_4 + \text{C}_2\text{H}_2 + \text{M}$	See Table 2		
<i>C₆H₅O Radical Reactions</i>			
$\text{C}_6\text{H}_5\text{O} + \text{M} \rightarrow \text{C}_3\text{H}_5 + \text{CO} + \text{M}$	See Table 2		
<i>C₆H₅CH₂ Radical Reactions</i>			
$\text{C}_6\text{H}_5\text{CH}_2 + \text{M} \rightarrow \text{C}_3\text{H}_3 + 2\text{C}_2\text{H}_2 + \text{M}$ $\quad \rightarrow \text{C}_4\text{H}_4 + \text{C}_3\text{H}_3 + \text{M}$ $\quad \rightarrow \text{C}_3\text{H}_5 + \text{C}_2\text{H}_2 + \text{M}$ $\quad \rightarrow \text{C}_7\text{H}_7(\text{BCH}) + \text{M}$	See Table 2		

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 1
 BIMOLECULAR REACTIONS (continued)

Reaction	$k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Temp/K	Error limits ($\Delta \log k$)
<i>C₆H₅CH₃ Reactions</i>			
$\text{C}_6\text{H}_5\text{CH}_3 + \text{M} \rightarrow \text{C}_6\text{H}_5\text{CH}_2 + \text{H} + \text{M}$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_5 + \text{CH}_3 + \text{M}$	See Table 2		
<i>p-C₆H₄(CH₃)₂ Reactions</i>			
$p\text{-C}_6\text{H}_4(\text{CH}_3)_2 + \text{M} \rightarrow \text{C}_6\text{H}_4\text{CH}_2\text{CH}_3 + \text{H} + \text{M}$	See Table 2		
<i>C₆H₅C₂H₅ Reactions</i>			
$\text{C}_6\text{H}_5\text{C}_2\text{H}_5 + \text{M} \rightarrow \text{C}_6\text{H}_5\text{CH}_2 + \text{CH} + \text{M}$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_6 + \text{C}_2\text{H}_4 + \text{M}$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_5\text{CHCH}_2 + \text{H}_2 + \text{M}$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_5 + \text{C}_2\text{H}_5 + \text{M}$ $\quad \quad \quad \rightarrow \text{C}_6\text{H}_5\text{CHCH}_3 + \text{H} + \text{M}$	See Table 2		

 Table 2
 DECOMPOSITION REACTIONS

Reaction	k_∞/s^{-1} $k_0/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ F_c $k/\text{s}^{-1} = \frac{k_0 k_\infty [\text{M}]}{k_0[\text{M}] + k_\infty} F$	Temp/K	Error limits ($\Delta \log k$)
$\text{H}_2 + \text{Ar} \rightarrow 2\text{H} + \text{Ar}$	$k_0 = 3.7 \times 10^{-10} \exp(-48350/T)$	2500-8000	± 0.3
$\text{H}_2 + \text{H}_2 \rightarrow 2\text{H} + \text{H}_2$	$k_0 = 1.5 \times 10^{-9} \exp(-48350/T)$	2500-8000	± 0.5
$\text{H}_2\text{O} + \text{N}_2 \rightarrow \text{H} + \text{OH} + \text{N}_2$	$k_0 = 5.8 \times 10^{-9} \exp(-52920/T)$	2000-6000	± 0.5
$\text{H}_2\text{O}_2 + \text{M} \rightarrow 2\text{OH} + \text{M}$	$k_0(\text{Ar}) = 3 \times 10^{-8} \exp(-21600/T)$ $k_0(\text{N}_2) = 2 \times 10^{-7} \exp(-22900/T)$ $k_\infty = 3 \times 10^{14} \exp(-24400/T)$ $F_c(\text{Ar}) = 0.5$	1000-1500 700-1500 1000-1500 700-1500	± 0.2 ± 0.2 ± 0.5 $\Delta F_c = \pm 0.1$
$\text{CH}_3 + \text{M} \rightarrow \text{CH}_2 + \text{H} + \text{M}$	$k_0 = 1.7 \times 10^{-8} \exp(-45600/T)$	1500-3000	± 0.5
$\text{CH}_4 + \text{M} \rightarrow \text{CH}_3 + \text{H} + \text{M}$	$k_0(\text{Ar}) = 1.2 \times 10^{-6} \exp(-47000/T)$ $k_0(\text{CH}_4) = 1.4 \times 10^{-5} \exp(-48100/T)$ $k_\infty = 2.4 \times 10^{16} \exp(-52800/T)$ $F_c(\text{Ar}) = \exp(-0.45 - T/3231)$ $F_c(\text{CH}_4) = \exp(-0.37 - T/2210)$	1000-3000 1000-2000 1000-3000 1000-3000 1000-2000	± 0.3 ± 0.3 ± 0.5 $\Delta F_c = \pm 0.1$ $\Delta F_c = \pm 0.1$
$\text{HCHO} + \text{M} \rightarrow \text{H} + \text{CHO} + \text{M}$ $\quad \quad \quad \rightarrow \text{H}_2 + \text{CO} + \text{M}$	$k_0(1) = 2.1 \times 10^{-8} \exp(-39200/T)$ $k_1/k_2 = 0.5$ at 2200 K	1500-2500	± 0.3
$\text{CH}_3\text{O} + \text{M} \rightarrow \text{HCHO} + \text{H} + \text{M}$	$k_0 = 3.16 \times 10^2 T^{-2.7} \exp(-15400/T)$ [estimate]	300-1000	± 1.0
$\text{CH}_3\text{OOH} + \text{M} \rightarrow \text{CH}_3\text{O} + \text{OH} + \text{M}$	$k_\infty = 4 \times 10^{15} \exp(-21600/T)$	400-1000	± 0.5 at 600 K rising to ± 1.0 at 400 and 1000 K
$\text{NCO} + \text{Ar} \rightarrow \text{N} + \text{CO} + \text{Ar}$	$k_0 = 1.7 \times 10^{-9} \exp(-23500/T)$	1450-2600	± 0.4

KINETIC DATA FOR COMBUSTION MODELLING (continued)

Table 2
DECOMPOSITION REACTIONS (continued)

Reaction	k_{∞}/s^{-1} $k_0/cm^3 \text{ molecule}^{-1} s^{-1}$ F_c $k/s^{-1} = \frac{k_0 k_{\infty} [M]}{k_0[M] + k_{\infty}} F$	Temp/K	Error limits ($\Delta \log k$)
$C_2H_3 + M \rightarrow C_2H_2 + H + M$	$k_0 = 6.9 \times 10^{17} T^{-7.5} \exp(-22900/T)$ $k_{\infty} = 2 \times 10^{14} \exp(-20000/T)$ $F_c = 0.35$	500-2500 500-2500 500-2500	± 0.5 ± 0.5 $\Delta F_c = \pm 0.1$
$C_2H_6 + M \rightarrow 2CH_3 + M$	$k_0(Ar) = 1.1 \times 10^{25} T^{-8.24} \exp(-47090/T)$ $k_0(C_2H_6) = 4.5 \times 10^{-2} \exp(-41930/T)$ $k_{\infty} = 1.8 \times 10^{21} T^{-1.24} \exp(-45700/T)$ $F_c(Ar) = 0.38 \exp(-T/73) + 0.62 \exp(-T/1180)$ $F_c(C_2H_6) = 0.54 \exp(-T/1250)$	300-2000 800-1000 300-2000 300-2000 800-1000	± 0.5 ± 0.5 ± 0.3 $\Delta F_c = \pm 0.1$ $\Delta F_c = \pm 0.1$
$CH_3CHO + M \rightarrow CH_3 + CHO + M$	$k(1 \text{ atm.}) = 7 \times 10^{15} \exp(-41100/T)$ (pressure dependent region)	750-1200	± 0.4
$C_2H_3O + M \rightarrow HCHO + CH_3 + M$	$k_{\infty} = 8 \times 10^{13} \exp(-10830/T)$ [estimate]	300-600	± 1.0
$C_2H_5OOH + M \rightarrow C_2H_5O + OH + M$	$k_{\infty} 4 \times 10^{15} \exp(-21600/T)$	400-1000	± 1.0
$C_6H_5 + M \rightarrow C_2H_2 + C_4H_3 + M$ $\rightarrow C_2H_3 + C_4H_2 + M$ $\rightarrow \text{linear-}CH_5 + M$	No recommendation $4.0 \times 10^{13} \exp(-36700/T)$	1450-1900	± 0.4
$C_6H_6 + M \rightarrow C_6H_5 + H + M$ $\rightarrow C_4H_4 + H_2 + M$	$9.0 \times 10^{15} \exp(-54060/T)$	1200-2500	± 0.4 at 1200 K reducing to ± 0.3 at 2500 K
$C_6H_5O + M \rightarrow C_3H_5 + CO + M$	$2.5 \times 10^{11} \exp(-22100/T)$	1000-1580	± 0.2
$C_6H_5CH_2 + M \rightarrow C_3H_3 + 2C_2H_2 + M$ $\rightarrow C_4H_4 + C_3H_3 + M$ $\rightarrow C_5H_5 + C_2H_2 + M$ $\rightarrow C_7H_7 \text{ (BCH)} + M$	$5.1 \times 10^{13} \exp(-36370/T)$	1350-1900	± 0.3 at 1350 K rising to ± 0.5 1900 K
$C_6H_5CH_3 + M \rightarrow C_6H_5CH_2 + H + M$ $\rightarrow C_6H_5 + CH_3 + M$	$3.1 \times 10^{15} \exp(-44890/T)$ No recommendation	920-2200	± 0.3 at 900 K rising to ± 0.5 at 2200 K
$p\text{-}C_6H_4(CH_3)_2 + M \rightarrow p\text{-}C_6H_4CH_2CH_3 + H + M$	$4.0 \times 10^{15} \exp(-42600/T)$	1400-1800	± 0.5
$C_6H_5C_2H_5 + M \rightarrow C_6H_5CH_2 + CH + M$ $\rightarrow C_6H_6 + C_2H_4 + M$ $\rightarrow C_6H_5CHCH_2 + H_2 + M$ $\rightarrow C_6H_5 + C_2H_5 + M$ $\rightarrow C_6H_5CHCH_3 + H + M$	$6.1 \times 10^{15} \exp(-37800/T)$ No recommendations	770-1800	± 0.1 at 770 K rising to ± 0.4 at

Table 3
COMBINATION REACTIONS

Reaction	$k_{\infty}/cm^3 \text{ molecule}^{-1} s^{-1}$ $k_0/cm^6 \text{ molecule}^{-2} s^{-1}$ F_c $k/cm^3 \text{ molecule}^{-1} s^{-1} = \frac{k_0 k_{\infty} [M]}{k_0[M] + k_{\infty}} F$	Temp/K	Error limits ($\Delta \log k$)
$H + O_2 + Ar \rightarrow HO_2 + Ar$	$k_0 = 1.7 \times 10^{-30} T^{-0.8}$	300-2000	± 0.5

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 3
 COMBINATION REACTIONS (continued)

Reaction	$k_{\infty}/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ $k_0/\text{cm}^6 \text{ molecule}^{-2} \text{ s}^{-1}$ F_c $k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1} = \frac{k_0 k_{\infty} [M]}{k_0 [M] + k_{\infty}} F$	Temp/K	Error limits ($\Delta \log k$)
$\text{H} + \text{O}_2 + \text{H}_2 \rightarrow \text{HO}_2 + \text{H}_2$	$k_0 = 5.8 \times 10^{-30} T^{-0.8}$	300–2000	± 0.5
$\text{H} + \text{O}_2 + \text{N}_2 \rightarrow \text{HO}_2 + \text{N}_2$	$k_0 = 3.9 \times 10^{-30} T^{-0.8}$	300–2000	± 0.5
$\text{H} + \text{O}_2 + \text{H}_2\text{O} \rightarrow \text{HO}_2 + \text{H}_2\text{O}$	$k_0 = 4.3 \times 10^{-30} T^{-0.8}$	300–2000	± 0.5
$\text{H} + \text{H} + \text{Ar} \rightarrow \text{H}_2 + \text{Ar}$	$k_0 = 1.8 \times 10^{-30} T^{-1.0}$	300–2500	± 0.5
$\text{H} + \text{H} + \text{H}_2 \rightarrow \text{H}_2 + \text{H}_2$	$k_0 = 2.7 \times 10^{-31} T^{-0.6}$	100–5000	± 0.5
$\text{H} + \text{OH} + \text{H}_2\text{O} \rightarrow \text{H}_2\text{O} + \text{H}_2\text{O}$	$k_0 = 3.9 \times 10^{-25} T^{-2.0}$	300–3000	± 0.3
$\text{H} + \text{OH} + \text{Ar} \rightarrow \text{H}_2\text{O} + \text{Ar}$	$k_0 = 2.3 \times 10^{-26} T^{-2.0}$	300–3000	± 0.3
$\text{H} + \text{OH} + \text{N}_2 \rightarrow \text{H}_2\text{O} + \text{N}_2$	$k_0 = 6.1 \times 10^{-26} T^{-2.0}$	300–3000	± 0.3
$\text{H} + \text{CH}_3 + \text{M} \rightarrow \text{CH}_4 + \text{M}$	$k_0(\text{He}) = 6.2 \times 10^{-29} (T/3000)^{-1.8}$ $k_0(\text{Ar}) = 6 \times 10^{-29} (T/300)^{-1.8}$ $k_0(\text{C}_2\text{H}_6) = 3 \times 10^{-28} (T/300)^{-1.8}$ $k_{\infty} = 3.5 \times 10^{-10}$ $F_c(\text{He,Ar}) = \exp(-0.45 - T/3231)$ $F_c(\text{C}_2\text{H}_6) = \exp(-0.34 - T/3053)$	300–1000 300–1000 300–1000 300–1000 300–1000	± 0.3 ± 0.5 ± 0.5 ± 0.3 $\Delta F_c = \pm 0.1$ $\Delta F_c = \pm 0.1$
$\text{H} + \text{C}_2\text{H}_2 + \text{He} \rightarrow \text{C}_2\text{H}_3 + \text{He}$	$k_{\infty} = 1.4 \times 10^{-11} \exp(-1300/T)$ $k_0 = 3.3 \times 10^{-30} \exp(-740/T)$ $F_c = 0.44$	200–400 200–400 200–400	± 0.3 ± 0.5 $\Delta F_c = \pm 0.1$
$\text{H} + \text{C}_2\text{H}_3 + \text{M} \rightarrow \text{C}_2\text{H}_4 + \text{M}$	No recommendation		
$\text{H} + \text{C}_2\text{H}_4 + \text{M} \rightarrow \text{C}_2\text{H}_5 + \text{M}$	No recommendation		
$\text{H} + \text{C}_2\text{H}_5 + \text{M} \rightarrow \text{C}_2\text{H}_6 + \text{M}$	No recommendation		
$\text{H} + \text{C}_6\text{H}_5 + \text{M} \rightarrow \text{C}_6\text{H}_6 + \text{M}$	$k_{\infty} = 1.3 \times 10^{-10}$	1400–1700	± 0.5
$\text{H} + \text{C}_6\text{H}_6 + \text{M} \rightarrow \text{C}_6\text{H}_7 + \text{M}$	$k_{\infty} = 6.7 \times 10^{-11} \exp(-2170/T)$	300–1000	± 0.2
$\text{H} + \text{C}_6\text{H}_5\text{O} + \text{M} \rightarrow \text{C}_6\text{H}_5\text{OH} + \text{M}$	$k_{\infty} = 4.2 \times 10^{-10}$	1000	± 0.3
$\text{H} + \text{C}_6\text{H}_5\text{CH}_2 + \text{M} \rightarrow \text{C}_6\text{H}_5\text{CH}_3 + \text{M}$	$k_{\infty} = 5.5 \times 10^{-10}$	300–2000	± 0.2 at 300 K rising to ± 0.7 at 2000 K.
$\text{H} + \text{C}_6\text{H}_5\text{CH}_3 + \text{M} \rightarrow \text{C}_6\text{H}_6\text{CH}_3 + \text{M}$	$k_{\infty} = 1.2 \times 10^{-13}$	298	± 0.2
$\text{H} + \text{C}_6\text{H}_5\text{C}_2\text{H}_5 + \text{M} \rightarrow \text{C}_6\text{H}_6\text{C}_2\text{H}_5 + \text{M}$	$k_{\infty} = 3.3 \times 10^{-13}$	298	± 0.1
$\text{OH} + \text{OH} + \text{M} \rightarrow \text{H}_2\text{O}_2 + \text{M}$	$k_0(\text{N}_2) = 8 \times 10^{-31} (T/300)^{-0.76}$ $k_0(\text{H}_2\text{O}) = 4 \times 10^{-30}$ $k_{\infty} = 1.5 \times 10^{-11} (T/300)^{-0.37}$ $F_c(\text{N}_2) = 0.5$	250–1400 300–400 200–1500 200–1500	± 0.4 ± 0.5 $\Delta F_c = \pm 0.2$
$\text{OH} + \text{CH}_3 + \text{M} \rightarrow \text{CH}_3\text{OH} + \text{M}$	No data available for this channel (See Table 1)		

KINETIC DATA FOR COMBUSTION MODELLING (continued)

 Table 3
 COMBINATION REACTIONS (continued)

Reaction	$k_{\infty}/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ $k_0/\text{cm}^6 \text{ molecule}^{-2} \text{ s}^{-1}$ F_c $k/\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1} = \frac{k_0 k_{\infty} [M]}{k_0 [M] + k_{\infty}} F$	Temp/K	Error limits ($\Delta \log k$)
$\text{OH} + \text{C}_2\text{H}_2 + \text{M} \rightarrow \text{C}_2\text{H}_2\text{OH} + \text{M}$	See data sheet		
$\text{OH} + \text{C}_6\text{H}_6 + \text{M} \rightarrow \text{C}_6\text{H}_6\text{OH} + \text{M}$	$k_{\infty} = 3.8 \times 10^{-12} \exp(-340/T)$	240-340	± 0.2
$\text{OH} + \text{C}_6\text{H}_5\text{OH} + \text{M} \rightarrow \text{C}_6\text{H}_5(\text{OH})_2 + \text{M}$	$k_{\infty} = 2.8 \times 10^{-11}$	298	± 0.1
$\text{OH} + \text{C}_6\text{H}_5\text{CH}_3 + \text{M} \rightarrow \text{HOC}_6\text{H}_5\text{CH}_3 + \text{M}$	$k_{\infty} = 3.8 \times 10^{-12} \exp(180/T)$	200-300	± 0.4
$\text{OH} + \text{C}_6\text{H}_4(\text{CH}_3)_2 + \text{M} \rightarrow \text{C}_6\text{H}_4(\text{CH}_3)_2\text{OH} + \text{M}$	$k_{\infty} = 1.4 \times 10^{-11}$	300-320	± 0.1
$\text{OH} + \text{C}_6\text{H}_3\text{C}_2\text{H}_5 + \text{M} \rightarrow \text{HOC}_6\text{H}_3\text{C}_2\text{H}_5 + \text{M}$	7.5×10^{-12} at $p \leq 1$ atm.	298	± 0.1
$^3\text{CH}_2 + \text{C}_2\text{H}_2 + \text{M} \rightarrow \text{C}_3\text{H}_4 + \text{M}$	$2.0 \times 10^{-11} \exp(-3330/T)$ at $p = \leq 10$ Torr.	300-1000	± 0.3
$^3\text{CH}_2 + \text{C}_2\text{H}_4 + \text{M} \rightarrow \begin{matrix} \text{C}_3\text{H}_6 + \text{M} \\ c\text{-C}_3\text{H}_6 + \text{M} \\ \text{C}_3\text{H}_5 + \text{H} + \text{M} \end{matrix}$	$5.3 \times 10^{-12} \exp(-2660/T)$	300-1000	± 0.2 at 300 K rising to ± 0.3 at 1000 K
$^1\text{CH}_2 + \text{C}_2\text{H}_2 + \text{M} \rightarrow \begin{matrix} \text{CH}_2\text{CCH}_2 + \text{M} \\ \text{CH}_3\text{CCH} + \text{M} \\ \text{CH}_2\text{CCH} + \text{H} + \text{M} \end{matrix}$	3.7×10^{-10} independent of p	300-1000	± 0.3 at 300 K rising to ± 0.7 at 1000 K.
$^1\text{CH}_2 + \text{C}_2\text{H}_4 + \text{M} \rightarrow \text{C}_3\text{H}_6$	1.1×10^{-10} independent of p	300-1000	± 0.2 at 300 K rising to ± 0.5 at 1000 K.
$\text{CH}_3 + \text{O}_2 + \text{M} \rightarrow \text{CH}_3\text{O}_2 + \text{M}$	$k_0(\text{Ar}) = 1.5 \times 10^{-22} T^{-3.3}$ $k_0(\text{N}_2) = 1.6 \times 10^{-22} T^{-3.3}$ $k_{\infty} = 1.3 \times 10^{-15} T^{-1.2}$ $F_c = 0.466 - 1.30 \times 10^{-4} T$	300-800 300-800 300-800 300-800	± 0.3 ± 0.3 ± 0.3
$\text{CH}_3 + \text{CH}_3 + \text{Ar} \rightarrow \text{C}_2\text{H}_6 + \text{Ar}$	$k_{\infty} = 6 \times 10^{-11}$ $k_0 = 3.5 \times 10^{-7} T^{-7.0} \exp(-1390/T)$ $F_c = 0.38 \exp(-T/73)$ $+ 0.62 \exp(-T/1180)$	300-2000 300-2000 300-2000	± 0.05 at 300 K rising to ± 0.3 at 2000 K ± 0.3 $\Delta F_c = \pm 0.1$
$\text{CH}_3 + \text{C}_2\text{H}_2 + \text{M} \rightarrow \text{C}_3\text{H}_5 + \text{M}$	$k_{\infty} = 1 \times 10^{-12} \exp(-3900/T)$	300-600	± 0.5
$\text{CH}_3 + \text{C}_2\text{H}_4 + \text{M} \rightarrow n\text{-C}_3\text{H}_7 + \text{M}$	$3.5 \times 10^{-13} \exp(-3700/T)$	300-600	± 0.3
$\text{CH}_3 + \text{C}_2\text{H}_5 + \text{M} \rightarrow \text{C}_3\text{H}_8 + \text{M}$	$k_{\infty} = 4.7 \times 10^{-11}$	300-800	± 0.3
$\text{C}_2\text{H}_5 + \text{C}_2\text{H}_5 + \text{M} \rightarrow n\text{-C}_4\text{H}_{10} + \text{M}$	$k_{\infty} = 1.9 \times 10^{-11}$	300-1200	± 0.3
$\text{CH}_3\text{CO} + \text{O}_2 + \text{M} \rightarrow \text{CH}_3\text{CO}_3 + \text{M}$	2×10^{-12} for $p = 1-4$ Torr.	300	± 0.3

ELECTRICAL CONDUCTIVITY OF WATER

This table gives the electrical conductivity of highly purified water over a range of temperature and pressure. The first column of conductivity data refers to water at its own vapor pressure. Equations for calculating the conductivity at any temperature and pressure may be found in the reference.

REFERENCE

Marshall, W. L., *J. Chem. Eng. Data* 32, 221, 1987.

Conductivity in $\mu\text{S}/\text{cm}$ at the indicated pressure

$t/^\circ\text{C}$	Sat. vapor	50 MPa	100 MPa	200 MPa	400 MPa	600 MPa
0	0.0115	0.0150	0.0189	0.0275	0.0458	0.0667
25	0.0550	0.0686	0.0836	0.117	0.194	0.291
100	0.765	0.942	1.13	1.53	2.45	3.51
200	2.99	4.08	5.22	7.65	13.1	19.5
300	2.41	4.87	7.80	14.1	28.9	46.5
400		1.17	4.91	14.3	39.2	71.3
600			0.134	4.65	33.8	85.7

THERMODYNAMIC PROPERTIES OF AIR

These tables summarize the thermodynamic properties of air in the liquid and gaseous states, as well as along the saturation line. In the table for the saturation state, $P(\text{boil})$ is the bubble point temperature (i.e., the pressure at which boiling begins as the temperature of the liquid is raised), and $P(\text{con})$ is the dew point temperature (pressure at which condensation begins as the temperature of the gas is lowered). The other properties tabulated are density (ρ), enthalpy (H), entropy (S), and isobaric heat capacity (C_p). More detailed tables may be found in the references.

REFERENCES

1. Vasserman, A.A., and Rabinovich, V.A., *Thermophysical Properties of Liquid Air and its Components*, Izdatel'stvo Komiteta, Standartov, Moscow, 1968.
2. Vasserman, A.A., et al., *Thermophysical Properties of Air and Air Components*, Izdatel'stvo Nauka, Moscow, 1966.

Properties in the saturation state:

T K	$P(\text{boil})$ bar	$P(\text{con})$ bar	ρ (liq) g/cm ³	ρ (gas) g/L
65	0.1468	0.0861	0.939	0.464
70	0.3234	0.2052	0.917	1.033
75	0.6366	0.4321	0.894	2.048
80	1.146	0.8245	0.871	3.709
85	1.921	1.453	0.845	6.258
90	3.036	2.397	0.819	9.980
95	4.574	3.748	0.792	15.21
100	6.621	5.599	0.763	22.39
110	12.59	11.22	0.699	45.15
120	21.61	20.14	0.622	87.34
130	34.16	33.32	0.487	184.33
132.55	37.69	37.69	0.313	312.89

Properties of liquid air:

P bar	T K	ρ g/cm ³	H J/g	S J/g K	C_p J/g K
1	75	0.8935	-131.7	2.918	1.843
5	75	0.8942	-131.4	2.916	1.840
5	80	0.8718	-122.3	3.031	1.868
5	85	0.8482	-112.9	3.143	1.901
5	90	0.8230	-103.3	3.250	1.941
5	95	0.7962	-93.5	3.356	1.991
10	75	0.8952	-131.1	2.913	1.836
10	80	0.8729	-122.0	3.028	1.863
10	90	0.8245	-103.1	3.246	1.932
10	100	0.7695	-83.2	3.452	2.041
50	75	0.9025	-128.2	2.892	1.806
50	100	0.7859	-81.8	3.415	1.939
50	125	0.6222	-28.3	3.889	2.614
50	150	0.1879	91.9	4.764	2.721
100	75	0.9111	-124.5	2.867	1.774
100	100	0.8033	-79.4	3.376	1.852
100	125	0.6746	-31.4	3.805	2.062
100	150	0.4871	32.8	4.271	2.832

Properties of air in the gaseous state:

P bar	T K	ρ g/L	H J/g	S J/g K	C_p J/g K
1	100	3.556	98.3	5.759	1.032
1	200	1.746	199.7	6.463	1.007
1	300	1.161	300.3	6.871	1.007

THERMODYNAMIC PROPERTIES OF AIR (continued)

<i>P</i> bar	<i>T</i> K	ρ g/L	<i>H</i> J/g	<i>S</i> J/g K	<i>C_p</i> J/g K
1	500	0.696	503.4	7.389	1.030
1	1000	0.348	1046.6	8.138	1.141
10	200	17.835	195.2	5.766	1.049
10	300	11.643	298.3	6.204	1.021
10	500	6.944	502.9	6.727	1.034
10	1000	3.471	1047.2	7.477	1.142
100	200	213.950	148.8	4.949	1.650
100	300	116.945	279.9	5.486	1.158
100	500	66.934	499.0	6.048	1.073
100	1000	33.613	1052.4	6.812	1.151

PROPERTIES OF WATER IN THE RANGE 0 — 100 °C

This table summarizes the best available values of the density, specific heat capacity at constant pressure (C_p), vapor pressure, viscosity, thermal conductivity, dielectric constant, and surface tension for liquid water in the range 0 — 100 °C. All values (except vapor pressure) refer to a pressure of 100 kPa (1 bar). The temperature scale is IPTS-68.

t °C	Density g/cm ³	C_p J/g K	Vap. pres. kPa	Visc. μPa s	Ther. cond. mW/K m	Diel. const.	Surf. ten. mN/m
0	0.99984	4.2176	0.6113	1793	561.0	87.90	75.64
10	0.99970	4.1921	1.2281	1307	580.0	83.96	74.23
20	0.99821	4.1818	2.3388	1002	598.4	80.20	72.75
30	0.99565	4.1784	4.2455	797.7	615.4	76.60	71.20
40	0.99222	4.1785	7.3814	653.2	630.5	73.17	69.60
50	0.98803	4.1806	12.344	547.0	643.5	69.88	67.94
60	0.98320	4.1843	19.932	466.5	654.3	66.73	66.24
70	0.97778	4.1895	31.176	404.0	663.1	63.73	64.47
80	0.97182	4.1963	47.373	354.4	670.0	60.86	62.67
90	0.96535	4.2050	70.117	314.5	675.3	58.12	60.82
100	0.95840	4.2159	101.325	281.8	679.1	55.51	58.91
Ref.	1—3	2	1, 3	3	3	4	5

REFERENCES

1. L. Harr, J. S. Gallagher, and G. S. Kell, *NBS/NRC Steam Tables*, Hemisphere Publishing Corp., 1984.
2. K. N. Marsh, Ed., *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell Scientific Publications, Oxford, 1987.
3. J. V. Sengers and J. T. R. Watson, Improved international formulations for the viscosity and thermal conductivity of water substance, *J. Phys. Chem. Ref. Data*, 15, 1291, 1986.
4. D. G. Archer and P. Wang, The dielectric constant of water and Debye-Hückel limiting law slopes, *J. Phys. Chem. Ref. Data*, 19, 371, 1990.
5. N. B. Vargaftik, et al., International tables of the surface tension of water, *J. Phys. Chem. Ref. Data*, 12, 817, 1983.

ENTHALPY OF VAPORIZATION OF WATER

The enthalpy (heat) of vaporization of water is tabulated as a function of temperature on the IPTS-68 scale.

REFERENCE

Marsh, K. N., Ed., *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell, Oxford, 1987.

t °C	$\Delta_{\text{vap}}H$ kJ/mol	t °C	$\Delta_{\text{vap}}H$ kJ/mol
0	45.054	200	34.962
25	43.990	220	33.468
40	43.350	240	31.809
60	42.482	260	29.930
80	41.585	280	27.795
100	40.657	300	25.300
120	39.684	320	22.297
140	38.643	340	18.502
160	37.518	360	12.966
180	36.304	374	2.066

FIXED POINT PROPERTIES OF H₂O AND D₂O

Temperatures are given on the IPTS-68 scale.

REFERENCES

1. Haar, L., Gallagher, J.S., and Kell, G.S., *NBS/NRC Steam Tables*, Hemisphere Publishing Corp., 1984.
2. Levelt Sengers, J.M.H., Straub, J., Watanabe, K., and Hill, P.G., Assessment of critical parameter values for H₂O and D₂O, *J. Phys. Chem. Ref. Data*, 14, 193, 1985.
3. Kestin, J. et. al., Thermophysical properties of fluid D₂O, *J. Phys. Chem. Ref. Data*, 13, 601, 1984.
4. Kestin, J. et. al., Thermophysical properties of fluid H₂O, *J. Phys. Chem. Ref. Data*, 13, 175, 1984.
5. Hill, P.G., MacMillan, R.D.C., and Lee, V., A fundamental equation of state for heavy water, *J. Phys. Chem. Ref. Data*, 11, 1, 1982.

	Unit	H ₂ O	D ₂ O
Molar mass	g/mol	18.01528	20.02748
Melting point(101.325 kPa)	°C	0.00	3.82
Boiling point(101.325 kPa)	°C	100.00	101.42
Triple point temperature	°C	0.01	3.82
Triple point pressure	Pa	611.73	661
Triple point density(l)	g/cm ³	0.99978	1.1055
Triple point density(g)	mg/L	4.885	5.75
Critical temperature	°C	373.99	370.74
Critical pressure	MPa	22.064	21.671
Critical density	g/cm ³	0.322	0.356
Critical specific volume	cm ³ /g	3.11	2.81
Maximum density(saturated liquid)	g/cm ³	0.99995	1.1053
Temperature of maximum density	°C	4.0	11.2

THERMAL CONDUCTIVITY OF SATURATED H₂O AND D₂O

This table gives the thermal conductivity λ for water (H₂O or D₂O) in equilibrium with its vapor. Values for the liquid (λ_l) and vapor (λ_v) are listed, as well as the vapor pressure.

REFERENCES

1. Sengers, J.V. and Watson, J.T.R., Improved international formulations for the viscosity and thermal conductivity of water substance, *J. Phys. Chem. Ref. Data*, 15, 1291, 1986.
2. Matsunaga, N. and Nagashima, A., Transport properties of liquid and gaseous D₂O over a wide range of temperature and pressure, *J. Phys. Chem. Ref. Data*, 12, 933, 1983.

<i>t</i> /°C	H ₂ O			D ₂ O		
	<i>P</i> /kPa	λ_l /(mW/K m)	λ_v /(mW/K m)	<i>P</i> /kPa	λ_l /(mW/K m)	λ_v /(mW/K m)
0	0.6	561.0	16.49			
10	1.2	580.0	17.21	1.0	575	17.0
20	2.3	598.4	17.95	2.0	589	17.8
30	4.2	615.4	18.70	3.7	600	18.5
40	7.4	630.5	19.48	6.5	610	19.3
50	12.3	643.5	20.28	11.1	618	20.2
60	19.9	654.3	21.10	18.2	625	21.0
70	31.2	663.1	21.96	28.8	629	21.9
80	47.4	670.0	22.86	44.2	633	22.8
90	70.1	675.3	23.80	66.1	635	23.8
100	101.3	679.1	24.79	96.2	636	24.8
150	476	682.1	30.77	465	625	30.8
200	1555	663.4	39.10	1546	592	39.0
250	3978	621.4	51.18	3995	541	52.0
300	8593	547.7	71.78	8688	473	75.2
350	16530	447.6	134.59	16820	391	143.0

STANDARD DENSITY OF WATER

This table gives the density ρ of standard mean ocean water (SMOW), free from dissolved salts and gases, at a pressure of 101325 Pa. SMOW is a standard water sample of high purity and known isotopic composition. Methods of correcting for different isotopic compositions are discussed in the reference. The table below is reprinted with the permission of IUPAC. Note that the temperature scale is IPTS-68.

REFERENCE

Marsh, K. N., Ed., *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell Scientific Publications, Oxford, 1987.

$t_{68}/^{\circ}\text{C}$	$\rho/\text{kg m}^{-3}$									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	999.8426	8493	8558	8622	8683	8743	8801	8857	8912	8964
1	999.9015	9065	9112	9158	9202	9244	9284	9323	9360	9395
2	999.9429	9461	9491	9519	9546	9571	9595	9616	9636	9655
3	999.9672	9687	9700	9712	9722	9731	9738	9743	9747	9749
4	999.9750	9748	9746	9742	9736	9728	9719	9709	9696	9683
5	999.9668	9651	9632	9612	9591	9568	9544	9518	9490	9461
6	999.9430	9398	9365	9330	9293	9255	9216	9175	9132	9088
7	999.9043	8996	8948	8898	8847	8794	8740	8684	8627	8569
8	999.8509	8448	8385	8321	8256	8189	8121	8051	7980	7908
9	999.7834	7759	7682	7604	7525	7444	7362	7279	7194	7108
10	999.7021	6932	6842	6751	6658	6564	6468	6372	6274	6174
11	999.6074	5972	5869	5764	5658	5551	5443	5333	5222	5110
12	999.4996	4882	4766	4648	4530	4410	4289	4167	4043	3918
13	999.3792	3665	3536	3407	3276	3143	3010	2875	2740	2602
14	999.2464	2325	2184	2042	1899	1755	1609	1463	1315	1166
15	999.1016	0864	0712	0558	0403	0247	0090	9932*	9772*	9612*
16	998.9450	9287	9123	8957	8791	8623	8455	8285	8114	7942
17	998.7769	7595	7419	7243	7065	6886	6706	6525	6343	6160
18	998.5976	5790	5604	5416	5228	5038	4847	4655	4462	4268
19	998.4073	3877	3680	3481	3282	3081	2880	2677	2474	2269
20	998.2063	1856	1649	1440	1230	1019	0807	0594	0380	0164
21	997.9948	9731	9513	9294	9073	8852	8630	8406	8182	7957
22	997.7730	7503	7275	7045	6815	6584	6351	6118	5883	5648
23	997.5412	5174	4936	4697	4456	4215	3973	3730	3485	3240
24	997.2994	2747	2499	2250	2000	1749	1497	1244	0990	0735
25	997.0480	0223	9965*	9707*	9447*	9186*	8925*	8663*	8399*	8135*
26	996.7870	7604	7337	7069	6800	6530	6259	5987	5714	5441
27	996.5166	4891	4615	4337	4059	3780	3500	3219	2938	2655
28	996.2371	2087	1801	1515	1228	0940	0651	0361	0070	9778*
29	995.9486	9192	8898	8603	8306	8009	7712	7413	7113	6813
30	995.6511	6209	5906	5602	5297	4991	4685	4377	4069	3760
31	995.3450	3139	2827	2514	2201	1887	1572	1255	0939	0621
32	995.0302	9983*	9663*	9342*	9020*	8697*	8373*	8049*	7724*	7397*
33	994.7071	6743	6414	6085	5755	5423	5092	4759	4425	4091
34	994.3756	3420	3083	2745	2407	2068	1728	1387	1045	0703
35	994.0359	0015	9671*	9325*	8978*	8631*	8283*	7934*	7585*	7234*
36	993.6883	6531	6178	5825	5470	5115	4759	4403	4045	3687
37	993.3328	2968	2607	2246	1884	1521	1157	0793	0428	0062
38	992.9695	9328	8960	8591	8221	7850	7479	7107	6735	6361
39	992.5987	5612	5236	4860	4483	4105	3726	3347	2966	2586
40	992.2204									

* The leading figure decreases by 1.

VOLUMETRIC PROPERTIES OF AQUEOUS SODIUM CHLORIDE SOLUTIONS

This table gives the following properties of aqueous solutions of NaCl as a function of temperature and concentration:

Specific volume v (reciprocal of density) in cm^3/g

Isothermal compressibility $\kappa_T = -(1/v)(\partial v/\partial P)_T$ in GPa^{-1}

Cubic expansion coefficient $\alpha_v = (1/v)(\partial v/\partial T)_P$ in K^{-1}

All data refer to a pressure of 100 kPa (1 bar). The reference gives properties over a wider range of temperature and pressure.

REFERENCE

Rogers, P. S. Z., and Pitzer, K. S., *J. Phys. Chem. Ref. Data*, 11, 15, 1982.

Molality in mol/kg									
$T/^\circ\text{C}$	0.100	0.250	0.500	0.750	1.000	2.000	3.000	4.000	5.000
Specific volume v in cm^3/g									
0	0.995732	0.989259	0.978889	0.968991	0.959525	0.925426	0.896292	0.870996	0.848646
10	0.995998	0.989781	0.979804	0.970256	0.961101	0.927905	0.899262	0.874201	0.851958
20	0.997620	0.991564	0.981833	0.972505	0.963544	0.930909	0.902565	0.877643	0.855469
25	0.998834	0.992832	0.983185	0.973932	0.965038	0.932590	0.904339	0.879457	0.857301
30	1.000279	0.994319	0.984735	0.975539	0.966694	0.934382	0.906194	0.881334	0.859185
40	1.003796	0.997883	0.988374	0.979243	0.970455	0.938287	0.910145	0.885276	0.863108
50	1.008064	1.002161	0.992668	0.983551	0.974772	0.942603	0.914411	0.889473	0.867241
60	1.0130	1.0071	0.9976	0.9885	0.9797	0.9474	0.9191	0.8940	0.8716
70	1.0186	1.0127	1.0031	0.9939	0.9851	0.9526	0.9240	0.8987	0.8762
80	1.0249	1.0188	1.0092	0.9999	0.9909	0.9581	0.9293	0.9037	0.8809
90	1.0317	1.0256	1.0157	1.0063	0.9972	0.9640	0.9348	0.9089	0.8858
100	1.0391	1.0329	1.0228	1.0133	1.0040	0.9703	0.9406	0.9144	0.8910
Compressibility κ_T in GPa^{-1}									
0	0.503	0.492	0.475	0.459	0.443	0.389	0.346	0.315	0.294
10	0.472	0.463	0.449	0.436	0.423	0.377	0.341	0.313	0.294
20	0.453	0.446	0.433	0.422	0.411	0.371	0.338	0.313	0.294
25	0.447	0.440	0.428	0.417	0.407	0.369	0.337	0.313	0.294
30	0.443	0.436	0.425	0.414	0.404	0.367	0.337	0.313	0.294
40	0.438	0.432	0.421	0.411	0.401	0.367	0.338	0.315	0.296
50	0.438	0.431	0.421	0.411	0.402	0.369	0.340	0.317	0.299
60	0.44	0.44	0.43	0.42	0.41	0.38	0.35	0.32	0.30
70	0.45	0.44	0.43	0.42	0.42	0.38	0.36	0.33	0.31
80	0.46	0.45	0.44	0.43	0.43	0.39	0.37	0.34	0.32
90	0.47	0.47	0.46	0.45	0.44	0.41	0.38	0.35	0.33
100	0.49	0.48	0.47	0.46	0.45	0.42	0.39	0.37	0.34
Cubic expansion coefficient α_v in K^{-1}									
0	-0.058	-0.026	0.024	0.069	0.110	0.237	0.313	0.355	
10	0.102	0.123	0.156	0.186	0.213	0.297	0.349	0.380	
20	0.218	0.232	0.254	0.274	0.292	0.349	0.384	0.406	
25	0.267	0.278	0.296	0.312	0.327	0.373	0.401	0.420	
30	0.311	0.320	0.334	0.347	0.359	0.395	0.418	0.433	
40	0.389	0.394	0.402	0.410	0.417	0.438	0.451	0.460	
50	0.458	0.460	0.464	0.467	0.470	0.479	0.484	0.486	
60	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	
70	0.58	0.58	0.58	0.57	0.57	0.56	0.55	0.54	
80	0.64	0.63	0.63	0.62	0.61	0.60	0.58	0.56	
90	0.69	0.68	0.67	0.67	0.66	0.63	0.61	0.59	
100	0.74	0.73	0.72	0.71	0.70	0.66	0.64	0.61	

DENSITY OF D₂O

Density of liquid D₂O in g/cm³ at a pressure of 100 kPa (1 bar).

REFERENCE

Kirillin, V.A., Ed., *Heavy Water: Thermophysical Properties*, Gosudarstvennoe Energeticheskoe Izdatel'stvo, Moscow, 1963.

<i>t</i> /°C	3.8	5	10	15	20	25	30
Density	1.1053	1.1055	1.1057	1.1056	1.105	1.1044	1.1034
<i>t</i> /°C	35	40	45	50	55	60	65
Density	1.1019	1.1001	1.0979	1.0957	1.0931	1.0905	1.0875
<i>t</i> /°C	70	75	80	85	90	95	100
Density	1.0847	1.0815	1.0783	1.0748	1.0712	1.0673	1.0635

VAPOR PRESSURE OF ICE

The values of the vapor (sublimation) pressure of ice in this table were calculated from the equation recommended by the International Association for the Properties of Steam (IAPS) in 1993. Temperature values correspond to the ITS-90 temperature scale. The uncertainty in the pressure is estimated to be 0.1% for $t > -25^{\circ}\text{C}$ and 0.5% for $t < -25^{\circ}\text{C}$. The first entry in the table is the triple point of water.

REFERENCE

Wagner, W., Saul, A., and Pruss, A., *J. Phys. Chem. Ref. Data*, 23, 515, 1994.

$t/^{\circ}\text{C}$	p/Pa	$t/^{\circ}\text{C}$	p/Pa	$t/^{\circ}\text{C}$	p/Pa
0.01	611.657	-16	150.68	-33	27.71
0	611.15	-17	137.25	-34	24.90
-1	562.67	-18	124.92	-35	22.35
-2	517.72	-19	113.62	-36	20.04
-3	476.06	-20	103.26	-37	17.96
-4	437.47	-21	93.77	-38	16.07
-5	401.76	-22	85.10	-39	14.37
-6	368.73	-23	77.16	-40	12.84
-7	338.19	-24	69.91	-45	7.202
-8	309.98	-25	63.29	-50	3.936
-9	283.94	-26	57.25	-55	2.093
-10	259.90	-27	51.74	-60	1.080
-11	237.74	-28	46.73	-65	0.540
-12	217.32	-29	42.16	-70	0.261
-13	198.52	-30	38.01	-75	0.122
-14	181.22	-31	34.24	-80	0.055
-15	165.30	-32	30.82		

VAPOR PRESSURE OF WATER FROM 0 TO 370° C

This table gives the vapor pressure of water at intervals of 1° C from the melting point to the critical point.

REFERENCE

Haar, L., Gallagher, J.S., and Kell, G.S., *NBS/NRC Steam Tables*, Hemisphere Publishing Corp., New York, 1984.

<i>t</i> /°C	<i>P</i> /kPa	<i>t</i> /°C	<i>P</i> /kPa	<i>t</i> /°C	<i>P</i> /kPa	<i>t</i> /°C	<i>P</i> /kPa
0	0.61129	53	14.303	106	125.03	159	602.11
1	0.65716	54	15.012	107	129.39	160	617.66
2	0.70605	55	15.752	108	133.88	161	633.53
3	0.75813	56	16.522	109	138.50	162	649.73
4	0.81359	57	17.324	110	143.24	163	666.25
5	0.87260	58	18.159	111	148.12	164	683.10
6	0.93537	59	19.028	112	153.13	165	700.29
7	1.0021	60	19.932	113	158.29	166	717.83
8	1.0730	61	20.873	114	163.58	167	735.70
9	1.1482	62	21.851	115	169.02	168	753.94
10	1.2281	63	22.868	116	174.61	169	772.52
11	1.3129	64	23.925	117	180.34	170	791.47
12	1.4027	65	25.022	118	186.23	171	810.78
13	1.4979	66	26.163	119	192.28	172	830.47
14	1.5988	67	27.347	120	198.48	173	850.53
15	1.7056	68	28.576	121	204.85	174	870.98
16	1.8185	69	29.852	122	211.38	175	891.80
17	1.9380	70	31.176	123	218.09	176	913.03
18	2.0644	71	32.549	124	224.96	177	934.64
19	2.1978	72	33.972	125	232.01	178	956.66
20	2.3388	73	35.448	126	239.24	179	979.09
21	2.4877	74	36.978	127	246.66	180	1001.9
22	2.6447	75	38.563	128	254.25	181	1025.2
23	2.8104	76	40.205	129	262.04	182	1048.9
24	2.9850	77	41.905	130	270.02	183	1073.0
25	3.1690	78	43.665	131	278.20	184	1097.5
26	3.3629	79	45.487	132	286.57	185	1122.5
27	3.5670	80	47.373	133	295.15	186	1147.9
28	3.7818	81	49.324	134	303.93	187	1173.8
29	4.0078	82	51.342	135	312.93	188	1200.1
30	4.2455	83	53.428	136	322.14	189	1226.9
31	4.4953	84	55.585	137	331.57	190	1254.2
32	4.7578	85	57.815	138	341.22	191	1281.9
33	5.0335	86	60.119	139	351.09	192	1310.1
34	5.3229	87	62.499	140	361.19	193	1338.8
35	5.6267	88	64.958	141	371.53	194	1368.0
36	5.9453	89	67.496	142	382.11	195	1397.6
37	6.2795	90	70.117	143	392.92	196	1427.8
38	6.6298	91	72.823	144	403.98	197	1458.5
39	6.9969	92	75.614	145	415.29	198	1489.7
40	7.3814	93	78.494	146	426.85	199	1521.4
41	7.7840	94	81.465	147	438.67	200	1553.6
42	8.2054	95	84.529	148	450.75	201	1586.4
43	8.6463	96	87.688	149	463.10	202	1619.7
44	9.1075	97	90.945	150	475.72	203	1653.6
45	9.5898	98	94.301	151	488.61	204	1688.0
46	10.094	99	97.759	152	501.78	205	1722.9
47	10.620	100	101.32	153	515.23	206	1758.4
48	11.171	101	104.99	154	528.96	207	1794.5
49	11.745	102	108.77	155	542.99	208	1831.1
50	12.344	103	112.66	156	557.32	209	1868.4
51	12.970	104	116.67	157	571.94	210	1906.2
52	13.623	105	120.79	158	586.87	211	1944.6

VAPOR PRESSURE OF WATER FROM 0 TO 370° C (continued)

<i>t/°C</i>	<i>P/kPa</i>	<i>t/°C</i>	<i>P/kPa</i>	<i>t/°C</i>	<i>P/kPa</i>	<i>t/°C</i>	<i>P/kPa</i>
212	1983.6	253	4178.9	294	7881.3	335	13701
213	2023.2	254	4249.1	295	7995.2	336	13876
214	2063.4	255	4320.2	296	8110.3	337	14053
215	2104.2	256	4392.2	297	8226.8	338	14232
216	2145.7	257	4465.1	298	8344.5	339	14412
217	2187.8	258	4539.0	299	8463.5	340	14594
218	2230.5	259	4613.7	300	8583.8	341	14778
219	2273.8	260	4689.4	301	8705.4	342	14964
220	2317.8	261	4766.1	302	8828.3	343	15152
221	2362.5	262	4843.7	303	8952.6	344	15342
222	2407.8	263	4922.3	304	9078.2	345	15533
223	2453.8	264	5001.8	305	9205.1	346	15727
224	2500.5	265	5082.3	306	9333.4	347	15922
225	2547.9	266	5163.8	307	9463.1	348	16120
226	2595.9	267	5246.3	308	9594.2	349	16320
227	2644.6	268	5329.8	309	9726.7	350	16521
228	2694.1	269	5414.3	310	9860.5	351	16725
229	2744.2	270	5499.9	311	9995.8	352	16931
230	2795.1	271	5586.4	312	10133	353	17138
231	2846.7	272	5674.0	313	10271	354	17348
232	2899.0	273	5762.7	314	10410	355	17561
233	2952.1	274	5852.4	315	10551	356	17775
234	3005.9	275	5943.1	316	10694	357	17992
235	3060.4	276	6035.0	317	10838	358	18211
236	3115.7	277	6127.9	318	10984	359	18432
237	3171.8	278	6221.9	319	11131	360	18655
238	3228.6	279	6317.0	320	11279	361	18881
239	3286.3	280	6413.2	321	11429	362	19110
240	3344.7	281	6510.5	322	11581	363	19340
241	3403.9	282	6608.9	323	11734	364	19574
242	3463.9	283	6708.5	324	11889	365	19809
243	3524.7	284	6809.2	325	12046	366	20048
244	3586.3	285	6911.1	326	12204	367	20289
245	3648.8	286	7014.1	327	12364	368	20533
246	3712.1	287	7118.3	328	12525	369	20780
247	3776.2	288	7223.7	329	12688	370	21030
248	3841.2	289	7330.2	330	12852	371	21283
249	3907.0	290	7438.0	331	13019	372	21539
250	3973.6	291	7547.0	332	13187	373	21799
251	4041.2	292	7657.2	333	13357	373.98	22055
252	4109.6	293	7768.6	334	13528		

BOILING POINT OF WATER AT VARIOUS PRESSURES

Data are based on the equation of state recommended by the International Association for the Properties of Steam in 1984, as presented in Haar, Gallagher, and Kell, *NBS-NRC Steam Tables* (Hemisphere Publishing Corp., New York, 1984). The temperature scale is IPTS-68.

Note that: 1 mbar = 100 Pa = 0.000986923 atmos = 0.750062 mmHg.

P/mbar	T/°C	P/mbar	T/°C	P/mbar	T/°C	P/mbar	T/°C
50	32.88	915	97.17	1013.25	100.00	1200	104.81
100	45.82	920	97.32	1015	100.05	1250	105.99
150	53.98	925	97.47	1020	100.19	1300	107.14
200	60.07	930	97.62	1025	100.32	1350	108.25
250	64.98	935	97.76	1030	100.46	1400	109.32
300	69.11	940	97.91	1035	100.60	1450	110.36
350	72.70	945	98.06	1040	100.73	1500	111.38
400	75.88	950	98.21	1045	100.87	1550	112.37
450	78.74	955	98.35	1050	101.00	1600	113.33
500	81.34	960	98.50	1055	101.14	1650	114.26
550	83.73	965	98.64	1060	101.27	1700	115.18
600	85.95	970	98.78	1065	101.40	1750	116.07
650	88.02	975	98.93	1070	101.54	1800	116.94
700	89.96	980	99.07	1075	101.67	1850	117.79
750	91.78	985	99.21	1080	101.80	1900	118.63
800	93.51	990	99.35	1085	101.93	1950	119.44
850	95.15	995	99.49	1090	102.06	2000	120.24
900	96.71	1000	99.63	1095	102.19	2050	121.02
905	96.87	1005	99.77	1100	102.32	2100	121.79
910	97.02	1010	99.91	1150	103.59	2150	122.54

MELTING POINT OF ICE AS A FUNCTION OF PRESSURE

This table gives values of the melting temperature of ice at various pressures, as calculated from the equation for the ice I - liquid water phase boundary recommended by the International Association for the Properties of Steam (IAPS). Temperatures are on the ITS-90 scale. See the Reference for information on forms of ice that exist at higher pressures. The transition points for transformations of the various forms of ice (in each case in equilibrium with liquid water) are:

ice I - ice III	209.9 MPa	-21.985°C
ice III - ice V	350.1	-16.986
ice V - ice VI	632.4	0.16
ice VI - ice VII	2216	82

REFERENCE

Wagner, W., Saul, A., and Pruss, A., *J. Phys. Chem. Ref. Data*, 23, 515, 1994.

<i>p</i> /MPa	<i>t</i> /°C	<i>p</i> /MPa	<i>t</i> /°C	<i>p</i> /MPa	<i>t</i> /°C
0.1	0.00	40	-3.15	130	-12.07
1	-0.06	50	-4.02	140	-13.22
2	-0.14	60	-4.91	150	-14.40
3	-0.21	70	-5.83	160	-15.62
4	-0.29	80	-6.79	170	-16.85
5	-0.36	90	-7.78	180	-18.11
10	-0.74	100	-8.80	190	-19.39
20	-1.52	110	-9.86	200	-20.69
30	-2.32	120	-10.95	210	-22.00

PROPERTIES OF WATER AND STEAM AS A FUNCTION OF TEMPERATURE AND PRESSURE

This table gives properties of compressed water and superheated steam at selected pressures and temperatures. The properties included are density ρ , enthalpy H , entropy S , heat capacity at constant pressure C_p , and static dielectric constant (relative permittivity). The table was generated from the formulation approved by the International Association for the Properties of Water and Steam for general and scientific use. The reference state for this table is the liquid at the triple point, at which the internal energy and entropy are taken as zero. A duplicate entry in the temperature column indicates a phase transition (liquid-vapor) at that temperature; property values are then given for both phases. In the 100 MPa section of the table, an entry is given at the critical temperature, 647.10 K. Temperatures refer to the ITS-90 scale, on which the normal boiling point of water is 373.12 K (99.97°C).

REFERENCES

1. Release on the IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use, September 1996; available from Executive Secretary of IAPWS, Electric Power Research Institute, 3412 Hillview Ave., Palo Alto, CA 94304-1395.
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p/MPa	T/K	$\rho/\text{kg m}^{-3}$	$H/\text{J g}^{-1}$	$S/\text{J g}^{-1}\text{K}^{-1}$	$C_p/\text{J g}^{-1}\text{K}^{-1}$	Diel. const.
0.1	273.16	999.84	0.10	0.0000	4.2194	87.90
0.1	300	996.56	112.65	0.3931	4.1806	77.75
0.1	325	987.19	217.15	0.7276	4.1819	69.32
0.1	350	973.73	321.84	1.0380	4.1945	61.79
0.1	372.76	958.63	417.50	1.3028	4.2152	55.61
0.1	372.76	0.59034	2674.9	7.3588	2.0784	1.006
0.1	375	0.58653	2679.6	7.3713	2.0686	1.006
0.1	400	0.54761	2730.4	7.5025	2.0078	1.005
0.1	450	0.48458	2829.7	7.7365	1.9752	1.004
0.1	500	0.43514	2928.6	7.9447	1.9813	1.003
0.1	550	0.39507	3028.1	8.1344	2.0010	1.003
0.1	600	0.36185	3128.8	8.3096	2.0268	1.002
0.1	650	0.33384	3230.8	8.4730	2.0557	1.002
0.1	700	0.30988	3334.4	8.6264	2.0867	1.002
0.1	750	0.28915	3439.5	8.7715	2.1191	1.002
0.1	800	0.27102	3546.3	8.9093	2.1525	1.001
0.1	850	0.25504	3654.8	9.0408	2.1868	1.001
0.1	900	0.24085	3765.0	9.1668	2.2216	1.001
0.1	950	0.22815	3876.9	9.2879	2.2568	1.001
0.1	1000	0.21673	3990.7	9.4045	2.2921	1.001
0.1	1050	0.20640	4106.1	9.5172	2.3273	1.001
0.1	1100	0.19701	4223.4	9.6263	2.3621	1.001
0.1	1150	0.18844	4342.3	9.7321	2.3965	1.001
0.1	1200	0.18058	4463.0	9.8348	2.4302	1.001
1	273.16	1000.3	1.02	0.0000	4.2150	87.93
1	300	996.96	113.48	0.3928	4.1781	77.78
1	325	987.58	217.93	0.7272	4.1798	69.36
1	350	974.13	322.56	1.0374	4.1925	61.82
1	375	957.43	427.64	1.3274	4.2158	55.09
1	400	937.87	533.47	1.6005	4.2535	49.06
1	450	890.39	749.20	2.1086	4.3924	38.81
1	453.03	887.13	762.51	2.1381	4.4045	38.23
1	453.03	5.1450	2777.1	6.5850	2.7114	1.042
1	500	4.5323	2891.2	6.8250	2.2795	1.034

**PROPERTIES OF WATER AND STEAM AS A FUNCTION OF
TEMPERATURE AND PRESSURE (continued)**

p/MPa	T/K	$\rho/\text{kg m}^{-3}$	$H/\text{J g}^{-1}$	$S/\text{J g}^{-1}\text{K}^{-1}$	$C_p/\text{J g}^{-1}\text{K}^{-1}$	Diel. const.
1	550	4.0581	3001.8	7.0359	2.1647	1.028
1	600	3.6871	3109.0	7.2224	2.1292	1.024
1	650	3.3843	3215.2	7.3925	2.1254	1.020
1	700	3.1305	3321.7	7.5504	2.1368	1.017
1	750	2.9140	3429.0	7.6984	2.1566	1.015
1	800	2.7265	3537.5	7.8384	2.1816	1.013
1	850	2.5624	3647.3	7.9715	2.2098	1.012
1	900	2.4174	3758.5	8.0986	2.2402	1.011
1	950	2.2882	3871.3	8.2206	2.2721	1.010
1	1000	2.1723	3985.7	8.3380	2.3048	1.009
1	1050	2.0678	4101.8	8.4512	2.3380	1.008
1	1100	1.9729	4219.5	8.5608	2.3713	1.007
1	1150	1.8865	4338.9	8.6669	2.4044	1.007
1	1200	1.8074	4460.0	8.7699	2.4371	1.006
10	273.16	1004.8	10.1	0.000	4.173	88.30
10	300	1001.0	121.7	0.390	4.153	78.11
10	325	991.46	225.6	0.723	4.160	69.67
10	350	978.09	329.7	1.031	4.173	62.13
10	375	961.62	434.4	1.320	4.195	55.40
10	400	942.42	539.6	1.592	4.230	49.39
10	450	896.16	753.9	2.096	4.355	39.17
10	500	838.02	977.1	2.566	4.602	30.79
10	550	761.82	1218	3.027	5.140	23.53
10	584.15	688.42	1408	3.360	6.123	18.70
10	584.15	55.463	2725	5.616	7.140	1.404
10	600	49.773	2820	5.775	5.136	1.365
10	650	40.479	3022	6.100	3.396	1.267
10	700	35.355	3177	6.330	2.874	1.214
10	750	31.810	3314	6.520	2.645	1.179
10	800	29.107	3443	6.686	2.531	1.154
10	850	26.933	3568	6.838	2.473	1.134
10	900	25.123	3691	6.978	2.445	1.118
10	950	23.580	3813	7.110	2.436	1.105
10	1000	22.241	3935	7.235	2.439	1.095
10	1050	21.063	4057	7.354	2.450	1.086
10	1100	20.017	4180	7.469	2.466	1.078
10	1150	19.078	4304	7.579	2.485	1.072
10	1200	18.230	4429	7.685	2.507	1.066
100	273.16	1045.3	95.4	-0.008	3.905	91.83
100	300	1037.2	201.4	0.362	3.979	81.22
100	325	1026.6	301.3	0.682	4.008	72.58
100	350	1013.6	401.7	0.979	4.025	64.95
100	375	998.59	502.6	1.258	4.040	58.19
100	400	981.82	603.7	1.518	4.056	52.20
100	450	943.51	807.8	1.999	4.110	42.15
100	500	899.21	1015	2.436	4.196	34.15
100	550	848.78	1228	2.842	4.323	27.67
100	600	791.49	1448	3.225	4.501	22.29
100	647.10	730.24	1665	3.573	4.733	17.97
100	650	726.21	1679	3.595	4.750	17.72
100	700	651.77	1925	3.958	5.083	13.75
100	750	568.52	2188	4.322	5.449	10.34
100	800	482.23	2466	4.681	5.610	7.562
100	850	404.66	2742	5.016	5.380	5.571
100	900	343.61	3000	5.310	4.887	4.284
100	950	298.61	3231	5.560	4.382	3.477
100	1000	265.45	3440	5.774	3.978	2.956
100	1050	240.32	3631	5.961	3.683	2.601
100	1100	220.62	3809	6.127	3.471	2.347
100	1150	204.71	3979	6.278	3.319	2.158
100	1200	191.53	4142	6.417	3.209	2.011

PERMITTIVITY (DIELECTRIC CONSTANT) OF WATER AT VARIOUS FREQUENCIES

The permittivity of liquid water in the radiofrequency and microwave regions can be represented by the Debye equation (References 1 and 2):

$$\epsilon' = \epsilon_{\infty} + \frac{\epsilon_s - \epsilon_{\infty}}{1 + \omega^2 \tau^2}$$

$$\epsilon'' = \frac{(\epsilon_s - \epsilon_{\infty})\omega\tau}{1 + \omega^2 \tau^2}$$

where $\epsilon = \epsilon' + i\epsilon''$ is the (complex) relative permittivity (i.e., the absolute permittivity divided by the permittivity of free space $\epsilon_0 = 8.854 \cdot 10^{-12}$ F m⁻¹). Here ϵ_s is the static permittivity (see Reference 3 and the table "Properties of Water in the Range 0—100°C" in this Section); ϵ_{∞} is a parameter describing the permittivity in the high frequency limit; τ is the relaxation time for molecular orientation; and $\omega = 2\pi f$ is the angular frequency. The values in this table have been calculated from parameters given in Reference 2:

	0°C	25°C	50°C
ϵ_{∞}	5.7	5.2	4.0
τ/ps	17.67	8.27	4.75

Other useful quantities that can be calculated from the values in the table are the loss tangent:

$$\tan \delta = \epsilon'' / \epsilon'$$

and the absorption coefficient α which describes the power attenuation per unit length ($P = P_0 e^{-\alpha l}$):

$$\alpha = \frac{\pi f \epsilon''}{c \sqrt{\epsilon'}}$$

and c is the speed of light. The last equation is valid when $\epsilon''/\epsilon' \ll 1$.

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Frequency	0°C		25°C		50°C	
	ϵ'	ϵ''	ϵ'	ϵ''	ϵ'	ϵ''
0	87.90	0.00	78.36	0.00	69.88	0.00
1 kHz	87.90	0.00	78.36	0.00	69.88	0.00
1 MHz	87.90	0.01	78.36	0.00	69.88	0.00
10 MHz	87.90	0.09	78.36	0.04	69.88	0.02
100 MHz	87.89	0.91	78.36	0.38	69.88	0.20
200 MHz	87.86	1.82	78.35	0.76	69.88	0.39
500 MHz	87.65	4.55	78.31	1.90	69.87	0.98
1 GHz	86.90	9.01	78.16	3.79	69.82	1.96
2 GHz	84.04	17.39	77.58	7.52	69.65	3.92
3 GHz	79.69	24.64	76.62	11.13	69.36	5.85
4 GHz	74.36	30.49	75.33	14.58	68.95	7.75
5 GHz	68.54	34.88	73.73	17.81	68.45	9.62
10 GHz	42.52	40.88	62.81	29.93	64.49	18.05
20 GHz	19.56	30.78	40.37	36.55	52.57	28.99
30 GHz	12.50	22.64	26.53	33.25	40.57	32.74
40 GHz	9.67	17.62	18.95	28.58	31.17	32.43
50 GHz	8.28	14.34	14.64	24.53	24.42	30.47

THERMOPHYSICAL PROPERTIES OF FLUIDS

These tables give thermodynamic and transport properties of some important fluids, as generated from the equations of state presented in the references below. The properties tabulated are density (ρ), energy (E), enthalpy (H), entropy (S), isochoric heat capacity (C_v), isobaric heat capacity (C_p), speed of sound (v_s), viscosity (η), thermal conductivity (λ), and dielectric constant (D). All extensive properties are given on a molar basis. Not all properties are included for every substance. The references should be consulted for information on the uncertainties and the reference states for E , H , and S .

Values are given as a function of temperature for several isobars. The phase can be determined by noting the sharp decrease in density between two successive temperature entries; all lines above this point refer to the liquid phase, and all lines below refer to the gas phase. If there is no sharp discontinuity in density, all data in the table refer to the supercritical region (i.e., the isobar is above the critical pressure).

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Nitrogen (N₂)

T K	ρ mol/L	E J/mol	H J/mol	S J/mol K	C_v J/mol K	C_p J/mol K	η $\mu\text{Pa s}$	λ mW/m K	D
$P = 0.1 \text{ MPa (1 bar)}$									
70	30.017	-3828	-3824	73.8	28.5	57.2	203.9	143.5	1.45269
77.25	28.881	-3411	-3407	79.5	27.8	57.8	152.2	133.8	1.43386
77.25	0.163	1546	2161	151.6	21.6	31.4	5.3	7.6	1.00215
100	0.123	2041	2856	159.5	21.1	30.0	6.8	9.6	1.00162
200	0.060	4140	5800	179.9	20.8	29.2	12.9	18.4	1.00079
300	0.040	6223	8717	191.8	20.8	29.2	18.0	25.8	1.00053
400	0.030	8308	11635	200.2	20.9	29.2	22.2	32.3	1.00040
500	0.024	10414	14573	206.7	21.2	29.6	26.1	38.5	1.00032
600	0.020	12563	17554	212.2	21.8	30.1	29.5	44.5	1.00026
700	0.017	14770	20593	216.8	22.4	30.7	32.8	50.5	1.00023
800	0.015	17044	23698	221.0	23.1	31.4	35.8	56.3	1.00020
900	0.013	19383	26869	224.7	23.7	32.0	38.7	62.0	1.00017
1000	0.012	21786	30103	228.1	24.3	32.6	41.5	67.7	1.00016
1500	0.008	34530	47004	241.8	26.4	34.7	54.0	93.3	1.00010
$P = 1 \text{ MPa}$									
70	30.070	-3838	-3805	73.6	28.9	56.9	205.9	144.1	1.45355
80	28.504	-3267	-3232	81.3	27.8	57.7	139.5	130.7	1.42760
90	26.721	-2685	-2648	88.2	26.7	59.4	100.1	115.3	1.39824
100	24.634	-2073	-2032	94.6	26.2	64.4	73.1	98.5	1.36417
103.75	23.727	-1828	-1786	97.1	26.2	67.8	64.8	91.8	1.34947
103.75	1.472	1788	2467	138.1	24.1	45.0	7.6	12.5	1.01954
200	0.614	4048	5675	160.3	21.0	30.4	13.2	19.3	1.00812
300	0.402	6171	8661	172.5	20.9	29.6	18.1	26.3	1.00529
400	0.300	8273	11609	180.9	20.9	29.5	22.4	32.7	1.00395
500	0.240	10389	14563	187.5	21.3	29.7	26.1	38.8	1.00315
600	0.200	12544	17554	193.0	21.8	30.2	29.6	44.8	1.00262
700	0.171	14756	20600	197.7	22.4	30.8	32.8	50.7	1.00224
800	0.150	17032	23709	201.8	23.1	31.4	35.9	56.5	1.00196
900	0.133	19374	26884	205.6	23.7	32.1	38.8	62.2	1.00174
1000	0.120	21778	30121	209.0	24.3	32.7	41.5	67.8	1.00157
1500	0.080	34527	47029	222.7	26.4	34.8	54.0	93.4	1.00104
$P = 10 \text{ MPa}$									
65.32	31.120	-4176	-3855	68.6	31.8	53.8	275.7	153.8	1.47067
100	26.201	-2328	-1946	92.0	27.4	56.3	90.2	112.3	1.38942
200	7.117	3037	4442	136.4	22.7	45.5	17.6	30.4	1.09698
300	3.989	5667	8174	151.7	21.4	33.4	20.1	31.9	1.05347
400	2.898	7941	11392	161.0	21.3	31.3	23.7	36.7	1.03860
500	2.302	10148	14492	167.9	21.5	30.8	27.1	42.0	1.03055

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	η μ Pa s	λ mW/m K	<i>D</i>
600	1.918	12361	17575	173.5	21.9	30.9	30.4	47.4	1.02538
700	1.647	14613	20683	178.3	22.5	31.3	33.5	53.0	1.02175
800	1.445	16919	23837	182.5	23.2	31.8	36.4	58.6	1.01904
900	1.288	19283	27046	186.3	23.8	32.4	39.3	64.1	1.01694
1000	1.162	21705	30308	189.8	24.4	32.9	42.0	69.6	1.01526
1500	0.783	34504	47283	203.5	26.5	34.8	54.3	94.7	1.01020

Oxygen (O₂)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	η μ Pa s	λ mW/m K	<i>D</i>
<i>P</i> = 0.1 MPa (1 bar)									
60	40.049	-5883	-5880	72.4	34.9	53.4	425.2	188.2	1.55619
80	37.204	-4814	-4812	87.7	31.0	53.6	251.7	166.1	1.51114
100	0.123	2029	2840	172.9	21.4	30.5	7.5	9.3	1.00146
120	0.102	2458	3442	178.4	21.0	29.8	9.0	11.2	1.00121
140	0.087	2881	4035	182.9	20.9	29.5	10.5	13.1	1.00103
160	0.076	3301	4624	186.9	20.9	29.4	11.9	15.0	1.00090
180	0.067	3720	5210	190.3	20.8	29.3	13.3	16.7	1.00080
200	0.060	4138	5796	193.4	20.8	29.3	14.6	18.4	1.00072
220	0.055	4556	6381	196.2	20.8	29.3	15.9	20.1	1.00065
240	0.050	4974	6966	198.8	20.9	29.3	17.2	21.7	1.00060
260	0.046	5393	7552	201.1	20.9	29.3	18.4	23.2	1.00055
280	0.043	5812	8138	203.3	21.0	29.4	19.5	24.8	1.00051
300	0.040	6234	8726	205.3	21.1	29.4	20.6	26.3	1.00048
320	0.038	6657	9316	207.2	21.2	29.5	21.7	27.8	1.00045
340	0.035	7082	9908	209.0	21.3	29.7	22.8	29.3	1.00042
360	0.033	7510	10503	210.7	21.5	29.8	23.8	30.8	1.00040
380	0.032	7941	11100	212.3	21.6	30.0	24.8	32.2	1.00038

P = 1 MPa

60	40.084	-5887	-5863	72.3	34.9	53.3	428.5	188.4	1.55674
80	37.254	-4822	-4795	87.6	31.0	53.5	253.8	166.4	1.51192
100	34.153	-3741	-3712	99.7	28.5	55.2	155.6	137.9	1.46381
120	1.198	2163	2997	156.7	24.0	40.6	9.4	13.9	1.01429
140	0.950	2683	3735	162.4	22.2	34.4	10.8	14.9	1.01133
160	0.802	3151	4398	166.8	21.5	32.2	12.2	16.3	1.00955
180	0.698	3598	5030	170.5	21.2	31.2	13.5	17.7	1.00831
200	0.620	4035	5647	173.8	21.1	30.6	14.8	19.3	1.00738
220	0.559	4466	6255	176.7	21.0	30.3	16.1	20.8	1.00665
240	0.509	4894	6858	179.3	21.0	30.1	17.3	22.3	1.00606
260	0.468	5321	7458	181.7	21.0	29.9	18.5	23.8	1.00556
280	0.433	5748	8056	183.9	21.1	29.9	19.6	25.2	1.00515
300	0.403	6174	8654	186.0	21.1	29.9	20.7	26.7	1.00479
320	0.377	6602	9252	187.9	21.2	29.9	21.8	28.2	1.00448
340	0.355	7032	9851	189.7	21.4	30.0	22.8	29.6	1.00421
360	0.335	7463	10452	191.4	21.5	30.1	23.9	31.1	1.00397
380	0.317	7898	11056	193.1	21.7	30.2	24.9	32.6	1.00376

P = 10 MPa

60	40.419	-5931	-5684	71.5	35.1	53.0	461.8	189.9	1.56210
80	37.727	-4893	-4628	86.7	31.6	52.7	274.4	168.6	1.51936
100	34.881	-3856	-3570	98.5	29.1	53.4	171.0	141.2	1.47500
120	31.721	-2796	-2481	108.4	27.3	55.9	113.0	115.1	1.42677
140	27.890	-1662	-1304	117.5	26.2	62.9	76.3	91.8	1.36972
160	22.379	-322	125	127.0	26.1	84.8	48.6	71.2	1.29037
180	13.232	1489	2245	139.5	26.6	105.9	26.2	46.8	1.16560
200	8.666	2681	3835	147.9	24.0	60.6	21.2	34.0	1.10650

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	η μ Pa s	λ mW/m K	<i>D</i>
220	6.868	3424	4880	152.9	22.6	46.4	20.5	30.8	1.08380
240	5.836	4029	5742	156.6	22.0	40.6	20.8	30.1	1.07090
260	5.134	4573	6521	159.7	21.8	37.6	21.4	30.2	1.06219
280	4.613	5086	7254	162.5	21.6	35.8	22.1	30.8	1.05575
300	4.205	5581	7959	164.9	21.6	34.7	22.9	31.6	1.05073
320	3.874	6063	8645	167.1	21.7	33.9	23.7	32.6	1.04667
340	3.598	6538	9318	169.1	21.8	33.4	24.6	33.7	1.04329
360	3.363	7009	9982	171.0	21.9	33.0	25.4	34.9	1.04043
380	3.161	7477	10641	172.8	22.0	32.8	26.3	36.1	1.03796

Hydrogen (H₂)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	<i>D</i>
<i>P</i> = 0.1 MPa (1 bar)								
15	37.738	-605	-603	11.2	9.7	14.4	1319	1.24827
20	35.278	-524	-521	15.8	11.3	19.1	1111	1.23093
40	0.305	491	818	75.6	12.5	21.3	521	1.00186
60	0.201	748	1244	84.3	13.1	21.6	636	1.00122
80	0.151	1030	1694	90.7	15.3	23.7	714	1.00091
100	0.120	1370	2202	96.4	18.7	27.1	773	1.00073
120	0.100	1777	2776	101.6	21.8	30.2	827	1.00061
140	0.086	2237	3401	106.4	23.8	32.2	883	1.00052
160	0.075	2723	4054	110.8	24.6	33.0	940	1.00046
180	0.067	3216	4714	114.7	24.6	32.9	998	1.00041
200	0.060	3703	5367	118.1	24.1	32.4	1054	1.00037
220	0.055	4179	6009	121.2	23.4	31.8	1110	1.00033
240	0.050	4641	6638	123.9	22.8	31.2	1163	1.00030
260	0.046	5093	7256	126.4	22.3	30.6	1214	1.00028
280	0.043	5535	7865	128.6	21.9	30.2	1263	1.00026
300	0.040	5970	8466	130.7	21.6	29.9	1310	1.00024
400	0.030	8093	11421	139.2	21.0	29.3	1518	1.00018
<i>P</i> = 1 MPa								
15	38.109	-609	-583	10.9	10.1	14.1	1315	1.25089
20	35.852	-532	-504	15.5	11.4	18.4	1155	1.23496
40	3.608	399	676	54.1	12.9	28.4	498	1.02209
60	2.098	697	1173	64.3	13.2	23.5	635	1.01280
80	1.523	994	1651	71.1	15.4	24.7	719	1.00928
100	1.204	1343	2174	77.0	18.8	27.7	779	1.00733
120	0.999	1756	2758	82.3	21.9	30.6	835	1.00608
140	0.854	2219	3390	87.1	23.9	32.5	891	1.00520
160	0.747	2709	4048	91.5	24.7	33.2	949	1.00454
180	0.663	3204	4712	95.4	24.6	33.1	1006	1.00404
200	0.597	3693	5368	98.9	24.1	32.5	1063	1.00363
220	0.543	4170	6012	102.0	23.5	31.9	1118	1.00330
240	0.498	4634	6643	104.7	22.9	31.2	1171	1.00303
260	0.460	5087	7263	107.2	22.3	30.7	1222	1.00279
280	0.427	5530	7873	109.5	21.9	30.3	1271	1.00259
300	0.399	5966	8475	111.5	21.6	30.0	1317	1.00242
400	0.299	8091	11433	120.1	21.0	29.4	1525	1.00182
<i>P</i> = 10 MPa								
20	39.669	-568	-316	13.0	10.9	15.0	1458	1.26198
40	31.344	-209	110	27.3	13.2	27.0	1171	1.20354
60	21.273	255	725	39.7	13.8	32.5	931	1.13527
80	14.830	686	1360	48.8	15.9	31.1	886	1.09303
100	11.417	1110	1986	55.8	19.3	31.9	904	1.07109

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	<i>D</i>
120	9.357	1571	2640	61.8	22.4	33.5	941	1.05801
140	7.969	2068	3323	67.0	24.3	34.6	989	1.04925
160	6.963	2583	4020	71.7	25.0	34.9	1042	1.04294
180	6.195	3099	4713	75.7	24.9	34.4	1096	1.03814
200	5.588	3604	5393	79.3	24.4	33.6	1150	1.03436
220	5.094	4094	6057	82.5	23.7	32.8	1203	1.03129
240	4.683	4569	6704	85.3	23.1	32.0	1254	1.02874
260	4.336	5030	7336	87.8	22.6	31.3	1302	1.02659
280	4.038	5481	7958	90.1	22.1	30.8	1349	1.02475
300	3.780	5924	8570	92.3	21.8	30.4	1394	1.02315
400	2.869	8073	11559	100.9	21.2	29.6	1592	1.01753

Helium (He-4)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	η $\mu\text{Pa s}$	<i>D</i>
<i>P</i> = 0.1 MPa (1 bar)									
3	35.794	-39	-36	9.8	7.6	9.4	222	3.85	1.05646
4	32.477	-27	-24	13.3	9.1	16.3	185	3.33	1.05114
5	2.935	52	86	39.1	12.7	27.1	120	1.39	1.00456
10	1.238	120	201	55.2	12.5	21.7	185	2.26	1.00192
20	0.602	247	413	69.9	12.5	21.0	264	3.58	1.00093
50	0.240	623	1039	89.0	12.5	20.8	417	6.36	1.00037
100	0.120	1247	2079	103.4	12.5	20.8	589	9.78	1.00019
200	0.060	2494	4158	117.8	12.5	20.8	833	15.14	1.00009
300	0.040	3741	6237	126.3	12.5	20.8	1020	19.93	1.00006
400	0.030	4988	8315	132.3	12.5	20.8	1177	24.29	1.00005
500	0.024	6236	10394	136.9	12.5	20.8	1316	28.36	1.00004
600	0.020	7483	12472	140.7	12.5	20.8	1441	32.22	1.00003
700	0.017	8730	14551	143.9	12.5	20.8	1557	35.89	1.00003
800	0.015	9977	16630	146.7	12.5	20.8	1664	39.43	1.00002
900	0.013	11224	18708	149.1	12.5	20.8	1765	42.85	1.00002
1000	0.012	12471	20787	151.3	12.5	20.8	1861	46.16	1.00002
1500	0.008	18707	31179	159.7	12.5	20.8	2279	61.55	1.00001
<i>P</i> = 1 MPa									
3	39.703	-42	-16	8.6	7.1	7.8	300	5.63	1.06274
4	38.210	-34	-7	11.2	8.3	10.9	290	5.01	1.06034
5	35.818	-22	6	14.0	9.7	15.1	269	4.38	1.05650
10	15.378	78	143	32.2	12.3	30.5	198	3.07	1.02402
20	6.067	228	393	49.8	12.6	22.9	274	3.94	1.00943
50	2.353	617	1042	69.8	12.5	21.1	428	6.53	1.00365
100	1.186	1245	2089	84.3	12.5	20.9	597	9.89	1.00184
200	0.597	2495	4170	98.7	12.5	20.8	838	15.21	1.00093
300	0.399	3742	6249	107.1	12.5	20.8	1024	19.96	1.00062
400	0.300	4990	8327	113.1	12.5	20.8	1180	24.32	1.00046
500	0.240	6237	10406	117.8	12.5	20.8	1319	28.38	1.00037
600	0.200	7485	12484	121.5	12.5	20.8	1444	32.23	1.00031
700	0.172	8732	14562	124.7	12.5	20.8	1559	35.91	1.00027
800	0.150	9979	16641	127.5	12.5	20.8	1666	39.44	1.00023
900	0.133	11227	18719	130.0	12.5	20.8	1767	42.86	1.00021
1000	0.120	12474	20798	132.2	12.5	20.8	1862	46.17	1.00019
1500	0.080	18710	31190	140.6	12.5	20.8	2280	61.55	1.00012
<i>P</i> = 10 MPa									
4	51.978	-24	169	6.7	6.0	7.3	586	24.27	1.08262
5	51.118	-18	177	8.5	7.9	9.3	576	18.16	1.08122
10	46.872	23	236	16.6	11.0	14.5	546	9.31	1.07432

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	η μ Pa s	<i>D</i>
20	37.092	154	423	29.5	12.6	20.7	498	6.99	1.05854
50	19.192	572	1093	49.9	12.9	22.4	541	8.07	1.03003
100	10.525	1231	2181	65.0	12.8	21.3	674	10.93	1.01640
200	5.605	2500	4284	79.6	12.6	20.9	889	15.82	1.00871
300	3.829	3755	6367	88.0	12.6	20.8	1063	20.25	1.00595
400	2.908	5006	8445	94.0	12.6	20.8	1212	24.54	1.00452
500	2.344	6256	10522	98.6	12.5	20.8	1346	28.56	1.00364
600	1.963	7505	12599	102.4	12.5	20.8	1467	32.38	1.00305
700	1.689	8754	14676	105.6	12.5	20.8	1580	36.04	1.00262
800	1.481	10003	16753	108.4	12.5	20.8	1685	39.56	1.00230
900	1.320	11252	18830	110.9	12.5	20.8	1784	42.96	1.00205
1000	1.189	12500	20907	113.0	12.5	20.8	1877	46.26	1.00185
1500	0.797	18742	31294	121.5	12.5	20.8	2289	61.62	1.00124

Argon (Ar)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	η μ Pa s	λ mW/m K
<i>P</i> = 0.1 MPa (1 bar)									
85	35.243	-4811	-4808	53.6	23.1	44.7	820	278.8	132.4
90	0.138	1077	1802	129.4	13.1	22.5	174	7.5	6.0
100	0.123	1211	2024	131.8	12.9	21.9	184	8.2	6.6
120	0.102	1471	2456	135.7	12.6	21.4	203	9.8	7.8
140	0.087	1727	2881	139.0	12.6	21.1	220	11.4	9.0
160	0.076	1980	3302	141.8	12.5	21.0	235	13.0	10.2
180	0.067	2232	3722	144.3	12.5	21.0	250	14.5	11.4
200	0.060	2483	4141	146.5	12.5	20.9	263	16.0	12.5
220	0.055	2734	4559	148.5	12.5	20.9	276	17.5	13.7
240	0.050	2984	4976	150.3	12.5	20.9	289	18.9	14.8
260	0.046	3234	5394	152.0	12.5	20.9	300	20.3	15.8
280	0.043	3484	5811	153.5	12.5	20.8	312	21.6	16.9
300	0.040	3734	6227	155.0	12.5	20.8	323	22.9	17.9
320	0.038	3984	6644	156.3	12.5	20.8	333	24.2	18.9
340	0.035	4234	7060	157.6	12.5	20.8	344	25.4	19.9
360	0.033	4484	7477	158.7	12.5	20.8	354	26.6	20.8
380	0.032	4734	7893	159.9	12.5	20.8	363	27.8	21.7
<i>P</i> = 1 MPa									
85	35.307	-4820	-4792	53.5	23.1	44.6	823	281.3	133.0
90	34.542	-4598	-4569	56.1	21.6	44.7	808	242.7	124.2
100	32.909	-4145	-4115	60.9	19.9	46.2	753	185.0	109.2
120	1.181	1210	2057	114.3	14.7	30.1	189	10.3	9.3
140	0.945	1544	2603	118.5	13.5	25.4	212	11.8	10.1
160	0.799	1838	3089	121.8	13.0	23.6	231	13.3	11.1
180	0.697	2116	3551	124.5	12.8	22.7	247	14.8	12.1
200	0.619	2384	3999	126.9	12.7	22.2	262	16.3	13.2
220	0.559	2648	4438	128.9	12.6	21.8	275	17.7	14.2
240	0.509	2908	4873	130.8	12.6	21.6	288	19.1	15.3
260	0.468	3167	5304	132.6	12.6	21.5	301	20.4	16.3
280	0.433	3423	5732	134.2	12.6	21.4	312	21.8	17.3
300	0.403	3679	6159	135.6	12.5	21.3	324	23.1	18.3
320	0.377	3934	6583	137.0	12.5	21.2	334	24.3	19.2
340	0.355	4188	7007	138.3	12.5	21.2	345	25.5	20.2
360	0.335	4441	7429	139.5	12.5	21.1	355	26.7	21.1
380	0.317	4694	7851	140.6	12.5	21.1	365	27.9	22.0
<i>P</i> = 10 MPa									
90	35.208	-4694	-4410	55.0	21.9	43.2	846	265.2	129.5

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	η μ Pa s	λ mW/m K
100	33.744	-4271	-3974	59.6	20.4	44.0	800	205.0	115.1
120	30.525	-3396	-3069	67.8	18.8	46.9	672	131.2	92.1
140	26.609	-2447	-2072	75.5	17.6	54.1	526	85.9	71.7
160	20.816	-1279	-799	83.9	17.4	78.6	357	51.3	52.8
180	12.296	228	1042	94.8	17.3	83.6	257	27.8	32.0
200	8.442	1118	2302	101.4	15.3	48.6	268	23.3	23.6
220	6.776	1661	3137	105.4	14.2	36.8	284	22.8	21.6
240	5.787	2087	3815	108.4	13.7	31.6	300	23.2	21.3
260	5.105	2458	4416	110.8	13.4	28.8	314	23.9	21.4
280	4.596	2798	4974	112.9	13.2	27.1	327	24.8	21.8
300	4.195	3119	5503	114.7	13.1	25.9	339	25.7	22.3
320	3.869	3427	6012	116.3	13.0	25.0	350	26.7	22.9
340	3.596	3726	6506	117.8	13.0	24.4	361	27.7	23.5
360	3.364	4017	6989	119.2	12.9	23.9	372	28.7	24.2
380	3.164	4303	7464	120.5	12.9	23.5	381	29.7	24.9

Methane (CH₄)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	η μ Pa s	λ mW/m K	<i>D</i>
<i>P</i> = 0.1 MPa (1 bar)									
100	27.370	-5258	-5254	73.0	33.4	54.1	156.3	208.1	1.65504
125	0.099	3026	4039	156.5	25.4	34.6	5.0	13.4	1.00193
150	0.081	3667	4896	162.7	25.2	34.0	5.9	16.2	1.00159
175	0.069	4301	5743	168.0	25.2	33.8	6.9	19.1	1.00136
200	0.061	4935	6587	172.5	25.3	33.8	7.8	21.9	1.00119
225	0.054	5571	7434	176.5	25.5	34.0	8.7	24.8	1.00105
250	0.048	6216	8288	180.1	26.0	34.4	9.6	27.8	1.00095
275	0.044	6875	9156	183.4	26.6	35.0	10.4	30.9	1.00086
300	0.040	7552	10042	186.4	27.5	35.9	11.2	34.1	1.00079
325	0.037	8252	10951	189.4	28.5	36.9	12.0	37.6	1.00073
350	0.034	8979	11887	192.1	29.7	38.0	12.8	41.2	1.00068
375	0.032	9737	12853	194.8	30.9	39.3	13.5	45.1	1.00063
400	0.030	10528	13852	197.4	32.3	40.7	14.3	49.1	1.00059
425	0.028	11354	14886	199.9	33.7	42.1	15.0	53.3	1.00056
450	0.027	12215	15956	202.3	35.2	43.5	15.7	57.6	1.00053
500	0.024	14047	18204	207.1	38.0	46.4	17.0	66.5	1.00047
600	0.020	18111	23101	216.0	42.9	51.3	19.4	84.1	1.00039
<i>P</i> = 1 MPa									
100	27.413	-5268	-5231	72.9	33.4	54.0	158.1	208.9	1.65617
125	25.137	-3882	-3842	85.3	32.4	57.4	89.2	168.2	1.59261
150	0.969	3282	4315	140.9	27.9	45.2	6.2	18.4	1.01911
175	0.765	4041	5348	147.3	26.4	38.9	7.1	20.6	1.01507
200	0.644	4736	6289	152.3	25.9	36.8	8.0	23.1	1.01268
225	0.560	5410	7197	156.6	25.9	36.0	8.9	25.8	1.01102
250	0.497	6081	8093	160.4	26.2	35.8	9.7	28.7	1.00979
275	0.448	6758	8991	163.8	26.8	36.1	10.6	31.7	1.00882
300	0.408	7449	9901	167.0	27.6	36.7	11.4	34.9	1.00803
325	0.375	8160	10829	169.9	28.6	37.6	12.1	38.3	1.00738
350	0.347	8897	11781	172.8	29.7	38.6	12.9	41.9	1.00683
375	0.323	9662	12760	175.5	31.0	39.8	13.6	45.7	1.00636
400	0.302	10460	13770	178.1	32.4	41.1	14.4	49.6	1.00595
425	0.284	11291	14814	180.6	33.8	42.4	15.1	53.8	1.00559
450	0.268	12157	15892	183.1	35.2	43.8	15.7	58.1	1.00527
500	0.241	13997	18153	187.8	38.1	46.6	17.0	66.9	1.00474
600	0.200	18073	23070	196.8	43.0	51.4	19.5	84.5	1.00394

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	η μ Pa s	λ mW/m K	<i>D</i>
<i>P</i> = 10 MPa									
100	27.815	-5362	-5003	72.0	33.8	53.2	175.4	217	1.66668
125	25.754	-4036	-3648	84.1	32.7	55.3	100.4	178.8	1.60895
150	23.441	-2655	-2229	94.4	31.4	58.6	65.7	144.6	1.54553
175	20.613	-1175	-689	103.9	30.3	65.5	44.9	113.4	1.47021
200	16.602	542	1144	113.6	30.1	84.7	29.4	85.8	1.36789
225	10.547	2680	3628	125.3	30.8	102.2	17.6	61.0	1.22352
250	7.013	4289	5714	134.1	29.3	67.4	14.3	47.6	1.14481
275	5.530	5387	7195	139.8	28.7	53.4	13.8	44.1	1.11297
300	4.685	6320	8454	144.2	28.9	48.0	13.9	44.6	1.09513
325	4.115	7192	9622	147.9	29.6	45.8	14.3	46.6	1.08322
350	3.695	8047	10753	151.3	30.5	44.9	14.7	49.2	1.07450
375	3.366	8903	11874	154.4	31.7	44.8	15.2	52.3	1.06773
400	3.101	9774	12999	157.3	32.9	45.2	15.8	55.7	1.06227
425	2.880	10666	14138	160.0	34.3	46.0	16.3	59.4	1.05775
450	2.692	11584	15298	162.7	35.7	46.9	16.9	63.3	1.05392
500	2.389	13507	17692	167.7	38.5	48.9	18.0	71.6	1.04775
600	1.963	17700	22795	177.0	43.3	52.9	20.2	88.3	1.03911

Ethane (C₂H₆)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	<i>D</i>
<i>P</i> = 0.1 MPa (1 bar)								
95	21.50	-14555	-14550	80.2	47.2	68.7	1970	1.93480
100	21.32	-14210	-14205	83.8	47.1	69.3	1943	1.92500
125	20.41	-12468	-12463	99.3	45.0	69.8	1775	1.87634
150	19.47	-10717	-10712	112.1	43.4	70.4	1587	1.82726
175	18.49	-8938	-8933	123.1	42.7	72.1	1396	1.77671
200	0.062	5503	7123	210.1	34.5	43.8	258	1.00208
225	0.054	6401	8238	215.4	36.5	45.5	273	1.00183
250	0.049	7349	9401	220.3	38.9	47.7	287	1.00164
275	0.044	8360	10624	224.9	41.6	50.2	300	1.00148
300	0.040	9439	11914	229.4	44.5	53.1	312	1.00136
325	0.037	10592	13278	233.8	47.6	56.1	324	1.00125
350	0.035	11823	14719	238.1	50.7	59.2	335	1.00116
375	0.032	13133	16240	242.3	54.0	62.4	345	1.00108
400	0.030	14525	17841	246.4	57.2	65.6	355	1.00101
450	0.027	17548	21282	254.5	63.6	72.0	375	1.00090
500	0.024	20883	25035	262.4	69.7	78.1	393	1.00081
600	0.020	28429	33415	277.6	80.9	89.3	428	1.00067
<i>P</i> = 1 MPa								
95	21.514	-14562	-14515	80.2	47.3	68.7	1972	1.93537
100	21.334	-14217	-14170	83.7	47.2	69.3	1946	1.92560
125	20.427	-12478	-12429	99.2	45.0	69.8	1778	1.87709
150	19.494	-10731	-10679	112.0	43.4	70.3	1592	1.82823
175	18.515	-8957	-8903	123.0	42.7	72.0	1402	1.77800
200	17.464	-7127	-7070	132.7	42.9	74.9	1209	1.72513
225	16.288	-5199	-5137	141.8	43.8	80.2	1008	1.66733
250	0.564	6762	8534	198.7	41.6	57.5	260	1.01909
275	0.489	7902	9949	204.1	43.2	56.2	280	1.01650
300	0.435	9063	11363	209.0	45.5	57.2	297	1.01467
325	0.393	10273	12815	213.7	48.3	59.1	311	1.01327
350	0.360	11546	14321	218.1	51.3	61.5	325	1.01214
375	0.333	12889	15893	222.5	54.4	64.2	337	1.01121
400	0.310	14306	17534	226.7	57.5	67.1	349	1.01043

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	<i>D</i>
450	0.272	17367	21038	234.9	63.8	73.0	370	1.00917
500	0.244	20730	24836	242.9	69.9	78.9	390	1.00819
600	0.201	28313	33278	258.3	81.0	89.8	427	1.00677

P = 10 MPa

95	21.624	-14626	-14163	79.5	47.4	68.5	2000	1.94104
100	21.448	-14286	-13819	83.0	47.4	69.1	1974	1.93146
125	20.570	-12572	-12086	98.5	45.5	69.3	1814	1.88436
150	19.678	-10858	-10350	111.1	43.9	69.6	1637	1.83753
175	18.758	-9130	-8596	121.9	43.3	70.8	1459	1.79010
200	17.793	-7363	-6801	131.5	43.5	73.0	1284	1.74134
225	16.760	-5535	-4938	140.3	44.3	76.4	1110	1.69017
250	15.620	-3609	-2969	148.6	45.8	81.5	935	1.63488
275	14.301	-1539	-839	156.7	47.9	89.4	758	1.57249
300	12.666	757	1547	165.0	50.8	102.7	577	1.49740
325	10.398	3443	4404	174.1	54.7	129.1	399	1.39745
350	7.292	6643	8015	184.8	58.8	150.1	290	1.26832
375	5.182	9419	11349	194.1	60.0	115.7	289	1.18570
400	4.182	11577	13968	200.8	61.4	96.9	310	1.14797
450	3.204	15379	18500	211.5	65.8	87.5	347	1.11193
500	2.677	19135	22870	220.7	71.2	88.0	378	1.09288
600	2.076	27160	31978	237.3	81.8	94.7	427	1.07142

Propane (C₃H₈)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	<i>D</i>
<i>P</i> = 0.1 MPa (1 bar)								
90	16.526	-21486	-21426	87.3	59.2	84.5	2126	2.07988
100	16.295	-20639	-20577	96.2	59.6	85.2	2041	2.05806
125	15.726	-18495	-18432	115.4	59.2	86.5	1856	2.00674
150	15.156	-16319	-16253	131.3	58.9	88.0	1685	1.95796
175	14.577	-14096	-14028	145.0	59.5	90.3	1521	1.91036
200	13.982	-11806	-11735	157.3	61.0	93.5	1359	1.86300
225	13.339	-9395	-9387	168.5	63.4	97.9	1197	1.81487
250	0.050	9194	11213	257.6	57.2	66.8	228	1.00238
275	0.045	10691	12930	264.1	61.6	70.7	239	1.00215
300	0.041	12297	14752	270.5	66.2	75.1	249	1.00195
325	0.037	14019	16689	276.7	71.1	79.8	259	1.00179
350	0.035	15862	18744	282.8	76.0	84.6	269	1.00166
375	0.032	17827	20921	288.8	80.9	89.5	278	1.00154
400	0.030	19912	23217	294.7	85.7	94.3	286	1.00144
450	0.027	24441	28166	306.4	95.2	103.6	303	1.00128
500	0.024	29428	33573	317.7	104.1	112.6	318	1.00115
600	0.020	40677	45658	339.7	120.4	128.8	347	1.00095

P = 1 MPa

90	16.526	-21486	-21426	87.2	59.3	84.5	2128	2.08034
100	16.295	-20639	-20577	96.2	59.7	85.2	2043	2.05856
125	15.726	-18495	-18432	115.3	59.2	86.4	1859	2.00736
150	15.156	-16319	-16253	131.2	59.0	88.0	1690	1.95873
175	14.577	-14096	-14028	144.9	59.6	90.2	1526	1.91132
200	13.982	-11806	-11735	157.2	61.1	93.4	1365	1.86421
225	13.361	-9424	-9349	168.4	63.4	97.7	1205	1.81642
250	12.696	-6919	-6840	179.0	66.4	103.3	1045	1.76672
275	11.962	-4252	-4169	189.1	70.0	110.8	881	1.71316
300	11.102	-1360	-1270	199.2	74.1	121.9	708	1.65216
325	0.428	13278	15614	255.2	74.1	89.6	233	1.02067

THERMOPHYSICAL PROPERTIES OF FLUIDS (continued)

<i>T</i> K	ρ mol/L	<i>E</i> J/mol	<i>H</i> J/mol	<i>S</i> J/mol K	<i>C_v</i> J/mol K	<i>C_p</i> J/mol K	<i>v_s</i> m/s	<i>D</i>
350	0.383	15259	17869	261.9	78.0	91.2	248	1.01846
375	0.349	17318	20183	268.3	82.2	94.2	261	1.01678
400	0.322	19472	22582	274.4	86.7	97.8	272	1.01544
450	0.279	24092	27672	286.4	95.7	105.9	293	1.01337
500	0.248	29137	33172	298.0	104.4	114.1	312	1.01184
600	0.203	40455	45374	320.2	120.5	129.7	344	1.00968
<i>P</i> = 10 MPa								
90	16.590	-21553	-20951	86.5	59.9	84.4	2146	2.08489
100	16.364	-20714	-20103	95.4	60.1	85.1	2068	2.06350
125	15.810	-18595	-17962	114.5	59.6	86.1	1895	2.01342
150	15.259	-16448	-15793	130.3	59.3	87.5	1733	1.96617
175	14.705	-14261	-13581	144.0	59.9	89.5	1577	1.92048
200	14.141	-12016	-11309	156.1	61.4	92.4	1425	1.87557
225	13.562	-9692	-8955	167.2	63.7	96.1	1277	1.83076
250	12.960	-7268	-6496	177.5	66.7	100.7	1133	1.78529
275	12.322	-4721	-3909	187.4	70.2	106.4	991	1.73826
300	11.631	-2027	-1167	196.9	74.1	113.2	851	1.68849
325	10.860	843	1764	206.3	78.4	121.5	715	1.63437
350	9.973	3924	4927	215.7	82.9	132.0	582	1.57361
375	8.905	7270	8393	225.2	87.7	146.1	455	1.50271
400	7.561	10957	12279	235.3	93.0	165.7	339	1.41671
450	4.614	18845	21013	255.8	101.8	167.8	249	1.24060
500	3.241	25567	28652	272.0	107.8	142.7	276	1.16439
600	2.242	38131	42591	297.4	121.7	140.5	332	1.11122

VIRIAL COEFFICIENTS OF SELECTED GASES

Henry V. Kehiaian

This table gives second virial coefficients of about 110 inorganic and organic gases as a function of temperature. Selected data from the literature have been fitted by least squares to the equation

$$B/\text{cm}^3 \text{ mol}^{-1} = \sum_{i=1}^n a(i) \left[(T_0/T) - 1 \right]^{i-1}$$

where $T_0 = 298.15$ K. The table gives the coefficients $a(i)$ and values of B at fixed temperature increments, as calculated from this smoothing equation.

The equation may be used with the tabulated coefficients for interpolation within the indicated temperature range. It should not be used for extrapolation beyond this range.

Compounds are listed in the modified Hill order (see Introduction), with carbon-containing compounds following those compounds not containing carbon.

A useful compilation of virial coefficient data from the literature may be found in:

J. H. Dymond and E. B. Smith, *The Virial Coefficients of Pure Gases and Mixtures, A Critical Compilation*, Oxford University Press, Oxford, 1980.

Compounds Not Containing Carbon

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹	
Ar	Argon	100	-184	
		120	-131	
		140	-98	
		a(1) = -16	160	-76
		a(2) = -60	80	-60
		a(3) = -10	200	-48
			300	-16
			400	-1
			500	7
			600	12
			700	15
			800	18
	900	20		
	1000	22		
BF ₃	Boron trifluoride	200	-338	
		240	-202	
		280	-129	
		a(1) = -106	320	-85
		a(2) = -330	360	-56
		a(3) = -251	400	-37
		a(4) = -80	440	-23
ClH	Hydrogen chloride	190	-451	
		230	-269	
		270	-181	
		a(1) = -144	310	-132
		a(2) = -325	350	-102
		a(3) = -277	390	-81
		a(4) = -170	430	-66
			470	-54
Cl ₂	Chlorine	210	-508	
		220	-483	

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		230	-457
	a(1) = -303	240	-432
	a(2) = -555	250	-407
	a(3) = 9	260	-383
	a(4) = 329	270	-360
	a(5) = 68	280	-339
		290	-318
		300	-299
		350	-221
		400	-166
		450	-126
		500	-97
		600	-59
		700	-36
		800	-22
		900	-12
F ₂	Fluorine	80	-386
		110	-171
		140	-113
	a(1) = -25	170	-73
	a(2) = 21	200	-47
	a(3) = -185	230	-32
	a(4) = 113	260	-25
F ₄ Si	Silicon tetrafluoride	210	-268
		240	-213
		270	-170
	a(1) = -138	300	-136
	a(2) = -312	330	-108
		360	-84
		390	-64
		420	-47
		450	-32
F ₅ I	Iodine pentafluoride	320	-2540
		330	-2344
		340	-2172
	a(1) = -3077	350	-2021
	a(2) = -8474	360	-1890
	a(3) = -9116	370	-1775
		380	-1674
		390	-1587
		400	-1510
		410	-1443
F ₅ P	Phosphorus pentafluoride	320	-162
		340	-143
		360	-127
	a(1) = -186	380	-112
	a(2) = -345	400	-98
		420	-86
		440	-75
		460	-64
F ₆ Mo	Molybdenum hexafluoride	300	-896
		310	-810
		320	-737

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
	a(1) = -914	330	-677
	a(2) = -2922	340	-627
	a(3) = -4778	350	-586
		360	-553
		370	-527
		380	-506
		390	-491
F ₆ S	Sulfur hexafluoride	200	-685
		250	-416
		300	-275
	a(1) = -279	350	-190
	a(2) = -647	400	-135
	a(3) = -335	450	-96
	a(4) = -72	500	-68
F ₆ U	Uranium hexafluoride	320	-1030
		340	-905
		360	-805
	a(1) = -1204	380	-724
	a(2) = -2690	400	-658
	a(3) = -2144	420	-604
		440	-560
F ₆ W	Tungsten hexafluoride	320	-641
		340	-578
		360	-523
	a(1) = -719	380	-473
	a(2) = -1143	400	-428
		420	-387
		440	-350
		460	-317
H ₂	Hydrogen	15	-230
		20	-151
		25	-108
	a(1) = 15.4	30	-82
	a(2) = -9.0	35	-64
	a(3) = -0.2	40	-52
		45	-42
		50	-35
		60	-24
		70	-16
		80	-11
		90	-7
		100	-3
		200	11
		300	15
		400	18
H ₂ O	Water	300	-1126
		320	-850
		340	-660
	a(1) = -1158	360	-526
	a(2) = -5157	380	-428
	a(3) = -10301	400	-356
	a(4) = -10597	420	-301
	a(5) = -4415	440	-258

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		460	-224
		480	-197
		500	-175
		600	-104
		700	-67
		800	-44
		900	-30
		1000	-20
		1100	-14
		1200	-11
H ₃ N	Ammonia	290	-302
		300	-265
		310	-236
	a(1) = -271	320	-213
	a(2) = -1022	330	-194
	a(3) = -2715	340	-179
	a(4) = -4189	350	-166
		360	-154
		370	-144
		380	-135
		400	-118
		420	-101
H ₃ P	Phosphine	190	-457
		200	-404
		210	-364
	a(1) = -146	220	-332
	a(2) = -733	230	-305
	a(3) = 1022	240	-281
	a(4) = -1220	250	-258
		260	-235
		270	-213
		280	-190
		290	-166
He	Helium	2	-172
		6	-48
		10	-24
	a(1) = 12	14	-13
	a(2) = -1	18	-7
		22	-3
		26	-1
		30	1
		50	6
		70	8
		90	10
		110	10
		150	11
		250	12
		650	13
		700	13
Kr	Krypton	110	-363
		120	-307
		130	-263
	a(1) = -51	140	-229
	a(2) = -118	150	-201

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹	
	a(3) = -29	160	-178	
	a(4) = -5	170	-159	
		180	-143	
		190	-129	
		200	-117	
		250	-75	
		300	-51	
		400	-23	
		500	-8	
		600	2	
		700	8	
NO	Nitric oxide	120	-232	
		130	-176	
		140	-138	
		a(1) = -12	150	-113
		a(2) = -119	160	-96
		a(3) = 89	170	-83
		a(4) = -73	180	-73
			190	-65
			200	-58
			210	-52
			230	-42
			250	-32
			270	-24
N ₂	Nitrogen	75	-274	
		100	-161	
		125	-104	
		a(1) = -4	150	-71
		a(2) = -56	175	-49
		a(3) = -12	200	-34
			225	-24
			250	-15
			300	-4
			400	9
			500	16
		600	21	
		700	24	
N ₂ O	Nitrous oxide	240	-219	
		260	-181	
		280	-151	
		a(1) = -130	300	-128
		a(2) = -307	320	-110
		a(3) = -248	340	-96
			360	-85
			380	-76
			400	-68
Ne	Neon	60	-25	
		80	-13	
		100	-6	
		a(1) = 10.8	120	-1
		a(2) = -7.5	140	2
		a(3) = 0.4	160	4
			180	6
			200	7

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		300	11
		400	13
		500	14
		600	15
O ₂	Oxygen	90	-241
		110	-161
		130	-117
	a(1) = -16	150	-88
	a(2) = -62	170	-69
	a(3) = -8	190	-55
	a(4) = -3	210	-44
		230	-36
		250	-29
		270	-23
		290	-18
		310	-14
		330	-10
		350	-7
		400	-1
O ₂ S	Sulfur dioxide	290	-465
		320	-354
		350	-276
	a(1) = -430	380	-221
	a(2) = -1193	410	-181
	a(3) = -1029	440	-153
		470	-132
Xe	Xenon	160	-421
		170	-377
		180	-340
	a(1) = -130	190	-307
	a(2) = -262	200	-280
	a(3) = -87	210	-255
		220	-234
		230	-215
		240	-199
		250	-184
		300	-129
		350	-93
		400	-69
		500	-39
		600	-21
		650	-14

Compounds Containing Carbon

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
CClF ₃	Chlorotrifluoromethane	240	-369
		290	-237
		340	-165
	a(1) = -223	390	-119
	a(2) = -504	440	-86
	a(3) = -340	490	-60
	a(4) = -291	540	-39

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹	
CCl ₂ F ₂	Dichlorodifluoromethane	250	-769	
		280	-570	
		310	-441	
		a(1) = -486	340	-353
		a(2) = -1217	370	-289
		a(3) = -1188	400	-241
		a(4) = -698	430	-204
		460	-174	
CCl ₃ F	Trichlorofluoromethane	240	-1140	
		280	-879	
		320	-689	
		a(1) = -786	360	-545
		a(2) = -1428	400	-431
		a(3) = -142	440	-340
			480	-265
CCl ₄	Tetrachloromethane	320	-1345	
		340	-1171	
		360	-1040	
		a(1) = -1600	380	-942
		a(2) = -4059	400	-868
		a(3) = -4653	420	-814
CF ₄	Tetrafluoromethane	250	-137	
		300	-87	
		350	-55	
		a(1) = -88	400	-32
		a(2) = -238	450	-16
		a(3) = -70	500	-4
			600	14
			700	25
			800	33
CHClF ₂	Chlorodifluoromethane	300	-343	
		325	-298	
		350	-257	
		a(1) = -347	375	-221
		a(2) = -575	400	-188
		a(3) = 187	425	-158
CHCl ₂ F	Dichlorofluoromethane	250	-728	
		275	-634	
		300	-557	
		a(1) = -562	325	-491
		a(2) = -862	350	-434
			375	-385
			400	-343
			425	-305
			450	-271
CHCl ₃	Trichloromethane	320	-1001	
		330	-926	
		340	-858	
		a(1) = -1193	350	-797
		a(2) = -2936	360	-740
		a(3) = -1751	370	-689
	380	-642		

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	$B/\text{cm}^3 \text{mol}^{-1}$	
		390	-599	
		400	-559	
CHF ₃	Trifluoromethane	200	-433	
		220	-350	
		240	-288	
		a(1) = -177	260	-241
		a(2) = -399	280	-204
		a(3) = -250	300	-174
			320	-151
			340	-132
			360	-116
			380	-103
			400	-91
CH ₂ Cl ₂	Dichloromethane	320	-706	
		330	-634	
		340	-574	
		a(1) = -913	350	-524
		a(2) = -3371	360	-482
		a(3) = -5013	370	-447
			380	-420
			400	-380
			420	-357
CH ₂ F ₂	Difluoromethane	280	-375	
		290	-343	
		300	-316	
		a(1) = -321	310	-294
		a(2) = -754	320	-275
		a(3) = -1300	330	-260
			340	-248
			350	-238
CH ₃ Br	Bromomethane	280	-645	
		290	-596	
		300	-551	
		a(1) = -559	310	-509
		a(2) = -1324	320	-469
			340	-396
			360	-332
			380	-274
CH ₃ Cl	Chloromethane	280	-466	
		300	-402	
		320	-348	
		a(1) = -407	340	-304
		a(2) = -887	360	-266
		a(3) = -385	380	-234
			400	-206
			420	-182
			440	-161
			460	-142
			480	-126
			500	-112
	600	-58		
CH ₃ F	Fluoromethane	280	-244	

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		300	-205
		320	-174
	a(1) = -209	340	-150
	a(2) = -525	360	-129
	a(3) = -365	380	-112
		400	-99
		420	-87
CH ₃ I	Iodomethane	310	-725
		320	-646
		330	-582
	a(1) = -844	340	-531
	a(2) = -3353	350	-492
	a(3) = -6590	360	-462
		370	-441
		380	-427
CH ₄	Methane	110	-328
		120	-276
		130	-237
	a(1) = -43	140	-206
	a(2) = -114	150	-181
	a(3) = -19	160	-160
	a(4) = -7	170	-143
		180	-128
		190	-116
		200	-105
		250	-66
		300	-43
		350	-27
		400	-16
		500	0
		600	10
CH ₄ O	Methanol	320	-1431
		330	-1299
		340	-1174
	a(1) = -1752	350	-1056
	a(2) = -4694	360	-945
		370	-840
		380	-741
		390	-646
		400	-557
CH ₅ N	Methylamine	300	-451
		325	-367
		350	-304
	a(1) = -459	375	-257
	a(2) = -1191	400	-220
	a(3) = -995	425	-192
		450	-170
		500	-140
		550	-122
CO	Carbon monoxide	210	-36
		240	-24
		270	-15
	a(1) = -9	300	-8

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
	a(2) = -58	330	-3
	a(3) = -18	360	1
		420	7
		480	11
CO ₂	Carbon dioxide	220	-244
		240	-204
		260	-172
	a(1) = -127	280	-146
	a(2) = -288	300	-126
	a(3) = -118	320	-108
		340	-94
		360	-81
		380	-71
		400	-62
		500	-30
		600	-13
		700	-1
		800	7
		900	12
		1000	16
		1100	19
CS ₂	Carbon disulfide	280	-932
		310	-740
		340	-603
	a(1) = -807	370	-504
	a(2) = -1829	400	-431
	a(3) = -1371	430	-375
C ₂ Cl ₂ F ₄	1,2-Dichloro-1,1,2,2-tetrafluoroethane	300	-801
		320	-695
		340	-608
	a(1) = -812	360	-536
	a(2) = -1773	380	-475
	a(3) = -963	400	-423
		420	-379
		440	-341
		460	-307
		480	-279
		500	-253
C ₂ Cl ₃ F ₃	1,1,2-Trichloro-1,2,2-trifluoroethane	290	-1041
		310	-943
		330	-856
	a(1) = -999	350	-780
	a(2) = -1479	370	-712
		390	-651
		410	-596
		430	-546
		450	-500
C ₂ H ₂	Ethyne	200	-573
		210	-500
		220	-440
	a(1) = -216	230	-390
	a(2) = -375	240	-349
	a(3) = -716	250	-315

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	$B/\text{cm}^3 \text{mol}^{-1}$	
		260	-287	
		270	-263	
C ₂ H ₃ N	Ethanenitrile	330	-3468	
		340	-2971	
		350	-2563	
		a(1) = -5840	360	-2233
		a(2) = -29175	370	-1970
		a(3) = -47611	380	-1765
			390	-1610
			400	-1499
			410	-1425
		C ₂ H ₄	Ethene	240	-218
270	-172			
300	-139			
a(1) = -140	330			-113
a(2) = -296	360			-92
a(3) = -101	390			-76
	420			-63
	450			-52
C ₂ H ₄ Cl ₂	1,2-Dichloroethane			370	-812
		390	-716	
		410	-635	
		a(1) = -1362	430	-566
		a(2) = -3240	450	-508
		a(3) = -2100	470	-458
			490	-416
			510	-379
			530	-347
			550	-319
			570	-295
C ₂ H ₄ O	Ethanal	290	-1352	
		320	-927	
		350	-654	
		a(1) = -1217	380	-482
		a(2) = -4647	410	-375
		a(3) = -5725	440	-314
			470	-283
		C ₂ H ₄ O ₂	Methyl methanoate	320	-821
330	-744			
340	-677			
a(1) = -1035	350			-620
a(2) = -3425	360			-571
a(3) = -4203	370			-528
	380			-492
	390			-461
	400			-435
C ₂ H ₅ Cl	Chloroethane			320	-634
		360	-450	
		400	-330	
		a(1) = -777	440	-249
		a(2) = -2205	480	-195
		a(3) = -1764	520	-157

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹	
		560	-131	
		600	-114	
C ₂ H ₆	Ethane	200	-409	
		220	-337	
		240	-284	
		a(1) = -184	260	-242
		a(2) = -376	280	-209
		a(3) = -143	300	-181
		a(4) = -54	320	-159
			340	-140
			360	-123
			380	-109
			400	-96
			500	-52
			600	-24
C ₂ H ₆ O	Ethanol	320	-2710	
		330	-2135	
		340	-1676	
		a(1) = -4475	350	-1317
		a(2) = -29719	360	-1043
		a(3) = -56716	370	-843
			380	-705
			390	-622
C ₂ H ₆ O	Dimethyl ether	275	-536	
		280	-517	
		285	-499	
		a(1) = -455	290	-482
		a(2) = -965	295	-465
			300	-449
			305	-433
			310	-418
C ₂ H ₇ N	Dimethylamine	310	-606	
		320	-563	
		330	-523	
		a(1) = -662	340	-487
		a(2) = -1504	350	-454
		a(3) = -667	360	-423
			370	-395
			380	-369
			390	-345
			400	-322
C ₂ H ₇ N	Ethylamine	300	-773	
		310	-710	
		320	-654	
		a(1) = -785	330	-604
		a(2) = -2012	340	-558
		a(3) = -1397	350	-517
			360	-480
			370	-447
			380	-416
			390	-389
	400	-363		
C ₃ H ₆	Cyclopropane	300	-383	

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		310	-356
		320	-332
	a(1) = -388	330	-310
	a(2) = -861	340	-290
	a(3) = -538	350	-272
		360	-256
		370	-241
		380	-227
		390	-215
		400	-204
C ₃ H ₆	Propene	280	-395
		300	-342
		320	-299
	a(1) = -347	340	-262
	a(2) = -727	360	-232
	a(3) = -325	380	-205
		400	-183
		420	-163
		440	-146
		460	-131
		480	-118
		500	-106
C ₃ H ₆ O	2-Propanone	300	-1996
		320	-1522
		340	-1198
	a(1) = -2051	360	-971
	a(2) = -8903	380	-806
	a(3) = -18056	400	-683
	a(4) = -16448	420	-586
		440	-506
		460	-437
		480	-375
C ₃ H ₆ O	Ethyl methanoate	330	-1003
		340	-916
		350	-839
	a(1) = -1371	360	-771
	a(2) = -4231	370	-712
	a(3) = -4312	380	-660
		390	-614
C ₃ H ₆ O	Methyl ethanoate	320	-1320
		330	-1186
		340	-1074
	a(1) = -1709	350	-980
	a(2) = -6348	360	-903
	a(3) = -9650	370	-840
		380	-789
		390	-749
C ₃ H ₇ Cl	1-Chloropropane	310	-1001
		340	-772
		370	-614
	a(1) = -1121	400	-501
	a(2) = -3271	430	-417
	a(3) = -3786	460	-352
	a(4) = -1974	490	-302

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		520	-261
		550	-227
		580	-198
C ₃ H ₈	Propane	240	-641
		260	-527
		280	-444
	a(1) = -386	300	-381
	a(2) = -844	320	-331
	a(3) = -720	340	-292
	a(4) = -574	360	-259
		380	-232
		400	-208
		440	-169
		480	-138
		520	-112
		560	-90
C ₃ H ₈ O	1-Propanol	380	-873
		385	-826
		390	-783
	a(1) = -2690	395	-744
	a(2) = -12040	400	-709
	a(3) = -16738	405	-679
		410	-651
		415	-627
		420	-606
C ₃ H ₈ O	2-Propanol	380	-821
		385	-766
		390	-717
	a(1) = -3165	395	-674
	a(2) = -16092	400	-636
	a(3) = -24197	405	-604
		410	-576
		415	-552
		420	-533
C ₃ H ₉ N	Trimethylamine	310	-675
		320	-628
		330	-585
	a(1) = -737	340	-547
	a(2) = -1669	350	-512
	a(3) = -986	360	-480
		370	-450
C ₄ H ₈	1-Butene	300	-624
		320	-539
		340	-470
	a(1) = -633	360	-413
	a(2) = -1442	380	-366
	a(3) = -932	400	-327
		420	-294
C ₄ H ₈ O	2-Butanone	310	-2056
		320	-1878
		330	-1712
	a(1) = -2282	340	-1555

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
	a(2) = -5907	350	-1407
		360	-1267
		370	-1135
C ₄ H ₈ O ₂	Propyl methanoate	330	-1496
		340	-1354
		350	-1231
	a(1) = -2118	360	-1126
	a(2) = -7299	370	-1035
	a(3) = -8851	380	-957
		390	-890
		400	-834
C ₄ H ₈ O ₂	Ethyl ethanoate	330	-1543
		340	-1385
		350	-1254
	a(1) = -2272	360	-1144
	a(2) = -8818	370	-1055
	a(3) = -13130	380	-982
		390	-923
		400	-878
C ₄ H ₈ O ₂	Methyl propanoate	330	-1588
		340	-1444
		350	-1319
	a(1) = -2216	360	-1211
	a(2) = -7339	370	-1117
	a(3) = -8658	380	-1037
		390	-968
		400	-908
C ₄ H ₉ Cl	1-Chlorobutane	330	-1224
		370	-898
		410	-691
	a(1) = -1643	450	-551
	a(2) = -4897	490	-449
	a(3) = -6178	530	-371
	a(4) = -3718	570	-309
C ₄ H ₁₀	Butane	250	-1170
		280	-863
		310	-668
	a(1) = -735	340	-536
	a(2) = -1835	370	-442
	a(3) = -1922	400	-371
	a(4) = -1330	430	-315
		460	-270
		490	-232
		520	-199
		550	-171
C ₄ H ₁₀	2-Methylpropane	270	-900
		300	-697
		330	-553
	a(1) = -707	360	-450
	a(2) = -1719	390	-374
	a(3) = -1282	420	-317
		450	-273

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	$B/\text{cm}^3 \text{mol}^{-1}$	
		480	-240	
		510	-215	
$\text{C}_4\text{H}_{10}\text{O}$	1-Butanol	350	-1693	
		360	-1544	
		370	-1402	
		a(1) = -2629	380	-1268
		a(2) = -6315	390	-1141
		400	-1021	
		420	-796	
		440	-593	
$\text{C}_4\text{H}_{10}\text{O}$	2-Methyl-1-propanol	390	-1076	
		400	-979	
		410	-887	
		a(1) = -2269	420	-800
		a(2) = -5065	430	-716
		440	-636	
$\text{C}_4\text{H}_{10}\text{O}$	2-Butanol	380	-1110	
		390	-1005	
		400	-906	
		a(1) = -2232	410	-811
		a(2) = -5209	420	-721
$\text{C}_4\text{H}_{10}\text{O}$	2-Methyl-2-propanol	380	-924	
		390	-827	
		400	-736	
		a(1) = -1952	410	-649
		a(2) = -4775	420	-567
$\text{C}_4\text{H}_{10}\text{O}$	Diethyl ether	280	-1550	
		300	-1199	
		320	-954	
		a(1) = -1226	340	-776
		a(2) = -4458	360	-638
		a(3) = -7746	380	-525
		a(4) = -10005	400	-428
			420	-340
$\text{C}_4\text{H}_{11}\text{N}$	Diethylamine	320	-1228	
		330	-1134	
		340	-1056	
		a(1) = -1522	350	-988
		a(2) = -5204	360	-926
		a(3) = -15047	370	-868
		a(4) = -28835	380	-812
			390	-755
			400	-697
$\text{C}_5\text{H}_5\text{N}$	Pyridine	350	-1257	
		360	-1176	
		370	-1099	
		a(1) = -1765	380	-1026
		a(2) = -3431	390	-957
			400	-892
			420	-770
			440	-659

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
C ₅ H ₁₀	Cyclopentane	300	-1049
		305	-1015
		310	-981
		a(1) = -1062 315	-949
		a(2) = -2116 320	-918
C ₅ H ₁₀	1-Pentene	310	-966
		320	-898
		330	-836
		a(1) = -1055 340	-780
		a(2) = -2377 350	-729
		a(3) = -1189 360	-681
		370	-638
		380	-598
		390	-561
		400	-527
410	-495		
C ₅ H ₁₀ O	2-Pentanone	330	-2850
		340	-2420
		350	-2076
		a(1) = -4962 360	-1804
		a(2) = -26372 370	-1595
		a(3) = -46537 380	-1440
		390	-1332
C ₅ H ₁₂	Pentane	300	-1234
		310	-1130
		320	-1038
		a(1) = -1254 330	-957
		a(2) = -3345 340	-884
		a(3) = -2726 350	-818
		400	-579
		450	-436
		500	-348
		550	-294
C ₅ H ₁₂	2-Methylbutane	280	-1263
		290	-1166
		300	-1079
		a(1) = -1095 310	-1001
		a(2) = -2503 320	-931
		a(3) = -1534 330	-867
		340	-810
		350	-757
		400	-557
		450	-424
C ₅ H ₁₂	2,2-Dimethylpropane	300	-916
		310	-843
		320	-780
		a(1) = -931 330	-724
		a(2) = -2387 340	-674
		a(3) = -2641 350	-629
		a(4) = -1810 360	-590
		370	-554
		380	-521
		390	-492

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		400	-464
		450	-357
		500	-279
		550	-218
C ₆ H ₆	Benzene	290	-1588
		300	-1454
		310	-1335
	a(1) = -1477	320	-1231
	a(2) = -3851	330	-1139
	a(3) = -3683	340	-1056
	a(4) = -1423	350	-983
		400	-712
		450	-542
		500	-429
		550	-349
		600	-291
C ₆ H ₇ N	2-Methylpyridine	360	-1656
		370	-1523
		380	-1404
	a(1) = -2940	390	-1297
	a(2) = -8813	400	-1202
	a(3) = -7809	410	-1117
		420	-1040
		430	-972
C ₆ H ₇ N	3-Methylpyridine	380	-1819
		390	-1612
		400	-1448
	a(1) = -6304	410	-1322
	a(2) = -30415	420	-1230
	a(3) = -44549	430	-1166
C ₆ H ₇ N	4-Methylpyridine	380	-1787
		390	-1578
		400	-1417
	a(1) = -6553	410	-1297
	a(2) = -32873	420	-1214
	a(3) = -49874	430	-1163
C ₆ H ₁₂	Cyclohexane	300	-1698
		320	-1391
		340	-1170
	a(1) = -1733	360	-1007
	a(2) = -5618	380	-883
	a(3) = -9486	400	-786
	a(4) = -7936	420	-707
		440	-641
		460	-584
		480	-534
		500	-488
		520	-446
		540	-406
		560	-368
C ₆ H ₁₂	Methylcyclopentane	305	-1447
		315	-1357

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹
		325	-1272
	a(1) = -1512	335	-1192
	a(2) = -2910	345	-1117
C ₆ H ₁₄	Hexane	300	-1920
		310	-1724
		320	-1561
	a(1) = -1961	330	-1424
	a(2) = -6691	340	-1309
	a(3) = -13167	350	-1209
	a(4) = -15273	360	-1123
		370	-1046
		380	-978
		390	-916
		400	-859
		410	-806
		430	-707
		450	-616
C ₆ H ₁₅ N	Triethylamine	330	-1562
		340	-1444
		350	-1340
	a(1) = -2061	360	-1249
	a(2) = -5735	370	-1169
	a(3) = -5899	380	-1099
		390	-1037
		400	-983
C ₇ H ₈	Toluene	350	-1641
		360	-1511
		370	-1394
	a(1) = -2620	380	-1289
	a(2) = -7548	390	-1195
	a(3) = -6349	400	-1110
		410	-1034
		420	-965
		430	-903
C ₇ H ₁₄	1-Heptene	340	-1781
		350	-1651
		360	-1532
	a(1) = -2491	370	-1424
	a(2) = -6230	380	-1324
	a(3) = -3780	390	-1233
		400	-1150
		410	-1073
C ₇ H ₁₆	Heptane	300	-2782
		320	-2297
		340	-1928
	a(1) = -2834	360	-1641
	a(2) = -8523	380	-1415
	a(3) = -10068	400	-1233
	a(4) = -5051	420	-1085
		440	-963
		460	-862
		480	-775
		500	-702

VIRIAL COEFFICIENTS OF SELECTED GASES (continued)

Mol. form.	Name	T/K	B/cm ³ mol ⁻¹	
		540	-583	
		580	-490	
		620	-416	
		660	-355	
		700	-304	
C ₈ H ₁₀	1,2-Dimethylbenzene	380	-2046	
		390	-1848	
		400	-1681	
		a(1) = -5632	410	-1543
		a(2) = -22873	420	-1428
		a(3) = -28900	430	-1335
			440	-1261
C ₈ H ₁₀	1,3-Dimethylbenzene	380	-2082	
		390	-1865	
		400	-1679	
		a(1) = -5808	410	-1521
		a(2) = -23244	420	-1388
		a(3) = -27607	430	-1276
			440	-1184
C ₈ H ₁₀	1,4-Dimethylbenzene	380	-2043	
		390	-1851	
		400	-1680	
		a(1) = -4921	410	-1529
		a(2) = -16843	420	-1395
		a(3) = -16159	430	-1276
			440	-1171
C ₈ H ₁₆	1-Octene	360	-2147	
		370	-2000	
		380	-1861	
		a(1) = -3273	390	-1729
		a(2) = -6557	400	-1604
			410	-1485
C ₈ H ₁₈	Octane	300	-4042	
		350	-2511	
		400	-1704	
		a(1) = -4123	450	-1234
		a(2) = -13120	500	-936
		a(3) = -16408	550	-732
		a(4) = -8580	600	-583
			650	-468
			700	-375

VAN DER WAALS CONSTANTS FOR GASES

The van der Waals equation of state for a real gas is

$$(P + n^2a/V^2)(V - nb) = nRT$$

where P is the pressure, V the volume, T the temperature, n the amount of substance (in moles), and R the gas constant. The van der Waals constants a and b are characteristic of the substance and are independent of temperature. They are related to the critical temperature and pressure, T_c and P_c , by

$$a = 27R^2T_c^2/64P_c \quad b = RT_c/8P_c$$

This table gives values of a and b for some common gases. Most of the values have been calculated from the critical temperature and pressure values given in the table "Critical Constants" in this section. Van der Waals constants for other gases may easily be calculated from the data in that table.

To convert the van der Waals constants to SI units, note that 1 bar L²/mol² = 0.1 Pa m⁶/mol² and 1 L/mol = 0.001 m³/mol.

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Substance	a bar L ² /mol ²	b L/mol	Substance	a bar L ² /mol ²	b L/mol
Acetic acid	17.71	0.1065	Hydrogen sulfide	4.544	0.0434
Acetone	16.02	0.1124	Isobutane	13.32	0.1164
Acetylene	4.516	0.0522	Krypton	5.193	0.0106
Ammonia	4.225	0.0371	Methane	2.303	0.0431
Aniline	29.14	0.1486	Methanol	9.476	0.0659
Argon	1.355	0.0320	Methylamine	7.106	0.0588
Benzene	18.82	0.1193	Neon	0.208	0.0167
Bromine	9.75	0.0591	Neopentane	17.17	0.1411
Butane	13.89	0.1164	Nitric oxide	1.46	0.0289
1-Butanol	20.94	0.1326	Nitrogen	1.370	0.0387
2-Butanone	19.97	0.1326	Nitrogen dioxide	5.36	0.0443
Carbon dioxide	3.658	0.0429	Nitrogen trifluoride	3.58	0.0545
Carbon disulfide	11.25	0.0726	Nitrous oxide	3.852	0.0444
Carbon monoxide	1.472	0.0395	Octane	37.88	0.2374
Chlorine	6.343	0.0542	1-Octanol	44.71	0.2442
Chlorobenzene	25.80	0.1454	Oxygen	1.382	0.0319
Chloroethane	11.66	0.0903	Ozone	3.570	0.0487
Chloromethane	7.566	0.0648	Pentane	19.09	0.1449
Cyclohexane	21.92	0.1411	1-Pentanol	25.88	0.1568
Cyclopropane	8.34	0.0747	Phenol	22.93	0.1177
Decane	52.74	0.3043	Propane	9.39	0.0905
1-Decanol	59.51	0.3086	1-Propanol	16.26	0.1079
Diethyl ether	17.46	0.1333	2-Propanol	15.82	0.1109
Dimethyl ether	8.690	0.0774	Propene	8.442	0.0824
Dodecane	69.38	0.3758	Pyridine	19.77	0.1137
1-Dodecanol	75.70	0.3750	Pyrrole	18.82	0.1049
Ethane	5.580	0.0651	Silane	4.38	0.0579
Ethanol	12.56	0.0871	Sulfur dioxide	6.865	0.0568
Ethylene	4.612	0.0582	Sulfur hexafluoride	7.857	0.0879
Fluorine	1.171	0.0290	Tetrachloromethane	20.01	0.1281
Furan	12.74	0.0926	Tetrachlorosilane	20.96	0.1470
Helium	0.0346	0.0238	Tetrafluoroethylene	6.954	0.0809
Heptane	31.06	0.2049	Tetrafluoromethane	4.040	0.0633
1-Heptanol	38.17	0.2150	Tetrafluorosilane	5.259	0.0724
Hexane	24.84	0.1744	Tetrahydrofuran	16.39	0.1082
1-Hexanol	31.79	0.1856	Thiophene	17.21	0.1058
Hydrazine	8.46	0.0462	Toluene	24.86	0.1497
Hydrogen	0.2452	0.0265	1,1,1-Trichloroethane	20.15	0.1317
Hydrogen bromide	4.500	0.0442	Trichloromethane	15.34	0.1019
Hydrogen chloride	3.700	0.0406	Trifluoromethane	5.378	0.0640
Hydrogen cyanide	11.29	0.0881	Trimethylamine	13.37	0.1101
Hydrogen fluoride	9.565	0.0739	Water	5.537	0.0305
Hydrogen iodide	6.309	0.0530	Xenon	4.192	0.0516

MEAN FREE PATH AND RELATED PROPERTIES OF GASES

In the simplest version of the kinetic theory of gases, molecules are treated as hard spheres of diameter d which make binary collisions only. In this approximation the mean distance traveled by a molecule between successive collisions, the mean free path l , is related to the collision diameter by:

$$l = \frac{kT}{\pi\sqrt{2}Pd^2}$$

where P is the pressure, T the absolute temperature, and k the Boltzmann constant. At standard conditions ($P = 100\,000$ Pa and $T = 298.15$ K) this relation becomes:

$$l = \frac{9.27 \cdot 10^{-27}}{d^2}$$

where l and d are in meters.

Using the same model and the same standard pressure, the collision diameter can be calculated from the viscosity η by the kinetic theory relation:

$$\eta = \frac{2.67 \cdot 10^{-20} (MT)^{1/2}}{d^2}$$

where η is in units of $\mu\text{Pa s}$ and M is the molar mass in g/mol. Kinetic theory also gives a relation for the mean velocity \bar{v} of molecules of mass m :

$$\bar{v} = \left(\frac{8kT}{\pi m} \right)^{1/2} = 145.5 (T/M)^{1/2} \text{ m/s}$$

Finally, the mean time τ between collisions can be calculated from the relation $\tau\bar{v} = l$.

The table below gives values of l , \bar{v} , and τ for some common gases at 25°C and atmospheric pressure, as well as the value of d , all calculated from measured gas viscosities (see References 2 and 3 and the table "Viscosity of Gases" in this section). It is seen from the above equations that the mean free path varies directly with T and inversely with P , while the mean velocity varies as the square root of T and, in this approximation, is independent of P .

A more accurate model, in which molecular interactions are described by a Lennard-Jones potential, gives mean free path values about 5% lower than this table (see Reference 4).

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Gas	d	l	\bar{v}	τ
Air	$3.66 \cdot 10^{-10}$ m	$6.91 \cdot 10^{-8}$ m	467 m/s	148 ps
Ar	3.58	7.22	397	182
CO ₂	4.53	4.51	379	119
H ₂	2.71	12.6	1769	71
He	2.15	20.0	1256	159
Kr	4.08	5.58	274	203
N ₂	3.70	6.76	475	142
NH ₃	4.32	4.97	609	82
Ne	2.54	14.3	559	256
O ₂	3.55	7.36	444	166
Xe	4.78	4.05	219	185

INFLUENCE OF PRESSURE ON FREEZING POINTS

This table illustrates the variation of the freezing point of representative types of liquids with pressure. Substances are listed in alphabetical order. Note that 1 MPa = 0.01 kbar = 9.87 atm.

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Substance	Molecular formula	Freezing point in °C at:		
		0.1 MPa	100 MPa	1000 MPa
Acetic acid	C ₂ H ₄ O ₂	16.6	37	
Acetophenone	C ₈ H ₈ O	20.0	41.2	
Aniline	C ₆ H ₇ N	-6.0	13.5	140
Benzene	C ₆ H ₆	5.5	33.4	
Benzonitrile	C ₇ H ₅ N	-12.8	7.6	
Benzyl alcohol	C ₇ H ₈ O	-15.2	0.2	
Bromobenzene	C ₆ H ₅ Br	-30.6	-12	108
Bromoethane	C ₂ H ₅ Br	-118.6	-108	
1-Bromonaphthalene	C ₁₀ H ₇ Br	-1.8	6.1	
1-Bromopropane	C ₃ H ₇ Br	-110	-98	
<i>p</i> -Bromotoluene	C ₇ H ₇ Br	28.0	56.7	
Butanoic acid	C ₄ H ₈ O ₂	-5.7	13.8	
1-Butanol	C ₄ H ₁₀ O	-89.8	-77.2	
Carbon disulfide	CS ₂	-111.5	-98	
Chlorobenzene	C ₆ H ₅ Cl	-45.2	-28	84
<i>p</i> -Chlorotoluene	C ₇ H ₇ Cl	6.9	33.1	
<i>o</i> -Cresol	C ₇ H ₈ O	29.8	47.7	
<i>m</i> -Cresol	C ₇ H ₈ O	11.8	25.6	
<i>p</i> -Cresol	C ₇ H ₈ O	35.8	56.2	
Cyclohexane	C ₆ H ₁₂	6.6	32.5	
Cyclohexanol	C ₆ H ₁₂ O	25.5	62.3	
1,2-Dibromoethane	C ₂ H ₄ Br ₂	9.9	34.0	
<i>p</i> -Dichlorobenzene	C ₆ H ₄ Cl ₂	52.7	79.1	
Dichloromethane	CH ₂ Cl ₂	-95.1	-83	
<i>N,N</i> -Dimethylaniline	C ₈ H ₁₁ N	2.5	26.3	
1,4-Dioxane	C ₄ H ₈ O ₂	11	23	
Ethanol	C ₂ H ₆ O	-114.1	-108	
Formamide	CH ₃ NO	-15.5	10.8	
Formic acid	CH ₂ O ₂	8.3	20.6	
Furan	C ₄ H ₄ O	-85.6	-73	
Hexamethyldisiloxane	C ₆ H ₁₈ OSi ₂	-66	-37	
Menthol	C ₁₀ H ₂₀ O	42	60	
Methyl benzoate	C ₈ H ₈ O ₂	-15	31.8	
2-Methyl-2-butanol	C ₅ H ₁₂ O	-8.8	13.4	
2-Methyl-2-propanol	C ₄ H ₁₀ O	25.4	58.1	
Naphthalene	C ₁₀ H ₈	78.2	115.7	
Nitrobenzene	C ₆ H ₅ NO ₂	5.7	13.5	
<i>m</i> -Nitrotoluene	C ₇ H ₇ NO ₂	15.5	40.6	
Pentachloroethane	C ₂ HCl ₅	-29.0	-6.3	
Potassium	K	63.7	78	170
Potassium chloride	ClK	771		945
Propanoic acid	C ₃ H ₆ O ₂	-20.7	-1.2	
Silver chloride	AgCl	455		545
Sodium	Na	97.8	106	167
Sodium chloride	ClNa	800.7		997
Sodium fluoride	FNa	996		1115
Tetrachloromethane	CCl ₄	-23.0	14.2	
Tribromomethane	CHBr ₃	8.1	31.5	
Trichloromethane	CHCl ₃	-63.6	-45.2	
Water	H ₂ O	0.0	-9.0	
<i>o</i> -Xylene	C ₈ H ₁₀	-25.2	-3.5	
<i>m</i> -Xylene	C ₈ H ₁₀	-47.8	-25.2	
<i>p</i> -Xylene	C ₈ H ₁₀	13.2	46.0	

CRITICAL CONSTANTS

The parameters of the liquid–gas critical point are important constants in determining the behavior of fluids. This table lists the critical temperature, pressure, and molar volume, as well as the normal boiling point, for approximately 850 inorganic and organic substances. The properties and their units are:

- T_b : Normal boiling point in kelvins at a pressure of 101.325 kPa (1 atmosphere); an “s” following the value indicates a sublimation point (temperature at which the solid is in equilibrium with the gas at a pressure of 101.325 kPa)
 T_c : Critical temperature in kelvins
 P_c : Critical pressure in megapascals
 V_c : Critical molar volume in cm³/mol

The number of digits given for T_b , T_c , and P_c indicates the estimated accuracy of these quantities; however, values of T_c greater than 750 K may be in error by 10 K or more. Although most V_c values are given to three figures, they cannot be assumed accurate to better than a few percent. All values are experimentally determined except for a few values, indicated by an asterisk*, which are based on extrapolations. Methods of measurement are described and critiqued in Reference 1.

Many of the critical constants in this table are taken from reviews produced by the IUPAC Commission on Thermodynamics (References 1– 8). Compounds are listed by molecular formula in modified Hill order, with compounds not containing carbon preceding those that do contain carbon. The assistance of Douglas Ambrose is gratefully acknowledged.

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Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
AlBr ₃	Aluminum bromide	528	763	2.89	310	9
AlCl ₃	Aluminum chloride	453 s	620	2.63	257	9
AlI ₃	Aluminum iodide	655	983		408	9
Ar	Argon	87.30	150.87	4.898	75	9
As	Arsenic	876	1673		35	9
AsCl ₃	Arsenic(III) chloride	403	654		252	9
AsH ₃	Arsine	210.7	373.1			9
BBr ₃	Boron tribromide	364	581		272	9
BCl ₃	Boron trichloride	285.80	455	3.87	239	9
BF ₃	Boron trifluoride	172	260.8	4.98	115	9
BI ₃	Boron triiodide	482.7	773		356	9
B ₂ H ₆	Diborane	180.8	289.8	4.05		9
BiBr ₃	Bismuth tribromide	726	1220		301	9
BiCl ₃	Bismuth trichloride	720	1179	12.0	261	9
BrH	Hydrogen bromide	206.77	363.2	8.55		9
BrI	Iodine bromide	389	719		139	9
Br ₂	Bromine	332.0	588	10.34	127	9
Br ₂ Hg	Mercury(II) bromide	595	1012			9
Br ₃ Ga	Gallium(III) bromide	552	806.7		303	9
Br ₃ HSi	Tribromosilane	382	610.0		305	9
Br ₃ P	Phosphorus(III) bromide	446.4	711		300	9
Br ₃ Sb	Antimony(III) bromide	553	904		300	9
Br ₄ Ge	Germanium(IV) bromide	459.50	718		392	9
Br ₄ Hf	Hafnium(IV) bromide	596 s	746		415	9
Br ₄ Si	Tetrabromosilane	427	663		382	9
Br ₄ Sn	Tin(IV) bromide	478	744		417	9
Br ₄ Ti	Titanium(IV) bromide	503	795.7		391	9
Br ₄ Zr	Zirconium(IV) bromide	633 s	805		424	9
Br ₅ Ta	Tantalum(V) bromide	622	974		461	9
ClFO ₃	Perchloryl fluoride	226.40	368.4	5.37	161	9
ClF ₂ N	Nitrogen chloride difluoride	206	337.5	5.15		9
ClF ₂ P	Phosphorus(III) chloride difluoride	225.9	362.4	4.52		9
ClF ₂ PS	Phosphorothioic chloride difluoride	279.5	439.2	4.14		9
ClF ₃ Si	Chlorotrifluorosilane	203.2	307.7	3.46		9
ClF ₅	Chlorine pentafluoride	260.1	416	5.27	233	9
ClF ₃ S	Sulfur chloride pentafluoride	254.10	390.9			9
ClH	Hydrogen chloride	188	324.7	8.31	81	9
ClH ₄ N	Ammonium chloride	611 s	1155	163.5		9
ClH ₄ P	Phosphonium chloride	246 s	322.3	7.37		9
ClNO	Nitrosyl chloride	267.7	440			9
ClOV	Vanadyl chloride	400	636		171	9
Cl ₂	Chlorine	239.11	416.9	7.991	123	9
Cl ₂ FP	Phosphorus(III) dichloride fluoride	287.00	463.0	4.96		9
Cl ₂ F ₂ Si	Dichlorodifluorosilane	241	369.0	3.5		9

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
Cl ₂ Hg	Mercury(II) chloride	577	973		174	9
Cl ₂ OSe	Selenium oxychloride	450	730	7.09	235	9
Cl ₃ FSi	Trichlorofluorosilane	285.40	438.6	3.58		9
Cl ₃ Ga	Gallium(III) chloride	474	694		263	9
Cl ₃ HSi	Trichlorosilane	306	479		268	9
Cl ₃ P	Phosphorus(III) chloride	349.3	563		264	9
Cl ₃ Sb	Antimony(III) chloride	493.5	794		272	9
Cl ₄ Ge	Germanium(IV) chloride	359.70	553.2	3.861	330	9
Cl ₄ Hf	Hafnium(IV) chloride	590 s	725.7	5.42	314	9
Cl ₄ ORe	Rhenium(VI) oxytetrachloride	496	781		362	9
Cl ₄ OW	Tungsten(VI) oxytetrachloride	500.70	782		338	9
Cl ₄ Si	Tetrachlorosilane	330.80	508.1	3.593	326	9
Cl ₄ Sn	Tin(IV) chloride	387.30	591.9	3.75	351	9
Cl ₄ Te	Tellurium tetrachloride	660	1002	8.56	310	9
Cl ₄ Ti	Titanium(IV) chloride	409.60	638	4.66	339	9
Cl ₄ Zr	Zirconium(IV) chloride	604 s	778	5.77	319	9
Cl ₅ Mo	Molybdenum(V) chloride	541	850		369	9
Cl ₅ Nb	Niobium(V) chloride	527.2	803.5	4.88	397	9
Cl ₅ P	Phosphorus(V) chloride	433 s	646			9
Cl ₅ Ta	Tantalum(V) chloride	512.50	767		402	9
Cl ₆ W	Tungsten(VI) chloride	619.90	923		422	9
Cs	Cesium	944	1938	9.4	341	43
FH	Hydrogen fluoride	293	461	6.48	69	9
FNO ₂	Nitryl fluoride	200.8	349.5			9
F ₂	Fluorine	85.03	144.13	5.172	66	9
F ₂ HN	Difluoramine	250	403			9
F ₂ N ₂	<i>cis</i> -Difluorodiazine	167.40	272	7.09		9
F ₂ N ₂	<i>trans</i> -Difluorodiazine	161.70	260	5.57		9
F ₂ O	Fluorine monoxide	128.40	215			9
F ₂ Xe	Xenon difluoride	387.50	631	9.32	148	9
F ₃ N	Nitrogen trifluoride	144.40	234.0	4.46	126	9
F ₃ NO	Trifluoramine oxide	185.7	303	6.43	147	9
F ₃ P	Phosphorus(III) fluoride	171.4	271.2	4.33		9
F ₃ PS	Phosphorothioic trifluoride	220.90	346.0	3.82		9
F ₄ N ₂	Tetrafluorohydrazine	199	309	3.75		9
F ₄ S	Sulfur tetrafluoride	232.70	364			9
F ₄ Si	Tetrafluorosilane	187	259.0	3.72		9
F ₄ Xe	Xenon tetrafluoride	388.90	612	7.04	188	9
F ₅ Nb	Niobium(V) fluoride	502	737	6.28	155	9
F ₆ Mo	Molybdenum(VI) fluoride	307.2	473	4.75	226	9
F ₆ S	Sulfur hexafluoride	209.35	318.69	3.77	199	9
F ₆ Se	Selenium hexafluoride	226.55	345.5			9
F ₆ Te	Tellurium hexafluoride	234.25	356			9
F ₆ U	Uranium(VI) fluoride	329.65	505.8	4.66	250	9
F ₆ W	Tungsten(VI) fluoride	290.3	444	4.34	233	9
Gal ₃	Gallium(III) iodide	613	951		395	9
GeH ₄	Germane	185.1	312.2	4.95	147	9
GeI ₄	Germanium(IV) iodide	650	973		500	9
HI	Hydrogen iodide	237.60	424.0	8.31		9
H ₂	Hydrogen	20.28	32.97	1.293	65	9
H ₂ O	Water	373.2	647.14	22.06	56	9
H ₂ O ₂	Hydrogen peroxide	423.4	728*	22*		31
H ₂ S	Hydrogen sulfide	213.60	373.2	8.94	99	9
H ₂ Se	Hydrogen selenide	231.90	411	8.92		9
H ₃ N	Ammonia	239.82	405.5	11.35	72	9
H ₃ P	Phosphine	185.40	324.5	6.54		9
H ₄ N ₂	Hydrazine	386.70	653	14.7		9
He	Helium	4.22	5.19	0.227	57	9
HfI ₄	Hafnium iodide	667 s	916		528	9

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
Hg	Mercury	629.88	1750	172.00	43	9
HgI ₂	Mercury(II) iodide	627	1072			9
I ₂	Iodine	457.6	819		155	9
I ₃ Sb	Antimony(III) iodide	674	1102			9
I ₄ Si	Tetraiodosilane	560.50	944		558	9
I ₄ Sn	Tin(IV) iodide	637.50	968		531	9
I ₄ Ti	Titanium(IV) iodide	650	1040		505	9
I ₄ Zr	Zirconium(IV) iodide	704 s	960		530	9
K	Potassium	1032	2223*	16*	209*	20
Kr	Krypton	119.93	209.41	5.50	91	9
Li	Lithium	1615	3223*	67*	66*	20
NO	Nitric oxide	121.41	180	6.48	58	9
N ₂	Nitrogen	77.36	126.21	3.39	90	9
N ₂ O	Nitrous oxide	184.67	309.57	7.255	97	9
N ₂ O ₄	Nitrogen tetroxide	294.30	431	10.1	167	9
Na	Sodium	1156	2573*	35*	116*	20
Ne	Neon	27.07	44.4	2.76	42	9
O ₂	Oxygen	90.20	154.59	5.043	73	9
O ₂ S	Sulfur dioxide	263.10	430.8	7.884	122	9
O ₃	Ozone	161.80	261.1	5.57	89	9
O ₃ S	Sulfur trioxide	318	491.0	8.2	127	9
O ₄ Os	Osmium(VIII) oxide	408	678			9
O ₇ Re ₂	Rhenium(VII) oxide	633	942		334	9
P	Phosphorus	553.7	994			9
Rb	Rubidium	961	2093*	16*	247*	20
Rn	Radon	211.5	377	6.28		9
S	Sulfur	717.75	1314	20.7		9
Se	Selenium	958	1766	27.2		9
Xe	Xenon	165.03	289.77	5.841	118	34
CBrClF ₂	Bromochlorodifluoromethane	269.5	426.88	4.254	246	9
CBrF ₃	Bromotrifluoromethane	215.4	340.2	3.97	196	9
CBr ₂ F ₂	Dibromodifluoromethane	295.91	471.3	4.45		9
CClF ₃	Chlorotrifluoromethane	191.8	302	3.870	180	9
CCl ₂ F ₂	Dichlorodifluoromethane	243.4	384.95	4.136	217	9
CCl ₂ O	Carbonyl chloride [Phosgene]	281	455	5.67	190	9
CCl ₃ F	Trichlorofluoromethane	296.9	471.1	4.47	247	18
CCl ₄	Tetrachloromethane	350.0	556.6	4.516	276	9
CF ₃ I	Trifluoroiodomethane	250.7	396.44	3.953	226	24
CF ₄	Tetrafluoromethane	145.2	227.6	3.74	140	9
CHBrF ₂	Bromodifluoromethane	258.6	411.98	5.132	275	47
CHClF ₂	Chlorodifluoromethane	232.5	369.5	5.035	164	18
CHCl ₂ F	Dichlorofluoromethane	282.1	451.58	5.18	196	9
CHCl ₃	Trichloromethane	334.32	536.4	5.47	239	9
CHF ₃	Trifluoromethane	191.1	298.98	4.82	133	42
CHN	Hydrogen cyanide	299	456.7	5.39	139	9
CH ₂ ClF	Chlorofluoromethane	264.1	427	5.70		37
CH ₂ Cl ₂	Dichloromethane	313	510	6.10		9
CH ₂ F ₂	Difluoromethane	221.6	351.56	5.83	123	42
CH ₂ O ₂	Formic acid	374	588			7
CH ₃ Cl	Chloromethane	249.06	416.25	6.679	139	9
CH ₃ Cl ₃ Si	Methyltrichlorosilane	338.8	517	3.28	348	9
CH ₃ F	Fluoromethane	194.8	317.8	5.88	113	9
CH ₃ I	Iodomethane	315.58	528			9
CH ₃ NO ₂	Nitromethane	374.34	588	5.87	173	9
CH ₄	Methane	111.67	190.56	4.599	98.60	2
CH ₄ O	Methanol	337.8	512.5	8.084	117	4
CH ₄ S	Methanethiol	279.1	470	7.23	147	8
CH ₃ ClSi	Chloromethylsilane	280	517.8			9
CH ₃ N	Methylamine	266.83	430.7	7.614		9

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
CH ₆ N ₂	Methylhydrazine	360.7	567	8.24	271	9
CH ₆ Si	Methylsilane	215.7	352.4			8
CO	Carbon monoxide	81.7	132.91	3.499	93	9
COS	Carbon oxysulfide	223	375	5.88	137	9
CO ₂	Carbon dioxide	194.6 s	304.13	7.375	94	22
CS ₂	Carbon disulfide	319	552	7.90	173	9
C ₂ Br ₂ ClF ₃	1,2-Dibromo-1-chloro-1,2,2-trifluoroethane	366	560.7	3.61	368	9
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane	320.50	487.8	3.393	341	9
C ₂ ClF ₃	Chlorotrifluoroethene	245.4	379	4.05	212	9
C ₂ ClF ₅	Chloropentafluoroethane	234.1	353.2	3.229	252	9
C ₂ Cl ₂ F ₄	1,1-Dichloro-1,2,2,2-tetrafluoroethane	276.6	418.6	3.30	294	9
C ₂ Cl ₂ F ₄	1,2-Dichloro-1,1,2,2-tetrafluoroethane	276.7	418.78	3.252	297	42
C ₂ Cl ₃ F ₃	1,1,1-Trichloro-2,2,2-trifluoroethane	318.7	482.9			40
C ₂ Cl ₃ F ₃	1,1,2-Trichloro-1,2,2-trifluoroethane	320.9	487.3	3.42	325	9
C ₂ Cl ₄	Tetrachloroethene	394.5	620.2			9
C ₂ Cl ₄ F ₂	1,1,2,2-Tetrachloro-1,2-difluoroethane	366.0	551			9
C ₂ Cl ₆	Hexachloroethane	457.85	695	3.34*	412*	12
C ₂ F ₃ N	Trifluoroacetonitrile	204.4	311.11	3.618	202	9
C ₂ F ₄	Tetrafluoroethene	197.3	306.5	3.94	172	9
C ₂ F ₆	Hexafluoroethane	195.1	293		222	9
C ₂ HClF ₂	1-Chloro-2,2-difluoroethene	254.7	400.6	4.46	197	9
C ₂ HClF ₄	1-Chloro-1,1,2,2-tetrafluoroethane	261.5	399.9	3.72	244	9
C ₂ HClF ₄	1-Chloro-1,2,2,2-tetrafluoroethane	261	395.65	3.643	244	42
C ₂ HCl ₂ F ₃	1,2-Dichloro-1,1,2-trifluoroethane	302.7	461.6		278	19
C ₂ HCl ₂ F ₃	2,2-Dichloro-1,1,1-trifluoroethane	300.97	456.83	3.661	278	35
C ₂ HCl ₃	Trichloroethene	360.36	544.2	5.02		9
C ₂ HF ₃ O ₂	Trifluoroacetic acid	346	491.3	3.258	204	9
C ₂ HF ₅	Pentafluoroethane	225.1	339.17	3.620	208.0	29,30
C ₂ HF ₅ O	Trifluoromethyl difluoromethyl ether	235	354.0	3.33	192	25, 45,46
C ₂ H ₂	Acetylene	188.45	308.3	6.138	112.2	6
C ₂ H ₂ ClF ₃	2-Chloro-1,1,1-trifluoroethane	279.3	425.01		228	40
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethene	333.3	544.2			9
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethene	321.9	516.5	5.51		9
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	418.4	661.15			9
C ₂ H ₂ F ₂	1,1-Difluoroethene	187.5	302.9	4.46	154	9
C ₂ H ₂ F ₄	1,1,1,2-Tetrafluoroethane	247.07	374.18	4.065	198	36
C ₂ H ₂ F ₄	1,1,2,2-Tetrafluoroethane	253.3	391.74	4.615	191	19,42
C ₂ H ₂ F ₄ O	Bis(difluoromethyl) ether	275	420.25	4.228	223	46
C ₂ H ₃ Cl	Chloroethene [Vinyl chloride]	259.4	432	5.67	179	12
C ₂ H ₃ ClF ₂	1-Chloro-1,1-difluoroethane	264.1	410.34	4.048	225	19,32
C ₂ H ₃ Cl ₂ F	1,1-Dichloro-1-fluoroethane	305.2	477.5	4.194	255	26,42
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	347.24	545	4.30		9
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	387.0	602*	4.48*	281*	12
C ₂ H ₃ F	Fluoroethene	201	327.9	5.24	144	9
C ₂ H ₃ F ₃	1,1,1-Trifluoroethane	225.90	345.86	3.764	194	27,28
C ₂ H ₃ F ₃	1,1,2-Trifluoroethane	276.9	429.8	5.241	207	40
C ₂ H ₃ F ₃ O	Methyl trifluoromethyl ether	249.49	378.02	3.588	228	47
C ₂ H ₃ N	Acetonitrile	354.80	545.6	4.884	173	14
C ₂ H ₄	Ethylene [Ethene]	169.38	282.34	5.041	131	6
C ₂ H ₄ Br ₂	1,2-Dibromoethane	404.8	583.0	7.2		9
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	330.5	523	5.07	236	9
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	356.7	561	5.4	225	9
C ₂ H ₄ F ₂	1,1-Difluoroethane	249.10	386.7	4.50	181	9,19
C ₂ H ₄ O	Acetaldehyde	293.3	466		154	7
C ₂ H ₄ O	Oxirane [Ethylene oxide]	283.8	469	7.2	142	7
C ₂ H ₄ O ₂	Acetic acid	391.1	590.7	5.78	171	7
C ₂ H ₄ O ₂	Methyl formate	304.9	487.2	6.00	172	7
C ₂ H ₅ Br	Bromoethane	311.7	503.9	6.23	215	9

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₂ H ₅ Cl	Chloroethane	285.5	460.4	5.3		9
C ₂ H ₅ F	Fluoroethane	235.5	375.31	5.028		9
C ₂ H ₆	Ethane	184.6	305.32	4.872	145.5	2
C ₂ H ₆ Cl ₂ Si	Dichlorodimethylsilane	343.5	520.4	3.49	350	9
C ₂ H ₆ O	Ethanol	351.44	514.0	6.137	168	4
C ₂ H ₆ O	Dimethyl ether	248.4	400.2	5.34	168	7
C ₂ H ₆ O ₂	1,2-Ethanediol	470.5	720	8		7,14
C ₂ H ₆ S	Ethanethiol	308.2	499	5.49	207	8
C ₂ H ₆ S	Dimethyl sulfide	310.48	503	5.53	203.7	8
C ₂ H ₆ S ₂	Dimethyl disulfide	382.89	615			8
C ₂ H ₇ N	Ethylamine	289.7	456	5.62	182	9
C ₂ H ₇ N	Dimethylamine	280.03	437.22	5.340		9
C ₂ H ₈ N ₂	1,2-Ethanediamine	390	613.1	6.707		11,12
C ₂ N ₂	Cyanogen	252.1	400	5.98		9
C ₃ ClF ₅ O	Chloropentafluoroacetone	281	410.6	2.878		9
C ₃ Cl ₂ F ₆	1,3-Dichloro-1,1,2,2,3,3-hexafluoropropane	308.9	453	2.753		41
C ₃ F ₆ O	Perfluoroacetone	245.8	357.14	2.84	329	9
C ₃ F ₆ O	Perfluorooxetane	244.8	361.8	3.03	272	18,47
C ₃ F ₈	Perfluoropropane	236.6	345.1	2.680	299	9
C ₃ F ₈ O ₂	Perfluorodimethoxymethane	263	372.3	2.333	363	18
C ₃ HF ₇	1,1,1,2,3,3,3-Heptafluoropropane	256.8	374.89	2.929	274	39,47
C ₃ HF ₇ O	Trifluoromethyl 1,1,2,2-tetrafluoroethyl ether	270	387.78	2.293	337	18,47
C ₃ H ₂ F ₆	1,1,1,2,3,3-Hexafluoropropane	279.3	412.38	3.412	269	33
C ₃ H ₂ F ₆	1,1,1,3,3,3-Hexafluoropropane	272.2	398.07			45
C ₃ H ₂ F ₆ O	1,2,2,2-Tetrafluoroethyl difluoromethyl ether	296.50	428.95	3.050	315	32
C ₃ H ₃ F ₃	3,3,3-Trifluoropropene	256	376.2	3.80	211	9
C ₃ H ₃ F ₅	1,1,1,3,3-Pentafluoropropane	288.5	427.20			45
C ₃ H ₃ F ₅	1,1,1,2,2-Pentafluoropropane	255.8	380.11	3.137	273	9
C ₃ H ₃ F ₅	1,1,2,2,3-Pentafluoropropane	298.2	447.57			45
C ₃ H ₃ F ₅ O	Methyl pentafluoroethyl ether	278.74	406.80	2.887	301	32
C ₃ H ₃ F ₅ O	Difluoromethyl 2,2,2-trifluoroethyl ether	302.39	443.99			38
C ₃ H ₃ N	Acrylonitrile	350.5	540	4.660		11,12
C ₃ H ₃ NO	Isoxazole	368	552.0			9
C ₃ H ₄	Allene	238.8	394	5.25		6
C ₃ H ₄	Propyne	250.0	402.4	5.63	163.5	6
C ₃ H ₅ Cl	3-Chloropropene	318.3	514			9
C ₃ H ₅ F ₃ O	2,2,2-Trifluoroethyl methyl ether	304.77	448.98	3.513	277	32
C ₃ H ₅ N	Propanenitrile	370.29	561.3	4.26	229	9
C ₃ H ₆	Propene	225.46	364.9	4.60	185	6
C ₃ H ₆	Cyclopropane	240.34	398.0	5.54	162	5
C ₃ H ₆ Cl ₂	1,2-Dichloropropane	369.6	578.5			13
C ₃ H ₆ Cl ₂	1,3-Dichloropropane	394.1	614.6			13
C ₃ H ₆ O	Allyl alcohol	370.2	545.1			4
C ₃ H ₆ O	Propanal	321	505	5.26	204	7
C ₃ H ₆ O	Acetone	329.20	508.1	4.700	213	7
C ₃ H ₆ O	Methyloxirane [1,2-Propylene oxide]	308	485	5.2	190	7
C ₃ H ₆ O ₂	Propanoic acid	414.30	598.5	4.67	233	7
C ₃ H ₆ O ₂	Ethyl formate	327.6	508.54	4.74	229	7
C ₃ H ₆ O ₂	Methyl acetate	330.02	506.5	4.750	228	7
C ₃ H ₆ O ₃	Dimethyl carbonate	363.7	557	4.80	252	7
C ₃ H ₇ Cl	1-Chloropropane	319.7	503	4.58		9
C ₃ H ₇ Cl	2-Chloropropane	308.9	484			13
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide	426	649.6		262	9
C ₃ H ₈	Propane	231.1	369.83	4.248	200	2
C ₃ H ₈ O	1-Propanol	370.4	536.8	5.169	218	4
C ₃ H ₈ O	2-Propanol	355.5	508.3	4.764	222	4
C ₃ H ₈ O	Ethyl methyl ether	280.6	437.9	4.38	222	7
C ₃ H ₈ O ₂	1,2-Propylene glycol	460.8	676.4	5.941		7,14

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₃ H ₈ O ₂	1,3-Propylene glycol [Trimethylene glycol]	487.6	718.2	6.55		14,17
C ₃ H ₈ O ₂	2-Methoxyethanol [Ethylene glycol monomethyl ether]	397.3	597.6	5.285	263	7,11,12
C ₃ H ₈ O ₂	Dimethoxymethane [Methylal]	315	491	3.96	213	7
C ₃ H ₈ O ₃	Glycerol	563	850	7.5		7
C ₃ H ₈ S	1-Propanethiol	341.0	537	4.6	286	8
C ₃ H ₈ S	Ethyl methyl sulfide	339.9	533	4.25		8
C ₃ H ₉ BO ₃	Trimethyl borate	340.7	501.7	3.59		9
C ₃ H ₉ ClSi	Trimethylchlorosilane	333	497.8	3.20	366	9
C ₃ H ₉ N	Propylamine	320.37	497.0	4.72		9
C ₃ H ₉ N	Isopropylamine	304.91	471.8	4.54	221	9
C ₃ H ₉ N	Trimethylamine	276.02	432.79	4.087	254	9
C ₄ Br ₂ F ₈	1,4-Dibromooctafluorobutane	370	532.5	2.39		9
C ₄ Cl ₂ F ₆	1,2-Dichloro-1,2,3,3,4,4-hexafluorocyclobutane	332.7	497*	2.73*	386*	12
C ₄ F ₈	Perfluorocyclobutane	267.3	388.46	2.784	324	9
C ₄ F ₁₀	Perfluorobutane	271.3	386.4	2.323	378	9
C ₄ F ₁₀	Perfluoroisobutane	273	395.4			9
C ₄ H ₂ F ₈ O	Perfluoroethyl 2,2,2-trifluoroethyl ether	301.04	421.68	2.330	409	32
C ₄ H ₃ F ₇ O	Perfluoropropyl methyl ether	307.38	437.70	2.481	377	32
C ₄ H ₃ F ₇ O	Perfluoroisopropyl methyl ether	302.49	433.30	2.553	369	32
C ₄ H ₄ O	Furan	304.7	490.2	5.3	218	7
C ₄ H ₄ O ₄	Maleic acid		620			7
C ₄ H ₄ S	Thiophene	357.2	580	5.70	219	8
C ₄ H ₅ F ₅ O	Perfluoroethyl ethyl ether	301.26	431.23	2.533	366	32
C ₄ H ₅ N	Pyrrole	402.94	639.7	6.34	200	10
C ₄ H ₆	1,3-Butadiene	268.74	425	4.32	221	6
C ₄ H ₆	1-Butyne	281.23	440	4.60	208	6
C ₄ H ₆	2-Butyne	300.1	488.7			9
C ₄ H ₆ O ₂	Vinyl acetate	346.0	519.2	4.185		7
C ₄ H ₆ O ₂	γ -Butyrolactone	477	731	5.13		7,11
C ₄ H ₆ O ₃	Acetic anhydride	412.7	606	4.0		7
C ₄ H ₆ O ₃	Propylene carbonate	515	762.7	4.14		17
C ₄ H ₇ N	Butanenitrile	390.8	585.4	3.88		9
C ₄ H ₈	1-Butene	266.89	419.5	4.02	240.8	6
C ₄ H ₈	<i>cis</i> -2-Butene	276.86	435.5	4.21	233.8	6
C ₄ H ₈	<i>trans</i> -2-Butene	274.03	428.6	4.10	237.7	6
C ₄ H ₈	Isobutene	266.3	417.9	4.000	238.8	6
C ₄ H ₈	Cyclobutane	285.8	460.0	4.98	210	9
C ₄ H ₈ O	Ethyl vinyl ether	308.7	475	4.07		7
C ₄ H ₈ O	Butanal	348.0	537	4.32	258	7
C ₄ H ₈ O	Isobutanal	337.7	544	5.1		7
C ₄ H ₈ O	2-Butanone [Methyl ethyl ketone]	352.74	536.7	4.207	267	7
C ₄ H ₈ O	Tetrahydrofuran	338	540.5	5.19	224	7
C ₄ H ₈ OS	<i>S</i> -Ethyl thioacetate	389.6	590.55	4.075	319	11,12
C ₄ H ₈ O ₂	Butanoic acid	436.90	615.2	4.06	292	7
C ₄ H ₈ O ₂	2-Methylpropanoic acid	427.60	605.0	3.70	290	7
C ₄ H ₈ O ₂	Propyl formate	354.1	538.0	4.06	285	7
C ₄ H ₈ O ₂	Isopropyl formate	341.4	535	3.95		7
C ₄ H ₈ O ₂	Ethyl acetate	350.26	523.3	3.87	286	7
C ₄ H ₈ O ₂	Methyl propanoate	353.0	530.7	4.00	282	7
C ₄ H ₈ O ₂	1,4-Dioxane	374.7	588	5.21	238	7
C ₄ H ₈ S	Tetrahydrothiophene	394.3	632	5.4		8
C ₄ H ₉ Cl	1-Chlorobutane	351.6	539.2			13
C ₄ H ₉ Cl	2-Chlorobutane	341.4	518.6			13
C ₄ H ₉ Cl	2-Chloro-2-methylpropane	324.1	500			13
C ₄ H ₉ N	Pyrrolidine	359.71	568	6.00	238	10
C ₄ H ₁₀	Butane	272.7	425.12	3.796	255	2
C ₄ H ₁₀	Isobutane	261.42	407.8	3.640	259	5
C ₄ H ₁₀ O	1-Butanol	390.88	563.0	4.414	274	4

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₄ H ₁₀ O	2-Butanol [sec-Butyl alcohol]	372.66	536.2	4.202	269	4
C ₄ H ₁₀ O	2-Methyl-1-propanol [Isobutyl alcohol]	381.04	547.8	4.295	274	4
C ₄ H ₁₀ O	2-Methyl-2-propanol [tert-Butyl alcohol]	355.6	506.2	3.972	275	4
C ₄ H ₁₀ O	Diethyl ether	307.7	466.7	3.644	281	7
C ₄ H ₁₀ O	Methyl propyl ether	312.3	476.2	3.801		7
C ₄ H ₁₀ O	Isopropyl methyl ether	303.92	464.4	3.762		7
C ₄ H ₁₀ O ₂	2-Methyl-1,3-propanediol	484.8	708.0	5.35		17
C ₄ H ₁₀ O ₂	1,2-Butanediol	463.7	680	5.21	303	7,23
C ₄ H ₁₀ O ₂	1,3-Butanediol	480.7	676	4.02	305	7,23
C ₄ H ₁₀ O ₂	1,4-Butanediol [Tetramethylene glycol]	508	723.8	5.52		17
C ₄ H ₁₀ O ₂	1,2-Dimethoxyethane [Ethylene glycol dimethyl ether]	357.7	540	3.90	308	7
C ₄ H ₁₀ O ₂	1,2-Propylene glycol monomethyl ether	392	579.8	4.113		11,12
C ₄ H ₁₀ O ₃	Diethylene glycol	519.0	750	4.7		7
C ₄ H ₁₀ S	1-Butanethiol	371.7	570	4.0	324	8
C ₄ H ₁₀ S	Diethyl sulfide	365.3	557.8	3.90	317.6	8,15
C ₄ H ₁₀ S ₂	Diethyl disulfide	427.2	642			8
C ₄ H ₁₁ N	Butylamine	350.15	531.9	4.25	277	10
C ₄ H ₁₁ N	sec-Butylamine	335.88	514.3	4.20	278	10
C ₄ H ₁₁ N	tert-Butylamine	317.19	483.9	3.84	292	10
C ₄ H ₁₁ N	Isobutylamine	340.90	519	4.07	278	10
C ₄ H ₁₁ N	Diethylamine	328.7	499.99	3.758		9
C ₄ H ₁₂ N ₂ O	N-(2-Aminoethyl)ethanolamine	512	739.2	4.65		17
C ₄ H ₁₂ Si	Tetramethylsilane	299.8	448.6	2.821	361.6	8
C ₄ H ₁₂ Sn	Tetramethylstannane	351	521.8	2.981		8
C ₄ H ₁₃ N ₃	Bis(2-aminoethyl)amine	480	709.8	4.38		14,17
C ₅ F ₁₂	Perfluoropentane	302.4	420.59	2.045	473	9
C ₅ H ₂ F ₆ O ₂	Hexafluoroacetylacetone	327.30	485.1	2.767		9
C ₅ H ₄ O ₂	Furfural	434.9	670*	5.89*		7
C ₅ H ₅ N	Pyridine	388.38	620.0	5.67	243	10
C ₅ H ₆ N ₂	2-Methylpyrazine	410	634.3	5.01	283	9
C ₅ H ₆ O	2-Methylfuran	337.9	528	4.7	247	7
C ₅ H ₇ N	1-Methylpyrrole	385.96	596.0	4.86	271	10
C ₅ H ₇ N	2-Methylpyrrole	420.8	654	5.08	266	10
C ₅ H ₇ N	3-Methylpyrrole	416.1	647	5.08	266	10
C ₅ H ₈	1-Pentyne	313.3	493.5			9
C ₅ H ₈	Cyclopentene	317.4	506.5	4.80	245	6
C ₅ H ₈ O	Cyclopentanone	403.72	624	4.60		7
C ₅ H ₈ O	3,4-Dihydro-2H-pyran	359	562	4.56	268	7
C ₅ H ₉ N	Pentanenitrile	414.5	610.3	3.58		9
C ₅ H ₉ NO	N-Methyl-2-pyrrolidone	475	721.8		311	9
C ₅ H ₁₀	1-Pentene	303.11	464.8	3.56	298.4	6
C ₅ H ₁₀	cis-2-Pentene	310.08	475	3.69		6
C ₅ H ₁₀	trans-2-Pentene	309.49	471	3.52		9
C ₅ H ₁₀	2-Methyl-1-butene	304.4	470	3.8		9
C ₅ H ₁₀	3-Methyl-1-butene	293.3	452.7	3.53	304.9	6
C ₅ H ₁₀	2-Methyl-2-butene	311.71	470	3.42		6
C ₅ H ₁₀	Cyclopentane	322.5	511.7	4.51	259	5
C ₅ H ₁₀ O	Cyclopentanol	413.57	619.5	4.9		4
C ₅ H ₁₀ O	Allyl ethyl ether	340.8	518			7
C ₅ H ₁₀ O	Pentanal	376	567	3.97	313	7
C ₅ H ₁₀ O	2-Pentanone [Methyl propyl ketone]	375.41	561.1	3.683	321	7
C ₅ H ₁₀ O	3-Pentanone [Diethyl ketone]	374.9	561.4	3.729	331	7
C ₅ H ₁₀ O	3-Methyl-2-butanone	367.48	553.0	3.80	308	7
C ₅ H ₁₀ O	Tetrahydropyran	361	572	4.77	263	7
C ₅ H ₁₀ O	2-Methyltetrahydrofuran	351	537	3.76	267	7
C ₅ H ₁₀ O ₂	Pentanoic acid	459.3	637.2	3.63	346	7
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid	449.7	629	3.40		7
C ₅ H ₁₀ O ₂	Isobutyl formate	371.4	551	3.88	355	7

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₅ H ₁₀ O ₂	Propyl acetate	374.69	549.7	3.36	345	7
C ₅ H ₁₀ O ₂	Isopropyl acetate	361.8	531.0	3.31	344	7
C ₅ H ₁₀ O ₂	Ethyl propanoate	372.3	546.7	3.45	342	7
C ₅ H ₁₀ O ₂	Methyl butanoate	376.0	554.5	3.47	340	7
C ₅ H ₁₀ O ₂	Methyl isobutanoate	365.7	540.7	3.43	339	7
C ₅ H ₁₀ O ₃	2-Methoxyethyl acetate	416	630.0			7
C ₅ H ₁₁ Cl	1-Chloropentane	381.6	571.2			13
C ₅ H ₁₁ Cl	2-Chloro-2-methylbutane	358.8	509.1			13
C ₅ H ₁₁ N	Piperidine	379.37	594	4.94	288	10
C ₅ H ₁₂	Pentane	309.21	469.7	3.370	311	2
C ₅ H ₁₂	Isopentane	301.03	460.4	3.38	306	5
C ₅ H ₁₂	Neopentane	282.63	433.8	3.196	307	5
C ₅ H ₁₂ O	1-Pentanol	411.13	588.1	3.897	326	4
C ₅ H ₁₂ O	2-Pentanol	392.5	560.3	3.675	329	4
C ₅ H ₁₂ O	3-Pentanol	389.40	559.6		325	4
C ₅ H ₁₂ O	2-Methyl-1-butanol	400.7	575.4	3.94		4
C ₅ H ₁₂ O	3-Methyl-1-butanol	404.3	577.2	3.93		4
C ₅ H ₁₂ O	2-Methyl-2-butanol	375.6	543.7	3.71		4
C ₅ H ₁₂ O	3-Methyl-2-butanol	386.1	556.1	3.87		4
C ₅ H ₁₂ O	Butyl methyl ether	343.31	512.7	3.37	329	7
C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether	328.2	497.1	3.430		7
C ₅ H ₁₂ O	Ethyl propyl ether	336.36	500.2	3.370	339	7
C ₅ H ₁₂ O ₂	2-Propoxyethanol	423.0	615	3.65	364	7
C ₅ H ₁₂ O ₂	Diethoxymethane	361	531.7			7
C ₅ H ₁₂ O ₂	1,2-Dimethoxypropane	369	543.0			7
C ₅ H ₁₂ O ₂	2,2-Dimethoxypropane	356	510			7
C ₅ H ₁₂ O ₃	Diethylene glycol monomethyl ether	466	672	3.67		11,12
C ₅ H ₁₂ S	3-Methyl-1-butanethiol	389	594			8
C ₆ BrF ₅	Bromopentafluorobenzene	410	601	3.0		9
C ₆ ClF ₅	Chloropentafluorobenzene	391.11	570.81	3.238	376	9
C ₆ Cl ₂ F ₄	1,2-Dichloro-3,4,5,6-tetrafluorobenzene	430.9	626	5.32		9
C ₆ Cl ₃ F ₃	1,3,5-Trichloro-2,4,6-trifluorobenzene	471.6	684.8	3.27	448	9
C ₆ F ₆	Hexafluorobenzene	353.41	516.73	3.273	335	9
C ₆ F ₁₀	Perfluorocyclohexene	325.2	461.8			9
C ₆ F ₁₂	Perfluoro-1-hexene	330.2	454.4			9
C ₆ F ₁₂	Perfluorocyclohexane	325.95	457.2	2.43		9
C ₆ F ₁₄	Perfluorohexane	329.8	448.77	1.868	606	9
C ₆ F ₁₄	Perfluoro-2-methylpentane	330.8	455.3	1.923	532	9
C ₆ F ₁₄	Perfluoro-3-methylpentane	331.6	450	1.69		9
C ₆ F ₁₄	Perfluoro-2,3-dimethylbutane	333.0	463	1.87	525	9
C ₆ HF ₅	Pentafluorobenzene	358.89	530.97	3.531	324	9
C ₆ HF ₅ O	Pentafluorophenol	418.8	609	4.0	348	9
C ₆ HF ₁₁	Undecafluorocyclohexane	335.2	477.7			9
C ₆ H ₂ F ₄	1,2,3,4-Tetrafluorobenzene	367.5	550.83	3.791	313	9
C ₆ H ₂ F ₄	1,2,3,5-Tetrafluorobenzene	357.6	535.25	3.747		9
C ₆ H ₂ F ₄	1,2,4,5-Tetrafluorobenzene	363.4	543.35	3.801		9
C ₆ H ₃ ClF ₂	1-Chloro-2,4-difluorobenzene	400	609.6			13
C ₆ H ₃ ClF ₂	1-Chloro-2,5-difluorobenzene	401	612.5			13
C ₆ H ₃ ClF ₂	1-Chloro-3,4-difluorobenzene	400	609.2			13
C ₆ H ₃ ClF ₂	1-Chloro-3,5-difluorobenzene	391.7	592.0			13
C ₆ H ₃ F ₃	1,2,3-Trifluorobenzene	368	560.3			13
C ₆ H ₃ F ₃	1,2,4-Trifluorobenzene	363	551.1			13
C ₆ H ₃ F ₃	1,3,5-Trifluorobenzene	348.7	530.9			13
C ₆ H ₄ BrF	1-Bromo-2-fluorobenzene	427	669.6			13
C ₆ H ₄ BrF	1-Bromo-3-fluorobenzene	423	652.0			13
C ₆ H ₄ BrF	1-Bromo-4-fluorobenzene	424.7	654.8			13
C ₆ H ₄ ClF	1-Chloro-2-fluorobenzene	410.8	633.8			13
C ₆ H ₄ ClF	1-Chloro-3-fluorobenzene	400.8	615.9			13

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₆ H ₄ ClF	1-Chloro-4-fluorobenzene	403	620.1			13
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	446	685.7			13
C ₆ H ₄ F ₂	<i>o</i> -Difluorobenzene	367	566.0			13
C ₆ H ₄ F ₂	<i>m</i> -Difluorobenzene	355.8	548.4			13
C ₆ H ₄ F ₂	<i>p</i> -Difluorobenzene	362	556.9	4.40		9,13
C ₆ H ₅ Br	Bromobenzene	429.21	670	4.52	324	9
C ₆ H ₅ Cl	Chlorobenzene	404.87	633.4	4.52	308	9,13
C ₆ H ₅ F	Fluorobenzene	357.88	560.09	4.551	269	9
C ₆ H ₅ I	Iodobenzene	461.6	721	4.52	351	9
C ₆ H ₆	Benzene	353.24	562.05	4.895	256	3
C ₆ H ₆ O	Phenol	455.02	694.2	5.93		7
C ₆ H ₇ N	Aniline	457.32	699	4.89	287	9
C ₆ H ₇ N	2-Methylpyridine [2-Picoline]	402.53	621.0	4.60	292	10
C ₆ H ₇ N	3-Methylpyridine [3-Picoline]	417.29	645.0	4.65	288	10
C ₆ H ₇ N	4-Methylpyridine [4-Picoline]	418.51	645.7	4.70	292	10
C ₆ H ₁₀	1,5-Hexadiene	332.6	508			6
C ₆ H ₁₀	Cyclohexene	356.13	560.4			6
C ₆ H ₁₀ O	Cyclohexanone	428.58	665	4.6		7
C ₆ H ₁₀ O	2-Methylcyclopentanone	412.7	631			7
C ₆ H ₁₀ O	Mesityl oxide	403	605	4.00	353	7
C ₆ H ₁₀ O ₂	Ethyl <i>trans</i> -2-butenolate	411	599			7
C ₆ H ₁₀ S	Diallyl sulfide	411.8	653			8
C ₆ H ₁₁ Cl	Chlorocyclohexane	415	586			13
C ₆ H ₁₁ N	Hexanenitrile	436.80	633.8	3.30		9
C ₆ H ₁₂	1-Hexene	336.63	504.0	3.21	355.1	6
C ₆ H ₁₂	Cyclohexane	353.88	553.8	4.08	308	5
C ₆ H ₁₂	Methylcyclopentane	345.0	532.7	3.79	318	5
C ₆ H ₁₂ O	Butyl vinyl ether	367	540	3.20	384	7
C ₆ H ₁₂ O	Hexanal	404	592	3.46	378	7
C ₆ H ₁₂ O	2-Hexanone [Butyl methyl ketone]	400.8	587.1	3.30	377	7
C ₆ H ₁₂ O	3-Hexanone [Ethyl propyl ketone]	396.7	583.0	3.320	378	7
C ₆ H ₁₂ O	4-Methyl-2-pentanone [Isobutyl methyl ketone]	389.7	574.6	3.270		7
C ₆ H ₁₂ O	3,3-Dimethyl-2-butanone	379.3	570.9	3.43	382	7
C ₆ H ₁₂ O	Cyclohexanol	433.99	647.1	4.401		11,12
C ₆ H ₁₂ O ₂	Hexanoic acid	478.4	655	3.38	413	7
C ₆ H ₁₂ O ₂	Pentyl formate	403.6	576	3.46	412	7
C ₆ H ₁₂ O ₂	Isopentyl formate	396.7	578			7
C ₆ H ₁₂ O ₂	Butyl acetate	399.3	575.6	3.14		7
C ₆ H ₁₂ O ₂	<i>sec</i> -Butyl acetate	385	571	3.01		7
C ₆ H ₁₂ O ₂	Isobutyl acetate	389.7	561	2.99	401	7
C ₆ H ₁₂ O ₂	Propyl propanoate	395.7	570	3.06		7
C ₆ H ₁₂ O ₂	Ethyl butanoate	394.5	568.8	3.1	415	7
C ₆ H ₁₂ O ₂	Ethyl 2-methylpropanoate	383.3	554	3.1	415	7
C ₆ H ₁₂ O ₂	Methyl pentanoate	400.6	590	3.20	422	7
C ₆ H ₁₂ O ₃	1,2-Propylene glycol monomethyl ether acetate	420	597.8	3.01	432	7
C ₆ H ₁₂ O ₃	2-Ethoxyethyl acetate	429.6	608.0	3.17	443	7,23
C ₆ H ₁₂ O ₃	Paraldehyde	397.5	563			7
C ₆ H ₁₂ S	Cyclohexanethiol	432.0	684		401	8
C ₆ H ₁₃ Cl	1-Chlorohexane	408.3	599			13
C ₆ H ₁₃ Cl	3-Chloro-3-methylpentane	389	528			13
C ₆ H ₁₄	Hexane	341.88	507.6	3.025	368	2
C ₆ H ₁₄	2-Methylpentane	333.41	497.7	3.04	368	5
C ₆ H ₁₄	3-Methylpentane	336.42	504.6	3.12	368	5
C ₆ H ₁₄	2,2-Dimethylbutane	322.88	489.0	3.10	358	5
C ₆ H ₁₄	2,3-Dimethylbutane	331.08	500.0	3.15	361	5
C ₆ H ₁₄ O	2-Methoxy-2-methylbutane	359.3	535	3.20	374	7
C ₆ H ₁₄ O	1-Hexanol	430.8	610.3	3.417	387	4
C ₆ H ₁₄ O	2-Hexanol	413	585.9	3.31	384	4

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₆ H ₁₄ O	3-Hexanol	408	582.4	3.36	383	4
C ₆ H ₁₄ O	2-Methyl-1-pentanol	422	604.4	3.45		4
C ₆ H ₁₄ O	4-Methyl-1-pentanol	425.1	603.5			4
C ₆ H ₁₄ O	2-Methyl-2-pentanol	394.3	559.5			4
C ₆ H ₁₄ O	4-Methyl-2-pentanol	404.8	574.4			4
C ₆ H ₁₄ O	2-Methyl-3-pentanol	399.7	576.0	3.46		4
C ₆ H ₁₄ O	3-Methyl-3-pentanol	395.6	575.6	3.52		4
C ₆ H ₁₄ O	Dipropyl ether	363.23	530.6	3.028		7
C ₆ H ₁₄ O	Diisopropyl ether	341.6	500.3	2.832	386	7
C ₆ H ₁₄ O	<i>tert</i> -Butyl ethyl ether	345.8	509.4	2.934	395	7
C ₆ H ₁₄ O	Methyl pentyl ether	372	546.5	3.042	391	7
C ₆ H ₁₄ O ₂	1-Propoxy-2-propanol	423	605.1	3.051		14
C ₆ H ₁₄ O ₂	2-Butoxyethanol	441.6	634	3.27	424	7
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane [Acetal]	375.40	540	3.22		7
C ₆ H ₁₄ O ₂	1,2-Diethoxyethane [Ethylene glycol diethyl ether]	394.4	542			7
C ₆ H ₁₄ O ₃	Diethylene glycol monoethyl ether [Carbitol]	469	670	3.167		11,12
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether	435	617			7
C ₆ H ₁₄ O ₄	Triethylene glycol	558	780	3.3		7
C ₆ H ₁₅ N	Dipropylamine	382.5	555.8	3.63		9
C ₆ H ₁₅ N	Diisopropylamine	357.1	523.1	3.02		9
C ₆ H ₁₅ N	Triethylamine	362	535.6	3.032	389	9
C ₇ F ₈	Perfluorotoluene	377.7	534.47	2.705	428	9
C ₇ F ₁₄	Perfluoro-1-heptene	354.2	478.2			9
C ₇ F ₁₄	Perfluoromethylcyclohexane	349.5	485.91	2.019	570	9
C ₇ F ₁₆	Perfluoroheptane	355.7	474.8	1.62	664	9
C ₇ HF ₁₅	1 <i>H</i> -Pentadecafluoroheptane	369.2	495.8			9
C ₇ H ₃ F ₅	2,3,4,5,6-Pentafluorotoluene	390.7	566.52	3.126	384	9
C ₇ H ₄ BrF ₃	1-Bromo-2-(trifluoromethyl)benzene	440.7	656.5			13
C ₇ H ₄ BrF ₃	1-Bromo-3-(trifluoromethyl)benzene	424.7	627.1			13
C ₇ H ₄ BrF ₃	1-Bromo-4-(trifluoromethyl)benzene	433	629.8			13
C ₇ H ₅ N	Benzonitrile	464.3	699.4	4.21		9
C ₇ H ₆ F ₂	2,4-Difluorotoluene	390	581.4			13
C ₇ H ₆ F ₂	2,5-Difluorotoluene	391	587.8			13
C ₇ H ₆ F ₂	2,6-Difluorotoluene	385	581.8			13
C ₇ H ₆ F ₂	3,4-Difluorotoluene	385	598.5			13
C ₇ H ₆ O	Benzaldehyde	452.0	695	4.7		7
C ₇ H ₇ F	2-Fluorotoluene	388	591.2			13
C ₇ H ₇ F	3-Fluorotoluene	388	591.8			13
C ₇ H ₇ F	4-Fluorotoluene	389.8	592.1			13
C ₇ H ₈	Toluene	383.78	591.80	4.110	316	3,15
C ₇ H ₈ O	<i>o</i> -Cresol	464.19	697.6	4.17		7
C ₇ H ₈ O	<i>m</i> -Cresol	475.42	705.8	4.36		7
C ₇ H ₈ O	<i>p</i> -Cresol	475.13	704.6	4.07		7
C ₇ H ₈ O	Benzyl alcohol	478.46	715	4.3		9
C ₇ H ₈ O	Anisole [Methoxybenzene]	426.9	646.5	4.24	341	7,11,12
C ₇ H ₉ N	2-Methylaniline	473.5	707	4.37		9
C ₇ H ₉ N	3-Methylaniline	476.5	707	4.28		9
C ₇ H ₉ N	4-Methylaniline	473.6	706	4.58		9
C ₇ H ₉ N	<i>N</i> -Methylaniline	469.4	701	5.20		9
C ₇ H ₉ N	2,3-Dimethylpyridine	434.27	655.4	4.10	356	23
C ₇ H ₉ N	2,4-Dimethylpyridine	431.53	647	3.95	361	23
C ₇ H ₉ N	2,5-Dimethylpyridine	430.13	645	3.85	361	23
C ₇ H ₉ N	2,6-Dimethylpyridine	417.16	624	3.85	361	23
C ₇ H ₉ N	3,4-Dimethylpyridine	452.25	684	4.20	355	23
C ₇ H ₉ N	3,5-Dimethylpyridine	444.99	668	4.05	361	23
C ₇ H ₁₄	1-Heptene	366.79	537.3	2.92	409	6
C ₇ H ₁₄	Cycloheptane	391.6	604.2	3.82	353	5
C ₇ H ₁₄	Methylcyclohexane	374.08	572.1	3.48	369	5

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₇ H ₁₄	Ethylcyclopentane	376.7	569.5	3.40	375	5
C ₇ H ₁₄	1,1-Dimethylcyclopentane	360.7	547	3.45		21
C ₇ H ₁₄	<i>cis</i> -1,2-Dimethylcyclopentane	372.7	565	3.45		21
C ₇ H ₁₄	<i>trans</i> -1,2-Dimethylcyclopentane	365.1	553	3.45		21
C ₇ H ₁₄	<i>cis</i> -1,3-Dimethylcyclopentane	364.0	551	3.45		21
C ₇ H ₁₄	<i>trans</i> -1,3-Dimethylcyclopentane	364.9	553	3.45		21
C ₇ H ₁₄ O	Heptanal	426.0	617	3.16	434	7
C ₇ H ₁₄ O	2-Heptanone [Methyl pentyl ketone]	424.20	611.4	2.97	436	7
C ₇ H ₁₄ O	3-Heptanone [Ethyl butyl ketone]	420	606.6		433	7
C ₇ H ₁₄ O	4-Heptanone	417	602.0		434	7
C ₇ H ₁₄ O	5-Methyl-2-hexanone [Methyl isopentyl ketone]	417	604.1			7
C ₇ H ₁₄ O	2-Methyl-3-hexanone	408	593.3			7
C ₇ H ₁₄ O ₂	Heptanoic acid	495.4	678	3.16		7
C ₇ H ₁₄ O ₂	Pentyl acetate	422.4	599	2.73	470	7,23
C ₇ H ₁₄ O ₂	Isopentyl acetate	415.7	586.1	2.76		7
C ₇ H ₁₄ O ₂	Butyl propanoate	420.0	594.5			7
C ₇ H ₁₄ O ₂	Isobutyl propanoate	410	584			7
C ₇ H ₁₄ O ₂	Propyl butanoate	416.2	593.1	2.72		7
C ₇ H ₁₄ O ₂	Propyl isobutanoate	408.6	579.4			7
C ₇ H ₁₄ O ₂	Ethyl pentanoate	419.3	593.3			7
C ₇ H ₁₄ O ₂	Ethyl 3-methylbutanoate	408.2	582.4			7
C ₇ H ₁₄ O ₃	Ethyl 3-ethoxypropanoate	439	621.0	2.66	458	7
C ₇ H ₁₅ Cl	1-Chloroheptane	433.6	614			13
C ₇ H ₁₆	Heptane	371.6	540.2	2.74	428	2
C ₇ H ₁₆	2-Methylhexane	363.19	530.4	2.74	421	5
C ₇ H ₁₆	3-Methylhexane	365	535.2	2.81	404	5
C ₇ H ₁₆	3-Ethylpentane	366.7	540.6	2.89	416	5
C ₇ H ₁₆	2,2-Dimethylpentane	352.4	520.5	2.77	416	5
C ₇ H ₁₆	2,3-Dimethylpentane	362.93	537.3	2.91	393	5
C ₇ H ₁₆	2,4-Dimethylpentane	353.64	519.8	2.74	418	5
C ₇ H ₁₆	3,3-Dimethylpentane	359.21	536.4	2.95	414	5
C ₇ H ₁₆	2,2,3-Trimethylbutane	354.01	531.1	2.95	398	5
C ₇ H ₁₆ O	2-Ethoxy-2-methylbutane	375	546	2.935	463	7
C ₇ H ₁₆ O	1-Heptanol	449.60	632.6	3.058	435	4
C ₇ H ₁₆ O	2-Heptanol	432	608.3	3.021	442	4
C ₇ H ₁₆ O	3-Heptanol, (<i>S</i>)	430	605.4		434	4
C ₇ H ₁₆ O	4-Heptanol	429	602.6		432	4
C ₇ H ₁₆ O ₂	1-Butoxy-2-propanol	444.7	624.9	2.739		14
C ₇ H ₁₆ O ₂	1- <i>tert</i> -Butoxy-2-methoxyethane		574			7
C ₇ H ₁₆ O ₂	2,2-Diethoxypropane	387	510.7			7
C ₇ H ₁₆ O ₃	Diethylene glycol monopropyl ether	486	680	3.00	489	7
C ₇ H ₂₀ Si ₂	Bis(trimethylsilyl)methane	406	573.9	1.99		8
C ₈ F ₁₆ O	Perfluoro-2-butyltetrahydrofuran	375.8	500.2	1.607	588	9
C ₈ F ₁₈	Perfluorooctane	379.1	502	1.66		9
C ₈ H ₆ S	Benzo[b]thiophene	494	764	4.76	379	8
C ₈ H ₇ N	4-Methylbenzotrile	490.2	723			9
C ₈ H ₇ N	1 <i>H</i> -Indole	526.8	794	4.8	356	10
C ₈ H ₈	Styrene	418	635.2	3.87		15
C ₈ H ₈ O	Acetophenone	475	709.6	4.01	388	7,23
C ₈ H ₈ O ₂	Phenyl acetate	469	685.7	3.59		17
C ₈ H ₈ O ₃	Methyl salicylate	496.1	709			7
C ₈ H ₁₀	Ethylbenzene	409.34	617.15	3.609	374	3,15
C ₈ H ₁₀	<i>o</i> -Xylene	417.7	630.3	3.732	370	3
C ₈ H ₁₀	<i>m</i> -Xylene	412.27	617.0	3.541	375	3
C ₈ H ₁₀	<i>p</i> -Xylene	411.52	616.2	3.511	378	3
C ₈ H ₁₀ O	2-Ethylphenol	477.7	703.0			7
C ₈ H ₁₀ O	3-Ethylphenol	491.6	716.4			7
C ₈ H ₁₀ O	4-Ethylphenol	491.1	716.4			7

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₈ H ₁₀ O	2,3-Xylenol	490.1	722.8			7
C ₈ H ₁₀ O	2,4-Xylenol	484.13	707.6			7
C ₈ H ₁₀ O	2,5-Xylenol	484.3	706.9			7
C ₈ H ₁₀ O	2,6-Xylenol	474.22	701.0			7
C ₈ H ₁₀ O	3,4-Xylenol	500	729.8			7
C ₈ H ₁₀ O	3,5-Xylenol	494.89	715.6			7
C ₈ H ₁₀ O	α -Methylbenzenemethanol	478	699	3.77		14
C ₈ H ₁₀ O	Ethoxybenzene	442.96	647	3.4		7
C ₈ H ₁₀ O	2-Methylanisole	444	662.0			7
C ₈ H ₁₀ O	3-Methylanisole	448.7	665.3			7
C ₈ H ₁₀ O	4-Methylanisole	448.7	666			7
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline	476.2	698			9
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	467.30	687	3.63		9
C ₈ H ₁₄ O ₄	Diethyl succinate	490.9	663			7
C ₈ H ₁₅ N	Octanenitrile	478.40	674.4	2.85		9
C ₈ H ₁₆	1-Octene	394.44	567.0	2.68	468	6
C ₈ H ₁₆	Cyclooctane	422	647.2	3.56	410	5
C ₈ H ₁₆	Ethylcyclohexane	405.1	609	3.04		21
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane	403.0	606	2.95		21
C ₈ H ₁₆	<i>trans</i> -1,2-Dimethylcyclohexane	396.7	596	2.94		21
C ₈ H ₁₆	<i>cis</i> -1,3-Dimethylcyclohexane	393.3	591	2.94		21
C ₈ H ₁₆	<i>trans</i> -1,3-Dimethylcyclohexane	397.7	598	2.94		21
C ₈ H ₁₆	<i>trans</i> -1,4-Dimethylcyclohexane	392.6	587.7			5
C ₈ H ₁₆ O	Octanal	444	639	2.96	488	7
C ₈ H ₁₆ O	2-Octanone [Hexyl methyl ketone]	445.7	632.7		497	7
C ₈ H ₁₆ O	3-Octanone [Ethyl amyl ketone]	440.7	627.7		497	7
C ₈ H ₁₆ O	4-Octanone [Butyl propyl ketone]	436	623.8		497	7
C ₈ H ₁₆ O	2-Methyl-3-heptanone [Butyl isopropyl ketone]	431	614.9			7
C ₈ H ₁₆ O	5-Methyl-3-heptanone	434	619.0			7
C ₈ H ₁₆ O ₂	Octanoic acid	512	693	2.87	519	7
C ₈ H ₁₆ O ₂	2-Ethylhexanoic acid	501	674	2.78	528	7
C ₈ H ₁₆ O ₂	Hexyl acetate	444.7	618.4			7
C ₈ H ₁₆ O ₂	Isopentyl propanoate	433.4	611			7
C ₈ H ₁₆ O ₂	Butyl butanoate	439	612.1			7
C ₈ H ₁₆ O ₂	Isobutyl butanoate	430.1	611			7
C ₈ H ₁₆ O ₂	Isobutyl isobutanoate	421.8	602			7
C ₈ H ₁₆ O ₂	Propyl 3-methylbutanoate	429.1	609			7
C ₈ H ₁₆ O ₂	Ethyl hexanoate	440	615.2			7
C ₈ H ₁₆ O ₂	Methyl heptanoate	447	628			7
C ₈ H ₁₆ O ₃	2-Butoxyethyl acetate	465	640.7	2.694	549	7
C ₈ H ₁₆ O ₄	Diethylene glycol monoethyl ether acetate	491.7	673.5	2.59		17
C ₈ H ₁₇ Cl	1-Chlorooctane	456.7	643			13
C ₈ H ₁₈	Octane	398.82	568.7	2.49	492	2
C ₈ H ₁₈	2-Methylheptane	390.81	559.7	2.50	488	5
C ₈ H ₁₈	3-Methylheptane	392.1	563.6	2.55	464	5
C ₈ H ₁₈	4-Methylheptane	390.87	561.7	2.54	476	5
C ₈ H ₁₈	3-Ethylhexane	391.8	565.5	2.61	455	5
C ₈ H ₁₈	2,2-Dimethylhexane	380.01	549.8	2.53	478	5
C ₈ H ₁₈	2,3-Dimethylhexane	388.77	563.5	2.63	468	5
C ₈ H ₁₈	2,4-Dimethylhexane	382.7	553.5	2.56	472	5
C ₈ H ₁₈	2,5-Dimethylhexane	382.27	550.0	2.49	482	5
C ₈ H ₁₈	3,3-Dimethylhexane	385.12	562.0	2.65	443	5
C ₈ H ₁₈	3,4-Dimethylhexane	390.88	568.8	2.69	466	5
C ₈ H ₁₈	3-Ethyl-2-methylpentane	388.81	567.1	2.70	442	5
C ₈ H ₁₈	3-Ethyl-3-methylpentane	391.42	576.5	2.81	455	5
C ₈ H ₁₈	2,2,3-Trimethylpentane	383	563.5	2.73	436	5
C ₈ H ₁₈	2,2,4-Trimethylpentane [Isooctane]	372.37	543.8	2.57	468	5
C ₈ H ₁₈	2,3,3-Trimethylpentane	388.0	573.5	2.82	455	5

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₈ H ₁₈	2,3,4-Trimethylpentane	386.7	566.4	2.73	460	5
C ₈ H ₁₈	2,2,3,3-Tetramethylbutane	379.60	567.8	2.87	461	9
C ₈ H ₁₈ O	1-Octanol	468.31	652.5	2.777	497	4
C ₈ H ₁₈ O	2-Octanol	452.5	629.6	2.754	519	4
C ₈ H ₁₈ O	3-Octanol	444	628.5		515	4
C ₈ H ₁₈ O	4-Octanol	449.5	625.1		515	4
C ₈ H ₁₈ O	4-Methyl-3-heptanol	443	623.5			4
C ₈ H ₁₈ O	5-Methyl-3-heptanol	445	621.2			4
C ₈ H ₁₈ O	2-Ethyl-1-hexanol	457.8	640.6	2.8		4
C ₈ H ₁₈ O	Dibutyl ether	413.43	584	3.0		7
C ₈ H ₁₈ O	Di- <i>tert</i> -butyl ether	380.38	550			9
C ₈ H ₁₈ O ₂	1- <i>tert</i> -Butoxy-2-ethoxyethane	421.2	585			7
C ₈ H ₁₈ O ₃	Diethylene glycol monobutyl ether	504	692	2.79		7
C ₈ H ₁₈ O ₃	Diethylene glycol diethyl ether	461	612			7
C ₈ H ₁₈ O ₅	Tetraethylene glycol	601	800	3.2		7
C ₈ H ₁₈ S	1-Octanethiol	472.3	667		504	8
C ₈ H ₁₈ S	Dibutyl sulfide	458	650	2.48		8
C ₈ H ₁₉ N	Dibutylamine	432.8	607.5	3.11		9
C ₈ H ₁₉ N	Diisobutylamine	412.8	584.4	3.20		9
C ₈ H ₂₀ Si	Tetraethylsilane	427.9	605	2.50	587	8
C ₉ F ₂₀	Perfluorononane	398.5	524	1.56		9
C ₉ H ₇ N	Quinoline	510.31	782	4.86	371	10
C ₉ H ₇ N	Isoquinoline	516.37	803	5.10	374	10
C ₉ H ₁₀	Indan	451.12	684.9	3.95		3
C ₉ H ₁₂	Propylbenzene	432.39	638.35	3.200	440	3
C ₉ H ₁₂	Isopropylbenzene [Cumene]	425.56	631.0	3.209		3
C ₉ H ₁₂	2-Ethyltoluene	438.4	651	3.38		21
C ₉ H ₁₂	3-Ethyltoluene	434.5	637	3.25		21
C ₉ H ₁₂	4-Ethyltoluene	435	640.2	3.23		3
C ₉ H ₁₂	1,2,3-Trimethylbenzene	449.27	664.5	3.454		3
C ₉ H ₁₂	1,2,4-Trimethylbenzene	442.53	649.1	3.232		3
C ₉ H ₁₂	1,3,5-Trimethylbenzene [Mesitylene]	437.89	637.3	3.127		3
C ₉ H ₁₂ O	2-Methoxy-1,4-dimethylbenzene	467	677.3			7
C ₉ H ₁₂ O	1-Methoxy-2,4-dimethylbenzene	465	682			7
C ₉ H ₁₃ N	2-Methyl- <i>N,N</i> -dimethylaniline	467.3	668	3.12		9
C ₉ H ₁₈	1-Nonene	420.1	594.0		526	6
C ₉ H ₁₈	Cyclononane	451.6	682	3.34		21
C ₉ H ₁₈	1 α ,3 α ,5 β -1,3,5-Trimethylcyclohexane	413.7	602.2			5
C ₉ H ₁₈ O	Nonanal	464	659	2.68	543	7
C ₉ H ₁₈ O	2-Nonanone [Heptyl methyl ketone]	468.5	652.2	2.48	560	7,11,12
C ₉ H ₁₈ O	3-Nonanone [Ethyl hexyl ketone]	463	648.1		560	7
C ₉ H ₁₈ O	4-Nonanone [Pentyl propyl ketone]	460.7	643.7		560	7
C ₉ H ₁₈ O	5-Nonanone [Dibutyl ketone]	461.60	641.4	2.32	560	7
C ₉ H ₁₈ O ₂	Nonanoic acid	527.7	712	2.35		7
C ₉ H ₁₈ O ₂	Isopentyl butanoate	452	619			7
C ₉ H ₁₈ O ₂	Isobutyl 3-methylbutanoate	441.7	621			7
C ₉ H ₁₈ O ₂	Ethyl heptanoate	460	634			7
C ₉ H ₂₀	Nonane	423.97	594.6	2.29	555	2
C ₉ H ₂₀	2-Methyloctane	416.4	582.8	2.31		5
C ₉ H ₂₀	2,2-Dimethylheptane	405.9	576.7	2.35		5
C ₉ H ₂₀	2,2,5-Trimethylhexane	397.24	569.8			5
C ₉ H ₂₀	2,2,3,3-Tetramethylpentane	413.4	607.5	2.74		5
C ₉ H ₂₀	2,2,3,4-Tetramethylpentane	406.2	592.6	2.60		5
C ₉ H ₂₀	2,2,4,4-Tetramethylpentane	395.44	574.6	2.49		5
C ₉ H ₂₀	2,3,3,4-Tetramethylpentane	414.7	607.5	2.72		5
C ₉ H ₂₀ O	1-Nonanol	486.52	670.7	2.528	572	4
C ₉ H ₂₀ O	2-Nonanol	466.7	649.6	2.53	575	4
C ₉ H ₂₀ O	3-Nonanol	468	648.0		577	4

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₉ H ₂₀ O	4-Nonanol	465.7	645.1		575	4
C ₁₀ F ₈	Perfluoronaphthalene	482	673.1			9
C ₁₀ F ₁₈	Perfluorodecalin	415	566	1.52		9
C ₁₀ F ₂₂	Perfluorodecane	417.4	542	1.45		9
C ₁₀ H ₈	Naphthalene	491.1	748.4	4.05	407	3
C ₁₀ H ₆ N	1-Naphthylamine	573.9	850	5.0	438	10
C ₁₀ H ₉ N	2-Naphthylamine	579.4	850	4.9	438	10
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene [Tetralin]	480.8	720	3.65	408	4
C ₁₀ H ₁₄	Butylbenzene	456.46	660.5	2.89	497	3
C ₁₀ H ₁₄	Isobutylbenzene	445.94	650	3.05		4
C ₁₀ H ₁₄	1-Isopropyl-4-methylbenzene [<i>p</i> -Cymene]	450.3	652	2.8		3
C ₁₀ H ₁₄	<i>p</i> -Diethylbenzene	456.9	657.9	2.803		3
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene [Durene]	470.0	676	2.9		3
C ₁₀ H ₁₄ O	Thymol	505.7	698			7
C ₁₀ H ₁₆	<i>d</i> -Limonene	451	653		470	6
C ₁₀ H ₁₆	α -Pinene	429.4	644		454	6
C ₁₀ H ₁₆	3-Carene, (+)	444	658		487	6
C ₁₀ H ₁₈	1,3-Decadiene	442	615			9
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	469.0	702.3	3.20		9
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	460.5	687.1			9
C ₁₀ H ₂₀	1-Decene	443.7	617	2.22	584	6
C ₁₀ H ₂₀ O	Decanal	481.7	674	2.60	599	7
C ₁₀ H ₂₀ O	2-Decanone [Methyl octyl ketone]	483	671.8		625	7
C ₁₀ H ₂₀ O	3-Decanone [Ethyl heptyl ketone]	476	667.6		628	7
C ₁₀ H ₂₀ O	4-Decanone [Hexyl propyl ketone]	479.7	662.9		628	7
C ₁₀ H ₂₀ O	5-Decanone [Butyl pentyl ketone]	477	661.0		628	7
C ₁₀ H ₂₀ O	5-Methyl-2-isopropylcyclohexanol [Menthol]	489	694			9
C ₁₀ H ₂₀ O ₂	Decanoic acid [Capric acid]	541.9	722	2.10	638	7
C ₁₀ H ₂₀ O ₂	2-Ethylhexyl acetate	472	642	2.09	681	7
C ₁₀ H ₂₀ O ₂	Ethyl octanoate	481.7	649			7
C ₁₀ H ₂₀ O ₄	Diethylene glycol monobutyl ether acetate	518	693.9	2.15		17
C ₁₀ H ₂₂	Decane	447.30	617.7	2.11	624	2
C ₁₀ H ₂₂	3,3,5-Trimethylheptane	428.9	609.5	2.32		5
C ₁₀ H ₂₂	2,2,3,3-Tetramethylhexane	433.5	623.0	2.51		5
C ₁₀ H ₂₂	2,2,5,5-Tetramethylhexane	410.6	581.4	2.19		5
C ₁₀ H ₂₂ O	1-Decanol	504.3	687.3	2.315	649	4
C ₁₀ H ₂₂ O	2-Decanol	484	668.6		646	4
C ₁₀ H ₂₂ O	3-Decanol	486	666.1		643	4
C ₁₀ H ₂₂ O	4-Decanol	483.7	663.7		643	4
C ₁₀ H ₂₂ O	5-Decanol	474	663.2		646	4
C ₁₀ H ₂₂ S	Diisopentyl sulfide	484	664			8
C ₁₁ H ₁₀	1-Methylnaphthalene	517.9	772	3.60		3
C ₁₁ H ₁₀	2-Methylnaphthalene	514.3	761			3
C ₁₁ H ₁₆	Pentylbenzene	478.6	675	2.58		16
C ₁₁ H ₂₂ O	2-Undecanone	504.7	688		692	7
C ₁₁ H ₂₂ O	3-Undecanone	500	685		692	7
C ₁₁ H ₂₂ O	4-Undecanone		681		692	7
C ₁₁ H ₂₂ O	5-Undecanone	500	679		692	7
C ₁₁ H ₂₂ O	6-Undecanone	501	678		692	7
C ₁₁ H ₂₂ O ₂	Ethyl nonanoate	500.2	664			7
C ₁₁ H ₂₄	Undecane	469.1	639	1.98	689	2
C ₁₁ H ₂₄ O	1-Undecanol	518	703.6	2.147	718	4
C ₁₂ H ₈	Acenaphthylene	553	792	3.20		21
C ₁₂ H ₈ O	Dibenzofuran	560	824	3.64	495	7
C ₁₂ H ₈ S	Dibenzothiophene	605.7	897	3.86	512	8
C ₁₂ H ₉ N	Carbazole	627.84	901.8	3.13	454	10
C ₁₂ H ₁₀	Biphenyl	529.3	773	3.38	497	3
C ₁₂ H ₁₀ O	Diphenyl ether	531.2	767			7

CRITICAL CONSTANTS (continued)

Molecular formula	Name	T_b/K	T_c/K	P_c/MPa	$V_c/cm^3 mol^{-1}$	Ref.
C ₁₂ H ₁₂	2,7-Dimethylnaphthalene	538	775	3.23	601	3
C ₁₂ H ₁₈	Hexylbenzene	499.3	695	2.35		16
C ₁₂ H ₁₈	Hexamethylbenzene	536.6	758			3
C ₁₂ H ₂₀ O	[1,1'-Bicyclohexyl]-2-one	537	787			7
C ₁₂ H ₂₄	1-Dodecene	487.0	658	1.93		6
C ₁₂ H ₂₄ O	2-Dodecanone	519.7	702		752	7
C ₁₂ H ₂₄ O	3-Dodecanone		701		752	7
C ₁₂ H ₂₄ O	4-Dodecanone		697		759	7
C ₁₂ H ₂₄ O	5-Dodecanone		695		759	7
C ₁₂ H ₂₄ O	6-Dodecanone		694		762	7
C ₁₂ H ₂₆	Dodecane	489.47	658	1.82	754	2
C ₁₂ H ₂₆ O	1-Dodecanol	533	719.4	1.994		4
C ₁₃ H ₉ N	Acridine	618.01	891.1	3.21	548	10
C ₁₃ H ₉ N	Phenanthridine	622.1	895	3.6	548	10
C ₁₃ H ₁₀ O	Benzophenone	578.6	830	3.35	568	7
C ₁₃ H ₁₁ N	9-Methyl-9H-carbazole	616.79	890	3.38	572	10
C ₁₃ H ₁₂	Diphenylmethane	538.2	760	2.71	563	3
C ₁₃ H ₂₀	Heptylbenzene	513	708	2.14		16
C ₁₃ H ₂₆ O	2-Tridecanone	536	717		820	7
C ₁₃ H ₂₆ O	3-Tridecanone		716		823	7
C ₁₃ H ₂₆ O	4-Tridecanone		712		823	7
C ₁₃ H ₂₆ O	5-Tridecanone		710		826	7
C ₁₃ H ₂₆ O	6-Tridecanone		709		826	7
C ₁₃ H ₂₆ O	7-Tridecanone	534	708		830	7
C ₁₃ H ₂₆ O ₂	Methyl dodecanoate	540	712			7
C ₁₃ H ₂₈	Tridecane	508.62	675	1.68	823	2
C ₁₃ H ₂₈ O	1-Tridecanol	547	734	1.935		9
C ₁₄ H ₁₀	Anthracene	613.1	869.3		554	9
C ₁₄ H ₁₀	Phenanthrene	613	869			4
C ₁₄ H ₂₂	Octylbenzene	537	725	1.98		16
C ₁₄ H ₂₈ O	2-Tetradecanone		728		896	7
C ₁₄ H ₂₈ O	3-Tetradecanone		727		896	7
C ₁₄ H ₂₈ O	4-Tetradecanone		725		900	7
C ₁₄ H ₂₈ O	7-Tetradecanone		723		904	7
C ₁₄ H ₃₀	Tetradecane	526.73	693	1.57	894	2
C ₁₄ H ₃₀ O	1-Tetradecanol	560	747	1.81		9
C ₁₅ H ₃₂	Pentadecane	543.8	708	1.48	966	2
C ₁₆ H ₂₆	Decylbenzene	566	752	1.72		16
C ₁₆ H ₃₄	Hexadecane	560.01	723	1.40	1034	2
C ₁₆ H ₃₄	2,2,4,4,6,8,8-Heptamethylnonane	519.5	692			5
C ₁₆ H ₃₄ O	1-Hexadecanol	585	770	1.61		9
C ₁₇ H ₂₈	Undecylbenzene	589	763	1.64		16
C ₁₇ H ₃₆	Heptadecane	575.2	736	1.34	1103	2
C ₁₇ H ₃₆ O	1-Heptadecanol	597	780	1.50		9
C ₁₈ H ₁₄	<i>o</i> -Terphenyl	605	857	2.99	731	3
C ₁₈ H ₁₄	<i>m</i> -Terphenyl	636	883	2.48	724	3
C ₁₈ H ₁₄	<i>p</i> -Terphenyl	649	908	2.99	729	3
C ₁₈ H ₃₈	Octadecane	589.5	747	1.29	1189	2
C ₁₈ H ₃₈ O	1-Octadecanol	608	790	1.44		9
C ₁₉ H ₃₂	Tridecylbenzene	619	790	1.54		16
C ₁₉ H ₄₀	Nonadecane	603.1	755	1.16		3
C ₂₀ H ₄₂	Eicosane	616	768	1.07		3
C ₂₀ H ₄₂ O	1-Eicosanol [Arachic alcohol]	629	809	1.30		9
C ₂₁ H ₄₄	Heneicosane	629.7	778	1.03		2
C ₂₂ H ₄₆	Docosane	641.8	786	0.98		2
C ₂₃ H ₄₈	Tricosane	653	790	0.92		2
C ₂₄ H ₅₀	Tetracosane	664.5	800	0.87		2
C ₃₀ H ₅₀	Squalene	694.5	795.9	0.59		15

SUBLIMATION PRESSURE OF SOLIDS

This table gives the sublimation (vapor) pressure of some representative solids as a function of temperature. Entries include simple inorganic and organic substances in their solid phase below room temperature, as well as polycyclic organic compounds which show measurable sublimation pressure only at elevated temperatures. Substances are listed by molecular formula in the Hill order. Values marked by * represent the solid-liquid-gas triple point. Note that some pressure values are in pascals (Pa) and others are in kilopascals (kPa). For conversion, 1 kPa = 7.506 mmHg = 0.0098692 atm.

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Ar	T/K	55	60	65	70	75	80	83.81*	
Argon	p/kPa	0.2	0.8	2.8	7.7	18.7	40.7	68.8*	
BrH	T/K	135	140	150	160	170	180	185.1*	
Hydrogen bromide	p/kPa	0.1	0.3	1.1	3.3	8.7	20.1	27.4*	
Br ₂	T/K	170	180	190	200	210	220	230	240*
Bromine	p/Pa	0.069	0.416	2.04	8.45	30.3	96.0	273	710*
ClH	T/K	120	130	140	150	155	159.0*		
Hydrogen chloride	p/kPa	0.1	0.5	1.9	5.8	9.5	13.5*		
Cl ₂	T/K	120	130	140	150	160	170*		
Chlorine	p/Pa	0.144	1.52	11.2	63.1	283	1054*		
F ₄ Si	T/K	130	140	150	160	170	175	180	186.3*
Tetrafluorosilane	p/kPa	0.2	0.9	3.9	14.0	43.8	74.2	122.4	220.8*
F ₆ S	T/K	150	165	180	190	200	210	220	223.1*
Sulfur hexafluoride	p/kPa	0.4	2.6	11.3	25.9	54.5	106.1	195.1	232.7*
HI	T/K	160	170	180	190	200	210	220	222.4*
Hydrogen iodide	p/kPa	0.2	0.8	2.2	5.3	11.7	23.6	44.1	49.3*
H ₂ O	T/K	190	210	225	240	250	260	270	273.16*
Water	p/Pa	0.032	0.702	4.942	27.28	76.04	195.8	470.1	611.66*
H ₂ S	T/K	140	150	160	165	170	175	180	187.6*
Hydrogen sulfide	p/kPa	0.2	0.6	1.9	3.2	5.2	8.3	12.7	22.7*
H ₃ N	T/K	160	170	180	190	195	195.4*		
Ammonia	p/kPa	0.1	0.4	1.2	3.5	5.8	6.12*		
I ₂	T/K	240	250	260	270	280	290	300	310*
Iodine	p/Pa	0.081	0.297	0.971	2.89	7.92	20.1	47.9	107*
Kr	T/K	80	90	95	100	105	110	115.8*	
Krypton	p/kPa	0.4	2.7	6.0	12.1	22.8	40.4	73.1*	
NO	T/K	85	90	95	100	105	109.5*		
Nitric oxide	p/kPa	0.1	0.4	1.3	3.8	10.0	21.9*		
Xe	T/K	110	120	130	140	150	155	160	161.4*
Xenon	p/kPa	0.3	1.5	4.9	14.0	34.2	51.1	74.2	81.7*
CHN	T/K	200	210	220	230	240	250	255	259.83*
Hydrogen cyanide	p/kPa	0.2	0.4	1.0	2.2	4.8	9.7	13.6	18.62*
CH ₄	T/K	65	70	75	80	85	90.69*		
Methane	p/kPa	0.1	0.3	0.8	2.1	4.9	11.70*		

SUBLIMATION PRESSURE OF SOLIDS (continued)

CO Carbon monoxide	<i>T</i> /K <i>p</i> /kPa	50 0.1	55 0.6	60 2.6	65 8.2	68.13* 15.4*			
CO ₂ Carbon dioxide	<i>T</i> /K <i>p</i> /kPa	130 0.032	140 0.187	155 1.674	170 9.987	185 44.02	194.7 101.3	205 227.1	216.58* 518.0*
C ₂ Cl ₆ Hexachloroethane	<i>T</i> /K <i>p</i> /Pa	275 0.004	300 0.056	325 0.383	350 1.62	375 5.30	400 14.8	425 36.4	459.9* 107.4*
C ₂ H ₂ Acetylene	<i>T</i> /K <i>p</i> /kPa	130 0.2	140 0.7	150 2.6	160 7.8	170 20.6	180 49.0	190 106.3	192.4* 126.0*
C ₂ H ₄ O ₂ Acetic acid	<i>T</i> /K <i>p</i> /kPa	250 0.092	260 0.199	270 0.406	280 0.79	289.7* 1.29*			
C ₅ H ₁₂ Neopentane	<i>T</i> /K <i>p</i> /kPa	200 0.7	210 1.6	220 3.6	230 7.3	240 13.9	250 24.8	255 32.4	256.58* 35.8*
C ₆ H ₆ Cl ₆ 1,2,3,4,5,6-Hexa- chlorocyclohexane (Lindane)	<i>T</i> /K <i>p</i> /Pa	300 0.01	320 0.13	330 0.39	340 1.04	350 2.66	360 6.42	370 14.8	380 32.7
C ₆ H ₆ O ₂ Resorcinol	<i>T</i> /K <i>p</i> /Pa	330 1.03	340 2.78	350 7.09	360 17.2	370 39.6	380 87.6		
C ₆ H ₆ O ₂ <i>p</i> -Hydroquinone	<i>T</i> /K <i>p</i> /Pa	350 1.20	360 3.18	370 7.96	380 19.0	390 43.4	400 95.1		
C ₁₀ H ₈ Naphthalene	<i>T</i> /K <i>p</i> /Pa	250 0.036	270 0.514	280 1.662	290 4.918	300 13.43	310 34.15	330 182.9	353.43* 999.6*
C ₁₂ H ₈ N ₂ Phenazine	<i>T</i> /K <i>p</i> /Pa	290 0.0013	300 0.0046	310 0.0150	320 0.0448				
C ₁₂ H ₈ O Dibenzofuran	<i>T</i> /K <i>p</i> /Pa	300 0.408	310 1.21	320 3.35	330 8.71	340 21.4	350 50.0		
C ₁₂ H ₉ N Carbazole	<i>T</i> /K <i>p</i> /Pa	350 0.086	355 0.140	360 0.245					
C ₁₃ H ₇ NO ₂ Benz[<i>g</i>]isoquinoline- 5,10-dione	<i>T</i> /K <i>p</i> /Pa	330 0.006	340 0.018	350 0.053	360 0.148	370 0.394	380 0.994		
C ₁₃ H ₈ O 1H-Phenalen-1-one	<i>T</i> /K <i>p</i> /Pa	330 0.040	340 0.113	350 0.302					
C ₁₃ H ₈ O ₂ 3-Hydroxy-1H- phenalen-1-one	<i>T</i> /K <i>p</i> /Pa	400 0.006	410 0.018	420 0.053	430 0.144				
C ₁₃ H ₉ N Acridine	<i>T</i> /K <i>p</i> /Pa	290 0.0024	300 0.0085	310 0.0278	320 0.0845				
C ₁₃ H ₉ N Phenanthridine	<i>T</i> /K <i>p</i> /Pa	310 0.020	320 0.066	330 0.206	340 0.603				

SUBLIMATION PRESSURE OF SOLIDS (continued)

$C_{14}H_{10}$ Anthracene	<i>T</i> /K <i>p</i> /Pa	320 0.014	330 0.043	340 0.125	350 0.342	360 1.01	370 2.38	380 5.35	390 11.5
$C_{14}H_{10}$ Phenanthrene	<i>T</i> /K <i>p</i> /Pa	300 0.025	310 0.085	320 0.270	330 0.796	340 2.02	350 4.89	360 11.2	
$C_{16}H_{10}$ Pyrene	<i>T</i> /K <i>p</i> /Pa	320 0.008	330 0.024	340 0.073	350 0.208	360 0.556	370 1.32	380 2.86	390 6.30
$C_{16}H_{10}O$ 1-Pyrenol	<i>T</i> /K <i>p</i> /Pa	360 0.005	370 0.016	380 0.047	390 0.135	400 0.364			
$C_{16}H_{12}S$ Benzo[b]naphtho- (2,1-d)thiophene	<i>T</i> /K <i>p</i> /Pa	330 0.001	340 0.004	350 0.012	360 0.036	370 0.098	380 0.255	390 0.631	
$C_{17}H_{12}$ 11 <i>H</i> -Benzo[b]fluorene	<i>T</i> /K <i>p</i> /Pa	340 0.003	350 0.009	360 0.029	370 0.085	380 0.235	390 0.619	400 1.55	
$C_{18}H_{10}O_4$ 6,11-Dihydroxy-5,12- naphthacenedione	<i>T</i> /K <i>p</i> /Pa	420 0.008	430 0.022	440 0.055	450 0.131				
$C_{18}H_{12}$ Chrysene	<i>T</i> /K <i>p</i> /Pa	390 0.087	400 0.221	410 0.539	420 1.26				
$C_{18}H_{12}$ Naphthacene	<i>T</i> /K <i>p</i> /Pa	390 0.005	400 0.014	410 0.035	420 0.084	430 0.194	440 0.432	450 0.928	460 1.929
$C_{20}H_{12}$ Perylene	<i>T</i> /K <i>p</i> /Pa	390 0.006	400 0.015	410 0.040	420 0.102	430 0.246			
$C_{22}H_{14}$ Pentacene	<i>T</i> /K <i>p</i> /Pa	450 0.002	460 0.006	470 0.013	480 0.031	490 0.069			
$C_{24}H_{12}$ Coronene	<i>T</i> /K <i>p</i> /Pa	430 0.004	440 0.010	450 0.021	460 0.046	470 0.097	480 0.197	490 0.389	500 0.747

VAPOR PRESSURE

This table gives vapor pressure data for about 1800 inorganic and organic substances. In order to accommodate elements and compounds ranging from refractory to highly volatile in a single table, the temperature at which the vapor pressure reaches specified pressure values is listed. The pressure values run in decade steps from 1 Pa (about 7.5 $\mu\text{m Hg}$) to 100 kPa (about 750 mm Hg). All temperatures are given in $^{\circ}\text{C}$.

The data used in preparing the table came from a large number of sources; the main references used for each substance are indicated in the last column. Since the data were refit in most cases, values appearing in this table may not be identical with values in the source cited. The temperature entry in the 100 kPa column is close to, but not identical with, the normal boiling point (which is defined as the temperature at which the vapor pressure reaches 101.325 kPa). Although some temperatures are quoted to 0.1 $^{\circ}\text{C}$, uncertainties of several degrees should generally be assumed. Values followed by an "e" were obtained by extrapolating (usually with an Antoine equation) beyond the region for which experimental measurements were available and are thus subject to even greater uncertainty.

Compounds are listed by molecular formula following the Hill convention. Substances not containing carbon are listed first, followed by those that contain carbon. To locate an organic compound by name or CAS Registry Number when the molecular formula is not known, use the table *Physical Constants of Organic Compounds* in Section 3 and its indexes to determine the molecular formula. The indexes to *Physical Constants of Inorganic Compounds* in Section 4 can be used in a similar way.

More extensive and detailed vapor pressure data on selected important substances appear in other tables in this section of the *Handbook*. These substances are flagged by a symbol following the name as follows:

- * See *Vapor Pressure of Fluids below 300 K*
- ** See *IUPAC Recommended Data for Vapor Pressure Calibration*
- *** See *Vapor Pressure of Ice and Vapor Pressure of Water from 0 to 370 $^{\circ}\text{C}$*

The following notations appear after individual temperature entries:

- s — Indicates the substance is a solid at this temperature.
- e — Indicates an extrapolation beyond the region where experimental measurements exist.
- i — Indicates the value was calculated from ideal gas thermodynamic functions, such as those in the *JANAF Thermochemical Tables* (see Reference 8).

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Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
Substances not containing carbon:								
Ag	Silver	1010	1140	1302	1509	1782	2160	2
AgBr	Silver(I) bromide	569 i	656 i	765 i	905 i	1093 i	1359 i	9
AgCl	Silver(I) chloride	670	769	873	1052	1264	1561	4
AgI	Silver(I) iodide	594	686	803	959	1177	1503	4
Al	Aluminum	1209	1359	1544	1781	2091	2517	2
AlB ₃ H ₁₂	Aluminum borohydride				-46.8	-9.4	45.5	4
AlCl ₃	Aluminum trichloride	58.4 s	76.5 s	97.1 s	120.7 s	148.2 s	180.5 s	4
AlF ₃	Aluminum trifluoride	744 s	819 s	906 s	1008 s	1130 s	1276 s	8
AlI ₃	Aluminum triiodide				218	285	385	4
Al ₂ O ₃	Aluminum oxide			2122	2351	2629	2975	4
Ar	Argon*		-226.4 s	-220.3 s	-212.4 s	-201.7 s	-186.0	1,5,31
As	Arsenic	280 s	323 s	373 s	433 s	508 s	601 s	3
AsCl ₃	Arsenic(III) chloride			-8 e	21.3	63.1	129.4	1
AsF ₃	Arsenic(III) fluoride					8.1	56.0	4
AsI ₃	Arsenic(III) iodide				187	261	367 e	7
As ₂ O ₃	Arsenic(III) oxide (arsenolite)	133.7 s	163.0 s	196.8 s	236.2 s	283.0		34
At	Astatine	88 s	119 s	156 s	202 s	258 s	334	2
Au	Gold	1373	1541	1748	2008	2347	2805	2
B	Boron	2075	2289	2549	2868	3272	3799	2
BBr ₃	Boron tribromide			-45 e	-15 e	27.5	90.4	1
BCl ₃	Boron trichloride*			-94.0	-70.5	-37.4	12.3	4
BF ₃	Boron trifluoride*	-173.9 s	-166.0 s	-156.0 s	-143.0 s	-125.9	-101.1	4
B ₂ F ₄	Tetrafluorodiborane						-34	1
B ₂ H ₆	Diborane			-162 e	-147.0	-125.8	-92.6	1
B ₃ H ₉	Pentaborane(9)				-34.8	3.8	57.6	4
Ba	Barium	638 s	765	912	1115	1413	1897	9
Be	Beryllium	1189 s	1335	1518	1750	2054	2469	2
BeBr ₂	Beryllium bromide	203 s	240 s	283 s	335 s	397 s	473 s	4
BeCl ₂	Beryllium chloride	196 s	237 s	284 s	339 s	402 s	487	4
BeF ₂	Beryllium fluoride		686 e	767 e	869	999	1172 e	7
BeI ₂	Beryllium iodide	188 s	229 s	276 s	333 s	402 s	487	4
Bi	Bismuth	668	768	892	1052	1265	1562	2
BiBr ₃	Bismuth tribromide			217 s	273 i	348 i	455 i	4,9
BiCl ₃	Bismuth trichloride				248.9	328.6	438.7	1,4
BrCs	Cesium bromide	531 s	601 s	701 i	834 i	1019 i	1293 e	9
BrH	Hydrogen bromide*		-153.3 s	-140.4 s	-123.8 s	-101.5 s	-67.0	5
BrH ₃ Si	Bromosilane				-81.0	-47.3	2.2	4
BrH ₄ N	Ammonium bromide	121 s	154 s	195 s	246 s	310.4 s	395.1 s	5
BrK	Potassium bromide	597 s	674 s	773				25
BrLi	Lithium bromide		630	733	868	1049	1308	4
BrNa	Sodium bromide			791	931	1120	1389	4
BrRb	Rubidium bromide			766	903	1087	1350	4
BrTl	Thallium(I) bromide				509	635	817	4
Br ₂	Bromine*	-87.7 s	-71.8 s	-52.7 s	-29.3 s	2.5	58.4	1
Br ₂ Cd	Cadmium bromide	373 s	435 s	509 s				27
Br ₂ Hg	Mercury(II) bromide	71 s	98 s	132 s	174 s	227 s	318	4
Br ₂ OS	Thionyl bromide	-49 e	-29 e	-5 e	27.8	72.9	139.6	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
Br ₂ Pb	Lead(II) bromide	374	431	502	597	726	914	4
Br ₂ S ₂	Sulfur bromide	-7 e	15 e	42 e	78.4	128.1	200.9	5
Br ₃ In	Indium(III) bromide			304.6 s	328.7 s	364.8 s		1
Br ₃ OP	Phosphorus(V) oxybromide				64 e	115.5	191.4	5
Br ₃ P	Phosphorus(III) bromide		-23 e	5 e	42.3	94.6	172.6	5
Br ₃ Sb	Antimony(III) bromide				136.5	196.9	286.5	1
Br ₄ Ge	Germanium(IV) bromide				51	105	188	4
Br ₄ Sn	Tin(IV) bromide				67	122	204	4
Br ₄ Zr	Zirconium(IV) bromide	136 s	167 s	203 s	245 s	295 s	356 s	4
Br ₅ P	Phosphorus(V) bromide		-19 s	4 s	31 s	65.5 s	110.1	5
Ca	Calcium	591 s	683 s	798 s	954	1170	1482	2
Cd	Cadmium	257 s	310 s	381	472	594	767	2
CdCl ₂	Cadmium chloride	412 s	471 s	541 s	634	768	959	23, 27
CdF ₂	Cadmium fluoride				1257	1461	1742	4
CdI ₂	Cadmium iodide	296 s	344 s	406	498	622	795	4,27
CdO	Cadmium oxide	770 s	866 s	983 s	1128 s	1314 s	1558 s	4
Ce	Cerium	1719	1921	2169	2481	2886	3432	14
ClCs	Cesium chloride			730	864	1043	1297	4
ClCu	Copper(I) chloride		459	543	675	914	1477	4
ClF	Chlorine fluoride*				-144.4	-122.6	-90.2	5
ClF ₂ P	Phosphorus(III) chloride difluoride				-119.5	-91.1	-47.6	5
ClF ₃	Chlorine trifluoride				-63.7	-33.0	11.4	5
ClF ₅	Chlorine pentafluoride				-88 e	-59	-14	7
ClH	Hydrogen chloride*				-138.2 s	-118.0	-85.2	1,5
ClHO ₂ S	Chlorosulfonic acid	-40 e	-20 e	5 e	38.7	85.0	153.6	5
ClH ₄ N	Ammonium chloride	91 s	121 s	159 s	204.7 s	263.1 s	339.5 s	5
ClK	Potassium chloride	625 s	704 s	804	945	1137	1411	23,25
ClLi	Lithium chloride		649 i	761 i	905 i	1101 i	1381 i	8
ClNO	Nitrosyl chloride		-116 s	-100 s	-78.7 s	-50.2	-5.7	5
ClNO ₂	Nitryl chloride	-121 e	-113 e	-102 e	-86.1	-60.9	-15.7	5
ClNa	Sodium chloride	653 s	733 s	835	987	1182	1461	23,25
ClO ₂	Chlorine dioxide*					-34.3	10.5	5
ClRb	Rubidium chloride			777	916	1105	1379	4
ClTI	Thallium(I) chloride				504	626	806	4
Cl ₂	Chlorine*	-145 s	-133.7 s	-120.2 s	-103.6 s	-76.1	-34.2	1
Cl ₂ Co	Cobalt(II) chloride					818	1048	4
Cl ₂ FP	Phosphorus(III) dichloride fluoride				-71.1	-37.4	13.5	5
Cl ₂ F ₃ P	Phosphorus(V) dichloride trifluoride		-120 e	-101 e	-77.1	-44.3	3 e	7
Cl ₂ Fe	Iron(II) chloride				685	821	1025	4
Cl ₂ Hg	Mercury(II) chloride	64.4 s	94.7 s	130.8 s	174.5 s	228.5 s	304.0	4
Cl ₂ Mg	Magnesium chloride			762	908	1111	1414	4
Cl ₂ Mn	Manganese(II) chloride				760	933	1189	4
Cl ₂ Ni	Nickel(II) chloride	534 s	592 s	662 s	747 s	852 s	985 s	4
Cl ₂ OS	Thionyl chloride	-99 e	-81 e	-58 e	-27.1	14.6	75.2	5
Cl ₂ O ₂ S	Sulfuryl chloride				-27 e	11.8	69.0	5
Cl ₂ Pb	Lead(II) chloride			541 e	637	765	949	23
Cl ₂ S	Sulfur dichloride	-76 e	-61 e	-41 e	-16.7	15.3	58.7	5
Cl ₂ S ₂	Sulfur chloride	-55 e	-36 e	-12 e	21.0	67.2	137.1	5
Cl ₂ Sn	Tin(II) chloride		253	308	381	479	622	4
Cl ₂ Zn	Zinc chloride	305 i	356 i	419 i	497 i	596 i	726 i	4,9,12
Cl ₃ Fe	Iron(III) chloride	118 s	153 s	190 s	229 s	268 s	319	4
Cl ₃ HSi	Trichlorosilane			-81 e	-56 e	-21 e	31.6	7
Cl ₃ N	Nitrogen trichloride				-25 e	13.2	70.6	5
Cl ₃ OP	Phosphorus(V) oxychloride					39.9	105.0	5
Cl ₃ P	Phosphorus(III) chloride	-93 e	-77 e	-55 e	-26.0	14.5	75.7	5
Cl ₄ Po	Polonium(IV) chloride					300.6	389.4	5
Cl ₄ Se	Selenium tetrachloride	23 s	45 s	71 s	102 s	141.4 s	191.1 s	5
Cl ₄ Si	Tetrachlorosilane*				-39 e	0 e	57.3	1
Cl ₄ Te	Tellurium tetrachloride				237 e	299.4	387.8	5
Cl ₄ Zr	Zirconium(IV) chloride	117 s	146 s	181 s	222 s	272 s	336 s	9
Cl ₅ P	Phosphorus(V) chloride	-2 s	19 s	44 s	74 s	111.4 s	158.9 s	5
Co	Cobalt	1517	1687	1892	2150	2482	2925	2
Cr	Chromium	1383 s	1534 s	1718 s	1950	2257	2669	2
Cs	Cesium	144.5	195.6	260.9	350.0	477.1	667.0	13,30

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
CsF	Cesium fluoride				825	999	1249	4
CsI	Cesium iodide	523 s	595 s	692	854	1029	1278	4,25
Cu	Copper	1236	1388	1577	1816	2131	2563	2
CuI	Copper(I) iodide				636	864	1331	4
Dy	Dysprosium	1105 s	1250 s	1431 i	1681 i	2031 i	2558 i	3
Er	Erbium	1231 s	1390 s	1612 i	1890 i	2279 i	2859 i	3
Eu	Europium	590 s	684 s	799 s	961	1179	1523	14
FH	Hydrogen fluoride*				-71.1	-33.7	19.2	1,5
FHO ₃ S	Fluorosulfonic acid	-14 e	4 e	28 e	59.1	101.3	162.2	5
FK	Potassium fluoride			869	1017	1216	1499	4
FLi	Lithium fluoride	801 s	896	1024	1188	1395	1672	4,12,25
FNO	Nitrosyl fluoride			-131 e	-116.1	-94.3	-60.1	5
FNO ₂	Nitryl fluoride		-156 e	-144 e	-128.1	-106.0	-72.6	5
FNO ₃	Fluorine nitrate	-160 e	-149 e	-135 e	-115.1	-87.4	-45.0	5
FNa	Sodium fluoride		920 s	1058	1218	1426	1702	4,12,24
FRb	Rubidium fluoride			910	1001	1145	1409	4,12
F ₂	Fluorine*	-235 s	-229.5 s	-222.9 s	-214.8	-204.3	-188.3	1,5
F ₂ O	Fluorine monoxide*	-211.7	-204.7	-195.9	-184.2	-168.2	-144.9	5
F ₂ OS	Thionyl fluoride			-124 e	-106.5	-81.5	-44.1	5
F ₂ O ₂ Re	Rhenium(VI) dioxydifluoride				89.2	131.9	185 e	26
F ₂ Pb	Lead(II) fluoride				865	1054	1292	4
F ₂ Xe	Xenon difluoride			2.9 s	31.8 s	67.9 s	114 s	1,5
F ₂ Zn	Zinc fluoride	731 s	813 s	911 i	1048 i	1237 i	1503 i	9
F ₃ N	Nitrogen trifluoride*	-201 e	-194 e	-185 e	-172.8	-155.5	-129.2	5
F ₃ OP	Phosphorus(V) oxyfluoride	-124 s	-113 s	-100 s	-83.7 s	-64.1 s	-39.7 s	5
F ₃ P	Phosphorus(III) fluoride*				-152 e	-132.6	-101.4	5
F ₄ MoO	Molybdenum(VI) oxytetrafluoride	-21 s	3 s	33 s	69.3 s	117.3	184.1	26
F ₄ ORe	Rhenium(VI) oxytetrafluoride	5 s	26 s	50.7 s	80.1 s	117.1	171.2	26
F ₄ OW	Tungsten(VI) oxytetrafluoride	2 s	25 s	52.1 s	84.3 s	126.7	185.4	26
F ₄ S	Sulfur tetrafluoride				-110.0	-82.1	-40.3	5
F ₄ Se	Selenium tetrafluoride				13.6	51.6	104.7	5
F ₄ Si	Tetrafluorosilane*	-166 s	-157 s	-145.6 s	-132.3 s	-115.7 s	-94.9 s	4,7
F ₅ Mo	Molybdenum(V) fluoride			86.6	140.3	213 e	26	
F ₅ Nb	Niobium(V) fluoride			80	140	224	4	
F ₅ ORe	Rhenium(VII) oxypentafluoride	-103 s	-84 s	-59 s	-28 s	13.7 s	72.8	26
F ₅ Os	Osmium(V) fluoride			74.1	113.2	162.3	226 e	26
F ₅ P	Phosphorus(V) fluoride	-157 s	-148 s	-137 s	-124.5 s	-108.6 s	-84.8	5
F ₅ Re	Rhenium(V) fluoride			58.8	99.5	152 e	221 e	26
F ₅ Ta	Tantalum(V) fluoride					119	229	4
F ₆ Ir	Iridium(VI) fluoride	-88 s	-71 s	-51 s	-27 s	3.8 s	53.1	26
F ₆ Mo	Molybdenum(VI) fluoride	-98 s	-82 s	-64 s	-41.2 s	-13.4 s	33.5	26
F ₆ Os	Osmium(VI) fluoride	-89 s	-73 s	-54 s	-30.6 s	-1.7 s	47.4	26
F ₆ Re	Rhenium(VI) fluoride	-97 s	-82 s	-63 s	-40.2 s	-11.9 s	33.4	26
F ₆ S	Sulfur hexafluoride*	-158 s	-147 s	-133.6 s	-116.6 s	-94.4 s	-64.1 s	5
F ₆ Se	Selenium hexafluoride	-143 s	-132 s	-118 s	-100.7 s	-77.8 s	-46.5 s	5
F ₆ Te	Tellurium hexafluoride	-142 s	-130 s	-115 s	-96 s	-71.8 s	-39.1 s	5
F ₆ W	Tungsten(VI) fluoride	-107 s	-92 s	-74 s	-52.1 s	-24.8 s	16.9	26
F ₁₀ S ₂	Sulfur decafluoride					-22.0	28.5	5
Fe	Iron	1455 s	1617	1818	2073	2406	2859	2
Fr	Francium	131 e	181 e	246 e	335 e	465 e	673 e	2
Ga	Gallium	1037	1175	1347	1565	1852	2245	2
Gd	Gadolinium	1563 i	1755 i	1994 i	2300 i	2703 i	3262 i	3
Ge	Germanium	1371	1541	1750	2014	2360	2831	2
HI	Hydrogen iodide*	-146 s	-135.2 s	-120.8 s	-101.9 s	-75.9 s	-35.9	5
HKO	Potassium hydroxide	520 e	601 e	704	842	1035	1325	4
HNO ₃	Nitric acid			-37 e	-9 e	28.4	82.2	5
HN ₃	Hydrazoic acid			-79 e	-54 e	-18.0	35.7	5
HNaO	Sodium hydroxide	513	605	722	874	1080	1377	4
H ₂	Hydrogen*					-258.6	-252.8	1
H ₂ I ₂ Si	Diiodosilane				11.8	70.5	149.4	4
H ₂ O	Water***	-60.7 s	-42.2 s	-20.3 s	7.0	45.8	99.6	36,37
H ₂ O ₂	Hydrogen peroxide			13 e	45 e	89.0	149.8	5
H ₂ O ₄ S	Sulfuric acid	72	103	140	187	248	330	4
H ₂ S	Hydrogen sulfide*		-149 s	-136 s	-118.9 s	-95.9 s	-60.5	1,5
H ₂ S ₂	Hydrogen disulfide				-27 e	12.2	70.7	5
H ₂ Se	Hydrogen selenide	-145 s	-134 s	-120 s	-102.8 s	-78.9 s	-41.5	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
H ₂ Te	Hydrogen telluride					-46.6	-2.3	5
H ₃ ISi	Iodosilane				-47.7	-10.1	45.2	4
H ₃ N	Ammonia*	-139 s	-127 s	-112 s	-94.5 s	-71.3	-33.6	1,5,6
H ₃ NO	Hydroxylamine				43.7	73.3	109.8	4
H ₃ P	Phosphine*	-182 s	-173 s	-161 s	-145 s	-122.7	-88.0	5
H ₄ IN	Ammonium iodide	125 s	159 s	201 s	253 s	318.4 s	405.2 s	5
H ₄ N ₂	Hydrazine				14.7	55.6	113 e	5
H ₄ Si	Silane*			-181	-165.4	-143.7	-111.8	4
He	Helium*					-270.6	-268.9	2
Hf	Hafnium	2416	2681	3004	3406	3921	4603	9
Hg	Mercury**	42.0	76.6	120.0	175.6	250.3	355.9	29,30
HgI ₂	Mercury(II) iodide	85.1 s	115.6 s	152.4 s	197.8 s	255.1 s	353.6	4
Ho	Holmium	1159 s	1311 s	1502 i	1767 i	2137 i	2691 i	3
IK	Potassium iodide			731	866	1052	1322	4
ILi	Lithium iodide	545	619	710	824	972	1170	4
INa	Sodium iodide			753	883	1058	1301	4
IRb	Rubidium iodide			733	866	1045	1302	4
ITl	Thallium(I) iodide				520	644	821	4
I ₂	Iodine (rhomboh)	-12.8 s	9.3 s	35.9 s	68.7 s	108 s	184.0	1,2
I ₂ Pb	Lead(II) iodide			470	558	682	869	4
I ₂ Zn	Zinc iodide	301 s	351 s	409 s	488 i	598 i	750 i	9
I ₃ Sb	Antimony(III) iodide				214.9	292.0	401.2	4
I ₄ Sn	Tin(IV) iodide				167.1	242.7	347.7	4
I ₄ Zr	Zirconium(IV) iodide	187 s	220 s	259 s	305 s	361 s	430 s	4
In	Indium	923	1052	1212	1417	1689	2067	2
Ir	Iridium	2440 s	2684	2979	3341	3796	4386	2
K	Potassium	200.2	256.5	328	424	559	756.2	13,30
Kr	Krypton*	-214.0 s	-208.0 s	-199.4 s	-188.9 s	-174.6 s	-153.6	5
La	Lanthanum	1732 i	1935 i	2185 i	2499 i	2905 i	3453 i	3
Li	Lithium	524.3	612.3	722.1	871.2	1064.3	1337.1	13,30
Lu	Lutetium	1633 s	1829.8	2072.8	2380 i	2799 i	3390 i	3
Mg	Magnesium	428 s	500 s	588 s	698	859	1088	2
Mn	Manganese	955 s	1074 s	1220 s	1418	1682	2060	2
Mo	Molybdenum	2469 s	2721	3039	3434	3939	4606	2
MoO ₃	Molybdenum(VI) oxide				801	935	1151	4
NO	Nitric oxide*	-201 s	-195 s	-188 s	-179.3 s	-168.1 s	-151.9	5
N ₂	Nitrogen*	-236 s	-232 s	-226.8 s	-220.2 s	-211.1 s	-195.9	1,5
N ₂ O	Nitrous oxide*	-167 s	-157 s	-145.4 s	-131.1 s	-112.9 s	-88.7	5
N ₂ O ₄	Nitrogen tetroxide	-92 s	-78 s	-61 s	-41.1 s	-16.6 s	28.7	5
N ₂ O ₅	Nitrogen pentoxide	-71 s	-56 s	-40 s	-19.9 s	3.9 s	33.2	5
Na	Sodium	280.6	344.2	424.3	529	673	880.2	13,30
Nb	Niobium	2669	2934	3251	3637	4120	4740	2
Nd	Neodymium	1322.3	1501.2	1725.3	2023 i	2442 i	3063 i	3
Ne	Neon*	-261 s	-260 s	-258 s	-255 s	-252 s	-246.1	2
Ni	Nickel	1510	1677	1881	2137	2468	2911	2
OPb	Lead(II) oxide	724	816	928	1065	1241	1471	4
OSr	Strontium oxide	1789 s	1903 s	2047 s	2235 s	2488 s		4
O ₂	Oxygen*				-211.9	-200.5	-183.1	1,28
O ₂ S	Sulfur dioxide*			-98 s	-80 s	-52.2	-10.3	1,5
O ₂ Se	Selenium dioxide	124.5 s	153.9 s	188 s	228 s	275 s	315 s	38
O ₂ Si	Silicon dioxide	1966 i	2149 i	2368 i				8
O ₃	Ozone*	-189 e	-182 e	-172 e	-158 e	-139.7	-111.5	5
O ₃ P ₂	Phosphorus(III) oxide				47.3	100.3	172.8	4
O ₃ S	Sulfur trioxide				-20 s	6.6 s	44.5	5
O ₃ Sb ₂	Antimony(III) oxide (valentinite)	426.1 s	478 s	539 s	610 s	907	1420	4,35
O ₅ P ₂	Phosphorus(V) oxide	285 s	328 s	377.5 s	434.4 s	500.5 s	591	4
O ₇ Re ₂	Rhenium(VII) oxide	147 s	176 s	208 s	244 s	284 s	362	4
Os	Osmium	2887 s	3150	3478	3875	4365	4983	2
P	Phosphorus (white)	6 s	34 s	69	115	180	276	3,9
P	Phosphorus (red)	182 s	216 s	256 s	303 s	362 s	431 s	2,3
Pb	Lead	705	815	956	1139	1387	1754	2
PbS	Lead(II) sulfide	656 s	741 s	838 s	953 s	1088 s	1280	4
Pd	Palladium	1448 s	1624	1844	2122	2480	2961	2
Po	Polonium				573 e	730.2	963.3	5
Pr	Praseodymium	1497.7	1699.4	1954 i	2298 i	2781 i	3506 i	3
Pt	Platinum	2057	2277 e	2542	2870	3283	3821	2

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
Pu	Plutonium	1483	1680	1925	2238	2653	3226	2
Ra	Radium	546 s	633 s	764	936	1173	1526	2
Rb	Rubidium	160.4	212.5	278.9	368	496.1	685.3	13,30
Re	Rhenium	3030 s	3341	3736	4227	4854	5681	2
Rh	Rhodium	2015	2223	2476	2790	3132	3724	2
Rn	Radon*	-163 s	-152 s	-139 s	-121.4 s	-97.6 s	-62.3	5
Ru	Ruthenium	2315 s	2538	2814	3151	3572	4115	2
S	Sulfur	102 s	135	176	235	318	444	3
Sb	Antimony	534 s	603 s	738	946	1218	1585	2,3
Sc	Scandium	1372 s	1531 s	1733 i	1993 i	2340 i	2828 i	3
Se	Selenium	227	279	344	431	540	685	3
Si	Silicon	1635	1829	2066	2363	2748	3264	2
Sm	Samarium	728 s	833 s	967 s	1148 i	1402 i	1788 i	3
Sn	Tin	1224	1384	1582	1834	2165	2620	2
Sr	Strontium	523 s	609 s	717 s	866	1072	1373	2
Ta	Tantalum	3024	3324	3684	4122	4666	5361	2
Tb	Terbium	1516.1	1706.1	1928 i	2232 i	2640 i	3218 i	3
Tc	Technetium	2454 e	2725 e	3051 e	3453 e	3961 e	4621 e	2
Te	Tellurium			502 e	615 e	768.8	992.4	5
Th	Thorium	2360	2634	2975	3410	3986	4782	2
Ti	Titanium	1709	1898	2130 e	2419	2791	3285	2
Tl	Thallium	609	704	824	979	1188	1485	2
Tm	Thulium	844 s	962 s	1108 s	1297 s	1548 i	1944 i	3
U	Uranium	2052	2291	2586	2961	3454	4129	2
V	Vanadium	1828 s	2016	2250	2541	2914	3406	2
W	Tungsten	3204 s	3500	3864	4306	4854	5550	2
Xe	Xenon*	-190 s	-181 s	-170 s	-155.8 s	-136.6 s	-108.4	5,32
Y	Yttrium	1610.1	1802.3	2047 i	2354 i	2763 i	3334 i	3
Yb	Ytterbium	463 s	540 s	637 s	774 s	993 i	1192 i	3
Zn	Zinc	337 s	397 s	477	579	717	912 e	2
Zr	Zirconium	2366	2618	2924	3302	3780	4405	2

Substances containing carbon:

C	Carbon (graphite)		2566 s	2775 s	3016 s	3299 s	3635 s	15
CBrClF ₂	Bromochloro- difluoromethane	-136 e	-123 e	-106 e	-83.4	-51.8	-4.3	1
CBrCl ₃	Bromotrichloromethane				-6 e	38.9	104.4	5
CBrF ₃	Bromotrifluoromethane*	-168 e	-156 e	-142 e	-122.8	-96.6	-58.1	5
CBrN	Cyanogen bromide				-13 s	17.7 s	61.0	1
CBr ₂ F ₂	Dibromodifluoromethane		-110 e	-91 e	-66 e	-30 e	22.5	1
CBr ₄	Tetrabromomethane			25.6 s	65.8 s	111.6	188.9	5
CClF ₃	Chlorotrifluoromethane	-176 e	-167 e	-155 e	-139 e	-116 e	-81.7	5
CClN	Cyanogen chloride		-94.6 s	-78.1 s	-57 s	-29 s	13.0	5
CCl ₂ F ₂	Dichlorodifluoromethane*	-150 e	-138 e	-122 e	-101.8	-73.1	-30.0	5
CCl ₂ O	Carbonyl chloride	-127 e	-113 e	-96 e	-73 e	-40.6	7.2	5
CCl ₃ F	Trichlorofluoromethane*		-107 e	-89 e	-63 e	-28.5	23.3	1,5
CCl ₃ NO ₂	Trichloronitromethane		-59 e	-30 e	4.4	47.8	112.0	5
CCl ₄	Tetrachloromethane*	-79.4 s	-70.8 s	-53.5 s	-24.4 s	15.8	76.2	1,5
CFN	Cyanogen fluoride		-135 s	-121.2 s	-104.1 s	-82.8 s	-46.2	1,5
CF ₄	Tetrafluoromethane*	-199.9 s	-193 s	-183.9 s	-171.6	-153.9	-128.3	1,5
CHBrF ₂	Bromodifluoromethane		-128 s	-111.4 s	-89.7 s	-59.7 s	-16 s	5
CHBr ₃	Tribromomethane				30.5	78.3	148.8	1
CHClF ₂	Chlorodifluoromethane*	-152 e	-141 e	-126 e	-107.1	-80.5	-41.1	5
CHCl ₂ F	Dichlorofluoromethane	-76 e	-70 e	-61 e	-49 e	-28.7	8.6	1
CHCl ₃	Trichloromethane*			-61 e	-34 e	4.3	60.8	1
CHF ₃	Trifluoromethane*			-152 e	-136 e	-114.4	-82.3	1
CHI ₃	Triiodomethane	51.1 s	82.7 s	121 e			218.0	5
CHN	Hydrogen cyanide*			-77 s	-52.6 s	-22.7 s	25.4	1,5
CHNO	Cyanic acid			-81.1	-56.8	-23.9	23 e	5
CH ₂ BrCl	Bromochloromethane	-83 e	-69 e	-50 e	-25 e	11.4	67.7	1
CH ₂ Br ₂	Dibromomethane			-37 e	-7 e	35.2	96.5	5
CH ₂ ClF	Chlorofluoromethane		-124 e	-108 e	-86.2	-55.7	-9.4	5
CH ₂ Cl ₂	Dichloromethane*		-92 e	-73 e	-48 e	-12.5	39.3	1
CH ₂ F ₂	Difluoromethane*	-156.7	-145.8	-131.9	-113.6	-88.6	-51.9	1
CH ₂ I ₂	Diiodomethane			17 e	55 e	106.1	181.6	5
CH ₂ O	Formaldehyde*				-91 e	-61.7	-19.3	1

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
CH ₂ O ₂	Formic acid	-56 s	-40.4 s	-22.3 s	-0.8 s	37.0	100.2	1,5
CH ₃ AsF ₂	Methyldifluoroarsine				-15 e	22.1	76.1	5
CH ₃ BO	Borane carbonyl				-124	-99	-64	4
CH ₃ Br	Bromomethane				-77 e	-44.3	3.3	1
CH ₃ Cl	Chloromethane*	-140.2 s	-128.6 s	-114.7 s	-96 e	-67.1	-24.4	1,33
CH ₃ Cl ₃ Si	Methyltrichlorosilane		-83 e	-61 e	-33 e	7 e	65.7	1
CH ₃ F	Fluoromethane*				-130 e	-111 e	-78.6	1
CH ₃ I	Iodomethane				-49 e	-12.4	42.1	1
CH ₃ NO	Formamide		22 e	53 e	93 e	145.0	218 e	5
CH ₃ NO ₂	Nitromethane				-2 e	40 e	100.8	1
CH ₃ NO ₃	Methyl nitrate		-75 e	-55 e	-27 e	9.8	63 e	5
CH ₄	Methane*	-220 s	-214.2 s	-206.8 s	-197 s	-183.6 s	-161.7	5,41
CH ₂ Cl ₂ Si	Dichloromethylsilane			-77 e	-51 e	-14 e	40.5	1
CH ₄ O	Methanol*	-87 e	-69 e	-47.5	-20.4	15.2	64.2	11
CH ₄ S	Methanethiol		-115 e	-97 e	-74 e	-41.7	5.7	1
CH ₃ ClSi	Chloromethylsilane	-129 e	-115 e	-97.9	-74.4	-41.5	8.3	5
CH ₅ N	Methylamine				-76.7	-48.1	-6.6	1
CH ₆ N ₂	Methylhydrazine			-31 e	-4.7	32.9	91 e	1
CH ₆ O ₂ Si	Methyl silyl ether				-90.2	-61.8	-18 e	1
CH ₆ Si	Methylsilane			-144 e	-124.6	-97.5	-57.5	5
CIN	Cyanogen iodide						153.8	5
CNNa	Sodium cyanide		672 e	798	961	1182	1497	4
CN ₄ O ₈	Tetranitromethane				18.0	61.8	124 e	5
CO	Carbon monoxide*			-223 s	-216.5 s	-207.2 s	-191.7	40
COS	Carbon oxysulfide*			-136 e	-117 e	-90.0	-50.4	1
COSe	Carbon oxyselenide			-120	-98	-67	-22	4
CO ₂	Carbon dioxide*	-159.1 s	-148.9 s	-136.7 s	-121.6 s	-103.1 s	-78.6 s	5
CS ₂	Carbon disulfide		-96 e	-76 e	-49 e	-10.9	45.9	1
CSe ₂	Carbon diselenide			-24 e	9.4	56.2	127 e	1
C ₂ Br ₂ ClF ₃	1,2-Dibromo-1-chloro-1,2,2-trifluoroethane						92.3	5
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane		-97 e	-75 e	-46 e	-7.2	47.1	5
C ₂ Br ₄	Tetrabromoethylene		-54.5 s	-31.7 s	-3.5 s	32.2 s	226.0	5
C ₂ ClF ₃	Chlorotrifluoroethylene	-146 e	-134 e	-119 e	-99 e	-71 e	-28.4	1
C ₂ ClF ₅	Chloropentafluoroethane					-80.3	-39.4	1
C ₂ Cl ₂ F ₄	1,1-Dichlorotetrafluoroethane					-45.4	2.7	5
C ₂ Cl ₂ F ₄	1,2-Dichlorotetrafluoroethane				-76.8	-44.9	3.2	5
C ₂ Cl ₃ F ₃	1,1,1-Trichlorotrifluoroethane						45.6	1,5
C ₂ Cl ₃ F ₃	1,1,2-Trichlorotrifluoroethane					-8.2	47.3	1,5
C ₂ Cl ₃ N	Trichloroacetonitrile				-16 e	25.3	85.1	1
C ₂ Cl ₄	Tetrachloroethylene			-22 e	10 e	54.4	120.7	1
C ₂ Cl ₄ F ₂	1,1,1,2-Tetrachloro-2,2-difluoroethane				-7 e	31.0	91.1	5
C ₂ Cl ₄ F ₂	1,1,2,2-Tetrachloro-1,2-difluoroethane					32.3	92.5	1
C ₂ Cl ₄ O	Trichloroacetyl chloride			-25 e	7 e	51.7	117.8	1,5
C ₂ Cl ₆	Hexachloroethane	-7.6 s	9.9 s	33.6 s	67.7 s	116.9 s	184.2 s	5
C ₂ F ₃ N	Trifluoroacetonitrile				-126.1	-102.5	-67.8	1
C ₂ F ₄	Tetrafluoroethylene				-132.3	-109.7	-75.8	1
C ₂ F ₄ N ₂ O ₄	1,1,2,2-Tetrafluoro-1,2-dinitroethane				-30 e	6.4	59.5	5
C ₂ F ₆	Hexafluoroethane**			-155.2 s	-137.5 s	-113.4 s	-78.4 s	1,5
C ₂ HBrClF ₃	2-Bromo-2-chloro-1,1,1-trifluoroethane				-41.4	-4.8	49.8	1
C ₂ HBr ₃ O	Tribromoacetaldehyde			15.0	52.7	103.0	173.5	5
C ₂ HClF ₄	1-Chloro-1,1,2,2-tetrafluoroethane			-110 e	-87.6	-57.0	-12.1	5
C ₂ HCl ₂ F ₃	2,2-Dichloro-1,1,1-trifluoroethane		-101.0	-82.2	-57.4	-23.3	26.7	18
C ₂ HCl ₃	Trichloroethylene	-74 e	-59 e	-39 e	-12 e	26.7	86.8	1
C ₂ HCl ₃ O	Trichloroacetaldehyde			-41.6	-9.8	33.8	97.4	5
C ₂ HCl ₃ O ₂	Trichloroacetic acid				83.8	130.0	197.2	1,5
C ₂ HCl ₅	Pentachloroethane		-23 e	3 e	37.4	86.0	159.4	1
C ₂ HF ₃ O ₂	Trifluoroacetic acid					16.8	71.4	1,5
C ₂ HF ₅ O	Trifluoromethyl difluoromethyl ether	-147 e	-136 e	-121 e	-102 e	-75.0	-35.4	20
C ₂ H ₂	Acetylene*			-146.6 s	-130.7 s	-110.6 s	-84.8 s	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₂ H ₂ Br ₂	<i>cis</i> -1,2-Dibromoethylene		-45 e	-21 e	10 e	52.2	114.8	1
C ₂ H ₂ Br ₂	<i>trans</i> -1,2-Dibromoethylene				-4 e	42.2	107.4	5
C ₂ H ₂ Br ₂ Cl ₂	1,2-Dibromo-1,1-dichloroethane					103.6	177.8	5
C ₂ H ₂ Br ₂ Cl ₂	1,2-Dibromo-1,2-dichloroethane		-11 e	22 e	64.1	119 e	193 e	5
C ₂ H ₂ Br ₄	1,1,2,2-Tetrabromoethane	14 e	38 e	69 e	109 e	163.7	242.9	5
C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	-116 e	-101 e	-82 e	-57 e	-21.4	31.2	1
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene			-62 e	-34 e	3.8	60.3	1
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene				-44 e	-7.5	47.3	1
C ₂ H ₂ Cl ₂ F ₂	1,2-Dichloro-1,1-difluoroethane	-101 e	-87 e	-68 e	-42.2	-6.8	46.3	5
C ₂ H ₂ Cl ₂ O	Chloroacetyl chloride			-23.7	5.6	46.1	105.6	5
C ₂ H ₂ Cl ₄	1,1,1,2-Tetrachloroethane	-58 e	-40 e	-15 e	17 e	62.2	129.7	1
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane		-22 e	1 e	32.4	76.9	144.7	1
C ₂ H ₂ F ₄	1,1,1,2-Tetrafluoroethane				-94.3	-66.8	-26.4	17
C ₂ H ₂ F ₄	1,1,2,2-Tetrafluoroethane				-96.0	-66.9	-23.3	5
C ₂ H ₂ O	Ketene		-151 e	-135 e	-115 e	-88.2	-50.0	1
C ₂ H ₃ Br	Bromoethylene	-124 e	-110 e	-92 e	-68 e	-34.5	15.4	5
C ₂ H ₃ BrO	Acetyl bromide	-78 e	-65 e	-49 e	-25 e	13.9	84 e	5
C ₂ H ₃ Br ₃	1,1,2-Tribromoethane	-18 e	4 e	32 e	68 e	117.1	188.4	5
C ₂ H ₃ Cl	Chloroethylene	-139 e	-127 e	-110 e	-89 e	-59.0	-14.1	1
C ₂ H ₃ ClF ₂	1-Chloro-1,1-difluoroethane		-123 e	-107 e	-85.3	-55.4	-10.5	5
C ₂ H ₃ ClO	Acetyl chloride	-100 e	-85 e	-66 e	-40 e	-3.6	50.4	1
C ₂ H ₃ ClO ₂	Chloroacetic acid				78.4	123.9	188.9	1
C ₂ H ₃ Cl ₂ F	1,1-Dichloro-1-fluoroethane		-101 e	-83 e	-57.9	-22.7	31.4	5
C ₂ H ₃ Cl ₂ F	1,2-Dichloro-1-fluoroethane			-50 e	-23.8	14.1	73.4	5
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane				-25.3	14.2	73.7	5
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane			-23 e	7 e	49.9	113.4	1
C ₂ H ₃ F	Fluoroethylene			-153.3	-135.2	-109.9	-72.2	5
C ₂ H ₃ FO	Acetyl fluoride					-64.1	17.0	5
C ₂ H ₃ F ₃	1,1,1-Trifluoroethane				-113 e	-86.6	-47.8	1
C ₂ H ₃ F ₃ O	2,2,2-Trifluoroethanol			-33 e	-8 e	26.0	74 e	5
C ₂ H ₃ I	Iodoethylene				-41 e	-3 e	55.6	5
C ₂ H ₃ IO	Acetyl iodide				-0.6	47 e	107.0	5
C ₂ H ₃ N	Acetonitrile				-20 e	21.4	81.2	1
C ₂ H ₃ NO	Methylisocyanate				-43.5	-10.2	38.8	1
C ₂ H ₃ NS	Methyl thiocyanate			-18.4	16.2	63.5	132.5	5
C ₂ H ₄	Ethylene*				-155.6	-135.1	-104.0	1,10
C ₂ H ₄ BrCl	1-Bromo-2-chloroethane				-0.4	41.7	105.7	6
C ₂ H ₄ Br ₂	1,1-Dibromoethane		-49 e	-26 e	5 e	46.4	107.6	5
C ₂ H ₄ Br ₂	1,2-Dibromoethane				18 e	62.2	130.9	1
C ₂ H ₄ ClF	1-Chloro-1-fluoroethane				-69.9	-36.1	15.8	5
C ₂ H ₄ Cl ₂	1,1-Dichloroethane		-84 e	-64 e	-36.7	1.0	56.9	1
C ₂ H ₄ Cl ₂	1,2-Dichloroethane				-16.4	23.7	83.1	1
C ₂ H ₄ F ₂	1,1-Difluoroethane			-115.2	-94.6	-66.1	-24.3	19
C ₂ H ₄ N ₂ O ₆	Ethylene glycol dinitrate	4 e	25.6	51.0	81 e	117 e	162 e	5
C ₂ H ₄ O	Acetaldehyde		-105 e	-87 e	-62.8	-29.4	20.0	5
C ₂ H ₄ O	Ethylene oxide		-111 e	-93 e	-70 e	-37.0	10.2	1
C ₂ H ₄ O ₂	Acetic acid	-42.8 s	-26.7 s	-8 s	14.2 s	55.9	117.5	1,5
C ₂ H ₄ O ₂	Methyl formate		-95 e	-76 e	-51.8	-18.1	31.4	5
C ₂ H ₄ O ₃	Peroxyacetic acid				14.4	55.3	109.7	5
C ₂ H ₄ O ₃	Glycolic acid						99.9	5
C ₂ H ₅ AsF ₂	Ethylidifluoroarsine			-36 e	-6.0	35.0	93.1	5
C ₂ H ₅ Br	Bromoethane	-111 e	-96 e	-77 e	-51.3	-15.5	38.0	5
C ₂ H ₅ Cl	Chloroethane	-126 e	-112 e	-94 e	-70 e	-37.0	12.0	1
C ₂ H ₅ ClO	2-Chloroethanol	-61 e	-39 e	-12 e	23 e	67.1	127.3	5
C ₂ H ₅ ClO	Chloromethyl methyl ether	-96 e	-80 e	-59 e	-32 e	6 e	61 e	5
C ₂ H ₅ Cl ₃ OSi	Trichloroethoxysilane	-78 e	-60 e	-36.0	-4.6	38.7	102.0	5
C ₂ H ₅ Cl ₃ Si	Trichloroethylsilane	-79 e	-61 e	-38 e	-8 e	34.9	98.7	5
C ₂ H ₅ F	Fluoroethane		-142 e	-127 e	-106.3	-78.7	-37.9	1
C ₂ H ₅ FO	2-Fluoroethanol			-22 e	8.3	47.5	99 e	5
C ₂ H ₅ I	Iodoethane	-94 e	-78 e	-56 e	-27.9	11.9	71.9	5
C ₂ H ₅ N	Ethyleneimine		-74 e	-55 e	-30 e	4.1	55 e	5
C ₂ H ₅ NO	Acetamide	16.7 s	39.1 s	65.2 s	102.8	150.8	218.2	5
C ₂ H ₅ NO	<i>N</i> -Methylformamide		13 e	41 e	78 e	127.9	199.1	1
C ₂ H ₅ NO ₂	Nitroethane	-61 e	-44 e	-21 e	8.3	50.1	113.5	5
C ₂ H ₅ NO ₃	Ethyl nitrate	-81 e	-63 e	-41 e	-12 e	28.2	87 e	1
C ₂ H ₆	Ethane*	-183.3 s	-173.2	-161.3	-145.3	-122.8	-88.8	41
C ₂ H ₆ Cl ₂ Si	Dichlorodimethylsilane					11.1	70.1	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₂ H ₆ Hg	Dimethyl mercury				-13.5	29.0	92.1	5
C ₂ H ₆ N ₂ O	<i>N</i> -Nitrosodimethylamine				30.7	80.5	149.8	5
C ₂ H ₆ O	Ethanol	-73 e	-56 e	-34 e	-7 e	29.2	78.0	1,5
C ₂ H ₆ O	Dimethyl ether*		-135 e	-118 e	-96.8	-67.6	-25.1	1,5
C ₂ H ₆ OS	Dimethyl sulfoxide			27.4	65.0	115.9	188.6	1
C ₂ H ₆ O ₂	Ethylene glycol	2 e	24 e	51.1	86.1	132.5	196.9	1
C ₂ H ₆ O ₂	Ethyl hydroperoxide	-70 e	-49 e	-25 e	6.8	47.0	101 e	5
C ₂ H ₆ O ₂ S	Dimethyl sulfone				109 e	166.8	248.9	5
C ₂ H ₆ S	Ethanethiol	-112 e	-97 e	-78 e	-53 e	-18 e	34.7	1
C ₂ H ₆ S	Dimethyl sulfide		-96 e	-77 e	-51.2	-16.0	37.0	1,5
C ₂ H ₆ S ₂	Dimethyl disulfide	-71 e	-53 e	-29 e	1.7	45.0	109.3	5
C ₂ H ₇ BO ₂	Dimethoxyborane	-116 e	-101.9	-83.5	-59.2	-25.4	25 e	5
C ₂ H ₇ N	Ethylamine			-71 e	-53 e	-27 e	16.4	1
C ₂ H ₇ N	Dimethylamine			-88 e	-66.9	-37.2	6.6	1
C ₂ H ₇ NO	Ethanolamine		11 e	35 e	66.2	109.0	170.6	1
C ₂ H ₈ N ₂	1,2-Ethanediamine				17.0	57.5	116.6	1,5
C ₂ H ₈ N ₂	1,1-Dimethylhydrazine			-52 e	-25.6	10.5	63 e	5
C ₂ H ₈ N ₂	1,2-Dimethylhydrazine		-49 e	-33 e	-9 e	26.4	88 e	1
C ₂ N ₂	Cyanogen	-127 s	-114.1 s	-98.5 s	-79.2 s	-54.9 s	-21.4	5
C ₃ ClF ₅ O	Chloropentafluoroacetone	-122 e	-109 e	-93 e	-71 e	-39.4	7.4	5
C ₃ Cl ₆	Hexachloropropene	-12 e	11 e	40 e	79 e	132.8	213.6	5
C ₃ F ₆	Perfluoropropene	-150 e	-138 e	-122 e	-101 e	-72 e	-30.6	5
C ₃ F ₆ O	Perfluoroacetone			-113 e	-94 e	-67.8	-27.6	5
C ₃ F ₈	Perfluoropropane		-139 e	-124 e	-105 e	-77.5	-37.0	1
C ₃ HN	Cyanoacetylene			-58.7 s	-35.6 s	-7 s	42.0	5
C ₃ H ₂ F ₆ O	1,1,1,3,3,3-Hexafluoro-2-propanol					12.7	57.1	5
C ₃ H ₃ F ₅	1,1,1,2,2-Pentafluoropropane					-60 e	-17.9	5
C ₃ H ₃ N	2-Propenenitrile		-72 e	-50 e	-22 e	17.7	77.0	1
C ₃ H ₃ NS	Thiazole					54.4	117.8	5
C ₃ H ₄	Allene*		-129 e	-118 e	-101.4	-76.7	-34.7	5
C ₃ H ₄	Propyne				-94 e	-65.3	-23.2	1
C ₃ H ₄ ClF ₃	3-Chloro-1,1,1-trifluoropropane	-102 e	-87 e	-68 e	-43 e	-8 e	45.3	5
C ₃ H ₄ Cl ₂ O	1,1-Dichloroacetone				1 e	47.8	118.0	5
C ₃ H ₄ Cl ₂ O ₂	Methyl dichloroacetate	-44 e	-25 e	0 e	33 e	77.7	142.3	5
C ₃ H ₄ Cl ₄	1,1,1,2-Tetrachloropropane	-48 e	-28 e	-2 e	32 e	79.1	149.5	5
C ₃ H ₄ F ₄ O	2,2,3,3-Tetrafluoro-1-propanol			-10 e	17 e	53.9	107.2	5
C ₃ H ₄ O	Acrolein		-87 e	-67 e	-40 e	-3.0	52.8	1
C ₃ H ₄ O ₂	Propenoic acid				35 e	78.0	140.7	1
C ₃ H ₄ O ₂	Vinyl formate			-58 e	-34 e	-1.6	46.2	1
C ₃ H ₄ O ₂	2-Oxetanone		-21 e	8 e	45.5	93.8	159.3	5
C ₃ H ₄ O ₃	Ethylene carbonate	12.7 s	37 e				247	5
C ₃ H ₅ Br	<i>cis</i> -1-Bromopropene	-100 e	-84 e	-64 e	-37 e	1.0	57.4	5
C ₃ H ₅ Br	2-Bromopropene	-112 e	-95 e	-75 e	-47 e	-9 e	48.0	5
C ₃ H ₅ Br	3-Bromopropene	-98 e	-80 e	-58 e	-28 e	12 e	69.6	5
C ₃ H ₅ Cl	<i>cis</i> -1-Chloropropene	-114 e	-100 e	-81 e	-55 e	-20.1	32.4	5
C ₃ H ₅ Cl	<i>trans</i> -1-Chloropropene		-97 e	-77 e	-52 e	-16.2	37.0	5
C ₃ H ₅ Cl	2-Chloropropene	-120 e	-106 e	-87 e	-63 e	-28.7	22.3	5
C ₃ H ₅ Cl	3-Chloropropene	-107 e	-92 e	-72.4	-46.3	-9.8	44.6	5
C ₃ H ₅ ClO	Epichlorohydrin			-21 e	11 e	53.8	115.5	5
C ₃ H ₅ ClO ₂	Methyl chloroacetate		-28 e	-5 e	25 e	66.9	129.1	5
C ₃ H ₅ Cl ₃	1,1,3-Trichloropropane	-51 e	-31 e	-5 e	28 e	75.3	145.1	5
C ₃ H ₅ Cl ₃	1,2,3-Trichloropropane			2 e	37 e	84.9	156.3	5
C ₃ H ₅ Cl ₃ Si	Trichloro-2-propenylsilane					53.0	116.5	5
C ₃ H ₅ I	3-Iodopropene	-80 e	-62 e	-39 e	-8 e	36 e	101.5	5
C ₃ H ₅ N	Propanenitrile	-69.4	-55.3	-36.0	-7.9	35.2	97.4	1,5
C ₃ H ₅ NO	Acrylamide			109.6	161 e		5	5
C ₃ H ₅ NO	3-Hydroxypropanenitrile	-11 e	18 e	53 e	96.1	150.3	220.8	5
C ₃ H ₅ NS	Ethyl thiocyanate	-39 e	-20 e	4 e	35 e	79.1	143.4	5
C ₃ H ₅ NS	Ethyl isothiocyanate				17.4	66 e	136 e	5
C ₃ H ₅ N ₃ O ₉	Trinitroglycerol	48.6	75.7	118 e	191 e	353 e	1007 e	5
C ₃ H ₆	Propene*	-160.6	-149.0	-134.3	-114.9	-88.2	-47.9	1,5
C ₃ H ₆	Cyclopropane			-124 e	-104 e	-75.7	-33.1	1
C ₃ H ₆ BrCl	1-Bromo-3-chloropropane	-51 e	-31 e	-6 e	28 e	74.1	142.9	5
C ₃ H ₆ Br ₂	1,2-Dibromopropane	-46 e	-26 e	-2 e	31 e	75.3	139.5	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₃ H ₆ Br ₂	1,3-Dibromopropane	-30 e	-9 e	17 e	52 e	98.7	166.8	5
C ₃ H ₆ Cl ₂	1,1-Dichloropropane				-14 e	27.0	87.7	5
C ₃ H ₆ Cl ₂	1,2-Dichloropropane	-78 e	-61 e	-38.1	-8.1	33.7	95.9	5
C ₃ H ₆ Cl ₂	1,3-Dichloropropane	-65 e	-46 e	-22 e	10 e	54.0	119.9	5
C ₃ H ₆ Cl ₂	2,2-Dichloropropane				-28 e	10.8	68.9	5
C ₃ H ₆ Cl ₂ O	1,3-Dichloro-2-propanol			21.8	59.0	107.6	173.9	5
C ₃ H ₆ N ₂ O ₄	1,1-Dinitropropane	-9 e	12 e	39 e	73.2	120 e	187 e	5
C ₃ H ₆ O	Allyl alcohol	-63 e	-48 e	-21.9	6.8	44.5	96.2	5
C ₃ H ₆ O	Methyl vinyl ether			-114 e	-89 e	-52.7	4.6	1
C ₃ H ₆ O	Propanal			-69 e	-42 e	-6 e	47.7	1
C ₃ H ₆ O	Acetone	-95	-81.8	-62.8	-35.6	1.3	55.7	1,5
C ₃ H ₆ O	Methyloxirane	-109 e	-95 e	-76 e	-51.5	-17.2	33.9	5
C ₃ H ₆ O ₂	Propanoic acid			0 e	35.1	79.9	140.8	1,5
C ₃ H ₆ O ₂	Ethyl formate		-80 e	-61 e	-35 e	1 e	54.0	1
C ₃ H ₆ O ₂	Methyl acetate	-95 e	-79 e	-59 e	-33 e	3.3	56.6	1
C ₃ H ₆ O ₂	1,3-Dioxolane		-72 e	-50 e	-22 e	17.0	75.3	1
C ₃ H ₆ O ₃	1,3,5-Trioxane					53 e	113.7	1
C ₃ H ₆ S	Thietane		-62 e	-40 e	-9 e	32.5	94.5	5
C ₃ H ₇ Br	1-Bromopropane	-95 e	-78 e	-57 e	-28 e	11.6	70.6	1
C ₃ H ₇ Br	2-Bromopropane		-84 e	-65 e	-39.6	-1.7	59.1	1,5
C ₃ H ₇ Cl	1-Chloropropane	-106 e	-90 e	-71 e	-44.5	-8.1	46.2	1
C ₃ H ₇ Cl	2-Chloropropane		-91 e	-74 e	-51.1	-17.8	35.4	1,5
C ₃ H ₇ ClO	2-Chloro-1-propanol				23 e	63.8	125.7	5
C ₃ H ₇ F	1-Fluoropropane	-133 e	-120 e	-103 e	-80.7	-49.4	-2.8	5
C ₃ H ₇ I	1-Iodopropane	-78 e	-60 e	-37 e	-6 e	36.9	102.0	5
C ₃ H ₇ I	2-Iodopropane	-89 e	-71 e	-47 e	-16.3	26.5	89.2	5
C ₃ H ₇ N	Allylamine		-88 e	-65 e	-37 e	0.4	52 e	5
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide	-39 e	-20 e	5 e	38.0	83.9	152.6	1
C ₃ H ₇ NO	<i>N</i> -Methylacetamide	-13.3 s	13 s	43 e	83.8	136.1	206.3	5
C ₃ H ₇ NO ₂	1-Nitropropane	-56 e	-37 e	-13 e	20 e	64.8	130.8	1
C ₃ H ₇ NO ₂	2-Nitropropane		-48 e	-22 e	10.7	55.6	119.8	1
C ₃ H ₇ NO ₃	Propyl nitrate			-23.9	6.1	48.1	111 e	5
C ₃ H ₈	Propane*	-156.9	-145.6	-130.9	-111.4	-83.8	-42.3	1,41
C ₃ H ₈ O	1-Propanol	-54 e	-38 e	-16 e	10 e	47 e	96.9	1,5
C ₃ H ₈ O	2-Propanol	-65 e	-49 e	-28 e	-1.3	33.6	82.0	1,5
C ₃ H ₈ O	Ethyl methyl ether	-98 e	-89 e	-77 e	-60 e	-34.8	7.0	5
C ₃ H ₈ O ₂	1,2-Propylene glycol	-11 e	13 e	42 e	78 e	125.0	187.2	5
C ₃ H ₈ O ₂	1,3-Propylene glycol	4 e	30 e	62 e	101 e	149.9	214.0	5
C ₃ H ₈ O ₂	Ethylene glycol monomethyl ether	-57 e	-37 e	-12 e	21 e	63.8	124.3	1
C ₃ H ₈ O ₂	Dimethoxymethane	-93 e	-81 e	-64 e	-42 e	-9.3	41.7	5
C ₃ H ₈ O ₃	Glycerol	96 e	113 e	136 e	168 e	213.4	287 e	1
C ₃ H ₈ S	1-Propanethiol	-94 e	-78 e	-57 e	-29.1	9.6	67.4	1,5
C ₃ H ₈ S	2-Propanethiol	-102 e	-87 e	-67 e	-41 e	-3 e	52.2	1
C ₃ H ₈ S	Ethyl methyl sulfide	-94 e	-78 e	-57 e	-29.7	8.8	66.3	1
C ₃ H ₈ S ₂	1,3-Propanedithiol	-53 e	-28 e	3 e	43 e	97 e	172.4	5
C ₃ H ₉ As	Trimethylarsine			-74 e	-45 e	-5.4	52.0	5
C ₃ H ₉ BO ₃	Trimethyl borate				-14 e	15.6	67.9	5
C ₃ H ₉ BS	Methyl dimethylthioborane			-62 e	-30.4	11.4	70.7	5
C ₃ H ₉ ClSi	Trimethylchlorosilane				-37.8	0.4	57.3	5
C ₃ H ₉ N	Propylamine		-81 e	-63 e	-38.3	-4.1	46.9	1,5
C ₃ H ₉ N	Isopropylamine		-91 e	-74 e	-50.4	-17.6	31.5	1,5
C ₃ H ₉ N	Trimethylamine		-114 e	-97 e	-75.0	-43.8	2.6	1,5
C ₃ H ₉ NO	1-Amino-2-propanol			18 e	53.2	98.2	157.9	5
C ₃ H ₉ O ₄ P	Trimethyl phosphate	-31 e	-7 e	23.6	62.8	116.0	192.0	5
C ₃ H ₉ P	Trimethylphosphine			-81 e	-53 e	-15.0	37.1	5
C ₃ H ₉ Sb	Trimethylstibine			-56 e	-23.8	19 e	80 e	5
C ₃ H ₁₀ N ₂	1,2-Propanediamine		-35.4	-12.0	18.8	61 e	119 e	5
C ₃ N ₂ O	Carbonyl dicyanide				-21.7	15.3	65.2	5
C ₄ Cl ₆	Hexachloro-1,3-butadiene	-1 e	22 e	50 e	86.7	137.0	209.7	5
C ₄ F ₆ O ₃	Trifluoroacetic acid anhydride			-63 e	-39 e	-7.1	38.8	5
C ₄ F ₈	Perfluorocyclobutane						-6.2	1
C ₄ F ₁₀	Perfluorobutane		-122 e	-105 e	-82 e	-49.8	-2.5	1,5
C ₄ H ₂ Cl ₂ O ₂	<i>trans</i> -2-Butenedioyl dichloride			8.0	45.6	94.3	159.8	5
C ₄ H ₂ Cl ₂ S	2,5-Dichlorothiophene			-20 e	22 e	81.4	171 e	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₄ H ₂ O ₃	Maleic anhydride				73.7	127.9	201.7	5
C ₄ H ₃ ClS	2-Chlorothiophene		-62 e	-35 e	2 e	51.8	123 e	5
C ₄ H ₃ IS	2-Iodothiophene			-25 e	23 e	94.9	181.0	5
C ₄ H ₄	1-Buten-3-yne			-96.1	-73.4	-41.8	4.9	5
C ₄ H ₄ N ₂	Succinonitrile	24.8 s					266.0	5
C ₄ H ₄ O	Furan			-78 e	-54 e	-20 e	31.0	1
C ₄ H ₄ O ₂	Diketene				19.3	63.3	126 e	5
C ₄ H ₄ O ₃	Succinic anhydride				121 e	180.8	260.8	5
C ₄ H ₄ O ₄	Fumaric acid	123.9 s	150 s	180 s				5
C ₄ H ₄ S	Thiophene				-17 e	23.7	83.7	5
C ₄ H ₅ Cl	2-Chloro-1,3-butadiene	-113 e	-95 e	-71 e	-41 e	0.3	59.0	5
C ₄ H ₅ ClO	2-Methyl-2-propenoyl chloride		-57 e	-35 e	-5 e	36.4	98.2	5
C ₄ H ₅ Cl ₃ O ₂	Ethyl trichloroacetate			15.3	51.9	100.1	166.6	5
C ₄ H ₅ N	3-Butenenitrile	-67 e	-48 e	-23.1	9.3	53.7	118.4	5
C ₄ H ₅ N	Methylacrylonitrile				-12 e	29.0	89.8	5
C ₄ H ₅ N	Pyrrrole			-8 e	24 e	66.7	129.4	1
C ₄ H ₅ NO ₂	Methyl cyanoacetate	-3 e	19 e	48 e	84 e	134.0	204.6	5
C ₄ H ₅ NS	Allyl isothiocyanate	-45 e	-27 e	-3 e	32.1	89 e	198 e	5
C ₄ H ₅ NS	4-Methylthiazole						67.0	5
C ₄ H ₆	1,2-Butadiene	-132 e	-117 e	-98 e	-72.8	-38.9	10.5	5
C ₄ H ₆	1,3-Butadiene*			-106 e	-83 e	-51.9	-4.7	1
C ₄ H ₆	1-Butyne	-125 e	-111 e	-94 e	-71.2	-39.4	7.8	1
C ₄ H ₆	2-Butyne		-89.2 s	-73.8 s	-53.5 s	-23.9	26.6	5
C ₄ H ₆ Cl ₂ O ₂	Ethyl dichloroacetate			2.6	40.1	89.1	156.3	5
C ₄ H ₆ O	Divinyl ether		-99 e	-80 e	-56 e	-22.1	28.0	5
C ₄ H ₆ O	<i>trans</i> -2-Butenal	-74 e	-56 e	-33 e	-3 e	39.7	102.4	5
C ₄ H ₆ O	3-Buten-2-one					21 e	81.0	5
C ₄ H ₆ O	Cyclobutanone			-34 e	-4 e	37.1	97 e	5
C ₄ H ₆ O ₂	<i>cis</i> -Crotonic acid			30 e	63 e	106.7	168.9	5
C ₄ H ₆ O ₂	<i>trans</i> -Crotonic acid				74 e	120.8	184.9	5
C ₄ H ₆ O ₂	3-Butenoic acid	-19 e	2 e	27 e	61 e	105.6	168.6	5
C ₄ H ₆ O ₂	Methacrylic acid			22 e	56 e	99.9	161.5	5
C ₄ H ₆ O ₂	Vinyl acetate	-88 e	-71 e	-50 e	-22 e	16.2	72.2	1
C ₄ H ₆ O ₂	Methyl acrylate		-71 e	-48 e	-18 e	22 e	79.9	5
C ₄ H ₆ O ₂	2,3-Butanedione					30.7	84.8	5
C ₄ H ₆ O ₂	gamma-Butyrolactone		-17 e	24 e	72 e	130.2	203 e	5
C ₄ H ₆ O ₃	Acetic anhydride	-44 e	-25 e	-1 e	31 e	75.1	139.7	1
C ₄ H ₆ O ₃	Propylene carbonate	-40 e	-5 e	43 e	112 e	220 e	410 e	5
C ₄ H ₆ O ₄	Dimethyl oxalate				50.5	98.1	163.0	5
C ₄ H ₇ Br	<i>trans</i> -1-Bromo-1-butene	-87 e	-68 e	-43.3	-11.4	31.9	94.4	5
C ₄ H ₇ Br	2-Bromo-1-butene	-87 e	-70 e	-48 e	-20 e	20.7	80.6	5
C ₄ H ₇ Br	<i>cis</i> -2-Bromo-2-butene	-90 e	-72 e	-49.0	-18.5	23.5	85.2	5
C ₄ H ₇ Br	<i>trans</i> -2-Bromo-2-butene	-86 e	-67 e	-43.4	-12.0	31.0	93.5	5
C ₄ H ₇ Br ₃	1,2,3-Tribromobutane	0 e	23 e	53 e	91 e	143.7	219.5	5
C ₄ H ₇ Br ₃	1,2,4-Tribromobutane	-3 e	20 e	49 e	87 e	139.4	214.5	5
C ₄ H ₇ Cl	3-Chloro-1-butene			-64 e	-36 e	4 e	63.6	5
C ₄ H ₇ Cl	<i>cis</i> -2-Chloro-2-butene	-100 e	-83 e	-62 e	-34 e	6 e	66.4	5
C ₄ H ₇ Cl	<i>trans</i> -2-Chloro-2-butene	-102 e	-86 e	-65 e	-37 e	3 e	62.2	5
C ₄ H ₇ Cl	3-Chloro-2-methylpropene		-75 e	-54 e	-25 e	13.8	71.5	5
C ₄ H ₇ ClO ₂	Ethyl chloroacetate			-2.6	32.6	79.1	143.8	5
C ₄ H ₇ N	Butanenitrile	-67 e	-48 e	-24 e	8 e	52.3	117.2	1
C ₄ H ₈	1-Butene	-139.0	-125.2	-107.8	-85.3	-53.7	-6.6	1,5
C ₄ H ₈	<i>cis</i> -2-Butene	-131.2	-117.4	-99.8	-76.7	-44.8	3.4	1,5
C ₄ H ₈	<i>trans</i> -2-Butene			-102 e	-80 e	-47.6	0.6	1
C ₄ H ₈	Isobutene	-139.1	-125.5	-108.2	-85.5	-54.5	-7.3	1,5
C ₄ H ₈	Cyclobutane				-71.8	-38.1	12.1	5
C ₄ H ₈	Methylcyclopropane	-130 e	-116 e	-99.3	-76.3	-44.2	4.2	5
C ₄ H ₈ Br ₂	1,2-Dibromobutane	-54 e	-30 e	0.4	39.6	92.1	166.1	5
C ₄ H ₈ Br ₂	1,4-Dibromobutane	-13 e	9 e	37 e	74 e	124.0	196.5	5
C ₄ H ₈ Cl ₂	1,1-Dichlorobutane			-25 e	6 e	49.3	113.4	5
C ₄ H ₈ Cl ₂	1,2-Dichlorobutane			-28.4	5.8	53.1	123.1	5
C ₄ H ₈ Cl ₂	1,4-Dichlorobutane		-26 e	0 e	35 e	82.4	153.4	5
C ₄ H ₈ Cl ₂	2,2-Dichlorobutane		-58 e	-35 e	-5 e	37.8	102.1	5
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether	-32 e	-9 e	19.8	56.9	106.9	177.9	5
C ₄ H ₈ O	Ethyl vinyl ether		-102 e	-81 e	-53.1	-16.5	34.7	5
C ₄ H ₈ O	1,2-Epoxybutane	-135 e	-114 e	-87 e	-53 e	-5.5	62.1	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₄ H ₈ O	Butanal	-88 e	-72 e	-50 e	-22 e	16.6	74.5	1,5
C ₄ H ₈ O	Isobutanal			-56 e	-29 e	8 e	63.8	1
C ₄ H ₈ O	2-Butanone	-85 e	-68 e	-46 e	-18.1	21.2	79.2	1
C ₄ H ₈ O	Tetrahydrofuran	-94 e	-78 e	-57.3	-29.8	9 e	65.6	1
C ₄ H ₈ O ₂	Butanoic acid			12.9	52.2	101.4	163.3	1,5
C ₄ H ₈ O ₂	2-Methylpropanoic acid	-30.1	-8.2	18.1	50.5	92.9	154.0	5
C ₄ H ₈ O ₂	Propyl formate	-78 e	-62 e	-42 e	-15.1	23.0	80.4	1,5
C ₄ H ₈ O ₂	Isopropyl formate	-80 e	-65 e	-47 e	-22.2	13.2	67.7	5
C ₄ H ₈ O ₂	Ethyl acetate	-83 e	-66 e	-45 e	-18 e	20.4	76.8	1
C ₄ H ₈ O ₂	Methyl propanoate	-80 e	-64 e	-43 e	-15.8	22.2	79.0	1
C ₄ H ₈ O ₂	<i>cis</i> -2-Butene-1,4-diol	17 e	44 e	77 e	117.4	168.5	234.9	5
C ₄ H ₈ O ₂	1,3-Dioxane			-37 e	-3 e	43.4	106.0	5
C ₄ H ₈ O ₂	1,4-Dioxane					39.6	101.0	1
C ₄ H ₈ O ₂ S	Sulfolane		49 e	87 e	135 e	198.0	283.5	5
C ₄ H ₈ S	Tetrahydrothiophene	-66 e	-47 e	-23 e	9.4	54.1	120.5	1
C ₄ H ₉ Br	1-Bromobutane	-68.4	-53.9	-34.1	-5.4	37.6	101.1	1,5
C ₄ H ₉ Br	2-Bromobutane	-86 e	-68 e	-46 e	-16 e	26.6	90.7	5
C ₄ H ₉ Br	1-Bromo-2-methylpropane	-85 e	-68 e	-46 e	-16 e	26.8	91.1	5
C ₄ H ₉ Br	2-Bromo-2-methylpropane					11.7	72.4	1,5
C ₄ H ₉ Cl	1-Chlorobutane	-87 e	-71 e	-49 e	-21 e	18.4	78.1	1
C ₄ H ₉ Cl	2-Chlorobutane	-96 e	-80 e	-59 e	-31.0	8.5	67.9	1
C ₄ H ₉ Cl	1-Chloro-2-methylpropane	-94 e	-78 e	-56.6	-28.7	10.2	68.5	5
C ₄ H ₉ Cl	2-Chloro-2-methylpropane					-4.2	50.3	5
C ₄ H ₉ Cl ₃ Si	Butyltrichlorosilane					77.2	148.4	5
C ₄ H ₉ F	1-Fluorobutane	-114 e	-99 e	-80 e	-55 e	-20.0	32.1	5
C ₄ H ₉ F	2-Fluorobutane	-117 e	-103 e	-85 e	-60.7	-26.7	24.7	5
C ₄ H ₉ I	1-Iodobutane	-62 e	-43 e	-19 e	14 e	60.5	130.0	5
C ₄ H ₉ I	2-Iodobutane	-70 e	-51 e	-27 e	5 e	50 e	119.5	5
C ₄ H ₉ I	1-Iodo-2-methylpropane		-47 e	-21.4	12.0	56.8	120.0	5
C ₄ H ₉ I	2-Iodo-2-methylpropane	-75.1 s	-58.8 s	-39.5 s	-5.2	41 e	100.0	5
C ₄ H ₉ N	Pyrrolidine		-59 e	-38 e	-10 e	28.5	86.2	1
C ₄ H ₉ NO	<i>N</i> -Methylpropanamide				81.1	105 e		5
C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide	-8 e	8 e	28.0	56.4	98.2	165.7	1
C ₄ H ₉ NO	2-Butanone oxime		-18 e	7 e	38.9	81.9	142.9	5
C ₄ H ₉ NO	Morpholine				21 e	64.5	128.5	1
C ₄ H ₉ NO ₃	Isobutyl nitrate			-18 e	15.1	59.2	123.0	5
C ₄ H ₁₀	Butane*	-134.3	-121.0	-103.9	-81.1	-49.1	-0.8	1,41
C ₄ H ₁₀	Isobutane*		-129.0	-113.0	-90.9	-59.4	-12.0	1,41
C ₄ H ₁₀ O	1-Butanol	-37 e	-20 e	0 e	28 e	64 e	117.4	1
C ₄ H ₁₀ O	2-Butanol	-50 e	-34 e	-14 e	12.6	48.2	99.2	1,5
C ₄ H ₁₀ O	2-Methyl-1-propanol	-39 e	-24 e	-5 e	20.9	56.0	107.6	1,5
C ₄ H ₁₀ O	2-Methyl-2-propanol					34.4	82.1	1,5
C ₄ H ₁₀ O	Diethyl ether	-111 e	-96 e	-77 e	-52.6	-17.8	34.1	1
C ₄ H ₁₀ O	Methyl propyl ether				-40 e	-11.3	38.7	5
C ₄ H ₁₀ O	Isopropyl methyl ether				-56 e	-21.2	30.4	5
C ₄ H ₁₀ O ₂	1,3-Butanediol	-4 e	23 e	55 e	94 e	142.9	206.1	5
C ₄ H ₁₀ O ₂	1,4-Butanediol		45 e	77 e	116 e	164.7	227.6	5
C ₄ H ₁₀ O ₂	2,3-Butanediol		15 e	43 e	77 e	121.2	180.3	5
C ₄ H ₁₀ O ₂	Ethylene glycol monoethyl ether	-49 e	-29 e	-3 e	30 e	73.6	135.3	1
C ₄ H ₁₀ O ₂	Ethylene glycol dimethyl ether			-44 e	-15 e	25.2	85.2	1
C ₄ H ₁₀ O ₂	Dimethylacetal	-89 e	-74 e	-55 e	-29 e	7.7	64.1	5
C ₄ H ₁₀ O ₂	Diethylperoxide				-39 e	3.6	65.0	5
C ₄ H ₁₀ O ₂ S	Bis(2-hydroxyethyl) sulfide			31 e	114.2		282.0	5
C ₄ H ₁₀ O ₃	Diethylene glycol	35 e	58 e	86 e	123 e	173.6	245.2	1
C ₄ H ₁₀ O ₄ S	Diethyl sulfate		3 e	36 e	79 e	134 e	208.3	5
C ₄ H ₁₀ S	1-Butanethiol	-77 e	-59 e	-37 e	-6 e	35.4	98.0	5
C ₄ H ₁₀ S	2-Butanethiol	-86 e	-69 e	-47 e	-17 e	23.4	84.5	5
C ₄ H ₁₀ S	2-Methyl-1-propanethiol		-66 e	-44 e	-15 e	26.5	88.1	5
C ₄ H ₁₀ S	2-Methyl-2-propanethiol					5.8	63.8	5
C ₄ H ₁₀ S	Diethyl sulfide	-80 e	-62 e	-40 e	-10.8	30.3	91.7	1
C ₄ H ₁₀ S	Methyl propyl sulfide	-78 e	-61 e	-38 e	-8 e	33.1	95.1	5
C ₄ H ₁₀ S	Isopropyl methyl sulfide	-85 e	-68 e	-46 e	-17 e	23.4	84.3	5
C ₄ H ₁₀ S ₂	1,4-Butanedithiol	-17 e	5 e	32 e	69.1	119.9	195.1	5
C ₄ H ₁₀ S ₂	Diethyl disulfide	-46 e	-26 e	0 e	35 e	82.4	153.5	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₄ H ₁₁ N	Butylamine			-46 e	-18.1	20.0	75.9	5
C ₄ H ₁₁ N	<i>sec</i> -Butylamine			-55 e	-29.1	7.5	62.3	5
C ₄ H ₁₁ N	<i>tert</i> -Butylamine			-67 e	-42.4	-8.1	43.7	5
C ₄ H ₁₁ N	Isobutylamine	-85 e	-70 e	-50 e	-24.5	12.0	67.3	5
C ₄ H ₁₁ N	Diethylamine			-46 e	-26 e	5 e	55.2	1
C ₄ H ₁₁ NO	<i>N,N</i> -Dimethylethanolamine	-52 e	-31 e	-6 e	27 e	70.9	133 e	5
C ₄ H ₁₁ NO ₂	Diethanolamine	53 e	77 e	107 e	146 e	197.3	268 e	5
C ₄ H ₁₂ BN	(Dimethylamino)dimethylborane		-81 e	-60.1	-31.9	7.0	64.2	5
C ₄ H ₁₂ Cl ₂ OSi ₂	1,3-Dichloro-1,1,3,3-tetramethyldisiloxane		-33 e	-9 e	23.8	69.1	136.5	5
C ₄ H ₁₂ O ₄ Si	Tetramethyl silicate				14.4	59.3	119.7	5
C ₄ H ₁₂ Si	Tetramethylsilane			-83 e	-59 e	-25 e	26.7	5
C ₄ H ₁₂ Sn	Tetramethylstannane			-55.0	-25.6	16.6	77.7	5
C ₄ H ₁₃ N ₃	Diethylenetriamine	-10 e	13 e	43 e	80 e	129.6	198 e	5
C ₄ NiO ₄	Nickel carbonyl					-12	42	4
C ₅ F ₁₂	Perfluoropentane				-54.7	-20.9	28.6	5
C ₅ FeO ₅	Iron pentacarbonyl				0	44	105	4
C ₅ H ₄ ClN	2-Chloropyridine			7.4	45.8	97.3	169.9	5
C ₅ H ₄ O ₂	Furfural	-26 e	-8 e	16 e	47 e	92.4	161.4	1
C ₅ H ₅ N	Pyridine			-23 e	8 e	51.0	114.9	1
C ₅ H ₆	1,3-Cyclopentadiene			-77 e	-51 e	-14 e	39.8	5
C ₅ H ₆ N ₂	Pentanedinitrile	24.1	52 e	85 e	126 e	178 e	245 e	5
C ₅ H ₆ O	2-Methylfuran			-66 e	-35 e	6 e	64.5	1
C ₅ H ₆ O ₂	Furfuryl alcohol	-30 e	-5 e	25 e	62.6	109.3	169.7	5
C ₅ H ₆ S	2-Methylthiophene		-58 e	-32 e	2 e	47.9	112.2	1
C ₅ H ₆ S	3-Methylthiophene		-53 e	-28 e	6 e	50.6	115.1	1
C ₅ H ₇ N	1-Methylpyrrole				8 e	49.9	112.3	5
C ₅ H ₇ NO ₂	Ethyl cyanoacetate	16 e	39 e	67.0	102.1	146.7	205.6	5
C ₅ H ₈	1,2-Pentadiene	-109 e	-93 e	-73 e	-46.1	-9.7	44.5	5
C ₅ H ₈	<i>cis</i> -1,3-Pentadiene	-109 e	-93 e	-73 e	-47.0	-10.5	43.7	1,5
C ₅ H ₈	<i>trans</i> -1,3-Pentadiene			-75 e	-49.0	-13 e	42 e	1
C ₅ H ₈	1,4-Pentadiene	-120 e	-105 e	-86 e	-60.9	-26.2	25.6	5
C ₅ H ₈	2,3-Pentadiene	-106 e	-90 e	-70 e	-42.9	-6.3	47.9	5
C ₅ H ₈	3-Methyl-1,2-butadiene	-111 e	-95 e	-75 e	-49.2	-13.1	40.4	5
C ₅ H ₈	2-Methyl-1,3-butadiene	-115 e	-100 e	-81 e	-55.4	-19.7	33.7	1,5
C ₅ H ₈	1-Pentyne			-75 e	-49.1	-13.5	39.9	5
C ₅ H ₈	2-Pentyne	-100 e	-85 e	-65 e	-37.9	-0.5	55.7	5
C ₅ H ₈	3-Methyl-1-butyne			-82 e	-57.5	-23.1	28.6	5
C ₅ H ₈	Cyclopentene	-109 e	-94 e	-74 e	-48 e	-11.1	43.8	5
C ₅ H ₈	Spiropentane	-110 e	-95 e	-76 e	-51 e	-15 e	38.6	5
C ₅ H ₈ O	3-Methyl-3-buten-2-one			-35 e	-5 e	36.0	97.3	5
C ₅ H ₈ O	Cyclopropyl methyl ketone		-57 e	-31 e	3 e	49 e	112 e	5
C ₅ H ₈ O	Cyclopentanone		-39 e	-14 e	19 e	64 e	130.3	1
C ₅ H ₈ O	3,4-Dihydro-2H-pyran				-22 e	22.0	84.9	5
C ₅ H ₈ O ₂	4-Pentenoic acid	0 e	19 e	44 e	77 e	122.0	187.5	5
C ₅ H ₈ O ₂	Vinyl propanoate					31.2	94 e	5
C ₅ H ₈ O ₂	Ethyl acrylate		-55 e	-32.7	-2.8	38.5	99.2	5
C ₅ H ₈ O ₂	Methyl methacrylate			-31 e	-1 e	39.7	100.0	1
C ₅ H ₈ O ₂	2,4-Pentanedione			-5 e	24.7	67.8	137.4	1
C ₅ H ₈ O ₂	Tetrahydro-2H-pyran-2-one		5 e	35.1	74.4	128.3	207.0	5
C ₅ H ₈ O ₃	Methyl acetoacetate				50.1	101.1	171.3	5
C ₅ H ₈ O ₄	Glutaric acid		121 e	153.2	191.9	240.3	302.5	5
C ₅ H ₈ O ₄	Dimethyl malonate	-22 e	1 e	30.0	66.7	114.7	180.2	5
C ₅ H ₉ ClO ₂	Ethyl 2-chloropropanoate			1.4	36.4	82.5	146.0	5
C ₅ H ₉ ClO ₂	Isopropyl chloroacetate			-2 e	35.0	83.3	148.1	5
C ₅ H ₉ N	Pentanenitrile	-54 e	-34 e	-8 e	26 e	72.2	140.9	1
C ₅ H ₉ N	2,2-Dimethylpropanenitrile					41.1	104.8	5
C ₅ H ₉ NO	<i>N</i> -Methyl-2-pyrrolidone	1 e	24 e	53.1	92.3	147.2	229 e	5
C ₅ H ₁₀	1-Pentene	-118.9	-103.4	-84.0	-58.8	-23.3	29.6	1,5
C ₅ H ₁₀	<i>cis</i> -2-Pentene	-113.8	-98.1	-78.4	-52.7	-16.8	36.6	1,5
C ₅ H ₁₀	<i>trans</i> -2-Pentene	-114.5	-98.9	-79.1	-53.3	-17.5	36.0	1,5
C ₅ H ₁₀	2-Methyl-1-butene	-117.7	-102.2	-82.7	-57.2	-21.9	30.8	1,5
C ₅ H ₁₀	3-Methyl-1-butene	-125.0	-110.1	-91.2	-66.7	-32.1	19.7	1,5
C ₅ H ₁₀	2-Methyl-2-butene	-113.4	-97.6	-77.7	-51.6	-15.8	38.2	1,5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.	
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa		
C ₅ H ₁₀	Cyclopentane			-77.0	-45.4	-7.1	48.8	5	
C ₅ H ₁₀	Ethylcyclopropane	-118 e	-102 e	-83 e	-57 e	-20 e	35.5	5	
C ₅ H ₁₀	<i>cis</i> -1,2-Dimethylcyclopropane	-118 e	-103 e	-83 e	-57 e	-20 e	36.6	5	
C ₅ H ₁₀	<i>trans</i> -1,2-Dimethylcyclopropane	-122 e	-108 e	-89 e	-63 e	-27 e	27.8	5	
C ₅ H ₁₀ Br ₂	1,5-Dibromopentane	1 e	25 e	54 e	93 e	145.6	221.8	5	
C ₅ H ₁₀ Cl ₂	1,2-Dichloropentane				30 e	77.4	147.8	5	
C ₅ H ₁₀ Cl ₂	1,5-Dichloropentane	-31 e	-10 e	17 e	54 e	104.1	178.9	5	
C ₅ H ₁₀ N ₂	3-(Dimethylamino)propanenitrile				51.1	101.8	171.4	5	
C ₅ H ₁₀ O	Cyclopentanol		-13 e	11.5	42.2	82.5	140.0	5	
C ₅ H ₁₀ O	Allyl ethyl ether			-56 e	-28.7	9.8	67.2	5	
C ₅ H ₁₀ O	Pentanal	-71 e	-53 e	-31 e	-1 e	40.8	102.6	5	
C ₅ H ₁₀ O	2-Pentanone				-1 e	40.3	101.9	1,5	
C ₅ H ₁₀ O	3-Pentanone			-31 e	-1 e	40 e	101.6	1	
C ₅ H ₁₀ O	3-Methyl-2-butanone	-69 e	-54 e	-34 e	-6.9	32.2	94.0	1,5	
C ₅ H ₁₀ O	Tetrahydropyran				-15 e	26.0	88 e	5	
C ₅ H ₁₀ O	2-Methyltetrahydrofuran				-20 e	19.7	79.8	5	
C ₅ H ₁₀ O ₂	Pentanoic acid	-7.4	15.3	42.7	76.3	122.1	185.7	5	
C ₅ H ₁₀ O ₂	2-Methylbutanoic acid	-10 e	10 e	36 e	69 e	112.8	175.2	5	
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid	-15.8	4 e	30.0	64.7	110.6	176.1	5	
C ₅ H ₁₀ O ₂	Butyl formate			-29 e	2 e	44.4	105.7	5	
C ₅ H ₁₀ O ₂	Isobutyl formate	-69 e	-53 e	-31 e	-3 e	37.4	97.6	5	
C ₅ H ₁₀ O ₂	Propyl acetate	-69 e	-51 e	-29 e	0 e	40.9	101.2	1	
C ₅ H ₁₀ O ₂	Isopropyl acetate			-61 e	-40 e	-11 e	29.8	88.2	5
C ₅ H ₁₀ O ₂	Ethyl propanoate	-69 e	-52 e	-30 e	-1 e	38.9	98.7	1	
C ₅ H ₁₀ O ₂	Methyl butanoate	-68 e	-50 e	-28 e	0.9	41.7	102.3	5	
C ₅ H ₁₀ O ₂	Methyl isobutanoate	-83 e	-65 e	-41 e	-11 e	31 e	92.1	5	
C ₅ H ₁₀ O ₂	Tetrahydrofurfuryl alcohol	-40 e	-16 e	15 e	55 e	106 e	176.8	5	
C ₅ H ₁₀ O ₃	Diethyl carbonate		-42 e	-17 e	17 e	61.6	125.9	5	
C ₅ H ₁₀ O ₃	Ethylene glycol monomethyl ether acetate	-47 e	-26 e	0 e	34 e	79.4	144.1	5	
C ₅ H ₁₀ S	Thiacyclohexane				24 e	71.1	141.2	5	
C ₅ H ₁₀ S	Cyclopentanethiol				18 e	64 e	131.7	5	
C ₅ H ₁₁ Br	1-Bromopentane	-60 e	-41 e	-16 e	16 e	61.5	129.1	5	
C ₅ H ₁₁ Br	2-Bromopentane	-69 e	-51 e	-27 e	5 e	49.7	116.9	5	
C ₅ H ₁₁ Br	3-Bromopentane	-68 e	-50 e	-26 e	6 e	50.8	118.1	5	
C ₅ H ₁₁ Br	1-Bromo-3-methylbutane	-67 e	-49 e	-25 e	8 e	52.4	119.9	5	
C ₅ H ₁₁ Cl	1-Chloropentane	-73 e	-55 e	-32 e	-1 e	42.5	107.9	5	
C ₅ H ₁₁ Cl	2-Chloropentane	-80 e	-62 e	-39 e	-9 e	33.2	96.1	5	
C ₅ H ₁₁ Cl	3-Chloropentane	-77 e	-60 e	-37 e	-7 e	34.9	97.3	5	
C ₅ H ₁₁ Cl	2-Chloro-2-methylbutane			-52 e	-21 e	21.8	85.2	5	
C ₅ H ₁₁ Cl	1-Chloro-2,2-dimethylpropane				-17 e	23.5	83.9	5	
C ₅ H ₁₁ F	1-Fluoropentane	-97 e	-80 e	-60 e	-32 e	5.7	62.4	5	
C ₅ H ₁₁ I	1-Iodopentane	-47 e	-27 e	-1 e	34 e	83.0	156.5	5	
C ₅ H ₁₁ I	1-Iodo-3-methylbutane		-34 e	-6.6	28.8	77.3	147.8	5	
C ₅ H ₁₁ N	Cyclopentylamine	-66 e	-48 e	-26 e	4 e	45.8	108 e	5	
C ₅ H ₁₁ N	Piperidine				2 e	43.3	105.8	5	
C ₅ H ₁₁ N	<i>N</i> -Methylpyrrolidine				-23 e	18.5	78 e	5	
C ₅ H ₁₁ NO ₃	3-Methylbutyl nitrate		-26 e	1.0	35.5	81.7	147.0	5	
C ₅ H ₁₂	Pentane**	-115.5	-99.8	-80.0	-54.0	-18.1	35.7	16	
C ₅ H ₁₂	Isopentane	-119 e	-105 e	-86 e	-61 e	-26 e	27.5	1	
C ₅ H ₁₂	Neopentane*		-107.5 s	-90.8 s	-68.8 s	-38.5 s	9.2	1,5	
C ₅ H ₁₂ N ₂ O	Tetramethylurea			20.7	58.0	106.7	179.5	5	
C ₅ H ₁₂ O	1-Pentanol	-27 e	-10 e	12 e	41 e	79.8	137.4	5	
C ₅ H ₁₂ O	2-Pentanol	-35 e	-19 e	1 e	28.0	64.9	118.7	1	
C ₅ H ₁₂ O	3-Pentanol	-41 e	-25 e	-4 e	24 e	61.1	114.9	5	
C ₅ H ₁₂ O	2-Methyl-1-butanol	-27 e	-11 e	9 e	36.2	73.4	128.3	1	
C ₅ H ₁₂ O	3-Methyl-1-butanol	-22 e	-7 e	13 e	39.1	75.7	130.1	5	
C ₅ H ₁₂ O	2-Methyl-2-butanol			-5 e	17.7	50.6	101.7	1,5	
C ₅ H ₁₂ O	3-Methyl-2-butanol			-3 e	22.7	58.2	111.1	5	
C ₅ H ₁₂ O	2,2-Dimethyl-1-propanol					59.2	112.7	5	
C ₅ H ₁₂ O	Butyl methyl ether			-54 e	-27 e	12 e	69.8	1	
C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether			-66 e	-39 e	-2 e	54.8	1	
C ₅ H ₁₂ O	Ethyl propyl ether	-92 e	-77 e	-57 e	-30.5	6.7	63.4	1,5	

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₅ H ₁₂ O ₂	1,5-Pentanediol	25 e	52 e	85 e	125 e	175.1	238.9	5
C ₅ H ₁₂ O ₂	Ethylene glycol monopropyl ether				40 e	85.6	149.3	5
C ₅ H ₁₂ O ₂	Diethoxymethane		-65 e	-43 e	-14 e	27.3	87.7	5
C ₅ H ₁₂ O ₃	Diethylene glycol monomethyl ether		12 e	40 e	76 e	124.2	193.7	1
C ₅ H ₁₂ S	1-Pentanethiol	-60 e	-41 e	-17 e	15 e	60 e	126.2	1
C ₅ H ₁₂ S	2-Pentanethiol	-70 e	-52 e	-28 e	3 e	46.6	111.9	5
C ₅ H ₁₂ S	3-Pentanethiol	-70 e	-51 e	-28 e	4 e	47.7	113.4	5
C ₅ H ₁₂ S	2-Methyl-1-butanethiol				8.0	52.3	118.5	5
C ₅ H ₁₂ S	3-Methyl-1-butanethiol				7.8	51.9	117.9	5
C ₅ H ₁₂ S	2-Methyl-2-butanethiol				-8.0	34.6	98.7	5
C ₅ H ₁₂ S	Butyl methyl sulfide		-43 e	-19 e	13 e	57 e	123.0	1
C ₅ H ₁₂ S	<i>tert</i> -Butyl methyl sulfide				-7.8	34.7	98.4	5
C ₅ H ₁₂ S	Ethyl propyl sulfide	-64 e	-46 e	-23 e	9 e	52.7	118.0	5
C ₅ H ₁₂ S	Ethyl isopropyl sulfide	-72 e	-54 e	-31 e	0 e	42.7	106.9	5
C ₅ H ₁₃ N	Pentylamine		-52 e	-29 e	1 e	42.8	104.0	5
C ₆ BrF ₅	Bromopentafluorobenzene			-10 e	23 e	68 e	136.0	5
C ₆ ClF ₅	Chloropentafluorobenzene		-44 e	-21 e	11 e	53.8	117.6	1
C ₆ Cl ₃ F ₃	1,3,5-Trichloro-2,4,6-trifluorobenzene	-19 e	4 e	32 e	70 e	121.7	197.9	1
C ₆ F ₆	Hexafluorobenzene		-56.9 s	-36 s	-11.5 s	22.6	79.9	1,5
C ₆ F ₁₂	Perfluorocyclohexane				-46.2 s	-7.6 s	48.9 s	5
C ₆ F ₁₄	Perfluorohexane		-75 e	-57 e	-32 e	2.8	56.8	5
C ₆ F ₁₄	Perfluoro-2-methylpentane				-33 e	2.9	57.1	5
C ₆ F ₁₄	Perfluoro-3-methylpentane	-95 e	-80 e	-60 e	-34 e	2.8	57.9	5
C ₆ F ₁₄	Perfluoro-2,3-dimethylbutane					4.3	59.3	5
C ₆ HF ₅	Pentafluorobenzene			-41 e	-13 e	27 e	85.3	5
C ₆ HF ₅ O	Pentafluorophenol				39 e	82 e	145.2	5
C ₆ H ₂ F ₄	1,2,3,4-Tetrafluorobenzene			-36 e	-7 e	33.8	94.0	1
C ₆ H ₂ F ₄	1,2,3,5-Tetrafluorobenzene			-43 e	-14 e	25.5	84.1	1
C ₆ H ₂ F ₄	1,2,4,5-Tetrafluorobenzene					30.7	89.9	1
C ₆ H ₃ Cl ₃ O	2,4,6-Trichlorophenol			71.8	114.0	169.5	245.7	5
C ₆ H ₃ F ₃	1,3,5-Trifluorobenzene					18.2	75.0	5
C ₆ H ₄ Br ₂	<i>m</i> -Dibromobenzene	-7 e	16 e	44 e	83 e	137.0	218.2	5
C ₆ H ₄ ClNO ₂	1-Chloro-4-nitrobenzene	15.4 s	35.8 s		97 e	156.0	238 e	5
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene		-13 e	16.3	53.9	104.6	180.0	1,5
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene		-22 e	8.0	46.7	97.8	172.5	1,5
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	-45.5 s	-21.8 s	8 s	46.7 s	99.0	173.6	1,5
C ₆ H ₄ O ₂	<i>p</i> -Benzoquinone	-4.1 s	17.8 s	43.5 s	74.3 s	111.6 s		5
C ₆ H ₃ AsCl ₂	Dichlorophenylarsine	6.9	35.2	70 e	113 e	170 e	245 e	5
C ₆ H ₅ Br	Bromobenzene		-25 e	1 e	34.9	83.1	155.4	1
C ₆ H ₅ Cl	Chlorobenzene		-43 e	-17 e	16.8	62.9	131.3	1,5
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol				45.8	97.9	173.9	5
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol			39.7	80.2	135.1	213.4	5
C ₆ H ₅ ClO	<i>p</i> -Chlorophenol			45.0	86.5	142.0	219.9	5
C ₆ H ₅ Cl ₃ Si	Trichlorophenylsilane			33 e	70.2	122.6	201 e	5
C ₆ H ₅ F	Fluorobenzene				-16.9	24.2	84.4	1
C ₆ H ₅ I	Iodobenzene	-30 e	-7 e	20.9	58.5	110.6	187.8	1
C ₆ H ₅ NO ₂	Nitrobenzene		10 e	40 e	78 e	132 e	210.3	1
C ₆ H ₅ NO ₃	<i>p</i> -Nitrophenol	72.6 s	97.4 s					5
C ₆ H ₆	1,5-Hexadien-3-yne	-82 e	-66 e	-44.3	-16.0	23.7	83.6	5
C ₆ H ₆	Benzene**			-40 s	-15.1 s	20.0	79.7	1,5
C ₆ H ₆ ClN	<i>o</i> -Chloroaniline		10 e	39.0	75.2	131.4	208.3	5
C ₆ H ₆ ClN	<i>m</i> -Chloroaniline	-5 e	19.7	49.4	94.2	162 e	1069 e	5
C ₆ H ₆ N ₂ O ₂	<i>p</i> -Nitroaniline	87.8 s			192.0	252.6	331.2	5
C ₆ H ₆ O	Phenol	-9.7 s	9.6 s	34.1 s	68.9	113.7	181.4	1,5
C ₆ H ₆ O ₃	1,2,3-Benzenetriol				162.0	222.8	308.3	5
C ₆ H ₆ S	Benzenethiol		-15 e	12 e	47 e	96.0	168.6	5
C ₆ H ₇ N	Aniline		-2.5	26.7	63.5	112.5	183.5	1,5
C ₆ H ₇ N	2-Methylpyridine	-56.5	-37.8	-13.9	18.3	62.9	129.0	1,5
C ₆ H ₇ N	3-Methylpyridine			-5 e	28.8	75.2	143.7	1
C ₆ H ₇ N	4-Methylpyridine	-58.2 s	-43.1 s	-3.9 s	29.6	76.1	144.9	1,5
C ₆ H ₈	<i>cis</i> -1,3,5-Hexatriene					21 e	78 e	5
C ₆ H ₈	1,3-Cyclohexadiene	-88 e	-71 e	-50 e	-21 e	19 e	79.9	5
C ₆ H ₈	1,4-Cyclohexadiene				-15 e	27.3	85.0	5
C ₆ H ₈ N ₂	Adiponitrile	30 e	61 e	100 e	148.6	211.8	297 e	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₆ H ₈ N ₂	<i>m</i> -Phenylenediamine			94.5	140.2	200.8	285.0	5
C ₆ H ₈ N ₂	Phenylhydrazine		38 e	69 e	109 e	163.9	242.5	5
C ₆ H ₈ O ₄	Dimethyl maleate		5 e	36 e	76 e	127.3	197 e	5
C ₆ H ₈ S	2,5-Dimethylthiophene		-43 e	-16 e	20 e	67.5	134.8	5
C ₆ H ₁₀	<i>trans</i> -1,3-Hexadiene	-86 e	-70 e	-51 e	-24 e	14 e	72 e	5
C ₆ H ₁₀	<i>trans</i> -1,4-Hexadiene	-98 e	-81 e	-60 e	-33 e	7 e	65 e	5
C ₆ H ₁₀	1,5-Hexadiene	-99 e	-84 e	-64 e	-37 e	0.9	59.2	5
C ₆ H ₁₀	<i>cis,cis</i> -2,4-Hexadiene					18 e	79.6	5
C ₆ H ₁₀	<i>trans,cis</i> -2,4-Hexadiene	-89 e	-73 e	-52 e	-23 e	18 e	79.6	5
C ₆ H ₁₀	<i>trans,trans</i> -2,4-Hexadiene					18 e	79.6	5
C ₆ H ₁₀	<i>trans</i> -2-Methyl-1,3-pentadiene	-92 e	-75 e	-54 e	-26 e	14 e	75.6	5
C ₆ H ₁₀	2,3-Dimethyl-1,3-butadiene			-59 e	-30 e	9.7	68.1	5
C ₆ H ₁₀	1-Hexyne	-91 e	-75 e	-54 e	-26 e	12.8	71.0	5
C ₆ H ₁₀	2-Hexyne	-84 e	-67 e	-46 e	-17 e	23.6	84.1	5
C ₆ H ₁₀	3-Hexyne	-86 e	-69 e	-48 e	-19.1	21.0	81.0	1,5
C ₆ H ₁₀	4-Methyl-1-pentyne	-97 e	-81 e	-61 e	-34 e	4.1	60.7	5
C ₆ H ₁₀	4-Methyl-2-pentyne	-91 e	-74 e	-54 e	-26 e	13.8	72.7	5
C ₆ H ₁₀	Cyclohexene	-87 e	-70 e	-49 e	-19 e	21 e	82.6	1
C ₆ H ₁₀ Cl ₂	1,1-Dichlorocyclohexane	-39 e	-19 e	8 e	43 e	93.5	170.5	5
C ₆ H ₁₀ Cl ₂	<i>cis</i> -1,2-Dichlorocyclohexane			27 e	69 e	125.7	206.2	5
C ₆ H ₁₀ O	4-Methyl-4-penten-2-one	-59 e	-41 e	-17 e	14 e	57.0	121.0	5
C ₆ H ₁₀ O	Cyclohexanone		-25 e	1 e	36 e	84 e	155.2	1
C ₆ H ₁₀ O	Mesityl oxide	-56 e	-37 e	-13 e	19 e	63.5	129.3	5
C ₆ H ₁₀ O ₂	Vinyl butanoate					53 e	114.5	5
C ₆ H ₁₀ O ₂	Ethyl methacrylate				8 e	53.2	116.8	5
C ₆ H ₁₀ O ₂	Allyl glycidyl ether				40.1	85.7	152.8	5
C ₆ H ₁₀ O ₃	Ethyl acetoacetate	-25 e	-3 e	25.7	62.3	111.3	180.2	5
C ₆ H ₁₀ O ₃	Propanoic anhydride	-32 e	-15 e	6 e	36 e	77.6	142.9	5
C ₆ H ₁₀ O ₄	Diethyl oxalate	-5 e	18 e	44.9	79.4	124.3	185.2	5
C ₆ H ₁₀ O ₄	Dimethyl succinate			30 e	70.4	123.3	195.4	5
C ₆ H ₁₀ O ₄	Ethylene glycol diacetate	-17 e	6 e	35.0	71.9	121.1	190.0	5
C ₆ H ₁₀ S	Diallylsulfide	-58 e	-38 e	-12.4	21.7	68.8	138.1	5
C ₆ H ₁₁ Cl	Chlorocyclohexane		-35 e	-9 e	25 e	71.6	142.1	5
C ₆ H ₁₁ N	Hexanenitrile	-40 e	-19 e	8 e	43 e	91.5	163.2	1,5
C ₆ H ₁₁ N	4-Methylpentanenitrile		-50 e	-20 e	20 e	75.2	155.2	5
C ₆ H ₁₁ NO	Caprolactam	36.8 s	58.9 s	86.6 s			270	5
C ₆ H ₁₂	1-Hexene	-99.8	-82.8	-61.4	-33.7	5.2	63.1	1,5
C ₆ H ₁₂	<i>cis</i> -2-Hexene	-97 e	-80 e	-58 e	-30 e	9.9	68.5	5
C ₆ H ₁₂	<i>trans</i> -2-Hexene	-94 e	-78 e	-57 e	-30 e	9.3	67.5	5
C ₆ H ₁₂	<i>cis</i> -3-Hexene	-96 e	-79 e	-59 e	-30.8	7.9	66.0	5
C ₆ H ₁₂	<i>trans</i> -3-Hexene	-95 e	-79 e	-58 e	-30.0	8.8	66.7	5
C ₆ H ₁₂	2-Methyl-1-pentene	-98 e	-82 e	-62 e	-34.2	4.1	61.7	5
C ₆ H ₁₂	3-Methyl-1-pentene	-104 e	-88 e	-68 e	-41.5	-3.6	53.8	5
C ₆ H ₁₂	4-Methyl-1-pentene	-105 e	-89 e	-69 e	-41.6	-3.6	53.5	5
C ₆ H ₁₂	2-Methyl-2-pentene	-95 e	-78 e	-58 e	-30 e	9.0	66.9	5
C ₆ H ₁₂	3-Methyl- <i>cis</i> -2-pentene	-95 e	-79 e	-58 e	-30 e	8.9	67.3	5
C ₆ H ₁₂	3-Methyl- <i>trans</i> -2-pentene	-93 e	-77 e	-55 e	-27.4	11.7	70.0	5
C ₆ H ₁₂	4-Methyl- <i>cis</i> -2-pentene	-102 e	-86 e	-66 e	-38.7	-0.9	56.0	5
C ₆ H ₁₂	4-Methyl- <i>trans</i> -2-pentene	-100 e	-84 e	-64 e	-36.8	1.2	58.2	5
C ₆ H ₁₂	2-Ethyl-1-butene	-98 e	-81 e	-60 e	-32 e	6.6	64.3	5
C ₆ H ₁₂	2,3-Dimethyl-1-butene	-103 e	-87 e	-67 e	-39.9	-1.9	55.2	5
C ₆ H ₁₂	3,3-Dimethyl-1-butene	-110 e	-95 e	-76 e	-50.8	-14.5	40.8	5
C ₆ H ₁₂	2,3-Dimethyl-2-butene		-75 e	-54 e	-25 e	14 e	72.9	1
C ₆ H ₁₂	Cyclohexane	-85.6 s	-68.9 s	-47.6 s	-19.8 s	19.3	80.4	1,5
C ₆ H ₁₂	Methylcyclopentane	-97 e	-80 e	-58 e	-28.8	11.6	71.4	1,5
C ₆ H ₁₂	Ethylcyclobutane	-99 e	-82 e	-61 e	-32 e	9 e	70.2	5
C ₆ H ₁₂	Isopropylcyclopropane	-104 e	-88 e	-68 e	-40 e	-1 e	57.9	5
C ₆ H ₁₂	1-Ethyl-1-methylcyclopropane	-105 e	-89 e	-69 e	-41 e	-3 e	56.3	5
C ₆ H ₁₂	1,1,2-Trimethylcyclopropane	-109 e	-94 e	-73 e	-46 e	-7 e	52.0	5
C ₆ H ₁₂ Cl ₂	1,2-Dichlorohexane				49 e	98.1	171.7	5
C ₆ H ₁₂ Cl ₂ O	2,2'-Dichlorodisopropyl ether		-1 e	27.3	63.4	112.3	182.1	5
C ₆ H ₁₂ O	Butyl vinyl ether	-87 e	-67 e	-42 e	-9.3	33.6	93.2	5
C ₆ H ₁₂ O	Isobutyl vinyl ether	-87 e	-68 e	-44 e	-13 e	26.5	80.7	5
C ₆ H ₁₂ O	Hexanal	-56 e	-37 e	-13 e	19 e	62.6	127.8	5
C ₆ H ₁₂ O	2-Hexanone	-43 e	-21 e	4.2	34.5	61.9	127.2	1,5
C ₆ H ₁₂ O	3-Hexanone		-40 e	-16 e	15 e	58.5	123.1	1
C ₆ H ₁₂ O	3-Methyl-2-pentanone				8.5	52.7	117.0	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₆ H ₁₂ O	4-Methyl-2-pentanone	-61 e	-43 e	-21 e	9 e	51.5	116.1	5
C ₆ H ₁₂ O	2-Methyl-3-pentanone					50.2	113.0	5
C ₆ H ₁₂ O	3,3-Dimethyl-2-butanone			-30 e	0 e	42.5	105.7	1
C ₆ H ₁₂ O	Cyclohexanol			34 e	61 e	99.2	160.7	1
C ₆ H ₁₂ O ₂	Hexanoic acid		33 e	59 e	93 e	139.3	204.5	1
C ₆ H ₁₂ O ₂	4-Methylpentanoic acid	36 e	49 e	67.1	92.9	133.6	206.8	5
C ₆ H ₁₂ O ₂	Diethylacetic acid	-9 e	16 e	46 e	83 e	130.7	192.5	5
C ₆ H ₁₂ O ₂	Isopentyl formate	-60 e	-41 e	-17 e	15 e	59.1	124 e	5
C ₆ H ₁₂ O ₂	Butyl acetate	-63 e	-43 e	-19 e	14 e	61.0	125.6	1,5
C ₆ H ₁₂ O ₂	Isobutyl acetate	-63 e	-45 e	-21 e	10 e	53.4	116 e	5
C ₆ H ₁₂ O ₂	Propyl propanoate	-62 e	-42 e	-18 e	14 e	58.3	122.0	5
C ₆ H ₁₂ O ₂	Ethyl butanoate	-49 e	-34 e	-14 e	14.3	55.2	121.1	5
C ₆ H ₁₂ O ₂	Ethyl 2-methylpropanoate	-65 e	-47 e	-24.6	5.4	47.3	109.8	5
C ₆ H ₁₂ O ₂	Methyl pentanoate				19.2	63.7	127.4	5
C ₆ H ₁₂ O ₂	Methyl isopentanoate					53.3	116.3	5
C ₆ H ₁₂ O ₂	Diacetone alcohol	-41 e	-17 e	13 e	50.1	98.5	164 e	5
C ₆ H ₁₂ O ₃	Ethylene glycol monoethyl ether acetate	-25 e	-8 e	14 e	44.6	88.0	155.6	5
C ₆ H ₁₂ O ₃	Paraldehyde				17 e	62.2	124 e	5
C ₆ H ₁₂ S	Cyclohexanethiol					84.8	158.3	5
C ₆ H ₁₂ S	<i>cis</i> -Tetrahydro-2,5-dimethylthiophene	-53 e	-34 e	-8 e	25 e	72.0	142.1	5
C ₆ H ₁₂ S	Tetrahydro-3-methyl-2H-thiopyran	-48 e	-27 e	0 e	35 e	84.1	157.5	5
C ₆ H ₁₃ Br	1-Bromohexane	-45 e	-25 e	2 e	36 e	83.7	154.8	5
C ₆ H ₁₃ Cl	1-Chlorohexane	-55 e	-36 e	-11 e	21 e	66.7	134.6	5
C ₆ H ₁₃ F	1-Fluorohexane	-80 e	-62 e	-40 e	-11 e	30.4	91.1	5
C ₆ H ₁₃ I	1-Iodohexane	-33 e	-11 e	16 e	53 e	104.0	180.8	5
C ₆ H ₁₃ N	Cyclohexylamine			-9 e	22 e	66.6	133.5	1
C ₆ H ₁₄	Hexane	-96.4 s	-79.2	-57.6	-29.3	9.8	68.3	16
C ₆ H ₁₄	2-Methylpentane	-100 e	-84 e	-64 e	-36 e	2 e	59.9	1
C ₆ H ₁₄	3-Methylpentane	-99 e	-83 e	-62 e	-34.3	4.6	62.9	1
C ₆ H ₁₄	2,2-Dimethylbutane		-90 e	-71.5	-45.5	-7.7	49.4	1
C ₆ H ₁₄	2,3-Dimethylbutane	-103 e	-87 e	-66 e	-39.0	-0.4	57.6	1
C ₆ H ₁₄ O	1-Hexanol		5 e	28 e	56.8	97.3	157.1	1
C ₆ H ₁₄ O	2-Hexanol	-28 e	-10 e	12 e	41.4	81.5	139.6	1
C ₆ H ₁₄ O	3-Hexanol	-43 e	-23 e	1 e	33 e	75.4	135.1	1
C ₆ H ₁₄ O	2-Methyl-1-pentanol			14 e	45.9	88.3	147.6	5
C ₆ H ₁₄ O	4-Methyl-1-pentanol			24 e	53 e	92.4	151.4	5
C ₆ H ₁₄ O	2-Methyl-2-pentanol	-29 e	-15 e	3 e	27.1	63.0	120.9	5
C ₆ H ₁₄ O	3-Methyl-2-pentanol				36.5	76.1	133.8	5
C ₆ H ₁₄ O	4-Methyl-2-pentanol	-43 e	-24 e	0 e	30 e	71.9	131.3	5
C ₆ H ₁₄ O	2-Methyl-3-pentanol				29.8	68.8	126.0	5
C ₆ H ₁₄ O	3-Methyl-3-pentanol		-23 e	-4 e	22.9	61.1	121.1	5
C ₆ H ₁₄ O	2-Ethyl-1-butanol		-5 e	17 e	46 e	85.7	146.1	5
C ₆ H ₁₄ O	3,3-Dimethyl-1-butanol	-37 e	-16 e	9 e	42 e	84.3	142.5	5
C ₆ H ₁₄ O	2,3-Dimethyl-2-butanol			-5 e	23 e	61.3	118.2	5
C ₆ H ₁₄ O	Dipropyl ether	-80 e	-63 e	-41 e	-12 e	28.8	89.7	1
C ₆ H ₁₄ O	Diisopropyl ether		-76 e	-55 e	-28 e	11 e	68.1	1
C ₆ H ₁₄ O	Butyl ethyl ether	-78 e	-61 e	-39 e	-10 e	31.0	91.9	1
C ₆ H ₁₄ O	<i>tert</i> -Butyl ethyl ether	-90 e	-74 e	-53 e	-24.6	14.4	72.6	5
C ₆ H ₁₄ O ₂	2-Methyl-2,4-pentanediol	-8 e	17 e	48 e	86 e	134.4	197.5	5
C ₆ H ₁₄ O ₂	Ethylene glycol monobutyl ether	-31 e	-8 e	20 e	55 e	103.2	170.2	5
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane	-68 e	-49 e	-26 e	3.7	44.2	101.9	5
C ₆ H ₁₄ O ₂	Ethylene glycol diethyl ether		-59 e	-35.3	-2.8	44.4	118.8	5
C ₆ H ₁₄ O ₃	1,2,6-Hexanetriol	92 e	114.8	146.0	191 e			5
C ₆ H ₁₄ O ₃	Dipropylene glycol				110 e	162.6	231.4	5
C ₆ H ₁₄ O ₃	Diethylene glycol monoethyl ether			40 e	80.3	132.4	201.4	5
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether	-42 e	-20 e	8.3	44.3	92.3	159.4	5
C ₆ H ₁₄ O ₃	Trimethylolpropane	73 e	98 e	128 e	167.8	220.5	295 e	5
C ₆ H ₁₄ O ₄	Triethylene glycol	44 e	74 e	109.0	152.6	207.2	277.9	5
C ₆ H ₁₄ S	1-Hexanethiol	-45 e	-25 e	1 e	35 e	81.7	152.2	5
C ₆ H ₁₄ S	2-Hexanethiol	-50 e	-32 e	-8 e	25 e	69.9	138.4	5
C ₆ H ₁₄ S	Dipropyl sulfide	-50 e	-30 e	-6 e	28 e	73.6	142.4	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₆ H ₁₄ S	Diisopropyl sulfide	-65 e	-47 e	-23 e	9 e	53.1	119.6	5
C ₆ H ₁₄ S	Isopropyl propyl sulfide				18.5	63.8	131.6	5
C ₆ H ₁₄ S	Butyl ethyl sulfide	-49 e	-30 e	-5 e	29 e	74.8	143.8	5
C ₆ H ₁₅ N	Hexylamine			-10 e	22 e	66.0	130.6	5
C ₆ H ₁₅ N	Butylethylamine				6.1	47.7	107.0	5
C ₆ H ₁₅ N	Dipropylamine		-48 e	-25 e	6 e	47.5	108.8	5
C ₆ H ₁₅ N	Diisopropylamine			-47 e	-17.5	23.5	84.0	5
C ₆ H ₁₅ N	Triethylamine	-58 e	-45 e	-29 e	-5 e	29.9	88.5	1
C ₆ H ₁₅ NO	2-Diethylaminoethanol					97 e	160.6	5
C ₆ H ₁₅ NO ₃	Triethanolamine	75 e	108 e	148 e	196 e	256.7	334 e	5
C ₆ H ₁₅ O ₄ P	Triethyl phosphate			34	76	132	211	4
C ₆ H ₁₆ N ₂	Hexamethylenediamine				76.0	128.2	199.0	5
C ₆ H ₁₆ O ₂ Si	Diethoxydimethylsilane	-62 e	-44 e	-21.2	9.1	51.0	113.0	5
C ₆ H ₁₈ Cl ₂ O ₂ Si ₃	1,5-Dichloro-1,1,3,3,5,5-hexamethyltrisiloxane	-29 e	-7 e	22.2	59.7	110.5	183.4	5
C ₆ H ₁₈ OSi ₂	Hexamethyldisiloxane		-56 e	-34 e	-5 e	37.1	100.1	5
C ₆ MoO ₆	Molybdenum hexacarbonyl		17.4 s	42.8 s	73.1 s	109.9 s	155.4 s	5
C ₇ F ₁₄	Perfluoromethylcyclohexane				-21 e	18 e	75.9	1
C ₇ F ₁₆	Perfluoroheptane		-62 e	-41 e	-14 e	24.7	82.1	1
C ₇ HF ₁₅	1H-Pentadecafluoroheptane				-7 e	35.9	96.0	5
C ₇ H ₃ ClF ₃ NO ₂	1-Chloro-2-nitro-4-(trifluoromethyl)benzene	3 e	26 e	55 e	92.8	145.2	222.0	5
C ₇ H ₃ F ₅	2,3,4,5,6-Pentafluorotoluene			-20 e	11 e	53.6	117.0	5
C ₇ H ₄ ClF ₃	1-Chloro-2-(trifluoromethyl)benzene			1 e	34.5	81.8	151.8	5
C ₇ H ₄ ClF ₃	1-Chloro-3-(trifluoromethyl)benzene	-53 e	-34 e	-9 e	24.2	69.8	137.2	5
C ₇ H ₄ ClF ₃	1-Chloro-4-(trifluoromethyl)benzene			-9 e	24.2	70.4	138.1	5
C ₇ H ₄ Cl ₂ O	<i>o</i> -Chlorobenzoyl chloride				93 e	149 e	237.0	5
C ₇ H ₄ Cl ₂ O	<i>m</i> -Chlorobenzoyl chloride				87.8	147 e	225.0	5
C ₇ H ₄ F ₃ NO ₂	1-Nitro-3-(trifluoromethyl)benzene		11 e	39 e	76.2	127.3	202.2	5
C ₇ H ₄ F ₄	1-Fluoro-4-(trifluoromethyl)benzene			-38 e	-6 e	38.6	102.3	5
C ₇ H ₅ BrO	Benzoyl bromide	-15 e	11 e	42.6	83.9	139.5	218.0	5
C ₇ H ₅ ClO	Benzoyl chloride			27.5	67.0	120.4	196.7	5
C ₇ H ₅ Cl ₃	(Trichloromethyl)benzene		9 e	40.6	81.5	136.2	213.0	5
C ₇ H ₅ F ₃	(Trifluoromethyl)benzene				-3 e	39 e	101.6	5
C ₇ H ₅ N	Benzonitrile		-6 e	23.9	63.1	115.7	190.0	5
C ₇ H ₅ NS	Phenyl isothiocyanate				79.4	105 e	117 e	5
C ₇ H ₆ Cl ₂	2,4-Dichlorotoluene		6 e	33 e	68.3	119.5	199.1	5
C ₇ H ₆ Cl ₂	3,4-Dichlorotoluene	-13 e	9 e	38 e	76 e	129.3	208.4	5
C ₇ H ₆ Cl ₂	(Dichloromethyl)benzene			31	72	130	213	4
C ₇ H ₆ O	Benzaldehyde		-9 e	19 e	54.6	104.6	178.3	1
C ₇ H ₆ O ₂	Salicylaldehyde		-1 e	29 e	68 e	120.7	196.2	5
C ₇ H ₇ Br	<i>o</i> -Bromotoluene		-10 e	17 e	54 e	104.8	181.1	5
C ₇ H ₇ Br	<i>m</i> -Bromotoluene	-34 e	-11 e	19.4	58.1	109.9	183.1	5
C ₇ H ₇ Br	<i>p</i> -Bromotoluene				57 e	107.8	183.8	5
C ₇ H ₇ Br	(Bromomethyl)benzene			25.4	66.8	121.7	198.3	5
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene		-24 e	3 e	38 e	86.3	158.7	1,5
C ₇ H ₇ Cl	<i>m</i> -Chlorotoluene	-41 e	-21 e	6 e	41 e	89 e	161.8	5
C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene				40 e	88.9	161.5	1,5
C ₇ H ₇ Cl	(Chloromethyl)benzene	-34 e	-11 e	17.7	55.4	106.3	178.9	5
C ₇ H ₇ ClO	1-Chloro-2-methoxybenzene	-22 e	2 e	33 e	72 e	125.2	201 e	5
C ₇ H ₇ F	<i>o</i> -Fluorotoluene		-50 e	-26 e	5 e	49.0	113.9	5
C ₇ H ₇ F	<i>m</i> -Fluorotoluene	-67 e	-48 e	-25 e	7 e	51.0	116.1	5
C ₇ H ₇ F	<i>p</i> -Fluorotoluene		-48 e	-24 e	7 e	51 e	116.2	5
C ₇ H ₇ NO ₂	<i>o</i> -Nitrotoluene	23 e	40 e	62 e	94 e	141.9	221.9	5
C ₇ H ₇ NO ₂	<i>m</i> -Nitrotoluene			45 e	89.7	148.7	231.3	5
C ₇ H ₇ NO ₃	2-Nitroanisole	15 e	45 e	82 e	129 e	189.4	271.8	5
C ₇ H ₈	Toluene	-78.1	-57.1	-31.3	1.5	45.2	110.1	5
C ₇ H ₈	Bicyclo[2.2.1]hepta-2,5-diene				-15 e	27.4	91 e	5
C ₇ H ₈ Cl ₂ Si	Dichloromethylphenylsilane			32.4	71.8	126.0	205.0	5
C ₇ H ₈ O	<i>o</i> -Cresol	-6.4 s	12.8 s	40.2	72.3	120.3	190.5	1,5
C ₇ H ₈ O	<i>m</i> -Cresol	20.8	33.6	52.4	82.6	130.6	201.8	1,5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₇ H ₈ O	<i>p</i> -Cresol	-0.2 s	20.7 s	52.7	83.1	130.7	201.5	1,5
C ₇ H ₈ O	Benzyl alcohol	8 e	28 e	54 e	88 e	134.7	204.9	1
C ₇ H ₈ O	Anisole		-21 e	4 e	38 e	84 e	153.2	1,5
C ₇ H ₈ S	3-Methylbenzenethiol		0 e	29 e	66 e	117.9	194.6	5
C ₇ H ₉ N	Benzylamine			25.6	62.6	112.7	183.9	5
C ₇ H ₉ N	<i>o</i> -Methylaniline	1.0	18.8	42.6	76.1	125.6	199.9	1,5
C ₇ H ₉ N	<i>m</i> -Methylaniline	3.8	22.0	46.2	80.1	128.8	202.9	1,5
C ₇ H ₉ N	<i>p</i> -Methylaniline				77.1	126.2	199.9	5
C ₇ H ₉ N	<i>N</i> -Methylaniline	-16 e	6 e	34 e	70.3	121.1	195.8	1
C ₇ H ₉ N	2-Ethylpyridine	-46 e	-26 e	-1 e	33 e	79.3	149.0	5
C ₇ H ₉ N	3-Ethylpyridine	-38 e	-17 e	9 e	44 e	92.7	166.5	5
C ₇ H ₉ N	4-Ethylpyridine	-35 e	-15 e	11 e	46 e	94.4	168.6	5
C ₇ H ₉ N	2,3-Dimethylpyridine				42 e	89.9	160.6	5
C ₇ H ₉ N	2,4-Dimethylpyridine		-25 e	3.7	40.0	87.5	157.9	1,5
C ₇ H ₉ N	2,5-Dimethylpyridine			4 e	39 e	86.2	156.6	1
C ₇ H ₉ N	2,6-Dimethylpyridine			-3 e	29.9	75.8	143.6	1
C ₇ H ₉ N	3,4-Dimethylpyridine		-9 e	19 e	55 e	104.8	178.6	5
C ₇ H ₉ N	3,5-Dimethylpyridine			11 e	48 e	98 e	171.5	1
C ₇ H ₁₀ N ₂	Toluene-2,4-diamine			100.4	145.3	202.9	279.5	5
C ₇ H ₁₂	1-Heptyne	-75 e	-57 e	-35 e	-5 e	37.1	99.5	5
C ₇ H ₁₂	2-Heptyne		-51 e	-27 e	4 e	46.9	111.5	5
C ₇ H ₁₂	3-Heptyne	-71 e	-53 e	-31 e	0 e	42.7	106.4	5
C ₇ H ₁₂	5-Methyl-1-hexyne	-80 e	-62 e	-40 e	-11 e	30.1	91.4	5
C ₇ H ₁₂	5-Methyl-2-hexyne	-75 e	-57 e	-34 e	-4 e	38.6	102.0	5
C ₇ H ₁₂	2-Methyl-3-hexyne	-78 e	-61 e	-39 e	-9 e	32.6	94.8	5
C ₇ H ₁₂	4,4-Dimethyl-1-pentyne		-73 e	-52 e	-24 e	15.9	75.6	5
C ₇ H ₁₂	4,4-Dimethyl-2-pentyne		-70 e	-48 e	-19 e	21.4	82.6	5
C ₇ H ₁₂	Bicyclo[4.1.0]heptane					49.9	116.3	5
C ₇ H ₁₂	Cycloheptene			-30.0	3.4	47.5	108 e	5
C ₇ H ₁₂	1-Methylbicyclo(3,1,0)hexane					29.8	92.6	5
C ₇ H ₁₂	Methylenecyclohexane	-76 e	-58 e	-35 e	-5 e	38 e	103.0	5
C ₇ H ₁₂	1-Methylcyclohexene	-72 e	-53 e	-30 e	1 e	45 e	109.8	5
C ₇ H ₁₂	4-Methylcyclohexene	-76 e	-59 e	-36 e	-5 e	37.9	102.3	5
C ₇ H ₁₂	1-Ethylcyclopentene	-75 e	-57 e	-34 e	-3 e	40.7	105.8	5
C ₇ H ₁₂	1,2-Dimethylcyclopentene	-75 e	-57 e	-34 e	-3 e	40.2	105.3	5
C ₇ H ₁₂	1,5-Dimethylcyclopentene	-77 e	-59 e	-36 e	-5.5	37.3	101.5	5
C ₇ H ₁₂ O	Cycloheptanone			18 e	53.7	104.0	178.7	5
C ₇ H ₁₂ O ₂	Butyl acrylate	-52 e	-31 e	-4.5	30.4	78.0	146.9	5
C ₇ H ₁₂ O ₂	Propyl methacrylate				26 e	73.8	139.7	5
C ₇ H ₁₂ O ₃	Ethyl levulinate		17 e	45.3	82.6	133.2	205.7	5
C ₇ H ₁₂ O ₄	Diethyl malonate	-23 e	4 e	36.0	76.4	128.5	198.3	5
C ₇ H ₁₂ O ₄	Dimethyl glutarate	-11 e	15 e	47 e	87.7	139.8	209.5	5
C ₇ H ₁₃ ClO	Heptanoyl chloride	-17 e	4 e	29.4	59.7	96.9	144.0	5
C ₇ H ₁₄	1-Heptene	-82.1	-63.8	-40.6	-10.7	31.1	93.2	1,5
C ₇ H ₁₄	<i>cis</i> -2-Heptene	-79 e	-61 e	-38 e	-8 e	34.3	98.0	5
C ₇ H ₁₄	<i>trans</i> -2-Heptene	-79 e	-61 e	-39 e	-8 e	34.0	97.5	5
C ₇ H ₁₄	<i>cis</i> -3-Heptene	-80 e	-62 e	-40 e	-10 e	32.3	95.3	5
C ₇ H ₁₄	<i>trans</i> -3-Heptene	-80 e	-62 e	-40 e	-10 e	32.2	95.2	5
C ₇ H ₁₄	2-Methyl-1-hexene	-81 e	-64 e	-42 e	-12 e	29.3	91.6	5
C ₇ H ₁₄	4-Methyl-1-hexene	-84 e	-67 e	-45 e	-16 e	25.3	86.3	5
C ₇ H ₁₄	2-Methyl-2-hexene	-80 e	-63 e	-40 e	-10 e	32.0	95.0	5
C ₇ H ₁₄	<i>cis</i> -3-Methyl-2-hexene	-79 e	-62 e	-39 e	-9 e	33.4	96.8	5
C ₇ H ₁₄	<i>trans</i> -4-Methyl-2-hexene	-83 e	-66 e	-44 e	-15 e	25.9	87.1	5
C ₇ H ₁₄	<i>trans</i> -5-Methyl-2-hexene	-83 e	-66 e	-44 e	-15 e	26.3	87.7	5
C ₇ H ₁₄	<i>trans</i> -2-Methyl-3-hexene	-84 e	-67 e	-45 e	-16 e	24.6	85.5	5
C ₇ H ₁₄	3-Ethyl-1-pentene	-85 e	-68 e	-46 e	-17 e	23.2	83.7	5
C ₇ H ₁₄	2,3-Dimethyl-1-pentene	-85 e	-68 e	-46 e	-17 e	23.4	83.8	5
C ₇ H ₁₄	2,4-Dimethyl-1-pentene	-88 e	-71 e	-50 e	-21 e	20.0	81.2	5
C ₇ H ₁₄	3,3-Dimethyl-1-pentene	-87 e	-71 e	-50 e	-21 e	18.1	77.1	5
C ₇ H ₁₄	4,4-Dimethyl-1-pentene	-94 e	-78 e	-57 e	-28 e	11.5	72.1	5
C ₇ H ₁₄	2,3-Dimethyl-2-pentene	-79 e	-62 e	-39 e	-9 e	33.5	96.9	5
C ₇ H ₁₄	2,4-Dimethyl-2-pentene	-84 e	-68 e	-46 e	-18 e	22.6	82.9	5
C ₇ H ₁₄	<i>cis</i> -3,4-Dimethyl-2-pentene	-83 e	-65 e	-43 e	-14 e	27.2	88.8	5
C ₇ H ₁₄	<i>trans</i> -3,4-Dimethyl-2-pentene	-82 e	-64 e	-42 e	-13 e	29.0	91.1	5
C ₇ H ₁₄	<i>cis</i> -4,4-Dimethyl-2-pentene	-90 e	-73 e	-51 e	-22 e	18.6	80.0	5
C ₇ H ₁₄	<i>trans</i> -4,4-Dimethyl-2-pentene	-90 e	-73 e	-52 e	-23 e	16.6	76.3	5
C ₇ H ₁₄	2,3,3-Trimethyl-1-butene	-91 e	-75 e	-53 e	-24.2	16.3	77.5	5
C ₇ H ₁₄	Cycloheptane				6 e	51.1	118.4	1

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₇ H ₁₄	Methylcyclohexane	-79 e	-62 e	-39 e	-7.9	35.5	100.5	1
C ₇ H ₁₄	Ethylcyclopentane	-76 e	-59 e	-35 e	-5 e	38.4	103.0	5
C ₇ H ₁₄	1,1-Dimethylcyclopentane		-69 e	-47 e	-17 e	24.8	87.4	5
C ₇ H ₁₄	<i>cis</i> -1,2-Dimethylcyclopentane			-38 e	-8 e	34.9	99.0	5
C ₇ H ₁₄	<i>trans</i> -1,2-Dimethylcyclopentane	-83 e	-66 e	-43 e	-13 e	28.4	91.4	5
C ₇ H ₁₄	<i>cis</i> -1,3-Dimethylcyclopentane	-84 e	-66 e	-44 e	-14 e	28.2	91.1	5
C ₇ H ₁₄	<i>trans</i> -1,3-Dimethylcyclopentane	-84 e	-67 e	-44 e	-14 e	27.4	90.3	5
C ₇ H ₁₄ O	1-Heptanal	-41 e	-21 e	4 e	37 e	83.7	152.3	5
C ₇ H ₁₄ O	2-Heptanone		-22 e	3 e	36 e	82.2	150.6	1
C ₇ H ₁₄ O	3-Heptanone		-28 e	0 e	36 e	83.2	147.0	5
C ₇ H ₁₄ O	4-Heptanone	-27 e	-6 e	18.8	50.2	90.3	143.4	5
C ₇ H ₁₄ O	5-Methyl-2-hexanone		-27 e	-2 e	31.0	76.6	144.4	5
C ₇ H ₁₄ O	2,4-Dimethyl-3-pentanone	-61 e	-42 e	-18 e	14 e	58.5	124.8	1
C ₇ H ₁₄ O ₂	Heptanoic acid	24 e	46 e	72 e	107 e	154.6	222.6	5
C ₇ H ₁₄ O ₂	Pentyl acetate	-58 e	-39 e	-14 e	20 e	70.1	149 e	5
C ₇ H ₁₄ O ₂	Isopentyl acetate	-51 e	-30 e	-4 e	30.3	76.2	141.4	5
C ₇ H ₁₄ O ₂	Isobutyl propanoate	-35 e	-19 e	2 e	31 e	72.0	136.1	5
C ₇ H ₁₄ O ₂	Propyl butanoate	-35 e	-19 e	3 e	32.0	74.9	142.8	5
C ₇ H ₁₄ O ₂	Propyl isobutanoate		-28 e	-5.7	24.5	67.5	133.3	5
C ₇ H ₁₄ O ₂	Isopropyl isobutanoate		-44 e	-19.7	12.2	56.0	120.1	5
C ₇ H ₁₄ O ₂	Ethyl 3-methylbutanoate	-57 e	-36 e	-10 e	23.9	69.5	134.4	5
C ₇ H ₁₄ O ₂	Methyl hexanoate	-47 e	-26 e	2 e	36.6	83.3	149 e	5
C ₇ H ₁₄ O ₂	4-Methoxy-4-methyl-2-pentanone				43 e	89.8	160 e	5
C ₇ H ₁₅ Br	1-Bromoheptane	-30 e	-9 e	18 e	54 e	104.4	178.4	5
C ₇ H ₁₅ Cl	1-Chloroheptane	-39 e	-19 e	7 e	41 e	88.6	159.9	5
C ₇ H ₁₅ F	1-Fluoroheptane	-64 e	-45 e	-22 e	10 e	53.3	117.4	5
C ₇ H ₁₅ I	1-Iodoheptane	-19 e	3 e	32 e	71 e	123.8	203.4	5
C ₇ H ₁₆	Heptane	-78.6	-60.2	-37.0	-6.6	35.4	98.0	16
C ₇ H ₁₆	2-Methylhexane	-82 e	-65 e	-43 e	-13 e	27.8	89.7	1
C ₇ H ₁₆	3-Methylhexane	-81 e	-64 e	-42 e	-12 e	29.2	91.5	1
C ₇ H ₁₆	3-Ethylpentane	-81 e	-63 e	-41 e	-11 e	30.5	93.1	1
C ₇ H ₁₆	2,2-Dimethylpentane	-90 e	-73 e	-52 e	-22.9	17.6	78.8	1
C ₇ H ₁₆	2,3-Dimethylpentane	-87 e	-68.4	-45.3	-14.9	26.8	89.3	5
C ₇ H ₁₆	2,4-Dimethylpentane	-89 e	-72 e	-50 e	-21.3	19.2	80.1	1
C ₇ H ₁₆	3,3-Dimethylpentane	-88 e	-71 e	-49 e	-18.8	22.9	85.6	1
C ₇ H ₁₆	2,2,3-Trimethylbutane				-23.2	18.1	80.4	5
C ₇ H ₁₆ O	1-Heptanol		17 e	40 e	70.1	112.5	176 e	1
C ₇ H ₁₆ O	2-Heptanol	-9 e	7 e	27 e	55.0	95.2	158.7	5
C ₇ H ₁₆ O	3-Heptanol	-8 e	7 e	27 e	54.5	93.9	156.3	5
C ₇ H ₁₆ O	4-Heptanol	-16 e	1 e	22 e	51 e	91.9	154.6	5
C ₇ H ₁₆ O	2,2-Dimethyl-3-pentanol			9 e	35 e	73.1	135.5	5
C ₇ H ₁₆ S	1-Heptanethiol	-30 e	-9 e	18 e	53 e	102.7	176.4	5
C ₇ H ₁₇ N	Heptylamine			5 e	39 e	86.7	156.4	5
C ₇ H ₁₈ N ₂	<i>N,N</i> -Diethyl-1,3-propanediamine				50.1	99.9	167.7	5
C ₈ F ₁₈	Perfluorooctane				5 e	45.0	105.6	5
C ₈ H ₄ O ₃	Phthalic anhydride	48.2 s	72.4 s			192.7	284.2	5
C ₈ H ₆ O	Benzofuran	-16 e		12 e	47.9	97.7	170.7	5
C ₈ H ₇ Cl	<i>o</i> -Chlorostyrene	-33 e	-10 e	20 e	58 e	110.8	188 e	5
C ₈ H ₇ N	2-Methylbenzotrile		1 e	32.1	72.2	126.6	204.7	5
C ₈ H ₇ N	4-Methylbenzotrile			40.1	78.7	134.3	221.3	5
C ₈ H ₇ N	Benzeneacetonitrile	-3 e	23 e	55.3	97.4	153.7	233.1	5
C ₈ H ₇ N	Indole	20.6 s	44.5 s				254.0	5
C ₈ H ₇ NO ₄	Methyl 2-nitrobenzoate	17 e	49 e	89 e	140 e	208 e	302 e	5
C ₈ H ₈	Styrene		-31 e	-5 e	28.6	75.4	144.7	1
C ₈ H ₈	1,3,5,7-Cyclooctatetraene				24.3	71.0	140.1	5
C ₈ H ₈ O	Acetophenone			36 e	73 e	125.3	201.5	5
C ₈ H ₈ O ₂	Phenyl acetate		3 e	33.1	72.2	123.9	195.5	5
C ₈ H ₈ O ₂	Methyl benzoate		-1 e	29 e	68 e	121.2	198.9	5
C ₈ H ₈ O ₂	4-Methoxybenzaldehyde	9 e	35 e	68.1	110.8	167.9	248.5	5
C ₈ H ₈ O ₃	Methyl salicylate	-1 e	22 e	51 e	88.8	141.8	219.9	5
C ₈ H ₉ Cl	1-Chloro-2-ethylbenzene	-30 e	-9 e	18 e	54 e	103.7	177.9	5
C ₈ H ₉ Cl	1-Chloro-4-ethylbenzene	-27 e	-6 e	22 e	58 e	108.7	183.9	5
C ₈ H ₉ NO ₂	1-Ethyl-4-nitrobenzene	10 e	36 e	69 e	111.6	168 e	245 e	5
C ₈ H ₁₀	Ethylbenzene	-56.2	-36.8	-12.0	21.1	67.1	135.7	1
C ₈ H ₁₀	<i>o</i> -Xylene			-7 e	27 e	74.2	143.9	1
C ₈ H ₁₀	<i>m</i> -Xylene		-35 e	-10 e	23.4	69.8	138.7	1
C ₈ H ₁₀	<i>p</i> -Xylene				22.4	68.9	137.9	1

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₈ H ₁₀ O	<i>o</i> -Ethylphenol		16.9	44.5	81.1	130.9	204.0	5
C ₈ H ₁₀ O	<i>m</i> -Ethylphenol	5.6	29.2	57.5	91.9	144.8	217.9	5
C ₈ H ₁₀ O	<i>p</i> -Ethylphenol			60 e	95.5	144.6	217.5	5
C ₈ H ₁₀ O	2,3-Xylenol	14.3 s	34.3 s	57.2 s	91.4	141.7	216.4	1,5
C ₈ H ₁₀ O	2,4-Xylenol			50.2	85.5	137.2	210.5	1,5
C ₈ H ₁₀ O	2,5-Xylenol	13.4 s	33.2 s	55.9 s	87.4	137.0	210.6	5
C ₈ H ₁₀ O	2,6-Xylenol	-3.1 s	16.7 s	39.6 s	75.3	125.9	200.6	1,5
C ₈ H ₁₀ O	3,4-Xylenol	19.7 s	40.2 s	63.7 s	102.1	152.3	226.4	1,5
C ₈ H ₁₀ O	3,5-Xylenol	16.5 s	37.2 s	61.1 s	98.0	147.9	221.3	1,5
C ₈ H ₁₀ O	Benzeneethanol	2 e	25 e	54 e	92 e	143.6	217.7	5
C ₈ H ₁₀ O	Phenotole		-9 e	17 e	51 e	99 e	169.3	5
C ₈ H ₁₀ O ₂	2-Phenoxyethanol	21 e	46 e	75.9	115.4	168.7	244.8	5
C ₈ H ₁₀ O ₂	1,3-Dimethoxybenzene	18 e	34 e	56 e	86.7	135.5	223 e	5
C ₈ H ₁₁ N	<i>p</i> -Ethylaniline	-2 e	21 e	49 e	87 e	139.4	216.7	5
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline	-15 e	8 e	38 e	76.4	128.8	204.2	5
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline			28 e	66 e	118.1	193.6	1
C ₈ H ₁₁ N	2,4-Xylidine	-2 e	21 e	51 e	88 e	139.1	210.9	5
C ₈ H ₁₁ N	2,6-Xylidine			37 e	80 e	137.7	217.7	5
C ₈ H ₁₁ N	5-Ethyl-2-picoline	-33 e	-9.3	20 e			178.0	5
C ₈ H ₁₁ NO	<i>o</i> -Phenetidine	0 e	27 e	60 e	102.2	156.0	228.1	5
C ₈ H ₁₂	1,5-Cyclooctadiene		-37 e	-8 e	30 e	80.2	150 e	5
C ₈ H ₁₂	4-Vinylcyclohexene	-62 e	-43 e	-19 e	14.1	59.9	129 e	5
C ₈ H ₁₂ O ₄	Diethyl maleate	-6 e	20 e	52.2	93.5	148.4	224.8	5
C ₈ H ₁₄	2,5-Dimethyl-1,5-hexadiene	-38 e	-26 e	-10 e	14 e	50.8	115.1	5
C ₈ H ₁₄	1-Octyne	-59 e	-40 e	-16 e	16 e	60.3	125.8	1
C ₈ H ₁₄	2-Octyne	-52 e	-33 e	-8 e	25 e	70.6	137.8	1
C ₈ H ₁₄	3-Octyne	-55 e	-35 e	-11 e	22 e	66.8	132.8	1
C ₈ H ₁₄	4-Octyne	-56 e	-36 e	-12 e	21 e	65.6	131.4	1
C ₈ H ₁₄	1-Ethylcyclohexene	-55 e	-35 e	-11 e	22 e	68 e	136.5	5
C ₈ H ₁₄ O ₂	Cyclohexyl acetate					103.1	172.9	5
C ₈ H ₁₄ O ₂	Butyl methacrylate				47 e	93.3	159.0	5
C ₈ H ₁₄ O ₃	Butanoic anhydride	-28 e	-2 e	30 e	71 e	123.8	196.5	5
C ₈ H ₁₄ O ₄	Ethyl succinate	-6 e	20 e	51.0	91.1	143.7	216.1	5
C ₈ H ₁₄ O ₄	Dipropyl oxalate	-4 e	20 e	49.9	88.6	140.4	213.0	5
C ₈ H ₁₄ O ₄	Dimethyl adipate		28 e	61 e	103 e	156.1	227.3	5
C ₈ H ₁₅ Br	(2-Bromoethyl)cyclohexane	-14 e	8 e	36.9	75.3	129.7	212.5	5
C ₈ H ₁₅ ClO	Octanoyl chloride	1 e	22 e	46 e	74.7	109 e	150 e	5
C ₈ H ₁₅ N	Octanenitrile	-15 e	8 e	37 e	75 e	127.7	204.4	5
C ₈ H ₁₆	1-Octene	-65.7	-46.1	-21.4	10.5	54.9	120.9	1,5
C ₈ H ₁₆	<i>cis</i> -2-Octene	-59 e	-41 e	-17 e	15 e	59 e	125.2	5
C ₈ H ₁₆	<i>trans</i> -2-Octene	-59 e	-41 e	-17 e	14 e	59 e	124.5	5
C ₈ H ₁₆	<i>cis</i> -3-Octene	-65 e	-46 e	-22 e	10 e	55.1	122.4	5
C ₈ H ₁₆	<i>trans</i> -3-Octene	-61 e	-43 e	-19 e	13 e	57 e	122.8	5
C ₈ H ₁₆	<i>cis</i> -4-Octene	-63 e	-44 e	-20 e	11 e	56 e	122.1	5
C ₈ H ₁₆	<i>trans</i> -4-Octene	-65 e	-46 e	-22 e	10 e	54.6	121.8	5
C ₈ H ₁₆	2-Methyl-1-heptene	-66 e	-48 e	-24 e	8 e	52.3	118.7	5
C ₈ H ₁₆	2,2-Dimethyl- <i>cis</i> -3-hexene	-74 e	-56 e	-33 e	-3 e	40.1	105.0	5
C ₈ H ₁₆	2,3-Dimethyl-2-hexene	-65 e	-47 e	-23 e	10 e	54.3	121.3	5
C ₈ H ₁₆	2,3,3-Trimethyl-1-pentene		-53 e	-30 e	1 e	43.8	107.9	5
C ₈ H ₁₆	2,4,4-Trimethyl-1-pentene	-79 e	-61 e	-38 e	-7 e	36.2	101.0	5
C ₈ H ₁₆	2,3,4-Trimethyl-2-pentene	-68 e	-49 e	-26 e	6 e	50.0	115.8	5
C ₈ H ₁₆	2,4,4-Trimethyl-2-pentene	-73 e	-56 e	-33 e	-2 e	40.4	104.5	5
C ₈ H ₁₆	Cyclooctane				30 e	78 e	150.7	1
C ₈ H ₁₆	Ethylcyclohexane	-61 e	-42 e	-17 e	15.8	61.9	131.3	5
C ₈ H ₁₆	1,1-Dimethylcyclohexane			-27 e	5 e	50.6	119.1	5
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane		-44 e	-20 e	14 e	59.7	129.2	5
C ₈ H ₁₆	<i>trans</i> -1,2-Dimethylcyclohexane	-68 e	-49 e	-25 e	8 e	53.9	122.9	5
C ₈ H ₁₆	<i>cis</i> -1,3-Dimethylcyclohexane	-68 e	-48 e	-23 e	10 e	55.6	123.1	5
C ₈ H ₁₆	<i>trans</i> -1,3-Dimethylcyclohexane	-62 e	-45 e	-23 e	8 e	51.5	120.9	5
C ₈ H ₁₆	<i>cis</i> -1,4-Dimethylcyclohexane	-66 e	-47 e	-23 e	10 e	55.3	123.8	5
C ₈ H ₁₆	<i>trans</i> -1,4-Dimethylcyclohexane			-27 e	5 e	50.6	118.9	5
C ₈ H ₁₆	Propylcyclopentane	-60 e	-41 e	-16 e	16.5	62.1	130.5	5
C ₈ H ₁₆	Isopropylcyclopentane	-65 e	-46 e	-21 e	12 e	57.3	125.9	5
C ₈ H ₁₆	1-Ethyl-1-methylcyclopentane	-67 e	-49 e	-24 e	8 e	53.2	121.0	5
C ₈ H ₁₆	<i>cis</i> -1-Ethyl-2-methylcyclopentane	-63 e	-44 e	-19 e	13.3	59.1	127.6	5
C ₈ H ₁₆	1,1,2-Trimethylcyclopentane				2 e	46.2	113.2	5
C ₈ H ₁₆	1,1,3-Trimethylcyclopentane	-77 e	-59 e	-36 e	-5 e	38.7	104.4	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₈ H ₁₆	1',2',4a-1,2,4-Trimethylcyclopentane	-70 e	-52 e	-28 e	4 e	48.9	116.2	5
C ₈ H ₁₆	1',2a,4'-1,2,4-Trimethylcyclopentane	-74 e	-56 e	-33 e	-1 e	42.8	108.8	5
C ₈ H ₁₆ O	1-Propylcyclopentanol	9 e	24 e	43 e	69.0	108.4	173.5	5
C ₈ H ₁₆ O	Octanal			6 e	45.7	97.8	170.2	5
C ₈ H ₁₆ O	2-Octanone		-3 e	23 e	57 e	103.8	172.1	5
C ₈ H ₁₆ O	3-Octanone			8 e	47.7	97 e	161 e	5
C ₈ H ₁₆ O	2,2,4-Trimethyl-3-pentanone			11.3	42.1	81.7	134.6	5
C ₈ H ₁₆ O ₂	Octanoic acid	37 e	58 e	85 e	120 e	165.5	238.4	1,5
C ₈ H ₁₆ O ₂	2-Ethylhexanoic acid				108 e	159.6	226.6	5
C ₈ H ₁₆ O ₂	Hexyl acetate	-37 e	-13 e	16 e	52.8	100.4	164 e	5
C ₈ H ₁₆ O ₂	Isopentyl propanoate			3.1	40.7	90.6	159.8	5
C ₈ H ₁₆ O ₂	Isobutyl isobutanoate	-47 e	-26 e	0.4	34.8	81.1	147.0	5
C ₈ H ₁₆ O ₂	Propyl 3-methylbutanoate			1.8	38.9	87.9	155.6	5
C ₈ H ₁₆ O ₂	Ethyl hexanoate	-31 e	-9 e	18.7	53.9	100.7	166.2	5
C ₈ H ₁₆ O ₂	Methyl heptanoate	-30 e	-9 e	19 e	54.2	102.4	172 e	5
C ₈ H ₁₆ O ₄	Diethylene glycol monoethyl ether acetate	-16 e	10.6	43.9	86.2	141.3	216.6	5
C ₈ H ₁₇ Br	1-Bromooctane	-17 e	6 e	34 e	72 e	123.8	200.3	5
C ₈ H ₁₇ Cl	1-Chlorooctane	-25 e	-4 e	23 e	59 e	108.8	182.9	5
C ₈ H ₁₇ Cl	3-(Chloromethyl)heptane					100.3	172.4	5
C ₈ H ₁₇ F	1-Fluorooctane				29 e	74.6	141.8	5
C ₈ H ₁₇ I	1-Iodooctane	-6 e	18 e	48 e	87 e	142.5	224.5	5
C ₈ H ₁₈	Octane		-42.6	-17.9	14.4	58.9	125.3	16
C ₈ H ₁₈	2-Methylheptane	-69 e	-49.1	-24.5	7.6	51.6	117.2	1,5
C ₈ H ₁₈	3-Methylheptane	-67 e	-48.1	-23.6	8.5	52.7	118.5	1,5
C ₈ H ₁₈	4-Methylheptane	-65 e	-47 e	-24 e	7.8	51.6	117.2	5
C ₈ H ₁₈	3-Ethylhexane				8 e	52.1	118.1	5
C ₈ H ₁₈	2,2-Dimethylhexane	-73 e	-55 e	-32 e	-1.5	41.6	106.4	5
C ₈ H ₁₈	2,3-Dimethylhexane				5 e	49.2	115.1	5
C ₈ H ₁₈	2,4-Dimethylhexane				0.6	43.9	109.0	5
C ₈ H ₁₈	2,5-Dimethylhexane	-71 e	-53 e	-30 e	0.7	43.8	108.6	5
C ₈ H ₁₈	3,3-Dimethylhexane	-72 e	-54 e	-30 e	1.4	45.4	111.5	5
C ₈ H ₁₈	3,4-Dimethylhexane				7 e	50.9	117.3	5
C ₈ H ₁₈	3-Ethyl-2-methylpentane	-69 e	-50 e	-27 e	5 e	48.9	115.2	5
C ₈ H ₁₈	3-Ethyl-3-methylpentane	-70 e	-51 e	-27 e	5 e	50.2	117.8	5
C ₈ H ₁₈	2,2,3-Trimethylpentane	-74 e	-56 e	-32 e	-0.8	43.1	109.4	5
C ₈ H ₁₈	2,2,4-Trimethylpentane	-81.9	-63.4	-39.8	-8.9	34.0	98.8	5
C ₈ H ₁₈	2,3,3-Trimethylpentane	-72 e	-54 e	-30 e	2.1	46.9	114.3	5
C ₈ H ₁₈	2,3,4-Trimethylpentane	-74 e	-54.5	-30.0	2.2	46.7	113.1	1,5
C ₈ H ₁₈	2,2,3,3-Tetramethylbutane	-62.5 s	-44 s	-20.9 s	8.9 s	48.8 s	105.8	5
C ₈ H ₁₈ O	1-Octanol	12 e	30 e	53 e	84 e	128.2	194.8	1,39
C ₈ H ₁₈ O	2-Octanol			40 e	69.9	112.5	179.4	1,39
C ₈ H ₁₈ O	3-Octanol	12 e	24 e	40 e	64 e	102.8	174.1	1
C ₈ H ₁₈ O	4-Octanol			40 e	66.9	107.3	176.0	1,39
C ₈ H ₁₈ O	4-Methyl-3-heptanol	-52 e	-28 e	1 e	39 e	87.6	155.0	5
C ₈ H ₁₈ O	5-Methyl-3-heptanol	-35 e	-16 e	8 e	40 e	84.8	153.0	5
C ₈ H ₁₈ O	4-Methyl-4-heptanol	-17 e	1 e	24 e	55 e	97.2	160.7	5
C ₈ H ₁₈ O	2-Ethyl-1-hexanol			45 e	75 e	118.3	184.2	1
C ₈ H ₁₈ O	2-Ethyl-2-hexanol	-13 e	4 e	26 e	55 e	96.3	160.3	5
C ₈ H ₁₈ O	2,4,4-Trimethyl-2-pentanol		-7 e	13 e	40 e	79.8	146.1	5
C ₈ H ₁₈ O	2,2,4-Trimethyl-3-pentanol	-2 e	9 e	24 e	47 e	82.6	150.4	5
C ₈ H ₁₈ O	Dibutyl ether	-55 e	-35 e	-8 e	26 e	73.0	141.2	5
C ₈ H ₁₈ O	Di- <i>sec</i> -butyl ether			-19 e	12.1	55.4	120.6	5
C ₈ H ₁₈ O	Di- <i>tert</i> -butyl ether			-33 e	-2 e	41.7	106.8	1
C ₈ H ₁₈ O ₂	Ethylene glycol monohexyl ether	-13 e	14 e	46 e	86 e	137.7	206.9	5
C ₈ H ₁₈ O ₂	1,2-Dipropoxyethane			-44.2	-2.0	63.6	179.2	5
C ₈ H ₁₈ O ₂	Di- <i>tert</i> -butyl peroxide			-26 e	4.3	46.6	110.5	5
C ₈ H ₁₈ O ₃	Diethylene glycol monobutyl ether	14 e	37 e	66.8	104.9	153 e	230.4	5
C ₈ H ₁₈ O ₃	Diethylene glycol diethyl ether	-32 e	-7 e	25 e	64.9	117.1	189 e	5
C ₈ H ₁₈ O ₅	Tetraethylene glycol	89 e	117 e	151.1	192.2	242.9	307.3	5
C ₈ H ₁₈ S	1-Octanethiol	-15 e	6 e	34 e	71 e	122.1	198.5	5
C ₈ H ₁₈ S	Dibutyl sulfide	-22 e	0 e	27 e	63 e	113.5	188.4	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₈ H ₁₉ N	Dibutylamine	-37 e	-16 e	10 e	44 e	90.8	159.1	5
C ₈ H ₁₉ N	Diisobutylamine	-57 e	-36 e	-9.0	25.5	72.2	139.0	5
C ₈ H ₂₀ O ₄ Si	Ethyl silicate	-77 e	-52 e	-21 e	21.6	80.5	164.1	5
C ₈ H ₂₀ Si	Tetraethylsilane			-6.5	30.5	80.6	152.6	5
C ₉ F ₂₀	Perfluorononane					40 e	114.7	5
C ₉ H ₆ N ₂ O ₂	Toluene-2,4-diisocyanate		39 e	72 e	113.9	169.7	247 e	5
C ₉ H ₇ N	Quinoline	-1.3	23.7	55.4	96.8	153.4	236.5	1,5
C ₉ H ₇ N	Isoquinoline		30.2	60.7	101.3	157.9	242.7	1,5
C ₉ H ₈	Indene			12 e	53.0	106.8	181.0	5
C ₉ H ₁₀	<i>cis</i> -1-Propenylbenzene	-38 e	-15.4	13.3	51.4	103.7	178.4	5
C ₉ H ₁₀	<i>trans</i> -1-Propenylbenzene		-16 e	13.3	51.6	103.7	178.4	5
C ₉ H ₁₀	Isopropenylbenzene			3.2	41.5	92.8	164.9	5
C ₉ H ₁₀	Indan	-33 e	-12 e	16 e	52 e	102.3	177.5	1
C ₉ H ₁₀ O	2,4-Dimethylbenzaldehyde	-3 e	23 e	54 e	93.2	144.6	214.5	5
C ₉ H ₁₀ O ₂	Ethyl benzoate	-18 e	8 e	39 e	80.1	135.1	212.8	5
C ₉ H ₁₀ O ₂	Benzyl acetate	-11 e	15 e	46.6	86.9	139.5	211 e	5
C ₉ H ₁₁ Br	1-Bromo-4-isopropylbenzene	-8 e	15 e	45 e	84 e	138.1	218.5	5
C ₉ H ₁₁ Cl	1-Chloro-2-isopropylbenzene	-23 e	-1 e	27 e	64 e	114.6	190.5	5
C ₉ H ₁₁ Cl	1-Chloro-4-isopropylbenzene		3 e	31 e	69 e	120.5	197.8	5
C ₉ H ₁₂	Propylbenzene	-43 e	-23 e	4 e	38 e	86.7	158.8	1
C ₉ H ₁₂	Isopropylbenzene	-46 e	-26 e	-1 e	33 e	80.9	152.0	1
C ₉ H ₁₂	<i>o</i> -Ethyltoluene	-40 e	-19 e	8 e	43 e	92.1	164.7	5
C ₉ H ₁₂	<i>m</i> -Ethyltoluene	-42 e	-21 e	5 e	40.4	88.9	160.8	5
C ₉ H ₁₂	<i>p</i> -Ethyltoluene	-41 e	-21 e	6 e	41 e	89.2	161.5	5
C ₉ H ₁₂	1,2,3-Trimethylbenzene		-12 e	15 e	52 e	101.5	175.6	1
C ₉ H ₁₂	1,2,4-Trimethylbenzene	-37 e	-16 e	11 e	47 e	95.9	168.9	1
C ₉ H ₁₂	1,3,5-Trimethylbenzene	-39 e	-18 e	9 e	43.7	92.4	164.3	1
C ₉ H ₁₂ O	Benzyl ethyl ether		-10 e	20.4	59.3	111.3	184.5	5
C ₉ H ₁₂ O	Phenyl propyl ether		-10 e	21 e	61 e	113.9	189.3	5
C ₉ H ₁₂ O	Phenyl isopropyl ether	-20 e	-1 e	23 e	56 e	103.7	176.9	5
C ₉ H ₁₃ N	2,4,6-Trimethylaniline	12 e	36 e	66 e	104.1	154.9	226 e	5
C ₉ H ₁₃ N	<i>N,N</i> -Dimethyl- <i>o</i> -toluidine	-25 e	-3 e	24.4	60.6	110.7	184.5	5
C ₉ H ₁₃ N	Amphetamine			33 e	70.1	118 e	202.0	5
C ₉ H ₁₄ O	Isophorone		1 e	33.1	75.1	132.4	215.1	5
C ₉ H ₁₄ O ₆	Triacetin	37.6	62 e	90 e	124 e	165 e	214 e	5
C ₉ H ₁₆ O ₄	Diethyl glutarate	-1 e	26 e	60.2	103.3	159.6	236.5	5
C ₉ H ₁₇ N	Nonanenitrile	-3 e	21 e	50.9	90.7	145.4	225.1	5
C ₉ H ₁₈	1-Nonene	-50.1	-29.4	-3.3	30.4	77.1	146.4	1,5
C ₉ H ₁₈	2-Methyl-1-octene	-53 e	-34 e	-9 e	25 e	72 e	144.1	5
C ₉ H ₁₈	Butylcyclopentane	-45 e	-24 e	1 e	36 e	84 e	156.1	5
C ₉ H ₁₈	Propylcyclohexane	-46 e	-26 e	0 e	35.1	83.6	156.2	5
C ₉ H ₁₈	Isopropylcyclohexane	-48 e	-28 e	-2 e	33 e	81.3	154.0	5
C ₉ H ₁₈	<i>trans</i> -1-Ethyl-4-methylcyclohexane	-53 e	-33 e	-8 e	25 e	71.8	141.5	5
C ₉ H ₁₈	1,1,2-Trimethylcyclohexane			-12 e	23 e	71.5	145.5	5
C ₉ H ₁₈	1,1,3-Trimethylcyclohexane	-60 e	-41 e	-16 e	18 e	65.2	136.1	5
C ₉ H ₁₈	1',2a,4a-1,2,4-Trimethylcyclohexane	-71 e	-50 e	-22 e	15 e	65.7	140.7	5
C ₉ H ₁₈	1',3',5'-1,3,5-Trimethylcyclohexane	-72 e	-50 e	-22 e	14 e	65.1	140.0	5
C ₉ H ₁₈	Isobutylcyclopentane	-105 e	-88 e	-64 e	-28 e	31 e	147.0	5
C ₉ H ₁₈	<i>cis</i> -1-Methyl-2-propylcyclopentane	-52 e	-33 e	-7 e	28 e	77 e	152.0	5
C ₉ H ₁₈	<i>trans</i> -1-Methyl-2-propylcyclopentane	-56 e	-36 e	-11 e	23 e	72 e	145.8	5
C ₉ H ₁₈	1,1,3,3-Tetramethylcyclopentane	-72 e	-54 e	-30 e	2 e	47 e	117.4	5
C ₉ H ₁₈ O	Nonanal		-3 e	27.4	65.5	115.6	184.6	5
C ₉ H ₁₈ O	2-Nonanone		8 e	35 e	71 e	121.0	194.0	5
C ₉ H ₁₈ O	5-Nonanone			-1 e	39.1	94 e	188 e	5
C ₉ H ₁₈ O	2,6-Dimethyl-4-heptanone	-32 e	-12 e	14 e	48 e	96.2	167.7	5
C ₉ H ₁₈ O ₂	Nonanoic acid	48 e	69 e	97 e	133 e	182.7	255.1	5
C ₉ H ₁₈ O ₂	Heptyl acetate	-16 e	6 e	34 e	70 e	119.9	191.9	5
C ₉ H ₁₈ O ₂	Isopentyl butanoate				55 e	105.6	178.4	5
C ₉ H ₁₈ O ₂	Isobutyl 3-methylbutanoate			11.3	48.3	97.9	168.3	5
C ₉ H ₁₈ O ₂	Propyl hexanoate	-26 e	-2 e	28 e	65.1	113.4	178 e	5
C ₉ H ₁₈ O ₂	Methyl octanoate	-26 e	-9 e	13 e	40 e	76 e	127.9	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₉ H ₁₉ Cl	1-Chlorononane	-11 e	11 e	39 e	76 e	127.8	204.7	5
C ₉ H ₂₀	Nonane	-46.8	-26.0	0.0	34.0	80.8	150.3	16
C ₉ H ₂₀	2-Methyloctane	-49 e	-30 e	-5 e	28 e	73.9	142.8	5
C ₉ H ₂₀	3-Methyloctane	-49 e	-29 e	-5 e	29 e	74.7	143.7	5
C ₉ H ₂₀	4-Methyloctane	-50 e	-30 e	-6 e	27 e	73.2	141.9	5
C ₉ H ₂₀	2,2-Dimethylheptane	-58 e	-39 e	-15 e	18 e	63.6	132.3	5
C ₉ H ₂₀	2,3-Dimethylheptane	-53 e	-33 e	-9 e	25 e	70.8	140.0	5
C ₉ H ₂₀	2,6-Dimethylheptane	-55 e	-36 e	-12 e	21 e	66.4	134.7	5
C ₉ H ₂₀	3-Ethyl-4-methylhexane			-9 e	24 e	70.6	139.9	5
C ₉ H ₂₀	2,2,4-Trimethylhexane	-66.1	-46.4	-21.3	11.8	57.7	126.0	5
C ₉ H ₂₀	2,2,5-Trimethylhexane	-65.1	-45.8	-21.2	11.2	56.2	123.7	1,5
C ₉ H ₂₀	2,3,3-Trimethylhexane	-58 e	-38 e	-13 e	20 e	66.7	137.2	5
C ₉ H ₂₀	2,3,5-Trimethylhexane	-60 e	-41 e	-16 e	17 e	62.3	130.9	5
C ₉ H ₂₀	2,4,4-Trimethylhexane	-62 e	-43 e	-18 e	15 e	61.0	130.2	5
C ₉ H ₂₀	3,3,4-Trimethylhexane	-53 e	-33 e	-7 e	28 e	76.3	148.9	5
C ₉ H ₂₀	3,3-Diethylpentane			-9 e	26 e	73.7	145.7	1
C ₉ H ₂₀	3-Ethyl-2,4-dimethylpentane	-58 e	-38 e	-13 e	20 e	66.7	136.2	5
C ₉ H ₂₀	2,2,3,3-Tetramethylpentane				21 e	68.5	139.8	1
C ₉ H ₂₀	2,2,3,4-Tetramethylpentane	-61 e	-42 e	-17 e	16 e	62.5	132.6	1
C ₉ H ₂₀	2,2,4,4-Tetramethylpentane		-49 e	-25 e	8 e	53.2	121.8	1
C ₉ H ₂₀	2,3,3,4-Tetramethylpentane	-57 e	-37 e	-12 e	22 e	69.7	141.1	1
C ₉ H ₂₀ O	1-Nonanol		40 e	64 e	96.9	141.0	213.0	5,39
C ₉ H ₂₀ O	3-Nonanol		24 e	47 e	78 e	123.0	194.2	5
C ₉ H ₂₀ O	4-Nonanol			45 e	76.4	121.3	192.0	5
C ₉ H ₂₀ O	5-Nonanol	13 e	31 e	54 e	84.5	128.1	194.7	5
C ₉ H ₂₀ O	2,2,4,4-Tetramethyl-3-pentanol				58	100	167	5
C ₉ H ₂₀ S	1-Nonanethiol	-2 e	21 e	49 e	87 e	140.4	219.2	5
C ₉ H ₂₁ BO ₃	Triisopropyl borate					73.1	139.0	5
C ₉ H ₂₁ N	Nonylamine		9 e	37 e	75 e	126.2	202.1	5
C ₉ H ₂₁ N	Tripropylamine	-39 e	-18 e	8 e	42 e	88.2	156.0	5
C ₁₀ F ₈	Perfluoronaphthalene	5.2 s	25.1 s	48.1 s				5
C ₁₀ F ₂₂	Perfluorodecane					52 e	132.9	5
C ₁₀ H ₇ Br	1-Bromonaphthalene	17 e	45 e	80.3	126.7	189.8	280.5	5
C ₁₀ H ₇ Cl	1-Chloronaphthalene	14 e	39 e	70.5	112.8	171.6	258.6	5
C ₁₀ H ₈	Naphthalene**	3.2 s	24.1 s	49.3 s	80.7	135.6	217.5	1,5
C ₁₀ H ₈	Azulene	24.1 s	46 s	71.5 s	103.3	162.6	244.0	5
C ₁₀ H ₈ O	1-Naphthol				137.2	196.7	281.8	5
C ₁₀ H ₈ O	2-Naphthol				140.7	200.5	286.8	5
C ₁₀ H ₉ N	1-Naphthalenamine		62 e	99.0	146.9	210.7	300.1	5
C ₁₀ H ₉ N	2-Naphthalenamine	36.3 s	65.9 s	103 s	150.9	215.1	305.5	5
C ₁₀ H ₉ N	2-Methylquinoline	5.3	31.9	63.8	102.9	165.8	247.2	5
C ₁₀ H ₉ N	4-Methylquinoline	29 e	54 e	85 e	127 e	183.0	265.1	5
C ₁₀ H ₉ N	6-Methylquinoline	27 e	51 e	81 e	122 e	179.2	264.5	5
C ₁₀ H ₉ N	8-Methylquinoline	15 e	40 e	70 e	111 e	166.1	247.3	5
C ₁₀ H ₁₀	<i>m</i> -Divinylbenzene	-29 e	-4 e	27.1	67.6	122.1	199 e	5
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate	27 e	56 e	92.7	137.8	195.8	272.7	5
C ₁₀ H ₁₀ O ₄	Dimethyl isophthalate			85 e	129.5	189.2	273 e	5
C ₁₀ H ₁₀ O ₄	Dimethyl terephthalate	56.6 s	79.4 s	106.1 s	137.9 s	197.9	282 e	5
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene	-21 e	3 e	33.2	74.1	127.4	207.8	5
C ₁₀ H ₁₂	2-Ethylstyrene	-31 e	-8 e	21 e	60 e	111.7	187 e	5
C ₁₀ H ₁₂	3-Ethylstyrene	-28 e	-5.3	24.1	62.6	116 e	193 e	5
C ₁₀ H ₁₂	4-Ethylstyrene	-31 e	-8.2	21.3	60.5	115 e	196 e	5
C ₁₀ H ₁₂ O	Estragole			48.5	88.0	140.7	214.6	5
C ₁₀ H ₁₂ O	4-Isopropylbenzaldehyde			54.1	96.0	152.2	231.5	5
C ₁₀ H ₁₂ O ₂	4-Allyl-2-methoxyphenol	9 e	37 e	72 e	115.9	173.8	252.9	5
C ₁₀ H ₁₂ O ₂	2-Phenylethyl acetate	-4 e	22 e	54 e	96 e	152.3	232.0	5
C ₁₀ H ₁₂ O ₂	Propyl benzoate	-8 e	18 e	50.2	92.3	149.2	230.5	5
C ₁₀ H ₁₂ O ₂	Ethyl phenylacetate	-9 e	19 e	52 e	95 e	150.2	225 e	5
C ₁₀ H ₁₂ O ₂	Isoeugenol			125 e		185.3	267.1	5
C ₁₀ H ₁₄	Butylbenzene	-28 e	-7 e	21 e	56.9	107.6	182.8	1,5
C ₁₀ H ₁₄	<i>sec</i> -Butylbenzene	-35 e	-14 e	13 e	48 e	98.3	172.8	5
C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	-37 e	-16 e	10 e	46 e	94.9	168.6	5
C ₁₀ H ₁₄	Isobutylbenzene	-36 e	-15 e	12 e	47.9	97.8	172.3	5
C ₁₀ H ₁₄	<i>o</i> -Cymene	-39 e	-16 e	13 e	51 e	103.1	177.8	5
C ₁₀ H ₁₄	<i>m</i> -Cymene	-34 e	-13 e	14 e	50 e	99.9	174.6	5
C ₁₀ H ₁₄	<i>p</i> -Cymene	-33 e	-12 e	16 e	52 e	102.2	176.6	5
C ₁₀ H ₁₄	<i>o</i> -Diethylbenzene	-28 e	-6 e	21 e	58 e	107.9	182.9	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₁₀ H ₁₄	<i>m</i> -Diethylbenzene	-28 e	-7 e	20 e	56 e	106.2	180.6	5
C ₁₀ H ₁₄	<i>p</i> -Diethylbenzene	-28 e	-6 e	21 e	57 e	108.1	183.3	5
C ₁₀ H ₁₄	3-Ethyl-1,2-dimethylbenzene	-22 e	0 e	28 e	66 e	117.2	193.4	5
C ₁₀ H ₁₄	4-Ethyl-1,2-dimethylbenzene	-24 e	-2 e	26 e	63 e	113.6	189.2	5
C ₁₀ H ₁₄	2-Ethyl-1,3-dimethylbenzene		-2 e	26 e	63 e	113.7	189.5	5
C ₁₀ H ₁₄	2-Ethyl-1,4-dimethylbenzene	-27 e	-5 e	23 e	60 e	110.6	186.4	5
C ₁₀ H ₁₄	1-Ethyl-2,4-dimethylbenzene	-25 e	-4 e	24 e	61 e	112.2	187.9	5
C ₁₀ H ₁₄	1-Ethyl-3,5-dimethylbenzene	-28 e	-6 e	21 e	58 e	108.3	183.2	5
C ₁₀ H ₁₄	1-Methyl-2-propylbenzene	-27 e	-6 e	22 e	58.2	108.9	184.3	5
C ₁₀ H ₁₄	1-Methyl-3-propylbenzene	-29 e	-8 e	20 e	56.1	106.5	181.3	5
C ₁₀ H ₁₄	1-Methyl-4-propylbenzene	-29 e	-7 e	20 e	56.6	107.4	182.8	5
C ₁₀ H ₁₄	1,2,3,4-Tetramethylbenzene		7 e	36 e	74 e	126.6	204.5	5
C ₁₀ H ₁₄	1,2,3,5-Tetramethylbenzene	-19 e	3 e	32 e	69 e	120.9	197.5	5
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene					119.9	196.3	5
C ₁₀ H ₁₄ O	2-Butylphenol	7 e	31 e	61 e	101 e	155.2	234.4	5
C ₁₀ H ₁₄ O	Butyl phenyl ether	-16 e	8 e	38 e	77 e	131.3	209.7	5
C ₁₀ H ₁₄ O	Thymol	18.9 s	37.9 s	59.5	101.2	155.0	230.4	5
C ₁₀ H ₁₅ N	2-Methyl-5-isopropylaniline	19 e	43 e	72 e	107.4	150 e	204 e	5
C ₁₀ H ₁₅ N	<i>N</i> -Butylaniline	11 e	35 e	66 e	106 e	160.9	241.0	5
C ₁₀ H ₁₅ N	<i>N,N</i> -Diethylaniline	-11 e	14 e	44.3	84.2	138.4	216.3	5
C ₁₀ H ₁₆	Dipentene	-42 e	-19 e	10.6	48.7	100.2	173.9	5
C ₁₀ H ₁₆	<i>d</i> -Limonene	-45 e	-21 e	9.1	48.0	100.4	174.5	5
C ₁₀ H ₁₆	<i>l</i> -Limonene	-33 e	-12 e	16 e	52.0	102.3	177.0	21
C ₁₀ H ₁₆	β -Myrcene			9.4	47.3	98.3	171.0	5
C ₁₀ H ₁₆	α -Pinene	-48 e	-27 e	-1 e	33.6	82.2	155.1	21
C ₁₀ H ₁₆	β -Pinene	-43 e	-22 e	5.0	40.6	90.5	165.5	21
C ₁₀ H ₁₆	Camphene					90.7	160.1	4
C ₁₀ H ₁₆	Terpinolene			26.5	64.9	115.4	184.6	5
C ₁₀ H ₁₆	β -Phellandrene			16 e	53.2	104 e	171.0	5
C ₁₀ H ₁₆ O	(+)-Camphor	-15.8 s	10 s	41.5 s	80.8 s	131.4 s	207.6	5
C ₁₀ H ₁₆ O	Pulegone	37 e	49.1	66.4	92.2	135.1	220.2	5
C ₁₀ H ₁₈	1-Decyne	-34 e	-13 e	14 e	51 e	100.3	173.5	5
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	-26 e	-4 e	24 e	62.4	115.5	195.3	1
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene		-10 e	18 e	55.3	107.9	186.8	1
C ₁₀ H ₁₈ O	α -Terpineol			48	89	142	217	4
C ₁₀ H ₁₈ O	Eucalyptol			10.6	48.5	100.3	175.4	5
C ₁₀ H ₁₈ O	<i>trans</i> -Geraniol	4 e	31 e	63.2	104.3	157.7	229.6	5
C ₁₀ H ₁₈ O ₄	Sebacic acid	125.9 s						5
C ₁₀ H ₁₈ O ₄	Dipropyl succinate	11 e	38 e	72.1	115.4	172.3	250.4	5
C ₁₀ H ₁₈ O ₄	Diethyl adipate	4 e	35 e	72 e	116.6	171.2	239.5	5
C ₁₀ H ₁₉ N	Decanenitrile	13 e	36 e	66 e	105.8	160.6	241.6	5
C ₁₀ H ₂₀	1-Decene	-35.5	-13.7	13.7	49.0	97.9	170.1	1,5
C ₁₀ H ₂₀	Cyclodecane			29 e	68 e	121.3	201.8	1
C ₁₀ H ₂₀	Butylcyclohexane	-31 e	-9 e	18 e	54 e	104.7	180.4	5
C ₁₀ H ₂₀	Isobutylcyclohexane	-37 e	-16 e	10 e	46 e	95.9	170.8	5
C ₁₀ H ₂₀	<i>tert</i> -Butylcyclohexane	-39 e	-18 e	9 e	45 e	95.3	171.1	5
C ₁₀ H ₂₀ O	Decanal		16 e	47.2	86.3	137.7	208.0	5
C ₁₀ H ₂₀ O ₂	Decanoic acid	58 e	80 e	108 e	145 e	195.2	269.5	5
C ₁₀ H ₂₀ O ₂	Octyl acetate	-26 e	-3 e	27 e	66.3	120.0	198.2	5
C ₁₀ H ₂₀ O ₂	2-Ethylhexyl acetate	-11 e	5 e	26 e	57.6	107.1	197.2	5
C ₁₀ H ₂₀ O ₂	Isopentyl isopentanoate			22 e	62.8	116.9	193.6	5
C ₁₀ H ₂₀ O ₂	Ethyl octanoate	-17 e	9 e	41 e	81.4	133.2	203 e	5
C ₁₀ H ₂₀ O ₄	Diethylene glycol monobutyl ether acetate	6 e	34 e	69 e	112.6	169.2	245.4	5
C ₁₀ H ₂₁ Br	1-Bromodecane	9 e	33 e	63 e	104 e	159.2	240.0	5
C ₁₀ H ₂₁ Cl	1-Chlorodecane	2 e	25 e	54 e	92 e	145.7	225.3	5
C ₁₀ H ₂₁ F	1-Fluorodecane	-22 e	0 e	27 e	64 e	113.3	185.7	5
C ₁₀ H ₂₂	Decane		-10.6	16.7	52.3	101.1	173.7	16
C ₁₀ H ₂₂	2-Methylnonane	-34 e	-14 e	12 e	47 e	94.8	166.5	5
C ₁₀ H ₂₂	3-Methylnonane	-34 e	-14 e	12 e	47 e	95.1	167.3	5
C ₁₀ H ₂₂	4-Methylnonane	-36 e	-16 e	10 e	45 e	93.1	165.2	5
C ₁₀ H ₂₂	5-Methylnonane	-36 e	-16 e	10 e	45 e	92.6	164.6	5
C ₁₀ H ₂₂	2,4-Dimethyloctane				38 e	84.9	155.4	5
C ₁₀ H ₂₂	2,7-Dimethyloctane	-39 e	-19 e	7 e	41 e	88.4	159.4	5
C ₁₀ H ₂₂	2,2,6-Trimethylheptane	-46 e	-27 e	-2 e	32 e	78.5	148.4	5
C ₁₀ H ₂₂	3,3,5-Trimethylheptane			0 e	35 e	82.7	155.2	5
C ₁₀ H ₂₂	2,2,3,3-Tetramethylhexane	-46 e	-25 e	1 e	36 e	85.6	159.8	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₁₀ H ₂₂	2,2,5,5-Tetramethylhexane			-10 e	22 e	68.3	137.0	5
C ₁₀ H ₂₂	2,4-Dimethyl-3-isopropylpentane	-46 e	-26 e	0 e	35 e	83.2	156.5	5
C ₁₀ H ₂₂	2,2,3,3,4-Pentamethylpentane		-24 e	3 e	39 e	89.1	165.5	5
C ₁₀ H ₂₂	2,2,3,4,4-Pentamethylpentane		-29 e	-3 e	33 e	82.8	158.7	5
C ₁₀ H ₂₂ O	1-Decanol	30 e	50 e	75 e	109 e	157.3	230.6	1,39
C ₁₀ H ₂₂ O	4-Decanol	18 e	37 e	61 e	93 e	139 e	210 e	5
C ₁₀ H ₂₂ O	Dipentyl ether	-31 e	-8 e	22 e	60 e	111.6	186.2	5
C ₁₀ H ₂₂ O	Diisopentyl ether			14.0	51.5	101.8	172.8	5
C ₁₀ H ₂₂ O ₂	Ethylene glycol dibutyl ether	0 e	20 e	44 e	78.4	127.1	202.9	5
C ₁₀ H ₂₂ O ₅	Tetraethylene glycol dimethyl ether				138 e	200.9	275.3	5
C ₁₀ H ₂₂ S	1-Decanethiol	11 e	34 e	64 e	103 e	157.5	238.6	5
C ₁₀ H ₂₂ S	Diisopentylsulfide			7 e	82 e	118 e	139 e	5
C ₁₀ H ₂₃ N	Dipentylamine				77 e	127.7	202.0	5
C ₁₀ H ₃₀ O ₃ Si ₄	Decamethyltetrasiloxane	-31 e	-6 e	26 e	66.8	118.8	193.9	5
C ₁₀ H ₃₀ O ₅ Si ₅	Decamethylcyclopentasiloxane	-2 e	19 e	46 e	82 e	132.9	210.4	5
C ₁₁ H ₈ O ₂	1-Naphthalenecarboxylic acid				191.9	239.3	299.6	5
C ₁₁ H ₈ O ₂	2-Naphthalenecarboxylic acid				197.9	246.0	308.1	5
C ₁₁ H ₁₀	1-Methylnaphthalene	5 e	29 e	60 e	102 e	159.1	244.1	1
C ₁₁ H ₁₀	2-Methylnaphthalene			57 e	99 e	156.0	240.5	1
C ₁₁ H ₁₂ O ₂	Ethyl <i>trans</i> -cinnamate			79	125	187	271	4
C ₁₁ H ₁₂ O ₃	Myristicin	23 e	53 e	88.9	135.2	196.0	279.4	5
C ₁₁ H ₁₄	4-Isopropylstyrene	-25 e	-1 e	30.2	70.3	124.5	202.1	5
C ₁₁ H ₁₄	1,2,3,4-Tetrahydro-5-methylnaphthalene	9 e	31 e	60 e	99 e	153.1	233.8	5
C ₁₁ H ₁₄	1,2,3,4-Tetrahydro-6-methylnaphthalene	17 e	36 e	62 e	97 e	147.8	228.5	5
C ₁₁ H ₁₄ O ₂	Butyl benzoate	6 e	34 e	67.9	110.3	165 e	237 e	5
C ₁₁ H ₁₆	Pentylbenzene	-14 e	8 e	37 e	74 e	126.7	204.9	5
C ₁₁ H ₁₆	<i>p-tert</i> -Butyltoluene	-24 e	-2 e	27 e	64.1	115.5	190.8	5
C ₁₁ H ₁₆	1,3-Diethyl-5-methylbenzene	-26 e	-1 e	29.5	69.5	123.5	200.2	5
C ₁₁ H ₁₆	2-Ethyl-1,3,5-trimethylbenzene		6 e	36 e	75.7	129.6	207.6	5
C ₁₁ H ₁₆	1-Ethyl-2,4,5-trimethylbenzene	-13 e	11 e	40 e	79.4	132.1	207.7	5
C ₁₁ H ₂₀	1-Undecyne	-22 e	0 e	29 e	67 e	118.5	194.5	5
C ₁₁ H ₂₀	2-Undecyne	-17 e	6 e	35 e	74 e	127.4	205.4	5
C ₁₁ H ₂₀ O ₂	10-Undecenoic acid	35 e	67 e	105 e	150.0	205.4	274.5	5
C ₁₁ H ₂₀ O ₄	Ethyl diethylmalonate			74 e	105 e	149.4	219 e	5
C ₁₁ H ₂₁ N	Undecanenitrile			78.6	120.3	177.3	259.9	5
C ₁₁ H ₂₂	1-Undecene	-21.6	1.2	29.7	66.4	117.1	192.2	5
C ₁₁ H ₂₂	<i>cis</i> -2-Undecene	-14 e	7 e	34 e	70.2	120.6	196 e	5
C ₁₁ H ₂₂	<i>trans</i> -2-Undecene	-14 e	7 e	33 e	69.3	119.6	195 e	5
C ₁₁ H ₂₂	<i>cis</i> -4-Undecene	-19 e	3 e	30 e	66.6	117.1	192 e	5
C ₁₁ H ₂₂	<i>trans</i> -4-Undecene	-17 e	4 e	31 e	67.1	117.4	193 e	5
C ₁₁ H ₂₂	<i>cis</i> -5-Undecene	-19 e	2 e	30 e	66.2	116.7	191 e	5
C ₁₁ H ₂₂	<i>trans</i> -5-Undecene	-18 e	3 e	31 e	67.0	117.4	192 e	5
C ₁₁ H ₂₂	Pentylcyclohexane	-17 e	6 e	34 e	72 e	124.2	202.7	5
C ₁₁ H ₂₂	Hexylcyclopentane	-15 e	7 e	36 e	73 e	125.0	202.5	5
C ₁₁ H ₂₂ O	2-Undecanone	17 e	37 e	64.3	103.0	153.6	232.6	1,5
C ₁₁ H ₂₂ O	6-Undecanone		28 e	57 e	95 e	148.4	226.9	1
C ₁₁ H ₂₂ O ₂	Undecanoic acid	68 e	90 e	118 e	156 e	207.2	283.6	5
C ₁₁ H ₂₂ O ₂	Heptyl butanoate	2 e	29 e	62 e	102.6	155.1	224.7	5
C ₁₁ H ₂₂ O ₂	Propyl octanoate	-2 e	23 e	55 e	94.0	145.2	215 e	5
C ₁₁ H ₂₂ O ₂	Methyl decanoate	10 e	33 e	62 e	100.9	154.0	232 e	5
C ₁₁ H ₂₄	Undecane	-18.4	4.3	32.6	69.5	120.2	195.4	16
C ₁₁ H ₂₄	2-Methyldecane	-20 e	1 e	28 e	64 e	114.0	188.7	5
C ₁₁ H ₂₄	3-Methyldecane	-35 e	-10 e	22 e	61.9	115.6	190.4	5
C ₁₁ H ₂₄	4-Methyldecane	-38 e	-12 e	20 e	60.8	113.9	186.4	5
C ₁₁ H ₂₄	2,4,7-Trimethyloctane				43 e	94 e	170.4	5
C ₁₁ H ₂₄ O	1-Undecanol	52.2	80.0	82 e	118 e	167.6	244.1	5
C ₁₁ H ₂₄ S	1-Undecanethiol	23 e	47 e	77 e	118 e	173.6	256.8	5
C ₁₂ F ₂₇ N	Trinonafluorobutylamine		3 e	29.0	63.3	109.9	176.8	5
C ₁₂ H ₈	Acenaphthylene	24 s	49.8 s	80.6 s				5
C ₁₂ H ₉ N	Carbazole					254.7	354.0	5
C ₁₂ H ₁₀	Acenaphthene				126.2	187 e	276 e	1
C ₁₂ H ₁₀	Biphenyl			69.0	111.1	169.5	254.7	1
C ₁₂ H ₁₀ N ₂	Azobenzene			98.1	144.8	206.7	292.7	4
C ₁₂ H ₁₀ O	Diphenyl ether		44 e	75 e	116 e	173 e	257.4	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₁₂ H ₁₀ O	1-Acetonaphthone	37 e	69 e	107.0	154.6	215.2	294.9	5
C ₁₂ H ₁₀ O	2-Acetonaphthone	48.3 s		118.7	163.0	221.1	300.3	5
C ₁₂ H ₁₀ S	Diphenyl sulfide	20 e	51 e	88.7	137.5	202.2	291.8	5
C ₁₂ H ₁₁ N	Diphenylamine	48 s		102.8	150.5	213.7	301.4	5
C ₁₂ H ₁₂	1-Ethyl-naphthalene	16 e	41 e	72 e	114 e	171.8	257.7	5
C ₁₂ H ₁₂	2-Ethyl-naphthalene	14 e	39 e	71 e	113 e	171.2	257.3	5
C ₁₂ H ₁₂	1,2-Dimethylnaphthalene	26 e	51 e	82 e	123 e	180.5	265.7	5
C ₁₂ H ₁₂	2,7-Dimethylnaphthalene	31.5 s	53.1 s	78.8 s	115.9	175 e	260 e	5
C ₁₂ H ₁₄ O ₄	Diethyl phthalate	12 e	51 e	96 e	150.5	215.9	296.2	5
C ₁₂ H ₁₆	<i>p</i> -Isopropenylisopropylbenzene	-11 e	15 e	46 e	87 e	142.4	221 e	5
C ₁₂ H ₁₆	Cyclohexylbenzene		28 e	58 e	98 e	154.7	239.5	5
C ₁₂ H ₁₆ O ₂	3-Methylbutyl benzoate			66 e	115.0	177.7	261.4	5
C ₁₂ H ₁₈	Hexylbenzene	-2 e	22 e	51 e	90 e	144.5	225.5	5
C ₁₂ H ₁₈	1,2-Diisopropylbenzene	-14 e	9 e	37 e	74 e	125.9	203.2	5
C ₁₂ H ₁₈	1,3-Diisopropylbenzene	-14 e	8 e	36 e	74 e	125.5	202.6	5
C ₁₂ H ₁₈	1,4-Diisopropylbenzene	-6 e	18 e	49 e	90 e	148.8	238 e	5
C ₁₂ H ₁₈	Hexamethylbenzene	46.3 s	72.5 s	81.7 s	121.8 s	178.3	263.7	5
C ₁₂ H ₁₈	1,5,9-Cyclododecatriene	-14 e	11 e	44 e	87 e	145.0	229.8	5
C ₁₂ H ₂₀ O ₂	Geranyl acetate			67.7	110.8	166.9	242.9	5
C ₁₂ H ₂₀ O ₄	Dibutyl maleate	12.3	50.4	94.0	144.2	203 e	272 e	5
C ₁₂ H ₂₂	1-Dodecyne	-11 e	13 e	43 e	82 e	135.8	214.4	5
C ₁₂ H ₂₂	Cyclohexylcyclohexane		20 e	53.1	96.0	154.1	237.2	5
C ₁₂ H ₂₂ O ₂	Methyl 10-undecenoate	10 e	38 e	73 e	116 e	172.2	247.1	5
C ₁₂ H ₂₂ O ₄	Dimethyl sebacate		53 e	97	150	214	293	4
C ₁₂ H ₂₃ N	Dodecanenitrile	36 e	60 e	92 e	133 e	190.5	275.5	5
C ₁₂ H ₂₄	1-Dodecene	-8.3	15.2	44.8	82.9	135.4	212.8	5
C ₁₂ H ₂₄	Hexylcyclohexane	-3 e	20 e	50 e	89 e	143.1	224.2	5
C ₁₂ H ₂₄	Heptylcyclopentane	-1 e	22 e	51 e	90 e	143.5	223.5	5
C ₁₂ H ₂₄ O	Dodecanal			70 e	116.2	175.9	256.6	5
C ₁₂ H ₂₄ O ₂	Dodecanoic acid	78 e	100 e	128 e	166 e	219.1	298.1	5
C ₁₂ H ₂₄ O ₂	Decyl acetate	12 e	40 e	74 e	115.1	168.1	238 e	5
C ₁₂ H ₂₄ O ₂	Ethyl decanoate	8 e	35 e	69 e	111.8	166.1	238 e	5
C ₁₂ H ₂₅ Br	1-Bromododecane	31 e	57 e	90 e	132 e	190.8	275.3	5
C ₁₂ H ₂₅ Cl	1-Chlorododecane	27 e	51 e	81 e	122 e	178.7	262.6	5
C ₁₂ H ₂₆	Dodecane	-5.4	18.2	47.6	85.8	138.2	215.8	16
C ₁₂ H ₂₆ O	1-Dodecanol				133 e	185.0	264.1	1
C ₁₂ H ₂₆ O ₃	Diethylene glycol dibutyl ether	5 e	34.4	70.2	115.3	174.1	253.8	5
C ₁₂ H ₂₇ N	Tributylamine	-26 e	1 e	35 e	77.7	134.5	213.4	5
C ₁₂ H ₂₇ N	Triisobutylamine		1 e	28.9	64.9	112.5	178.5	5
C ₁₂ H ₂₇ O ₄ P	Tributyl phosphate					205 e	288.3	5
C ₁₂ H ₃₆ O ₆ Si ₆	Dodecamethylcyclohexasiloxane	18 e	41 e	69 e	108 e	162.2	244.7	5
C ₁₃ H ₉ N	Acridine			124.4	176.2	246.0	345.4	5
C ₁₃ H ₉ N	Phenanthridine	79 s						5
C ₁₃ H ₁₀	Fluorene	48.4 s			137.4	205.4	295 e	5
C ₁₃ H ₁₀ O ₂	Phenyl benzoate			102.3	151.4	217.9	313.3	5
C ₁₃ H ₁₀ O ₃	Phenyl salicylate				166.0	224.8	312.4	5
C ₁₃ H ₁₂	Diphenylmethane		45 e	77 e	119.3	177.7	263.6	1,5
C ₁₃ H ₁₃ N	Methyldiphenylamine	35 e	63 e	98.4	143.1	201.6	281.6	5
C ₁₃ H ₁₄	1-Isopropylnaphthalene	27 e	51 e	82 e	123.2	180.8	267.3	5
C ₁₃ H ₂₀	Heptylbenzene	12 e	36 e	66 e	107 e	162.7	246.2	5
C ₁₃ H ₂₄ O ₂	Ethyl 10-undecenoate	32 e	55 e	86 e	125.2	179.5	258.4	5
C ₁₃ H ₂₆	1-Tridecene	4.1	28.5	59.0	98.3	152.5	232.3	5
C ₁₃ H ₂₆	Heptylcyclohexane	11 e	34 e	65 e	105 e	160.9	244.3	5
C ₁₃ H ₂₆	Octylcyclopentane	13 e	36 e	66 e	106 e	160.9	243.1	5
C ₁₃ H ₂₆ O ₂	Tridecanoic acid	87 e	109 e	138 e	176 e	230.3	311.5	5
C ₁₃ H ₂₆ O ₂	Methyl dodecanoate	38 e	61 e	90 e	130 e	184.9	269 e	5
C ₁₃ H ₂₈	Tridecane	7.2	31.5	61.8	101.1	155.1	234.9	16
C ₁₃ H ₂₈ O	1-Tridecanol	71.6	101.0	103 e	140 e	192.3	273.1	5
C ₁₄ H ₁₀	Anthracene	89.2 s	125.9 s	151.5 s	165 s	238.8	340.2	1,5
C ₁₄ H ₁₀	Phenanthrene	53 s	83 s	120.8	170.4	238.4	337.7	5
C ₁₄ H ₁₀ O ₂	Benzil			123	175	246	346	4
C ₁₄ H ₁₂	<i>cis</i> -Stilbene	26 e	54 e	88 e	130.4	183 e	253 e	5
C ₁₄ H ₁₂	<i>trans</i> -Stilbene				155.6	218.1	305.8	5
C ₁₄ H ₁₂ O ₂	Benzoin				181	248	342	4
C ₁₄ H ₁₄	1,1-Diphenylethane	19 e	47 e	82.0	125.3	181 e	254 e	5
C ₁₄ H ₁₅ N	Dibenzylamine	48 e	77 e	113.1	158.9	218.5	299.4	5
C ₁₄ H ₁₆	1-Butylnaphthalene	67 e	82 e	103 e	135 e	186.7	288.6	5

VAPOR PRESSURE (continued)

Mol. Form.	Name	Temperature in °C for the indicated pressure						Ref.
		1 Pa	10 Pa	100 Pa	1 kPa	10 kPa	100 kPa	
C ₁₄ H ₁₆	2-Butylnaphthalene	44 e	67 e	98 e	139 e	197.5	287.4	5
C ₁₄ H ₂₂	Octylbenzene	20.1	46.2	79.1	121.9	178.1	263.8	5
C ₁₄ H ₂₆ O ₄	Diethyl sebacate		83 e	120	166	225	305	4
C ₁₄ H ₂₇ N	Tetradecanenitrile	52 e	79 e	114.0	159.0	219.7	306.3	5
C ₁₄ H ₂₈	1-Tetradecene	16.1	41.3	72.7	113.2	168.7	250.6	5
C ₁₄ H ₂₈	Octylcyclohexane	16.9	44.3	77.8	120.0	177.6	263.2	5
C ₁₄ H ₂₈	Nonylcyclopentane	25 e	49 e	80 e	120 e	177.2	261.5	5
C ₁₄ H ₂₈ O ₂	Tetradecanoic acid	96 e	118 e	147 e	186 e	241.3	325.6	5
C ₁₄ H ₃₀	Tetradecane	19.1	44.1	75.3	115.7	171.1	253.0	16
C ₁₄ H ₃₀ O	1-Tetradecanol	80.0	110.5	149.6	152 e	205.3	286.7	5
C ₁₄ H ₃₁ N	Tetradecylamine			104 e	147 e	206.1	290.9	5
C ₁₄ H ₄₂ O ₅ Si ₆	Tetradecamethylhexasiloxane	6 e	36 e	72 e	117 e	176.0	259.1	5
C ₁₅ H ₁₈	1-Pentylnaphthalene	34 e	62 e	96 e	141.3	202.2	289 e	5
C ₁₅ H ₂₄	Nonylbenzene	33.0	58.9	92.0	135.4	193.7	281.4	5
C ₁₅ H ₃₀	Nonylcyclohexane	35 e	60 e	92 e	134 e	193.4	280.9	5
C ₁₅ H ₃₀	Decylcyclopentane	37 e	61 e	93 e	134 e	192.5	278.8	5
C ₁₅ H ₃₀ O ₂	Methyl tetradecanoate		75 e	110	155	214	295	4
C ₁₅ H ₃₂	Pentadecane	30.5	56.1	88.1	129.6	186.3	270.1	16
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate		104.0	142.7	191.5	254.5	339.4	4
C ₁₆ H ₃₂	1-Hexadecene	38.4	65.0	98.1	140.5	198.8	284.3	5
C ₁₆ H ₃₂ O ₂	Hexadecanoic acid		136 e	165 e	205 e	261.9	350.2	5
C ₁₆ H ₃₄	Hexadecane	41.1	67.4	100.3	142.7	200.7	286.3	16
C ₁₆ H ₃₄ O	1-Hexadecanol	99.5	130.6	171.9	175 e	229.0	311.7	5
C ₁₆ H ₃₅ N	Hexadecylamine	63 e	91 e	126 e	171 e	232.6	320.5	5
C ₁₇ H ₁₀ O	Benzanthrone		184 e	229.3	290.3	377.2	511 e	5
C ₁₇ H ₃₄ O ₂	Methyl hexadecanoate	65 e	93	129	177			4
C ₁₇ H ₃₆	Heptadecane	51.5	78.5	112.0	155.3	214.5	302 e	16
C ₁₇ H ₃₆ O	1-Heptadecanol	94 e	117 e	146 e	185 e	240.1	323.3	5
C ₁₈ H ₁₄	<i>o</i> -Terphenyl	66 e	94 e	129 e	176 e	241.3	336.3	5
C ₁₈ H ₁₄	<i>m</i> -Terphenyl	87 e	118 e	156 e	206.6	275.3	374.6	5
C ₁₈ H ₁₄	<i>p</i> -Terphenyl	127.1 s	154.7 s		217.2	284.0	383.0	5
C ₁₈ H ₃₀	Hexaethylbenzene				144.1	206.8	297.5	5
C ₁₈ H ₃₄ O ₂	Oleic acid	94 e	126 e	165.5	214.5	277.0	359.7	5
C ₁₈ H ₃₄ O ₂	Elaidic acid		124 e	166	216	280	361	4
C ₁₈ H ₃₆ O	Stearaldehyde			142 e	186 e	246.9	336.7	5
C ₁₈ H ₃₆ O ₂	Stearic acid		153 e	183 e	223 e	281.6	374.5	5
C ₁₈ H ₃₈	Octadecane	61.5	89.0	123.1	167.3	227.6	316 e	16
C ₁₈ H ₃₈ O	1-Octadecanol	106 e	130 e	160 e	200.5	257.3	343.0	5
C ₁₉ H ₁₆	Triphenylmethane	81 s		112 e	175 e	254.6	360.0	5
C ₁₉ H ₃₆ O ₂	Methyl oleate	85 e	114 e	149.7	195.6	256 e	340 e	5
C ₁₉ H ₄₀	Nonadecane	71.1	99.1	133.8	178.8	240.1	330 e	16
C ₂₀ H ₄₂	Eicosane	80.4	108.9	144.2	189.8	252.1	344 e	16
C ₂₀ H ₄₂ O	1-Eicosanol	119 e	143 e	173 e	213 e	270.0	355.1	5
C ₂₀ H ₆₀ O ₈ Si ₉	Eicosamethylnonasiloxane			141 e	183.1	236.7	307.1	5
C ₂₁ H ₂₁ O ₄ P	Tri- <i>o</i> -cresyl phosphate	119.0	156.1	201.0	256.3	326.3	418 e	5
C ₂₁ H ₂₁ O ₄ P	Tri- <i>m</i> -cresyl phosphate	147.8	177.3	211.4	251.3	298 e	355 e	5
C ₂₁ H ₂₁ O ₄ P	Tri- <i>p</i> -cresyl phosphate	140.6	174 e	214 e	262 e	320 e	392 e	5
C ₂₁ H ₄₄	Heneicosane	82.3	113.5	152.2	201.6	263.8	355.9	5
C ₂₂ H ₄₂ O ₂	Brassicidic acid	134 e	166 e	203.6	249.8	307.6	382.0	5
C ₂₂ H ₄₂ O ₂	Erucic acid	126 e	160 e	199.4	247.4	306.5	381.1	5
C ₂₂ H ₄₂ O ₂	Butyl oleate	95.5	124.2	158 e	198 e	245 e	304 e	5
C ₂₂ H ₄₄ O ₂	Behenic acid	145.4	176.5	213.7	259.3	316.2	390 e	5
C ₂₂ H ₄₄ O ₂	Butyl stearate	99.6	128 e	162 e	201 e	249 e	307 e	5
C ₂₂ H ₄₆	Docosane	83.5	115.0	154.0	203.6	274.8	368.0	5
C ₂₃ H ₄₈	Tricosane	102.9	135.1	174.8	221 e	285.3	379.5	5
C ₂₄ H ₃₈ O ₄	Dioctyl phthalate	130 e	163.7	203.8	252 e	311 e	385 e	5
C ₂₄ H ₃₈ O ₄	Bis(2-ethylhexyl) phthalate	122.0	153.2	189.2	231.3	281.1	341.1	5
C ₂₄ H ₅₀	Tetracosane	115.0	148.1	188.5	239.1	295.4	390.6	5
C ₂₅ H ₅₂	Pentacosane	119.7	152.7	193.2	244.4	305.0	401.1	5
C ₂₆ H ₅₄	Hexacosane	125.1	158.8	200.1	252.1	314.3	411.3	5
C ₂₇ H ₅₆	Heptacosane	136.7	168.8	206.5	255.8	323.3	421.2	5
C ₂₈ H ₅₈	Octacosane	136.5	169.8	210.9	263.1	332.0	430.6	5
C ₂₉ H ₆₀	Nonacosane	148.2	182.8	221.2	271.5	340.2	439.7	5
C ₃₀ H ₆₂	Squalane	66 e	84 e	105.8	131.9	163.7	203.2	5
C ₇₀	Carbon (fullerene-C ₇₀)	598 s	662 s					22

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K

This table gives vapor pressures of 67 important fluids in the temperature range 2 to 300 K. Helium (⁴He), hydrogen (H₂), and neon (Ne) are covered on this page. The remaining fluids are listed on subsequent pages by molecular formula in the Hill order (see Introduction). The data have been taken from evaluated sources; references are listed at the end of the table.

Pressures are given in kilopascals (kPa). Note that:

$$1 \text{ kPa} = 7.50062 \text{ Torr}$$

$$100 \text{ kPa} = 1 \text{ bar}$$

$$101.325 \text{ kPa} = 1 \text{ atmos}$$

s following an entry indicates that the compound is solid at that temperature.

Helium		Hydrogen		Neon	
T/K	P/kPa	T/K	P/kPa	T/K	P/kPa
2.2	5.3	14.0	7.90	25.0	51.3
2.3	6.7	14.5	10.38	26.0	71.8
2.4	8.3	15.0	13.43	27.0	98.5
2.5	10.2	15.5	17.12	28.0	132.1
2.6	12.4	16.0	21.53	29.0	173.5
2.7	14.8	16.5	26.74	30.0	223.8
2.8	17.5	17.0	32.84	31.0	284.0
2.9	20.6	17.5	39.92	32.0	355.2
3.0	24.0	18.0	48.08	33.0	438.6
3.1	27.8	18.5	57.39	34.0	535.2
3.2	32.0	19.0	67.96	35.0	646.2
3.3	36.5	19.5	79.89	36.0	772.8
3.4	41.5	20.0	93.26	37.0	916.4
3.5	47.0	20.5	108.2	38.0	1078
3.6	52.9	21.0	124.7	39.0	1260
3.7	59.3	21.5	143.1	40.0	1462
3.8	66.1	22.0	163.2	41.0	1688
3.9	73.5	22.5	185.3	42.0	1939
4.0	81.5	23.0	209.4	43.0	2216
4.1	90.0	23.5	235.7	44.0	2522
4.2	99.0	24.0	264.2		
4.3	108.7	24.5	295.1		
4.4	119.0	25.0	328.5		
4.5	129.9	25.5	364.3		
4.6	141.6	26.0	402.9		
4.7	153.9	26.5	444.3		
4.8	167.0	27.0	488.5		
4.9	180.8	27.5	535.7		
5.0	195.4	28.0	586.1		
5.1	210.9	28.5	639.7		
		29.0	696.7		
		29.5	757.3		
		30.0	821.4		
		30.5	889.5		
		31.0	961.5		
		31.5	1038.0		
		32.0	1119.0		
		32.5	1204.0		
Ref.	17,18		1		13

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	Ar Argon	BCl ₃ Boron trichloride	BF ₃ Boron trifluoride	BrH Hydrogen bromide	Br ₂ Bromine	ClF Chlorine fluoride	ClH Hydrogen chloride
50	0.1 s						
55	0.2 s						
60	0.8 s						
65	2.8 s						
70	7.7 s						
75	18.7 s						
80	40.7 s						
85	79.0						
90	134						
95	213						
100	324						
105	473						
110	666						
115	910					0.1	
120	1214					0.3	0.1 s
125	1584					0.6	0.3 s
130	2027					1.2	0.5 s
135	2553			0.1 s		2.1	1.0 s
140	3170			0.3 s		3.6	1.9 s
145	3892		7.7	0.6 s		6.0	3.4 s
150	4736		13.4	1.1 s		9.5	5.8 s
155			22.3	1.9 s		14.6	9.5 s
160			35.2	3.3 s		21.8	14.7
165			53.7	5.4 s		31.7	22.0
170			79.1	8.7 s		44.8	31.9
175			113	13.4 s		62.0	45.1
180		0.1	157	20.1 s		84.2	62.5
185		0.2	214	29.5 s		112	84.7
190		0.3	285	37.9		147	113
195		0.5	372	51.8		190	148
200		0.8	479	69.5		242	190
205		1.2	608	91.8		304	242
210		1.8	762	119		378	304
215		2.6	944	153		464	377
220		3.8	1160	194	0.1 s	564	463
225		5.2	1413	242	0.2 s	680	563
230		7.2	1709	299	0.3 s	812	678
235		9.7	2056	366	0.4 s	961	811
240		12.9	2460	443	0.7 s	1130	961
245		17.0	2913	532	1.1 s	1319	1132
250		22.0	3481	633	1.7 s	1529	1325
255		28.1	4123	748	2.6 s	1762	1542
260		35.6	4874	878	3.8 s	2019	1784
265		44.5		1023	5.5 s	2301	2054
270		55.1		1185	7.3	2608	2354
275		67.6		1364	9.5	2941	2686
280		82.2		1562	12.3	3303	3053
285		99.1		1780	15.6	3693	3457
290		119		2018	19.7	4111	3901
295		141		2278	24.6	4560	4388
300		166		2561	30.5	5039	4921
Ref.	8,15	12	12	12	12	12	12

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	ClO ₂ Chlorine dioxide	Cl ₂ Chlorine	Cl ₄ Si Silicon tetrachloride	FH Hydrogen fluoride	F ₂ Fluorine	F ₂ O Difluorine oxide	F ₃ N Nitrogen trifluoride
50							
55					0.4		
60					1.5		
65					4.8		
70					12.3		
75					27.6	0.1	
80					55.3	0.2	
85					101	0.5	0.1
90					172	1.2	0.2
95					276	2.6	0.4
100					420	5.3	0.9
105					615	10.1	2.0
110					870	18.0	4.0
115					1196	30.5	7.3
120					1605	49.3	12.8
125					2108	76.7	21.1
130					2721	115	33.5
135					3458	168	51.1
140					4339	237	75.4
145						328	108
150						444	150
155						588	205
160						766	273
165						981	357
170						1238	459
175		1.8				1541	581
180		2.8				1895	726
185		4.2				2303	896
190		6.1		0.3		2771	1092
195	0.1	8.7		0.5		3302	1319
200	0.3	12.3		0.8		3899	1578
205	0.5	16.9		1.2		4567	1871
210	0.9	22.9	0.1	1.7		5308	2203
215	1.4	30.5	0.2	2.3			2577
220	2.3	40.1	0.3	3.2			2995
225	3.5	51.9	0.5	4.4			3464
230	5.3	66.4	0.7	5.9			3991
235	7.6	84.0	1.0	7.9			
240	10.8	105	1.5	10.3			
245	14.9	130	2.0	13.4			
250	20.1	160	2.8	17.2			
255	26.6	194	3.8	21.8			
260	34.6	234	5.0	27.4			
265	44.4	280	6.6	34.2			
270	56.1	332	8.6	42.2			
275	69.9	392	11.1	51.8			
280	86.2	459	14.2	63.1			
285	105	535	17.9	76.3			
290	127	619	22.3	91.7			
295	151	714	27.7	110			
300	179	818	34.0	130			
Ref.	12	5	12	12	12	12	1

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	F ₃ P Phosphorus trifluoride	F ₄ Si Silicon tetrafluoride	F ₆ S Sulfur hexafluoride	HI Hydrogen iodide	H ₂ S Hydrogen sulfide	H ₃ N Ammonia	H ₃ P Phosphine
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100							
105	0.1						
110	0.2						0.1
115	0.5						0.2
120	1.0						0.4
125	1.9	0.1 s					0.7
130	3.5	0.2 s					1.3
135	5.9	0.4 s			0.1 s		2.3
140	9.5	0.9 s	0.1 s		0.2 s		3.9
145	14.9	1.9 s	0.2 s		0.3 s		6.2
150	22.5	3.8 s	0.4 s		0.6 s		9.6
155	33.1	7.5 s	0.8 s	0.1 s	1.1 s		14.5
160	47.3	14.0 s	1.5 s	0.2 s	1.9 s	0.1 s	21.1
165	66.0	25.2 s	2.6 s	0.4 s	3.2 s	0.2 s	30.0
170	90.1	43.8 s	4.4 s	0.8 s	5.2 s	0.3 s	41.6
175	121	74.2 s	7.1 s	1.3 s	8.3 s	0.6 s	56.6
180	159	122 s	11.3 s	2.2 s	12.7 s	1.2 s	75.6
185	206	197 s	17.3 s	3.4 s	18.9 s	2.1 s	99.2
190	262	280	25.9 s	5.3 s	26.6	3.5 s	128
195	330	376	38.0 s	8.0 s	36.7	5.8 s	163
200	410	488	54.4 s	11.7 s	49.8	8.7	205
205	503	618	76.6 s	16.8 s	66.4	12.6	254
210	611	766	106 s	23.6 s	87.1	17.9	312
215	736	932	145 s	32.5 s	113	24.9	379
220	877	1117	195 s	44.0 s	144	34.1	456
225	1037	1324	249	56.2	182	45.9	544
230	1217	1555	305	71.4	227	60.8	644
235	1418	1816	371	89.7	281	79.6	756
240	1640	2111	448	112	344	103	881
245	1885	2449	536	137	416	131	1019
250	2154	2841	636	168	500	165	1172
255	2448	3301	750	203	597	207	1341
260	2767		878	244	706	256	1525
265	3112		1021	290	830	313	1725
270			1181	343	969	381	1942
275			1358	404	1124	460	2176
280			1554	472	1297	552	2428
285			1768	548	1488	655	2699
290			2003	633	1698	774	2987
295			2258	727	1929	909	3295
300			2534	831	2181	1062	3621
Ref.	12	12	12,15	12	12,15	11	12

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	H ₄ Si Silane	Kr Krypton	NO Nitric oxide	N ₂ Nitrogen	N ₂ O Nitrous oxide	O ₂ Oxygen	O ₂ S Sulfur dioxide
50				0.4 s			
55				1.8 s		0.2	
60				6.3 s		0.7	
65				17.4		2.3	
70				38.6		6.3	
75		0.1 s		76.1		14.5	
80		0.4 s		137		30.1	
85		1.1 s	0.1 s	229		56.8	
90		2.7 s	0.4 s	361		99.3	
95	0.1	6.0 s	1.3 s	541		163	
100	0.2	12.1 s	3.8 s	779		254	
105	0.4	22.8 s	10.0 s	1084		379	
110	1.0	40.4 s	23.5	1467		543	
115	1.9	68.0 s	46.8	1939	0.1	756	
120	3.5	103	86.5	2513	0.1	1022	
125	6.1	150	151	3209	0.3	1351	
130	10.0	211	248		0.7	1749	
135	15.8	290	391		1.3	2225	
140	24.1	388	592		2.5	2788	
145	35.3	509	867		4.3	3448	
150	50.3	655	1231		7.1	4219	
155	69.8	830	1703		11.4		
160	94.6	1037	2302		17.6		
165	126	1278	3050		26.4		
170	164	1557	3971		38.5		0.1
175	210	1877	5089		54.7		0.2
180	265	2241	6433		75.9		0.3
185	331	2655			103		0.5
190	408	3120			138		0.8
195	498	3641			181		1.3
200	602	4223			234		2.0
205	722	4870			298		3.0
210	859				374		4.4
215	1017				465		6.3
220	1196				571		9.0
225	1398				694		12.6
230	1628				835		17.3
235	1888				996		23.3
240	2180				1179		31.1
245	2509				1385		40.9
250	2880				1615		53.2
255	3296				1870		68.3
260	3763				2152		86.7
265	4288				2462		109
270					2802		136
275					3172		168
280					3573		205
285					4006		249
290					4473		300
295					4973		359
300					5508		426
Ref.	12	13, 15	12, 15	1	12	3	12

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	O ₃ Ozone	Rn Radon	Xe Xenon	CBrF ₃ Bromotri- fluoromethane	CClF ₃ Chlorotri- fluoromethane	CCl ₂ F ₂ Dichlorodi- fluoromethane	CCl ₃ F Trichloro- fluoromethane
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100	0.1		0.1	s			
105	0.2		0.1	s			
110	0.4		0.3	s			
115	1.0		0.7	s	0.1		
120	2.0		1.5	s	0.2		
125	3.8		2.7	s	0.3		
130	6.8	0.1	4.9	s	0.6		
135	11.5	0.3	8.5	s	0.1		
140	18.7	0.5	14.0	s	0.3		
145	29.1	0.9	22.2	s	0.5		
150	43.7	1.5	34.2	s	0.9		
155	63.6	2.4	51.1	s	1.5	8.3	0.1
160	89.9	3.8	74.2	s	2.5	12.6	0.3
165	124	5.8	101		3.9	18.6	0.5
170	168	8.6	134		5.9	26.8	0.8
175	222	12.5	173		8.8	37.6	1.3
180	289	17.7	222	12.8	51.7	2.1	
185	367	24.5	280	18.1	69.7	3.2	
190	468	33.2	348	25.1	92.3	4.8	0.2
195	584	44.4	428	34.1	120	6.9	0.3
200	721	58.2	521	45.6	155	9.9	0.4
205	881	75.3	628	60.0	196	13.7	0.6
210	1068	96	750	77.8	246	18.8	1.0
215	1285	121	889	99.5	304	25.2	1.4
220	1536	151	1045	126	372	33.3	2.0
225	1824	185	1220	157	451	43.3	2.9
230	2155		1416	194	542	55.5	4.1
235	2534		1633	237	646	70.4	5.6
240	2968		1872	287	763	88.1	7.6
245	3464		2136	344	896	109	10.1
250	4031		2425	410	1044	134	13.3
255	4678		2742	485	1210	163	17.2
260	5417		3087	570	1394	196	22.1
265			3462	665	1598	234	28.0
270			3869	771	1823	278	35.1
275			4310	889	2071	327	43.7
280			4786	1021	2343	383	53.8
285			5299	1166	2641	445	65.7
290				1325	2968	515	79.6
295				1501	3325	593	95.6
300				1692	3716	679	114.1
Ref.	12	15	12,13	12	12	12	12

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	CCl ₄ Tetrachloro- methane	CF ₄ Tetrafluoro- methane	CO Carbon monoxide	COS Carbon oxysulfide	CO ₂ Carbon dioxide	CHClF ₂ Chlorodifluo- methane	CHCl ₃ Trichloro- methane
50			0.1 s				
55			0.6 s				
60			2.6 s				
65			8.2 s				
70			21.0				
75			44.4				
80			83.7				
85			147				
90		0.1	239				
95		0.3	371				
100		0.8	545				
105		1.7	771				
110		3.4	1067				
115		6.5	1428				
120		11.5	1877				
125		19.3	2400				
130		30.8	3064				
135		47.4			0.1 s		
140		70.2		0.1	0.2 s		
145		101		0.2	0.4 s		
150		141		0.4	0.8 s	0.1	
155		191		0.8	1.7 s	0.3	
160		254		1.3	3.1 s	0.5	
165		332		2.2	5.7 s	0.8	
170		425		3.4	9.9 s	1.4	
175		537		5.2	16.8 s	2.3	
180		669		7.8	27.6 s	3.6	
185		824		11.3	44.0 s	5.5	
190		1005		15.9	68.4 s	8.1	
195		1216		22.1	104 s	11.8	
200		1460		30.0	155 s	16.7	
205		1743		40.1	227 s	23.1	
210		2073		52.7	327 s	31.5	
215		2457		68.2	465 s	42.1	0.1
220		2907		87.2	600	55.3	0.2
225		3438		110	735	71.7	0.3
230				137	894	91.6	0.4
235				169	1075	116	0.7
240				207	1283	144	1.0
245				250	1519	178	1.4
250				301	1786	218	2.0
255	1.5			358	2085	264	2.7
260	2.1			423	2419	317	3.7
265	2.8			497	2790	377	5.0
270	3.7			580	3203	446	6.6
275	4.9			673	3658	525	8.7
280	6.4			777	4160	613	11.3
285	8.2			892	4712	711	14.4
290	10.5			1019	5315	821	18.3
295	13.2			1159	5984	944	22.9
300	16.5			1313	6710	1080	28.5
Ref.	12	12	9	12	6	12	12

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	CHF ₃ Trifluoro- methane	CHN Hydrogen cyanide	CH ₂ Cl ₂ Dichloro- methane	CH ₂ F ₂ Difluoro methane	CH ₂ O Formaldehyde	CH ₃ Cl Chloromethane	CH ₃ F Fluoromethane
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100							
105							
110							
115							
120	0.1						
125	0.2						
130	0.4						
135	0.7						0.6
140	1.4			0.1			1.2
145	2.5			0.2			2.1
150	4.3			0.3			3.6
155	7.1			0.6			5.9
160	11.1			1.0			9.3
165	17.0			1.7			14.1
170	25.3			2.8			20.9
175	36.5			4.4			29.9
180	51.4			6.8			42.0
185	70.9			10.2	1.3	2.1	57.6
190	95.8			14.8	2.0	3.1	77.4
195	127			21.2	3.0	4.6	102
200	166	0.1 s	0.1	29.5	4.4	6.7	133
205	214	0.2 s	0.2	40.5	6.4	9.5	171
210	271	0.4 s	0.3	54.5	9.1	13.1	216
215	340	0.6 s	0.4	72.1	12.7	17.9	270
220	421	1 s	0.6	94.1	17.4	24.0	333
225	516	1.5 s	0.9	121	23.4	31.8	408
230	626	2.2 s	1.4	154	31.0	41.4	495
235	754	3.3 s	2.0	193	40.6	53.3	595
240	900	4.7 s	2.8	240	52.5	67.7	711
245	1067	6.8 s	3.8	295	67.0	85.1	843
250	1257	9.7 s	5.3	360	84.6	106	993
255	1472	13.6 s	7.1	434	106	131	1163
260	1713	18.8	9.5	521	131	159	1355
265	1984	24.1	12.4	620	161	193	1571
270	2287	30.5	16.1	732	196	232	1813
275	2624	38.3	20.7	860	236	277	2084
280	3000	47.7	26.3	1004	283	327	2387
285	3418	58.8	33.0	1165	337	385	2724
290	3881	72.1	41.1	1346	399	450	3099
295	4393	87.6	50.8	1547	470	524	3516
300		105.9	62.1	1770	549	606	3978
Ref.	12	12,16	12	12	12	12	12

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	CH ₄ Methane	CH ₃ O Methanol	C ₂ H ₂ Acetylene	C ₂ H ₄ Ethylene	C ₂ H ₆ Ethane	C ₂ H ₆ O Dimethyl ether	C ₃ H ₄ Propadiene
50							
55							
60							
65	0.1						
70	0.3						
75	0.8						
80	2.1						
85	4.9						
90	10.6						
95	20.0						
100	34.5						
105	57.0						
110	88.4			0.3			
115	133			0.8	0.1		
120	192			1.4	0.4		
125	269			2.7	0.7		
130	368		0.1 s	4.5	1.3		
135	491		0.3 s	7.7	2.2		
140	642		0.7 s	11.9	3.8		
145	824		1.3 s	18.3	6.0		
150	1041		2.6 s	27.5	9.7		0.1
155	1297		4.6 s	39.9	15.0	0.1	0.2
160	1594		7.8 s	56.4	21.5	0.2	0.3
165	1937		12.8 s	77.9	31.0	0.3	0.6
170	2331		20.6 s	105	42.9	0.5	1.0
175	2779		32.2 s	140	59.0	0.9	1.7
180	3288		49.0 s	182	78.7	1.4	2.7
185	3865		72.9 s	234	104	2.1	4.1
190	4520		106 s	296	135	3.2	6.1
195			146	369	172	4.7	8.9
200			190	456	217	6.8	12.5
205			244	557	271	9.6	17.4
210			309	673	334	13.3	23.7
215			385	806	407	18.1	31.6
220			475	958	492	24.3	41.4
225			579	1128	590	32.1	53.5
230		0.1	699	1321	700	41.9	68.2
235		0.2	837	1535	826	53.9	85.8
240		0.4	993	1774	967	68.6	107
245		0.5	1170	2039	1125	86.3	131
250		0.8	1370	2331	1301	108	160
255		1.2	1593	2652	1496	133	193
260		1.7	1843	3005	1712	162	230
265		2.4	2121	3391	1949	197	273
270		3.3	2429	3813	2210	237	322
275		4.5	2771	4275	2495	283	376
280		6.2	3150		2806	335	438
285		8.3	3567		3146	395	506
290		11	4028		3515	463	582
295		14.4	4535		3917	538	666
300		18.7	5093		4355	623	759
Ref.	2,16	12	12,16	4	2	12	12

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

T/K	C ₃ H ₆ Propylene	C ₃ H ₈ Propane	C ₄ H ₆ Buta-1,3-diene	C ₄ H ₁₀ Butane	C ₄ H ₁₀ Isobutane	C ₅ H ₁₂ Pentane	C ₅ H ₁₂ Neopentane
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100							
105							
110							
115							
120							
125							
130							
135							
140	0.1						
145	0.2						
150	0.4						
155	0.7						
160	1.2	0.8			0.1		
165	2.0	1.4			0.1		
170	3.1	2.2	0.1	0.1	0.3		
175	4.7	3.3	0.2	0.2	0.4		
180	7.0	5.0	0.4	0.3	0.7		
185	10.1	7.3	0.6	0.5	1.1		0.1 s
190	14.2	10.5	1.0	0.8	1.7		0.2 s
195	19.7	15.0	1.5	1.3	2.5		0.4 s
200	26.9	20.1	2.3	1.9	3.7		0.7 s
205	35.9	27.0	3.4	2.8	5.3		1.1 s
210	47.3	36.0	4.8	4.0	7.4		1.6 s
215	61.3	47.0	6.7	5.7	10.2		2.4 s
220	78.5	60.0	9.2	7.8	13.8	1.0	3.6 s
225	99.2	77.0	12.5	10.6	18.3	1.5	5.2 s
230	124	97.0	16.7	14.1	24.0	2.1	7.3 s
235	153	120	21.9	18.5	31.1	3.0	10.2 s
240	188	148	28.4	24.1	39.8	4.2	13.9 s
245	228	180	36.3	30.9	50.3	5.7	18.7 s
250	274	218	46.0	39.1	62.9	7.6	24.8 s
255	327	261	57.6	49.1	77.8	10.0	32.4 s
260	387	311	71.3	61.0	95.4	13.0	41.6
265	456	367	87.6	75.0	116	16.6	51.4
270	533	431	107	91.5	140	21.1	63.0
275	619	502	129	111	167	26.6	76.6
280	715	582	154	133	198	33.1	92.3
285	822	671	184	159	234	40.8	111
290	940	769	217	188	274	50.0	131
295	1069	878	255	221	319	60.7	155
300	1212	998	297	258	370	73.2	182
Ref.	7	2	12	2	2	14	12,16

VAPOR PRESSURE OF FLUIDS AT TEMPERATURES BELOW 300 K (continued)

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IUPAC RECOMMENDED DATA FOR VAPOR PRESSURE CALIBRATION

These precise vapor pressure values are recommended as secondary standards. Values are given in kPa (1 kPa = 0.0098692 atm = 7.5006 Torr).
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REFERENCE

Marsh, K.N., Ed., *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell Scientific Publications, Oxford (1987).

T/K	CO ₂ (s)	H ₂ O(s)	C ₁₀ H ₈ (s)	n-C ₅ H ₁₂	C ₆ H ₆	C ₆ F ₆	H ₂ O	Hg
180	27.62							
190	68.44							
200	155.11	0.0002						
210	327.17	0.0007						
220		0.0026						
230		0.0089						
240		0.0273						
250		0.0760		7.60				
260		0.1958	0.0001	12.98				
270		0.4701	0.0005	21.15			0.485	
280			0.0017	33.11	5.148	4.322	0.991	
290			0.0049	50.01	8.606	7.463	1.919	
300			0.0134	73.17	13.816	12.328	3.535	
310			0.0341	104.07	21.389	19.576	6.228	
320			0.0814	144.3	32.054	30.009	10.540	
330			0.1829	195.7	46.656	44.578	17.202	
340			0.3899	260.1	66.152	64.380	27.167	
350			0.7920	339.4	91.609	90.664	41.647	
360				435.9	124.192	124.816	62.139	
370				551.5	165.2	168.4	90.453	
380				688.8	215.9	223.0	128.74	
390				850.2	277.7	290.4	179.48	
400				1038	353.2	372.6	245.54	0.138
410				1256	441.0	471.5	330.15	0.215
420				1507	545.5	589.3	436.89	0.329
430				1793	667.6	728.3	569.73	0.493
440				2120	808.8	890.9	732.99	0.724
450				2490	971.1	1080	931.36	1.045
460				2910	1156	1297	1169.9	1.485
470					1366	1547	1453.9	2.078
480					1602	1833	1789.0	2.866
490					1868	2159	2181.4	3.899
500					2164	2530	2637.3	5.239
510					2494	2954	3163.3	6.955
520					2861		3766.4	9.131
530					3267		4453.9	11.861
540					3717		5233.5	15.256
550					4216		6113.4	19.438
560					4770		7102.0	25.547
570							8208.6	30.74
580							9443.0	38.19
590							10816	47.09
600							12339	57.64

ENTHALPY OF VAPORIZATION

The molar enthalpy (heat) of vaporization $\Delta_{\text{vap}}H$, which is defined as the enthalpy change in the conversion of one mole of liquid to gas at constant temperature, is tabulated here for approximately 850 inorganic and organic compounds. Values are given, when available, both at the normal boiling point t_b , referred to a pressure of 101.325 kPa (760 mmHg), and at 25°C. Substances are listed by molecular formula in the modified Hill order (see Preface).

The values in this table were measured either by calorimetric techniques or by application of the Claperyon equation to the variation of vapor pressure with temperature. See Reference 1 for a discussion of the accuracy of different experimental techniques and for methods of estimating enthalpy of vaporization at other temperatures.

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Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
AgBr	Silver(I) bromide	1502	198	
AgCl	Silver(I) chloride	1547	199	
AgI	Silver(I) iodide	1506	143.9	
Al	Aluminum	2519	294	
AlB ₃ H ₁₂	Aluminum borohydride	44.5	30	
AlBr ₃	Aluminum tribromide	255	23.5	
AlI ₃	Aluminum triiodide	382	32.2	
Ar	Argon	-185.85	6.43	
AsBr ₃	Arsenic(III) bromide	221	41.8	
AsCl ₃	Arsenic(III) chloride	130	35.01	
AsF ₃	Arsenic(III) fluoride	57.8	29.7	
AsF ₅	Arsenic(V) fluoride	-52.8	20.8	
AsH ₃	Arsine	-62.5	16.69	
AsI ₃	Arsenic(III) iodide	424	59.3	
Au	Gold	2856	324	
B	Boron	4000	480	
BBr ₃	Boron tribromide	91	30.5	
BCl ₃	Boron trichloride	12.65	23.77	23.1
BF ₃	Boron trifluoride	-101	19.33	
BI ₃	Boron triiodide	210	40.5	
B ₂ F ₄	Tetrafluorodiborane	-34	28	
B ₂ H ₆	Diborane	-92.4	14.28	
B ₄ H ₁₀	Tetraborane	18	27.1	
B ₅ H ₁₁	Pentaborane(11)	63	31.8	
Ba	Barium	1897	140	
BeCl ₂	Beryllium chloride	482	105	
BeI ₂	Beryllium iodide	487	70.5	
Bi	Bismuth	1564	151	
BiBr ₃	Bismuth tribromide	453	75.4	
BiCl ₃	Bismuth trichloride	447	72.61	
BrF	Bromine fluoride	20	25.1	
BrF ₃	Bromine trifluoride	125.8	47.57	

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
BrF ₅	Bromine pentafluoride	40.76	30.6	
BrH	Hydrogen bromide	-66.38		12.69
BrH ₃ Si	Bromosilane	1.9	24.4	
BrIn	Indium(I) bromide	656	92	
BrTl	Thallium(I) bromide	819	99.56	
Br ₂	Bromine	58.8	29.96	30.91
Br ₂ Cd	Cadmium bromide	844	115	
Br ₂ H ₂ Si	Dibromosilane	66	31	
Br ₂ Hg	Mercury(II) bromide	322	58.89	
Br ₂ Pb	Lead(II) bromide	892	133	
Br ₂ Sn	Tin(II) bromide	639	102	
Br ₂ Zn	Zinc bromide	697	118	
Br ₃ Ga	Gallium(III) bromide	279	38.9	
Br ₃ HSi	Tribromosilane	109	34.8	
Br ₃ OP	Phosphorus(V) oxybromide	191.7	38	
Br ₃ P	Phosphorus(III) bromide	172.95	38.8	
Br ₃ Sb	Antimony(III) bromide	280	59	
Br ₄ Ge	Germanium(IV) bromide	186.35	41.4	
Br ₄ Si	Tetrabromosilane	154	37.9	
Br ₄ Sn	Tin(IV) bromide	205	43.5	
Br ₄ Ti	Titanium(IV) bromide	230	44.37	
Br ₅ Ta	Tantalum(V) bromide	349	62.3	
Cd	Cadmium	767	99.87	
CdCl ₂	Cadmium chloride	960	124.3	
CdF ₂	Cadmium fluoride	1748	214	
CdI ₂	Cadmium iodide	742	115	
ClF	Chlorine fluoride	-101.1	24	
ClFO ₃	Perchloryl fluoride	-46.75	19.33	
ClF ₂ P	Phosphorus(III) chloride difluoride	-47.25	17.6	
ClF ₃	Chlorine trifluoride	11.75	27.53	
ClF ₃ Si	Chlorotrifluorosilane	-70.0	18.7	
ClH	Hydrogen chloride	-85	16.15	9.08
ClH ₃ Si	Chlorosilane	-30.4	21	
ClNO	Nitrosyl chloride	-5.5	25.78	
ClNO ₂	Nitryl chloride	-15	25.7	
ClO ₂	Chlorine dioxide	11	30	
ClTl	Thallium(I) chloride	720	102.2	
Cl ₂	Chlorine	-34.04	20.41	17.65
Cl ₂ Cr	Chromium(II) chloride	1300	197	
Cl ₂ CrO ₂	Chromyl chloride	117	35.1	
Cl ₂ FP	Phosphorus(III) dichloride fluoride	14	24.9	
Cl ₂ F ₂ Si	Dichlorodifluorosilane	-32	21.2	
Cl ₂ H ₂ Si	Dichlorosilane	8.3	25	24.2
Cl ₂ Hg	Mercury(II) chloride	304	58.9	
Cl ₂ O	Chlorine monoxide	2.2	25.9	
Cl ₂ OS	Thionyl chloride	75.6	31.7	31
Cl ₂ O ₂ S	Sulfuryl chloride	69.4	31.4	30.1
Cl ₂ Pb	Lead(II) chloride	951	127	
Cl ₂ Sn	Tin(II) chloride	623	86.8	
Cl ₂ Ti	Titanium(II) chloride	1500	232	
Cl ₂ Zn	Zinc chloride	732	126	
Cl ₃ Ga	Gallium(III) chloride	201	23.9	
Cl ₃ HSi	Trichlorosilane	33		25.7
Cl ₃ OP	Phosphorus(V) oxychloride	105.5	34.35	38.6
Cl ₃ OV	Vanadyl trichloride	127	36.78	
Cl ₃ P	Phosphorus(III) chloride	75.95	30.5	32.1
Cl ₃ Sb	Antimony(III) chloride	220.3	45.19	
Cl ₃ Ti	Titanium(III) chloride	960	124	

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
Cl ₄ Ge	Germanium(IV) chloride	86.55	27.9	
Cl ₄ OW	Tungsten(VI) oxytetrachloride	227.55	67.8	
Cl ₄ Si	Tetrachlorosilane	57.65	28.7	29.7
Cl ₄ Sn	Tin(IV) chloride	114.15	34.9	
Cl ₄ Te	Tellurium tetrachloride	387	77	
Cl ₄ Th	Thorium(IV) chloride	921	146.4	
Cl ₄ Ti	Titanium(IV) chloride	136.45	36.2	
Cl ₄ V	Vanadium(IV) chloride	148	41.4	42.5
Cl ₅ Mo	Molybdenum(V) chloride	268	62.8	
Cl ₅ Nb	Niobium(V) chloride	254.0	52.7	
Cl ₅ Ta	Tantalum(V) chloride	239.35	54.8	
Cl ₆ W	Tungsten(VI) chloride	346.75	52.7	
FH ₃ Si	Fluorosilane	-98.6	18.8	
FLi	Lithium fluoride	1673	147	
FNO	Nitrosyl fluoride	-59.9	19.28	
FNO ₂	Nitryl fluoride	-72.4	18.05	
FNS	Thionitrosyl fluoride (NSF)	4.8	22.2	
F ₂	Fluorine	-188.12	6.62	
F ₂ H ₂ Si	Difluorosilane	-77.8	16.3	
F ₂ O	Fluorine monoxide	-144.75	11.09	
F ₂ OS	Thionyl fluoride	-43.8	21.8	
F ₂ O ₂	Fluorine dioxide	-57	19.1	
F ₂ Pb	Lead(II) fluoride	1293	160.4	
F ₂ Zn	Zinc fluoride	1500	190.1	
F ₃ HSi	Trifluorosilane	-95	16.2	
F ₃ N	Nitrogen trifluoride	-128.75	11.56	
F ₃ O ₂ Re	Rhenium(VII) dioxytrifluoride	185.4	65.7	
F ₃ P	Phosphorus(III) fluoride	-101.5	16.5	
F ₃ PS	Phosphorus(V) sulfide trifluoride	-52.25	19.6	
F ₄ MoO	Molybdenum(VI) oxytetrafluoride	186.0	50.6	
F ₄ N ₂	Tetrafluorohydrazine	-74	13.27	
F ₄ ORe	Rhenium(VI) oxytetrafluoride	171.7	61.0	
F ₄ OW	Tungsten(VI) oxytetrafluoride	185.9	59.5	
F ₄ S	Sulfur tetrafluoride	-40.45	26.44	
F ₄ Se	Selenium tetrafluoride	106	47.2	
F ₄ Th	Thorium(IV) fluoride	1680	258	
F ₅ I	Iodine pentafluoride	100.5	41.3	
F ₅ Mo	Molybdenum(V) fluoride	213.6	51.8	
F ₅ Nb	Niobium(V) fluoride	229	52.3	
F ₅ Os	Osmium(V) fluoride	225.9	65.6	
F ₅ P	Phosphorus(V) fluoride	-84.6	17.2	
F ₅ Re	Rhenium(V) fluoride	221.3	58.1	
F ₅ Ta	Tantalum(V) fluoride	229.2	56.9	
F ₅ V	Vanadium(V) fluoride	48.3	44.52	
F ₆ Ir	Iridium(VI) fluoride	53.6	30.9	
F ₆ Mo	Molybdenum(VI) fluoride	34.0	29.0	
F ₆ Os	Osmium(VI) fluoride	47.5	28.1	
F ₆ Re	Rhenium(VI) fluoride	33.8	28.7	
F ₆ S	Sulfur hexafluoride			8.99
F ₆ W	Tungsten(VI) fluoride	17.1	26.5	
Ga	Gallium	2204	254	
GaI ₃	Gallium(III) iodide	340	56.5	
Ge	Germanium	2833	334	
GeH ₄	Germane	-88.1	14.06	
Ge ₂ H ₆	Digermane	30.8	25.1	
Ge ₃ H ₈	Trigermane	110.5	32.2	
HI	Hydrogen iodide	-35.55	19.76	17.36
HLiO	Lithium hydroxide	1626	188	

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
HNO ₃	Nitric acid	83		39.1
HN ₃	Hydrazoic acid	35.7	30.5	
HNaO	Sodium hydroxide	1388	175	
H ₂	Hydrogen	-252.87	0.90	
H ₂ O	Water	100.0	40.65	43.98
H ₂ O ₂	Hydrogen peroxide	150.2		51.6
H ₂ S	Hydrogen sulfide	-59.55	18.67	14.08
H ₂ S ₂	Hydrogen disulfide	70.7		33.78
H ₂ Se	Hydrogen selenide	-41.25	19.7	
H ₂ Te	Hydrogen telluride	-2	19.2	
H ₃ N	Ammonia	-33.33	23.33	19.86
H ₃ P	Phosphine	-87.75	14.6	
H ₃ Sb	Stibine	-17	21.3	
H ₄ N ₂	Hydrazine	113.55	41.8	44.7
H ₄ P ₂	Diphosphine	63.5	28.8	
H ₄ Si	Silane	-111.9	12.1	
H ₄ Sn	Stannane	-51.8	19.05	
H ₆ Si ₂	Disilane	-14.3	21.2	
H ₈ Si ₃	Trisilane	52.9	28.5	
He	Helium	-268.93	0.08	
Hg	Mercury	356.73	59.11	
HgI ₂	Mercury(II) iodide	354	59.2	
IIn	Iidium(I) iodide	712	90.8	
ITl	Thallium(I) iodide	824	104.7	
I ₂	Iodine	184.4	41.57	
I ₂ Pb	Lead(II) iodide	872	104	
I ₂ Sn	Tin(II) iodide	714	105	
I ₃ P	Phosphorus(III) iodide	227	43.9	
I ₃ Sb	Antimony(III) iodide	401	68.6	
I ₄ Si	Tetraiodosilane	287.35	50.2	
I ₄ Sn	Tin(IV) iodide	364.35	56.9	
I ₄ Ti	Titanium(IV) iodide	377	58.4	
Kr	Krypton	-153.22	9.08	
MoO ₃	Molybdenum(VI) oxide	1155	138	
NO	Nitric oxide	-151.74	13.83	
N ₂	Nitrogen	-195.79	5.57	
N ₂ O	Nitrous oxide	-88.48	16.53	
N ₂ O ₄	Nitrogen tetroxide	21.15	38.12	
Ne	Neon	-246.08	1.71	
O ₂	Oxygen	-182.95	6.82	
O ₂ S	Sulfur dioxide	-10.05	24.94	22.92
O ₃ S	Sulfur trioxide	45	40.69	43.14
P	Phosphorus	280.5	12.4	14.2
Pb	Lead	1749	179.5	
S	Sulfur	444.60	45	
STl ₂	Thallium(I) sulfide	1367	154	
Se	Selenium	685	95.48	
Te	Tellurium	988	114.1	
Xe	Xenon	-108.11	12.57	
CClF ₃	Chlorotrifluoromethane	-81.4	15.8	
CCl ₂ F ₂	Dichlorodifluoromethane	-29.8	20.1	
CCl ₃ F	Trichlorofluoromethane	23.7	25.1	
CCl ₄	Tetrachloromethane	76.8	29.82	32.43
CHBr ₃	Tribromomethane	149.1	39.66	46.05
CHClF ₂	Chlorodifluoromethane	-40.7	20.2	
CHCl ₂ F	Dichlorofluoromethane	8.9	25.2	
CHCl ₃	Trichloromethane	61.17	29.24	31.28
CH ₂ BrCl	Bromochloromethane	68.0	30.0	

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
CH ₂ Br ₂	Dibromomethane	97	32.92	36.97
CH ₂ Cl ₂	Dichloromethane	40	28.06	28.82
CH ₂ I ₂	Diiodomethane	182	42.5	
CH ₂ O ₂	Formic acid	101	22.69	20.10
CH ₃ Br	Bromomethane	3.5	23.91	22.81
CH ₃ Cl	Chloromethane	-24.09	21.40	18.92
CH ₃ I	Iodomethane	42.55	27.34	27.97
CH ₃ NO	Formamide	220		60.15
CH ₃ NO ₂	Nitromethane	101.19	33.99	38.27
CH ₄	Methane	-161.48	8.19	
CH ₄ O	Methanol	64.6	35.21	37.43
CH ₅ N	Methylamine	-6.32	25.60	23.37
CH ₆ N ₂	Methylhydrazine	87.5	36.12	40.37
CN ₄ O ₈	Tetranitromethane	126.1	40.74	49.93
CO	Carbon monoxide	-191.5	6.04	
CS ₂	Carbon disulfide	46	26.74	27.51
C ₂ Br ₂ ClF ₃	1,2-Dibromo-1-chloro-1,2,2-trifluoroethane	93	31.17	35.04
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane	47.35	27.03	28.39
C ₂ ClF ₅	Chloropentafluoroethane	-37.95	19.41	
C ₂ Cl ₂ F ₄	1,2-Dichlorotetrafluoroethane	3.8	23.3	
C ₂ Cl ₃ F ₃	1,1,1-Trichlorotrifluoroethane	46.1	26.85	28.08
C ₂ Cl ₃ F ₃	1,1,2-Trichloro-1,2,2-trifluoroethane	47.7	27.04	28.40
C ₂ Cl ₄	Tetrachloroethylene	121.3	34.68	39.68
C ₂ F ₆	Hexafluoroethane	-78.1	16.15	
C ₂ HBrClF ₃	2-Bromo-2-chloro-1,1,1-trifluoroethane	50.2	28.08	29.61
C ₂ HCl ₃	Trichloroethylene	87.21	31.40	34.54
C ₂ HCl ₅	Pentachloroethane	159.8	36.9	
C ₂ HF ₃ O ₂	Trifluoroacetic acid	73	33.3	
C ₂ H ₂ Br ₄	1,1,2,2-Tetrabromoethane	243.5	48.7	
C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	31.6	26.14	26.48
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	60.1	30.2	
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	48.7	28.9	
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	146.5	37.64	45.71
C ₂ H ₃ Br	Bromoethylene	15.8	23.4	
C ₂ H ₃ Cl	Chloroethylene	-13.3	20.8	
C ₂ H ₃ Cl ₂ F	1,1-Dichloro-1-fluoroethane	32.0	26.06	26.48
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	74.09	29.86	32.50
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	113.8	34.82	40.24
C ₂ H ₃ F ₃	1,1,1-Trifluoroethane	-47.25	18.99	
C ₂ H ₃ N	Acetonitrile	81.65	29.75	32.94
C ₂ H ₄	Ethylene	-103.77	13.53	
C ₂ H ₄ Br ₂	1,2-Dibromoethane	131.6	34.77	41.73
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	57.4	28.85	30.62
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	83.5	31.98	35.16
C ₂ H ₄ F ₂	1,1-Difluoroethane	-24.95	21.56	19.08
C ₂ H ₄ O	Acetaldehyde	20.1	25.76	25.47
C ₂ H ₄ O	Ethylene oxide	10.6	25.54	24.75
C ₂ H ₄ O ₂	Acetic acid	117.9	23.70	23.36
C ₂ H ₄ O ₂	Methyl formate	31.7	27.92	28.35
C ₂ H ₅ Br	Bromoethane	38.5	27.04	28.03
C ₂ H ₅ Cl	Chloroethane	12.3	24.65	
C ₂ H ₅ ClO	2-Chloroethanol	128.6	41.4	
C ₂ H ₅ I	Iodoethane	72.5	29.44	31.93
C ₂ H ₅ NO	<i>N</i> -Methylformamide	199.51		56.19
C ₂ H ₅ NO ₂	Nitroethane	114.0	38.0	
C ₂ H ₆	Ethane	-88.6	14.69	5.16
C ₂ H ₆ O	Ethanol	78.29	38.56	42.32
C ₂ H ₆ O	Dimethyl ether	-24.8	21.51	18.51

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₂ H ₆ OS	Dimethyl sulfoxide	189	43.1	
C ₂ H ₆ O ₂	Ethylene glycol	197.3	50.5	
C ₂ H ₆ S	Ethanethiol	35.1	26.79	27.30
C ₂ H ₆ S	Dimethyl sulfide	37.33	27.0	27.65
C ₂ H ₆ S ₂	1,2-Ethanedithiol	146.1	37.93	44.68
C ₂ H ₆ S ₂	Dimethyl disulfide	109.8	33.78	37.86
C ₂ H ₇ N	Dimethylamine	6.88	26.40	25.05
C ₂ H ₇ NO	Ethanolamine	171	49.83	
C ₂ H ₈ N ₂	1,2-Ethanediamine	117	37.98	44.98
C ₂ H ₈ N ₂	1,1-Dimethylhydrazine	63.9	32.55	35.0
C ₂ N ₂	Cyanogen	-21.1	23.33	19.75
C ₃ Cl ₂ F ₆	1,2-Dichlorohexafluoropropane	34.1	26.28	26.93
C ₃ H ₃ Cl ₃ O ₂	Methyl trichloroacetate	153.8		48.33
C ₃ H ₃ N	Acrylonitrile	77.3	32.6	
C ₃ H ₄ Cl ₂ O ₂	Methyl dichloroacetate	142.9	39.28	47.72
C ₃ H ₄ O	Acrolein	52.6	28.3	
C ₃ H ₄ O ₂	2-Oxetanone	162		47.03
C ₃ H ₅ Br	3-Bromopropene	70.1	30.24	32.73
C ₃ H ₅ Cl	3-Chloropropene	45.1	29.0	
C ₃ H ₅ ClO ₂	Methyl chloroacetate	129.5	39.23	46.73
C ₃ H ₅ Cl ₃	1,2,3-Trichloropropane	157	37.1	
C ₃ H ₅ N	Propanenitrile	97.14	31.81	36.03
C ₃ H ₆	Propene	-47.69	18.42	14.24
C ₃ H ₆	Cyclopropane	-32.81	20.05	16.93
C ₃ H ₆ Br ₂	1,2-Dibromopropane	141.9	35.61	41.67
C ₃ H ₆ Br ₂	1,3-Dibromopropane	167.3		47.45
C ₃ H ₆ Cl ₂	1,3-Dichloropropane	120.9	35.18	40.75
C ₃ H ₆ O	Allyl alcohol	97.0	40.0	
C ₃ H ₆ O	Propanal	48	28.31	29.62
C ₃ H ₆ O	Acetone	56.05	29.10	30.99
C ₃ H ₆ O	Methyloxirane	35	27.35	27.89
C ₃ H ₆ O	Oxetane	47.6	28.67	29.85
C ₃ H ₆ O ₂	Propanoic acid	141.15		32.14
C ₃ H ₆ O ₂	Ethyl formate	54.4	29.91	31.96
C ₃ H ₆ O ₂	Methyl acetate	56.87	30.32	32.29
C ₃ H ₆ S	Thietane	95	32.32	35.97
C ₃ H ₇ Br	1-Bromopropane	71.1	29.84	32.01
C ₃ H ₇ Br	2-Bromopropane	59.5	28.33	30.17
C ₃ H ₇ Cl	1-Chloropropane	46.5	27.18	28.35
C ₃ H ₇ Cl	2-Chloropropane	35.7	26.30	26.90
C ₃ H ₇ I	1-Iodopropane	102.6	32.08	36.25
C ₃ H ₇ I	2-Iodopropane	89.5	30.68	34.06
C ₃ H ₇ NO	<i>N</i> -Ethylformamide	198		58.44
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide	153		46.89
C ₃ H ₇ NO ₂	1-Nitropropane	131.1	38.5	
C ₃ H ₇ NO ₂	2-Nitropropane	120.2	36.8	
C ₃ H ₈	Propane	-42.1	19.04	14.79
C ₃ H ₈ O	1-Propanol	97.2	41.44	47.45
C ₃ H ₈ O	2-Propanol	82.3	39.85	45.39
C ₃ H ₈ O ₂	1,2-Propylene glycol	187.6	52.4	
C ₃ H ₈ O ₂	1,3-Propylene glycol	214.4	57.9	
C ₃ H ₈ O ₂	Ethylene glycol monomethyl ether	124.1	37.54	45.17
C ₃ H ₈ O ₃	Glycerol	290	61.0	
C ₃ H ₈ S	1-Propanethiol	67.8	29.54	31.89
C ₃ H ₈ S	2-Propanethiol	52.6	27.91	29.45
C ₃ H ₈ S	Ethyl methyl sulfide	66.7	29.53	31.85
C ₃ H ₈ S ₂	1,3-Propanedithiol	172.9		49.66
C ₃ H ₉ N	Propylamine	47.22	29.55	31.27

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₃ H ₉ N	Isopropylamine	31.76	27.83	28.36
C ₃ H ₉ N	Trimethylamine	2.87	22.94	21.66
C ₃ H ₁₀ N ₂	1,3-Propanediamine	139.8	40.85	50.16
C ₄ F ₈	Perfluorocyclobutane	-5.9	23.2	
C ₄ F ₁₀	Perfluorobutane	-1.9	22.9	
C ₄ H ₄ N ₂	Succinonitrile	266	48.5	
C ₄ H ₄ N ₂	Pyrimidine	123.8	43.09	49.79
C ₄ H ₄ N ₂	Pyridazine	208		53.47
C ₄ H ₄ O	Furan	31.5	27.10	27.45
C ₄ H ₄ O ₂	Diketene	126.1	36.80	42.89
C ₄ H ₄ S	Thiophene	84.0	31.48	34.70
C ₄ H ₅ Cl ₃ O ₂	Ethyl trichloroacetate	167.5		50.97
C ₄ H ₅ N	2-Methylacrylonitrile	90.3	31.8	
C ₄ H ₅ N	Pyrrrole	129.79	38.75	45.09
C ₄ H ₅ N	Cyclopropanecarbonitrile	135.1	35.55	41.94
C ₄ H ₅ NO ₂	Methyl cyanoacetate	200.5	48.2	
C ₄ H ₅ NS	4-Methylthiazole	133.3	37.58	43.85
C ₄ H ₆	1,2-Butadiene	10.9	24.02	23.21
C ₄ H ₆	1,3-Butadiene	-4.41	22.47	20.86
C ₄ H ₆	1-Butyne	8.08	24.52	23.35
C ₄ H ₆ Cl ₂ O ₂	Ethyl dichloroacetate	155		50.60
C ₄ H ₆ O ₂	Vinyl acetate	72.5	34.6	
C ₄ H ₆ O ₂	Methyl acrylate	80.7	33.1	
C ₄ H ₆ O ₂	γ -Butyrolactone	204	52.2	
C ₄ H ₆ O ₃	Acetic anhydride	139.5	38.2	
C ₄ H ₆ S	2,3-Dihydrothiophene	112.1	33.24	37.74
C ₄ H ₆ S	2,5-Dihydrothiophene	122.4	34.83	39.95
C ₄ H ₇ ClO ₂	Ethyl chloroacetate	144.3	40.43	49.47
C ₄ H ₇ N	Butanenitrile	117.6	33.68	39.33
C ₄ H ₇ N	2-Methylpropanenitrile	103.9	32.39	37.13
C ₄ H ₈	1-Butene	-6.26	22.07	20.22
C ₄ H ₈	<i>cis</i> -2-Butene	3.71	23.34	22.16
C ₄ H ₈	<i>trans</i> -2-Butene	0.88	22.72	21.40
C ₄ H ₈	Cyclobutane	12.6	24.19	23.51
C ₄ H ₈ Br ₂	1,4-Dibromobutane	197		53.09
C ₄ H ₈ Cl ₂	1,2-Dichlorobutane	124.1	33.90	39.58
C ₄ H ₈ Cl ₂	1,4-Dichlorobutane	161		46.36
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether	178.5	45.2	
C ₄ H ₈ O	Ethyl vinyl ether	35.5	26.2	
C ₄ H ₈ O	1,2-Epoxybutane	63.4	30.3	
C ₄ H ₈ O	Butanal	74.8	31.5	
C ₄ H ₈ O	2-Butanone	79.59	31.30	34.79
C ₄ H ₈ O	Tetrahydrofuran	65	29.81	31.99
C ₄ H ₈ O ₂	Butanoic acid	163.75		40.45
C ₄ H ₈ O ₂	2-Methylpropanoic acid	154.45		35.30
C ₄ H ₈ O ₂	Propyl formate	80.9	33.61	37.53
C ₄ H ₈ O ₂	Ethyl acetate	77.11	31.94	35.60
C ₄ H ₈ O ₂	Methyl propanoate	79.8	32.24	35.85
C ₄ H ₈ O ₂	1,3-Dioxane	106.1	34.37	39.09
C ₄ H ₈ O ₂	1,4-Dioxane	101.5	34.16	38.60
C ₄ H ₈ S	Tetrahydrothiophene	121.0	34.66	39.43
C ₄ H ₉ Br	1-Bromobutane	101.6	32.51	36.64
C ₄ H ₉ Br	2-Bromobutane	91.3	30.77	34.41
C ₄ H ₉ Br	1-Bromo-2-methylpropane	91.1	31.33	34.82
C ₄ H ₉ Br	2-Bromo-2-methylpropane	73.3	29.23	31.81
C ₄ H ₉ Cl	1-Chlorobutane	78.6	30.39	33.51
C ₄ H ₉ Cl	2-Chlorobutane	68.2	29.17	31.53
C ₄ H ₉ Cl	1-Chloro-2-methylpropane	68.5	29.22	31.67

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₄ H ₉ Cl	2-Chloro-2-methylpropane	50.9	27.55	28.98
C ₄ H ₉ I	1-Iodobutane	130.6	34.66	40.63
C ₄ H ₉ I	2-Iodobutane	120.1	33.27	38.46
C ₄ H ₉ I	1-Iodo-2-methylpropane	121.1	33.54	38.83
C ₄ H ₉ I	2-Iodo-2-methylpropane	100.1	31.43	35.41
C ₄ H ₉ N	Pyrrolidine	86.56	33.01	37.52
C ₄ H ₉ NO	N-Ethylacetamide	205		64.89
C ₄ H ₉ NO	N,N-Dimethylacetamide	165		50.24
C ₄ H ₉ NO	Morpholine	128	37.1	
C ₄ H ₁₀	Butane	-0.5	22.44	21.02
C ₄ H ₁₀	Isobutane	-11.73	21.30	19.23
C ₄ H ₁₀ O	1-Butanol	117.73	43.29	52.35
C ₄ H ₁₀ O	2-Butanol	99.51	40.75	49.72
C ₄ H ₁₀ O	2-Methyl-1-propanol	107.89	41.82	50.82
C ₄ H ₁₀ O	2-Methyl-2-propanol	82.4	39.07	46.69
C ₄ H ₁₀ O	Diethyl ether	34.5	26.52	27.10
C ₄ H ₁₀ O	Methyl propyl ether	39.1	26.75	27.60
C ₄ H ₁₀ O	Isopropyl methyl ether	30.77	26.05	26.41
C ₄ H ₁₀ O ₂	1,2-Butanediol	190.5	52.84	71.55
C ₄ H ₁₀ O ₂	1,3-Butanediol	207.5	54.31	74.46
C ₄ H ₁₀ O ₂	Ethylene glycol monoethyl ether	135	39.22	48.21
C ₄ H ₁₀ O ₂	Ethylene glycol dimethyl ether	85	32.42	36.39
C ₄ H ₁₀ O ₃	Diethylene glycol	245.8	52.3	
C ₄ H ₁₀ S	1-Butanethiol	98.5	32.23	36.63
C ₄ H ₁₀ S	2-Butanethiol	85	30.59	33.99
C ₄ H ₁₀ S	2-Methyl-1-propanethiol	88.5	31.01	34.63
C ₄ H ₁₀ S	2-Methyl-2-propanethiol	64.3	28.45	30.78
C ₄ H ₁₀ S	Diethyl sulfide	92.1	31.77	35.80
C ₄ H ₁₀ S	Methyl propyl sulfide	95.6	32.08	36.24
C ₄ H ₁₀ S	Isopropyl methyl sulfide	84.8	30.71	34.15
C ₄ H ₁₀ S ₂	1,4-Butanedithiol	195.5		55.10
C ₄ H ₁₀ S ₂	Diethyl disulfide	154.1	37.58	45.18
C ₄ H ₁₁ N	Butylamine	77.00	31.81	35.72
C ₄ H ₁₁ N	sec-Butylamine	62.73	29.92	32.85
C ₄ H ₁₁ N	tert-Butylamine	44.04	28.27	29.64
C ₄ H ₁₁ N	Isobutylamine	67.75	30.61	33.85
C ₄ H ₁₁ N	Diethylamine	55.5	29.06	31.31
C ₄ H ₁₁ N	Isopropylmethylamine	50.4	28.71	30.69
C ₄ H ₁₁ NO	2-Amino-2-methyl-1-propanol	165.5	50.6	
C ₄ H ₁₁ NO ₂	Diethanolamine	268.8	65.2	
C ₅ H ₂ F ₆ O ₂	Hexafluoroacetylacetone	54.15	27.05	30.58
C ₅ H ₄ O ₂	Furfural	161.7	43.2	
C ₅ H ₅ N	Pyridine	115.23	35.09	40.21
C ₅ H ₆ O ₂	Furfuryl alcohol	171	53.6	
C ₅ H ₆ S	2-Methylthiophene	112.6	33.90	38.87
C ₅ H ₆ S	3-Methylthiophene	115.5	34.24	39.43
C ₅ H ₇ N	trans-3-Pentenenitrile	142.6	37.09	44.77
C ₅ H ₇ N	Cyclobutanecarbonitrile	149.6	36.88	44.34
C ₅ H ₈	Spiropentane	39	26.76	27.49
C ₅ H ₈ O	Cyclopropyl methyl ketone	111.3	34.07	39.41
C ₅ H ₈ O	Cyclopentanone	130.57	36.35	42.72
C ₅ H ₈ O ₂	Methyl cyclopropanecarboxylate	114.9	35.25	41.27
C ₅ H ₈ O ₂	Allyl acetate	103.5	36.3	
C ₅ H ₈ O ₂	Ethyl acrylate	99.4	34.7	
C ₅ H ₈ O ₂	Methyl methacrylate	100.5	36.0	
C ₅ H ₈ O ₂	2,4-Pentanedione	138	34.30	41.77
C ₅ H ₉ N	Pentanenitrile	141.3	36.09	43.60
C ₅ H ₉ N	3-Methylbutanenitrile	127.5	35.10	41.64

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₅ H ₉ N	2,2-Dimethylpropanenitrile	106.1	32.40	37.35
C ₅ H ₁₀	1-Pentene	29.96	25.20	25.47
C ₅ H ₁₀	<i>cis</i> -2-Pentene	36.93		26.86
C ₅ H ₁₀	<i>trans</i> -2-Pentene	36.34		26.76
C ₅ H ₁₀	2-Methyl-1-butene	31.2	25.50	25.92
C ₅ H ₁₀	3-Methyl-1-butene	20.1		23.77
C ₅ H ₁₀	2-Methyl-2-butene	38.56	26.31	27.06
C ₅ H ₁₀	Cyclopentane	49.3	27.30	28.52
C ₅ H ₁₀ Cl ₂	1,2-Dichloropentane	148.3	36.45	43.89
C ₅ H ₁₀ Cl ₂	1,5-Dichloropentane	179		50.71
C ₅ H ₁₀ O	Cyclopentanol	140.42		57.05
C ₅ H ₁₀ O	2-Pentanone	102.26	33.44	38.40
C ₅ H ₁₀ O	3-Pentanone	101.96	33.45	38.52
C ₅ H ₁₀ O	3-Methyl-2-butanone	94.33	32.35	36.78
C ₅ H ₁₀ O	3,3-Dimethyloxetane	80.6	30.85	33.94
C ₅ H ₁₀ O	Tetrahydropyran	88	31.17	34.58
C ₅ H ₁₀ O ₂	Pentanoic acid	186.1	44.1	
C ₅ H ₁₀ O ₂	2-Methylbutanoic acid	177		46.91
C ₅ H ₁₀ O ₂	Butyl formate	106.1	36.58	41.11
C ₅ H ₁₀ O ₂	Isobutyl formate	98.2	33.6	
C ₅ H ₁₀ O ₂	Propyl acetate	101.54	33.92	39.72
C ₅ H ₁₀ O ₂	Isopropyl acetate	88.6	32.93	37.20
C ₅ H ₁₀ O ₂	Ethyl propanoate	99.1	33.88	39.21
C ₅ H ₁₀ O ₂	Methyl butanoate	102.8	33.79	39.28
C ₅ H ₁₀ O ₂	Methyl isobutanoate	92.5	32.61	37.32
C ₅ H ₁₀ O ₂	Tetrahydrofurfuryl alcohol	178	45.2	
C ₅ H ₁₀ O ₃	Diethyl carbonate	126		43.60
C ₅ H ₁₀ O ₃	Ethylene glycol monomethyl ether acetate	143	43.9	
C ₅ H ₁₀ S	Thiacyclohexane	141.8	35.96	42.58
C ₅ H ₁₀ S	Cyclopentanethiol	132.1	35.32	41.42
C ₅ H ₁₁ Br	1-Bromopentane	129.8	35.01	41.28
C ₅ H ₁₁ Cl	1-Chloropentane	107.8	33.15	38.24
C ₅ H ₁₁ Cl	2-Chloropentane	97.0	31.79	36.03
C ₅ H ₁₁ Cl	1-Chloro-3-methylbutane	98.9	32.02	36.24
C ₅ H ₁₁ I	1-Iodopentane	155		45.27
C ₅ H ₁₁ N	Piperidine	106.22		39.29
C ₅ H ₁₂	Pentane	36.06	25.79	26.43
C ₅ H ₁₂	Isopentane	27.88	24.69	24.85
C ₅ H ₁₂	Neopentane	9.48	22.74	21.84
C ₅ H ₁₂ O	1-Pentanol	137.98	44.36	57.02
C ₅ H ₁₂ O	2-Pentanol	119.3	41.40	54.21
C ₅ H ₁₂ O	3-Pentanol	116.25		54.0
C ₅ H ₁₂ O	2-Methyl-1-butanol	128		55.16
C ₅ H ₁₂ O	3-Methyl-1-butanol	131.1	44.07	55.61
C ₅ H ₁₂ O	2-Methyl-2-butanol	102.4	39.04	50.10
C ₅ H ₁₂ O	3-Methyl-2-butanol	112.9		53.0
C ₅ H ₁₂ O	Butyl methyl ether	70.16	29.55	32.37
C ₅ H ₁₂ O	<i>sec</i> -Butyl methyl ether	59.1	28.09	30.23
C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether	55.2	27.94	29.82
C ₅ H ₁₂ O	Isobutyl methyl ether	58.6	28.02	30.13
C ₅ H ₁₂ O	Ethyl propyl ether	63.21	28.94	31.43
C ₅ H ₁₂ O	Ethyl isopropyl ether	54.1	28.21	30.08
C ₅ H ₁₂ O ₂	1-Ethoxy-2-methoxyethane	102.1	34.33	39.83
C ₅ H ₁₂ O ₂	1,5-Pentanediol	239	60.7	
C ₅ H ₁₂ O ₂	Ethylene glycol monopropyl ether	149.8	41.40	52.12
C ₅ H ₁₂ O ₂	Diethoxymethane	88	31.33	35.65
C ₅ H ₁₂ O ₃	Diethylene glycol monomethyl ether	193	46.6	
C ₅ H ₁₂ S	1-Pentanethiol	126.6	34.88	41.24

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₅ H ₁₂ S	2-Methyl-1-butanethiol	119.1	33.79	39.45
C ₅ H ₁₂ S	2-Methyl-2-butanethiol	99.1	31.37	35.67
C ₅ H ₁₂ S	Butyl methyl sulfide	123.5	34.47	40.46
C ₅ H ₁₂ S	<i>tert</i> -Butyl methyl sulfide	99	31.47	35.84
C ₅ H ₁₂ S	Ethyl propyl sulfide	118.6	34.24	39.97
C ₅ H ₁₂ S	Ethyl isopropyl sulfide	107.5	32.74	37.78
C ₅ H ₁₃ N	Pentylamine	104.3	34.01	40.08
C ₅ H ₁₃ N	Ethylisopropylamine	69.6	29.94	33.13
C ₆ ClF ₅	Chloropentafluorobenzene	117.96	34.76	41.07
C ₆ F ₆	Hexafluorobenzene	80.26	31.66	35.71
C ₆ HF ₅	Pentafluorobenzene	85.74	32.15	36.27
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	180	39.66	50.21
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	173	38.62	48.58
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	174	38.79	49.0
C ₆ H ₄ F ₂	<i>o</i> -Difluorobenzene	94	32.21	36.18
C ₆ H ₄ F ₂	<i>m</i> -Difluorobenzene	82.6	31.10	34.59
C ₆ H ₄ F ₂	<i>p</i> -Difluorobenzene	89	31.77	35.54
C ₆ H ₅ Br	Bromobenzene	156.06		44.54
C ₆ H ₅ Cl	Chlorobenzene	131.72	35.19	40.97
C ₆ H ₅ F	Fluorobenzene	84.73	31.19	34.58
C ₆ H ₅ I	Iodobenzene	188.4	39.5	
C ₆ H ₅ NO ₂	Nitrobenzene	210.8		55.01
C ₆ H ₆	Benzene	80.09	30.72	33.83
C ₆ H ₆ ClN	<i>o</i> -Chloroaniline	208.8	44.4	
C ₆ H ₆ O	Phenol	181.87	45.69	57.82
C ₆ H ₆ S	Benzenethiol	169.1	39.93	47.56
C ₆ H ₇ N	Aniline	184.17	42.44	55.83
C ₆ H ₇ N	2-Methylpyridine	129.38	36.17	42.48
C ₆ H ₇ N	3-Methylpyridine	144.14	37.35	44.44
C ₆ H ₇ N	4-Methylpyridine	145.36	37.51	44.56
C ₆ H ₇ N	1-Cyclopentenecarbonitrile			44.98
C ₆ H ₉ N	Cyclopentanecarbonitrile			43.43
C ₆ H ₉ NO ₃	Triacetamide			60.41
C ₆ H ₁₀	Cyclohexene	82.98	30.46	33.47
C ₆ H ₁₀ O	Cyclohexanone	155.43		45.06
C ₆ H ₁₀ O	Mesityl oxide	130	36.1	
C ₆ H ₁₀ O ₂	Methyl cyclobutanecarboxylate	135.5	37.13	44.72
C ₆ H ₁₀ O ₃	Propanoic anhydride	170	41.7	
C ₆ H ₁₀ O ₄	Diethyl oxalate	185.7	42.0	
C ₆ H ₁₀ O ₄	Ethylene glycol diacetate	190		61.44
C ₆ H ₁₁ N	Hexanenitrile	163.65		47.91
C ₆ H ₁₂	1-Hexene	63.48		30.61
C ₆ H ₁₂	<i>cis</i> -2-Hexene	68.8		32.19
C ₆ H ₁₂	<i>trans</i> -2-Hexene	67.9		31.60
C ₆ H ₁₂	<i>cis</i> -3-Hexene	66.4		31.23
C ₆ H ₁₂	<i>trans</i> -3-Hexene	67.1		31.55
C ₆ H ₁₂	2-Methyl-1-pentene	62.1		30.48
C ₆ H ₁₂	3-Methyl-1-pentene	54.2		28.62
C ₆ H ₁₂	4-Methyl-1-pentene	53.9		28.71
C ₆ H ₁₂	2-Methyl-2-pentene	67.3		31.60
C ₆ H ₁₂	3-Methyl- <i>cis</i> -2-pentene	67.7		32.09
C ₆ H ₁₂	3-Methyl- <i>trans</i> -2-pentene	70.4		31.35
C ₆ H ₁₂	4-Methyl- <i>cis</i> -2-pentene	56.3		29.48
C ₆ H ₁₂	4-Methyl- <i>trans</i> -2-pentene	58.6		29.97
C ₆ H ₁₂	2-Ethyl-1-butene	64.7		31.13
C ₆ H ₁₂	2,3-Dimethyl-1-butene	55.6		29.18
C ₆ H ₁₂	3,3-Dimethyl-1-butene	41.2		26.61
C ₆ H ₁₂	2,3-Dimethyl-2-butene	73.3	29.64	32.51

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₆ H ₁₂	Cyclohexane	80.73	29.97	33.01
C ₆ H ₁₂	Methylcyclopentane	71.8	29.08	31.64
C ₆ H ₁₂	Ethylcyclobutane	70.8	28.67	31.24
C ₆ H ₁₂ Cl ₂	1,2-Dichlorohexane	173		48.16
C ₆ H ₁₂ O	Butyl vinyl ether	94	31.58	36.17
C ₆ H ₁₂ O	2-Hexanone	127.6	36.35	43.14
C ₆ H ₁₂ O	3-Hexanone	123.5	35.36	42.47
C ₆ H ₁₂ O	3-Methyl-2-pentanone	117.5	34.16	40.53
C ₆ H ₁₂ O	4-Methyl-2-pentanone	116.5	34.49	40.61
C ₆ H ₁₂ O	2-Methyl-3-pentanone	113.5	33.84	39.79
C ₆ H ₁₂ O	3,3-Dimethyl-2-butanone	106.1	33.39	37.91
C ₆ H ₁₂ O	Cyclohexanol	160.84		62.01
C ₆ H ₁₂ O ₂	Butyl acetate	126.1	36.28	43.86
C ₆ H ₁₂ O ₂	<i>tert</i> -Butyl acetate	95.1	33.07	38.03
C ₆ H ₁₂ O ₂	Isobutyl acetate	116.5	35.9	
C ₆ H ₁₂ O ₂	Propyl propanoate	122.5	35.54	43.45
C ₆ H ₁₂ O ₂	Ethyl butanoate	121.5	35.47	42.68
C ₆ H ₁₂ O ₂	Ethyl 2-methylpropanoate	110.1	33.67	39.83
C ₆ H ₁₂ O ₂	Methyl pentanoate	127.4	35.36	43.10
C ₆ H ₁₂ O ₂	Methyl 2,2-dimethylpropanoate	101.1	33.42	38.76
C ₆ H ₁₂ O ₃	Ethylene glycol monoethyl ether acetate	156.4	40.76	52.61
C ₆ H ₁₂ S	Cyclohexanethiol	158.9	37.06	44.57
C ₆ H ₁₃ Br	1-Bromohexane	155.3		45.89
C ₆ H ₁₃ Cl	1-Chlorohexane	135	35.67	42.83
C ₆ H ₁₃ I	1-Iodohexane	181		49.75
C ₆ H ₁₃ N	Cyclohexylamine	134	36.14	43.67
C ₆ H ₁₄	Hexane	68.73	28.85	31.56
C ₆ H ₁₄	2-Methylpentane	60.26	27.79	29.89
C ₆ H ₁₄	3-Methylpentane	63.27	28.06	30.28
C ₆ H ₁₄	2,2-Dimethylbutane	49.73	26.31	27.68
C ₆ H ₁₄	2,3-Dimethylbutane	57.93	27.38	29.12
C ₆ H ₁₄ N ₂	Azopropane	114		39.88
C ₆ H ₁₄ O	1-Hexanol	157.6	44.50	61.61
C ₆ H ₁₄ O	2-Hexanol	140	41.01	58.46
C ₆ H ₁₄ O	2-Methyl-1-pentanol	149	50.2	
C ₆ H ₁₄ O	4-Methyl-1-pentanol	151.9	44.46	60.47
C ₆ H ₁₄ O	2-Methyl-2-pentanol	121.1	39.59	54.77
C ₆ H ₁₄ O	4-Methyl-2-pentanol	131.6	44.2	
C ₆ H ₁₄ O	2-Ethyl-1-butanol	147	43.2	
C ₆ H ₁₄ O	Dipropyl ether	90.08	31.31	35.69
C ₆ H ₁₄ O	Diisopropyl ether	68.51	29.10	32.12
C ₆ H ₁₄ O	Butyl ethyl ether	92.3	31.63	36.32
C ₆ H ₁₄ O	Methyl pentyl ether	99	32.02	36.85
C ₆ H ₁₄ O ₂	2-Methyl-2,4-pentanediol	197.1	57.3	
C ₆ H ₁₄ O ₂	Ethylene glycol monobutyl ether	168.4		56.59
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane	102.25	36.28	43.20
C ₆ H ₁₄ O ₂	Ethylene glycol diethyl ether	119.4	36.28	43.20
C ₆ H ₁₄ O ₃	Bis(ethoxymethyl) ether	140.6	36.17	44.69
C ₆ H ₁₄ O ₃	Diethylene glycol monoethyl ether	196	47.5	
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether	162	36.17	44.69
C ₆ H ₁₄ O ₄	Triethylene glycol	285	71.4	
C ₆ H ₁₄ S	Dipropyl sulfide	142.9	36.60	44.21
C ₆ H ₁₄ S	Diisopropyl sulfide	120.1	33.80	39.60
C ₆ H ₁₄ S	Isopropyl propyl sulfide	132.1	35.11	41.78
C ₆ H ₁₄ S	Butyl ethyl sulfide	144.3	37.01	44.51
C ₆ H ₁₄ S	Methyl pentyl sulfide	145.1	37.41	45.24
C ₆ H ₁₅ N	Hexylamine	132.8	36.54	45.10
C ₆ H ₁₅ N	Butylethylamine	107.5	33.97	40.15

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₆ H ₁₅ N	Dipropylamine	109.3	33.47	40.04
C ₆ H ₁₅ N	Diisopropylamine	83.9	30.40	34.61
C ₆ H ₁₅ N	Isopropylpropylamine	96.9	32.14	37.23
C ₆ H ₁₅ N	Triethylamine	89	31.01	34.84
C ₆ MoO ₆	Molybdenum hexacarbonyl	701	72.51	
C ₇ H ₃ F ₅	2,3,4,5,6-Pentafluorotoluene	117.5	34.75	41.12
C ₇ H ₅ F ₃	(Trifluoromethyl)benzene	102.1	32.63	37.60
C ₇ H ₅ N	Benzonitrile	191.1	45.9	
C ₇ H ₆ O	Benzaldehyde	179.0	42.5	
C ₇ H ₆ O ₂	Salicylaldehyde	197	38.2	
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene	159.0	37.5	
C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene	162.4	38.7	
C ₇ H ₇ F	<i>o</i> -Fluorotoluene	115	35.4	
C ₇ H ₇ F	<i>p</i> -Fluorotoluene	116.6	34.08	39.42
C ₇ H ₈	Toluene	110.63	33.18	38.01
C ₇ H ₈ O	<i>o</i> -Cresol	191.04	45.19	
C ₇ H ₈ O	<i>m</i> -Cresol	202.27	47.40	61.71
C ₇ H ₈ O	<i>p</i> -Cresol	201.98	47.45	
C ₇ H ₈ O	Benzyl alcohol	205.31	50.48	
C ₇ H ₈ O	Anisole	153.7	38.97	46.90
C ₇ H ₉ N	Benzylamine	185		60.16
C ₇ H ₉ N	<i>o</i> -Methylaniline	200.3	44.6	
C ₇ H ₉ N	<i>m</i> -Methylaniline	203.3	44.9	
C ₇ H ₉ N	<i>p</i> -Methylaniline	200.4	44.3	
C ₇ H ₉ N	1-Cyclohexenecarbonitrile			53.55
C ₇ H ₉ N	2,3-Dimethylpyridine	161.12	39.08	47.82
C ₇ H ₉ N	2,4-Dimethylpyridine	158.38	38.53	47.49
C ₇ H ₉ N	2,5-Dimethylpyridine	156.98	38.68	47.04
C ₇ H ₉ N	2,6-Dimethylpyridine	144.01	37.46	45.34
C ₇ H ₉ N	3,4-Dimethylpyridine	179.10	39.99	50.50
C ₇ H ₉ N	3,5-Dimethylpyridine	171.84	39.46	49.33
C ₇ H ₁₀ O	Dicyclopentyl ketone	161		53.70
C ₇ H ₁₁ N	Cyclohexanecarbonitrile			51.92
C ₇ H ₁₂	1-Methylbicyclo(3,1,0)hexane	93.1	31.07	34.77
C ₇ H ₁₂ O ₄	Diethyl malonate	200	54.8	
C ₇ H ₁₄	1-Heptene	93.64		35.49
C ₇ H ₁₄	<i>cis</i> -2-Heptene	98.4		36.26
C ₇ H ₁₄	<i>trans</i> -2-Heptene	98		36.27
C ₇ H ₁₄	<i>cis</i> -3-Heptene	95.8		35.81
C ₇ H ₁₄	<i>trans</i> -3-Heptene	95.7		35.84
C ₇ H ₁₄	<i>cis</i> -3-Methyl-3-hexene	95.4		36.31
C ₇ H ₁₄	<i>trans</i> -3-Methyl-3-hexene	93.5		35.70
C ₇ H ₁₄	2,4-Dimethyl-1-pentene	81.6		33.03
C ₇ H ₁₄	4,4-Dimethyl-1-pentene	72.5		31.13
C ₇ H ₁₄	2,4-Dimethyl-2-pentene	83.4		34.19
C ₇ H ₁₄	<i>cis</i> -4,4-Dimethyl-2-pentene	80.4		32.56
C ₇ H ₁₄	<i>trans</i> -4,4-Dimethyl-2-pentene	76.7		32.81
C ₇ H ₁₄	2-Ethyl-3-methyl-1-butene	89		34.35
C ₇ H ₁₄	2,3,3-Trimethyl-1-butene	77.9		32.09
C ₇ H ₁₄	Methylcyclohexane	100.93	31.27	35.36
C ₇ H ₁₄	Ethylcyclopentane	103.5	31.96	36.40
C ₇ H ₁₄	<i>cis</i> -1,3-Dimethylcyclopentane	90.8	30.40	34.20
C ₇ H ₁₄ O	2-Heptanone	151.05		47.24
C ₇ H ₁₄ O	2,2-Dimethyl-3-pentanone	125.6	36.09	42.34
C ₇ H ₁₄ O	2,4-Dimethyl-3-pentanone	125.4	34.64	41.51
C ₇ H ₁₄ O	1-Methylcyclohexanol	155	79.0	
C ₇ H ₁₄ O	<i>cis</i> -2-Methylcyclohexanol	165	48.5	
C ₇ H ₁₄ O	<i>trans</i> -2-Methylcyclohexanol	167.5	53.0	

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₇ H ₁₄ O ₂	Pentyl acetate	149.2	38.42	48.56
C ₇ H ₁₄ O ₂	Isopentyl acetate	142.5	37.5	
C ₇ H ₁₄ O ₂	Ethyl pentanoate	146.1	36.96	47.01
C ₇ H ₁₄ O ₂	Ethyl 3-methylbutanoate	135.0	37.0	
C ₇ H ₁₄ O ₂	Ethyl 2,2-dimethylpropanoate	118.4	34.51	41.25
C ₇ H ₁₄ O ₂	Methyl hexanoate	149.5	38.55	48.04
C ₇ H ₁₅ Br	1-Bromoheptane	179		50.60
C ₇ H ₁₅ Cl	1-Chloroheptane	159		47.66
C ₇ H ₁₆	Heptane	98.5	31.77	36.57
C ₇ H ₁₆	2-Methylhexane	90.04	30.62	34.87
C ₇ H ₁₆	3-Methylhexane	92	30.9	
C ₇ H ₁₆	3-Ethylpentane	93.5	31.12	35.22
C ₇ H ₁₆	2,2-Dimethylpentane	79.2	29.23	32.42
C ₇ H ₁₆	2,3-Dimethylpentane	89.78	30.46	34.26
C ₇ H ₁₆	2,4-Dimethylpentane	80.49	29.55	32.88
C ₇ H ₁₆	3,3-Dimethylpentane	86.06	29.62	33.03
C ₇ H ₁₆	2,2,3-Trimethylbutane	80.86	28.90	32.05
C ₇ H ₁₆ O	Hexyl methyl ether	126.1	34.93	42.07
C ₇ H ₁₆ O	1-Heptanol	176.45		66.81
C ₇ H ₁₆ O	3-Heptanol	157	42.5	
C ₇ H ₁₆ O	Butyl propyl ether	118.1	33.72	40.22
C ₇ H ₁₆ O	Ethyl pentyl ether	117.6	34.41	41.01
C ₇ H ₁₇ N	Heptylamine	156		49.96
C ₈ F ₁₈	Perfluorooctane	105.9	33.38	41.13
C ₈ H ₈	Styrene	145	38.7	
C ₈ H ₈ O	Acetophenone	202	43.98	55.40
C ₈ H ₈ O ₂	Methyl benzoate	199		55.57
C ₈ H ₈ O ₃	Methyl salicylate	222.9	46.7	
C ₈ H ₁₀	Ethylbenzene	136.19	35.57	42.24
C ₈ H ₁₀	<i>o</i> -Xylene	144.5	36.24	43.43
C ₈ H ₁₀	<i>m</i> -Xylene	139.12	35.66	42.65
C ₈ H ₁₀	<i>p</i> -Xylene	138.37	35.67	42.40
C ₈ H ₁₀ O	2,4-Xylenol	210.98		64.96
C ₈ H ₁₀ O	2,5-Xylenol	211.1	46.9	
C ₈ H ₁₀ O	2,6-Xylenol	201.07		75.31
C ₈ H ₁₀ O	3,4-Xylenol	227		85.03
C ₈ H ₁₀ O	3,5-Xylenol	221.74		82.01
C ₈ H ₁₀ O	Phenetole	169.81		51.04
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline	203.0		58.3
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	194.15		52.83
C ₈ H ₁₁ N	2,4-Dimethylaniline	214		61.3
C ₈ H ₁₁ N	2,5-Dimethylaniline	214		61.7
C ₈ H ₁₁ N	2,3,6-Trimethylpyridine	171.6	39.95	50.61
C ₈ H ₁₁ N	2,4,6-Trimethylpyridine	170.6	39.87	50.33
C ₈ H ₁₄	1-Octyne	126.3	35.83	42.30
C ₈ H ₁₄	2-Octyne	137.6	37.26	44.49
C ₈ H ₁₄	3-Octyne	133.1	36.94	43.92
C ₈ H ₁₄	4-Octyne	131.6	36.0	42.73
C ₈ H ₁₄ O ₃	Butanoic anhydride	200	50.0	
C ₈ H ₁₅ N	Octanenitrile	205.25		56.80
C ₈ H ₁₆	1-Octene	121.29	34.07	40.34
C ₈ H ₁₆	<i>cis</i> -2,2-Dimethyl-3-hexene	105.5		36.86
C ₈ H ₁₆	<i>trans</i> -2,2-Dimethyl-3-hexene	100.8		37.03
C ₈ H ₁₆	3-Ethyl-2-methyl-1-pentene	109.5		37.27
C ₈ H ₁₆	2,4,4-Trimethyl-1-pentene	101.4		35.59
C ₈ H ₁₆	2,4,4-Trimethyl-2-pentene	104.9		37.23
C ₈ H ₁₆	Ethylcyclohexane	131.9	34.04	40.56
C ₈ H ₁₆	1,1-Dimethylcyclohexane	119.6	32.51	37.92

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane	129.8	33.47	39.70
C ₈ H ₁₆	<i>trans</i> -1,2-Dimethylcyclohexane	123.5	32.96	38.36
C ₈ H ₁₆	<i>cis</i> -1,3-Dimethylcyclohexane	120.1	32.91	38.26
C ₈ H ₁₆	<i>trans</i> -1,3-Dimethylcyclohexane	124.5	33.39	39.16
C ₈ H ₁₆	<i>cis</i> -1,4-Dimethylcyclohexane	124.4	33.28	39.02
C ₈ H ₁₆	<i>trans</i> -1,4-Dimethylcyclohexane	119.4	32.56	37.90
C ₈ H ₁₆	Propylcyclopentane	131	34.70	41.08
C ₈ H ₁₆	Isopropylcyclopentane	126.5	33.56	39.44
C ₈ H ₁₆	1-Ethyl-1-methylcyclopentane	121.6	33.20	38.85
C ₈ H ₁₆ O	2,2,4-Trimethyl-3-pentanone	135.1	35.64	43.30
C ₈ H ₁₆ O ₂	Octanoic acid	239	58.5	
C ₈ H ₁₆ O ₂	2-Ethylhexanoic acid	228		75.60
C ₈ H ₁₆ O ₂	Isobutyl isobutanoate	148.6	38.2	
C ₈ H ₁₆ O ₂	Ethyl hexanoate	167		51.72
C ₈ H ₁₆ O ₂	Methyl heptanoate	174		51.62
C ₈ H ₁₇ Br	1-Bromooctane	200		55.77
C ₈ H ₁₇ Cl	1-Chlorooctane	181.5		52.42
C ₈ H ₁₇ F	1-Fluorooctane	142.4	40.43	49.65
C ₈ H ₁₈	Octane	125.67	34.41	41.49
C ₈ H ₁₈	2-Methylheptane	117.66	33.26	39.67
C ₈ H ₁₈	3-Methylheptane	118.9	33.66	39.83
C ₈ H ₁₈	4-Methylheptane	117.72	33.35	39.69
C ₈ H ₁₈	3-Ethylhexane	118.6	33.59	39.64
C ₈ H ₁₈	2,2-Dimethylhexane	106.86	32.07	37.28
C ₈ H ₁₈	2,3-Dimethylhexane	115.62	33.17	38.78
C ₈ H ₁₈	2,4-Dimethylhexane	109.5	32.51	37.76
C ₈ H ₁₈	2,5-Dimethylhexane	109.12	32.54	37.85
C ₈ H ₁₈	3,3-Dimethylhexane	111.97	32.31	37.53
C ₈ H ₁₈	3,4-Dimethylhexane	117.73	33.24	38.97
C ₈ H ₁₈	3-Ethyl-2-methylpentane	115.66	32.93	38.52
C ₈ H ₁₈	3-Ethyl-3-methylpentane	118.27	32.78	37.99
C ₈ H ₁₈	2,2,3-Trimethylpentane	110	31.94	36.91
C ₈ H ₁₈	2,2,4-Trimethylpentane	99.22	30.79	35.14
C ₈ H ₁₈	2,3,3-Trimethylpentane	114.8	32.12	37.27
C ₈ H ₁₈	2,3,4-Trimethylpentane	113.5	32.36	37.75
C ₈ H ₁₈	2,2,3,3-Tetramethylbutane	106.45		42.90
C ₈ H ₁₈ N ₂	Azobutane			49.31
C ₈ H ₁₈ O	1-Octanol	195.16		70.98
C ₈ H ₁₈ O	2-Octanol	180	44.4	
C ₈ H ₁₈ O	2-Ethyl-1-hexanol	184.6	54.2	
C ₈ H ₁₈ O	Dibutyl ether	140.28	36.49	44.97
C ₈ H ₁₈ O	Di- <i>sec</i> -butyl ether	121.1	34.06	40.84
C ₈ H ₁₈ O	Di- <i>tert</i> -butyl ether	107.23	32.15	37.61
C ₈ H ₁₈ O ₂	1,2-Dipropoxyethane			50.62
C ₈ H ₁₈ O ₃	Diethylene glycol diethyl ether	188		58.40
C ₈ H ₁₈ S	Dibutyl sulfide	185		52.96
C ₈ H ₁₈ S	Di- <i>tert</i> -butyl sulfide	149.1	33.26	43.76
C ₈ H ₁₈ S	Diisobutyl sulfide	171		48.71
C ₈ H ₁₉ N	Dibutylamine	159.6	38.44	49.45
C ₈ H ₁₉ N	2-Ethylhexylamine	169.2	40.0	
C ₉ H ₇ N	Quinoline	237.16	49.7	59.30
C ₉ H ₇ N	Isoquinoline	243.22	49.0	60.26
C ₉ H ₁₀	Cyclopropylbenzene	173.6		50.22
C ₉ H ₁₀	Indan	177.97	39.63	48.79
C ₉ H ₁₀ O ₂	Benzyl acetate	213	49.4	
C ₉ H ₁₂	Propylbenzene	159.24		46.22
C ₉ H ₁₂	Isopropylbenzene	152.41		45.13
C ₉ H ₁₂	1,2,3-Trimethylbenzene	176.12		49.05

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₉ H ₁₂	1,2,4-Trimethylbenzene	169.38		47.93
C ₉ H ₁₂	1,3,5-Trimethylbenzene	164.74		47.50
C ₉ H ₁₄ O ₆	Triacetin	259		85.74
C ₉ H ₁₈	Butylcyclopentane	156.6	36.16	45.89
C ₉ H ₁₈	Propylcyclohexane	156.7		45.08
C ₉ H ₁₈	Isopropylcyclohexane	154.8		44.02
C ₉ H ₁₈ O	2-Nonanone	195.3		56.44
C ₉ H ₁₈ O	5-Nonanone	188.45		53.30
C ₉ H ₁₈ O	2,6-Dimethyl-4-heptanone	169.4		50.92
C ₉ H ₁₈ O ₂	Methyl octanoate	192.9		56.41
C ₉ H ₂₀	Nonane	150.82	37.18	46.55
C ₉ H ₂₀	2,2,5-Trimethylhexane	124.09	33.65	40.16
C ₉ H ₂₀	2,3,5-Trimethylhexane	131.4	34.43	41.41
C ₉ H ₂₀	3,3-Diethylpentane	146.3	34.61	42.0
C ₉ H ₂₀	2,2,4,4-Tetramethylpentane	122.29	32.51	38.49
C ₉ H ₂₀ O	1-Nonanol	213.37		76.86
C ₁₀ H ₇ Br	1-Bromonaphthalene	281	39.3	
C ₁₀ H ₇ Cl	1-Chloronaphthalene	259	52.1	
C ₁₀ H ₈	Naphthalene	217.9	43.2	
C ₁₀ H ₉ N	2-Methylquinoline	246.5		66.1
C ₁₀ H ₉ N	4-Methylquinoline	262		67.6
C ₁₀ H ₉ N	6-Methylquinoline	258.6		67.7
C ₁₀ H ₉ N	8-Methylquinoline	247.5		65.7
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene	207.6	43.9	
C ₁₀ H ₁₄	Butylbenzene	183.31	38.87	51.36
C ₁₀ H ₁₄	<i>sec</i> -Butylbenzene	173.3		47.98
C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	169.1		47.71
C ₁₀ H ₁₄	Isobutylbenzene	172.79		47.86
C ₁₀ H ₁₄	1-Isopropyl-4-methylbenzene	177.1	38.2	
C ₁₀ H ₁₆ O	(+)-Camphor	207.4	59.5	
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	195.8	41.0	
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	187.3	40.2	
C ₁₀ H ₁₉ N	Decanenitrile	243		66.84
C ₁₀ H ₂₀	1-Decene	170.5		50.43
C ₁₀ H ₂₀	Butylcyclohexane	180.9		49.36
C ₁₀ H ₂₀ O ₂	2-Ethylhexyl acetate	199	43.5	
C ₁₀ H ₂₀ O ₂	Isopentyl isopentanoate	190.4	45.9	
C ₁₀ H ₂₂	Decane	174.15	39.58	51.42
C ₁₀ H ₂₂	2-Methylnonane	167.1	38.23	49.63
C ₁₀ H ₂₂	3-Methylnonane	167.9	38.26	49.71
C ₁₀ H ₂₂	5-Methylnonane	165.1	38.14	49.34
C ₁₀ H ₂₂	2,4-Dimethyloctane	156	36.47	47.13
C ₁₀ H ₂₂ O	1-Decanol	231.1		81.50
C ₁₀ H ₂₂ O	Diisopentyl ether	172.5	35.1	
C ₁₀ H ₂₂ S	1-Decanethiol	240.6		65.48
C ₁₁ H ₁₀	1-Methylnaphthalene	244.7	45.5	
C ₁₁ H ₂₁ N	Undecanenitrile	253		71.14
C ₁₁ H ₂₂	Pentylcyclohexane	203.7		53.88
C ₁₁ H ₂₄	Undecane	195.9	41.91	56.58
C ₁₁ H ₂₄	2-Methyldecane	189.3	40.25	54.28
C ₁₁ H ₂₄	4-Methyldecane	187	40.70	53.76
C ₁₁ H ₂₄	2,4,7-Trimethyloctane	168.1	38.22	49.91
C ₁₂ F ₂₇ N	Tris(perfluorobutyl)amine	178	46.4	
C ₁₂ H ₁₀ O	Diphenyl ether	258.0	48.2	
C ₁₂ H ₁₆	Cyclohexylbenzene	240.1		59.94
C ₁₂ H ₂₂	Cyclohexylcyclohexane	238		57.98
C ₁₂ H ₂₃ N	Dodecanenitrile	277		76.12
C ₁₂ H ₂₄	1-Dodecene	213.8		60.78

ENTHALPY OF VAPORIZATION (continued)

Mol. Form.	Name	$t_b/^\circ\text{C}$	$\Delta_{\text{vap}}H(t_b)$ kJ/mol	$\Delta_{\text{vap}}H(25^\circ\text{C})$ kJ/mol
C ₁₂ H ₂₆	2,2,4,6,6-Pentamethylheptane	177.8		48.97
C ₁₂ H ₂₆	Dodecane	216.32	44.09	61.52
C ₁₂ H ₂₆ O	1-Dodecanol	259		91.96
C ₁₂ H ₂₇ BO ₃	Tributyl borate	234	56.1	
C ₁₂ H ₂₇ N	Tributylamine	216.5	46.9	
C ₁₃ H ₁₃ N	<i>N</i> -Benzylaniline	306.5		79.6
C ₁₃ H ₂₆ O ₂	Methyl dodecanoate	267		77.17
C ₁₃ H ₂₈	Tridecane	235.47	46.20	66.68
C ₁₄ H ₁₀	Phenanthrene	340		75.50
C ₁₄ H ₁₂ O ₂	Benzyl benzoate	323.5	53.6	
C ₁₄ H ₂₇ N	Tetradecanenitrile			85.29
C ₁₄ H ₃₀	Tetradecane	253.58	48.16	71.73
C ₁₄ H ₃₀ O	1-Tetradecanol	289		102.20
C ₁₅ H ₃₂	Pentadecane	270.6	50.08	76.77
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate	340	79.2	
C ₁₆ H ₃₂	1-Hexadecene	284.9		80.25
C ₁₆ H ₃₄	Hexadecane	286.86	51.84	81.35
C ₁₇ H ₃₆	Heptadecane	302.0	53.58	86.47
C ₁₈ H ₃₄ O ₂	Oleic acid	360	67.4	
C ₁₈ H ₃₈	Octadecane	316.3	55.23	91.44
C ₁₉ H ₄₀	Nonadecane	329.9	56.93	96.4
C ₂₀ H ₄₂	Eicosane	343	58.49	101.81

ENTHALPY OF FUSION

This table lists the molar enthalpy (heat) of fusion, $\Delta_{\text{fus}}H$, of over 800 inorganic and organic compounds. All values refer to the enthalpy change at equilibrium between the liquid phase and the most stable solid phase at the transition temperature. Most values of $\Delta_{\text{fus}}H$ are given at the normal melting point t_m . However, a "t" following the entry in the melting point column indicate a triple-point temperature, where the solid, liquid, and gas phases are in equilibrium. Substances are listed by molecular formula in the Hill order, with substances containing carbon (except graphite) following those that do not contain carbon.

All temperatures are given on the ITS-90 scale.

A * following an entry indicates that the value includes the enthalpy of transition between crystalline phases whose transformation occurs within 1°C of the melting point.

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Molecular formula	Name	t_m /°C	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
Ag	Silver	961.78	11.28
AgBr	Silver(I) bromide	432	9.12
AgCl	Silver(I) chloride	455	13.2
AgI	Silver(I) iodide	558	9.41
AgNO ₃	Silver(I) nitrate	212	11.5
Ag ₂ S	Silver(I) sulfide	825	14.1
Al	Aluminum	660.32	10.789
AlBr ₃	Aluminum bromide	97.5	11.25
AlCl ₃	Aluminum chloride	192.6	35.4
AlF ₃	Aluminum fluoride	2250 t	98
AlI ₃	Aluminum iodide	188.28	15.9
Al ₂ O ₃	Aluminum oxide	2053	111.4
Al ₂ S ₃	Aluminum sulfide	1100	55
Am	Americium	1176	14.39
Ar	Argon	-189.36 t	1.18
As	Arsenic (gray)	817 t	24.44
AsBr ₃	Arsenic(III) bromide	31.1	11.7
AsCl ₃	Arsenic(III) chloride	-16	10.1
AsF ₃	Arsenic(III) fluoride	-5.9	10.4
Au	Gold	1064.18	12.72
B	Boron	2075	50.2
BCl ₃	Boron trichloride	-107	2.10
BF ₃	Boron trifluoride	-126.8	4.20
BHO ₂	Metaboric acid (γ form)	236	14.3
BH ₃ O ₃	Boric acid (orthoboric acid)	170.9	22.3
BN	Boron nitride	2966	81

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
BNaO ₂	Sodium metaborate	966	36.2
B ₂ O ₃	Boron oxide	450	24.56
Ba	Barium	727	7.12
BaBr ₂	Barium bromide	857	32.2
BaCl ₂	Barium chloride	962	15.85
BaF ₂	Barium fluoride	1368	17.8
BaH ₂	Barium hydride	1200	25
BaH ₂ O ₂	Barium hydroxide	408	16
BaI ₂	Barium iodide	711	26.5
BaO	Barium oxide	1972	46
BaO ₄ S	Barium sulfate	1580	40
BaS	Barium sulfide	2229	63
Be	Beryllium	1287	7.895
BeBr ₂	Beryllium bromide	508	18
BeCl ₂	Beryllium chloride	415	8.66
BeF ₂	Beryllium fluoride	552	4.77
BeI ₂	Beryllium iodide	470	18
BeO	Beryllium oxide	2577	86
BeO ₄ S	Beryllium sulfate	1127	6
Bi	Bismuth	271.40	11.145
BiCl ₃	Bismuth trichloride	230	10.9
BrF ₅	Bromine pentafluoride	-60.5	5.67
BrH	Hydrogen bromide	-86.80	2.41
BrIn	Indium(I) bromide	290	15
BrK	Potassium bromide	734	25.5
BrLi	Lithium bromide	552	17.6
BrNa	Sodium bromide	747	26.11
BrNaO ₃	Sodium bromate	381	28.11
BrRb	Rubidium bromide	682	15.5
BrTl	Thallium(I) bromide	460	16.4
Br ₂	Bromine	-7.2	10.57
Br ₂ Ca	Calcium bromide	742	29.1
Br ₂ Cd	Cadmium bromide	568	20.9
Br ₂ Fe	Iron(II) bromide	691	50.2
Br ₂ Hg	Mercury(II) bromide	236	17.9
Br ₂ Mg	Magnesium bromide	711	39.3
Br ₂ Pb	Lead(II) bromide	371	16.44
Br ₂ Sr	Strontium bromide	657	10.1
Br ₂ Zn	Zinc bromide	394	16.7
Br ₃ Ga	Gallium(III) bromide	121.5	12.1
Br ₃ In	Indium(III) bromide	420	26
Br ₃ Pu	Plutonium(III) bromide	681	55.2
Br ₃ U	Uranium(III) bromide	727	43.9
Br ₄ Sn	Tin(IV) bromide	29.1	12.2
Br ₄ Th	Thorium(IV) bromide	679	66.9
Br ₄ Ti	Titanium(IV) bromide	39	12.9
Br ₄ U	Uranium(IV) bromide	519	55.2
Br ₅ Ta	Tantalum(V) bromide	265	45.6
C	Carbon (graphite)	4489 t	117
Ca	Calcium	842	8.54
CaCl ₂	Calcium chloride	775	28.05
CaF ₂	Calcium fluoride	1418	30
CaH ₂	Calcium hydride	1000	6.7
CaI ₂	Calcium iodide	783	41.8
CaO	Calcium oxide	2898	80
CaO ₄ S	Calcium sulfate	1460	28
CaS	Calcium sulfide	2524	70
Cd	Cadmium	321.07	6.21

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
CdCl ₂	Cadmium chloride	564	48.58
CdF ₂	Cadmium fluoride	1110	22.6
CdI ₂	Cadmium iodide	387	15.3
Ce	Cerium	798	5.46
CeCl ₃	Cerium(III) chloride	817	54.4
ClCs	Cesium chloride	645	15.9
ClCu	Copper(I) chloride	430	10.2
ClH	Hydrogen chloride	-114.17	2.00
ClI	Iodine chloride	27.39	11.6
ClIn	Indium(I) chloride	211	21.3
ClK	Potassium chloride	771	26.53
CLi	Lithium chloride	610	19.9
CLiO ₄	Lithium perchlorate	236	29
ClNa	Sodium chloride	800.7	28.16
ClNaO ₃	Sodium chlorate	248	22.1
ClRb	Rubidium chloride	715	18.4
ClTl	Thallium(I) chloride	430	15.56
Cl ₂	Chlorine	-101.5	6.40
Cl ₂ Co	Cobalt(II) chloride	740	45
Cl ₂ Cr	Chromium(II) chloride	814	32.2
Cl ₂ Cu	Copper(II) chloride	630	20.4
Cl ₂ Fe	Iron(II) chloride	677	43.01
Cl ₂ Hg	Mercury(II) chloride	276	19.41
Cl ₂ Mg	Magnesium chloride	714	43.1
Cl ₂ Mn	Manganese(II) chloride	650	30.7
Cl ₂ Ni	Nickel(II) chloride	1009	71.2
Cl ₂ Pb	Lead(II) chloride	501	21.75
Cl ₂ Sn	Tin(II) chloride	247.1	14.52
Cl ₂ Sr	Strontium chloride	874	17.5
Cl ₃ Fe	Iron(III) chloride	304	43.1
Cl ₃ Ga	Gallium(III) chloride	77.9	11.13
Cl ₃ In	Indium(III) chloride	583	27
Cl ₃ La	Lanthanum chloride	859	43.1
Cl ₃ OP	Phosphorus(V) oxychloride	1.18	13.1
Cl ₃ P	Phosphorus(III) chloride	-112	7.10
Cl ₃ Sb	Antimony(III) chloride	73.4	12.7
Cl ₄ OW	Tungsten(VI) oxytetrachloride	211	45
Cl ₄ Si	Tetrachlorosilane	-68.74	7.60
Cl ₄ Sn	Tin(IV) chloride	-34.07	9.20
Cl ₄ Th	Thorium(IV) chloride	770	40.2
Cl ₄ Ti	Titanium(IV) chloride	-24.12	9.97
Cl ₄ U	Uranium(IV) chloride	590	45
Cl ₄ V	Vanadium(IV) chloride	-25.7	2.30
Cl ₄ Zr	Zirconium(IV) chloride	437 t	50
Cl ₅ Mo	Molybdenum(V) chloride	194	19
Cl ₅ Nb	Niobium(V) chloride	204.7	38.3
Cl ₅ Ta	Tantalum(V) chloride	216	41.6
Cl ₆ W	Tungsten(VI) chloride	275	6.60
Co	Cobalt	1495	16.06
CoF ₂	Cobalt(II) fluoride	1127	59
Cr	Chromium	1907	21.0
Cr ₂ O ₃	Chromium(III) oxide	2329	130
Cs	Cesium	28.5	2.09
CsF	Cesium fluoride	703	21.7
CsHO	Cesium hydroxide	342.3	7.78
Cs ₂ O ₄ S	Cesium sulfate	1005	35.7
Cu	Copper	1084.62	12.93
CuF ₂	Copper(II) fluoride	836	55

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
CuO	Copper(II) oxide	1446	11.8
Dy	Dysprosium	1412	11.06
Er	Erbium	1529	19.9
Eu	Europium	822	9.21
FH	Hydrogen fluoride	-83.35	4.58
FK	Potassium fluoride	858	27.2
FLi	Lithium fluoride	848.2	27.09
FNa	Sodium fluoride	996	33.35
FRb	Rubidium fluoride	833	17.3
FTl	Thallium(I) fluoride	326	13.87
F ₂	Fluorine	-219.66	0.51
F ₂ Fe	Iron(II) fluoride	1100	52
F ₂ HK	Potassium hydrogen fluoride	238.9	6.62
F ₂ Mg	Magnesium fluoride	1263	58.5
F ₂ Pb	Lead(II) fluoride	830	14.7
F ₂ Sr	Strontium fluoride	1477	28.5
F ₃ In	Indium(III) fluoride	1170	64
F ₃ Pu	Plutonium(III) fluoride	1396	59.8
F ₄ Pu	Plutonium(IV) fluoride	1027	65.3
F ₄ Th	Thorium(IV) fluoride	1110	44.0
F ₄ U	Uranium(IV) fluoride	1036	42.7
F ₄ Zr	Zirconium(IV) fluoride	932 t	64.2
F ₅ Nb	Niobium(V) fluoride	80	12.2
F ₅ V	Vanadium(V) fluoride	19.5	49.96
F ₆ Ir	Iridium(VI) fluoride	44	8.40
F ₆ Mo	Molybdenum(VI) fluoride	17.5	4.33
F ₆ Pu	Plutonium(VI) fluoride	52	17.6
F ₆ S	Sulfur hexafluoride	-50.7 t	5.02
F ₆ U	Uranium(VI) fluoride	64.0 t	19.1
F ₆ W	Tungsten(VI) fluoride	2.3	4.10
Fe	Iron	1538	13.81
FeI ₂	Iron(II) iodide	587	45
FeO	Iron(II) oxide	1377	24
FeS	Iron(II) sulfide	1188	31.5
Fe ₃ O ₄	Iron(II,III) oxide	1597	138
Ga	Gallium	29.76	5.576
GaI ₃	Gallium(III) iodide	212	12.9
GaSb	Gallium antimonide	712	25.1
Ga ₂ O ₃	Gallium(III) oxide	1806	100
Gd	Gadolinium	1313	10.0
Ge	Germanium	938.25	36.94
HI	Hydrogen iodide	-50.76	2.87
HKO	Potassium hydroxide	406	7.9
HLi	Lithium hydride	688.7	22.59
HLiO	Lithium hydroxide	471.1	20.88
HNO ₃	Nitric acid	-41.6	10.5
HNaO	Sodium hydroxide	323	6.60
HORb	Rubidium hydroxide	382	8.0
H ₂	Hydrogen	-259.34	0.12
H ₂ Mg	Magnesium hydride	327	14
H ₂ O	Water	0.00	6.01
H ₂ O ₂	Hydrogen peroxide	-0.43	12.50
H ₂ O ₂ Sr	Strontium hydroxide	535	23
H ₂ O ₄ S	Sulfuric acid	10.31	10.71
H ₂ S	Hydrogen sulfide	-85.5	2.38
H ₂ Sr	Strontium hydride	1050	23
H ₃ N	Ammonia	-77.73	5.66
H ₃ O ₂ P	Hypophosphorous acid	26.5	9.7

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
H ₃ O ₃ P	Phosphorous acid	74.4	12.8
H ₃ O ₄ P	Phosphoric acid	42.4	13.4
H ₄ IN	Ammonium iodide	551	21
H ₄ N ₂	Hydrazine	1.4	12.6
H ₄ N ₂ O ₃	Ammonium nitrate	210	6.40
Hf	Hafnium	2233	27.2
Hg	Mercury	-38.83	2.29
HgI ₂	Mercury(II) iodide	259	18.9
Hg ₂ I ₂	Mercury(I) iodide	290	27
Ho	Holmium	1474	17.0
In	Indium(I) iodide	364.4	17.26
IK	Potassium iodide	681	24
ILi	Lithium iodide	469	14.6
INa	Sodium iodide	660	23.6
IRb	Rubidium iodide	642	12.5
ITl	Thallium(I) iodide	441.7	14.73
I ₂	Iodine	113.7	15.52
I ₂ Mg	Magnesium iodide	634	26
I ₂ Pb	Lead(II) iodide	410	23.4
I ₂ Sr	Strontium iodide	538	19.7
I ₃ In	Indium(III) iodide	207	18.48
I ₄ Si	Tetraiodosilane	120.5	19.7
I ₄ Th	Thorium(IV) iodide	570	61.4
I ₄ Ti	Titanium(IV) iodide	150	19.8
I ₄ U	Uranium(IV) iodide	506	70.7
In	Indium	156.60	3.281
InSb	Indium antimonide	525	25.5
In ₂ O ₃	Indium(III) oxide	1912	105
Ir	Iridium	2446	41.12
K	Potassium	63.5	2.33
KNO ₃	Potassium nitrate	337	10.1
K ₂ O ₄ S	Potassium sulfate	1069	36.4
K ₂ S	Potassium sulfide	948	16.15
Kr	Krypton	-157.38 t	1.64
La	Lanthanum	918	6.20
Li	Lithium	180.50	3.00
LiNO ₃	Lithium nitrate	253	24.9
Li ₂ O ₃ Si	Lithium metasilicate	1201	28
Li ₂ O ₄ S	Lithium sulfate	859	7.50
Lu	Lutetium	1663	22
Mg	Magnesium	650	8.48
MgO	Magnesium oxide	2825	77
MgO ₄ S	Magnesium sulfate	1127	14.6
MgS	Magnesium sulfide	2226	63
Mg ₂ O ₄ Si	Magnesium orthosilicate	1897	71
Mn	Manganese	1246	12.91
MnO	Manganese(II) oxide	1839	54.4
Mo	Molybdenum	2623	37.48
MoO ₃	Molybdenum(VI) oxide	801	48
NNaO ₃	Sodium nitrate	307	15
NO	Nitric oxide	-163.6	2.30
NO ₃ Rb	Rubidium nitrate	305	5.60
NO ₃ Tl	Thallium(I) nitrate	206	9.6
N ₂	Nitrogen	-210.0	0.71
N ₂ O	Nitrous oxide	-90.8	6.54
N ₂ O ₄	Nitrogen tetroxide	-9.3	14.65
Na	Sodium	97.80	2.60
Na ₂ O	Sodium oxide	1132	48

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
Na ₂ O ₃ Si	Sodium metasilicate	1089	52
Na ₂ O ₄ S	Sodium sulfate	884	23.6
Na ₂ S	Sodium sulfide	1172	19
Nb	Niobium	2477	30
NbO	Niobium(II) oxide	1936	85
NbO ₂	Niobium(IV) oxide	1901	92
Nb ₂ O ₅	Niobium(V) oxide	1512	104.3
Nd	Neodymium	1021	7.14
Ne	Neon	-248.61 t	0.328
Ni	Nickel	1455	17.04
NiS	Nickel(II) sulfide	976	30.1
Np	Neptunium	644	3.20
OSr	Strontium oxide	2531	81
OTl ₂	Thallium(I) oxide	579	30.3
OV	Vanadium(II) oxide	1789	63
OZn	Zinc oxide	1974	52.3
O ₂	Oxygen	-218.79	0.44
O ₂ Si	Silicon dioxide (cristobalite)	1722	9.6
O ₂ Zr	Zirconium(IV) oxide	2709	87
O ₃ S	Sulfur trioxide	16.8	8.60
O ₃ Tl ₂	Thallium(III) oxide	834	53
O ₃ W	Tungsten(VI) oxide	1472	73
O ₃ Y ₂	Yttrium oxide	2438	105
O ₄ Os	Osmium(VIII) oxide	41	9.8
O ₄ SSr	Strontium sulfate	1606	36
O ₄ STl ₂	Thallium(I) sulfate	632	23
O ₅ P ₂	Phosphorus(V) oxide	562	27.2
O ₅ Ta ₂	Tantalum(V) oxide	1784	120
O ₅ V ₂	Vanadium(V) oxide	670	64.5
O ₇ Re ₂	Rhenium(VII) oxide	297	64.2
Os	Osmium	3033	57.85
P	Phosphorus (white)	44.15	0.66
Pa	Protactinium	1572	12.34
Pb	Lead	327.46	4.782
PbS	Lead(II) sulfide	1113	49.4
Pd	Palladium	1554.9	16.74
Pr	Praseodymium	931	6.89
Pt	Platinum	1768.4	22.17
Pu	Plutonium	640	2.82
Rb	Rubidium	39.3	2.19
Re	Rhenium	3186	60.43
Rh	Rhodium	1964	26.59
Ru	Ruthenium	2334	38.59
S	Sulfur (monoclinic)	115.21	1.72
SSr	Strontium sulfide	2226	63
STl ₂	Thallium(I) sulfide	448	12
Sb	Antimony	630.63	19.79
Sc	Scandium	1541	14.1
Se	Selenium (gray)	220.5	6.69
Si	Silicon	1414	50.21
Sm	Samarium	1074	8.62
Sn	Tin (white)	231.93	7.173
Sr	Strontium	777	7.43
Ta	Tantalum	3017	36.57
Tb	Terbium	1356	10.15
Tc	Technetium	2157	33.29
Te	Tellurium	449.51	17.49
Th	Thorium	1750	13.81

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
Ti	Titanium	1668	14.15
Tl	Thallium	304	4.14
Tm	Thulium	1545	16.84
U	Uranium	1135	9.14
V	Vanadium	1910	21.5
W	Tungsten	3422	52.31
Xe	Xenon	-111.79 t	2.27
Y	Yttrium	1522	11.4
Yb	Ytterbium	819	7.66
Zn	Zinc	419.53	7.068
Zr	Zirconium	1855	21.00
CBaO ₃	Barium carbonate	1555	40
CBrCl ₃	Bromotrichloromethane	-5.65	2.53
CBr ₄	Tetrabromomethane	92.3	3.76
CCaO ₃	Calcium carbonate (calcite)	1330	36
CCl ₂ O	Carbonyl chloride	-127.78	5.74
CCl ₃ F	Trichlorofluoromethane	-110.44	6.89
CCl ₄	Tetrachloromethane	-22.62	2.56
CF ₄	Tetrafluoromethane	-183.60	0.704
CHBr ₃	Tribromomethane	8.69	11.05
CHClF ₂	Chlorodifluoromethane	-157.42	4.12
CHCl ₃	Trichloromethane	-63.41	9.5
CHF ₃	Trifluoromethane	-155.2	4.06
CHI ₃	Triiodomethane	121.2	16.44
CHN	Hydrogen cyanide	-13.29	8.41
CHNaO ₂	Sodium formate	257.3	17.7
CHO ₂ Tl	Thallium(I) formate	101	10.9
CH ₂ Cl ₂	Dichloromethane	-97.2	4.60
CH ₂ N ₂	Cyanamide	45.56	7.27
CH ₂ N ₄	Tetrazole	157.3	18.2
CH ₂ O ₂	Formic acid	8.3	12.68
CH ₃ Br	Bromomethane	-93.68	5.98
CH ₃ Cl	Chloromethane	-97.7	6.43
CH ₃ NO	Formamide	2.49	8.44
CH ₃ NO ₂	Nitromethane	-28.38	9.70
CH ₃ NO ₃	Methyl nitrate	-83.0	8.24
CH ₄	Methane	-182.47	0.94
CH ₄ N ₂ O	Urea	133.3	13.9
CH ₄ N ₂ S	Thiourea	178	14.0
CH ₄ O	Methanol	-97.53	3.215
CH ₄ S	Methanethiol	-123	5.91
CH ₅ N	Methylamine	-93.5	6.13
CH ₆ N ₂	Methylhydrazine	-52.36	10.42
CK ₂ O ₃	Potassium carbonate	898	27.6
CLi ₂ O ₃	Lithium carbonate	723	41
CMgO ₃	Magnesium carbonate	990	59
CNa ₂ O ₃	Sodium carbonate	858.1	29.7
CO	Carbon monoxide	-205.02	0.833
COS	Carbon oxysulfide	-138.8	4.73
CO ₂	Carbon dioxide	-56.56 t	9.02
CO ₃ Sr	Strontium carbonate	1494	40
CO ₃ Tl ₂	Thallium(I) carbonate	272	18.4
CS ₂	Carbon disulfide	-112.1	4.39
CSe ₂	Carbon diselenide	-43.7	6.36
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane	-110.32	7.04
C ₂ ClF ₃	Chlorotrifluoroethene	-158.2	5.55
C ₂ ClF ₅	Chloropentafluoroethane	-99.4	1.86
C ₂ Cl ₂ F ₄	1,2-Dichloro-1,1,2,2-tetrafluoroethane	-92.53	1.51

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
C ₂ Cl ₃ F ₃	1,1,2-Trichloro-1,2,2-trifluoroethane	-36.22	2.47
C ₂ Cl ₄	Tetrachloroethene	-22.3	10.88
C ₂ Cl ₄ F ₂	1,1,2,2-Tetrachloro-1,2-difluoroethane	24.8	3.67
C ₂ Cl ₆	Hexachloroethane	186.8 t	9.75
C ₂ F ₄	Tetrafluoroethene	-131.15	7.72
C ₂ F ₆	Hexafluoroethane	-100.05	2.69
C ₂ HCl ₃	Trichloroethylene	-84.7	8.45
C ₂ HCl ₃ O ₂	Trichloroacetic acid	59.2	5.90
C ₂ HCl ₅	Pentachloroethane	-28.78	11.3
C ₂ H ₂ Cl ₂	1,1-Dichloroethene	-122.56	6.51
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethene	-80.0	7.2
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	-42.4	9.17
C ₂ H ₃ Br	Bromoethene	-139.54	5.12
C ₂ H ₃ Cl	Chloroethene	-153.84	4.92
C ₂ H ₃ ClO ₂	Chloroacetic acid	63	12.28
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	-30.01	2.35
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	-36.3	11.46
C ₂ H ₃ F ₃	1,1,1-Trifluoroethane	-111.3	6.19
C ₂ H ₃ KO ₂	Potassium acetate	309	7.65
C ₂ H ₃ N	Acetonitrile	-43.82	8.16
C ₂ H ₃ NaO ₂	Sodium acetate	328.2	17.9
C ₂ H ₄	Ethylene	-169.15	3.35
C ₂ H ₄ Br ₂	1,2-Dibromoethane	9.84	10.89
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	-96.9	7.87
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	-35.7	8.84
C ₂ H ₄ O	Acetaldehyde	-123.37	2.31
C ₂ H ₄ O	Ethylene oxide	-112.5	5.17
C ₂ H ₄ O ₂	Acetic acid	16.64	11.73
C ₂ H ₅ Br	Bromoethane	-118.6	7.47
C ₂ H ₅ Cl	Chloroethane	-138.4	4.45
C ₂ H ₅ NO	Acetamide	80.16	15.59
C ₂ H ₅ NO ₂	Nitroethane	-89.5	9.85
C ₂ H ₆	Ethane	-182.79	2.72*
C ₂ H ₆ N ₂ O	<i>N</i> -Methylurea	104.9	14.0
C ₂ H ₆ O	Ethanol	-114.14	4.931
C ₂ H ₆ O	Dimethyl ether	-141.5	4.94
C ₂ H ₆ OS	Dimethyl sulfoxide	17.89	14.37
C ₂ H ₆ O ₂	Ethylene glycol	-12.69	9.96
C ₂ H ₆ O ₂ S	Dimethyl sulfone	108.9	18.30
C ₂ H ₆ S	Ethanethiol	-147.88	4.98
C ₂ H ₆ S	Dimethyl sulfide	-98.24	7.99
C ₂ H ₆ S ₂	Dimethyl disulfide	-84.67	9.19
C ₂ H ₆ Zn	Dimethyl zinc	-43.0	6.83
C ₂ H ₇ N	Dimethylamine	-92.18	5.94
C ₂ H ₈ N ₂	1,2-Ethanediamine	11.14	22.58
C ₂ H ₈ N ₂	1,1-Dimethylhydrazine	-57.20	10.07
C ₂ H ₈ N ₂	1,2-Dimethylhydrazine	-8.9	13.64
C ₂ N ₂	Cyanogen	-27.83	8.11
C ₃ F ₆ O	Perfluoroacetone	-125.45	8.38
C ₃ F ₈	Perfluoropropane	-147.70	0.477
C ₃ H ₃ N	Acrylonitrile	-83.48	6.23
C ₃ H ₃ NS	Thiazole	-33.62	9.57
C ₃ H ₃ N ₃	1,3,5-Triazine	80.3	14.56
C ₃ H ₄	Allene	-136.6	4.40
C ₃ H ₄ N ₂	1 <i>H</i> -Pyrazole	70.7	14.0
C ₃ H ₄ N ₂	Imidazole	89.5	12.82
C ₃ H ₄ O ₂	Acrylic acid	12.5	9.51
C ₃ H ₅ N	Propanenitrile	-92.78	5.03

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
$\text{C}_3\text{H}_5\text{N}_3\text{O}_9$	Trinitroglycerol	13.5	21.87
C_3H_6	Propene	-185.24	3.003
C_3H_6	Cyclopropane	-127.58	5.44
$\text{C}_3\text{H}_6\text{Br}_2$	1,2-Dibromopropane	-55.49	8.94
$\text{C}_3\text{H}_6\text{Br}_2$	1,3-Dibromopropane	-34.5	14.6
$\text{C}_3\text{H}_6\text{Cl}_2$	1,2-Dichloropropane, (\pm)	-100.53	6.40
$\text{C}_3\text{H}_6\text{Cl}_2$	2,2-Dichloropropane	-33.9	2.30
$\text{C}_3\text{H}_6\text{O}$	Acetone	-94.7	5.77
$\text{C}_3\text{H}_6\text{O}$	Methyloxirane	-111.9	6.53
$\text{C}_3\text{H}_6\text{O}$	Oxetane	-97	6.5
$\text{C}_3\text{H}_6\text{O}_2$	Propanoic acid	-20.5	10.66
$\text{C}_3\text{H}_6\text{O}_2$	Methyl acetate	-98.25	7.49
$\text{C}_3\text{H}_6\text{O}_2$	1,3-Dioxolane	-97.22	6.57
$\text{C}_3\text{H}_6\text{O}_3$	1,3,5-Trioxane	60.29	15.11
$\text{C}_3\text{H}_6\text{S}$	Thietane	-73.24	8.25
$\text{C}_3\text{H}_7\text{Br}$	1-Bromopropane	-110.3	6.44
$\text{C}_3\text{H}_7\text{Br}$	2-Bromopropane	-89.0	6.53
$\text{C}_3\text{H}_7\text{Cl}$	1-Chloropropane	-122.9	5.54
$\text{C}_3\text{H}_7\text{Cl}$	2-Chloropropane	-117.18	7.39
$\text{C}_3\text{H}_7\text{N}$	Cyclopropylamine	-35.39	13.18
$\text{C}_3\text{H}_7\text{NO}$	<i>N,N</i> -Dimethylformamide	-60.48	7.90
C_3H_8	Propane	-187.63	3.50
$\text{C}_3\text{H}_8\text{N}_2\text{O}$	<i>N,N</i> -Dimethylurea	182.1	23.0
$\text{C}_3\text{H}_8\text{N}_2\text{O}$	<i>N,N'</i> -Dimethylurea	106.6	13.0
$\text{C}_3\text{H}_8\text{O}$	1-Propanol	-124.39	5.37
$\text{C}_3\text{H}_8\text{O}$	2-Propanol	-87.9	5.41
$\text{C}_3\text{H}_8\text{O}_2$	1,3-Propylene glycol	-27.7	7.1
$\text{C}_3\text{H}_8\text{O}_2$	Dimethoxymethane	-105.1	8.33
$\text{C}_3\text{H}_8\text{O}_3$	Glycerol	18.1	18.3
$\text{C}_3\text{H}_8\text{S}$	1-Propanethiol	-113.13	5.48
$\text{C}_3\text{H}_8\text{S}$	2-Propanethiol	-130.5	5.74
$\text{C}_3\text{H}_8\text{S}$	Ethyl methyl sulfide	-105.93	9.76
$\text{C}_3\text{H}_9\text{N}$	Propylamine	-84.75	10.97
$\text{C}_3\text{H}_9\text{N}$	Isopropylamine	-95.13	7.33
$\text{C}_3\text{H}_9\text{N}$	Trimethylamine	-117.1	7
$\text{C}_3\text{H}_9\text{NO}$	3-Amino-1-propanol	12.4	19.7
C_4F_8	Perfluorocyclobutane	-40.19	2.77
C_4F_{10}	Perfluorobutane	-129.1	7.66
$\text{C}_4\text{H}_2\text{O}_3$	Maleic anhydride	52.56	13.60
$\text{C}_4\text{H}_4\text{N}_2$	Succinonitrile	57.98	3.70
$\text{C}_4\text{H}_4\text{N}_2$	Pyrazine	51.0	12.9
$\text{C}_4\text{H}_4\text{O}$	Furan	-85.61	3.80
$\text{C}_4\text{H}_4\text{O}_3$	Succinic anhydride	119	20.4
$\text{C}_4\text{H}_4\text{S}$	Thiophene	-38.21	5.07
$\text{C}_4\text{H}_5\text{N}$	Pyrrole	-23.39	7.91
C_4H_6	1,2-Butadiene	-136.2	6.96
C_4H_6	1,3-Butadiene	-108.91	7.98
C_4H_6	1-Butyne	-125.7	6.03
C_4H_6	2-Butyne	-32.2	9.23
$\text{C}_4\text{H}_6\text{O}$	Divinyl ether	-100.6	7.9
$\text{C}_4\text{H}_6\text{O}_2$	<i>cis</i> -Crotonic acid	15	12.6
$\text{C}_4\text{H}_6\text{O}_2$	<i>trans</i> -Crotonic acid	71.5	13.0
$\text{C}_4\text{H}_6\text{O}_2$	γ -Butyrolactone	-43.61	9.57
$\text{C}_4\text{H}_6\text{O}_3$	Acetic anhydride	-74.1	10.5
$\text{C}_4\text{H}_6\text{O}_4$	Succinic acid	187.9	32.4
$\text{C}_4\text{H}_6\text{O}_4$	Dimethyl oxalate	54.8	21.1
C_4H_8	1-Butene	-185.34	3.96
C_4H_8	<i>cis</i> -2-Butene	-138.88	7.31

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
C ₄ H ₈	<i>trans</i> -2-Butene	-105.52	9.76
C ₄ H ₈	Isobutene	-140.7	5.92
C ₄ H ₈	Cyclobutane	-90.7	1.09
C ₄ H ₈	Methylcyclopropane	-177.6	2.8
C ₄ H ₈ O	Butanal	-96.86	10.77
C ₄ H ₈ O	2-Butanone	-86.64	8.39
C ₄ H ₈ O	Tetrahydrofuran	-108.44	8.54
C ₄ H ₈ O ₂	Butanoic acid	-5.1	11.59
C ₄ H ₈ O ₂	Ethyl acetate	-83.8	10.48
C ₄ H ₈ O ₂	1,4-Dioxane	11.85	12.84
C ₄ H ₈ S	Tetrahydrothiophene	-96.2	7.35
C ₄ H ₉ Br	1-Bromobutane	-112.6	9.23
C ₄ H ₉ Br	2-Bromobutane, (\pm)	-112.65	6.89
C ₄ H ₉ Cl	2-Chloro-2-methylpropane	-25.60	2.07
C ₄ H ₉ N	Pyrrolidine	-57.79	8.58
C ₄ H ₉ NO	Morpholine	-4.8	14.5
C ₄ H ₁₀	Butane	-138.3	4.66
C ₄ H ₁₀	Isobutane	-159.4	4.54
C ₄ H ₁₀ O	1-Butanol	-88.6	9.37
C ₄ H ₁₀ O	2-Butanol	-88.5	5.97
C ₄ H ₁₀ O	2-Methyl-1-propanol	-101.9	6.32
C ₄ H ₁₀ O	2-Methyl-2-propanol	25.69	6.70
C ₄ H ₁₀ O	Diethyl ether	-116.2	7.19
C ₄ H ₁₀ O ₂	1,4-Butanediol	20.4	18.70
C ₄ H ₁₀ O ₂	Ethylene glycol dimethyl ether	-69.20	12.6
C ₄ H ₁₀ S	1-Butanethiol	-115.7	10.46
C ₄ H ₁₀ S	Diethyl sulfide	-103.91	10.90
C ₄ H ₁₁ N	<i>tert</i> -Butylamine	-66.94	0.882
C ₄ H ₁₂ Pb	Tetramethyl lead	-30.2	10.80
C ₄ H ₁₂ Si	Tetramethylsilane	-99.06	6.87
C ₄ H ₁₂ Sn	Tetramethylstannane	-55.1	9.30
C ₅ H ₄ O ₂	Furfural	-38.1	14.37
C ₅ H ₅ N	Pyridine	-41.70	8.28
C ₅ H ₆ O	2-Methylfuran	-91.3	8.55
C ₅ H ₆ O ₂	Furfuryl alcohol	-14.6	13.13
C ₅ H ₈	<i>cis</i> -1,3-Pentadiene	-140.8	5.64
C ₅ H ₈	<i>trans</i> -1,3-Pentadiene	-87.4	7.14
C ₅ H ₈	1,4-Pentadiene	-148.2	6.12
C ₅ H ₈	2-Methyl-1,3-butadiene	-145.9	4.93
C ₅ H ₈	Cyclopentene	-135.0	3.36
C ₅ H ₈	Spiropentane	-107.0	6.43
C ₅ H ₈ O ₂	Methyl methacrylate	-47.55	14.4
C ₅ H ₈ O ₃	4-Oxopentanoic acid	33	9.22
C ₅ H ₈ O ₄	Glutaric acid	97.8	20.3
C ₅ H ₉ N	Pentanenitrile	-96.2	9
C ₅ H ₁₀	1-Pentene	-165.12	5.94
C ₅ H ₁₀	<i>cis</i> -2-Pentene	-151.36	7.11
C ₅ H ₁₀	<i>trans</i> -2-Pentene	-140.21	8.35
C ₅ H ₁₀	2-Methyl-1-butene	-137.53	7.91
C ₅ H ₁₀	3-Methyl-1-butene	-168.43	5.36
C ₅ H ₁₀	2-Methyl-2-butene	-133.72	7.60
C ₅ H ₁₀	Cyclopentane	-93.4	0.61
C ₅ H ₁₀ O	Cyclopentanol	-17.5	1.535
C ₅ H ₁₀ O	2-Pentanone	-76.8	10.63
C ₅ H ₁₀ O	3-Pentanone	-39	11.59
C ₅ H ₁₀ O	3-Methyl-2-butanone	-93.1	9.34
C ₅ H ₁₀ O	Tetrahydropyran	-49.1	1.8
C ₅ H ₁₀ O ₂	Pentanoic acid	-33.6	14.16

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
C ₅ H ₁₁ Br	1-Bromopentane	-88.0	14.37
C ₅ H ₁₁ N	Cyclopentylamine	-82.7	8.31
C ₅ H ₁₁ N	Piperidine	-11.02	14.85
C ₅ H ₁₂	Pentane	-129.67	8.40
C ₅ H ₁₂	Isopentane	-159.77	5.15
C ₅ H ₁₂	Neopentane	-16.4	3.10
C ₅ H ₁₂ O	1-Pentanol	-77.6	10.50
C ₅ H ₁₂ O	2-Methyl-2-butanol	-9.1	4.46
C ₅ H ₁₂ O	Butyl methyl ether	-115.7	10.85
C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether	-108.6	7.60
C ₅ H ₁₂ O ₄	Pentaerythritol	258	4.8
C ₅ H ₁₂ S	1-Pentanethiol	-75.65	17.53
C ₆ Cl ₆	Hexachlorobenzene	228.83	25.2
C ₆ F ₆	Hexafluorobenzene	5.03	11.59
C ₆ F ₁₄	Perfluorohexane	-88.2	6.84
C ₆ HF ₅	Pentafluorobenzene	-47.4	10.87
C ₆ HF ₅ O	Pentafluorophenol	37.5	16.41
C ₆ H ₂ F ₄	1,2,3,5-Tetrafluorobenzene	-46.25	6.36
C ₆ H ₂ F ₄	1,2,4,5-Tetrafluorobenzene	3.88	15.05
C ₆ H ₃ Cl ₃	1,2,3-Trichlorobenzene	51.3	17.9
C ₆ H ₃ Cl ₃	1,2,4-Trichlorobenzene	16.92	16.4
C ₆ H ₃ Cl ₃	1,3,5-Trichlorobenzene	62.8	18.1
C ₆ H ₃ N ₃ O ₆	1,3,5-Trinitrobenzene	122.9	15.4
C ₆ H ₄ ClNO ₂	1-Chloro-2-nitrobenzene	32.1	17.9
C ₆ H ₄ ClNO ₂	1-Chloro-3-nitrobenzene	44.4	19.4
C ₆ H ₄ ClNO ₂	1-Chloro-4-nitrobenzene	82	14.1
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	-17.0	12.4
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	-24.8	12.6
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	53.09	18.19
C ₆ H ₄ F ₂	<i>o</i> -Difluorobenzene	-47.1	11.05
C ₆ H ₄ F ₂	<i>m</i> -Difluorobenzene	-69.12	8.58
C ₆ H ₄ O ₂	<i>p</i> -Benzoquinone	115	18.5
C ₆ H ₅ Br	Bromobenzene	-30.72	10.70
C ₆ H ₅ Cl	Chlorobenzene	-45.31	9.6
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol	9.4	13.0
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol	32.6	14.9
C ₆ H ₅ ClO	<i>p</i> -Chlorophenol	42.8	14.1
C ₆ H ₅ F	Fluorobenzene	-42.18	11.31
C ₆ H ₅ I	Iodobenzene	-31.3	9.75
C ₆ H ₅ NO	Nitrosobenzene	67	31.0
C ₆ H ₅ NO ₂	Nitrobenzene	5.7	12.12
C ₆ H ₅ NO ₃	<i>o</i> -Nitrophenol	44.8	17.7
C ₆ H ₅ NO ₃	<i>m</i> -Nitrophenol	96.8	20.6
C ₆ H ₅ NO ₃	<i>p</i> -Nitrophenol	113.6	18.8
C ₆ H ₆	Benzene	5.49	9.87
C ₆ H ₆ ClN	<i>o</i> -Chloroaniline	-1.9	11.9
C ₆ H ₆ ClN	<i>m</i> -Chloroaniline	-10.28	10.15
C ₆ H ₆ ClN	<i>p</i> -Chloroaniline	70.5	20.0
C ₆ H ₆ N ₂ O ₂	<i>o</i> -Nitroaniline	71.0	16.1
C ₆ H ₆ N ₂ O ₂	<i>m</i> -Nitroaniline	113.4	23.6
C ₆ H ₆ N ₂ O ₂	<i>p</i> -Nitroaniline	147.5	21.2
C ₆ H ₆ O	Phenol	40.89	11.51
C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	172.4	26.8
C ₆ H ₆ O ₂	Pyrocatechol	104.6	22.8
C ₆ H ₆ O ₂	Resorcinol	109.4	20.4
C ₆ H ₆ S	Benzenethiol	-14.93	11.48
C ₆ H ₇ N	Aniline	-6.02	10.54
C ₆ H ₇ N	2-Methylpyridine	-66.68	9.72

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
C ₆ H ₇ N	3-Methylpyridine	-18.14	14.18
C ₆ H ₇ N	4-Methylpyridine	3.67	12.58
C ₆ H ₈ N ₂	<i>o</i> -Phenylenediamine	102.1	23.1
C ₆ H ₈ N ₂	<i>m</i> -Phenylenediamine	66.0	15.57
C ₆ H ₈ N ₂	<i>p</i> -Phenylenediamine	141.1	23.8
C ₆ H ₈ N ₂	Phenylhydrazine	20.6	14.05
C ₆ H ₁₀	Cyclohexene	-103.5	3.29
C ₆ H ₁₀ O	Cyclohexanone	-27.9	1.328
C ₆ H ₁₀ O ₂	2-Oxepanone	-1.0	13.83
C ₆ H ₁₀ O ₄	Adipic acid	152.5	36.3
C ₆ H ₁₁ Cl	Chlorocyclohexane	-43.81	2.043
C ₆ H ₁₂	1-Hexene	-139.76	9.35
C ₆ H ₁₂	<i>cis</i> -2-Hexene	-141.11	8.88
C ₆ H ₁₂	2,3-Dimethyl-2-butene	-74.19	6.45
C ₆ H ₁₂	Cyclohexane	6.59	2.68
C ₆ H ₁₂	Methylcyclopentane	-142.42	6.93
C ₆ H ₁₂ O	Hexanal	-56	13.3
C ₆ H ₁₂ O	2-Hexanone	-55.5	14.9
C ₆ H ₁₂ O	3-Hexanone	-55.4	13.49
C ₆ H ₁₂ O	Cyclohexanol	25.93	1.78
C ₆ H ₁₂ O ₃	Paraldehyde	12.6	13.5
C ₆ H ₁₃ Br	1-Bromohexane	-83.7	18.1
C ₆ H ₁₃ N	Cyclohexylamine	-17.8	17.5
C ₆ H ₁₄	Hexane	-95.35	13.08
C ₆ H ₁₄	2-Methylpentane	-153.6	6.27
C ₆ H ₁₄	3-Methylpentane	-162.90	5.30
C ₆ H ₁₄	2,2-Dimethylbutane	-98.8	0.58
C ₆ H ₁₄	2,3-Dimethylbutane	-128.10	0.79
C ₆ H ₁₄ O	1-Hexanol	-47.4	15.38
C ₆ H ₁₄ O	Dipropyl ether	-114.8	10.8
C ₆ H ₁₄ O	Diisopropyl ether	-85.4	12.04
C ₆ H ₁₄ O ₂	1,6-Hexanediol	41.5	22.2
C ₇ F ₈	Perfluorotoluene	-65.49	11.54
C ₇ F ₁₆	Perfluoroheptane	-51.2	6.95
C ₇ H ₃ F ₅	2,3,4,5,6-Pentafluorotoluene	-29.78	13.1
C ₇ H ₅ ClO	Benzoyl chloride	-0.4	19.2
C ₇ H ₅ ClO ₂	<i>o</i> -Chlorobenzoic acid	140.2	25.6
C ₇ H ₅ N	Benzonitrile	-13.99	9.1
C ₇ H ₅ N ₃ O ₆	2,4,6-Trinitrotoluene	80.5	22.9
C ₇ H ₆ O ₂	Benzoic acid	122.35	18.02
C ₇ H ₆ O ₃	<i>o</i> -Hydroxybenzoic acid	159.0	14.2
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene	-35.8	9.6
C ₇ H ₇ NO	Benzamide	127.3	19.5
C ₇ H ₇ NO ₂	<i>p</i> -Nitrotoluene	51.63	16.81
C ₇ H ₈	Toluene	-94.95	6.64
C ₇ H ₈ O	<i>o</i> -Cresol	31.03	15.82
C ₇ H ₈ O	<i>m</i> -Cresol	12.24	10.71
C ₇ H ₈ O	<i>p</i> -Cresol	34.77	12.71
C ₇ H ₈ O	Benzyl alcohol	-15.4	8.97
C ₇ H ₈ O	Anisole	-37.13	12.9
C ₇ H ₉ N	<i>o</i> -Methylaniline	-14.41	11.66
C ₇ H ₉ N	<i>m</i> -Methylaniline	-31.3	7.9
C ₇ H ₉ N	<i>p</i> -Methylaniline	43.6	18.9
C ₇ H ₁₄	1-Heptene	-118.9	12.41
C ₇ H ₁₄	Cycloheptane	-8.46	1.88
C ₇ H ₁₄	Methylcyclohexane	-126.6	6.75
C ₇ H ₁₄ O	1-Heptanal	-43.4	23.2
C ₇ H ₁₄ O	Cycloheptanol	7.2	1.60

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
C ₇ H ₁₄ O ₂	Heptanoic acid	-7.17	15.13
C ₇ H ₁₅ Br	1-Bromoheptane	-56.1	21.8
C ₇ H ₁₆	Heptane	-90.55	14.03
C ₇ H ₁₆	2-Methylhexane	-118.2	9.19
C ₇ H ₁₆	3-Ethylpentane	-118.55	9.55
C ₇ H ₁₆	2,2-Dimethylpentane	-123.7	5.82
C ₇ H ₁₆	2,4-Dimethylpentane	-119.2	6.85
C ₇ H ₁₆	3,3-Dimethylpentane	-134.4	6.85
C ₇ H ₁₆	2,2,3-Trimethylbutane	-24.6	2.26
C ₇ H ₁₆ O	1-Heptanol	-33.2	18.17
C ₈ H ₈	Styrene	-30.65	10.9
C ₈ H ₈ O ₂	<i>o</i> -Toluic acid	103.5	19.5
C ₈ H ₈ O ₂	<i>m</i> -Toluic acid	109.9	15.7
C ₈ H ₈ O ₂	<i>p</i> -Toluic acid	179.6	22.7
C ₈ H ₈ O ₂	Benzeneacetic acid	76.5	16.3
C ₈ H ₈ O ₂	Methyl benzoate	-12.4	9.74
C ₈ H ₁₀	Ethylbenzene	-94.96	9.18
C ₈ H ₁₀	<i>o</i> -Xylene	-25.2	13.6
C ₈ H ₁₀	<i>m</i> -Xylene	-47.8	11.6
C ₈ H ₁₀	<i>p</i> -Xylene	13.25	17.12
C ₈ H ₁₀ O	2,3-Xylenol	72.5	21.0
C ₈ H ₁₀ O	2,5-Xylenol	74.8	23.4
C ₈ H ₁₀ O	2,6-Xylenol	45.8	18.9
C ₈ H ₁₀ O	3,4-Xylenol	65.1	18.1
C ₈ H ₁₀ O	3,5-Xylenol	63.4	17.4
C ₈ H ₁₆	1-Octene	-101.7	15.31
C ₈ H ₁₆	Cyclooctane	14.59	2.41
C ₈ H ₁₆	Ethylcyclohexane	-111.3	8.33
C ₈ H ₁₆	1,1-Dimethylcyclohexane	-33.3	2.07
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane	-49.8	1.64
C ₈ H ₁₆	<i>trans</i> -1,2-Dimethylcyclohexane	-88.15	10.49
C ₈ H ₁₆	<i>cis</i> -1,3-Dimethylcyclohexane	-75.53	10.82
C ₈ H ₁₆	<i>trans</i> -1,3-Dimethylcyclohexane	-90.07	9.87
C ₈ H ₁₆	<i>cis</i> -1,4-Dimethylcyclohexane	-87.39	9.31
C ₈ H ₁₆	<i>trans</i> -1,4-Dimethylcyclohexane	-36.93	12.33
C ₈ H ₁₆ O ₂	Octanoic acid	16.5	21.35
C ₈ H ₁₇ Br	1-Bromooctane	-55.0	24.7
C ₈ H ₁₈	Octane	-56.82	20.73
C ₈ H ₁₈	2-Methylheptane	-109.02	11.92
C ₈ H ₁₈	3-Methylheptane	-120.48	11.69
C ₈ H ₁₈	4-Methylheptane	-121.0	10.8
C ₈ H ₁₈	2,2,4-Trimethylpentane	-107.3	9.20
C ₈ H ₁₈ O	1-Octanol	-14.8	23.7
C ₉ H ₇ N	Quinoline	-14.78	10.66
C ₉ H ₇ N	Isoquinoline	26.47	13.54
C ₉ H ₈	Indene	-1.5	10.20
C ₉ H ₁₀	Indan	-51.38	8.60
C ₉ H ₁₂	Propylbenzene	-99.6	9.27
C ₉ H ₁₂	Isopropylbenzene	-96.02	7.33
C ₉ H ₁₂	<i>o</i> -Ethyltoluene	-79.83	9.96
C ₉ H ₁₂	<i>m</i> -Ethyltoluene	-95.6	7.6
C ₉ H ₁₂	<i>p</i> -Ethyltoluene	-62.35	12.7
C ₉ H ₁₂	1,2,3-Trimethylbenzene	-25.4	8.18
C ₉ H ₁₂	1,2,4-Trimethylbenzene	-43.77	13.19
C ₉ H ₁₂	1,3,5-Trimethylbenzene	-44.72	9.51
C ₉ H ₁₈	Propylcyclohexane	-94.9	10.37
C ₉ H ₁₈ O	Nonanal	-19.3	30.5
C ₉ H ₁₈ O	5-Nonanone	-3.8	24.93

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
C ₉ H ₁₈ O ₂	Nonanoic acid	12.4	19.82
C ₉ H ₂₀	Nonane	-53.46	15.47
C ₉ H ₂₀	3,3-Diethylpentane	-33.1	10.09
C ₉ H ₂₀	2,2,3,3-Tetramethylpentane	-9.75	2.33
C ₉ H ₂₀	2,2,4,4-Tetramethylpentane	-66.54	9.74
C ₁₀ H ₇ Br	1-Bromonaphthalene	6.1	15.2
C ₁₀ H ₇ Br	2-Bromonaphthalene	55.9	14.4
C ₁₀ H ₇ Cl	1-Chloronaphthalene	-2.5	12.9
C ₁₀ H ₇ Cl	2-Chloronaphthalene	58.0	14.0
C ₁₀ H ₈	Naphthalene	80.26	19.01
C ₁₀ H ₈ O	1-Naphthol	95.0	23.1
C ₁₀ H ₈ O	2-Naphthol	121.5	18.1
C ₁₀ H ₁₄	Butylbenzene	-87.85	11.22
C ₁₀ H ₁₄	1-Isopropyl-4-methylbenzene	-67.94	9.66
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	79.3	21
C ₁₀ H ₁₄ O	Thymol	49.5	21.3
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	-42.9	9.49
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	-30.4	14.41
C ₁₀ H ₁₈ O ₄	Sebacic acid	130.9	40.8
C ₁₀ H ₂₀	1-Decene	-66.3	13.81
C ₁₀ H ₂₀	Butylcyclohexane	-74.73	14.16
C ₁₀ H ₂₀ O	Decanal	-4.0	34.5
C ₁₀ H ₂₀ O ₂	Decanoic acid	31.4	27.8
C ₁₀ H ₂₂	Decane	-29.6	28.72
C ₁₀ H ₂₂ O	1-Decanol	6.9	43
C ₁₁ H ₁₀	1-Methylnaphthalene	-30.43	6.95
C ₁₁ H ₁₀	2-Methylnaphthalene	34.6	12.13
C ₁₁ H ₂₄	Undecane	-25.5	22.2
C ₁₂ H ₈	Acenaphthylene	91.8	6.9
C ₁₂ H ₉ N	Carbazole	246.3	24.1
C ₁₂ H ₁₀	Acenaphthene	93.4	21.49
C ₁₂ H ₁₀	Biphenyl	68.93	18.57
C ₁₂ H ₁₀ N ₂	Azobenzene	67.88	22.52
C ₁₂ H ₁₀ N ₂ O	<i>trans</i> -Azoxybenzene	34.6	17.9
C ₁₂ H ₁₀ O	Diphenyl ether	26.87	17.22
C ₁₂ H ₁₁ N	Diphenylamine	53.2	18.5
C ₁₂ H ₁₆	Cyclohexylbenzene	7.07	15.6
C ₁₂ H ₁₈	Hexamethylbenzene	165.5	20.6
C ₁₂ H ₂₄	1-Dodecene	-35.2	19.9
C ₁₂ H ₂₄ O ₂	Dodecanoic acid	43.8	36.3
C ₁₂ H ₂₆	Dodecane	-9.57	36.8
C ₁₂ H ₂₆ O	1-Dodecanol	23.9	40.2
C ₁₃ H ₁₀	9 <i>H</i> -Fluorene	114.77	19.58
C ₁₃ H ₁₀ O	Benzophenone	47.9	18.19
C ₁₃ H ₁₂	Diphenylmethane	25.4	18.6
C ₁₃ H ₂₈	Tridecane	-5.4	28.50
C ₁₃ H ₂₈ O	1-Tridecanol	31.7	41.4
C ₁₄ H ₁₀	Anthracene	215.76	29.4
C ₁₄ H ₁₀	Phenanthrene	99.24	16.46
C ₁₄ H ₁₀ O ₂	Benzil	94.87	23.5
C ₁₄ H ₁₂	<i>trans</i> -Stilbene	124.2	27.7
C ₁₄ H ₁₂ O ₂	α -Phenylbenzeneacetic acid	147.29	31.3
C ₁₄ H ₂₈ O ₂	Tetradecanoic acid	54.2	45.1
C ₁₄ H ₃₀	Tetradecane	5.82	45.07
C ₁₄ H ₃₀ O	1-Tetradecanol	38.2	25.1*
C ₁₅ H ₃₂	Pentadecane	9.95	34.6
C ₁₆ H ₁₀	Fluoranthene	110.19	18.69
C ₁₆ H ₁₀	Pyrene	150.62	17.36

ENTHALPY OF FUSION (continued)

Molecular formula	Name	$t_m/^\circ\text{C}$	$\Delta_{\text{fus}}H/\text{kJ mol}^{-1}$
C ₁₆ H ₃₂ O ₂	Hexadecanoic acid	62.5	53.7
C ₁₆ H ₃₄	Hexadecane	18.12	53.36
C ₁₆ H ₃₄ O	1-Hexadecanol	49.2	33.6
C ₁₇ H ₃₆	Heptadecane	22.0	40.16
C ₁₈ H ₁₂	Benz[a]anthracene	160.5	21.4
C ₁₈ H ₁₂	Benzo[c]phenanthrene	68	16.3
C ₁₈ H ₁₂	Chrysene	255.5	26.2
C ₁₈ H ₁₂	Triphenylene	197.8	24.74
C ₁₈ H ₁₄	<i>o</i> -Terphenyl	56.20	17.19
C ₁₈ H ₁₄	<i>p</i> -Terphenyl	213.9	35.3
C ₁₈ H ₁₅ N	Triphenylamine	126.5	24.9
C ₁₈ H ₃₆ O ₂	Stearic acid	69.3	61.2
C ₁₈ H ₃₈	Octadecane	28.2	61.7
C ₁₈ H ₃₈ O	1-Octadecanol	57.9	45
C ₁₉ H ₄₀	Nonadecane	32.0	45.8
C ₂₀ H ₁₂	Perylene	277.76	31.9
C ₂₀ H ₁₂	Benzo[a]pyrene	181.1	17.3
C ₂₀ H ₁₂	Benzo[e]pyrene	181.4	16.6
C ₂₀ H ₁₄	2,2'-Binaphthalene	187.9	38.9
C ₂₀ H ₄₂	Eicosane	36.6	69.9
C ₂₀ H ₄₂ O	1-Eicosanol	65.4	42
C ₂₄ H ₁₂	Coronene	437.4	19.2

PRESSURE AND TEMPERATURE DEPENDENCE OF LIQUID DENSITY

This table gives data on the variation of the density of some common liquids with pressure and temperature. The pressure dependence is described to first order by the isothermal compressibility coefficient κ defined as

$$\kappa = -(1/V) (\partial V/\partial P)_T$$

where V is the volume, and the temperature dependence by the cubic expansion coefficient α ,

$$\alpha = (1/V) (\partial V/\partial T)_P$$

Substances are listed by molecular formula in the Hill order. More precise data on the variation of density with temperature over a wide temperature range can be found in Reference 1.

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Molecular formula	Name	Isothermal Compressibility		Cubic Thermal Expansion	
		$t/^\circ\text{C}$	$\kappa \times 10^4/\text{MPa}^{-1}$	$t/^\circ\text{C}$	$\alpha \times 10^3/^\circ\text{C}^{-1}$
Cl ₃ P	Phosphorus trichloride	20	9.45	20	1.9
H ₂ O	Water	20	4.591	20	0.206
		25	4.524	25	0.256
		30	4.475	30	0.302
Hg	Mercury	20	0.401	20	1.811
CCl ₄	Tetrachloromethane	20	10.50	20	1.14
		40	12.20	40	1.21
		70	15.6	70	1.33
CHBr ₃	Tribromomethane	50	8.76	25	0.91
CHCl ₃	Trichloromethane	20	9.96	20	1.21
		50	12.9	50	1.33
CH ₂ Br ₂	Dibromomethane	27	6.85		
CH ₂ Cl ₂	Dichloromethane	25	10.3	25	1.39
CH ₃ I	Iodomethane	27	10.3	25	1.26
CH ₄ O	Methanol	20	12.14	20	1.49
		40	13.83	40	1.59
CS ₂	Carbon disulfide	20	9.38	20	1.12
		40	10.6	35	1.16
C ₂ Cl ₄	Tetrachloroethylene	25	7.56	25	1.02
C ₂ HCl ₃	Trichloroethylene	25	8.57	25	1.17
C ₂ H ₂ Cl ₂	trans-1,2-Dichloroethylene	25	11.2	25	1.36
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	20	7.97	25	0.93
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	30	8.46	20	1.14
C ₂ H ₄ O ₂	Acetic acid	20	9.08	20	1.08
		80	13.7	80	1.38
C ₂ H ₅ Br	Bromoethane	20	11.53	20	1.31
C ₂ H ₅ I	Iodoethane	20	9.82	25	1.17
C ₂ H ₆ O	Ethanol	20	11.19	20	1.40
		70	15.93	70	1.67
C ₂ H ₆ O ₂	Ethylene glycol	20	3.64	20	0.626
C ₃ H ₆ O	Acetone	20	12.62	20	1.46
		40	15.6	40	1.57
C ₃ H ₇ Br	1-Bromopropane	0	10.22	25	1.2
C ₃ H ₇ Cl	1-Chloropropane	0	12.09	20	1.4
C ₃ H ₇ I	1-Iodopropane	0	10.22	25	1.09
C ₃ H ₈ O	1-Propanol	0	8.43	0	1.22
C ₃ H ₈ O	2-Propanol	40	13.32	40	1.55
C ₃ H ₈ O ₂	1,2-Propanediol	0	4.45	20	0.695

PRESSURE AND TEMPERATURE DEPENDENCE OF LIQUID DENSITY (continued)

Molecular formula	Name	Isothermal Compressibility		Cubic Thermal Expansion	
		$t/^\circ\text{C}$	$\kappa \times 10^4/\text{MPa}^{-1}$	$t/^\circ\text{C}$	$\alpha \times 10^3/^\circ\text{C}^{-1}$
C ₃ H ₈ O ₂	1,3-Propanediol	0	4.09	20	0.61
C ₃ H ₈ O ₃	Glycerol	0	2.54	20	0.520
C ₄ H ₈ O ₂	Ethyl acetate	20	11.32	20	1.35
		60	16.2	60	1.54
C ₄ H ₉ Br	1-Bromobutane	25	10.26	20	1.13
C ₄ H ₉ I	1-Iodobutane	0	7.73	25	1.02
C ₄ H ₁₀ O	1-Butanol	0	8.10	0	1.12
C ₄ H ₁₀ O	Diethyl ether	20	18.65	20	1.65
		30	20.85	30	1.72
C ₄ H ₁₀ O ₃	Diethylene glycol	0	3.34	20	0.635
C ₅ H ₁₀	Cyclopentane	20	13.31	20	1.35
C ₅ H ₁₁ Br	1-Bromopentane	0	8.42	25	1.04
C ₅ H ₁₁ I	1-Iodopentane	0	7.56		
C ₅ H ₁₂	Pentane	25	21.80	25	1.64
C ₅ H ₁₂ O	1-Pentanol	0	7.71	0	1.02
C ₆ H ₅ Br	Bromobenzene	20	6.46	20	0.86
C ₆ H ₅ Cl	Chlorobenzene	20	7.45	20	0.94
C ₆ H ₅ NO ₂	Nitrobenzene	20	4.93	25	0.833
C ₆ H ₆	Benzene	25	9.66	25	1.14
		45	11.28	45	1.21
C ₆ H ₆ O	Phenol	60	6.05	60	0.82
C ₆ H ₇ N	Aniline	20	4.53	20	0.81
		80	6.32	80	0.91
C ₆ H ₁₂	Cyclohexane	20	11.30	20	1.15
		60	15.2	60	1.29
C ₆ H ₁₄	Hexane	25	16.69	25	1.41
		45	20.27	45	1.52
C ₆ H ₁₄	2-Methylpentane	0	13.97	25	1.43
C ₆ H ₁₄	3-Methylpentane	0	14.57	25	1.40
C ₆ H ₁₄	2,3-Dimethylbutane	20	17.97	25	1.39
C ₆ H ₁₄ O	1-Hexanol	25	8.24	25	1.03
C ₆ H ₁₅ NO ₃	Triethanolamine	0	3.61	55	0.53
C ₇ H ₈	Toluene	20	8.96	20	1.05
		50	11.0	50	1.13
C ₇ H ₈ O	Anisole	20	6.60	20	0.951
C ₇ H ₁₄	Cycloheptane	20	9.22		
C ₇ H ₁₆	Heptane	25	14.38	25	1.26
C ₈ H ₁₀	<i>o</i> -Xylene	25	8.10	25	0.96
C ₈ H ₁₀	<i>m</i> -Xylene	20	8.46	20	0.99
C ₈ H ₁₀	<i>p</i> -Xylene	25	8.59	25	1.00
C ₈ H ₁₆	Cyclooctane	20	8.03		
C ₈ H ₁₈	Octane	25	12.82	25	1.16
		45	15.06	45	1.23
C ₈ H ₁₈ O	1-Octanol	25	7.64	25	0.827
C ₉ H ₁₂	Mesitylene	25	8.14	25	0.94
C ₉ H ₁₄ O ₆	Triacetin	0	4.49	25	0.94
C ₉ H ₂₀	Nonane	25	11.75	25	1.08
C ₁₀ H ₂₂	Decane	25	10.94	25	1.02
C ₁₁ H ₂₄	Undecane	25	10.31	25	0.97
C ₁₂ H ₂₆	Dodecane	25	9.88	25	0.93
C ₁₃ H ₂₈	Tridecane	25	9.48	25	0.90
C ₁₄ H ₃₀	Tetradecane	25	9.10	25	0.87
C ₁₅ H ₃₂	Pentadecane	25	8.82		
C ₁₆ H ₂₂ O ₄	Butyl phthalate	0	5.0	25	0.86
C ₁₆ H ₃₄	Hexadecane	25	8.57		
		45	9.78		
C ₁₉ H ₃₆ O ₂	Methyl oleate	0	6.18	60	0.85

PROPERTIES OF CRYOGENIC FLUIDS

This table gives physical and thermodynamic properties of eight cryogenic fluids. The properties are:

M	Molar mass in grams per mole	ρ (g) @ T_b	Vapor density at the normal boiling point in grams per liter
T_t	Triple point temperature in kelvins	C_p (l) @ T_b	Liquid heat capacity at constant pressure at the normal boiling point in joules per gram kelvin
P_t	Triple point pressure in kilopascals	C_p (g) @ T_b	Vapor heat capacity at constant pressure at the normal boiling point in joules per gram kelvin
ρ_t (l)	Liquid density at the triple point in grams per milliliter	T_c	Critical temperature in kelvins
$\Delta_{fus}H @ T_t$	Enthalpy of fusion at the triple point in joules per gram	P_c	Critical pressure in megapascals
T_b	Normal boiling point in kelvins at a pressure of 101325 pascals (760 mmHg)	ρ_c	Critical density in grams per milliliter
$\Delta_{vap}H @ T_b$	Enthalpy of vaporization at the normal boiling point in joules per gram		
ρ (l) @ T_b	Liquid density at the normal boiling point in grams per milliliter		

In the case of air, the value given for the triple point temperature is the incipient solidification temperature, and the normal boiling point value is the incipient boiling (bubble) point. See Reference 3 for more details.

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Property	Units	Air	N ₂	O ₂	H ₂	He	Ne	Ar	Kr	Xe	CH ₄
M	g/mol	28.96	28.014	31.999	2.0159	4.0026	20.180	39.948	83.800	131.290	16.043
T_t	K	59.75	63.15	54.3584	13.8		24.5561	83.8058	115.8	161.4	90.694
P_t	kPa		12.463	0.14633	7.042		50	68.95	72.92	81.59	11.696
ρ_t (l)	g/mL	0.959	0.870	1.306	0.0770		1.251	1.417	2.449	2.978	0.4515
$\Delta_{fus}H @ T_t$	J/g		25.3	13.7	59.5		16.8	28.0	16.3	13.8	58.41
T_b	K	78.67	77.35	90.188	20.28	4.2221	27.07	87.293	119.92	165.10	111.668
$\Delta_{vap}H @ T_b$	J/g	198.7	198.8	213.1	445	20.7	84.8	161.0	108.4	96.1	510.83
ρ (l) @ T_b	g/mL	0.8754	0.807	1.141	0.0708	0.124901	1.204	1.396	2.418	2.953	0.4224
ρ (g) @ T_b	g/L	3.199	4.622	4.467	1.3390	16.89	9.51	5.79	8.94		1.816
C_p (l) @ T_b	J/g K	1.865	2.042	1.699	9.668	4.545	1.877	1.078	0.533	0.340	3.481
C_p (g) @ T_b	J/g K		1.341	0.980	12.24	9.78		0.570	0.248	0.158	2.218
T_c	K	132.5	126.20	154.581	32.98	5.1953	44.40	150.663	209.40	289.73	190.56
P_c	MPa	3.766	3.390	5.043	1.293	0.227460	2.760	4.860	5.500	5.840	4.592
ρ_c	g/mL	0.316	0.313	0.436	0.031	0.06964	0.484	0.531	0.919	1.110	0.1627

PROPERTIES OF REFRIGERANTS

This table gives physical properties of compounds that have been used as working fluids in traditional refrigeration systems or are under consideration as replacements in newer systems. Some are also used as solvents and blowing agents. Many of the compounds listed are believed to be less harmful to the environment than the traditional halocarbons refrigerants.

Compounds are listed by their ASHRAE standard refrigerant designations (Reference 1), which appear in the first column. These codes are often prefixed by symbols such as CFC- (for chlorofluorocarbon), HCFC- (for hydrochlorofluorocarbon), or simply R- (for refrigerant). The molecular formula and CAS Registry Number are also given. The properties tabulated are:

- t_m normal melting point in °C
- t_b normal boiling point in °C (at 101.325 kPa or 760 mmHg)
- t_c critical temperature in °C
- TLV Threshold Limit Value, which is the maximum safe concentration in air in the workplace, expressed as the time-weighted average (TWA) in parts per million by volume over an 8-hr workday and 40-hr workweek. A value followed by C is an absolute ceiling limit. Asphyxiants that are not otherwise toxic are indicated by "asphyx".

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Further references and additional data on the critical properties may be found in the table "Critical Constants" in this section.

Code	Name	Molecular Formula	CAS Reg. No.	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$t_c/^\circ\text{C}$	TLV
10	Tetrachloromethane	CCl ₄	56-23-5	-22.62	76.8	283.4	5
11	Trichlorofluoromethane	CCl ₃ F	75-69-4	-110.44	23.7	197.9	1000C
12	Dichlorodifluoromethane	CCl ₂ F ₂	75-71-8	-158	-29.8	111.80	1000
12B1	Bromochlorodifluoromethane	CBrClF ₂	353-59-3	-159.5	-3.7	153.73	
12B2	Dibromodifluoromethane	CBF ₂ F ₂	75-61-6	-110.1	22.76	198.1	100
13	Chlorotrifluoromethane	CClF ₃	75-72-9	-181	-81.4	29	
13B1	Bromotrifluoromethane	CBrF ₃	75-63-8	-172	-57.8	67.0	1000
14	Tetrafluoromethane	CF ₄	75-73-0	-183.60	-128.0	-45.5	
20	Trichloromethane	CHCl ₃	67-66-3	-63.41	61.17	263.2	10
21	Dichlorofluoromethane	CHCl ₂ F	75-43-4	-135	8.9	178.43	10
22	Chlorodifluoromethane	CHClF ₂	75-45-6	-157.42	-40.7	96.3	1000
22B1	Bromodifluoromethane	CHBrF ₂	1511-62-2	-145	-14.6	138.83	
23	Trifluoromethane	CHF ₃	75-46-7	-155.2	-82.1	25.83	
30	Dichloromethane	CH ₂ Cl ₂	75-09-2	-97.2	40	237	50
31	Chlorofluoromethane	CH ₂ ClF	593-70-4	-135.1	-9.1	154	
32	Difluoromethane	CH ₂ F ₂	75-10-5	-136.8	-51.6	78.41	
40	Chloromethane	CH ₃ Cl	74-87-3	-97.7	-24.09	143.10	50
41	Fluoromethane	CH ₃ F	593-53-3	-141.8	-78.4	44.6	
50	Methane	CH ₄	74-82-8	-182.47	-161.48	-82.59	asphyx
110	Hexachloroethane	C ₂ Cl ₆	67-72-1	186.8	184.7 sp	422	1
111	Pentachlorofluoroethane	C ₂ Cl ₅ F	354-56-3	101.3	138		
112	1,1,2,2-Tetrachloro-1,2-difluoroethane	C ₂ Cl ₄ F ₂	76-12-0	24.8	92.8	278	500
112a	1,1,1,2-Tetrachloro-2,2-difluoroethane	C ₂ Cl ₄ F ₂	76-11-9	41.0	92.8		500
113	1,1,2-Trichloro-1,2,2-trifluoroethane	C ₂ Cl ₃ F ₃	76-13-1	-36.22	47.7	214.1	1000
113a	1,1,1-Trichloro-2,2,2-trifluoroethane	C ₂ Cl ₃ F ₃	354-58-5	14.37	45.5	209.7	
114	1,2-Dichloro-1,1,2,2-tetrafluoroethane	C ₂ Cl ₂ F ₄	76-14-2	-92.53	3.5	145.63	1000
114a	1,1-Dichloro-1,2,2,2-tetrafluoroethane	C ₂ Cl ₂ F ₄	374-07-2	-56.6	3.4	145.4	
114B2	1,2-Dibromotetrafluoroethane	C ₂ Br ₂ F ₄	124-73-2	-110.32	47.35	214.6	

PROPERTIES OF REFRIGERANTS (continued)

Code	Name	Molecular Formula	CAS Reg. No.	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$t_c/^\circ\text{C}$	TLV
115	Chloropentafluoroethane	C ₂ ClF ₅	76-15-3	-99.4	-39.1	80.0	1000
116	Hexafluoroethane	C ₂ F ₆	76-16-4	-100.05	-78.1	20	
120	Pentachloroethane	C ₂ HCl ₅	76-01-7	-28.78	162.0		
121	1,1,2,2-Tetrachloro-1-fluoroethane	C ₂ HCl ₄ F	354-14-3	-82.6	116.7		
121a	1,1,1,2-Tetrachloro-2-fluoroethane	C ₂ HCl ₄ F	354-11-0	-95.3	117.1		
122	1,2,2-Trichloro-1,1-difluoroethane	C ₂ HCl ₃ F ₂	354-21-2	-140	71.9		
122a	1,2,2-Trichloro-1,2-difluoroethane	C ₂ HCl ₃ F ₂	354-15-4	-174	72.5		
122b	1,1,1-Trichloro-2,2-difluoroethane	C ₂ HCl ₃ F ₂	354-12-1		73		
123	2,2-Dichloro-1,1,1-trifluoroethane	C ₂ HCl ₂ F ₃	306-83-2	-107	27.82	183.68	
123a	1,2-Dichloro-1,1,2-trifluoroethane	C ₂ HCl ₂ F ₃	354-23-4	-78	29.5	188.4	
124	1-Chloro-1,2,2,2-tetrafluoroethane	C ₂ HClF ₄	2837-89-0		-12	122.50	
124a	1-Chloro-1,1,2,2-tetrafluoroethane	C ₂ HClF ₄	354-25-6	-117	-11.7	126.7	
125	Pentafluoroethane	C ₂ HF ₅	354-33-6	-103	-48.1	66.02	
E125	Trifluoromethyl difluoromethyl ether	C ₂ HF ₅ O	3822-68-2	-157	-38	80.8	
130	1,1,2,2-Tetrachloroethane	C ₂ H ₂ Cl ₄	79-34-5	-42.4	145.2	388.00	1
131	1,1,2-Trichloro-2-fluoroethane	C ₂ H ₂ Cl ₃ F	359-28-4		102.4		
132	1,2-Dichloro-1,2-difluoroethane	C ₂ H ₂ Cl ₂ F ₂	431-06-1	-101.2	59.6		
132b	1,2-Dichloro-1,1-difluoroethane	C ₂ H ₂ Cl ₂ F ₂	1649-08-7	-101.2	46.2		
133	1-Chloro-1,2,2-trifluoroethane	C ₂ H ₂ ClF ₃	431-07-2		17.3		
133a	2-Chloro-1,1,1-trifluoroethane	C ₂ H ₂ ClF ₃	75-88-7	-105.5	6.1	151.86	
133b	1-Chloro-1,1,2-trifluoroethane	C ₂ H ₂ ClF ₃	421-04-5		12		
134	1,1,2,2-Tetrafluoroethane	C ₂ H ₂ F ₄	359-35-3	-89	-19.9	118.59	
134a	1,1,1,2-Tetrafluoroethane	C ₂ H ₂ F ₄	811-97-2	-103.3	-26.08	101.03	
E134	Bis(difluoromethyl) ether	C ₂ H ₂ F ₄ O	1691-17-4		2	147.10	
140	1,1,2-Trichloroethane	C ₂ H ₃ Cl ₃	79-00-5	-36.3	113.8	329	10
140a	1,1,1-Trichloroethane	C ₂ H ₃ Cl ₃	71-55-6	-30.01	74.09	272	350
141	1,2-Dichloro-1-fluoroethane	C ₂ H ₃ Cl ₂ F	430-57-9	-60	73.8		
141b	1,1-Dichloro-1-fluoroethane	C ₂ H ₃ Cl ₂ F	1717-00-6	-103.5	32.0	204.1	
142	1-Chloro-2,2-difluoroethane	C ₂ H ₃ ClF ₂	338-65-8		35.1		
142b	1-Chloro-1,1-difluoroethane	C ₂ H ₃ ClF ₂	75-68-3	-130.8	-9.1	137.19	
143	1,1,2-Trifluoroethane	C ₂ H ₃ F ₃	430-66-0	-84	3.7	156.6	
143a	1,1,1-Trifluoroethane	C ₂ H ₃ F ₃	420-46-2	-111.3	-47.25	72.71	
143m	Methyl trifluoromethyl ether	C ₂ H ₃ F ₃ O	421-14-7	-149	-23.66	104.87	
E143a	2,2,2-Trifluoroethyl methyl ether	C ₃ H ₅ F ₃ O	460-43-5		31.62	175.83	
150	1,2-Dichloroethane	C ₂ H ₄ Cl ₂	107-06-2	-35.7	83.5	288	10
150a	1,1-Dichloroethane	C ₂ H ₄ Cl ₂	75-34-3	-96.9	57.3	250	100
151	1-Chloro-2-fluoroethane	C ₂ H ₄ ClF	762-50-5		52.8		
151a	1-Chloro-1-fluoroethane	C ₂ H ₄ ClF	1615-75-4		16.2		
152	1,2-Difluoroethane	C ₂ H ₄ F ₂	624-72-6		26		
152a	1,1-Difluoroethane	C ₂ H ₄ F ₂	75-37-6	-117	-24.05	113.5	
160	Chloroethane	C ₂ H ₅ Cl	75-00-3	-138.4	12.3	187.2	100
161	Fluoroethane	C ₂ H ₅ F	353-36-6	-143.2	-37.7	102.16	
170	Ethane	C ₂ H ₆	74-84-0	-182.79	-88.6	32.17	asphyx
216ca	1,3-Dichloro-1,1,2,2,3,3-hexafluoropropane	C ₃ Cl ₂ F ₆	662-01-1	-125.4	35.7	180	
218	Perfluoropropane	C ₃ F ₈	76-19-7	-147.70	-36.6	71.9	
227ca2	Trifluoromethyl 1,1,2,2-tetrafluoroethyl ether	C ₃ HF ₇ O	2356-61-8	-141	-3	114.63	
227ea	1,1,1,2,3,3,3-Heptafluoropropane	C ₃ HF ₇	431-89-0	-131	-16.4	101.74	
227me	Trifluoromethyl 1,2,2,2-tetrafluoroethyl ether	C ₃ HF ₇ O	2356-62-9		-9.6		
236ea	1,1,1,2,3,3-Hexafluoropropane	C ₃ H ₂ F ₆	431-63-0		6.1	139.23	
236fa	1,1,1,3,3,3-Hexafluoropropane	C ₃ H ₂ F ₆	690-39-1	-93.6	-1.0	124.92	
236me	1,2,2,2-Tetrafluoroethyl difluoromethyl ether	C ₃ H ₂ F ₆ O	57041-67-5		23.35	155.80	
245ca	1,1,2,2,3-Pentafluoropropane	C ₃ H ₃ F ₅	679-86-7		25.0	174.42	
245cb	1,1,1,2,2-Pentafluoropropane	C ₃ H ₃ F ₅	1814-88-6		-17.4	106.96	
245fa	1,1,1,3,3-Pentafluoropropane	C ₃ H ₃ F ₅	460-73-1		15.3	154.05	
245mc	Methyl pentafluoroethyl ether	C ₃ H ₃ F ₅ O	22410-44-2		5.59	133.65	
245mf	Difluoromethyl 2,2,2-trifluoroethyl ether	C ₃ H ₃ F ₅ O	1885-48-9		29.24	170.84	
245qc	Difluoromethyl 1,1,2-trifluoroethyl ether	C ₃ H ₃ F ₅ O	69948-24-9		43.1		
254pc	Methyl 1,1,2,2-tetrafluoroethyl ether	C ₃ H ₄ F ₄ O	425-88-7	-107	37.1		

PROPERTIES OF REFRIGERANTS (continued)

Code	Name	Molecular Formula	CAS Reg. No.	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$t_c/^\circ\text{C}$	TLV
290	Propane	C ₃ H ₈	74-98-6	-187.63	-42.1	96.68	2500
C316	1,2-Dichloro-1,2,3,3,4,4-hexafluorocyclobutane	C ₄ Cl ₂ F ₆	356-18-3	-24.2	59.5	224	
C317	1-Chloro-1,2,2,3,3,4,4-heptafluorocyclobutane	C ₄ ClF ₇	377-41-3	-39.1	25		
C318	Perfluorocyclobutane	C ₄ F ₈	115-25-3	-40.19	-5.9	115.31	
347mcc	Perfluoropropyl methyl ether	C ₄ H ₃ F ₇ O	375-03-1		34.23	164.55	
347mmy	Perfluoroisopropyl methyl ether	C ₄ H ₃ F ₇ O	22052-84-2		29.34	160.15	
600	Butane	C ₄ H ₁₀	106-97-8	-138.3	-0.5	151.97	800
600a	Isobutane	C ₄ H ₁₀	75-28-5	-159.4	-11.73	134.6	
610	Diethyl ether	C ₄ H ₁₀ O	60-29-7	-116.2	34.5	193.5	400
611	Methyl formate	C ₂ H ₄ O ₂	107-31-3	-99	31.7	214.0	100
717	Ammonia	H ₃ N	7664-41-7	-77.73	-33.33	132.3	25
744	Carbon dioxide	CO ₂	124-38-9	-56.56	-78.5 sp	30.98	5000
764	Sulfur dioxide	O ₂ S	7446-09-5	-75.5	-10.05	157.6	2
1112a	1,1-Dichloro-2,2-difluoroethene	C ₂ Cl ₂ F ₂	79-35-6	-116	19		
1113	Chlorotrifluoroethene	C ₂ ClF ₃	79-38-9	-158.2	-27.8	106	
1114	Tetrafluoroethene	C ₂ F ₄	116-14-3	-131.15	-75.9	33.3	
1120	Trichloroethene	C ₂ HCl ₃	79-01-6	-84.7	87.21	271.0	50
1130	<i>trans</i> -1,2-Dichloroethene	C ₂ H ₂ Cl ₂	156-60-5	-49.8	48.7	243.3	200
1132a	1,1-Difluoroethene	C ₂ H ₂ F ₂	75-38-7	-144	-85.7	29.7	500
1140	Chloroethene	C ₂ H ₃ Cl	75-01-4	-153.84	-13.8	159	
1141	Fluoroethene	C ₂ H ₃ F	75-02-5	-160.5	-72	54.7	1
1150	Ethylene	C ₂ H ₄	74-85-1	-169.15	-103.77	9.19	asphyx
1270	Propene	C ₃ H ₆	115-07-1	-185.24	-47.69	91.7	asphyx

DENSITY AND SPECIFIC VOLUME OF MERCURY

The data in this table have been adjusted to the ITS-90 temperature scale. The uncertainty in density values is 0.0003 g/mL between –20 and –10°C; 0.0001 or less between –10 and 200°C; and 0.0002 between 200 and 300°C.

REFERENCE

Ambrose, D., *Metrologia*, 27, 245, 1990.

$t/^\circ\text{C}$	$\rho/(\text{g/mL})$	$v/(\text{mL/kg})$	$t/^\circ\text{C}$	$\rho/(\text{g/mL})$	$v/(\text{mL/kg})$	$t/^\circ\text{C}$	$\rho/(\text{g/mL})$	$v/(\text{mL/kg})$
-20	13.64461	73.2890	27	13.52869	73.9170	74	13.41423	74.5477
-19	13.64212	73.3024	28	13.52624	73.9304	75	13.41181	74.5612
-18	13.63964	73.3157	29	13.52379	73.9438	76	13.40939	74.5746
-17	13.63716	73.3291	30	13.52134	73.9572	77	13.40697	74.5881
-16	13.63468	73.3424	31	13.51889	73.9705	78	13.40455	74.6016
-15	13.63220	73.3558	32	13.51645	73.9839	79	13.40213	74.6150
-14	13.62972	73.3691	33	13.51400	73.9973	80	13.39971	74.6285
-13	13.62724	73.3824	34	13.51156	74.0107	81	13.39729	74.6420
-12	13.62476	73.3958	35	13.50911	74.0241	82	13.39487	74.6554
-11	13.62228	73.4091	36	13.50667	74.0375	83	13.39245	74.6689
-10	13.61981	73.4225	37	13.50422	74.0509	84	13.39003	74.6824
-9	13.61733	73.4358	38	13.50178	74.0643	85	13.38762	74.6959
-8	13.61485	73.4492	39	13.49934	74.0777	86	13.38520	74.7094
-7	13.61238	73.4625	40	13.49690	74.0911	87	13.38278	74.7229
-6	13.60991	73.4759	41	13.49446	74.1045	88	13.38037	74.7364
-5	13.60743	73.4892	42	13.49202	74.1179	89	13.37795	74.7498
-4	13.60496	73.5026	43	13.48958	74.1313	90	13.37554	74.7633
-3	13.60249	73.5160	44	13.48714	74.1447	91	13.37313	74.7768
-2	13.60002	73.5293	45	13.48470	74.1581	92	13.37071	74.7903
-1	13.59755	73.5427	46	13.48226	74.1715	93	13.36830	74.8038
0	13.59508	73.5560	47	13.47982	74.1850	94	13.36589	74.8173
1	13.59261	73.5694	48	13.47739	74.1984	95	13.36347	74.8308
2	13.59014	73.5827	49	13.47495	74.2118	96	13.36106	74.8443
3	13.58768	73.5961	50	13.47251	74.2252	97	13.35865	74.8579
4	13.58521	73.6095	51	13.47008	74.2386	98	13.35624	74.8714
5	13.58275	73.6228	52	13.46765	74.2520	99	13.35383	74.8849
6	13.58028	73.6362	53	13.46521	74.2655	100	13.35142	74.8984
7	13.57782	73.6495	54	13.46278	74.2789	110	13.3273	75.0337
8	13.57535	73.6629	55	13.46035	74.2923	120	13.3033	75.1693
9	13.57289	73.6763	56	13.45791	74.3057	130	13.2793	75.3052
10	13.57043	73.6896	57	13.45548	74.3192	140	13.2553	75.4413
11	13.56797	73.7030	58	13.45305	74.3326	150	13.2314	75.5778
12	13.56551	73.7164	59	13.45062	74.3460	160	13.2075	75.7147
13	13.56305	73.7297	60	13.44819	74.3594	170	13.1836	75.8519
14	13.56059	73.7431	61	13.44576	74.3729	180	13.1597	75.9895
15	13.55813	73.7565	62	13.44333	74.3863	190	13.1359	76.1274
16	13.55567	73.7698	63	13.44090	74.3998	200	13.1120	76.2659
17	13.55322	73.7832	64	13.43848	74.4132	210	13.0882	76.4047
18	13.55076	73.7966	65	13.43605	74.4266	220	13.0644	76.5440
19	13.54831	73.8100	66	13.43362	74.4401	230	13.0406	76.6838
20	13.54585	73.8233	67	13.43120	74.4535	240	13.0167	76.8241
21	13.54340	73.8367	68	13.42877	74.4670	250	12.9929	76.9650
22	13.54094	73.8501	69	13.42635	74.4804	260	12.9691	77.1064
23	13.53849	73.8635	70	13.42392	74.4939	270	12.9453	77.2484
24	13.53604	73.8769	71	13.42150	74.5073	280	12.9214	77.3909
25	13.53359	73.8902	72	13.41908	74.5208	290	12.8975	77.5341
26	13.53114	73.9036	73	13.41665	74.5342	300	12.8736	77.6779

THERMAL PROPERTIES OF MERCURY

Lev R. Fokin

The first of these tables gives the molar heat capacity at constant pressure of liquid and gaseous mercury as a function of temperature. To convert to specific heat in units of J/g K, divide these values by 200.59, the atomic weight of mercury.

REFERENCE

Douglas, T. B., Ball, A. T., and Ginnings, D. C., *J. Res. Natl. Bur. Stands.*, 46, 334, 1951.

<i>t</i> /°C	<i>C_p</i> /(J/mol K)		<i>t</i> /°C	<i>C_p</i> /(J/mol K)		<i>t</i> /°C	<i>C_p</i> /(J/mol K)	
	Liquid	Gas		Liquid	Gas		Liquid	Gas
-38.84	28.2746	20.786	140	27.3675	20.786	340	27.1500	20.836
-20	28.1466	20.786	160	27.3090	20.786	356.73	27.1677	20.849
0	28.0190	20.786	180	27.2588	20.790	360	27.1709	20.853
20	27.9002	20.786	200	27.2169	20.790	380	27.1981	20.870
25	27.8717	20.786	220	27.1834	20.794	400	27.2324	20.891
40	27.7897	20.786	240	27.1583	20.794	420	27.2738	20.916
60	27.6880	20.786	260	27.1412	20.799	440	27.3207	20.941
80	27.5952	20.786	280	27.1320	20.807	460	27.3742	20.974
100	27.5106	20.786	300	27.1303	20.815	480	27.4332	21.008
120	27.4349	20.786	320	27.1366	20.824	500	27.4985	21.046

The second table gives the molar heat capacity of solid mercury in its rhombohedral (α -mercury) form.

REFERENCES

1. Busey and Giaque, *J. Am. Chem. Soc.*, 75, 806, 1953.
2. Amitin, Lebedeva, and Paukov, *Rus. J. Phys. Chem.*, 2666, 1979.

<i>t</i> /°C	<i>C_p</i> /J mol ⁻¹	<i>t</i> /°C	<i>C_p</i> /J mol ⁻¹	<i>t</i> /°C	<i>C_p</i> /J mol ⁻¹	<i>t</i> /°C	<i>C_p</i> /J mol ⁻¹
-268.99	0.99*	-248.15	12.74	-193.15	23.16	-113.15	26.15
-268.99	0.97**	-243.15	14.78	-183.15	23.76	-93.15	26.69
-268.15	1.6	-233.15	17.90	-173.15	24.24	-73.15	27.28
-263.15	4.6	-223.15	19.94	-153.15	25.00	-53.15	27.96
-258.15	7.6	-213.15	21.40	-133.15	25.61	-38.87	28.5
-253.15	10.33	-203.15	22.42				

* Superconducting state

** Normal state

The final table gives the cubic thermal expansion coefficient α , the isothermal compressibility coefficient κ_T , and the speed of sound U for liquid mercury as a function of temperature. These properties are defined as follows:

$$\alpha = \frac{1}{v} \left(\frac{\partial v}{\partial T} \right)_p \quad \kappa_T = -\frac{1}{v} \left(\frac{\partial v}{\partial P} \right)_T \quad U^2 = \left(\frac{\partial P}{\partial \rho} \right)_s \quad \rho = v^{-1}$$

where v is the specific volume (given in the table on the preceding page).

REFERENCE

Vukalovich, M. P., et al., *Thermophysical Properties of Mercury*, Moscow Standard Press, 1971.

<i>t</i> /°C	$\alpha \times 10^4/\text{K}^{-1}$	$\kappa_T \times 10^6/\text{bar}^{-1}$		<i>U</i> /m s ⁻¹	<i>t</i> /°C	$\alpha \times 10^4/\text{K}^{-1}$	$\kappa_T \times 10^6/\text{bar}^{-1}$		<i>U</i> /m s ⁻¹
		At 1 bar	At 1000 bar				At 1 bar	At 1000 bar	
-20	1.818	3.83		1470	120	1.8058	4.513	4.33	1404.7
0	1.8144	3.918	3.78	1460.8	140	1.8074	4.622		1395.4
20	1.8110	4.013	3.87	1451.4	160	1.8100	4.731	4.53	1386.1
40	1.8083	4.109	3.96	1442.0	180	1.8136	4.844		1376.7
60	1.8064	4.207		1432.7	200	1.818	4.96		1367
80	1.8053	4.308	4.14	1423.4	250	1.834	5.26		1344
100	1.8051	4.410		1414.1	300	1.856	5.59		1321

SURFACE TENSION OF COMMON LIQUIDS

The surface tension γ of about 200 liquids is tabulated here as a function of temperature. Values of γ are given in units of millinewtons per meter (mN/m), which is equivalent to dyn/cm in cgs units. The values refer to a nominal pressure of one atmosphere (about 100 kPa) except in cases where the indicated temperature is above the normal boiling point of the substance; in those cases, the applicable pressure is the saturation vapor pressure at the temperature in question.

The uncertainty of the values is 0.1 to 0.2 mN/m or less in most cases. Values at temperatures between the points tabulated can be obtained by linear interpolation to a good approximation.

Substances are listed by molecular formula in the modified Hill order, with substances not containing carbon appearing before those that do contain carbon. A more extensive compilation of surface tension may be found in the Reference.

REFERENCE

Jasper, J. J., *J. Phys. Chem. Ref. Data*, 1, 841, 1972.

Mol. form.	Name	γ in mN/m				
		10°C	25°C	50°C	75°C	100°C
Br ₂	Bromine	43.68	40.95	36.40		
Cl ₂ O ₂ S	Sulfuryl chloride		28.78			
Cl ₃ OP	Phosphoryl chloride		32.03	28.85	25.66	
Cl ₃ P	Phosphorus trichloride		27.98	24.81		
Cl ₄ Si	Silicon tetrachloride	19.78	18.29	15.80		
H ₂ O	Water	74.23	71.99	67.94	63.57	58.91
H ₄ N ₂	Hydrazine		66.39			
Hg	Mercury	488.55	485.48	480.36	475.23	470.11
CCl ₄	Tetrachloromethane		26.43	23.37	20.31	17.25
CS ₂	Carbon disulfide	33.81	31.58	27.87		
CHBr ₃	Tribromomethane		44.87	41.60	38.33	
CHCl ₃	Trichloromethane		26.67	23.44	20.20	
CH ₂ Br ₂	Dibromomethane		39.05	35.33	31.61	
CH ₂ Cl ₂	Dichloromethane		27.20			
CH ₂ O ₂	Formic acid		37.13	34.38	31.64	
CH ₃ I	Iodomethane	32.19	30.34			
CH ₃ NO	Formamide		57.03	54.92	52.82	50.71
CH ₃ NO ₂	Nitromethane	39.04	36.53	32.33		
CH ₄ O	Methanol	23.23	22.07	20.14		
CH ₅ N	Methylamine		19.15			
C ₂ HCl ₅	Pentachloroethane		34.15	31.20	28.26	
C ₂ HF ₃ O ₂	Trifluoroacetic acid		13.53	11.42		
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane		35.58	32.41	29.24	26.07
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane		25.18	22.07		
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane		34.02	30.65	27.27	23.89
C ₂ H ₃ N	Acetonitrile		28.66	25.51		
C ₂ H ₄ Br ₂	1,2-Dibromoethane		39.55	36.25	32.95	
C ₂ H ₄ Cl ₂	1,1-Dichloroethane		24.07			
C ₂ H ₄ Cl ₂	1,2-Dichloroethane		31.86	28.29	24.72	
C ₂ H ₄ O	Acetaldehyde	22.54	20.50	17.10		
C ₂ H ₄ O ₂	Acetic acid		27.10	24.61	22.13	
C ₂ H ₄ O ₂	Methyl formate	26.72	24.36	20.43	16.50	12.57
C ₂ H ₅ Br	Bromoethane	25.36	23.62			
C ₂ H ₅ I	Iodoethane	30.38	28.46	25.24		
C ₂ H ₅ NO ₂	Nitroethane	34.02	32.13	29.00		
C ₂ H ₆ O	Ethanol	23.22	21.97	19.89		
C ₂ H ₆ OS	Dimethyl sulfoxide		42.92	40.06		
C ₂ H ₆ O ₂	Ethylene glycol		47.99	45.76	43.54	41.31
C ₂ H ₆ S	Dimethyl sulfide	25.27	24.06			
C ₂ H ₆ S	Ethanethiol		23.08			
C ₂ H ₆ S ₂	Dimethyl disulfide		33.39	30.04		
C ₂ H ₇ N	Dimethylamine		26.34			
C ₂ H ₇ N	Ethylamine		19.20			

SURFACE TENSION OF COMMON LIQUIDS (continued)

Mol. form.	Name	γ in mN/m				
		10°C	25°C	50°C	75°C	100°C
C ₂ H ₇ NO	Ethanolamine		48.32	45.53	42.73	
C ₃ H ₅ Br	3-Bromopropene		26.31	23.17		
C ₃ H ₅ Cl	3-Chloropropene		23.14			
C ₃ H ₅ ClO	Epichlorohydrin	38.40	36.36	32.96	29.56	26.16
C ₃ H ₅ N	Propanenitrile		26.75	23.87		
C ₃ H ₆ Cl ₂	1,2-Dichloropropane		28.32	25.22	22.12	
C ₃ H ₆ O	Acetone		23.46	20.66		
C ₃ H ₆ O	Allyl alcohol	26.63	25.28	23.02	20.77	
C ₃ H ₆ O ₂	Ethyl formate	25.16	23.18			
C ₃ H ₆ O ₂	Methyl acetate	26.66	24.73	21.51		
C ₃ H ₆ O ₂	Propanoic acid		26.20	23.72	21.23	
C ₃ H ₇ Br	1-Bromopropane	27.08	25.26	22.21		
C ₃ H ₇ Br	2-Bromopropane	25.03	23.25	20.30		
C ₃ H ₇ Cl	1-Chloropropane	23.16	21.30			
C ₃ H ₇ Cl	2-Chloropropane	20.49	19.16			
C ₃ H ₇ NO ₂	2-Nitropropane	31.02	29.29	26.39		
C ₃ H ₈ O	1-Propanol	24.48	23.32	21.38	19.43	
C ₃ H ₈ O	2-Propanol	22.11	20.93	18.96	16.98	
C ₃ H ₈ O ₂	2-Methoxyethanol	32.32	30.84	28.38	25.92	23.46
C ₃ H ₈ S	1-Propanethiol		24.20	21.02		
C ₃ H ₈ S	2-Propanethiol		21.33	18.39		
C ₃ H ₉ N	Propylamine		21.75			
C ₃ H ₉ N	Trimethylamine		13.41			
C ₄ H ₄ N ₂	Pyridazine	49.51	47.96	45.37	42.78	40.19
C ₄ H ₄ N ₂	Pyrimidine		30.33	27.80	25.28	22.75
C ₄ H ₄ S	Thiophene		30.68	27.36		
C ₄ H ₅ N	Pyrrole	38.71	37.06	34.31		
C ₄ H ₆ O ₃	Acetic anhydride	34.08	31.93	28.34	24.75	21.16
C ₄ H ₇ N	Butanenitrile		26.92	24.33	21.73	
C ₄ H ₈ O	2-Butanone		23.97	21.16		
C ₄ H ₈ O ₂	1,4-Dioxane		32.75	29.28	25.80	22.32
C ₄ H ₈ O ₂	Ethyl acetate	25.13	23.39	20.49	17.58	14.68
C ₄ H ₈ O ₂	Methyl propanoate	26.32	24.44	21.29		
C ₄ H ₈ O ₂	Butanoic acid		26.05	23.75	21.45	
C ₄ H ₉ Br	1-Bromobutane	27.58	25.90	23.08	20.27	17.45
C ₄ H ₉ Cl	1-Chlorobutane	24.85	23.18	20.39		
C ₄ H ₉ I	1-Iodobutane	29.79	28.24	25.67	23.09	20.51
C ₄ H ₉ N	Pyrrolidine	30.58	29.23	26.98		
C ₄ H ₁₀ O	1-Butanol	26.28	24.93	22.69	20.44	18.20
C ₄ H ₁₀ O	2-Butanol	23.74	22.54	20.56	18.57	16.58
C ₄ H ₁₀ O	2-Methyl-2-propanol		19.96	17.71		
C ₄ H ₁₀ O	Diethyl ether		16.65			
C ₄ H ₁₀ O ₂	2-Ethoxyethanol		28.35	26.11	23.86	21.62
C ₄ H ₁₀ O ₃	Diethylene glycol		44.77	42.57	40.37	38.17
C ₄ H ₁₀ S	Diethyl sulfide	26.22	24.57	21.80		
C ₄ H ₁₁ N	Butylamine		23.44	20.63		
C ₄ H ₁₁ N	Isobutylamine		21.75	19.02		
C ₄ H ₁₁ N	<i>tert</i> -Butylamine		16.87			
C ₄ H ₁₁ N	Diethylamine		19.85			
C ₅ H ₄ O ₂	Furfural	45.08	43.09	39.78	36.46	33.14
C ₅ H ₅ N	Pyridine		36.56	33.29	30.03	
C ₅ H ₈	Cyclopentene	24.45	22.20			
C ₅ H ₈ O	Cyclopentanone	34.45	32.80	30.05	27.30	24.55
C ₅ H ₁₀	1-Pentene	17.10	15.45			
C ₅ H ₁₀	2-Methyl-2-butene	18.61	17.15			
C ₅ H ₁₀	Cyclopentane	24.07	21.88	18.22		
C ₅ H ₁₀ O	2-Pentanone		23.25	21.62		

SURFACE TENSION OF COMMON LIQUIDS (continued)

Mol. form.	Name	γ in mN/m				
		10°C	25°C	50°C	75°C	100°C
C ₅ H ₁₀ O	3-Pentanone		24.74	22.13		
C ₅ H ₁₀ O	Pentanal	26.95	25.44	22.91		
C ₅ H ₁₀ O ₂	Butyl formate	26.05	24.52	21.95	19.39	16.82
C ₅ H ₁₀ O ₂	Propyl acetate	25.48	23.80	21.00	18.20	15.40
C ₅ H ₁₀ O ₂	Isopropyl acetate	23.37	21.76	19.08	16.40	
C ₅ H ₁₀ O ₂	Ethyl propanoate	25.55	23.80	20.88	17.96	
C ₅ H ₁₀ O ₂	Methyl butanoate	26.34	24.62	21.76	18.89	16.03
C ₅ H ₁₁ Cl	1-Chloropentane	26.01	24.40	21.71	19.02	16.33
C ₅ H ₁₁ N	Piperidine	30.64	28.91	26.03	23.14	20.26
C ₅ H ₁₂	Pentane	17.15	15.49			
C ₅ H ₁₂ O	1-Pentanol	26.67	25.36	23.17	20.99	18.80
C ₅ H ₁₂ O	2-Pentanol	24.96	23.45	20.94	18.43	15.92
C ₅ H ₁₂ O	3-Methyl-1-butanol	24.94	23.71	21.66	19.61	17.56
C ₅ H ₁₃ N	Pentylamine		24.69	22.14	19.58	
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	37.15	35.43	32.57	29.70	26.83
C ₆ H ₅ Br	Bromobenzene	36.98	35.24	32.34	29.44	26.54
C ₆ H ₅ Cl	Chlorobenzene	34.78	32.99	30.02	27.04	24.06
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol		39.70	36.89	34.09	31.28
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol		41.18	38.66	36.13	33.61
C ₆ H ₅ F	Fluorobenzene	28.47	26.66	23.65	20.64	
C ₆ H ₅ I	Iodobenzene	40.40	38.71	35.91	33.10	30.29
C ₆ H ₅ NO ₂	Nitrobenzene			40.56	37.66	34.77
C ₆ H ₆	Benzene		28.22	25.00	21.77	
C ₆ H ₆ O	Phenol			38.20	35.53	32.86
C ₆ H ₇ N	Aniline		42.12	39.41	36.69	
C ₆ H ₇ N	2-Methylpyridine		33.00	29.90	26.79	
C ₆ H ₈ N ₂	Adiponitrile		45.45	43.02	40.58	
C ₆ H ₁₀	Cyclohexene	28.01	26.17	23.12		
C ₆ H ₁₀ O	Cyclohexanone	36.43	34.57	31.46	28.36	25.25
C ₆ H ₁₁ N	Hexanenitrile		27.37	25.11	22.84	
C ₆ H ₁₂	Cyclohexane	26.43	24.65	21.68		
C ₆ H ₁₂	Methylcyclopentane	23.47	21.72	18.82		
C ₆ H ₁₂	1-Hexene	19.44	17.90	15.33		
C ₆ H ₁₂ O	Cyclohexanol		32.92	30.50	28.09	25.67
C ₆ H ₁₂ O	2-Hexanone		25.45	22.72		
C ₆ H ₁₂ O ₂	Butyl acetate	26.48	24.88	22.21	19.54	16.87
C ₆ H ₁₂ O ₂	Isobutyl acetate	24.58	23.06	20.53	17.99	15.46
C ₆ H ₁₂ O ₂	Ethyl butanoate	25.51	23.94	21.33	18.71	16.10
C ₆ H ₁₂ O ₃	Paraldehyde	27.22	25.63	22.97	20.32	17.66
C ₆ H ₁₃ Cl	1-Chlorohexane	27.28	25.73	23.13	20.54	17.94
C ₆ H ₁₃ N	Cyclohexylamine		31.22	28.25	25.28	
C ₆ H ₁₄	Hexane	19.42	17.89	15.33		
C ₆ H ₁₄	2-Methylpentane	18.37	16.88	14.39		
C ₆ H ₁₄	3-Methylpentane	19.20	17.61	14.96		
C ₆ H ₁₄ O	Diisopropyl ether		17.27	14.65		
C ₆ H ₁₄ O	1-Hexanol		25.81	23.81	21.80	19.80
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane		20.89	18.31	15.74	
C ₆ H ₁₄ O ₂	2-Butoxyethanol	27.36	26.14	24.10	22.06	20.02
C ₆ H ₁₅ N	Triethylamine		20.22	17.74		
C ₆ H ₁₅ N	Dipropylamine		22.31	19.75	17.20	
C ₆ H ₁₅ N	Diisopropylamine		19.14	16.45		
C ₇ H ₅ N	Benzonitrile		38.79	35.90	33.00	
C ₇ H ₆ O	Benzaldehyde	39.63	38.00	35.27	32.55	29.82
C ₇ H ₈	Toluene	29.71	27.93	24.96	21.98	19.01
C ₇ H ₈ O	<i>o</i> -Cresol		36.90	34.38	31.85	29.32
C ₇ H ₈ O	<i>m</i> -Cresol		35.69	33.38	31.07	28.76
C ₇ H ₈ O	Benzyl alcohol				27.89	24.44

SURFACE TENSION OF COMMON LIQUIDS (continued)

Mol. form.	Name	γ in mN/m				
		10°C	25°C	50°C	75°C	100°C
C ₇ H ₈ O	Anisole		35.10	32.09	29.08	
C ₇ H ₉ N	<i>N</i> -Methylaniline		36.90	34.47	32.05	
C ₇ H ₉ N	2,3-Dimethylpyridine		32.71	30.04	27.36	
C ₇ H ₉ N	Benzylamine		39.30	36.27	33.23	
C ₇ H ₁₄	Methylcyclohexane	24.98	23.29	20.46		
C ₇ H ₁₄	1-Heptene	21.29	19.80	17.33	14.85	
C ₇ H ₁₄ O	2-Heptanone		26.12	23.48		
C ₇ H ₁₄ O ₂	Pentyl acetate	26.67	25.17	22.69	20.20	17.72
C ₇ H ₁₄ O ₂	Heptanoic acid		27.76	25.64		
C ₇ H ₁₆	Heptane	21.12	19.65	17.20	14.75	
C ₇ H ₁₆	3-Methylhexane	20.76	19.31	16.88	14.46	
C ₈ H ₈ O	Acetophenone		39.04	36.15	33.27	
C ₈ H ₈ O ₂	Methyl benzoate		37.17	34.25	31.32	
C ₈ H ₈ O ₃	Methyl salicylate	40.98	39.22	36.28	33.35	30.41
C ₈ H ₁₀	Ethylbenzene	30.39	28.75	26.01	23.28	20.54
C ₈ H ₁₀	<i>o</i> -Xylene	31.41	29.76	27.01	24.25	21.50
C ₈ H ₁₀	<i>m</i> -Xylene	30.13	28.47	25.71	22.95	20.19
C ₈ H ₁₀	<i>p</i> -Xylene		28.01	25.32	22.64	19.95
C ₈ H ₁₀ O	Phenetole		32.41	29.65	26.89	
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline		35.52	32.90	30.27	
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline		36.33	33.65	30.98	
C ₈ H ₁₆	Ethylcyclohexane	26.73	25.15	22.51		
C ₈ H ₁₈	Octane	22.57	21.14	18.77	16.39	14.01
C ₈ H ₁₈	2,5-Dimethylhexane	20.77	19.40	17.12	14.84	12.56
C ₈ H ₁₈ O	1-Octanol	28.30	27.10	25.12		
C ₈ H ₁₉ N	Dibutylamine		24.12	21.74	19.36	
C ₈ H ₁₉ N	Diisobutylamine		21.72	19.44	17.16	
C ₉ H ₇ N	Quinoline	44.19	42.59	39.94	37.28	34.62
C ₉ H ₁₂	Cumene	29.27	27.69	25.05	22.42	19.78
C ₉ H ₁₂	1,2,4-Trimethylbenzene	30.74	29.20	26.64	24.07	21.51
C ₉ H ₁₂	Mesitylene	28.89	27.55	25.31	23.07	20.82
C ₉ H ₁₈ O	5-Nonanone		26.28	23.85		
C ₉ H ₂₀	Nonane	23.79	22.38	20.05	17.71	15.37
C ₉ H ₂₀ O	1-Nonanol	29.03	27.89	26.00	24.10	22.20
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene		33.17	30.78	28.40	
C ₁₀ H ₂₂	Decane	24.75	23.37	21.07	18.77	16.47
C ₁₀ H ₂₂ O	1-Decanol	29.61	28.51	26.68	24.85	23.02
C ₁₁ H ₂₄	Undecane	25.56	24.21	21.96	19.70	17.45
C ₁₂ H ₁₀ O	Diphenyl ether		26.75	24.80		
C ₁₂ H ₂₇ N	Tributylamine		24.39	22.32	20.24	
C ₁₃ H ₂₈	Tridecane	26.86	25.55	23.37	21.19	19.01
C ₁₄ H ₁₂ O ₂	Benzyl benzoate	44.47	42.82	40.06	37.31	34.55
C ₁₄ H ₃₀	Tetradecane	27.43	26.13	23.96	21.78	19.61
C ₁₆ H ₃₄	Hexadecane		27.05	24.91	22.78	20.64
C ₁₈ H ₃₈	Octadecane		27.87	25.77	23.66	21.55

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS

Christian Wohlfarth

The permittivity of a substance (often called the dielectric constant) is the ratio of the electric displacement D to the electric field strength E when an external field is applied to the substance. The quantity tabulated here is the relative permittivity, which is the ratio of the actual permittivity to the permittivity of a vacuum; it is a dimensionless number.

The table gives the static relative permittivity ϵ_r , i.e., the relative permittivity measured in static fields or at low frequencies where no relaxation effects occur. The fourth column of the table lists the value of ϵ_r at the temperature specified in the third column, usually 293.15 or 298.15 K. Otherwise, the temperature closest to 293.15 K was chosen, or (as it is the case for many of the substances included here) ϵ_r is given at the only temperature for which data are available.

The static permittivity refers to nominal atmospheric pressure as long as the corresponding temperature is below the normal boiling point. Otherwise, at temperatures above the normal boiling point, the pressure is understood to be the saturated vapor pressure of the substance considered.

For substances where information on the temperature dependence of the permittivity is available, the table gives the coefficients of a simple polynomial fitting of permittivity to temperature with an equation of the form

$$\epsilon_r(T) = a + bT + cT^2 + dT^3$$

where T is the absolute temperature in K. Since the parameter d was used in only a few cases where the quadratic fit was not satisfactory, only a , b , and c are listed as columns in the table, while the d values are given at the end of this introduction. For all other substances, $d = 0$. The temperature range of the fit is given in the last column. The coefficients of the fitting equation can be used to calculate dielectric constants within the fitted temperature range but should not be used for extrapolation outside this range. The user who needs dielectric constant data with more accuracy than can be provided by this equation is referred to Reference 1, which gives the original data together with their literature source.

Substances are listed by molecular formula in modified Hill order, with substances not containing carbon preceding those that do contain carbon.

* Indicates that the isomer was not specified in the original reference.

** Indicates a compound for which the cubic term is needed:

Ethanol	$d = -0.15512E-05$
<i>N</i> -Methylacetamide	$d = -0.12998E-04$
1,2-Propylene glycol	$d = -0.32544E-05$
1-Butanol	$d = -0.48841E-06$
2-Butanol	$d = -0.89512E-06$
2-Methyl-1-propanol	$d = -0.45229E-06$
2-Methyl-2-propanol	$d = -0.25968E-05$
<i>N</i> -Butylacetamide	$d = -0.48716E-05$

REFERENCES

1. Wohlfarth, Ch., "Static Dielectric Constants of Pure Liquids and Binary Liquid Mixtures", *Landolt-Börnstein, Numerical Data and Functional Relationships in Science and Technology*, New Series, Editor in Chief, O. Madelung, Group IV, Macroscopic and Technical Properties of Matter, Volume 6, Springer-Verlag, Berlin, Heidelberg, New York, 1991.
2. Marsh, K. N., Ed., *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell Scientific Publications, Oxford, 1987.

Mol. Form.	Name	T/K	ϵ	a	b	c	Range/K
AlBr ₃	Aluminum tribromide	373.2	3.38				
Ar	Argon	140.00	1.3247	0.12408E+01	0.68755E-02	-0.45344E-04	87-149
AsH ₃	Arsine	200.9	2.40	0.37674E+01	-0.97454E-02	0.14537E-04	157-201
BBr ₃	Boron tribromide	273.2	2.58				
B ₂ H ₆	Diborane	180.66	1.8725	0.23848E+01	-0.29501E-02	0.64189E-06	108-181
B ₅ H ₉	Pentaborane(9)	298.2	21.1	0.40952E+03	-0.24414E+01	0.38225E-02	226-298
BrF ₃	Bromine trifluoride	298.2	106.8				
BrF ₅	Bromine pentafluoride	297.7	7.91	0.11428E+02	-0.11822E-01		262-298
BrH	Hydrogen bromide	186.8	8.23				
BrNO	Nitrosyl bromide	288.4	13.4				
Br ₂	Bromine	297.9	3.1484	0.32701E+01	-0.12535E-03		273-327
Br ₂ OS	Thionyl bromide	293.2	9.06				
Br ₃ OV	Vanadyl tribromide	298.2	3.6	0.61112E+01	-0.84211E-02		203-298
Br ₄ Ge	Germanium(IV) bromide	299.9	2.955	0.34450E+01	-0.16083E-02		300-316
Br ₄ Sn	Tin(IV) bromide	303.45	3.169	0.50001E+01	-0.60383E-02		304-316
ClFO ₃	Perchloryl fluoride	150.2	2.194	0.23808E+01	-0.38629E-03	-0.57143E-05	125-150
ClF ₃	Chlorine trifluoride	293.2	4.394	0.96716E+01	-0.18000E-01		273-313

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
ClF ₅	Chlorine pentafluoride	193.2	4.28	0.78192E+01	-0.20860E-01	0.13132E-04	193-256
ClH	Hydrogen chloride	158.9	14.3	0.47316E+02	-0.28455E+00	0.48650E-03	159-258
ClNO	Nitrosyl chloride	285.2	18.2				
Cl ₂	Chlorine	208.0	2.147	0.29440E+01	-0.44649E-02	0.30388E-05	208-240
Cl ₂ F ₃ P	Phosphorus(V) dichloride trifluoride	228.63	2.8129	0.46501E+01	-0.80358E-02		172-229
Cl ₂ OS	Thionyl chloride	298.2	8.675				
Cl ₂ OSe	Selenium oxychloride	293.2	46.2				
Cl ₂ O ₂ S	Sulfuryl chloride	293.2	9.1				
Cl ₂ S	Sulfur dichloride	298.2	2.915				
Cl ₂ S ₂	Sulfur chloride	288.2	4.79				
Cl ₃ F ₂ P	Phosphorus(V) trichloride difluoride	268.0	2.3752	0.28905E+01	-0.19228E-02		215-268
Cl ₃ OP	Phosphorus(V) oxychloride	293.2	14.1				
Cl ₃ OV	Vanadyl trichloride	298.2	3.4				
Cl ₃ P	Phosphorus(III) chloride	290.2	3.498	0.59098E+01	-0.83322E-02		290-333
Cl ₃ PS	Phosphorus(V) sulfide trichloride	298.2	4.94				
Cl ₄ FP	Phosphorus(V) tetrachloride fluoride	272.64	2.6499	0.33503E+01	-0.29651E-02		244-273
Cl ₄ Ge	Germanium(IV) chloride	273.2	2.463	-0.55078E+01	0.64881E-01	-0.13091E-03	246-273
Cl ₄ Pb	Lead(IV) chloride	293.2	2.78				
Cl ₄ Si	Tetrachlorosilane	273.2	2.248	0.58041E+01	-0.27129E-01	0.51678E-04	207-273
Cl ₄ Sn	Tin(IV) chloride	273.2	3.014	0.43951E+01	-0.48805E-02		234-273
Cl ₄ Ti	Titanium(IV) chloride	257.4	2.843	0.33668E+01	-0.19675E-02		237-257
Cl ₄ V	Vanadium(IV) chloride	298.2	3.05				
Cl ₅ P	Phosphorus(V) chloride	433.2	2.85				
Cl ₅ Sb	Antimony(V) chloride	293.0	3.222	0.45413E+01	-0.45078E-02		276-320
FH	Hydrogen fluoride	273.2	83.6	0.50352E+03	-0.19297E+01	0.14372E-02	200-273
F ₂	Fluorine	53.48	1.4913	0.14144E+01	0.26387E-02	-0.28356E-04	54-144
F ₃ I	Iodine pentafluoride	293.2	37.13	0.95184E+02	-0.19800E+00		273-313
F ₆ S	Sulfur hexafluoride	223.2	1.81				
F ₆ Xe	Xenon hexafluoride	328.2	4.10				
F ₇ I	Iodine heptafluoride	298.2	1.75				
F ₁₀ S ₂	Sulfur decafluoride	293.2	2.0202				
HI	Hydrogen iodide	220.2	3.87	0.51557E+03	-0.44552E+01	0.96795E-02	220-236
H ₂	Hydrogen	13.52	1.2792	0.13327E+01	-0.51946E-02		14-19
H ₂ O	Water	293.2	80.100	0.24921E+03	-0.79069E+00	0.72997E-03	273-372
H ₂ O ₂	Hydrogen peroxide	290.2	74.6	0.48511E+03	-0.23145E+01	0.31020E-02	233-303
H ₂ S	Hydrogen sulfide	283.2	5.93	0.14736E+02	-0.33675E-01	0.96740E-05	212-363
H ₃ N	Ammonia	293.2	16.61	0.66756E+02	-0.24696E+00	0.25913E-03	238-323
H ₄ N ₂	Hydrazine	298.2	51.7	0.22061E+03	-0.89633E+00	0.11066E-02	278-323
He	Helium	2.055	1.0555	0.10640E+01	-0.35584E-02		2-4
I ₂	Iodine	391.25	11.08	0.64730E+02	-0.29266E+00	0.39759E-03	391-441
Kr	Krypton	119.80	1.664				
Mn ₂ O ₇	Manganese(VII) oxide	293.2	3.28	0.37655E+01	-0.16463E-02		283-312
NO	Nitric oxide	1.997					
N ₂	Nitrogen	63.15	1.4680	0.12550E+01	0.67949E-02	-0.56704E-04	63-126
N ₂ O ₃	Nitrogen trioxide	203.2	31.13	0.92287E+02	-0.43306E+00	0.65000E-03	203-243
N ₂ O ₄	Nitrogen tetroxide	293.2	2.44	0.28212E+01	-0.13000E-02		253-293
Ne	Neon	26.11	1.1907	0.12667E+01	-0.29064E-02		26-29
O ₂	Oxygen	54.478	1.5684	0.15434E+01	0.14615E-02	-0.21964E-04	55-154
O ₂ S	Sulfur dioxide	298.2	16.3	0.52045E+02	-0.16125E+00	0.11042E-03	213-449
O ₃	Ozone	90.2	4.75	0.86344E+01	-0.54807E-01	0.12596E-03	90-185
O ₃ S	Sulfur trioxide	291.2	3.11				
P	Phosphorus	307.2	4.096	0.79018E+00	0.23911E-01	-0.42826E-04	307-358
S	Sulfur	407.2	3.4991	0.51651E+01	-0.77381E-02	0.89120E-05	407-479
Se	Selenium	510.65	5.44	0.67569E+01	-0.25829E-02		511-575
Xe	Xenon	161.35	1.880				
CBrClF ₂	Bromochlorodifluoromethane	123.2	3.920	0.52442E+01	-0.11000E-01		123-223
CBrCl ₃	Bromotrichloromethane	293.2	2.405	0.29249E+01	-0.17650E-02		273-333
CBrF ₃	Bromotrifluoromethane	123.2	3.730	0.54154E+01	-0.13680E-01		123-173
CBr ₂ Cl ₂	Dibromodichloromethane	298.2	2.542	0.32330E+01	-0.23162E-02		298-333

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
CBr ₂ F ₂	Dibromodifluoromethane	273.2	2.939	0.67296E+01	-0.22133E-01	0.30213E-04	139-273
CBr ₃ Cl	Tribromochloromethane	333.2	2.601				
CBr ₃ F	Tribromofluoromethane	293.2	3.00	0.53203E+01	-0.11061E-01	0.10688E-04	206-323
CBr ₃ NO ₂	Tribromonitromethane	298.2	9.034	0.16079E+02	-0.23630E-01		298-328
CClF ₃	Chlorotrifluoromethane	123.2	3.010	0.43677E+01	-0.11020E-01		123-173
CCl ₂ F ₂	Dichlorodifluoromethane	123.2	3.500	0.46984E+01	-0.97600E-02		123-223
CCl ₂ O	Carbonyl chloride	295.2	4.30				
CCl ₃ D	Trichloromethane- <i>d</i>	298.2	4.67				
CCl ₃ F	Trichlorofluoromethane	293.2	3.00	0.53203E+01	-0.11061E-01	0.10688E-04	206-323
CCl ₃ NO ₂	Trichloronitromethane	293.2	7.319	0.14403E+02	-0.24178E-01		276-333
CCl ₄	Tetrachloromethane	293.2	2.2379	0.28280E+01	-0.20339E-02	0.71795E-07	283-333
CF ₄	Tetrafluoromethane	126.3	1.685	0.20350E+01	-0.27616E-02		126-142
CHBr ₃	Tribromomethane	283.2	4.404	0.71707E+01	-0.98000E-02		283-343
CHCl ₃	Trichloromethane	293.2	4.8069	0.15115E+02	-0.51830E-01	0.56803E-04	218-323
CHF ₃	Trifluoromethane	294.0	5.2	0.11442E+03	-0.75600E+00	0.13562E-02	130-263
CHN	Hydrogen cyanide	293.2	114.9	0.37331E+04	-0.23180E+02	0.36963E-01	258-299
CH ₂ Br ₂	Dibromomethane	283.2	7.77	0.18060E+02	-0.36333E-01		283-313
CH ₂ Cl ₂	Dichloromethane	298.0	8.93	0.40452E+02	-0.17748E+00	0.23942E-03	184-306
CH ₂ F ₂	Difluoromethane	152.2	53.74	0.19428E+03	-0.12939E+01	0.24280E-02	152-224
CH ₂ I ₂	Diiodomethane	298.2	5.32				
CH ₂ O ₂	Formic acid	298.2	51.1	0.14040E+03	-0.24673E+00	-0.17151E-03	287-358
CH ₃ Br	Bromomethane	275.7	9.71	0.40580E+02	-0.18418E+00	0.26219E-03	195-276
CH ₃ Cl	Chloromethane	295.2	10.0	0.42775E+02	-0.16175E+00	0.17108E-03	190-392
CH ₃ ClO ₂ S	Methanesulfonyl chloride	293.2	34.0	0.10384E+03	-0.33838E+00	0.34156E-03	293-373
CH ₃ DO	Methan- <i>d</i> ₁ -ol	297.5	31.68	0.20839E+03	-0.10318E+01	0.14740E-02	176-298
CH ₃ F	Fluoromethane	131.0	51.0	0.11338E+03	-0.63979E+00	0.96983E-03	150-299
CH ₃ I	Iodomethane	293.2	6.97	0.24264E+02	-0.93914E-01	0.11926E-03	223-303
CH ₃ NO	Formamide	293.2	111.0	0.26076E+03	-0.61145E+00	0.34296E-03	278-333
CH ₃ NO ₂	Nitromethane	293.2	37.27	0.11227E+03	-0.35591E+00	0.34206E-03	288-343
CH ₃ NO ₂	Methyl nitrite	200.0	20.77	0.11071E+03	-0.73428E+00	0.14054E-02	110-260
CH ₃ NO ₃	Methyl nitrate	293.2	23.9				
CH ₄	Methane	91.0	1.6761	0.15996E+01	0.27434E-02	-0.22086E-04	91-184
CH ₄ O	Methanol	293.2	33.0	0.19341E+03	-0.92211E+00	0.12839E-02	177-293
CH ₅ N	Methylamine	215.2	16.7	0.34398E+02	-0.73630E-01	-0.41279E-04	198-258
CN ₄ O ₈	Tetranitromethane	293.2	2.317				
COS	Carbon oxysulfide	185.0	4.47	0.84702E+01	-0.21488E-01		143-185
COSe	Carbon oxyselenide	283.2	3.47	0.48740E+01	-0.49425E-02		219-283
CO ₂	Carbon dioxide	295.0	1.4492	0.79062E+00	0.10639E-01	-0.28510E-04	220-300
CS ₂	Carbon disulfide	293.2	2.6320	0.45024E+01	-0.12054E-01	0.19147E-04	154-319
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane	298.2	2.34				
C ₂ Cl ₂ F ₄	1,2-Dichlorotetrafluoroethane	273.2	2.4842	0.36663E+01	-0.42271E-02	-0.36255E-06	193-273
C ₂ Cl ₂ O ₂	Oxalyl chloride	294.35	3.470				
C ₂ Cl ₃ N	Trichloroacetonitrile	292.2	7.85				
C ₂ Cl ₄	Tetrachloroethylene	303.2	2.268				
C ₂ Cl ₄ F ₂	1,1,2,2-Tetrachloro-1,2-difluoroethane	308.2	2.52				
C ₂ HBr ₃ O	Tribromoacetaldehyde	293.2	7.6				
C ₂ HCl ₃	Trichloroethylene	301.5	3.390	0.58319E+01	-0.80828E-02		302-338
C ₂ HCl ₃ F ₂	1,2,2-Trichloro-1,1-difluoroethane	303.2	4.01	0.75423E+01	-0.11667E-01		303-333
C ₂ HCl ₃ O	Trichloroacetaldehyde	298.2	6.8				
C ₂ HCl ₃ O ₂	Trichloroacetic acid	333.2	4.34	0.13412E+01	0.90000E-02	-0.24130E-14	333-393
C ₂ HCl ₅	Pentachloroethane	298.2	3.716	0.65972E+01	-0.96800E-02		298-338
C ₂ HF ₃ O ₂	Trifluoroacetic acid	293.2	8.42	0.21652E+02	-0.68146E-01	0.78571E-04	263-323
C ₂ H ₂	Acetylene	195.0	2.4841				
C ₂ H ₂ Br ₂	<i>cis</i> -1,2-Dibromoethylene	298.2	7.08				
C ₂ H ₂ Br ₂	<i>trans</i> -1,2-Dibromoethylene	298.2	2.88				
C ₂ H ₂ Br ₄	1,1,2,2-Tetrabromoethane	303.2	6.72	0.16246E+02	-0.31500E-01		303-333
C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	293.2	4.60				
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	298.2	9.20				
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	293.2	2.14				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₂ H ₂ Cl ₂ O ₂	Dichloroacetic acid	293.2	8.33	0.11014E+02	-0.10859E-01	0.49242E-05	284-363
C ₂ H ₂ Cl ₄	1,1,1,2-Tetrachloroethane	207.2	9.22	0.19606E+02	-0.49847E-01		207-233
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	293.2	8.50				
C ₂ H ₂ I ₂	<i>cis</i> -1,2-Diiodoethylene	345.65	4.46				
C ₂ H ₃ ClO	Acetyl chloride	295.2	15.8				
C ₂ H ₃ ClO ₂	Chloroacetic acid	338.2	12.35	0.17310E+02	-0.14674E-01		338-393
C ₂ H ₃ Cl ₂ NO ₂	1,1-Dichloro-1-nitroethane	303.2	16.3	0.37576E+02	-0.70400E-01		303-333
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	293.2	7.243	0.27705E+02	-0.10621E+00	0.12424E-03	258-318
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	298.2	7.1937	0.17147E+02	-0.33371E-01		288-318
C ₂ H ₃ F ₃ O	2,2,2-Trifluoroethanol	293.2	27.68	0.90593E+02	-0.21421E+00		293-318
C ₂ H ₃ N	Acetonitrile	293.2	36.64	0.29724E+03	-0.15508E+01	0.22591E-02	288-333
C ₂ H ₃ NO	Methyl isocyanate	288.7	21.75				
C ₂ H ₄	Ethylene	270.0	1.4833	0.13546E+01	0.62614E-02	-0.21374E-04	200-270
C ₂ H ₄ BrCl	1-Bromo-2-chloroethane	283.2	7.41	0.19493E+02	-0.59054E-01	0.58036E-04	263-363
C ₂ H ₄ Br ₂	1,2-Dibromoethane	293.2	4.9612	0.67142E+01	-0.59800E-02		293-313
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	298.2	10.10	0.24429E+02	-0.48000E-01		288-318
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	293.2	10.42	0.24404E+02	-0.47892E-01		293-343
C ₂ H ₄ Cl ₂ O	Bis(chloromethyl) ether	293.2	3.51				
C ₂ H ₄ N ₂ O ₆	Ethylene glycol dinitrate	293.2	28.26				
C ₂ H ₄ O	Acetaldehyde	291.2	21.0				
C ₂ H ₄ O	Ethylene oxide	293.2	12.42	0.52661E+02	-0.21337E+00	0.25947E-03	293-243
C ₂ H ₄ OS	Thioacetic acid	298.2	14.30				
C ₂ H ₄ O ₂	Acetic acid	293.2	6.20	-0.15731E+02	0.12662E+00	-0.17738E-03	293-363
C ₂ H ₄ O ₂	Methyl formate	288.2	9.20	0.19699E+02	-0.36429E-01		288-302
C ₂ H ₄ O ₃ S	Ethylene glycol sulfite	298.2	39.6	0.85483E+02	-0.15400E+00		298-328
C ₂ H ₅ Br	Bromoethane	298.2	9.01	0.28473E+02	-0.85495E-01	0.67971E-04	243-308
C ₂ H ₅ Cl	Chloroethane	293.2	9.45	0.60693E+02	-0.31290E+00	0.47154E-03	237-293
C ₂ H ₅ ClO	2-Chloroethanol	293.2	25.80	0.11155E+03	-0.30149E+00		140-175
C ₂ H ₅ I	Iodoethane	293.2	7.82	0.25598E+02	-0.94367E-01	0.11424E-03	183-343
C ₂ H ₅ N	Ethyleneimine	298.2	18.3	0.61405E+02	-0.14474E+00		273-298
C ₂ H ₅ NO	Acetamide	363.7	67.6	-0.20055E+03	0.15515E+01	-0.22392E-02	364-448
C ₂ H ₅ NO	<i>N</i> -Methylformamide	293.2	189.0	0.10383E+04	-0.43165E+01	0.48398E-02	276-353
C ₂ H ₅ NO	Acetaldoxime	298.2	4.70				
C ₂ H ₅ NO ₂	Nitroethane	288.2	29.11	0.57406E+02	-0.97657E-01		276-333
C ₂ H ₅ NO ₂	Methyl carbamate	328.2	18.48	0.36773E+02	-0.55700E-01		328-368
C ₂ H ₅ NO ₃	Ethyl nitrate	293.2	19.7				
C ₂ H ₆	Ethane	95.0	1.9356	0.20185E+01	-0.51493E-03	-0.48148E-05	95-295
C ₂ H ₆ O	Ethanol	293.2	25.3	0.15145E+03	-0.87020E+00	0.19570E-02	163-523
C ₂ H ₆ O	Dimethyl ether	258.0	6.18	0.22389E+02	-0.86524E-01	0.91291E-04	155-258
C ₂ H ₆ OS	Dimethyl sulfoxide	293.2	47.24	0.38478E+02	0.16939E+00	-0.47423E-03	288-343
C ₂ H ₆ O ₂	Ethylene glycol	293.2	41.4	0.14355E+03	-0.48573E+00	0.46703E-03	293-423
C ₂ H ₆ O ₂ S	Dimethyl sulfone	383.2	47.39	0.10830E+03	-0.15900E+00		383-398
C ₂ H ₆ O ₄ S	Dimethyl sulfate	298.2	55.0				
C ₂ H ₆ S	Ethanethiol	298.2	6.667				
C ₂ H ₆ S	Dimethyl sulfide	294.2	6.70				
C ₂ H ₆ S ₂	1,2-Ethanedithiol	293.2	7.26	0.11228E+02	-0.13500E-01		293-333
C ₂ H ₆ S ₂	Dimethyl disulfide	298.2	9.6	0.19109E+02	-0.32000E-01		298-323
C ₂ H ₇ N	Ethylamine	273.2	8.7	0.30163E+02	-0.79000E-01		233-273
C ₂ H ₇ NO	Ethanolamine	293.2	31.94	0.14890E+03	-0.62491E+00	0.77143E-03	253-293
C ₂ H ₈ N ₂	1,2-Ethanediamine	293.2	13.82	0.48922E+02	-0.17021E+00	0.17262E-03	273-333
C ₃ Cl ₆ O	Hexachloroacetone	291.9	3.925	0.76423E+01	-0.15838E-01	0.10618E-04	269-303
C ₃ F ₆ O	Perfluoroacetone	202.2	2.104	0.34809E+01	-0.92883E-02	0.12282E-04	151-238
C ₃ HN	Cyanoacetylene	291.9	72.3	0.91803E+03	-0.49149E+01	0.69104E-02	281-314
C ₃ H ₂ F ₆ O	1,1,1,3,3,3-Hexafluoro-2-propanol	293.2	16.70				
C ₃ H ₃ ClO ₃	4-Chloro-1,3-dioxolan-2-one	313.2	62.0				
C ₃ H ₃ N	Acrylonitrile	293.2	33.0	0.11109E+03	-0.36806E+00	0.34879E-03	233-413
C ₃ H ₃ NO ₂	Cyanoacetic acid	277.2	33.4				
C ₃ H ₄	Allene	269.0	2.025	0.26049E+01	-0.44147E-03	-0.63420E-05	156-269
C ₃ H ₄	Propyne	246.0	3.218	0.60871E+01	-0.11730E-01		185-246

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₃ H ₄ ClF ₃	3-Chloro-1,1,1-trifluoropropane	295.2	7.32	0.22361E+02	-0.68840E-01	0.60594E-04	275-313
C ₃ H ₄ ClNO	2-Chloroethyl isocyanate	288.2	29.1	0.64311E+02	-0.12217E+00		288-403
C ₃ H ₄ Cl ₂ O	1,1-Dichloroacetone	293.2	14.6				
C ₃ H ₄ F ₄ O	2,2,3,3-Tetrafluoro-1-propanol	298.2	21.03				
C ₃ H ₄ O	Propargyl alcohol	293.2	20.8	0.99895E+02	-0.38911E+00	0.40776E-03	213-293
C ₃ H ₄ O ₃	Ethylene carbonate	313.2	89.78	0.20746E+03	-0.37610E+00		313-343
C ₃ H ₅ Br	3-Bromopropene	293.2	7.0				
C ₃ H ₅ BrO ₂	2-Bromopropanoic acid	294.2	11.0				
C ₃ H ₅ Br ₃	1,2,3-Tribromopropane	303.2	6.00	0.11024E+02	-0.16596E-01		303-358
C ₃ H ₅ Cl	2-Chloropropene	299.25	8.92				
C ₃ H ₅ Cl	3-Chloropropene	293.2	8.2				
C ₃ H ₅ ClN ₂ O ₆	3-Chloro-1,2-propanediol dinitrate	293.2	17.50				
C ₃ H ₅ ClO	Epichlorohydrin	293.2	22.6				
C ₃ H ₅ ClO ₂	Ethyl chloroformate	308.7	9.736	0.15356E+02	-0.18250E-01		309-349
C ₃ H ₅ ClO ₂	Methyl chloroacetate	293.2	12.0				
C ₃ H ₅ Cl ₃	1,2,3-Trichloropropane	293.2	7.5				
C ₃ H ₅ I	3-Iodopropene	292.2	6.1				
C ₃ H ₅ N	Propanenitrile	293.2	29.7	0.82222E+02	-0.22937E+00	0.17424E-03	213-473
C ₃ H ₅ NO	Ethyl isocyanate	293.2	19.7				
C ₃ H ₅ NS	Ethyl isothiocyanate	293.2	19.6				
C ₃ H ₅ N ₃ O ₉	Trinitroglycerol	293.2	19.25				
C ₃ H ₆	Propene	220.0	2.1365	0.29623E+01	-0.37564E-02		220-250
C ₃ H ₆ Br ₂	1,2-Dibromopropane	283.2	4.60	0.54973E+01	-0.31695E-02		283-333
C ₃ H ₆ Br ₂	1,3-Dibromopropane	293.2	9.482	0.29193E+02	-0.94450E-01	0.92800E-04	293-368
C ₃ H ₆ ClNO ₂	2-Chloro-2-nitropropane	250.4	31.90				
C ₃ H ₆ Cl ₂	1,2-Dichloropropane	293.2	8.37	0.18915E+02	-0.35907E-01		281-323
C ₃ H ₆ Cl ₂	1,3-Dichloropropane	303.2	10.27	0.21609E+02	-0.37333E-01		303-333
C ₃ H ₆ Cl ₂	2,2-Dichloropropane	293.2	11.37	0.32421E+02	-0.72188E-01		245-293
C ₃ H ₆ N ₂ O ₄	2,2-Dinitropropane	325.1	42.4				
C ₃ H ₆ O	Allyl alcohol	293.2	19.7	0.62714E+02	-0.14771E+00	0.37879E-05	213-303
C ₃ H ₆ O	Propanal	290.2	18.5				
C ₃ H ₆ O	Acetone	293.2	21.01	0.88157E+02	-0.34300E+00	0.38925E-03	273-323
C ₃ H ₆ O ₂	Propanoic acid	298.2	3.44	0.18793E+01	0.46841E-02	0.19983E-05	289-408
C ₃ H ₆ O ₂	Ethyl formate	288.2	8.57	0.15884E+02	-0.25333E-01		288-318
C ₃ H ₆ O ₂	Methyl acetate	288.2	7.07	0.13190E+02	-0.21226E-01		276-318
C ₃ H ₆ O ₃	3-Hydroxypropanoic acid	296.2	30.0				
C ₃ H ₆ O ₃	Dimethyl carbonate	298.2	3.087				
C ₃ H ₆ O ₃	1,3,5-Trioxane	338.2	15.55				
C ₃ H ₇ Br	1-Bromopropane	293.2	8.09	0.17769E+02	-0.32599E-01		274-328
C ₃ H ₇ Br	2-Bromopropane	293.2	9.46	0.26195E+02	-0.72995E-01	0.55454E-04	186-328
C ₃ H ₇ Cl	1-Chloropropane	293.2	8.588	0.21214E+02	-0.43130E-01		273-313
C ₃ H ₇ ClO	3-Chloro-1-propanol	215.2	36.0	0.12436E+03	-0.60841E+00	0.92060E-03	145-215
C ₃ H ₇ ClO	1-Chloro-2-propanol	153.2	59.0	-0.19169E+02	0.13605E+01	-0.55567E-02	153-177
C ₃ H ₇ ClO ₂	3-Chloro-1,2-propanediol	293.2	31.0				
C ₃ H ₇ I	1-Iodopropane	293.2	7.07	0.13744E+02	-0.22745E-01		293-323
C ₃ H ₇ I	2-Iodopropane	298.2	8.19				
C ₃ H ₇ NO	<i>N</i> -Ethylformamide	298.2	102.7	0.64764E+03	-0.28499E+01	0.34286E-02	298-338
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide	293.2	38.25	0.15364E+03	-0.60367E+00	0.71505E-03	213-353
C ₃ H ₇ NO	<i>N</i> -Methylacetamide	303.2	179.0	0.15975E+04	-0.90451E+01	0.18345E-01	303-473
C ₃ H ₇ NO ₂	1-Nitropropane	288.2	24.70	0.94999E+02	-0.38358E+00	0.48480E-03	276-333
C ₃ H ₇ NO ₂	2-Nitropropane	288.2	26.74	0.60138E+02	-0.11566E+00		276-303
C ₃ H ₇ NO ₂	Propyl nitrite	250.0	12.35	0.70552E+02	-0.40362E+00	0.66687E-03	110-310
C ₃ H ₇ NO ₂	Isopropyl nitrite	260.0	13.92	0.74578E+02	-0.38283E+00	0.57071E-03	150-300
C ₃ H ₇ NO ₂	Ethyl carbamate	328.2	14.14	0.32431E+02	-0.65097E-01	0.28571E-04	328-368
C ₃ H ₈	Propane	293.19	1.6678	0.22883E+01	-0.23276E-02	0.84710E-06	90-300
C ₃ H ₈ O	1-Propanol	293.2	20.8	0.98045E+02	-0.36860E+00	0.36422E-03	193-493
C ₃ H ₈ O	2-Propanol	293.2	20.18	0.10416E+03	-0.41011E+00	0.42049E-03	193-493
C ₃ H ₈ O ₂	1,2-Propylene glycol	303.2	27.5	0.24546E+03	-0.15738E+01	0.38068E-02	193-403
C ₃ H ₈ O ₂	1,3-Propylene glycol	293.2	35.1	0.11365E+03	-0.36680E+00	0.33766E-03	288-328

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₃ H ₈ O ₂	Ethylene glycol monomethyl ether	298.2	17.2	0.11803E+03	-0.58000E+00	0.81001E-03	254-318
C ₃ H ₈ O ₂	Dimethoxymethane	293.2	2.644	0.25877E+01	-0.93019E-03	0.38472E-05	171-293
C ₃ H ₈ O ₃	Glycerol	293.2	46.53	0.77503E+02	-0.37984E-01	-0.23107E-03	288-343
C ₃ H ₈ S	1-Propanethiol	288.2	5.937	0.11602E+02	-0.19580E-01		273-318
C ₃ H ₈ S	2-Propanethiol	298.2	5.952				
C ₃ H ₈ S ₂	1,2-Propanedithiol	293.2	7.24	0.14667E+02	-0.32660E-01	0.25000E-04	293-333
C ₃ H ₈ S ₂	1,3-Propanedithiol	303.2	8.11	0.66607E+01	0.31310E-01	-0.87500E-04	303-343
C ₃ H ₉ BO ₃	Trimethyl borate	293.2	2.2762				
C ₃ H ₉ ClSi	Trimethylchlorosilane	273.2	10.21	-0.19492E+02	0.29806E+00	-0.69284E-03	223-273
C ₃ H ₉ N	Propylamine	296.2	5.08	0.17719E+02	-0.59022E-01	0.54780E-04	204-296
C ₃ H ₉ N	Isopropylamine	293.2	5.6268	0.40429E+02	-0.21441E+00	0.32634E-03	213-298
C ₃ H ₉ N	Trimethylamine	298.2	2.440	0.39745E+01	-0.51331E-02		273-298
C ₃ H ₉ O ₄ P	Trimethyl phosphate	293.2	20.6				
C ₄ Cl ₆	Hexachloro-1,3-butadiene	293.2	2.55				
C ₄ Cl ₆ O ₃	Trichloroacetic anhydride	298.2	5.0				
C ₄ F ₆ O ₃	Trifluoroacetic acid anhydride	298.2	2.7				
C ₄ H ₂ Cl ₄ O ₃	Dichloroacetic anhydride	298.2	15.8				
C ₄ H ₂ O ₃	Maleic anhydride	326.2	52.75				
C ₄ H ₃ F ₇ O	2,2,3,3,4,4,4-Heptafluoro-1-butanol	298.2	14.4				
C ₄ H ₄ N ₂	Succinonitrile	298.2	62.6	0.17724E+03	-0.54654E+00	0.54046E-03	236-351
C ₄ H ₄ N ₂	Pyrazine	323.2	2.80				
C ₄ H ₄ O	Furan	277.1	2.88	0.13636E+01	0.12864E-01	-0.22701E-04	188-277
C ₄ H ₄ S	Thiophene	293.2	2.739	0.32941E+01	-0.19019E-02		253-293
C ₄ H ₅ Cl	2-Chloro-1,3-butadiene	293.2	4.914				
C ₄ H ₅ Cl ₃ O ₂	Ethyl trichloroacetate	293.2	8.428				
C ₄ H ₅ N	Pyrrole	293.0	8.00	0.12672E+02	-0.14075E-01	-0.62671E-05	293-357
C ₄ H ₅ NO	Allyl isocyanate	288.2	15.15	0.34299E+02	-0.66444E-01		288-333
C ₄ H ₆	1,3-Butadiene	265.0	2.050	0.27674E+01	-0.26738E-02		185-265
C ₄ H ₆ O	Divinyl ether	288.2	3.94				
C ₄ H ₆ O	Ethoxyacetylene	298.2	8.05				
C ₄ H ₆ O	Cyclobutanone	298.2	14.27	0.43974E+02	-0.15712E+00	0.19264E-03	220-317
C ₄ H ₆ O ₂	Methyl acrylate	303.2	7.03	0.11968E+02	-0.16500E-01		303-333
C ₄ H ₆ O ₂	2,3-Butanedione	298.2	4.04	0.46907E+01	-0.22302E-02		278-348
C ₄ H ₆ O ₂	γ -Butyrolactone	293.2	39.0				
C ₄ H ₆ O ₃	Acetic anhydride	293.2	22.45				
C ₄ H ₆ O ₃	Propylene carbonate	293.0	66.14	0.15940E+03	-0.39530E+00	0.26284E-03	273-333
C ₄ H ₇ Br	<i>cis</i> -2-Bromo-2-butene	293.2	5.38				
C ₄ H ₇ Br	<i>trans</i> -2-Bromo-2-butene	293.2	6.76				
C ₄ H ₇ BrO ₂	2-Bromobutanoic acid	293.2	7.2				
C ₄ H ₇ BrO ₂	Ethyl bromoacetate	303.2	9.75	0.15627E+02	-0.19600E-01		303-333
C ₄ H ₇ BrO ₂	Methyl 3-bromopropanoate	303.2	5.81	0.36001E+01	0.72500E-02		303-343
C ₄ H ₇ ClO ₂	Propyl chlorocarbonate	293.2	11.2				
C ₄ H ₇ ClO ₂	Methyl 2-chloropropanoate	303.2	11.45	0.22449E+02	-0.36250E-01		303-343
C ₄ H ₇ N	Butanenitrile	293.2	24.83	0.53884E+02	-0.99257E-01		293-333
C ₄ H ₇ N	2-Methylpropanenitrile	293.2	24.42	0.52554E+02	-0.96000E-01		293-313
C ₄ H ₇ NO	2-Pyrrolidone	298.2	28.18	0.11054E+03	-0.47945E+00	0.68182E-03	298-338
C ₄ H ₈	1-Butene	220.0	2.2195	0.29354E+01	-0.32580E-02		220-250
C ₄ H ₈	<i>cis</i> -2-Butene	296.0	1.960	0.28802E+01	-0.31064E-02		197-296
C ₄ H ₈	Isobutene	288.7	2.1225	0.33701E+01	-0.43295E-02		220-289
C ₄ H ₈ Br ₂	1,2-Dibromobutane	293.2	4.74	0.11199E+03	-0.63334E+00	0.91250E-03	293-333
C ₄ H ₈ Br ₂	1,3-Dibromobutane	293.2	9.14	0.34031E+02	-0.13254E+00	0.16250E-03	293-333
C ₄ H ₈ Br ₂	1,4-Dibromobutane	303.2	8.68	0.20944E+02	-0.55620E-01	0.50000E-04	303-333
C ₄ H ₈ Br ₂	2,3-Dibromobutane	298.2	6.245	0.23849E+02	-0.96300E-01	0.12500E-03	293-333
C ₄ H ₈ Br ₂	1,2-Dibromo-2-methylpropane	293.2	4.1				
C ₄ H ₈ Cl ₂	1,2-Dichlorobutane	293.2	7.74	0.31925E+02	-0.13232E+00	0.17007E-03	293-356
C ₄ H ₈ Cl ₂	1,4-Dichlorobutane	308.2	9.30	0.59766E+01	0.49300E-01	-0.12500E-03	308-338
C ₄ H ₈ Cl ₂	1,2-Dichloro-2-methylpropane	296.0	7.15	0.39429E+02	-0.20028E+00	0.30917E-03	165-296
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether	293.2	21.20				
C ₄ H ₈ O	Butanal	298.2	13.45				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₄ H ₈ O	2-Butanone	293.2	18.56	0.15457E+02	0.90152E-01	-0.27100E-03	293-333
C ₄ H ₈ O	Tetrahydrofuran	295.2	7.52	0.30739E+02	-0.12946E+00	0.17195E-03	224-295
C ₄ H ₈ O ₂	Butanoic acid	287.2	2.98	0.15010E+01	0.50046E-02		287-403
C ₄ H ₈ O ₂	2-Methylpropanoic acid	293.2	2.58				
C ₄ H ₈ O ₂	Propyl formate	303.2	6.92				
C ₄ H ₈ O ₂	Ethyl acetate	293.2	6.0814	0.15646E+02	-0.44066E-01	0.39137E-04	293-433
C ₄ H ₈ O ₂	Methyl propanoate	293.2	6.200	0.12798E+02	-0.22540E-01		293-333
C ₄ H ₈ O ₂	1,4-Dioxane	293.2	2.2189	0.27299E+01	-0.17440E-02		293-313
C ₄ H ₈ O ₃	2-Hydroxybutanoic acid	296.2	37.7				
C ₄ H ₈ O ₃	3-Hydroxybutanoic acid	296.2	31.5				
C ₄ H ₈ O ₃	Ethyl methyl carbonate	293.2	2.985				
C ₄ H ₈ O ₃	Ethylene glycol monoacetate	303.2	12.95				
C ₄ H ₉ Br	1-Bromobutane	283.2	7.315	0.22542E+02	-0.79306E-01	0.89867E-04	183-363
C ₄ H ₉ Br	2-Bromobutane	298.2	8.64	0.18461E+02	-0.32933E-01		274-328
C ₄ H ₉ Br	1-Bromo-2-methylpropane	273.2	7.70	0.37558E+02	-0.20571E+00	0.35496E-03	112-273
C ₄ H ₉ Br	2-Bromo-2-methylpropane	293.0	10.98	0.35085E+02	-0.14075E+00	0.19960E-03	258-293
C ₄ H ₉ Cl	1-Chlorobutane	293.2	7.276	0.13565E+02	-0.10161E-01	-0.38750E-04	273-323
C ₄ H ₉ Cl	2-Chlorobutane	293.2	8.564	0.30376E+02	-0.11377E+00	0.13429E-03	273-323
C ₄ H ₉ Cl	1-Chloro-2-methylpropane	293.2	7.027	0.14945E+02	-0.33747E-01	0.23036E-04	273-323
C ₄ H ₉ Cl	2-Chloro-2-methylpropane	293.2	9.663	0.35077E+02	-0.12867E+00	0.14304E-03	273-323
C ₄ H ₉ I	1-Iodobutane	293.2	6.27	0.16493E+02	-0.50262E-01	0.52485E-04	293-323
C ₄ H ₉ I	2-Iodobutane	293.2	7.873	0.10883E+02	-0.14680E-02	-0.30000E-04	293-323
C ₄ H ₉ I	2-Iodo-2-methylpropane	283.2	6.65	0.76780E+01	0.69900E-02	-0.37500E-04	283-323
C ₄ H ₉ N	Pyrrolidine	293.0	8.30	0.38191E+02	-0.15462E+00	0.17941E-03	274-333
C ₄ H ₉ NO	<i>N</i> -Methylpropanamide	293.2	170.0				
C ₄ H ₉ NO	<i>N</i> -Ethylacetamide	293.2	135.0	0.74494E+03	-0.31400E+01	0.36131E-02	213-353
C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide	294.2	38.85	0.15420E+03	-0.57506E+00	0.61911E-03	294-433
C ₄ H ₉ NO	2-Butanone oxime	293.2	3.4				
C ₄ H ₉ NO	Morpholine	298.2	7.42				
C ₄ H ₉ NO ₂	<i>tert</i> -Butyl nitrite	298.2	11.47				
C ₄ H ₉ NO ₂	Propyl carbamate	338.2	12.06	0.24356E+02	-0.36400E-01		338-378
C ₄ H ₉ NO ₂	Ethyl- <i>N</i> -methyl carbamate	298.2	21.10	0.11477E+03	-0.47568E+00	0.54127E-03	298-373
C ₄ H ₉ NO ₂	<i>N</i> -Acetyethanolamine	298.2	96.6	0.37016E+03	-0.13113E+01	0.13214E-02	298-348
C ₄ H ₉ NO ₃	Butyl nitrate	293.2	13.10				
C ₄ H ₁₀	Butane	295.0	1.7697	0.22379E+01	-0.13884E-02	-0.66711E-06	135-303
C ₄ H ₁₀	Isobutane	295.0	1.7518	0.23295E+01	-0.19953E-02	0.14197E-06	115-303
C ₄ H ₁₀ O	1-Butanol	293.2	17.84	0.10578E+03	-0.50587E+00	0.84733E-03	193-553
C ₄ H ₁₀ O	2-Butanol	293.2	17.26	0.13850E+03	-0.75146E+00	0.14086E-02	172-533
C ₄ H ₁₀ O	2-Methyl-1-propanol	293.2	17.93	0.10762E+03	-0.51398E+00	0.83702E-03	173-533
C ₄ H ₁₀ O	2-Methyl-2-propanol	298.2	12.47	0.22541E+03	-0.14990E+01	0.34050E-02	298-503
C ₄ H ₁₀ O	Diethyl ether	293.2	4.2666	0.79725E+01	-0.12519E-01		283-301
C ₄ H ₁₀ O ₂	1,2-Butanediol	298.2	22.4	0.63702E+02	-0.13807E+00		278-323
C ₄ H ₁₀ O ₂	1,3-Butanediol	298.2	28.8	0.72883E+02	-0.14770E+00		278-323
C ₄ H ₁₀ O ₂	1,4-Butanediol	298.2	31.9	0.13079E+03	-0.46985E+00	0.46320E-03	288-328
C ₄ H ₁₀ O ₂	Ethylene glycol monoethyl ether	298.2	13.38				
C ₄ H ₁₀ O ₂	Ethylene glycol dimethyl ether	296.7	7.30	0.48832E+02	-0.24218E+00	0.34413E-03	256-318
C ₄ H ₁₀ O ₂ S	Bis(2-hydroxyethyl) sulfide	293.2	28.61	0.13128E+03	-0.52719E+00	0.60465E-03	253-333
C ₄ H ₁₀ O ₃	Diethylene glycol	293.2	31.82	0.13973E+03	-0.54725E+00	0.61149E-03	288-343
C ₄ H ₁₀ O ₃ S	Diethyl sulfite	293.2	15.6				
C ₄ H ₁₀ O ₄	1,2,3,4-Butanetetrol	393.2	28.2				
C ₄ H ₁₀ O ₄ S	Diethyl sulfate	293.2	29.2				
C ₄ H ₁₀ S	1-Butanethiol	288.2	5.204	0.11201E+02	-0.20767E-01		273-318
C ₄ H ₁₀ S	2-Butanethiol	288.2	5.645	0.10866E+02	-0.17993E-01		273-318
C ₄ H ₁₀ S	2-Methyl-1-propanethiol	298.2	4.961				
C ₄ H ₁₀ S	2-Methyl-2-propanethiol	293.2	5.475	0.10597E+02	-0.17500E-01		283-313
C ₄ H ₁₀ S	Diethyl sulfide	298.2	5.723				
C ₄ H ₁₁ N	Butylamine	293.2	4.71	0.13322E+02	-0.44176E-01	0.50250E-04	223-333
C ₄ H ₁₁ N	Diethylamine	293.2	3.680	0.26462E+02	-0.13750E+00	0.20373E-03	243-323
C ₄ H ₁₁ NO ₂	Diethanolamine	293.2	25.75	0.73435E+02	-0.21377E+00	0.17500E-03	273-323

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₄ H ₁₂ O ₂ Si	Dimethoxydimethylsilane	298.2	3.663				
C ₄ H ₁₂ O ₃ Si	Trimethoxymethylsilane	298.2	4.9				
C ₄ H ₁₂ O ₄ Si	Tetramethyl silicate	293.2	6.0				
C ₄ H ₁₂ Si	Diethylsilane	293.2	2.544				
C ₄ H ₁₂ Si	Tetramethylsilane	293.2	1.921				
C ₄ H ₁₃ N ₃	Diethylenetriamine	293.2	12.62	0.57840E+02	-0.23873E+00	0.28841E-03	213-333
C ₅ FeO ₅	Iron pentacarbonyl	293.2	2.602				
C ₅ H ₄ BrN	2-Bromopyridine	298.2	23.18	0.73391E+02	-0.23678E+00	0.22930E-03	298-398
C ₅ H ₄ ClN	2-Chloropyridine	298.2	27.32	0.98702E+02	-0.34237E+00	0.34502E-03	298-398
C ₅ H ₄ F ₈ O	2,2,3,3,4,4,5,5-Octafluoro-1-pentanol	298.2	15.30				
C ₅ H ₄ O ₂	Furfural	293.2	42.1				
C ₅ H ₅ N	Pyridine	293.2	13.260	0.43991E+02	-0.15150E+00	0.15925E-03	293-323
C ₅ H ₅ NO	Pyridine-1-oxide	343.0	35.94	0.20878E+02	0.16450E+00	-0.35269E-03	343-398
C ₅ H ₆ O	2-Methylfuran	293.2	2.76				
C ₅ H ₆ O ₂	Furfuryl alcohol	298.2	16.85				
C ₅ H ₇ Cl ₃ O ₂	Propyl trichloroacetate	298.2	8.32				
C ₅ H ₇ NO ₂	Ethyl cyanoacetate	263.2	31.62				
C ₅ H ₈	1,3-Pentadiene*	298.2	2.319				
C ₅ H ₈	1,4-Pentadiene	294.0	2.054	0.29994E+01	-0.34578E-02	0.85300E-06	178-294
C ₅ H ₈	2-Methyl-1,3-butadiene	293.2	2.098	0.28170E+01	-0.23147E-02	-0.43975E-06	198-293
C ₅ H ₈	Cyclopentene	295.0	2.083	0.28177E+01	-0.27597E-02	0.89346E-06	171-319
C ₅ H ₈ O	Cyclopentanone	298.2	13.58	0.24083E+02	-0.30286E-01	-0.16802E-04	219-298
C ₅ H ₈ O ₂	Ethyl acrylate	303.2	6.05	0.47827E+02	-0.24394E+00	0.35000E-03	303-343
C ₅ H ₈ O ₂	Methyl <i>trans</i> -2-butenate	293.2	6.6645				
C ₅ H ₈ O ₂	Methyl methacrylate	303.2	6.32	0.32098E+02	-0.14568E+00	0.20000E-03	303-343
C ₅ H ₈ O ₂	2,4-Pentanedione	303.2	26.524				
C ₅ H ₈ O ₄	Dimethyl malonate	293.2	9.82	0.26470E+02	-0.76656E-01	0.67888E-04	293-433
C ₅ H ₉ BrO ₂	Ethyl 2-bromopropanoate	293.2	9.4				
C ₅ H ₉ ClO ₂	Isobutyl chlorocarbonate	293.2	9.1				
C ₅ H ₉ ClO ₂	Ethyl 2-chloropropanoate	303.2	11.95	0.25965E+02	-0.46250E-01		303-343
C ₅ H ₉ ClO ₂	Ethyl 3-chloropropanoate	303.2	10.19	0.21951E+02	-0.38750E-01		303-343
C ₅ H ₉ ClO ₂	Methyl 4-chlorobutanoate	303.2	9.51	0.17127E+02	-0.25000E-01		303-343
C ₅ H ₉ N	Pentanenitrile	293.2	20.04	0.55793E+02	-0.15750E+00	0.12432E-03	183-333
C ₅ H ₉ N	2,2-Dimethylpropanenitrile	293.2	21.1	0.58418E+02	-0.16884E+00	0.14131E-03	293-453
C ₅ H ₉ NO	Isobutyl isocyanate	293.2	11.638	0.38026E+02	-0.12714E+00	0.12679E-03	293-353
C ₅ H ₉ NO	<i>N</i> -Methyl-2-pyrrolidone	293.2	32.55				
C ₅ H ₁₀	1-Pentene	293.2	2.011	-0.11438E+01	0.25420E-01	-0.50000E-04	273-293
C ₅ H ₁₀	2-Methyl-1-butene	293.2	2.180				
C ₅ H ₁₀	2-Methyl-2-butene	296.0	1.979	0.26064E+01	-0.19578E-02	-0.53908E-06	225-296
C ₅ H ₁₀	Cyclopentane	293.2	1.9687	0.24287E+01	-0.15304E-02	-0.13095E-06	278-313
C ₅ H ₁₀	Ethylcyclopropane	293.2	1.933				
C ₅ H ₁₀ Br ₂	1,2-Dibromopentane	298.2	4.39				
C ₅ H ₁₀ Br ₂	1,4-Dibromopentane	293.2	9.05	0.26443E+02	-0.88640E-01	0.10000E-03	293-333
C ₅ H ₁₀ Br ₂	1,5-Dibromopentane	303.2	9.14	0.38192E+02	-0.15648E+00	0.20000E-03	303-333
C ₅ H ₁₀ Cl ₂	1,2-Dichloropentane	293.2	6.89	0.19016E+02	-0.57954E-01	0.56801E-04	293-356
C ₅ H ₁₀ Cl ₂	1,5-Dichloropentane	298.2	9.92				
C ₅ H ₁₀ O	Cyclopentanol	288.2	18.5	0.10565E+03	-0.44244E+00	0.48657E-03	258-323
C ₅ H ₁₀ O	Pentanal	293.2	10.00				
C ₅ H ₁₀ O	2,2-Dimethylpropanal	293.2	9.051	0.18645E+02	-0.32395E-01	-0.16157E-05	280-333
C ₅ H ₁₀ O	2-Pentanone	293.2	15.45	0.40893E+02	-0.10423E+00	0.60557E-04	204-353
C ₅ H ₁₀ O	3-Pentanone	293.2	17.00	0.12690E+02	0.95177E-01	-0.27321E-03	233-353
C ₅ H ₁₀ O	3-Methyl-2-butanone	293.2	10.37	0.30695E+02	-0.10962E+00	0.13810E-03	293-328
C ₅ H ₁₀ O	Tetrahydropyran	293.2	5.66	0.19793E+02	-0.76071E-01	0.94852E-04	234-333
C ₅ H ₁₀ O	2-Methyltetrahydrofuran	298.2	6.97				
C ₅ H ₁₀ O ₂	Pentanoic acid	294.4	2.661	0.33491E+01	-0.75156E-02	0.17820E-04	250-344
C ₅ H ₁₀ O ₂	Butyl formate	303.2	6.10	0.21532E+02	-0.84106E-01	0.10952E-03	288-323
C ₅ H ₁₀ O ₂	Isobutyl formate	293.2	6.41				
C ₅ H ₁₀ O ₂	Propyl acetate	293.2	5.62	0.17677E+02	-0.61404E-01	0.69196E-04	253-353
C ₅ H ₁₀ O ₂	Ethyl propanoate	293.2	5.76				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₅ H ₁₀ O ₂	Methyl butanoate	301.2	5.48	0.38604E+02	-0.19171E+00	0.27128E-03	301-343
C ₅ H ₁₀ O ₂	Tetrahydrofurfuryl alcohol	303.2	13.48				
C ₅ H ₁₀ O ₂ S	3-Methyl sulfolane	298.2	29.4	0.53158E+02	-0.93730E-01	0.47275E-04	298-398
C ₅ H ₁₀ O ₃	Diethyl carbonate	297.2	2.820				
C ₅ H ₁₀ O ₃	Ethyl lactate	303.2	15.4	0.31225E+02	-0.43531E-01	-0.28571E-04	273-373
C ₅ H ₁₀ O ₄	1,2,3-Propanetriol-1-acetate	242.2	38.57	0.10653E+03	-0.26439E+00	-0.62371E-04	215-242
C ₅ H ₁₁ Br	2-Bromo-2-methylbutane	298.2	9.21				
C ₅ H ₁₁ Br	1-Bromopentane	299.2	6.31	0.20954E+02	-0.78743E-01	0.98908E-04	183-328
C ₅ H ₁₁ Br	3-Bromopentane	298.2	8.37				
C ₅ H ₁₁ Br	1-Bromo-3-methylbutane	291.5	6.33	0.27743E+02	-0.13927E+00	0.22627E-03	123-292
C ₅ H ₁₁ Cl	1-Chloropentane	293.2	6.654	0.18626E+02	-0.54719E-01	0.47143E-04	273-323
C ₅ H ₁₁ Cl	1-Chloro-3-methylbutane	292.0	6.10	0.22228E+02	-0.93189E-01	0.12991E-03	171-297
C ₅ H ₁₁ Cl	2-Chloro-2-methylbutane	222.75	12.31	0.55104E+02	-0.29866E+00	0.47840E-03	201-223
C ₅ H ₁₁ F	1-Fluoropentane	293.2	3.931				
C ₅ H ₁₁ I	1-Iodopentane	293.2	5.78	0.15753E+02	-0.50543E-01	0.56401E-04	293-323
C ₅ H ₁₁ I	3-Iodopentane	293.2	7.432				
C ₅ H ₁₁ I	1-Iodo-3-methylbutane	292.2	5.6				
C ₅ H ₁₁ I	2-Iodo-2-methylbutane	293.2	8.192				
C ₅ H ₁₁ N	Piperidine	293.0	4.33	0.82317E+01	-0.11229E-01	-0.71429E-05	293-333
C ₅ H ₁₁ N	<i>N</i> -Methylpyrrolidine	298.2	32.2				
C ₅ H ₁₁ NO	2,2-Dimethylpropanamide	298.2	20.13	0.10400E+03	-0.46017E+00	0.60000E-03	298-328
C ₅ H ₁₁ NO	<i>N,N</i> -Diethylformamide	293.2	29.6				
C ₅ H ₁₁ NO	2-Pentanone oxime	293.2	3.3				
C ₅ H ₁₁ NO ₂	Pentyl nitrite	298.2	7.21				
C ₅ H ₁₂	Pentane	293.2	1.8371				
C ₅ H ₁₂	Isopentane	293.2	1.845	0.22384E+01	-0.12985E-02	-0.16182E-06	143-293
C ₅ H ₁₂	Neopentane	296.0	1.769	0.10949E+02	-0.63057E-01	0.10835E-03	251-296
C ₅ H ₁₂ N ₂ O	Tetramethylurea	293.2	23.10				
C ₅ H ₁₂ O	1-Pentanol	298.2	15.13	0.73397E+02	-0.28165E+00	0.28427E-03	213-513
C ₅ H ₁₂ O	2-Pentanol	298.2	13.71	0.16437E+03	-0.86506E+00	0.11955E-02	273-323
C ₅ H ₁₂ O	3-Pentanol	298.2	13.35	0.12838E+03	-0.60980E+00	0.75000E-03	288-318
C ₅ H ₁₂ O	2-Methyl-1-butanol	298.2	15.63	0.14020E+02	0.13948E+00	-0.45000E-03	288-318
C ₅ H ₁₂ O	3-Methyl-1-butanol	293.2	15.63	0.79733E+02	-0.31272E+00	0.32014E-03	173-513
C ₅ H ₁₂ O	2-Methyl-2-butanol	298.2	5.78	0.11662E+03	-0.69756E+00	0.10920E-02	268-318
C ₅ H ₁₂ O	3-Methyl-2-butanol	298.2	12.1				
C ₅ H ₁₂ O	2,2-Dimethyl-1-propanol	333.2	8.35	0.92350E+02	-0.41870E+00	0.50000E-03	333-373
C ₅ H ₁₂ O ₂	1,2-Pentanediol	296.8	17.31	0.18436E+03	-0.10682E+01	0.17037E-02	197-297
C ₅ H ₁₂ O ₂	1,4-Pentanediol	295.7	26.74	0.13568E+03	-0.59198E+00	0.75398E-03	193-318
C ₅ H ₁₂ O ₂	1,5-Pentanediol	293.2	26.2	0.11858E+03	-0.45920E+00	0.49341E-03	243-343
C ₅ H ₁₂ O ₂	2,3-Pentanediol	296.9	17.37	0.95876E+02	-0.46463E+00	0.67434E-03	238-297
C ₅ H ₁₂ O ₂	2,4-Pentanediol	294.2	24.69	0.11914E+03	-0.52569E+00	0.69607E-03	224-294
C ₅ H ₁₂ O ₂	Diethoxymethane	293.2	2.527	0.25294E+01	0.73988E-04	-0.28331E-06	227-293
C ₅ H ₁₂ O ₄	Tetramethoxymethane	293.2	2.40				
C ₅ H ₁₂ O ₅	Xylitol	293.2	40.0				
C ₅ H ₁₂ S	1-Pentanethiol	293.2	4.847	0.71131E+01	-0.30228E-02	-0.16414E-04	273-333
C ₅ H ₁₂ S	2-Methyl-2-butanethiol	293.2	5.087	0.15116E+02	-0.50700E-01	0.56250E-04	273-333
C ₅ H ₁₂ S ₄	Tetrakis(methylthio)methane	343.2	2.818				
C ₅ H ₁₃ N	Pentylamine	293.2	4.27	0.11274E+02	-0.34965E-01	0.37706E-04	223-353
C ₅ H ₁₃ N ₃	1,1,3,3-Tetramethylguanidine	298.2	11.5				
C ₅ H ₁₄ OSi	Ethoxytrimethylsilane	298.2	3.013				
C ₆ F ₆	Hexafluorobenzene	298.2	2.029	0.24041E+01	-0.83086E-03	-0.14286E-05	298-338
C ₆ F ₁₄	Perfluorohexane	298.2	1.76				
C ₆ H ₃ N ₃ O ₇	2,4,6-Trinitrophenol	294.2	4.0				
C ₆ H ₄ BrF	1-Bromo-2-fluorobenzene	298.2	4.72				
C ₆ H ₄ BrF	1-Bromo-3-fluorobenzene	298.2	4.85				
C ₆ H ₄ BrF	1-Bromo-4-fluorobenzene	298.2	2.60				
C ₆ H ₄ BrNO ₂	1-Bromo-3-nitrobenzene	328.2	20.2	0.81413E+02	-0.27645E+00	0.27367E-03	328-413
C ₆ H ₄ Br ₂	<i>o</i> -Dibromobenzene	293.2	7.86	-0.81849E-02	0.62671E-01	-0.12222E-03	293-353
C ₆ H ₄ Br ₂	<i>m</i> -Dibromobenzene	293.2	4.81	0.93214E+01	-0.20273E-01	0.16667E-04	293-353

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₆ H ₄ Br ₂	<i>p</i> -Dibromobenzene	368.2	2.57				
C ₆ H ₄ ClF	1-Chloro-2-fluorobenzene	298.2	6.10				
C ₆ H ₄ ClF	1-Chloro-3-fluorobenzene	298.2	4.96				
C ₆ H ₄ ClF	1-Chloro-4-fluorobenzene	298.2	3.34				
C ₆ H ₄ ClNO ₂	1-Chloro-2-nitrobenzene	323.2	37.7	0.16800E+03	-0.59708E+00	0.59957E-03	323-436
C ₆ H ₄ ClNO ₂	1-Chloro-3-nitrobenzene	323.2	20.9	0.77193E+02	-0.25118E+00	0.23798E-03	323-433
C ₆ H ₄ ClNO ₂	1-Chloro-4-nitrobenzene	393.2	8.09				
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	293.2	10.12	0.13629E+02	0.10622E-02	-0.44444E-04	293-353
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	293.2	5.02	0.77565E+01	-0.93333E-02	-0.26880E-14	293-353
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	328.2	2.3943	0.26999E+01	-0.35325E-03	-0.17619E-05	328-363
C ₆ H ₄ FI	1-Fluoro-2-iodobenzene	298.2	8.22				
C ₆ H ₄ FI	1-Fluoro-4-iodobenzene	298.2	3.12				
C ₆ H ₄ F ₂	<i>o</i> -Difluorobenzene	301.2	13.38	0.59107E+02	-0.23611E+00	0.27987E-03	273-323
C ₆ H ₄ F ₂	<i>m</i> -Difluorobenzene	301.2	5.01	0.14448E+02	-0.46982E-01	0.51948E-04	273-323
C ₆ H ₄ I ₂	<i>o</i> -Diiodobenzene	323.2	5.41	0.31150E+02	-0.14428E+00	0.20000E-03	323-353
C ₆ H ₄ I ₂	<i>m</i> -Diiodobenzene	323.2	4.11				
C ₆ H ₄ I ₂	<i>p</i> -Diiodobenzene	393.2	2.88				
C ₆ H ₄ N ₂	2-Pyridinecarbonitrile	303.2	93.77	0.45596E+03	-0.17746E+01	0.19105E-02	303-398
C ₆ H ₄ N ₂	3-Pyridinecarbonitrile	323.2	20.54	0.60484E+02	-0.17280E+00	0.15218E-03	323-398
C ₆ H ₄ N ₂	4-Pyridinecarbonitrile	353.2	5.23	0.12533E+02	-0.30115E-01	0.26674E-04	353-398
C ₆ H ₄ N ₂ O ₄	1,3-Dinitrobenzene	365.2	22.9	0.10406E+03	-0.34133E+00	0.32609E-03	365-413
C ₆ H ₅ Br	Bromobenzene	293.2	5.45	0.94100E+01	-0.12537E-01	-0.31127E-05	234-333
C ₆ H ₅ Cl	Chlorobenzene	293.2	5.6895	0.19471E+02	-0.70786E-01	0.82466E-04	293-430
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol	296.2	7.40	0.29755E+02	-0.11256E+00	0.12390E-03	296-448
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol	293.2	6.255				
C ₆ H ₅ ClO	<i>p</i> -Chlorophenol	314.2	11.18	0.31997E+02	-0.94241E-01	0.88392E-04	314-453
C ₆ H ₅ ClO ₂ S	Benzenesulfonyl chloride	323.2	28.90	0.83886E+02	-0.23405E+00	0.19713E-03	323-473
C ₆ H ₅ ClS	4-Chlorobenzenethiol	338.2	3.59				
C ₆ H ₅ F	Fluorobenzene	293.2	5.465				
C ₆ H ₅ I	Iodobenzene	293.2	4.59	0.89442E+01	-0.20008E-01	0.17641E-04	243-323
C ₆ H ₅ NOS	<i>N</i> -Sulfinylaniline	298.2	6.97				
C ₆ H ₅ NO ₂	Nitrobenzene	293.0	35.6	0.11212E+03	-0.35211E+00	0.31128E-03	279-533
C ₆ H ₅ NO ₃	<i>o</i> -Nitrophenol	323.2	16.50	0.33827E+02	-0.62123E-01	0.26774E-04	323-453
C ₆ H ₅ NO ₃	<i>m</i> -Nitrophenol	373.2	35.45	0.18967E+03	-0.66144E+00	0.66532E-03	373-458
C ₆ H ₅ NO ₃	<i>p</i> -Nitrophenol	393.2	42.20	0.22901E+03	-0.74264E+00	0.68006E-03	393-463
C ₆ H ₆	Benzene	293.2	2.2825	0.26706E+01	-0.91648E-03	-0.14257E-05	293-513
C ₆ H ₆ BrN	<i>m</i> -Bromoaniline	293.2	13.0				
C ₆ H ₆ ClN	<i>o</i> -Chloroaniline	293.2	13.40				
C ₆ H ₆ ClN	<i>m</i> -Chloroaniline	293.2	13.3				
C ₆ H ₆ N ₂ O ₂	<i>o</i> -Nitroaniline	353.0	47.3	0.18900E+03	-0.56977E+00	0.47484E-03	353-468
C ₆ H ₆ N ₂ O ₂	<i>m</i> -Nitroaniline	398.0	35.6	0.20352E+03	-0.66582E+00	0.61310E-03	398-468
C ₆ H ₆ N ₂ O ₂	<i>p</i> -Nitroaniline	428.0	78.5	0.48673E+03	-0.15040E+01	0.12857E-02	428-468
C ₆ H ₆ O	Phenol	303.2	12.40	0.63391E+02	-0.24988E+00	0.26930E-03	303-433
C ₆ H ₆ O ₂	Pyrocatechol	388.2	17.57	0.74930E+02	-0.22142E+00	0.18919E-03	388-463
C ₆ H ₆ O ₂	Resorcinol	393.2	13.55	0.30252E+02	-0.56443E-01	0.35578E-04	393-463
C ₆ H ₆ S	Benzenethiol	303.2	4.26	0.57155E+01	-0.70336E-02	0.73617E-05	303-358
C ₆ H ₇ N	Aniline	293.2	7.06	0.89534E+01	0.38990E-02	-0.36310E-04	293-413
C ₆ H ₇ N	2-Methylpyridine	293.2	10.18	0.34560E+02	-0.11980E+00	0.12500E-03	293-333
C ₆ H ₇ N	3-Methylpyridine	303.0	11.10	0.19643E+03	-0.11167E+01	0.16667E-02	303-333
C ₆ H ₇ N	4-Methylpyridine	293.0	12.2	0.33765E+02	-0.10113E+00	0.93860E-04	274-333
C ₆ H ₇ NO	2-Methylpyridine-1-oxide	323.2	36.4	0.11705E+03	-0.35301E+00	0.32000E-03	323-398
C ₆ H ₇ NO	3-Methylpyridine-1-oxide	318.2	28.26	0.59851E+02	-0.12682E+00	0.86622E-04	318-398
C ₆ H ₈	1,3-Cyclohexadiene	184.2	2.68				
C ₆ H ₈	1,4-Cyclohexadiene	296.0	2.211	0.27459E+01	-0.16975E-02	-0.36461E-06	232-356
C ₆ H ₈ N ₂	Phenylhydrazine	293.2	7.15				
C ₆ H ₈ N ₂	2,5-Dimethylpyrazine	293.2	2.436				
C ₆ H ₈ N ₂	2,6-Dimethylpyrazine	308.2	2.653				
C ₆ H ₈ O ₂	1,4-Cyclohexanedione	351.2	4.40				
C ₆ H ₉ Cl ₃ O ₂	Butyl trichloroacetate	293.2	7.480				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₆ H ₉ Cl ₃ O ₂	Isobutyl trichloroacetate	293.2	7.667				
C ₆ H ₉ N	Cyclopentanecarbonitrile	293.2	22.68	0.69830E+02	-0.25303E+00	0.31491E-03	201-293
C ₆ H ₁₀	1,5-Hexadiene	294.0	2.125	0.30014E+01	-0.28668E-02	-0.31026E-06	151-294
C ₆ H ₁₀	<i>cis,cis</i> -2,4-Hexadiene	297.0	2.163	0.27284E+01	-0.17178E-02	-0.62926E-06	234-351
C ₆ H ₁₀	<i>trans,trans</i> -2,4-Hexadiene	297.0	2.123	0.26774E+01	-0.16977E-02	-0.55637E-06	232-353
C ₆ H ₁₀	2-Methyl-1,3-pentadiene*	298.2	2.422				
C ₆ H ₁₀	3-Methyl-1,3-pentadiene	298.2	2.426				
C ₆ H ₁₀	4-Methyl-1,3-pentadiene	293.2	2.599	0.51328E+01	-0.12774E-01	0.14215E-04	198-323
C ₆ H ₁₀	2,3-Dimethyl-1,3-butadiene	293.2	2.102	0.26258E+01	-0.17990E-02	0.12035E-06	223-323
C ₆ H ₁₀	1-Hexyne	296.0	2.621	0.58591E+01	-0.17099E-01	0.20856E-04	184-296
C ₆ H ₁₀	Cyclohexene	293.2	2.2176	0.30598E+01	-0.39841E-02	0.37554E-05	141-313
C ₆ H ₁₀ O	Butoxyacetylene	298.2	6.62				
C ₆ H ₁₀ O	Cyclohexanone	293.0	16.1	0.41577E+02	-0.11463E+00	0.92454E-04	253-423
C ₆ H ₁₀ O	Mesityl oxide	273.2	15.6				
C ₆ H ₁₀ O ₂	Ethyl 2-butenolate	293.2	5.4				
C ₆ H ₁₀ O ₂	Ethyl methacrylate	303.2	5.68	0.40962E+02	-0.20520E+00	0.29286E-03	303-343
C ₆ H ₁₀ O ₃	Ethyl acetoacetate	293.2	14.0				
C ₆ H ₁₀ O ₃	Propanoic anhydride	293.2	18.30				
C ₆ H ₁₀ O ₄	Monomethyl glutarate	293.2	8.37	0.16779E+02	-0.39839E-01	0.38095E-04	293-363
C ₆ H ₁₀ O ₄	Diethyl oxalate	293.2	8.266	0.21938E+02	-0.66226E-01	0.66800E-04	293-368
C ₆ H ₁₀ O ₄	Dimethyl succinate	293.2	7.19	0.13551E+02	-0.23109E-01	0.55440E-05	293-433
C ₆ H ₁₀ O ₄	Ethylene glycol diacetate	290.2	7.7	0.25093E+02	-0.95171E-01	0.12224E-03	223-290
C ₆ H ₁₁ Br	Bromocyclohexane	303.2	8.0026				
C ₆ H ₁₁ BrO ₂	Ethyl 2-bromobutanoate	303.2	8.57	0.49005E+02	-0.23193E+00	0.32500E-03	303-333
C ₆ H ₁₁ BrO ₂	Ethyl 2-bromo-2-methylpropanoate	303.2	8.55	0.77044E+02	-0.40784E+00	0.60000E-03	303-333
C ₆ H ₁₁ Cl	Chlorocyclohexane	303.2	7.9505				
C ₆ H ₁₁ N	Hexanenitrile	298.2	17.26				
C ₆ H ₁₁ N	4-Methylpentanenitrile	295.2	17.5				
C ₆ H ₁₁ NO	Cyclohexanone oxime	362.2	3.04				
C ₆ H ₁₂	1-Hexene	294.0	2.077	0.31476E+01	-0.50003E-02	0.46673E-05	149-294
C ₆ H ₁₂	<i>trans</i> -2-Hexene	295.0	1.978	0.24338E+01	-0.11323E-02	-0.13720E-05	157-295
C ₆ H ₁₂	<i>cis</i> -3-Hexene	296.0	2.069	0.30691E+01	-0.45458E-02	0.39898E-05	155-296
C ₆ H ₁₂	<i>trans</i> -3-Hexene	293.2	1.954				
C ₆ H ₁₂	Cyclohexane	293.2	2.0243	0.24293E+01	-0.12095E-02	-0.58741E-06	283-333
C ₆ H ₁₂	Methylcyclopentane	293.2	1.9853	0.21587E+01	-0.22450E-03	-0.12500E-05	293-323
C ₆ H ₁₂	Ethylcyclobutane	293.2	1.965				
C ₆ H ₁₂ Br ₂	1,6-Dibromohexane	298.2	8.52	-0.55185E+01	0.11746E+00	-0.23658E-03	274-328
C ₆ H ₁₂ Br ₂	3,4-Dibromohexane	298.2	6.732				
C ₆ H ₁₂ Cl ₂	1,6-Dichlorohexane	308.2	8.60	0.11277E+02	0.67200E-02	-0.50000E-04	308-338
C ₆ H ₁₂ O	1-Methylcyclopentanol	310.1	7.11	0.75444E+02	-0.36617E+00	0.47021E-03	310-333
C ₆ H ₁₂ O	Isobutyl vinyl ether	293.2	3.34	0.48060E+01	-0.50000E-02	-0.41495E-14	293-323
C ₆ H ₁₂ O	2-Hexanone	293.2	14.56	0.70378E+02	-0.29385E+00	0.35289E-03	243-293
C ₆ H ₁₂ O	4-Methyl-2-pentanone	293.2	13.11	0.36341E+02	-0.97119E-01	0.61896E-04	204-373
C ₆ H ₁₂ O	3,3-Dimethyl-2-butanone	293.2	12.73	0.66857E+02	-0.28552E+00	0.34422E-03	243-293
C ₆ H ₁₂ O	Cyclohexanol	293.2	16.40	0.10173E+03	-0.43072E+00	0.47926E-03	293-423
C ₆ H ₁₂ O ₂	Hexanoic acid	298.2	2.600	0.21730E+01	0.14840E-02	-0.16526E-06	298-433
C ₆ H ₁₂ O ₂	2-Ethylbutanoic acid	296.2	2.72				
C ₆ H ₁₂ O ₂	<i>tert</i> -Butylacetic acid	296.2	2.85				
C ₆ H ₁₂ O ₂	Pentyl formate	292.2	5.7				
C ₆ H ₁₂ O ₂	Isopentyl formate	288.2	5.44	0.29257E+02	-0.14028E+00	0.20000E-03	288-323
C ₆ H ₁₂ O ₂	Butyl acetate	293.2	5.07	0.13825E+02	-0.43994E-01	0.48214E-04	253-353
C ₆ H ₁₂ O ₂	<i>sec</i> -Butyl acetate	293.2	5.135	0.12427E+02	-0.32035E-01	0.24286E-04	273-323
C ₆ H ₁₂ O ₂	<i>tert</i> -Butyl acetate	293.2	5.672	0.55435E+02	-0.30494E+00	0.46107E-03	273-323
C ₆ H ₁₂ O ₂	Isobutyl acetate	293.2	5.068	0.14323E+02	-0.46048E-01	0.49286E-04	273-323
C ₆ H ₁₂ O ₂	Propyl propanoate	293.2	5.249				
C ₆ H ₁₂ O ₂	Ethyl butanoate	301.2	5.18	0.48698E+02	-0.25660E+00	0.37237E-03	301-343
C ₆ H ₁₂ O ₂	Methyl pentanoate	293.2	4.992				
C ₆ H ₁₂ O ₂	Diacetone alcohol	298.2	18.2				
C ₆ H ₁₂ O ₃	Ethylene glycol monoethyl ether acetate	303.2	7.567	0.23290E+02	-0.71566E-01	0.65000E-04	303-323

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₆ H ₁₂ S	Cyclohexanethiol	298.2	5.420				
C ₆ H ₁₃ Br	1-Bromohexane	298.2	5.82	0.15233E+02	-0.44385E-01	0.43039E-04	274-328
C ₆ H ₁₃ Cl	1-Chlorohexane	293.2	6.104	0.15994E+02	-0.43647E-01	0.33393E-04	273-323
C ₆ H ₁₃ ClO	6-Chloro-1-hexanol	242.2	21.6	-0.73364E+01	0.46377E+00	-0.14202E-02	195-242
C ₆ H ₁₃ I	1-Iodohexane	293.3	5.35	0.16685E+02	-0.61309E-01	0.77262E-04	293-323
C ₆ H ₁₃ N	Cyclohexylamine	293.2	4.547				
C ₆ H ₁₃ NO	<i>N</i> -Propylpropanamide	298.2	118.1	0.58846E+03	-0.22012E+01	0.20870E-02	298-328
C ₆ H ₁₃ NO	<i>N</i> -Butylacetamide	293.2	104.0	0.70739E+03	-0.37369E+01	0.71585E-02	253-493
C ₆ H ₁₃ NO	<i>N,N</i> -Diethylacetamide	293.2	32.1				
C ₆ H ₁₄	Hexane	293.2	1.8865	0.19768E+01	0.70933E-03	-0.34470E-05	293-473
C ₆ H ₁₄	2-Methylpentane	293.2	1.886	0.20745E+01	0.50871E-03	-0.39286E-05	273-323
C ₆ H ₁₄	3-Methylpentane	293.2	1.886	0.24739E+01	-0.23190E-02	0.10714E-05	273-323
C ₆ H ₁₄	2,2-Dimethylbutane	293.2	1.869	0.22740E+01	-0.96229E-03	-0.14286E-05	273-313
C ₆ H ₁₄	2,3-Dimethylbutane	293.2	1.889	0.24305E+01	-0.20081E-02	0.53571E-06	273-323
C ₆ H ₁₄ O	1-Hexanol	293.2	13.03	0.62744E+02	-0.24214E+00	0.24704E-03	233-513
C ₆ H ₁₄ O	2-Hexanol	298.2	11.06				
C ₆ H ₁₄ O	3-Hexanol	298.2	9.66				
C ₆ H ₁₄ O	3-Methyl-1-pentanol	298.2	15.2				
C ₆ H ₁₄ O	3-Methyl-3-pentanol	293.2	4.322				
C ₆ H ₁₄ O	2-Ethyl-1-butanol	362.2	6.19				
C ₆ H ₁₄ O	2,2-Dimethyl-1-butanol	293.2	10.5	0.14054E+03	-0.72925E+00	0.97821E-03	243-393
C ₆ H ₁₄ O	Dipropyl ether	297.0	3.38	0.14600E+02	-0.72670E-01	0.11742E-03	161-297
C ₆ H ₁₄ O	Diisopropyl ether	303.2	3.805				
C ₆ H ₁₄ OS	Dipropyl sulfoxide	303.2	30.37	0.84868E+02	-0.23486E+00	0.18198E-03	303-373
C ₆ H ₁₄ O ₂	2-Methyl-2,4-pentanediol	293.2	25.86	0.14531E+03	-0.65285E+00	0.83503E-03	203-333
C ₆ H ₁₄ O ₂	Ethylene glycol diethyl ether	293.2	3.90	0.99099E+01	-0.33403E-01	0.44048E-04	223-303
C ₆ H ₁₄ O ₂ S	Dipropyl sulfone	303.2	32.62	0.70195E+02	-0.15008E+00	0.86506E-04	303-398
C ₆ H ₁₄ O ₃	1,2,6-Hexanetriol	285.3	31.5	0.26127E+03	-0.14552E+01	0.22765E-02	261-285
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether	298.2	7.23	0.28291E+02	-0.11236E+00	0.14000E-03	298-333
C ₆ H ₁₄ O ₄	Triethylene glycol	293.2	23.69	0.91845E+02	-0.33827E+00	0.36062E-03	253-333
C ₆ H ₁₄ O ₆	<i>D</i> -Glucitol	353.2	35.5				
C ₆ H ₁₄ O ₆	<i>D</i> -Mannitol	443.2	24.6				
C ₆ H ₁₄ S	1-Hexanethiol	293.2	4.436	0.11774E+02	-0.37298E-01	0.41875E-04	273-333
C ₆ H ₁₅ B	Triethylborane	293.2	1.974				
C ₆ H ₁₅ N	Hexylamine	293.2	4.08	0.80244E+01	-0.16627E-01	0.10874E-04	253-373
C ₆ H ₁₅ N	Dipropylamine	293.2	2.923	0.11376E+02	-0.49796E-01	0.71792E-04	243-323
C ₆ H ₁₅ N	Triethylamine	293.2	2.418	0.29205E+01	-0.14007E-02	-0.13469E-05	233-323
C ₆ H ₁₅ OP	Triethylphosphine oxide	323.2	35.5				
C ₆ H ₁₅ O ₄ P	Triethyl phosphate	298.2	13.20	0.61230E+02	-0.26047E+00	0.33333E-03	298-333
C ₆ H ₁₅ PS	Triethylphosphine sulfide	371.2	39.0				
C ₆ H ₁₆ O ₂ Si	Diethoxydimethylsilane	298.2	3.216				
C ₆ H ₁₆ Si	Triethylsilane	293.2	2.323				
C ₆ H ₁₈ N ₃ OP	Hexamethylphosphoric triamide	293.2	31.3	0.95666E+02	-0.29769E+00	0.26407E-03	283-363
C ₆ H ₁₈ N ₄	<i>N,N'</i> -Bis(2-aminoethyl)-1,2-ethanediamine	293.2	10.76	0.50699E+02	-0.21730E+00	0.27582E-03	213-333
C ₆ H ₁₈ OSi ₂	Hexamethyldisiloxane	293.2	2.179	0.34537E+01	-0.61530E-02	0.61544E-05	213-313
C ₆ H ₁₈ O ₃ Si ₃	Hexamethylcyclotrisiloxane	343.2	2.139				
C ₆ H ₁₉ NSi ₂	Hexamethyldisilazane	294.2	2.273	0.23358E+01	0.16127E-02	-0.62078E-05	294-333
C ₇ F ₁₄	Perfluoromethylcyclohexane	298.2	1.82				
C ₇ F ₁₆	Perfluoroheptane	289.2	1.847				
C ₇ H ₃ Cl ₅	2,3,4,5,6-Pentachlorotoluene	293.2	4.8				
C ₇ H ₄ ClNO	4-Chlorophenyl isocyanate	288.2	3.177	0.40896E+01	-0.31667E-02		288-348
C ₇ H ₅ BrO	Benzoyl bromide	293.2	21.33	0.84231E+02	-0.31089E+00	0.32857E-03	283-313
C ₇ H ₅ ClO	Benzoyl chloride	293.2	23.0				
C ₇ H ₅ FO	Benzoyl fluoride	293.2	22.7				
C ₇ H ₅ F ₃	(Trifluoromethyl)benzene	298.2	9.22				
C ₇ H ₅ N	Benzonitrile	293.2	25.9	0.57605E+02	-0.13354E+00	0.87767E-04	273-453
C ₇ H ₅ NO	Phenyl isocyanate	293.2	8.940	0.17541E+02	-0.29790E-01	0.15476E-05	293-353
C ₇ H ₆ ClNO ₂	4-Chloro-3-nitrotoluene	301.2	28.07				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₇ H ₆ Cl ₂	2,4-Dichlorotoluene	301.2	5.68				
C ₇ H ₆ Cl ₂	2,6-Dichlorotoluene	301.2	3.36				
C ₇ H ₆ Cl ₂	3,4-Dichlorotoluene	301.2	9.39				
C ₇ H ₆ Cl ₂	(Dichloromethyl)benzene	293.2	6.9				
C ₇ H ₆ O	Benzaldehyde	293.2	17.85	0.35046E+02	-0.61271E-01	0.16222E-04	301-346
C ₇ H ₆ O ₂	Salicylaldehyde	293.2	18.35	0.51315E+02	-0.15379E+00	0.14111E-03	289-453
C ₇ H ₇ Br	<i>o</i> -Bromotoluene	293.2	4.641	0.10229E+02	-0.25050E-01	0.20357E-04	273-323
C ₇ H ₇ Br	<i>m</i> -Bromotoluene	293.2	5.566	0.11522E+02	-0.24946E-01	0.15714E-04	273-323
C ₇ H ₇ Br	<i>p</i> -Bromotoluene	293.2	5.503	0.10014E+02	-0.13918E-01	-0.50000E-05	273-293
C ₇ H ₇ Br	(Bromomethyl)benzene	293.2	6.658	0.18482E+02	-0.57207E-01	0.57321E-04	273-323
C ₇ H ₇ BrO	<i>o</i> -Bromoanisole	303.2	8.96	0.12023E+02	-0.59116E-02	-0.13787E-04	303-358
C ₇ H ₇ BrO	<i>p</i> -Bromoanisole	303.2	7.40	0.74367E+01	0.12648E-01	-0.42128E-04	303-358
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene	293.2	4.721	0.11507E+02	-0.31148E-01	0.27143E-04	273-323
C ₇ H ₇ Cl	<i>m</i> -Chlorotoluene	293.2	5.763	0.13921E+02	-0.37186E-01	0.31786E-04	273-323
C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene	293.2	6.25	0.20265E+01	0.40060E-01	-0.87500E-04	293-333
C ₇ H ₇ Cl	(Chloromethyl)benzene	293.2	6.854	0.17108E+02	-0.45285E-01	0.35000E-04	273-323
C ₇ H ₇ ClO	<i>p</i> -Chloroanisole	293.2	7.84	0.64019E+01	0.30560E-01	-0.87500E-04	293-333
C ₇ H ₇ ClO ₂ S	<i>p</i> -Toluenesulfonyl chloride	343.2	22.6				
C ₇ H ₇ ClO ₃ S	4-Methoxybenzenesulfonyl chloride	314.2	27.2				
C ₇ H ₇ F	<i>o</i> -Fluorotoluene	298.2	4.23				
C ₇ H ₇ F	<i>m</i> -Fluorotoluene	298.2	5.41				
C ₇ H ₇ F	<i>p</i> -Fluorotoluene	298.2	5.88				
C ₇ H ₇ I	<i>p</i> -Iodotoluene	308.2	4.4				
C ₇ H ₇ N	2-Vinylpyridine	293.2	9.126				
C ₇ H ₇ N	4-Vinylpyridine	293.2	10.50				
C ₇ H ₇ NO ₂	Benzyl nitrite	298.2	7.78				
C ₇ H ₇ NO ₂	<i>o</i> -Nitrotoluene	293.0	26.26	0.10420E+03	-0.41726E+00	0.51607E-03	273-323
C ₇ H ₇ NO ₂	<i>m</i> -Nitrotoluene	303.2	24.95	0.62492E+02	-0.16235E+00	0.12844E-03	303-403
C ₇ H ₇ NO ₂	<i>p</i> -Nitrotoluene	331.2	22.2				
C ₇ H ₇ NO ₂ S	4-Nitrothioanisole	346.0	21.7				
C ₇ H ₇ NO ₃	2-Nitroanisole	293.2	45.75	0.16684E+03	-0.58196E+00	0.57382E-03	293-423
C ₇ H ₇ NO ₃	3-Nitroanisole	318.2	25.7	0.65402E+02	-0.16460E+00	0.12560E-03	318-443
C ₇ H ₇ NO ₃	4-Nitroanisole	338.2	26.95	0.59811E+02	-0.10955E+00	0.36042E-04	338-443
C ₇ H ₈	Toluene	296.35	2.379	0.32584E+01	-0.34410E-02	0.15937E-05	207-316
C ₇ H ₈ O	<i>o</i> -Cresol	298.2	6.76	0.21633E+02	-0.71069E-01	0.70590E-04	298-453
C ₇ H ₈ O	<i>m</i> -Cresol	298.2	12.44	0.81716E+02	-0.35039E+00	0.39878E-03	274-463
C ₇ H ₈ O	<i>p</i> -Cresol	298.2	13.05	0.70253E+02	-0.28870E+00	0.31979E-03	298-453
C ₇ H ₈ O	Benzyl alcohol	303.2	11.916	0.13661E+03	-0.72127E+00	0.10225E-02	303-333
C ₇ H ₈ O	Anisole	294.2	4.30	0.10887E+02	-0.32372E-01	0.33629E-04	294-413
C ₇ H ₈ O ₂	2-Methoxyphenol	298.2	11.95	0.31751E+02	-0.88173E-01	0.72953E-04	291-448
C ₇ H ₈ O ₂	3-Methoxyphenol	298.2	11.59	0.37279E+02	-0.12113E+00	0.11698E-03	298-433
C ₇ H ₈ O ₂	4-Methoxyphenol	333.7	11.05	0.39483E+02	-0.12142E+00	0.10841E-03	334-453
C ₇ H ₈ O ₂ S	Ethyl thiophene-2-carboxylate	293.2	6.18				
C ₇ H ₈ O ₂ S	Methyl phenyl sulfone	373.2	37.9				
C ₇ H ₈ S	Benzenemethanethiol	298.2	4.705	0.16628E+02	-0.68276E-01	0.94636E-04	298-358
C ₇ H ₈ S	4-Methylbenzenethiol	323.2	4.74	0.87052E+01	-0.15347E-01	0.95238E-05	323-358
C ₇ H ₈ S	(Methylthio)benzene	303.2	4.88	0.21841E+02	-0.97630E-01	0.13750E-03	303-343
C ₇ H ₉ N	Benzylamine	293.2	5.18				
C ₇ H ₉ N	<i>o</i> -Methylaniline	298.2	6.138	0.10988E+02	-0.18976E-01	0.91958E-05	298-398
C ₇ H ₉ N	<i>m</i> -Methylaniline	298.2	5.816	0.13477E+02	-0.35551E-01	0.33135E-04	298-398
C ₇ H ₉ N	<i>p</i> -Methylaniline	333.2	5.058	0.78897E+01	-0.10196E-01	0.51190E-05	333-403
C ₇ H ₉ N	<i>N</i> -Methylaniline	293.2	5.96				
C ₇ H ₉ N	2-Ethylpyridine	293.2	8.33	0.36397E+02	-0.15070E+00	0.18750E-03	293-333
C ₇ H ₉ N	4-Ethylpyridine	293.2	10.98	-0.73831E+01	0.14326E+00	-0.27500E-03	293-333
C ₇ H ₉ N	2,4-Dimethylpyridine	293.2	9.60	0.25895E+02	-0.73900E-01	0.62500E-04	293-333
C ₇ H ₉ N	2,6-Dimethylpyridine	293.2	7.33	0.17714E+02	-0.39080E-01	0.12500E-04	293-333
C ₇ H ₉ NO	2,6-Dimethylpyridine-1-oxide	298.2	46.11	0.22765E+03	-0.90760E+00	0.10011E-02	298-398
C ₇ H ₉ NO	<i>o</i> -Methoxyaniline	303.2	5.230	0.79911E+01	-0.92183E-02	0.37879E-06	303-393
C ₇ H ₉ NO	<i>m</i> -Methoxyaniline	298.2	8.76	0.28179E+02	-0.97840E-01	0.11027E-03	289-393

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	a	b	c	Range/K
C ₇ H ₉ NO	<i>p</i> -Methoxyaniline	333.2	7.85	0.30149E+02	-0.10523E+00	0.11467E-03	333-453
C ₇ H ₁₀ N ₂	1-Methyl-1-phenylhydrazine	292.2	7.3				
C ₇ H ₁₁ Cl ₃ O ₂	Isopentyl trichloroacetate	293.2	7.287				
C ₇ H ₁₂	1,6-Heptadiene	293.0	2.161	0.30815E+01	-0.36095E-02	0.16354E-05	184-293
C ₇ H ₁₂	Cycloheptene	295.0	2.265	0.32309E+01	-0.42373E-02	0.32572E-05	227-363
C ₇ H ₁₂ O	Cycloheptanone	298.2	13.16	0.17511E+03	-0.11221E+01	0.19417E-02	258-298
C ₇ H ₁₂ O	2-Methylcyclohexanone	293.2	14.0				
C ₇ H ₁₂ O	3-Methylcyclohexanone	293.2	12.4				
C ₇ H ₁₂ O	4-Methylcyclohexanone	293.2	12.35				
C ₇ H ₁₂ O ₂	Cyclohexanecarboxylic acid	304.2	2.67				
C ₇ H ₁₂ O ₂	Cyclohexyl formate	293.2	6.47				
C ₇ H ₁₂ O ₂	Butyl acrylate	301.2	5.25	0.38296E+02	-0.19109E+00	0.27006E-03	301-343
C ₇ H ₁₂ O ₄	Monomethyl adipate	293.2	6.69	0.11962E+02	-0.23973E-01	0.20608E-04	293-433
C ₇ H ₁₂ O ₄	Diethyl malonate	304.2	7.550	0.14809E+02	-0.31207E-01	0.24066E-04	304-393
C ₇ H ₁₂ O ₄	Dimethyl glutarate	293.2	7.87	0.20697E+02	-0.57794E-01	0.48405E-04	293-433
C ₇ H ₁₂ O ₅	1,2,3-Propanetriol-1,3-diacetate	288.2	9.80	0.28321E+02	-0.89073E-01	0.86891E-04	258-374
C ₇ H ₁₄	1-Heptene	293.2	2.092	0.21755E+01	0.13896E-02	-0.57049E-05	273-323
C ₇ H ₁₄	2-Methyl-2-hexene	293.2	2.962				
C ₇ H ₁₄	3-Ethyl-2-pentene	293.2	2.051				
C ₇ H ₁₄	Cycloheptane	293.2	2.0784	0.25136E+01	-0.15089E-02	0.84915E-07	278-333
C ₇ H ₁₄	Methylcyclohexane	293.2	2.024				
C ₇ H ₁₄ Br ₂	1,2-Dibromoheptane	298.2	3.77				
C ₇ H ₁₄ Br ₂	2,3-Dibromoheptane	298.2	5.08				
C ₇ H ₁₄ Br ₂	3,4-Dibromoheptane	298.2	4.70				
C ₇ H ₁₄ Cl ₂	1,7-Dichloroheptane	298.2	8.34				
C ₇ H ₁₄ O	1-Heptanal	295.2	9.07				
C ₇ H ₁₄ O	2-Heptanone	293.2	11.95	0.38348E+02	-0.12531E+00	0.12005E-03	253-413
C ₇ H ₁₄ O	3-Heptanone	293.2	12.7				
C ₇ H ₁₄ O	4-Heptanone	293.2	12.60	0.41520E+02	-0.13839E+00	0.13497E-03	253-393
C ₇ H ₁₄ O	5-Methyl-2-hexanone	293.2	13.53	0.52353E+02	-0.17695E+00	0.15195E-03	293-333
C ₇ H ₁₄ O	Cyclohexanemethanol	333.2	9.70	0.10164E+03	-0.45839E+00	0.54762E-03	333-368
C ₇ H ₁₄ O	2-Methylcyclohexanol*	293.2	9.375	0.17315E+03	-0.98794E+00	0.14634E-02	273-323
C ₇ H ₁₄ O	3-Methylcyclohexanol*	293.2	13.79	0.65896E+02	-0.21954E+00	0.14107E-03	273-323
C ₇ H ₁₄ O	4-Methylcyclohexanol*	293.2	13.45	0.65021E+02	-0.22896E+00	0.17946E-03	273-323
C ₇ H ₁₄ O ₂	Heptanoic acid	288.2	3.04	0.36423E+01	-0.31996E-02	0.39362E-05	288-423
C ₇ H ₁₄ O ₂	Pentyl acetate	293.2	4.79	0.12091E+02	-0.36536E-01	0.39732E-04	253-353
C ₇ H ₁₄ O ₂	Isopentyl acetate	293.2	4.72				
C ₇ H ₁₄ O ₂	Butyl propanoate	293.2	4.838				
C ₇ H ₁₄ O ₂	Propyl butanoate	293.2	4.3				
C ₇ H ₁₄ O ₂	Ethyl pentanoate	291.2	4.71				
C ₇ H ₁₄ O ₂	Ethyl 3-methylbutanoate	293.2	4.71				
C ₇ H ₁₄ O ₂	Methyl hexanoate	293.2	4.615				
C ₇ H ₁₅ Br	1-Bromoheptane	303.2	5.255	0.15289E+02	-0.50621E-01	0.57753E-04	203-343
C ₇ H ₁₅ Br	2-Bromoheptane	295.2	6.46				
C ₇ H ₁₅ Br	4-Bromoheptane	295.2	6.81				
C ₇ H ₁₅ Cl	1-Chloroheptane	293.2	5.521	0.14279E+02	-0.39431E-01	0.32321E-04	273-323
C ₇ H ₁₅ Cl	2-Chloroheptane	295.2	6.52				
C ₇ H ₁₅ Cl	3-Chloroheptane	295.2	6.70				
C ₇ H ₁₅ Cl	4-Chloroheptane	295.2	6.54				
C ₇ H ₁₅ I	1-Iodoheptane	298.2	4.92	0.11856E+02	-0.33493E-01	0.34368E-04	294-323
C ₇ H ₁₅ I	3-Iodoheptane	295.2	6.39				
C ₇ H ₁₆	Heptane	293.2	1.9209	0.24740E+01	-0.22577E-02	0.12428E-05	273-373
C ₇ H ₁₆	2-Methylhexane	293.2	1.9221	0.24759E+01	-0.22535E-02	0.12500E-05	293-323
C ₇ H ₁₆	3-Methylhexane	293.2	1.920	0.27089E+01	-0.37908E-02	0.37500E-05	273-323
C ₇ H ₁₆	3-Ethylpentane	293.2	1.942	0.23771E+01	-0.15140E-02	0.10093E-06	163-363
C ₇ H ₁₆	2,2-Dimethylpentane	293.2	1.915	0.23414E+01	-0.14362E-02	-0.51322E-07	153-353
C ₇ H ₁₆	2,3-Dimethylpentane	293.2	1.929	0.25637E+01	-0.26328E-02	0.16071E-05	273-323
C ₇ H ₁₆	2,4-Dimethylpentane	293.2	1.902	0.23979E+01	-0.17436E-02	0.17857E-06	273-323
C ₇ H ₁₆	3,3-Dimethylpentane	291.3	1.9419	0.24007E+01	-0.16802E-02	0.36069E-06	291-322

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₇ H ₁₆	2,2,3-Trimethylbutane	293.2	1.930				
C ₇ H ₁₆ O	1-Heptanol	293.2	11.75	0.60662E+02	-0.24049E+00	0.25155E-03	239-513
C ₇ H ₁₆ O	2-Heptanol	293.7	9.72	0.10050E+03	-0.49793E+00	0.64504E-03	207-365
C ₇ H ₁₆ O	3-Heptanol	296.1	7.07	0.19586E+03	-0.11465E+01	0.17175E-02	248-349
C ₇ H ₁₆ O	4-Heptanol	296.2	6.18	0.28995E+03	-0.18499E+01	0.30109E-02	270-301
C ₇ H ₁₆ O	2-Methyl-2-hexanol	297.0	3.257				
C ₇ H ₁₆ O	3-Methyl-2-hexanol	297.2	4.990	0.59724E+02	-0.32417E+00	0.47058E-03	244-372
C ₇ H ₁₆ O	3-Methyl-3-hexanol	298.2	3.248				
C ₇ H ₁₆ O	3-Ethyl-3-pentanol	293.2	3.158				
C ₇ H ₁₆ O	2,2-Dimethyl-1-pentanol	293.2	6.020	0.37318E+02	-0.17095E+00	0.22022E-03	283-393
C ₇ H ₁₆ O	Ethyl pentyl ether	296.2	3.6				
C ₇ H ₁₆ O	Ethyl isopentyl ether	293.2	3.955	0.66541E+01	-0.55450E-02	-0.12500E-04	293-323
C ₇ H ₁₆ O ₃	Triethoxymethane	293.2	4.779				
C ₇ H ₁₆ S	1-Heptanethiol	293.2	4.194	0.71333E+01	-0.97320E-02	-0.12500E-05	273-333
C ₇ H ₁₇ N	Heptylamine	293.2	3.81	0.87794E+01	-0.24363E-01	0.25325E-04	253-373
C ₇ H ₁₈ O ₃ Si	Triethoxymethylsilane	298.2	3.845				
C ₈ H ₄ F ₆	1,3-Bis(trifluoromethyl)benzene	303.2	5.98				
C ₈ H ₆	Phenylacetylene	298.2	2.98				
C ₈ H ₆ Cl ₂	2,5-Dichlorostyrene	298.2	2.58				
C ₈ H ₆ Cl ₄	1,2,3,4-Tetrachloro-5,6-dimethylbenzene	293.2	8.0				
C ₈ H ₆ Cl ₄	1,2,3,5-Tetrachloro-4,6-dimethylbenzene	293.2	5.4				
C ₈ H ₆ O	Phenoxyacetylene	298.2	4.76				
C ₈ H ₇ N	Benzeneacetonitrile	299.2	17.87	0.82175E+02	-0.37416E+00	0.53220E-03	299-343
C ₈ H ₇ NO ₂	4-Methoxyphenyl isocyanate	333.2	10.26	0.20780E+02	-0.31571E-01		333-403
C ₈ H ₇ NO ₄	Methyl 2-nitrobenzoate	300.1	27.76				
C ₈ H ₈	Styrene	293.2	2.4737	0.44473E+01	-0.11422E-01	0.16000E-04	293-313
C ₈ H ₈ O	Acetophenone	298.2	17.44	0.26099E+02	0.64048E-02	-0.11905E-03	298-333
C ₈ H ₈ O ₂	Benzeneacetic acid	353.2	3.47	0.24104E+01	0.30000E-02		353-393
C ₈ H ₈ O ₂	Benzyl formate	303.2	6.34	0.26162E+02	-0.11026E+00	0.14787E-03	303-358
C ₈ H ₈ O ₂	Phenyl acetate	298.2	5.403	0.11327E+02	-0.26707E-01	0.22938E-04	298-404
C ₈ H ₈ O ₂	Methyl benzoate	302.7	6.642	0.17486E+02	-0.51027E-01	0.50222E-04	303-393
C ₈ H ₈ O ₂	(Hydroxyacetyl)benzene	298.2	21.33	0.42286E+02	-0.69215E-01	-0.35714E-05	298-368
C ₈ H ₈ O ₂	4-Methoxybenzaldehyde	303.2	22.0				
C ₈ H ₈ O ₃	Methyl salicylate	314.4	8.80	0.20501E+02	-0.39045E-01	0.68298E-05	223-398
C ₈ H ₉ Br	1-Bromo-2-ethylbenzene	298.2	5.55				
C ₈ H ₉ Br	1-Bromo-3-ethylbenzene	298.2	5.56				
C ₈ H ₉ Br	1-Bromo-4-ethylbenzene	298.2	5.42				
C ₈ H ₉ BrO	1-Bromo-2-ethoxybenzene	313.2	7.04	0.23146E+02	-0.75753E-01	0.77778E-04	313-358
C ₈ H ₉ Cl	1-Chloro-2-ethylbenzene	298.2	4.36				
C ₈ H ₉ Cl	1-Chloro-3-ethylbenzene	298.2	5.18				
C ₈ H ₉ Cl	1-Chloro-4-ethylbenzene	298.2	5.16				
C ₈ H ₉ NO ₂	1-Ethyl-2-nitrobenzene	273.4	21.9				
C ₈ H ₉ NO ₂	Methyl 2-aminobenzoate	298.2	21.9				
C ₈ H ₉ NO ₂	Ethyl 4-pyridinecarboxylate	293.2	8.95				
C ₈ H ₁₀	Ethylbenzene	293.2	2.4463	0.35969E+01	-0.53169E-02	0.47500E-05	293-323
C ₈ H ₁₀	<i>o</i> -Xylene	293.2	2.562	0.36163E+01	-0.40177E-02	0.14286E-05	273-323
C ₈ H ₁₀	<i>m</i> -Xylene	293.2	2.359	0.28421E+01	-0.10191E-02	-0.21429E-05	273-323
C ₈ H ₁₀	<i>p</i> -Xylene	293.2	2.2735	0.23140E+01	0.97221E-03	-0.37500E-05	293-363
C ₈ H ₁₀ O	2,3-Xylenol	343.2	4.81	0.14399E+02	-0.41438E-01	0.39244E-04	343-433
C ₈ H ₁₀ O	2,4-Xylenol	303.2	5.060	0.22125E+02	-0.85543E-01	0.96548E-04	303-363
C ₈ H ₁₀ O	2,5-Xylenol	338.2	5.36	0.18049E+02	-0.54991E-01	0.51656E-04	338-455
C ₈ H ₁₀ O	2,6-Xylenol	313.2	4.90	0.12284E+02	-0.32996E-01	0.29867E-04	313-453
C ₈ H ₁₀ O	3,4-Xylenol	333.2	9.02	0.54423E+02	-0.21153E+00	0.22508E-03	333-453
C ₈ H ₁₀ O	3,5-Xylenol	323.2	9.06	0.54251E+02	-0.21647E+00	0.23542E-03	323-453
C ₈ H ₁₀ O	Benzeneethanol	293.2	12.31	0.12170E+03	-0.63124E+00	0.87776E-03	278-333
C ₈ H ₁₀ O	1-Phenylethanol	293.2	8.77	0.32971E+02	-0.12042E+00	0.12809E-03	293-423
C ₈ H ₁₀ O	Phenetole	293.2	4.216	-0.15043E+02	0.13752E+00	-0.24500E-03	293-313

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₈ H ₁₀ O	2-Methylanisole	293.2	3.502	0.50825E+01	-0.62297E-02	0.28571E-05	293-333
C ₈ H ₁₀ O	3-Methylanisole	293.2	3.967	0.12830E+02	-0.49701E-01	0.66429E-04	293-333
C ₈ H ₁₀ O	4-Methylanisole	293.2	3.914	0.86608E+01	-0.23510E-01	0.25000E-04	293-333
C ₈ H ₁₀ O ₂	1,2-Dimethoxybenzene	293.2	4.45	0.74604E+01	-0.13445E-01	0.10737E-04	293-443
C ₈ H ₁₀ O ₂	1,3-Dimethoxybenzene	298.2	5.363	0.11911E+02	-0.30804E-01	0.29643E-04	298-358
C ₈ H ₁₀ O ₂	1,4-Dimethoxybenzene	333.7	5.60	0.11289E+02	-0.20765E-01	0.11987E-04	334-463
C ₈ H ₁₀ O ₂ S	Ethyl phenyl sulfone	348.2	39.0				
C ₈ H ₁₀ S	(Ethylthio)benzene	298.2	4.95				
C ₈ H ₁₁ N	<i>p</i> -Ethylaniline	298.2	4.84				
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline	293.2	5.87				
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	298.2	4.90	0.84052E+01	-0.13549E-01	0.62835E-05	289-453
C ₈ H ₁₁ N	2,4,6-Trimethylpyridine	298.2	7.807	0.20990E+02	-0.57419E-01	0.44286E-04	298-358
C ₈ H ₁₁ NO	4-Ethoxyaniline	298.2	7.43				
C ₈ H ₁₂ N ₂ O ₂	Hexamethylene diisocyanate	288.2	14.41	0.26715E+02	-0.42696E-01		288-403
C ₈ H ₁₂ O ₄	Diethyl maleate	298.2	7.560	0.13953E+02	-0.21969E-01	0.17817E-05	298-343
C ₈ H ₁₂ O ₄	Diethyl fumarate	296.2	6.56				
C ₈ H ₁₄	1,7-Octadiene	293.0	2.186	0.28376E+01	-0.17442E-02	-0.16141E-05	214-293
C ₈ H ₁₄	<i>cis</i> -Cyclooctene	296.0	2.306	0.31115E+01	-0.32058E-02	0.16713E-05	269-406
C ₈ H ₁₄	1,2-Dimethylcyclohexene	296.0	2.144	0.26443E+01	-0.17973E-02	0.35815E-06	211-374
C ₈ H ₁₄	1,3-Dimethylcyclohexene	296.0	2.182	0.29951E+01	-0.34615E-02	0.24026E-05	213-373
C ₈ H ₁₄ O ₂	Methyl cyclohexanecarboxylate	293.2	4.87				
C ₈ H ₁₄ O ₂	Cyclohexyl acetate	293.2	5.08				
C ₈ H ₁₄ O ₃	Butanoic anhydride	293.2	12.8				
C ₈ H ₁₄ O ₃	2-Methylpropanoic anhydride	292.2	13.6				
C ₈ H ₁₄ O ₄	Diisopropyl oxalate	293.2	6.403	0.10709E+02	-0.16328E-01	0.56000E-05	293-368
C ₈ H ₁₄ O ₄	Diethyl succinate	293.2	6.098	0.80213E+01	0.11810E-02	-0.26400E-04	293-343
C ₈ H ₁₄ O ₄	Dimethyl adipate	293.2	6.84	0.11739E+02	-0.17281E-01	0.11447E-05	293-433
C ₈ H ₁₅ N	Octanenitrile	293.2	13.90				
C ₈ H ₁₆	1-Octene	293.2	2.113	0.24348E+01	0.34200E-03	-0.50000E-05	273-323
C ₈ H ₁₆	<i>cis</i> -3-Octene	298.2	2.062				
C ₈ H ₁₆	<i>trans</i> -3-Octene	298.2	2.002				
C ₈ H ₁₆	<i>cis</i> -4-Octene	298.2	2.053				
C ₈ H ₁₆	<i>trans</i> -4-Octene	298.2	2.004				
C ₈ H ₁₆	3-Methyl-2-heptene*	293.2	2.436				
C ₈ H ₁₆	2,5-Dimethyl-2-hexene	293.2	2.431				
C ₈ H ₁₆	2,4,4-Trimethyl-1-pentene	298.2	2.0908				
C ₈ H ₁₆	Cyclooctane	295.0	2.116	0.25036E+01	-0.12460E-02	-0.23175E-06	295-411
C ₈ H ₁₆ Br ₂	1,8-Dibromooctane	298.2	7.43	0.94117E+00	0.61520E-01	-0.13333E-03	298-328
C ₈ H ₁₆ Cl ₂	1,8-Dichlorooctane	298.2	7.64				
C ₈ H ₁₆ O	2-Octanone	293.2	9.51	-0.16219E+02	0.18799E+00	-0.34156E-03	293-333
C ₈ H ₁₆ O	3-Octanone	303.2	10.50				
C ₈ H ₁₆ O ₂	Octanoic acid	288.2	2.85	0.29391E+01	-0.38721E-03		288-423
C ₈ H ₁₆ O ₂	2-Ethylhexanoic acid	296.2	2.64				
C ₈ H ₁₆ O ₂	Hexyl acetate	293.2	4.42				
C ₈ H ₁₆ O ₂	Pentyl propanoate	293.2	4.552				
C ₈ H ₁₆ O ₂	Isopentyl propanoate	273.2	5.21	0.17665E+02	-0.71718E-01	0.95635E-04	273-373
C ₈ H ₁₆ O ₂	Butyl butanoate	298.2	4.39	0.79684E+01	-0.12000E-01	0.15266E-13	298-318
C ₈ H ₁₆ O ₂	Propyl pentanoate	292.2	4.0				
C ₈ H ₁₆ O ₂	Ethyl hexanoate	293.2	4.45	0.11007E+02	-0.32800E-01	0.35714E-04	253-353
C ₈ H ₁₆ O ₂	Methyl heptanoate	293.2	4.355				
C ₈ H ₁₆ O ₃	Isopentyl lactate	273.2	11.2	0.48649E+02	-0.21253E+00	0.27619E-03	273-373
C ₈ H ₁₇ Br	1-Bromooctane	293.2	5.0957	0.12404E+02	-0.35050E-01	0.34542E-04	283-353
C ₈ H ₁₇ Br	2-Bromooctane	293.2	5.44				
C ₈ H ₁₇ Cl	1-Chlorooctane	298.2	5.05	0.11346E+02	-0.25120E-01	0.13450E-04	274-328
C ₈ H ₁₇ Cl	2-Chlorooctane	293.2	5.42				
C ₈ H ₁₇ F	1-Fluorooctane	293.2	3.89				
C ₈ H ₁₇ I	1-Iodooctane	293.2	4.67	0.12452E+02	-0.41229E-01	0.50108E-04	233-313
C ₈ H ₁₇ NO ₂	1-Nitrooctane	293.2	11.46				
C ₈ H ₁₈	Octane	293.2	1.948	0.22590E+01	-0.84212E-03	-0.75758E-06	233-393

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₈ H ₁₈	2-Methylheptane	293.2	1.9519				
C ₈ H ₁₈	3-Ethylhexane	293.2	1.9617				
C ₈ H ₁₈	2,2-Dimethylhexane	293.2	1.9498				
C ₈ H ₁₈	2,5-Dimethylhexane	293.95	1.9619	0.25821E+01	-0.26804E-02	0.19404E-05	294-324
C ₈ H ₁₈	3,3-Dimethylhexane	293.2	1.9645				
C ₈ H ₁₈	3,4-Dimethylhexane	292.1	1.9814	0.26849E+01	-0.33712E-02	0.32949E-05	292-324
C ₈ H ₁₈	3-Ethyl-3-methylpentane	291.49	1.9869	0.25983E+01	-0.28027E-02	0.24195E-05	292-324
C ₈ H ₁₈	2,2,3-Trimethylpentane	293.2	1.960				
C ₈ H ₁₈	2,2,4-Trimethylpentane	293.2	1.943	0.23677E+01	-0.14768E-02	0.94261E-07	173-373
C ₈ H ₁₈	2,3,3-Trimethylpentane	293.2	1.9780				
C ₈ H ₁₈	2,3,4-Trimethylpentane	293.2	1.9738				
C ₈ H ₁₈ O	1-Octanol	293.2	10.30	0.51647E+02	-0.20371E+00	0.21320E-03	258-513
C ₈ H ₁₈ O	2-Octanol	293.2	8.13	0.63760E+02	-0.27643E+00	0.31075E-03	213-513
C ₈ H ₁₈ O	3-Octanol	293.2	5.55	0.12505E+03	-0.70646E+00	0.10245E-02	223-383
C ₈ H ₁₈ O	4-Octanol	293.2	4.48	0.51049E+02	-0.26664E+00	0.37280E-03	243-403
C ₈ H ₁₈ O	2-Methyl-1-heptanol	293.1	5.16	0.61698E+02	-0.33647E+00	0.49066E-03	236-328
C ₈ H ₁₈ O	3-Methyl-1-heptanol	290.3	2.884	0.84687E+01	-0.33712E-01	0.49793E-04	241-316
C ₈ H ₁₈ O	4-Methyl-1-heptanol	290.6	4.63	0.48612E+02	-0.26773E+00	0.39972E-03	237-332
C ₈ H ₁₈ O	5-Methyl-1-heptanol	290.4	7.68	0.54581E+02	-0.24772E+00	0.29734E-03	235-328
C ₈ H ₁₈ O	6-Methyl-1-heptanol	290.3	10.54	0.57997E+02	-0.23517E+00	0.24663E-03	265-328
C ₈ H ₁₈ O	2-Methyl-2-heptanol	292.2	3.43				
C ₈ H ₁₈ O	3-Methyl-2-heptanol	289.6	7.47	0.39178E+02	-0.17976E+00	0.24218E-03	229-329
C ₈ H ₁₈ O	4-Methyl-2-heptanol	290.0	3.59	0.39715E+02	-0.23115E+00	0.36771E-03	240-333
C ₈ H ₁₈ O	5-Methyl-2-heptanol	278.5	7.5	0.68568E+02	-0.40706E+00	0.67433E-03	230-279
C ₈ H ₁₈ O	6-Methyl-2-heptanol	290.1	6.41	0.77520E+02	-0.41724E+00	0.59448E-03	239-329
C ₈ H ₁₈ O	2-Methyl-3-heptanol	293.2	3.260	-0.59739E+01	0.56700E-01	-0.83125E-04	343-403
C ₈ H ₁₈ O	3-Methyl-3-heptanol	293.2	3.013	-0.38440E+01	0.42327E-01	-0.61250E-04	343-403
C ₈ H ₁₈ O	4-Methyl-3-heptanol	293.2	3.312	-0.48003E+01	0.50740E-01	-0.75000E-04	343-403
C ₈ H ₁₈ O	5-Methyl-3-heptanol	293.2	3.832	0.61967E+01	-0.63750E-02		343-383
C ₈ H ₁₈ O	6-Methyl-3-heptanol	293.2	4.992	0.23037E+02	-0.98029E-01	0.12479E-03	283-383
C ₈ H ₁₈ O	2-Methyl-4-heptanol	296.3	3.338	0.42102E+00	0.10427E-01	-0.20438E-05	230-333
C ₈ H ₁₈ O	3-Methyl-4-heptanol	290.0	7.46	0.33354E+02	-0.14077E+00	0.17750E-03	230-330
C ₈ H ₁₈ O	4-Methyl-4-heptanol	296.2	2.902				
C ₈ H ₁₈ O	2-Ethyl-1-hexanol	298.2	7.58	0.86074E+02	-0.42636E+00	0.55078E-03	208-318
C ₈ H ₁₈ O	2,2-Dimethyl-1-hexanol	293.2	4.50	0.91244E+01	-0.21785E-01	0.21018E-04	283-393
C ₈ H ₁₈ O	Dibutyl ether	293.2	3.0830	0.65383E+01	-0.16172E-01	0.14969E-04	293-314
C ₈ H ₁₈ OS	Dibutyl sulfoxide	313.2	24.73	0.67156E+02	-0.16448E+00	0.92275E-04	313-393
C ₈ H ₁₈ O ₂	2-Ethyl-1,3-hexanediol	293.2	18.73	0.57919E+02	-0.17128E+00	0.12949E-03	233-333
C ₈ H ₁₈ O ₂ S	Dibutyl sulfone	323.2	25.72	0.66248E+02	-0.16417E+00	0.12001E-03	323-398
C ₈ H ₁₈ O ₄	Triethylene glycol dimethyl ether	298.2	7.62				
C ₈ H ₁₈ O ₅	Tetraethylene glycol	293.2	20.44	0.83547E+02	-0.31691E+00	0.34689E-03	253-333
C ₈ H ₁₈ S	1-Octanethiol	293.2	3.949	0.63667E+01	-0.87920E-02	0.18750E-05	273-333
C ₈ H ₁₈ S	Dibutyl sulfide	298.2	4.29				
C ₈ H ₁₉ N	Octylamine	293.2	3.58	0.77931E+01	-0.20015E-01	0.19347E-04	273-373
C ₈ H ₁₉ N	Dibutylamine	293.2	2.765	0.52504E+01	-0.10538E-01	0.71485E-05	243-323
C ₈ H ₂₀ O ₄ Si	Ethyl silicate	293.2	2.50				
C ₈ H ₂₀ Si	Tetraethylsilane	293.2	2.090				
C ₈ H ₂₀ Sn	Tetraethylstannane	293.2	2.241				
C ₈ H ₂₃ N ₅	Tetraethylenepentamine	293.2	9.40	0.40553E+02	-0.16681E+00	0.20659E-03	213-333
C ₈ H ₂₄ O ₄ Si ₄	Octamethylcyclotetrasiloxane	296.2	2.390	0.36286E+01	-0.56885E-02	0.50874E-05	296-333
C ₉ H ₆ N ₂ O ₂	Toluene-2,4-diisocyanate	293.2	8.433	0.22174E+02	-0.66982E-01	0.68571E-04	293-353
C ₉ H ₆ O ₂	2 <i>H</i> -1-Benzopyran-2-one	343.2	34.04	0.11311E+03	-0.33804E+00	0.31324E-03	343-423
C ₉ H ₇ N	Quinoline	293.2	9.16	0.33432E+02	-0.13497E+00	0.17788E-03	258-323
C ₉ H ₇ N	Isoquinoline	298.2	11.0	0.14412E+03	-0.79935E+00	0.11839E-02	298-323
C ₉ H ₈ O	Cinnamaldehyde	305.8	17.72	0.41837E+02	-0.11060E+00	0.10401E-03	306-354
C ₉ H ₈ O ₄	2-(Acetyloxy)benzoic acid	333.2	6.55	0.69994E+01	-0.14553E-02		333-416
C ₉ H ₁₀	1-Propenylbenzene	293.2	2.73				
C ₉ H ₁₀	Allylbenzene	293.2	2.63				
C ₉ H ₁₀	Isopropenylbenzene	293.2	2.28				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₉ H ₁₀ OS	4-Acetylthioanisole	355.2	11.34				
C ₉ H ₁₀ O ₂	Ethyl benzoate	293.2	6.20	0.18216E+02	-0.62361E-01	0.72884E-04	288-343
C ₉ H ₁₀ O ₂	Methyl 4-methylbenzoate	306.2	4.3				
C ₉ H ₁₀ O ₂	Benzyl acetate	303.2	5.34	0.11727E+02	-0.30869E-01	0.32340E-04	303-358
C ₉ H ₁₀ O ₂	Phenyl propanoate	293.2	4.77				
C ₉ H ₁₀ O ₂	4-Acetylanisole	313.2	17.3				
C ₉ H ₁₀ O ₃	Ethyl salicylate	308.2	8.48	0.18910E+02	-0.35623E-01	0.46529E-05	225-321
C ₉ H ₁₀ O ₃	Methyl 2-methoxybenzoate	294.2	7.7				
C ₉ H ₁₁ Br	(3-Bromopropyl)benzene	302.2	5.41	0.11360E+02	-0.27471E-01	0.25775E-04	302-358
C ₉ H ₁₁ NO	<i>N</i> -Ethylbenzamide	352.7	42.6	-0.20109E+03	0.17866E+01	-0.31065E-02	353-389
C ₉ H ₁₁ NO	<i>N,N</i> -Dimethylbenzamide	318.2	20.77	0.76725E+02	-0.26908E+00	0.29409E-03	318-443
C ₉ H ₁₁ NO ₂	Ethyl 2-aminobenzoate	298.2	4.14				
C ₉ H ₁₂	Propylbenzene	293.2	2.370	0.26933E+01	0.21679E-03	-0.44643E-05	273-323
C ₉ H ₁₂	Isopropylbenzene	293.2	2.381	0.31149E+01	-0.30801E-02	0.19643E-05	273-323
C ₉ H ₁₂	<i>o</i> -Ethyltoluene	293.2	2.595				
C ₉ H ₁₂	<i>m</i> -Ethyltoluene	293.2	2.365				
C ₉ H ₁₂	<i>p</i> -Ethyltoluene	293.2	2.265				
C ₉ H ₁₂	1,2,3-Trimethylbenzene	293.2	2.656	0.76006E+01	-0.29118E-01	0.41786E-04	273-323
C ₉ H ₁₂	1,2,4-Trimethylbenzene	293.2	2.377	0.31517E+01	-0.30634E-02	0.14286E-05	273-323
C ₉ H ₁₂	1,3,5-Trimethylbenzene	293.2	2.279	0.38998E+01	-0.88072E-02	0.11149E-04	288-358
C ₉ H ₁₂ O	Benzenepropanol	293.2	11.97	0.94482E+02	-0.45540E+00	0.59307E-03	213-303
C ₉ H ₁₂ O	α -Ethylbenzenemethanol	293.2	6.68	0.44520E+02	-0.21505E+00	0.29443E-03	233-373
C ₉ H ₁₂ O	α,α -Dimethylbenzenemethanol	303.2	5.61	0.57072E+01	0.86568E-02	-0.29580E-04	303-373
C ₉ H ₁₂ O	1-Phenyl-2-propanol	293.2	9.35	0.10762E+03	-0.56026E+00	0.76915E-03	233-373
C ₉ H ₁₂ O	Benzyl ethyl ether	298.2	3.90				
C ₉ H ₁₂ O	2,6-Dimethylanisole	293.2	3.780	0.76700E+01	-0.18298E-01	0.17143E-04	293-333
C ₉ H ₁₂ O	3,5-Dimethylanisole	293.2	3.711	0.54981E+01	-0.56651E-02	-0.14286E-05	293-333
C ₉ H ₁₂ O ₂ S	Butyl thiophene-2-carboxylate	293.2	6.40				
C ₉ H ₁₂ S	Benzenepropanethiol	303.2	4.36	0.82411E+01	-0.15034E-01	0.73617E-05	303-358
C ₉ H ₁₃ N	Benzylethylamine	293.2	4.3				
C ₉ H ₁₃ N	<i>N</i> -Propylaniline	293.2	5.48				
C ₉ H ₁₃ N	2-Methyl- <i>N,N</i> -dimethylaniline	293.2	3.4				
C ₉ H ₁₃ N	4-Methyl- <i>N,N</i> -dimethylaniline	293.2	3.9				
C ₉ H ₁₄ OSi	Trimethylphenoxysilane	298.2	3.3953				
C ₉ H ₁₄ O ₆	Triacetin	293.6	7.11	0.17819E+02	-0.53656E-01	0.57759E-04	219-304
C ₉ H ₁₄ Si	Trimethylphenylsilane	298.2	2.3533	0.21463E+01	0.32711E-02	-0.86264E-05	288-323
C ₉ H ₁₆ O ₂	2-Nonenoic acid	296.2	2.5				
C ₉ H ₁₆ O ₂	Cyclohexyl propanoate	293.2	4.82				
C ₉ H ₁₆ O ₂	Ethyl cyclohexanecarboxylate	293.2	4.64				
C ₉ H ₁₆ O ₄	Diethyl glutarate	303.2	6.659				
C ₉ H ₁₇ N	Nonanenitrile	293.2	12.08				
C ₉ H ₁₈	1-Nonene	293.2	2.180	0.22710E+01	0.15797E-02	-0.64286E-05	273-323
C ₉ H ₁₈ Br ₂	1,9-Dibromononane	293.2	7.153	0.18931E+02	-0.57764E-01	0.60000E-04	293-343
C ₉ H ₁₈ O	2-Nonanone	295.2	9.14				
C ₉ H ₁₈ O	5-Nonanone	293.2	10.6				
C ₉ H ₁₈ O	Di- <i>tert</i> -butyl ketone	287.65	10.0				
C ₉ H ₁₈ O	2,6-Dimethyl-4-heptanone	293.2	9.91	0.33178E+02	-0.11290E+00	0.11454E-05	273-393
C ₉ H ₁₈ O ₂	Nonanoic acid	294.9	2.475	0.25039E+01	0.67274E-03	-0.24180E-05	295-365
C ₉ H ₁₈ O ₂	2-Methyloctanoic acid	293.2	2.39				
C ₉ H ₁₈ O ₂	2-Ethylheptanoic acid	293.2	1.98				
C ₉ H ₁₈ O ₂	Heptyl acetate	293.2	4.2				
C ₉ H ₁₈ O ₂	Pentyl butanoate	301.2	4.08	0.59029E+01	-0.49905E-02	-0.34292E-05	301-343
C ₉ H ₁₈ O ₂	Isopentyl butanoate	293.2	4.0				
C ₉ H ₁₈ O ₂	Isobutyl pentanoate	292.2	3.8				
C ₉ H ₁₈ O ₂	Methyl octanoate	293.2	4.101				
C ₉ H ₁₉ Br	1-Bromononane	298.2	4.74	0.79870E+01	-0.10488E-01	-0.13450E-05	274-328
C ₉ H ₁₉ Cl	1-Chlorononane	293.2	4.803	0.95528E+01	-0.16200E-01	-0.16365E-13	293-323
C ₉ H ₁₉ NO	<i>N,N</i> -Dibutylformamide	293.2	18.4				
C ₉ H ₂₀	Nonane	293.2	1.9722	0.23894E+01	-0.14830E-02	0.14881E-06	253-393

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₉ H ₂₀	2-Methyloctane	293.2	1.967				
C ₉ H ₂₀	4-Methyloctane	293.2	1.967				
C ₉ H ₂₀	2,4-Dimethylheptane	293.2	1.89				
C ₉ H ₂₀	2,5-Dimethylheptane	293.2	1.89				
C ₉ H ₂₀	2,6-Dimethylheptane	293.2	1.987				
C ₉ H ₂₀ N ₂ O	Tetraethylurea	296.8	14.29	0.52820E+02	-0.18790E+00	0.19580E-03	205-411
C ₉ H ₂₀ O	1-Nonanol	293.2	8.83	0.97467E+02	-0.51103E+00	0.71429E-03	288-343
C ₉ H ₂₀ O	2-Nonanol	298.2	6.66	0.10136E+03	-0.55612E+00	0.80000E-03	288-308
C ₉ H ₂₀ O	3-Nonanol	298.2	4.49	0.55214E+02	-0.31920E+00	0.50000E-03	288-308
C ₉ H ₂₀ O	4-Nonanol	298.2	3.69	0.27954E+01	0.30000E-02	-0.52375E-13	288-308
C ₉ H ₂₀ O	5-Nonanol	298.2	3.54	-0.25463E+01	0.35320E-01	-0.50000E-04	288-308
C ₉ H ₂₁ B	Tripropylborane	293.2	2.026				
C ₉ H ₂₁ N	Nonylamine	293.2	3.42	0.53575E+01	-0.71982E-02	0.19481E-05	293-373
C ₉ H ₂₁ N	Tripropylamine	293.2	2.380	0.33380E+01	-0.86332E-02	0.18322E-04	243-293
C ₉ H ₂₁ O ₄ P	Tripropyl phosphate	293.2	10.93	0.33166E+02	-0.10514E+00	0.10000E-03	293-373
C ₁₀ H ₇ Br	1-Bromonaphthalene	298.2	4.768	0.10561E+02	-0.27671E-01	0.27655E-04	293-323
C ₁₀ H ₇ Cl	1-Chloronaphthalene	298.2	5.04	0.84861E+01	-0.12357E-01	0.26899E-05	274-328
C ₁₀ H ₇ NO ₂	1-Nitronaphthalene	333.2	19.68	0.36267E+02	-0.41283E-01	-0.25595E-04	333-403
C ₁₀ H ₈	Naphthalene	363.2	2.54				
C ₁₀ H ₈ O	1-Naphthol	373.0	5.03	0.16489E+02	-0.46700E-01	0.42857E-04	373-453
C ₁₀ H ₈ O	2-Naphthol	413.0	4.95	0.92865E+01	-0.10500E-01	0.42501E-15	413-453
C ₁₀ H ₉ N	1-Naphthylamine	333.2	5.20	0.10577E+02	-0.22114E-01	0.17857E-04	333-453
C ₁₀ H ₉ N	2-Naphthylamine	393.0	5.26	0.19722E+02	-0.60679E-01	0.60714E-04	393-473
C ₁₀ H ₉ N	2-Methylquinoline	293.2	7.24	0.11688E+02	-0.78400E-02	-0.25000E-04	293-333
C ₁₀ H ₉ N	4-Methylquinoline	293.2	9.31	0.17788E+02	-0.32580E-01	0.12500E-04	293-333
C ₁₀ H ₉ N	6-Methylquinoline	293.2	8.48	0.21696E+02	-0.63400E-01	0.62500E-04	293-333
C ₁₀ H ₉ N	8-Methylquinoline	293.2	6.58	0.19356E+02	-0.61900E-01	0.62500E-04	293-333
C ₁₀ H ₁₀ O ₄	Methyl 2-(acetyloxy)benzoate	328.9	5.31	0.19579E+02	-0.69970E-01	0.80889E-04	329-371
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate	293.2	8.66				
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene	298.2	2.771	0.29172E+01	0.12832E-02	-0.59453E-05	298-343
C ₁₀ H ₁₂	4-Ethylstyrene	298.2	3.350				
C ₁₀ H ₁₂	Dicyclopentadiene	313.2	2.43	0.30564E+01	-0.20000E-02	0.82443E-15	313-373
C ₁₀ H ₁₂ O	Tetrahydro-2-naphthol*	293.2	11.70	0.98978E+02	-0.48267E+00	0.63008E-03	293-363
C ₁₀ H ₁₂ O	4-Isopropylbenzaldehyde	288.2	10.68				
C ₁₀ H ₁₂ O ₂	4-Allyl-2-methoxyphenol	293.2	9.55	0.52377E+02	-0.24380E+00	0.33333E-03	273-323
C ₁₀ H ₁₂ O ₂	2-Phenylethyl acetate	297.2	4.93				
C ₁₀ H ₁₂ O ₂	Benzyl propanoate	303.0	5.11	0.42301E+01	0.13962E-01	-0.36426E-04	303-358
C ₁₀ H ₁₂ O ₂	Phenyl butanoate	293.2	4.48				
C ₁₀ H ₁₂ O ₂	Propyl benzoate	303.2	5.78	0.10927E+02	-0.20535E-01	0.11745E-04	303-358
C ₁₀ H ₁₂ O ₂	Ethyl phenylacetate	293.2	5.320				
C ₁₀ H ₁₄	Butylbenzene	293.2	2.359				
C ₁₀ H ₁₄	<i>sec</i> -Butylbenzene	293.2	2.357	0.28348E+01	-0.68586E-03	-0.32143E-05	273-323
C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	293.2	2.359	0.27924E+01	-0.38350E-03	-0.37500E-05	273-323
C ₁₀ H ₁₄	Isobutylbenzene	293.2	2.318	0.28055E+01	-0.92614E-03	-0.25000E-05	273-323
C ₁₀ H ₁₄	1-Isopropyl-4-methylbenzene	298.2	2.2322	0.25266E+01	-0.25121E-03	-0.24867E-05	277-333
C ₁₀ H ₁₄	<i>o</i> -Diethylbenzene	293.2	2.594				
C ₁₀ H ₁₄	<i>m</i> -Diethylbenzene	293.2	2.369				
C ₁₀ H ₁₄	<i>p</i> -Diethylbenzene	293.2	2.259				
C ₁₀ H ₁₄	1-Ethyl-3,5-dimethylbenzene	293.2	2.275				
C ₁₀ H ₁₄	1,2,3,4-Tetramethylbenzene	296.0	2.538	0.33822E+01	-0.33630E-02	0.17475E-05	273-412
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	356.0	2.223	0.26834E+01	-0.10327E-02	-0.73533E-06	356-430
C ₁₀ H ₁₄ N ₂	<i>L</i> -Nicotine	293.2	8.937	0.21347E+02	-0.57177E-01	0.50655E-04	293-363
C ₁₀ H ₁₄ O	1-Phenyl-2-methyl-2-propanol	298.2	5.71	0.21922E+02	-0.84231E-01	0.99475E-04	298-423
C ₁₀ H ₁₄ O	Butyl phenyl ether	293.2	3.734				
C ₁₀ H ₁₄ O	Thymol	333.2	4.259				
C ₁₀ H ₁₅ N	<i>N,N</i> -Diethylaniline	303.2	5.15	0.50773E+01	0.15399E-01	-0.50000E-04	303-328
C ₁₀ H ₁₆	γ -Terpinene	298.2	2.2738				
C ₁₀ H ₁₆	<i>d</i> -Limonene	298.2	2.3746				
C ₁₀ H ₁₆	<i>l</i> -Limonene	298.2	2.3738				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₁₀ H ₁₆	Terpinolene	298.2	2.2918				
C ₁₀ H ₁₆	α -Pinene	298.2	2.1787				
C ₁₀ H ₁₆	β -Pinene	298.2	2.4970				
C ₁₀ H ₁₆	α -Terpinene	298.2	2.4526				
C ₁₀ H ₁₆	β -Myrcene	298.2	2.3				
C ₁₀ H ₁₆ O	Carvenone	293.2	18.8				
C ₁₀ H ₁₆ O	<i>d</i> -Fenchone	294.2	12.8				
C ₁₀ H ₁₇ Cl	2-Chlorobornane	368.2	5.21				
C ₁₀ H ₁₈	Pinane	298.2	2.1456				
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	293.2	2.219	0.25410E+01	-0.11420E-02	0.15092E-06	293-373
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	293.2	2.184	0.26615E+01	-0.21241E-02	0.16864E-05	293-373
C ₁₀ H ₁₈ O	Eucalyptol	298.2	4.57				
C ₁₀ H ₁₈ O ₂	Cyclohexyl butanoate	293.2	4.58				
C ₁₀ H ₁₈ O ₄	Diethyl adipate	293.2	6.109	0.14824E+02	-0.40749E-01	0.37600E-04	293-343
C ₁₀ H ₂₀	1-Decene	293.2	2.136	0.19091E+01	0.33442E-02	-0.87500E-05	273-323
C ₁₀ H ₂₀	<i>cis</i> -5-Decene	298.2	2.071				
C ₁₀ H ₂₀	<i>trans</i> -5-Decene	298.2	2.030				
C ₁₀ H ₂₀	5-Methyl-4-nonene	293.2	2.175				
C ₁₀ H ₂₀	2,4,6-Trimethyl-3-heptene	293.2	2.293				
C ₁₀ H ₂₀ Br ₂	1,10-Dibromodecane	303.2	6.56	0.17350E+02	-0.50328E-01	0.48633E-04	303-368
C ₁₀ H ₂₀ Cl ₂	1,10-Dichlorodecane	308.2	6.68	-0.57423E+01	0.94220E-01	-0.17500E-03	308-338
C ₁₀ H ₂₀ O	2-Decanone	287.2	8.3				
C ₁₀ H ₂₀ O	Menthol	309.3	3.90	0.68202E+01	-0.15894E-01	0.20837E-04	309-358
C ₁₀ H ₂₀ O ₂	2,2-Dimethyloctanoic acid	296.2	2.8				
C ₁₀ H ₂₀ O ₂	Octyl acetate	288.2	4.18	-0.34691E+01	0.58106E-01	-0.10952E-03	288-323
C ₁₀ H ₂₀ O ₂	2-Methylheptyl acetate	288.2	4.27	0.23285E+02	-0.11538E+00	0.17143E-03	288-323
C ₁₀ H ₂₀ O ₂	Pentyl pentanoate	305.6	4.076	0.77641E+01	-0.14335E-01	0.73740E-05	306-393
C ₁₀ H ₂₀ O ₂	Isopentyl pentanoate	292.2	3.6				
C ₁₀ H ₂₀ O ₂	Isopentyl isopentanoate	288.2	4.39	0.14698E+02	-0.57726E-01	0.76190E-04	288-323
C ₁₀ H ₂₀ O ₂	Methyl nonanoate	293.2	3.943				
C ₁₀ H ₂₁ Br	1-Bromodecane	298.2	4.44	0.11202E+02	-0.33491E-01	0.36314E-04	274-328
C ₁₀ H ₂₁ Cl	1-Chlorodecane	293.2	4.581	0.68741E+01	-0.12210E-02	-0.22500E-04	293-323
C ₁₀ H ₂₁ NO	<i>N,N</i> -Dibutylacetamide	293.2	19.1				
C ₁₀ H ₂₂	Decane	293.2	1.9853	0.24054E+01	-0.15445E-02	0.44643E-06	253-393
C ₁₀ H ₂₂	2,7-Dimethyloctane	293.2	1.98				
C ₁₀ H ₂₂	4-Propylheptane	293.2	1.9955				
C ₁₀ H ₂₂ O	1-Decanol	293.2	7.93	0.47195E+02	-0.20740E+00	0.24942E-03	293-343
C ₁₀ H ₂₂ O	2-Decanol	298.2	5.82	0.13621E+03	-0.81000E+00	0.12500E-02	288-308
C ₁₀ H ₂₂ O	3-Decanol	298.2	4.05	0.52090E+02	-0.31020E+00	0.50000E-03	288-308
C ₁₀ H ₂₂ O	4-Decanol	298.2	3.42	-0.11260E+02	0.93960E-01	-0.15000E-03	288-308
C ₁₀ H ₂₂ O	5-Decanol	298.2	3.24	-0.25832E+01	0.31456E-01	-0.40000E-04	288-308
C ₁₀ H ₂₂ O	2,2-Dimethyl-1-octanol	293.2	7.86	0.69536E+02	-0.34596E+00	0.46250E-03	293-333
C ₁₀ H ₂₂ O	Dipentyl ether	298.2	2.798				
C ₁₀ H ₂₂ O	Diisopentyl ether	293.2	2.817	0.44690E+01	-0.63710E-02	0.25000E-05	293-323
C ₁₀ H ₂₂ OS	Dipentyl sulfoxide	348.2	18.8				
C ₁₀ H ₂₂ O ₅	Tetraethylene glycol dimethyl ether	298.2	7.68				
C ₁₀ H ₂₂ S	Dipentyl sulfide	298.2	3.826				
C ₁₀ H ₂₃ N	Decylamine	293.2	3.31	0.61497E+01	-0.12801E-01	0.10606E-04	293-373
C ₁₀ H ₃₀ O ₃ Si ₄	Decamethyltetrasiloxane	293.2	2.370				
C ₁₀ H ₃₀ O ₅ Si ₅	Decamethylcyclopentasiloxane	293.2	2.50				
C ₁₁ H ₁₀	1-Methylnaphthalene	293.2	2.915	0.45126E+01	-0.76480E-02	0.75000E-05	293-333
C ₁₁ H ₁₀	2-Methylnaphthalene	313.2	2.747				
C ₁₁ H ₁₀ O	1-Methoxynaphthalene	293.2	4.020	0.71885E+01	-0.14838E-01	0.13750E-04	293-333
C ₁₁ H ₁₀ O	2-Methoxynaphthalene	353.2	3.563	0.56702E+01	-0.69754E-02	0.28571E-05	353-373
C ₁₁ H ₁₂ O ₂	Ethyl <i>trans</i> -cinnamate	293.2	5.63				
C ₁₁ H ₁₂ O ₃	Ethyl benzoylacetate	303.2	13.50	0.93644E+01	0.74280E-01	-0.20000E-03	303-323
C ₁₁ H ₁₄ O ₂	Benzyl butanoate	301.2	4.55				
C ₁₁ H ₁₄ O ₂	Phenyl pentanoate	293.2	4.30				
C ₁₁ H ₁₄ O ₂	Butyl benzoate	303.2	5.52	0.77854E+01	-0.34972E-02	-0.13149E-04	303-358

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₁₁ H ₁₄ O ₂	Isobutyl benzoate	291.2	5.39				
C ₁₁ H ₁₆	1,3-Diethyl-5-methylbenzene	293.2	2.264				
C ₁₁ H ₁₆	Pentamethylbenzene	334.0	2.358	0.30196E+01	-0.22619E-02	0.83831E-06	334-413
C ₁₁ H ₂₂	1-Undecene	293.2	2.137	0.22132E+01	0.13121E-02	-0.53571E-05	273-323
C ₁₁ H ₂₂ O	2-Undecanone	285.3	8.3				
C ₁₁ H ₂₂ O ₂	Nonyl acetate	293.2	3.87				
C ₁₁ H ₂₂ O ₂	Pentyl hexanoate	288.2	4.22	0.83503E+01	-0.18449E-01	0.14286E-04	288-323
C ₁₁ H ₂₃ Br	1-Bromoundecane	272.6	4.61				
C ₁₁ H ₂₄	Undecane	293.2	1.9972	0.23637E+01	-0.12500E-02	-0.85869E-16	283-363
C ₁₁ H ₂₄ O	1-Undecanol	313.2	5.98				
C ₁₁ H ₂₅ N	Undecylamine	293.2	3.25	0.54945E+01	-0.96161E-02	0.66017E-05	293-373
C ₁₂ F ₂₇ N	Tris(perfluorobutyl)amine	293.2	2.15				
C ₁₂ H ₈ O	Dibenzofuran	373.2	3.00				
C ₁₂ H ₁₀	Biphenyl	348.2	2.53	0.26869E+01	0.63072E-03	-0.30995E-05	348-428
C ₁₂ H ₁₀ N ₂ O	<i>trans</i> -Azoxybenzene	311.2	5.2				
C ₁₂ H ₁₀ O	Diphenyl ether	283.2	3.726				
C ₁₂ H ₁₀ O	2-Acetonaphthone	333.2	13.03	0.14538E+03	-0.73040E+00	0.10000E-02	333-363
C ₁₂ H ₁₀ OS	Diphenyl sulfoxide	344.7	16.6				
C ₁₂ H ₁₀ O ₂ S	Diphenyl sulfone	406.2	21.1				
C ₁₂ H ₁₀ S	Diphenyl sulfide	298.2	5.43				
C ₁₂ H ₁₁ N	Diphenylamine	323.2	3.73				
C ₁₂ H ₁₁ NO	<i>N</i> -1-Naphthylenylacetamide	433.2	24.3	0.84739E+02	-0.12391E+00	-0.35714E-04	433-533
C ₁₂ H ₁₂	1,6-Dimethylnaphthalene	293.2	2.7250				
C ₁₂ H ₁₂ O	1-Ethoxynaphthalene	292.2	3.3				
C ₁₂ H ₁₄ O ₂	Propyl cinnamate	293.2	5.45				
C ₁₂ H ₁₄ O ₄	Diethyl phthalate	293.2	7.86				
C ₁₂ H ₁₆ O	2-Cyclohexylphenol	328.2	3.97				
C ₁₂ H ₁₆ O	4-Cyclohexylphenol	404.2	4.42				
C ₁₂ H ₁₆ O ₂	Pentyl benzoate	293.2	5.07				
C ₁₂ H ₁₆ O ₃	Pentyl salicylate	301.2	6.25				
C ₁₂ H ₁₆ O ₃	Isopentyl salicylate	293.12	7.26	0.13129E+02	-0.19190E-01	-0.36060E-05	225-397
C ₁₂ H ₁₇ NO	<i>N</i> -Butyl- <i>N</i> -phenylacetamide	298.2	11.66				
C ₁₂ H ₁₈	Hexylbenzene	293.2	2.3				
C ₁₂ H ₁₈	1,3,5-Triethylbenzene	293.2	2.256				
C ₁₂ H ₁₈	Hexamethylbenzene	449.0	2.172	0.35710E+01	-0.46912E-02	0.35088E-05	449-489
C ₁₂ H ₂₀ O ₂	<i>l</i> -Bornyl acetate	303.2	4.46	0.60791E+01	0.98200E-02	-0.50000E-04	303-323
C ₁₂ H ₂₂ O	Dicyclohexyl ether	293.2	3.45	0.95324E+01	-0.31740E-01	0.37500E-04	293-333
C ₁₂ H ₂₂ O	Cyclododecanone	303.2	11.4	0.39327E+02	-0.13248E+00	0.13298E-03	303-423
C ₁₂ H ₂₂ O ₆	Dibutyl tartrate	314.2	9.4				
C ₁₂ H ₂₄	1-Dodecene	293.2	2.152	0.22581E+01	0.11106E-02	-0.50000E-05	273-323
C ₁₂ H ₂₄ O ₂	Decyl acetate	293.2	3.75				
C ₁₂ H ₂₄ O ₂	Ethyl decanoate	293.2	3.75	0.70969E+01	-0.15080E-01	0.12500E-04	293-353
C ₁₂ H ₂₄ O ₂	Methyl undecanoate	293.2	3.671				
C ₁₂ H ₂₅ Br	1-Bromododecane	298.2	4.07	0.86103E+01	-0.20891E-01	0.18994E-04	274-328
C ₁₂ H ₂₅ Cl	1-Chlorododecane	298.2	4.17	0.10002E+02	-0.27798E-01	0.27559E-04	274-328
C ₁₂ H ₂₅ I	1-Iodododecane	298.2	3.91	0.34641E+01	0.97404E-02	-0.27602E-04	293-323
C ₁₂ H ₂₆	Dodecane	293.2	2.0120	0.23697E+01	-0.12200E-02	-0.36375E-16	283-363
C ₁₂ H ₂₆ O	1-Dodecanol	303.2	5.82	0.18518E+02	-0.44859E-01	0.99900E-05	303-358
C ₁₂ H ₂₆ O	2-Butyl-1-octanol	363.2	3.28				
C ₁₂ H ₂₇ BO ₃	Tributyl borate	293.2	2.23				
C ₁₂ H ₂₇ N	Dodecylamine	303.2	3.07	0.27999E+01	0.44810E-02	-0.11905E-04	303-373
C ₁₂ H ₂₇ N	Tributylamine	293.2	2.340	0.19846E+01	0.28108E-02	-0.54545E-05	233-293
C ₁₂ H ₂₇ O ₄ P	Tributyl phosphate	293.2	8.34	0.26304E+02	-0.88480E-01	0.92857E-04	293-373
C ₁₂ H ₂₈ O ₄ Si	Tetrapropoxysilane	298.2	3.21				
C ₁₂ H ₂₈ Sn	Tetrapropylstannane	293.2	2.267				
C ₁₂ H ₃₀ OSi ₂	Hexaethyldisiloxane	298.2	2.259	0.36559E+01	-0.72406E-02	0.85714E-05	298-333
C ₁₃ H ₁₀ O	Benzophenone	300.2	12.62	0.34130E+02	-0.10249E+00	0.10268E-03	300-420
C ₁₃ H ₁₀ O ₃	Phenyl salicylate	290.2	6.92	0.26545E+02	-0.11180E+00	0.15220E-03	290-358
C ₁₃ H ₁₂	Diphenylmethane	303.2	2.540	0.30638E+01	-0.17286E-02		303-333

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	<i>a</i>	<i>b</i>	<i>c</i>	Range/K
C ₁₃ H ₁₂ O	Benzyl phenyl ether	313.2	3.748				
C ₁₃ H ₁₈ O ₂	Hexyl benzoate	293.2	4.80				
C ₁₃ H ₂₀	Heptylbenzene	293.2	2.26				
C ₁₃ H ₂₀ O	α -Ionone*	292.4	10.78				
C ₁₃ H ₂₀ O	β -Ionone*	297.65	11.66				
C ₁₃ H ₂₄ O ₄	Diethyl nonanedioate	303.2	5.133				
C ₁₃ H ₂₆	1-Tridecene	293.2	2.139	0.14154E+01	0.66514E-02	-0.14286E-04	273-323
C ₁₃ H ₂₆ O	7-Tridecanone	303.2	7.6				
C ₁₃ H ₂₆ O ₂	Ethyl undecanoate	293.2	3.55				
C ₁₃ H ₂₆ O ₂	Methyl dodecanoate	293.2	3.539				
C ₁₃ H ₂₇ Br	1-Bromotridecane	281.15	4.19				
C ₁₃ H ₂₈	Tridecane	293.2	2.0213	0.23731E+01	-0.12000E-02	-0.21841E-15	283-363
C ₁₃ H ₂₈	5-Butylnonane	293.2	2.0319				
C ₁₃ H ₂₈ O	1-Tridecanol	333.2	4.02				
C ₁₄ H ₁₀	Anthracene	502.0	2.649	0.20571E+02	-0.69169E-01	0.66667E-04	502-516
C ₁₄ H ₁₀	Phenanthrene	383.2	2.72				
C ₁₄ H ₁₀ O ₂	Benzil	368.2	13.04	-0.23599E+02	0.22715E+00	-0.34667E-03	368-393
C ₁₄ H ₁₂ O ₂	Benzyl benzoate	303.2	5.26	0.76856E+01	-0.80000E-02	-0.80361E-15	303-358
C ₁₄ H ₁₂ O ₃	Benzyl salicylate	301.2	4.12				
C ₁₄ H ₁₄	1,2-Diphenylethane	331.2	2.47	0.31178E+01	-0.21572E-02	0.59800E-06	331-451
C ₁₄ H ₁₄ O	Dibenzyl ether	293.2	3.821	0.80154E+01	-0.20536E-01	0.21250E-04	293-333
C ₁₄ H ₁₅ N	Dibenzylamine	293.2	3.446				
C ₁₄ H ₁₆ O ₂ Si	Dimethyldiphenoxysilane	298.2	3.500	0.51669E+01	-0.77001E-02	0.70156E-05	283-353
C ₁₄ H ₁₈ O ₂	Pentyl cinnamate	293.2	4.89				
C ₁₄ H ₂₂	Octylbenzene	293.2	2.26				
C ₁₄ H ₂₆ O ₄	Diisobutyl adipate	293.2	5.19				
C ₁₄ H ₂₆ O ₄	Diethyl sebacate	303.2	4.995	0.39143E+02	-0.20965E+00	0.32000E-03	303-313
C ₁₄ H ₂₈ O ₂	Dodecyl acetate	293.2	3.6				
C ₁₄ H ₂₈ O ₂	Ethyl laurate	273.2	3.94				
C ₁₄ H ₂₈ O ₂	Methyl tridecanoate	293.2	3.442				
C ₁₄ H ₂₉ Br	1-Bromotetradecane	293.2	3.84	0.10058E+02	-0.33905E-01	0.43528E-04	274-328
C ₁₄ H ₃₀	Tetradecane	293.2	2.0343	0.23832E+01	-0.11900E-02	-0.51229E-16	283-363
C ₁₄ H ₃₀ O	1-Tetradecanol	318.2	4.42	0.12272E+02	-0.24667E-01	-0.13168E-13	318-358
C ₁₄ H ₃₁ N	Tetradecylamine	312.55	2.90				
C ₁₅ H ₁₂ O ₄	Phenyl 2-(acetyloxy)benzoate	384.2	4.33				
C ₁₅ H ₂₆ O ₆	Tributyryl	282.8	5.72	0.13152E+02	-0.36684E-01	0.36795E-04	199-283
C ₁₅ H ₃₀ O ₂	Methyl tetradecanoate	293.2	3.352				
C ₁₅ H ₃₁ Br	1-Bromopentadecane	293.35	3.88				
C ₁₅ H ₃₂	Pentadecane	293.2	2.0391	0.23792E+01	-0.11600E-02	-0.71069E-16	283-363
C ₁₅ H ₃₂ O	1-Pentadecanol	333.2	3.70				
C ₁₅ H ₃₃ N	Pentadecylamine	313.25	2.85				
C ₁₅ H ₃₃ N	Triisopentylamine	294.2	2.29				
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate	293.2	6.58	0.12444E+02	-0.20000E-01		293-333
C ₁₆ H ₃₂ O ₂	Hexadecanoic acid	338.2	2.417				
C ₁₆ H ₃₂ O ₂	Ethyl myristate	293.2	3.50	0.52642E+01	-0.60000E-02	-0.47358E-15	293-353
C ₁₆ H ₃₂ O ₂	Methyl pentadecanoate	293.2	3.296				
C ₁₆ H ₃₃ Br	1-Bromo-hexadecane	298.2	3.68	0.58668E+01	-0.73333E-02	-0.52666E-14	298-328
C ₁₆ H ₃₃ I	1-Iodo-hexadecane	293.2	3.57	0.79531E+01	-0.22859E-01	0.26955E-04	293-323
C ₁₆ H ₃₄	Hexadecane	293.2	2.0460	0.23861E+01	-0.11600E-02	0.25555E-15	293-363
C ₁₆ H ₃₄ O	1-Hexadecanol	333.2	3.69	0.85935E+01	-0.14714E-01	-0.45533E-13	333-363
C ₁₆ H ₃₅ N	Hexadecylamine	328.35	2.71				
C ₁₆ H ₃₆ Sn	Tetrabutylstannane	293.2	9.74	0.56115E+02	-0.24812E+00	0.30682E-03	293-313
C ₁₇ H ₁₂ O ₃	2-Naphthyl salicylate	293.0	6.30	0.11229E+02	-0.18857E-01	0.70332E-05	293-353
C ₁₇ H ₃₄ O	9-Heptadecanone	328.2	5.43	0.44176E+02	-0.21183E+00	0.28571E-03	328-363
C ₁₇ H ₃₄ O ₂	Methyl palmitate	313.2	3.124				
C ₁₇ H ₃₆	Heptadecane	293.2	2.0578	0.23627E+01	-0.10400E-02	-0.10397E-12	293-308
C ₁₇ H ₃₆ O	1-Heptadecanol	333.2	3.41				
C ₁₈ H ₂₆ O ₄	Dipentyl phthalate	293.2	6.00				
C ₁₈ H ₂₈ O ₂	Phenyl laurate	293.2	3.28				

PERMITTIVITY (DIELECTRIC CONSTANT) OF LIQUIDS (continued)

Mol. Form.	Name	T/K	ϵ	a	b	c	Range/K
C ₁₈ H ₃₀ O ₂	Linolenic acid	293.2	2.825	0.33867E+01	-0.19181E-02		274-368
C ₁₈ H ₃₀ O ₄	Dicyclohexyl adipate	308.2	4.84				
C ₁₈ H ₃₂ O ₂	Linoleic acid	293.2	2.754	0.32073E+01	-0.15477E-02		275-368
C ₁₈ H ₃₄ O ₂	Oleic acid	293.2	2.336	0.25385E+01	-0.69448E-03		275-368
C ₁₈ H ₃₄ O ₄	Dibutyl sebacate	293.2	4.54				
C ₁₈ H ₃₆ O ₂	Stearic acid	293.2	2.314	0.27159E+01	-0.13300E-02		293-373
C ₁₈ H ₃₆ O ₂	Hexadecyl acetate	308.2	3.19	0.47310E+01	-0.50000E-02	0.41338E-14	308-348
C ₁₈ H ₃₆ O ₂	Ethyl palmitate	303.2	3.07	0.57938E+01	-0.12294E-01	0.10919E-04	303-455
C ₁₈ H ₃₆ O ₂	Methyl heptadecanoate	313.2	3.07				
C ₁₈ H ₃₇ Br	1-Bromooctadecane	303.35	3.53	0.46790E+01	-0.30355E-02	-0.24798E-05	303-332
C ₁₈ H ₃₈ O	1-Octadecanol	333.2	3.38	0.73784E+01	-0.12000E-01	-0.22871E-13	333-363
C ₁₈ H ₃₉ BO ₃	Trihexyl borate	293.2	2.22				
C ₁₈ H ₃₉ N	Octadecylamine	326.35	2.67				
C ₁₉ H ₁₆	Triphenylmethane	367.2	2.46	0.40201E+01	-0.66507E-02	0.65329E-05	367-448
C ₁₉ H ₁₈ O ₃ Si	Methyltriphenoxysilane	298.2	3.628				
C ₁₉ H ₃₂ O ₂	Methyl linolenate	293.2	3.355				
C ₁₉ H ₃₄ O ₂	Methyl linoleate	293.2	3.466				
C ₁₉ H ₃₆ O ₂	Methyl oleate	293.2	3.211				
C ₁₉ H ₃₈ O	10-Nonadecanone	353.2	5.37				
C ₁₉ H ₃₈ O ₂	Methyl stearate	313.2	3.021				
C ₁₉ H ₄₀	Nonadecane	293.2	2.0706				
C ₂₀ H ₃₀ O ₄	Dihexyl phthalate	293.2	5.62				
C ₂₀ H ₃₈ O ₂	Ethyl oleate	301.2	3.17	0.57033E+01	-0.11223E-01	0.93447E-05	301-423
C ₂₀ H ₄₀ O ₂	Octadecyl acetate	308.2	3.07	0.44569E+01	-0.45000E-02	0.33923E-14	308-348
C ₂₀ H ₄₀ O ₂	Ethyl stearate	313.2	2.958	0.70930E+01	-0.19081E-01	0.19555E-04	331-440
C ₂₀ H ₄₀ O ₂	Methyl nonadecanoate	313.2	2.982				
C ₂₀ H ₄₂ O	1-Eicosanol	338.2	3.13	0.21700E+01	0.12497E-01	-0.28571E-04	338-363
C ₂₀ H ₄₂ O	Didecyl ether	293.2	2.644	0.41465E+01	-0.62240E-02	0.37500E-05	293-333
C ₂₀ H ₆₀ O ₈ Si ₉	Eicosamethylnonasiloxane	293.2	2.645	0.57840E+01	-0.16568E-01	0.20000E-04	293-323
C ₂₁ H ₂₁ O ₄ P	Tricresyl phosphate*	298.2	6.7				
C ₂₁ H ₃₈ O ₆	1,2,3-Propanetriyl hexanoate	293.2	4.476				
C ₂₂ H ₄₂ O ₂	Butyl oleate	298.2	4.00				
C ₂₂ H ₄₄ O ₂	Butyl stearate	298.2	3.120	0.73894E+02	-0.46261E+00	0.75500E-03	298-343
C ₂₂ H ₄₆	Docosane	293.2	2.0840				
C ₂₂ H ₄₆ O	1-Docosanol	348.2	2.94	0.82062E+01	-0.25069E-01	0.28571E-04	348-373
C ₂₄ H ₂₀ O ₄ Si	Tetraphenoxysilane	333.2	3.4915				
C ₂₄ H ₃₈ O ₄	Dioctyl phthalate	293.2	5.22				
C ₂₆ H ₅₀ O ₄	Dioctyl sebacate	299.2	4.01				
C ₂₇ H ₅₀ O ₆	1,2,3-Propanetriyl octanoate	293.2	3.931				
C ₃₀ H ₅₈ O ₄	Ethylene glycol ditetradecanoate	343.2	2.98				
C ₃₀ H ₆₂	Triacontane	373.2	1.9112				
C ₃₀ H ₆₂	2,6,10,15,19,23-Hexamethyltetracosane	373.2	1.9106				
C ₃₄ H ₆₆ O ₄	Ethylene glycol dipalmitate	348.2	2.89				
C ₃₄ H ₆₈ O ₂	Hexadecyl stearate	333.2	2.61				
C ₃₈ H ₇₄ O ₄	Ethylene glycol distearate	353.2	2.79				
C ₃₉ H ₇₄ O ₆	Glycerol trilaurate	313.2	3.287				
C ₅₁ H ₉₈ O ₆	Glycerol tripalmitate	328.2	2.901	-0.29131E+01	0.32206E-01	-0.44154E-04	328-393
C ₅₇ H ₁₀₄ O ₆	Glycerol trioleate	293.2	3.109				
C ₅₇ H ₁₀₄ O ₆	Glycerol trielaidate	313.2	2.980				
C ₅₇ H ₁₁₀ O ₆	Glycerol tristearate	353.2	2.740				

PERMITTIVITY (DIELECTRIC CONSTANT) OF GASES

This table gives the relative permittivity ϵ (often called the dielectric constant) of some common gases at a temperature of 20°C and pressure of one atmosphere (101.325 kPa). Values of the permanent dipole moment μ in Debye Units (1 D = 3.33564×10^{-30} C m) are also included.

The density dependence of the permittivity is given by the equation

$$\frac{\epsilon - 1}{\epsilon + 2} = \rho_m \left(\frac{4\pi N \alpha}{3} + \frac{4\pi N \mu^2}{9kT} \right)$$

where ρ_m is the molar density, N is Avogadro's number, k is the Boltzmann constant, T is the temperature, and α is the molecular polarizability. Therefore, in regions where the gas can be considered ideal, $\epsilon - 1$ is approximately proportional to the pressure at constant temperature. For nonpolar gases ($\mu = 0$), $\epsilon - 1$ is inversely proportional to temperature at constant pressure.

The number of significant figures indicates the accuracy of the values given. The values of ϵ for air, Ar, H₂, He, N₂, O₂, and CO₂ are recommended as reference values; these are accurate to 1 ppm or better.

The second part of the table gives the permittivity of water vapor in equilibrium with liquid water as a function of temperature (derived from Reference 4).

REFERENCE

1. A. A. Maryott and F. Buckley, *Table of Dielectric Constants and Electric Dipole Moments of Substances in the Gaseous State*, National Bureau of Standards Circular 537, 1953.
2. B. A. Younglove, *J. Phys. Chem. Ref. Data*, 11, Suppl. 1, 1982; 16, 577, 1987 (for data on N₂, H₂, O₂, and hydrocarbons over a range of pressure and temperature).
3. Landolt-Börnstein, *Numerical Data and Functional Relationships in Science and Technology*, New Series, Group IV, Vol. 4, Springer-Verlag, Heidelberg, 1980 (for data at high pressures).
4. G. Birnbaum and S. K. Chatterjee, *J. Appl. Phys.*, 23, 220, 1952 (for data on water vapor).

Mol. form.	Name	ϵ	μ/D
Compounds not containing carbon			
	Air (dry, CO ₂ free)	1.0005364	
Ar	Argon	1.0005172	0
BF ₃	Boron trifluoride	1.0011	0
BrH	Hydrogen bromide	1.00279	0.827
ClH	Hydrogen chloride	1.00390	1.109
F ₃ N	Nitrogen trifluoride	1.0013	0.235
F ₆ S	Sulfur hexafluoride	1.00200	0
HI	Hydrogen iodide	1.00214	0.448
H ₂	Hydrogen	1.0002538	0
H ₂ S	Hydrogen sulfide	1.00344	0.97
H ₃ N	Ammonia	1.00622	1.471
He	Helium	1.0000650	0
Kr	Krypton	1.00078	0
NO	Nitric oxide	1.00060	0.159
N ₂	Nitrogen	1.0005480	0
N ₂ O	Nitrous oxide	1.00104	0.161
Ne	Neon	1.00013	0
O ₂	Oxygen	1.0004947	0
O ₂ S	Sulfur dioxide	1.00825	1.633
O ₃	Ozone	1.0017	0.534
Xe	Xenon	1.00126	0
Compounds containing carbon			
CF ₄	Tetrafluoromethane	1.00121	0
CO	Carbon monoxide	1.00065	0.110
CO ₂	Carbon dioxide	1.000922	0

PERMITTIVITY (DIELECTRIC CONSTANT) OF GASES (continued)

Mol. form.	Name	ϵ	μ/D
CH ₃ Br	Bromomethane	1.01028	1.822
CH ₃ Cl	Chloromethane	1.01080	1.892
CH ₃ F	Fluoromethane	1.00973	1.858
CH ₃ I	Iodomethane	1.00914	1.62
CH ₄	Methane	1.00081	0
C ₂ H ₂	Acetylene	1.00124	0
C ₂ H ₃ Cl	Chloroethylene	1.0075	1.45
C ₂ H ₄	Ethylene	1.00134	0
C ₂ H ₅ Cl	Chloroethane	1.01325	2.05
C ₂ H ₆	Ethane	1.00140	0
C ₂ H ₆ O	Dimethyl ether	1.0062	1.30
C ₃ H ₆	Propene	1.00228	0.366
C ₃ H ₆	Cyclopropane	1.00178	0
C ₃ H ₈	Propane	1.00200	0.084
C ₄ H ₁₀	Butane	1.00258	0
C ₄ H ₁₀	Isobutane	1.00260	0.132

PERMITTIVITY OF SATURATED WATER VAPOR

$t/^\circ\text{C}$	ϵ	$t/^\circ\text{C}$	ϵ
0	1.00007	60	1.00144
10	1.00012	70	1.00213
20	1.00022	80	1.00305
30	1.00037	90	1.00428
40	1.00060	100	1.00587
50	1.00095		

AZEOTROPIC DATA FOR BINARY MIXTURES

Liquid mixtures having an extremum (maximum or minimum) vapor pressure at constant temperature, as a function of composition, are called azeotropic mixtures, or simply azeotropes. Mixtures that do not show a maximum or minimum are called zeotropic. Azeotropes in which the pressure is a maximum are often called positive azeotropes, while pressure-minimum azeotropes are called negative azeotropes. The coordinates of an azeotropic point are the azeotropic temperature t_{az} , pressure P_{az} , and liquid-phase composition, usually expressed as mole fractions. At the azeotropic point, the vapor-phase composition is the same as the liquid-phase composition.

This table gives azeotropic data for a number of binary mixtures at normal atmospheric pressure ($P_{az} = 101.3$ kPa). Component 1 of each mixture is given in bold face. The temperature t_{az} and mole fraction x_1 of component 1 are listed for each choice of component 2.

The components are arranged in a modified Hill order, with substances that do not contain carbon preceding those that do contain carbon.

REFERENCES

1. Lide, D.R., and Kehiaian, H.V., *CRC Handbook of Thermophysical and Thermochemical Data*, CRC Press, Boca Raton, FL, 1994.
2. Horsley, L.H., *Azeotropic Data, III*, American Chemical Society, Washington, D.C., 1973.

Molecular formula	Name	$t_{az}/^{\circ}\text{C}$	x_1
Water H₂O			
CHCl ₃	Trichloromethane	56.1	0.160
CH ₂ O ₂	Formic acid	107.2	0.427
CH ₃ NO ₂	Nitromethane	83.6	0.511
CS ₂	Carbon disulfide	42.6	0.109
C ₂ H ₃ N	Acetonitrile	76.5	0.307
C ₂ H ₅ NO ₂	Nitroethane	87.2	0.624
C ₂ H ₆ O	Ethanol	78.2	0.096
C ₄ H ₈ O ₂	Ethyl acetate	70.4	0.312
C ₄ H ₁₀ O	1-Butanol	92.7	0.753
C ₄ H ₁₀ O	2-Butanol	87	0.601
C ₅ H ₅ N	Pyridine	93.6	0.755
C ₅ H ₁₁ N	Piperidine	92.8	0.718
C ₅ H ₁₂	Pentane	34.6	0.054
C ₆ H ₅ Cl	Chlorobenzene	90.2	0.712
C ₆ H ₆	Benzene	69.3	0.295
C ₆ H ₆ O	Phenol	99.5	0.981
C ₆ H ₁₀	Cyclohexene	70.8	0.308
C ₆ H ₁₂	Cyclohexane	69.5	0.300
C ₆ H ₁₄	Hexane	61.6	0.221
C ₇ H ₈	Toluene	84.1	0.444
C ₇ H ₁₆	Heptane	79.2	0.452
C ₈ H ₁₀	1,3-Dimethylbenzene	92	0.767
C ₈ H ₁₀	Ethylbenzene	92	0.744
C ₈ H ₁₈	Octane	89.6	0.673
C ₈ H ₁₈ O	Dibutyl ether	92.9	0.781
C ₉ H ₂₀	Nonane	94.8	0.970
C ₁₂ H ₂₇ N	Tributylamine	99.7	0.976
Tetrachloromethane CCl₄			
CH ₂ O ₂	Formic acid	66.7	0.569
CH ₃ NO ₂	Nitromethane	71.3	0.660
CH ₄ O	Methanol	55.7	0.445
C ₂ H ₃ N	Acetonitrile	65.1	0.566
C ₂ H ₆ O	Ethanol	65.0	0.615
C ₃ H ₆ O	Acetone	56.1	0.047
C ₃ H ₈ O	1-Propanol	73.4	0.820
C ₄ H ₁₀ O	1-Butanol	76.6	0.951
Formic acid CH₂O₂			
CS ₂	Carbon disulfide	42.6	0.253
Nitromethane CH₃NO₂			
CS ₂	Carbon disulfide	41.2	0.845
Methanol CH₄O			
C ₃ H ₆ O	Acetone	55.5	0.198

AZEOTROPIC DATA FOR BINARY MIXTURES (continued)

Molecular formula	Name	$t_{az}/^{\circ}\text{C}$	x_1
C ₃ H ₆ O ₂	Methyl acetate	53.5	0.352
C ₅ H ₁₀	Cyclopentane	38.8	0.263
C ₅ H ₁₂	Pentane	30.9	0.145
C ₅ H ₁₂ O	<i>tert</i> -Butyl methyl ether	51.3	0.315
C ₆ H ₆	Benzene	57.5	0.610
C ₆ H ₁₂	Cyclohexane	53.9	0.601
C ₇ H ₈	Toluene	63.5	0.883
C ₇ H ₁₆	Heptane	59.1	0.769
C ₈ H ₁₈	Octane	62.8	0.881
C ₉ H ₂₀	Nonane	64.1	0.953
Carbon disulfide CS₂			
C ₂ H ₆ O	Ethanol	42.6	0.860
C ₃ H ₆ O	Acetone	39.3	0.608
C ₃ H ₈ O	1-Propanol	45.7	0.931
C ₄ H ₈ O ₂	Ethyl acetate	46.1	0.974
Acetonitrile C₂H₃N			
C ₂ H ₆ O	Ethanol	72.5	0.469
C ₇ H ₈	Toluene	81.4	0.900
Acetic acid C₂H₄O₂			
C ₄ H ₈ O ₂	1,4-Dioxane	119.5	0.831
C ₅ H ₅ N	Pyridine	138.1	0.579
C ₆ H ₆	Benzene	80.1	0.026
C ₆ H ₁₂	Cyclohexane	78.8	0.130
C ₆ H ₁₄	Hexane	68.3	0.084
C ₆ H ₁₅ N	Triethylamine	163	0.774
C ₇ H ₈	Toluene	100.7	0.375
C ₇ H ₁₆	Heptane	91.7	0.451
C ₈ H ₁₀	Ethylbenzene	114.7	0.774
C ₈ H ₁₈	Octane	105.7	0.688
C ₉ H ₂₀	Nonane	112.9	0.826
Iodoethane C₂H₅I			
C ₆ H ₁₄	Hexane	64.7	0.420
Ethanol C₂H₆O			
C ₅ H ₁₀	Cyclopentane	44.7	0.110
C ₅ H ₁₂	Pentane	34.3	0.076
C ₆ H ₆	Benzene	67.9	0.440
C ₆ H ₁₂	Cyclohexane	64.8	0.430
C ₆ H ₁₄	Hexane	58.7	0.332
C ₇ H ₈	Toluene	76.7	0.810
C ₈ H ₁₈	Octane	77	0.898
Ethylene glycol C₂H₆O₂			
C ₇ H ₈	Toluene	110.1	0.034
C ₇ H ₁₆	Heptane	97.9	0.048
C ₈ H ₁₈ O	Dibutyl ether	139.5	0.125
C ₁₀ H ₂₂	Decane	161	0.406
Dimethyl sulfide C₂H₆S			
C ₅ H ₁₂	Pentane	31.8	0.503
1,2-Ethanediamine C₂H₈N₂			
C ₇ H ₈	Toluene	104	0.406
Propanenitrile C₃H₅N			
C ₆ H ₁₄	Hexane	63.5	0.134
Acetone C₃H₆O			
C ₃ H ₆ O ₂	Methyl acetate	55.8	0.544
C ₅ H ₁₀	Cyclopentane	41	0.404
C ₆ H ₁₂	Cyclohexane	53	0.751
Ethyl formate C₃H₆O₂			
C ₅ H ₁₂	Pentane	32.5	0.294
Methyl acetate C₃H₆O₂			
C ₆ H ₁₂	Cyclohexane	55.5	0.801

AZEOTROPIC DATA FOR BINARY MIXTURES (continued)

Molecular formula	Name	$t_{az}/^{\circ}\text{C}$	x_1
C ₆ H ₁₄	Hexane	51.8	0.642
	Propanoic acid C₃H₆O₂		
C ₅ H ₅ N	Pyridine	148.6	0.686
C ₇ H ₁₆	Heptane	97.8	0.027
C ₉ H ₁₂	Propylbenzene	139.5	0.830
	1-Nitropropane C₃H₇NO₂		
C ₃ H ₈ O	1-Propanol	97.0	0.061
C ₇ H ₁₆	Heptane	96.6	0.149
	1-Propanol C₃H₈O		
C ₄ H ₈ O ₂	1,4-Dioxane	95.3	0.642
C ₆ H ₆	Benzene	77.1	0.209
C ₆ H ₁₂	Cyclohexane	74.7	0.241
C ₇ H ₁₆	Heptane	84.6	0.470
	2-Propanol C₃H₈O		
C ₄ H ₁₁ N	Butylamine	74.7	0.646
C ₅ H ₁₂	Pentane	35.5	0.071
C ₆ H ₁₂	Cyclohexane	69.4	0.397
C ₇ H ₈	Toluene	80.6	0.773
	Ethyl methyl sulfide C₃H₈S		
C ₆ H ₁₂	Methylcyclopentane	65.6	0.664
C ₇ H ₁₆	2,2-Dimethylpentane	66.4	0.908
	1-Propanethiol C₃H₈S		
C ₆ H ₁₂	Cyclohexane	67.8	0.978
C ₆ H ₁₄	Hexane	64.4	0.557
C ₆ H ₁₄ O	Diisopropyl ether	65.9	0.714
	Thiophene C₄H₄S		
C ₆ H ₁₂	Cyclohexane	77.9	0.412
C ₆ H ₁₄	Hexane	68.5	0.114
	Butanal C₄H₈O		
C ₆ H ₁₄	Hexane	60	0.296
	2-Butanone C₄H₈O		
C ₄ H ₉ Cl	1-Chlorobutane	77	0.440
C ₄ H ₁₁ N	Butylamine	74	0.353
C ₆ H ₆	Benzene	78.3	0.460
C ₆ H ₁₂	Cyclohexane	71.8	0.438
C ₇ H ₁₆	Heptane	77	0.764
	Butanoic acid C₄H₈O₂		
C ₅ H ₅ N	Pyridine	163.2	0.912
C ₆ H ₅ Cl	Chlorobenzene	131.8	0.035
C ₈ H ₁₀	1,2-Dimethylbenzene	143	0.118
	1,4-Dioxane C₄H₈O₂		
C ₄ H ₉ Br	1-Bromobutane	98	0.580
	Ethyl acetate C₄H₈O₂		
C ₆ H ₁₄	Hexane	65.2	0.394
	Methyl propanoate C₄H₈O₂		
C ₄ H ₉ Cl	1-Chlorobutane	76.8	0.392
	Propyl formate C₄H₈O₂		
C ₄ H ₉ Cl	1-Chlorobutane	76.1	0.392
C ₆ H ₆	Benzene	78.5	0.440
C ₆ H ₁₂	Cyclohexane	75	0.469
	1-Butanol C₄H₁₀O		
C ₅ H ₅ N	Pyridine	118.6	0.704
C ₆ H ₅ Cl	Chlorobenzene	115.3	0.659
C ₆ H ₁₀	Cyclohexene	82	0.055
C ₇ H ₈	Toluene	105.5	0.324
C ₇ H ₁₆	Heptane	93.9	0.229
C ₈ H ₁₀	1,2-Dimethylbenzene	116.8	0.811
C ₈ H ₁₈ O	Dibutyl ether	117.7	0.892

AZEOTROPIC DATA FOR BINARY MIXTURES (continued)

Molecular formula	Name	$t_{az}/^{\circ}\text{C}$	x_1
	2-Butanol C₄H₁₀O		
C ₆ H ₆	Benzene	78.5	0.161
C ₇ H ₁₆	Heptane	88.1	0.439
	Diethyl ether C₄H₁₀O		
C ₅ H ₁₂	Pentane	33.7	0.553
	tert-Butyl alcohol C₄H₁₀O		
C ₆ H ₆	Benzene	74.0	0.378
C ₇ H ₁₆	Heptane	78	0.688
	Methyl propyl ether C₄H₁₀O		
C ₅ H ₁₂	Pentane	35.6	0.215
	2-Ethoxyethanol C₄H₁₀O₂		
C ₇ H ₁₆	Heptane	96.5	0.153
C ₉ H ₁₂	Propylbenzene	134.6	0.842
	2-Furaldehyde C₅H₄O₂		
C ₇ H ₁₆	Heptane	98.3	0.055
C ₉ H ₁₂	Propylbenzene	151.4	0.475
	Pyridine C₅H₅N		
C ₇ H ₈	Toluene	110.1	0.249
	Benzene C₆H₆		
C ₆ H ₁₀	Cyclohexene	78.9	0.635
C ₆ H ₁₂	Cyclohexane	77.6	0.538
	Phenol C₆H₆O		
C ₆ H ₇ N	2-Methylpyridine	185.5	0.752
C ₇ H ₉ N	2,4-Dimethylpyridine	193.4	0.601
C ₉ H ₁₂	1,3,5-Trimethylbenzene	163.5	0.253
C ₁₀ H ₂₂	Decane	168	0.449
	Aniline C₆H₇N		
C ₉ H ₁₂	1,3,5-Trimethylbenzene	164.4	0.150
C ₁₀ H ₂₂ O	Dipentyl ether	177.5	0.675
C ₁₂ H ₂₆	Dodecane	180.4	0.821
	2-Methylpyridine C₆H₇N		
C ₈ H ₁₈	Octane	121.1	0.470
	Cyclohexanol C₆H₁₂O		
C ₈ H ₁₀	1,2-Dimethylbenzene	143	0.147

VISCOSITY OF GASES

The following table gives the viscosity of some common gases as a function of temperature. Unless otherwise noted, the viscosity values refer to a pressure of 100 kPa (1 bar). The notation $P=0$ indicates the low pressure limiting value is given. The difference between the viscosity at 100 kPa and the limiting value is generally less than 1%. Viscosity is given in units of $\mu\text{Pa s}$; note that $1 \mu\text{Pa s} = 10^{-5}$ poise. Substances are listed in the modified Hill order (see Introduction).

		Viscosity in micropascal seconds ($\mu\text{Pa s}$)						
		100 K	200 K	300 K	400 K	500 K	600 K	Ref.
	Air	7.1	13.3	18.6	23.1	27.1	30.8	1
Ar	Argon	8.0	15.9	22.9	28.8	34.2	39.0	2,8
BF ₃	Boron trifluoride		12.3	17.1	21.7	26.1	30.2	13
ClH	Hydrogen chloride			14.6	19.7	24.3		13
F ₆ S	Sulfur hexafluoride ($P=0$)			15.3	19.8	23.9	27.7	10
H ₂	Hydrogen ($P=0$)	4.2	6.8	9.0	10.9	12.7	14.4	4
D ₂	Deuterium ($P=0$)	5.9	9.6	12.6	15.4	17.9	20.3	11
H ₂ O	Water			10.0	13.3	17.3	21.4	6
D ₂ O	Deuterium oxide			11.1	13.7	17.7	22.0	7
He	Helium ($P=0$)	9.7	15.3	20.0	24.4	28.4	32.3	8
Kr	Krypton ($P=0$)	8.8	17.1	25.6	33.1	39.8	45.9	8
NO	Nitric oxide		13.8	19.2	23.8	28.0	31.9	13
N ₂	Nitrogen ($P=0$)		12.9	17.9	22.2	26.1	29.6	12
N ₂ O	Nitrous oxide		10.0	15.0	19.4	23.6	27.4	13
Ne	Neon ($P=0$)	14.4	24.3	32.1	38.9	45.0	50.8	8
O ₂	Oxygen ($P=0$)	7.5	14.6	20.8	26.1	30.8	35.1	12
O ₂ S	Sulfur dioxide		8.6	12.9	17.5	21.7		13
Xe	Xenon ($P=0$)	8.3	15.4	23.2	30.7	37.6	44.0	8
CO	Carbon monoxide	6.7	12.9	17.8	22.1	25.8	29.1	13
CO ₂	Carbon dioxide		10.0	15.0	19.7	24.0	28.0	9,10
CHCl ₃	Chloroform			10.2	13.7	16.9	20.1	13
CH ₄	Methane		7.7	11.2	14.3	17.0	19.4	10
CH ₄ O	Methanol				13.2	16.5	19.6	13
C ₂ H ₂	Acetylene			10.4	13.5	16.5		13
C ₂ H ₄	Ethylene		7.0	10.4	13.6	16.5	19.1	3
C ₂ H ₆	Ethane		6.4	9.5	12.3	14.9	17.3	5
C ₂ H ₆ O	Ethanol				11.6	14.5	17.0	13
C ₃ H ₈	Propane			8.3	10.9	13.4	15.8	5
C ₄ H ₁₀	Butane			7.5	10.0	12.3	14.6	5
C ₄ H ₁₀	Isobutane			7.6	10.0	12.3	14.6	5
C ₄ H ₁₀ O	Diethyl ether			7.6	10.1	12.4		13
C ₅ H ₁₂	Pentane			6.7	9.2	11.4	13.4	13
C ₆ H ₁₄	Hexane				8.6	10.8	12.8	13

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VISCOSITY OF LIQUIDS

The absolute viscosity of some common liquids at temperatures between -25 and 100°C is given in this table. Values were derived by fitting experimental data to suitable expressions for the temperature dependence. The substances are arranged by molecular formula in the modified Hill order (see Preface). All values are given in units of millipascal seconds (mPa s); this unit is identical to centipoise (cp).

Viscosity values correspond to a nominal pressure of 1 atmosphere. If a value is given at a temperature above the normal boiling point, the applicable pressure is understood to be the vapor pressure of the liquid at that temperature. A few values are given at a temperature slightly below the normal freezing point; these refer to the supercooled liquid.

The accuracy ranges from 1% in the best cases to 5 to 10% in the worst cases. Additional significant figures are included in the table to facilitate interpolation.

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Molecular formula	Name	Viscosity in mPa s					
		-25°C	0°C	25°C	50°C	75°C	100°C
Compounds not containing carbon							
Br ₂	Bromine		1.252	0.944	0.746		
Cl ₃ HSi	Trichlorosilane		0.415	0.326			
Cl ₃ P	Phosphorous trichloride	0.870	0.662	0.529	0.439		
Cl ₄ Si	Tetrachlorosilane			99.4	96.2		
H ₂ O	Water		1.793	0.890	0.547	0.378	0.282
H ₄ N ₂	Hydrazine			0.876	0.628	0.480	0.384
Hg	Mercury			1.526	1.402	1.312	1.245
NO ₂	Nitrogen dioxide		0.532	0.402			
Compounds containing carbon							
CCl ₃ F	Trichlorofluoromethane	0.740	0.539	0.421			
CCl ₄	Tetrachloromethane		1.321	0.908	0.656	0.494	
CS ₂	Carbon disulfide		0.429	0.352			
CHBr ₃	Tribromomethane			1.857	1.367	1.029	
CHCl ₃	Trichloromethane	0.988	0.706	0.537	0.427		
CHN	Hydrogen cyanide		0.235	0.183			
CH ₂ Br ₂	Dibromomethane	1.948	1.320	0.980	0.779	0.652	
CH ₂ Cl ₂	Dichloromethane	0.727	0.533	0.413			
CH ₂ O ₂	Formic acid			1.607	1.030	0.724	0.545
CH ₃ I	Iodomethane		0.594	0.469			
CH ₃ NO	Formamide		7.114	3.343	1.833		
CH ₃ NO ₂	Nitromethane	1.311	0.875	0.630	0.481	0.383	0.317
CH ₄ O	Methanol	1.258	0.793	0.544			
CH ₅ N	Methylamine	0.319	0.231				
C ₂ Cl ₃ F ₃	1,1,2-Trichlorotrifluoroethane	1.465	0.945	0.656	0.481		
C ₂ Cl ₄	Tetrachloroethylene		1.114	0.844	0.663	0.535	0.442
C ₂ HCl ₃	Trichloroethylene		0.703	0.545	0.444	0.376	
C ₂ HCl ₅	Pentachloroethane		3.761	2.254	1.491	1.061	
C ₂ HF ₃ O ₂	Trifluoroacetic acid			0.808	0.571		
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	0.786	0.575	0.445			
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	0.522	0.398	0.317	0.261		
C ₂ H ₂ Cl ₄	1,1,1,2-Tetrachloroethane	3.660	2.200	1.437	1.006	0.741	0.570
C ₂ H ₃ ClF ₂	1-Chloro-1,1-difluoroethane	0.477	0.376				

VISCOSITY OF LIQUIDS (continued)

Molecular formula	Name	Viscosity in mPa s					
		-25°C	0°C	25°C	50°C	75°C	100°C
C ₂ H ₃ ClO	Acetyl chloride			0.368	0.294		
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	1.847	1.161	0.793	0.578	0.428	
C ₂ H ₃ N	Acetonitrile		0.400	0.369	0.284	0.234	
C ₂ H ₄ Br ₂	1,2-Dibromoethane			1.595	1.116	0.837	0.661
C ₂ H ₄ Cl ₂	1,1-Dichloroethane			0.464	0.362		
C ₂ H ₄ Cl ₂	1,2-Dichloroethane		1.125	0.779	0.576	0.447	
C ₂ H ₄ O ₂	Acetic acid			1.056	0.786	0.599	0.464
C ₂ H ₄ O ₂	Methyl formate		0.424	0.325			
C ₂ H ₅ Br	Bromoethane	0.635	0.477	0.374			
C ₂ H ₅ Cl	Chloroethane	0.416	0.319				
C ₂ H ₅ I	Iodoethane		0.723	0.556	0.444	0.365	
C ₂ H ₅ NO	<i>N</i> -Methylformamide		2.549	1.678	1.155	0.824	0.606
C ₂ H ₅ NO ₂	Nitroethane	1.354	0.940	0.688	0.526	0.415	0.337
C ₂ H ₆ O	Ethanol	3.262	1.786	1.074	0.694	0.476	
C ₂ H ₆ OS	Dimethyl sulfoxide			1.987	1.290		
C ₂ H ₆ O ₂	Ethylene glycol			16.1	6.554	3.340	1.975
C ₂ H ₆ S	Dimethyl sulfide		0.356	0.284			
C ₂ H ₆ S	Ethanethiol		0.364	0.287			
C ₂ H ₇ N	Dimethylamine	0.300	0.232				
C ₂ H ₇ NO	Ethanolamine			21.1	8.560	3.935	1.998
C ₃ H ₃ Br	3-Bromopropene		0.620	0.471	0.373		
C ₃ H ₃ Cl	3-Chloropropene		0.408	0.314			
C ₃ H ₃ ClO	Epichlorohydrin	2.492	1.570	1.073	0.781	0.597	0.474
C ₃ H ₃ N	Propanenitrile			0.294	0.240	0.202	
C ₃ H ₆ O	Acetone	0.540	0.395	0.306	0.247		
C ₃ H ₆ O	Allyl alcohol			1.218	0.759	0.505	
C ₃ H ₆ O	Propanal			0.321	0.249		
C ₃ H ₆ O ₂	Ethyl formate		0.506	0.380	0.300		
C ₃ H ₆ O ₂	Methyl acetate		0.477	0.364	0.284		
C ₃ H ₆ O ₂	Propanoic acid		1.499	1.030	0.749	0.569	0.449
C ₃ H ₇ Br	1-Bromopropane		0.645	0.489	0.387		
C ₃ H ₇ Br	2-Bromopropane		0.612	0.458	0.359		
C ₃ H ₇ Cl	1-Chloropropane		0.436	0.334			
C ₃ H ₇ Cl	2-Chloropropane		0.401	0.303			
C ₃ H ₇ I	1-Iodopropane		0.970	0.703	0.541	0.436	0.363
C ₃ H ₇ I	2-Iodopropane		0.883	0.653	0.506	0.407	
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide		1.176	0.794	0.624		
C ₃ H ₇ NO ₂	1-Nitropropane	1.851	1.160	0.798	0.589	0.460	0.374
C ₃ H ₈ O	1-Propanol	8.645	3.815	1.945	1.107	0.685	
C ₃ H ₈ O	2-Propanol		4.619	2.038	1.028	0.576	
C ₃ H ₈ O ₂	1,2-Propylene glycol		248	40.4	11.3	4.770	2.750
C ₃ H ₈ O ₃	Glycerol			934	152	39.8	14.8
C ₃ H ₈ S	1-Propanethiol		0.503	0.385			
C ₃ H ₈ S	2-Propanethiol		0.477	0.357	0.280		
C ₃ H ₉ N	Propylamine			0.376			
C ₃ H ₉ N	Isopropylamine		0.454	0.325			
C ₄ H ₄ O	Furan	0.661	0.475	0.361			
C ₄ H ₅ N	Pyrrole		2.085	1.225	0.828	0.612	
C ₄ H ₆ O ₃	Acetic anhydride		1.241	0.843	0.614	0.472	0.377
C ₄ H ₇ N	Butanenitrile			0.553	0.418	0.330	0.268
C ₄ H ₈ O	2-Butanone	0.720	0.533	0.405	0.315	0.249	
C ₄ H ₈ O	Tetrahydrofuran	0.849	0.605	0.456	0.359		
C ₄ H ₈ O ₂	1,4-Dioxane			1.177	0.787	0.569	
C ₄ H ₈ O ₂	Ethyl acetate		0.578	0.423	0.325	0.259	
C ₄ H ₈ O ₂	Methyl propionate		0.581	0.431	0.333	0.266	
C ₄ H ₈ O ₂	Propyl formate		0.669	0.485	0.370	0.293	
C ₄ H ₈ O ₂	Butanoic acid		2.215	1.426	0.982	0.714	0.542

VISCOSITY OF LIQUIDS (continued)

Molecular formula	Name	Viscosity in mPa s					
		-25°C	0°C	25°C	50°C	75°C	100°C
C ₄ H ₈ O ₂	2-Methylpropanoic acid		1.857	1.226	0.863	0.639	0.492
C ₄ H ₈ O ₂ S	Sulfolane				6.280	3.818	2.559
C ₄ H ₈ S	Tetrahydrothiophene			0.973	0.912		
C ₄ H ₉ Br	1-Bromobutane		0.815	0.606	0.471	0.379	
C ₄ H ₉ Cl	1-Chlorobutane		0.556	0.422	0.329	0.261	
C ₄ H ₉ N	Pyrrolidine	1.914	1.071	0.704	0.512		
C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide			1.927			
C ₄ H ₉ NO	Morpholine			2.021	1.247	0.850	0.627
C ₄ H ₁₀ O	1-Butanol	12.19	5.185	2.544	1.394	0.833	0.533
C ₄ H ₁₀ O	2-Butanol			3.096	1.332	0.698	0.419
C ₄ H ₁₀ O	2-Methyl-2-propanol			4.312	1.421	0.678	
C ₄ H ₁₀ O	Diethyl ether		0.283	0.224			
C ₄ H ₁₀ O ₃	Diethylene glycol			30.200	11.130	4.917	2.505
C ₄ H ₁₀ S	Diethyl sulfide		0.558	0.422	0.331	0.267	
C ₄ H ₁₁ N	Butylamine		0.830	0.574	0.409	0.298	
C ₄ H ₁₁ N	Isobutylamine		0.770	0.571	0.367		
C ₄ H ₁₁ N	Diethylamine			0.319	0.239		
C ₄ H ₁₁ NO ₂	Diethanolamine				109.5	28.7	9.100
C ₅ H ₄ O ₂	Furfural		2.501	1.587	1.143	0.906	0.772
C ₅ H ₅ N	Pyridine		1.361	0.879	0.637	0.497	0.409
C ₅ H ₁₀	1-Pentene	0.313	0.241	0.195			
C ₅ H ₁₀	2-Methyl-2-butene		0.255	0.203			
C ₅ H ₁₀	Cyclopentane		0.555	0.413	0.321		
C ₅ H ₁₀ O	Mesityl oxide	1.291	0.838	0.602	0.465	0.381	0.326
C ₅ H ₁₀ O	2-Pentanone		0.641	0.470	0.362	0.289	0.238
C ₅ H ₁₀ O	3-Pentanone		0.592	0.444	0.345	0.276	0.227
C ₅ H ₁₀ O ₂	Butyl formate		0.937	0.644	0.472	0.362	0.289
C ₅ H ₁₀ O ₂	Propyl acetate		0.768	0.544	0.406	0.316	0.255
C ₅ H ₁₀ O ₂	Ethyl propanoate		0.691	0.501	0.380	0.299	0.242
C ₅ H ₁₀ O ₂	Methyl butanoate		0.759	0.541	0.406	0.318	0.257
C ₅ H ₁₀ O ₂	Methyl isobutanoate		0.672	0.488	0.373	0.296	
C ₅ H ₁₁ N	Piperidine			1.573	0.958	0.649	0.474
C ₅ H ₁₂	Pentane	0.351	0.274	0.224			
C ₅ H ₁₂	Isopentane	0.376	0.277	0.214			
C ₅ H ₁₂ O	1-Pentanol	25.4	8.512	3.619	1.820	1.035	0.646
C ₅ H ₁₂ O	2-Pentanol			3.470	1.447	0.761	0.465
C ₅ H ₁₂ O	3-Pentanol			4.149	1.473	0.727	0.436
C ₅ H ₁₂ O	2-Methyl-1-butanol			4.453	1.963	1.031	0.612
C ₅ H ₁₂ O	3-Methyl-1-butanol		8.627	3.692	1.842	1.031	0.631
C ₅ H ₁₃ N	Pentylamine		1.030	0.702	0.493	0.356	
C ₆ F ₆	Hexafluorobenzene			2.789	1.730	1.151	
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene		1.958	1.324	0.962	0.739	0.593
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene		1.492	1.044	0.787	0.628	0.525
C ₆ H ₅ Br	Bromobenzene		1.560	1.074	0.798	0.627	0.512
C ₆ H ₅ Cl	Chlorobenzene	1.703	1.058	0.753	0.575	0.456	0.369
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol			3.589	1.835	1.131	0.786
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol				4.041		
C ₆ H ₅ F	Fluorobenzene		0.749	0.550	0.423	0.338	
C ₆ H ₅ I	Iodobenzene		2.354	1.554	1.117	0.854	0.683
C ₆ H ₅ NO ₂	Nitrobenzene		3.036	1.863	1.262	0.918	0.704
C ₆ H ₆	Benzene			0.604	0.436	0.335	
C ₆ H ₆ ClN	<i>o</i> -Chloroaniline			3.316	1.913	1.248	0.887
C ₆ H ₆ O	Phenol				3.437	1.784	1.099
C ₆ H ₇ N	Aniline			3.847	2.029	1.247	0.850
C ₆ H ₈ N ₂	Phenylhydrazine			13.0	4.553	1.850	0.848
C ₆ H ₁₀	Cyclohexene		0.882	0.625	0.467	0.364	
C ₆ H ₁₀ O	Cyclohexanone			2.017	1.321	0.919	0.671

VISCOSITY OF LIQUIDS (continued)

Molecular formula	Name	Viscosity in mPa s					
		-25°C	0°C	25°C	50°C	75°C	100°C
C ₆ H ₁₁ N	Hexanenitrile			0.912	0.650	0.488	0.382
C ₆ H ₁₂	Cyclohexane			0.894	0.615	0.447	
C ₆ H ₁₂	Methylcyclopentane	0.927	0.653	0.479	0.364		
C ₆ H ₁₂	1-Hexene	0.441	0.326	0.252	0.202		
C ₆ H ₁₂ O	Cyclohexanol			57.5	12.3	4.274	1.982
C ₆ H ₁₂ O	2-Hexanone	1.300	0.840	0.583	0.429	0.329	0.262
C ₆ H ₁₂ O	4-Methyl-2-pentanone			0.545	0.406		
C ₆ H ₁₂ O ₂	Butyl acetate		1.002	0.685	0.500	0.383	0.305
C ₆ H ₁₂ O ₂	Isobutyl acetate			0.676	0.493	0.370	0.286
C ₆ H ₁₂ O ₂	Ethyl butanoate			0.639	0.453		
C ₆ H ₁₂ O ₂	Diacetone alcohol	28.7	6.621	2.798	1.829	1.648	
C ₆ H ₁₂ O ₃	Paraldehyde			1.079	0.692	0.485	0.362
C ₆ H ₁₃ N	Cyclohexylamine			1.944	1.169	0.782	0.565
C ₆ H ₁₄	Hexane		0.405	0.300	0.240		
C ₆ H ₁₄	2-Methylpentane		0.372	0.286	0.226		
C ₆ H ₁₄	3-Methylpentane		0.395	0.306			
C ₆ H ₁₄ O	Dipropyl ether		0.542	0.396	0.304	0.242	
C ₆ H ₁₄ O	1-Hexanol			4.578	2.271	1.270	0.781
C ₆ H ₁₅ N	Triethylamine		0.455	0.347	0.273	0.221	
C ₆ H ₁₅ N	Dipropylamine		0.751	0.517	0.377	0.288	0.228
C ₆ H ₁₅ N	Diisopropylamine			0.393	0.300	0.237	
C ₆ H ₁₅ NO ₃	Triethanolamine			609	114	31.5	11.7
C ₇ H ₅ N	Benzonitrile			1.267	0.883	0.662	0.524
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene		1.390	0.964	0.710	0.547	0.437
C ₇ H ₇ Cl	<i>m</i> -Chlorotoluene		1.165	0.823	0.616	0.482	0.391
C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene			0.837	0.621	0.483	0.390
C ₇ H ₈	Toluene	1.165	0.778	0.560	0.424	0.333	0.270
C ₇ H ₈ O	<i>o</i> -Cresol				3.035	1.562	0.961
C ₇ H ₈ O	<i>m</i> -Cresol			12.9	4.417	2.093	1.207
C ₇ H ₈ O	Benzyl alcohol			5.474	2.760	1.618	1.055
C ₇ H ₈ O	Anisole			1.056	0.747	0.554	0.427
C ₇ H ₉ N	<i>N</i> -Methylaniline		4.120	2.042	1.222	0.825	0.606
C ₇ H ₉ N	<i>o</i> -Methyl aniline		10.3	3.823	1.936	1.198	0.839
C ₇ H ₉ N	<i>m</i> -Methyl aniline		8.180	3.306	1.679	1.014	0.699
C ₇ H ₉ N	Benzylamine			1.624	1.080	0.769	0.577
C ₇ H ₁₄	Methylcyclohexane		0.991	0.679	0.501	0.390	0.316
C ₇ H ₁₄	1-Heptene		0.441	0.340	0.273	0.226	
C ₇ H ₁₄ O	2-Heptanone			0.714	0.407	0.297	
C ₇ H ₁₄ O ₂	Heptanoic acid			3.840	2.282	1.488	1.041
C ₇ H ₁₆	Heptane	0.757	0.523	0.387	0.301	0.243	
C ₇ H ₁₆	3-Methylhexane			0.350			
C ₇ H ₁₆ O	1-Heptanol			5.810	2.603	1.389	0.849
C ₇ H ₁₆ O	2-Heptanol			3.955	1.799	0.987	0.615
C ₇ H ₁₆ O	3-Heptanol				1.957	0.976	0.584
C ₇ H ₁₆ O	4-Heptanol			4.207	1.695	0.882	0.539
C ₇ H ₁₇ N	Heptylamine			1.314	0.865	0.600	0.434
C ₈ H ₈	Styrene		1.050	0.695	0.507	0.390	0.310
C ₈ H ₈ O	Acetophenone			1.681			0.634
C ₈ H ₈ O ₂	Methyl benzoate			1.857			
C ₈ H ₈ O ₃	Methyl salicylate					1.102	0.815
C ₈ H ₁₀	Ethylbenzene		0.872	0.631	0.482	0.380	0.304
C ₈ H ₁₀	<i>o</i> -Xylene		1.084	0.760	0.561	0.432	0.345
C ₈ H ₁₀	<i>m</i> -Xylene		0.795	0.581	0.445	0.353	0.289
C ₈ H ₁₀	<i>p</i> -Xylene			0.603	0.457	0.359	0.290
C ₈ H ₁₀ O	Phenetole			1.197	0.817	0.594	0.453
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline		1.996	1.300	0.911	0.675	0.523
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline		3.981	2.047	1.231	0.825	0.596

VISCOSITY OF LIQUIDS (continued)

Molecular formula	Name	Viscosity in mPa s					
		-25°C	0°C	25°C	50°C	75°C	100°C
C ₈ H ₁₆	Ethylcyclohexane		1.139	0.784	0.579		
C ₈ H ₁₆ O ₂	Octanoic acid			5.020	2.656	1.654	1.147
C ₈ H ₁₈	Octane		0.700	0.508	0.385	0.302	0.243
C ₈ H ₁₈ O	1-Octanol			7.288	3.232	1.681	0.991
C ₈ H ₁₈ O	4-Methyl-3-heptanol		1.904	1.085	0.702	0.497	0.375
C ₈ H ₁₈ O	5-Methyl-3-heptanol		2.052	1.178	0.762	0.536	0.401
C ₈ H ₁₈ O	2-Ethyl-1-hexanol		20.7	6.271	2.631	1.360	0.810
C ₈ H ₁₈ O	Dibutyl ether	1.417	0.918	0.637	0.466	0.356	0.281
C ₈ H ₁₉ N	Dibutylamine		1.509	0.918	0.619	0.449	0.345
C ₈ H ₁₉ N	Diisobutylamine		1.115	0.723	0.511	0.384	0.303
C ₉ H ₇ N	Quinoline			3.337	1.892	1.201	0.833
C ₉ H ₁₀	Indane		2.230	1.357	0.931	0.692	0.545
C ₉ H ₁₂	Cumene		1.075	0.737	0.547		
C ₉ H ₁₄ O	Isophorone		4.201	2.329	1.415	0.923	0.638
C ₉ H ₁₈ O	5-Nonanone			1.199	0.834	0.619	0.484
C ₉ H ₁₈ O ₂	Nonanoic acid			7.011	3.712	2.234	1.475
C ₉ H ₂₀	Nonane		0.964	0.665	0.488	0.375	0.300
C ₉ H ₂₀ O	1-Nonanol			9.123	4.032		
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate		63.2	14.4	5.309	2.824	1.980
C ₁₀ H ₁₄	Butylbenzene			0.950	0.683	0.515	
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	12.8	5.645	3.042	1.875	1.271	0.924
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	6.192	3.243	1.948	1.289	0.917	0.689
C ₁₀ H ₂₀ O ₂	Decanoic acid				4.327	2.651	
C ₁₀ H ₂₂	Decane	2.188	1.277	0.838	0.598	0.453	0.359
C ₁₀ H ₂₂ O	1-Decanol			10.9	4.590		
C ₁₁ H ₂₄	Undecane		1.707	1.098	0.763	0.562	0.433
C ₁₂ H ₁₀ O	Diphenyl ether				2.130	1.407	1.023
C ₁₂ H ₂₆	Dodecane		2.277	1.383	0.930	0.673	0.514
C ₁₃ H ₁₂	Diphenylmethane					1.265	0.929
C ₁₃ H ₂₈	Tridecane		2.909	1.724	1.129	0.796	0.594
C ₁₄ H ₃₀	Tetradecane			2.128	1.376	0.953	0.697
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate	483	66.4	16.6	6.470	3.495	2.425
C ₁₆ H ₃₄	Hexadecane			3.032	1.879	1.260	0.899
C ₁₈ H ₃₈	Octadecane				2.487	1.609	1.132

THERMAL CONDUCTIVITY OF GASES

This table gives the thermal conductivity of several gases as a function of temperature. Unless otherwise noted, the values refer to a pressure of 100 kPa (1 bar) or to the saturation vapor pressure if that is less than 100 kPa. The notation $P = 0$ indicates the low pressure limiting value is given. In general, the $P = 0$ and $P = 100$ kPa values differ by less than 1%. Units are milliwatts per meter kelvin. Substances are listed in the modified Hill order.

MF	Name	Thermal conductivity in mW/m K						Ref.
		100 K	200 K	300 K	400 K	500 K	600 K	
	Air	9.4	18.4	26.2	33.3	39.7	45.7	1
Ar	Argon	6.2	12.4	17.9	22.6	26.8	30.6	2,8
BF ₃	Boron trifluoride			19.0	24.6			11
ClH	Hydrogen chloride		9.2	14.5	19.5	24.0	28.1	11
F ₆ S	Sulfur hexafluoride ($P = 0$)			13.0	20.6	27.5	33.8	16
H ₂	Hydrogen ($P = 0$)	68.6	131.7	186.9	230.4			4
H ₂ O	Water			18.7	27.1	35.7	47.1	6
	Deuterium oxide				27.0	36.5	47.6	7
H ₂ S	Hydrogen sulfide			14.6	20.5	26.4	32.4	11
H ₃ N	Ammonia			24.4	37.4	51.6	66.8	11
He	Helium ($P = 0$)	75.5	119.3	156.7	190.6	222.3	252.4	8
Kr	Krypton ($P = 0$)	3.3	6.4	9.5	12.3	14.8	17.1	8
NO	Nitric oxide		17.8	25.9	33.1	39.6	46.2	11
N ₂	Nitrogen	9.8	18.7	26.0	32.3	38.3	44.0	12
N ₂ O	Nitrous oxide		9.8	17.4	26.0	34.1	41.8	11
Ne	Neon ($P = 0$)	22.3	37.6	49.8	60.3	69.9	78.7	8
O ₂	Oxygen	9.3	18.4	26.3	33.7	41.0	48.1	10
O ₂ S	Sulfur dioxide			9.6	14.3	20.0	25.6	11
Xe	Xenon ($P = 0$)	2.0	3.6	5.5	7.3	8.9	10.4	8
CCl ₂ F ₂	Dichlorodifluoromethane			9.9	15.0	20.1	25.2	13
CF ₄	Tetrafluoromethane ($P = 0$)			16.0	24.1	32.2	39.9	16
CO	Carbon monoxide ($P = 0$)			25.0	32.3	39.2	45.7	14
CO ₂	Carbon dioxide		9.6	16.8	25.1	33.5	41.6	9
CHCl ₃	Trichloromethane			7.5	11.1	15.1		11
CH ₄	Methane		22.5	34.1	49.1	66.5	84.1	5,15
CH ₄ O	Methanol				26.2	38.6	53.0	11
C ₂ Cl ₂ F ₄	1,2-Dichlorotetrafluoroethane			10.25	15.7	21.1		13
C ₂ Cl ₃ F ₃	1,1,2-Trichlorotrifluoroethane			9.0	13.6	18.3		13
C ₂ H ₂	Acetylene			21.4	33.3	45.4	56.8	11
C ₂ H ₄	Ethylene		11.1	20.5	34.6	49.9	68.6	3
C ₂ H ₆	Ethane		11.0	21.3	35.4	52.2	70.5	5
C ₂ H ₆ O	Ethanol			14.4	25.8	38.4	53.2	11
C ₃ H ₆ O	Acetone			11.5	20.2	30.6	42.7	11
C ₃ H ₈	Propane			18.0	30.6	45.5	61.9	5
C ₄ F ₈	Perfluorocyclobutane			12.5	19.5			13
C ₄ H ₁₀	Butane			16.4	28.4	43.0	59.1	5
C ₄ H ₁₀	Isobutane			16.1	27.9	42.1	57.6	5
C ₄ H ₁₀ O	Diethyl ether			15.1	25.0	37.1		11
C ₅ H ₁₂	Pentane			14.4	24.9	37.8	52.7	11
C ₆ H ₁₄	Hexane				23.4	35.4	48.7	11

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THERMAL CONDUCTIVITY OF LIQUIDS

This table gives the thermal conductivity of some common liquids at temperatures between -25 and 100°C. All values are given in units of watts per meter kelvin (W/m K). Values refer to nominal atmospheric pressure (about 100 kPa); when an entry is given at a temperature above the normal boiling point of the substance, the pressure is understood to be the saturation vapor pressure at that temperature.

Substances are arranged by molecular formula in the modified Hill order, with compounds not containing carbon preceding those that do contain carbon.

The values for water, benzene, toluene, heptane, and dimethyl phthalate are particularly well determined and can be used for calibration purposes.

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Molecular formula	Name	Thermal conductivity in W/m K					
		-25°C	0°C	25°C	50°C	75°C	100°C
Cl ₄ Si	Silicon tetrachloride			0.099	0.096		
H ₂ O	Water		0.5610	0.6071	0.6435	0.6668	0.6791
Hg	Mercury	7.25	7.77	8.25	8.68	9.07	9.43
CCl ₄	Tetrachloromethane		0.104	0.099	0.093	0.088	
CS ₂	Carbon disulfide		0.154	0.149			
CHCl ₃	Trichloromethane	0.127	0.122	0.117	0.112	0.107	0.102
CH ₂ Br ₂	Dibromomethane	0.120	0.114	0.108	0.103	0.097	
CH ₄ O	Methanol	0.214	0.207	0.200	0.193		
C ₂ Cl ₄	Tetrachloroethylene		0.117	0.110	0.104	0.097	0.091
C ₂ HCl ₃	Trichloroethylene	0.133	0.124	0.116	0.108	0.100	
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane		0.106	0.101	0.096		
C ₂ H ₃ N	Acetonitrile	0.208	0.198	0.188	0.178	0.168	
C ₂ H ₄ O ₂	Acetic acid			0.158	0.153	0.149	0.144
C ₂ H ₅ Cl	Chloroethane	0.145	0.132	0.119	0.106	0.093	
C ₂ H ₅ NO	N-Methylformamide			0.203	0.201	0.199	0.196
C ₂ H ₆ O	Ethanol		0.176	0.169	0.162		
C ₂ H ₆ O ₂	Ethylene glycol		0.256	0.256	0.256	0.256	0.256
C ₂ H ₇ NO	Ethanolamine			0.299	0.286	0.274	0.261
C ₃ H ₅ ClO	Epichlorohydrin	0.142	0.137	0.131	0.125	0.119	0.114
C ₃ H ₆ O	Acetone		0.169	0.161			
C ₃ H ₆ O ₂	Methyl acetate	0.174	0.164	0.153	0.143	0.133	0.122
C ₃ H ₇ NO	N,N-Dimethylformamide			0.184	0.178	0.171	0.165
C ₃ H ₈ O	1-Propanol	0.162	0.158	0.154	0.149	0.145	0.141
C ₃ H ₈ O	2-Propanol	0.146	0.141	0.135	0.129	0.124	0.118
C ₃ H ₈ O ₂	1,2-Propanediol		0.202	0.200	0.199	0.198	0.197
C ₃ H ₈ O ₃	Glycerol			0.292	0.295	0.297	0.300
C ₃ H ₉ N	Trimethylamine	0.143	0.133				
C ₄ H ₄ O	Furan	0.142	0.134	0.126			
C ₄ H ₄ S	Thiophene			0.199	0.195	0.191	0.186
C ₄ H ₆	2-Butyne	0.137	0.129	0.121			
C ₄ H ₈ O	2-Butanone	0.158	0.151	0.145	0.139	0.133	
C ₄ H ₈ O	Tetrahydrofuran	0.132	0.126	0.120	0.114		
C ₄ H ₈ O ₂	1,4-Dioxane			0.159	0.147	0.135	0.123
C ₄ H ₈ O ₂	Ethyl acetate	0.162	0.153	0.144	0.135	0.126	
C ₄ H ₁₀ O	1-Butanol		0.158	0.154	0.149		
C ₄ H ₁₀ O	Diethyl ether	0.150	0.140	0.130	0.120	0.110	0.100
C ₅ H ₅ N	Pyridine		0.169	0.165	0.161	0.158	
C ₅ H ₈	Cyclopentene	0.143	0.136	0.129			
C ₅ H ₁₀	1-Pentene	0.131	0.124	0.116			
C ₅ H ₁₀	Cyclopentane	0.140	0.133	0.126			
C ₅ H ₁₂	Pentane	0.132	0.122	0.113	0.103	0.095	0.087
C ₅ H ₁₂ O	1-Pentanol		0.157	0.153	0.149	0.145	
C ₆ H ₅ Cl	Chlorobenzene	0.136	0.131	0.127	0.122	0.117	0.112

THERMAL CONDUCTIVITY OF LIQUIDS (continued)

Molecular formula	Name	Thermal conductivity in W/m K					
		-25°C	0°C	25°C	50°C	75°C	100°C
C ₆ H ₆	Benzene			0.1411	0.1329	0.1247	
C ₆ H ₆ O	Phenol				0.156	0.153	0.151
C ₆ H ₁₀	Cyclohexene	0.142	0.136	0.130	0.124	0.118	
C ₆ H ₁₀ O	Mesityl oxide	0.170	0.163	0.156	0.149	0.142	0.134
C ₆ H ₁₂	Cyclohexane			0.123	0.117	0.111	
C ₆ H ₁₂	1-Hexene	0.137	0.129	0.121	0.113		
C ₆ H ₁₂ O	Cyclohexanol			0.134	0.131		
C ₆ H ₁₂ O	2-Hexanone	0.151	0.145	0.139	0.133	0.127	0.121
C ₆ H ₁₄	Hexane	0.137	0.128	0.120	0.111	0.102	0.093
C ₆ H ₁₄ O	1-Hexanol	0.159	0.154	0.150	0.145	0.141	0.137
C ₇ H ₆ O	Benzaldehyde			0.151	0.141	0.131	0.121
C ₇ H ₈	Toluene	0.1461	0.1386	0.1311	0.1236	0.1161	
C ₇ H ₈ O	Anisole	0.170	0.163	0.156	0.150	0.143	0.136
C ₇ H ₁₆	Heptane	0.1378	0.1303	0.1228	0.1152	0.1077	
C ₇ H ₁₆ O	1-Heptanol		0.166	0.159	0.153	0.147	0.141
C ₈ H ₈	Styrene	0.148	0.142	0.137	0.131	0.126	0.120
C ₈ H ₁₀	Ethylbenzene			0.130	0.124	0.118	0.112
C ₈ H ₁₀	<i>o</i> -Xylene			0.131	0.126	0.120	0.114
C ₈ H ₁₀	<i>m</i> -Xylene			0.130	0.124	0.118	0.113
C ₈ H ₁₀	<i>p</i> -Xylene			0.130	0.124	0.118	0.112
C ₈ H ₁₈	Octane	0.143	0.135	0.128	0.120	0.113	0.106
C ₈ H ₁₈ O	1-Octanol		0.168	0.161	0.154	0.147	0.141
C ₉ H ₁₂	Cumene			0.128	0.120	0.112	0.107
C ₉ H ₁₂	Mesitylene	0.147	0.141	0.136	0.130	0.124	0.118
C ₉ H ₂₀	Nonane	0.144	0.138	0.131	0.124	0.118	0.111
C ₉ H ₂₀ O	1-Nonanol		0.166	0.161	0.155	0.149	0.143
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate		0.1501	0.1473	0.1443	0.1409	0.1373
C ₁₀ H ₁₄	<i>p</i> -Cymene	0.132	0.127	0.122	0.117	0.112	0.107
C ₁₀ H ₂₂	Decane	0.144	0.138	0.132	0.126	0.119	0.113
C ₁₀ H ₂₂ O	1-Decanol			0.162	0.156	0.150	0.145
C ₁₁ H ₂₄	Undecane			0.140	0.135	0.129	0.123
C ₁₂ H ₁₀ O	Diphenyl ether				0.139	0.135	0.131
C ₁₂ H ₂₆	Dodecane		0.157	0.152	0.146	0.140	0.135
C ₁₂ H ₂₆ O	1-Dodecanol			0.146	0.142	0.139	0.135
C ₁₃ H ₂₈	Tridecane			0.137	0.132	0.127	0.122
C ₁₄ H ₃₀	Tetradecane			0.136	0.131	0.126	0.121
C ₁₄ H ₃₀ O	1-Tetradecanol				0.167	0.162	0.157
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate	0.144	0.140	0.136	0.133	0.129	0.125
C ₁₆ H ₃₄	Hexadecane			0.140	0.135	0.130	0.125
C ₁₈ H ₃₈	Octadecane				0.146	0.142	0.137

DIFFUSION IN GASES

This table gives binary diffusion coefficients D_{12} for a number of common gases as a function of temperature. Values refer to atmospheric pressure. The diffusion coefficient is inversely proportional to pressure as long as the gas is in a regime where binary collisions dominate. See Reference 1 for a discussion of the dependence of D_{12} on temperature and composition.

The first part of the table gives data for several gases in the presence of a large excess of air. The remainder applies to equimolar mixtures of gases. Each gas pair is ordered alphabetically according to the most common way of writing the formula. The listing of pairs then follows alphabetical order by the first constituent.

REFERENCES

1. Marrero, T. R., and Mason, E. A., *J. Phys. Chem. Ref. Data*, 1, 1, 1972.
2. Kestin, J., et al., *J. Phys. Chem. Ref. Data*, 13, 229, 1984.

$D_{12}/\text{cm}^2 \text{ s}^{-1}$ for $p = 101.325 \text{ kPa}$ and the Specified T/K

System	200	273.15	293.15	373.15	473.15	573.15	673.15
Large Excess of Air							
Ar-air		0.167	0.148	0.289	0.437	0.612	0.810
CH ₄ -air			0.106	0.321	0.485	0.678	0.899
CO-air			0.208	0.315	0.475	0.662	0.875
CO ₂ -air			0.160	0.252	0.390	0.549	0.728
H ₂ -air		0.668	0.627	1.153	1.747	2.444	3.238
H ₂ O-air			0.242	0.399	0.638	0.873	1.135
He-air		0.617	0.580	1.057	1.594	2.221	2.933
SF ₆ -air				0.150	0.233	0.329	0.438
Equimolar Mixture							
Ar-CH ₄				0.306	0.467	0.657	0.876
Ar-CO		0.168	0.187	0.290	0.439	0.615	0.815
Ar-CO ₂		0.129	0.078	0.235	0.365	0.517	0.689
Ar-H ₂		0.698	0.794	1.228	1.876	2.634	3.496
Ar-He	0.381	0.645	0.726	1.088	1.617	2.226	2.911
Ar-Kr	0.064	0.117	0.134	0.210	0.323	0.456	0.605
Ar-N ₂		0.168	0.190	0.290	0.439	0.615	0.815
Ar-Ne	0.160	0.277	0.313	0.475	0.710	0.979	1.283
Ar-O ₂		0.166	0.189	0.285	0.430	0.600	0.793
Ar-SF ₆				0.128	0.202	0.290	0.389
Ar-Xe	0.052	0.095	0.108	0.171	0.264	0.374	0.498
CH ₄ -H ₂			0.782	1.084	1.648	2.311	3.070
CH ₄ -He			0.723	0.992	1.502	2.101	2.784
CH ₄ -N ₂			0.220	0.317	0.480	0.671	0.890
CH ₄ -O ₂			0.210	0.341	0.523	0.736	0.978
CH ₄ -SF ₆				0.167	0.257	0.363	0.482
CO-CO ₂			0.162	0.250	0.384		
CO-H ₂	0.408	0.686	0.772	1.162	1.743	2.423	3.196
CO-He	0.365	0.619	0.698	1.052	1.577	2.188	2.882
CO-Kr		0.131	0.581	0.227	0.346	0.485	0.645
CO-N ₂	0.133	0.208	0.231	0.336	0.491	0.673	0.878
CO-O ₂			0.202	0.307	0.462	0.643	0.849
CO-SF ₆				0.144	0.226	0.323	0.432
CO ₂ -C ₃ H ₈			0.084	0.133	0.209		
CO ₂ -H ₂	0.315	0.552	0.412	0.964	1.470	2.066	2.745
CO ₂ -H ₂ O			0.162	0.292	0.496	0.741	1.021
CO ₂ -He	0.300	0.513	0.400	0.878	1.321		
CO ₂ -N ₂			0.160	0.253	0.392	0.553	0.733
CO ₂ -N ₂ O	0.055	0.099	0.113	0.177	0.276		
CO ₂ -Ne	0.131	0.227	0.199	0.395	0.603	0.847	

DIFFUSION IN GASES (continued)

System	200	273.15	293.15	373.15	473.15	573.15	673.15
CO ₂ -O ₂			0.159	0.248	0.380	0.535	0.710
CO ₂ -SF ₆				0.099	0.155		
D ₂ -H ₂	0.631	1.079	1.219	1.846	2.778	3.866	5.103
H ₂ -He	0.775	1.320	1.490	2.255	3.394	4.726	6.242
H ₂ -Kr	0.340	0.601	0.682	1.053	1.607	2.258	2.999
H ₂ -N ₂	0.408	0.686	0.772	1.162	1.743	2.423	3.196
H ₂ -Ne	0.572	0.982	0.317	1.684	2.541	3.541	4.677
H ₂ -O ₂		0.692	0.756	1.188	1.792	2.497	3.299
H ₂ -SF ₆			0.208	0.649	0.998	1.400	1.851
H ₂ -Xe		0.513	0.122	0.890	1.349	1.885	2.493
H ₂ O-N ₂			0.242	0.399			
H ₂ O-O ₂			0.244	0.403	0.645	0.882	1.147
He-Kr	0.330	0.559	0.629	0.942	1.404	1.942	2.550
He-N ₂	0.365	0.619	0.698	1.052	1.577	2.188	2.882
He-Ne	0.563	0.948	1.066	1.592	2.362	3.254	4.262
He-O ₂		0.641	0.697	1.092	1.640	2.276	2.996
He-SF ₆			1.109	0.592	0.871	1.190	1.545
He-Xe	0.282	0.478	0.538	0.807	1.201	1.655	2.168
Kr-N ₂		0.131	0.149	0.227	0.346	0.485	0.645
Kr-Ne	0.131	0.228	0.258	0.392	0.587	0.812	1.063
Kr-Xe	0.035	0.064	0.073	0.116	0.181	0.257	0.344
N ₂ -Ne			0.258	0.483	0.731	1.021	1.351
N ₂ -O ₂			0.202	0.307	0.462	0.643	0.849
N ₂ -SF ₆				0.148	0.231	0.328	0.436
N ₂ -Xe		0.107	0.123	0.188	0.287	0.404	0.539
Ne-Xe	0.111	0.193	0.219	0.332	0.498	0.688	0.901
O ₂ -SF ₆			0.097	0.154	0.238	0.334	0.441

DIFFUSION COEFFICIENTS IN LIQUIDS AT INFINITE DILUTION

This table lists diffusion coefficients D_{AB} at infinite dilution for some binary liquid mixtures. Although values are given to two decimal places, measurements in the literature are often in poor agreement. Therefore most values in the table cannot be relied upon to better than 10%.

Solvents are listed in alphabetical order, as are the solutes within each solvent group.

REFERENCE

Landolt-Börnstein, *Numerical Data and Functional Relationships in Science and Technology*, Sixth Edition, Vol. II/5a, 1969.

Solute	Solvent	$t/^\circ\text{C}$	D_{AB} $10^{-5} \text{ cm}^2 \text{ s}^{-1}$	Solute	Solvent	$t/^\circ\text{C}$	D_{AB} $10^{-5} \text{ cm}^2 \text{ s}^{-1}$
Acetic acid	Acetone	25	3.31	Acetone	Tetrachloromethane	25	1.75
Benzoic acid	Acetone	25	2.62	Benzene	Tetrachloromethane	25	1.42
Formic acid	Acetone	25	3.77	Cyclohexane	Tetrachloromethane	25	1.30
Nitrobenzene	Acetone	20	2.94	Ethanol	Tetrachloromethane	25	1.90
Tetrachloromethane	Acetone	25	3.29	Iodine	Tetrachloromethane	30	1.63
Trichloromethane	Acetone	25	3.64	Trichloromethane	Tetrachloromethane	25	1.66
Water	Acetone	25	4.56	Acetic acid	Toluene	25	2.26
Acetic acid	Benzene	25	2.09	Benzene	Toluene	25	2.54
Aniline	Benzene	25	1.96	Benzoic acid	Toluene	25	1.49
Benzoic acid	Benzene	25	1.38	Cyclohexane	Toluene	25	2.42
Bromobenzene	Benzene	8	1.45	Formic acid	Toluene	25	2.65
2-Butanone	Benzene	30	2.09	Water	Toluene	25	6.19
Chloroethylene	Benzene	8	1.77	Acetone	Trichloromethane	25	2.55
Cyclohexane	Benzene	25	2.25	Benzene	Trichloromethane	25	2.89
Ethanol	Benzene	25	3.02	2-Butanone	Trichloromethane	25	2.13
Formic acid	Benzene	25	2.28	Butyl acetate	Trichloromethane	25	1.71
Heptane	Benzene	25	1.78	Diethyl ether	Trichloromethane	25	2.15
Methanol	Benzene	25	3.80	Ethanol	Trichloromethane	15	2.20
Toluene	Benzene	25	1.85	Ethyl acetate	Trichloromethane	25	2.02
1,2,4-Trichlorobenzene	Benzene	8	1.34	Acetic acid	Water	25	1.29
Trichloromethane	Benzene	25	2.26	Acetone	Water	25	1.28
Adipic acid	1-Butanol	30	0.40	Acetonitrile	Water	15	1.26
Benzene	1-Butanol	25	1.00	Alanine	Water	25	0.91
Biphenyl	1-Butanol	25	0.63	Allyl alcohol	Water	15	0.90
Butyric acid	1-Butanol	30	0.51	Aniline	Water	20	0.92
p-Dichlorobenzene	1-Butanol	25	0.82	Arabinose	Water	20	0.69
Methanol	1-Butanol	30	0.59	Benzene	Water	20	1.02
Oleic acid	1-Butanol	30	0.25	1-Butanol	Water	25	0.56
Propane	1-Butanol	25	1.57	Caprolactam	Water	25	0.87
Water	1-Butanol	25	0.56	Chloroethylene	Water	25	1.34
Benzene	Cyclohexane	25	1.41	Cyclohexane	Water	20	0.84
Tetrachloromethane	Cyclohexane	25	1.49	Diethylamine	Water	20	0.97
Toluene	Cyclohexane	25	1.57	Ethanol	Water	25	1.24
Allyl alcohol	Ethanol	20	0.98	Ethanolamine	Water	25	1.08
Benzene	Ethanol	25	1.81	Ethyl acetate	Water	20	1.00
Iodine	Ethanol	25	1.32	Ethylbenzene	Water	20	0.81
Iodobenzene	Ethanol	20	1.00	Ethylene glycol	Water	25	1.16
3-Methyl-1-butanol	Ethanol	20	0.81	Glucose	Water	25	0.67
Pyridine	Ethanol	20	1.10	Glycerol	Water	25	1.06
Tetrachloromethane	Ethanol	25	1.50	Glycine	Water	25	1.05
Water	Ethanol	25	1.24	Lactose	Water	15	0.38
Acetic acid	Ethyl acetate	20	2.18	Maltose	Water	15	0.38
Acetone	Ethyl acetate	20	3.18	Mannitol	Water	15	0.50
2-Butanone	Ethyl acetate	30	2.93	Methane	Water	25	1.49
Ethyl benzoate	Ethyl acetate	20	1.85	Methanol	Water	15	1.28
Nitrobenzene	Ethyl acetate	20	2.25	3-Methyl-1-butanol	Water	10	0.69
Water	Ethyl acetate	25	3.20	Methylcyclopentane	Water	20	0.85
Benzene	Heptane	25	3.91	Phenol	Water	20	0.89
Toluene	Heptane	25	3.72	1-Propanol	Water	15	0.87
Bromobenzene	Hexane	8	2.60	Propene	Water	25	1.44
2-Butanone	Hexane	30	3.74	Pyridine	Water	25	0.58
Dodecane	Hexane	25	2.73	Raffinose	Water	15	0.33
Iodine	Hexane	25	4.45	Sucrose	Water	25	0.52
Methane	Hexane	25	0.09	Toluene	Water	20	0.85
Propane	Hexane	25	4.87	Urea	Water	25	1.38
Tetrachloromethane	Hexane	25	3.70	Urethane	Water	15	0.80
Toluene	Hexane	25	4.21				

VAPOR PRESSURE OF SATURATED SALT SOLUTIONS

This table gives the vapor pressure of water above saturated solutions of some common salts at ambient temperatures. Data on pure water are given on the last line for comparison.

The references provide additional information on water activity, osmotic coefficient, and enthalpy of vaporization.

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4. Apelblat, A. and Korin, E., *J. Chem. Thermodynamics*, 30, 59, 1998.

Salt	Vapor Pressure in kPa							Ref.
	10°C	15°C	20°C	25°C	30°C	35°C	40°C	
BaCl ₂	0.971	1.443	2.073	2.887	3.903	5.133	6.576	1
Ca(NO ₃) ₂	0.701	1.015	1.381	1.772	2.154	2.487		1
CuSO ₄	1.113	1.574	2.189	2.996	4.037	5.363		3
FeSO ₄	0.978	1.516	2.208	3.035	3.950	4.884		3
KBr	0.953	1.338	1.853	2.533	3.419	4.563		3
KIO ₃	1.100	1.564	2.177	2.970	3.979	5.236	6.778	4
K ₂ CO ₃	0.541	0.802	1.134	1.536	1.997	2.499	3.016	1
LiCl	0.128	0.193	0.279	0.384				2
Mg(NO ₃) ₂	0.726	0.999	1.339	1.749	2.231	2.782	3.397	1
MnCl ₂	0.697	1.064	1.515	2.020	2.535	3.002		3
NH ₄ Cl	0.971	1.328	1.836	2.481				2
NH ₄ NO ₃	0.853	1.152	1.524	1.972				2
(NH ₄) ₂ SO ₄	0.901	1.319	1.871	2.573	3.439	4.474		3
NaBr	0.722	1.004	1.376	1.858	2.475	3.255	4.229	4
NaCl	0.921	1.285	1.768	2.401	3.218	4.262	5.581	4
NaNO ₂	0.703	0.994	1.381	1.888	2.540	3.368	4.403	4
NaNO ₃	0.884	1.244	1.719	2.335	3.121	4.109	5.333	4
RbCl	0.862	1.215	1.684	2.298	3.088	4.089	5.343	4
ZnSO ₄	0.945	1.401	1.986	2.698	3.523	4.431	5.382	1
Water	1.228	1.706	2.339	3.169	4.246	5.627	7.381	

DIFFUSION OF GASES IN WATER

This table gives values of the diffusion coefficient, D , for diffusion of several common gases in water at various temperatures. For simple one-dimensional transport, the diffusion coefficient describes the time-rate of change of concentration, dc/dt , through the equation

$$dc/dt = D d^2c/dx^2$$

where x is, for example, the perpendicular distance from a gas-liquid interface. The values below have been selected from the references indicated; in some cases data have been refitted to permit interpolation in temperature.

Gas-liquid diffusion coefficients are difficult to measure, and large differences are found between values obtained by different authors and through different experimental methods. See References 1 and 2 for a discussion of measurement techniques.

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	$D/10^{-5} \text{ cm}^2 \text{ s}^{-1}$						Ref.
	10°C	15°C	20°C	25°C	30°C	35°C	
Ar				2.5			3,4
CHCl ₂ F				1.80			5
CH ₃ Br				1.35			5
CH ₃ Cl				1.40			5
CH ₄	1.24	1.43	1.62	1.84	2.08	2.35	1
CO ₂	1.26	1.45	1.67	1.91	2.17	2.47	1
C ₂ H ₂	1.43	1.59	1.78	1.99	2.23		2
Cl ₂		1.13	1.5	1.89			2,6
HBr				3.15			6
HCl				3.07			6
H ₂	3.62	4.08	4.58	5.11	5.69	6.31	1
H ₂ S				1.36			2,6
He	5.67	6.18	6.71	7.28	7.87	8.48	1,3
Kr	1.20	1.39	1.60	1.84	2.11	2.40	1,3
NH ₃		1.3	1.5				2
NO ₂			1.23	1.4	1.59		2,6
N ₂				2.0			2
N ₂ O		1.62	2.11	2.57			2,6
Ne	2.93	3.27	3.64	4.03	4.45	4.89	1,3
O ₂		1.67	2.01	2.42			2,6
Rn	0.81	0.96	1.13	1.33	1.55	1.80	1
SO ₂			1.62	1.83	2.07	2.32	2
Xe	0.93	1.08	1.27	1.47	1.70	1.95	1,3

PROPERTIES OF ICE AND SUPERCOOLED WATER

The common form of ice at ambient temperature and pressure is hexagonal ice, designated as ice I_h (see phase diagram in Section 12). The data given here refer to that form. Data have been taken from the references indicated; values have been interpolated and smoothed in some cases. All properties are sensitive to the method of preparation of the sample, since air or other gases are sometimes occluded. For this reason there is often disagreement among values found in the literature.

Density values (except at 0°C) and the thermal expansion coefficient were calculated from the temperature variation in the crystal lattice constants of ice (see Ref. 1). The thermal expansion coefficient appears to become negative around -200°C, but there is considerable scatter in the data.

Density of ice I_h and supercooled water in g cm⁻³

<i>t</i> /°C	ρ (ice)	ρ (supercooled water)
0	0.9167	0.9998
-10	0.9187	0.9982
-20	0.9203	0.9935
-30	0.9216	0.9839
-40	0.9228	
-50	0.9240	
-60	0.9252	
-80	0.9274	
-100	0.9292	
-120	0.9305	
-140	0.9314	
-160	0.9331	
-180	0.9340	
Ref.	1	8

Phase transition properties:

$$\Delta_{\text{fus}}H(0^\circ\text{C}) = 333.6 \text{ J/g (Ref. 2)}$$

$$\Delta_{\text{sub}}H(0^\circ\text{C}) = 2838 \text{ J/g (Ref. 2)}$$

Other properties of ice I_h :

α_V : cubic thermal expansion coefficient, $\alpha_V = -(1/V)(\partial V/\partial t)_p$

κ : adiabatic compressibility, $\kappa = -(1/V)(\partial V/\partial p)_S$

ϵ : relative permittivity (dielectric constant)

k : thermal conductivity

c_p : specific heat capacity at constant pressure

PROPERTIES OF ICE AND SUPERCOOLED WATER (continued)

$t/^\circ\text{C}$	$\alpha_V/10^{-6}^\circ\text{C}^{-1}$	$\kappa/10^{-5}\text{ MPa}^{-1}$	ϵ	$k/\text{W cm}^{-1}^\circ\text{C}^{-1}$	$c_p/\text{J g}^{-1}^\circ\text{C}^{-1}$
0	159	13.0	91.6	0.0214	2.11
-10	155	12.8	94.4	0.023	2.03
-20	149	12.7	97.5	0.024	1.96
-30	143	12.5	99.7	0.025	1.88
-40	137	12.4	101.9	0.026	1.80
-50	130	12.2	106.9	0.028	1.72
-60	122	12.1	119.5	0.030	1.65
-80	105	11.9		0.033	1.50
-100	85	11.6		0.037	1.36
-120	77	11.4		0.042	1.23
-140	60	11.3		0.049	1.10
-160	45	11.2		0.057	0.97
-180	30	11.1		0.070	0.83
-200		11.0		0.087	0.67
-220		10.9		0.118	0.50
-240		10.9		0.20	0.29
-250		10.9		0.32	0.17
Ref.	1,2,3,5	1,5	6	7	1

REFERENCES

1. Eisenberg, D., and Kauzmann, W., *The Structure and Properties of Water*, Oxford University Press, Oxford, 1969.
2. Landolt-Börnstein, *Numerical Data and Functional Relationships in Science and Technology, New Series, V/1b*, Springer-Verlag, Heidelberg, 1982.
3. LaPlaca, S., and Post, B., *Acta Cryst.*, 13, 503, 1960. [Thermal expansion of lattice]
4. Brill, R., and Tippe, A., *Acta Cryst.*, 23, 343, 1967. [Thermal expansion of lattice]
5. Leadbetter, A. J., *Proc. Roy. Soc. A* 287, 403, 1965. [Compressibility and thermal expansion]
6. Auty, R. P., and Cole, R. H., *J. Chem. Phys.*, 20, 1309, 1952. [Dielectric constant]
7. Slack, G. A., *Phys. Rev. B*, 22, 3065, 1980. [Thermal conductivity]
8. Hare, D. E., and Sorensen, C. M., *J. Chem. Phys.*, 87, 4840, 1987. [Supercooled water]
9. Hobbs, P. V., *Ice Physics*, Clarendon Press, Oxford, 1974.

PROPERTIES OF LIQUID HELIUM

The following data were obtained by a critical evaluation of all existing experimental measurements on liquid helium, using a fitting procedure described in the reference. All values refer to liquid helium at saturated vapor pressure; temperatures are on the ITS-90 scale. Several properties show a singularity at the lambda point (2.1768 K).

<p>p : vapor pressure ρ : density C_s : molar heat capacity $\Delta_{\text{vap}}H$: molar enthalpy of vaporization ϵ : relative permittivity (dielectric constant)</p>	<p>σ : surface tension α : coefficient of linear expansion η : viscosity λ : thermal conductivity</p>
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REFERENCE

Donnelly, R. J., and Barenghi, C. F., *J. Phys. Chem. Reference Data* 27, 1217, 1998.

T/K	p/kPa	$\rho/\text{g cm}^{-3}$	$C_s/\text{J mol}^{-1}\text{K}^{-1}$	$\Delta_{\text{vap}}H/\text{J mol}^{-1}$	ϵ	$\sigma/\text{mN m}^{-1}$	$10^3\alpha/\text{K}^{-1}$	$\eta/\mu\text{Pa s}$	$\lambda/\text{W cm}^{-1}\text{K}^{-1}$
0.0		0.1451397	0	59.83	1.057255		0.000		
0.5		0.1451377	0.010	70.24	1.057254	0.3530	0.107		
1.0	0.01558	0.1451183	0.415	80.33	1.057246	0.3471	0.309	3.873	
1.5	0.4715	0.1451646	4.468	89.35	1.057265	0.3322	-2.36	1.346	
2.0	3.130	0.1456217	21.28	93.07	1.057449	0.3021	-12.2	1.468	
2.5	10.23	0.1448402	9.083	92.50	1.057135	0.2623	39.4	3.259	0.1497
3.0	24.05	0.1412269	9.944	94.11	1.055683	0.2161	61.5	3.517	0.1717
3.5	47.05	0.1360736	12.37	92.84	1.053615	0.1626	88.7	3.509	0.1868
4.0	81.62	0.1289745	15.96	87.00	1.050770	0.1095	129	3.319	0.1965
4.5	130.3	0.1188552	21.8	75.86	1.046725	0.0609	211		
5.0	196.0		44.7	47.67		0.0157			

SURFACE TENSION OF AQUEOUS MIXTURES

The composition dependence of the surface tension of binary mixtures of several compounds with water is given in this table. The data are tabulated as a function of the mass percent of the non-aqueous component. Data for methanol, ethanol, 1-propanol, and 2-propanol are taken from Reference 1, which also gives values at other temperatures.

REFERENCES

1. Vazquez, G., Alvarez, E., and Navaza, J. M., *J. Chem. Eng. Data*, 40, 611, 1995.
2. *Landolt-Börnstein, Numerical Data and Functional Relationships in Science and Technology, New Series, IV/16, Surface Tension*, Springer-Verlag, Heidelberg, 1997.

Surface Tension in mN/m² for the Specified Mass %

Compound	<i>t</i> /°C	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Acetic acid	30	71.2	51.4	43.3	41.2	38.2	37.4	36.1	33.5	31.5	30.2	26.3
Acetone	25	72.0	44.9	40.5	36.7	33.0	30.1	29.4	29.4	27.6	24.5	23.1
Acetonitrile	20	72.8	48.5	40.2	34.1	31.6	30.6	30.0	29.6	29.1	28.7	28.4
1,2-Butanediol	25	72.0	66.1	60.4	55.1	50.1	45.6	43.3	41.9	40.8	39.2	35.8
1,3-Butanediol	30	71.2	58.1	51.6	48.7	45.8	43.9	42.4	41.2	40.0	39.0	37.0
1,4-Butanediol	30	71.2	61.2	56.9	54.2	52.0	50.7	49.5	47.9	46.6	45.2	43.8
Butanoic acid	30	71.2	42.4	37.5	35.5	34.8	32.2	30.8	29.2	27.4	26.3	25.5
2-Butanone	20	72.8	41.6	32.2				25.2				24.6
γ -Butyrolactone	30	71.2	64	58	53	50	48	46	45	44	42.8	42.7
Chloroacetic acid	25	72.0	59.8	53.6	51.3	49.7	48.3	47.5	46.1			
Diethanolamine	25	72.0	66.8	63.2	60.7	58.8	57.2	55.7	54.3	52.7	50.6	47.2
<i>N,N</i> -Dimethylacetamide	25	72.0	72.0	72.0	72.4	73.5	74.9	75.4	73.0	65.7	54.7	36.4
<i>N,N</i> -Dimethylformamide	25	72.0	65.4	59.2	53.8	49.6	47.3	46.9	44.9	42.3	38.4	35.2
1,4-Dioxane	25	72.0					41.2	39.6	37.9	36.2	34.5	33.7
Ethanol	25	72.01	47.53	37.97	32.98	30.16	27.96	26.23	25.01	23.82	22.72	21.82
Ethylene glycol	20	72.8	68.5	64.9	61.9		57.0					48.2
Formic acid	20	72.8	66	60	55.7	52.2	50.3	48.8	47.1	44.7	40.9	38.0
Glycerol	25	72.0	70.5	69.5	68.5	67.9	67.4	66.9	66.5	65.7	64.5	62.5
Methanol	25	72.01	56.18	47.21	41.09	36.51	32.86	29.83	27.48	25.54	23.93	22.51
Morpholine	20	72.8	65.1	60.7	58.9	56.7	53.0	49.6	47.0	43.7	41.8	38.7
Nitric acid	20	72.8	71.9	70.7	68.9	66.6	63.8	60.6	56.8	52.6	47.9	42.6
Propanoic acid	30	71.2	46.6	42.2	37.7	35.6	33.1	31.7	30.2	28.2	27.4	25.8
1-Propanol	25	72.01	34.32	27.84	25.98	25.26	24.80	24.49	24.08	23.86	23.59	23.28
2-Propanol	25	72.01	40.42	30.57	26.82	25.27	24.26	23.51	22.68	22.14	21.69	21.22
1,2-Propylene glycol	30	71.2	60.5	54.9	50.7	47.2	44.5	41.5	38.6	37.6	36.3	35.5
1,3-Propylene glycol	30	71.2	62.6	58.8	55.7	53.8	52.8	51.7	50.8	49.6	48.2	47.0
Pyridine	25	72.0	52.8	51.2	48.0	46.8	46.6	45.8	45.0	43.6	40.9	37.0
Sulfolane	20	72.8					62.5	61.6	59.6	57.1	54.9	50.9
Sulfuric acid	50	67.9	73.5	75.1	73.6	71.2	68.0	64.1	60.0	56.4	53.6	51.7
Trichloroacetaldehyde	25	72.0	56.7	51.0	46.7	44.1	43.0	42.5	41.5	38.9	34.7	29.4
Trichloroacetic acid	25	72.0	55.8	46.5	42.8	41.6	40.6	39.4	38.3	37.4	36.5	

VISCOSITY OF CARBON DIOXIDE ALONG THE SATURATION LINE

The table below gives the viscosity of gas and liquid CO₂ along the liquid-vapor saturation line.

REFERENCES

1. Fenghour, A., Wakeham, W. A., and Vesovic, V., *J. Phys. Chem. Ref. Data*, 27, 31, 1998.
2. Angus, S., et al., *International Tables for the Fluid State: Carbon Dioxide*, Pergamon Press, Oxford, 1976.

<i>T</i> /K	<i>P</i> /kPa	Gas $\eta/\mu\text{Pa s}$	Liquid $\eta/\mu\text{Pa s}$
205	227	10.33	
210	327	10.60	
215	465	10.87	
220	600	11.13	241.68
225	735	11.41	221.72
230	894	11.69	203.75
235	1075	11.98	187.48
240	1283	12.27	172.67
245	1519	12.58	159.13
250	1786	12.90	146.69
255	2085	13.24	135.20
260	2419	13.61	124.30
265	2790	14.02	114.63
270	3203	14.47	105.21
275	3658	14.99	96.44
280	4160	15.61	87.89
285	4712	16.37	79.64
290	5315	17.36	71.47
295	5984	18.79	63.01
300	6710	21.29	53.33
302	6997	23.52	48.30

PERMITTIVITY (DIELECTRIC CONSTANT) OF WATER AS A FUNCTION OF TEMPERATURE AND PRESSURE

The following table summarizes the relative permittivity (static dielectric constant) of liquid water and steam over a wide range of temperature and pressure. Values are given from slightly above the freezing point to 1000 K and at pressures from normal atmospheric to 1000 MPa (about 10000 atm). The values are generated from an equation that correlates the best experimental measurements from a large number of sources. The correlating equation and full details of the formulation may be found in Reference 1.

Temperatures are given on the ITS-90 scale. Liquid–vapor boundaries are indicated by horizontal lines.

REFERENCE

Fernandez, D. P., Goodwin, A. R. H., Lemmon, E. W., Levelt Sengers, J. M. H., and Williams, R. C., *J. Phys. Chem. Ref. Data*, 26, 1125, 1997.

T/K	Pressure in MPa										
	0.1	1	2	5	10	20	50	100	200	500	1000
275	87.16	87.20	87.24	87.36	87.57	87.97	89.16	91.05	94.55	103.7	
280	85.19	85.23	85.27	85.39	85.59	85.98	87.14	88.98	92.38	101.3	
285	83.27	83.30	83.34	83.46	83.65	84.04	85.17	86.96	90.27	98.91	
290	81.39	81.42	81.46	81.57	81.76	82.14	83.24	84.99	88.22	96.64	
295	79.55	79.58	79.62	79.73	79.92	80.29	81.37	83.08	86.24	94.44	
300	77.75	77.78	77.82	77.93	78.11	78.48	79.54	81.22	84.31	92.31	
305	75.99	76.02	76.06	76.17	76.35	76.71	77.75	79.40	82.43	90.25	101.3
310	74.27	74.30	74.33	74.44	74.62	74.98	76.01	77.63	80.61	88.26	99.06
315	72.58	72.61	72.65	72.76	72.93	73.28	74.30	75.90	78.84	86.34	96.87
320	70.93	70.97	71.00	71.11	71.28	71.63	72.64	74.22	77.11	84.48	94.76
340	64.70	64.73	64.77	64.87	65.04	65.38	66.36	67.89	70.65	77.58	87.07
360	<u>59.00</u>	59.03	59.07	59.17	59.34	59.68	60.65	62.15	64.83	71.45	80.36
380	1.006	53.83	53.86	53.97	54.14	54.48	55.45	56.94	59.57	65.95	74.43
400	1.005	49.06	49.10	49.21	49.39	49.73	50.71	52.20	54.80	61.00	69.12
420	1.005	44.70	44.74	44.85	45.04	45.39	46.39	47.90	50.48	56.53	64.35
440	1.004	<u>40.70</u>	40.74	40.85	41.05	41.42	42.45	43.98	46.55	52.48	60.03
460	1.004	1.041	37.04	37.17	37.37	37.76	38.84	40.40	42.99	48.81	56.11
480	1.004	1.038	<u>33.61</u>	33.75	33.97	34.39	35.53	37.14	39.75	45.47	52.55
500	1.003	1.034	1.074	<u>30.55</u>	30.79	31.25	32.47	34.15	36.79	42.44	49.30
550	1.003	1.028	1.059	1.177	<u>23.53</u>	24.18	25.73	27.67	30.46	35.99	42.38
600	1.002	1.024	1.049	1.137	1.365	<u>17.50</u>	19.90	22.29	25.34	30.82	36.82
650	1.002	1.020	1.041	1.112	1.267	2.066	14.50	17.72	21.12	26.62	32.31
700	1.002	1.017	1.036	1.095	1.214	1.603	8.963	13.75	17.60	23.17	28.60
750	1.002	1.015	1.031	1.082	1.179	1.452	4.424	10.34	14.65	20.30	25.51
800	1.001	1.013	1.027	1.071	1.154	1.365	2.844	7.562	12.17	17.88	22.91
850	1.001	1.012	1.024	1.063	1.134	1.307	2.269	5.571	10.10	15.83	20.70
900	1.001	1.011	1.022	1.056	1.118	1.265	1.975	4.284	8.416	14.08	18.80
950	1.001	1.010	1.020	1.050	1.105	1.232	1.793	3.477	7.066	12.57	17.15
1000	1.001	1.009	1.018	1.046	1.095	1.206	1.668	2.956	6.003	11.27	15.72
1050	1.001	1.008	1.016	1.041	1.086	1.184	1.576	2.601	5.172	10.14	14.45
1100	1.001	1.007	1.015	1.038	1.078	1.167	1.505	2.347	4.523	9.160	13.34
1150	1.001	1.007	1.014	1.035	1.072	1.151	1.449	2.158	4.012	8.309	12.35
1200	1.001	1.006	1.013	1.032	1.066	1.139	1.403	2.011	3.606	7.569	11.47

VISCOSITY AND DENSITY OF AQUEOUS HYDROXIDE SOLUTIONS

The viscosity and density of aqueous hydroxide solutions at 25°C is tabulated here as a function of concentration. Viscosity is given in millipascal second, which is equal to the c.g.s. unit centipoise (cP). The last entry in each column refers to the saturated solution.

REFERENCE

Sipos, P. M., Hefter, G., and May, P. M., *J. Chem. Eng. Data* 45, 613, 2000.

Viscosity in mPa s

c/mol L ⁻¹	LiOH	NaOH	KOH	CsOH	(CH ₃) ₄ NOH
0.5	1.017	0.997	0.937	0.91	1.017
1.0	1.169	1.116	0.990	0.94	1.186
1.5	1.340	1.248	1.050	0.97	1.430
2.0	1.537	1.396	1.116	1.03	1.762
3.0	2.050	1.754	1.269	1.19	3.031
4.0	2.734	2.228	1.448	1.41	7.238
5.0		2.867	1.657	1.67	
6.0		3.727	1.902	1.98	
7.0		4.869	2.196	2.40	
8.0		6.351	2.554	3.09	
9.0		8.230	3.005	4.31	
10.0		10.554	3.581	6.46	
11.0		13.362	4.328		
12.0		16.677	5.303		
13.0		20.503	6.577		
14.0		24.826	8.235		
15.0		29.604			
16.0		34.767			
17.0		40.212			
18.0		45.800			
19.0		51.354			
Sat.	3.311	51.911	8.526		8.850

Density in g/cm³

c/mol L ⁻¹	LiOH	NaOH	KOH	CsOH	(CH ₃) ₄ NOH
0.5	1.012	1.019	1.022	1.063	0.999
1.0	1.025	1.040	1.045	1.128	1.002
1.5	1.038	1.059	1.068	1.193	1.005
2.0	1.050	1.078	1.090	1.257	1.009
3.0	1.072	1.115	1.133	1.383	1.019
4.0	1.093	1.149	1.174	1.508	1.030
5.0		1.182	1.214	1.632	
6.0		1.213	1.253	1.755	
7.0		1.243	1.290	1.876	
8.0		1.271	1.326	1.997	
9.0		1.299	1.362	2.117	
10.0		1.325	1.396	2.236	
11.0		1.350	1.429	2.354	
12.0		1.374	1.462	2.471	
13.0		1.397	1.494	2.587	
14.0		1.419	1.524	2.703	
15.0		1.441			
16.0		1.461			
17.0		1.481			
18.0		1.499			
19.0		1.517			
Sat.	1.109	1.519	1.529	2.800	1.032

VAPOR PRESSURE OF MERCURY

The following table gives the vapor pressure of mercury in kilopascals (100 kPa = 1 bar) from 0°C to 800°C.

REFERENCES

1. Vukalovich, M. P., and Fokin, L. R., *Thermophysical Properties of Mercury*, Standards Press (USSR), 1972.
2. Vargaftik, N. B., Vinogradov, Y. K., and Yargin, V. S., *Handbook of Physical Properties of Liquids and Gases, Third Edition*, Begell House, New York, 1996.

<i>t</i> /°C	<i>p</i> /kPa	<i>t</i> /°C	<i>p</i> /kPa	<i>t</i> /°C	<i>p</i> /kPa
0	2.728x10 ⁻⁵	270	16.527	540	1290.1
10	7.101x10 ⁻⁵	280	20.993	550	1434.0
20	1.729x10 ⁻⁴	290	26.435	560	1589.9
30	3.680x10 ⁻⁴	300	33.015	570	1758.4
40	8.626x10 ⁻⁴	310	40.910	580	1940.3
50	1.786x10 ⁻³	320	50.320	590	2136
60	3.536x10 ⁻³	330	61.460	600	2346
70	6.724x10 ⁻³	340	74.567	610	2572
80	0.01232	350	89.896	620	2814
90	0.02128	360	107.72	630	3072
100	0.03745	370	128.34	640	3347
110	0.06247	380	152.07	650	3641
120	0.1015	390	179.25	660	3953
130	0.1608	400	210.24	670	4285
140	0.2491	410	245.4	680	4636
150	0.3778	420	285.2	690	5009
160	0.5618	430	329.9	700	5403
170	0.8204	440	380.1	710	5820
180	1.178	450	436.2	720	6259
190	1.664	460	498.6	730	6722
200	2.315	470	567.9	740	7210
210	3.177	480	644.6	750	7722
220	4.304	490	729.2	760	8260
230	5.758	500	822.2	770	8825
240	7.614	510	924.2	780	9417
250	9.959	520	1035.8	790	10037
260	12.892	530	1157.6	800	10685

VISCOSITY OF LIQUID METALS

This table gives the viscosity of several liquid metals as a function of temperature. Experimental data from some of the references was smoothed to produce the table. Viscosity is given in millipascal second (mPa s), which equals the c.g.s. unit centipoise (cP).

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Viscosity in mPa s

$t/^{\circ}\text{C}$	Lithium	Sodium	Potassium	Rubidium	Cesium	Gallium
50				0.542	0.598	1.921
100		0.687	0.441	0.435	0.469	1.608
150		0.542	0.358	0.365	0.389	1.397
200	0.566	0.451	0.303	0.316	0.334	1.245
250	0.503	0.387	0.263	0.280	0.294	1.130
300	0.453	0.341	0.234	0.252	0.264	1.040
350	0.412	0.306	0.211	0.230	0.240	0.968
400	0.379	0.278	0.193	0.212	0.221	0.909
450	0.352	0.255	0.178	0.197	0.206	0.859
500	0.328	0.237	0.166	0.185	0.192	0.817
550	0.308	0.221	0.155	0.174	0.181	0.781
600	0.290	0.208	0.146	0.165	0.171	0.750
650	0.275	0.196	0.138	0.157	0.163	0.722
700	0.261	0.186	0.132	0.150	0.156	0.698
750	0.249	0.177	0.126	0.143	0.149	0.677
800	0.238	0.170	0.120	0.138	0.143	0.657
850	0.228	0.163	0.115	0.133	0.138	0.640
900	0.219	0.156	0.111	0.128	0.134	0.624
950	0.211	0.151	0.107	0.124	0.129	0.610
1000	0.204	0.146	0.104	0.120	0.125	0.597
1050	0.197	0.141	0.101	0.117	0.122	0.585
1100	0.191	0.137	0.098	0.114	0.119	0.574
1150	0.185	0.133	0.095	0.111	0.116	
1200	0.180	0.129	0.092	0.108	0.113	
1250	0.175	0.126	0.090	0.105	0.110	
1300	0.170	0.123	0.088	0.103	0.108	
1350	0.166	0.120	0.086	0.101	0.106	
1400	0.162	0.117	0.084	0.099	0.104	
1450	0.158	0.115	0.082	0.097	0.102	
1500	0.155	0.113	0.081	0.095	0.100	
1550	0.151	0.110	0.079	0.093	0.098	
1600	0.148	0.108	0.078	0.092	0.097	
1650	0.145	0.106	0.076	0.090	0.095	
1700	0.142	0.105	0.075		0.094	
1750	0.139	0.103	0.074		0.092	
1800	0.137	0.101			0.091	
1850	0.135	0.100			0.090	
1900	0.132	0.098			0.089	
1950	0.130	0.097			0.088	
2000	0.128	0.096			0.086	

VISCOSITY OF LIQUID METALS (continued)

<i>t</i> /°C	Viscosity in mPa s							
	Aluminum	Calcium	Cobalt	Gold	Indium	Magnesium	Nickel	Silver
250					1.35			
300					1.22			
350					1.12			
400					1.04			
450					0.98			
700	1.289					1.10		
750	1.200					0.96		
800	1.115					0.84		
850	1.028	1.107				0.74		
900		0.959				0.67		
1000								3.80
1050								3.56
1100				5.130				3.31
1150				4.874				3.06
1200				4.640				2.82
1250				4.429				2.61
1300				4.240				2.42
1350								2.28
1400								2.20
1450								2.19
1500			4.15				4.35	
1550			3.89				4.09	
1600			3.64				3.87	
1650			3.41				3.67	
1700			3.20				3.49	
1750			2.99				3.32	

PROPERTIES OF AMINO ACIDS

This table gives selected properties of some important amino acids and closely related compounds. The first part of the table lists the 20 “standard” amino acids that are the basic constituents of proteins (structures of these amino acids may be found in the following table). The second part includes other amino acids and related compounds of biochemical importance. Within each part of the table the compounds are listed by name in alphabetical order.

Symbol — Three-letter symbol for the standard amino acids

M_r — Molecular weight

t_m — Melting point

pK_a , pK_b , pK_c , pK_d — Negative of the logarithm of the acid dissociation constants for the COOH and NH₂ groups (and, in some cases, other groups) in the molecule (at 25°C)

pI — pH at the isoelectric point

S — Solubility in water at 25°C in units of grams of compound per kilogram of water; when quantitative data are not available, the notations s.l.s. (for slightly soluble) and v.s. (for very soluble) are used.

Data on the enthalpy of formation of many of these compounds are included in the table “Standard Thermodynamic Properties of Chemical Substances” in Section 5 of this Handbook. Absorption spectra and optical rotation data can be found in Reference 3. Partial molar volume and other thermodynamic properties, including solubility as a function of temperature, are given in References 3 and 5. Most of the pK values come from Reference 7.

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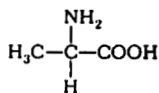
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The standard amino acids:

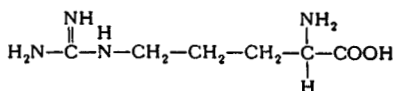
Symbol	Name	Mol. form.	M_r	t_m /°C	pK_a	pK_b	pK_c	pI	S/g kg ⁻¹
Ala	Alanine	C ₃ H ₇ NO ₂	89.09	297	2.33	9.71		6.00	165.0
Arg	Arginine	C ₆ H ₁₄ N ₄ O ₂	174.20	244	2.03	9.00	12.10	10.76	182.6
Asn	Asparagine	C ₄ H ₈ N ₂ O ₃	132.12	235	2.16	8.73		5.41	25.1
Asp	Aspartic acid	C ₄ H ₇ NO ₄	133.10	270	1.95	9.66	3.71	2.77	4.95
Cys	Cysteine	C ₃ H ₇ NO ₂ S	121.16	240	1.91	10.28	8.14	5.07	v.s.
Glu	Glutamic acid	C ₅ H ₉ NO ₄	147.13	160	2.16	9.58	4.15	3.22	8.61
Gln	Glutamine	C ₅ H ₁₀ N ₂ O ₃	146.15	185	2.18	9.00		5.65	42
Gly	Glycine	C ₂ H ₅ NO ₂	75.07	290	2.34	9.58		5.97	250.9
His	Histidine	C ₆ H ₉ N ₃ O ₂	155.16	287	1.70	9.09	6.04	7.59	43.5
Ile	Isoleucine	C ₆ H ₁₃ NO ₂	131.17	284	2.26	9.60		6.02	34.2
Leu	Leucine	C ₆ H ₁₃ NO ₂	131.17	293	2.32	9.58		5.98	22.0
Lys	Lysine	C ₆ H ₁₄ N ₂ O ₂	146.19	224	2.15	9.16	10.67	9.74	5.8
Met	Methionine	C ₅ H ₁₁ NO ₂ S	149.21	281	2.16	9.08		5.74	56
Phe	Phenylalanine	C ₉ H ₁₁ NO ₂	165.19	283	2.18	9.09		5.48	27.9
Pro	Proline	C ₅ H ₉ NO ₂	115.13	221	1.95	10.47		6.30	1623
Ser	Serine	C ₃ H ₇ NO ₃	105.09	228	2.13	9.05		5.68	50.2
Thr	Threonine	C ₄ H ₉ NO ₃	119.12	256	2.20	8.96		5.60	98.1
Trp	Tryptophan	C ₁₁ H ₁₂ N ₂ O ₂	204.23	289	2.38	9.34		5.89	13.2
Tyr	Tyrosine	C ₉ H ₁₁ NO ₃	181.19	343	2.24	9.04	10.10	5.66	0.46
Val	Valine	C ₅ H ₁₁ NO ₂	117.15	315	2.27	9.52		5.96	88.5

STRUCTURES OF COMMON AMINO ACIDS

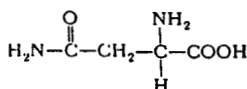
Alanine
(Ala, A)



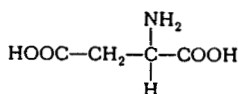
Arginine
(Arg, R)



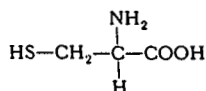
Asparagine
(Asn, N)



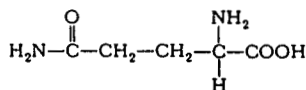
Aspartic acid
(Asp, D)



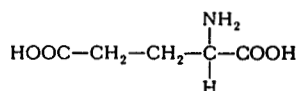
Cysteine
(Cys, C)



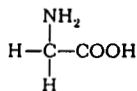
Glutamine
(Gln, Q)



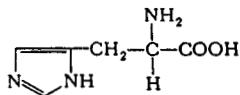
Glutamic acid
(Glu, E)



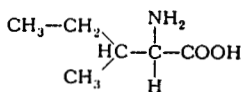
Glycine
(Gly, G)



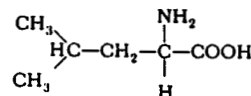
Histidine
(His, H)



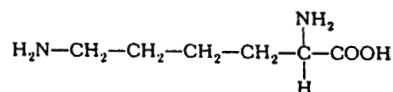
Isoleucine
(Ile, I)



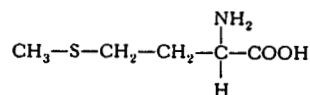
Leucine
(Leu, L)



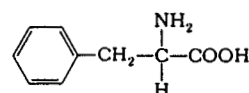
Lysine
(Lys, K)



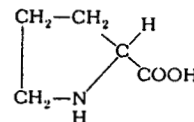
Methionine
(Met, M)



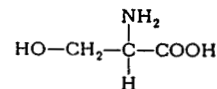
Phenylalanine
(Phe, F)



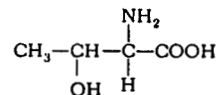
Proline
(Pro, P)



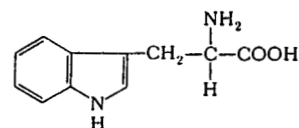
Serine
(Ser, S)



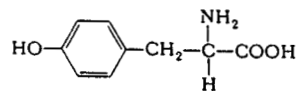
Threonine
(Thr, T)



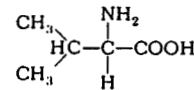
Tryptophan
(Trp, W)



Tyrosine
(Tyr, Y)



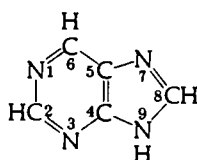
Valine
(Val, V)



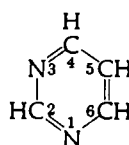
PROPERTIES OF PURINE AND PYRIMIDINE BASES

This table lists some of the important purine and pyrimidine bases that occur in nucleic acids. The pK_a values (negative logarithm of the acid dissociation constant) are given for each ionization stage. The last column gives the aqueous solubility S at the indicated temperature in units of grams per 100 grams of solution.

The numbering system in the rings is:



Purine



Pyrimidine

REFERENCES

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2. S. Budavari, Ed., *The Merck Index*, 11th Ed., Merck and Co., Rahway, NJ., 1989.

Common name	Systematic name	Mol form.	Mol. wt.	pK_a values			S /mass % (temp.)
Pyrimidines							
Cytosine	4-Amino-2-hydroxypyrimidine	$C_4H_5N_3O$	111.10	4.5	12.2		0.76 (25°C)
5-Methylcytosine	4-Amino-2-hydroxy-5-methylpyrimidine	$C_5H_7N_3O$	125.13	4.6	12.4		0.45 (25°C)
5-Hydroxymethylcytosine	4-Amino-2-hydroxy-5-hydroxymethylpyrimidine	$C_5H_7N_3O_2$	141.13	4.3	13		
Uracil	2,4-Dihydroxypyrimidine	$C_4H_4N_2O_2$	112.09	0.5	9.5	>13	0.36 (25°C)
Thymine	5-Methyluracil	$C_5H_6N_2O_2$	126.11	9.9	>13		0.4 (25°C)
Orotic acid	Uracil-6-carboxylic acid	$C_5H_4N_2O_4$	156.10	2.4	9.5	>13	0.18 (18°C)
Purines							
Adenine	6-Aminopurine	$C_5H_5N_5$	135.14	<1	4.1	9.8	0.09 (25°C)
Guanine	2-Amino-6-hydroxypurine	$C_5H_5N_5O$	151.13	3.3	9.2	12.3	0.004 (40°C)
7-Methylguanine	7-Methyl-2-amino-6-hydroxypurine	$C_6H_7N_5O$	165.16	3.5	9.9		
Isoguanine	6-Amino-2-hydroxypurine	$C_5H_5N_5O$	151.13	4.5	9.0		0.006 (25°C)
Xanthine	2,6-Dioxopurine	$C_5H_4N_4O_2$	152.11	0.8	7.4	11.1	0.05 (20°C)
Hypoxanthine	6-Hydroxypurine	$C_5H_4N_4O$	136.11	2.0	8.9	12.1	0.07 (19°C)
Uric acid	2,6,8-Trihydroxypurine	$C_5H_4N_4O_3$	168.11	5.4	11.3		0.002 (20°C)

THE GENETIC CODE

This table gives the correspondence between a messenger RNA codon and the amino acid which it specifies. The symbols for bases in the codon are:

- U: uracil
- C: cytosine
- A: adenine
- G: guanine

The amino acid symbols are given in the table entitled "Structures of Common Amino Acids". A chain-initiating codon is indicated by **init** and a chain-terminating codon by **term**.

Example: UCA codes for **Ser**, UAC codes for **Tyr**, etc.

First position	Second position				Third position
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	term	term	A
	Leu	Ser	term	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met (init)	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val (init)	Ala	Glu	Gly	G

PROPERTIES OF FATTY ACIDS

This table gives the systematic names and selected properties of some of the more important fatty acids of five or more carbon atoms. Compounds are listed first by degree of saturation and, secondly, by number of carbon atoms. The following data are included:

M_r : Molecular weight
 t_m : Melting point in °C

S: Aqueous solubility at 20°C in units of grams of solute per 100 grams of water

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2. Fasman, G. D., Ed., *Practical Handbook of Biochemistry and Molecular Biology*, CRC Press, Boca Raton, FL, 1989.

Common name	Systematic name	Mol. form.	M_r	$t_m/^\circ\text{C}$	S
Saturated					
Valeric acid	Pentanoic acid	$\text{C}_5\text{H}_{10}\text{O}_2$	102.13	-34	2.5
Isovaleric acid	3-Methylbutanoic acid	$\text{C}_5\text{H}_{10}\text{O}_2$	102.13	-29.3	4.3
Caproic acid	Hexanoic acid	$\text{C}_6\text{H}_{12}\text{O}_2$	116.16	-3	0.967
Enanthic acid	Heptanoic acid	$\text{C}_7\text{H}_{14}\text{O}_2$	130.19	-7.5	0.24
Caprylic acid	Octanoic acid	$\text{C}_8\text{H}_{16}\text{O}_2$	144.21	16.3	0.080
Pelargonic acid	Nonanoic acid	$\text{C}_9\text{H}_{18}\text{O}_2$	158.24	12.3	0.0284
Capric acid	Decanoic acid	$\text{C}_{10}\text{H}_{20}\text{O}_2$	172.27	31.9	0.015
Lauric acid	Dodecanoic acid	$\text{C}_{12}\text{H}_{24}\text{O}_2$	200.32	43.2	0.0055
Tridecylic acid	Tridecanoic acid	$\text{C}_{13}\text{H}_{26}\text{O}_2$	214.35	41.5	0.0033
Myristic acid	Tetradecanoic acid	$\text{C}_{14}\text{H}_{28}\text{O}_2$	228.38	53.9	0.0020
Pentadecylic acid	Pentadecanoic acid	$\text{C}_{15}\text{H}_{30}\text{O}_2$	242.40	52.3	0.0012
Palmitic acid	Hexadecanoic acid	$\text{C}_{16}\text{H}_{32}\text{O}_2$	256.43	63.1	0.00072
Margaric acid	Heptadecanoic acid	$\text{C}_{17}\text{H}_{34}\text{O}_2$	270.46	61.3	0.00042
Stearic acid	Octadecanoic acid	$\text{C}_{18}\text{H}_{36}\text{O}_2$	284.48	69.6	0.00029
Arachidic acid	Eicosanoic acid	$\text{C}_{20}\text{H}_{40}\text{O}_2$	312.54	76.5	
Phytanic acid	3,7,11,15-Tetramethylhexadecanoic acid	$\text{C}_{20}\text{H}_{40}\text{O}_2$	312.54	-65	
Behenic acid	Docosanoic acid	$\text{C}_{22}\text{H}_{44}\text{O}_2$	340.59	81.5	
Lignoceric acid	Tetracosanoic acid	$\text{C}_{24}\text{H}_{48}\text{O}_2$	368.64	87.5	
Cerotic acid	Hexacosanoic acid	$\text{C}_{26}\text{H}_{52}\text{O}_2$	396.70	88.5	
Montanic acid	Octacosanoic acid	$\text{C}_{28}\text{H}_{56}\text{O}_2$	424.75	90.9	
Monounsaturated					
Caproleic acid	9-Decenoic acid	$\text{C}_{10}\text{H}_{18}\text{O}_2$	170.25	26.5	
Palmitoleic acid	<i>cis</i> -9-Hexadecenoic acid	$\text{C}_{16}\text{H}_{30}\text{O}_2$	254.41	-0.1	
Oleic acid	<i>cis</i> -9-Octadecenoic acid	$\text{C}_{18}\text{H}_{34}\text{O}_2$	282.47	13.4	
Elaidic acid	<i>trans</i> -9-Octadecenoic acid	$\text{C}_{18}\text{H}_{34}\text{O}_2$	282.47	45	
Vaccenic acid	<i>trans</i> -11-Octadecenoic acid	$\text{C}_{18}\text{H}_{34}\text{O}_2$	282.47	44	
Erucic acid	<i>cis</i> -13-Docosenoic acid	$\text{C}_{22}\text{H}_{42}\text{O}_2$	338.57	34.7	
Brassicic acid	<i>trans</i> -13-Docosenoic acid	$\text{C}_{22}\text{H}_{42}\text{O}_2$	338.57	61.9	
Nervonic acid	<i>cis</i> -15-Tetracosenoic acid	$\text{C}_{24}\text{H}_{46}\text{O}_2$	366.63	43	
Diunsaturated					
Linoleic acid	<i>cis,cis</i> -9,12-Octadecadienoic acid	$\text{C}_{18}\text{H}_{32}\text{O}_2$	280.45	-12	
Triunsaturated					
<i>cis</i> -Eleostearic acid	<i>trans,cis,trans</i> -9,11,13-Octadecatrienoic acid	$\text{C}_{18}\text{H}_{30}\text{O}_2$	278.44	49	
<i>trans</i> -Eleostearic acid	<i>trans,trans,trans</i> -9,11,13-Octadecatrienoic acid	$\text{C}_{18}\text{H}_{30}\text{O}_2$	278.44	71.5	
Linolenic acid	<i>cis,cis,cis</i> -9,12,15-Octadecatrienoic acid	$\text{C}_{18}\text{H}_{30}\text{O}_2$	278.44	-11	
Tetraunsaturated					
Arachidonic acid	5,8,11,14-Eicosatetraenoic acid, (all- <i>trans</i>)	$\text{C}_{20}\text{H}_{32}\text{O}_2$	304.47	-49.5	

CARBOHYDRATE NAMES AND SYMBOLS

The following table lists the systematic names and symbols for selected carbohydrates and some of their derivatives. The symbols for monosaccharide residues and derivatives are recommended by IUPAC for use in describing the structures of oligosaccharide chains. A more complete list can be found in the reference.

REFERENCE

McNaught, A. D., *Pure Appl. Chem.*, 68, 1919-2008, 1996.

Common Name	Symbol	Systematic Name
Abequose	Abe	3,6-Dideoxy-D- <i>xylo</i> -hexose
<i>N</i> -Acetyl-2-deoxyneur-2-enaminic acid	Neu2en5Ac	
<i>N</i> -Acetylgalactosamine	GalNAc	
<i>N</i> -Acetylglucosamine	GlcNAc	
<i>N</i> -Acetylneuraminic acid	Neu5Ac	
Allose	All	<i>allo</i> -Hexose
Altrose	Alt	<i>altro</i> -Hexose
Apiose	Api	3- <i>C</i> -(Hydroxymethyl)- <i>glycero</i> -tetrose
Arabinitol	Ara-ol	Arabinitol
Arabinose	Ara	<i>arabino</i> -Pentose
Arcanose		2,6-Dideoxy-3- <i>C</i> -methyl-3- <i>O</i> -methyl- <i>xylo</i> -hexose
Ascarylose		3,6-Dideoxy-L- <i>arabino</i> -hexose
Boivinos		2,6-Dideoxy-D-gulose
Chalcos		4,6-Dideoxy-3- <i>O</i> -methyl-D- <i>xylo</i> -hexose
Cladinose		2,6-Dideoxy-3- <i>C</i> -methyl-3- <i>O</i> -methyl-L- <i>ribo</i> -hexose
Colitose		3,6-Dideoxy-L- <i>xylo</i> -hexose
Cymarose		6-Deoxy-3- <i>O</i> -methyl- <i>ribo</i> -hexose
3-Deoxy-D- <i>manno</i> -oct-2-ulosonic acid	Kdo	
2-Deoxyribose	dRib	2-Deoxy- <i>erythro</i> -pentose
2,3-Diamino-2,3-dideoxy-D-glucose	GlcN3N	
Diginose		2,6-Dideoxy-3- <i>O</i> -methyl- <i>lyxo</i> -hexose
Digitalose		6-Deoxy-3- <i>O</i> -methyl-D-galactose
Digitoxose		2,6-Dideoxy-D- <i>ribo</i> -hexose
3,4-Di- <i>O</i> -methylrhamnose	Rha3,4Me ₂	
Ethyl glucopyranuronate	Glc _p A6Et	
Evalose		6-Deoxy-3- <i>C</i> -methyl-D-mannose
Fructose	Fru	<i>arabino</i> -Hex-2-ulose
Fucitol	Fuc-ol	6-Deoxy-D-galactitol
Fucose	Fuc	6-Deoxygalactose
β-D-Galactopyranose 4-sulfate	β-D-Galp4S	
Galactosamine	GalN	2-Amino-2-deoxygalactose
Galactose	Gal	<i>galacto</i> -Hexose
Glucitol	Glc-ol	
Glucosamine	GlcN	2-Amino-2-deoxyglucose
Glucose	Glc	<i>gluco</i> -Hexose
Glucuronic acid	GlcA	
<i>N</i> -Glycolylneuraminic acid	Neu5Gc	
Gulose	Gul	<i>gulo</i> -Hexose
Hamamelose		2- <i>C</i> -(Hydroxymethyl)-D-ribose
Idose	Ido	<i>ido</i> -Hexose
Iduronic acid	IdoA	
Lactose	Lac	β-D-Galactopyranosyl-(1→4)-D-glucose
Lyxose	Lyx	<i>lyxo</i> -Pentose
Maltose		α-D-Glucopyranosyl-(1→4)-D-glucose
Mannose	Man	<i>manno</i> -Hexose
2- <i>C</i> -Methylxylose	Xyl2CMe	
Muramic acid	Mur	2-Amino-3- <i>O</i> -[(R)-1-carboxyethyl]-2-deoxy-D-glucose
Mycarose		2,6-Dideoxy-3- <i>C</i> -methyl-L- <i>ribo</i> -hexose
Mycinose		6-Deoxy-2,3-di- <i>O</i> -methyl-D-allose
Neuraminic acid	Neu	5-Amino-3,5-dideoxy-D- <i>glycero</i> -D- <i>galacto</i> -non-2-ulosonic acid

CARBOHYDRATE NAMES AND SYMBOLS (continued)

Common Name	Symbol	Systematic Name
Panose		α -D-Glucopyranosyl-(1→6)- α -D-glucopyranosyl-(1→4)-D-glucose
Paratose		3,6-Dideoxy-D- <i>ribo</i> -hexose
Primeverose		β -D-Xylopyranosyl-(1→6)-D-glucose
Psicose	Psi	<i>ribo</i> -Hex-2-ulose
Quinovose	Qui	6-Deoxyglucose
Raffinose		β -D-Fructofuranosyl- α -D-galactopyranosyl-(1→6)- α -D-glucopyranoside
Rhamnose	Rha	6-Deoxymannose
Rhodinose		2,3,6-Trideoxy-L- <i>threo</i> -hexose
Ribose	Rib	<i>ribo</i> -Pentose
Ribose 5-phosphate	Rib5P	
Ribulose	Ribulo (Rul)	<i>erythro</i> -Pent-2-ulose
Rutinose		α -L-Rhamnopyranosyl-(1→6)-D-glucose
Sarmentose		2,6-Dideoxy-3- <i>O</i> -methyl-D- <i>xylo</i> -hexose
Sedoheptulose		D- <i>altro</i> -Hept-2-ulose
Sorbose	Sor	<i>xylo</i> -Hex-2-ulose
Streptose		5-Deoxy-3- <i>C</i> -formyl-L-lyxose
Sucrose		β -D-Fructofuranosyl- α -D-glucopyranoside
Tagatose	Tag	<i>lyxo</i> -Hex-2-ulose
Talose	Tal	<i>talo</i> -Hexose
Turanose		α -D-Glucopyranosyl-(1→3)-D-fructose
Tyvelose	Tyv	3,6-Dideoxy-D- <i>arabino</i> -hexose
Xylose	Xyl	<i>xylo</i> -Pentose
Xylulose	Xylulo (Xul)	<i>threo</i> -Pent-2-ulose

BIOLOGICAL BUFFERS

This table of frequently used buffers gives the pK_a value at 25°C and the useful pH range of each buffer. The buffers are listed in order of increasing pH.

The table is reprinted with permission of Sigma Chemical Company, St. Louis, Mo.

Acronym	Name	Mol. wt.	pK_a	Useful pH range
MES	2-(<i>N</i> -Morpholino)ethanesulfonic acid	195.2	6.1	5.5—6.7
BIS TRIS	<i>Bis</i> (2-hydroxyethyl)iminotris(hydroxymethyl)methane	209.2	6.5	5.8—7.2
ADA	<i>N</i> -(2-Acetamido)-2-iminodiacetic acid	190.2	6.6	6.0—7.2
ACES	2-[(2-Amino-2-oxoethyl)amino]ethanesulfonic acid	182.2	6.8	6.1—7.5
PIPES	Piperazine- <i>N,N'</i> - <i>bis</i> (2-ethanesulfonic acid)	302.4	6.8	6.1—7.5
MOPSO	3-(<i>N</i> -Morpholino)-2-hydroxypropanesulfonic acid	225.3	6.9	6.2—7.6
BIS TRIS PROPANE	1,3- <i>Bis</i> [<i>tris</i> (hydroxymethyl)methylamino]propane	282.3	6.8 ^a	6.3—9.5
BES	<i>N,N</i> - <i>Bis</i> (2-hydroxyethyl)-2-aminoethanesulfonic acid	213.2	7.1	6.4—7.8
MOPS	3-(<i>N</i> -Morpholino)propanesulfonic acid	209.3	7.2	6.5—7.9
HEPES	<i>N</i> -(2-Hydroxyethyl)piperazine- <i>N'</i> -(2-ethanesulfonic acid)	238.3	7.5	6.8—8.2
TES	<i>N</i> - <i>Tris</i> (hydroxymethyl)methyl-2-aminoethanesulfonic acid	229.2	7.5	6.8—8.2
DIPSO	3-[<i>N,N</i> - <i>Bis</i> (2-hydroxyethyl)amino]-2-hydroxypropanesulfonic acid	243.3	7.6	7.0—8.2
TAPSO	3-[<i>N</i> - <i>Tris</i> (hydroxymethyl)methylamino]-2-hydroxypropanesulfonic acid	259.3	7.6	7.0—8.2
TRIZMA	<i>Tris</i> (hydroxymethyl)aminomethane	121.1	8.1	7.0—9.1
HEPPSO	<i>N</i> -(2-hydroxyethyl)piperazine- <i>N'</i> -(2-hydroxypropanesulfonic acid)	268.3	7.8	7.1—8.5
POPSO	Piperazine- <i>N,N'</i> - <i>bis</i> (2-hydroxypropanesulfonic acid)	362.4	7.8	7.2—8.5
EPPS	<i>N</i> -(2-Hydroxyethyl)piperazine- <i>N'</i> -(3-propanesulfonic acid)	252.3	8.0	7.3—8.7
TEA	Triethanolamine	149.2	7.8	7.3—8.3
TRICINE	<i>N</i> - <i>Tris</i> (hydroxymethyl)methylglycine	179.2	8.1	7.4—8.8
BICINE	<i>N,N</i> - <i>Bis</i> (2-hydroxyethyl)glycine	163.2	8.3	7.6—9.0
TAPS	<i>N</i> - <i>Tris</i> (hydroxymethyl)methyl-3-aminopropanesulfonic acid	243.3	8.4	7.7—9.1
AMPSO	3-[(1,1-Dimethyl-2-hydroxyethyl)amino]-2-hydroxypropanesulfonic acid	227.3	9.0	8.3—9.7
CHES	2-(<i>N</i> -Cyclohexylamino)ethanesulfonic acid	207.3	9.3	8.6—10.0
CAPSO	3-(Cyclohexylamino)-2-hydroxy-1-propanesulfonic acid	237.3	9.6	8.9—10.3
AMP	2-Amino-2-methyl-1-propanol	89.1	9.7	9.0—10.5
CAPS	3-(Cyclohexylamino)-1-propanesulfonic acid	221.3	10.4	9.7—11.1

^a $pK_a = 9.0$ for the second dissociation stage.

TYPICAL pH VALUES OF BIOLOGICAL MATERIALS AND FOODS

This table gives typical pH ranges for various biological fluids and common foods. All values refer to 25°C.

Biological Materials			
Blood, human	7.35-7.45		Grapes
Blood, dog	6.9-7.2		Hominy (lye)
Spinal fluid, human	7.3-7.5		Jams, fruit
Saliva, human	6.5-7.5		Jellies, fruit
Gastric contents, human	1.0-3.0		Lemons
Duodenal contents, human	4.8-8.2		Limes
Feces, human	4.6-8.4		Maple syrup
Urine, human	4.8-8.4		Milk, cows
Milk, human	6.6-7.6		Olives
Bile, human	6.8-7.0		Oranges
			Oysters
			Peaches
			Pears
			Peas
			Pickles, dill
			Pickles, sour
			Pimento
			Plums
			Potatoes
			Pumpkin
			Raspberries
			Rhubarb
			Salmon
			Sauerkraut
			Shrimp
			Soft drinks
			Spinach
			Squash
			Strawberries
			Sweet potatoes
			Tomatoes
			Tuna
			Turnips
			Vinegar
			Water, drinking
			Wines
Foods			
Apples	2.9-3.3		
Apricots	3.6-4.0		
Asparagus	5.4-5.8		
Bananas	4.5-4.7		
Beans	5.0-6.0		
Beers	4.0-5.0		
Beets	4.9-5.5		
Blackberries	3.2-3.6		
Bread, white	5.0-6.0		
Butter	6.1-6.4		
Cabbage	5.2-5.4		
Carrots	4.9-5.3		
Cheese	4.8-6.4		
Cherries	3.2-4.0		
Cider	2.9-3.3		
Corn	6.0-6.5		
Crackers	6.5-8.5		
Dates	6.2-6.4		
Eggs, fresh white	7.6-8.0		
Flour, wheat	5.5-6.5		
Gooseberries	2.8-3.0		
Grapefruit	3.0-3.3		

CHEMICAL COMPOSITION OF THE HUMAN BODY

The elemental composition of the "standard man" of mass 70 kg is given below.

REFERENCES

1. Padikal, T.N., and Fivozinsky, S.P., *Medical Physics Data Book, National Bureau of Standards Handbook 138*, U. S. Government Printing Office, Washington, DC, 1981.
2. Snyder, W.S., et al., *Reference Man: Anatomical, Physiological, and Metabolic Characteristics*, Pergamon, New York, 1975.

Element	Amount (g)	Percent of total body mass
Oxygen	43,000	61
Carbon	16,000	23
Hydrogen	7000	10
Nitrogen	1800	2.6
Calcium	1000	1.4
Phosphorus	780	1.1
Sulfur	140	0.20
Potassium	140	0.20
Sodium	100	0.14
Chlorine	95	0.12
Magnesium	19	0.027
Silicon	18	0.026
Iron	4.2	0.006
Fluorine	2.6	0.0037
Zinc	2.3	0.0033
Rubidium	0.32	0.00046
Strontium	0.32	0.00046
Bromine	0.20	0.00029
Lead	0.12	0.00017
Copper	0.072	0.00010
Aluminum	0.061	0.00009
Cadmium	0.050	0.00007
Boron	<0.048	0.00007
Barium	0.022	0.00003
Tin	<0.017	0.00002
Manganese	0.012	0.00002
Iodine	0.013	0.00002
Nickel	0.010	0.00001
Gold	<0.010	0.00001
Molybdenum	<0.0093	0.00001
Chromium	<0.0018	0.000003
Cesium	0.0015	0.000002
Cobalt	0.0015	0.000002
Uranium	0.00009	0.0000001
Beryllium	0.000036	
Radium	$3.1 \cdot 10^{-11}$	

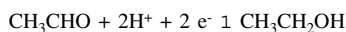
STANDARD TRANSFORMED GIBBS ENERGY OF FORMATION FOR IMPORTANT BIOCHEMICAL SPECIES

Petr Vanýsek

This table lists transformed values of the standard Gibbs energy of formation for several molecules and ions of biochemical importance. Values of $\Delta_f G^\circ$ are given at pH 7, 298.15 K, and 100 kPa for infinite dilution and for two finite ionic strengths, $I = 0.1$ mol/L and $I = 0.25$ mol/L. The charge of the species (z_i) is also given.

The table can be used for calculating practical (pH 7) reduction potentials for important biological processes. Such listing is more compact than offering reduction potentials, which would require tabulating a large number of reactant-product combinations.

To calculate the standard apparent reduction potential E° for reduction of acetaldehyde to ethanol at infinite dilution, for example, write first the reaction:



The change in hydrogen count can be accomplished by adding H^+ , which in turn has to be compensated by adding the appropriate number of electrons (reduction). The correct count of electrons is needed in the subsequent equation for the reduction potential:

$$E^\circ = [-1/nF] \cdot [\Delta_f G^\circ(\text{product}) - \Delta_f G^\circ(\text{reactant})]$$

where n is the number of electrons to be added and F is the Faraday constant.

Specifically, for the above reaction:

$$E^\circ = [-1/(2 \cdot 9.6485 \cdot 10^4 \text{ C mol}^{-1})] \cdot [58.1 \cdot 10^3 \text{ J mol}^{-1} - 20.83 \cdot 10^3 \text{ J mol}^{-1}] = -0.193 \text{ V.}$$

REFERENCE

Alberty, R. A., *Arch. Biochem. Biophys.*, **353**, 116-130, 1998; **358**, 25-39, 1998.

Compound	$\Delta_f G^\circ / \text{kJ mol}^{-1}$			z_i
	$I = 0$	$I = 0.1 \text{ mol/L}$	$I = 0.25 \text{ mol/L}$	
Acetaldehyde	20.83	23.27	24.06	0
Acetate	-249.44	-248.22	-247.82	-1
Acetone	80.03	83.71	84.89	0
<i>cis</i> -Aconitate	-797.26	-800.94	-802.12	-3
Adenine	512.07	515.13	516.12	0
Adenosine	519.43	527.39	529.96	0
Adenosine diphosphate (ADP)	-1234.36	-1230.97	-1230.12	-3
Adenosine monophosphate (AMP)	-367.5	-361.99	-360.29	-2
Adenosine triphosphate (ATP)	-2098	-2097.55	-2097.89	-4
Alanine	-91.31	-87.02	-85.64	0
Ammonium	80.52	82.35	82.94	1
Arabinose	-342.67	-336.55	-334.57	0
<i>L</i> -Asparagine	-206.28	-201.38	-199.8	0
Aspartate	-456.15	-453.09	-452.1	-1
1-Butanol	227.72	233.84	235.82	0
Butyrate	-72.94	-69.26	-68.08	-1
Carbonate	-547.33	-547.15	-547.1	-2
<i>iso</i> -Citrate	-956.82	-958.84	-959.58	-3
Citrate	-963.46	-965.49	-966.23	-3
CO(aq)	-119.9	-119.9	-119.9	0
CO(g)	-137.17	-137.17	-137.17	0
CO ₂ (g)	-394.36	-394.36	-394.36	0
Creatine	100.41	105.92	107.69	0
Creatinine	256.55	260.84	262.22	0
<i>L</i> -Cysteine	-59.23	-55.01	-53.65	0
<i>L</i> -Cystine	-187.03	-179.69	-177.32	0
Cytochrome c [oxidized]	0	-5.51	-7.29	3
Cytochrome c [reduced]	-24.54	-26.96	-27.75	2
Ethanol	58.1	61.77	62.96	0

**STANDARD TRANSFORMED GIBBS ENERGY OF FORMATION FOR
IMPORTANT BIOCHEMICAL SPECIES (continued)**

Compound	$\Delta_f G^{\circ} / \text{kJ mol}^{-1}$			z_i
	$I = 0$	$I = 0.1 \text{ mol/L}$	$I = 0.25 \text{ mol/L}$	
Ethyl acetate	-18	-13.1	-11.52	0
Ferredoxin [oxidized]	0	-0.61	-0.81	1
Ferredoxin [reduced]	38.07	38.07	38.07	0
Flavin adenine dinucleotide [oxidized]	1238.65	1255.17	1260.51	-2
Flavin adenine dinucleotide [reduced]	1279.68	1297.43	1303.16	-2
Flavin mononucleotide [oxidized]	759.17	768.35	771.32	-2
Flavin mononucleotide [reduced]	800.2	810.61	813.97	-2
Formate	-311.04	-311.04	-311.04	-1
Fructose	-436.03	-428.69	-426.32	0
Fructose-6-phosphate	-1321.71	-1317.16	-1315.74	-1
Fumarate	-521.96	-523.18	-523.58	-2
Galactose	-429.45	-422.11	-419.74	0
Galactose-1-phosphate	-1317.5	-1313.01	-1311.6	-2
Glucose	-436.42	-429.08	-426.71	0
Glucose-1-phosphate	-1318.03	-1313.34	-1311.89	-2
Glucose-6-phosphate	-1325	-1320.37	-1318.92	-2
Glutamate	-377.82	-373.54	-372.16	-1
Glutamine	-128.46	-122.34	-120.36	0
Glutathione [oxidized]	1198.69	1214.6	1219.74	-2
Glutathione [reduced]	625.56	633.52	636.09	-1
Glycerol	-177.83	-172.93	-171.35	0
Glycerol-3-phosphate	-1080.22	-1077.83	-1077.14	-1
Glycine	-180.13	-177.07	-176.08	0
Glycolate	-411.08	-409.86	-409.46	-1
Glycylglycine	-200.55	-195.65	-194.07	0
Glyoxylate	-428.64	-428.64	-428.64	-1
H ₂ (aq)	97.51	98.74	99.13	0
H ₂ (g)	79.91	81.17	81.53	0
H ₂ O	-157.28	-156.05	-155.66	0
β -Hydroxypropionate	-318.62	-316.17	-315.38	-1
Hydrogen peroxide	-54.12	-52.89	-52.5	0
Hypoxanthine	249.33	251.77	252.56	0
Indole	503.49	507.78	509.16	0
<i>L</i> -Isoleucine	175.53	183.49	186.06	0
Lactate	-316.94	-314.49	-313.7	-1
Lactose	-688.29	-674.82	-670.48	0
<i>L</i> -Leucine	-167.18	-175.14	-177.71	0
Lyxose	-349.58	-343.46	-341.48	0
Malate	-682.83	-682.83	-682.83	-2
Maltose	-695.65	-682.19	-677.84	0
<i>D</i> -Mannitol	-383.22	-374.65	-371.89	0
Mannose	-431.51	-424.17	-421.8	0
Methane	109.11	111.55	112.34	0
Methanol	-15.45	-13.04	-12.25	0
<i>L</i> -Methionine	-63.4	-56.67	-54.49	0
Methylamine	199.88	202.94	203.93	1
N ₂ (aq)	18.07	18.07	18.07	0
N ₂ (g)	0	0	0	0
Nicotinamide adenine dinucleotide (NAD) [reduced]	1101.47	1115.55	1120.09	-2
Nicotinamide adenine dinucleotide (NAD) [oxidized]	1038.86	1054.17	1059.11	-1
Nicotinamide adenine dinucleotide phosphate (NADP) [reduced]	1064.85	1070.97	1072.95	-4
Nicotinamide adenine dinucleotide phosphate (NADP) [oxidized]	998.91	1008.7	1011.86	-3

**STANDARD TRANSFORMED GIBBS ENERGY OF FORMATION FOR
IMPORTANT BIOCHEMICAL SPECIES (continued)**

Compound	$\Delta_r G^{\circ} / \text{kJ mol}^{-1}$			z_i
	$I = 0$	$I = 0.1 \text{ mol/L}$	$I = 0.25 \text{ mol/L}$	
O ₂ (aq)	16.4	16.4	16.4	0
O ₂ (g)	0	0	0	0
Oxalate	-673.9	-676.35	-677.14	-2
Oxaloacetate	-713.37	-714.6	-714.99	-2
Oxalosuccinate	-979.06	-979.06	-979.06	-2
2-Oxoglutarate	-633.59	-633.59	-633.59	-2
Palmitate	979.25	997.6	1003.54	-1
L-Phenylalanine	232.42	239.15	241.33	0
Phosphate	-1058.56	-1059.17	-1059.49	-2
1-Propanol	143.84	148.74	150.32	0
2-Propanol	134.43	139.32	140.9	0
Pyrophosphate	-1937.66	-1941.82	-1943.35	-1
Pyruvate	-352.4	-351.18	-350.78	-1
Retinal	1118.78	1135.91	1141.45	0
Retinol	1170.77	1189.13	1195.06	0
Ribose	-339.23	-333.11	-331.13	0
Ribose-1-phosphate	-1215.87	-1212.24	-1211.14	-2
Ribose-5-phosphate	-1223.95	-1220.32	-1219.22	-2
Ribulose	-336.38	-330.26	-328.28	0
L-Serine	-231.18	-226.89	225.81	0
D-Sorbose	-432.47	-425.13	-422.76	0
Succinate	-530.62	-530.62	-530.62	-2
Sucrose	-685.66	-672.2	-667.85	0
Thioredoxin [oxidized]	0	0	0	0
Thioredoxin [reduced]	54.03	55.26	55.65	0
L-Tryptophane	366.88	374.22	376.59	0
L-Tyrosine	68.82	75.55	77.73	0
Ubiquinone [oxidized]	3596.07	3651.15	3668.94	0
Ubiquinone [reduced]	3586.16	3642.47	3660.65	0
Urate	-206.1	-204.85	204.45	-1
Urea	-42.92	-40.53	-39.73	0
L-Valine	-80.87	-87.6	-89.78	0
Xylose	-350.93	-344.81	-342.83	0
D-Xylulose	-346.59	-340.47	-338.49	0

THERMODYNAMIC QUANTITIES FOR THE IONIZATION REACTIONS OF BUFFERS IN WATER

Robert N. Goldberg, Nand Kishore, and Rebecca M. Lennen

This table contains selected values for the pK , standard molar enthalpy of reaction $\Delta_r H^\circ$, and standard molar heat-capacity change $\Delta_r C_p^\circ$ for the ionization reactions of 64 buffers many of which are relevant to biochemistry and to biology.¹ The values pertain to the temperature $T = 298.15$ K and the pressure $p = 0.1$ MPa. The standard state is the hypothetical ideal solution of unit molality. These data permit one to calculate values of the pK and of $\Delta_r H^\circ$ at temperatures in the vicinity $\{T \approx (274 \text{ K to } 350 \text{ K})\}$ of the reference temperature $\theta = 298.15$ K by using the following equations²

$$\Delta_r G_T^\circ = -RT \ln K_T = \ln(10) \cdot RT \cdot pK_T, \quad (1)$$

$$R \ln K_T = -(\Delta_r G_\theta^\circ / \theta) + \Delta_r H_\theta^\circ \{(1/\theta) - (1/T)\} + \Delta_r C_{p\theta}^\circ \{(\theta/T) - 1 + \ln(T/\theta)\}, \quad (2)$$

$$\Delta_r H_T^\circ = \Delta_r H_\theta^\circ + \Delta_r C_{p\theta}^\circ (T - \theta). \quad (3)$$

Here, $\Delta_r G^\circ$ is the standard molar Gibbs energy change and K is the equilibrium constant for a reaction; R is the gas constant ($8.314472 \text{ J K}^{-1} \text{ mol}^{-1}$). The subscripts T and θ denote the temperature to which a quantity pertains, the subscript p denotes constant pressure, and the subscript r denotes that the quantity refers to a reaction. Combination of equations (1) and (2) yields the following equation that gives pK as a function of temperature:

$$pK_T = -\{R \ln(10)\}^{-1} [-\{\ln(10) \cdot RT \cdot pK_\theta / \theta\} + \Delta_r H_\theta^\circ \{(1/\theta) - (1/T)\} + \Delta_r C_{p\theta}^\circ \{(\theta/T) - 1 + \ln(T/\theta)\}]. \quad (4)$$

The above equations neglect higher order terms that involve temperature derivatives of $\Delta_r C_p^\circ$. Also, it is important to recognize that the values of pK and $\Delta_r H^\circ$ effectively pertain to ionic strength $I = 0$. However, the values of pK and $\Delta_r H^\circ$ are almost always dependent on the ionic strength and the actual composition of the solution. These issues are discussed in Reference 1 which also gives an approximate method for making appropriate corrections.

REFERENCES

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Selected Values of Thermodynamic Quantities for the Ionization Reactions of Buffers in Water at $T = 298.15$ K and $p = 0.1$ MPa

Buffer	Reaction	pK	$\Delta_r H^\circ$ kJ mol ⁻¹	$\Delta_r C_p^\circ$ J K ⁻¹ mol ⁻¹
ACES	$HL^\pm = H^+ + L^-$, (HL = C ₄ H ₁₀ N ₂ O ₄ S)	6.847	30.43	-49
Acetate	$HL = H^+ + L^-$, (HL = C ₂ H ₄ O ₂)	4.756	-0.41	-142
ADA	$H_3L^+ = H^+ + H_2L^\pm$, (H ₂ L = C ₆ H ₁₀ N ₂ O ₅)	1.59		
	$H_2L^\pm = H^+ + HL^-$	2.48	16.7	
	$HL^- = H^+ + L^{2-}$	6.844	12.23	-144
2-Amino-2-methyl-1,3-propanediol	$HL^\pm = H^+ + L^-$, (L = C ₄ H ₁₁ NO ₂)	8.801	49.85	-44
2-Amino-2-methyl-1-propanol	$HL^\pm = H^+ + L^-$, (L = C ₄ H ₁₁ NO)	9.694	54.05	≈-21
3-Amino-1-propanesulfonic acid	$HL = H^+ + L^-$, (HL = C ₃ H ₉ NO ₃ S)	10.2		
Ammonia	$NH_4^+ = H^+ + NH_3$	9.245	51.95	8
AMPSO	$HL^\pm = H^+ + L^-$, (HL = C ₇ H ₁₇ NO ₅ S)	9.138	43.19	-61
Arsenate	$H_3AsO_4 = H^+ + H_2AsO_4^-$	2.31	-7.8	
	$H_2AsO_4^- = H^+ + HAsO_4^{2-}$	7.05	1.7	
	$HAsO_4^{2-} = H^+ + AsO_4^{3-}$	11.9	15.9	
Barbital	$H_2L = H^+ + HL^-$, (H ₂ L = C ₈ H ₁₂ N ₂ O ₃)	7.980	24.27	-135
	$HL^- = H^+ + L^{2-}$	12.8		
BES	$HL^\pm = H^+ + L^-$, (HL = C ₆ H ₁₅ NO ₅ S)	7.187	24.25	-2
Bicine	$H_2L^+ = H^+ + HL^\pm$, (HL = C ₆ H ₁₃ NO ₄)	2.0		
	$HL^\pm = H^+ + L^-$	8.334	26.34	0
Bis-tris	$H_3L^+ = H^+ + H_2L^\pm$, (H ₂ L = C ₈ H ₁₉ NO ₅)	6.484	28.4	27
Bis-tris propane	$H_2L^{2+} = H^+ + HL^+$, (L = C ₁₁ H ₂₆ N ₂ O ₆)	6.65		
	$HL^+ = H^+ + L$	9.10		
Borate	$H_3BO_3 = H^+ + H_2BO_3^-$	9.237	13.8	≈240
Cacodylate	$H_2L^+ = H^+ + HL$, (HL = C ₂ H ₆ AsO ₂)	1.78	-3.5	
	$HL = H^+ + L^-$	6.28	-3.0	-86

**THERMODYNAMIC QUANTITIES FOR THE IONIZATION REACTIONS
OF BUFFERS IN WATER (continued)**

Selected Values of Thermodynamic Quantities for the Ionization Reactions of Buffers in Water at $T = 298.15$ K and $p = 0.1$ MPa

Buffer	Reaction	pK	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$	$\frac{\Delta_r C_p^\circ}{\text{J K}^{-1} \text{mol}^{-1}}$
CAPS	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_9\text{H}_{19}\text{NO}_3\text{S}$)	10.499	48.1	57
CAPSO	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_9\text{H}_{19}\text{NO}_4\text{S}$)	9.825	46.67	21
Carbonate	$\text{H}_2\text{CO}_3 = \text{H}^+ + \text{HCO}_3^-$	6.351	9.15	-371
	$\text{HCO}_3^- = \text{H}^+ + \text{CO}_3^{2-}$	10.329	14.70	-249
CHES	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_8\text{H}_{17}\text{NO}_3\text{S}$)	9.394	39.55	9
Citrate	$\text{H}_3\text{L} = \text{H}^+ + \text{H}_2\text{L}^-$, ($\text{H}_3\text{L} = \text{C}_6\text{H}_8\text{O}_7$)	3.128	4.07	-131
	$\text{H}_2\text{L}^- = \text{H}^+ + \text{HL}^{2-}$	4.761	2.23	-178
	$\text{HL}^{2-} = \text{H}^+ + \text{L}^{3-}$	6.396	-3.38	-254
L-Cysteine	$\text{H}_3\text{L}^+ = \text{H}^+ + \text{H}_2\text{L}$, ($\text{H}_2\text{L} = \text{C}_3\text{H}_7\text{NO}_2\text{S}$)	1.71	≈ -0.6	
	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$	8.36	36.1	≈ -66
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	10.75	34.1	≈ -204
Diethanolamine	$\text{HL}^+ = \text{H}^+ + \text{L}$, (L = $\text{C}_4\text{H}_{11}\text{NO}_2$)	8.883	42.08	36
Diglycolate	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_4\text{H}_6\text{O}_5$)	3.05	-0.1	≈ -142
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	4.37	-7.2	≈ -138
3,3-Dimethylglutarate	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_7\text{H}_{12}\text{O}_4$)	3.70		
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	6.34		
DIPSO	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_7\text{H}_{17}\text{NO}_6\text{S}$)	7.576	30.18	42
Ethanolamine	$\text{HL}^+ = \text{H}^+ + \text{L}$, (L = $\text{C}_2\text{H}_7\text{NO}$)	9.498	50.52	26
<i>N</i> -Ethylmorpholine	$\text{HL}^+ = \text{H}^+ + \text{L}$, (L = $\text{C}_6\text{H}_{13}\text{NO}$)	7.77	27.4	
Glycerol 2-phosphate	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_3\text{H}_9\text{NO}_6\text{P}$)	1.329	-12.2	-330
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	6.650	-1.85	-212
Glycine	$\text{H}_2\text{L}^+ = \text{H}^+ + \text{HL}^\pm$, (HL = $\text{C}_2\text{H}_5\text{NO}_2$)	2.351	4.00	-139
	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$	9.780	44.2	-57
Glycine amide	$\text{HL}^+ = \text{H}^+ + \text{L}$, (L = $\text{C}_2\text{H}_6\text{N}_2\text{O}$)	8.04	42.9	
Glycylglycine	$\text{H}_2\text{L}^+ = \text{H}^+ + \text{HL}^\pm$, (HL = $\text{C}_4\text{H}_8\text{N}_2\text{O}_3$)	3.140	0.11	-128
	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$	8.265	43.4	-16
Glycylglycylglycine	$\text{H}_2\text{L}^+ = \text{H}^+ + \text{HL}^\pm$, (HL = $\text{C}_6\text{H}_{11}\text{N}_3\text{O}_4$)	3.224	0.84	
	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$	8.090	41.7	
HEPES	$\text{H}_2\text{L}^+ = \text{H}^+ + \text{HL}^\pm$, (HL = $\text{C}_8\text{H}_{18}\text{N}_2\text{O}_4\text{S}$)	≈ 3.0		
	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$	7.564	20.4	47
HEPPS	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_6\text{H}_{20}\text{N}_2\text{O}_4\text{S}$)	7.957	21.3	48
HEPPSO	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_9\text{H}_{20}\text{N}_2\text{O}_5\text{S}$)	8.042	23.70	47
L-Histidine	$\text{H}_3\text{L}^{2+} = \text{H}^+ + \text{H}_2\text{L}^+$, (HL = $\text{C}_6\text{H}_9\text{N}_3\text{O}_2$)	1.5 ₄	3.6	
	$\text{H}_2\text{L}^+ = \text{H}^+ + \text{HL}$	6.07	29.5	176
	$\text{HL} = \text{H}^+ + \text{L}^-$	9.34	43.8	-233
Hydrazine	$\text{H}_2\text{L}^{2+} = \text{H}^+ + \text{HL}^+$, (L = H_4N_2)	-0.99	38.1	
	$\text{HL}^+ = \text{H}^+ + \text{L}$	8.02	41.7	
Imidazole	$\text{HL}^+ = \text{H}^+ + \text{L}$, (L = $\text{C}_3\text{H}_4\text{N}_2$)	6.993	36.64	-9
Maleate	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_4\text{H}_4\text{O}_4$)	1.92	1.1	≈ -21
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	6.27	-3.6	≈ -31
2-Mercaptoethanol	$\text{HL} = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_2\text{H}_6\text{OS}$)	9.7 ₅	26.2	
MES	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_6\text{H}_{13}\text{NO}_4\text{S}$)	6.270	14.8	5
Methylamine	$\text{HL}^+ = \text{H}^+ + \text{L}$, (L = CH_5N)	10.645	55.34	33
2-Methylimidazole	$\text{HL}^+ = \text{H}^+ + \text{L}$, (L = $\text{C}_4\text{H}_6\text{N}_2$)	8.0 ₁	36.8	
MOPS	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, (HL = $\text{C}_7\text{H}_{15}\text{NO}_4\text{S}$)	7.184	21.1	25
MOPSO	$\text{H}_2\text{L}^+ = \text{H}^+ + \text{HL}^\pm$, (HL = $\text{C}_7\text{H}_{15}\text{NO}_5\text{S}$)	0.060		
	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$	6.90	25.0	≈ 38
Oxalate	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_2\text{H}_2\text{O}_4$)	1.27	-3.9	≈ -231
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	4.266	7.00	-231
Phosphate	$\text{H}_3\text{PO}_4 = \text{H}^+ + \text{H}_2\text{PO}_4^-$	2.148	-8.0	-141
	$\text{H}_2\text{PO}_4^- = \text{H}^+ + \text{HPO}_4^{2-}$	7.198	3.6	-230
	$\text{HPO}_4^{2-} = \text{H}^+ + \text{PO}_4^{3-}$	12.35	16.0	-242

**THERMODYNAMIC QUANTITIES FOR THE IONIZATION REACTIONS
OF BUFFERS IN WATER (continued)**

Selected Values of Thermodynamic Quantities for the Ionization Reactions of Buffers in Water at $T = 298.15$ K and $p = 0.1$ MPa

Buffer	Reaction	pK	$\frac{\Delta_r H^\circ}{\text{kJ mol}^{-1}}$	$\frac{\Delta_r C_p^\circ}{\text{J K}^{-1} \text{mol}^{-1}}$
Phthalate	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_8\text{H}_6\text{O}_4$)	2.950	-2.70	-91
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	5.408	-2.17	-295
Piperazine	$\text{H}_2\text{L}^{2+} = \text{H}^+ + \text{HL}^+$, ($\text{L} = \text{C}_4\text{H}_{10}\text{N}_2$)	5.333	31.11	86
	$\text{HL}^+ = \text{H}^+ + \text{L}$	9.731	42.89	75
PIPES	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, ($\text{HL} = \text{C}_8\text{H}_{18}\text{N}_2\text{O}_6\text{S}_2$)	7.141	11.2	22
POPSO	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, ($\text{HL} = \text{C}_{10}\text{H}_{22}\text{N}_2\text{O}_8\text{S}_2$)	≈ 8.0		
Pyrophosphate	$\text{H}_4\text{P}_2\text{O}_7 = \text{H}^+ + \text{H}_3\text{P}_2\text{O}_7^-$	0.83	-9.2	≈ -90
	$\text{H}_3\text{P}_2\text{O}_7^- = \text{H}^+ + \text{H}_2\text{P}_2\text{O}_7^{2-}$	2.26	-5.0	≈ -130
	$\text{H}_2\text{P}_2\text{O}_7^{2-} = \text{H}^+ + \text{HP}_2\text{O}_7^{3-}$	6.72	0.5	-136
	$\text{HP}_2\text{O}_7^{3-} = \text{H}^+ + \text{P}_2\text{O}_7^{4-}$	9.46	1.4	-141
Succinate	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_4\text{H}_6\text{O}_4$)	4.207	3.0	-121
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	5.636	-0.5	-217
Sulfate	$\text{HSO}_4^- = \text{H}^+ + \text{SO}_4^{2-}$	1.987	-22.4	-258
Sulfite	$\text{H}_2\text{SO}_3 = \text{H}^+ + \text{HSO}_3^-$	1.857	-17.80	-272
	$\text{HSO}_3^- = \text{H}^+ + \text{SO}_3^{2-}$	7.172	-3.65	-262
TAPS	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, ($\text{HL} = \text{C}_7\text{H}_{17}\text{NO}_6\text{S}$)	8.44	40.4	15
TAPSO	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, ($\text{HL} = \text{C}_7\text{H}_{17}\text{NO}_7\text{S}$)	7.635	39.09	-16
L(+)-Tartaric acid	$\text{H}_2\text{L} = \text{H}^+ + \text{HL}^-$, ($\text{H}_2\text{L} = \text{C}_4\text{H}_6\text{O}_6$)	3.036	3.19	-147
	$\text{HL}^- = \text{H}^+ + \text{L}^{2-}$	4.366	0.93	-218
TES	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$, ($\text{HL} = \text{C}_6\text{H}_{15}\text{NO}_6\text{S}$)	7.550	32.13	0
Tricine	$\text{H}_2\text{L}^+ = \text{H}^+ + \text{HL}^\pm$, ($\text{HL} = \text{C}_6\text{H}_{13}\text{NO}_5$)	2.023	5.85	-196
	$\text{HL}^\pm = \text{H}^+ + \text{L}^-$	8.135	31.37	-53
Triethanolamine	$\text{HL}^+ = \text{H}^+ + \text{L}$, ($\text{L} = \text{C}_6\text{H}_{15}\text{NO}_3$)	7.762	33.6	50
Triethylamine	$\text{HL}^+ = \text{H}^+ + \text{L}$, ($\text{L} = \text{C}_6\text{H}_{15}\text{N}$)	10.72	43.13	151
Tris	$\text{HL}^+ = \text{H}^+ + \text{L}$, ($\text{L} = \text{C}_4\text{H}_{11}\text{NO}_3$)	8.072	47.45	-59

PREPARATION OF SPECIAL ANALYTICAL REAGENTS

Aluminon (qualitative test for aluminum). Aluminon is a trade name for the ammonium salt of aurintricarboxylic acid. Dissolve 1 g of the salt in 1 L of distilled water. Shake the solution well to insure thorough mixing.

Bang's reagent (for glucose estimation). Dissolve 100 g of K_2CO_3 , 66 g of KCl and 160 g of $KHCO_3$ in the order given in about 700 mL of water at 30°C. Add 4.4 g of $CuSO_4$ and dilute to 1 L after the CO_2 is evolved. This solution should be shaken only in such a manner as not to allow entry of air. After 24 hours 300 mL are diluted to 1 L with saturated KCl solution, shaken gently and used after 24 hours; 50 mL is equivalent to 10 mg glucose.

Barfoed's reagent (test for glucose). See Cupric acetate.

Baudisch's reagent. See Cupferron.

Benedict's solution (qualitative reagent for glucose). With the aid of heat, dissolve 173 g of sodium citrate and 100 g of Na_2CO_3 in 800 mL of water. Filter, if necessary, and dilute to 850 mL. Dissolve 17.3 g of $CuSO_4 \cdot 5H_2O$ in 100 mL of water. Pour the latter solution, with constant stirring, into the carbonate-citrate solution, and dilute to 1 L.

Benzidine hydrochloride solution (for sulfite determination). Make a paste of 8 g of benzidine hydrochloride ($C_{12}H_8(NH_3)_2 \cdot 2HCl$) and 20 mL of water, add 20 mL of HCl (sp. gr. 1.12) and dilute to 1 L with water. Each mL of this solution is equivalent to 0.00357 g of H_2SO_4 .

Bertrand's reagent (glucose estimation). Consists of the following solutions:

1. Dissolve 200 g of Rochelle salt and 150 g of NaOH in sufficient water to make 1 L of solution.
2. Dissolve 40 g of $CuSO_4$ in enough water to make 1 L of solution.
3. Dissolve 50 g of $Fe_2(SO_4)_3$ and 200 g of H_2SO_4 (sp. gr. 1.84) in sufficient water to make 1 L of solution.
4. Dissolve 5 g of $KMnO_4$ in sufficient water to make 1 L of solution.

Bial's reagent (for pentose). Dissolve 1 g of orcinol (5-methyl-1,3-benzenediol) in 500 mL of 30% HCl to which 30 drops of a 10% solution of $FeCl_3$ has been added.

Boutron — Boudet soap solution:

1. Dissolve 100 g of pure castile soap in about 2.5 L of 56% ethanol.
2. Dissolve 0.59 g of $Ba(NO_3)_2$ in 1 L of water.

Adjust the castile soap solution so that 2.4 mL of it will give a permanent lather with 40 mL of solution (b). When adjusted, 2.4 mL of soap solution is equivalent to 220 parts per million of hardness (as $CaCO_3$) for a 40 mL sample. See also Soap solution.

Brucke's reagent (protein precipitation). See Potassium iodide-mercuric iodide.

Clarke's soap solution (estimation of hardness in water).

1. Dissolve 100 g of pure powdered castile soap in 1 L of 80% ethanol and allow to stand over night.
2. Prepare a solution of $CaCl_2$ by dissolving 0.5 g of $CaCO_3$ in HCl (sp. gr. 1.19), neutralize with NH_4OH and make slightly alkaline to litmus, and dilute to 500 mL. One mL is equivalent to 1 mg of $CaCO_3$.

Titrate (1) against (2) and dilute (1) with 80% ethanol until 1 mL of the resulting solution is equivalent to 1 mL of (2) after making allowance for the lather factor (the amount of standard soap solution required to produce a permanent lather in 50 mL of distilled water). One mL of the adjusted solution after subtracting the lather factor is equivalent to 1 mg of $CaCO_3$. See also Soap solution.

Cobalticyanide paper (Rinnmann's test for Zn). Dissolve 4 g of $K_3Co(CN)_6$ and 1 g of $KClO_3$ in 100 mL of water. Soak filter paper in solution and dry at 100°C. Apply drop of zinc solution and burn in an evaporating dish. A green disk is obtained if zinc is present.

Cochineal. Extract 1 g of cochineal for 4 days with 20 mL of alcohol and 60 mL of distilled water. Filter.

Congo red. Dissolve 0.5 g of congo red in 90 mL of distilled water and 10 mL of alcohol.

Cupferron (Baudisch's reagent for iron analysis). Dissolve 6 g of the ammonium salt of *N*-hydroxy-*N*-nitrosoaniline (cupferron) in 100 mL of H_2O . Reagent good for 1 week only and must be kept in the dark.

Cupric acetate (Barfoed's reagent for reducing monosaccharides). Dissolve 66 g of cupric acetate and 10 mL of glacial acetic acid in water and dilute to 1 L.

Cupric oxide, ammoniacal; Schweitzer's reagent (dissolves cotton, linen, and silk, but not wool).

1. Dissolve 5 g of cupric sulfate in 100 mL of boiling water, and add sodium hydroxide until precipitation is complete. Wash the precipitate well, and dissolve it in a minimum quantity of ammonium hydroxide.
2. Bubble a slow stream of air through 300 mL of strong ammonium hydroxide containing 50 g of fine copper turnings. Continue for 1 hour.

Cupric sulfate in glycerin-potassium hydroxide (reagent for silk). Dissolve 10 g of cupric sulfate, $CuSO_4 \cdot 5H_2O$, in 100 mL of water and add 5 g of glycerol. Add KOH solution slowly until a deep blue solution is obtained.

Cupron (precipitates copper). Dissolve 5 g of benzoinoxime in 100 mL of 95% ethanol.

Cuprous chloride, acidic (reagent for CO in gas analysis).

1. Cover the bottom of a 2-L flask with a layer of cupric oxide about 0.5 inch deep, suspend a coil of copper wire so as to reach from the bottom to the top of the solution, and fill the flask with hydrochloric acid (sp. gr. 1.10). Shake occasionally. When the solution becomes nearly colorless, transfer to reagent bottles, which should also contain copper wire. The stock bottle may be refilled with dilute hydrochloric acid until either the cupric oxide or the copper wire is used up. Copper sulfate may be substituted for copper oxide in the above procedure.
2. Dissolve 340 g of $CuCl_2 \cdot 2H_2O$ in 600 mL of conc. HCl and reduce the cupric chloride by adding 190 mL of a saturated solution of stannous chloride or until the solution is colorless. The stannous chloride is prepared by treating 300 g of metallic tin in a 500 mL flask with conc. HCl until no more tin goes into solution.
3. (Winkler method). Add a mixture of 86 g of CuO and 17 g of finely divided metallic Cu, made by the reduction of CuO with hydrogen, to a solution of HCl, made by diluting 650 mL of conc. HCl with 325 mL of water. After the mixture has been added slowly and with frequent stirring, a spiral of copper wire is suspended in the bottle, reaching all the way to the bottom. Shake occasionally, and when the solution becomes colorless, it is ready for use.

PREPARATION OF SPECIAL ANALYTICAL REAGENTS (continued)

Cuprous chloride, ammoniacal (reagent for CO in gas analysis).

1. The acid solution of cuprous chloride as prepared above is neutralized with ammonium hydroxide until an ammonia odor persists. An excess of metallic copper must be kept in the solution.
2. Pour 800 mL of acidic cuprous chloride, prepared by the Winkler method, into about 4 L of water. Transfer the precipitate to a 250 mL graduate. After several hours, siphon off the liquid above the 50 mL mark and refill with 7.5% NH_4OH solution which may be prepared by diluting 50 mL of conc. NH_4OH with 150 mL of water. The solution is well shaken and allowed to stand for several hours. It should have a faint odor of ammonia.

Dichlorofluorescein indicator. Dissolve 1 g in 1 L of 70% alcohol or 1 g of the sodium salt in 1 L of water.

Dimethylglyoxime, 0.01 N. Dissolve 0.6 g of dimethylglyoxime (2,3-butanedione oxime) in 500 mL of 95% ethanol. This is an especially sensitive test for nickel, a very definite crimson color being produced.

Diphenylamine (reagent for rayon). Dissolve 0.2 g in 100 mL of concentrated sulfuric acid.

Diphenylamine sulfonate (for titration of iron with $\text{K}_2\text{Cr}_2\text{O}_7$). Dissolve 0.32 g of the barium salt of diphenylamine sulfonic acid in 100 mL of water, add 0.5 g of sodium sulfate and filter off the precipitate of BaSO_4 .

Diphenylcarbazide. Dissolve 0.2 g of diphenylcarbazide in 10 mL of glacial acetic acid and dilute to 100 mL with 95% ethanol.

Esbach's reagent (estimation of protein). To a water solution of 10 g of picric acid and 20 g of citric acid, add sufficient water to make 1 L of solution.

Eschka's compound. Two parts of calcined ("light") magnesia are thoroughly mixed with 1 part of anhydrous sodium carbonate.

Fehling's solution (reagent for reducing sugars.)

1. Copper sulfate solution. Dissolve 34.66 g of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in water and dilute to 500 mL.
2. Alkaline tartrate solution. Dissolve 173 g of potassium sodium tartrate (Rochelle salt, $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$) and 50 g of NaOH in water and dilute when cold to 500 mL.

Mix equal volumes of the two solutions at the time of using.

Ferric-alum indicator. Dissolve 140 g of ferric ammonium sulfate crystals in 400 mL of hot water. When cool, filter, and make up to a volume of 500 mL with dilute nitric acid.

Folin's mixture (for uric acid). To 650 mL of water add 500 g of $(\text{NH}_4)_2\text{SO}_4$, 5 g of uranium acetate, and 6 g of glacial acetic acid. Dilute to 1 L.

Formaldehyde — sulfuric acid (Marquis' reagent for alkaloids). Add 10 mL of formaldehyde solution to 50 mL of sulfuric acid.

Froehde's reagent. See Sulfomolybdic acid.

Fuchsin (reagent for linen). Dissolve 1 g of fuchsin in 100 mL of alcohol.

Fuchsin — sulfurous acid (Schiff's reagent for aldehydes). Dissolve 0.5 g of fuchsin and 9 g of sodium bisulfite in 500 mL of water, and add 10 mL of HCl. Keep in well-stoppered bottles and protect from light.

Gunzberg's reagent (detection of HCl in gastric juice). Prepare as needed a solution containing 4 g of phloroglucinol (1,3,5-benzenetriol) and 2 g of vanillin in 100 mL of absolute ethanol.

Hager's reagent. See Picric acid.

Hanus solution (for iodine number). Dissolve 13.2 g of resublimed iodine in 1 L of glacial acetic acid which will pass the dichromate test for reducible matter. Add sufficient bromine to double the halogen content, determined by titration (3 mL is about the proper amount). The iodine may be dissolved by the aid of heat, but the solution should be cold when the bromine is added.

Iodine, tincture of. To 50 mL of water add 70 g of I_2 and 50 g of KI. Dilute to 1 L with alcohol.

Iodo-potassium iodide (Wagner's reagent for alkaloids). Dissolve 2 g of iodine and 6 g of KI in 100 mL of water.

Litmus (indicator). Extract litmus powder three times with boiling alcohol, each treatment consuming an hour. Reject the alcoholic extract. Treat residue with an equal weight of cold water and filter; then exhaust with five times its weight of boiling water, cool and filter. Combine the aqueous extracts.

Magnesia mixture (reagent for phosphates and arsenates). Dissolve 55 g of magnesium chloride and 105 g of ammonium chloride in water, barely acidify with hydrochloric acid, and dilute to 1 L. The ammonium hydroxide may be omitted until just previous to use. The reagent, if completely mixed and stored for any period of time, becomes turbid.

Magnesium uranyl acetate. Dissolve 100 g of $\text{UO}_2(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$ in 60 mL of glacial acetic acid and dilute to 500 mL. Dissolve 330 g of $\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ in 60 mL of glacial acetic acid and dilute to 200 mL. Heat solutions to the boiling point until clear, pour the magnesium solution into the uranyl solution, cool and dilute to 1 L. Let stand over night and filter if necessary.

Marme's reagent. See Potassium-cadmium iodide.

Marquis' reagent. See Formaldehyde-sulfuric acid.

Mayer's reagent (white precipitate with most alkaloids in slightly acid solutions). Dissolve 1.358 g of HgCl_2 in 60 mL of water and pour into a solution of 5 g of KI in 10 mL of H_2O . Add sufficient water to make 100 mL.

Methyl orange indicator. Dissolve 1 g of methyl orange in 1 L of water. Filter, if necessary.

Methyl orange, modified. Dissolve 2 g of methyl orange and 2.8 g of xylene cyanole FF in 1 L of 50% alcohol.

Methyl red indicator. Dissolve 1 g of methyl red in 600 mL of alcohol and dilute with 400 mL of water.

Methyl red, modified. Dissolve 0.50 g of methyl red and 1.25 g of xylene cyanole FF in 1 L of 90% alcohol. Or, dissolve 1.25 g of methyl red and 0.825 g of methylene blue in 1 L of 90% alcohol.

Millon's reagent (for albumins and phenols). Dissolve 1 part of mercury in 1 part of 6 cold fuming nitric acid. Dilute with twice the volume of water and decant the clear solution after several hours.

Molisch's reagent. See 1-Naphthol.

1-Naphthol (Molisch's reagent for wool). Dissolve 15 g of 1-naphthol in 100 mL of alcohol or chloroform.

Nessler's reagent (for ammonia). Dissolve 50 g of KI in the smallest possible quantity of cold water (50 mL). Add a saturated solution of mercuric chloride (about 22 g in 350 mL of water will be needed) until an excess is indicated by the formation of a precipitate. Then add 200 mL of 5 N NaOH and dilute to 1 L. Let settle, and draw off the clear liquid.

PREPARATION OF SPECIAL ANALYTICAL REAGENTS (continued)

Nickel oxide, ammoniacal (reagent for silk). Dissolve 5 g of nickel sulfate in 100 mL of water, and add sodium hydroxide solution until nickel hydroxide is completely precipitated. Wash the precipitate well and dissolve in 25 mL of concentrated ammonium hydroxide and 25 mL of water.

Nitron (detection of nitrate radical). Dissolve 10 g of nitron (1,4-diphenyl-3-(phenylamino)-1,2,4-triazolium hydroxide) in 5 mL of glacial acetic acid and 95 mL of water. The solution may be filtered with slight suction through an alundum crucible and kept in a dark bottle.

1-Nitroso-2-naphthol. Make a saturated solution in 50% acetic acid (1 part of glacial acetic acid with 1 part of water). Does not keep well.

Nylander's solution (carbohydrates). Dissolve 20 g of bismuth subnitrate and 40 g of Rochelle salt in 1 L of 8% NaOH solution. Cool and filter.

Obermayer's reagent (for indoxyl in urine). Dissolve 4 g of FeCl_3 in 1 L of HCl (sp. gr. 1.19).

Oxine. Dissolve 14 g of 8-hydroxyquinoline in 30 mL of glacial acetic acid. Warm slightly, if necessary. Dilute to 1 L.

Oxygen absorbent. Dissolve 300 g of ammonium chloride in 1 L of water and add 1 L of concentrated ammonium hydroxide solution. Shake the solution thoroughly. For use as an oxygen absorbent, a bottle half full of copper turnings is filled nearly full with the $\text{NH}_4\text{Cl-NH}_4\text{OH}$ solution and the gas passed through.

Pasteur's salt solution. To 1 L of distilled water add 2.5 g of potassium phosphate, 0.25 g of calcium phosphate, 0.25 g of magnesium sulfate, and 12.00 g of ammonium tartrate.

Pavy's solution (glucose reagent). To 120 mL of Fehling's solution, add 300 mL of NH_4OH (sp. gr. 0.88) and dilute to 1 L with water.

Phenanthroline ferrous ion indicator. Dissolve 1.485 g of 1,10-phenanthroline monohydrate in 100 mL of 0.025 M ferrous sulfate solution.

Phenolphthalein. Dissolve 1 g of phenolphthalein in 50 mL of alcohol and add 50 mL of water.

Phenolsulfonic acid (determination of nitrogen as nitrate). Dissolve 25 g of phenol in 150 mL of conc. H_2SO_4 , add 75 mL of fuming H_2SO_4 (15% SO_3), stir well and heat for 2 hours at 100°C .

Phloroglucinol solution (pentosans). Make a 3% phloroglucinol (1,3,5-benzenetriol) solution in alcohol. Keep in a dark bottle.

Phosphomolybdic acid (Sonnenschein's reagent for alkaloids).

1. Prepare ammonium phosphomolybdate and after washing with water, boil with nitric acid and expel NH_3 ; evaporate to dryness and dissolve in 2 M nitric acid.

2. Dissolve ammonium molybdate in HNO_3 and treat with phosphoric acid. Filter, wash the precipitate, and boil with aqua regia until the ammonium salt is decomposed. Evaporate to dryness. The residue dissolved in 10% HNO_3 constitutes Sonnenschein's reagent.

Phosphoric acid — sulfuric acid mixture. Dilute 150 mL of conc. H_2SO_4 and 100 mL of conc. H_3PO_4 (85%) with water to a volume of 1 L.

Phosphotungstic acid (Schcibicr's reagent for alkaloids).

1. Dissolve 20 g of sodium tungstate and 15 g of sodium phosphate in 100 mL of water containing a little nitric acid.

2. The reagent is a 10% solution of phosphotungstic acid in water. The phosphotungstic acid is prepared by evaporating a mixture of 10 g of sodium tungstate dissolved in 5 g of phosphoric acid (sp. gr. 1.13) and enough boiling water to effect solution. Crystals of phosphotungstic acid separate.

Picric acid (Hager's reagent for alkaloids, wool and silk). Dissolve 1 g of picric acid in 100 mL of water.

Potassium antimonate (reagent for sodium). Boil 22 g of potassium antimonate with 1 L of water until nearly all of the salt has dissolved, cool quickly, and add 35 mL of 10% potassium hydroxide. Filter after standing overnight.

Potassium-cadmium iodide (Marme's reagent for alkaloids). Add 2 g of CdI_2 to a boiling solution of 4 g of KI in 12 mL of water, and then mix with 12 mL of saturated KI solution.

Potassium hydroxide (for CO_2 absorption). Dissolve 360 g of KOH in water and dilute to 1 L.

Potassium iodide — mercuric iodide (Brucke's reagent for proteins). Dissolve 50 g of KI in 500 mL of water, and saturate with mercuric iodide (about 120 g). Dilute to 1 L.

Potassium pyrogallate (for oxygen absorption). For mixtures of gases containing less than 28% oxygen, add 100 mL of KOH solution (50 g of KOH to 100 mL of water) to 5 g of pyrogallol. For mixtures containing more than 28% oxygen the KOH solution should contain 120 g of KOH to 100 mL of water.

Pyrogallol, alkaline.

1. Dissolve 75 g of pyrogallol in 75 mL of water.

2. Dissolve 500 g of KOH in 250 mL of water. When cool, adjust until sp. gr. is 1.55.

For use, add 270 mL of solution (2) to 30 mL of solution (1).

Rosolic acid (indicator). Dissolve 1 g of rosolic acid in 10 mL of alcohol and add 100 mL of water.

Scheibler's reagent. See Phosphotungstic acid.

Schiff's reagent. See Fuchsin-sulfurous acid.

Schweitzer's reagent. See Cupric oxide, ammoniacal.

Soap solution (reagent for hardness in water). Dissolve 100 g of dry castile soap in 1 L of 80% alcohol (5 parts alcohol to 1 part water). Allow to stand several days and dilute with 70% to 80% alcohol until 6.4 mL produces a permanent lather with 20 mL of standard calcium solution. The latter solution is made by dissolving 0.2 g of CaCO_3 in a small amount of dilute HCl, evaporating to dryness and making up to 1 L.

Sodium bismuthate (oxidation of manganese). Heat 20 parts of NaOH nearly to redness in an iron or nickel crucible and add slowly 10 parts of basic bismuth nitrate which has been previously dried. Add 2 parts of sodium peroxide, and pour the brownish-yellow fused mass onto an iron plate to cool. When cool, break up in a mortar, extract with water, and collect on an asbestos filter.

Sodium hydroxide (for CO_2 absorption). Dissolve 330 g of NaOH in water and dilute to 1 L.

Sodium nitroprusside (reagent for hydrogen sulfide and wool). Use a freshly prepared solution of 1 g of sodium nitroferricyanide in 10 mL of water.

Sodium oxalate (primary standard). Dissolve 30 g of the commercial salt in 1 L of water, make slightly alkaline with sodium hydroxide, and let stand until perfectly clear. Filter and evaporate the filtrate to 100 mL. Cool and filter. Pulverize the residue and wash it several times with small volumes of water. The procedure is repeated until the mother liquor is free from sulfate and is neutral to phenolphthalein.

Sodium plumbite (reagent for wool). Dissolve 5 g of sodium hydroxide in 100 mL of water. Add 5 g of litharge (PbO) and boil until dissolved.

PREPARATION OF SPECIAL ANALYTICAL REAGENTS (continued)

Sodium polysulfide. Dissolve 480 g of $\text{Na}_2\text{S}\cdot 9\text{H}_2\text{O}$ in 500 mL of water, add 40 g of NaOH and 18 g of sulfur. Stir thoroughly and dilute to 1 L with water.

Sonnenschein's reagent. See Phosphomolybdic acid.

Starch solution.

1. Make a paste with 2 g of soluble starch and 0.01 g of HgI_2 with a small amount of water. Add the mixture slowly to 1 L of boiling water and boil for a few minutes. Keep in a glass stoppered bottle. If other than soluble starch is used, the solution will not clear on boiling; it should be allowed to stand and the clear liquid decanted.

2. A solution of starch which keeps indefinitely is made as follows: Mix 500 mL of saturated NaCl solution (filtered), 80 mL of glacial acetic acid, 20 mL of water and 3 g of starch. Bring slowly to a boil and boil for 2 minutes.

3. Make a paste with 1 g of soluble starch and 5 mg of HgI_2 , using as little cold water as possible. Then pour about 200 mL of boiling water on the paste and stir immediately. This will give a clear solution if the paste is prepared correctly and the water actually boiling. Cool and add 4 g of KI. Starch solution decomposes on standing due to bacterial action, but this solution will keep well if stored under a layer of toluene.

Stoke's reagent. Dissolve 30 g of FeSO_4 and 20 g of tartaric acid in water and dilute to 1 L. Just before using, add concentrated NH_4OH until the precipitate first formed is redissolved.

Sulfanilic acid (reagent for nitrites). Dissolve 0.5 g of sulfanilic acid in a mixture of 15 mL of glacial acetic acid and 135 mL of recently boiled water.

Sulfomolybdic acid (Froehde's reagent for alkaloids and glucosides). Dissolve 10 g of molybdic acid or sodium molybdate in 100 mL of conc. H_2SO_4 .

Tannic acid (reagent for albumin, alkaloids, and gelatin). Dissolve 10 g of tannic acid in 10 mL of alcohol and dilute with water to 100 mL.

Titration mixture. (residual chlorine in water analysis). Prepare 1 L of dilute HCl (100 mL of HCl (sp. gr. 1.19) in sufficient water to make 1 L).

Dissolve 1 g of *o*-tolidine in 100 mL of the dilute HCl and dilute to 1 L with dilute HCl solution.

Trinitrophenol solution. See Picric acid.

Turmeric tincture (reagent for borates). Digest ground turmeric root with several quantities of water which are discarded. Dry the residue and digest it several days with six times its weight of alcohol. Filter.

Uffelmann's reagent (turns yellow in presence of lactic acid). To a 2% solution of pure phenol in water, add a water solution of FeCl_3 until the phenol solution becomes violet in color.

Wagner's reagent. See Iodo-potassium iodide.

Wagner's solution (used in phosphate rock analysis to prevent precipitation of iron and aluminum). Dissolve 25 g of citric acid and 1 g of salicylic acid in water and dilute to 1 L. Use 50 mL of the reagent.

Wij's iodine monochloride solution (for iodine number). Dissolve 13 g of resublimed iodine in 1 L of glacial acetic acid which will pass the dichromate test for reducible matter. Set aside 25 mL of this solution. Pass into the remainder of the solution dry chlorine gas (dried and washed by passing through H_2SO_4 (sp. gr. 1.84)) until the characteristic color of free iodine has been discharged. Now add the iodine solution which was reserved, until all free chlorine has been destroyed. A slight excess of iodine does little or no harm, but an excess of chlorine must be avoided. Preserve in well stoppered, amber colored bottles. Avoid use of solutions which have been prepared for more than 30 days.

Wij's special solution (for iodine number). To 200 mL of glacial acetic acid that will pass the dichromate test for reducible matter, add 12 g of dichloramine T (*N,N*-dichloro-4-methyl-benzenesulfonamide), and 16.6 g of dry KI (in small quantities with continual shaking until all the KI has dissolved). Make up to 1 L with the same quality of acetic acid used above and preserve in a dark colored bottle.

Zimmermann-Reinhardt reagent (determination of iron). Dissolve 70 g of $\text{MnSO}_4\cdot 4\text{H}_2\text{O}$ in 500 mL of water, add 125 mL of conc. H_2SO_4 and 125 mL of 85% H_3PO_4 , and dilute to 1 L.

Zinc chloride solution, basic (reagent for silk). Dissolve 1000 g of zinc chloride in 850 mL of water, and add 40 g of zinc oxide. Heat until solution is complete.

Zinc uranyl acetate (reagent for sodium). Dissolve 10 g of $\text{UO}_2(\text{C}_2\text{H}_3\text{O}_2)_2\cdot 2\text{H}_2\text{O}$ in 6 g of 30% acetic acid with heat, if necessary, and dilute to 50 mL. Dissolve 30 g of $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2\cdot \text{H}_2\text{O}$ in 3 g of 30% acetic acid and dilute to 50 mL. Mix the two solutions, add 50 mg of NaCl, allow to stand overnight and filter.

STANDARD SOLUTIONS OF ACIDS, BASES, AND SALTS

For each compound listed, the last column of this table gives the mass in grams which is contained in 1 liter of a solution whose amount-of-substance concentration divided by the equivalence factor of the compound equals 0.1 mol/L. In the older literature such a solution is often referred to as a "decinormal solution" (0.1 N).

REFERENCE

Compendium of Analytical Nomenclature (IUPAC), Pergamon Press, Oxford, 1978.

Name	Formula	Atomic or molecular weight	Equivalence factor	Mass in grams
Acetic acid	HC ₂ H ₃ O ₂	60.0530	1	6.0053
Ammonia	NH ₃	17.0306	1	1.7031
Ammonium ion	NH ₄ ⁺	18.0386	1	1.8039
Ammonium chloride	NH ₄ Cl	53.4916	1	5.3492
Ammonium sulfate	(NH ₄) ₂ SO ₄	132.1388	1/2	6.6069
Ammonium thiocyanate	NH ₄ CNS	76.1204	1	7.6120
Barium	Ba	137.34	1/2	6.867
Barium carbonate	BaCO ₃	197.3494	1/2	9.8675
Barium chloride hydrate	BaCl ₂ · 2H ₂ O	244.2767	1/2	12.2138
Barium hydroxide	Ba(OH) ₂	171.3547	1/2	8.5677
Barium oxide	BaO	153.3394	1/2	7.6670
Bromine	Br	79.909	1	7.9909
Calcium	Ca	40.08	1/2	2.004
Calcium carbonate	CaCO ₃	100.0894	1/2	5.0045
Calcium chloride	CaCl ₂	110.9860	1/2	5.5493
Calcium chloride hydrate	CaCl ₂ · 6H ₂ O	219.0150	1/2	10.9508
Calcium hydroxide	Ca(OH) ₂	74.0947	1/2	3.7047
Calcium oxide	CaO	56.0794	1/2	2.8040
Chlorine	Cl	35.453	1	3.5453
Citric acid	C ₆ H ₈ O ₇ · H ₂ O	210.1418	1/3	7.0047
Cobalt	Co	58.9332	1/2	2.9466
Copper	Cu	63.54	1/2	3.177
Copper oxide (cupric)	CuO	79.5394	1/2	3.9770
Copper sulfate hydrate	CuSO ₄ · 5H ₂ O	249.6783	1/2	12.4839
Hydrochloric acid	HCl	36.4610	1	3.6461
Hydrocyanic acid	HCN	27.0258	1	2.7026
Iodine	I	126.9044	1	12.6904
Lactic acid	C ₃ H ₆ O ₃	90.0795	1	9.0080
Malic acid	C ₄ H ₆ O ₅	134.0894	1/2	6.7045
Magnesium	Mg	24.312	1/2	1.2156
Magnesium carbonate	MgCO ₃	84.3214	1/2	4.2161
Magnesium chloride	MgCl ₂	95.2180	1/2	4.7609
Magnesium chloride hydrate	MgCl ₂ · 6H ₂ O	203.2370	1/2	10.1623
Magnesium oxide	MgO	40.3114	1/2	2.0156
Manganese	Mn	54.938	1/2	2.7469
Manganese sulfate	MnSO ₄	150.9996	1/2	7.5500
Mercuric chloride	HgCl ₂	271.4960	1/2	13.5748
Nickel	Ni	58.71	1/2	2.9356
Nitric acid	HNO ₃	63.0129	1	6.3013
Oxalic acid	H ₂ C ₂ O ₄	90.0358	1/2	4.5018
Oxalic acid hydrate	H ₂ C ₂ O ₄ · 2H ₂ O	126.0665	1/2	6.3033
Oxalic acid anhydride	C ₂ O ₃	72.0205	1/2	3.6010
Phosphoric acid	H ₃ PO ₄	97.9953	1/3	3.2665
Potassium	K	39.102	1	3.9102
Potassium bicarbonate	KHCO ₃	100.1193	1	10.0119
Potassium carbonate	K ₂ CO ₃	138.2134	1/2	6.9106
Potassium chloride	KCl	74.5550	1	7.4555

STANDARD SOLUTIONS OF ACIDS, BASES, AND SALTS (continued)

Name	Formula	Atomic or molecular weight	Equivalence factor	Mass in grams
Potassium cyanide	KCN	65.1199	1	6.5120
Potassium hydroxide	KOH	56.1094	1	5.6109
Potassium oxide	K ₂ O	94.2034	1/2	4.7102
Potassium tartrate	K ₂ H ₄ C ₄ O ₆	226.2769	1/2	11.3139
Silver	Ag	107.87	1	10.787
Silver nitrate	AgNO ₃	169.8749	1	16.9875
Sodium	Na	22.9898	1	2.2990
Sodium bicarbonate	NaHCO ₃	84.0071	1	8.4007
Sodium carbonate	Na ₂ CO ₃	105.9890	1/2	5.2995
Sodium chloride	NaCl	58.4428	1	5.8443
Sodium hydroxide	NaOH	39.9972	1	3.9997
Sodium oxide	Na ₂ O	61.9790	1/2	3.0990
Sodium sulfide	Na ₂ S	78.0436	1/2	3.9022
Succinic acid	H ₂ C ₄ H ₄ O ₄	118.0900	1/2	5.9045
Sulfuric acid	H ₂ SO ₄	98.0775	1/2	4.9039
Tartaric acid	C ₄ H ₆ O ₆	150.0888	1/2	7.5044
Zinc	Zn	65.37	1/2	3.269
Zinc sulfate hydrate	ZnSO ₄ · 7H ₂ O	287.5390	1/2	14.3769

STANDARD SOLUTIONS OF OXIDATION AND REDUCTION REAGENTS

For each reagent listed, the last column of this table gives the mass in grams which is contained in a solution whose amount-of-substance concentration divided by the equivalence factor of the compound equals 0.1 mol/L. The equivalence factor given refers to the most common reactions of the reagent. In the older literature such a solution is often called a "decinormal solution" (0.1 N).

REFERENCE

Compendium of Analytical Nomenclature (IUPAC), Pergamon Press, Oxford, 1978.

Name	Formula	Atomic or molecular weight	Equivalence factor	Mass in grams
Antimony	Sb	121.75	1/2	6.0875
Arsenic	As	74.9216	1/2	3.7461
Arsenic trisulfide	As ₂ S ₃	246.0352	1/4	6.1509
Arsenous oxide	As ₂ O ₃	197.8414	1/4	4.9460
Barium peroxide	BaO ₂	169.3388	1/2	8.4669
Barium peroxide hydrate	BaO ₂ · 8H ₂ O	313.4615	1/2	15.6730
Calcium	Ca	40.08	1/2	2.004
Calcium carbonate	CaCO ₃	100.0894	1/2	5.0045
Calcium hypochlorite	Ca(OCl) ₂	142.9848	1/4	3.5746
Calcium oxide	CaO	56.0794	1/2	2.8040
Chlorine	Cl	35.453	1	3.5453
Chromium trioxide	CrO ₃	99.9942	1/3	3.3331
Ferrous ammonium sulfate	FeSO ₄ (NH ₄)SO ₄ · 6H ₂ O	392.0764	1	39.2076
Hydroferrocyanic acid	H ₄ Fe(CN) ₆	215.9860	1	21.5986
Hydrogen peroxide	H ₂ O ₂	34.0147	1/2	1.7007
Hydrogen sulfide	H ₂ S	34.0799	1/2	1.7040
Iodine	I	126.9044	1	12.6904
Iron	Fe	55.847	1	5.5847
Iron oxide (ferrous)	FeO	71.8464	1	7.1846
Iron oxide (ferric)	Fe ₂ O ₃	159.6922	1/2	7.9846
Lead peroxide	PbO ₂	239.1888	1/2	11.9594
Manganese dioxide	MnO ₂	86.9368	1/2	4.3468
Nitric acid	HNO ₃	63.0129	1/3	2.1004
Nitrogen trioxide	N ₂ O ₃	76.0116	1/4	1.9002
Nitrogen pentoxide	N ₂ O ₅	108.0104	1/6	1.8001
Oxalic acid	C ₂ H ₂ O ₄	90.0358	1/2	4.5018
Oxalic acid hydrate	C ₂ H ₂ O ₄ · 2H ₂ O	126.0665	1/2	6.3033
Oxygen	O	15.9994	1/2	0.8000
Potassium dichromate	K ₂ Cr ₂ O ₇	294.1918	1/6	4.9032
Potassium chlorate	KClO ₃	122.5532	1/6	2.0425
Potassium chromate	K ₂ CrO ₄	194.1076	1/3	6.4733
Potassium ferrocyanide	K ₄ Fe(CN) ₆	368.3621	1	36.8362
Potassium ferrocyanide hydrate	K ₄ Fe(CN) ₆ · 3H ₂ O	422.4081	1	42.2408
Potassium iodide	KI	166.0064	1	16.6006
Potassium nitrate	KNO ₃	101.1069	1/3	3.3702
Potassium perchlorate	KClO ₄	138.5526	1/8	1.7319
Potassium permanganate	KMnO ₄	158.0376	1/5	3.1608
Sodium chlorate	NaClO ₃	106.4410	1/6	1.7740
Sodium nitrate	NaNO ₃	84.9947	1/3	2.8332
Sodium thiosulfate hydrate	Na ₂ S ₂ O ₃ · 5H ₂ O	248.1825	1	24.8183
Stannous chloride	SnCl ₂	189.5960	1/2	9.4798
Stannous oxide	SnO	134.6894	1/2	6.7345
Sulfur dioxide	SO ₂	64.0628	1/2	3.2031
Tin	Sn	118.69	1/2	5.935

**ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF
INORGANIC SUBSTANCES**

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Determination	Reagents	Ref.
Aluminium	Alizarin Red S	Onishi, Part II a, p 28. (5), Snell, <i>Metals I</i> , p 587. (7)
	Aluminon	Fries/Getrost, p 16. (2), Onishi, <i>Ila</i> , p 21. (5), Snell, <i>Metals I</i> , p 590. (7)
	Aluminon + Cetyltrimethylammonium bromide	Huaxue Shiji, 8, 85, (1986)
	Chrome Azurol S	Onishi, Part IIa, p 26. (5), Snell, <i>Metals I</i> , p 605. (7)
	Chrome Azurol S + Cetyltrimethylammonium bromide	Marczenko, p 133 (3), Snell, <i>Metals I</i> , p 606. (7)
	Chromazol KS + Cetylpyridinium bromide	<i>Analyst</i> , 107, 428, (1982).
	Eriochrome Cyanine R	Fries/Getrost, p 19 (2), Onishi, Part IIa p 25. (5), Snell, <i>Metals I</i> , p 611. (7)
Ammonia	Eriochrome Cyanine R + Cetyltrimethylammonium bromide	Snell, <i>Metals I</i> , p 613. (7), <i>Analyst</i> , 107, 1431, (1982).
	8-Hydroxyquinoline	Fries/Getrost, p 22 (2), Marczenko, p 131 (3), Onishi, Part IIa, p 31. (5), Snell, <i>Metals I</i> , p 622 (7)
	Phenol + Sodium hypochlorite	Boltz, p 210 (1), Marczenko, p 413 (3), Snell, <i>Nonmetals</i> , p 604 (9)
Antimony	Brilliant Green	Onishi, Part IIa, p 102. (5), Snell, <i>Metals I</i> , p 384. (7)
	Bromopyrogallol Red Rhodamine B	<i>Talanta</i> , 13, 507, (1966). Fries/Getrost, p 32, (2), Marczenko, p 141. (3), Onishi, Part IIa, p 93. (5), Snell, <i>Metals I</i> , p 404. (7)
Arsenic	Silver diethyldithiocarbamate	Fries/Getrost, p 36. (2)
	Silver diethyldithiocarbamate	Fries/Getrost, p 41. (2), Marczenko, p 153. (3), Onishi, Part IIa, p 153. (5), Snell, <i>Metals I</i> , p 370. (7)
Barium	Sulfonazo III	Fries/Getrost, p 46. (2), Snell, <i>Metals II</i> , p 1782. (8), Onishi, Part IIa, p 202. (5)
Beryllium	Beryllon II	Snell, <i>Metals I</i> , p 667. (7)
	Chrome Azurol S	Marczenko, p 163. (3), Snell, <i>Metals I</i> , p 672. (7)
	Chrome Azurol S + Cetyltrimethylammonium bromide	Marczenko, p 164. (3), Snell, <i>Metals I</i> , p 673. (7)
	Eriochrome Cyanine R	Snell, <i>Metals I</i> , p 675. (7), <i>Talanta</i> , 31, 249, (1984).
Bismuth	Eriochrome Cyanine R + Cetyltrimethylammonium bromide	Zh, <i>Anal. Khim.</i> , 33, 1298, (1978).
	Dithizone	Onishi, Part IIa, p 262. (5), Snell, <i>Metals I</i> , p 303. (7)
	Pyrocatechol Violet Pyrocatechol Violet + Cetyltrimethylammonium bromide Thiourea	Fres. <i>Z. Anal. Chem.</i> , 186, 418, (1962). Zh. <i>Anal. Khim.</i> , 38, 216, (1983). Onishi, Part IIa, p 260. (5), Snell, <i>Metals I</i> , p 317. (7)
Boron	Xylenol Orange	Friez/Getrost, p 57. (2), Marczenko, p 172. (3), Snell, <i>Metals I</i> , p 320. (7)
	Azomethine H Carminic acid	Snell, <i>Nonmetals</i> , p 165. (9) Boltz, p 14. (1), Fries/Getrost, p 65. (2), Snell, <i>Nonmetals</i> , p 170. (9), Williams, p 35. (11)
	Curcumin	Boltz, p 8. (1), Fries/Getrost, p 68. (2), Marczenko, p 180. (3), Snell, <i>Nonmetals</i> , p 180. (9), Fres. <i>Z. Anal. Chem.</i> , 323, 266, (1986).

**ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF
INORGANIC SUBSTANCES (continued)**

Determination	Reagents	Ref.
	Methylene Blue	Boltz, p 21. (1), Marczenko, p 183. (3), Snell, Nonmetals, p 205. (9), <i>Talanta</i> , 31, 547, (1984).
Bromide	Fluorescein	Boltz, p 48. (1), Snell, Nonmetals, p 276., <i>Fres. Z. Anal. Chem.</i> , 301, 28 (1980).
	Phenol Red	Boltz, p 44. (1), Marczenko, p 190. (3), Snell, Nonmetals, p 28. (9)
Cadmium	2-(5-Bromo-2-pyridylazo)-5-diethylaminophenol	Marczenko, p 197. (3)
	Cadion Dithizone	Onishi, Part IIa, p 323. (5) Fries/Getrost, p 78. (2), Onishi, Part IIa, p 315. (5), Snell, <i>Metals I</i> , p 279. (7), West, p 25. (10).
Calcium	4-(2-Pyridylazo)resorcinol	<i>Fres. Z. Anal. Chem.</i> , 310, 51, (1982).
	Chlorophosphonazo III	Marczenko, p 207. (3), Snell, <i>Metals II</i> , p 1744. (8)
	Glyoxal-bis(2-hydroxyanil)	Fries/Getrost, p 86. (2), Onishi, Part IIa, p 352. (5), Snell, <i>Metals I</i> , p 1762. (8)
	Murexide	Onishi, Part IIa, p 357. (5), Snell, <i>Metals II</i> , p 1769. (8)
Cerium	Phthalein Purple	<i>Anal. Chim. Acta</i> , 34, 71 (1966).
	<i>N</i> -benzoyl- <i>N</i> -phenylhydroxylamine	<i>Anal. Chim. Acta</i> , 48, 155, (1969).
	8-Hydroxyquinoline	Fries/Getrost, p 93. (2), Marczenko, p 220. (3), Onishi, Part IIa, p 383. (7)
Chlorine	<i>N,N</i> -Diethyl-1,4-phenylenediamine	Boltz, p 92. (1), Fries/Getrost, p 101. (2), Snell, Nonmetals, p 225. (9), <i>Analyst</i> , 90, 187, (1965).
Chromium	1,5-Diphenylcarbazide	Fries/Getrost, p 105. (2), Onishi, Part IIa, p 412. (5), Snell, <i>Metals I</i> , p 714. (7), West, p 12. (10)
	4-(2-Pyridylazo)resorcinol	Snell, <i>Metals I</i> , p 736. (7), West, p 17. (10)
Cobalt	4-(2-Pyridylazo)resorcinol + Tetradecyldimethylbenzylammonium chloride	West, p 17. (10), <i>Anal. Chim. Acta</i> , 67, 297, (1973).
	4-(2-Pyridylazo)resorcinol + Hydrogen peroxide	<i>Fres. Z. Anal. Chem.</i> , 304, 382, (1980).
	Nitroso-R salt	Fries/Getrost, p 118. (2), Onishi, Part IIa, p 454. (5), Snell, <i>Metals I</i> , p 953. (7)
	1-Nitroso-2-naphthol	Fries/Getrost, p 111. (2), Marczenko, p 246. (3), Snell, <i>Metals I</i> , p 947. (5)
	2-Nitroso-1-naphthol	Fries/Getrost, p 113. (2), Onishi, Part IIa, p 459. (5), Snell, <i>Metals I</i> , p 949. (7), West, p 45. (10)
Copper	4-(2-Pyridylazo)resorcinol	Snell, <i>Metals I</i> , p 969. (7), West, p 44. (10)
	4-(2-Pyridylazo)resorcinol + Diphenylguanidine	<i>Zh. Anal. Khim.</i> , 35, 1306, (1980).
	Bathocuproine	Fries/Getrost, p 135. (2), Snell, <i>Metals I</i> , p 148. (7)
	Bathocuproine disulfonic acid	Fries/Getrost, p 137. (2), West, p 52. (10)
	Dithizone	Marczenko, p 258. (3), Onishi, Part IIa, p 529. (5), Snell, <i>Metals I</i> , p 199. (7)
	Neocuproine	Snell, <i>Metals I</i> , p 217. (5), West, p 51. (10)
	Cuprizone	Onishi, Part IIa, p 534. (5), Snell, <i>Metals I</i> , p 157. (7), West, p 53. (10)
Cyanide	4-(2-pyridylazo)resorcinol + Tetradecyldimethylbenzylammonium chloride	<i>Anal. Chim. Acta</i> , 138, 321, (1982).
	Barbituric Acid + Pyridine	Fries/Getrost, p 153. (2), Snell, Nonmetals, p 653. (9)
	Barbituric Acid + Pyridine-4-carboxylic acid	<i>Anal. Chim. Acta</i> , 99, 197, (1978).

**ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF
INORGANIC SUBSTANCES (continued)**

Determination	Reagents	Ref.
Fluoride	Alizarin Fluorine blue + Lanthanum(III) ion	Boltz, p 129. (1), Fries/Getrost, p 158. (2), Snell, <i>Nonmetals</i> , p 333. (9), Williams, p 354. (11)
	Eriochrome Cyanine R + Zirconium(IV) ion	Boltz, p 119. (1), Snell, <i>Nonmetals</i> , p 359. (2), Williams, p 357. (10)
Gallium	Pyrocatechol violet + Diphenylguanidine	Snell, <i>Metals I</i> , p 500. (7)
	8-Hydroxyquinoline	Onishi Pt IIa, p 582. (5), Snell, <i>Metals I</i> , p 505. (7)
	1-(2-Pyridylazo)-2-naphthol	Snell, <i>Metals I</i> , p 512. (7)
	4-(2-Pyridylazo)resorcinol	Snell, <i>Metals I</i> , p 513. (7)
Germanium	Rhodamine B	Marczenko, p 284. (3), Onishi, Part IIa, p 578. (5), Snell, <i>Metals I</i> , p 515. (7)
	Xylenol Orange	Fries/Getrost, p 166. (2), Snell, <i>Metals I</i> , p 523. (7)
	Xylenol Orange + 8-Hydroxyquinoline	<i>Zh. Anal. Khim.</i> , 26, 75, (1971).
Gold	Brilliant Green + Molybdate	Snell, <i>Metals I</i> , p 562. (7)
	Phenylfluorone	Fries/Getrost, p 168. (2), Marczenko, p 292. (3), Onishi, Part IIa, p 607. (5), Snell, <i>Metals I</i> , p 570. (7)
Hafnium	5-(4-Diethylaminobenzylidene) rhodanine	Fries/Getrost, p 173. (2), Onishi, Part IIa, p 631. (5), Snell, <i>Metals II</i> , p 1516. (8)
	Rhodamine B	Fries/Getrost, p 175. (2), Marczenko, p 301. (3), Onishi, Part IIa, p 637. (5), Snell, <i>Metals II</i> , p 513. (8)
Indium	Arsenazo III	Snell, <i>Metals II</i> , p 1184. (8), <i>Talanta</i> , 19, 807, (1972).
	Bromopyrogallol Red	Snell, <i>Metals I</i> , p 469. (7)
Iodide	Chrome Azurol S	Snell, <i>Metals I</i> , p 474. (7)
	Chrome Azurol S + Cetyltrimethylammonium bromide	<i>Anal. Chim. Acta</i> , 67, 107, (1973).
	Dithizone	Fries/Getrost, p 179. (2), Onishi, Part IIa, p 672. (5), Snell, <i>Metals I</i> , p 474. (7)
	8-Hydroxyquinoline	Onishi, Part IIa, p 670. (5), Snell, <i>Metals I</i> , p 475. (7)
Iridium	1-(2-Pyridylazo)-2-naphthol	Snell, <i>Metals I</i> , p 480. (7)
	4-(2-Pyridylazo)resorcinol	Marczenko, p 309. (3), Snell, <i>Metals I</i> , p 480. (7)
Iron	Neocuproine + Copper(II)	<i>Anal. Chim. Acta</i> , 69, 321, (1974).
	Starch	Boltz, p 162. (1), Marczenko, p 316. (3), Snell, <i>Nonmetals</i> , p 307. (9)
Iron	Rhodamine 6G + Tin(II)	Marczenko, p 323. (3)
	N,N-Dimethyl-4-nitrosoaniline	<i>Anal. Chem.</i> , 27, 1776, (1955).
Iron	Bathophenanthroline	Fries/Getrost, p 189. (2), Onishi, Part IIa, p 729. (5), Snell, <i>Metals I</i> , p 763. (7)
	Bathophenanthroline disulfonic acid	Fries/Getrost, p 191. (2), Snell, <i>Metals I</i> , p 772. (7)
	2,2'-Bipyridyl	Snell, <i>Metals I</i> , p 750. (7)
	Chrome Azurol S + Cetyltrimethylammonium bromide	Snell, <i>Metals I</i> , p 757. (7), <i>Coll. Czech. Chem. Comm.</i> , 45, 2656, (1980).
	1,10-Phenanthroline	Fries/Getrost, p 199. (2), Marczenko, p 331. (3), Onishi, Part IIa, p 725. (5), Snell, <i>Metals I</i> , p 795. (7)
	1,10-Phenanthroline + Bromothymol Blue	<i>Zh. Anal. Khim.</i> , 25, 1348, (1970).
Lanthanum	Ferrozine	Onishi, Part IIa, p 730. (5), Snell, <i>Metals I</i> , p 783. (7)
Lanthanum	Arsenazo III	Marczenko, p 468. (3), Snell, <i>Metals II</i> , p 1910. (8)

**ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF
INORGANIC SUBSTANCES (continued)**

Determination	Reagents	Ref.
Lead	Dithizone	Fries/Getrost, p 207. (2), Onishi, Part IIa, p 824. (5), Snell, <i>Metals I</i> , p 2. (7), West, p 34. (10)
	Sodium diethyldithiocarbamate	Fries/Getrost, p 214. (2), Snell, <i>Metals I</i> , p 27. (7)
	4-(2-Pyridylazo)resorcinol	Fries/Getrost, p 220. (2), Marczenko, p 347. (3), Snell, <i>Metals I</i> , p 34. (7)
Lithium	Thoron	Onishi, Part IIa, p 863. (5), Snell, <i>Metals II</i> , p 1726. (8), <i>Talanta</i> , 30, 587, (1983).
Magnesium	Eriochrome Black T	Fries/Getrost, p 226. (2), Marczenko, p 355. (3), Onishi, Part IIb, p 13. (6), Snell, <i>Metals II</i> , p 1932. (8)
	8-Hydroxyquinoline	Onishi, Part IIb, p 11. (6), Snell, <i>Metals II</i> , p 1938. (8)
	8-Hydroxyquinoline + Butylamine	Fries/Getrost, p 228. (2), Snell, <i>Metals II</i> , p 1938. (8)
	Titan Yellow	Fries/Getrost, p 234. (2), Marczenko, p 352. (3), Snell, <i>Metals II</i> , p 1945. (8)
Manganese	Xylidyl Blue	Fries/Getrost, p 231. (2), Onishi, Part IIb, p 14. (6), Snell, <i>Metals II</i> , p 1950. (8)
	Formaldoxime	Fries/Getrost, p 236. (2), Marczenko, p 364. (3), Onishi Part IIb, p 38. (6), Snell, <i>Metals II</i> , 1010. (8)
	Formaldoxime	Fries/Getrost, p 236. (2), Marczenko, p 364. (3), Onishi Part IIb, p 38. (6), Snell, <i>Metals II</i> , 1010. (8)
Mercury	Dithizone	Fries/Getrost, p 243. (2), Marczenko, p 373. (3), Onishi, Part IIb, p 66. (6), Snell, <i>Metals I</i> , p 107. (7), West, p 29. (10)
	Michler's thioketone	Marczenko, p 375. (3), Snell, <i>Metals I</i> , p 126. (7)
Molybdenum	Xylenol Orange	<i>Talanta</i> , 16, 1023, (1969)
	Bromopyrogallol Red + Cetylpyridium chloride	West, p 58. (10)
	Phenylfluorone	Snell, <i>Metals II</i> , p 1311., <i>Microchem. J.</i> , 31, 56, (1985).
Nickel	Toluene-3,4-dithiol	Fries/Getrost, p 251. (2), Marczenko, p 384. (3), Onishi, Part IIb, p 96. (6), Snell, <i>Metals II</i> , p 1301. (8)
	2-(5-Bromo-2-pyridylazo)-5-diethylaminophenol	Marczenko, p 397. (3), <i>Talanta</i> 28, 189, (1981).
	Dimethylglyoxime	Fries/Getrost, p 263. (2), Marczenko, p 393. (3), Onishi, Part IIb, p 125. (6), Snell, <i>Metals I</i> , p 887. (7)
	Dimethylglyoxime + Oxidant	Fries/Getrost, p 263. (2), Onishi, Part IIb, p 125. (6), Snell, <i>Metals I</i> , p 887. (7)
Niobium	2,2'-Furildioxime	Marczenko, p 396. (3), Snell, <i>Metals I</i> , p 904. (7)
	2-(2-Pyridylazo)-2-naphthol	Snell, <i>Metals I</i> , p 910. (7)
	4-(2-Pyridylazo)resorcinol	Snell, <i>Metals I</i> , p 911. (7), West, p 39. (10), <i>Anal. Chim. Acta</i> , 82, 431, (1976).
	N-Benzoyl-N-phenylhydroxylamine	Snell, <i>Metals II</i> , p 1425. (8)
	Pyrocatechol + EDTA or 2,2'Bipyridyl or 1-(2-thenoyl)-3,3,3,-trifluoroacetone	Snell, <i>Metals II</i> , p 1427. (8)
Niobium	Bromopyrogallol red	Marczenko, p 407. (3), Snell, <i>Metals II</i> , p 1426. (8)
	Bromopyrogallol red + Cetylpyridinium chloride	<i>Talanta</i> , 32, 189, (1985).
	4-(2-Pyridylazo)resorcinol	Fries/Getrost, p 274. (2), Marczenko, p 406. (3), Onishi, Part IIb, p 160. (7), Snell, <i>Metals II</i> , p 1447. (8)

**ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF
INORGANIC SUBSTANCES (continued)**

Determination	Reagents	Ref.
	Sulfochlorophenol S	Onishi, Part IIb, p 161. (7), Snell, <i>Metals II</i> , p 1430. (8)
Nitrate	Xylenol Orange	Onishi, Part IIb, p 164. (7)
	Brucine	Boltz, p 227. (1), Fries/Getrost, p 280. (2), Snell, <i>Nonmetals</i> , p 546. (9)
	Chromotropic acid	Boltz, p 229. (1), Fries/Getrost, p 281. (2), Snell, <i>Nonmetals</i> , p 548. (9), Williams, p 132. (11), <i>Fres. Z. Anal. Chem.</i> , 320, 490, (1985).
Nitrite	Sulfanilamide + <i>N</i> -(1-Naphthyl)ethylenediamine dihydrochloride	Fries/Getrost, p 279. (2), Snell, <i>Nonmetals</i> , p 559. (9)
	Sulfanilamide + <i>N</i> -(1-Naphthyl)ethylenediamine dihydrochlorine	Boltz, p 241. (1), Snell, <i>Nonmetals</i> , p 585. (8), <i>Analyst</i> , 109, 1281, (1984).
	Sulfanilic acid + 1-Naphthylamine	Boltz, p 237. (1), Fries/Getrost, p 285. (2), Marzenko, p 419. (3), Snell, <i>Nonmetals</i> , p 586. (9)
Osmium	1,5-Diphenylcarbazine	Marzenko, p 428. (3)
Palladium	2-(5-Bromo-2-pyridylazo)-5-diethylaminophenol	<i>Talanta</i> , 33, 939, (1986).
	Dithizone	Marzenko, p 440. (3), Onishi, Part IIb, p 227. (6), Snell, <i>Metals II</i> , p 1577. (8)
	2-Nitroso-1-naphthol	Fries/Getrost, p 294. (2), Onishi, Part IIb, p 226. (6), Snell, <i>Metals II</i> , p 1581. (8)
	4-(2-Pyridylazo)resorcinol	Snell, <i>Metals II</i> , p 1583. (8) <i>Analyst</i> , 107, 708, (1982).
Phosphate	Rhodamine B + Molybdate	Snell, <i>Nonmetals</i> , p 103. (9)
	Malachite Green + Molybdate	Snell, <i>Nonmetals</i> , p 12. (9), <i>Analyst</i> , 108, 361, (1983).
Platinum	Sulfochlorophenolazorhodamine	Onishi, Part IIb, p 253. (6), <i>Talanta</i> , 34, 87, (1987).
	Dithizone	Fries/Getrost, p 300. (2), Onishi, Part IIb, p 253. (6), Snell, <i>Metals II</i> , p 1534. (8)
	2-Mercaptobenzothiazole	Fries/Getrost, p 302. (2), <i>Zh. Anal. Khim.</i> , 24, 1172, (1969).
Rare Earths	Arsenazo I	Marzenko, p 470. (3), Onishi, Part IIa, p 785. (5), Snell, <i>Metals II</i> , p 1857. (8)
	Arsenazo III	Fries/Getrost, p 309. (2), Marzenko, p 468. (3), Onishi, Part IIa, p 786. (5), Snell, <i>Metals II</i> , p 1862. (8)
	Xylenol Orange	Onishi, Part IIa, p 787. (5), Snell, <i>Metals II</i> , p 1874. (8)
Rhenium	2,2'-Furildioxime	Fries/Getrost, p 310. (2), Marzenko, p 481. (3), Onishi, Part IIb, p 288. (6), Snell, <i>Metals II</i> , p 1659. (8)
Rhodium	1-(2-Pyridylazo)-2-naphthol	Fries/Getrost, p 311. (2), Snell, <i>Metals II</i> , p 1553. (8)
Ruthenium	1,10-Phenanthroline	Onishi, Part IIb, p 331. (6), Snell, <i>Metals II</i> , p 1623. (8)
	Thiourea	Fries/Getrost, p 318. (2), Onishi, Part IIb, p 329. (6), Snell, <i>Metals II</i> , p 1626. (8)
	1,4-Diphenylthiosemicarbazide	Marzenko, p 493. (3), Onishi, Part IIb, p 330. (8)
Scandium	Alizarin red S	Fries/Getrost, p 319. (2), Onishi, Part IIb, p 360. (6), Snell, <i>Metals I</i> , p 536. (7)
	Arsenazo III	Onishi, Part IIb, p 359. (6), Snell, <i>Metals I</i> , p 539. (7)

**ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF
INORGANIC SUBSTANCES (continued)**

Determination	Reagents	Ref.
	Chrome Azurol S	Snell, <i>Metals I</i> , p 551. (7), <i>Anal. Chim. Acta</i> , 159, 309, (1984).
	Xylenol Orange	Marczenko, p 501. (3), Onishi, Part IIb, p 357. (6), Snell, <i>Metals I</i> , p 547. (7)
Selenium	3,3'-Diaminobenzidine	Boltz, p 391. (1), Fries/Getrost, p 323. (2), Marczenko, p 508. (3), Snell, <i>Nonmetals</i> , p 490. (9), West, p 4. (10).
Silver	2,3-Diaminonaphthaline Dithizone	Snell, <i>Nonmetals</i> , p 501. (9) Fries/Getrost, p 328. (2), Marczenko, p 524. (3), Onishi, Part IIb, p 379. (6), Snell, <i>Metals I</i> , p 82. (7)
Sulfate	Eosin + 1,10-Phenanthroline	Snell, <i>Metals I</i> , p 93. (7)
Sulfide	Methylthymol blue + Barium (II) <i>N,N</i> ,-Dimethyl-1,4-phenylenediamine	Snell, <i>Nonmetals</i> , p 457. (9) Boltz, p 483. (1), Fries/Getrost, p 344. (2), Snell, <i>Nonmetals</i> , p 400. (9), Williams, p 578. (11)
Sulfite	Pararosaniline + Formaldehyde	Boltz, p 478. (1), Marczenko, p 540. (3), Snell, <i>Nonmetals</i> , p 430. (9), Williams, p 591. (11)
Tantalum	Methyl Violet	Marczenko, p 551. (3), Snell, <i>Metals II</i> , p 1485. (8)
	4-(2-Pyridylazo)resorcinol Phenylfluorone	Snell, <i>Metals II</i> , p 1488. (8) Onishi, Part IIb, p 166. (6), Snell, <i>Metals II</i> , p 1486. (8)
Tellurium	Diethyldithiocarbamate	Boltz, p 402. (1), Fries/Getrost, p 348. (2), Snell, <i>Nonmetals</i> , p 533. (9), Williams, p 220. (10)
	Bismuthiol II	Boltz, p 401. (1), Marczenko, p 557. (3), Snell, <i>Nonmetals</i> , p 524. (9)
Thallium	Brilliant green	Fries/Getrost, p 352. (2), Marczenko, p 567. (3), Onishi, Part IIb, p 426. (6), Snell, <i>Metals I</i> , p 45. (7)
	Dithizone	Fries/Getrost, p 355. (2), Onishi, Part IIb, p 426. (6), Snell, <i>Metals I</i> , p 54. (7)
	Rhodamine B	Fries/Getrost, p 354. (2), Marczenko, p 566. (3), Onishi, Part IIb, p 424. (6), Snell, <i>Metals I</i> , p 63. (7)
Thorium	Arsenazo III	Fries/Getrost, p 360. (2), Marczenko, p 575. (3), Onishi, Part IIb, p 460. (6), Snell, <i>Metals II</i> , p 1820. (8)
	Thoron	Marczenko, p 574. (3), Onishi, Part IIb, p 463. (6), Snell, <i>Metals I</i> , p 1835. (7)
	Xylenol Orange	Snell, <i>Metals I</i> , p 1852. (7)
Tin	Xylenol Orange + Cetyltrimethylammonium bromide Pyrocatechol violet (and + Cetyltrimethylammonium bromide)	<i>Talanta</i> , 26, 499, (1979). Marczenko, p 585. (3), Onishi, Part IIb, p 501. (6), Snell, <i>Metals I</i> , p 422. (7)
	Gallein	Onishi, Part IIb, p 507, 510. (6), Snell, <i>Metals I</i> , p 432. (7)
	Phenylfluorone	Fries/Getrost, p 368. (2), Marczenko, p 582. (3), Onishi, Part IIb, p 497. (6), Snell, <i>Metals I</i> , p 444. (7)
	Toluene-3,4-dithiol + Dispersant	Fries/Getrost, p 366. (2), Onishi, Part IIb, p 502. (6), Snell, <i>Metals I</i> , p 427. (7)
Titanium	Chromotropic acid	Marczenko, p 593. (3), Onishi, Part IIb, p 551. (6), Snell, <i>Metals II</i> , p 1080. (8)

**ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF
INORGANIC SUBSTANCES (continued)**

Determination	Reagents	Ref.
	Diantipyrinylmethane	Onishi, Part IIb, p 545. (6), Snell, <i>Metals II</i> , 1085. (8)
	Tiron	Fries/Getrost, p 376. (2), Onishi, Part IIb, p 549. (6), Snell, <i>Metals II</i> , p 1114. (8)
Tungsten	Pyrocatechol Violet	Snell, <i>Metals II</i> , p 1265. (8)
	Tetraphenylarsonium chloride + Thiocyanate	Onishi, Part IIb, p 596. (6), Snell, <i>Metals II</i> , p 1278. (8)
	Toluene-3,5-dithiol	Marczenko, p 605. (3), Onishi, Part IIb, p 590. (6), Snell, <i>Metals II</i> , p 1267. (8)
Uranium	Arsenazo III	Marczenko, p 611. (3), Onishi, Part IIb, p 627. (6), Snell, <i>Metals II</i> , p 1356. (8)
	2-(5-Bromo-2-pyridylazo)diethylaminophenol	Fries/Getrost, p 388. (2), Onishi, Part IIb, p 625. (6)
	Chlorophosphonazo III	Snell, <i>Metals II</i> , p 1367. (8), <i>Fres. Z. Anal. Chem.</i> , 306, 110, (1981).
	1-(2-Pyridylazo)-2-naphthol	Fries/Getrost, p 386. (2), Onishi, Part IIb, p 625. (6), Snell, <i>Metals II</i> , p 1387. (8)
Vanadium	<i>N</i> -Benzoyl- <i>N</i> -phenylhydroxylamine	Fries/Getrost, p 395. (2), Marczenko, p 625. (3), Snell, <i>Metals II</i> , p 1196. (8)
	8-Hydroxyquinoline	Marczenko, p 623. (3), Snell, <i>Metals II</i> , p 1209. (8)
	4-(2-pyridylazo)resorcinol	Fries/Getrost, p 404. (23), Marczenko, p 628. (3), Onishi, Part IIb, p 625. (6), Snell, <i>Metals II</i> , p 1226. (8)
Yttrium	Alizarin Red S	Fries/Getrost, p 406. (2), Onishi, Part IIa, p 784. (5), Snell, <i>Metals II</i> , p 1919. (8)
	Arsenazo III	Marczenko, p 468. (3), Onishi, Part IIa, p 786. (5), Snell, <i>Metals II</i> , p 1921. (8)
	Xylenol Orange	Fries/Getrost, p 406. (2), Onishi, Part IIa, p 787. (5), Snell, <i>Metals II</i> , p 1923. (8)
Zinc	Dithizone	Fries/Getrost, p 408. (2), Marczenko, p 637. (3), Onishi, Part IIb, p 708. (6), Snell, <i>Metals II</i> , p 1042. (8)
	1-(2-Pyridylazo)-2-naphthol	Marczenko, p 639. (3), Onishi, Part IIb, p 719. (6), Snell, <i>Metals II</i> , p 1056. (8)
	Xylenol Orange	Fries/Getrost, p 417. (2), Snell, <i>Metals II</i> , p 1062. (8), <i>Talanta</i> , 26, 693, (1979).
	Zircon	Fries/Getrost, p 412. (2), Onishi, Part IIb, p 719. (6), Snell, <i>Metals II</i> , p 1063. (8), West, p 23. (10)
Zirconium	Alizarin Red S	Fries/Getrost, p 421. (2), Marczenko, p 647. (3), Onishi, Part IIb, p 763. (6), Snell, <i>Metals II</i> , p 1136. (8)
	Arsenazo III	Fries/Getrost, p 421. (2), Onishi, Part IIb, p 770. (6), Snell, <i>Metals II</i> , p 1143. (8)
	Pyrocatechol Violet	Onishi, Part IIb, p 771. (6), Snell, <i>Metals II</i> , p 1149. (8)
	Morin	Fries/Getrost, p 424. (2), Onishi, Part IIb, p 765. (6), Snell, <i>Metals II</i> , p 1158. (8)
	Xylenol Orange	Fries/Getrost, p 419. (2), Marczenko, p 648. (3), Onishi, Part IIb, p 767. (6), Snell, <i>Metals II</i> , p 1167. (8)

ORGANIC ANALYTICAL REAGENTS FOR THE DETERMINATION OF INORGANIC SUBSTANCES (continued)

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ACID-BASE INDICATORS

A. K. Covington

The first part of this table lists some common acid-base indicators in alphabetical order along with the approximate pH range(s) at which a color change occurs. Following this is a table of the same indicators ordered by pH range, which includes the nature of the color change, instructions on preparation of the indicator solution, and the acid dissociation constant pK , when available. The color code is:

C = colorless A = amber B/G = blue-green Pk = pink Y = yellow V = violet R = red B = blue
 P = purple O = orange

REFERENCE

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Indicator	pH Range	Indicator	pH Range
Alizarin	5.6-7.2; 11.0-12.4	Erythrosin, disodium salt	2.2-3.6
Alizarin Red S	4.6-6.0	4-(<i>p</i> -Ethoxyphenylazo)- <i>m</i> -phenylene-diamine monohydrochloride	4.4-5.8
Alizarin Yellow R	10.1-12.0	Ethyl bis(2,4-dimethylphenyl) ethanoate	8.4-9.6
Benzopurpurine 4B	2.2-4.2	Ethyl Orange	3.4-4.8
4,4'-Bis(2-amino-1-naphthylazo)-2,2'-stilbenedisulfonic acid	3.0-4.0	Ethyl Red	4.0-5.8
4,4'-Bis(4-amino-1-naphthylazo)-2,2'-stilbenedisulfonic acid	8.0-9.0	Ethyl Violet	0.0-2.4
Brilliant Yellow	6.6-7.8	5,5'-Indigodisulfonic acid, disodium salt	11.4-13.0
Bromocresol Green	3.8-5.4	Malachite Green	0.2-1.8
Bromocresol Purple	5.2-6.8	Metacresol Purple	1.2-2.8; 7.4-9.0
Bromophenol Blue	3.0-4.6	Metanil Yellow	1.2-2.4
Bromothymol Blue	6.0-7.6	Methyl Green	0.2-1.8
Chlorophenol Red	5.2-6.8	Methyl Orange	3.2-4.4
Clayton Yellow	12.2-13.2	Methyl Red	4.8-6.0
Congo Red	3.0-5.0	Methyl Violet	0.0-1.6
<i>o</i> -Cresolphthalein	8.2-9.8	<i>p</i> -Naphtholbenzein	8.2-10.0
Cresol Red	0.0-1.0; 7.0-8.8	Neutral Red	6.8-8.0
Crystal Violet	0.0-1.8	<i>p</i> -Nitrophenol	5.4-6.6
Curcumin (Turmaric)	7.4-8.6	<i>m</i> -Nitrophenol	6.8-8.6
<i>p</i> -(2,4-Dihydroxyphenylazo) benzenesulfonic acid, sodium salt	11.4-12.6	Orange IV	1.4-2.8
<i>p</i> -Dimethylaminoazobenzene	2.8-4.4	Paramethyl Red	1.0-3.0
4-(4-Dimethylamino-1-naphylazo)-3-methoxybenzenesulfonic acid	3.5-4.8	Phenolphthalein	8.2-10.0
2-(<i>p</i> -Dimethylamino-phenylazo)pyridine	0.2-1.8; 4.4-5.6	Phenol Red	6.6-8.0
<i>N,N</i> -Dimethyl- <i>p</i> -(<i>m</i> -tolylazo)aniline	2.6-4.8	4-Phenylazodiphenylamine	1.2-2.6
2,4-Dinitrophenol	2.0-4.7	4-Phenylazo-1-naphthylamine	4.0-5.6
2-(2,4 Dinitrophenylazo)-1-naphthol-3,6-disulfonic acid, disodium salt	6.0-7.0	Propyl Red	4.8-6.6
6,8-Dinitro-2,4-(1 <i>H</i>)quinazolinedione	6.4-8.0	Quinaldine Red	1.4-3.2
		Resazurin	3.8-6.4
		Resorcin Blue	4.4-6.2
		Tetrabromophenolphthalein ethyl ester, potassium salt	3.0-4.2
		Thymol Blue	1.2-2.8; 8.0-9.6
		Thymolphthalein	9.4-10.6
		4- <i>o</i> -Tolylazo- <i>o</i> -toluidine	1.4-2.8
		1,3,5-Trinitrobenzene	12.0-14.0
		2,4,6-Trinitrotoluene	11.5-13.0
		Turmaric	7.4-8.6

ACID-BASE INDICATORS (continued)

pH range	Color change	Indicator	pK	Preparation
0.0-1.0	R-Y	Cresol Red		0.1 g in 26.2 mL 0.01 M NaOH + 223.8 mL water
0.0-1.6	Y-B	Methyl Violet		0.01-0.05% in water
0.0-1.8	Y-B	Crystal Violet		0.02% in water
0.0-2.4	Y-B	Ethyl Violet		0.1 g in 50 mL 50% v/v methanol-water
0.2-1.8	Y-B/G	Malachite Green	1.3	water
0.2-1.8	Y-B	Methyl Green		0.1% in water
0.2-1.8	Y-R	2-(<i>p</i> -Dimethylaminophenylazo)pyridine		0.1% in ethanol
1.0-3.0	R-Y	Paramethyl Red		ethanol
1.2-2.4	R-Y	Metanil Yellow		0.01% in water
1.2-2.6	R-Y	4-Phenylazodiphenylamine		0.01 g in 1 mL 1 M HCl + 50 mL ethanol + 49 mL water
1.2-2.8	R-Y	Thymol Blue	1.65	0.1 g in 21.5 mL 0.01 M NaOH + 228.5 mL water
1.2-2.8	R-Y	Metacresol Purple	1.51	0.1 g in 26.2 mL 0.01 M NaOH + 223.8 mL water
1.4-2.8	R-Y	Orange IV		0.01% in water
1.4-2.8	O-Y	4- <i>o</i> -Tolylazo- <i>o</i> -toluidine		water
1.4-3.2	C-R	Quinaldine Red	2.63	1% in ethanol
2.0-4.7	C-Y	2,4-Dinitrophenol	3.96	sat. solution in water
2.2-3.6	O-R	Erythrosin, disodium salt		0.1% in water
2.2-4.2	V-R	Benzopurpurine 4B		0.1% in water
2.6-4.8	R-Y	<i>N,N</i> -Dimethyl- <i>p</i> -(<i>m</i> -tolylazo)aniline		0.1% in water
2.8-4.4	R-Y	<i>p</i> -Dimethylaminoazobenzene		0.1 g in 100 mL 90% v/v ethanol-water
3.0-4.0	P-R	4,4'-Bis(2-amino-1-naphthylazo)-2,2'-stilbenedisulfonic acid		0.1 g in 5.9 mL 0.05 M NaOH + 94.1 mL water
3.0-4.2	Y-B	Tetrabromophenolphthalein ethyl ester, potassium salt		0.1% in ethanol
3.0-4.6	Y-B	Bromophenol Blue	4.10	0.1 g in 14.9 mL 0.01 M NaOH + 235.1 mL water
3.0-5.0	B-R	Congo Red		0.1% in water
3.2-4.4	R-Y	Methyl Orange	3.46	0.1% in water
3.4-4.8	R-Y	Ethyl Orange	4.34	0.05-0.2% in water or aqueous ethanol
3.5-4.8	V-Y	4-(4-Dimethylamino-1-naphylazo)-3-methoxybenzenesulfonic acid		0.1% in 60% ethanol-water
3.8-5.4	Y-B	Bromocresol Green	4.90	0.1 g in 14.3 mL 0.01 M NaOH + 235.7 mL water
3.8-6.4	O-V	Resazurin		water
4.0-5.6	R-Y	4-Phenylazo-1-naphthylamine		0.1% in ethanol
4.0-5.8	C-R	Ethyl Red	5.42	0.1 g in 100 mL 50% v/v methanol-water
4.4-5.6	R-Y	2-(<i>p</i> -Dimethylaminophenylazo)pyridine		0.1% in ethanol
4.4-5.8	O-Y	4-(<i>p</i> -Ethoxyphenylazo)- <i>m</i> -phenylenediamine monohydrochloride		0.1% in water
4.4-6.2	R-B	Resorcin Blue		0.2% in ethanol
4.6-6.0	Y-R	Alizarin Red S		water
4.8-6.0	R-Y	Methyl Red	5.00	0.02 g in 100 mL 60% v/v ethanol-water
4.8-6.6	R-Y	Propyl Red	5.48	ethanol
5.2-6.8	Y-P	Bromocresol Purple	6.40	0.1 g in 18.5 mL 0.01 M NaOH + 231.5 mL water
5.2-6.8	Y-R	Chlorophenol Red	6.25	0.1 g in 23.6 mL 0.01 M NaOH + 226.4 mL water
5.4-6.6	C-Y	<i>p</i> -Nitrophenol	7.15	0.1% in water
5.6-7.2	Y-R	Alizarin		0.1% in methanol
6.0-7.0	Y-B	2-(2,4-Dinitrophenylazo)-1-naphthol-3,6-disulfonic acid, disodium salt		0.1% in water
6.0-7.6	Y-B	Bromothymol Blue	7.30	0.1 g in 16 mL 0.01 M NaOH + 234 mL water
6.4-8.0	C-Y	6,8-Dinitro-2,4-(1 <i>H</i>)quinazolinedione		25 g in 115 mL 1 M NaOH + 50 mL water at 100°C
6.6-7.8	Y-R	Brilliant Yellow		1% in water
6.6-8.0	Y-R	Phenol Red	8.00	0.1 g in 28.2 mL 0.01 M NaOH + 221.8 mL water
6.8-8.0	R-A	Neutral Red		0.01 g in 100 mL 50% v/v ethanol-water
6.8-8.6	C-Y	<i>m</i> -Nitrophenol	8.28	0.3% in water
7.0-8.8	Y-R	Cresol Red	8.46	0.1 g in 26.2 mL 0.01 M NaOH + 223.8 mL water
7.4-8.6	Y-R	Turmeric (Curcumin)		ethanol
7.4-9.0	Y-P	Metacresol Purple	8.3	0.1 g in 26.2 mL 0.01 M NaOH + 223.8 mL water

ACID-BASE INDICATORS (continued)

pH range	Color change	Indicator	pK	Preparation
8.0-9.0	B-R	4,4'-Bis(4-amino-1-naphthylazo)-2,2'-stilbenedisulfonic acid		0.1 g in 5.9 mL 0.05 M NaOH + 94.1 mL water
8.0-9.6	Y-B	Thymol Blue	9.20	0.1 g in 21.5 mL 0.01 M NaOH + 228.5 mL water
8.2-10.0	O-B	<i>p</i> -Naphtholbenzein		1% in dil. alkali
8.2-10.0	C-Pk	Phenolphthalein	9.5	0.5 g in 100 mL 50% v/v ethanol-water
8.2-9.8	C-R	<i>o</i> -Cresolphthalein		0.04% in ethanol
8.4-9.6	C-B	Ethyl bis(2,4-dimethylphenyl)ethanoate		sat. solution in 50% acetone-ethanol
9.4-10.6	C-B	Thymolphthalein		0.04 g in 100 mL 50% v/v ethanol-water
10.1-12.0	Y-R	Alizarin Yellow R		0.01% in water
11.0-12.4	R-P	Alizarin		0.1% in methanol
11.4-12.6	Y-O	<i>p</i> -(2,4-Dihydroxyphenylazo) benzenesulfonic acid, sodium salt		0.1% in water
11.4-13.0	B-Y	5,5'-Indigodisulfonic acid, disodium salt		water
11.5-13.0	C-O	2,4,6-Trinitrotoluene		0.1-0.5% in ethanol
12.0-14.0	C-O	1,3,5-Trinitrobenzene		0.1-0.5% in ethanol
12.2-13.2	Y-A	Clayton Yellow		0.1% in water

FLUORESCENT INDICATORS

Jack DeMent

Fluorescent indicators are substances which show definite changes in fluorescence with change in pH. Some fluorescent materials are not suitable for indicators since their change in fluorescence is too gradual. Fluorescent indicators find greatest utility in the titration of opaque, highly turbid or deeply colored solutions. A long wavelength ultraviolet ("black light") lamp in a dimly lighted room provides the best environment for titrations involving fluorescent indicators, although bright daylight is sometimes sufficient to evoke a response in the bright green, yellow and orange fluorescent indicators. Titrations are carried out in non-fluorescent glassware. One should check the glassware prior to use to make certain that it does not fluoresce due to the wavelengths of light involved in the titration. The meniscus of the liquid in the burette can be followed when a few particles of an insoluble fluorescent solid are dropped onto its surface.

In this table the indicators are arranged by approximate pH range covered. In the case of some of the dyestuffs the end point may vary slightly with the source or manufacturer.

pH 0 to 2

Indicator	C.I.	From pH	To pH
Benzoflavine	—	0.3, yellow fl.	1.7, green fl.
3,6-Dioxypthalimide	—	0, blue fl.	2.4, green fl.
Eosine YS	768	0, yellow colored	3.0, yellow fl.
Erythrosine	772	0, yellow colored	3.6, yellow fl.
Esculin	—	1.5, colorless	2, blue fl.
4-Ethoxyacridone	—	1.2, green fl.	3.2, blue fl.
3,6-Tetramethyldiaminoxanthone	—	1.2, green fl.	3.4, blue fl.

pH 2 to 4

Chromotropic acid	—	3.5, colorless	4.5, blue fl.
Fluorescein	766	4, colorless	4.5, green fl.
Magdala Red	—	3.0, purple colored	4.0, fl.
α -Naphthylamine	—	3.4, colorless	4.8, blue fl.
β -Naphthylamine	—	2.8, colorless	4.4, violet fl.
Phloxine	774	3.4, colorless	5.0, bright yellow fl.
Salicylic acid	—	2.5, colorless	3.5, blue fl.

pH 4 to 6

Acridine	788	4.9, green fl.	5.1, violet colored
Dichlorofluorescein	—	4.0, colorless	5.0, green fl.
3,6-Dioxyxanthone	—	5.4, colorless	7.6, blue-violet fl.
Erythrosine	772	4.0, colorless	4.5, yellow-green fl.
β -Methylsculetin	—	4.0, colorless	6.2, blue fl.
Neville-Winther acid	—	6.0, colorless	6.5, blue fl.
Resorufin	—	4.4, yellow fl.	6.4, weak orange fl.
Quinic acid	—	4.0, yellow colored	5.0, blue fl.
Quinine [first end point]	—	5.0, blue fl.	6.1, violet fl.

pH 6 to 8

Acid R Phosphine	—	(claimed for range pH 6.0-7.0)	
Brilliant Diazol Yellow	—	6.5, colorless	7.5, violet fl.
Cleves acid	—	6.5, colorless	7.5, green fl.
Coumaric acid	—	7.2, colorless	9.0, green fl.
3,6-Dioxypthalic dinitrile	—	5.8, blue fl.	8.2, green fl.
Magnesium 8-hydroxyquinolate	—	6.5, colorless	7.5, golden fl.
β -Methylumbelliferone	—	7.0, colorless	7.5, blue fl.
1-Naphthol-4-sulfonic acid	—	6.0, colorless	6.5, blue fl.
Orcinaurine	—	6.5, colorless	8.0, green fl.
Patent Phosphine	789	(for the range pH 6.0-7.0, green-yellow fl.)	
Thioflavine	816	(for the region pH 6.5-7.0, yellow fl.)	
Umbelliferone	—	6.5, colorless	7.6, blue fl.

FLUORESCENT INDICATORS (Continued)

pH 8 to 10

Indicator	C.I.	From pH	To pH
Acridine Orange	788	8.4, orange colored	10.4, green fl.
Ethoxyphenyl-naphthostilbazonium chloride G Salt	—	9, green fl.	11, non-fl.
Naphthazol derivatives	—	9.0, dull blue fl.	9.5, bright blue fl.
α -Naphthionic acid	—	8.2, colorless	10.0, yellow or green fl.
2-Naphthol-3,6-disulfonic acid	—	9, blue fl.	11, green fl.
β -Naphthol	—	9.5, dark blue fl.	Light blue fl. at higher pH
α -Naphtholsulfonic acid	—	8.6, colorless	Blue fl. at higher pH
1,4-Naphtholsulfonic acid	—	8.0, dark blue fl.	9.0, bright violet fl.
Orcinsulfonphthalein	—	8.2, dark blue fl.	Light blue fl. at higher pH
Quinine [second end point]	—	8.6, yellow colored	10.0 fl.
R-Salt	—	9.5, violet fl.	10.0, colorless
Sodium 1-naphthol-2-sulfonate	—	9.0, dull blue fl.	9.5, bright blue fl.
	—	9.0, dark blue fl.	10.0, bright violet fl.

pH 10 to 12

Coumarin	—	9.8, deep green fl.	12, light green fl.
Eosine BN	771	10.5, colorless	14.0, yellow fl.
Papaverine (permanganate oxidized)	—	9.5, yellow fl.	11.0, blue fl.
Schaffers Salt	—	5.0, violet fl.	11.0, green-blue fl.
SS-Acid (sodium salt)	—	10.0, violet fl.	12.0, yellow colored

pH 12 to 14

Cotarnine	—	12.0, yellow fl.	13.0, white fl.
α -Naphthionic acid	—	12, blue fl.	13, green fl.
β -Naphthionic acid	—	12, blue fl.	13, violet fl.

CONVERSION FORMULAS FOR CONCENTRATION OF SOLUTIONS

<p>A = Weight per cent of solute B = Molecular weight of solvent E = Molecular weight of solute F = Grams of solute per liter of solution</p>	<p>G = Molality M = Molarity N = Mole fraction R = Density of solution in grams per milliliter</p>
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Concentration of solute—SOUGHT	Concentration of solute—GIVEN				
	A	N	G	M	F
A	—	$\frac{100N \times E}{N \times E + (1 - N)B}$	$\frac{100G \times E}{1000 + G \times E}$	$\frac{M \times E}{10R}$	$\frac{F}{10R}$
N	$\frac{\frac{A}{E}}{\frac{A}{E} + \frac{100 - A}{B}}$	—	$\frac{B \times G}{B \times G + 1000}$	$\frac{B \times M}{M(B - E) + 1000R}$	$\frac{B \times F}{F(B - E) + 1000R \times E}$
G	$\frac{1000A}{E(100 - A)}$	$\frac{1000N}{B - N \times B}$	—	$\frac{1000M}{1000R - (M \times E)}$	$\frac{1000F}{E(1000R - F)}$
M	$\frac{10R \times A}{E}$	$\frac{1000R \times N}{N \times E + (1 - N)B}$	$\frac{1000R \times G}{1000 + E \times G}$	—	$\frac{F}{E}$
F	$10AR$	$\frac{1000R \times N \times E}{N \times E + (1 - N)B}$	$\frac{1000R \times G \times E}{1000 + G \times E}$	$M \times E$	—

ELECTROCHEMICAL SERIES

Petr Vanýsek

There are three tables for this electrochemical series. Each table lists standard reduction potentials, E° values, at 298.15 K (25°C), and at a pressure of 101.325 kPa (1 atm). Table 1 is an alphabetical listing of the elements, according to the symbol of the elements. Thus, data for silver (Ag) precedes those for aluminum (Al). Table 2 lists only those reduction reactions which have E° values positive in respect to the standard hydrogen electrode. In Table 2, the reactions are listed in the order of increasing positive potential, and they range from 0.0000 V to +3.4 V. Table 3 lists only those reduction potentials which have E° negative with respect to the standard hydrogen electrode. In Table 3, the reactions are listed in the order of decreasing potential and range from 0.0000 V to -4.10 V. The reliability of the potentials is not the same for all the data. Typically, the values with fewer significant figures have lower reliability. The values of reduction potentials, in particular those of less common reactions, are not definite; they are subject to occasional revisions.

Abbreviations: ac = acetate; bipy = 2,2'-dipyridine, or bipyridine; en = ethylenediamine; phen = 1,10-phenanthroline.

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2. A. J. Bard, R. Parsons, and J. Jordan, *Standard Potentials in Aqueous Solutions*, Marcel Dekker, New York, 1985.
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TABLE 1
Alphabetical Listing

Reaction	E°/V	Reaction	E°/V
$\text{Ac}^{3+} + 3 e \rightleftharpoons \text{Ac}$	-2.20	$\text{Al}(\text{OH})_4^- + 3 e \rightleftharpoons \text{Al} + 4 \text{OH}^-$	-2.328
$\text{Ag}^+ + e \rightleftharpoons \text{Ag}$	0.7996	$\text{H}_2\text{AlO}_3^- + \text{H}_2\text{O} + 3 e \rightleftharpoons \text{Al} + 4 \text{OH}^-$	-2.33
$\text{Ag}^{2+} + e \rightleftharpoons \text{Ag}^+$	1.980	$\text{AlF}_6^{3-} + 3 e \rightleftharpoons \text{Al} + 6 \text{F}^-$	-2.069
$\text{Ag}(\text{ac}) + e \rightleftharpoons \text{Ag} + (\text{ac})^-$	0.643	$\text{Am}^{4+} + e \rightleftharpoons \text{Am}^{3+}$	2.60
$\text{AgBr} + e \rightleftharpoons \text{Ag} + \text{Br}^-$	0.07133	$\text{Am}^{2+} + 2 e \rightleftharpoons \text{Am}$	-1.9
$\text{AgBrO}_3 + e \rightleftharpoons \text{Ag} + \text{BrO}_3^-$	0.546	$\text{Am}^{3+} + 3 e \rightleftharpoons \text{Am}$	-2.048
$\text{Ag}_2\text{C}_2\text{O}_4 + 2 e \rightleftharpoons 2 \text{Ag} + \text{C}_2\text{O}_4^{2-}$	0.4647	$\text{Am}^{3+} + e \rightleftharpoons \text{Am}^{2+}$	-2.3
$\text{AgCl} + e \rightleftharpoons \text{Ag} + \text{Cl}^-$	0.22233	$\text{As} + 3 \text{H}^+ + 3 e \rightleftharpoons \text{AsH}_3$	-0.608
$\text{AgCN} + e \rightleftharpoons \text{Ag} + \text{CN}^-$	-0.017	$\text{As}_2\text{O}_3 + 6 \text{H}^+ + 6 e \rightleftharpoons 2 \text{As} + 3 \text{H}_2\text{O}$	0.234
$\text{Ag}_2\text{CO}_3 + 2 e \rightleftharpoons 2 \text{Ag} + \text{CO}_3^{2-}$	0.47	$\text{HAsO}_2 + 3 \text{H}^+ + 3 e \rightleftharpoons \text{As} + 2 \text{H}_2\text{O}$	0.248
$\text{Ag}_2\text{CrO}_4 + 2 e \rightleftharpoons 2 \text{Ag} + \text{CrO}_4^{2-}$	0.4470	$\text{AsO}_2^- + 2 \text{H}_2\text{O} + 3 e \rightleftharpoons \text{As} + 4 \text{OH}^-$	-0.68
$\text{AgF} + e \rightleftharpoons \text{Ag} + \text{F}^-$	0.779	$\text{H}_3\text{AsO}_4 + 2 \text{H}^+ + 2 e^- \rightleftharpoons \text{HAsO}_2 + 2 \text{H}_2\text{O}$	0.560
$\text{Ag}_4[\text{Fe}(\text{CN})_6] + 4 e \rightleftharpoons 4 \text{Ag} + [\text{Fe}(\text{CN})_6]^{4-}$	0.1478	$\text{AsO}_4^{3-} + 2 \text{H}_2\text{O} + 2 e \rightleftharpoons \text{AsO}_2^- + 4 \text{OH}^-$	-0.71
$\text{AgI} + e \rightleftharpoons \text{Ag} + \text{I}^-$	-0.15224	$\text{At}_2 + 2 e \rightleftharpoons 2 \text{At}^-$	0.3
$\text{AgIO}_3 + e \rightleftharpoons \text{Ag} + \text{IO}_3^-$	0.354	$\text{Au}^+ + e \rightleftharpoons \text{Au}$	1.692
$\text{Ag}_2\text{MoO}_4 + 2 e \rightleftharpoons 2 \text{Ag} + \text{MoO}_4^{2-}$	0.4573	$\text{Au}^{3+} + 2 e \rightleftharpoons \text{Au}^+$	1.401
$\text{AgNO}_2 + e \rightleftharpoons \text{Ag} + 2 \text{NO}_2^-$	0.564	$\text{Au}^{3+} + 3 e \rightleftharpoons \text{Au}$	1.498
$\text{Ag}_2\text{O} + \text{H}_2\text{O} + 2 e \rightleftharpoons 2 \text{Ag} + 2 \text{OH}^-$	0.342	$\text{Au}^{2+} + e^- \rightleftharpoons \text{Au}^+$	1.8
$\text{Ag}_2\text{O}_3 + \text{H}_2\text{O} + 2 e \rightleftharpoons 2 \text{AgO} + 2 \text{OH}^-$	0.739	$\text{AuOH}^{2+} + \text{H}^+ + 2 e \rightleftharpoons \text{Au}^+ + \text{H}_2\text{O}$	1.32
$\text{Ag}^{3+} + 2 e \rightleftharpoons \text{Ag}^+$	1.9	$\text{AuBr}_2^- + e \rightleftharpoons \text{Au} + 2 \text{Br}^-$	0.959
$\text{Ag}^{3+} + e \rightleftharpoons \text{Ag}^{2+}$	1.8	$\text{AuBr}_4^- + 3 e \rightleftharpoons \text{Au} + 4 \text{Br}^-$	0.854
$\text{Ag}_2\text{O}_2 + 4 \text{H}^+ + e \rightleftharpoons 2 \text{Ag} + 2 \text{H}_2\text{O}$	1.802	$\text{AuCl}_4^- + 3 e \rightleftharpoons \text{Au} + 4 \text{Cl}^-$	1.002
$2 \text{AgO} + \text{H}_2\text{O} + 2 e \rightleftharpoons \text{Ag}_2\text{O} + 2 \text{OH}^-$	0.607	$\text{Au}(\text{OH})_3 + 3 \text{H}^+ + 3 e \rightleftharpoons \text{Au} + 3 \text{H}_2\text{O}$	1.45
$\text{AgOCN} + e \rightleftharpoons \text{Ag} + \text{OCN}^-$	0.41	$\text{H}_3\text{BO}_3^- + 5 \text{H}_2\text{O} + 8 e \rightleftharpoons \text{BH}_4^- + 8 \text{OH}^-$	-1.24
$\text{Ag}_2\text{S} + 2 e \rightleftharpoons 2 \text{Ag} + \text{S}^{2-}$	-0.691	$\text{H}_2\text{BO}_3^- + \text{H}_2\text{O} + 3 e \rightleftharpoons \text{B} + 4 \text{OH}^-$	-1.79
$\text{Ag}_2\text{S} + 2 \text{H}^+ + 2 e \rightleftharpoons 2 \text{Ag} + \text{H}_2\text{S}$	-0.0366	$\text{H}_3\text{BO}_3 + 3 \text{H}^+ + 3 e \rightleftharpoons \text{B} + 3 \text{H}_2\text{O}$	-0.8698
$\text{AgSCN} + e \rightleftharpoons \text{Ag} + \text{SCN}^-$	0.08951	$\text{B}(\text{OH})_3 + 7 \text{H}^+ + 8 e \rightleftharpoons \text{BH}_4^- + 3 \text{H}_2\text{O}$	-0.481
$\text{Ag}_2\text{SeO}_3 + 2 e \rightleftharpoons 2 \text{Ag} + \text{SeO}_4^{2-}$	0.3629	$\text{Ba}^{2+} + 2 e \rightleftharpoons \text{Ba}$	-2.912
$\text{Ag}_2\text{SO}_4 + 2 e \rightleftharpoons 2 \text{Ag} + \text{SO}_4^{2-}$	0.654	$\text{Ba}^{2+} + 2 e \rightleftharpoons \text{Ba}(\text{Hg})$	-1.570
$\text{Ag}_2\text{WO}_4 + 2 e \rightleftharpoons 2 \text{Ag} + \text{WO}_4^{2-}$	0.4660	$\text{Ba}(\text{OH})_2 + 2 e \rightleftharpoons \text{Ba} + 2 \text{OH}^-$	-2.99
$\text{Al}^{3+} + 3 e \rightleftharpoons \text{Al}$	-1.662	$\text{Be}^{2+} + 2 e \rightleftharpoons \text{Be}$	-1.847
$\text{Al}(\text{OH})_3 + 3 e \rightleftharpoons \text{Al} + 3 \text{OH}^-$	-2.31	$\text{Be}_2\text{O}_3^{2-} + 3 \text{H}_2\text{O} + 4 e \rightleftharpoons 2 \text{Be} + 6 \text{OH}^-$	-2.63

ELECTROCHEMICAL SERIES (continued)

TABLE 1
Alphabetical Listing (continued)

Reaction	E°/V	Reaction	E°/V
p -benzoquinone + 2 H ⁺ + 2 e \rightleftharpoons hydroquinone	0.6992	HClO ₂ + 3 H ⁺ + 4 e \rightleftharpoons Cl ⁻ + 2 H ₂ O	1.570
Bi ⁺ + e \rightleftharpoons Bi	0.5	ClO ₂ ⁻ + H ₂ O + 2 e \rightleftharpoons ClO ⁻ + 2 OH ⁻	0.66
Bi ³⁺ + 3 e \rightleftharpoons Bi	0.308	ClO ₂ ⁻ + 2 H ₂ O + 4 e \rightleftharpoons Cl ⁻ + 4 OH ⁻	0.76
Bi ³⁺ + 2 e \rightleftharpoons Bi ⁺	0.2	ClO ₂ (aq) + e \rightleftharpoons ClO ₂ ⁻	0.954
Bi + 3 H ⁺ + 3 e \rightleftharpoons BiH ₃	-0.8	ClO ₃ ⁻ + 2 H ⁺ + e \rightleftharpoons ClO ₂ + H ₂ O	1.152
BiCl ₄ ⁻ + 3 e \rightleftharpoons Bi + 4 Cl ⁻	0.16	ClO ₃ ⁻ + 3 H ⁺ + 2 e \rightleftharpoons HClO ₂ + H ₂ O	1.214
Bi ₂ O ₃ + 3 H ₂ O + 6 e \rightleftharpoons 2 Bi + 6 OH ⁻	-0.46	ClO ₃ ⁻ + 6 H ⁺ + 5 e \rightleftharpoons 1/2 Cl ₂ + 3 H ₂ O	1.47
Bi ₂ O ₄ + 4 H ⁺ + 2 e \rightleftharpoons 2 BiO ⁺ + 2 H ₂ O	1.593	ClO ₃ ⁻ + 6 H ⁺ + 6 e \rightleftharpoons Cl ⁻ + 3 H ₂ O	1.451
BiO ⁺ + 2 H ⁺ + 3 e \rightleftharpoons Bi + H ₂ O	0.320	ClO ₃ ⁻ + H ₂ O + 2 e \rightleftharpoons ClO ₂ ⁻ + 2 OH ⁻	0.33
BiOCl + 2 H ⁺ + 3 e \rightleftharpoons Bi + Cl ⁻ + H ₂ O	0.1583	ClO ₃ ⁻ + 3 H ₂ O + 6 e \rightleftharpoons Cl ⁻ + 6 OH ⁻	0.62
Bk ⁴⁺ + e \rightleftharpoons Bk ³⁺	1.67	ClO ₄ ⁻ + 2 H ⁺ + 2 e \rightleftharpoons ClO ₃ ⁻ + H ₂ O	1.189
Bk ²⁺ + 2 e \rightleftharpoons Bk	-1.6	ClO ₄ ⁻ + 8 H ⁺ + 7 e \rightleftharpoons 1/2 Cl ₂ + 4 H ₂ O	1.39
Bk ³⁺ + e \rightleftharpoons Bk ²⁺	-2.8	ClO ₄ ⁻ + 8 H ⁺ + 8 e \rightleftharpoons Cl ⁻ + 4 H ₂ O	1.389
Br ₂ (aq) + 2 e \rightleftharpoons 2 Br ⁻	1.0873	ClO ₄ ⁻ + H ₂ O + 2 e \rightleftharpoons ClO ₃ ⁻ + 2 OH ⁻	0.36
Br ₂ (l) + 2 e \rightleftharpoons 2 Br ⁻	1.066	Cm ⁴⁺ + e \rightleftharpoons Cm ³⁺	3.0
HBrO + H ⁺ + 2 e \rightleftharpoons Br ⁻ + H ₂ O	1.331	Cm ³⁺ + 3 e \rightleftharpoons Cm	-2.04
HBrO + H ⁺ + e \rightleftharpoons 1/2 Br ₂ (aq) + H ₂ O	1.574	Co ²⁺ + 2 e \rightleftharpoons Co	-0.28
HBrO + H ⁺ + e \rightleftharpoons 1/2 Br ₂ (l) + H ₂ O	1.596	Co ³⁺ + e \rightleftharpoons Co ²⁺	1.92
BrO ⁻ + H ₂ O + 2 e \rightleftharpoons Br ⁻ + 2 OH ⁻	0.761	[Co(NH ₃) ₆] ³⁺ + e \rightleftharpoons [Co(NH ₃) ₆] ²⁺	0.108
BrO ₃ ⁻ + 6 H ⁺ + 5 e \rightleftharpoons 1/2 Br ₂ + 3 H ₂ O	1.482	Co(OH) ₂ + 2 e \rightleftharpoons Co + 2 OH ⁻	-0.73
BrO ₃ ⁻ + 6 H ⁺ + 6 e \rightleftharpoons Br ⁻ + 3 H ₂ O	1.423	Co(OH) ₃ + e \rightleftharpoons Co(OH) ₂ + OH ⁻	0.17
BrO ₃ ⁻ + 3 H ₂ O + 6 e \rightleftharpoons Br ⁻ + 6 OH ⁻	0.61	Cr ²⁺ + 2 e \rightleftharpoons Cr	-0.913
(CN) ₂ + 2 H ⁺ + 2 e \rightleftharpoons 2 HCN	0.373	Cr ³⁺ + e \rightleftharpoons Cr ²⁺	-0.407
2 HCNO + 2 H ⁺ + 2 e \rightleftharpoons (CN) ₂ + 2 H ₂ O	0.330	Cr ³⁺ + 3 e \rightleftharpoons Cr	-0.744
(CNS) ₂ + 2 e \rightleftharpoons 2 CNS ⁻	0.77	Cr ₂ O ₇ ²⁻ + 14 H ⁺ + 6 e \rightleftharpoons 2 Cr ³⁺ + 7 H ₂ O	1.232
CO ₂ + 2 H ⁺ + 2 e \rightleftharpoons HCOOH	-0.199	CrO ₂ ⁻ + 2 H ₂ O + 3 e \rightleftharpoons Cr + 4 OH ⁻	-1.2
Ca ⁺ + e \rightleftharpoons Ca	-3.80	HCrO ₄ ⁻ + 7 H ⁺ + 3 e \rightleftharpoons Cr ³⁺ + 4 H ₂ O	1.350
Ca ²⁺ + 2 e \rightleftharpoons Ca	-2.868	CrO ₂ + 4 H ⁺ + e \rightleftharpoons Cr ³⁺ + 2H ₂ O	1.48
Ca(OH) ₂ + 2 e \rightleftharpoons Ca + 2 OH ⁻	-3.02	Cr(V) + e \rightleftharpoons Cr(IV)	1.34
Calomel electrode, 1 molar KCl	0.2800	CrO ₄ ²⁻ + 4 H ₂ O + 3 e \rightleftharpoons Cr(OH) ₃ + 5 OH ⁻	-0.13
Calomel electrode, 1 molar KCl (NCE)	0.2801	Cr(OH) ₃ + 3 e \rightleftharpoons Cr + 3 OH ⁻	-1.48
Calomel electrode, 0.1 molar KCl	0.3337	Cs ⁺ + e \rightleftharpoons Cs	-3.026
Calomel electrode, saturated KCl (SCE)	0.2412	Cu ⁺ + e \rightleftharpoons Cu	0.521
Calomel electrode, saturated NaCl (SSCE)	0.2360	Cu ²⁺ + e \rightleftharpoons Cu ⁺	0.153
Cd ²⁺ + 2 e \rightleftharpoons Cd	-0.4030	Cu ²⁺ + 2 e \rightleftharpoons Cu	0.3419
Cd ²⁺ + 2 e \rightleftharpoons Cd(Hg)	-0.3521	Cu ²⁺ + 2 e \rightleftharpoons Cu(Hg)	0.345
Cd(OH) ₂ + 2 e \rightleftharpoons Cd(Hg) + 2 OH ⁻	-0.809	Cu ³⁺ + e \rightleftharpoons Cu ²⁺	2.4
CdSO ₄ + 2 e \rightleftharpoons Cd + SO ₄ ²⁻	-0.246	Cu ₂ O ₃ + 6 H ⁺ + 2 e \rightleftharpoons 2Cu ²⁺ + 3 H ₂ O	2.0
Cd(OH) ₄ ²⁻ + 2 e \rightleftharpoons Cd + 4 OH ⁻	-0.658	Cu ²⁺ + 2 CN ⁻ + e \rightleftharpoons [Cu(CN) ₂] ⁻	1.103
CdO + H ₂ O + 2 e \rightleftharpoons Cd + 2 OH ⁻	-0.783	CuI ₂ ⁻ + e \rightleftharpoons Cu + 2 I ⁻	0.00
Ce ³⁺ + 3 e \rightleftharpoons Ce	-2.336	Cu ₂ O + H ₂ O + 2 e \rightleftharpoons 2 Cu + 2 OH ⁻	-0.360
Ce ³⁺ + 3 e \rightleftharpoons Ce(Hg)	-1.4373	Cu(OH) ₂ + 2 e \rightleftharpoons Cu + 2 OH ⁻	-0.222
Ce ⁴⁺ + e \rightleftharpoons Ce ³⁺	1.72	2 Cu(OH) ₂ + 2 e \rightleftharpoons Cu ₂ O + 2 OH ⁻ + H ₂ O	-0.080
CeOH ³⁺ + H ⁺ + e \rightleftharpoons Ce ³⁺ + H ₂ O	1.715	2 D ⁺ + 2 e \rightleftharpoons D ₂	-0.013
Cf ⁴⁺ + e \rightleftharpoons Cf ³⁺	3.3	Dy ²⁺ + 2 e \rightleftharpoons Dy	-2.2
Cf ³⁺ + e \rightleftharpoons Cf ²⁺	-1.6	Dy ³⁺ + 3 e \rightleftharpoons Dy	-2.295
Cf ³⁺ + 3 e \rightleftharpoons Cf	-1.94	Dy ³⁺ + e \rightleftharpoons Dy ²⁺	-2.6
Cf ²⁺ + 2 e \rightleftharpoons Cf	-2.12	Er ²⁺ + 2 e \rightleftharpoons Er	-2.0
Cl ₂ (g) + 2 e \rightleftharpoons 2 Cl ⁻	1.35827	Er ³⁺ + 3 e \rightleftharpoons Er	-2.331
HClO + H ⁺ + e \rightleftharpoons 1/2 Cl ₂ + H ₂ O	1.611	Er ³⁺ + e \rightleftharpoons Er ²⁺	-3.0
HClO + H ⁺ + 2 e \rightleftharpoons Cl ⁻ + H ₂ O	1.482	Es ³⁺ + e \rightleftharpoons Es ²⁺	-1.3
ClO ⁻ + H ₂ O + 2 e \rightleftharpoons Cl ⁻ + 2 OH ⁻	0.81	Es ³⁺ + 3 e \rightleftharpoons Es	-1.91
ClO ₂ + H ⁺ + e \rightleftharpoons HClO ₂	1.277	Es ²⁺ + 2 e \rightleftharpoons Es	-2.23
HClO ₂ + 2 H ⁺ + 2 e \rightleftharpoons HClO + H ₂ O	1.645	Eu ²⁺ + 2 e \rightleftharpoons Eu	-2.812
HClO ₂ + 3 H ⁺ + 3 e \rightleftharpoons 1/2 Cl ₂ + 2 H ₂ O	1.628	Eu ³⁺ + 3 e \rightleftharpoons Eu	-1.991

ELECTROCHEMICAL SERIES (continued)

TABLE 1
Alphabetical Listing (continued)

Reaction	E°/V	Reaction	E°/V
$\text{Eu}^{3+} + e \rightleftharpoons \text{Eu}^{2+}$	-0.36	$\text{Ho}^{3+} + 3 e \rightleftharpoons \text{Ho}$	-2.33
$\text{F}_2 + 2 \text{H}^+ + 2 e \rightleftharpoons 2 \text{HF}$	3.053	$\text{Ho}^{3+} + e \rightleftharpoons \text{Ho}^{2+}$	-2.8
$\text{F}_2 + 2 e \rightleftharpoons 2 \text{F}^-$	2.866	$\text{I}_2 + 2 e \rightleftharpoons 2 \text{I}^-$	0.5355
$\text{F}_2\text{O} + 2 \text{H}^+ + 4 e \rightleftharpoons \text{H}_2\text{O} + 2 \text{F}^-$	2.153	$\text{I}_3^- + 2 e \rightleftharpoons 3 \text{I}^-$	0.536
$\text{Fe}^{2+} + 2 e \rightleftharpoons \text{Fe}$	-0.447	$\text{H}_3\text{IO}_6^{2-} + 2 e \rightleftharpoons \text{IO}_3^- + 3 \text{OH}^-$	0.7
$\text{Fe}^{3+} + 3 e \rightleftharpoons \text{Fe}$	-0.037	$\text{H}_3\text{IO}_6 + \text{H}^+ + 2 e \rightleftharpoons \text{IO}_3^- + 3 \text{H}_2\text{O}$	1.601
$\text{Fe}^{3+} + e \rightleftharpoons \text{Fe}^{2+}$	0.771	$2 \text{HIO} + 2 \text{H}^+ + 2 e \rightleftharpoons \text{I}_2 + 2 \text{H}_2\text{O}$	1.439
$2 \text{HFeO}_4^- + 8 \text{H}^+ + 6 e \rightleftharpoons \text{Fe}_2\text{O}_3 + 5 \text{H}_2\text{O}$	2.09	$\text{HIO} + \text{H}^+ + 2 e \rightleftharpoons \text{I}^- + \text{H}_2\text{O}$	0.987
$\text{HFeO}_4^- + 4 \text{H}^+ + 3 e \rightleftharpoons \text{FeOOH} + 2 \text{H}_2\text{O}$	2.08	$\text{IO}^- + \text{H}_2\text{O} + 2 e \rightleftharpoons \text{I}^- + 2 \text{OH}^-$	0.485
$\text{HFeO}_4^- + 7 \text{H}^+ + 3 e \rightleftharpoons \text{Fe}^{3+} + 4 \text{H}_2\text{O}$	2.07	$2 \text{IO}_3^- + 12 \text{H}^+ + 10 e \rightleftharpoons \text{I}_2 + 6 \text{H}_2\text{O}$	1.195
$\text{Fe}_2\text{O}_3 + 4 \text{H}^+ + 2 e \rightleftharpoons 2 \text{FeOH}^+ + \text{H}_2\text{O}$	0.16	$\text{IO}_3^- + 6 \text{H}^+ + 6 e \rightleftharpoons \text{I}^- + 3 \text{H}_2\text{O}$	1.085
$[\text{Fe}(\text{CN})_6]^{3-} + e \rightleftharpoons [\text{Fe}(\text{CN})_6]^{4-}$	0.358	$\text{IO}_3^- + 2 \text{H}_2\text{O} + 4 e \rightleftharpoons \text{IO}^- + 4 \text{OH}^-$	0.15
$\text{FeO}_4^{2-} + 8 \text{H}^+ + 3 e \rightleftharpoons \text{Fe}^{3+} + 4 \text{H}_2\text{O}$	2.20	$\text{IO}_3^- + 3 \text{H}_2\text{O} + 6 e \rightleftharpoons \text{IO}^- + 6 \text{OH}^-$	0.26
$[\text{Fe}(\text{bipy})_2]^{3+} + e \rightleftharpoons [\text{Fe}(\text{bipy})_2]^{2+}$	0.78	$\text{In}^+ + e \rightleftharpoons \text{In}$	-0.14
$[\text{Fe}(\text{bipy})_3]^{3+} + e \rightleftharpoons [\text{Fe}(\text{bipy})_3]^{2+}$	1.03	$\text{In}^{2+} + e \rightleftharpoons \text{In}^+$	-0.40
$\text{Fe}(\text{OH})_3 + e \rightleftharpoons \text{Fe}(\text{OH})_2 + \text{OH}^-$	-0.56	$\text{In}^{3+} + e \rightleftharpoons \text{In}^{2+}$	-0.49
$[\text{Fe}(\text{phen})_3]^{3+} + e \rightleftharpoons [\text{Fe}(\text{phen})_3]^{2+}$	1.147	$\text{In}^{3+} + 2 e \rightleftharpoons \text{In}^+$	-0.443
$[\text{Fe}(\text{phen})_3]^{3+} + e \rightleftharpoons [\text{Fe}(\text{phen})_3]^{2+}$ (1 molar H_2SO_4)	1.06	$\text{In}^{3+} + 3 e \rightleftharpoons \text{In}$	-0.3382
$[\text{Ferricinium}]^+ + e \rightleftharpoons \text{ferrocene}$	0.400	$\text{In}(\text{OH})_3 + 3 e \rightleftharpoons \text{In} + 3 \text{OH}^-$	-0.99
$\text{Fm}^{3+} + e \rightleftharpoons \text{Fm}^{2+}$	-1.1	$\text{In}(\text{OH})_4^- + 3 e \rightleftharpoons \text{In} + 4 \text{OH}^-$	-1.007
$\text{Fm}^{3+} + 3 e \rightleftharpoons \text{Fm}$	-1.89	$\text{In}_2\text{O}_3 + 3 \text{H}_2\text{O} + 6 e \rightleftharpoons 2 \text{In} + 6 \text{OH}^-$	-1.034
$\text{Fm}^{2+} + 2 e \rightleftharpoons \text{Fm}$	-2.30	$\text{Ir}^{3+} + 3 e \rightleftharpoons \text{Ir}$	1.156
$\text{Fr}^+ + e \rightleftharpoons \text{Fr}$	-2.9	$[\text{IrCl}_6]^{2-} + e \rightleftharpoons [\text{IrCl}_6]^{3-}$	0.8665
$\text{Ga}^{3+} + 3 e \rightleftharpoons \text{Ga}$	-0.549	$[\text{IrCl}_6]^{3-} + 3 e \rightleftharpoons \text{Ir} + 6 \text{Cl}^-$	0.77
$\text{Ga}^+ + e \rightleftharpoons \text{Ga}$	-0.2	$\text{Ir}_2\text{O}_3 + 3 \text{H}_2\text{O} + 6 e \rightleftharpoons 2 \text{Ir} + 6 \text{OH}^-$	0.098
$\text{GaOH}^{2+} + \text{H}^+ + 3 e \rightleftharpoons \text{Ga} + \text{H}_2\text{O}$	-0.498	$\text{K}^+ + e \rightleftharpoons \text{K}$	-2.931
$\text{H}_2\text{GaO}_3 + \text{H}_2\text{O} + 3 e \rightleftharpoons \text{Ga} + 4 \text{OH}^-$	-1.219	$\text{La}^{3+} + 3 e \rightleftharpoons \text{La}$	-2.379
$\text{Gd}^{3+} + 3 e \rightleftharpoons \text{Gd}$	-2.279	$\text{La}(\text{OH})_3 + 3 e \rightleftharpoons \text{La} + 3 \text{OH}^-$	-2.90
$\text{Ge}^{2+} + 2 e \rightleftharpoons \text{Ge}$	0.24	$\text{Li}^+ + e \rightleftharpoons \text{Li}$	-3.0401
$\text{Ge}^{4+} + 4 e \rightleftharpoons \text{Ge}$	0.124	$\text{Lr}^{3+} + 3 e \rightleftharpoons \text{Lr}$	-1.96
$\text{Ge}^{4+} + 2 e \rightleftharpoons \text{Ge}^{2+}$	0.00	$\text{Lu}^{3+} + 3 e \rightleftharpoons \text{Lu}$	-2.28
$\text{GeO}_2 + 2 \text{H}^+ + 2 e \rightleftharpoons \text{GeO} + \text{H}_2\text{O}$	-0.118	$\text{Md}^{3+} + e \rightleftharpoons \text{Md}^{2+}$	-0.1
$\text{H}_2\text{GeO}_3 + 4 \text{H}^+ + 4 e \rightleftharpoons \text{Ge} + 3 \text{H}_2\text{O}$	-0.182	$\text{Md}^{3+} + 3 e \rightleftharpoons \text{Md}$	-1.65
$2 \text{H}^+ + 2 e \rightleftharpoons \text{H}_2$	0.00000	$\text{Md}^{2+} + 2 e \rightleftharpoons \text{Md}$	-2.40
$\text{H}_2 + 2 e \rightleftharpoons 2 \text{H}^-$	-2.23	$\text{Mg}^+ + e \rightleftharpoons \text{Mg}$	-2.70
$\text{HO}_2 + \text{H}^+ + e \rightleftharpoons \text{H}_2\text{O}_2$	1.495	$\text{Mg}^{2+} + 2 e \rightleftharpoons \text{Mg}$	-2.372
$2 \text{H}_2\text{O} + 2 e \rightleftharpoons \text{H}_2 + 2 \text{OH}^-$	-0.8277	$\text{Mg}(\text{OH})_2 + 2 e \rightleftharpoons \text{Mg} + 2 \text{OH}^-$	-2.690
$\text{H}_2\text{O}_2 + 2 \text{H}^+ + 2 e \rightleftharpoons 2 \text{H}_2\text{O}$	1.776	$\text{Mn}^{2+} + 2 e \rightleftharpoons \text{Mn}$	-1.185
$\text{Hf}^{4+} + 4 e \rightleftharpoons \text{Hf}$	-1.55	$\text{Mn}^{3+} + 3 e \rightleftharpoons \text{Mn}^{2+}$	1.5415
$\text{HfO}^{2+} + 2 \text{H}^+ + 4 e \rightleftharpoons \text{Hf} + \text{H}_2\text{O}$	-1.724	$\text{MnO}_2 + 4 \text{H}^+ + 2 e \rightleftharpoons \text{Mn}^{2+} + 2 \text{H}_2\text{O}$	1.224
$\text{HfO}_2 + 4 \text{H}^+ + 4 e \rightleftharpoons \text{Hf} + 2 \text{H}_2\text{O}$	-1.505	$\text{MnO}_4^- + e \rightleftharpoons \text{MnO}_4^{2-}$	0.558
$\text{HfO}(\text{OH})_2 + \text{H}_2\text{O} + 4 e \rightleftharpoons \text{Hf} + 4 \text{OH}^-$	-2.50	$\text{MnO}_4^- + 4 \text{H}^+ + 3 e \rightleftharpoons \text{MnO}_2 + 2 \text{H}_2\text{O}$	1.679
$\text{Hg}^{2+} + 2 e \rightleftharpoons \text{Hg}$	0.851	$\text{MnO}_4^- + 8 \text{H}^+ + 5 e \rightleftharpoons \text{Mn}^{2+} + 4 \text{H}_2\text{O}$	1.507
$2 \text{Hg}^{2+} + 2 e \rightleftharpoons \text{Hg}_2^{2+}$	0.920	$\text{MnO}_4^- + 2 \text{H}_2\text{O} + 3 e \rightleftharpoons \text{MnO}_2 + 4 \text{OH}^-$	0.595
$\text{Hg}_2^{2+} + 2 e \rightleftharpoons 2 \text{Hg}$	0.7973	$\text{MnO}_4^{2-} + 2 \text{H}_2\text{O} + 2 e \rightleftharpoons \text{MnO}_2 + 4 \text{OH}^-$	0.60
$\text{Hg}_2(\text{ac})_2 + 2 e \rightleftharpoons 2 \text{Hg} + 2(\text{ac})^-$	0.51163	$\text{Mn}(\text{OH})_2 + 2 e \rightleftharpoons \text{Mn} + 2 \text{OH}^-$	-1.56
$\text{Hg}_2\text{Br}_2 + 2 e \rightleftharpoons 2 \text{Hg} + 2 \text{Br}^-$	0.13923	$\text{Mn}(\text{OH})_3 + e \rightleftharpoons \text{Mn}(\text{OH})_2 + \text{OH}^-$	0.15
$\text{Hg}_2\text{Cl}_2 + 2 e \rightleftharpoons 2 \text{Hg} + 2 \text{Cl}^-$	0.26808	$\text{Mn}_2\text{O}_3 + 6 \text{H}^+ + e \rightleftharpoons 2 \text{Mn}^{2+} + 3 \text{H}_2\text{O}$	1.485
$\text{Hg}_2\text{HPO}_4 + 2 e \rightleftharpoons 2 \text{Hg} + \text{HPO}_4^{2-}$	0.6359	$\text{Mo}^{3+} + 3 e \rightleftharpoons \text{Mo}$	-0.200
$\text{Hg}_2\text{I}_2 + 2 e \rightleftharpoons 2 \text{Hg} + 2 \text{I}^-$	-0.0405	$\text{MoO}_2 + 4 \text{H}^+ + 4 e \rightleftharpoons \text{Mo} + 4 \text{H}_2\text{O}$	-0.152
$\text{Hg}_2\text{O} + \text{H}_2\text{O} + 2 e \rightleftharpoons 2 \text{Hg} + 2 \text{OH}^-$	0.123	$\text{H}_3\text{Mo}_7\text{O}_{24}^{3-} + 45 \text{H}^+ + 42 e \rightleftharpoons 7 \text{Mo} + 24 \text{H}_2\text{O}$	0.082
$\text{HgO} + \text{H}_2\text{O} + 2 e \rightleftharpoons \text{Hg} + 2 \text{OH}^-$	0.0977	$\text{MoO}_3 + 6 \text{H}^+ + 6 e \rightleftharpoons \text{Mo} + 3 \text{H}_2\text{O}$	0.075
$\text{Hg}(\text{OH})_2 + 2 \text{H}^+ + 2 e \rightleftharpoons \text{Hg} + 2 \text{H}_2\text{O}$	1.034	$\text{N}_2 + 2 \text{H}_2\text{O} + 6 \text{H}^+ + 6 e \rightleftharpoons 2 \text{NH}_4\text{OH}$	0.092
$\text{Hg}_2\text{SO}_4 + 2 e \rightleftharpoons 2 \text{Hg} + \text{SO}_4^{2-}$	0.6125	$3 \text{N}_2 + 2 \text{H}^+ + 2 e \rightleftharpoons 2 \text{NH}_3$	-3.09
$\text{Ho}^{2+} + 2 e \rightleftharpoons \text{Ho}$	-2.1	$\text{N}_5^+ + 3 \text{H}^+ + 2 e \rightleftharpoons 2 \text{NH}_4^+$	1.275

ELECTROCHEMICAL SERIES (continued)

TABLE 1
Alphabetical Listing (continued)

Reaction	E°/V	Reaction	E°/V
$N_2O + 2 H^+ + 2 e \rightleftharpoons N_2 + H_2O$	1.766	$H_2P_2^- + e \rightleftharpoons P + 2 OH^-$	-1.82
$H_2N_2O_2 + 2 H^+ + 2 e \rightleftharpoons N_2 + 2 H_2O$	2.65	$H_3PO_2 + H^+ + e \rightleftharpoons P + 2 H_2O$	-0.508
$N_2O_4 + 2 e \rightleftharpoons 2 NO_2^-$	0.867	$H_3PO_3 + 2 H^+ + 2 e \rightleftharpoons H_3PO_2 + H_2O$	-0.499
$N_2O_4 + 2 H^+ + 2 e \rightleftharpoons 2 NHO_2$	1.065	$H_3PO_3 + 3 H^+ + 3 e \rightleftharpoons P + 3 H_2O$	-0.454
$N_2O_4 + 4 H^+ + 4 e \rightleftharpoons 2 NO + 2 H_2O$	1.035	$HPO_3^{2-} + 2 H_2O + 2 e \rightleftharpoons H_2PO_2^- + 3 OH^-$	-1.65
$2 NH_3OH^+ + H^+ + 2 e \rightleftharpoons N_2H_5^+ + 2 H_2O$	1.42	$HPO_3^{2-} + 2 H_2O + 3 e \rightleftharpoons P + 5 OH^-$	-1.71
$2 NO + 2 H^+ + 2 e \rightleftharpoons N_2O + H_2O$	1.591	$H_3PO_4 + 2 H^+ + 2 e \rightleftharpoons H_3PO_3 + H_2O$	-0.276
$2 NO + H_2O + 2 e \rightleftharpoons N_2O + 2 OH^-$	0.76	$PO_4^{3-} + 2 H_2O + 2 e \rightleftharpoons HPO_3^{2-} + 3 OH^-$	-1.05
$HNO_2 + H^+ + e \rightleftharpoons NO + H_2O$	0.983	$Pa^{3+} + 3 e \rightleftharpoons Pa$	-1.34
$2 HNO_2 + 4 H^+ + 4 e \rightleftharpoons H_2N_2O_2 + 2 H_2O$	0.86	$Pa^{4+} + 4 e \rightleftharpoons Pa$	-1.49
$2 HNO_2 + 4 H^+ + 4 e \rightleftharpoons N_2O + 3 H_2O$	1.297	$Pa^{4+} + e \rightleftharpoons Pa^{3+}$	-1.9
$NO_2^- + H_2O + e \rightleftharpoons NO + 2 OH^-$	-0.46	$Pb^{2+} + 2 e \rightleftharpoons Pb$	-0.1262
$2 NO_2^- + 2 H_2O + 4 e \rightleftharpoons N_2O_2^{2-} + 4 OH^-$	-0.18	$Pb^{2+} + 2 e \rightleftharpoons Pb(Hg)$	-0.1205
$2 NO_2^- + 3 H_2O + 4 e \rightleftharpoons N_2O + 6 OH^-$	0.15	$PbBr_2 + 2 e \rightleftharpoons Pb + 2 Br^-$	-0.284
$NO_3^- + 3 H^+ + 2 e \rightleftharpoons HNO_2 + H_2O$	0.934	$PbCl_2 + 2 e \rightleftharpoons Pb + 2 Cl^-$	-0.2675
$NO_3^- + 4 H^+ + 3 e \rightleftharpoons NO + 2 H_2O$	0.957	$PbF_2 + 2 e \rightleftharpoons Pb + 2 F^-$	-0.3444
$2 NO_3^- + 4 H^+ + 2 e \rightleftharpoons N_2O_4 + 2 H_2O$	0.803	$PbHPO_4 + 2 e \rightleftharpoons Pb + HPO_4^{2-}$	-0.465
$NO_3^- + H_2O + 2 e \rightleftharpoons NO_2^- + 2 OH^-$	0.01	$PbI_2 + 2 e \rightleftharpoons Pb + 2 I^-$	-0.365
$2 NO_3^- + 2 H_2O + 2 e \rightleftharpoons N_2O_4 + 4 OH^-$	-0.85	$PbO + H_2O + 2 e \rightleftharpoons Pb + 2 OH^-$	-0.580
$Na^+ + e \rightleftharpoons Na$	-2.71	$PbO_2 + 4 H^+ + 2 e \rightleftharpoons Pb^{2+} + 2 H_2O$	1.455
$Nb^{3+} + 3 e \rightleftharpoons Nb$	-1.099	$HPbO_2^- + H_2O + 2 e \rightleftharpoons Pb + 3 OH^-$	-0.537
$NbO_2 + 2 H^+ + 2 e \rightleftharpoons NbO + H_2O$	-0.646	$PbO_2 + H_2O + 2 e \rightleftharpoons PbO + 2 OH^-$	0.247
$NbO_2 + 4 H^+ + 4 e \rightleftharpoons Nb + 2 H_2O$	-0.690	$PbO_2 + SO_4^{2-} + 4 H^+ + 2 e \rightleftharpoons PbSO_4 + 2 H_2O$	1.6913
$NbO + 2 H^+ + 2 e \rightleftharpoons Nb + H_2O$	-0.733	$PbSO_4 + 2 e \rightleftharpoons Pb + SO_4^{2-}$	-0.3588
$Nb_2O_5 + 10 H^+ + 10 e \rightleftharpoons 2 Nb + 5 H_2O$	-0.644	$PbSO_4 + 2 e \rightleftharpoons Pb(Hg) + SO_4^{2-}$	-0.3505
$Nd^{3+} + 3 e \rightleftharpoons Nd$	-2.323	$Pd^{2+} + 2 e \rightleftharpoons Pd$	0.951
$Nd^{2+} + 2 e \rightleftharpoons Nd$	-2.1	$[PdCl_4]^{2-} + 2 e \rightleftharpoons Pd + 4 Cl^-$	0.591
$Nd^{3+} + e \rightleftharpoons Nd^{2+}$	-2.7	$[PdCl_6]^{2-} + 2 e \rightleftharpoons [PdCl_4]^{2-} + 2 Cl^-$	1.288
$Ni^{2+} + 2 e \rightleftharpoons Ni$	-0.257	$Pd(OH)_2 + 2 e \rightleftharpoons Pd + 2 OH^-$	0.07
$Ni(OH)_2 + 2 e \rightleftharpoons Ni + 2 OH^-$	-0.72	$Pm^{2+} + 2 e \rightleftharpoons Pm$	-2.2
$NiO_2 + 4 H^+ + 2 e \rightleftharpoons Ni^{2+} + 2 H_2O$	1.678	$Pm^{3+} + 3 e \rightleftharpoons Pm$	-2.30
$NiO_2 + 2 H_2O + 2 e \rightleftharpoons Ni(OH)_2 + 2 OH^-$	-0.490	$Pm^{3+} + e \rightleftharpoons Pm^{2+}$	-2.6
$No^{3+} + e \rightleftharpoons No^{2+}$	1.4	$Po^{4+} + 2 e \rightleftharpoons Po^{2+}$	0.9
$No^{3+} + 3 e \rightleftharpoons No$	-1.20	$Po^{4+} + 4 e \rightleftharpoons Po$	0.76
$No^{2+} + 2 e \rightleftharpoons No$	-2.50	$Pr^{4+} + e \rightleftharpoons Pr^{3+}$	3.2
$Np^{3+} + 3 e \rightleftharpoons Np$	-1.856	$Pr^{2+} + 2 e \rightleftharpoons Pr$	-2.0
$Np^{4+} + e \rightleftharpoons Np^{3+}$	0.147	$Pr^{3+} + 3 e \rightleftharpoons Pr$	-2.353
$NpO_2 + H_2O + H^+ + e \rightleftharpoons Np(OH)_3$	-0.962	$Pr^{3+} + e \rightleftharpoons Pr^{2+}$	-3.1
$O_2 + 2 H^+ + 2 e \rightleftharpoons H_2O_2$	0.695	$Pt^{2+} + 2 e \rightleftharpoons Pt$	1.18
$O_2 + 4 H^+ + 4 e \rightleftharpoons 2 H_2O$	1.229	$[PtCl_4]^{2-} + 2 e \rightleftharpoons Pt + 4 Cl^-$	0.755
$O_2 + H_2O + 2 e \rightleftharpoons HO_2^- + OH^-$	-0.076	$[PtCl_6]^{2-} + 2 e \rightleftharpoons [PtCl_4]^{2-} + 2 Cl^-$	0.68
$O_2 + 2 H_2O + 2 e \rightleftharpoons H_2O_2 + 2 OH^-$	-0.146	$Pt(OH)_2 + 2 e \rightleftharpoons Pt + 2 OH^-$	0.14
$O_2 + 2 H_2O + 4 e \rightleftharpoons 4 OH^-$	0.401	$PtO_3 + 2 H^+ + 2 e \rightleftharpoons PtO_2 + H_2O$	1.7
$O_3 + 2 H^+ + 2 e \rightleftharpoons O_2 + H_2O$	2.076	$PtO_3 + 4 H^+ + 2 e \rightleftharpoons Pt(OH)_2^{2+} + H_2O$	1.5
$O_3 + H_2O + 2 e \rightleftharpoons O_2 + 2 OH^-$	1.24	$PtOH^+ + H^+ + 2 e \rightleftharpoons Pt + H_2O$	1.2
$O(g) + 2 H^+ + 2 e \rightleftharpoons H_2O$	2.421	$PtO_2 + 2 H^+ + 2 e \rightleftharpoons PtO + H_2O$	1.01
$OH + e \rightleftharpoons OH^-$	2.02	$PtO_2 + 4 H^+ + 4 e \rightleftharpoons Pt + 2 H_2O$	1.00
$HO_2^- + H_2O + 2 e \rightleftharpoons 3 OH^-$	0.878	$Pu^{3+} + 3 e \rightleftharpoons Pu$	-2.031
$OsO_4 + 8 H^+ + 8 e \rightleftharpoons Os + 4 H_2O$	0.838	$Pu^{4+} + e \rightleftharpoons Pu^{3+}$	1.006
$OsO_4 + 4 H^+ + 4 e \rightleftharpoons OsO_2 + 2 H_2O$	1.02	$Pu^{5+} + e \rightleftharpoons Pu^{4+}$	1.099
$[Os(bipy)_2]^{3+} + e \rightleftharpoons [Os(bipy)_2]^{2+}$	0.81	$PuO_2(OH)_2 + 2 H^+ + 2 e \rightleftharpoons Pu(OH)_4$	1.325
$[Os(bipy)_3]^{3+} + e \rightleftharpoons [Os(bipy)_3]^{2+}$	0.80	$PuO_2(OH)_2 + H^+ + e \rightleftharpoons PuO_2OH + H_2O$	1.062
$P(\text{red}) + 3 H^+ + 3 e \rightleftharpoons PH_3(g)$	-0.111	$Ra^{2+} + 2 e \rightleftharpoons Ra$	-2.8
$P(\text{white}) + 3 H^+ + 3 e \rightleftharpoons PH_3(g)$	-0.063	$Rb^+ + e \rightleftharpoons Rb$	-2.98
$P + 3 H_2O + 3 e \rightleftharpoons PH_3(g) + 3 OH^-$	-0.87	$Re^{3+} + 3 e \rightleftharpoons Re$	0.300

ELECTROCHEMICAL SERIES (continued)

TABLE 1
Alphabetical Listing (continued)

Reaction	E°/V	Reaction	E°/V
$\text{ReO}_4^- + 4 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{ReO}_2 + 2 \text{H}_2\text{O}$	0.510	$\text{SiO}_2 (\text{quartz}) + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Si} + 2 \text{H}_2\text{O}$	0.857
$\text{ReO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Re} + 2 \text{H}_2\text{O}$	0.2513	$\text{SiO}_3^{2-} + 3 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons \text{Si} + 6 \text{OH}^-$	-1.697
$\text{ReO}_4^- + 2 \text{H}^+ + \text{e} \rightleftharpoons \text{ReO}_3 + \text{H}_2\text{O}$	0.768	$\text{Sm}^{3+} + \text{e} \rightleftharpoons \text{Sm}^{2+}$	-1.55
$\text{ReO}_4^- + 4 \text{H}_2\text{O} + 7 \text{e} \rightleftharpoons \text{Re} + 8 \text{OH}^-$	-0.584	$\text{Sm}^{3+} + 3 \text{e} \rightleftharpoons \text{Sm}$	-2.304
$\text{ReO}_4^- + 8 \text{H}^+ + 7 \text{e} \rightleftharpoons \text{Re} + 4 \text{H}_2\text{O}$	0.368	$\text{Sm}^{2+} + 2 \text{e} \rightleftharpoons \text{Sm}$	-2.68
$\text{Rh}^+ + \text{e} \rightleftharpoons \text{Rh}$	0.600	$\text{Sn}^{2+} + 2 \text{e} \rightleftharpoons \text{Sn}$	-0.1375
$\text{Rh}^+ + 2 \text{e} \rightleftharpoons \text{Rh}$	0.600	$\text{Sn}^{4+} + 2 \text{e} \rightleftharpoons \text{Sn}^{2+}$	0.151
$\text{Rh}^{3+} + 3 \text{e} \rightleftharpoons \text{Rh}$	0.758	$\text{Sn}(\text{OH})_3^+ + 3 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Sn}^{2+} + 3 \text{H}_2\text{O}$	0.142
$[\text{RhCl}_6]^{3-} + 3 \text{e} \rightleftharpoons \text{Rh} + 6 \text{Cl}^-$	0.431	$\text{SnO}_2 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Sn}^{2+} + 2 \text{H}_2\text{O}$	-0.094
$\text{RhOH}^{2+} + \text{H}^+ + 3 \text{e} \rightleftharpoons \text{Rh} + \text{H}_2\text{O}$	0.83	$\text{SnO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Sn} + 2 \text{H}_2\text{O}$	-0.117
$\text{Ru}^{2+} + 2 \text{e} \rightleftharpoons \text{Ru}$	0.455	$\text{SnO}_2 + 3 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{SnOH}^+ + \text{H}_2\text{O}$	-0.194
$\text{Ru}^{3+} + \text{e} \rightleftharpoons \text{Ru}^{2+}$	0.2487	$\text{SnO}_2 + 2 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons \text{Sn} + 4 \text{OH}^-$	-0.945
$\text{RuO}_2 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Ru}^{2+} + 2 \text{H}_2\text{O}$	1.120	$\text{HSnO}_2^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{Sn} + 3 \text{OH}^-$	-0.909
$\text{RuO}_4^- + \text{e} \rightleftharpoons \text{RuO}_4^{2-}$	0.59	$\text{Sn}(\text{OH})_6^{2-} + 2 \text{e} \rightleftharpoons \text{HSnO}_2^- + 3 \text{OH}^- + \text{H}_2\text{O}$	-0.93
$\text{RuO}_4 + \text{e} \rightleftharpoons \text{RuO}_4^-$	1.00	$\text{Sr}^+ + \text{e} \rightleftharpoons \text{Sr}$	-4.10
$\text{RuO}_4 + 6 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Ru}(\text{OH})_2^{2+} + 2 \text{H}_2\text{O}$	1.40	$\text{Sr}^{2+} + 2 \text{e} \rightleftharpoons \text{Sr}$	-2.899
$\text{RuO}_4 + 8 \text{H}^+ + 8 \text{e} \rightleftharpoons \text{Ru} + 4 \text{H}_2\text{O}$	1.038	$\text{Sr}^{2+} + 2 \text{e} \rightleftharpoons \text{Sr}(\text{Hg})$	-1.793
$[\text{Ru}(\text{bipy})_3]^{3+} + \text{e} \rightleftharpoons [\text{Ru}(\text{bipy})_3]^{2+}$	1.24	$\text{Sr}(\text{OH})_2 + 2 \text{e} \rightleftharpoons \text{Sr} + 2 \text{OH}^-$	-2.88
$[\text{Ru}(\text{H}_2\text{O})_6]^{3+} + \text{e} \rightleftharpoons [\text{Ru}(\text{H}_2\text{O})_6]^{2+}$	0.23	$\text{Ta}_2\text{O}_5 + 10 \text{H}^+ + 10 \text{e} \rightleftharpoons 2 \text{Ta} + 5 \text{H}_2\text{O}$	-0.750
$[\text{Ru}(\text{NH}_3)_6]^{3+} + \text{e} \rightleftharpoons [\text{Ru}(\text{NH}_3)_6]^{2+}$	0.10	$\text{Ta}^{3+} + 3 \text{e} \rightleftharpoons \text{Ta}$	-0.6
$[\text{Ru}(\text{en})_3]^{3+} + \text{e} \rightleftharpoons [\text{Ru}(\text{en})_3]^{2+}$	0.210	$\text{Tc}^{2+} + 2 \text{e} \rightleftharpoons \text{Tc}$	0.400
$[\text{Ru}(\text{CN})_6]^{3-} + \text{e} \rightleftharpoons [\text{Ru}(\text{CN})_6]^{4-}$	0.86	$\text{TcO}_4^- + 4 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{TcO}_2 + 2 \text{H}_2\text{O}$	0.782
$\text{S} + 2 \text{e} \rightleftharpoons \text{S}^{2-}$	-0.47627	$\text{Tc}^{3+} + \text{e} \rightleftharpoons \text{Tc}^{2+}$	0.3
$\text{S} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{S}(\text{aq})$	0.142	$\text{TcO}_4^- + 8 \text{H}^+ + 7 \text{e} \rightleftharpoons \text{Tc} + 4 \text{H}_2\text{O}$	0.472
$\text{S} + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{SH}^- + \text{OH}^-$	-0.478	$\text{Tb}^{4+} + \text{e} \rightleftharpoons \text{Tb}^{3+}$	3.1
$2 \text{S} + 2 \text{e} \rightleftharpoons \text{S}_2^{2-}$	-0.42836	$\text{Tb}^{3+} + 3 \text{e} \rightleftharpoons \text{Tb}$	-2.28
$\text{S}_2\text{O}_6^{2-} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{H}_2\text{SO}_3$	0.564	$\text{Te} + 2 \text{e} \rightleftharpoons \text{Te}^{2-}$	-1.143
$\text{S}_2\text{O}_8^{2-} + 2 \text{e} \rightleftharpoons 2 \text{SO}_4^{2-}$	2.010	$\text{Te} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{Te}$	-0.793
$\text{S}_2\text{O}_8^{2-} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{HSO}_4^-$	2.123	$\text{Te}^{4+} + 4 \text{e} \rightleftharpoons \text{Te}$	0.568
$\text{S}_4\text{O}_6^{2-} + 2 \text{e} \rightleftharpoons 2 \text{S}_2\text{O}_3^{2-}$	0.08	$\text{TeO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Te} + 2 \text{H}_2\text{O}$	0.593
$2 \text{H}_2\text{SO}_3 + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{HS}_2\text{O}_4^- + 2 \text{H}_2\text{O}$	-0.056	$\text{TeO}_3^{2-} + 3 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons \text{Te} + 6 \text{OH}^-$	-0.57
$\text{H}_2\text{SO}_3 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{S} + 3 \text{H}_2\text{O}$	0.449	$\text{TeO}_4^- + 8 \text{H}^+ + 7 \text{e} \rightleftharpoons \text{Te} + 4 \text{H}_2\text{O}$	0.472
$2 \text{SO}_3^{2-} + 2 \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{S}_2\text{O}_4^{2-} + 4 \text{OH}^-$	-1.12	$\text{H}_6\text{TeO}_6 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{TeO}_2 + 4 \text{H}_2\text{O}$	1.02
$2 \text{SO}_3^{2-} + 3 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons \text{S}_2\text{O}_3^{2-} + 6 \text{OH}^-$	-0.571	$\text{Th}^{4+} + 4 \text{e} \rightleftharpoons \text{Th}$	-1.899
$\text{SO}_4^{2-} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{SO}_3 + \text{H}_2\text{O}$	0.172	$\text{ThO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Th} + 2 \text{H}_2\text{O}$	-1.789
$2 \text{SO}_4^{2-} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{S}_2\text{O}_6^{2-} + \text{H}_2\text{O}$	-0.22	$\text{Th}(\text{OH})_4 + 4 \text{e} \rightleftharpoons \text{Th} + 4 \text{OH}^-$	-2.48
$\text{SO}_4^{2-} + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{SO}_3^{2-} + 2 \text{OH}^-$	-0.93	$\text{Ti}^{2+} + 2 \text{e} \rightleftharpoons \text{Ti}$	-1.630
$\text{Sb} + 3 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{SbH}_3$	-0.510	$\text{Ti}^{3+} + \text{e} \rightleftharpoons \text{Ti}^{2+}$	-0.9
$\text{Sb}_2\text{O}_3 + 6 \text{H}^+ + 6 \text{e} \rightleftharpoons 2 \text{Sb} + 3 \text{H}_2\text{O}$	0.152	$\text{TiO}_2 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Ti}^{2+} + 2 \text{H}_2\text{O}$	-0.502
$\text{Sb}_2\text{O}_5 (\text{senarmontite}) + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Sb}_2\text{O}_3 + 2 \text{H}_2\text{O}$	0.671	$\text{Ti}^{3+} + 3 \text{e} \rightleftharpoons \text{Ti}$	-1.37
$\text{Sb}_2\text{O}_5 (\text{valentinite}) + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Sb}_2\text{O}_3 + 2 \text{H}_2\text{O}$	0.649	$\text{TiOH}^{3+} + \text{H}^+ + \text{e} \rightleftharpoons \text{Ti}^{3+} + \text{H}_2\text{O}$	-0.055
$\text{Sb}_2\text{O}_5 + 6 \text{H}^+ + 4 \text{e} \rightleftharpoons 2 \text{SbO}^+ + 3 \text{H}_2\text{O}$	0.581	$\text{Ti}^+ + \text{e} \rightleftharpoons \text{Ti}$	-0.336
$\text{SbO}^+ + 2 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{Sb} + 2 \text{H}_2\text{O}$	0.212	$\text{Ti}^+ + \text{e} \rightleftharpoons \text{Ti}(\text{Hg})$	-0.3338
$\text{SbO}_2^- + 2 \text{H}_2\text{O} + 3 \text{e} \rightleftharpoons \text{Sb} + 4 \text{OH}^-$	-0.66	$\text{Ti}^{3+} + 2 \text{e} \rightleftharpoons \text{Ti}^+$	1.252
$\text{SbO}_3^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{SbO}_2^- + 2 \text{OH}^-$	-0.59	$\text{Ti}^{3+} + 3 \text{e} \rightleftharpoons \text{Ti}$	0.741
$\text{Sc}^{3+} + 3 \text{e} \rightleftharpoons \text{Sc}$	-2.077	$\text{TlBr} + \text{e} \rightleftharpoons \text{Tl} + \text{Br}^-$	-0.658
$\text{Se} + 2 \text{e} \rightleftharpoons \text{Se}^{2-}$	-0.924	$\text{TlCl} + \text{e} \rightleftharpoons \text{Tl} + \text{Cl}^-$	-0.5568
$\text{Se} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{Se}(\text{aq})$	-0.399	$\text{TlI} + \text{e} \rightleftharpoons \text{Tl} + \text{I}^-$	-0.752
$\text{H}_2\text{SeO}_3 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Se} + 3 \text{H}_2\text{O}$	0.74	$\text{Ti}_2\text{O}_3 + 3 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons 2 \text{Ti}^+ + 6 \text{OH}^-$	0.02
$\text{Se} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{Se}$	-0.082	$\text{TlOH} + \text{e} \rightleftharpoons \text{Tl} + \text{OH}^-$	-0.34
$\text{SeO}_3^{2-} + 3 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons \text{Se} + 6 \text{OH}^-$	-0.366	$\text{Ti}(\text{OH})_3 + 2 \text{e} \rightleftharpoons \text{TlOH} + 2 \text{OH}^-$	-0.05
$\text{SeO}_4^{2-} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{SeO}_3 + \text{H}_2\text{O}$	1.151	$\text{Ti}_2\text{SO}_4 + 2 \text{e} \rightleftharpoons \text{Ti} + \text{SO}_4^{2-}$	-0.4360
$\text{SeO}_4^{2-} + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{SeO}_3^{2-} + 2 \text{OH}^-$	0.05	$\text{Tm}^{3+} + \text{e} \rightleftharpoons \text{Tm}^{2+}$	-2.2
$\text{SiF}_6^{2-} + 4 \text{e} \rightleftharpoons \text{Si} + 6 \text{F}^-$	-1.24	$\text{Tm}^{3+} + 3 \text{e} \rightleftharpoons \text{Tm}$	-2.319
$\text{SiO} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Si} + \text{H}_2\text{O}$	-0.8	$\text{Tm}^{2+} + 2 \text{e} \rightleftharpoons \text{Tm}$	-2.4

ELECTROCHEMICAL SERIES (continued)

TABLE 1
Alphabetical Listing (continued)

Reaction	E°/V	Reaction	E°/V
$U^{3+} + 3 e \rightleftharpoons U$	-1.798	$2 WO_3 + 2 H^+ + 2 e \rightleftharpoons W_2O_5 + H_2O$	-0.029
$U^{4+} + e \rightleftharpoons U^{3+}$	-0.607	$H_4XeO_6 + 2 H^+ + 2 e \rightleftharpoons XeO_3 + 3 H_2O$	2.42
$UO_2^+ + 4 H^+ + e \rightleftharpoons U^{4+} + 2 H_2O$	0.612	$XeO_3 + 6 H^+ + 6 e \rightleftharpoons Xe + 3 H_2O$	2.10
$UO_2^{2+} + e \rightleftharpoons UO^{+2}$	0.062	$XeF + e \rightleftharpoons Xe + F^-$	3.4
$UO_2^{2+} + 4 H^+ + 2 e \rightleftharpoons U^{4+} + 2 H_2O$	0.327	$Y^{3+} + 3 e \rightleftharpoons Y$	-2.372
$UO_2^{2+} + 4 H^+ + 6 e \rightleftharpoons U + 2 H_2O$	-1.444	$Yb^{3+} + e \rightleftharpoons Yb^{2+}$	-1.05
$V^{2+} + 2 e \rightleftharpoons V$	-1.175	$Yb^{3+} + 3 e \rightleftharpoons Yb$	-2.19
$V^{3+} + e \rightleftharpoons V^{2+}$	-0.255	$Yb^{2+} + 2 e \rightleftharpoons Yb$	-2.76
$VO^{2+} + 2 H^+ + e \rightleftharpoons V^{3+} + H_2O$	0.337	$Zn^{2+} + 2 e \rightleftharpoons Zn$	-0.7618
$VO_2^+ + 2 H^+ + e \rightleftharpoons VO^{2+} + H_2O$	0.991	$Zn^{2+} + 2 e \rightleftharpoons Zn(Hg)$	-0.7628
$V_2O_5 + 6 H^+ + 2 e \rightleftharpoons 2 VO^{2+} + 3 H_2O$	0.957	$ZnO^{2-} + 2 H_2O + 2 e \rightleftharpoons Zn + 4 OH^-$	-1.215
$V_2O_5 + 10 H^+ + 10 e \rightleftharpoons 2 V + 5 H_2O$	-0.242	$ZnSO_4 \cdot 7 H_2O + 2 e \rightleftharpoons Zn(Hg) + SO_4^{2-} + 7 H_2O$	-0.7993
$V(OH)_4^+ + 2 H^+ + e \rightleftharpoons VO^{2+} + 3 H_2O$	1.00	(Saturated $ZnSO_4$)	
$V(OH)_4^+ + 4 H^+ + 5 e \rightleftharpoons V + 4 H_2O$	-0.254	$ZnOH^+ + H^+ + 2 e \rightleftharpoons Zn + H_2O$	-0.497
$[V(phen)_3]^{3+} + e \rightleftharpoons [V(phen)_3]^{2+}$	0.14	$Zn(OH)_4^{2-} + 2 e \rightleftharpoons Zn + 4 OH^-$	-1.199
$W^{3+} + 3 e \rightleftharpoons W$	0.1	$Zn(OH)_2 + 2 e \rightleftharpoons Zn + 2 OH^-$	-1.249
$W_2O_5 + 2 H^+ + 2 e \rightleftharpoons 2 WO_2 + H_2O$	-0.031	$ZnO + H_2O + 2 e \rightleftharpoons Zn + 2 OH^-$	-1.260
$WO_2 + 4 H^+ + 4 e \rightleftharpoons W + 2 H_2O$	-0.119	$ZrO_2 + 4 H^+ + 4 e \rightleftharpoons Zr + 2 H_2O$	-1.553
$WO_3 + 6 H^+ + 6 e \rightleftharpoons W + 3 H_2O$	-0.090	$ZrO(OH)_2 + H_2O + 4 e \rightleftharpoons Zr + 4 OH^-$	-2.36
$WO_3 + 2 H^+ + 2 e \rightleftharpoons WO_2 + H_2O$	0.036	$Zr^{4+} + 4 e \rightleftharpoons Zr$	-1.45

TABLE 2
Reduction Reactions Having E° Values More Positive than that of the Standard Hydrogen Electrode

Reaction	E°/V	Reaction	E°/V
$2 H^+ + 2 e \rightleftharpoons H_2$	0.00000	$Sn(OH)_3^+ + 3 H^+ + 2 e \rightleftharpoons Sn^{2+} + 3 H_2O$	0.142
$CuI_2^- + e \rightleftharpoons Cu + I^-$	0.00	$Np^{4+} + e \rightleftharpoons Np^{3+}$	0.147
$Ge^{4+} + 2 e \rightleftharpoons Ge^{2+}$	0.00	$Ag_4[Fe(CN)_6] + 4 e \rightleftharpoons 4 Ag + [Fe(CN)_6]^{4-}$	0.1478
$NO_3^- + H_2O + 2 e \rightleftharpoons NO_2^- + 2 OH^-$	0.01	$IO_3^- + 2 H_2O + 4 e \rightleftharpoons IO^- + 4 OH^-$	0.15
$Tl_2O_3 + 3 H_2O + 4 e \rightleftharpoons 2 Tl^+ + 6 OH^-$	0.02	$Mn(OH)_3 + e \rightleftharpoons Mn(OH)_2 + OH^-$	0.15
$SeO_4^{2-} + H_2O + 2 e \rightleftharpoons SeO_3^{2-} + 2 OH^-$	0.05	$2 NO_2^- + 3 H_2O + 4 e \rightleftharpoons N_2O + 6 OH^-$	0.15
$WO_3 + 2 H^+ + 2 e \rightleftharpoons WO_2 + H_2O$	0.036	$Sn^{4+} + 2 e \rightleftharpoons Sn^{2+}$	0.151
$UO_2^{2+} + e \rightleftharpoons UO_2^+$	0.062	$Sb_2O_3 + 6 H^+ + 6 e \rightleftharpoons 2 Sb + 3 H_2O$	0.152
$Pd(OH)_2 + 2 e \rightleftharpoons Pd + 2 OH^-$	0.07	$Cu^{2+} + e \rightleftharpoons Cu^+$	0.153
$AgBr + e \rightleftharpoons Ag + Br^-$	0.07133	$BiOCl + 2 H^+ + 3 e \rightleftharpoons Bi + Cl^- + H_2O$	0.1583
$MoO_3 + 6 H^+ + 6 e \rightleftharpoons Mo + 3 H_2O$	0.075	$BiCl_4^- + 3 e \rightleftharpoons Bi + 4 Cl^-$	0.16
$S_2O_6^{2-} + 2 e \rightleftharpoons 2 S_2O_3^{2-}$	0.08	$Fe_2O_3 + 4 H^+ + 2 e \rightleftharpoons 2 FeOH^+ + H_2O$	0.16
$H_3Mo_7O_{24}^{3-} + 45 H^+ + 42 e \rightleftharpoons 7 Mo + 24 H_2O$	0.082	$Co(OH)_3 + e \rightleftharpoons Co(OH)_2 + OH^-$	0.17
$AgSCN + e \rightleftharpoons Ag + SCN^-$	0.8951	$SO_4^{2-} + 4 H^+ + 2 e \rightleftharpoons H_2SO_3 + H_2O$	0.172
$N_2 + 2 H_2O + 6 H^+ + 6 e \rightleftharpoons 2 NH_4OH$	0.092	$Bi^{3+} + 2 e \rightleftharpoons Bi^+$	0.2
$HgO + H_2O + 2 e \rightleftharpoons Hg + 2 OH^-$	0.0977	$[Ru(en)_3]^{3+} + e \rightleftharpoons [Ru(en)_3]^{2+}$	0.210
$Ir_2O_3 + 3 H_2O + 6 e \rightleftharpoons 2 Ir + 6 OH^-$	0.098	$SbO^+ + 2 H^+ + 3 e \rightleftharpoons Sb + 2 H_2O$	0.212
$2 NO + 2 e \rightleftharpoons N_2O_2^{2-}$	0.10	$AgCl + e \rightleftharpoons Ag + Cl^-$	0.22233
$[Ru(NH_3)_6]^{3+} + e \rightleftharpoons [Ru(NH_3)_6]^{2+}$	0.10	$[Ru(H_2O)_6]^{3+} + e \rightleftharpoons [Ru(H_2O)_6]^{2+}$	0.23
$W^{3+} + 3 e \rightleftharpoons W$	0.1	$As_2O_3 + 6 H^+ + 6 e \rightleftharpoons 2 As + 3 H_2O$	0.234
$[Co(NH_3)_6]^{3+} + e \rightleftharpoons [Co(NH_3)_6]^{2+}$	0.108	Calomel electrode, saturated NaCl (SSCE)	0.2360
$Hg_2O + H_2O + 2 e \rightleftharpoons 2 Hg + 2 OH^-$	0.123	$Ge^{2+} + 2 e \rightleftharpoons Ge$	0.24
$Ge^{4+} + 4 e \rightleftharpoons Ge$	0.124	$Ru^{3+} + e \rightleftharpoons Ru^{2+}$	0.24
$Hg_2Br_2 + 2 e \rightleftharpoons 2 Hg + 2 Br^-$	0.13923	Calomel electrode, saturated KCl	0.2412
$Pt(OH)_2 + 2 e \rightleftharpoons Pt + 2 OH^-$	0.14	$PbO + H_2O + 2 e \rightleftharpoons PbO + 2 OH^-$	0.247
$[V(phen)_3]^{3+} + e \rightleftharpoons [V(phen)_3]^{2+}$	0.14	$HAsO_2 + 3 H^+ + 3 e \rightleftharpoons As + 2 H_2O$	0.248
$S + 2 H^+ + 2 e \rightleftharpoons H_2S(aq)$	0.142	$Ru^{3+} + e \rightleftharpoons Ru^{2+}$	0.2487

ELECTROCHEMICAL SERIES (continued)

TABLE 2

Reduction Reactions Having E° Values More Positive than that of the Standard Hydrogen Electrode (continued)

Reaction	E°/V	Reaction	E°/V
$\text{ReO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Re} + 2 \text{H}_2\text{O}$	0.2513	$[\text{PdCl}_4]^{2-} + 2 \text{e} \rightleftharpoons \text{Pd} + 4 \text{Cl}^-$	0.591
$\text{IO}_3^- + 3 \text{H}_2\text{O} + 6 \text{e} \rightleftharpoons \text{I}^- + \text{OH}^-$	0.26	$\text{TeO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Te} + 2 \text{H}_2\text{O}$	0.593
$\text{Hg}_2\text{Cl}_2 + 2 \text{e} \rightleftharpoons 2 \text{Hg} + 2 \text{Cl}^-$	0.26808	$\text{MnO}_4^- + 2 \text{H}_2\text{O} + 3 \text{e} \rightleftharpoons \text{MnO}_2 + 4 \text{OH}^-$	0.595
Calomel electrode, 1 molal KCl	0.2800	$\text{Rh}^{2+} + 2 \text{e} \rightleftharpoons \text{Rh}$	0.600
Calomel electrode, 1 molar KCl (NCE)	0.2801	$\text{Rh}^+ + \text{e} \rightleftharpoons \text{Rh}$	0.600
$\text{At}_2 + 2 \text{e} \rightleftharpoons 2 \text{At}^-$	0.3	$\text{MnO}_4^{2-} + 2 \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{MnO}_2 + 4 \text{OH}^-$	0.60
$\text{Re}^{3+} + 3 \text{e} \rightleftharpoons \text{Re}$	0.300	$2 \text{AgO} + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{Ag}_2\text{O} + 2 \text{OH}^-$	0.607
$\text{Tc}^{3+} + \text{e} \rightleftharpoons \text{Tc}^{2+}$	0.3	$\text{BrO}_3^- + 3 \text{H}_2\text{O} + 6 \text{e} \rightleftharpoons \text{Br}^- + 6 \text{OH}^-$	0.61
$\text{Bi}^{3+} + 3 \text{e} \rightleftharpoons \text{Bi}$	0.308	$\text{UO}_2^{+} + 4 \text{H}^+ + \text{e} \rightleftharpoons \text{U}^{4+} + 2 \text{H}_2\text{O}$	0.612
$\text{BiO}^+ + 2 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{Bi} + \text{H}_2\text{O}$	0.320	$\text{Hg}_2\text{SO}_4 + 2 \text{e} \rightleftharpoons 2 \text{Hg} + \text{SO}_4^{2-}$	0.6125
$\text{UO}_2^{2+} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{U}^{4+} + 2 \text{H}_2\text{O}$	0.327	$\text{ClO}_3^- + 3 \text{H}_2\text{O} + 6 \text{e} \rightleftharpoons \text{Cl}^- + 6 \text{OH}^-$	0.62
$\text{ClO}_3^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{ClO}_2^- + 2 \text{OH}^-$	0.33	$\text{Hg}_2\text{HPO}_4 + 2 \text{e} \rightleftharpoons 2 \text{Hg} + \text{HPO}_4^{2-}$	0.6359
$2 \text{HCNO} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons (\text{CN})_2 + 2 \text{H}_2\text{O}$	0.330	$\text{Ag}(\text{ac}) + \text{e} \rightleftharpoons \text{Ag} + (\text{ac})^-$	0.643
Calomel electrode, 0.1 molar KCl	0.3337	$\text{Sb}_2\text{O}_5(\text{valentinite}) + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Sb}_2\text{O}_3 + 2 \text{H}_2\text{O}$	0.649
$\text{VO}^{2+} + 2 \text{H}^+ + \text{e} \rightleftharpoons \text{V}^{3+} + \text{H}_2\text{O}$	0.337	$\text{Ag}_2\text{SO}_4 + 2 \text{e} \rightleftharpoons 2 \text{Ag} + \text{SO}_4^{2-}$	0.654
$\text{Cu}^{2+} + 2 \text{e} \rightleftharpoons \text{Cu}$	0.3419	$\text{ClO}_2^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{ClO}^- + 2 \text{OH}^-$	0.66
$\text{Ag}_2\text{O} + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons 2 \text{Ag} + 2 \text{OH}^-$	0.342	$\text{Sb}_2\text{O}_5(\text{senarmontite}) + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Sb}_2\text{O}_3 + 2 \text{H}_2\text{O}$	0.671
$\text{Cu}^{2+} + 2 \text{e} \rightleftharpoons \text{Cu}(\text{Hg})$	0.345	$[\text{PtCl}_6]^{2-} + 2 \text{e} \rightleftharpoons [\text{PtCl}_4]^{2-} + 2 \text{Cl}^-$	0.68
$\text{AgIO}_3 + \text{e} \rightleftharpoons \text{Ag} + \text{IO}_3^-$	0.354	$\text{O}_2 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{O}_2$	0.695
$[\text{Fe}(\text{CN})_6]^{3-} + \text{e} \rightleftharpoons [\text{Fe}(\text{CN})_6]^{4-}$	0.358	$p\text{-benzoquinone} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{hydroquinone}$	0.6992
$\text{ClO}_4^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{ClO}_3^- + 2 \text{OH}^-$	0.36	$\text{H}_3\text{IO}_6^{2-} + 2 \text{e} \rightleftharpoons \text{IO}_3^- + 3 \text{OH}^-$	0.7
$\text{Ag}_2\text{SeO}_3 + 2 \text{e} \rightleftharpoons 2 \text{Ag} + \text{SeO}_3^{2-}$	0.3629	$\text{Ag}_2\text{O}_3 + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons 2 \text{AgO} + 2 \text{OH}^-$	0.739
$\text{ReO}_4^- + 8 \text{H}^+ + 7 \text{e} \rightleftharpoons \text{Re} + 4 \text{H}_2\text{O}$	0.368	$\text{Tl}^{3+} + 3 \text{e} \rightleftharpoons \text{Tl}$	0.741
$(\text{CN})_2 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{HCN}$	0.373	$[\text{PtCl}_4]^{2-} + 2 \text{e} \rightleftharpoons \text{Pt} + 4 \text{Cl}^-$	0.755
$[\text{Fericinium}]^+ + \text{e} \rightleftharpoons \text{ferrocene}$	0.400	$\text{Rh}^{3+} + 3 \text{e} \rightleftharpoons \text{Rh}$	0.758
$\text{Tc}^{2+} + 2 \text{e} \rightleftharpoons \text{Tc}$	0.400	$\text{ClO}_2 + 2 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons \text{Cl}^- + 4 \text{OH}^-$	0.76
$\text{O}_2 + 2 \text{H}_2\text{O} + 4 \text{e} \rightleftharpoons 4 \text{OH}^-$	0.401	$2 \text{NO} + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{N}_2\text{O} + 2 \text{OH}^-$	0.76
$\text{AgOCN} + \text{e} \rightleftharpoons \text{Ag} + \text{OCN}^-$	0.41	$\text{Po}^{4+} + 4 \text{e} \rightleftharpoons \text{Po}$	0.76
$[\text{RhCl}_6]^{3-} + 3 \text{e} \rightleftharpoons \text{Rh} + 6 \text{Cl}^-$	0.431	$\text{BrO}^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{Br}^- + 2 \text{OH}^-$	0.761
$\text{Ag}_2\text{CrO}_4 + 2 \text{e} \rightleftharpoons 2 \text{Ag} + \text{CrO}_4^{2-}$	0.4470	$\text{ReO}_4^- + 2 \text{H}^+ + \text{e} \rightleftharpoons \text{ReO}_3 + \text{H}_2\text{O}$	0.768
$\text{H}_2\text{SO}_3 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{S} + 3 \text{H}_2\text{O}$	0.449	$(\text{CNS})_2 + 2 \text{e} \rightleftharpoons 2 \text{CNS}^-$	0.77
$\text{Ru}^{2+} + 2 \text{e} \rightleftharpoons \text{Ru}$	0.455	$[\text{IrCl}_6]^{3-} + 3 \text{e} \rightleftharpoons \text{Ir} + 6 \text{Cl}^-$	0.77
$\text{Ag}_2\text{MoO}_4 + 2 \text{e} \rightleftharpoons 2 \text{Ag} + \text{MoO}_4^{2-}$	0.4573	$\text{Fe}^{3+} + \text{e} \rightleftharpoons \text{Fe}^{2+}$	0.771
$\text{Ag}_2\text{C}_2\text{O}_4 + 2 \text{e} \rightleftharpoons 2 \text{Ag} + \text{C}_2\text{O}_4^{2-}$	0.4647	$\text{AgF} + \text{e} \rightleftharpoons \text{Ag} + \text{F}^-$	0.779
$\text{Ag}_2\text{WO}_4 + 2 \text{e} \rightleftharpoons 2 \text{Ag} + \text{WO}_4^{2-}$	0.4660	$[\text{Fe}(\text{bipy})_2]^{3+} + \text{e} \rightleftharpoons [\text{Fe}(\text{bipy})_2]^{2+}$	0.78
$\text{Ag}_2\text{CO}_3 + 2 \text{e} \rightleftharpoons 2 \text{Ag} + \text{CO}_3^{2-}$	0.47	$\text{TcO}_4^- + 4 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{TcO}_2 + 2 \text{H}_2\text{O}$	0.782
$\text{TcO}_4^- + 8 \text{H}^+ + 7 \text{e} \rightleftharpoons \text{Tc} + 4 \text{H}_2\text{O}$	0.472	$\text{Hg}_2^{2+} + 2 \text{e} \rightleftharpoons 2 \text{Hg}$	0.7973
$\text{TeO}_4^- + 8 \text{H}^+ + 7 \text{e} \rightleftharpoons \text{Te} + 4 \text{H}_2\text{O}$	0.472	$\text{Ag}^+ + \text{e} \rightleftharpoons \text{Ag}$	0.7996
$\text{IO}^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{I}^- + 2 \text{OH}^-$	0.485	$[\text{Os}(\text{bipy})_3]^{3+} + \text{e} \rightleftharpoons [\text{Os}(\text{bipy})_3]^{2+}$	0.80
$\text{NiO}_2 + 2 \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{Ni}(\text{OH})_2 + 2 \text{OH}^-$	0.490	$2 \text{NO}_3^- + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{N}_2\text{O}_4 + 2 \text{H}_2\text{O}$	0.803
$\text{Bi}^+ + \text{e} \rightleftharpoons \text{Bi}$	0.5	$[\text{Os}(\text{bipy})_2]^{3+} + \text{e} \rightleftharpoons [\text{Os}(\text{bipy})_2]^{2+}$	0.81
$\text{ReO}_4^- + 4 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{ReO}_2 + 2 \text{H}_2\text{O}$	0.510	$\text{RhOH}^{2+} + \text{H}^+ + 3 \text{e} \rightleftharpoons \text{Rh} + \text{H}_2\text{O}$	0.83
$\text{Hg}_2(\text{ac})_2 + 2 \text{e} \rightleftharpoons 2 \text{Hg} + 2(\text{ac})^-$	0.51163	$\text{OsO}_4 + 8 \text{H}^+ + 8 \text{e} \rightleftharpoons \text{Os} + 4 \text{H}_2\text{O}$	0.838
$\text{Cu}^+ + \text{e} \rightleftharpoons \text{Cu}$	0.521	$\text{ClO}^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{Cl}^- + 2 \text{OH}^-$	0.841
$\text{I}_2 + 2 \text{e} \rightleftharpoons 2 \text{I}^-$	0.5355	$\text{Hg}^{2+} + 2 \text{e} \rightleftharpoons \text{Hg}$	0.851
$\text{I}_3^- + 2 \text{e} \rightleftharpoons 3 \text{I}^-$	0.536	$\text{AuBr}_4^- + 3 \text{e} \rightleftharpoons \text{Au} + 4 \text{Br}^-$	0.854
$\text{AgBrO}_3 + \text{e} \rightleftharpoons \text{Ag} + \text{BrO}_3^-$	0.546	$\text{SiO}_2(\text{quartz}) + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Si} + 2 \text{H}_2\text{O}$	0.857
$\text{MnO}_4^- + \text{e} \rightleftharpoons \text{MnO}_2^-$	0.558	$2 \text{HNO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{H}_2\text{N}_2\text{O}_2 + \text{H}_2\text{O}$	0.86
$\text{H}_3\text{AsO}_4 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{HAsO}_2 + 2 \text{H}_2\text{O}$	0.560	$[\text{Ru}(\text{CN})_6]^{3-} + \text{e}^- \rightleftharpoons [\text{Ru}(\text{CN})_6]^{4-}$	0.86
$\text{S}_2\text{O}_6^{2-} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{H}_2\text{SO}_3$	0.564	$[\text{IrCl}_6]^{2-} + \text{e} \rightleftharpoons [\text{IrCl}_6]^{3-}$	0.8665
$\text{AgNO}_2 + \text{e} \rightleftharpoons \text{Ag} + \text{NO}_2^-$	0.564	$\text{N}_2\text{O}_4 + 2 \text{e} \rightleftharpoons 2 \text{NO}_2^-$	0.867
$\text{Te}^{4+} + 4 \text{e} \rightleftharpoons \text{Te}$	0.568	$\text{HO}_2^- + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons 3 \text{OH}^-$	0.878
$\text{Sb}_2\text{O}_5 + 6 \text{H}^+ + 4 \text{e} \rightleftharpoons 2 \text{SbO}^+ + 3 \text{H}_2\text{O}$	0.581	$\text{Po}^{4+} + 2 \text{e} \rightleftharpoons \text{Po}^{2+}$	0.9
$\text{RuO}_4^- + \text{e} \rightleftharpoons \text{RuO}_4^{2-}$	0.59	$2 \text{Hg}^+ + 2 \text{e} \rightleftharpoons \text{Hg}_2^{2+}$	0.920

ELECTROCHEMICAL SERIES (continued)

TABLE 2

Reduction Reactions Having E° Values More Positive than that of the Standard Hydrogen Electrode (continued)

Reaction	E°/V	Reaction	E°/V
$\text{NO}_3^- + 3 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{HNO}_2 + \text{H}_2\text{O}$	0.934	$\text{Cl}_2(\text{g}) + 2 \text{e} \rightleftharpoons 2\text{Cl}^-$	1.35827
$\text{Pd}^{2+} + 2 \text{e} \rightleftharpoons \text{Pd}$	0.951	$\text{ClO}_4^- + 8 \text{H}^+ + 8 \text{e} \rightleftharpoons \text{Cl}^- + 4 \text{H}_2\text{O}$	1.389
$\text{ClO}_2(\text{aq}) + \text{e} \rightleftharpoons \text{ClO}_2^-$	0.954	$\text{ClO}_4^- + 8 \text{H}^+ + 7 \text{e} \rightleftharpoons 1/2 \text{Cl}_2 + 4 \text{H}_2\text{O}$	1.39
$\text{NO}_3^- + 4 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{NO} + 2 \text{H}_2\text{O}$	0.957	$\text{No}^{3+} + \text{e} \rightleftharpoons \text{No}^{2+}$	1.4
$\text{V}_2\text{O}_5 + 6 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{VO}^{2+} + 3 \text{H}_2\text{O}$	0.957	$\text{RuO}_4 + 6 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Ru}(\text{OH})_2^{2+} + 2 \text{H}_2\text{O}$	1.40
$\text{AuBr}_2^- + \text{e} \rightleftharpoons \text{Au} + 2 \text{Br}^-$	0.959	$\text{Au}^{3+} + 2 \text{e} \rightleftharpoons \text{Au}^+$	1.401
$\text{HNO}_2 + \text{H}^+ + \text{e} \rightleftharpoons \text{NO} + \text{H}_2\text{O}$	0.983	$2 \text{NH}_3\text{OH}^+ + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{N}_2\text{H}_5^+ + 2 \text{H}_2\text{O}$	1.42
$\text{HIO} + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{I}^- + \text{H}_2\text{O}$	0.987	$\text{BrO}_3^- + 6 \text{H}^+ + 6 \text{e} \rightleftharpoons \text{Br}^- + 3 \text{H}_2\text{O}$	1.423
$\text{VO}_2^+ + 2 \text{H}^+ + \text{e} \rightleftharpoons \text{VO}^{2+} + \text{H}_2\text{O}$	0.991	$2 \text{HIO} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{I}_2 + 2 \text{H}_2\text{O}$	1.439
$\text{PtO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Pt} + 2 \text{H}_2\text{O}$	1.00	$\text{Au}(\text{OH})_3 + 3 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{Au}^- + 3 \text{H}_2\text{O}$	1.45
$\text{RuO}_4 + \text{e} \rightleftharpoons \text{RuO}_4^-$	1.00	$3\text{IO}_3^- + 6 \text{H}^+ + 6 \text{e} \rightleftharpoons \text{Cl}^- + 3 \text{H}_2\text{O}$	1.451
$\text{V}(\text{OH})_4^+ + 2 \text{H}^+ + \text{e} \rightleftharpoons \text{VO}^{2+} + 3 \text{H}_2\text{O}$	1.00	$\text{PbO}_2 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Pb}^{2+} + 2 \text{H}_2\text{O}$	1.455
$\text{AuCl}_4^- + 3 \text{e} \rightleftharpoons \text{Au} + 4 \text{Cl}^-$	1.002	$\text{ClO}_3^- + 6 \text{H}^+ + 5 \text{e} \rightleftharpoons 1/2 \text{Cl}_2 + 3 \text{H}_2\text{O}$	1.47
$\text{Pu}^{4+} + \text{e} \rightleftharpoons \text{Pu}^{3+}$	1.006	$\text{CrO}_2 + 4 \text{H}^+ + \text{e} \rightleftharpoons \text{Cr}^{3+} + 2 \text{H}_2\text{O}$	1.48
$\text{PtO}_2 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{PtO} + \text{H}_2\text{O}$	1.01	$\text{BrO}_3^- + 6 \text{H}^+ + 5 \text{e} \rightleftharpoons 1/2 \text{Br}_2 + 3 \text{H}_2\text{O}$	1.482
$\text{OsO}_4 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{OsO}_2 + 2 \text{H}_2\text{O}$	1.02	$\text{HClO} + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Cl}^- + \text{H}_2\text{O}$	1.482
$\text{H}_6\text{TeO}_6 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{TeO}_2 + 4 \text{H}_2\text{O}$	1.02	$\text{Mn}_2\text{O}_3 + 6 \text{H}^+ + \text{e} \rightleftharpoons 2 \text{Mn}^{2+} + 3 \text{H}_2\text{O}$	1.485
$[\text{Fe}(\text{bipy})_3]^{3+} + \text{e} \rightleftharpoons [\text{Fe}(\text{bipy})_3]^{2+}$	1.03	$\text{HO}_2 + \text{H}^+ + \text{e} \rightleftharpoons \text{H}_2\text{O}_2$	1.495
$\text{Hg}(\text{OH})_2 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Hg} + 2 \text{H}_2\text{O}$	1.034	$\text{Au}^{3+} + 3 \text{e} \rightleftharpoons \text{Au}$	1.498
$\text{N}_2\text{O}_4 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons 2 \text{NO} + 2 \text{H}_2\text{O}$	1.035	$\text{PtO}_3 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Pt}(\text{OH})_2^{2+} + \text{H}_2\text{O}$	1.5
$\text{RuO}_4 + 8 \text{H}^+ + 8 \text{e} \rightleftharpoons \text{Ru} + 4\text{H}_2\text{O}$	1.038	$\text{MnO}_4^- + 8 \text{H}^+ + 5 \text{e} \rightleftharpoons \text{Mn}^{2+} + 4 \text{H}_2\text{O}$	1.507
$[\text{Fe}(\text{phen})_3]^{3+} + \text{e} \rightleftharpoons [\text{Fe}(\text{phen})_3]^{2+}$ (1 molar H_2SO_4)	1.06	$\text{Mn}^{3+} + \text{e} \rightleftharpoons \text{Mn}^{2+}$	1.5415
$\text{PuO}_2(\text{OH})_2 + \text{H}^+ + \text{e} \rightleftharpoons \text{PuO}_2\text{OH} + \text{H}_2\text{O}$	1.062	$\text{HClO}_2 + 3 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{Cl}^- + 2 \text{H}_2\text{O}$	1.570
$\text{N}_2\text{O}_4 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{HNO}_2$	1.065	$\text{HBrO} + \text{H}^+ + \text{e} \rightleftharpoons 1/2 \text{Br}_2(\text{aq}) + \text{H}_2\text{O}$	1.574
$\text{Br}_2(\text{l}) + 2 \text{e} \rightleftharpoons 2\text{Br}^-$	1.066	$2 \text{NO} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{N}_2\text{O} + \text{H}_2\text{O}$	1.591
$\text{IO}_3^- + 6 \text{H}^+ + 6 \text{e} \rightleftharpoons \text{I}^- + 3 \text{H}_2\text{O}$	1.085	$\text{Bi}_2\text{O}_4 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{BiO}^+ + 2 \text{H}_2\text{O}$	1.593
$\text{Br}_2(\text{aq}) + 2 \text{e} \rightleftharpoons 2\text{Br}^-$	1.0873	$\text{HBrO} + \text{H}^+ + \text{e} \rightleftharpoons 1/2 \text{Br}_2(\text{l}) + \text{H}_2\text{O}$	1.596
$\text{Pu}^{5+} + \text{e} \rightleftharpoons \text{Pu}^{4+}$	1.099	$\text{H}_5\text{IO}_6 + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{IO}_3^- + 3 \text{H}_2\text{O}$	1.601
$\text{Cu}^{2+} + 2 \text{CN}^- + \text{e} \rightleftharpoons [\text{Cu}(\text{CN})_2]^-$	1.103	$\text{HClO} + \text{H}^+ + \text{e} \rightleftharpoons 1/2 \text{Cl}_2 + \text{H}_2\text{O}$	1.611
$\text{RuO}_2 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Ru}^{2+} + 2 \text{H}_2\text{O}$	1.120	$\text{HClO}_2 + 3 \text{H}^+ + 3 \text{e} \rightleftharpoons 1/2 \text{Cl}_2 + 2 \text{H}_2\text{O}$	1.628
$[\text{Fe}(\text{phen})_3]^{3+} + \text{e} \rightleftharpoons [\text{Fe}(\text{phen})_3]^{2+}$	1.147	$\text{HClO}_2 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{HClO} + \text{H}_2\text{O}$	1.645
$\text{SeO}_4^{2-} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{H}_2\text{SeO}_3 + \text{H}_2\text{O}$	1.151	$\text{Bk}^{4+} + \text{e} \rightleftharpoons \text{Bk}^{3+}$	1.67
$\text{ClO}_3^- + 2 \text{H}^+ + \text{e} \rightleftharpoons \text{ClO}_2 + \text{H}_2\text{O}$	1.152	$\text{NiO}_2 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Ni}^{2+} + 2 \text{H}_2\text{O}$	1.678
$\text{Ir}^{3+} + 3 \text{e} \rightleftharpoons \text{Ir}$	1.156	$\text{MnO}_4^- + 4 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{MnO}_2 + 2 \text{H}_2\text{O}$	1.679
$\text{Pt}^{2+} + 2 \text{e} \rightleftharpoons \text{Pt}$	1.18	$\text{PbO}_2 + \text{SO}_4^{2-} + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{PbSO}_4 + 2 \text{H}_2\text{O}$	1.6913
$\text{ClO}_4^- + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{ClO}_3^- + \text{H}_2\text{O}$	1.189	$\text{Au}^+ + \text{e} \rightleftharpoons \text{Au}$	1.692
$2 \text{IO}_3^- + 12 \text{H}^+ + 10 \text{e} \rightleftharpoons \text{I}_2 + 6 \text{H}_2\text{O}$	1.195	$\text{PtO}_3 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{PtO}_2 + \text{H}_2\text{O}$	1.7
$\text{PtOH}^+ + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Pt} + \text{H}_2\text{O}$	1.2	$\text{CeOH}^{3+} + \text{H}^+ + \text{e} \rightleftharpoons \text{Ce}^{3+} + \text{H}_2\text{O}$	1.715
$\text{ClO}_3^- + 3 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{HClO}_2 + \text{H}_2\text{O}$	1.214	$\text{Ce}^{4+} + \text{e} \rightleftharpoons \text{Ce}^{3+}$	1.72
$\text{MnO}_2 + 4 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Mn}^{2+} + 2 \text{H}_2\text{O}$	1.224	$\text{N}_2\text{O} + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{N}_2 + \text{H}_2\text{O}$	1.766
$\text{O}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons 2 \text{H}_2\text{O}$	1.229	$\text{H}_2\text{O}_2 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{H}_2\text{O}$	1.776
$\text{Cr}_2\text{O}_7^{2-} + 14 \text{H}^+ + 6 \text{e} \rightleftharpoons 2 \text{Cr}^{3+} + 7 \text{H}_2\text{O}$	1.232	$\text{Ag}^{3+} + \text{e} \rightleftharpoons \text{Ag}^{2+}$	1.8
$\text{O}_3 + \text{H}_2\text{O} + 2 \text{e} \rightleftharpoons \text{O}_2 + 2 \text{OH}^-$	1.24	$\text{Au}^{2+} + \text{e}^- \rightleftharpoons \text{Au}^+$	1.8
$[\text{Ru}(\text{bipy})_3]^{3+} + \text{e} \rightleftharpoons [\text{Ru}(\text{bipy})_3]^{2+}$	1.24	$\text{Ag}_2\text{O}_2 + 4 \text{H}^+ + \text{e} \rightleftharpoons 2 \text{Ag} + 2 \text{H}_2\text{O}$	1.802
$\text{Ti}^{3+} + 2 \text{e} \rightleftharpoons \text{Ti}^+$	1.252	$\text{Co}^{3+} + \text{e} \rightleftharpoons \text{Co}^{2+}$ (2 molar H_2SO_4)	1.83
$\text{N}_2\text{H}_5^+ + 3 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{NH}_4^+$	1.275	$\text{Ag}^{3+} + 2 \text{e} \rightleftharpoons \text{Ag}^+$	1.9
$\text{ClO}_2 + \text{H}^+ + \text{e} \rightleftharpoons \text{HClO}_2$	1.277	$\text{Co}^{3+} + \text{e} \rightleftharpoons \text{Co}^{2+}$	1.92
$[\text{PdCl}_6]^{2-} + 2 \text{e} \rightleftharpoons [\text{PdCl}_4]^{2-} + 2 \text{Cl}^-$	1.288	$\text{Ag}^{2+} + \text{e} \rightleftharpoons \text{Ag}^+$	1.980
$2 \text{HNO}_2 + 4 \text{H}^+ + 4 \text{e} \rightleftharpoons \text{N}_2\text{O} + 3 \text{H}_2\text{O}$	1.297	$\text{Cu}_2\text{O}_3 + 6 \text{H}^+ + 2 \text{e} \rightleftharpoons 2 \text{Cu}^{2+} + 3 \text{H}_2\text{O}$	2.0
$\text{AuOH}^{2+} + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Au}^+ + \text{H}_2\text{O}$	1.32	$\text{S}_2\text{O}_8^{2-} + 2 \text{e} \rightleftharpoons 2 \text{SO}_4^{2-}$	2.010
$\text{PuO}_2(\text{OH})_2 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Pu}(\text{OH})_4$	1.325	$\text{OH} + \text{e} \rightleftharpoons \text{OH}^-$	2.02
$\text{HBrO} + \text{H}^+ + 2 \text{e} \rightleftharpoons \text{Br}^- + \text{H}_2\text{O}$	1.331	$\text{HFeO}_4^- + 7 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{Fe}^{3+} + 4 \text{H}_2\text{O}$	2.07
$\text{Cr}(\text{V}) + \text{e} \rightleftharpoons \text{Cr}(\text{IV})$	1.34	$\text{O}_3 + 2 \text{H}^+ + 2 \text{e} \rightleftharpoons \text{O}_2 + \text{H}_2\text{O}$	2.076
$\text{HCrO}_4^- + 7 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{Cr}^{3+} + 4 \text{H}_2\text{O}$	1.350	$\text{HFeO}_4^- + 4 \text{H}^+ + 3 \text{e} \rightleftharpoons \text{FeOOH} + 2 \text{H}_2\text{O}$	2.08

ELECTROCHEMICAL SERIES (continued)

TABLE 2

Reduction Reactions Having E° Values More Positive than that of the Standard Hydrogen Electrode (continued)

Reaction	E°/V	Reaction	E°/V
$2\text{HFeO}_4^- + 8\text{H}^+ + 6\text{e} \rightleftharpoons \text{Fe}_2\text{O}_3 + 5\text{H}_2\text{O}$	2.09	$\text{H}_2\text{N}_2\text{O}_2 + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{N}_2 + 2\text{H}_2\text{O}$	2.65
$\text{XeO}_3 + 6\text{H}^+ + 6\text{e} \rightleftharpoons \text{Xe} + 3\text{H}_2\text{O}$	2.10	$\text{F}_2 + 2\text{e} \rightleftharpoons 2\text{F}^-$	2.866
$\text{S}_2\text{O}_8^{2-} + 2\text{H}^+ + 2\text{e} \rightleftharpoons 2\text{HSO}_4^-$	2.123	$\text{Cm}^{4+} + \text{e} \rightleftharpoons \text{Cm}^{3+}$	3.0
$\text{F}_2\text{O} + 2\text{H}^+ + 4\text{e} \rightleftharpoons \text{H}_2\text{O} + 2\text{F}^-$	2.153	$\text{F}_2 + 2\text{H}^+ + 2\text{e} \rightleftharpoons 2\text{HF}$	3.053
$\text{FeO}_4^{2-} + 8\text{H}^+ + 3\text{e} \rightleftharpoons \text{Fe}^{3+} + 4\text{H}_2\text{O}$	2.20	$\text{Tb}^{4+} + \text{e} \rightleftharpoons \text{Tb}^{3+}$	3.1
$\text{Cu}^{3+} + \text{e} \rightleftharpoons \text{Cu}^{2+}$	2.4	$\text{Pr}^{4+} + \text{e} \rightleftharpoons \text{Pr}^{3+}$	3.2
$\text{H}_4\text{XeO}_6 + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{XeO}_3 + 3\text{H}_2\text{O}$	2.42	$\text{Cf}^{4+} + \text{e} \rightleftharpoons \text{Cf}^{3+}$	3.3
$\text{O}(\text{g}) + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{H}_2\text{O}$	2.421	$\text{XeF} + \text{e} \rightleftharpoons \text{Xe} + \text{F}^-$	3.4
$\text{Am}^{4+} + \text{e} \rightleftharpoons \text{Am}^{3+}$	2.60		

TABLE 3

Reduction Reactions Having E° Values More Negative than that of the Standard Hydrogen Electrode

Reaction	E°/V	Reaction	E°/V
$2\text{H}^+ + 2\text{e} \rightleftharpoons \text{H}_2$	0.00000	$\text{Cu}(\text{OH})_2 + 2\text{e} \rightleftharpoons \text{Cu} + 2\text{OH}^-$	-0.222
$2\text{D}^+ + 2\text{e} \rightleftharpoons \text{D}_2$	-0.013	$\text{V}_2\text{O}_5 + 10\text{H}^+ + 10\text{e} \rightleftharpoons 2\text{V} + 5\text{H}_2\text{O}$	-0.242
$\text{AgCN} + \text{e} \rightleftharpoons \text{Ag} + \text{CN}^-$	-0.017	$\text{CdSO}_4 + 2\text{e} \rightleftharpoons \text{Cd} + \text{SO}_4^{2-}$	-0.246
$2\text{WO}_3 + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{W}_2\text{O}_5 + \text{H}_2\text{O}$	-0.029	$\text{V}(\text{OH})_4^+ + 4\text{H}^+ + 5\text{e} \rightleftharpoons \text{V} + 4\text{H}_2\text{O}$	-0.254
$\text{W}_2\text{O}_5 + 2\text{H}^+ + 2\text{e} \rightleftharpoons 2\text{WO}_2 + \text{H}_2\text{O}$	-0.031	$\text{V}^{3+} + \text{e} \rightleftharpoons \text{V}^{2+}$	-0.255
$\text{Ag}_2\text{S} + 2\text{H}^+ + 2\text{e} \rightleftharpoons 2\text{Ag} + \text{H}_2\text{S}$	-0.0366	$\text{Ni}^{2+} + 2\text{e} \rightleftharpoons \text{Ni}$	-0.257
$\text{Fe}^{3+} + 3\text{e} \rightleftharpoons \text{Fe}$	-0.037	$\text{PbCl}_2 + 2\text{e} \rightleftharpoons \text{Pb} + 2\text{Cl}^-$	-0.2675
$\text{Hg}_2\text{I}_2 + 2\text{e} \rightleftharpoons 2\text{Hg} + 2\text{I}^-$	-0.0405	$\text{H}_3\text{PO}_4 + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{H}_3\text{PO}_3 + \text{H}_2\text{O}$	-0.276
$\text{Tl}(\text{OH})_3 + 2\text{e} \rightleftharpoons \text{TlOH} + 2\text{OH}^-$	-0.05	$\text{Co}^{2+} + 2\text{e} \rightleftharpoons \text{Co}$	-0.28
$\text{TiOH}^{3+} + \text{H}^+ + \text{e} \rightleftharpoons \text{Ti}^{3+} + \text{H}_2\text{O}$	-0.055	$\text{PbBr}_2 + 2\text{e} \rightleftharpoons \text{Pb} + 2\text{Br}^-$	-0.284
$2\text{H}_2\text{SO}_3 + \text{H}^+ + 2\text{e} \rightleftharpoons \text{HS}_2\text{O}_4^- + 2\text{H}_2\text{O}$	-0.056	$\text{Tl}^+ + \text{e} \rightleftharpoons \text{Tl}(\text{Hg})$	-0.3338
$\text{P}(\text{white}) + 3\text{H}^+ + 3\text{e} \rightleftharpoons \text{PH}_3(\text{g})$	-0.063	$\text{Tl}^+ + \text{e} \rightleftharpoons \text{Tl}$	-0.336
$\text{O}_2 + \text{H}_2\text{O} + 2\text{e} \rightleftharpoons \text{HO}_2^- + \text{OH}^-$	-0.076	$\text{In}^{3+} + 3\text{e} \rightleftharpoons \text{In}$	-0.3382
$2\text{Cu}(\text{OH})_2 + 2\text{e} \rightleftharpoons \text{Cu}_2\text{O} + 2\text{OH}^- + \text{H}_2\text{O}$	-0.080	$\text{TlOH} + \text{e} \rightleftharpoons \text{Tl} + \text{OH}^-$	-0.34
$\text{Se} + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{H}_2\text{Se}$	-0.082	$\text{PbF}_2 + 2\text{e} \rightleftharpoons \text{Pb} + 2\text{F}^-$	-0.3444
$\text{WO}_3 + 6\text{H}^+ + 6\text{e} \rightleftharpoons \text{W} + 3\text{H}_2\text{O}$	-0.090	$\text{PbSO}_4 + 2\text{e} \rightleftharpoons \text{Pb}(\text{Hg}) + \text{SO}_4^{2-}$	-0.3505
$\text{SnO}_2 + 4\text{H}^+ + 2\text{e} \rightleftharpoons \text{Sn}^{2+} + 2\text{H}_2\text{O}$	-0.094	$\text{Cd}^{2+} + 2\text{e} \rightleftharpoons \text{Cd}(\text{Hg})$	-0.3521
$\text{Md}^{3+} + \text{e} \rightleftharpoons \text{Md}^{2+}$	-0.1	$\text{PbSO}_4 + 2\text{e} \rightleftharpoons \text{Pb} + \text{SO}_4^{2-}$	-0.3588
$\text{P}(\text{red}) + 3\text{H}^+ + 3\text{e} \rightleftharpoons \text{PH}_3(\text{g})$	-0.111	$\text{Cu}_2\text{O} + \text{H}_2\text{O} + 2\text{e} \rightleftharpoons 2\text{Cu} + 2\text{OH}^-$	-0.360
$\text{SnO}_2 + 4\text{H}^+ + 4\text{e} \rightleftharpoons \text{Sn} + 2\text{H}_2\text{O}$	-0.117	$\text{Eu}^{3+} + \text{e} \rightleftharpoons \text{Eu}^{2+}$	-0.36
$\text{GeO}_2 + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{GeO} + \text{H}_2\text{O}$	-0.118	$\text{PbI}_2 + 2\text{e} \rightleftharpoons \text{Pb} + 2\text{I}^-$	-0.365
$\text{WO}_2 + 4\text{H}^+ + 4\text{e} \rightleftharpoons \text{W} + 2\text{H}_2\text{O}$	-0.119	$\text{SeO}_3^{2-} + 3\text{H}_2\text{O} + 4\text{e} \rightleftharpoons \text{Se} + 6\text{OH}^-$	-0.366
$\text{Pb}^{2+} + 2\text{e} \rightleftharpoons \text{Pb}(\text{Hg})$	-0.1205	$\text{Se} + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{H}_2\text{Se}(\text{aq})$	-0.399
$\text{Pb}^{2+} + 2\text{e} \rightleftharpoons \text{Pb}$	-0.1262	$\text{In}^{2+} + \text{e} \rightleftharpoons \text{In}^+$	-0.40
$\text{CrO}_4^{2-} + 4\text{H}_2\text{O} + 3\text{e} \rightleftharpoons \text{Cr}(\text{OH})_3 + 5\text{OH}^-$	-0.13	$\text{Cd}^{2+} + 2\text{e} \rightleftharpoons \text{Cd}$	-0.4030
$\text{Sn}^{2+} + 2\text{e} \rightleftharpoons \text{Sn}$	-0.1375	$\text{Cr}^{3+} + \text{e} \rightleftharpoons \text{Cr}^{2+}$	-0.407
$\text{In}^+ + \text{e} \rightleftharpoons \text{In}$	-0.14	$2\text{S} + 2\text{e} \rightleftharpoons \text{S}_2^{2-}$	-0.42836
$\text{O}_2 + 2\text{H}_2\text{O} + 2\text{e} \rightleftharpoons \text{H}_2\text{O}_2 + 2\text{OH}^-$	-0.146	$\text{Tl}_2\text{SO}_4 + 2\text{e} \rightleftharpoons \text{Tl} + \text{SO}_4^{2-}$	-0.4360
$\text{MoO}_2 + 4\text{H}^+ + 4\text{e} \rightleftharpoons \text{Mo} + 4\text{H}_2\text{O}$	-0.152	$\text{In}^{3+} + 2\text{e} \rightleftharpoons \text{In}^+$	-0.443
$\text{AgI} + \text{e} \rightleftharpoons \text{Ag} + \text{I}^-$	-0.15224	$\text{Fe}^{2+} + 2\text{e} \rightleftharpoons \text{Fe}$	-0.447
$2\text{NO}_2^- + 2\text{H}_2\text{O} + 4\text{e} \rightleftharpoons \text{N}_2\text{O}_2^{2-} + 4\text{OH}^-$	-0.18	$\text{H}_3\text{PO}_3 + 3\text{H}^+ + 3\text{e} \rightleftharpoons \text{P} + 3\text{H}_2\text{O}$	-0.454
$\text{H}_2\text{GeO}_3 + 4\text{H}^+ + 4\text{e} \rightleftharpoons \text{Ge} + 3\text{H}_2\text{O}$	-0.182	$\text{Bi}_2\text{O}_3 + 3\text{H}_2\text{O} + 6\text{e} \rightleftharpoons 2\text{Bi} + 6\text{OH}^-$	-0.46
$\text{SnO}_2 + 3\text{H}^+ + 2\text{e} \rightleftharpoons \text{SnOH}^+ + \text{H}_2\text{O}$	-0.194	$\text{NO}_2^- + \text{H}_2\text{O} + \text{e} \rightleftharpoons \text{NO} + 2\text{OH}^-$	-0.46
$\text{CO}_2 + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{HCOOH}$	-0.199	$\text{PbHPO}_4 + 2\text{e} \rightleftharpoons \text{Pb} + \text{HPO}_4^{2-}$	-0.465
$\text{Mo}^{3+} + 3\text{e} \rightleftharpoons \text{Mo}$	-0.200	$\text{S} + 2\text{e} \rightleftharpoons \text{S}^{2-}$	-0.47627
$\text{Ga}^+ + \text{e} \rightleftharpoons \text{Ga}$	-0.2	$\text{S} + \text{H}_2\text{O} + 2\text{e} \rightleftharpoons \text{HS}^- + \text{OH}^-$	-0.478
$2\text{SO}_2^{2-} + 4\text{H}^+ + 2\text{e} \rightleftharpoons \text{S}_2\text{O}_6^{2-} + \text{H}_2\text{O}$	-0.22	$\text{B}(\text{OH})_3 + 7\text{H}^+ + 8\text{e} \rightleftharpoons \text{BH}_4^- + 3\text{H}_2\text{O}$	-0.481

ELECTROCHEMICAL SERIES (continued)

TABLE 3

Reduction Reactions Having E° Values More Negative than that of the Standard Hydrogen Electrode (continued)

Reaction	E°/V	Reaction	E°/V
In ³⁺ + e ⇌ In ²⁺	-0.49	SnO ₂ + 2 H ₂ O + 4 e ⇌ Sn + 4 OH ⁻	-0.945
ZnOH ⁺ + H ⁺ + 2 e ⇌ Zn + H ₂ O	-0.497	In(OH) ₃ + 3 e ⇌ In + 3 OH ⁻	-0.99
GaOH ²⁺ + H ⁺ + 3 e ⇌ Ga + H ₂ O	-0.498	NpO ₂ + H ₂ O + H ⁺ + e ⇌ Np(OH) ₃	-0.962
H ₃ PO ₃ + 2 H ⁺ + 2 e ⇌ H ₃ PO ₂ + H ₂ O	-0.499	In(OH) ₄ ⁻ + 3 e ⇌ In + 4 OH ⁻	-1.007
TiO ₂ + 4 H ⁺ + 2 e ⇌ Ti ²⁺ + 2 H ₂ O	-0.502	In ₂ O ₃ + 3 H ₂ O + 6 e ⇌ 2 In + 6 OH ⁻	-1.034
H ₃ PO ₂ + H ⁺ + e ⇌ P + 2 H ₂ O	-0.508	PO ₄ ³⁻ + 2 H ₂ O + 2 e ⇌ HPO ₃ ²⁻ + 3 OH ⁻	-1.05
Sb + 3 H ⁺ + 3 e ⇌ SbH ₃	-0.510	Yb ³⁺ + e ⇌ Yb ²⁺	-1.05
HPbO ₂ ⁻ + H ₂ O + 2 e ⇌ Pb + 3 OH ⁻	-0.537	Nb ³⁺ + 3 e ⇌ Nb	-1.099
Ga ³⁺ + 3 e ⇌ Ga	-0.549	Fm ³⁺ + e ⇌ Fm ²⁺	-1.1
TiCl + e ⇌ Ti + Cl ⁻	-0.5568	2 SO ₃ ²⁻ + 2 H ₂ O + 2 e ⇌ S ₂ O ₄ ²⁻ + 4 OH ⁻	-1.12
Fe(OH) ₃ + e ⇌ Fe(OH) ₂ + OH ⁻	-0.56	Te + 2 e ⇌ Te ²⁻	-1.143
TeO ₃ ²⁻ + 3 H ₂ O + 4 e ⇌ Te + 6 OH ⁻	-0.57	V ²⁺ + 2 e ⇌ V	-1.175
2 SO ₃ ²⁻ + 3 H ₂ O + 4 e ⇌ S ₂ O ₃ ²⁻ + 6 OH ⁻	-0.571	Mn ²⁺ + 2 e ⇌ Mn	-1.185
PbO + H ₂ O + 2 e ⇌ Pb + 2 OH ⁻	-0.580	Zn(OH) ₄ ²⁻ + 2 e ⇌ Zn + 4 OH ⁻	-1.199
ReO ₂ ⁻ + 4 H ₂ O + 7 e ⇌ Re + 8 OH ⁻	-0.584	CrO ₂ + 2 H ₂ O + 3 e ⇌ Cr + 4 OH ⁻	-1.2
SbO ₃ ⁻ + H ₂ O + 2 e ⇌ SbO ₂ ⁻ + 2 OH ⁻	-0.59	No ³⁺ + 3 e ⇌ No	-1.20
Ta ³⁺ + 3 e ⇌ Ta	-0.6	ZnO ₂ ⁻ + 2 H ₂ O + 2 e ⇌ Zn + 4 OH ⁻	-1.215
U ⁴⁺ + e ⇌ U ³⁺	-0.607	H ₂ GaO ₃ ⁻ + H ₂ O + 3 e ⇌ Ga + 4 OH ⁻	-1.219
As + 3 H ⁺ + 3 e ⇌ AsH ₃	-0.608	H ₂ BO ₃ ⁻ + 5 H ₂ O + 8 e ⇌ BH ₄ ⁻ + 8 OH ⁻	-1.24
Nb ₂ O ₅ + 10 H ⁺ + 10 e ⇌ 2 Nb + 5 H ₂ O	-0.644	SiF ₆ ²⁻ + 4 e ⇌ Si + 6 F ⁻	-1.24
NbO ₂ + 2 H ⁺ + 2 e ⇌ NbO + H ₂ O	-0.646	Zn(OH) ₂ + 2 e ⇌ Zn + 2 OH ⁻	-1.249
Cd(OH) ₄ ²⁻ + 2 e ⇌ Cd + 4 OH ⁻	-0.658	ZnO + H ₂ O + 2 e ⇌ Zn + 2 OH ⁻	-1.260
TlBr + e ⇌ Tl + Br ⁻	-0.658	Es ³⁺ + e ⇌ Es ²⁺	-1.3
SbO ₂ ⁻ + 2 H ₂ O + 3 e ⇌ Sb + 4 OH ⁻	-0.66	Pa ³⁺ + 3 e ⇌ Pa	-1.34
AsO ₂ ⁻ + 2 H ₂ O + 3 e ⇌ As + 4 OH ⁻	-0.68	Ti ³⁺ + 3 e ⇌ Ti	-1.37
NbO ₂ + 4 H ⁺ + 4 e ⇌ Nb + 2 H ₂ O	-0.690	Ce ³⁺ + 3 e ⇌ Ce(Hg)	-1.4373
Ag ₂ S + 2 e ⇌ 2 Ag + S ²⁻	-0.691	UO ₂ ²⁺ + 4 H ⁺ + 6 e ⇌ U + 2 H ₂ O	-1.444
AsO ₄ ³⁻ + 2 H ₂ O + 2 e ⇌ AsO ₂ ⁻ + 4 OH ⁻	-0.71	Zr ⁴⁺ + 4 e ⇌ Zr	-1.45
Ni(OH) ₂ + 2 e ⇌ Ni + 2 OH ⁻	-0.72	Cr(OH) ₃ + 3 e ⇌ Cr + 3 OH ⁻	-1.48
Co(OH) ₂ + 2 e ⇌ Co + 2 OH ⁻	-0.73	Pa ⁴⁺ + 4 e ⇌ Pa	-1.49
NbO + 2 H ⁺ + 2 e ⇌ Nb + H ₂ O	-0.733	HfO ₂ + 4 H ⁺ + 4 e ⇌ Hf + 2 H ₂ O	-1.505
H ₂ SeO ₃ + 4 H ⁺ + 4 e ⇌ Se + 3 H ₂ O	-0.74	Hf ⁴⁺ + 4 e ⇌ Hf	-1.55
Cr ³⁺ + 3 e ⇌ Cr	-0.744	Sm ³⁺ + e ⇌ Sm ²⁺	-1.55
Ta ₂ O ₅ + 10 H ⁺ + 10 e ⇌ 2 Ta + 5 H ₂ O	-0.750	ZrO ₂ + 4 H ⁺ + 4 e ⇌ Zr + 2 H ₂ O	-1.553
TlI + e ⇌ Tl + I ⁻	-0.752	Mn(OH) ₂ + 2 e ⇌ Mn + 2 OH ⁻	-1.56
Zn ²⁺ + 2 e ⇌ Zn	-0.7618	Ba ²⁺ + 2 e ⇌ Ba(Hg)	-1.570
Zn ²⁺ + 2 e ⇌ Zn(Hg)	-0.7628	Bk ²⁺ + 2 e ⇌ Bk	-1.6
CdO + H ₂ O + 2 e ⇌ Cd + 2 OH ⁻	-0.783	Cf ³⁺ + e ⇌ Cf ²⁺	-1.6
Te + 2 H ⁺ + 2 e ⇌ H ₂ Te	-0.793	Ti ²⁺ + 2 e ⇌ Ti	-1.630
ZnSO ₄ ·7H ₂ O + 2 e ⇌ Zn(Hg) + SO ₄ ²⁻ + 7 H ₂ O	-0.7993	Md ³⁺ + 3 e ⇌ Md	-1.65
(Saturated ZnSO ₄)		HPO ₃ ²⁻ + 2 H ₂ O + 2 e ⇌ H ₂ PO ₂ ⁻ + 3 OH ⁻	-1.65
Bi + 3 H ⁺ + 3 e ⇌ BiH ₃	-0.8	Al ³⁺ + 3 e ⇌ Al	-1.662
SiO + 2 H ⁺ + 2 e ⇌ Si + H ₂ O	-0.8	SiO ₃ ²⁻ + H ₂ O + 4 e ⇌ Si + 6 OH ⁻	-1.697
Cd(OH) ₂ + 2 e ⇌ Cd(Hg) + 2 OH ⁻	-0.809	HPO ₃ ²⁻ + 2 H ₂ O + 3 e ⇌ P + 5 OH ⁻	-1.71
2 H ₂ O + 2 e ⇌ H ₂ + 2 OH ⁻	-0.8277	HfO ²⁺ + 2 H ⁺ + 4 e ⇌ Hf + H ₂ O	-1.724
2 NO ₃ ⁻ + 2 H ₂ O + 2 e ⇌ N ₂ O ₄ + 4 OH ⁻	-0.85	ThO ₂ + 4 H ⁺ + 4 e ⇌ Th + 2 H ₂ O	-1.789
H ₃ BO ₃ + 3 H ⁺ + 3 e ⇌ B + 3 H ₂ O	-0.8698	H ₂ BO ₃ + H ₂ O + 3 e ⇌ B + 4 OH ⁻	-1.79
P + 3 H ₂ O + 3 e ⇌ PH ₃ (g) + 3 OH ⁻	-0.87	Sr ²⁺ + 2 e ⇌ Sr(Hg)	-1.793
Ti ³⁺ + e ⇌ Ti ²⁺	-0.9	U ³⁺ + 3 e ⇌ U	-1.798
HSnO ₂ ⁻ + H ₂ O + 2 e ⇌ Sn + 3 OH ⁻	-0.909	H ₂ PO ₂ ⁻ + e ⇌ P + 2 OH ⁻	-1.82
Cr ²⁺ + 2 e ⇌ Cr	-0.913	Be ²⁺ + 2 e ⇌ Be	-1.847
Se + 2 e ⇌ Se ²⁻	-0.924	Np ³⁺ + 3 e ⇌ Np	-1.856
SO ₄ ²⁻ + H ₂ O + 2 e ⇌ SO ₃ ²⁻ + 2 OH ⁻	-0.93	Fm ³⁺ + 3 e ⇌ Fm	-1.89
Sn(OH) ₆ ²⁻ + 2 e ⇌ HSnO ₂ ⁻ + 3 OH ⁻ + H ₂ O	-0.93	Th ⁴⁺ + 4 e ⇌ Th	-1.899

ELECTROCHEMICAL SERIES (continued)

TABLE 3

Reduction Reactions Having E° Values More Negative than that of the Standard Hydrogen Electrode (continued)

Reaction	E°/V	Reaction	E°/V
Am ²⁺ + 2 e ⇌ Am	-1.9	ZrO(OH) ₂ + H ₂ O + 4 e ⇌ Zr + 4 OH ⁻	-2.36
Pa ⁴⁺ + e ⇌ Pa ³⁺	-1.9	Mg ²⁺ + 2 e ⇌ Mg	-2.372
Es ³⁺ + 3 e ⇌ Es	-1.91	Y ³⁺ + 3 e ⇌ Y	-2.372
Cf ³⁺ + 3 e ⇌ Cf	-1.94	La ³⁺ + 3 e ⇌ La	-2.379
Lr ³⁺ + 3 e ⇌ Lr	-1.96	Tm ²⁺ + 2 e ⇌ Tm	-2.4
Eu ³⁺ + 3 e ⇌ Eu	-1.991	Md ²⁺ + 2 e ⇌ Md	-2.40
Er ²⁺ + 2 e ⇌ Er	-2.0	Th(OH) ₄ + 4 e ⇌ Th + 4 OH ⁻	-2.48
Pr ²⁺ + 2 e ⇌ Pr	-2.0	HfO(OH) ₂ + H ₂ O + 4 e ⇌ Hf + 4 OH ⁻	-2.50
Pu ³⁺ + 3 e ⇌ Pu	-2.031	No ²⁺ + 2 e ⇌ No	-2.50
Cm ³⁺ + 3 e ⇌ Cm	-2.04	Dy ³⁺ + e ⇌ Dy ²⁺	-2.6
Am ³⁺ + 3 e ⇌ Am	-2.048	Pm ³⁺ + e ⇌ Pm ²⁺	-2.6
AlF ₆ ³⁻ + 3 e ⇌ Al + 6 F ⁻	-2.069	Be ₂ O ₃ ²⁻ + 3 H ₂ O + 4 e ⇌ 2 Be + 6 OH ⁻	-2.63
Sc ³⁺ + 3 e ⇌ Sc	-2.077	Sm ²⁺ + 2 e ⇌ Sm	-2.68
Ho ²⁺ + 2 e ⇌ Ho	-2.1	Mg(OH) ₂ + 2 e ⇌ Mg + 2 OH ⁻	-2.690
Nd ²⁺ + 2 e ⇌ Nd	-2.1	Nd ³⁺ + e ⇌ Nd ²⁺	-2.7
Cf ²⁺ + 2 e ⇌ Cf	-2.12	Mg ⁺ + e ⇌ Mg	-2.70
Yb ³⁺ + 3 e ⇌ Yb	-2.19	Na ⁺ + e ⇌ Na	-2.71
Ac ³⁺ + 3 e ⇌ Ac	-2.20	Yb ²⁺ + 2 e ⇌ Yb	-2.76
Dy ²⁺ + 2 e ⇌ Dy	-2.2	Bk ³⁺ + e ⇌ Bk ²⁺	-2.8
Tm ³⁺ + e ⇌ Tm ²⁺	-2.2	Ho ³⁺ + e ⇌ Ho ²⁺	-2.8
Pm ²⁺ + 2 e ⇌ Pm	-2.2	Ra ²⁺ + 2 e ⇌ Ra	-2.8
Es ²⁺ + 2 e ⇌ Es	-2.23	Eu ²⁺ + 2 e ⇌ Eu	-2.812
H ₂ + 2 e ⇌ 2 H ⁻	-2.23	Ca ²⁺ + 2 e ⇌ Ca	-2.868
Gd ³⁺ + 3 e ⇌ Gd	-2.279	Sr(OH) ₂ + 2 e ⇌ Sr + 2 OH ⁻	-2.88
Tb ³⁺ + 3 e ⇌ Tb	-2.28	Sr ²⁺ + 2 e ⇌ Sr	-2.89
Lu ³⁺ + 3 e ⇌ Lu	-2.28	Fr ⁺ + e ⇌ Fr	-2.9
Dy ³⁺ + 3 e ⇌ Dy	-2.295	La(OH) ₃ + 3 e ⇌ La + 3 OH ⁻	-2.90
Am ³⁺ + e ⇌ Am ²⁺	-2.3	Ba ²⁺ + 2 e ⇌ Ba	-2.912
Fm ²⁺ + 2 e ⇌ Fm	-2.30	K ⁺ + e ⇌ K	-2.931
Pm ³⁺ + 3 e ⇌ Pm	-2.30	Rb ⁺ + e ⇌ Rb	-2.98
Sm ³⁺ + 3 e ⇌ Sm	-2.304	Ba(OH) ₂ + 2 e ⇌ Ba + 2 OH ⁻	-2.99
Al(OH) ₃ + 3 e ⇌ Al + 3 OH ⁻	-2.31	Er ³⁺ + e ⇌ Er ²⁺	-3.0
Tm ³⁺ + 3 e ⇌ Tm	-2.319	Ca(OH) ₂ + 2 e ⇌ Ca + 2 OH ⁻	-3.02
Nd ³⁺ + 3 e ⇌ Nd	-2.323	Cs ⁺ + e ⇌ Cs	-3.026
Al(OH) ₃ ⁻ + 3 e ⇌ Al + 4 OH ⁻	-2.328	Li ⁺ + e ⇌ Li	-3.0401
H ₂ AlO ₃ ⁻ + H ₂ O + 3 e ⇌ Al + 4 OH ⁻	-2.33	3 N ₂ + 2 H ⁺ + 2 e ⇌ 2 HN ₃	-3.09
Ho ³⁺ + 3 e ⇌ Ho	-2.33	Pr ³⁺ + e ⇌ Pr ²⁺	-3.1
Er ³⁺ + 3 e ⇌ Er	-2.331	Ca ⁺ + e ⇌ Ca	-3.80
Ce ³⁺ + 3 e ⇌ Ce	-2.336	Sr ⁺ + e ⇌ Sr	-4.10
Pr ³⁺ + 3 e ⇌ Pr	-2.353		

REDUCTION AND OXIDATION POTENTIALS FOR CERTAIN ION RADICALS

Petr Vanýsek

There are two tables for ion radicals. The first table lists reduction potentials for organic compounds which produce anion radicals during reduction, a process described as $A + e^- \rightleftharpoons A^-$. The second table lists oxidation potentials for organic compounds which produce cation radicals during oxidation, a process described as $A \rightleftharpoons A^+ + e^-$. To obtain reduction potential for a reverse reaction, the sign for the potential is changed.

Unlike the table of the Electrochemical Series, which lists *standard* potentials, values for radicals are experimental values with experimental conditions given in the second column. Since the measurements leading to potentials for ion radicals are very dependent on conditions, an attempt to report standard potentials for radicals would serve no useful purpose. For the same reason, the potentials are also reported as experimental values, usually a half-wave potential ($E_{1/2}$ in polarography) or a peak potential (E_p in cyclic voltammetry). Unless otherwise stated, the values are reported vs. SCE (saturated calomel electrode). To obtain a value vs. normal hydrogen electrode, 0.241 V has to be added to the SCE values. All the ion radicals chosen for inclusion in the tables result from electrochemically reversible reactions. More detailed data on ion radicals can be found in the *Encyclopedia of Electrochemistry of Elements*, (A. J. Bard, Ed.), Vol. XI and XII in particular, Marcel Dekker, New York, 1978.

Abbreviations are: CV — cyclic voltammetry; DMF — *N,N*-Dimethylformamide; *E* swp — potential sweep; E° — standard potential; E_p — peak potential; $E_{p/2}$ — half-peak potential; $E_{1/2}$ — half wave potential; *M* — mol/L; MeCN — acetonitrile; pol — polarography; rot Pt disk — rotated Pt disk; SCE — saturated calomel electrode; TBABF₄ — tetrabutylammonium tetrafluoroborate; TBAI — tetrabutylammonium iodide; TBAP — tetrabutylammonium perchlorate; TEABr — tetraethylammonium bromide; TEAP — tetraethylammonium perchlorate; THF — tetrahydrofuran; TPACF₃SO₃ — tetrapropylammonium trifluoromethanesulfite; TPAP — tetrapropylammonium perchlorate; and wr — wire.

Reduction Potentials (Products are Anion Radicals)

Substance	Conditions/electrode/technique	Potential V (vs. SCE)
Acetone	DMF, 0.1 M TEABr/Hg/pol	$E_{1/2} = -2.84$
1-Naphthylphenylacetylene	DMF, 0.03 M TBAI/Hg/pol	$E_{1/2} = -1.91$
1-Naphthalenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -0.91$
2-Naphthalenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -0.96$
2-Phenanthrenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -1.00$
3-Phenanthrenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -0.94$
9-Phenanthrenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -0.83$
1-Anthracenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -0.75$
1-Pyrenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -0.76$
2-Pyrenecarboxaldehyde	-/Hg/pol	$E_{1/2} = -1.00$
Anthracene	DMF, 0.1 M TBAP/Pt disk/CV	$E_p = -2.00$
	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -1.93$
	MeCN, 0.1 M TEAP/Hg/CV	$E_{1/2} = -2.07$
	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.92$
9,10-Dimethylanthracene	DMF, 0.1 M TBAP/Pt/CV	$E_p = -2.08$
	MeCN, 0.1 M TBAP/Pt/CV	$E_p = -2.10$
1-Phenylanthracene	DMF, 0.5 M TBABF ₂ /Hg/CV	$E_{1/2} = -1.91$
	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.878$
2-Phenylanthracene	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.875$
8-Phenylanthracene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -1.91$
9-Phenylanthracene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -1.93$
	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.863$
1,8-Diphenylanthracene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -1.88$
1,9-Diphenylanthracene	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.846$
1,10-Diphenylanthracene	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.786$
8,9-Diphenylanthracene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -1.90$
9,10-Diphenylanthracene	MeCN, 0.1 M TBAP/rot Pt/E swp	$E_{1/2} = -1.83$
	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.835$
1,8,9-Triphenylanthracene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -1.85$
1,8,10-Triphenylanthracene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -1.81$
9,10-Dibiphenylanthracene	MeCN, 0.1 M TBAP/rot Pt/E swp	$E_{1/2} = -1.94$
Benz(a)anthracene	MeCN, 0.1 M TEAP/Hg/CV	$E_{1/2} = -2.11$
	MeCN, 0.1 M TEAP/Hg/pol	$E_{1/2} = -2.40^a$
Azulene	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.10^c$
Annulene	DMF, 0.5 M TBAP 0°C/Hg/pol	$E_{1/2} = -1.23$
Benzaldehyde	DMF, 0.1 M TBAP/Hg/pol	$E_{1/2} = -1.67$
Benzil	DMSO, 0.1 M TBAP/Hg/pol	$E_{1/2} = -1.04$

REDUCTION AND OXIDATION POTENTIALS FOR CERTAIN ION RADICALS (continued)

Reduction Potentials (Products are Anion Radicals) (continued)

Substance	Conditions/electrode/technique	Potential V (vs. SCE)
Benzophenone	-/Hg/pol	$E_{1/2} = -1.80$
	DMF/Pt dsk/CV	$E^\circ = -1.72$
Chrysene	MeCN, 0.1 M TEAP/Hg/pol	$E_{1/2} = -2.73^a$
Fluoranthrene	DMF, 0.1 M TBAP/Pt dsk/CV	$E_p = -1.76$
Cyclohexanone	DMF, 0.1 M TEABr/Hg/pol	$E_{1/2} = -2.79$
5,5-Dimethyl-3-phenyl-2-cyclohexen-1-one	DMF, 0.5 M/Hg/pol	$E_{1/2} = -1.71$
1,2,3-Indanetrione hydrate (ninhydrin)	DMF, 0.2 M NaNO ₃ /Hg/pol	$E_{1/2} = -0.039$
Naphthacene	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.53$
Naphthalene	DMF, 0.1 M TBAP/Pt dsk/CV	$E_p = -2.55$
	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -2.56$
	DMF, MeCN, 0.1 M TEAP/Hg/CV	$E_{1/2} = -2.63$
	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -2.50$
1-Phenylnaphthalene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -2.36$
1,2-Diphenylnaphthalene	DMF, 0.5 M TBABF ₄ /Hg/CV	$E_{1/2} = -2.25$
Cyclopentanone	DMF, 0.1 M TEABr/Hg/pol	$E_{1/2} = -2.82$
Phenanthrene	MeCN, 0.1 M TBAP/Pt wr/CV	$E_{1/2} = -2.47$
	MeCN, 0.1 M TEAP/Hg/pol	$E_{1/2} = -2.88^a$
Pentacene	THF, 0.1 M TBAP/rot Pt dsk/E swp	$E_{1/2} = -1.40$
Perylene	MeCN, 0.1 M TEAP/Hg/CV	$E_{1/2} = -1.73$
1,3-Diphenyl-1,3-propanedione	DMSO, 0.2 M TBAP/Hg/CV	$E_{1/2} = -1.42$
2,2-Dimethyl-1,3-diphenyl-1,3 propanedione	DMSO, TBAP/Hg/CV	$E_{1/2} = -1.80$
Pyrene	DMF, 0.1 M TBAP/Pt/CV	$E_p = -2.14$
	MeCN, 0.1 M TEAP/Hg/pol	$E_{1/2} = -2.49^a$
Diphenylsulfone	DMF, TEABr	$E_{1/2} = -2.16$
Triphenylene	MeCN, 0.1 M TEAP/Hg/pol	$E_{1/2} = -2.87^a$
9,10-Anthraquinone	DMF, 0.5 M TBAP, 20°/Pt dsk/CV	$E_{1/2} = -1.01$
1,4-Benzoquinone	MeCN, 0.1 M TEAP/Pt/CV	$E_p = -0.54$
1,4-Naphthohydroquinone, dipotassium salt	DMF, 0.5 M TBAP, 20°/Pt dsk/CV	$E_{1/2} = -1.55$
Rubrene	DMF, 0.1 M TBAP/Pt dsk/CV	$E_p = -1.48$
	DMF, 0.1 M TBAI/Hg/pol	$E_{1/2} = -1.410$
Benzocyclooctatetraene	THF, 0.1 M TBAP/Hg/pol	$E_{1/2} = -2.13$
<i>sym</i> -Dibenzocyclooctatetraene	THF, 0.1 M TBAP/Hg/pol	$E_{1/2} = -2.29$
Ubiquinone-6	MeCN, 0.1 M TEAP/Pt/CV	$E_p = -1.05^c$
(9-Phenyl-fluorenyl) ⁺	10.2 M H ₂ SO ₄ /Hg/CV	$E_p = -0.01^b$
(Triphenylcyclopropenyl) ⁺	MeCN, 0.1 M TEAP/Hg/CV	$E_p = -1.87$
(Triphenylmethyl) ⁺	MeCN, 0.1 M TBAP/Hg/pol	$E_{1/2} = 0.27$
	H ₂ SO ₄ , 10.2 M/Hg/CV	$E_p = -0.58^b$
(Tribiphenylmethyl) ⁺	MeCN, 0.1 M TBAP/Hg/pol	$E_{1/2} = 0.19$
(Tri-4- <i>t</i> -butyl-5-phenylmethyl) ⁺	MeCN, 0.1 M TBAP/Hg/pol	$E_{1/2} = 0.13$
(Tri-4-isopropylphenylmethyl) ⁺	MeCN, 0.1 M TBAP/Hg/pol	$E_{1/2} = 0.07$
(Tri-4-methylphenylmethyl) ⁺	MeCN, 0.1 M TBAP/Hg/pol	$E_{1/2} = 0.05$
(Tri-4-cyclopropylphenylmethyl) ⁺	MeCN, 0.1 M TBAP/Hg/pol	$E_{1/2} = 0.01$
(Tropylium) ⁺	MeCN, 0.1 M TBAP/Hg/pol	$E_{1/2} = -0.17$
	DMF, 0.15 M TBAI/Hg/pol	$E_{1/2} = -1.55$
	DMF, 0.15 M TBAI/Hg/pol	$E_{1/2} = -1.55$
	DMF, 0.15 M TBAI/Hg/pol	$E_{1/2} = -1.57$
	DMF, 0.15 M TBAI/Hg/pol	$E_{1/2} = -1.60$
	DMF, 0.15 M TBAI/Hg/pol	$E_{1/2} = -1.87$
	DMF, 0.15 M TBAI/Hg/pol	$E_{1/2} = -1.96$
	DMF, 0.15 M TBAI/Hg/pol	$E_{1/2} = -2.05$

REDUCTION AND OXIDATION POTENTIALS FOR CERTAIN ION RADICALS (continued)

Oxidation Potentials (Products are Cation Radicals)

Substance	Conditions/electrode/technique	Potential V (vs. SCE)
Anthracene	CH ₂ Cl ₂ , 0.2 M TBABF ₄ , -70°C/Pt dsk/CV	$E_p = +0.73^d$
9,10-Dimethylantracene	MeCN, 0.1 M LiClO ₄ /Pt wr/CV	$E_p = +1.0$
9,10-Dipropylantracene	MeCN, 0.1 M TEAP/Pt/CV	$E_p = +1.08$
1,8-Diphenylantracene	CH ₂ Cl ₂ , 0.2 M TPrACF ₃ SO ₃ /rot Pt wr/E swp	$E_{1/2} = +1.34$
8,9-Diphenylantracene	CH ₂ Cl ₂ , 0.2 M TPrACF ₃ SO ₃ /rot Pt wr/E swp	$E_{1/2} = +1.30$
9,10-Diphenylantracene	MeCN/Pt/CV	$E_p = +1.22$
Perylene	MeCN, 0.1 M TBAP/Pt/CV	$E_p = +1.34$
Pyrene	DMF, 0.1 M TBAP/Pt dsk/CV	$E_p = +1.25$
Rubrene	DMF, 0.1 M TBAP/Pt dsk/CV	$E_p = +1.10$
Tetracene	CH ₂ Cl ₂ , 0.2 M TBABF ₄ , -70°C/Pt wr/CV	$E_p = +0.35^d$
1,4-Dithiabenzene	MeCN, 0.1 M TEAP/Pt dsk/rot	$E_{1/2} = +0.69$
1,4-Dithianaphthalene	MeCN, 0.1 M TEAP/Pt dsk/rot	$E_{1/2} = +0.80$
Thianthrene	0.1 M TPAP/Pt/CV	$E_{1/2} = +1.28$

^a vs 0.01 M Ag/AgClO₄

^b vs. Hg/Hg₂SO₄, 17 M H₂SO₄

^c vs Hg pool

^d vs Ag/saturated AgNO₃

^e vs Ag/0.01 M Ag⁺

pH SCALE FOR AQUEOUS SOLUTIONS

A. K. Covington

The pH value is the negative decadic logarithm of the (relative) ion activity of the hydrogen ion in the solution.

$$\text{pH} = -\log a_{\text{H}} \quad (1)$$

This is only a notional definition since Equation 1 involves a single ion activity, which is immeasurable, and has to be attained through a nonthermodynamic assumption such as that described in Equation 5 below. In terms of substance concentration, molarity, Equation 1 may be rewritten

$$\text{pH} = -\log (c_{\text{H}}\gamma_{\text{H}}/c^{\circ}) \quad (2)$$

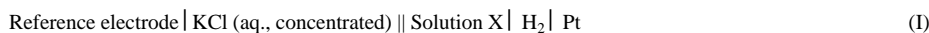
where c° is an arbitrary constant representing the standard state condition and equal to 1 mol dm^{-3} , c_{H} is the concentration of hydrogen ion and γ_{H} is the single ion activity of the hydrogen ion. In terms of molality, Equation 1 may be rewritten

$$\text{pH} = -\log (m_{\text{H}}\gamma_{\text{H}}/m^{\circ}) \quad (3)$$

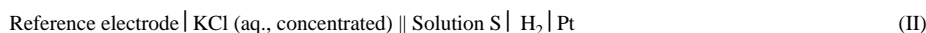
where m° is an arbitrary constant representing the standard state condition and equal to 1 mol kg^{-1} , m_{H} is the concentration of hydrogen ion and γ_{H} is the single ion activity of the hydrogen ion. For most purposes the difference between these two scales can be ignored for dilute aqueous solutions; the difference is 0.001 at 25°C and 0.02 at 100°C . Arising from the nonexperimental determinability of single ion activities, the definition and determination of pH have an operational basis, and depend on the assignment of pH values to a standard solution (or solutions) together with the determination of pH difference by a cell with liquid junction called the operational cell.

The Operational Definition of pH Difference^{1,2}

The electromotive force, EMF, $E(X)$ of the cell with liquid junction:



is measured, and likewise that, $E(S)$, of the cell:



The temperature of both cells (I and II) must be equal and uniform throughout, and the hydrogen gas pressures identical. The two bridge solutions may be any molality of KCl not less than 3.5 mol kg^{-1} provided they are the same.

The pH of the solution X, $\text{pH}(X)$, is then related to the assigned pH of the solution S, $\text{pH}(S)$ by the definition:

$$\text{pH}(X) = \text{pH}(S) + [E(S) - E(X)]/(RT/F) \ln 10 \quad (4)$$

where R is the gas constant, T the thermodynamic temperature, F the Faraday constant. The quantity $k = (RT/F) \ln 10$ is called the slope factor whose values are given as a function of temperature in Table 1. As a consequence of this definition any difference in liquid junction potential between cells I and II is subsumed into the value of $\text{pH}(X)$.

The pH Scale

The pH scale at a particular temperature is defined by Equation 4 as a straight line, on the plot of pH against $E(X)$, having a slope of k drawn through the pH value assigned to the Reference Value Standard (RVS) solution (as given in Table 2) and the value of $E(S)$ for cell II when it contains the Reference Value Standard solution. The solution chosen for the RVS is 0.05 mol kg^{-1} aqueous potassium hydrogen phthalate. The procedure by which $\text{pH}(\text{RVS})$ values have been assigned to the Reference Value Standard (RVS) is the cell III without transference:^{1,3}



The palladised-platinum hydrogen electrode is used to reduce the catalysed chemical reduction of the phthalate by hydrogen gas. The calculation involves a non-thermodynamic assumption, the Bates-Guggenheim Convention, for the single ion activity of the chloride ion^{1,2} as

$$\log (\gamma_{\text{Cl}})^{\circ} = -A(I/m^{\circ})^{1/2}/[1 + 1.5 (I/m^{\circ})^{1/2}] \quad (5)$$

where I is the ionic strength $= (1/2)\sum m_i z_i^2 = 0.0534 \text{ mol kg}^{-1}$ for the RVS solution and A is a known function of temperature (Table 1).

To prepare the RVS solution, dry the sample at 110°C for 2 h before use. The water should have a conductivity of less than 0.1 mS m^{-1} . The required solution contains 10.211 g kg^{-1} water. It can be prepared on a volume basis by dissolving 10.138 g potassium hydrogen phthalate in water and making up to 1 L at 20°C . This solution is 0.04964 mol/L with a density of 1.00300 g/L at 20°C .

pH SCALE FOR AQUEOUS SOLUTIONS (continued)

Primary Standards²

pH values may be assigned by the cell without transference method (cell III) to six other buffer solutions which meet certain criteria of reproducibility of preparation and properties. These solutions are called primary pH standards (PS), and details and the pH(PS) values assigned to them are given in Table 3. When these PS solutions are used in the operational cell I, the experimental value of the slope will not be in accord with the slope factor values of Table 1, and, moreover, the experimental value could change if additional primary solutions were to be defined. Hence the pH value determined for an unknown solution can be slightly dependent (± 0.02) on the choice of primary standard.^{2,4,5} Some useful data for standard buffers are given in Table 5.

Operational Standards^{2,6}

Operational standards (OS) are also defined which are traceable to the Reference Value Standard (RVS). Values are assigned by means of the operational cells I and II where the liquid junctions are the free diffusion type reproducibly formed in 1 mm vertical capillary tubes. These operational standards are not restricted in number provided certain preparation criteria are met, and pH(OS) values for 16 solutions are given in Table 4.² These OS represent an alternative procedure and are in no way to be regarded as inferior to the primary standards. As a consequence of their definition, all pH(OS) values fall on the line with slope given by the slope factor value for the appropriate temperature in Table 1. Any difference in liquid junction potential between the solutions of cells I and II and KCl is subsumed into the assigned value of pH(OS).

Measurement of pH. Choice of Standard Reference Solution

- 1a. If pH is not required to better than ± 0.05 any standard reference solution may be selected.
- 1b. If pH is required to ± 0.002 and interpretation in terms of hydrogen ion concentration or activity is desired, choose a standard reference solution, pH(PS) or pH(OS), to match X as closely as possible in terms of pH, composition and ionic strength.
2. Alternatively, a bracketting procedure may be adopted whereby two standard reference solutions are chosen whose pH values, pH(S1), pH(S2) are on either side of pH(X). Then if the corresponding potential difference measurements are $E(S1)$, $E(S2)$, $E(X)$, then pH(X) is obtained from

$$\text{pH}(X) = \text{pH}(S1) + [E(X) - E(S1)] / \%k$$

where $\%k = 100[E(S2) - E(S1)]/[pH(S2) - pH(S1)]$ is the apparent percentage slope. This procedure is very easily done on some pH meters simply by adjusting downwards the slope factor control with the electrodes in S2. The purpose of the bracketting procedure is to compensate for deficiencies in the electrodes and measuring system.

Information to be Given about the Measurement of pH(X)

The standard solutions selected for calibration of the pH meter system should be reported with the measurement as follows,

1. System calibrated with pH(RVS) = at ...K.
2. System calibrated with two primary standards pH(PS1) = and pH(PS2) = at ... K.
3. System calibrated with two operational standards pH(OS1) = and pH(OS2) = at K.

Interpretation of pH(X) in Terms of Hydrogen Ion Concentration

The operationally defined pH has no simple interpretation in terms of hydrogen ion concentration but the mean ionic activity coefficient of a typical 1:1 electrolyte can be substituted into equation 2 or 3 to obtain hydrogen ion concentration subject to an uncertainty of 3.9% in concentration corresponding to 0.02 in pH.

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pH SCALE FOR AQUEOUS SOLUTIONS (continued)

TABLE 1
Standard EMF, Slope Factor and Debye-Huckel Constant A
(Unit Weight of Solvent) as Functions of Temperature

Temperature/°C	E°/mV^7	Slope Factor k/mV	A^1
0	236.55	54.199	0.4918
5	234.13	55.191	0.4952
10	231.42	56.183	0.4988
15	228.57	57.175	0.5026
20	225.57	58.167	0.5066
25	222.34	59.159	0.5108
30	219.04	60.152	0.5150
35	215.65	61.144	0.5196
40	212.08	62.136	0.5242
45	208.35	63.128	0.5291
50	204.49	64.120	0.5341
55	200.56	65.112	0.5393
60	196.49	66.104	0.5448
70	187.82	68.088	0.5562
80	178.73	70.073	0.5685
90	169.52	72.057	0.5817
95	165.11	73.049	0.5886

TABLE 2
Values of pH(RVS) for the Reference Value Standard of 0.05 mol kg⁻¹ Potassium
Hydrogen Phthalate at Various Temperatures

$t/^\circ\text{C}$	pH(RVS)	$t/^\circ\text{C}$	pH(RVS)	$t/^\circ\text{C}$	pH(RVS)
0	4.000	35	4.018	65	4.097
5	3.998	37	4.022	70	4.116
10	3.997	40	4.027	75	4.137
15	3.998	45	4.038	80	4.159
20	4.001	50	4.050	85	4.183
25	4.005	55	4.064	90	4.21
30	4.011	60	4.080	95	4.24

pH SCALE FOR AQUEOUS SOLUTIONS (continued)

TABLE 3
Values of pH(PS) for Primary Standard Reference Solutions

Primary ref. standard	<i>t</i> /°C															
	0	5	10	15	20	25	30	35	37	40	50	60	70	80	90	95
Saturated (at 25° C) Potassium hydrogen tartrate	—	—	—	—	—	3.557	3.552	3.549	3.548	3.547	3.549	3.560	3.580	3.610	3.650	3.674
0.1 mol/kg Potassium dihydrogen citrate	3.863	3.840	3.820	3.802	3.788	3.776	3.766	3.759	3.756	3.754	3.749	—	—	—	—	—
0.025 mol/kg Disodium hydrogen phosphate +0.025 mol/kg Potassium dihydrogen phosphate	6.984	6.951	6.923	6.900	6.881	6.865	6.853	6.844	6.841	6.838	6.833	6.836	6.845	6.859	6.876	6.886
0.03043 mol/kg Disodium hydrogen phosphate +0.008695 mol/kg Potassium dihydrogen phosphate	7.534	7.500	7.472	7.448	7.429	7.413	7.400	7.389	7.386	7.380	7.367	—	—	—	—	—
0.01 mol/kg Disodium tetraborate	9.464	9.395	9.332	9.276	9.225	9.180	9.139	9.102	9.088	9.068	9.011	8.962	8.921	8.884	8.850	8.833
0.025 mol/kg Sodium hydrogen carbonate +0.025 mol/kg sodium carbonate	10.317	10.245	10.179	10.118	10.062	10.012	9.966	9.926	9.910	9.889	9.828	—	—	—	—	—

Note: Based on an uncertainty of ± 0.2 mV in determined ($E - E^0$), the uncertainty is ± 0.003 in pH in the range 0—50° C.

pH SCALE FOR AQUEOUS SOLUTIONS (continued)

TABLE 4
pH (OS) Values for Operational Reference Solutions

Operational standard ref. solution	<i>t</i> /°C														
	0	5	10	15	20	25	30	37	40	50	60	70	80	90	95
0.1 mol/kg Potassium tetroxalate ^a	—	—	—	—	1.475	1.479	1.483	1.490	1.493	1.503	1.513	1.52	1.53	1.53	1.53
0.05 mol/kg potassium tetroxalate ^a	—	—	1.638	1.642	1.644	1.646	1.648	1.649	1.650	1.653	1.660	1.671	1.689	1.72	1.73
0.05 mol/kg sodium hydrogen diglycolate ^b	—	3.466	3.470	3.476	3.484	3.492	3.502	3.519	3.527	3.558	3.595	—	—	—	—
Saturated (at 25° C) potassium hydrogen tartrate	—	—	—	—	—	3.556	3.549	3.544	3.542	3.544	3.553	3.570	3.596	3.627	3.649
0.05 mol/kg Potassium hydrogen phthalate (RVS)	4.000	3.998	3.997	3.998	4.000	4.005	4.011	4.022	4.027	4.050	4.080	4.115	4.159	4.21	4.24
0.1 mol/dm ³ Acetic acid + 0.1 mol/dm ³ sodium acetate	4.664	4.657	4.652	4.647	4.645	4.644	4.643	4.647	4.650	4.663	4.684	4.713	4.75	4.80	4.83
0.01 mol/dm ³ Acetic acid + 0.1 mol/dm ³ sodium acetate	4.729	4.722	4.717	4.714	4.712	4.713	4.715	4.722	4.726	4.743	4.768	4.800	4.839	4.88	4.91
0.02 mol/kg Piperazine phosphate ^c	—	6.477	6.419	6.364	6.310	6.259	6.209	6.143	6.116	6.030	5.952	—	—	—	—
0.025 mol/kg Disodium hydrogen phosphate + 0.025 mol/kg potassium dihydrogen phosphate	6.961	6.935	6.912	6.891	6.873	6.857	6.843	6.828	6.823	6.814	6.817	6.830	6.85	6.90	6.92
0.03043 mol/kg Disodium hydrogen phosphate + 0.008695 mol/kg potassium disodium phosphate	7.506	7.482	7.460	7.441	7.423	7.406	7.390	7.369	—	—	—	—	—	—	—
0.04 mol/kg Disodium hydrogen phosphate + 0.01 mol/kg potassium dihydrogen phosphate	—	7.512	7.488	7.466	7.445	7.428	7.414	7.404	—	—	—	—	—	—	—
0.05 mol/kg Tris hydrochloride + 0.01667 mol/kg Tris ^d	8.399	8.238	8.083	7.933	7.788	7.648	7.513	7.332	7.257	7.018	6.794	—	—	—	—
0.05 mol/kg Disodium tetraborate (Na ₂ B ₄ O ₇)	9.475	9.409	9.347	9.288	9.233	9.182	9.134	9.074	9.051	8.983	8.932	8.898	8.88	8.84	8.89
0.01 mol/kg Disodium tetraborate (Na ₂ B ₄ O ₇)	9.451	9.388	9.329	9.275	9.225	9.179	9.138	9.086	9.066	9.009	8.965	8.932	8.91	8.90	8.89

pH SCALE FOR AQUEOUS SOLUTIONS (continued)

TABLE 4
pH(OS) Values for Operational Standard Reference Solutions (continued)

Operational standard ref. solution	t/°C														
	0	5	10	15	20	25	30	37	40	50	60	70	80	90	95
0.025 mol/kg Sodium hydrogen carbonate + 0.025 mol/kg sodium carbonate	10.273	10.212	10.154	10.098	10.045	9.995	9.948	9.889	9.866	9.800	9.753	9.728	9.725	9.75	9.77
Saturated (at 20° C) calcium hydroxide	13.360	13.159	12.965	12.780	12.602	12.431	12.267	12.049	11.959	11.678	11.423	11.192	10.984	10.80	10.71

Note: Uncertainty is ±0.003 in pH between 0 and 60° C rising to ±0.01 above 70° C.

^a Potassium trihydrogen dioxalate (KH₃C₄O₈).

^b Sodium hydrogen 2,2'-oxydiethanoate.

^c C₄H₁₀N₂ · H₃PO₄.

^d 2-Amino-2-(hydroxymethyl)-1,3 propanediol or tris(hydroxymethyl)aminomethane.

TABLE 5
Useful Data on Some Standard Buffer Solutions

	Molecular formula	Molality (mol/kg)	Relative molar mass	Density at 20° C (g/cm ³)	Molarity at at 20° C (mol/L)	Mass of 1 L at 20° C (g)	Mass tolerance for ±0.001 pH ^a (g)	Mass tolerance expressed as a percentage (%)
Potassium tetraoxalate	KH ₃ C ₄ O ₈ · 2H ₂ O	0.1	254.1913	1.0091	0.09875	25.1017	0.07	0.27
Potassium tetraoxalate	KH ₃ C ₄ O ₈ · 2H ₂ O	0.05	254.1913	1.0038	0.04965	12.6202	0.034	0.26
Disodium hydrogen orthophosphate	Na ₂ HPO ₄	0.025	141.9588	1.0038	0.02492	3.5379	0.02	0.56
Potassium dihydrogen orthophosphate	KH ₂ PO ₄	0.025	136.0852					
Disodium tetraborate	Na ₂ B ₄ O ₇ · 10H ₂ O	0.05	381.367	1.0075	0.04985	19.0117	0.9	4.73
Disodium tetraborate	Na ₂ B ₄ O ₇ · 10H ₂ O	0.01	381.367	1.0001	0.009981	3.8064	0.19	0.49
Sodium carbonate	Na ₂ CO ₃	0.025	105.9887	1.0021	0.02494	2.6428	0.017	0.064
Sodium hydrogen carbonate	NaHCO ₃	0.025	84.0069					

a Calculated from known dilution value of solution.

PRACTICAL pH MEASUREMENTS ON NATURAL WATERS

A. K. Covington and W. Davison

(1) Dilute solutions and freshwater including 'acid-rain' samples ($I < 0.02 \text{ mol kg}^{-1}$)

Major problems could be encountered due to errors associated with the liquid junction. It is recommended that either a free diffusion junction is used or it is verified that the junction is working correctly using dilute solutions as follows. For commercial electrodes calibrated with IUPAC aqueous RVS or PS standards, the pH(X) of dilute solutions should be within ± 0.02 of those given in Table 1. The difference in determined pH(X) between a stirred and unstirred dilute solution should be < 0.02 . The characteristics of glass electrodes are such that below pH 5 the readings should be stable within 2 min, but for pH 5 to 8, 8 or so minutes may be necessary to attain stability. Interpretation of pH(X) measured in this way in terms of activity of hydrogen ion, a_{H^+} is subject¹ to an uncertainty of ± 0.02 in pH.

(2) Seawater

Measurements made by calibration of electrodes with IUPAC aqueous RVS or PS standards to obtain pH(X) are perfectly valid. However, the interpretation of pH(X) in terms of the activity of hydrogen ion is complicated by the non zero residual liquid junction potential as well as by systematic differences between electrode pairs, principally attributable to the reference electrode. For 35‰ salinity seawater ($S = 0.035$) a_{H^+} calculated from pH(X) is typically 12% too low. Special seawater pH scales have been devised to overcome this problem:

(i) The total hydrogen ion scale, pH_T , is defined in terms of the sum of free and complexed (total) hydrogen ion concentrations, where

$${}^T C_{\text{H}} = [\text{H}^+] + [\text{HSO}_4^-] + [\text{HF}].$$

$$\text{So, } \text{pH}_T = -\log {}^T C_{\text{H}}$$

Calibration of the electrodes with a buffer having a composition similar to that of seawater, to which pH_T has been assigned, results in values of $\text{pH}_T(\text{X})$ (Tables 2, 3) which are accurately interpretable in terms of ${}^T C_{\text{H}}$.

(ii) The free hydrogen ion scale, pH_F , is defined, and fully interpretable, in terms of the concentration of free hydrogen ions.

$$\text{pH}_F = -\log [\text{H}^+]$$

Values of pH_F as a function of temperature have been assigned to the same set of pH_T seawater buffers, and so alternatively can be used for calibration (Tables 2, 3)^{2,3}

(3) Estuarine water

Prescriptions for seawater scale buffers are available for a range of salinities. Reliable estuarine pH measurements can be made by calibrating with a buffer of the same salinity as the sample. However, these buffers are difficult to prepare and their use presumes prior knowledge of salinity of the sample. Interpretable measurements of estuarine pH can be made by calibration with IUPAC aqueous RVS or PS standards if the electrode pair is additionally calibrated using a 20‰ salinity seawater buffer.⁴ The difference between the assigned pH_{SWS} of the seawater buffer and its measured pH(X) value using RVS or PS standards is

$$\Delta\text{pH} = \text{pH}_{\text{SWS}} - \text{pH}(\text{X})$$

Values of ΔpH should be in the range of 0.08 to 0.18. It empirically corrects for differences between the two pH scales and for measurement errors associated with the electrode pair. The pH(X) of samples measured using IUPAC aqueous buffers, can be converted to pH_T or pH_F using the appropriate measured ΔpH :

$$\begin{aligned} \text{pH}_T &= \text{pH}(\text{X}) - \Delta\text{pH} \\ \text{or } \text{pH}_F &= \text{pH}(\text{X}) - \Delta\text{pH} \end{aligned}$$

This simple procedure is appropriate to pH measurement at salinities from 2‰ to 35‰. For salinities lower than 2‰ the procedures for freshwaters should be adopted.

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PRACTICAL pH MEASUREMENTS ON NATURAL WATERS (continued)

Table 1
pH of Dilute Solutions at 25°C, Degassed and Equilibrated with Air, Suitable as Quality Control Standards

	Ionic strength mmol kg⁻¹	Concentration(x) mmol kg⁻¹	pH p_{CO₂} = 0	pH p_{CO₂} = air
Potassium hydrogen phthalate	10.7	10	4.12	4.12
	1.1	1	4.33	4.33
xKH ₂ PO ₄ + xNa ₂ HPO ₄	9.9	2.5	7.07	7.05
xKH ₂ PO ₄ + 3.5xNa ₂ HPO ₄	10	0.87	7.61	7.58
Na ₂ B ₄ O ₇ · 10H ₂ O	10	5	9.20	—
HCl	0.1	0.1	4.03	4.03
SRM2694-I ^a	—	—	4.30	—
SRM2694-II ^a	—	—	3.59	—

Note: The pH of solutions near to pH 4 is virtually independent of temperature over the range of 5 to 30°C.

^a Simulated rainwater samples are available (Reference 5) from NIST containing sulfate, nitrate, chloride, fluoride, sodium, potassium, calcium and magnesium

Table 2
Composition of Seawater Buffer of Salinity S = 35‰ at 25°C
(Reference 3)

Solute	mol dm⁻³	mol kg⁻¹	g kg⁻¹	g dm⁻³
NaCl	0.3666	0.3493	20.416	20.946
Na ₂ SO ₄	0.02926	0.02788	3.96	4.063
KCl	0.01058	0.01008	0.752	0.772
CaCl ₂	0.01077	0.01026	1.139	1.169
MgCl ₂	0.05518	0.05258	5.006	5.139
Tris	0.06	0.05717	6.926	7.106
Tris · HCl	0.06	0.05717	9.010	9.244

Tris = tris(hydroxymethyl)aminomethane (HOCH₂)₃CNH₂.
A 20‰ buffer is made by diluting the 35‰ in the ratio 20:35.

Table 3
Assigned Values of 20‰ and 35‰ Buffers on Free and Total
Hydrogen Ion Scales. Calculated from Equations Provided by
Millero (Reference 3)

Temp (°C)	pH_T S = 20‰	pH_T S = 35‰	pH_F S = 20‰	pH_F S = 35‰
5	8.683	8.718	8.759	8.81
10	8.513	8.542	8.597	8.647
15	8.351	8.374	8.442	8.491
20	8.195	8.212	8.292	8.341
25	8.045	8.057	8.149	8.197
30	7.901	7.908	8.011	8.059
35	7.762	7.764	7.879	7.926

BUFFER SOLUTIONS GIVING ROUND VALUES OF pH AT 25°C

A		B		C		D		E	
pH	<i>x</i>	pH	<i>x</i>	pH	<i>x</i>	pH	<i>x</i>	pH	<i>x</i>
1.00	67.0	2.20	49.5	4.10	1.3	5.80	3.6	7.00	46.6
1.10	52.8	2.30	45.8	4.20	3.0	5.90	4.6	7.10	45.7
1.20	42.5	2.40	42.2	4.30	4.7	6.00	5.6	7.20	44.7
1.30	33.6	2.50	38.8	4.40	6.6	6.10	6.8	7.30	43.4
1.40	26.6	2.60	35.4	4.50	8.7	6.20	8.1	7.40	42.0
1.50	20.7	2.70	32.1	4.60	11.1	6.30	9.7	7.50	40.3
1.60	16.2	2.80	28.9	4.70	13.6	6.40	11.6	7.60	38.5
1.70	13.0	2.90	25.7	4.80	16.5	6.50	13.9	7.70	36.6
1.80	10.2	3.00	22.3	4.90	19.4	6.60	16.4	7.80	34.5
1.90	8.1	3.10	18.8	5.00	22.6	6.70	19.3	7.90	32.0
2.00	6.5	3.20	15.7	5.10	25.5	6.80	22.4	8.00	29.2
2.10	5.10	3.30	12.9	5.20	28.8	6.90	25.9	8.10	26.2
2.20	3.9	3.40	10.4	5.30	31.6	7.00	29.1	8.20	22.9
		3.50	8.2	5.40	34.1	7.10	32.1	8.30	19.9
		3.60	6.3	5.50	36.6	7.20	34.7	8.40	17.2
		3.70	4.5	5.60	38.8	7.30	37.0	8.50	14.7
		3.80	2.9	5.70	40.6	7.40	39.1	8.60	12.2
		3.90	1.4	5.80	42.3	7.50	40.9	8.70	10.3
		4.00	0.1	5.90	43.7	7.60	42.4	8.80	8.5
						7.70	43.5	8.90	7.0
						7.80	44.5	9.00	5.7
						7.90	45.3		
						8.00	46.1		

F		G		H		I		J	
pH	<i>x</i>	pH	<i>x</i>	pH	<i>x</i>	pH	<i>x</i>	pH	<i>x</i>
8.00	20.5	9.20	0.9	9.60	5.0	10.90	3.3	12.00	6.0
8.10	19.7	9.30	3.6	9.70	6.2	11.00	4.1	12.10	8.0
8.20	18.8	9.40	6.2	9.80	7.6	11.10	5.1	12.20	10.2
8.30	17.7	9.50	8.8	9.90	9.1	11.20	6.3	12.30	12.8
8.40	16.6	9.60	11.1	10.00	10.7	11.30	7.6	12.40	16.2
8.50	15.2	9.70	13.1	10.10	12.2	11.40	9.1	12.50	20.4
8.60	13.5	9.80	15.0	10.20	13.8	11.50	11.1	12.60	25.6
8.70	11.6	9.90	16.7	10.30	15.2	11.60	13.5	12.70	32.2
8.80	9.6	10.00	18.3	10.40	16.5	11.70	16.2	12.80	41.2
8.90	7.1	10.10	19.5	10.50	17.8	11.80	19.4	12.90	53.0
9.00	4.6	10.20	20.5	10.60	19.1	11.90	23.0	13.00	66.0
9.10	2.0	10.30	21.3	10.70	20.2	12.00	26.9		
		10.40	22.1	10.80	21.2				
		10.50	22.7	10.90	22.0				
		10.60	23.3	11.00	22.7				
		10.70	23.8						
		10.80	24.25						

- A. 25 ml of 0.2 molar KCl + *x* ml of 0.2 molar HCl.
 B. 50 ml of 0.1 molar potassium hydrogen phthalate + *x* ml of 0.1 molar HCl.
 C. 50 ml of 0.1 molar potassium hydrogen phthalate + *x* ml of 0.1 molar NaOH.
 D. 50 ml of 0.1 molar potassium dihydrogen phosphate + *x* ml of 0.1 molar NaOH.
 E. 50 ml of 0.1 molar tris(hydroxymethyl)aminomethane + *x* ml of 0.1 M HCl.
 F. 50 ml of 0.025 molar borax + *x* ml of 0.1 molar HCl.
 G. 50 ml of 0.025 molar borax + *x* ml of 0.1 molar NaOH.
 H. 50 ml of 0.05 molar sodium bicarbonate + *x* ml of 0.1 molar NaOH.
 I. 50 ml of 0.05 molar disodium hydrogen phosphate + *x* ml of 0.1 molar NaOH.
 J. 25 ml of 0.2 molar KCl + *x* ml of 0.2 molar NaOH.

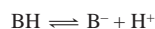
Final volume of mixtures = 100 ml.

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1. Bower, V.E., and Bates, R.G., *J. Res. Natl. Bur. Stand.*, 55, 197, 1955 (A–D).
2. Bates, R.G., and Bower, V.E., *Anal. Chem.*, 28, 1322, 1956 (E–J).

DISSOCIATION CONSTANTS OF INORGANIC ACIDS AND BASES

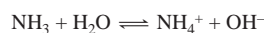
The data in this table are presented as values of pK_a , defined as the negative logarithm of the acid dissociation constant K_a for the reaction



Thus $pK_a = -\log K_a$, and the hydrogen ion concentration $[H^+]$ can be calculated from

$$K_a = \frac{[H^+][B^-]}{[BH]}$$

In the case of bases, the entry in the table is for the conjugate acid; e.g., ammonium ion for ammonia. The OH^- concentration in the system



can be calculated from the equation

$$K_b = K_{\text{water}} / K_a = \frac{[OH^-][NH_4^+]}{[NH_3]}$$

where $K_{\text{water}} = 1.01 \times 10^{-14}$ at 25 °C. Note that $pK_a + pK_b = pK_{\text{water}}$.

All values refer to dilute aqueous solutions at zero ionic strength at the temperature indicated. The table is arranged alphabetically by compound name.

REFERENCE

- Perrin, D. D., *Ionization Constants of Inorganic Acids and Bases in Aqueous Solution, Second Edition*, Pergamon, Oxford, 1982.

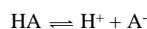
Name	Formula	Step	$t/^\circ\text{C}$	pK_a
Aluminum(III) ion	Al^{+3}		25	5.0
Ammonia	NH_3		25	9.25
Arsenic acid	H_3AsO_4	1	25	2.26
		2	25	6.76
		3	25	11.29
Arsenious acid	H_2AsO_3		25	9.29
Barium(II) ion	Ba^{+2}		25	13.4
Boric acid	H_3BO_3	1	20	9.27
		2	20	>14
Calcium(II) ion	Ca^{+2}		25	12.6
Carbonic acid	H_2CO_3	1	25	6.35
		2	25	10.33
Chlorous acid	$HClO_2$		25	1.94
Chromic acid	H_2CrO_4	1	25	0.74
		2	25	6.49
Cyanic acid	$HCNO$		25	3.46
Germanic acid	H_2GeO_3	1	25	9.01
		2	25	12.3
Hydrazine	N_2H_4		25	8.1
Hydrazoic acid	HN_3		25	4.6
Hydrocyanic acid	HCN		25	9.21
Hydrofluoric acid	HF		25	3.20
Hydrogen peroxide	H_2O_2		25	11.62
Hydrogen selenide	H_2Se	1	25	3.89
		2	25	11.0
Hydrogen sulfide	H_2S	1	25	7.05
		2	25	19
Hydrogen telluride	H_2Te	1	18	2.6
		2	25	11
Hydroxylamine	NH_2OH		25	5.94
Hypobromous acid	$HBrO$		25	8.55

DISSOCIATION CONSTANTS OF INORGANIC ACIDS AND BASES (continued)

Name	Formula	Step	<i>t</i> /°C	p <i>K</i> _a
Hypochlorous acid	HClO		25	7.40
Hypoiodous acid	HIO		25	10.5
Iodic acid	HIO ₃		25	0.78
Lithium ion	Li ⁺		25	13.8
Magnesium(II) ion	Mg ⁺²		25	11.4
Nitrous acid	HNO ₂		25	3.25
Perchloric acid	HClO ₄		20	-1.6
Periodic acid	HIO ₄		25	1.64
Phosphoric acid	H ₃ PO ₄	1	25	2.16
		2	25	7.21
		3	25	12.32
Phosphorous acid	H ₃ PO ₃	1	20	1.3
		2	20	6.70
Pyrophosphoric acid	H ₄ P ₂ O ₇	1	25	0.91
		2	25	2.10
		3	25	6.70
		4	25	9.32
Selenic acid	H ₂ SeO ₄	2	25	1.7
Selenious acid	H ₂ SeO ₃	1	25	2.62
		2	25	8.32
Silicic acid	H ₄ SiO ₄	1	30	9.9
		2	30	11.8
		3	30	12
		4	30	12
Sodium ion	Na ⁺		25	14.8
Strontium(II) ion	Sr ⁺²		25	13.2
Sulfamic acid	NH ₂ SO ₃ H		25	1.05
Sulfuric acid	H ₂ SO ₄	2	25	1.99
Sulfurous acid	H ₂ SO ₃	1	25	1.85
		2	25	7.2
Telluric acid	H ₂ TeO ₄	1	18	7.68
		2	18	11.0
Tellurous acid	H ₂ TeO ₃	1	25	6.27
		2	25	8.43
Tetrafluoroboric acid	HF ₄		25	0.5
Thiocyanic acid	HSCN		25	-1.8
Water	H ₂ O		25	13.995

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES

This table lists the dissociation (ionization) constants of over 1070 organic acids, bases, and amphoteric compounds. All data apply to dilute aqueous solutions and are presented as values of pK_a , which is defined as the negative of the logarithm of the equilibrium constant K_a for the reaction

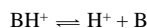


i.e.,

$$K_a = [H^+][A^-]/[HA]$$

where $[H^+]$, etc. represent the concentrations of the respective species in mol/L. It follows that $pK_a = pH + \log[HA] - \log[A^-]$, so that a solution with 50% dissociation has pH equal to the pK_a of the acid.

Data for bases are presented as pK_a values for the conjugate acid, i.e., for the reaction



In older literature, an ionization constant K_b was used for the reaction $B + H_2O \rightleftharpoons BH^+ + OH^-$. This is related to K_a by

$$pK_a + pK_b = pK_{\text{water}} = 14.00 \quad (\text{at } 25^\circ\text{C})$$

Compounds are listed by molecular formula in Hill order.

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7. Budavari, S., Editor, *The Merck Index, Twelfth Edition*, Merck & Co., Whitehouse Station, NJ, 1996.

Mol. Form.	Name	Step	$t/^\circ\text{C}$	pK_a	Mol. Form.	Name	Step	$t/^\circ\text{C}$	pK_a
CHNO	Cyanic acid		25	3.7	C ₂ H ₄ N ₂	Aminoacetonitrile		25	5.34
CH ₂ N ₂	Cyanamide		29	1.1	C ₂ H ₄ O	Acetaldehyde		25	13.57
CH ₂ O	Formaldehyde		25	13.27	C ₂ H ₄ OS	Thioacetic acid		25	3.33
CH ₂ O ₂	Formic acid		25	3.75	C ₂ H ₄ O ₂	Acetic acid		25	4.756
CH ₃ NO ₂	Nitromethane		25	10.21	C ₂ H ₄ O ₂ S	Thioglycolic acid		25	3.68
CH ₃ NS ₂	Carbamodithioic acid		25	2.95	C ₂ H ₄ O ₃	Glycolic acid		25	3.83
CH ₄ N ₂ O	Urea		25	0.10	C ₂ H ₅ N	Ethyleneimine		25	8.04
CH ₄ N ₂ S	Thiourea		25	-1	C ₂ H ₅ NO	Acetamide		25	15.1
CH ₄ O	Methanol		25	15.5	C ₂ H ₅ NO ₂	Acetohydroxamic acid			8.70
CH ₄ S	Methanethiol		25	10.33	C ₂ H ₅ NO ₂	Nitroethane		25	8.46
CH ₅ N	Methylamine		25	10.66	C ₂ H ₅ NO ₂	Glycine	1	25	2.35
CH ₅ NO	<i>O</i> -Methylhydroxylamine			12.5			2	25	9.78
CH ₅ N ₃	Guanidine		25	13.6	C ₂ H ₆ N ₂	Ethanimidamide		25	12.1
C ₂ HCl ₃ O	Trichloroacetaldehyde		25	10.04	C ₂ H ₆ O	Ethanol		25	15.5
C ₂ HCl ₃ O ₂	Trichloroacetic acid		20	0.66	C ₂ H ₆ OS	2-Mercaptoethanol		25	9.72
C ₂ HF ₃ O ₂	Trifluoroacetic acid		25	0.52	C ₂ H ₆ O ₂	Ethyleneglycol		25	15.1
C ₂ H ₂ Cl ₂ O ₂	Dichloroacetic acid		25	1.35	C ₂ H ₇ AsO ₂	Dimethylarsinic acid	1	25	1.57
C ₂ H ₂ O ₃	Glyoxylic acid		25	3.18			2	25	6.27
C ₂ H ₂ O ₄	Oxalic acid	1	25	1.25	C ₂ H ₇ N	Ethylamine		25	10.65
		2	25	3.81	C ₂ H ₇ N	Dimethylamine		25	10.73
C ₂ H ₃ BrO ₂	Bromoacetic acid		25	2.90	C ₂ H ₇ NO	Ethanolamine		25	9.50
C ₂ H ₃ ClO ₂	Chloroacetic acid		25	2.87	C ₂ H ₇ NO ₃ S	2-Aminoethanesulfonic acid	1	25	1.5
C ₂ H ₃ Cl ₃ O	2,2,2-Trichloroethanol		25	12.24			2	25	9.06
C ₂ H ₃ FO ₂	Fluoroacetic acid		25	2.59	C ₂ H ₇ NS	Cysteamine	1	25	8.27
C ₂ H ₃ F ₃ O	2,2,2-Trifluoroethanol		25	12.37			2	25	10.53
C ₂ H ₃ IO ₂	Iodoacetic acid		25	3.18	C ₂ H ₇ N ₅	Biguanide	1		11.52
C ₂ H ₃ NO ₄	Nitroacetic acid		24	1.48			2		2.93
C ₂ H ₃ N ₃	1H-1,2,3-Triazole		20	1.17	C ₂ H ₈ N ₂	1,2-Ethanediamine	1	25	9.92
C ₂ H ₃ N ₃	1H-1,2,4-Triazole		20	2.27			2	25	6.86

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	pK _a	Mol. Form.	Name	Step	<i>t</i> /°C	pK _a
C ₂ H ₈ O ₇ P ₂	1-Hydroxy-1,1-diphosphonoethane	1		1.35	C ₃ H ₉ NO	2-Methoxyethylamine		25	9.40
		2		2.87	C ₃ H ₉ NO	Trimethylamine oxide		20	4.65
		3		7.03	C ₃ H ₁₀ N ₂	1,2-Propanediamine, (±)	1	25	9.82
		4		11.3			2	25	6.61
C ₃ H ₂ O ₂	2-Propynoic acid		25	1.84	C ₃ H ₁₀ N ₂	1,3-Propanediamine	1	25	10.55
C ₃ H ₃ NO	Oxazole		33	0.8			2	25	8.88
C ₃ H ₃ NO	Isoxazole		25	-2.0	C ₃ H ₁₀ N ₂ O	1,3-Diamino-2-propanol	1	20	9.69
C ₃ H ₃ NO ₂	Cyanoacetic acid		25	2.47			2	20	7.93
C ₃ H ₃ NS	Thiazole		25	2.52	C ₃ H ₁₁ N ₃	1,2,3-Triaminopropane	1	20	9.59
C ₃ H ₃ N ₃ O ₃	Cyanuric acid	1		6.88			2	20	7.95
		2		11.40	C ₄ H ₄ FN ₃ O	Flucytosine			3.26
		3		13.5	C ₄ H ₄ N ₂	Pyrazine		20	0.65
C ₃ H ₄ N ₂	1 <i>H</i> -Pyrazole		25	2.49	C ₄ H ₄ N ₂	Pyrimidine		20	1.23
C ₃ H ₄ N ₂	Imidazole		25	6.99	C ₄ H ₄ N ₂	Pyridazine		20	2.24
C ₃ H ₄ N ₂ S	2-Thiazolamine		20	5.36	C ₄ H ₄ N ₂ O ₂	Uracil		25	9.45
C ₃ H ₄ O	Propargyl alcohol		25	13.6	C ₄ H ₄ N ₂ O ₃	Barbituric acid		25	4.01
C ₃ H ₄ O ₂	Acrylic acid		25	4.25	C ₄ H ₄ N ₂ O ₅	Alloxanic acid		25	6.64
C ₃ H ₄ O ₃	Pyruvic acid		25	2.39	C ₄ H ₄ N ₄ O ₂	5-Nitropyrimidinamine		20	0.35
C ₃ H ₄ O ₄	Malonic acid	1	25	2.85	C ₄ H ₄ O ₂	2-Butynoic acid		25	2.62
		2	25	5.70	C ₄ H ₄ O ₄	Maleic acid	1	25	1.92
C ₃ H ₄ O ₅	Hydroxypropanedioic acid	1		2.42			2	25	6.23
		2		4.54	C ₄ H ₄ O ₄	Fumaric acid	1	25	3.02
C ₃ H ₅ BrO ₂	3-Bromopropanoic acid		25	4.00			2	25	4.38
C ₃ H ₅ ClO ₂	2-Chloropropanoic acid		25	2.83	C ₄ H ₄ O ₅	Oxaloacetic acid	1	25	2.55
C ₃ H ₅ ClO ₂	3-Chloropropanoic acid		25	3.98			2	25	4.37
C ₃ H ₆ N ₂	3-Aminopropanenitrile		20	7.80			3	25	13.03
C ₃ H ₆ N ₆	1,3,5-Triazine-2,4,6-triamine		25	5.00	C ₄ H ₅ N	Pyrrrole		25	-3.8
C ₃ H ₆ O	Allyl alcohol		25	15.5	C ₄ H ₅ NO ₂	Succinimide		25	9.62
C ₃ H ₆ O ₂	Propanoic acid		25	4.87	C ₄ H ₅ N ₃	2-Pyrimidinamine		20	3.45
C ₃ H ₆ O ₂ S	(Methylthio)acetic acid		25	3.66	C ₄ H ₅ N ₃	4-Pyrimidinamine		20	5.71
C ₃ H ₆ O ₃	Lactic acid		25	3.86	C ₄ H ₅ N ₃ O	Cytosine	1		4.60
C ₃ H ₆ O ₃	3-Hydroxypropanoic acid		25	4.51			2		12.16
C ₃ H ₆ O ₄	Glyceric acid		25	3.52	C ₄ H ₅ N ₃ O ₂	6-Methyl-1,2,4-triazine-3,5(2 <i>H</i> ,4 <i>H</i>)-dione			7.6
C ₃ H ₇ N	Allylamine		25	9.49	C ₄ H ₆ N ₂	1-Methylimidazol		25	6.95
C ₃ H ₇ N	Azetidine		25	11.29	C ₄ H ₆ N ₄ O ₃	Allantoin		25	8.96
C ₃ H ₇ NO	2-Propanone oxime		25	12.42	C ₄ H ₆ N ₄ O ₃ S ₂	Acetazolamide			7.2
C ₃ H ₇ NO ₂	<i>L</i> -Alanine	1	25	2.34	C ₄ H ₆ O ₂	<i>trans</i> -Crotonic acid		25	4.69
		2	25	9.87	C ₄ H ₆ O ₂	3-Butenoic acid		25	4.34
C ₃ H ₇ NO ₂	β-Alanine	1	25	3.55	C ₄ H ₆ O ₂	Cyclopropanecarboxylic acid		25	4.83
		2	25	10.24	C ₄ H ₆ O ₃	2-Oxobutanoic acid		25	2.50
C ₃ H ₇ NO ₂	Sarcosine	1	25	2.21	C ₄ H ₆ O ₃	Acetoacetic acid		25	3.6
		2	25	10.1	C ₄ H ₆ O ₄	Succinic acid	1	25	4.21
C ₃ H ₇ NO ₂ S	<i>L</i> -Cysteine	1	25	1.5			2	25	5.64
		2	25	8.7	C ₄ H ₆ O ₄	Methylmalonic acid	1	25	3.07
		3	25	10.2			2	25	5.76
C ₃ H ₇ NO ₃	<i>L</i> -Serine	1	25	2.19	C ₄ H ₆ O ₅	Malic acid	1	25	3.40
		2	25	9.21			2	25	5.11
C ₃ H ₇ NO ₅ S	<i>DL</i> -Cysteic acid	1	25	1.3	C ₄ H ₆ O ₆	<i>DL</i> -Tartaric acid	1	25	3.03
		2	25	1.9			2	25	4.37
		3	25	8.70	C ₄ H ₆ O ₆	<i>meso</i> -Tartaric acid	1	25	3.17
C ₃ H ₇ N ₃ O ₂	Glycocylamine		25	2.82			2	25	4.91
C ₃ H ₈ O ₂	Ethylene glycol monomethyl ether		25	14.8	C ₄ H ₆ O ₆	<i>L</i> -Tartaric acid	1	25	2.98
			25				2	25	4.34
C ₃ H ₈ O ₃	Glycerol		25	14.15	C ₄ H ₆ O ₈	Dihydroxytartaric acid		25	1.92
C ₃ H ₉ N	Propylamine		25	10.54	C ₄ H ₇ ClO ₂	2-Chlorobutanoic acid			2.86
C ₃ H ₉ N	Isopropylamine		25	10.63	C ₄ H ₇ ClO ₂	3-Chlorobutanoic acid			4.05
C ₃ H ₉ N	Trimethylamine		25	9.80	C ₄ H ₇ ClO ₂	4-Chlorobutanoic acid			4.52

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a
C ₄ H ₇ NO ₂	4-Cyanobutanoic acid		25	2.42	C ₅ H ₄ N ₄ O	Hypoxanthine		25	8.7
C ₄ H ₇ NO ₃	<i>N</i> -Acetylglycine		25	3.67	C ₅ H ₄ N ₄ O	Allopurinol			10.2
C ₄ H ₇ NO ₄	Iminodiacetic acid	1		2.98	C ₅ H ₄ N ₄ O ₃	Uric acid		12	3.89
		2		9.89	C ₅ H ₄ N ₄ S	1,7-Dihydro-6H-purine-6-thione	1		7.77
C ₄ H ₇ NO ₄	<i>L</i> -Aspartic acid	1	25	1.99			2		11.17
		2	25	3.90	C ₅ H ₄ O ₂ S	2-Thiophenecarboxylic acid		25	3.49
		3	25	9.90	C ₅ H ₄ O ₂ S	3-Thiophenecarboxylic acid		25	4.1
C ₄ H ₇ N ₃ O	Creatinine	1	25	4.8	C ₅ H ₄ O ₃	2-Furancarboxylic acid		25	3.16
		2		9.2	C ₅ H ₄ O ₃	3-Furancarboxylic acid		25	3.9
C ₄ H ₇ N ₅	2,4,6-Pyrimidinetriamine		20	6.84	C ₅ H ₅ N	Pyridine		25	5.23
C ₄ H ₈ N ₂ O ₃	<i>L</i> -Asparagine	1	20	2.1	C ₅ H ₅ NO	2-Pyridinol	1	20	0.75
		2	20	8.80			2	20	11.65
C ₄ H ₈ N ₂ O ₃	<i>N</i> -Glycylglycine	1	25	3.14	C ₅ H ₅ NO	3-Pyridinol	1	20	4.79
		2		8.17			2	20	8.75
C ₄ H ₈ O ₂	Butanoic acid		25	4.83	C ₅ H ₅ NO	4-Pyridinol	1	20	3.20
C ₄ H ₈ O ₂	2-Methylpropanoic acid		20	4.84			2	20	11.12
C ₄ H ₈ O ₃	3-Hydroxybutanoic acid, (±)		25	4.70	C ₅ H ₅ NO	2(1H)-Pyridinone	1	20	0.75
C ₄ H ₈ O ₃	4-Hydroxybutanoic acid		25	4.72			2	20	11.65
C ₄ H ₈ O ₃	Ethoxyacetic acid		18	3.65	C ₅ H ₅ NO	Pyridine-1-oxide		24	0.79
C ₄ H ₉ N	Pyrrolidine		25	11.31	C ₅ H ₅ NO ₂	1 <i>H</i> -Pyrrole-2-carboxylic acid		20	4.45
C ₄ H ₉ NO	Morpholine		25	8.50	C ₅ H ₅ NO ₂	1 <i>H</i> -Pyrrole-3-carboxylic acid		20	5.00
C ₄ H ₉ NO ₂	2-Methylalanine	1	25	2.36					
		2	25	10.21	C ₅ H ₅ N ₃ O	Pyrazinecarboxamide			0.5
C ₄ H ₉ NO ₂	<i>N,N</i> -Dimethylglycine		25	9.89	C ₅ H ₅ N ₅	Adenine	1		4.3
C ₄ H ₉ NO ₂	<i>DL</i> -2-Aminobutanoic acid	1	25	2.29			2		9.83
		2	25	9.83	C ₅ H ₅ N ₃ O	Guanine		40	9.92
C ₄ H ₉ NO ₂	4-Aminobutanoic acid	1	25	4.031	C ₅ H ₆ N ₂	2-Pyridinamine		20	6.82
		2	25	10.556	C ₅ H ₆ N ₂	3-Pyridinamine		25	6.04
C ₄ H ₉ NO ₂ S	<i>DL</i> -Homocysteine	1	25	2.22	C ₅ H ₆ N ₂	4-Pyridinamine		25	9.11
		2	25	8.87	C ₅ H ₆ N ₂	2-Methylpyrazine		27	1.45
		3	25	10.86	C ₅ H ₆ N ₂ O ₂	Thymine		25	9.94
C ₄ H ₉ NO ₃	<i>L</i> -Threonine	1	25	2.09	C ₅ H ₆ O ₄	1,1-Cyclopropanedicarboxylic acid	1	25	1.82
		2	25	9.10			2	25	7.43
C ₄ H ₉ NO ₃	<i>L</i> -Homoserine	1	25	2.71	C ₅ H ₆ O ₄	<i>trans</i> -1-Propene-1,2-dicarboxylic acid	1	25	3.09
		2	25	9.62			2	25	4.75
C ₄ H ₉ N ₃ O ₂	Creatine	1	25	2.63	C ₅ H ₆ O ₄	1-Propene-2,3-dicarboxylic acid	1	25	3.85
		2	25	14.3			2	25	5.45
C ₄ H ₁₀ N ₂	Piperazine	1	25	9.73	C ₅ H ₆ O ₅	2-Oxoglutaric acid	1	25	2.47
		2	25	5.33			2	25	4.68
C ₄ H ₁₀ N ₂ O ₂	2,4-Diaminobutanoic acid	1	25	1.85	C ₅ H ₇ NO ₃	5,5-Dimethyl-2,4-oxazolinedione		37	6.13
		2	25	8.24					
		3	25	10.44	C ₅ H ₇ NO ₃	<i>L</i> -Pyroglutamic acid		25	3.32
C ₄ H ₁₀ O ₄	1,2,3,4-Butanetetrol			13.9	C ₅ H ₇ N ₃	2,5-Pyridinediamine		20	6.48
C ₄ H ₁₁ N	Butylamine		25	10.60	C ₅ H ₇ N ₃	Methylaminopyrazine		25	3.39
C ₄ H ₁₁ N	<i>sec</i> -Butylamine		25	10.56	C ₅ H ₇ N ₃ O ₄	Azaserine			8.55
C ₄ H ₁₁ N	<i>tert</i> -Butylamine		25	10.68	C ₅ H ₈ N ₂	2,4-Dimethylimidazole		25	8.36
C ₄ H ₁₁ N	Diethylamine		25	10.84	C ₅ H ₈ N ₄ O ₃ S ₂	Methazolamide			7.30
C ₄ H ₁₁ NO ₃	Tris(hydroxymethyl)methylamine		20	8.3	C ₅ H ₈ O ₂	<i>trans</i> -3-Pentenoic acid		25	4.51
C ₄ H ₁₂ N ₂	1,4-Butanediamine	1	25	10.80	C ₅ H ₈ O ₄	Dimethylmalonic acid		25	3.15
		2	25	9.63	C ₅ H ₈ O ₄	Glutaric acid	1	18	4.32
C ₅ H ₄ BrN	3-Bromopyridine		25	2.84			2	25	5.42
C ₅ H ₄ ClN	2-Chloropyridine		25	0.49	C ₅ H ₈ O ₄	Methylsuccinic acid	1	25	4.13
C ₅ H ₄ ClN	3-Chloropyridine		25	2.81			2	25	5.64
C ₅ H ₄ ClN	4-Chloropyridine		25	3.83	C ₅ H ₉ NO ₂	<i>L</i> -Proline	1	25	1.95
C ₅ H ₄ FN	2-Fluoropyridine		25	-0.44			2	25	10.64
C ₅ H ₄ N ₂ O ₂	4-Nitropyridine		25	1.61	C ₅ H ₉ NO ₃	5-Amino-4-oxopentanoic acid	1	25	4.05
C ₅ H ₄ N ₄	1 <i>H</i> -Purine	1	20	2.30			2	25	8.90
		2	20	8.96	C ₅ H ₉ NO ₃	<i>trans</i> -4-Hydroxyproline	1	25	1.82

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a
C ₅ H ₉ NO ₄	<i>L</i> -Glutamic acid	2	25	9.66	C ₆ H ₅ ClO	2-Chlorophenol		25	8.56
		1	25	2.13	C ₆ H ₅ ClO	3-Chlorophenol		25	9.12
		2	25	4.31	C ₆ H ₅ ClO	4-Chlorophenol		25	9.41
		3		9.67	C ₆ H ₅ Cl ₂ N	2,4-Dichloroaniline		22	2.05
C ₅ H ₉ N ₃	Histamine	1	25	6.04	C ₆ H ₅ FO	2-Fluorophenol		25	8.73
		2	25	9.75	C ₆ H ₅ FO	3-Fluorophenol		25	9.29
C ₅ H ₁₀ N ₂ O ₃	Glycylalanine		25	3.15	C ₆ H ₅ FO	4-Fluorophenol		25	9.89
C ₅ H ₁₀ N ₂ O ₃	<i>L</i> -Glutamine	1	25	2.17	C ₆ H ₅ IO	2-Iodophenol		25	8.51
		2	25	9.13	C ₆ H ₅ IO	3-Iodophenol		25	9.03
C ₅ H ₁₀ N ₂ O ₄	Glycylserine	1	25	2.98	C ₆ H ₅ IO	4-Iodophenol		25	9.33
		2	25	8.38	C ₆ H ₅ NO	2-Pyridinecarboxaldehyde		25	12.68
C ₅ H ₁₀ O ₂	Pentanoic acid		20	4.83	C ₆ H ₅ NO	4-Pyridinecarboxaldehyde		30	12.05
C ₅ H ₁₀ O ₂	2-Methylbutanoic acid		25	4.80	C ₆ H ₅ NO ₂	Nitrobenzene		0	3.98
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid		25	4.77	C ₆ H ₅ NO ₂	2-Pyridinecarboxylic acid	1	20	0.99
C ₅ H ₁₀ O ₂	2,2-Dimethylpropanoic acid		20	5.03	C ₆ H ₅ NO ₂	3-Pyridinecarboxylic acid	2	20	5.39
C ₅ H ₁₀ O ₄	<i>D</i> -2-Deoxyribose		25	12.61	C ₆ H ₅ NO ₂	4-Pyridinecarboxylic acid	1	25	2.00
C ₅ H ₁₀ O ₅	<i>L</i> -Ribose		25	12.22			2	25	4.82
C ₅ H ₁₀ O ₅	<i>D</i> -Xylose		18	12.14	C ₆ H ₅ NO ₂	1 <i>H</i> -Benzotriazole	1	25	1.77
C ₅ H ₁₁ N	Piperidine		25	11.123	C ₆ H ₅ N ₃ O	2-Amino-4-hydroxypteridine	2	25	4.84
C ₅ H ₁₁ N	<i>N</i> -Methylpyrrolidine		25	10.46	C ₆ H ₅ NO ₃	2-Nitrophenol		25	7.23
C ₅ H ₁₁ NO	4-Methylmorpholine		25	7.38	C ₆ H ₅ NO ₃	3-Nitrophenol		25	8.36
C ₅ H ₁₁ NO ₂	<i>L</i> -Valine	1	25	2.29	C ₆ H ₅ NO ₃	4-Nitrophenol		25	7.15
		2	25	9.74	C ₆ H ₅ N ₃	1 <i>H</i> -Benzotriazole		20	1.6
C ₅ H ₁₁ NO ₂	<i>DL</i> -Norvaline	1		2.36	C ₆ H ₅ N ₃ O	2-Amino-4-hydroxypteridine	1	20	2.27
		2		9.72	C ₆ H ₅ N ₃ O ₂	Xanthopterin	2	20	7.96
C ₅ H ₁₁ NO ₂	<i>L</i> -Norvaline	1	25	2.32			3	20	9.31
		2	25	9.81	C ₆ H ₆ BrN	2-Bromoaniline		25	2.53
C ₅ H ₁₁ NO ₂	<i>N</i> -Propylglycine	1	25	2.35	C ₆ H ₆ BrN	3-Bromoaniline		25	3.53
		2	25	10.19	C ₆ H ₆ BrN	4-Bromoaniline		25	3.89
C ₅ H ₁₁ NO ₂	5-Aminopentanoic acid	1	25	4.27	C ₆ H ₆ ClN	2-Chloroaniline		25	2.66
		2	25	10.77	C ₆ H ₆ ClN	3-Chloroaniline		25	3.52
C ₅ H ₁₁ NO ₂	Betaine		0	1.83	C ₆ H ₆ ClN	4-Chloroaniline		25	3.98
C ₅ H ₁₁ NO ₂ S	<i>L</i> -Methionine	1	25	2.13	C ₆ H ₆ FN	2-Fluoroaniline		25	3.20
		2	25	9.27	C ₆ H ₆ FN	3-Fluoroaniline		25	3.59
C ₅ H ₁₂ N ₂ O	Tetramethylurea			2	C ₆ H ₆ FN	4-Fluoroaniline		25	4.65
C ₅ H ₁₂ N ₂ O ₂	<i>L</i> -Ornithine	1	25	1.71	C ₆ H ₆ IN	2-Iodoaniline		25	2.54
		2	25	8.69	C ₆ H ₆ IN	3-Iodoaniline		25	3.58
		3	25	10.76	C ₆ H ₆ IN	4-Iodoaniline		25	3.81
C ₅ H ₁₃ N	Pentylamine		25	10.63	C ₆ H ₆ N ₂ O	3-Pyridinecarboxamide		20	3.3
C ₅ H ₁₃ N	3-Pentanamine		17	10.59	C ₆ H ₆ N ₂ O	2-Pyridinecarboxaldehyde oxime	1	20	3.59
C ₅ H ₁₃ N	3-Methyl-1-butanamine		25	10.60			2	20	10.18
C ₅ H ₁₃ N	2-Methyl-2-butanamine		19	10.85	C ₆ H ₆ N ₂ O ₂	2-Nitroaniline		25	-0.25
C ₅ H ₁₃ N	2,2-Dimethylpropylamine		25	10.15	C ₆ H ₆ N ₂ O ₂	3-Nitroaniline		25	2.46
C ₅ H ₁₃ N	Diethylmethylamine		25	10.35	C ₆ H ₆ N ₂ O ₂	4-Nitroaniline		25	1.02
C ₅ H ₁₄ NO	Choline		25	13.9	C ₆ H ₆ O	Phenol		25	9.99
C ₅ H ₁₄ N ₂	1,5-Pentanediamine	1	25	10.05	C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	1	25	9.85
		2	25	10.93			2	25	11.4
C ₆ H ₃ Cl ₃ N ₂ O ₂	4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid			3.6	C ₆ H ₆ O ₂	Pyrocatechol	1	25	9.34
C ₆ H ₃ N ₃ O ₇	2,4,6-Trinitrophenol		24	0.42			2	25	12.6
C ₆ H ₄ Cl ₂ O	2,3-Dichlorophenol		25	7.44	C ₆ H ₆ O ₂	Resorcinol	1	25	9.32
C ₆ H ₄ N ₂ O ₅	2,4-Dinitrophenol		25	4.07			2	25	11.1
C ₆ H ₄ N ₂ O ₅	2,5-Dinitrophenol		15	5.15	C ₆ H ₆ O ₂ S	Benzenesulfonic acid		20	1.3
C ₆ H ₄ N ₄	Pteridine		20	4.05	C ₆ H ₆ O ₃ S	Benzenesulfonic acid		25	0.70
C ₆ H ₅ BrO	2-Bromophenol		25	8.45	C ₆ H ₆ O ₄	5-Hydroxy-2-(hydroxymethyl)-4 <i>H</i> -pyran-4-one			7.9
C ₆ H ₅ BrO	3-Bromophenol		25	9.03	C ₆ H ₆ O ₄ S	3-Hydroxybenzenesulfonic acid		25	9.07
C ₆ H ₅ BrO	4-Bromophenol		25	9.37					
C ₆ H ₅ Br ₂ N	3,5-Dibromoaniline		25	2.34					

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	
C ₆ H ₆ O ₄ S	4-Hydroxybenzenesulfonic acid		25	9.11	C ₆ H ₁₀ O ₂	Cyclopentanecarboxylic acid		25	4.99	
C ₆ H ₆ O ₆	<i>cis</i> -1-Propene-1,2,3-tricarboxylic acid		25	1.95	C ₆ H ₁₀ O ₃	Ethyl acetoacetate		25	10.68	
C ₆ H ₆ O ₆	<i>trans</i> -1-Propene-1,2,3-tricarboxylic acid	1	25	2.80	C ₆ H ₁₀ O ₄	3-Methylglutaric acid		25	4.24	
C ₆ H ₆ S	Benzenethiol	2	25	4.46	C ₆ H ₁₀ O ₄	Adipic acid	1	18	4.41	
C ₆ H ₇ BO ₂	Benzenboronic acid		25	6.62	C ₆ H ₁₁ NO ₂	2-Piperidinecarboxylic acid	2	18	5.41	
C ₆ H ₇ N	Aniline		25	4.87	C ₆ H ₁₁ NO ₂	2-Piperidinecarboxylic acid	1	25	2.28	
C ₆ H ₇ N	2-Methylpyridine		25	6.00	C ₆ H ₁₁ NO ₃	Adipamic acid	2	25	10.72	
C ₆ H ₇ N	3-Methylpyridine		25	5.70	C ₆ H ₁₁ NO ₄	2-Amino adipic acid	1	25	4.63	
C ₆ H ₇ N	4-Methylpyridine		25	5.99	C ₆ H ₁₁ NO ₄	2-Amino adipic acid	2	25	2.14	
C ₆ H ₇ NO	2-Aminophenol	1	20	4.78	C ₆ H ₁₁ N ₃ O ₄	<i>N</i> -(<i>N</i> -Glycylglycyl)glycine	3	25	4.21	
C ₆ H ₇ NO	3-Aminophenol	2	20	9.97	C ₆ H ₁₁ N ₃ O ₄	<i>N</i> -(<i>N</i> -Glycylglycyl)glycine	1	25	9.77	
C ₆ H ₇ NO	4-Aminophenol	1	20	4.37	C ₆ H ₁₁ N ₃ O ₄	Glycylasparagine	2	25	3.225	
C ₆ H ₇ NO	4-Aminophenol	2	20	9.82	C ₆ H ₁₁ N ₃ O ₄	Glycylasparagine	2	25	8.09	
C ₆ H ₇ NO	2-Methoxypyridine	1	25	5.48	C ₆ H ₁₂ N ₂	Triethylenediamine	1	18	2.942	
C ₆ H ₇ NO	3-Methoxypyridine	2	25	10.30	C ₆ H ₁₂ N ₂	Triethylenediamine	2	18	8.44	
C ₆ H ₇ NO	4-Methoxypyridine		20	3.28	C ₆ H ₁₂ N ₂ O ₄ S ₂	<i>L</i> -Cystine	1	25	3.0	
C ₆ H ₇ NO	4-Methoxypyridine		25	4.78	C ₆ H ₁₂ N ₂ O ₄ S ₂	<i>L</i> -Cystine	2	25	8.7	
C ₆ H ₇ NO ₃ S	2-Aminobenzenesulfonic acid		25	6.58	C ₆ H ₁₂ N ₂ O ₄ S ₂	<i>L</i> -Cystine	3	25	1	
C ₆ H ₇ NO ₃ S	3-Aminobenzenesulfonic acid		25	2.46	C ₆ H ₁₂ N ₂ O ₄ S ₂	<i>L</i> -Cystine	4	25	2.1	
C ₆ H ₇ NO ₃ S	4-Aminobenzenesulfonic acid		25	3.74	C ₆ H ₁₂ O ₂	Hexanoic acid		25	8.02	
C ₆ H ₇ NO ₃ S	4-Aminobenzenesulfonic acid		25	3.23	C ₆ H ₁₂ O ₂	Hexanoic acid		25	8.71	
C ₆ H ₈ N ₂	<i>N</i> -Methylpyridinamine		20	9.65	C ₆ H ₁₂ O ₂	4-Methylpentanoic acid		18	4.85	
C ₆ H ₈ N ₂	<i>o</i> -Phenylenediamine	1	20	4.57	C ₆ H ₁₂ O ₂	4-Methylpentanoic acid		18	4.84	
C ₆ H ₈ N ₂	<i>o</i> -Phenylenediamine	2	20	0.80	C ₆ H ₁₂ O ₆	β - <i>D</i> -Fructose		25	12.27	
C ₆ H ₈ N ₂	<i>m</i> -Phenylenediamine	1	20	5.11	C ₆ H ₁₂ O ₆	α - <i>D</i> -Glucose		25	12.46	
C ₆ H ₈ N ₂	<i>m</i> -Phenylenediamine	2	20	2.50	C ₆ H ₁₂ O ₆	<i>D</i> -Mannose		25	12.08	
C ₆ H ₈ N ₂	<i>p</i> -Phenylenediamine	1	20	6.31	C ₆ H ₁₂ O ₆	<i>D</i> -Mannose		25	12.08	
C ₆ H ₈ N ₂	<i>p</i> -Phenylenediamine	2	20	2.97	C ₆ H ₁₃ N	Cyclohexylamine		25	10.64	
C ₆ H ₈ N ₂	Phenylhydrazine		15	8.79	C ₆ H ₁₃ N	Cyclohexylamine		25	10.64	
C ₆ H ₈ O ₂	2,4-Hexadienoic acid		25	4.76	C ₆ H ₁₃ N	1-Methylpiperidine		25	10.38	
C ₆ H ₈ O ₂	1,3-Cyclohexanedione		25	5.26	C ₆ H ₁₃ N	1-Methylpiperidine		25	10.38	
C ₆ H ₈ O ₄	2,2-Dimethyl-1,3-dioxane-4,6-dione		25	5.1	C ₆ H ₁₃ N	1,2-Dimethylpyrrolidine		26	10.20	
C ₆ H ₈ O ₆	<i>L</i> -Ascorbic acid	1	25	4.04	C ₆ H ₁₃ NO	<i>N</i> -Ethylmorpholine		25	7.67	
C ₆ H ₈ O ₆	<i>L</i> -Ascorbic acid	2	16	11.7	C ₆ H ₁₃ NO ₂	<i>L</i> -Leucine	1	25	2.33	
C ₆ H ₈ O ₇	Citric acid	1	25	3.13	C ₆ H ₁₃ NO ₂	<i>L</i> -Leucine	2	25	9.74	
C ₆ H ₈ O ₇	Citric acid	2	25	4.76	C ₆ H ₁₃ NO ₂	<i>L</i> -Leucine	1	25	2.32	
C ₆ H ₈ O ₇	Citric acid	3	25	6.40	C ₆ H ₁₃ NO ₂	<i>L</i> -Leucine	2	25	9.76	
C ₆ H ₈ O ₇	Isocitric acid	1	25	3.29	C ₆ H ₁₃ NO ₂	<i>L</i> -Norleucine	1	25	2.34	
C ₆ H ₈ O ₇	Isocitric acid	2	25	4.71	C ₆ H ₁₃ NO ₂	<i>L</i> -Norleucine	2	25	9.83	
C ₆ H ₈ O ₇	Isocitric acid	3	25	6.40	C ₆ H ₁₃ NO ₂	<i>L</i> -Norleucine	2	25	9.83	
C ₆ H ₉ NO ₆	Nitrilotriacetic acid	1	20	3.03	C ₆ H ₁₃ NO ₂	6-Aminohexanoic acid	1	25	4.37	
C ₆ H ₉ NO ₆	Nitrilotriacetic acid	2	20	3.07	C ₆ H ₁₃ NO ₂	6-Aminohexanoic acid	2	25	10.80	
C ₆ H ₉ NO ₆	Nitrilotriacetic acid	3	20	10.70	C ₆ H ₁₃ NO ₄	<i>N,N</i> -Bis(2-hydroxyethyl)glycine	2	20	8.35	
C ₆ H ₉ NO ₆	<i>L</i> - γ -Carboxyglutamic acid	1	25	1.7	C ₆ H ₁₃ NO ₄	<i>N,N</i> -Bis(2-hydroxyethyl)glycine		1	25	2.43
C ₆ H ₉ NO ₆	<i>L</i> - γ -Carboxyglutamic acid	2	25	3.2	C ₆ H ₁₃ N ₃ O ₃	Citrulline	2	25	9.69	
C ₆ H ₉ NO ₆	<i>L</i> - γ -Carboxyglutamic acid	3	25	4.75	C ₆ H ₁₄ N ₂	<i>cis</i> -1,2-Cyclohexanediamine	1	20	9.93	
C ₆ H ₉ NO ₆	<i>L</i> - γ -Carboxyglutamic acid	4	25	9.9	C ₆ H ₁₄ N ₂	<i>cis</i> -1,2-Cyclohexanediamine	2	20	6.13	
C ₆ H ₉ N ₃	4,6-Dimethylpyrimidinamine		20	4.82	C ₆ H ₁₄ N ₂	<i>trans</i> -1,2-Cyclohexanediamine	1	20	9.94	
C ₆ H ₉ N ₃ O ₂	<i>L</i> -Histidine	1	25	1.80	C ₆ H ₁₄ N ₂	<i>trans</i> -1,2-Cyclohexanediamine	2	20	6.47	
C ₆ H ₉ N ₃ O ₂	<i>L</i> -Histidine	2	25	6.04	C ₆ H ₁₄ N ₂	<i>cis</i> -2,5-Dimethylpiperazine	1	25	9.66	
C ₆ H ₉ N ₃ O ₂	<i>L</i> -Histidine	3	25	9.33	C ₆ H ₁₄ N ₂ O ₂	<i>L</i> -Lysine	2	25	5.20	
					C ₆ H ₁₄ N ₂ O ₂	<i>L</i> -Lysine	1	25	2.16	
					C ₆ H ₁₄ N ₂ O ₂	<i>L</i> -Lysine	2	25	9.06	
					C ₆ H ₁₄ N ₄ O ₂	<i>L</i> -Arginine	3	25	10.54	
					C ₆ H ₁₄ N ₄ O ₂	<i>L</i> -Arginine	1	25	1.82	
					C ₆ H ₁₄ N ₄ O ₂	<i>L</i> -Arginine	2	25	8.99	
					C ₆ H ₁₄ N ₄ O ₂	<i>L</i> -Arginine	3	25	12.5	
					C ₆ H ₁₄ O ₆	<i>D</i> -Mannitol		18	13.5	
					C ₆ H ₁₅ N	Hexylamine		25	10.56	
					C ₆ H ₁₅ N	Hexylamine		25	10.56	
					C ₆ H ₁₅ N	Diisopropylamine		25	11.05	
					C ₆ H ₁₅ N	Diisopropylamine		25	11.05	
					C ₆ H ₁₅ N	Triethylamine		25	10.75	
					C ₆ H ₁₅ N	Triethylamine		25	10.75	

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a
C ₆ H ₁₅ NO ₃	Triethanolamine		25	7.76			2	25	9.46
C ₆ H ₁₆ N ₂	1,6-Hexanediamine	1	0	11.86	C ₇ H ₆ O ₄	2,4-Dihydroxybenzoic acid	1	25	3.11
		2	0	10.76			2	25	8.55
C ₆ H ₁₆ N ₂	<i>N,N,N',N'</i> -Tetramethyl- 1,2-ethanediamine	1	25	10.40			3	25	14.0
		2	25	8.26	C ₇ H ₆ O ₄	2,5-Dihydroxybenzoic acid	1	25	2.97
C ₆ H ₁₉ NSi ₂	Hexamethyldisilazane			7.55	C ₇ H ₆ O ₄	3,4-Dihydroxybenzoic acid	1	25	4.48
C ₇ HF ₅ O ₂	Pentafluorobenzoic acid		25	1.75			2	25	8.83
C ₇ H ₃ Br ₂ NO	3,5-Dibromo-4- hydroxybenzonitrile			4.06			3	25	12.6
C ₇ H ₃ N ₃ O ₈	2,4,6-Trinitrobenzoic acid		25	0.65	C ₇ H ₆ O ₄	3,5-Dihydroxybenzoic acid	1	25	4.04
C ₇ H ₄ Cl ₃ NO ₃	Triclopyr			2.68	C ₇ H ₆ O ₅	2,4,6-Trihydroxybenzoic acid		25	1.68
C ₇ H ₄ N ₂ O ₆	2,4-Dinitrobenzoic acid		25	1.43	C ₇ H ₆ O ₅	3,4,5-Trihydroxybenzoic acid		25	4.41
C ₇ H ₅ BrO ₂	2-Bromobenzoic acid		25	2.85	C ₇ H ₇ NO	Benzamide		25	~13
C ₇ H ₅ BrO ₂	3-Bromobenzoic acid		25	3.81	C ₇ H ₇ NO ₂	Aniline-2-carboxylic acid	1	25	2.17
C ₇ H ₅ BrO ₂	4-Bromobenzoic acid		25	3.96			2	25	4.85
C ₇ H ₅ ClO ₂	2-Chlorobenzoic acid		25	2.90	C ₇ H ₇ NO ₂	Aniline-3-carboxylic acid	1	25	3.07
C ₇ H ₅ ClO ₂	3-Chlorobenzoic acid		25	3.84			2	25	4.79
C ₇ H ₅ ClO ₂	4-Chlorobenzoic acid		25	4.00	C ₇ H ₇ NO ₂	Aniline-4-carboxylic acid	1	25	2.50
C ₇ H ₅ FO ₂	2-Fluorobenzoic acid		25	3.27			2	25	4.87
C ₇ H ₅ FO ₂	3-Fluorobenzoic acid		25	3.86	C ₇ H ₇ NO ₃	4-Amino-2-hydroxy- benzoic acid			3.25
C ₇ H ₅ FO ₂	4-Fluorobenzoic acid		25	4.15			1		7.9
C ₇ H ₅ F ₃ O	2-(Trifluoromethyl)phenol		25	8.95	C ₇ H ₈ ClN ₃ O ₄ S ₂	Hydrochlorothiazide	2		9.2
C ₇ H ₅ F ₃ O	3-(Trifluoromethyl)phenol		25	8.68				18	7.89
C ₇ H ₅ IO ₂	2-Iodobenzoic acid		25	2.86	C ₇ H ₈ N ₄ O ₂	Theobromine		25	8.77
C ₇ H ₅ IO ₂	3-Iodobenzoic acid		25	3.87	C ₇ H ₈ N ₄ O ₂	Theophylline	1	25	10.29
C ₇ H ₅ IO ₂	4-Iodobenzoic acid		25	4.00	C ₇ H ₈ O	<i>o</i> -Cresol		25	10.09
C ₇ H ₅ NO	2-Hydroxybenzonitrile		25	6.86	C ₇ H ₈ O	<i>m</i> -Cresol		25	10.26
C ₇ H ₅ NO	3-Hydroxybenzonitrile		25	8.61	C ₇ H ₈ O	<i>p</i> -Cresol		25	9.53
C ₇ H ₅ NO	4-Hydroxybenzonitrile		25	7.97	C ₇ H ₈ OS	4-(Methylthio)phenol		25	9.98
C ₇ H ₅ NO ₃ S	Saccharin		18	11.68	C ₇ H ₈ O ₂	2-Methoxyphenol		25	9.65
C ₇ H ₅ NO ₄	2-Nitrobenzoic acid		25	2.17	C ₇ H ₈ O ₂	3-Methoxyphenol		25	10.21
C ₇ H ₅ NO ₄	3-Nitrobenzoic acid		25	3.46	C ₇ H ₈ O ₂	4-Methoxyphenol		25	9.43
C ₇ H ₅ NO ₄	4-Nitrobenzoic acid		25	3.43	C ₇ H ₈ S	Benzenemethanethiol		25	9.34
C ₇ H ₅ NO ₄	2,3-Pyridinedicarboxylic acid	1	25	2.43	C ₇ H ₉ N	Benzylamine		25	4.45
		2	25	4.78	C ₇ H ₉ N	2-Methylaniline		25	4.71
C ₇ H ₅ NO ₄	2,4-Pyridinedicarboxylic acid	1	25	2.15	C ₇ H ₉ N	3-Methylaniline		25	5.08
					C ₇ H ₉ N	4-Methylaniline		25	4.85
C ₇ H ₅ NO ₄	2,6-Pyridinedicarboxylic acid	1	25	2.16	C ₇ H ₉ N	<i>N</i> -Methylaniline		25	5.89
		2	25	4.76	C ₇ H ₉ N	2-Ethylpyridine		25	6.57
C ₇ H ₅ NO ₄	3,5-Pyridinedicarboxylic acid	1	25	2.80	C ₇ H ₉ N	2,3-Dimethylpyridine		25	6.99
					C ₇ H ₉ N	2,4-Dimethylpyridine		25	6.40
C ₇ H ₆ ClN ₃ O ₄ S ₂	Chlorothiazide	1		6.85	C ₇ H ₉ N	2,5-Dimethylpyridine		25	6.65
		2		9.45	C ₇ H ₉ N	2,6-Dimethylpyridine		25	6.46
C ₇ H ₆ F ₃ N	3-(Trifluoromethyl)aniline		25	3.49	C ₇ H ₉ N	3,4-Dimethylpyridine		25	6.15
C ₇ H ₆ F ₃ N	4-(Trifluoromethyl)aniline		25	2.45	C ₇ H ₉ N	3,5-Dimethylpyridine		25	4.53
C ₇ H ₆ N ₂	1 <i>H</i> -Benzimidazole		25	5.53	C ₇ H ₉ NO	2-Methoxyaniline		25	4.20
C ₇ H ₆ N ₂	2-Aminobenzonitrile		25	0.77	C ₇ H ₉ NO	3-Methoxyaniline		25	5.36
C ₇ H ₆ N ₂	3-Aminobenzonitrile		25	2.75	C ₇ H ₉ NO	4-Methoxyaniline		25	3.45
C ₇ H ₆ N ₂	4-Aminobenzonitrile		25	1.74	C ₇ H ₉ NS	2-(Methylthio)aniline		25	4.35
C ₇ H ₆ O	Benzaldehyde		25	14.90	C ₇ H ₉ NS	4-(Methylthio)aniline		25	4.00
C ₇ H ₆ O ₂	Benzoic acid		25	4.204	C ₇ H ₉ N ₅	2-Dimethylaminopurine	1	20	10.24
C ₇ H ₆ O ₂	Salicylaldehyde		25	8.37			2	20	1.69
C ₇ H ₆ O ₂	3-Hydroxybenzaldehyde		25	8.98	C ₇ H ₁₁ N ₃ O ₂	<i>L</i> -1-Methylhistidine	1	25	6.48
C ₇ H ₆ O ₂	4-Hydroxybenzaldehyde		25	7.61			2	25	8.85
C ₇ H ₆ O ₃	2-Hydroxybenzoic acid	1	20	2.98			3	25	1.92
		2	20	13.6	C ₇ H ₁₁ N ₃ O ₂	<i>L</i> -3-Methylhistidine	1	25	6.56
C ₇ H ₆ O ₃	3-Hydroxybenzoic acid	1	25	4.08			2	25	8.73
		2	19	9.92			3	25	
C ₇ H ₆ O ₃	4-Hydroxybenzoic acid	1	25	4.57					

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a
C ₇ H ₁₂ O ₂	Cyclohexanecarboxylic acid		25	4.91	C ₈ H ₉ NO ₂	4-(Methylamino)benzoic acid		25	5.04
C ₇ H ₁₂ O ₄	Heptanedioic acid	1	25	4.71	C ₈ H ₉ NO ₂	<i>N</i> -Phenylglycine	1	25	1.83
		2	25	5.58			2		4.39
C ₇ H ₁₂ O ₄	Butylpropanedioic acid	1	5	2.96	C ₈ H ₁₀ BrN	4-Bromo- <i>N,N</i> -dimethylaniline		25	4.23
C ₇ H ₁₃ NO ₄	α-Ethylglutamic acid	1	25	3.846	C ₈ H ₁₀ ClN	3-Chloro- <i>N,N</i> -dimethylaniline		20	3.83
		2	25	7.838	C ₈ H ₁₀ ClN	4-Chloro- <i>N,N</i> -dimethylaniline		20	4.39
C ₇ H ₁₄ O ₂	Heptanoic acid		25	4.89	C ₈ H ₁₀ N ₂ O ₂	<i>N,N</i> -Dimethyl-3-nitroaniline		25	2.62
C ₇ H ₁₄ O ₆	α-Methylglucoside		25	13.71	C ₈ H ₁₁ N	<i>N</i> -Ethylaniline		25	5.12
C ₇ H ₁₅ N	1-Ethylpiperidine		23	10.45	C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline		25	5.07
C ₇ H ₁₅ N	1,2-Dimethylpiperidine,(±)		25	10.22	C ₈ H ₁₁ N	2,6-Dimethylaniline		25	3.89
C ₇ H ₁₅ NO ₃	Carnitine		25	3.80	C ₈ H ₁₁ N	Benzenethanamine		25	9.83
C ₇ H ₁₇ N	Heptylamine		25	10.67	C ₈ H ₁₁ N	2,4,6-Trimethylpyridine		25	7.43
C ₇ H ₁₇ N	2-Heptanamine		19	10.7	C ₈ H ₁₁ NO	2-Ethoxyaniline		28	4.43
C ₈ H ₅ NO ₂	3-Cyanobenzoic acid		25	3.60	C ₈ H ₁₁ NO	3-Ethoxyaniline		25	4.18
C ₈ H ₅ NO ₂	4-Cyanobenzoic acid		25	3.55	C ₈ H ₁₁ NO	4-Ethoxyaniline		28	5.20
C ₈ H ₆ N ₂	Cinnoline		20	2.37	C ₈ H ₁₁ NO	4-(2-Aminoethyl)phenol	1	25	9.74
C ₈ H ₆ N ₂	Quinazoline		29	3.43			2	25	10.52
C ₈ H ₆ N ₂	Quinoxaline		20	0.56	C ₈ H ₁₁ NO	2-(2-Methoxyethyl)pyridine			5.5
C ₈ H ₆ N ₂	Phthalazine		20	3.47	C ₈ H ₁₁ NO ₂	Dopamine	1	25	8.9
C ₈ H ₆ N ₄ O ₅	Nitrofurantoin			7.2			2	25	10.6
C ₈ H ₆ O ₃	3-Formylbenzoic acid		25	3.84	C ₈ H ₁₁ NO ₃	Norepinephrine	1	25	8.64
C ₈ H ₆ O ₃	4-Formylbenzoic acid		25	3.77			2	25	9.70
C ₈ H ₆ O ₄	Phthalic acid	1	25	2.943	C ₈ H ₁₁ N ₃ O ₆	6-Azauridine			6.70
		2	25	5.432	C ₈ H ₁₁ N ₅	Phenylbiguanide	1		10.76
C ₈ H ₆ O ₄	Isophthalic acid	1	25	3.70			2		2.13
		2	25	4.60	C ₈ H ₁₂ N ₂ O ₃	Barbital		25	7.43
C ₈ H ₆ O ₄	Terephthalic acid	1	25	3.54	C ₈ H ₁₂ O ₂	5,5-Dimethyl-1,3-cyclohexanedione		25	5.15
		2	25	4.34	C ₈ H ₁₃ NO ₂	Arecoline			6.84
C ₈ H ₇ ClO ₂	2-Chlorobenzeneacetic acid		25	4.07	C ₈ H ₁₄ O ₂ S ₂	Thioctic acid			5.4
C ₈ H ₇ ClO ₂	3-Chlorobenzeneacetic acid		25	4.14	C ₈ H ₁₄ O ₄	Octanedioic acid	1	25	4.52
C ₈ H ₇ ClO ₂	4-Chlorobenzeneacetic acid		25	4.19	C ₈ H ₁₅ NO	Tropine		15	3.80
C ₈ H ₇ ClO ₃	2-Chlorophenoxyacetic acid		25	3.05	C ₈ H ₁₅ NO	Pseudotropine		15	3.80
C ₈ H ₇ ClO ₃	3-Chlorophenoxyacetic acid		25	3.10	C ₈ H ₁₆ N ₂ O ₃	<i>N</i> -Glycylleucine		25	3.18
C ₈ H ₇ NO ₄	2-Nitrobenzeneacetic acid		25	4.00	C ₈ H ₁₆ N ₂ O ₃	<i>N</i> -Leucylglycine	1	25	3.25
C ₈ H ₇ NO ₄	3-Nitrobenzeneacetic acid		25	3.97			2	25	8.2
C ₈ H ₇ NO ₄	4-Nitrobenzeneacetic acid		25	3.85	C ₈ H ₁₆ N ₂ O ₄ S ₂	Homocystine	1	25	1.59
C ₈ H ₈ F ₃ N ₃ O ₄ S ₂	Hydroflumethiazide	1		8.9			2	25	2.54
		2		9.7			3	25	8.52
C ₈ H ₈ N ₂	2-Methyl-1 <i>H</i> -benzimidazole		25	6.19			4	25	9.44
C ₈ H ₈ O ₂	<i>o</i> -Toluic acid		25	3.91	C ₈ H ₁₆ O ₂	Octanoic acid		25	4.89
C ₈ H ₈ O ₂	<i>m</i> -Toluic acid		25	4.25	C ₈ H ₁₆ O ₂	2-Propylpentanoic acid			4.6
C ₈ H ₈ O ₂	<i>p</i> -Toluic acid		25	4.37	C ₈ H ₁₇ N	2-Propylpiperidine,(<i>S</i>)			10.9
C ₈ H ₈ O ₂	Benzenecetic acid		25	4.31	C ₈ H ₁₇ N	2,2,4-Trimethylpiperidine		30	11.04
C ₈ H ₈ O ₂	1-(2-Hydroxyphenyl)ethanone		25	10.06	C ₈ H ₁₇ NO	<i>trans</i> -6-Propyl-3-piperidinol,(3 <i>S</i>)			10.3
C ₈ H ₈ O ₂	1-(3-Hydroxyphenyl)ethanone		25	9.19	C ₈ H ₁₉ N	Octylamine		25	10.65
C ₈ H ₈ O ₂	1-(4-Hydroxyphenyl)ethanone		25	8.05	C ₈ H ₁₉ N	<i>N</i> -Methyl-2-heptanamine		17	10.99
C ₈ H ₈ O ₃	2-Methoxybenzoic acid		25	4.08	C ₈ H ₁₉ N	Dibutylamine		21	11.25
C ₈ H ₈ O ₃	3-Methoxybenzoic acid		25	4.10	C ₈ H ₂₀ N ₂	1,8-Octanediamine	1	20	11.00
C ₈ H ₈ O ₃	4-Methoxybenzoic acid		25	4.50			2	20	10.1
C ₈ H ₈ O ₃	Phenoxyacetic acid		25	3.17	C ₉ H ₆ BrN	3-Bromoquinoline		25	2.69
C ₈ H ₈ O ₃	Mandelic acid		25	3.37	C ₉ H ₇ ClO ₂	<i>trans</i> - <i>o</i> -Chlorocinnamic acid		25	4.23
C ₈ H ₈ O ₄	2,5-Hydroxybenzeneacetic acid		25	4.40					
C ₈ H ₉ NO	Acetanilide		25	0.5					
C ₈ H ₉ NO ₂	2-(Methylamino)benzoic acid		25	5.34					
C ₈ H ₉ NO ₂	3-(Methylamino)benzoic acid		25	5.10					

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	pK _a	Mol. Form.	Name	Step	<i>t</i> /°C	pK _a
C ₉ H ₇ ClO ₂	<i>trans-m</i> -Chlorocinnamic acid		25	4.29	C ₉ H ₁₁ Cl ₂ N ₃ O ₄ S ₂	Methylclothiazide			9.4
C ₉ H ₇ ClO ₂	<i>trans-p</i> -Chlorocinnamic acid		25	4.41	C ₉ H ₁₁ N	<i>N</i> -Allylaniline		25	4.17
C ₉ H ₇ N	Quinoline		20	4.90	C ₉ H ₁₁ N	1-Indanamine		22	9.21
C ₉ H ₇ N	Isoquinoline		20	5.40	C ₉ H ₁₁ NO ₂	4-(Dimethylamino)-benzoic acid	1		6.03
C ₉ H ₇ NO	2-Quinolinol	1	20	-0.31	C ₉ H ₁₁ NO ₂	Ethyl 4-aminobenzoate	2		11.49
		2	20	11.76	C ₉ H ₁₁ NO ₂	<i>L</i> -Phenylalanine	1	25	2.20
C ₉ H ₇ NO	3-Quinolinol	1	20	4.28			2	25	9.31
		2	20	8.08	C ₉ H ₁₁ NO ₃	<i>L</i> -Tyrosine	1	25	2.20
C ₉ H ₇ NO	4-Quinolinol	1	20	2.23			2	25	9.11
		2	20	11.28	C ₉ H ₁₁ NO ₄	Levodopa	3	25	10.1
C ₉ H ₇ NO	6-Quinolinol	1	20	5.15			1	25	2.32
		2	20	8.90			2	25	8.72
C ₉ H ₇ NO	8-Quinolinol	1	25	4.91			3	25	9.96
		2	25	9.81	C ₉ H ₁₂ N ₂ O ₂	Tyrosineamide	4	25	11.79
C ₉ H ₇ NO	7-Isoquinolinol	1	20	5.68	C ₉ H ₁₃ N	<i>N</i> -Isopropylaniline	25		7.33
		2	20	8.90	C ₉ H ₁₃ NO ₃	Epinephrine	1	25	5.77
C ₉ H ₇ NO ₃	2-Cyanophenoxyacetic acid		25	2.98			2	25	8.66
C ₉ H ₇ NO ₃	3-Cyanophenoxyacetic acid		25	3.03	C ₉ H ₁₃ N ₂ O ₉ P	5'-Uridylic acid	1		9.95
C ₉ H ₇ NO ₃	4-Cyanophenoxyacetic acid		25	2.93			2		6.4
C ₉ H ₇ N ₇ O ₂ S	Azathioprine			8.2	C ₉ H ₁₃ N ₃ O ₅	Cytidine	1		9.5
C ₉ H ₈ N ₂	2-Quinolinamine		20	7.34			2		4.22
C ₉ H ₈ N ₂	3-Quinolinamine		20	4.91	C ₉ H ₁₄ ClNO	Phenylpropanolamine hydrochloride			12.5
C ₉ H ₈ N ₂	4-Quinolinamine		20	9.17					9.44
C ₉ H ₈ N ₂	1-Isoquinolinamine		20	7.62	C ₉ H ₁₄ N ₂ O ₃	Metharbital			8.45
C ₉ H ₈ N ₂	3-Isoquinolinamine		20	5.05	C ₉ H ₁₄ N ₃ O ₈ P	3'-Cytidylic acid	1		0.8
C ₉ H ₈ O ₂	<i>cis</i> -Cinnamic acid		25	3.88			2		4.28
C ₉ H ₈ O ₂	<i>trans</i> -Cinnamic acid		25	4.44			3		6.0
C ₉ H ₈ O ₂	α-Methylenebenzene-acetic acid			4.35	C ₉ H ₁₄ N ₄ O ₃	Carnosine	1	20	2.73
							2	20	6.87
C ₉ H ₈ O ₄	2-(Acetyloxy)benzoic acid		25	3.48			3	20	9.73
C ₉ H ₉ Br ₂ NO ₃	3,5-Dibromo- <i>L</i> -tyrosine	1		2.17	C ₉ H ₁₅ NO ₃ S	Captopril	1		3.7
		2		6.45			2		9.8
		3		7.60	C ₉ H ₁₅ N ₅ O	Minoxidil			4.61
C ₉ H ₉ ClO ₂	3-(2-Chlorophenyl)-propanoic acid		25	4.58	C ₉ H ₁₆ O ₄	Nonanedioic acid	1	25	4.53
C ₉ H ₉ ClO ₂	3-(3-Chlorophenyl)-propanoic acid		25	4.59			2	25	5.33
C ₉ H ₉ ClO ₂	3-(4-Chlorophenyl)-propanoic acid		25	4.61	C ₉ H ₁₈ O ₂	Nonanoic acid		25	4.96
C ₉ H ₉ I ₂ NO ₃	<i>L</i> -3,5-Diiodotyrosine	1	25	2.12	C ₉ H ₁₉ N	<i>N</i> -Butylpiperidine		23	10.47
		2	25	5.32	C ₉ H ₁₉ N	2,2,6,6-Tetramethyl-piperidine		25	11.07
		3	25	9.48	C ₉ H ₂₁ N	Nonylamine		25	10.64
C ₉ H ₉ NO ₃	<i>N</i> -Benzoylglycine		25	3.62	C ₁₀ H ₇ NO ₂	8-Quinolinecarboxylic acid		25	1.82
C ₉ H ₉ NO ₄	3-(2-Nitrophenyl)-propanoic acid		25	4.50	C ₁₀ H ₈ O	1-Naphthol		25	9.39
C ₉ H ₉ NO ₄	3-(4-Nitrophenyl)-propanoic acid		25	4.47	C ₁₀ H ₈ O	2-Naphthol		25	9.63
C ₉ H ₉ N ₃ O ₂	Carbendazim			4.48	C ₁₀ H ₉ N	1-Naphthylamine		25	3.92
C ₉ H ₉ N ₃ O ₂ S ₂	Sulfathiazole			7.2	C ₁₀ H ₉ N	2-Naphthylamine		25	4.16
C ₉ H ₁₀ INO ₃	<i>L</i> -3-Iodotyrosine	1	25	2.2	C ₁₀ H ₉ N	2-Methylquinoline		20	5.83
		2	25	8.7	C ₁₀ H ₉ N	4-Methylquinoline		20	5.67
		3	25	9.1	C ₁₀ H ₉ N	5-Methylquinoline		20	5.20
C ₉ H ₁₀ N ₂	2-Ethylbenzimidazole		25	6.18	C ₁₀ H ₉ NO	5-Amino-1-naphthol		25	3.97
C ₉ H ₁₀ O ₂	3,5-Dimethylbenzoic acid		25	4.32	C ₁₀ H ₉ NO	6-Methoxyquinoline		20	5.03
C ₉ H ₁₀ O ₂	Benzenepropanoic acid		25	4.66	C ₁₀ H ₉ NO ₂	1H-Indole-3-acetic acid			4.75
C ₉ H ₁₀ O ₂	α-Methylbenzeneacetic acid		25	4.64	C ₁₀ H ₁₀ O ₂	<i>o</i> -Methylcinnamic acid		25	4.50
C ₉ H ₁₀ O ₃	α-Hydroxy-α-methyl-benzenecetic acid		25	3.47	C ₁₀ H ₁₀ O ₂	<i>m</i> -Methylcinnamic acid		25	4.44
					C ₁₀ H ₁₀ O ₂	<i>p</i> -Methylcinnamic acid		25	4.56
					C ₁₀ H ₁₂ N ₂	Tryptamine		25	10.2
					C ₁₀ H ₁₂ N ₂ O	5-Hydroxytryptamine	1	25	9.8
							2	25	11.1

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a
C ₁₀ H ₁₂ N ₂ O ₅	Dinoseb			4.62	C ₁₁ H ₁₇ NO ₃	Isoproterenol			8.64
C ₁₀ H ₁₂ N ₄ O ₃	Dideoxyinosine			9.12	C ₁₁ H ₁₇ N ₃ O ₈	Tetrodotoxin			8.76
C ₁₀ H ₁₂ O	5,6,7,8-Tetrahydro-2-naphthalenol		25	10.48	C ₁₁ H ₁₈ ClNO ₃	Methoxamine hydrochloride		25	9.2
C ₁₀ H ₁₂ O ₂	Benzenebutanoic acid		25	4.76	C ₁₁ H ₁₈ N ₂ O ₃	Amobarbital		25	8.0
C ₁₀ H ₁₂ O ₅	Propyl 3,4,5-trihydroxybenzoate			8.11	C ₁₁ H ₂₅ N	Undecylamine		25	10.63
C ₁₀ H ₁₃ N ₅ O ₄	Adenosine	1	25	3.6	C ₁₁ H ₂₆ NO ₂ PS	Methylphosphonothioic acid S[2-[bis(1-isopropyl)amino]-ethyl], <i>O</i> -ethylester			7.9
C ₁₀ H ₁₄ N ₂	<i>L</i> -Nicotine	1		8.02	C ₁₂ H ₆ Cl ₄ O ₂ S	Bithionol	1		4.82
		2		3.12			2		10.50
C ₁₀ H ₁₄ N ₅ O ₇ P	5'-Adenylic acid	1		3.8	C ₁₂ H ₈ N ₂	1,10-Phenanthroline		25	4.84
		2		6.2	C ₁₂ H ₈ N ₂	Phenazine		20	1.20
C ₁₀ H ₁₄ O	2- <i>tert</i> -Butylphenol		25	10.62	C ₁₂ H ₁₀ O	2-Hydroxybiphenyl		25	10.01
C ₁₀ H ₁₄ O	3- <i>tert</i> -Butylphenol		25	10.12	C ₁₂ H ₁₀ O	3-Hydroxybiphenyl		25	9.64
C ₁₀ H ₁₄ O	4- <i>tert</i> -Butylphenol		25	10.23	C ₁₂ H ₁₀ O	4-Hydroxybiphenyl		25	9.55
C ₁₀ H ₁₅ N	<i>N</i> - <i>tert</i> -Butylaniline		25	7.00	C ₁₂ H ₁₁ N	Diphenylamine		25	0.79
C ₁₀ H ₁₅ N	<i>N,N</i> -Diethylaniline		25	6.57	C ₁₂ H ₁₁ N	2-Aminobiphenyl		25	3.83
C ₁₀ H ₁₅ NO	<i>d</i> -Ephedrine		10	10.139	C ₁₂ H ₁₁ N	3-Aminobiphenyl		18	4.25
C ₁₀ H ₁₅ NO	<i>l</i> -Ephedrine		10	9.958	C ₁₂ H ₁₁ N	4-Aminobiphenyl		18	4.35
C ₁₀ H ₁₇ N ₃ O ₆ S	<i>l</i> -Glutathione	1	25	2.12	C ₁₂ H ₁₁ N	2-Benzylpyridine		25	5.13
		2	25	3.59	C ₁₂ H ₁₁ N ₃	4-Aminoazobenzene		25	2.82
		3	25	8.75	C ₁₂ H ₁₂ N ₂	<i>p</i> -Benzidine	1	20	4.65
		4	25	9.65			2	20	3.43
C ₁₀ H ₁₈ N ₄ O ₅	<i>L</i> -Argininosuccinic acid	1	25	1.62	C ₁₂ H ₁₂ N ₂ O ₃	Phenobarbital	1		7.3
		2	25	2.70			2		11.8
		3	25	4.26	C ₁₂ H ₁₃ N ₃ N ₂ O ₃	Iocetamic acid			4
		4	25	9.58	C ₁₂ H ₁₃ N	<i>N,N</i> -Dimethyl-1-naphthylamine		25	4.83
C ₁₀ H ₁₈ O ₄	Sebacic acid	1		4.59	C ₁₂ H ₁₃ N	<i>N,N</i> -Dimethyl-2-naphthylamine		25	4.566
		2		5.59					
C ₁₀ H ₁₉ N	Bornylamine		25	10.17	C ₁₂ H ₁₄ N ₄ O ₂ S	Sulfamethazine	1		7.4
C ₁₀ H ₁₉ N	Neobornylamine		25	10.01			2		2.65
C ₁₀ H ₂₁ N	Butylcyclohexylamine		25	11.23	C ₁₂ H ₁₄ N ₄ O ₃ S	Sulfacytine			6.9
C ₁₀ H ₂₁ N	1,2,2,6,6-Pentamethylpiperidine		30	11.25	C ₁₂ H ₁₇ N ₅ O ₄	Agaritine	1		3.4
							2		8.86
C ₁₀ H ₂₃ N	Decylamine		25	10.64	C ₁₂ H ₂₀ N ₂ O ₂	Aspergillitic acid			5.5
C ₁₁ H ₈ N ₂	1 <i>H</i> -Perimidine		20	6.35	C ₁₂ H ₂₁ N ₅ O ₂ S ₂	Nizatidine	1		2.1
C ₁₁ H ₈ O ₂	1-Naphthalenecarboxylic acid		25	3.69			2		6.8
C ₁₁ H ₈ O ₂	2-Naphthalenecarboxylic acid		25	4.16	C ₁₂ H ₂₂ O ₁₁	Sucrose		25	12.7
C ₁₁ H ₁₁ N	Methyl-1-naphthylamine		27	3.67	C ₁₂ H ₂₂ O ₁₁	α-Maltose		21	12.05
C ₁₁ H ₁₂ N ₃ NO ₂	Iopanoic acid			4.8	C ₁₂ H ₂₃ N	Dicyclohexylamine			10.4
C ₁₁ H ₁₂ N ₂ O ₂	<i>L</i> -Tryptophan	1	25	2.46	C ₁₂ H ₂₇ N	Dodecylamine		25	10.63
		2	25	9.41	C ₁₃ H ₉ N	Acridine		20	5.58
C ₁₁ H ₁₂ N ₄ O ₃ S	Sulfamethoxypyridazine			6.7	C ₁₃ H ₉ N	Phenanthridine		20	5.58
C ₁₁ H ₁₃ F ₃ N ₂ O ₃ S	Mefluidide			4.6	C ₁₃ H ₁₀ N ₂	9-Acridinamine		20	9.99
C ₁₁ H ₁₃ NO ₃	Hydrastinine			11.38	C ₁₃ H ₁₀ N ₂	2-Phenylbenzimidazole	1	25	5.23
C ₁₁ H ₁₃ N ₃ O ₃ S	Sulfisoxazole			5			2	25	11.91
C ₁₁ H ₁₄ N ₂ O	Cytisine	1		6.11	C ₁₃ H ₁₀ O ₂	2-Phenylbenzoic acid		25	3.46
		2		13.08	C ₁₃ H ₁₀ O ₃	2-Phenoxybenzoic acid		25	3.53
C ₁₁ H ₁₄ O ₂	2- <i>tert</i> -Butylbenzoic acid		25	3.54	C ₁₃ H ₁₀ O ₃	3-Phenoxybenzoic acid		25	3.95
C ₁₁ H ₁₄ O ₂	3- <i>tert</i> -Butylbenzoic acid		25	4.20	C ₁₃ H ₁₀ O ₃	4-Phenoxybenzoic acid		25	4.57
C ₁₁ H ₁₄ O ₂	4- <i>tert</i> -Butylbenzoic acid		25	4.38	C ₁₃ H ₁₁ N ₃	3,6-Acridinediamine		20	9.65
C ₁₁ H ₁₆ N ₂ O ₂	Pilocarpine	1	25	1.6	C ₁₃ H ₁₂ Cl ₂ O ₄	Ethacrynic acid			3.50
		2	25	6.9	C ₁₃ H ₁₂ N ₂ O	Harmine			7.70
C ₁₁ H ₁₆ N ₄ O ₄	Pentostatin			5.2	C ₁₃ H ₁₂ N ₂ O ₃ S	Sulfabenzamide		25	4.57
C ₁₁ H ₁₇ N	<i>N,N</i> -Diethyl-2-methylaniline		25	7.24	C ₁₃ H ₁₃ N	4-Benzylaniline		25	2.17
					C ₁₃ H ₁₄ N ₂ O ₁₃	Harmaline			4.2
					C ₁₃ H ₁₅ N ₅ O ₃	Imazapyr	1		1.9
							2		3.6

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	pK _a	Mol. Form.	Name	Step	<i>t</i> /°C	pK _a
C ₁₃ H ₁₆ ClNO	Ketamine			7.5	C ₁₈ H ₃₃ ClN ₂ O ₅ S	Clindamycin			7.6
C ₁₃ H ₁₉ NO ₄ S	4-[(Dipropylamino)- sulfonyl]benzoic acid			5.8	C ₁₈ H ₃₉ N	Octadecylamine	25		10.60
C ₁₃ H ₂₁ N	2,6-Di- <i>tert</i> -butylpyridine			3.58	C ₁₉ H ₁₀ Br ₄ O ₅ S	Bromophenol Blue			4.0
C ₁₃ H ₂₉ N	(Tridecyl)amine	25		10.63	C ₁₉ H ₁₄ O ₅ S	Phenol Red			7.9
C ₁₄ H ₁₂ F ₃ NO ₄ S ₂	Perfluidone			2.5	C ₁₉ H ₁₆ ClNO ₄	Indomethacin			4.5
C ₁₄ H ₁₂ O ₂	α-Phenylbenzeneacetic acid	25		3.94	C ₁₉ H ₁₇ N ₃ O ₄ S ₂	Cephaloridine			3.2
C ₁₄ H ₁₂ O ₃	α-Hydroxy-α-phenyl- benzeneacetic acid	25		3.04	C ₁₉ H ₂₀ N ₂ O ₂	Phenylbutazone			4.5
C ₁₄ H ₁₈ N ₄ O ₃	Trimethoprim			6.6	C ₁₉ H ₂₁ N	Protriptyline			8.2
C ₁₄ H ₁₉ NO ₂	Methylphenidate			8.9	C ₁₉ H ₂₁ NO ₃	Thebaine	15		6.05
C ₁₄ H ₂₁ N ₃ O ₃ S	Tolazamide	25		3.6	C ₁₉ H ₂₂ N ₂ O	Cinchonine	1		5.85
C ₁₄ H ₂₂ N ₂ O ₃	Atenolol			9.6			2		9.92
C ₁₄ H ₃₁ N	Tetradecylamine	25		10.62	C ₁₉ H ₂₂ N ₂ O	Cinchonidine	1		5.80
C ₁₅ H ₁₀ ClN ₃ O ₃	Clonazepam	1		1.5			2		10.03
		2		10.5	C ₁₉ H ₂₂ N ₂ O ₂	Cupreine			6.57
C ₁₅ H ₁₁ I ₄ NO ₄	<i>L</i> -Thyroxine	1	25	2.2	C ₁₉ H ₂₂ O ₆	Gibberellic acid			4.0
		2	25	6.45	C ₁₉ H ₂₃ N ₃ O ₂	Ergometrinine			7.3
		3	25	10.1	C ₁₉ H ₂₃ N ₃ O ₂	Ergonovine			6.8
C ₁₅ H ₁₄ O ₃	Fenopropfen			7.3	C ₂₀ H ₁₄ O ₄	Phenolphthalein	25		9.7
C ₁₅ H ₁₅ NO ₂	Mefenamic acid			4.2	C ₂₀ H ₂₁ NO ₄	Papaverine			6.4
C ₁₅ H ₁₅ N ₃ O ₂	Methyl Red	1		2.5	C ₂₀ H ₂₃ N	Amitriptyline			9.4
		2		9.5	C ₂₀ H ₂₃ N ₇ O ₇	Folinic acid	1		3.1
C ₁₅ H ₁₇ ClN ₄	NeutralRed			6.7			2		4.8
C ₁₅ H ₁₉ NO ₂	Tropacocaine	15		4.32	C ₂₀ H ₂₄ N ₂ O ₂	Quinine	1	25	8.52
C ₁₅ H ₁₉ N ₃ O ₃	Imazethapyr	1		2.1			2	25	4.13
		2		3.9	C ₂₀ H ₂₄ N ₂ O ₂	Quinidine	1	20	5.4
C ₁₅ H ₂₁ N ₃ O ₂	Physostigmine	1		6.12			2	20	10.0
		2		12.24	C ₂₀ H ₂₆ N ₂ O ₂	Hydroquinine			5.33
C ₁₅ H ₂₆ N ₂	Sparteine	1	20	2.24	C ₂₁ H ₁₄ Br ₄ O ₅ S	Bromocresol Green			4.7
		2	20	9.46	C ₂₁ H ₁₆ Br ₂ O ₅ S	Bromocresol Purple			6.3
C ₁₅ H ₃₃ N	Pentadecylamine	25		10.61	C ₂₁ H ₁₈ O ₅ S	CresolRed			8.3
C ₁₆ H ₁₃ ClN ₂ O	Valium			3.4	C ₂₁ H ₂₁ NO ₆	Hydrastine			7.8
C ₁₆ H ₁₄ ClN ₃ O	Chlorodiazepoxide			4.8	C ₂₁ H ₂₂ N ₂ O ₂	Strychnine	25		8.26
C ₁₆ H ₁₆ N ₂ O ₂	Lysergic acid	1		3.44	C ₂₁ H ₂₃ ClFNO ₂	Haloperidol			8.3
		2		7.68	C ₂₁ H ₃₁ NO ₄	Furethidine			7.48
C ₁₆ H ₁₇ N ₃ O ₄ S	Cephalexin	1		5.2	C ₂₁ H ₃₅ N ₃ O ₇	Lisinopril	1		2.5
		2		7.3			2		4.0
C ₁₆ H ₁₉ N ₃ O ₄ S	Cephradine	1		2.63			3		6.7
		2		7.27	C ₂₂ H ₁₈ O ₄	<i>o</i> -Cresolphthalein	4		10.1
C ₁₆ H ₂₂ N ₂	Lycodine	1		3.97	C ₂₂ H ₂₂ FN ₃ O ₂	Droperidol			9.4
		2		8.08	C ₂₂ H ₂₃ NO ₇	Noscipine			7.64
C ₁₆ H ₃₅ N	Hexadecylamine	25		10.61	C ₂₂ H ₂₅ NO ₆	Colchicine		20	7.8
C ₁₇ H ₁₇ NO ₂	Apomorphine	1		7.0	C ₂₂ H ₂₅ N ₃ O	Benzpiperylon	1		12.36
		2		8.92			2		6.73
C ₁₇ H ₁₉ NO ₃	Piperine		18	12.22	C ₂₂ H ₃₃ NO ₂	Atisine			9.13
C ₁₇ H ₁₉ NO ₃	Morphine	1	25	8.21	C ₂₂ H ₃₃ NO ₂	Atisine			12.2
		2	20	9.85	C ₂₃ H ₂₆ N ₂ O ₄	Brucine	1		6.04
C ₁₇ H ₂₀ N ₄ O ₆	Riboflavin	1		1.7			2		11.07
		2	25	9.69	C ₂₄ H ₄₀ O ₄	Deoxycholic acid			6.58
C ₁₇ H ₂₀ O ₆	Mycophenolic acid			4.5	C ₂₄ H ₄₀ O ₅	Cholic acid			6.4
C ₁₇ H ₂₃ NO ₃	Hyoscyamine	21		9.7	C ₂₅ H ₂₉ I ₂ NO ₃	Amiodarone	25		6.56
C ₁₇ H ₂₇ NO ₄	Nadolol			9.67	C ₂₅ H ₄₁ NO ₉	Aconine			9.52
C ₁₈ H ₁₉ ClN ₄	Clozapine	1		3.70	C ₂₆ H ₄₃ NO ₆	Glycocholic acid			4.4
		2		7.60	C ₂₆ H ₄₅ NO ₇ S	Taurocholic acid			1.4
C ₁₈ H ₂₁ NO ₃	Codeine			8.21	C ₂₇ H ₃₈ Br ₂ O ₅ S	Bromothymol Blue			7.0
C ₁₈ H ₂₁ N ₃ O	Dibenzepin			8.25	C ₂₇ H ₃₈ N ₂ O ₄	Verapamil			8.6
C ₁₈ H ₃₂ O ₂	Linoleic acid			7.6	C ₂₉ H ₃₂ O ₁₃	Etoposide			9.8
					C ₂₉ H ₄₀ N ₂ O ₄	Emetine	1		5.77
							2		6.64

DISSOCIATION CONSTANTS OF ORGANIC ACIDS AND BASES (continued)

Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a	Mol. Form.	Name	Step	<i>t</i> /°C	p <i>K</i> _a
C ₃₀ H ₂₃ BrO ₄	Bromadiolone		21	4.04	C ₃₆ H ₅₁ NO ₁₁	Veratridine			9.54
C ₃₀ H ₄₈ O ₃	Oleanolic acid			2.52	C ₃₇ H ₆₇ NO ₁₃	Erythromycin			8.8
C ₃₁ H ₃₆ N ₂ O ₁₁	Novobiocin	1		4.3	C ₄₃ H ₅₈ N ₄ O ₁₂	Rifampin	1		1.7
		2		9.1			2		7.9
C ₃₂ H ₃₂ O ₁₃ S	Teniposide			10.13	C ₄₅ H ₇₃ NO ₁₅	Solanine		15	6.66
C ₃₃ H ₄₀ N ₂ O ₉	Reserpine			6.6	C ₄₆ H ₅₆ N ₄ O ₁₀	Vincristine			5.4
C ₃₄ H ₄₇ NO ₁₁	Aconitine			5.88	C ₄₆ H ₅₈ N ₄ O ₉	Vinblastine	1		5.4
							2		7.4

CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS: DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY

This table gives properties of aqueous solutions of 66 substances as a function of concentration. All data refer to a temperature of 20°C. The properties are:

Mass %:	Mass of solute divided by total mass of solution, expressed as percent.
m	Molality (moles of solute per kg of water).
c	Molarity (moles of solute per liter of solution).
ρ	Density of solution in g/cm ³ .
n	Index of refraction, relative to air, at a wavelength of 589 nm (sodium D line); the index of pure water at 20°C is 1.3330.
Δ	Freezing point depression in °C relative to pure water.
η	Absolute (dynamic) viscosity in mPa s (equal to centipoise, cP); the viscosity of pure water at 20°C is 1.002 mPa s.

Density data for aqueous solutions over a wider range of temperatures and pressures (and for other compounds) may be found in Reference 2. Solutes are listed in the following order:

Acetic acid	Lithium chloride	2-Propanol
Acetone	Magnesium chloride	Silver nitrate
Ammonia	Magnesium sulfate	Sodium acetate
Ammonium chloride	Maltose	Sodium bicarbonate
Ammonium sulfate	Manganese(II) sulfate	Sodium bromide
Barium chloride	D-Mannitol	Sodium carbonate
Calcium chloride	Methanol	Sodium chloride
Cesium chloride	Nitric acid	Sodium citrate
Citric acid	Oxalic acid	Sodium hydroxide
Copper sulfate	Phosphoric acid	Sodium nitrate
Disodium ethylenediamine tetraacetate (EDTA sodium)	Potassium bicarbonate	Sodium phosphate
Ethanol	Potassium bromide	Sodium hydrogen phosphate
Ethylene glycol	Potassium carbonate	Sodium dihydrogen phosphate
Ferric chloride	Potassium chloride	Sodium sulfate
Formic acid	Potassium hydroxide	Sodium thiosulfate
D-Fructose	Potassium iodide	Strontium chloride
D-Glucose	Potassium nitrate	Sucrose
Glycerol	Potassium permanganate	Sulfuric acid
Hydrochloric acid	Potassium hydrogen phosphate	Trichloroacetic acid
Lactic acid	Potassium dihydrogen phosphate	Tris(hydroxymethyl)methylamine
Lactose	Potassium sulfate	Urea
	1-Propanol	Zinc sulfate

REFERENCES

1. Wolf, A. V., *Aqueous Solutions and Body Fluids*, Hoeber, 1966.
2. Söhnel, O., and Novotny, P., *Densities of Aqueous Solutions of Inorganic Substances*, Elsevier, Amsterdam, 1985.

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
Acetic acid	0.5	0.084	0.083	0.9989	1.3334	0.16	1.012
CH ₃ COOH	1.0	0.168	0.166	0.9996	1.3337	0.32	1.022
	2.0	0.340	0.333	1.0011	1.3345	0.63	1.042
	3.0	0.515	0.501	1.0025	1.3352	0.94	1.063
	4.0	0.694	0.669	1.0038	1.3359	1.26	1.084
	5.0	0.876	0.837	1.0052	1.3366	1.58	1.105
	6.0	1.063	1.006	1.0066	1.3373	1.90	1.125
	7.0	1.253	1.175	1.0080	1.3381	2.23	1.143
	8.0	1.448	1.345	1.0093	1.3388	2.56	1.162
	9.0	1.647	1.515	1.0107	1.3395	2.89	1.186
	10.0	1.850	1.685	1.0121	1.3402	3.23	1.210
	12.0	2.271	2.028	1.0147	1.3416	3.91	1.253
	14.0	2.711	2.372	1.0174	1.3430	4.61	1.298
	16.0	3.172	2.718	1.0200	1.3444	5.33	1.341
	18.0	3.655	3.065	1.0225	1.3458	6.06	1.380
	20.0	4.163	3.414	1.0250	1.3472	6.81	1.431

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	22.0	4.697	3.764	1.0275	1.3485	7.57	1.478
	24.0	5.259	4.116	1.0299	1.3498	8.36	1.525
	26.0	5.851	4.470	1.0323	1.3512	9.17	1.572
	28.0	6.476	4.824	1.0346	1.3525	10.00	1.613
	30.0	7.137	5.180	1.0369	1.3537	10.84	1.669
	32.0	7.837	5.537	1.0391	1.3550	11.70	1.715
	34.0	8.579	5.896	1.0413	1.3562	12.55	1.762
	36.0	9.367	6.255	1.0434	1.3574	13.38	1.812
	38.0	10.207	6.615	1.0454	1.3586		1.852
	40.0	11.102	6.977	1.0474	1.3598		1.912
	50.0	16.653	8.794	1.0562	1.3653		2.158
	60.0	24.979	10.620	1.0629	1.3700		2.409
	70.0	38.857	12.441	1.0673	1.3738		2.629
	80.0	66.611	14.228	1.0680	1.3767		2.720
	90.0	149.875	15.953	1.0644	1.3771		2.386
	92.0	191.507	16.284	1.0629	1.3766		2.240
	94.0	260.894	16.602	1.0606	1.3759		2.036
	96.0	399.667	16.911	1.0578	1.3748		1.813
	98.0	815.987	17.198	1.0538	1.3734		1.535
	100.0		17.447	1.0477	1.3716		1.223
Acetone (CH ₃) ₂ CO	0.5	0.087	0.086	0.9975	1.3334	0.16	1.013
	1.0	0.174	0.172	0.9968	1.3337	0.32	1.024
	2.0	0.351	0.343	0.9954	1.3344	0.65	1.047
	3.0	0.533	0.513	0.9940	1.3352	0.97	1.072
	4.0	0.717	0.684	0.9926	1.3359	1.30	1.099
	5.0	0.906	0.853	0.9912	1.3366	1.63	1.125
	6.0	1.099	1.023	0.9899	1.3373	1.96	1.150
	7.0	1.296	1.191	0.9886	1.3381	2.29	1.174
	8.0	1.497	1.360	0.9874	1.3388	2.62	1.198
	9.0	1.703	1.528	0.9861	1.3395	2.95	1.221
	10.0	1.913	1.696	0.9849	1.3402	3.29	1.244
Ammonia NH ₃	0.5	0.295	0.292	0.9960	1.3332	0.55	1.009
	1.0	0.593	0.584	0.9938	1.3335	1.14	1.015
	2.0	1.198	1.162	0.9895	1.3339	2.32	1.029
	3.0	1.816	1.736	0.9853	1.3344	3.53	1.043
	4.0	2.447	2.304	0.9811	1.3349	4.78	1.057
	5.0	3.090	2.868	0.9770	1.3354	6.08	1.071
	6.0	3.748	3.428	0.9730	1.3359	7.43	1.085
	7.0	4.420	3.983	0.9690	1.3365	8.95	1.099
	8.0	5.106	4.533	0.9651	1.3370	10.34	1.113
	9.0	5.807	5.080	0.9613	1.3376	11.90	1.127
	10.0	6.524	5.622	0.9575	1.3381	13.55	1.141
	12.0	8.007	6.695	0.9502	1.3393	17.13	1.169
	14.0	9.558	7.753	0.9431	1.3404	21.13	1.195
	16.0	11.184	8.794	0.9361	1.3416	25.63	1.218
	18.0	12.889	9.823	0.9294	1.3428	30.70	1.237
	20.0	14.679	10.837	0.9228	1.3440	36.42	1.254
	22.0	16.561	11.838	0.9164	1.3453	43.36	1.268
	24.0	18.542	12.826	0.9102	1.3465	51.38	1.280
	26.0	20.630	13.801	0.9040	1.3477	60.77	1.288
	28.0	22.834	14.764	0.8980	1.3490	71.66	
	30.0	25.164	15.713	0.8920	1.3502	84.06	
Ammonium chloride NH ₄ Cl	0.5	0.094	0.093	0.9998	1.3340	0.32	0.999
	1.0	0.189	0.187	1.0014	1.3349	0.64	0.996
	2.0	0.382	0.376	1.0045	1.3369	1.27	0.992

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	3.0	0.578	0.565	1.0076	1.3388	1.91	0.988
	4.0	0.779	0.756	1.0107	1.3407	2.57	0.985
	5.0	0.984	0.948	1.0138	1.3426	3.25	0.982
	6.0	1.193	1.141	1.0168	1.3445	3.94	0.979
	7.0	1.407	1.335	1.0198	1.3464	4.66	0.976
	8.0	1.626	1.529	1.0227	1.3483	5.40	0.974
	9.0	1.849	1.726	1.0257	1.3502	6.16	0.972
	10.0	2.077	1.923	1.0286	1.3521	6.95	0.970
	12.0	2.549	2.320	1.0344	1.3559	8.60	0.969
	14.0	3.043	2.722	1.0401	1.3596		0.969
	16.0	3.561	3.128	1.0457	1.3634		0.971
	18.0	4.104	3.537	1.0512	1.3671		0.973
	20.0	4.674	3.951	1.0567	1.3708		0.978
	22.0	5.273	4.368	1.0621	1.3745		0.986
	24.0	5.903	4.789	1.0674	1.3782		0.996
Ammonium sulfate (NH ₄) ₂ SO ₄	0.5	0.038	0.038	1.0012	1.3338	0.17	1.008
	1.0	0.076	0.076	1.0042	1.3346	0.33	1.014
	2.0	0.154	0.153	1.0101	1.3363	0.63	1.027
	3.0	0.234	0.231	1.0160	1.3379	0.92	1.041
	4.0	0.315	0.309	1.0220	1.3395	1.21	1.057
	5.0	0.398	0.389	1.0279	1.3411	1.49	1.073
	6.0	0.483	0.469	1.0338	1.3428	1.77	1.090
	7.0	0.570	0.551	1.0397	1.3444	2.05	1.108
	8.0	0.658	0.633	1.0456	1.3460	2.33	1.127
	9.0	0.748	0.716	1.0515	1.3476	2.61	1.147
	10.0	0.841	0.800	1.0574	1.3492	2.89	1.168
	12.0	1.032	0.971	1.0691	1.3523	3.47	1.210
	14.0	1.232	1.145	1.0808	1.3555	4.07	1.256
	16.0	1.441	1.323	1.0924	1.3586	4.69	1.305
	18.0	1.661	1.504	1.1039	1.3616		1.359
	20.0	1.892	1.688	1.1154	1.3647		1.421
	22.0	2.134	1.876	1.1269	1.3677		1.490
	24.0	2.390	2.067	1.1383	1.3707		1.566
	26.0	2.659	2.262	1.1496	1.3737		1.650
	28.0	2.943	2.460	1.1609	1.3766		1.743
	30.0	3.243	2.661	1.1721	1.3795		1.847
	32.0	3.561	2.866	1.1833	1.3824		1.961
	34.0	3.898	3.073	1.1945	1.3853		2.086
	36.0	4.257	3.284	1.2056	1.3881		2.222
	38.0	4.638	3.499	1.2166	1.3909		2.371
	40.0	5.045	3.716	1.2277	1.3938		2.530
Barium chloride BaCl ₂	0.5	0.024	0.024	1.0026	1.3337	0.12	1.009
	1.0	0.049	0.048	1.0070	1.3345	0.23	1.016
	2.0	0.098	0.098	1.0159	1.3360	0.46	1.026
	3.0	0.149	0.148	1.0249	1.3375	0.69	1.037
	4.0	0.200	0.199	1.0341	1.3391	0.93	1.049
	5.0	0.253	0.251	1.0434	1.3406	1.18	1.062
	6.0	0.307	0.303	1.0528	1.3422	1.44	1.075
	7.0	0.361	0.357	1.0624	1.3438	1.70	1.087
	8.0	0.418	0.412	1.0721	1.3454	1.98	1.101
	9.0	0.475	0.468	1.0820	1.3470	2.27	1.114
	10.0	0.534	0.524	1.0921	1.3487	2.58	1.129
	12.0	0.655	0.641	1.1128	1.3520	3.22	1.161
	14.0	0.782	0.763	1.1342	1.3555	3.92	1.195
	16.0	0.915	0.889	1.1564	1.3591	4.69	1.234

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	18.0	1.054	1.019	1.1793	1.3627		1.277
	20.0	1.201	1.156	1.2031	1.3664		1.325
	22.0	1.355	1.297	1.2277	1.3703		1.378
	24.0	1.517	1.444	1.2531	1.3741		1.437
	26.0	1.687	1.597	1.2793	1.3781		1.503
Calcium chloride CaCl_2	0.5	0.045	0.045	1.0024	1.3342	0.22	1.015
	1.0	0.091	0.091	1.0065	1.3354	0.44	1.028
	2.0	0.184	0.183	1.0148	1.3378	0.88	1.050
	3.0	0.279	0.277	1.0232	1.3402	1.33	1.078
	4.0	0.375	0.372	1.0316	1.3426	1.82	1.110
	5.0	0.474	0.469	1.0401	1.3451	2.35	1.143
	6.0	0.575	0.567	1.0486	1.3475	2.93	1.175
	7.0	0.678	0.667	1.0572	1.3500	3.57	1.208
	8.0	0.784	0.768	1.0659	1.3525	4.28	1.242
	9.0	0.891	0.872	1.0747	1.3549	5.04	1.279
	10.0	1.001	0.976	1.0835	1.3575	5.86	1.319
	12.0	1.229	1.191	1.1014	1.3625	7.70	1.408
	14.0	1.467	1.413	1.1198	1.3677	9.83	1.508
	16.0	1.716	1.641	1.1386	1.3730	12.28	1.625
	18.0	1.978	1.878	1.1579	1.3784	15.11	1.764
	20.0	2.253	2.122	1.1775	1.3839	18.30	1.930
	22.0	2.541	2.374	1.1976	1.3895	21.70	2.127
	24.0	2.845	2.634	1.2180	1.3951	25.30	2.356
	26.0	3.166	2.902	1.2388	1.4008	29.70	2.645
	28.0	3.504	3.179	1.2600	1.4066	34.70	3.000
	30.0	3.862	3.464	1.2816	1.4124	41.00	3.467
	32.0	4.240	3.759	1.3036	1.4183	49.70	4.035
	34.0	4.642	4.062	1.3260	1.4242		4.820
	36.0	5.068	4.375	1.3488	1.4301		5.807
	38.0	5.522	4.698	1.3720	1.4361		7.321
	40.0	6.007	5.030	1.3957	1.4420		8.997
Cesium chloride CsCl	0.5	0.030	0.030	1.0020	1.3334	0.10	1.000
	1.0	0.060	0.060	1.0058	1.3337	0.20	0.997
	2.0	0.121	0.120	1.0135	1.3345	0.40	0.992
	3.0	0.184	0.182	1.0214	1.3353	0.61	0.988
	4.0	0.247	0.245	1.0293	1.3361	0.81	0.984
	5.0	0.313	0.308	1.0374	1.3369	1.02	0.980
	6.0	0.379	0.373	1.0456	1.3377	1.22	0.977
	7.0	0.447	0.438	1.0540	1.3386	1.43	0.974
	8.0	0.516	0.505	1.0625	1.3394	1.64	0.971
	9.0	0.587	0.573	1.0711	1.3403	1.85	0.969
	10.0	0.660	0.641	1.0798	1.3412	2.06	0.966
	12.0	0.810	0.782	1.0978	1.3430	2.51	0.961
	14.0	0.967	0.928	1.1163	1.3448	2.97	0.955
	16.0	1.131	1.079	1.1355	1.3468	3.46	0.950
	18.0	1.304	1.235	1.1552	1.3487	3.96	0.945
	20.0	1.485	1.397	1.1756	1.3507	4.49	0.939
	22.0	1.675	1.564	1.1967	1.3528		0.934
	24.0	1.876	1.737	1.2185	1.3550		0.930
	26.0	2.087	1.917	1.2411	1.3572		0.926
	28.0	2.310	2.103	1.2644	1.3594		0.924
	30.0	2.546	2.296	1.2885	1.3617		0.922
	32.0	2.795	2.497	1.3135	1.3641		0.922
	34.0	3.060	2.705	1.3393	1.3666		0.924
	36.0	3.341	2.921	1.3661	1.3691		0.926

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	<i>m</i> /mol kg ⁻¹	<i>c</i> /mol L ⁻¹	ρ /g cm ⁻³	<i>n</i>	Δ /°C	η /mPa s
	38.0	3.640	3.146	1.3938	1.3717		0.930
	40.0	3.960	3.380	1.4226	1.3744		0.934
	42.0	4.301	3.624	1.4525	1.3771		0.940
	44.0	4.667	3.877	1.4835	1.3800		0.947
	46.0	5.060	4.142	1.5158	1.3829		0.956
	48.0	5.483	4.418	1.5495	1.3860		0.967
	50.0	5.940	4.706	1.5846	1.3892		0.981
	60.0	8.910	6.368	1.7868	1.4076		1.120
	64.0	10.560	7.163	1.8842	1.4167		1.238
Citric acid	0.5	0.026	0.026	1.0002	1.3336	0.05	1.013
(HO)C(COOH) ₃	1.0	0.053	0.052	1.0022	1.3343	0.11	1.024
	2.0	0.106	0.105	1.0063	1.3356	0.21	1.048
	3.0	0.161	0.158	1.0105	1.3368	0.32	1.073
	4.0	0.217	0.211	1.0147	1.3381	0.43	1.098
	5.0	0.274	0.265	1.0189	1.3394	0.54	1.125
	6.0	0.332	0.320	1.0232	1.3407	0.65	1.153
	7.0	0.392	0.374	1.0274	1.3420	0.76	1.183
	8.0	0.453	0.430	1.0316	1.3433	0.88	1.214
	9.0	0.515	0.485	1.0359	1.3446	1.00	1.247
	10.0	0.578	0.541	1.0402	1.3459	1.12	1.283
	12.0	0.710	0.655	1.0490	1.3486	1.38	1.357
	14.0	0.847	0.771	1.0580	1.3514	1.66	1.436
	16.0	0.991	0.889	1.0672	1.3541	1.95	1.525
	18.0	1.143	1.008	1.0764	1.3569	2.26	1.625
	20.0	1.301	1.130	1.0858	1.3598	2.57	1.740
	22.0	1.468	1.254	1.0953	1.3626	2.88	1.872
	24.0	1.644	1.380	1.1049	1.3655	3.21	2.017
	26.0	1.829	1.508	1.1147	1.3684	3.55	2.178
	28.0	2.024	1.639	1.1246	1.3714	3.89	2.356
	30.0	2.231	1.772	1.1346	1.3744	4.25	2.549
Copper sulfate	0.5	0.031	0.031	1.0033	1.3339	0.08	1.017
CuSO ₄	1.0	0.063	0.063	1.0085	1.3348	0.14	1.036
	2.0	0.128	0.128	1.0190	1.3367	0.26	1.084
	3.0	0.194	0.194	1.0296	1.3386	0.37	1.129
	4.0	0.261	0.261	1.0403	1.3405	0.48	1.173
	5.0	0.330	0.329	1.0511	1.3424	0.59	1.221
	6.0	0.400	0.399	1.0620	1.3443	0.70	1.276
	7.0	0.472	0.471	1.0730	1.3462	0.82	1.336
	8.0	0.545	0.543	1.0842	1.3481	0.93	1.400
	9.0	0.620	0.618	1.0955	1.3501	1.05	1.469
	10.0	0.696	0.694	1.1070	1.3520	1.18	1.543
	12.0	0.854	0.850	1.1304	1.3560	1.45	1.701
	14.0	1.020	1.013	1.1545	1.3601	1.75	1.889
	16.0	1.193	1.182	1.1796	1.3644		2.136
	18.0	1.375	1.360	1.2059	1.3689		2.449
Disodium ethylenediamine tetraacetate (EDTA sodium)	0.5	0.015	0.015	1.0009	1.3339	0.07	1.017
Na ₂ C ₁₀ H ₁₄ N ₂ O ₈	1.0	0.030	0.030	1.0036	1.3348	0.14	1.032
	1.5	0.045	0.045	1.0062	1.3356	0.21	1.046
	2.0	0.061	0.060	1.0089	1.3365	0.27	1.062
	2.5	0.076	0.075	1.0115	1.3374	0.33	1.077
	3.0	0.092	0.090	1.0142	1.3383	0.40	1.093
	3.5	0.108	0.106	1.0169	1.3392	0.46	1.109
	4.0	0.124	0.121	1.0196	1.3400	0.52	1.125
	4.5	0.140	0.137	1.0223	1.3409	0.58	1.142

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	5.0	0.157	0.152	1.0250	1.3418	0.65	1.160
	5.5	0.173	0.168	1.0277	1.3427	0.71	1.178
	6.0	0.190	0.184	1.0305	1.3436	0.77	1.197
Ethanol $\text{CH}_3\text{CH}_2\text{OH}$	0.5	0.109	0.108	0.9973	1.3333	0.20	1.023
	1.0	0.219	0.216	0.9963	1.3336	0.40	1.046
	2.0	0.443	0.432	0.9945	1.3342	0.81	1.095
	3.0	0.671	0.646	0.9927	1.3348	1.23	1.140
	4.0	0.904	0.860	0.9910	1.3354	1.65	1.183
	5.0	1.142	1.074	0.9893	1.3360	2.09	1.228
	6.0	1.385	1.286	0.9878	1.3367	2.54	1.279
	7.0	1.634	1.498	0.9862	1.3374	2.99	1.331
	8.0	1.887	1.710	0.9847	1.3381	3.47	1.385
	9.0	2.147	1.921	0.9833	1.3388	3.96	1.442
	10.0	2.412	2.131	0.9819	1.3395	4.47	1.501
	12.0	2.960	2.551	0.9792	1.3410	5.56	1.627
	14.0	3.534	2.967	0.9765	1.3425	6.73	1.761
	16.0	4.134	3.382	0.9739	1.3440	8.01	1.890
	18.0	4.765	3.795	0.9713	1.3455	9.40	2.019
	20.0	5.427	4.205	0.9687	1.3469	10.92	2.142
	22.0	6.122	4.613	0.9660	1.3484	12.60	2.259
	24.0	6.855	5.018	0.9632	1.3498	14.47	2.370
	26.0	7.626	5.419	0.9602	1.3511	16.41	2.476
	28.0	8.441	5.817	0.9571	1.3524	18.43	2.581
	30.0	9.303	6.212	0.9539	1.3535	20.47	2.667
	32.0	10.215	6.601	0.9504	1.3546	22.44	2.726
	34.0	11.182	6.987	0.9468	1.3557	24.27	2.768
	36.0	12.210	7.370	0.9431	1.3566	25.98	2.803
	38.0	13.304	7.747	0.9392	1.3575	27.62	2.829
	40.0	14.471	8.120	0.9352	1.3583	29.26	2.846
	42.0	15.718	8.488	0.9311	1.3590	30.98	2.852
	44.0	17.055	8.853	0.9269	1.3598	32.68	2.850
	46.0	18.490	9.213	0.9227	1.3604	34.36	2.843
	48.0	20.036	9.568	0.9183	1.3610	36.04	2.832
	50.0	21.706	9.919	0.9139	1.3616	37.67	2.813
	60.0	32.559	11.605	0.8911	1.3638	44.93	2.547
	70.0	50.648	13.183	0.8676	1.3652		2.214
	80.0	86.824	14.649	0.8436	1.3658		1.881
	90.0	195.355	15.980	0.8180	1.3650		1.542
	92.0	249.620	16.225	0.8125	1.3646		1.475
	94.0	340.062	16.466	0.8070	1.3642		1.407
	96.0	520.946	16.697	0.8013	1.3636		1.342
	98.0		16.920	0.7954	1.3630		1.273
	100.0		17.133	0.7893	1.3614		1.203
Ethylene glycol $(\text{CH}_2\text{OH})_2$	0.5	0.081	0.080	0.9988	1.3335	0.15	1.010
	1.0	0.163	0.161	0.9995	1.3339	0.30	1.020
	2.0	0.329	0.322	1.0007	1.3348	0.61	1.048
	3.0	0.498	0.484	1.0019	1.3358	0.92	1.074
	4.0	0.671	0.646	1.0032	1.3367	1.24	1.099
	5.0	0.848	0.809	1.0044	1.3377	1.58	1.125
	6.0	1.028	0.972	1.0057	1.3386	1.91	1.153
	7.0	1.213	1.136	1.0070	1.3396	2.26	1.182
	8.0	1.401	1.299	1.0082	1.3405	2.62	1.212
	9.0	1.593	1.464	1.0095	1.3415	2.99	1.243
	10.0	1.790	1.628	1.0108	1.3425	3.37	1.277
	12.0	2.197	1.959	1.0134	1.3444	4.16	1.348

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	14.0	2.623	2.292	1.0161	1.3464	5.01	1.424
	16.0	3.069	2.626	1.0188	1.3484	5.91	1.500
	18.0	3.537	2.962	1.0214	1.3503	6.89	1.578
	20.0	4.028	3.300	1.0241	1.3523	7.93	1.661
	24.0	5.088	3.981	1.0296	1.3564	10.28	1.843
	28.0	6.265	4.669	1.0350	1.3605	13.03	2.047
	32.0	7.582	5.364	1.0405	1.3646	16.23	2.280
	36.0	9.062	6.067	1.0460	1.3687	19.82	2.537
	40.0	10.741	6.776	1.0514	1.3728	23.84	2.832
	44.0	12.659	7.491	1.0567	1.3769	28.32	3.166
	48.0	14.872	8.212	1.0619	1.3811	33.30	3.544
	52.0	17.453	8.939	1.0670	1.3851	38.81	3.981
	56.0	20.505	9.671	1.0719	1.3892	44.83	4.475
	60.0	24.166	10.406	1.0765	1.3931	51.23	5.026
Ferric chloride FeCl_3	0.5	0.031	0.031	1.0025	1.3344	0.21	1.024
	1.0	0.062	0.062	1.0068	1.3358	0.39	1.047
	2.0	0.126	0.125	1.0153	1.3386	0.75	1.093
	3.0	0.191	0.189	1.0238	1.3413	1.15	1.139
	4.0	0.257	0.255	1.0323	1.3441	1.56	1.187
	5.0	0.324	0.321	1.0408	1.3468	2.00	1.238
	6.0	0.394	0.388	1.0493	1.3496	2.48	1.292
	7.0	0.464	0.457	1.0580	1.3524	2.99	1.350
	8.0	0.536	0.526	1.0668	1.3552	3.57	1.412
	9.0	0.610	0.597	1.0760	1.3581	4.19	1.480
	10.0	0.685	0.669	1.0853	1.3611	4.85	1.553
	12.0	0.841	0.817	1.1040	1.3670	6.38	1.707
	14.0	1.004	0.969	1.1228	1.3730	8.22	1.879
	16.0	1.174	1.126	1.1420		10.45	2.080
	18.0	1.353	1.289	1.1615		13.08	2.311
	20.0	1.541	1.457	1.1816		16.14	2.570
	24.0	1.947	1.810	1.2234		23.79	3.178
	28.0	2.398	2.189	1.2679		33.61	4.038
	32.0	2.901	2.595	1.3153		49.16	5.274
	36.0	3.468	3.030	1.3654			7.130
	40.0	4.110	3.496	1.4176			9.674
Formic acid HCOOH	0.5	0.109	0.109	0.9994	1.3333	0.21	1.006
	1.0	0.219	0.217	1.0006	1.3336	0.42	1.011
	2.0	0.443	0.436	1.0029	1.3342	0.82	1.017
	3.0	0.672	0.655	1.0053	1.3348	1.24	1.195
	4.0	0.905	0.876	1.0077	1.3354	1.67	1.032
	5.0	1.143	1.097	1.0102	1.3359	2.10	1.039
	6.0	1.387	1.320	1.0126	1.3365	2.53	1.046
	7.0	1.635	1.544	1.0150	1.3371	2.97	1.052
	8.0	1.889	1.768	1.0175	1.3376	3.40	1.058
	9.0	2.149	1.994	1.0199	1.3382	3.84	1.064
	10.0	2.414	2.221	1.0224	1.3387	4.27	1.070
	12.0	2.962	2.678	1.0273	1.3397	5.19	1.082
	14.0	3.537	3.139	1.0322	1.3408	6.11	1.094
	16.0	4.138	3.605	1.0371	1.3418	7.06	1.106
	18.0	4.769	4.074	1.0419	1.3428	8.08	1.119
	20.0	5.431	4.548	1.0467	1.3437	9.11	1.132
	28.0	8.449	6.481	1.0654	1.3475	13.10	1.179
	36.0	12.220	8.477	1.0839	1.3511	17.65	1.227
	44.0	17.070	10.529	1.1015	1.3547	22.93	1.281
	52.0	23.535	12.633	1.1183	1.3581	29.69	1.340

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	60.0	32.587	14.813	1.1364	1.3612	38.26	1.410
	68.0	46.166	17.054	1.1544	1.3641		1.490
D-Fructose $\text{C}_6\text{H}_{12}\text{O}_6$	0.5	0.028	0.028	1.0002	1.3337	0.05	1.015
	1.0	0.056	0.056	1.0021	1.3344	0.10	1.028
	2.0	0.113	0.112	1.0061	1.3358	0.21	1.054
	3.0	0.172	0.168	1.0101	1.3373	0.32	1.080
	4.0	0.231	0.225	1.0140	1.3387	0.43	1.106
	5.0	0.292	0.283	1.0181	1.3402	0.54	1.134
	6.0	0.354	0.340	1.0221	1.3417	0.66	1.165
	7.0	0.418	0.399	1.0262	1.3431	0.78	1.198
	8.0	0.483	0.458	1.0303	1.3446	0.90	1.232
	9.0	0.549	0.517	1.0344	1.3461	1.03	1.270
	10.0	0.617	0.576	1.0385	1.3476	1.16	1.309
	12.0	0.757	0.697	1.0469	1.3507	1.43	1.391
	14.0	0.904	0.820	1.0554	1.3538	1.71	1.483
	16.0	1.057	0.945	1.0640	1.3569	2.01	1.587
	18.0	1.218	1.072	1.0728	1.3601	2.32	1.703
	20.0	1.388	1.201	1.0816	1.3634	2.64	1.837
	22.0	1.566	1.332	1.0906	1.3667	3.05	1.986
	24.0	1.753	1.465	1.0996	1.3700	3.43	2.154
	26.0	1.950	1.600	1.1089	1.3734	3.82	2.348
	28.0	2.159	1.738	1.1182	1.3768	4.20	2.562
	30.0	2.379	1.878	1.1276	1.3803		2.817
	32.0	2.612	2.020	1.1372	1.3839		3.112
	34.0	2.859	2.164	1.1469	1.3874		3.462
	36.0	3.122	2.312	1.1568	1.3911		3.899
	38.0	3.402	2.461	1.1668	1.3948		4.418
	40.0	3.700	2.613	1.1769	1.3985		5.046
	42.0	4.019	2.767	1.1871	1.4023		5.773
	44.0	4.361	2.925	1.1975	1.4062		6.644
	46.0	4.728	3.084	1.2080	1.4101		7.753
	48.0	5.124	3.247	1.2187	1.4141		9.060
D-Glucose $\text{C}_6\text{H}_{12}\text{O}_6$	0.5	0.028	0.028	1.0001	1.3337	0.05	1.010
	1.0	0.056	0.056	1.0020	1.3344	0.11	1.021
	2.0	0.113	0.112	1.0058	1.3358	0.21	1.052
	3.0	0.172	0.168	1.0097	1.3373	0.32	1.083
	4.0	0.231	0.225	1.0136	1.3387	0.43	1.113
	5.0	0.292	0.282	1.0175	1.3402	0.55	1.145
	6.0	0.354	0.340	1.0214	1.3417	0.67	1.179
	7.0	0.418	0.398	1.0254	1.3432	0.79	1.214
	8.0	0.483	0.457	1.0294	1.3447	0.91	1.250
	9.0	0.549	0.516	1.0334	1.3462	1.04	1.289
	10.0	0.617	0.576	1.0375	1.3477	1.17	1.330
	12.0	0.757	0.697	1.0457	1.3508	1.44	1.416
	14.0	0.904	0.819	1.0540	1.3539	1.73	1.512
	16.0	1.057	0.944	1.0624	1.3571	2.03	1.625
	18.0	1.218	1.070	1.0710	1.3603	2.35	1.757
	20.0	1.388	1.199	1.0797	1.3635	2.70	1.904
	22.0	1.566	1.329	1.0884	1.3668	3.07	2.063
	24.0	1.753	1.462	1.0973	1.3702	3.48	2.242
	26.0	1.950	1.597	1.1063	1.3736	3.90	2.458
	28.0	2.159	1.734	1.1154	1.3770	4.34	2.707
	30.0	2.379	1.873	1.1246	1.3805	4.79	2.998
	32.0	2.612	2.014	1.1340	1.3840		3.324
	34.0	2.859	2.158	1.1434	1.3876		3.704

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	36.0	3.122	2.304	1.1529	1.3912		4.193
	38.0	3.402	2.452	1.1626	1.3949		4.786
	40.0	3.700	2.603	1.1724	1.3986		5.493
	42.0	4.019	2.756	1.1823	1.4024		6.288
	44.0	4.361	2.912	1.1924	1.4062		7.235
	46.0	4.728	3.071	1.2026	1.4101		8.454
	48.0	5.124	3.232	1.2130	1.4141		9.883
	50.0	5.551	3.396	1.2235	1.4181		11.884
	52.0	6.013	3.562	1.2342	1.4222		14.489
	54.0	6.516	3.732	1.2451	1.4263		17.916
	56.0	7.064	3.905	1.2562	1.4306		22.886
	58.0	7.665	4.081	1.2676	1.4349		29.389
	60.0	8.326	4.261	1.2793	1.4394		37.445
Glycerol	0.5	0.055	0.054	0.9994	1.3336	0.07	1.011
CH ₂ OHCHOHCH ₂ OH	1.0	0.110	0.109	1.0005	1.3342	0.18	1.022
	2.0	0.222	0.218	1.0028	1.3353	0.41	1.048
	3.0	0.336	0.327	1.0051	1.3365	0.63	1.074
	4.0	0.452	0.438	1.0074	1.3376	0.85	1.100
	5.0	0.572	0.548	1.0097	1.3388	1.08	1.127
	6.0	0.693	0.659	1.0120	1.3400	1.32	1.157
	7.0	0.817	0.771	1.0144	1.3412	1.56	1.188
	8.0	0.944	0.883	1.0167	1.3424	1.81	1.220
	9.0	1.074	0.996	1.0191	1.3436	2.06	1.256
	10.0	1.207	1.109	1.0215	1.3448	2.32	1.291
	12.0	1.481	1.337	1.0262	1.3472	2.88	1.365
	14.0	1.768	1.568	1.0311	1.3496	3.47	1.445
	16.0	2.068	1.800	1.0360	1.3521	4.09	1.533
	18.0	2.384	2.035	1.0409	1.3547	4.76	1.630
	20.0	2.715	2.271	1.0459	1.3572	5.46	1.737
	24.0	3.429	2.752	1.0561	1.3624	7.01	1.988
	28.0	4.223	3.242	1.0664	1.3676	8.77	2.279
	32.0	5.110	3.742	1.0770	1.3730	10.74	2.637
	36.0	6.108	4.252	1.0876	1.3785	12.96	3.088
	40.0	7.239	4.771	1.0984	1.3841	15.50	3.653
	44.0	8.532	5.300	1.1092	1.3897		4.443
	48.0	10.024	5.838	1.1200	1.3954		5.413
	52.0	11.764	6.385	1.1308	1.4011		6.666
	56.0	13.820	6.944	1.1419	1.4069		8.349
	60.0	16.288	7.512	1.1530	1.4129		10.681
	64.0	19.305	8.092	1.1643	1.4189		13.657
	68.0	23.075	8.680	1.1755	1.4249		18.457
	72.0	27.923	9.277	1.1866	1.4310		27.625
	76.0	34.387	9.884	1.1976	1.4370		40.571
	80.0	43.436	10.498	1.2085	1.4431		59.900
	84.0	57.009	11.121	1.2192	1.4492		84.338
	88.0	79.632	11.753	1.2299	1.4553		147.494
	92.0	124.878	12.392	1.2404	1.4613		384.467
	96.0	260.615	13.039	1.2508	1.4674		780.458
	100.0		13.694	1.2611	1.4735		
Hydrochloric acid	0.5	0.138	0.137	1.0007	1.3341	0.49	1.008
HCl	1.0	0.277	0.275	1.0031	1.3353	0.99	1.015
	2.0	0.560	0.553	1.0081	1.3376	2.08	1.029
	3.0	0.848	0.833	1.0130	1.3399	3.28	1.044
	4.0	1.143	1.117	1.0179	1.3422	4.58	1.059
	5.0	1.444	1.403	1.0228	1.3445	5.98	1.075

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	6.0	1.751	1.691	1.0278	1.3468	7.52	1.091
	7.0	2.064	1.983	1.0327	1.3491	9.22	1.108
	8.0	2.385	2.277	1.0377	1.3515	11.10	1.125
	9.0	2.713	2.574	1.0426	1.3538	13.15	1.143
	10.0	3.047	2.873	1.0476	1.3561	15.40	1.161
	12.0	3.740	3.481	1.0576	1.3607	20.51	1.199
	14.0	4.465	4.099	1.0676	1.3653		1.239
	16.0	5.224	4.729	1.0777	1.3700		1.282
	18.0	6.020	5.370	1.0878	1.3746		1.326
	20.0	6.857	6.023	1.0980	1.3792		1.374
	22.0	7.736	6.687	1.1083	1.3838		1.426
	24.0	8.661	7.362	1.1185	1.3884		1.483
	26.0	9.636	8.049	1.1288	1.3930		1.547
	28.0	10.666	8.748	1.1391	1.3976		1.620
	30.0	11.754	9.456	1.1492	1.4020		1.705
	32.0	12.907	10.175	1.1594	1.4066		1.799
	34.0	14.129	10.904	1.1693	1.4112		1.900
	36.0	15.427	11.642	1.1791	1.4158		2.002
	38.0	16.810	12.388	1.1886	1.4204		2.105
	40.0	18.284	13.140	1.1977	1.4250		
Lactic acid	0.5	0.056	0.055	0.9992	1.3335	0.10	1.014
CH ₃ CHOHCOOH	1.0	0.112	0.111	1.0002	1.3340	0.19	1.027
	2.0	0.227	0.223	1.0023	1.3350	0.38	1.056
	3.0	0.343	0.334	1.0043	1.3360	0.57	1.084
	4.0	0.463	0.447	1.0065	1.3370	0.76	1.110
	5.0	0.584	0.560	1.0086	1.3380	0.95	1.138
	6.0	0.709	0.673	1.0108	1.3390	1.16	1.167
	7.0	0.836	0.787	1.0131	1.3400	1.36	1.198
	8.0	0.965	0.902	1.0153	1.3410	1.57	1.229
	9.0	1.098	1.017	1.0176	1.3420	1.79	1.262
	10.0	1.233	1.132	1.0199	1.3430	2.02	1.296
	12.0	1.514	1.365	1.0246	1.3450	2.49	1.366
	14.0	1.807	1.600	1.0294	1.3470	2.99	1.441
	16.0	2.115	1.837	1.0342	1.3491	3.48	1.522
	18.0	2.437	2.076	1.0390	1.3511	3.96	1.607
	20.0	2.775	2.318	1.0439	1.3532	4.44	1.699
	24.0	3.506	2.807	1.0536	1.3573		1.902
	28.0	4.317	3.305	1.0632	1.3615		2.136
	32.0	5.224	3.811	1.0728	1.3657		2.414
	36.0	6.244	4.325	1.0822	1.3700		2.730
	40.0	7.401	4.847	1.0915	1.3743		3.114
	44.0	8.722	5.377	1.1008	1.3786		3.566
	48.0	10.247	5.917	1.1105	1.3828		4.106
	52.0	12.026	6.466	1.1201	1.3871		4.789
	56.0	14.129	7.023	1.1297	1.3914		5.579
	60.0	16.652	7.588	1.1392	1.3958		6.679
	64.0	19.736	8.161	1.1486	1.4001		8.024
	68.0	23.590	8.741	1.1579	1.4045		9.863
	72.0	28.546	9.328	1.1670	1.4088		12.866
	76.0	35.154	9.922	1.1760	1.4131		16.974
	80.0	44.405	10.522	1.1848	1.4173		22.164
Lactose	0.5	0.015	0.015	1.0002	1.3337	0.03	1.013
C ₁₂ H ₂₂ O ₁₁	1.0	0.030	0.029	1.0021	1.3345	0.06	1.026
	2.0	0.060	0.059	1.0061	1.3359	0.11	1.058
	3.0	0.090	0.089	1.0102	1.3375	0.17	1.089
	4.0	0.122	0.119	1.0143	1.3390	0.23	1.120

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	5.0	0.154	0.149	1.0184	1.3406	0.29	1.154
	6.0	0.186	0.179	1.0225	1.3421	0.35	1.191
	7.0	0.220	0.210	1.0267	1.3437	0.42	1.232
	8.0	0.254	0.241	1.0308	1.3453	0.50	1.276
	9.0	0.289	0.272	1.0349	1.3468		1.321
	10.0	0.325	0.304	1.0390	1.3484		1.370
	12.0	0.398	0.367	1.0473	1.3515		1.476
	14.0	0.476	0.432	1.0558	1.3548		1.593
	16.0	0.556	0.498	1.0648	1.3582		1.724
	18.0	0.641	0.565	1.0746	1.3619		1.869
Lithium chloride	0.5	0.119	0.118	1.0012	1.3341	0.42	1.019
	1.0	0.238	0.237	1.0041	1.3351	0.84	1.037
LiCl	2.0	0.481	0.476	1.0099	1.3373	1.72	1.072
	3.0	0.730	0.719	1.0157	1.3394	2.68	1.108
	4.0	0.983	0.964	1.0215	1.3415	3.73	1.146
	5.0	1.241	1.211	1.0272	1.3436	4.86	1.185
	6.0	1.506	1.462	1.0330	1.3457	6.14	1.226
	7.0	1.775	1.715	1.0387	1.3478	7.56	1.269
	8.0	2.051	1.971	1.0444	1.3499	9.11	1.313
	9.0	2.333	2.230	1.0502	1.3520	10.79	1.360
	10.0	2.621	2.491	1.0560	1.3541	12.61	1.411
	12.0	3.217	3.022	1.0675	1.3583	16.59	1.522
	14.0	3.840	3.564	1.0792	1.3625	21.04	1.647
	16.0	4.493	4.118	1.0910	1.3668		1.787
	18.0	5.178	4.683	1.1029	1.3711		1.942
	20.0	5.897	5.260	1.1150	1.3755		2.128
	22.0	6.653	5.851	1.1274	1.3799		2.341
	24.0	7.449	6.453	1.1399	1.3844		2.600
	26.0	8.288	7.069	1.1527	1.3890		2.925
	28.0	9.173	7.700	1.1658	1.3936		3.318
	30.0	10.109	8.344	1.1791	1.3983		3.785
Magnesium chloride	0.5	0.053	0.053	1.0022	1.3343	0.26	1.024
	1.0	0.106	0.106	1.0062	1.3356	0.52	1.046
MgCl ₂	2.0	0.214	0.213	1.0144	1.3381	1.06	1.091
	3.0	0.325	0.322	1.0226	1.3406	1.65	1.139
	4.0	0.438	0.433	1.0309	1.3432	2.30	1.188
	5.0	0.553	0.546	1.0394	1.3457	3.01	1.241
	6.0	0.670	0.660	1.0479	1.3483		1.298
	7.0	0.791	0.777	1.0564	1.3508		1.358
	8.0	0.913	0.895	1.0651	1.3534		1.423
	9.0	1.039	1.015	1.0738	1.3560		1.493
	10.0	1.167	1.137	1.0826	1.3587		1.570
	12.0	1.432	1.387	1.1005	1.3641		1.745
	14.0	1.710	1.645	1.1189	1.3695		1.956
	16.0	2.001	1.911	1.1372	1.3749		2.207
	18.0	2.306	2.184	1.1553	1.3804		2.507
	20.0	2.626	2.467	1.1742	1.3859		2.867
	22.0	2.962	2.758	1.1938	1.3915		3.323
	24.0	3.317	3.060	1.2140	1.3972		3.917
	26.0	3.690	3.371	1.2346	1.4030		4.694
	28.0	4.085	3.692	1.2555	1.4089		5.709
	30.0	4.501	4.022	1.2763	1.4148		7.017
Magnesium sulfate	0.5	0.042	0.042	1.0033	1.3340	0.10	1.027
	1.0	0.084	0.084	1.0084	1.3350	0.19	1.054
MgSO ₄	2.0	0.170	0.169	1.0186	1.3371	0.36	1.112

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	3.0	0.257	0.256	1.0289	1.3391	0.52	1.177
	4.0	0.346	0.345	1.0392	1.3411	0.69	1.249
	5.0	0.437	0.436	1.0497	1.3431	0.87	1.328
	6.0	0.530	0.528	1.0602	1.3451	1.05	1.411
	7.0	0.625	0.623	1.0708	1.3471	1.24	1.498
	8.0	0.722	0.719	1.0816	1.3492	1.43	1.593
	9.0	0.822	0.817	1.0924	1.3512	1.64	1.702
	10.0	0.923	0.917	1.1034	1.3532	1.85	1.829
	12.0	1.133	1.122	1.1257	1.3572	2.31	2.104
	14.0	1.352	1.336	1.1484	1.3613	2.86	2.412
	16.0	1.582	1.557	1.1717	1.3654	3.67	2.809
	18.0	1.824	1.788	1.1955	1.3694		3.360
	20.0	2.077	2.027	1.2198	1.3735		4.147
	22.0	2.343	2.275	1.2447	1.3776		5.199
	24.0	2.624	2.532	1.2701	1.3817		6.498
	26.0	2.919	2.800	1.2961	1.3858		8.066
Maltose	0.5	0.015	0.015	1.0003	1.3337	0.03	1.016
$\text{C}_{12}\text{H}_{22}\text{O}_{11}$	1.0	0.030	0.029	1.0023	1.3345	0.06	1.030
	2.0	0.060	0.059	1.0063	1.3359	0.11	1.060
	3.0	0.090	0.089	1.0104	1.3374	0.17	1.092
	4.0	0.122	0.119	1.0144	1.3389	0.23	1.126
	5.0	0.154	0.149	1.0184	1.3404	0.29	1.162
	6.0	0.186	0.179	1.0224	1.3420	0.35	1.200
	7.0	0.220	0.210	1.0265	1.3435	0.42	1.239
	8.0	0.254	0.241	1.0305	1.3450	0.48	1.281
	9.0	0.289	0.272	1.0345	1.3466	0.55	1.325
	10.0	0.325	0.303	1.0385	1.3482	0.62	1.372
	12.0	0.398	0.367	1.0465	1.3513	0.77	1.474
	14.0	0.476	0.431	1.0545	1.3546	0.92	1.588
	16.0	0.556	0.497	1.0629	1.3578	1.08	1.715
	18.0	0.641	0.564	1.0716	1.3612	1.25	1.859
	20.0	0.730	0.631	1.0801	1.3644	1.43	2.021
	22.0	0.824	0.700	1.0894	1.3678	1.64	2.216
	24.0	0.923	0.770	1.0984	1.3714	1.85	2.463
	26.0	1.026	0.842	1.1080	1.3749	2.08	2.753
	28.0	1.136	0.914	1.1171	1.3785	2.34	3.066
	30.0	1.252	0.988	1.1269	1.3821	2.62	3.427
	40.0	1.948	1.375	1.1769	1.4013	4.41	6.926
	50.0	2.921	1.797	1.2304	1.4217		17.786
	52.0	3.165	1.886	1.2416	1.4260		22.034
	54.0	3.429	1.976	1.2528	1.4308		28.757
	56.0	3.718	2.068	1.2638	1.4350		38.226
	58.0	4.034	2.159	1.2740	1.4394		49.298
	60.0	4.382	2.253	1.2855	1.4440		
Manganese(II)	1.0	0.067	0.067	1.0080	1.3348	0.16	1.046
sulfate	2.0	0.135	0.135	1.0178	1.3366	0.31	1.090
MnSO_4	3.0	0.205	0.204	1.0277	1.3384	0.44	1.137
	4.0	0.276	0.275	1.0378	1.3402	0.57	1.187
	5.0	0.349	0.347	1.0480	1.3420	0.70	1.242
	6.0	0.423	0.421	1.0583	1.3438	0.84	1.301
	7.0	0.498	0.495	1.0688	1.3457	0.98	1.363
	8.0	0.576	0.572	1.0794	1.3475	1.12	1.431
	9.0	0.655	0.650	1.0902	1.3494	1.28	1.505
	10.0	0.736	0.729	1.1012	1.3513	1.44	1.587
	12.0	0.903	0.893	1.1236	1.3551	1.80	1.779

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	14.0	1.078	1.063	1.1467	1.3589	2.21	2.005
	16.0	1.261	1.240	1.1705	1.3629	2.67	2.272
	18.0	1.454	1.424	1.1950	1.3668	3.19	2.580
	20.0	1.656	1.616	1.2203	1.3708	3.80	2.938
D-Mannitol	0.5	0.028	0.027	1.0000	1.3337	0.05	1.019
$\text{CH}_2(\text{CHOH})_4\text{CH}_2\text{OH}$	1.0	0.055	0.055	1.0017	1.3345	0.10	1.032
	2.0	0.112	0.110	1.0053	1.3359	0.21	1.057
	3.0	0.170	0.166	1.0088	1.3374	0.32	1.081
	4.0	0.229	0.222	1.0124	1.3389	0.43	1.107
	5.0	0.289	0.279	1.0159	1.3403	0.54	1.135
	6.0	0.350	0.336	1.0195	1.3418	0.66	1.166
	7.0	0.413	0.393	1.0230	1.3433	0.77	1.200
	8.0	0.477	0.451	1.0266	1.3447	0.90	1.236
	9.0	0.543	0.509	1.0302	1.3462	1.02	1.275
	10.0	0.610	0.567	1.0338	1.3477	1.15	1.314
	11.0	0.678	0.626	1.0375	1.3491	1.28	1.355
	12.0	0.749	0.686	1.0412	1.3506	1.41	1.398
	13.0	0.820	0.746	1.0450	1.3521	1.55	1.443
	14.0	0.894	0.806	1.0489	1.3536	1.69	1.489
	15.0	0.969	0.867	1.0529	1.3552	1.84	1.537
Methanol	0.5	0.157	0.156	0.9973	1.3331	0.28	1.022
CH_3OH	1.0	0.315	0.311	0.9964	1.3332	0.56	1.040
	2.0	0.637	0.621	0.9947	1.3334	1.14	1.070
	3.0	0.965	0.930	0.9930	1.3336	1.75	1.100
	4.0	1.300	1.238	0.9913	1.3339	2.37	1.131
	5.0	1.643	1.544	0.9896	1.3341	3.02	1.163
	6.0	1.992	1.850	0.9880	1.3343	3.71	1.196
	7.0	2.349	2.155	0.9864	1.3346	4.41	1.229
	8.0	2.714	2.459	0.9848	1.3348	5.13	1.264
	9.0	3.087	2.762	0.9832	1.3351	5.85	1.297
	10.0	3.468	3.064	0.9816	1.3354	6.60	1.329
	12.0	4.256	3.665	0.9785	1.3359	8.14	1.389
	14.0	5.081	4.262	0.9755	1.3365	9.72	1.446
	16.0	5.945	4.856	0.9725	1.3370	11.36	1.501
	18.0	6.851	5.447	0.9695	1.3376	13.13	1.554
	20.0	7.803	6.034	0.9666	1.3381	15.02	1.604
	22.0	8.803	6.616	0.9636	1.3387	16.98	1.652
	24.0	9.856	7.196	0.9606	1.3392	19.04	1.697
	26.0	10.966	7.771	0.9576	1.3397	21.23	1.735
	28.0	12.138	8.341	0.9545	1.3402	23.59	1.769
	30.0	13.376	8.908	0.9514	1.3407	25.91	1.795
	32.0	14.688	9.470	0.9482	1.3411	28.15	1.814
	34.0	16.078	10.028	0.9450	1.3415	30.48	1.827
	36.0	17.556	10.580	0.9416	1.3419	32.97	1.835
	38.0	19.129	11.127	0.9382	1.3422	35.60	1.839
	40.0	20.807	11.669	0.9347	1.3425	38.60	1.837
	50.0	31.211	14.288	0.9156	1.3431	54.50	1.761
	60.0	46.816	16.749	0.8944	1.3426	74.50	1.600
	70.0	72.826	19.040	0.8715	1.3411		1.368
	80.0	124.844	21.144	0.8468	1.3385		1.128
	90.0	280.899	23.045	0.8204	1.3348		0.861
	100.0		24.710	0.7917	1.3290		0.586
Nitric acid	0.5	0.080	0.079	1.0009	1.3336	0.28	1.004
HNO_3	1.0	0.160	0.159	1.0037	1.3343	0.56	1.005
	2.0	0.324	0.320	1.0091	1.3356	1.12	1.007

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta^\circ\text{C}$	$\eta/\text{mPa s}$
	3.0	0.491	0.483	1.0146	1.3368	1.70	1.010
	4.0	0.661	0.648	1.0202	1.3381	2.32	1.014
	5.0	0.835	0.814	1.0257	1.3394	2.96	1.018
	6.0	1.013	0.982	1.0314	1.3407	3.63	1.022
	7.0	1.194	1.152	1.0370	1.3421	4.33	1.027
	8.0	1.380	1.324	1.0427	1.3434	5.05	1.032
	9.0	1.570	1.498	1.0485	1.3447	5.81	1.038
	10.0	1.763	1.673	1.0543	1.3460	6.60	1.044
	12.0	2.164	2.030	1.0660	1.3487	8.27	1.058
	14.0	2.583	2.395	1.0780	1.3514	10.08	1.075
	16.0	3.023	2.768	1.0901	1.3541	12.04	1.094
	18.0	3.484	3.149	1.1025	1.3569	14.16	1.116
	20.0	3.967	3.539	1.1150	1.3596		1.141
	22.0	4.476	3.937	1.1277	1.3624		1.169
	24.0	5.011	4.344	1.1406	1.3652		1.199
	26.0	5.576	4.760	1.1536	1.3680		1.233
	28.0	6.172	5.185	1.1668	1.3708		1.271
	30.0	6.801	5.618	1.1801	1.3736		1.311
	32.0	7.468	6.060	1.1934	1.3763		1.354
	34.0	8.175	6.512	1.2068	1.3790		1.400
	36.0	8.927	6.971	1.2202	1.3817		1.450
	38.0	9.727	7.439	1.2335	1.3842		1.504
	40.0	10.580	7.913	1.2466	1.3867		1.561
Oxalic acid (COOH) ₂	0.5	0.056	0.056	1.0006	1.3336	0.16	1.013
	1.0	0.112	0.111	1.0030	1.3342	0.30	1.023
	1.5	0.169	0.167	1.0054	1.3347	0.44	1.033
	2.0	0.227	0.224	1.0079	1.3353	0.57	1.044
	2.5	0.285	0.281	1.0103	1.3359	0.71	1.055
	3.0	0.343	0.337	1.0126	1.3364	0.84	1.065
	3.5	0.403	0.395	1.0150	1.3370	0.97	1.076
	4.0	0.463	0.452	1.0174	1.3375	1.09	1.086
	4.5	0.523	0.510	1.0197	1.3381		1.097
	5.0	0.585	0.568	1.0220	1.3386		1.108
	6.0	0.709	0.684	1.0265	1.3397		1.129
	7.0	0.836	0.802	1.0310	1.3407		1.150
	8.0	0.966	0.920	1.0355	1.3418		1.172
Phosphoric acid H ₃ PO ₄	0.5	0.051	0.051	1.0010	1.3335	0.12	1.010
	1.0	0.103	0.102	1.0038	1.3340	0.24	1.020
	2.0	0.208	0.206	1.0092	1.3349	0.46	1.050
	3.0	0.316	0.311	1.0146	1.3358	0.69	1.079
	4.0	0.425	0.416	1.0200	1.3367	0.93	1.108
	5.0	0.537	0.523	1.0254	1.3376	1.16	1.138
	6.0	0.651	0.631	1.0309	1.3385	1.38	1.169
	7.0	0.768	0.740	1.0363	1.3394	1.62	1.200
	8.0	0.887	0.850	1.0418	1.3403	1.88	1.232
	9.0	1.009	0.962	1.0474	1.3413	2.16	1.267
	10.0	1.134	1.075	1.0531	1.3422	2.45	1.303
	12.0	1.392	1.304	1.0647	1.3441	3.01	1.382
	14.0	1.661	1.538	1.0765	1.3460	3.76	1.469
	16.0	1.944	1.777	1.0885	1.3480	4.45	1.565
	18.0	2.240	2.022	1.1009	1.3500	5.25	1.671
	20.0	2.551	2.273	1.1135	1.3520	6.23	1.788
	22.0	2.878	2.529	1.1263	1.3540	7.38	1.914
	24.0	3.223	2.791	1.1395	1.3561	8.69	2.049
	26.0	3.585	3.059	1.1528	1.3582	10.12	2.198

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	28.0	3.968	3.333	1.1665	1.3604	11.64	2.365
	30.0	4.373	3.614	1.1804	1.3625	13.23	2.553
	32.0	4.802	3.901	1.1945	1.3647	14.94	2.766
	34.0	5.257	4.194	1.2089	1.3669	16.81	3.001
	36.0	5.740	4.495	1.2236	1.3691	18.85	3.260
	38.0	6.254	4.803	1.2385	1.3713	21.09	3.544
	40.0	6.803	5.117	1.2536	1.3735	23.58	3.856
Potassium bicarbonate KHCO_3	0.5	0.050	0.050	1.0014	1.3335	0.18	1.009
	1.0	0.101	0.100	1.0046	1.3341	0.34	1.015
	2.0	0.204	0.202	1.0114	1.3353	0.67	1.027
	3.0	0.309	0.305	1.0181	1.3365	0.98	1.040
	4.0	0.416	0.409	1.0247	1.3376	1.29	1.053
	5.0	0.526	0.515	1.0310	1.3386	1.60	1.067
	6.0	0.638	0.622	1.0379	1.3397	1.91	1.081
	7.0	0.752	0.730	1.0446	1.3409	2.22	1.096
	8.0	0.869	0.840	1.0514	1.3419	2.53	1.112
	9.0	0.988	0.951	1.0581	1.3430	2.84	1.128
	10.0	1.110	1.064	1.0650	1.3441	3.16	1.145
	12.0	1.362	1.293	1.0788	1.3462	3.79	1.183
	14.0	1.626	1.528	1.0929	1.3484	4.41	1.224
	16.0	1.903	1.770	1.1073	1.3506		1.270
	18.0	2.193	2.017	1.1221	1.3528		1.319
	20.0	2.497	2.272	1.1372	1.3550		1.373
	22.0	2.817	2.533	1.1527	1.3572		1.432
	24.0	3.154	2.801	1.1685	1.3595		1.497
Potassium bromide KBr	0.5	0.042	0.042	1.0018	1.3336	0.15	1.000
	1.0	0.085	0.084	1.0054	1.3342	0.29	0.998
	2.0	0.171	0.170	1.0127	1.3354	0.59	0.994
	3.0	0.260	0.257	1.0200	1.3366	0.88	0.990
	4.0	0.350	0.345	1.0275	1.3379	1.18	0.985
	5.0	0.442	0.435	1.0350	1.3391	1.48	0.981
	6.0	0.536	0.526	1.0426	1.3403	1.78	0.977
	7.0	0.633	0.618	1.0503	1.3416	2.10	0.974
	8.0	0.731	0.711	1.0581	1.3429	2.42	0.970
	9.0	0.831	0.806	1.0660	1.3441	2.74	0.967
	10.0	0.934	0.903	1.0740	1.3454	3.07	0.964
	12.0	1.146	1.099	1.0903	1.3481	3.76	0.958
	14.0	1.368	1.302	1.1070	1.3507	4.49	0.953
	16.0	1.601	1.512	1.1242	1.3535	5.25	0.949
	18.0	1.845	1.727	1.1419	1.3562	6.04	0.946
	20.0	2.101	1.950	1.1601	1.3591	6.88	0.944
	22.0	2.370	2.179	1.1788	1.3620	7.76	0.943
	24.0	2.654	2.416	1.1980	1.3650	8.70	0.943
	26.0	2.952	2.661	1.2179	1.3680	9.68	0.944
	28.0	3.268	2.914	1.2383	1.3711	10.72	0.947
	30.0	3.601	3.175	1.2593	1.3743	11.82	0.952
	32.0	3.954	3.445	1.2810	1.3776	12.98	0.959
	34.0	4.329	3.724	1.3033	1.3809		0.968
	36.0	4.727	4.012	1.3263	1.3843		0.979
	38.0	5.150	4.311	1.3501	1.3878		0.993
	40.0	5.602	4.620	1.3746	1.3914		1.010
Potassium carbonate K_2CO_3	0.5	0.036	0.036	1.0027	1.3339	0.18	1.013
	1.0	0.073	0.073	1.0072	1.3347	0.34	1.025
	2.0	0.148	0.147	1.0163	1.3365	0.66	1.048

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta^\circ\text{C}$	$\eta/\text{mPa s}$
	3.0	0.224	0.223	1.0254	1.3382	0.99	1.071
	4.0	0.301	0.299	1.0345	1.3399	1.32	1.094
	5.0	0.381	0.378	1.0437	1.3416	1.67	1.119
	6.0	0.462	0.457	1.0529	1.3433	2.03	1.146
	7.0	0.545	0.538	1.0622	1.3450	2.40	1.174
	8.0	0.629	0.620	1.0715	1.3467	2.77	1.204
	9.0	0.716	0.704	1.0809	1.3484	3.17	1.235
	10.0	0.804	0.789	1.0904	1.3501	3.57	1.269
	12.0	0.987	0.963	1.1095	1.3535	4.45	1.339
	14.0	1.178	1.144	1.1291	1.3569	5.39	1.414
	16.0	1.378	1.330	1.1490	1.3603	6.42	1.497
	18.0	1.588	1.523	1.1692	1.3637	7.55	1.594
	20.0	1.809	1.722	1.1898	1.3671	8.82	1.707
	24.0	2.285	2.139	1.2320	1.3739	11.96	1.978
	28.0	2.814	2.584	1.2755	1.3807	16.01	2.331
	32.0	3.405	3.057	1.3204	1.3874	21.46	2.834
	36.0	4.070	3.559	1.3665	1.3940	28.58	3.503
	40.0	4.824	4.093	1.4142	1.4006	37.55	4.360
	50.0	7.236	5.573	1.5404	1.4168		9.369
Potassium chloride KCl	0.5	0.067	0.067	1.0014	1.3337	0.23	1.000
	1.0	0.135	0.135	1.0046	1.3343	0.46	0.999
	2.0	0.274	0.271	1.0110	1.3357	0.92	0.999
	3.0	0.415	0.409	1.0174	1.3371	1.38	0.998
	4.0	0.559	0.549	1.0239	1.3384	1.85	0.997
	5.0	0.706	0.691	1.0304	1.3398	2.32	0.996
	6.0	0.856	0.835	1.0369	1.3411	2.80	0.994
	7.0	1.010	0.980	1.0434	1.3425	3.29	0.992
	8.0	1.166	1.127	1.0500	1.3438	3.80	0.990
	9.0	1.327	1.276	1.0566	1.3452	4.30	0.989
	10.0	1.490	1.426	1.0633	1.3466	4.81	0.988
	12.0	1.829	1.733	1.0768	1.3493	5.88	0.990
	14.0	2.184	2.048	1.0905	1.3521		0.994
	16.0	2.555	2.370	1.1043	1.3549		0.999
	18.0	2.944	2.701	1.1185	1.3577		1.004
	20.0	3.353	3.039	1.1328	1.3606		1.012
	22.0	3.783	3.386	1.1474	1.3635		1.024
	24.0	4.236	3.742	1.1623	1.3665		1.040
Potassium hydroxide KOH	0.5	0.090	0.089	1.0025	1.3340	0.30	1.010
	1.0	0.180	0.179	1.0068	1.3350	0.61	1.019
	2.0	0.364	0.362	1.0155	1.3369	1.24	1.038
	3.0	0.551	0.548	1.0242	1.3388	1.89	1.058
	4.0	0.743	0.736	1.0330	1.3408	2.57	1.079
	5.0	0.938	0.929	1.0419	1.3427	3.36	1.102
	6.0	1.138	1.124	1.0509	1.3445	4.14	1.126
	7.0	1.342	1.322	1.0599	1.3464	4.92	1.151
	8.0	1.550	1.524	1.0690	1.3483		1.177
	9.0	1.763	1.729	1.0781	1.3502		1.205
	10.0	1.980	1.938	1.0873	1.3520		1.233
	12.0	2.431	2.365	1.1059	1.3558		1.294
	14.0	2.902	2.806	1.1246	1.3595		1.361
	16.0	3.395	3.261	1.1435	1.3632		1.436
	18.0	3.913	3.730	1.1626	1.3670		1.521
	20.0	4.456	4.213	1.1818	1.3707		1.619
	22.0	5.027	4.711	1.2014	1.3744		1.732
	24.0	5.629	5.223	1.2210	1.3781		1.861

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	<i>m</i> /mol kg ⁻¹	<i>c</i> /mol L ⁻¹	ρ /g cm ⁻³	<i>n</i>	Δ /°C	η /mPa s
	26.0	6.262	5.750	1.2408	1.3818		2.006
	28.0	6.931	6.293	1.2609	1.3854		2.170
	30.0	7.639	6.851	1.2813	1.3889		2.357
	40.0	11.882	9.896	1.3881	1.4068		3.879
	50.0	17.824	13.389	1.5024	1.4247		7.892
Potassium iodide	0.5	0.030	0.030	1.0019	1.3337	0.11	0.999
	1.0	0.061	0.061	1.0056	1.3343	0.22	0.997
KI	2.0	0.123	0.122	1.0131	1.3357	0.43	0.991
	3.0	0.186	0.184	1.0206	1.3370	0.64	0.986
	4.0	0.251	0.248	1.0282	1.3384	0.86	0.981
	5.0	0.317	0.312	1.0360	1.3397	1.08	0.976
	6.0	0.385	0.377	1.0438	1.3411	1.30	0.969
	7.0	0.453	0.443	1.0517	1.3425	1.53	0.963
	8.0	0.524	0.511	1.0598	1.3440	1.77	0.957
	9.0	0.596	0.579	1.0679	1.3454	2.01	0.951
	10.0	0.669	0.648	1.0762	1.3469	2.26	0.946
	12.0	0.821	0.790	1.0931	1.3498	2.77	0.937
	14.0	0.981	0.937	1.1105	1.3529	3.30	0.929
	16.0	1.147	1.088	1.1284	1.3560	3.87	0.921
	18.0	1.322	1.244	1.1469	1.3593	4.46	0.915
	20.0	1.506	1.405	1.1659	1.3626	5.09	0.910
	22.0	1.699	1.571	1.1856	1.3661	5.76	0.905
	24.0	1.902	1.744	1.2060	1.3696	6.46	0.901
	26.0	2.117	1.922	1.2270	1.3733	7.21	0.898
	28.0	2.343	2.106	1.2487	1.3771	8.01	0.895
	30.0	2.582	2.297	1.2712	1.3810	8.86	0.892
	32.0	2.835	2.495	1.2944	1.3851	9.76	0.891
	34.0	3.103	2.700	1.3185	1.3893	10.72	0.890
	36.0	3.388	2.913	1.3434	1.3936	11.73	0.890
	38.0	3.692	3.134	1.3692	1.3981	12.81	0.893
	40.0	4.016	3.364	1.3959	1.4027	13.97	0.897
Potassium nitrate	0.5	0.050	0.050	1.0014	1.3335	0.17	0.999
	1.0	0.100	0.099	1.0045	1.3339	0.33	0.996
KNO ₃	2.0	0.202	0.200	1.0108	1.3349	0.64	0.990
	3.0	0.306	0.302	1.0171	1.3358	0.94	0.986
	4.0	0.412	0.405	1.0234	1.3368	1.22	0.983
	5.0	0.521	0.509	1.0298	1.3377	1.50	0.980
	6.0	0.631	0.615	1.0363	1.3386	1.76	0.977
	7.0	0.744	0.722	1.0428	1.3396	2.02	0.975
	8.0	0.860	0.830	1.0494	1.3405	2.27	0.973
	9.0	0.978	0.940	1.0560	1.3415	2.52	0.971
	10.0	1.099	1.051	1.0627	1.3425	2.75	0.970
	12.0	1.349	1.277	1.0762	1.3444		0.970
	14.0	1.610	1.509	1.0899	1.3463		0.972
	16.0	1.884	1.747	1.1039	1.3482		0.976
	18.0	2.171	1.991	1.1181	1.3502		0.982
	20.0	2.473	2.240	1.1326	1.3521		0.990
	22.0	2.790	2.497	1.1473	1.3541		0.999
	24.0	3.123	2.759	1.1623	1.3561		1.010
Potassium permanganate	0.5	0.032	0.032	1.0017		0.11	1.001
	1.0	0.064	0.064	1.0051		0.22	1.000
KMnO ₄	1.5	0.096	0.096	1.0085		0.32	0.999
	2.0	0.129	0.128	1.0118		0.43	0.998
	3.0	0.196	0.193	1.0186			0.995

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	4.0	0.264	0.260	1.0254			0.992
	5.0	0.333	0.327	1.0322			0.989
	6.0	0.404	0.394	1.0390			0.985
Potassium hydrogen phosphate K_2HPO_4	0.5	0.029	0.029	1.0025	1.3338	0.13	1.013
	1.0	0.058	0.058	1.0068	1.3345	0.25	1.023
	1.5	0.087	0.087	1.0110	1.3353	0.37	1.034
	2.0	0.117	0.117	1.0153	1.3361	0.49	1.046
	2.5	0.147	0.146	1.0195	1.3368	0.61	1.057
	3.0	0.178	0.176	1.0238	1.3376	0.73	1.069
	3.5	0.208	0.207	1.0281	1.3384	0.86	1.081
	4.0	0.239	0.237	1.0324	1.3392	0.97	1.094
	4.5	0.271	0.268	1.0368	1.3399	1.10	1.107
	5.0	0.302	0.299	1.0412	1.3407	1.22	1.120
	6.0	0.366	0.362	1.0500	1.3422	1.46	1.147
	7.0	0.432	0.426	1.0590	1.3438	1.70	1.177
	8.0	0.499	0.491	1.0680	1.3453	1.95	1.209
Potassium dihydrogen phosphate KH_2PO_4	0.5	0.037	0.037	1.0018	1.3336	0.13	1.010
	1.0	0.074	0.074	1.0053	1.3342	0.25	1.019
	1.5	0.112	0.111	1.0089	1.3348	0.37	1.028
	2.0	0.150	0.149	1.0125	1.3354	0.49	1.038
	3.0	0.227	0.225	1.0197	1.3365	0.72	1.060
	4.0	0.306	0.302	1.0269	1.3377	0.96	1.083
	5.0	0.387	0.380	1.0342	1.3388	1.19	1.108
	6.0	0.469	0.459	1.0414	1.3400	1.41	1.133
	7.0	0.553	0.539	1.0486	1.3411	1.63	1.160
	8.0	0.639	0.621	1.0558	1.3422	1.84	1.187
	9.0	0.727	0.703	1.0630	1.3434	2.04	1.215
	10.0	0.816	0.786	1.0703	1.3445	2.23	1.245
Potassium sulfate K_2SO_4	0.5	0.029	0.029	1.0022	1.3336	0.14	1.006
	1.0	0.058	0.058	1.0062	1.3343	0.26	1.011
	2.0	0.117	0.116	1.0143	1.3355	0.50	1.021
	3.0	0.177	0.176	1.0224	1.3368	0.73	1.033
	4.0	0.239	0.237	1.0306	1.3380	0.95	1.045
	5.0	0.302	0.298	1.0388	1.3393	1.17	1.058
	6.0	0.366	0.360	1.0470	1.3405		1.072
	7.0	0.432	0.424	1.0553	1.3417		1.087
	8.0	0.499	0.488	1.0637	1.3428		1.102
	9.0	0.568	0.554	1.0721	1.3440		1.117
	10.0	0.638	0.620	1.0806	1.3452		1.132
1-Propanol $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	1.0	0.168	0.166	0.9963	1.3339	0.31	1.051
	2.0	0.340	0.331	0.9946	1.3348	0.61	1.100
	3.0	0.515	0.496	0.9928	1.3357	0.93	1.152
	4.0	0.693	0.660	0.9911	1.3366	1.24	1.208
	5.0	0.876	0.823	0.9896	1.3376	1.57	1.267
	6.0	1.062	0.987	0.9882	1.3385	1.91	1.325
	7.0	1.252	1.149	0.9868	1.3394	2.26	1.387
	8.0	1.447	1.312	0.9855	1.3404	2.61	1.449
	9.0	1.646	1.474	0.9842	1.3414	2.99	1.514
	10.0	1.849	1.635	0.9829	1.3423	3.36	1.577
	12.0	2.269	1.958	0.9804	1.3442	4.09	1.710
	14.0	2.709	2.278	0.9779	1.3460	4.91	1.849
	16.0	3.169	2.595	0.9749	1.3477	5.78	1.986
	18.0	3.652	2.911	0.9719	1.3494	6.67	2.106

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	20.0	4.160	3.223	0.9686	1.3510	7.76	2.218
	24.0	5.254	3.838	0.9612	1.3539	9.12	2.432
	28.0	6.471	4.441	0.9533	1.3566	10.17	2.612
	32.0	7.830	5.033	0.9452	1.3592	10.66	2.765
	36.0	9.359	5.613	0.9370	1.3614		2.900
	40.0	11.093	6.182	0.9288	1.3635		3.010
	60.0	24.958	8.860	0.8875	1.3734		3.186
	80.0	66.556	11.275	0.8470	1.3812		2.822
	100.0		13.368	0.8034	1.3852		2.227
2-Propanol	1.0	0.168	0.166	0.9960	1.3338	0.30	1.056
CH ₃ CHOHCH ₃	2.0	0.340	0.331	0.9939	1.3346	0.60	1.112
	3.0	0.515	0.495	0.9920	1.3355	0.93	1.166
	4.0	0.693	0.659	0.9902	1.3364	1.26	1.225
	5.0	0.876	0.822	0.9884	1.3373	1.61	1.287
	6.0	1.062	0.985	0.9871	1.3382	1.96	1.352
	7.0	1.252	1.148	0.9855	1.3392	2.32	1.417
	8.0	1.447	1.310	0.9843	1.3400	2.68	1.485
	9.0	1.646	1.472	0.9831	1.3410	3.06	1.553
	10.0	1.849	1.633	0.9816	1.3420	3.48	1.629
	12.0	2.269	1.955	0.9793	1.3439	4.43	1.794
	14.0	2.709	2.276	0.9772	1.3459	5.29	1.970
	16.0	3.169	2.596	0.9751	1.3478	6.36	2.160
	18.0	3.652	2.913	0.9725	1.3496	7.40	2.352
	20.0	4.160	3.227	0.9696	1.3514	8.52	2.550
	40.0	11.093	6.191	0.9302	1.3642		
	60.0	24.958	8.809	0.8824	1.3717		
	80.0	66.556	11.103	0.8341	1.3765		
	100.0		13.058	0.7848	1.3742		
Silver nitrate AgNO ₃	0.5	0.030	0.030	1.0027	1.3336	0.10	1.003
	1.0	0.059	0.059	1.0070	1.3342	0.20	1.005
	2.0	0.120	0.120	1.0154	1.3352	0.40	1.009
	3.0	0.182	0.181	1.0239	1.3363	0.59	1.013
	4.0	0.245	0.243	1.0327	1.3374	0.78	1.016
	5.0	0.310	0.307	1.0417	1.3385	0.96	1.020
	6.0	0.376	0.371	1.0506	1.3396	1.15	1.024
	7.0	0.443	0.437	1.0597	1.3407	1.33	1.027
	8.0	0.512	0.503	1.0690	1.3419	1.51	1.031
	9.0	0.582	0.571	1.0785	1.3431	1.69	1.035
	10.0	0.654	0.641	1.0882	1.3443	1.87	1.039
	12.0	0.803	0.783	1.1079	1.3467	2.21	1.049
	14.0	0.958	0.930	1.1284	1.3493	2.55	1.060
	16.0	1.121	1.083	1.1496	1.3519	2.86	1.072
	18.0	1.292	1.241	1.1715	1.3546		1.086
	20.0	1.472	1.406	1.1942	1.3574		1.101
	22.0	1.660	1.577	1.2177	1.3602		1.117
	24.0	1.859	1.755	1.2420	1.3632		1.135
	26.0	2.068	1.940	1.2672	1.3662		1.154
	28.0	2.289	2.132	1.2933	1.3694		1.176
	30.0	2.523	2.332	1.3204	1.3726		1.200
	32.0	2.770	2.541	1.3487	1.3760		1.227
	34.0	3.033	2.758	1.3780	1.3795		1.257
	36.0	3.311	2.985	1.4087	1.3832		1.290
	38.0	3.608	3.223	1.4407	1.3871		1.326
	40.0	3.925	3.472	1.4743	1.3911		1.366

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
Sodium acetate CH_3COONa	0.5	0.061	0.061	1.0008	1.3337	0.22	1.021
	1.0	0.123	0.122	1.0034	1.3344	0.43	1.040
	2.0	0.249	0.246	1.0085	1.3358	0.88	1.080
	3.0	0.377	0.371	1.0135	1.3372	1.34	1.124
	4.0	0.508	0.497	1.0184	1.3386	1.82	1.171
	5.0	0.642	0.624	1.0234	1.3400	2.32	1.222
	6.0	0.778	0.752	1.0283	1.3414	2.85	1.278
	7.0	0.918	0.882	1.0334	1.3428	3.40	1.337
	8.0	1.060	1.013	1.0386	1.3442	3.98	1.401
	9.0	1.206	1.145	1.0440	1.3456	4.57	1.468
	10.0	1.354	1.279	1.0495	1.3470		1.539
	12.0	1.662	1.552	1.0607	1.3498		1.688
	14.0	1.984	1.829	1.0718	1.3526		1.855
	16.0	2.322	2.112	1.0830	1.3554		2.054
	18.0	2.676	2.400	1.0940	1.3583		2.284
	20.0	3.047	2.694	1.1050	1.3611		2.567
	22.0	3.438	2.993	1.1159	1.3639		2.948
24.0	3.849	3.297	1.1268	1.3666		3.400	
26.0	4.283	3.606	1.1377	1.3693		3.877	
28.0	4.741	3.921	1.1488	1.3720		4.388	
30.0	5.224	4.243	1.1602	1.3748		4.940	
Sodium bicarbonate NaHCO_3	0.5	0.060	0.060	1.0018	1.3337	0.20	1.015
	1.0	0.120	0.120	1.0054	1.3344	0.40	1.028
	1.5	0.181	0.180	1.0089	1.3351	0.59	1.042
	2.0	0.243	0.241	1.0125	1.3357	0.78	1.057
	2.5	0.305	0.302	1.0160	1.3364	0.98	1.071
	3.0	0.368	0.364	1.0196	1.3370	1.16	1.086
	3.5	0.432	0.426	1.0231	1.3377	1.35	1.102
	4.0	0.496	0.489	1.0266	1.3383	1.54	1.118
	4.5	0.561	0.552	1.0301	1.3390	1.72	1.134
	5.0	0.627	0.615	1.0337	1.3396	1.90	1.151
	5.5	0.693	0.679	1.0372	1.3403	2.08	1.168
6.0	0.760	0.743	1.0408	1.3409	2.26	1.185	
Sodium bromide NaBr	0.5	0.049	0.049	1.0021	1.3337	0.17	1.004
	1.0	0.098	0.098	1.0060	1.3344	0.34	1.007
	2.0	0.198	0.197	1.0139	1.3358	0.69	1.012
	3.0	0.301	0.298	1.0218	1.3372	1.04	1.017
	4.0	0.405	0.400	1.0298	1.3386	1.39	1.022
	5.0	0.512	0.504	1.0380	1.3401	1.76	1.028
	6.0	0.620	0.610	1.0462	1.3415	2.14	1.034
	7.0	0.732	0.717	1.0546	1.3430	2.53	1.040
	8.0	0.845	0.826	1.0630	1.3445	2.93	1.046
	9.0	0.961	0.937	1.0716	1.3460	3.34	1.053
	10.0	1.080	1.050	1.0803	1.3475	3.77	1.060
	12.0	1.325	1.281	1.0981	1.3506	4.67	1.077
	14.0	1.582	1.519	1.1164	1.3538	5.65	1.096
	16.0	1.851	1.765	1.1352	1.3570	6.74	1.119
	18.0	2.133	2.020	1.1546	1.3604		1.144
	20.0	2.430	2.283	1.1745	1.3638		1.174
	22.0	2.741	2.555	1.1951	1.3673		1.207
	24.0	3.069	2.837	1.2163	1.3708		1.244
26.0	3.415	3.129	1.2382	1.3745		1.287	
28.0	3.780	3.431	1.2608	1.3783		1.336	
30.0	4.165	3.744	1.2842	1.3822		1.395	
32.0	4.574	4.069	1.3083	1.3862		1.465	

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	34.0	5.007	4.406	1.3333	1.3903		1.546
	36.0	5.467	4.755	1.3592	1.3946		1.639
	38.0	5.957	5.119	1.3860	1.3990		1.745
	40.0	6.479	5.496	1.4138	1.4035		1.866
Sodium carbonate Na_2CO_3	0.5	0.047	0.047	1.0034	1.3341	0.22	1.025
	1.0	0.095	0.095	1.0086	1.3352	0.43	1.049
	2.0	0.193	0.192	1.0190	1.3375	0.75	1.102
	3.0	0.292	0.291	1.0294	1.3397	1.08	1.159
	4.0	0.393	0.392	1.0398	1.3419	1.42	1.222
	5.0	0.497	0.495	1.0502	1.3440	1.77	1.292
	6.0	0.602	0.600	1.0606	1.3462	2.13	1.367
	7.0	0.710	0.707	1.0711	1.3483		1.448
	8.0	0.820	0.816	1.0816	1.3504		1.538
	9.0	0.933	0.927	1.0922	1.3525		1.638
	10.0	1.048	1.041	1.1029	1.3547		1.754
	11.0	1.166	1.156	1.1136	1.3568		1.884
	12.0	1.287	1.273	1.1244	1.3589		2.028
	13.0	1.410	1.392	1.1353	1.3610		2.186
	14.0	1.536	1.514	1.1463	1.3631		2.361
	15.0	1.665	1.638	1.1574	1.3652		2.551
Sodium chloride NaCl	0.5	0.086	0.086	1.0018	1.3339	0.30	1.011
	1.0	0.173	0.172	1.0053	1.3347	0.59	1.020
	2.0	0.349	0.346	1.0125	1.3365	1.19	1.036
	3.0	0.529	0.523	1.0196	1.3383	1.79	1.052
	4.0	0.713	0.703	1.0268	1.3400	2.41	1.068
	5.0	0.901	0.885	1.0340	1.3418	3.05	1.085
	6.0	1.092	1.069	1.0413	1.3435	3.70	1.104
	7.0	1.288	1.256	1.0486	1.3453	4.38	1.124
	8.0	1.488	1.445	1.0559	1.3470	5.08	1.145
	9.0	1.692	1.637	1.0633	1.3488	5.81	1.168
	10.0	1.901	1.832	1.0707	1.3505	6.56	1.193
	12.0	2.333	2.229	1.0857	1.3541	8.18	1.250
	14.0	2.785	2.637	1.1008	1.3576	9.94	1.317
	16.0	3.259	3.056	1.1162	1.3612	11.89	1.388
	18.0	3.756	3.486	1.1319	1.3648	14.04	1.463
	20.0	4.278	3.928	1.1478	1.3684	16.46	1.557
	22.0	4.826	4.382	1.1640	1.3721	19.18	1.676
	24.0	5.403	4.847	1.1804	1.3757		1.821
	26.0	6.012	5.326	1.1972	1.3795		1.990
Sodium citrate $(\text{HO})\text{C}(\text{COONa})_3$	1.0	0.039	0.039	1.0049	1.3348	0.20	1.043
	2.0	0.079	0.078	1.0120	1.3366	0.39	1.081
	3.0	0.120	0.118	1.0186	1.3383	0.59	1.122
	4.0	0.161	0.159	1.0260	1.3401	0.79	1.166
	5.0	0.204	0.200	1.0331	1.3419	0.97	1.210
	6.0	0.247	0.242	1.0405	1.3437	1.17	1.263
	7.0	0.292	0.284	1.0482	1.3455	1.36	1.314
	8.0	0.337	0.327	1.0557	1.3473	1.57	1.371
	9.0	0.383	0.371	1.0632	1.3491	1.77	1.427
	10.0	0.431	0.415	1.0708	1.3509	1.96	1.499
	12.0	0.528	0.505	1.0861	1.3546	2.38	1.649
	14.0	0.631	0.598	1.1019	1.3583	2.82	1.832
	16.0	0.738	0.693	1.1173	1.3618	3.27	2.045
	18.0	0.851	0.790	1.1327	1.3656	3.82	2.290
	20.0	0.969	0.891	1.1492	1.3693	4.39	2.596

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	24.0	1.224	1.099	1.1813	1.3767		3.409
	28.0	1.507	1.318	1.2151	1.3845		4.586
	32.0	1.823	1.548	1.2487	1.3923		6.541
	36.0	2.180	1.792	1.2843	1.4001		9.788
Sodium hydroxide NaOH	0.5	0.126	0.125	1.0039	1.3344	0.43	1.027
	1.0	0.253	0.252	1.0095	1.3358	0.86	1.054
	2.0	0.510	0.510	1.0207	1.3386	1.74	1.112
	3.0	0.773	0.774	1.0318	1.3414	2.64	1.176
	4.0	1.042	1.043	1.0428	1.3441	3.59	1.248
	5.0	1.316	1.317	1.0538	1.3467	4.57	1.329
	6.0	1.596	1.597	1.0648	1.3494	5.60	1.416
	7.0	1.882	1.883	1.0758	1.3520	6.69	1.510
	8.0	2.174	2.174	1.0869	1.3546	7.87	1.616
	9.0	2.473	2.470	1.0979	1.3572	9.12	1.737
	10.0	2.778	2.772	1.1089	1.3597	10.47	1.882
	12.0	3.409	3.393	1.1309	1.3648	13.42	2.201
	14.0	4.070	4.036	1.1530	1.3697	16.76	2.568
	15.0	4.412	4.365	1.1640	1.3722		2.789
	16.0	4.762	4.701	1.1751	1.3746		3.043
	18.0	5.488	5.387	1.1971	1.3793		3.698
	20.0	6.250	6.096	1.2192	1.3840		4.619
	22.0	7.052	6.827	1.2412	1.3885		5.765
	24.0	7.895	7.579	1.2631	1.3929		7.100
	26.0	8.784	8.352	1.2848	1.3971		8.744
	28.0	9.723	9.145	1.3064	1.4012		10.832
	30.0	10.715	9.958	1.3277	1.4051		13.517
	32.0	11.766	10.791	1.3488	1.4088		16.844
	34.0	12.880	11.643	1.3697	1.4123		20.751
	36.0	14.064	12.512	1.3901	1.4156		25.290
	38.0	15.324	13.398	1.4102	1.4186		30.461
	40.0	16.668	14.300	1.4299	1.4215		36.312
Sodium nitrate NaNO ₃	0.5	0.059	0.059	1.0016	1.3336	0.20	1.004
	1.0	0.119	0.118	1.0050	1.3341	0.40	1.007
	2.0	0.240	0.238	1.0117	1.3353	0.79	1.012
	3.0	0.364	0.359	1.0185	1.3364	1.18	1.018
	4.0	0.490	0.483	1.0254	1.3375	1.56	1.025
	5.0	0.619	0.607	1.0322	1.3387	1.94	1.032
	6.0	0.751	0.734	1.0392	1.3398	2.32	1.040
	7.0	0.886	0.862	1.0462	1.3409	2.70	1.049
	8.0	1.023	0.991	1.0532	1.3421	3.08	1.059
	9.0	1.164	1.123	1.0603	1.3432	3.46	1.069
	10.0	1.307	1.256	1.0674	1.3443	3.84	1.081
	12.0	1.604	1.527	1.0819	1.3466	4.60	1.107
	14.0	1.915	1.806	1.0967	1.3489	5.37	1.138
	18.0	2.583	2.387	1.1272	1.3536	6.98	1.215
	20.0	2.941	2.689	1.1429	1.3559	7.81	1.263
	30.0	5.042	4.326	1.2256	1.3678		1.609
	40.0	7.844	6.200	1.3175	1.3802		2.226
Sodium phosphate Na ₃ PO ₄	0.5	0.031	0.031	1.0042	1.3343	0.19	1.033
	1.0	0.062	0.062	1.0100	1.3356	0.37	1.064
	1.5	0.093	0.093	1.0158	1.3369	0.53	1.094
	2.0	0.124	0.125	1.0216	1.3381	0.67	1.126
	2.5	0.156	0.157	1.0275	1.3394	0.79	1.161
	3.0	0.189	0.189	1.0335	1.3406		1.198

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	3.5	0.221	0.222	1.0395	1.3419		1.238
	4.0	0.254	0.255	1.0456	1.3432		1.281
	4.5	0.287	0.289	1.0517	1.3444		1.327
	5.0	0.321	0.323	1.0579	1.3457		1.375
	5.5	0.355	0.357	1.0642	1.3470		1.426
	6.0	0.389	0.392	1.0705	1.3482		1.480
	6.5	0.424	0.427	1.0768	1.3495		1.538
	7.0	0.459	0.462	1.0832	1.3507		1.598
	7.5	0.495	0.498	1.0896	1.3519		1.662
	8.0	0.530	0.535	1.0961	1.3532		1.729
Sodium hydrogen phosphate Na_2HPO_4	0.5	0.035	0.035	1.0032	1.3340	0.17	1.021
	1.0	0.071	0.071	1.0082	1.3349	0.32	1.042
	1.5	0.107	0.107	1.0131	1.3358	0.46	1.064
	2.0	0.144	0.143	1.0180	1.3368		1.088
	2.5	0.181	0.180	1.0229	1.3377		1.113
	3.0	0.218	0.217	1.0279	1.3386		1.138
	3.5	0.255	0.255	1.0328	1.3396		1.165
	4.0	0.293	0.292	1.0378	1.3405		1.193
	4.5	0.332	0.331	1.0428	1.3414		1.223
	5.0	0.371	0.369	1.0478	1.3424		1.254
	5.5	0.410	0.408	1.0528	1.3433		1.286
Sodium dihydrogen phosphate NaH_2PO_4	0.5	0.042	0.042	1.0019	1.3336	0.14	1.018
	1.0	0.084	0.084	1.0056	1.3343	0.28	1.035
	1.5	0.127	0.126	1.0094	1.3349	0.42	1.051
	2.0	0.170	0.169	1.0131	1.3356	0.56	1.068
	2.5	0.214	0.212	1.0168	1.3362	0.70	1.085
	3.0	0.258	0.255	1.0206	1.3369	0.84	1.103
	3.5	0.302	0.299	1.0244	1.3375	0.98	1.121
	4.0	0.347	0.343	1.0281	1.3382	1.12	1.140
	4.5	0.393	0.387	1.0319	1.3388	1.25	1.160
	5.0	0.439	0.432	1.0358	1.3395	1.39	1.180
	6.0	0.532	0.522	1.0434	1.3408	1.65	1.223
	7.0	0.627	0.613	1.0511	1.3421	1.89	1.270
	8.0	0.725	0.706	1.0589	1.3434	2.12	1.319
	9.0	0.824	0.800	1.0668	1.3447	2.35	1.371
	10.0	0.926	0.896	1.0747	1.3460	2.58	1.428
	12.0	1.137	1.091	1.0907	1.3486	3.06	1.552
	14.0	1.357	1.292	1.1070	1.3512	3.53	1.694
	16.0	1.588	1.499	1.1236	1.3538	4.03	1.861
	18.0	1.830	1.711	1.1404	1.3565	4.55	2.050
	20.0	2.084	1.930	1.1576	1.3592	5.10	2.283
	22.0	2.351	2.155	1.1752	1.3618		2.550
	24.0	2.632	2.387	1.1931	1.3646		2.850
	26.0	2.929	2.625	1.2113	1.3673		3.214
	28.0	3.242	2.870	1.2299	1.3700		3.682
	30.0	3.572	3.123	1.2488	1.3728		4.300
	32.0	3.923	3.383	1.2682	1.3756		5.079
	34.0	4.294	3.650	1.2879	1.3784		6.008
	36.0	4.689	3.925	1.3080	1.3812		7.098
	38.0	5.109	4.208	1.3285	1.3840		8.363
	40.0	5.557	4.499	1.3493	1.3869		9.814
Sodium sulfate Na_2SO_4	0.5	0.035	0.035	1.0027	1.3338	0.17	1.013
	1.0	0.071	0.071	1.0071	1.3345	0.32	1.026
	2.0	0.144	0.143	1.0161	1.3360	0.61	1.058

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	3.0	0.218	0.217	1.0252	1.3376	0.87	1.091
	4.0	0.293	0.291	1.0343	1.3391	1.13	1.126
	5.0	0.371	0.367	1.0436	1.3406	1.36	1.163
	6.0	0.449	0.445	1.0526	1.3420	1.56	1.202
	7.0	0.530	0.523	1.0619	1.3435		1.244
	8.0	0.612	0.603	1.0713	1.3449		1.289
	9.0	0.696	0.685	1.0808	1.3464		1.337
	10.0	0.782	0.768	1.0905	1.3479		1.390
	12.0	0.960	0.938	1.1101	1.3509		1.508
	14.0	1.146	1.114	1.1301	1.3539		1.646
	16.0	1.341	1.296	1.1503	1.3567		1.812
	18.0	1.545	1.483	1.1705	1.3595		2.005
	20.0	1.760	1.677	1.1907	1.3620		2.227
	22.0	1.986	1.875	1.2106	1.3643		2.481
Sodium thiosulfate $\text{Na}_2\text{S}_2\text{O}_3$	0.5	0.032	0.032	1.0024	1.3340	0.14	1.012
	1.0	0.064	0.064	1.0065	1.3351	0.28	1.023
	2.0	0.129	0.128	1.0148	1.3371	0.57	1.044
	3.0	0.196	0.194	1.0231	1.3392	0.84	1.066
	4.0	0.264	0.261	1.0315	1.3413	1.09	1.090
	5.0	0.333	0.329	1.0399	1.3434	1.34	1.115
	6.0	0.404	0.398	1.0483	1.3454	1.59	1.141
	7.0	0.476	0.468	1.0568	1.3475	1.83	1.169
	8.0	0.550	0.539	1.0654	1.3496	2.06	1.199
	9.0	0.626	0.611	1.0740	1.3517	2.30	1.231
	10.0	0.703	0.685	1.0827	1.3538	2.55	1.267
	12.0	0.862	0.835	1.1003	1.3581	3.06	1.345
	14.0	1.030	0.990	1.1182	1.3624	3.60	1.435
	16.0	1.205	1.150	1.1365	1.3667	4.17	1.537
	18.0	1.388	1.315	1.1551	1.3711	4.76	1.657
	20.0	1.581	1.485	1.1740	1.3756	5.37	1.798
	30.0	2.711	2.417	1.2739	1.3987		2.903
	40.0	4.216	3.498	1.3827	1.4229		5.758
Strontium chloride SrCl_2	0.5	0.032	0.032	1.0027	1.3339	0.16	1.012
	1.0	0.064	0.064	1.0071	1.3348	0.31	1.021
	2.0	0.129	0.128	1.0161	1.3366	0.62	1.039
	3.0	0.195	0.194	1.0252	1.3384	0.93	1.057
	4.0	0.263	0.261	1.0344	1.3402	1.26	1.076
	5.0	0.332	0.329	1.0437	1.3421	1.61	1.096
	6.0	0.403	0.399	1.0532	1.3440	1.98	1.116
	7.0	0.475	0.469	1.0628	1.3459	2.38	1.136
	8.0	0.549	0.541	1.0726	1.3478	2.80	1.157
	9.0	0.624	0.615	1.0825	1.3498	3.25	1.180
	10.0	0.701	0.689	1.0925	1.3518	3.74	1.204
	12.0	0.860	0.843	1.1131	1.3558	4.81	1.258
	14.0	1.027	1.002	1.1342	1.3599	6.03	1.317
	16.0	1.202	1.167	1.1558	1.3641	7.41	1.383
	18.0	1.385	1.338	1.1780	1.3684	8.98	1.460
	20.0	1.577	1.515	1.2008	1.3728	10.74	1.549
	22.0	1.779	1.699	1.2241	1.3772	12.74	1.650
	24.0	1.992	1.890	1.2481	1.3817	14.99	1.765
	26.0	2.216	2.087	1.2728	1.3864		1.897
	28.0	2.453	2.293	1.2983	1.3911		2.056
	30.0	2.703	2.507	1.3248	1.3961		2.245
	32.0	2.968	2.730	1.3523	1.4013		2.527

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	34.0	3.250	2.962	1.3811	1.4067		2.846
	36.0	3.548	3.205	1.4114	1.4124		3.206
Sucrose $\text{C}_{12}\text{H}_{22}\text{O}_{11}$	0.5	0.015	0.015	1.0002	1.3337	0.03	1.015
	1.0	0.030	0.029	1.0021	1.3344	0.06	1.028
	2.0	0.060	0.059	1.0060	1.3359	0.11	1.055
	3.0	0.090	0.089	1.0099	1.3373	0.17	1.084
	4.0	0.122	0.118	1.0139	1.3388	0.23	1.114
	5.0	0.154	0.149	1.0178	1.3403	0.29	1.146
	6.0	0.186	0.179	1.0218	1.3418	0.35	1.179
	7.0	0.220	0.210	1.0259	1.3433	0.42	1.215
	8.0	0.254	0.241	1.0299	1.3448	0.49	1.254
	9.0	0.289	0.272	1.0340	1.3463	0.55	1.294
	10.0	0.325	0.303	1.0381	1.3478	0.63	1.336
	12.0	0.398	0.367	1.0465	1.3509	0.77	1.429
	14.0	0.476	0.431	1.0549	1.3541	0.93	1.534
	16.0	0.556	0.497	1.0635	1.3573	1.10	1.653
	18.0	0.641	0.564	1.0722	1.3606	1.27	1.790
	20.0	0.730	0.632	1.0810	1.3639	1.47	1.945
	22.0	0.824	0.700	1.0899	1.3672	1.67	2.124
	24.0	0.923	0.771	1.0990	1.3706	1.89	2.331
	26.0	1.026	0.842	1.1082	1.3741	2.12	2.573
	28.0	1.136	0.914	1.1175	1.3776	2.37	2.855
	30.0	1.252	0.988	1.1270	1.3812	2.64	3.187
	32.0	1.375	1.063	1.1366	1.3848	2.94	3.762
	34.0	1.505	1.139	1.1464	1.3885	3.27	4.052
	36.0	1.643	1.216	1.1562	1.3922	3.63	4.621
	38.0	1.791	1.295	1.1663	1.3960	4.02	5.315
	40.0	1.948	1.375	1.1765	1.3999	4.45	6.162
	42.0	2.116	1.456	1.1868	1.4038	4.93	7.234
	44.0	2.295	1.539	1.1972	1.4078		8.596
	46.0	2.489	1.623	1.2079	1.4118		10.301
	48.0	2.697	1.709	1.2186	1.4159		12.515
	50.0	2.921	1.796	1.2295	1.4201		15.431
	60.0	4.382	2.255	1.2864	1.4419		58.487
	70.0	6.817	2.755	1.3472	1.4654		481.561
	80.0	11.686	3.299	1.4117	1.4906		
Sulfuric acid H_2SO_4	0.5	0.051	0.051	1.0016	1.3336	0.21	1.010
	1.0	0.103	0.102	1.0049	1.3342	0.42	1.019
	2.0	0.208	0.206	1.0116	1.3355	0.80	1.036
	3.0	0.315	0.311	1.0183	1.3367	1.17	1.059
	4.0	0.425	0.418	1.0250	1.3379	1.60	1.085
	5.0	0.537	0.526	1.0318	1.3391	2.05	1.112
	6.0	0.651	0.635	1.0385	1.3403	2.50	1.136
	7.0	0.767	0.746	1.0453	1.3415	2.95	1.159
	8.0	0.887	0.858	1.0522	1.3427	3.49	1.182
	9.0	1.008	0.972	1.0591	1.3439	4.08	1.206
	10.0	1.133	1.087	1.0661	1.3451	4.64	1.230
	12.0	1.390	1.322	1.0802	1.3475	5.93	1.282
	14.0	1.660	1.563	1.0947	1.3500	7.49	1.337
	16.0	1.942	1.810	1.1094	1.3525	9.26	1.399
	18.0	2.238	2.064	1.1245	1.3551	11.29	1.470
	20.0	2.549	2.324	1.1398	1.3576	13.64	1.546
	22.0	2.876	2.592	1.1554	1.3602	16.48	1.624
	24.0	3.220	2.866	1.1714	1.3628	19.85	1.706
	26.0	3.582	3.147	1.1872	1.3653	24.29	1.797
	28.0	3.965	3.435	1.2031	1.3677	29.65	1.894

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	30.0	4.370	3.729	1.2191	1.3701	36.21	2.001
	32.0	4.798	4.030	1.2353	1.3725	44.76	2.122
	34.0	5.252	4.339	1.2518	1.3749	55.28	2.255
	36.0	5.735	4.656	1.2685	1.3773		2.392
	38.0	6.249	4.981	1.2855	1.3797		2.533
	40.0	6.797	5.313	1.3028	1.3821		2.690
	42.0	7.383	5.655	1.3205	1.3846		2.872
	44.0	8.011	6.005	1.3386	1.3870		3.073
	46.0	8.685	6.364	1.3570	1.3895		3.299
	48.0	9.411	6.734	1.3759	1.3920		3.546
	50.0	10.196	7.113	1.3952	1.3945		3.826
	52.0	11.045	7.502	1.4149	1.3971		4.142
	54.0	11.969	7.901	1.4351	1.3997		4.499
	56.0	12.976	8.312	1.4558	1.4024		4.906
	58.0	14.080	8.734	1.4770	1.4050		5.354
	60.0	15.294	9.168	1.4987	1.4077		5.917
	70.0	23.790	11.494	1.6105			
	80.0	40.783	14.088	1.7272			
	90.0	91.762	16.649	1.8144			
	92.0	117.251	17.109	1.8240			
	94.0	159.734	17.550	1.8312			
	96.0	244.698	17.966	1.8355			
	98.0	499.592	18.346	1.8361			
	100.0		18.663	1.8305			
Trichloroacetic acid	0.5	0.031	0.031	1.0008	1.3337	0.11	1.011
	1.0	0.062	0.061	1.0034	1.3343	0.21	1.021
CCl ₃ COOH	2.0	0.125	0.123	1.0083	1.3356	0.42	1.044
	3.0	0.189	0.186	1.0133	1.3369	0.64	1.069
	4.0	0.255	0.249	1.0182	1.3381	0.86	1.096
	5.0	0.322	0.313	1.0230	1.3394	1.08	1.123
	6.0	0.391	0.377	1.0279	1.3406	1.30	1.150
	7.0	0.461	0.442	1.0328	1.3418	1.53	1.177
	8.0	0.532	0.508	1.0378	1.3431	1.76	1.204
	9.0	0.605	0.574	1.0428	1.3444	1.99	1.233
	10.0	0.680	0.641	1.0479	1.3456	2.23	1.263
	12.0	0.835	0.777	1.0583	1.3483	2.73	1.326
	14.0	0.996	0.916	1.0692	1.3510	3.26	1.393
	16.0	1.166	1.058	1.0806	1.3539	3.82	1.462
	18.0	1.343	1.203	1.0921	1.3568		1.533
	20.0	1.530	1.351	1.1035	1.3597		1.608
	24.0	1.933	1.654	1.1260	1.3652		1.768
	28.0	2.380	1.968	1.1485	1.3705		1.935
	32.0	2.880	2.294	1.1713	1.3759		2.118
	36.0	3.443	2.632	1.1947	1.3813		2.320
	40.0	4.080	2.984	1.2188	1.3868		2.543
	44.0	4.809	3.349	1.2435	1.3923		2.797
	48.0	5.650	3.726	1.2682	1.3977		3.076
Tris (hydroxymethyl)-methylamine	0.5	0.041	0.041	0.9994	1.3337	0.08	1.014
	1.0	0.083	0.083	1.0006	1.3344	0.16	1.027
	2.0	0.168	0.166	1.0030	1.3359	0.31	1.054
H ₂ NC(CH ₂ OH) ₃	3.0	0.255	0.249	1.0054	1.3374	0.47	1.083
	4.0	0.344	0.333	1.0078	1.3388	0.64	1.115
	5.0	0.434	0.417	1.0103	1.3403	0.80	1.148
	6.0	0.527	0.502	1.0128	1.3418	0.97	1.182

**CONCENTRATIVE PROPERTIES OF AQUEOUS SOLUTIONS:
DENSITY, REFRACTIVE INDEX, FREEZING POINT DEPRESSION, AND VISCOSITY (continued)**

Solute	Mass %	$m/\text{mol kg}^{-1}$	$c/\text{mol L}^{-1}$	$\rho/\text{g cm}^{-3}$	n	$\Delta/^\circ\text{C}$	$\eta/\text{mPa s}$
	7.0	0.621	0.587	1.0153	1.3433	1.15	1.218
	8.0	0.718	0.672	1.0179	1.3448	1.33	1.256
	9.0	0.816	0.758	1.0204	1.3463	1.51	1.295
	10.0	0.917	0.844	1.0230	1.3478	1.70	1.337
	12.0	1.126	1.019	1.0282	1.3508	2.08	1.427
	14.0	1.344	1.194	1.0335	1.3539	2.47	1.527
	16.0	1.572	1.372	1.0389	1.3570	2.90	1.642
	18.0	1.812	1.552	1.0443	1.3601	3.36	1.772
	20.0	2.064	1.733	1.0498	1.3633	3.85	1.920
	30.0	3.538	2.670	1.0781	1.3797		2.998
	40.0	5.503	3.657	1.1076	1.3970		5.208
Urea	0.5	0.084	0.083	0.9995	1.3337	0.16	1.007
(NH ₂) ₂ CO	1.0	0.168	0.167	1.0007	1.3344	0.31	1.010
	2.0	0.340	0.334	1.0033	1.3358	0.62	1.012
	3.0	0.515	0.502	1.0058	1.3372	0.93	1.017
	4.0	0.694	0.672	1.0085	1.3387	1.24	1.025
	5.0	0.876	0.842	1.0111	1.3401	1.55	1.033
	6.0	1.063	1.013	1.0138	1.3416	1.88	1.041
	7.0	1.253	1.185	1.0165	1.3431	2.22	1.049
	8.0	1.448	1.358	1.0192	1.3446	2.56	1.057
	9.0	1.647	1.531	1.0220	1.3461	2.91	1.065
	10.0	1.850	1.706	1.0248	1.3476	3.26	1.074
	12.0	2.270	2.059	1.0304	1.3506	3.95	1.091
	14.0	2.710	2.415	1.0360	1.3537	4.66	1.109
	16.0	3.171	2.775	1.0417	1.3568	5.40	1.130
	18.0	3.655	3.139	1.0473	1.3599	6.19	1.153
	20.0	4.163	3.506	1.0530	1.3629	7.00	1.178
	22.0	4.696	3.878	1.0586	1.3661	7.81	1.205
	24.0	5.258	4.253	1.0643	1.3692	8.64	1.235
	26.0	5.850	4.632	1.0699	1.3723	9.52	1.266
	28.0	6.475	5.014	1.0756	1.3754	10.45	1.298
	30.0	7.136	5.401	1.0812	1.3785	11.40	1.332
	32.0	7.835	5.791	1.0869	1.3817	12.34	1.371
	34.0	8.577	6.185	1.0926	1.3848	13.27	1.413
	36.0	9.366	6.584	1.0984	1.3881	14.20	1.459
	38.0	10.205	6.988	1.1044	1.3913	15.11	1.509
	40.0	11.100	7.397	1.1106	1.3947	15.99	1.565
	42.0	12.057	7.812	1.1171	1.3982	16.83	1.629
	44.0	13.082	8.234	1.1239	1.4018	17.62	1.700
	46.0	14.183	8.665	1.1313	1.4056		1.780
Zinc sulfate	0.5	0.031	0.031	1.0034	1.3339	0.08	1.021
ZnSO ₄	1.0	0.063	0.062	1.0085	1.3348	0.15	1.040
	2.0	0.126	0.126	1.0190	1.3366	0.28	1.081
	3.0	0.192	0.191	1.0296	1.3384	0.41	1.126
	4.0	0.258	0.258	1.0403	1.3403	0.53	1.175
	5.0	0.326	0.326	1.0511	1.3421	0.65	1.227
	6.0	0.395	0.395	1.0620	1.3439	0.77	1.283
	7.0	0.466	0.465	1.0730	1.3457	0.89	1.341
	8.0	0.539	0.537	1.0842	1.3475	1.01	1.403
	9.0	0.613	0.611	1.0956	1.3494	1.14	1.470
	10.0	0.688	0.686	1.1071	1.3513	1.27	1.545
	12.0	0.845	0.840	1.1308	1.3551	1.55	1.716
	14.0	1.008	1.002	1.1553	1.3590	1.89	1.918
	16.0	1.180	1.170	1.1806	1.3630	2.31	2.152

ION PRODUCT OF WATER SUBSTANCE
William L. Marshall and E. U. Franck

Pressure (bars)	Temperature (°C)								
	0	25	50	75	100	150	200	250	300
Saturated vapor	14.938	13.995	13.275	12.712	12.265	11.638	11.289	11.191	11.406
250	14.83	13.90	13.19	12.63	12.18	11.54	11.16	11.01	11.14
500	14.72	13.82	13.11	12.55	12.10	11.45	11.05	10.85	10.86
750	14.62	13.73	13.04	12.48	12.03	11.36	10.95	10.72	10.66
1,000	14.53	13.66	12.96	12.41	11.96	11.29	10.86	10.60	10.50
1,500	14.34	13.53	12.85	12.29	11.84	11.16	10.71	10.43	10.26
2,000	14.21	13.40	12.73	12.18	11.72	11.04	10.57	10.27	10.08
2,500	14.08	13.28	12.62	12.07	11.61	10.92	10.45	10.12	9.91
3,000	13.97	13.18	12.53	11.98	11.53	10.83	10.34	9.99	9.76
3,500	13.87	13.09	12.44	11.90	11.44	10.74	10.24	9.88	9.63
4,000	13.77	13.00	12.35	11.82	11.37	10.66	10.16	9.79	9.52
5,000	13.60	12.83	12.19	11.66	11.22	10.52	10.00	9.62	9.34
6,000	13.44	12.68	12.05	11.53	11.09	10.39	9.87	9.48	9.18
7,000	13.31	12.55	11.93	11.41	10.97	10.27	9.75	9.35	9.04
8,000	13.18	12.43	11.82	11.30	10.86	10.17	9.64	9.24	8.93
9,000	13.04	12.31	11.71	11.20	10.77	10.07	9.54	9.13	8.82
10,000	12.91	12.21	11.62	11.11	10.68	9.98	9.45	9.04	8.71

Pressure (bars)	Temperature (°C)								
	350	400	450	500	600	700	800	900	1000
Saturated vapor	12.30	—	—	—	—	—	—	—	—
250	11.77	19.43	21.59	22.40	23.27	23.81	24.23	24.59	24.93
500	11.14	11.88	13.74	16.13	18.30	19.29	19.92	20.39	20.80
750	10.79	11.17	11.89	13.01	15.25	16.55	17.35	17.93	18.39
1,000	10.54	10.77	11.19	11.81	13.40	14.70	15.58	16.22	16.72
1,500	10.22	10.29	10.48	10.77	11.59	12.50	13.30	13.97	14.50
2,000	9.98	9.98	10.07	10.23	10.73	11.36	11.98	12.54	12.97
2,500	9.79	9.74	9.77	9.86	10.18	10.63	11.11	11.59	12.02
3,000	9.61	9.54	9.53	9.57	9.78	10.11	10.49	10.89	11.24
3,500	9.47	9.37	9.33	9.34	9.48	9.71	10.02	10.35	10.62
4,000	9.34	9.22	9.16	9.15	9.23	9.41	9.65	9.93	10.13
5,000	9.13	8.99	8.90	8.85	8.85	8.95	9.11	9.30	9.42
6,000	8.96	8.80	8.69	8.62	8.57	8.61	8.72	8.86	8.97
7,000	8.81	8.64	8.51	8.42	8.34	8.34	8.40	8.51	8.64
8,000	8.68	8.50	8.36	8.25	8.13	8.10	8.13	8.21	8.38
9,000	8.57	8.37	8.22	8.10	7.95	7.89	7.89	7.95	8.12
10,000	8.46	8.25	8.09	7.96	7.78	7.70	7.68	7.70	7.85

Data in this table were calculated from the equation, $\log_{10} K_w^* = A + B/T + C/T^2 + D/T^3 + (E + F/T + G/T^2) \log_{10} \rho_w^*$, where $K_w^* = K_w/(\text{mol kg}^{-1})$, and $\rho_w^* = \rho_w/(\text{g cm}^{-3})$. The parameters are:

$$\begin{aligned}
 A &= -4.098 & E &= +13.957 \\
 B &= -3245.2 \text{ K} & F &= 1262.3 \text{ K} \\
 C &= +2.2362 \times 10^5 \text{ K}^2 & G &= +8.5641 \times 10^5 \text{ K}^2 \\
 D &= -3.984 \times 10^7 \text{ K}^3
 \end{aligned}$$

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IONIZATION CONSTANT OF NORMAL AND HEAVY WATER

This table gives the ionization constant in molality terms for H₂O and D₂O at temperatures from 0 to 100°C at the saturated vapor pressure. The quantity tabulated is $-\log K_W$, where K_W is defined by

$$K_W = m_+ \times m_-$$

and m_+ and m_- are the molalities, in mol/kg of water, for H⁺ and OH⁻, respectively.

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<i>t</i> /°C	$-\log K_W$	
	H ₂ O	D ₂ O
0	14.938	15.972
5	14.727	15.743
10	14.528	15.527
15	14.340	15.324
20	14.163	15.132
25	13.995	14.951
30	13.836	14.779
35	13.685	14.616
40	13.542	14.462
45	13.405	14.316
50	13.275	14.176
55	13.152	14.044
60	13.034	13.918
65	12.921	13.798
70	12.814	13.683
75	12.712	13.574
80	12.613	13.470
85	12.520	13.371
90	12.428	13.276
95	12.345	13.186
100	12.265	13.099

SOLUBILITY OF SELECTED GASES IN WATER

L. H. Gevantman

The values in this table are taken almost exclusively from the International Union of Pure and Applied Chemistry "Solubility Data Series". Unless noted, they comprise evaluated data fitted to a smoothing equation. The data at each temperature are then derived from the smoothing equation which expresses the mole fraction solubility X_1 of the gas in solution as:

$$\ln X_1 = A + B/T^* + C \ln T^*$$

where

$$T^* = T/100 \text{ K}$$

All values refer to a partial pressure of the gas of 101.325 kPa (one atmosphere).

The equation constants, the standard deviation for $\ln X_1$ (except where noted), and the temperature range over which the equation applies are given in the column headed Equation constants. There are two exceptions. The equation for methane has an added term, DT^* . The equation for H_2Se and H_2S takes the form,

$$\ln X_1 = A + B/T + C \ln T + DT$$

where T is the temperature in kelvin.

Solubilities given for those gases which react with water, namely ozone, nitrogen oxides, chlorine and its oxides, carbon dioxide, hydrogen sulfide, hydrogen selenide and sulfur dioxide, are recorded as bulk solubilities; i.e., all chemical species of the gas and its reaction products with water are included.

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
Hydrogen (H_2) $M_r = 2.01588$	288.15	1.510×10^{-5}	$A = -48.1611$	1
	293.15	1.455×10^{-5}	$B = 55.2845$	
	298.15	1.411×10^{-5}	$C = 16.8893$	
	303.15	1.377×10^{-5}	Std. dev. = $\pm 0.54\%$	
	308.15	1.350×10^{-5}	Temp.range = 273.15—353.15	
Deuterium (D_2) $M_r = 4.0282$	283.15	$1.675 \times 10^{-5} \pm 0.57\%$	Averaged experimental values	1
	288.15	$1.595 \times 10^{-5} \pm 0.57\%$		
	293.15	$1.512 \times 10^{-5} \pm 0.78\%$	Temp. range = 278.15—303.15	
	298.15	$1.460 \times 10^{-5} \pm 0.52\%$		
	303.15	$1.395 \times 10^{-5} \pm 0.37\%$		
Helium (He) $A_r = 4.0026$	288.15	7.123×10^{-6}	$A = -41.4611$	2
	293.15	7.044×10^{-6}	$B = 42.5962$	
	298.15	6.997×10^{-6}	$C = 14.0094$	
	303.15	6.978×10^{-6}	Std. dev. = $\pm 0.54\%$	
	308.15	6.987×10^{-6}	Temp.range = 273.15—348.15	
Neon (Ne) $A_r = 20.1797$	288.15	8.702×10^{-6}	$A = -52.8573$	2
	293.15	8.395×10^{-6}	$B = 61.0494$	
	298.15	8.152×10^{-6}	$C = 18.9157$	
	303.15	7.966×10^{-6}	Std. dev. = $\pm 0.47\%$	
	308.15	7.829×10^{-6}	Temp.range = 273.15—348.15	
Argon (Ar) $A_r = 39.948$	288.15	3.025×10^{-5}	$A = -57.6661$	3
	293.15	2.748×10^{-5}	$B = 74.7627$	
	298.15	2.519×10^{-5}	$C = 20.1398$	
	303.15	2.328×10^{-5}	Std. dev. = $\pm 0.26\%$	
	308.15	2.169×10^{-5}	Temp.range = 273.15—348.15	
Krypton (Kr) $A_r = 83.80$	288.15	5.696×10^{-5}	$A = -66.9928$	4
	293.15	5.041×10^{-5}	$B = 91.0166$	
	298.15	4.512×10^{-5}	$C = 24.2207$	

SOLUBILITY OF SELECTED GASES IN WATER (continued)

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
	303.15	4.079×10^{-5}	Std. dev. = $\pm 0.32\%$	
	308.15	3.725×10^{-5}	Temp.range = 273.15—353.15	
Xenon (Xe) $A_r = 131.29$	288.15	10.519×10^{-5}	$A = -74.7398$	4
	293.15	9.051×10^{-5}	$B = 105.210$	
	298.15	7.890×10^{-5}	$C = 27.4664$	
	303.15	6.961×10^{-5}	Std. dev. = $\pm 0.35\%$	
	308.15	6.212×10^{-5}	Temp.range = 273.15—348.15	
Radon-222(^{222}Rn) $A_r = 222$	288.15	2.299×10^{-4}	$A = -90.5481$	
	293.15	1.945×10^{-4}	$B = 130.026$	
	298.15	1.671×10^{-4}	$C = 35.0047$	
	303.15	1.457×10^{-4}	Std. dev. = $\pm 1.02\%$	
	308.15	1.288×10^{-4}	Temp.range = 273.15—373.15	
Oxygen (O_2) $M_r = 31.9988$	288.15	2.756×10^{-5}	$A = -66.7354$	5
	293.15	2.501×10^{-5}	$B = 87.4755$	
	298.15	2.293×10^{-5}	$C = 24.4526$	
	303.15	2.122×10^{-5}	Std. dev. = $\pm 0.36\%$	
	308.15	1.982×10^{-5}	Temp.range = 273.15—348.15	
Ozone (O_3) $M_r = 47.9982$	293.15	$1.885 \times 10^{-6} \pm 10\%$ pH = 7.0	Experimental value derived from Henry's Law Constant	5
Nitrogen (N_2) $M_r = 28.0134$	288.15	1.386×10^{-5}	$A = -67.3877$	6
	293.15	1.274×10^{-5}	$B = 86.3213$	
	298.15	1.183×10^{-5}	$C = 24.7981$	
	303.15	1.108×10^{-5}	Std. dev. = $\pm 0.72\%$	
	308.15	1.047×10^{-5}	Temp.range = 273.15—348.15	
Nitrous oxide (N_2O) $M_r = 44.0129$	288.15	5.948×10^{-4}	$A = -60.7467$	7
	293.15	5.068×10^{-4}	$B = 88.8280$	
	298.15	4.367×10^{-4}	$C = 21.2531$	
	303.15	3.805×10^{-4}	Std. dev. = $\pm 1.2\%$	
	308.15	3.348×10^{-4}	Temp.range = 273.15—313.15	
Nitric oxide (NO) $M_r = 30.0061$	288.15	4.163×10^{-5}	$A = -62.8086$	7
	293.15	3.786×10^{-5}	$B = 82.3420$	
	298.15	3.477×10^{-5}	$C = 22.8155$	
	303.15	3.222×10^{-5}	Std. dev. = $\pm 0.76\%$	
	308.15	3.012×10^{-5}	Temp.range = 273.15—358.15	
Carbon monoxide (CO) $M_r = 28.0104$	288.15	2.095×10^{-5}	Derived from Henry's Law Constant Equation	8
	293.15	1.918×10^{-5}		
	298.15	1.774×10^{-5}	Std. dev. = $\pm 0.043\%$	
	303.15	1.657×10^{-5}	Temp.range = 273.15—328.15	
	308.15	1.562×10^{-5}		
Carbon dioxide (CO_2) $M_r = 44.0098$	288.15	8.21×10^{-4}	Derived from Henry's Law Constant Equation	9
	293.15	7.07×10^{-4}		
	298.15	6.15×10^{-4}	Std. dev. = $\pm 1.1\%$	
	303.15	5.41×10^{-4}	Temp.range = 273.15—353.15	
	308.15	4.80×10^{-4}		
Hydrogen selenide (H_2Se) $M_r = 80.976$	288.15	1.80×10^{-3}	$A = 9.15$	10
	298.15	1.49×10^{-3}	$B = 974$	
	308.15	1.24×10^{-3}	$C = -3.542$ $D = 0.0042$	

SOLUBILITY OF SELECTED GASES IN WATER (continued)

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
			Std. dev. = $\pm 2.3 \times 10^{-5}$ Temp. range = 288.15—343.15	
Hydrogen sulfide (H ₂ S) $M_r = 34.082$	288.15	2.335×10^{-3}	$A = -24.912$	10
	293.15	2.075×10^{-3}	$B = 3477$	
	298.15	1.85×10^{-3}	$C = 0.3993$	
	303.15	1.66×10^{-3}	$D = 0.0157$	
	308.15	1.51×10^{-3}	Std. dev. = $\pm 6.5 \times 10^{-5}$ Temp. range = 283.15—603.15	
Sulfur dioxide (SO ₂) $M_r = 64.0648$	288.15	3.45×10^{-2}	$A = -25.2629$	11
	293.15	2.90×10^{-2}	$B = 45.7552$	
	298.15	2.46×10^{-2}	$C = 5.6855$	
	303.15	2.10×10^{-2}	Std. dev. = $\pm 1.8\%$	
	308.15	1.80×10^{-2}	Temp. range = 278.15—328.15	
Chlorine (Cl ₂) $M_r = 70.9054$	283.15	$2.48 \times 10^{-3} \pm 2\%$	Experimental data	11
	293.15	$1.88 \times 10^{-3} \pm 2\%$	Temp. range = 283.15—333.15	
	303.15	$1.50 \times 10^{-3} \pm 2\%$		
	313.15	$1.23 \times 10^{-3} \pm 2\%$		
Chlorine monoxide (Cl ₂ O) $M_r = 86.9048$	273.15	$5.25 \times 10^{-1} \pm 1\%$	Experimental data	11
	276.61	$4.54 \times 10^{-1} \pm 1\%$	Temp. range = 273.15—293.15	
	283.15	$4.273 \times 10^{-1} \pm 1\%$		
	293.15	$3.353 \times 10^{-1} \pm 1\%$		
Chlorine dioxide (ClO ₂) $M_r = 67.4515$	288.15	2.67×10^{-2}	$A = 7.9163$	11
	293.15	2.20×10^{-2}	$B = 0.4791$	
	298.15	1.823×10^{-2}	$C = 11.0593$	
	303.15	1.513×10^{-2}	Std. dev. = $\pm 4.6\%$	
	308.15	1.259×10^{-2}	Temp. range = 283.15—333.15	
Methane (CH ₄) $M_r = 16.0428$	288.15	3.122×10^{-5}	$A = -115.6477$	12
	293.15	2.806×10^{-5}	$B = 155.5756$	
	298.15	2.552×10^{-5}	$C = 65.2553$	
	303.15	2.346×10^{-5}	$D = -6.1698$	
	308.15	2.180×10^{-5}	Std. dev. = $\pm 0.056\%$ Temp. range = 273.15—328.15	
Ethane (C ₂ H ₆) $M_r = 30.0696$	288.15	4.556×10^{-5}	$A = -90.8225$	13
	293.15	3.907×10^{-5}	$B = 126.9559$	
	298.15	3.401×10^{-5}	$C = 34.7413$	
	303.15	3.002×10^{-5}	Std. dev. = $\pm 0.13\%$	
	308.15	2.686×10^{-5}	Temp. range = 273.15—323.15	
Propane (C ₃ H ₈) $M_r = 44.097$	288.15	3.813×10^{-5}	$A = -102.044$	14
	293.15	3.200×10^{-5}	$B = 144.345$	
	298.15	2.732×10^{-5}	$C = 39.4740$	
	303.15	2.370×10^{-5}	Std. dev. = $\pm 0.012\%$	
	308.15	2.088×10^{-5}	Temp. range = 273.15—347.15	
Butane (C ₄ H ₁₀) $M_r = 58.123$	288.15	3.274×10^{-5}	$A = -102.029$	14
	293.15	2.687×10^{-5}	$B = 146.040$	
	298.15	2.244×10^{-5}	$C = 38.7599$	
	303.15	1.906×10^{-5}	Std. dev. = $\pm 0.026\%$	
	308.15	1.645×10^{-5}	Temp. range = 273.15—349.15	
2-Methyl propane (Isobutane)	288.15	2.333×10^{-5}	$A = -129.714$	14

SOLUBILITY OF SELECTED GASES IN WATER (continued)

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
(C_4H_{10}) $M_r = 58.123$	293.15	1.947×10^{-5}	$B = 183.044$	
	298.15	1.659×10^{-5}	$C = 53.4651$	
	303.15	1.443×10^{-5}	Std. dev. = $\pm 0.034\%$	
	308.15	1.278×10^{-5}	Temp.range = 278.15—318.15	

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SOLUBILITY OF CARBON DIOXIDE IN WATER AT VARIOUS TEMPERATURES AND PRESSURES

The solubility of CO₂ in water, expressed as mole fraction of CO₂ in the liquid phase, is given for pressures up to atmospheric and temperatures of 0 to 100°C. Note that 1 standard atmosphere equals 101.325 kPa. The references give data over a wider range of temperature and pressure. The estimated accuracy is about 2%.

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<i>t</i> /°C	1000 × mole fraction of CO₂ in liquid phase						
	Partial pressure of CO₂ in kPa						
	5	10	20	30	40	50	100
0	0.067	0.135	0.269	0.404	0.538	0.671	1.337
5	0.056	0.113	0.226	0.338	0.451	0.564	1.123
10	0.048	0.096	0.191	0.287	0.382	0.477	0.950
15	0.041	0.082	0.164	0.245	0.327	0.409	0.814
20	0.035	0.071	0.141	0.212	0.283	0.353	0.704
25	0.031	0.062	0.123	0.185	0.247	0.308	0.614
30	0.027	0.054	0.109	0.163	0.218	0.271	0.541
35	0.024	0.048	0.097	0.145	0.193	0.242	0.481
40	0.022	0.043	0.087	0.130	0.173	0.216	0.431
45	0.020	0.039	0.078	0.117	0.156	0.196	0.389
50	0.018	0.036	0.071	0.107	0.142	0.178	0.354
55	0.016	0.033	0.065	0.098	0.131	0.163	0.325
60	0.015	0.030	0.060	0.090	0.121	0.150	0.300
65	0.014	0.028	0.056	0.084	0.112	0.140	0.279
70	0.013	0.026	0.052	0.079	0.105	0.131	0.261
75	0.012	0.025	0.049	0.074	0.099	0.123	0.245
80	0.012	0.023	0.047	0.070	0.093	0.116	0.232
85	0.011	0.022	0.044	0.067	0.089	0.111	0.221
90	0.011	0.021	0.042	0.064	0.085	0.106	0.211
95	0.010	0.020	0.041	0.061	0.082	0.102	0.203
100	0.010	0.020	0.039	0.059	0.079	0.098	0.196

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS

The solubility in water of about 800 organic compounds, including many compounds of environmental interest, is tabulated here. Values are given at 25°C or at the nearest temperature to this where data are available. In some cases solubility values are given at other temperatures as well.

Solubility of a solid is defined as the concentration of the compound in a solution that is in equilibrium with the solid phase at the specified temperature and one atmosphere pressure. For liquids whose water mixtures separate into two phases, the solubility given here is the concentration of the compound in the water-rich phase at equilibrium. In the case of gases (i.e., compounds whose vapor pressure at the specified temperature exceeds one atmosphere) the solubility is defined here as the concentration in the water phase when the partial pressure of the compound above the solution is 101.325 kPa (1 atm). Values for gases are marked with an asterisk.

All solubility values are expressed as mass percent of solute, $S = 100 w_2$, where the mass fraction w_2 is given by

$$w_2 = m_2/(m_1 + m_2) .$$

In these equations m_2 is the mass of solute and m_1 the mass of water. This quantity is related to other common measures of solubility as follows:

Molality:
$$m_2 = 1000w_2/M_2(1-w_2)$$

Mole fraction:
$$x_2 = (w_2/M_2)/\{(w_2/M_2) + (1-w_2)/M_1\}$$

Mass of solute per 100 g of H₂O:
$$r_2 = 100w_2/(1-w_2)$$

Here M_2 is the molar mass of the solute and $M_1 = 18.015$ g/mol is the molar mass of water. For small values of S the amount of substance concentration c_2 in moles per liter is approximately $10S/M_2$.

Data have been selected from evaluated sources wherever possible, in particular the *IUPAC Solubility Data Series* (References 1, 2, 3, 4, 25). The primary source for each value is listed in the column following the solubility values. The user is cautioned that wide variations of data are found in the literature for the lower solubility compounds.

The table also contains values of the Henry's Law constant k_H , which provides a measure of the partition of a substance between the atmosphere and the aqueous phase. Here k_H is defined as the limit of p_2/c_2 as the concentration approaches zero, where p_2 is the partial pressure of the solute above the solution and c_2 is the solute concentration (other formulations of Henry's Law are often used; see Reference 5). The values of k_H listed here are based on direct experimental measurement whenever available, but many of them are simply calculated as the ratio of the pure compound vapor pressure to the solubility. This approximation is reliable only for compounds of very low solubility. In fact, values of k_H found in the literature frequently differ by a factor of two or three, and variations over an order of magnitude are not unusual (Reference 5). Therefore the data given here should be taken only as a rough indication of the true Henry's Law constant, which is difficult to measure precisely.

All values of k_H refer to 25°C. If the vapor pressure of the compound at 25°C is greater than one atmosphere, it can be assumed that the k_H value has been calculated as $101.325/c_2$ kPa m³/mol. The source of the Henry's Law data is given in the last column. The air-water partition coefficient (i.e., ratio of air concentration to water concentration when both are expressed in the same units) is equal to k_H/RT or $k_H/2.48$ in the units used here.

Compounds are listed by molecular formula following the Hill convention. To locate a compound by name or CAS Registry Number when the molecular formula is not known, use the "Physical Constants of Organic Compounds" table in Section 3 and its indexes to determine the molecular formula.

* Indicates a value of S for a gas at a partial pressure of 101.325 kPa (1 atm) in equilibrium with the solution.

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AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

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Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k_H</i> /kPa m ³ mol ⁻¹	Ref.
CBrF ₃	Bromotrifluoromethane	25	0.032*	14		
CBF ₃	Tribromofluoromethane	25	0.040	14		
CBr ₄	Tetrabromomethane	30	0.024	14		
CClF ₃	Chlorotrifluoromethane	25	0.009*	10	6.9	13
CCl ₂ F ₂	Dichlorodifluoromethane	20	0.028*	5	41	13
CCl ₃ F	Trichlorofluoromethane	20	0.11	5	10.2	13
CCl ₄	Tetrachloromethane	25	0.065	20	2.99	13
CF ₄	Tetrafluoromethane	25	0.00187*	19		
CHBr ₃	Tribromomethane	25	0.30	5	0.047	13
CHClF ₂	Chlorodifluoromethane	25	0.30*	10	3.0	13
CHCl ₂ F	Dichlorofluoromethane	25	0.95*	10		
CHCl ₃	Trichloromethane	25	0.80	20	0.43	13
CHF ₃	Trifluoromethane	25	0.09*	14		
CHI ₃	Triiodomethane	25	0.012	14		
CH ₂ BrCl	Bromochloromethane	25	1.7	10	0.18	13
CH ₂ Br ₂	Dibromomethane	25	1.14	14	0.086	13
CH ₂ ClF	Chlorofluoromethane	25	1.05*	14		
CH ₂ Cl ₂	Dichloromethane	25	1.73	20	0.30	13
CH ₂ I ₂	Diiodomethane	30	0.124	10	0.032	13
CH ₃ Br	Bromomethane	20	1.80*	5	0.63	13
CH ₃ Cl	Chloromethane	25	0.535*	5	0.98	13
CH ₃ F	Fluoromethane	30	0.177*	5		
CH ₃ I	Iodomethane	20	1.4	10	0.54	13
CH ₃ NO ₂	Nitromethane	25	11.1	10		
CH ₄	Methane	25	0.00227*	18	67.4	5
CO	Carbon monoxide	25	0.00276*	18		
CO ₂	Carbon dioxide	25	0.1501	18		
CS ₂	Carbon disulfide	20	0.210	10		
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane	25	0.00030	25		
C ₂ ClF ₅	Chloropentafluoroethane	25	0.006*	10	260	13
C ₂ Cl ₂ F ₄	1,2-Dichlorotetrafluoroethane	25	0.013*	10	127	13
C ₂ Cl ₃ F ₃	1,1,2-Trichlorotrifluoroethane	25	0.017	25	32	13
C ₂ Cl ₄	Tetrachloroethylene	0	0.024	25		
		25	0.021	25	1.73	13
		50	0.020	25		
C ₂ Cl ₄ F ₂	1,1,2,2-Tetrachloro-1,2-difluoroethane	27	0.016	25		
C ₂ Cl ₆	Hexachloroethane	25	0.005	25	0.85	13
C ₂ F ₄	Tetrafluoroethylene	25	0.0158*	19		
C ₂ HBrClF ₃	2-Bromo-2-chloro-1,1,1-trifluoroethane	10	0.52	25		
		25	0.41	25		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
		40	0.40	25		
C ₂ HCl ₂ F ₃	2,2-Dichloro-1,1,1-trifluoroethane	25	0.46	25		
C ₂ HCl ₃	Trichloroethylene	0	0.145	25		
		25	0.128	25	1.03	13
		60	0.133	25		
C ₂ HCl ₃ O ₂	Trichloroacetic acid	25	92.3	27		
C ₂ HCl ₅	Pentachloroethane	25	0.049	25	0.25	13
C ₂ H ₂	Acetylene	25	0.1081*	19		
C ₂ H ₂ Br ₂ Cl ₂	1,2-Dibromo-1,2-dichloroethane	20	0.070	25		
C ₂ H ₂ Br ₄	1,1,2,2-Tetrabromoethane	0	0.052	25		
		25	0.068	25		
		50	0.106	25		
		100	0.307	25		
C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	5	0.310	25		
		25	0.242	25	2.62	13
		50	0.225	25		
		90	0.355	25		
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	10	0.76	25		
		25	0.64	25	0.46	13
		40	0.66	25		
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	10	0.53	25		
		25	0.45	25	0.96	13
		40	0.41	25		
C ₂ H ₂ Cl ₂ F ₂	1,2-Dichloro-1,1-difluoroethane	24	0.49	25		
C ₂ H ₂ Cl ₄	1,1,1,2-Tetrachloroethane	0	0.120	25		
		25	0.107	25	0.24	13
		50	0.123	25		
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	5	0.302	25		
		25	0.283	25	0.026	13
		50	0.318	25		
C ₂ H ₂ I ₂	<i>cis</i> -1,2-Diiodoethene	25	0.046	25		
C ₂ H ₂ I ₂	<i>trans</i> -1,2-Diiodoethene	25	0.015	25		
C ₂ H ₂ O ₄	Oxalic acid	20	8.69	27		
		80	45.8	27		
C ₂ H ₃ Br ₂ Cl	1,2-Dibromo-1-chloroethane	20	0.060	25		
C ₂ H ₃ Br ₃	1,1,2-Tribromoethane	20	0.050	25		
C ₂ H ₃ Cl	Chloroethylene	25	0.27*	5	2.68	13
C ₂ H ₃ Cl ₂ F	1,1-Dichloro-1-fluoroethane	25	0.042	25		
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	0	0.134	25		
		25	0.129	25	1.76	13
		50	0.138	25		
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	0	0.425	25		
		25	0.459	25	0.092	13
		50	0.536	25		
C ₂ H ₃ KO ₂	Potassium acetate	25	72.9			
C ₂ H ₃ NaO ₂	Sodium acetate	25	33.5			
C ₂ H ₄	Ethylene	25	0.01336*	19	21.7	5
C ₂ H ₄ BrCl	1-Bromo-2-chloroethane	30	0.683	25		
C ₂ H ₄ Br ₂	1,2-Dibromoethane	0	0.31	25		
		25	0.39	25	0.066	13
		50	0.54	25		
		75	0.76	25		
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	0	0.62	25		
		25	0.50	25	0.63	13
		50	0.50	25		
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	0	0.92	25		
		25	0.86	25	0.14	13
		50	1.05	25		
		100	2.17	25		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	<i>S</i> /mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₂ H ₄ O ₂	Methyl formate	25	23	10		
C ₂ H ₅ Br	Bromoethane	0	1.05	25		
		25	0.90	25	1.23	13
C ₂ H ₅ Cl	Chloroethane	0	0.45	25		
		25	0.67	25	1.02	13
C ₂ H ₅ F	Fluoroethane	25	0.216*	14		
C ₂ H ₅ I	Iodoethane	0	0.44	25		
		25	0.40	25	0.52	13
C ₂ H ₅ NO	Acetamide	20	40.8	10		
C ₂ H ₅ NO ₂	Nitroethane	25	4.68	10		
C ₂ H ₅ NO ₂	Methyl carbamate	15	69	27		
C ₂ H ₅ NO ₂	Glycine	25	20.06	26		
C ₂ H ₆	Ethane	25	0.00568*	18	50.6	5
C ₂ H ₆ O	Dimethyl ether	24	35.3*	10	0.077	13
C ₂ H ₆ OS	Dimethyl sulfoxide	25	25.3	10		
C ₂ H ₆ O ₄ S	Dimethyl sulfate	18	2.7	27		
C ₂ H ₆ S	Dimethyl sulfide	25	2	10		
C ₂ N ₂	Cyanogen	25	0.8	30		
C ₃ Br ₂ F ₆	1,2-Dibromo-1,1,2,3,3,3-hexafluoropropane	21	0.0068	25		
C ₃ Cl ₂ F ₆	1,2-Dichlorohexafluoropropane	21	0.0096	25		
C ₃ Cl ₃ F ₅	1,1,1-Trichloro-2,2,3,3,3-pentafluoropropane	21	0.0058	25		
C ₃ Cl ₄ F ₄	1,1,1,3-Tetrachloro-2,2,3,3-tetrafluoropropane	21	0.0052	25		
C ₃ Cl ₆	Hexachloropropene	20	0.00118	25		
C ₃ F ₆	Perfluoropropene	25	0.0194*	14		
C ₃ F ₈	Perfluoropropane	15	0.0015*	14		
C ₃ H ₃ N	2-Propenenitrile	20	7.35	10		
C ₃ H ₄	Propyne	25	0.364*	5	1.11	5
C ₃ H ₄ ClF ₃	3-Chloro-1,1,1-trifluoropropane	20	0.133	25		
C ₃ H ₄ Cl ₂	<i>cis</i> -1,3-Dichloropropene	20	0.27	5	0.24	5
C ₃ H ₄ Cl ₂	<i>trans</i> -1,3-Dichloropropene	20	0.28	5	0.18	5
C ₃ H ₄ Cl ₂	2,3-Dichloropropene	25	0.215	5	0.36	5
C ₃ H ₄ N ₂ O ₂	2,4-Imidazolidinedione	25	3.93	29		
C ₃ H ₄ O	Acrolein	20	20.8	10		
C ₃ H ₅ Br	3-Bromopropene	25	0.38	25		
C ₃ H ₅ Br ₂ Cl	1,2-Dibromo-3-chloropropene	20	0.123	25		
C ₃ H ₅ Cl	3-Chloropropene	25	0.40	25	1.10	5
		50	0.13	25		
C ₃ H ₅ ClO	Epichlorohydrin	20	6.58	10	0.003	13
C ₃ H ₅ Cl ₃	1,2,3-Trichloropropene	10	0.14	25		
		25	0.20	25	0.038	13
C ₃ H ₅ N	Propanenitrile	25	10.3	10		
C ₃ H ₆	Propene	25	0.0200*	5	21.3	5
C ₃ H ₆	Cyclopropane	25	0.0484*	19		
C ₃ H ₆ BrCl	1-Bromo-3-chloropropene	25	0.223	25		
C ₃ H ₆ Br ₂	1,2-Dibromopropene	25	0.143	10		
C ₃ H ₆ Br ₂	1,3-Dibromopropene	25	0.169	25		
C ₃ H ₆ Cl ₂	1,2-Dichloropropene	5	0.270	25		
		25	0.274	25	0.29	13
		40	0.297	25		
C ₃ H ₆ Cl ₂	1,3-Dichloropropene	5	0.218	25		
		25	0.280	25		
C ₃ H ₆ N ₆ O ₆	Hexahydro-1,3,5-trinitro-1,3,5-triazine	25	0.0060	17		
C ₃ H ₆ O	Propanal	25	30.6	10		
C ₃ H ₆ O	Methyloxirane	20	40.5	10	0.0087	13
C ₃ H ₆ O ₂	Ethyl formate	25	11.8	10		
C ₃ H ₆ O ₂	Methyl acetate	20	24.5	10		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	<i>S</i> /mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₃ H ₆ O ₃	1,3,5-Trioxane	25	17.4	30		
C ₃ H ₇ Br	1-Bromopropane	0	0.298	25		
		25	0.234	25	3.8	13
C ₃ H ₇ Br	2-Bromopropane	20	0.32	25	1.27	13
C ₃ H ₇ Cl	1-Chloropropane	25	0.250	25	1.41	13
C ₃ H ₇ Cl	2-Chloropropane	0	0.44	25		
		20	0.30	25		
C ₃ H ₇ F	1-Fluoropropane	14	0.386*	14		
C ₃ H ₇ F	2-Fluoropropane	15	0.366	14		
C ₃ H ₇ I	1-Iodopropane	0	0.114	25		
		20	0.100	25	0.93	13
C ₃ H ₇ I	2-Iodopropane	0	0.167	25		
		20	0.140	25		
C ₃ H ₇ NO ₂	1-Nitropropane	25	1.50	10		
C ₃ H ₇ NO ₂	2-Nitropropane	25	1.71	10		
C ₃ H ₇ NO ₂	Ethyl carbamate	15	48	27		
C ₃ H ₇ NO ₂	Alanine	25	14.30	26		
C ₃ H ₇ NO ₂	β-Alanine	25	47.1	26		
C ₃ H ₇ NO ₂	Sarcosine [N-Methylglycine]	25	30.0	26		
C ₃ H ₇ NO ₃	Serine	25	4.76	26		
C ₃ H ₇ N ₃ O ₂	Glycocyamine	25	0.5	26		
C ₃ H ₈	Propane	25	0.00669*	18	71.6	5
C ₃ H ₈ O ₂	Dimethoxymethane	16	24.4	10		
C ₄ Cl ₆	Hexachloro-1,3-butadiene	25	0.41	25		
C ₄ F ₈	Perfluorocyclobutane	21	0.014*	14		
C ₄ H ₄ N ₂	Succinonitrile	25	11.5	10		
C ₄ H ₄ N ₂ O ₂	Uracil	25	0.27	29		
C ₄ H ₄ O	Furan	25	1	10	0.54	13
C ₄ H ₅ N	Methylacrylonitrile	20	2.57	10		
C ₄ H ₅ N	Pyrrole	25	4.5	10		
C ₄ H ₅ N ₃ O	Cytosine	25	0.73	29		
C ₄ H ₆	1,3-Butadiene	25	0.0735*	5	20.7	13
C ₄ H ₆	1-Butyne	25	0.287*	5	1.91	5
C ₄ H ₆ BaO ₄	Barium acetate	25	44.2			
C ₄ H ₆ N ₂ O ₂	2,5-Piperazinedione	25	1.64	29		
C ₄ H ₆ O	<i>trans</i> -2-Butenal	20	15.6	10		
C ₄ H ₆ O ₂	<i>trans</i> -Crotonic acid	25	9	10		
C ₄ H ₆ O ₂	Methacrylic acid	20	8.9	10		
C ₄ H ₆ O ₂	Vinyl acetate	20	2.0	10		
C ₄ H ₆ O ₂	Methyl acrylate	25	4.94	10		
C ₄ H ₆ O ₄	Succinic acid	25	7.71	27		
		75	37.6	27		
C ₄ H ₆ O ₄	Dimethyl oxalate	20	5.82	27		
C ₄ H ₆ O ₅	Malic acid	25	58	27		
C ₄ H ₇ Br	4-Bromo-1-butene	25	0.076	25		
C ₄ H ₇ Cl	1-Chloro-2-methylpropene	25	0.916	5	0.12	5
C ₄ H ₇ N	Butanenitrile	20	3.3	10		
C ₄ H ₇ NO ₄	Aspartic acid	25	0.501	26		
C ₄ H ₈	1-Butene	25	0.0222*	5	25.6	13
C ₄ H ₈	Isobutene	25	0.0263*	5	21.6	13
C ₄ H ₈ Br ₂	1,4-Dibromobutane		0.035	25		
C ₄ H ₈ Cl ₂	1,1-Dichlorobutane	25	0.050	25		
C ₄ H ₈ Cl ₂	1,4-Dichlorobutane	25	0.16	25		
C ₄ H ₈ Cl ₂	2,3-Dichlorobutane	20	0.056	25		
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether	25	1.03	10	0.003	13
C ₄ H ₈ N ₂ O ₂	Succinamide	50	18.4	27		
C ₄ H ₈ N ₂ O ₃	Asparagine	25	2.45	26		
C ₄ H ₈ N ₂ O ₃	<i>N</i> -Glycylglycine	25	18.4	29		
C ₄ H ₈ O	<i>cis</i> -Crotonyl alcohol	20	16.6	10		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₄ H ₈ O	Ethyl vinyl ether	20	0.9	10		
C ₄ H ₈ O	Butanal	25	7.1	10		
C ₄ H ₈ O	Isobutanal	20	9.1	10		
C ₄ H ₈ O	2-Butanone	25	25.9	20		
C ₄ H ₈ O ₂	2-Methylpropanoic acid	20	22.8	10		
C ₄ H ₈ O ₂	Propyl formate	22	2.05	10		
C ₄ H ₈ O ₂	Ethyl acetate	25	8.08	10		
C ₄ H ₈ O ₂	Methyl propanoate		6	30		
C ₄ H ₉ Br	1-Bromobutane	25	0.087	25	1.2	13
C ₄ H ₉ Br	1-Bromo-2-methylpropane	18	0.051	25		
C ₄ H ₉ Cl	1-Chlorobutane	1	0.062	25		
		25	0.087	25	1.54	13
C ₄ H ₉ Cl	2-Chlorobutane	0	0.107	25		
		25	0.092	25		
C ₄ H ₉ Cl	1-Chloro-2-methylpropane	25	0.92	25		
C ₄ H ₉ Cl	2-Chloro-2-methylpropane	15	0.29	25		
C ₄ H ₉ I	1-Iodobutane	17	0.021	10	1.87	13
C ₄ H ₉ NO ₂	Ethyl- <i>N</i> -methyl carbamate	15	69	27		
C ₄ H ₉ NO ₂	2-Methylalanine	25	12.0	26		
C ₄ H ₉ NO ₂	<i>DL</i> -2-Aminobutanoic acid	25	17.4	26		
C ₄ H ₉ NO ₂	<i>DL</i> -3-Aminobutanoic acid	25	55.6	26		
C ₄ H ₉ NO ₃	Threonine	25	8.93	26		
C ₄ H ₉ NO ₃	L-Homoserine	25	52.4	26		
C ₄ H ₉ N ₃ O ₂	Creatine	25	1.6	26		
C ₄ H ₁₀	Butane	25	0.00724*	18	95.9	5
C ₄ H ₁₀	Isobutane	25	0.00535*	18	120	5
C ₄ H ₁₀ O	1-Butanol	0	10.4	1		
		25	7.4	1		
		50	6.4	1		
C ₄ H ₁₀ O	2-Butanol	10	23.9	1		
		25	18.1	1		
		50	14.0	1		
C ₄ H ₁₀ O	2-Methyl-1-propanol	0	11.5	1		
		25	8.1	1	0.00273	28
		50	6.5	1		
C ₄ H ₁₀ O	Diethyl ether	25	6.04	10	0.088	13
C ₄ H ₁₀ O	Methyl propyl ether	25	3.5	30		
C ₄ H ₁₀ O ₄	1,2,3,4-Butanetetrol	20	38.0	27		
C ₄ H ₁₀ S	1-Butanethiol	20	0.0597	10		
C ₄ H ₁₁ NO ₂	Diethanolamine	20	95.4	10		
C ₄ H ₁₂ Si	Tetramethylsilane	25	0.00196	10		
C ₅ Cl ₈	Octachloro-1,3-pentadiene	20	0.000020	25		
C ₅ F ₁₂	Perfluoropentane	25	0.00012	25		
C ₅ H ₄ N ₂ O ₄	Orotic acid	18	0.18	26		
C ₅ H ₄ N ₄ O	Hypoxanthine	25	0.070	29		
C ₅ H ₄ N ₄ O ₂	Xanthine	20	0.05	26		
C ₅ H ₄ N ₄ O ₃	Uric acid	20	0.002	26		
C ₅ H ₄ O ₂	Furfural	20	8.2	10		
C ₅ H ₅ N ₅	Adenine	25	0.104	29		
C ₅ H ₅ N ₅ O	Guanine	25	0.0068	29		
C ₅ H ₅ N ₅ O	Isoguanine	25	0.006	26		
C ₅ H ₆	1,3-Cyclopentadiene	25	0.068	3		
C ₅ H ₆ N ₂ O ₂	Thymine	25	0.35	29		
C ₅ H ₇ NO ₂	Ethyl cyanoacetate	20	25.9	10		
C ₅ H ₇ N ₃ O	5-Methylcytosine	25	0.45	26		
C ₅ H ₈	1,4-Pentadiene	25	0.056	3	12	5
C ₅ H ₈	2-Methyl-1,3-butadiene	25	0.061	3	7.78	5
		50	0.076*	3		
C ₅ H ₈	1-Pentyne	25	0.157	3	2.5	5

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₅ H ₈	Cyclopentene	25	0.054	3	6.56	13
C ₅ H ₈ O ₂	Ethyl acrylate	25	1.50	10		
C ₅ H ₈ O ₂	Methyl methacrylate	20	1.56	10		
C ₅ H ₈ O ₂	2,4-Pentanedione	20	16.6	10		
C ₅ H ₉ NO ₂	Proline	25	61.9	26		
C ₅ H ₉ NO ₃	trans-4-Hydroxyproline	25	26.5	26		
C ₅ H ₉ NO ₄	DL-Glutamic acid	25	2.30	29		
C ₅ H ₉ NO ₄	Glutamic acid	25	0.85	26		
C ₅ H ₁₀	1-Pentene	25	0.0148	3	40.3	5
C ₅ H ₁₀	cis-2-Pentene	25	0.0203	3	22.8	5
C ₅ H ₁₀	3-Methyl-1-butene	25	0.013*	3	54.7	5
C ₅ H ₁₀	2-Methyl-2-butene	25	0.041	3		
C ₅ H ₁₀	Cyclopentane	25	0.0157	3	19.1	13
C ₅ H ₁₀ Cl ₂	2,3-Dichloro-2-methylbutane	25	0.029	25		
C ₅ H ₁₀ Cl ₂	2,3-Dichloropentane	25	0.029	25		
C ₅ H ₁₀ Cl ₂	1,2-Dichloropentane	25	0.029	25		
C ₅ H ₁₀ Cl ₂	1,5-Dichloropentane	19	0.02	25		
C ₅ H ₁₀ N ₂ O ₃	Glutamine	25	4.0	26		
C ₅ H ₁₀ O	2-Pentanone	25	5.5	20	0.00847	28
C ₅ H ₁₀ O	3-Pentanone	25	4.72	20		
C ₅ H ₁₀ O	Tetrahydropyran	25	8.02	10		
C ₅ H ₁₀ O	2-Methyltetrahydrofuran	25	13.9	10	0.67	13
C ₅ H ₁₀ O ₂	Pentanoic acid	20	2.5	26		
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid	21	4.3	26		
C ₅ H ₁₀ O ₂	Isobutyl formate	22	1.0	10		
C ₅ H ₁₀ O ₂	Propyl acetate	20	2.3	10		
C ₅ H ₁₀ O ₂	Isopropyl acetate	20	2.9	10		
C ₅ H ₁₀ O ₂	Ethyl propanoate	20	1.92	10		
C ₅ H ₁₀ O ₂	Methyl butanoate		1.6	30		
C ₅ H ₁₁ Br	1-Bromopentane	25	0.0127	25		
C ₅ H ₁₁ Br	1-Bromo-3-methylbutane	16	0.020	25		
C ₅ H ₁₁ Cl	1-Chloropentane	5	0.020	25		
		25	0.021	25	2.37	13
C ₅ H ₁₁ Cl	3-Chloropentane	25	0.025	25		
C ₅ H ₁₁ NO ₂	Valine	25	8.13	26		
C ₅ H ₁₁ NO ₂	L-Norvaline	25	9.7	26		
C ₅ H ₁₁ NO ₂ S	Methionine	25	5.3	26		
C ₅ H ₁₂	Pentane	25	0.0041	3	128	13
C ₅ H ₁₂	Isopentane	25	0.00485	3	479	13
C ₅ H ₁₂	Neopentane	25	0.00332*	3	220	13
C ₅ H ₁₂ O	1-Pentanol	0	3.1	1		
		25	2.20	1		
		50	1.8	1		
C ₅ H ₁₂ O	2-Pentanol	25	4.3	21		
C ₅ H ₁₂ O	3-Pentanol	25	5.6	21		
C ₅ H ₁₂ O	2-Methyl-1-butanol	25	3.0	3		
C ₅ H ₁₂ O	3-Methyl-1-butanol	25	2.7	1		
C ₅ H ₁₂ O	2-Methyl-2-butanol	25	11.0	1		
C ₅ H ₁₂ O	3-Methyl-2-butanol	25	5.6	1		
C ₅ H ₁₂ O	2,2-Dimethyl-1-propanol	25	3.5	1		
C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether	25	3.62		0.070	13
C ₅ H ₁₂ O ₄	Pentaerythritol	15	5.3	30		
C ₆ Cl ₆	Hexachlorobenzene	25	0.0000005	2	0.131	11
C ₆ F ₁₄	Perfluorohexane	25	0.0000098	25		
C ₆ F ₁₄	Perfluoro-2-methylpentane	25	0.000017	25		
C ₆ HCl ₅	Pentachlorobenzene	25	0.000055	2	0.085	11
C ₆ HCl ₅ O	Pentachlorophenol	25	0.0013	24		
C ₆ H ₂ Br ₄	1,2,4,5-Tetrabromobenzene	25	0.0000434	2		
C ₆ H ₂ Cl ₄	1,2,3,4-Tetrachlorobenzene	25	0.0000433	2	0.144	11

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	<i>S</i> /mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₆ H ₂ Cl ₄	1,2,3,5-Tetrachlorobenzene	25	0.000346	2	0.59	11
C ₆ H ₂ Cl ₄	1,2,4,5-Tetrachlorobenzene	25	0.000606	2	0.122	11
C ₆ H ₂ Cl ₄ O	2,3,4,6-Tetrachlorophenol	25	0.017	24		
C ₆ H ₂ Cl ₄ O ₂	3,4,5,6-Tetrachloro-1,2-benzenediol	25	0.071	8		
C ₆ H ₃ Br ₃	1,2,4-Tribromobenzene	25	0.0010	2		
C ₆ H ₃ Br ₃	1,3,5-Tribromobenzene	25	0.0000789	2		
C ₆ H ₃ Br ₃ O	2,4,6-Tribromophenol	15	0.0007	2		
C ₆ H ₃ Cl ₃	1,2,3-Trichlorobenzene	25	0.00309	2	0.242	11
C ₆ H ₃ Cl ₃	1,2,4-Trichlorobenzene	25	0.00379	2	0.277	11
C ₆ H ₃ Cl ₃	1,3,5-Trichlorobenzene	25	0.000655	2	1.1	11
C ₆ H ₃ Cl ₃ O	2,4,5-Trichlorophenol	25	0.1	2		
C ₆ H ₃ Cl ₃ O	2,4,6-Trichlorophenol	25	0.050	24		
C ₆ H ₃ Cl ₃ O ₂	3,4,5-Trichloro-1,2-benzenediol	25	0.051	8		
C ₆ H ₃ N ₃ O ₇	2,4,6-Trinitrophenol	20	1.43	27		
C ₆ H ₄ BrCl	1-Bromo-2-chlorobenzene	25	0.0124	2		
C ₆ H ₄ BrCl	1-Bromo-3-chlorobenzene	25	0.0118	2		
C ₆ H ₄ BrCl	1-Bromo-4-chlorobenzene	25	0.00442	2		
C ₆ H ₄ BrI	1-Bromo-4-iodobenzene	25	0.000794	2		
C ₆ H ₄ Br ₂	<i>o</i> -Dibromobenzene	25	0.00748	2		
C ₆ H ₄ Br ₂	<i>m</i> -Dibromobenzene	25	0.0064	2		
C ₆ H ₄ Br ₂	<i>p</i> -Dibromobenzene	25	0.0020	2		
C ₆ H ₄ Br ₂ O	2,4-Dibromophenol	25	0.2	2		
C ₆ H ₄ ClI	1-Chloro-2-iodobenzene	25	0.00689	2		
C ₆ H ₄ ClI	1-Chloro-3-iodobenzene	25	0.00674	2		
C ₆ H ₄ ClI	1-Chloro-4-iodobenzene	25	0.00311	2		
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	0	0.0142	2		
		25	0.0147	2	0.195	28
		50	0.0212	2		
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	10	0.0103	2		
		25	0.0106	2	0.376	11
		50	0.0165	2		
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	10	0.00512	2		
		25	0.00829	2	0.244	28
		50	0.0167	2		
C ₆ H ₄ Cl ₂ O	2,4-Dichlorophenol	20	0.49	24		
C ₆ H ₄ Cl ₂ O ₂	3,5-Dichloro-1,2-benzenediol	25	0.78	8		
C ₆ H ₄ Cl ₂ O ₂	4,5-Dichloro-1,2-benzenediol	25	1.19	8		
C ₆ H ₄ F ₂	<i>o</i> -Difluorobenzene	25	0.114	2		
C ₆ H ₄ F ₂	<i>m</i> -Difluorobenzene	25	0.114	2		
C ₆ H ₄ F ₂	<i>p</i> -Difluorobenzene	25	0.122	2		
C ₆ H ₄ I ₂	<i>o</i> -Diiodobenzene	25	0.00192	2		
C ₆ H ₄ I ₂	<i>m</i> -Diiodobenzene	25	0.000185	2		
C ₆ H ₄ I ₂	<i>p</i> -Diiodobenzene	25	0.000893	2		
C ₆ H ₄ N ₂ O ₄	1,2-Dinitrobenzene	20	0.21	27		
C ₆ H ₄ N ₂ O ₄	1,3-Dinitrobenzene	20	2.09	27		
C ₆ H ₄ N ₂ O ₄	1,4-Dinitrobenzene	20	1.30	27		
C ₆ H ₄ O ₂	<i>p</i> -Benzoquinone	25	1.36	27		
C ₆ H ₅ Br	Bromobenzene	10	0.0387	2		
		25	0.0445	2	0.250	28
		40	0.0516	2		
C ₆ H ₅ BrO	<i>p</i> -Bromophenol	25	1.86	2		
C ₆ H ₅ Cl	Chlorobenzene	10	0.0387	2		
		25	0.0495	2	0.32	28
		50	0.0882	2		
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol	25	2.0	2		
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol	25	2.2	2		
C ₆ H ₅ ClO	<i>p</i> -Chlorophenol	25	2.7	2		
C ₆ H ₅ F	Fluorobenzene	27	0.154	2	0.70	11
C ₆ H ₅ I	Iodobenzene	10	0.0193	2		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
		25	0.0226	2	0.078	11
		45	0.0279	2		
C ₆ H ₅ NO ₂	Nitrobenzene	25	0.21	17		
C ₆ H ₅ NO ₃	2-Nitrophenol	20	0.21	27		
C ₆ H ₅ NO ₃	3-Nitrophenol	20	2.14	27		
C ₆ H ₅ NO ₃	4-Nitrophenol	20	1.32	27		
C ₆ H ₆	Benzene	10	0.178	3		
		25	0.178	22	0.557	22
		50	0.208	3		
C ₆ H ₆ ClN	<i>o</i> -Chloroaniline	25	0.876	10		
C ₆ H ₆ N ₂ O ₂	2-Nitroaniline	30	1.47	27		
C ₆ H ₆ N ₂ O ₂	3-Nitroaniline	30	0.121	27		
C ₆ H ₆ N ₂ O ₂	4-Nitroaniline	30	0.073	27		
C ₆ H ₆ O	Phenol	25	8.66	10		
C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	25	7.42	27		
C ₆ H ₆ O ₂	Pyrocatechol	20	31.1	27		
C ₆ H ₆ O ₂	Resorcinol	20	63.7	27		
C ₆ H ₆ O ₃	1,2,3-Benzenetriol	25	38.5	27		
C ₆ H ₆ O ₃	1,3,5-Benzenetriol	20	1.12	27		
C ₆ H ₆ O ₆	Aconitic acid	15	58.5	27		
C ₆ H ₇ N	Aniline	25	3.38	10	14	15
C ₆ H ₇ NO ₃ S	4-Aminobenzenesulfonic acid	7	0.59	27		
C ₆ H ₈	1,4-Cyclohexadiene	25	0.08	3	1.03	13
C ₆ H ₈ ClN	Aniline hydrochloride	15	15.1	27		
C ₆ H ₈ N ₂	Adiponitrile	20	0.80	16		
C ₆ H ₈ N ₂	<i>m</i> -Phenylenediamine	20	19.2	27		
C ₆ H ₈ N ₂	<i>p</i> -Phenylenediamine		1	30		
C ₆ H ₈ O ₄	Dimethyl maleate	25	8.0	10		
C ₆ H ₉ N ₃ O ₂	Histidine	25	4.17	26		
C ₆ H ₁₀	1,5-Hexadiene	25	0.017	3		
C ₆ H ₁₀	1-Hexyne	25	0.036	3	4.14	13
C ₆ H ₁₀	Cyclohexene	25	0.016	3	4.57	13
C ₆ H ₁₀ O	Cyclohexanone	25	8.8	20		
C ₆ H ₁₀ O	Mesityl oxide	20	2.89	10		
C ₆ H ₁₀ O ₃	Ethyl acetoacetate	25	12	10		
C ₆ H ₁₀ O ₄	Adipic acid	15	1.42	27		
C ₆ H ₁₁ NO	Caprolactam	25	84.0	10		
C ₆ H ₁₂	1-Hexene	25	0.0053	3	41.8	5
C ₆ H ₁₂	<i>trans</i> -2-Hexene	25	0.0067	3		
C ₆ H ₁₂	2-Methyl-1-pentene	25	0.0078	3	28.1	5
C ₆ H ₁₂	4-Methyl-1-pentene	25	0.0048	3	63.2	5
C ₆ H ₁₂	2,3-Dimethyl-1-butene	30	0.046	3		
C ₆ H ₁₂	Cyclohexane	25	0.0058	3	19.4	13
C ₆ H ₁₂	Methylcyclopentane	25	0.0043	3	36.7	5
C ₆ H ₁₂ N ₂ O ₄ S	<i>L</i> -Lanthionine	25	0.15	26		
C ₆ H ₁₂ N ₂ O ₄ S ₂	<i>L</i> -Cystine	25	0.011	26		
C ₆ H ₁₂ N ₄	Methenamine	12	44.8	27		
C ₆ H ₁₂ O	1-Hexen-3-ol	25	2.52	1		
C ₆ H ₁₂ O	4-Hexen-2-ol	25	3.81	1		
C ₆ H ₁₂ O	Butyl vinyl ether	20	0.3	10		
C ₆ H ₁₂ O	2-Hexanone	20	1.75	10		
C ₆ H ₁₂ O	4-Methyl-2-pentanone	25	1.7	10		
C ₆ H ₁₂ O	Cyclohexanol	10	4.62	1		
		25	3.8	1		
		40	3.30	1		
C ₆ H ₁₂ O ₂	Hexanoic acid	20	0.97	26		
C ₆ H ₁₂ O ₂	Isopentyl formate	22	0.3	27		
C ₆ H ₁₂ O ₂	Butyl acetate	20	0.68	10		
C ₆ H ₁₂ O ₂	<i>sec</i> -Butyl acetate	20	0.62	10		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₆ H ₁₂ O ₂	Isobutyl acetate	20	0.63	10		
C ₆ H ₁₂ O ₂	Propyl propanoate	25	0.6	27		
C ₆ H ₁₂ O ₂	Ethyl butanoate	20	0.49	10		
C ₆ H ₁₂ O ₃	Ethylene glycol monoethyl ether acetate		14	30		
C ₆ H ₁₂ O ₃	Paraldehyde	25	11	30		
C ₆ H ₁₂ O ₆	<i>D</i> -Galactose	20	40.6	27		
C ₆ H ₁₂ O ₆	α - <i>D</i> -Glucose	15	45.0	27		
		30	54.6	27		
		80	81.5	27		
C ₆ H ₁₃ Br	1-Bromohexane	25	0.00258	25		
C ₆ H ₁₃ Cl	1-Chlorohexane	5	0.0047	25		
		25	0.0064	25		
C ₆ H ₁₃ NO ₂	Leucine	25	2.15	26		
C ₆ H ₁₃ NO ₂	Isoleucine	25	3.31	26		
C ₆ H ₁₃ NO ₂	L-Norleucine	25	1.5	26		
C ₆ H ₁₃ NO ₂	Ethyl <i>N</i> -propylcarbamate	15	7.70	27		
C ₆ H ₁₄	Hexane	25	0.0011	3	183	13
		60	0.00136	3		
C ₆ H ₁₄	2-Methylpentane	25	0.00137	3	176	13
C ₆ H ₁₄	3-Methylpentane	25	0.00129	3	170	13
C ₆ H ₁₄	2,2-Dimethylbutane	25	0.0021	3	199	13
C ₆ H ₁₄	2,3-Dimethylbutane	25	0.0021	3	144	13
C ₆ H ₁₄ N ₂ O ₂	Lysine	25	0.58	26		
C ₆ H ₁₄ N ₄ O ₂	Arginine	25	15.44	26		
C ₆ H ₁₄ O	2-Methoxy-2-methylbutane	20	1.25	27		
C ₆ H ₁₄ O	1-Hexanol	0	0.79	1		
		25	0.60	1		
		50	0.51	1		
C ₆ H ₁₄ O	2-Hexanol	25	1.4	1		
C ₆ H ₁₄ O	3-Hexanol	25	1.6	1		
C ₆ H ₁₄ O	2-Methyl-1-pentanol	25	0.81	1		
C ₆ H ₁₄ O	4-Methyl-1-pentanol	25	0.76	1		
C ₆ H ₁₄ O	2-Methyl-2-pentanol	25	3.2	1		
C ₆ H ₁₄ O	3-Methyl-2-pentanol	25	1.9	1		
C ₆ H ₁₄ O	4-Methyl-2-pentanol	27	1.5	1		
C ₆ H ₁₄ O	2-Methyl-3-pentanol	25	2.0	1		
C ₆ H ₁₄ O	3-Methyl-3-pentanol	25	4.3	1		
C ₆ H ₁₄ O	2-Ethyl-1-butanol	25	1.0	1		
C ₆ H ₁₄ O	2,2-Dimethyl-1-butanol	25	0.8	1		
C ₆ H ₁₄ O	2,3-Dimethyl-2-butanol	25	4.2	1		
C ₆ H ₁₄ O	3,3-Dimethyl-2-butanol	25	2.4	1		
C ₆ H ₁₄ O	Dipropyl ether	25	0.49	10	0.26	13
C ₆ H ₁₄ O	Diisopropyl ether	20	1.2	10	0.26	13
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane	25	5	10		
C ₆ H ₁₄ O ₆	<i>D</i> -Mannitol	25	17.7	27		
C ₆ H ₁₅ N	Dipropylamine	20	2.5	10		
C ₆ H ₁₅ N	Triethylamine	20	5.5	10		
C ₆ H ₁₆ ClN	Triethylamine hydrochloride	25	57.8	27		
C ₇ F ₁₆	Perfluoroheptane	25	0.0000013	25		
C ₇ H ₄ ClNO ₄	3-Chloro-2-nitrobenzoic acid	25	0.047	27		
C ₇ H ₄ ClNO ₄	5-Chloro-2-nitrobenzoic acid	25	0.96	27		
C ₇ H ₄ Cl ₄ O	2,3,4,6-Tetrachloro-5-methylphenol	25	0.00061	2		
C ₇ H ₄ N ₂ O ₆	3,5-Dinitrobenzoic acid	25	0.134	27		
C ₇ H ₄ O ₆	4-Oxo-4H-pyran-2,6-dicarboxylic acid	25	1.45	27		
C ₇ H ₄ O ₇	3-Hydroxy-4-oxo-4H-pyran-2,6-dicarboxylic acid	25	0.84	27		
C ₇ H ₅ BrO ₂	2-Bromobenzoic acid	25	0.185	27		
C ₇ H ₅ BrO ₂	3-Bromobenzoic acid	25	0.040	27		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₇ H ₅ BrO ₂	4-Bromobenzoic acid	25	0.0056	27		
C ₇ H ₅ ClO ₂	2-Chlorobenzoic acid	25	0.209	27		
C ₇ H ₅ ClO ₂	3-Chlorobenzoic acid	25	0.040	27		
C ₇ H ₅ ClO ₂	4-Chlorobenzoic acid	25	0.072	27		
C ₇ H ₅ Cl ₃	(Trichloromethyl)benzene	5	0.0053	10		
C ₇ H ₅ Cl ₃ O	2,4,6-Trichloro-3-methylphenol	25	0.0112	2		
C ₇ H ₅ FO ₂	2-Fluorobenzoic acid	25	0.72	27		
C ₇ H ₅ FO ₂	3-Fluorobenzoic acid	25	0.15	27		
C ₇ H ₅ FO ₂	4-Fluorobenzoic acid	25	0.12	27		
C ₇ H ₅ IO ₂	2-Iodobenzoic acid	25	0.095	27		
C ₇ H ₅ IO ₂	3-Iodobenzoic acid	25	0.016	27		
C ₇ H ₅ IO ₂	4-Iodobenzoic acid	25	0.0027	27		
C ₇ H ₅ N	Benzonitrile	25	0.2	10		
C ₇ H ₅ NO	Benzoxazole	20	0.834	6		
C ₇ H ₅ NO ₃	3-Nitrobenzaldehyde	25	0.16	27		
C ₇ H ₅ NO ₃	4-Nitrobenzaldehyde	25	0.23	27		
C ₇ H ₅ NO ₃ S	Saccharin	25	0.40	27		
		100	4.0	27		
C ₇ H ₅ N ₃ O ₆	2,4,6-Trinitrotoluene	25	0.015	27		
		100	0.015	27		
C ₇ H ₆ Cl ₂	(Dichloromethyl)benzene	30	0.025	10		
C ₇ H ₆ Cl ₂ O	2,4-Dichloro-6-methylphenol	25	0.0283	2		
C ₇ H ₆ Cl ₂ O	2,6-Dichloro-4-methylphenol	25	0.0673	2		
C ₇ H ₆ N ₂	1 <i>H</i> -Benzimidazole	20	0.201	6		
C ₇ H ₆ N ₂	1 <i>H</i> -Indazole	20	0.0827	6		
C ₇ H ₆ O	Benzaldehyde	20	0.3	10		
C ₇ H ₆ O ₂	Benzoic acid	25	0.34	27		
C ₇ H ₆ O ₂	Salicylaldehyde	86	1.68	10		
C ₇ H ₆ O ₃	4-Hydroxybenzoic acid	25	0.64	27		
		80	12.0	27		
C ₇ H ₆ O ₅	3,4,5-Trihydroxybenzoic acid	15	0.94	27		
		100	25.0	27		
C ₇ H ₇ Br	<i>p</i> -Bromotoluene	25	0.011	2		
C ₇ H ₇ Cl	(Chloromethyl)benzene	20	0.0493	10		
C ₇ H ₇ ClO	2-Chloro-6-methylphenol	25	0.36	2		
C ₇ H ₇ ClO	4-Chloro-2-methylphenol	25	0.68	2		
C ₇ H ₇ ClO	4-Chloro-3-methylphenol	25	0.40	2		
C ₇ H ₇ NO	Benzamide	12	0.577	27		
C ₇ H ₇ NO ₂	2-Nitrotoluene	30	0.065	27		
C ₇ H ₇ NO ₂	3-Nitrotoluene	30	0.050	27		
C ₇ H ₇ NO ₂	4-Nitrotoluene	30	0.044	27		
C ₇ H ₇ NO ₃	2-Nitroanisole	30	0.169	10		
C ₇ H ₇ NO ₃	4-Nitroanisole	30	0.059	27		
C ₇ H ₈	Toluene	5	0.063	3		
		25	0.0531	22	0.660	22
C ₇ H ₈	1,3,5-Cycloheptatriene	25	0.064	3	0.47	13
C ₇ H ₈	1,6-Heptadiyne	25	0.125	3		
C ₇ H ₈ N ₂ S	Phenylthiourea	25	2.55	27		
C ₇ H ₈ N ₄ O ₂	Theophylline	20	0.52	29		
C ₇ H ₈ O	<i>o</i> -Cresol	40	3.08	10		
C ₇ H ₈ O	<i>m</i> -Cresol	40	2.51	10		
C ₇ H ₈ O	<i>p</i> -Cresol	40	2.26	10		
C ₇ H ₈ O	Benzyl alcohol	20	0.08	10		
C ₇ H ₈ O	Anisole	25	0.19	20	0.025	13
C ₇ H ₉ N	<i>o</i> -Methylaniline	20	1.66	10		
C ₇ H ₉ N	<i>p</i> -Methylaniline	21	7.35	10		
C ₇ H ₉ NO ₂ S	2-Methylbenzenesulfonamide	25	0.162	27		
C ₇ H ₉ NO ₂ S	3-Methylbenzenesulfonamide	25	0.78	27		
C ₇ H ₉ NO ₂ S	4-Methylbenzenesulfonamide	25	0.316	27		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₇ H ₁₂	1-Heptyne	25	0.0094	3	4.47	13
C ₇ H ₁₂	Cycloheptene	25	0.0066	3	4.9	13
C ₇ H ₁₂	1-Methylcyclohexene	25	0.0052	3		
C ₇ H ₁₂ O ₂	Cyclohexanecarboxylic acid	15	0.201	27		
C ₇ H ₁₄	1-Heptene	25	0.032	3	40.3	13
C ₇ H ₁₄	<i>trans</i> -2-Heptene	25	0.015	3	42.2	13
C ₇ H ₁₄	Cycloheptane	25	0.0030	3	9.59	13
C ₇ H ₁₄	Methylcyclohexane	25	0.00151	3	43.3	13
		50	0.0019	3		
C ₇ H ₁₄	Ethylcyclopentane	20	0.012	3		
C ₇ H ₁₄ O	1-Heptanal	11	0.124	27		
C ₇ H ₁₄ O	2-Heptanone	25	0.43	10	0.0171	28
C ₇ H ₁₄ O	3-Heptanone	20	1.43	10		
C ₇ H ₁₄ O	2,4-Dimethyl-3-pentanone	20	0.59	10		
C ₇ H ₁₄ O ₂	Heptanoic acid	15	0.24	27		
C ₇ H ₁₄ O ₂	Pentyl acetate	20	0.17	10		
C ₇ H ₁₄ O ₂	Isopentyl acetate	20	0.2	10		
C ₇ H ₁₄ O ₂	<i>sec</i> -Pentyl acetate	25	0.2	27		
C ₇ H ₁₄ O ₂	Butyl propanoate	22	0.572	27		
C ₇ H ₁₄ O ₂	Propyl butanoate	17	0.162	27		
C ₇ H ₁₄ O ₂	Ethyl pentanoate	25	0.3	27		
C ₇ H ₁₄ O ₂	Ethyl 3-methylbutanoate	20	0.2	10		
C ₇ H ₁₅ Br	1-Bromoheptane	25	0.00067	25		
C ₇ H ₁₅ Cl	1-Chloroheptane	25	0.00136	25		
C ₇ H ₁₅ I	1-Iodoheptane	25	0.00035	25		
C ₇ H ₁₆	Heptane	0	0.0003	3		
		25	0.00024	3	209	13
		40	0.00025	3		
C ₇ H ₁₆	2-Methylhexane	25	0.00025	3	346	5
C ₇ H ₁₆	3-Methylhexane	25	0.00026	3	249	13
C ₇ H ₁₆	2,2-Dimethylpentane	25	0.00044	3	318	5
C ₇ H ₁₆	2,3-Dimethylpentane	25	0.00052	3	175	5
C ₇ H ₁₆	2,4-Dimethylpentane	25	0.00042	3	323	13
C ₇ H ₁₆	3,3-Dimethylpentane	25	0.00059	3	186	5
C ₇ H ₁₆ O	1-Heptanol	10	0.25	1		
		25	0.174	1	0.00562	28
		50	0.12	1		
C ₇ H ₁₆ O	2-Heptanol	30	0.33	1		
C ₇ H ₁₆ O	3-Heptanol	25	0.43	1		
C ₇ H ₁₆ O	4-Heptanol	25	0.47	1		
C ₇ H ₁₆ O	2-Methyl-2-hexanol	25	1.0	1		
C ₇ H ₁₆ O	5-Methyl-2-hexanol	25	0.49	1		
C ₇ H ₁₆ O	3-Methyl-3-hexanol	25	1.2	1		
C ₇ H ₁₆ O	3-Ethyl-3-pentanol	25	1.7	1		
C ₇ H ₁₆ O	2,3-Dimethyl-2-pentanol	25	1.5	1		
C ₇ H ₁₆ O	2,4-Dimethyl-2-pentanol	25	1.3	1		
C ₇ H ₁₆ O	2,2-Dimethyl-3-pentanol	25	0.82	1		
C ₇ H ₁₆ O	2,3-Dimethyl-3-pentanol	25	1.6	1		
C ₇ H ₁₆ O	2,4-Dimethyl-3-pentanol	25	0.70	1		
C ₇ H ₁₆ O	2,3,3-Trimethyl-2-butanol	40	2.2	1		
C ₈ F ₁₈	Perfluorooctane	25	0.00000017	25		
C ₈ H ₄ F ₆	1,3-Bis(trifluoromethyl)benzene	25	0.0041	2		
C ₈ H ₆ N ₂	Quinoxaline	50	54	6		
C ₈ H ₆ O ₄	Phthalic acid	14	0.54	27		
C ₈ H ₆ O ₄	Isophthalic acid	25	0.013	27		
C ₈ H ₆ S	Benzo[b]thiophene	20	0.0130	6		
C ₈ H ₇ ClO ₃	3-Chloro-4-hydroxy-5-methoxybenzaldehyde	25	0.093	8		
C ₈ H ₇ ClO ₃	2-Chloro-4-hydroxy-5-methoxybenzaldehyde	25	0.013	8		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	<i>S</i> /mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₈ H ₇ Cl ₃ O	2,4,6-Trichloro-3,5-dimethylphenol	25	0.00050	2		
C ₈ H ₇ N	Indole	20	0.187	6		
C ₈ H ₈	Styrene	25	0.0321	22	0.286	22
		50	0.046	4	0.30	13
C ₈ H ₈ HgO ₂	Mercury(II) phenyl acetate		0.2	30		
C ₈ H ₈ N ₂	2-Methyl-1H-benzimidazole	20	0.145	6		
C ₈ H ₈ O	Acetophenone	25	0.55	28	0.00108	28
C ₈ H ₈ O ₂	<i>o</i> -Toluic acid	25	0.118	27		
C ₈ H ₈ O ₂	<i>m</i> -Toluic acid	25	0.098	27		
C ₈ H ₈ O ₂	<i>p</i> -Toluic acid	25	0.345	27		
C ₈ H ₈ O ₂	Benzeneacetic acid	25	1.71	27		
C ₈ H ₈ O ₂	Methyl benzoate	20	0.21	10		
C ₈ H ₈ O ₃	4-Methoxybenzoic acid	25	0.023	27		
C ₈ H ₈ O ₃	Mandelic acid	25	11.3	27		
C ₈ H ₈ O ₃	Methyl salicylate	30	0.74	10		
C ₈ H ₈ O ₃	4-Hydroxy-3-methoxybenzaldehyde	25	0.247	8		
C ₈ H ₉ ClO	4-Chloro-2,5-dimethylphenol	25	0.89	2		
C ₈ H ₉ ClO	4-Chloro-2,6-dimethylphenol	25	0.52	2		
C ₈ H ₉ ClO	4-Chloro-3,5-dimethylphenol	25	0.34	2		
C ₈ H ₉ NO	Acetanilide	20	0.52	27		
		70	2.7	27		
C ₈ H ₁₀	Ethylbenzene	0	0.020	4		
		25	0.0161	22	0.843	22
		40	0.0200	4		
C ₈ H ₁₀	<i>o</i> -Xylene	25	0.0171	22	0.551	22
		45	0.021	4		
C ₈ H ₁₀	<i>m</i> -Xylene	0	0.0203	4		
		25	0.0161	22	0.730	22
		40	0.022	4		
C ₈ H ₁₀	<i>p</i> -Xylene	0	0.0160	4		
		25	0.0181	22	0.690	22
		40	0.022	4		
C ₈ H ₁₀ N ₄ O ₂	Caffeine	25	2.12	29		
C ₈ H ₁₀ O	2,4-Xylenol	25	0.787	10		
C ₈ H ₁₀ O	3,5-Xylenol	29	0.62	10		
C ₈ H ₁₀ O	Phenetole	25	0.12	10		
C ₈ H ₁₁ N	2,5-Dimethylaniline	20	0.66	27		
C ₈ H ₁₂	4-Vinylcyclohexene	25	0.005	4		
C ₈ H ₁₄	1-Octyne	25	0.0024	4	7.87	13
C ₈ H ₁₆	1-Octene	25	0.00027	4	96.3	13
C ₈ H ₁₆	Cyclooctane	25	0.00079	4	10.7	13
C ₈ H ₁₆	Ethylcyclohexane	40	0.00066	4		
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane	25	0.00060	4	36	5
C ₈ H ₁₆	<i>trans</i> -1,4-Dimethylcyclohexane	25	0.000384	4	88.2	5
C ₈ H ₁₆	Propylcyclopentane	25	0.00020	4	90.2	5
C ₈ H ₁₆	1,1,3-Trimethylcyclopentane	25	0.00037	4	159	5
C ₈ H ₁₆ N ₂ O ₄ S ₂	Homocystine	25	0.02	26		
C ₈ H ₁₆ O	2-Octanone	25	0.113	10		
C ₈ H ₁₆ O ₂	Octanoic acid	25	0.080	26		
C ₈ H ₁₆ O ₂	Hexyl acetate	20	0.02	10		
C ₈ H ₁₆ O ₂	<i>sec</i> -Hexyl acetate	20	0.13	10		
C ₈ H ₁₆ O ₂	Pentyl propanoate	20	0.1	27		
C ₈ H ₁₆ O ₂	Isobutyl isobutanoate	20	0.5	10		
C ₈ H ₁₆ O ₂	Ethyl hexanoate	20	0.063	27		
C ₈ H ₁₇ Br	1-Bromooctane	25	0.000167	25		
C ₈ H ₁₇ Cl	1-Chlorooctane	25	0.0345	25		
C ₈ H ₁₇ Cl	3-(Chloromethyl)heptane	20	0.01	10		
C ₈ H ₁₈	Octane	25	0.000071	4	311	13
		50	0.00010	4		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	<i>S</i> /mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₈ H ₁₈	3-Methylheptane	25	0.000079	4	376	5
C ₈ H ₁₈	2,2,4-Trimethylpentane	25	0.00022	4	307	13
C ₈ H ₁₈	2,3,4-Trimethylpentane	25	0.00018	4	206	13
C ₈ H ₁₈ O	1-Octanol	25	0.054	1		
C ₈ H ₁₈ O	2-Octanol	25	0.4	1		
C ₈ H ₁₈ O	2-Methyl-2-heptanol	30	0.25	1		
C ₈ H ₁₈ O	2-Ethyl-1-hexanol	25	0.01	1		
C ₈ H ₁₈ O	Dibutyl ether	20	0.03	10	0.48	13
C ₈ H ₁₉ N	Dibutylamine	20	0.47	10		
C ₈ H ₁₉ N	2-Ethylhexylamine	20	0.25	10		
C ₈ H ₂₀ Si	Tetraethylsilane	25	0.0000325	10		
C ₈ H ₇ BrO ₄	2-(Acetyloxy)-5-bromobenzoic acid		0.07	30		
C ₉ H ₇ N	Quinoline	20	0.633	6		
C ₉ H ₇ N	Isoquinoline	20	0.452	6		
C ₉ H ₈ O ₂	<i>trans</i> -Cinnamic acid	25	0.056	27		
C ₉ H ₈ O ₄	2-(Acetyloxy)benzoic acid		0.25	27		
C ₉ H ₉ I ₂ NO ₃	L-3,5-Diiodotyrosine	25	0.062	26		
C ₉ H ₉ N	3-Methyl-1H-indole	20	0.050	6		
C ₉ H ₉ NO ₃	<i>N</i> -Benzoylglycine	25	0.37	29		
C ₉ H ₁₀	Indan	25	0.010	4		
C ₉ H ₁₀ O ₂	Ethyl benzoate	25	0.083	20		
C ₉ H ₁₁ NO ₂	<i>DL</i> -Phenylalanine	25	1.40	29		
C ₉ H ₁₁ NO ₂	Phenylalanine	25	2.71	26		
C ₉ H ₁₁ NO ₃	<i>L</i> -Tyrosine	25	0.046	26		
C ₉ H ₁₁ NO ₃	<i>DL</i> -Tyrosine	25	0.35	30		
C ₉ H ₁₁ NO ₄	Levodopa [3-Hydroxy- <i>L</i> -tyrosine]	25	62.3	26		
C ₉ H ₁₂	1,8-Nonadiene	25	0.0125	4		
C ₉ H ₁₂	Propylbenzene	25	0.0052	22	1.041	22
C ₉ H ₁₂	Isopropylbenzene	25	0.0050	22	1.466	22
C ₉ H ₁₂	<i>o</i> -Ethyltoluene	25	0.0093	5	0.529	13
C ₉ H ₁₂	<i>p</i> -Ethyltoluene	25	0.0094	5	0.500	13
C ₉ H ₁₂	1,2,3-Trimethylbenzene	25	0.0070	22	0.343	22
C ₉ H ₁₂	1,2,4-Trimethylbenzene	25	0.0057	22	0.569	22
C ₉ H ₁₂	1,3,5-Trimethylbenzene	25	0.0050	22	0.781	22
C ₉ H ₁₄ N ₄ O ₃	Carnosine	25	24.4	26		
C ₉ H ₁₄ O ₆	Triacetin	25	5.8	10		
C ₉ H ₁₆	1-Nonyne	25	0.00072	4		
C ₉ H ₁₈	1,1,3-Trimethylcyclohexane	25	0.000177	4	105	13
C ₉ H ₁₈ O	Diisobutyl ketone	25	0.043	10		
C ₉ H ₁₈ O ₂	Nonanoic acid	20	0.0284	26		
C ₉ H ₁₈ O ₂	Ethyl heptanoate	20	0.029	27		
C ₉ H ₂₀	Nonane	25	0.000017	4	333	13
		50	0.000022	4		
C ₉ H ₂₀	4-Methyloctane	25	0.0000115	4	1000	5
C ₉ H ₂₀	2,2,5-Trimethylhexane	25	0.00008	4	246	13
C ₉ H ₂₀ O	3,5-Dimethyl-4-heptanol	15	0.072	1		
C ₉ H ₂₀ O	1-Nonanol	25	0.014	1		
C ₉ H ₂₀ O	2-Nonanol	15	0.026	1		
C ₉ H ₂₀ O	3-Nonanol	15	0.032	1		
C ₉ H ₂₀ O	4-Nonanol	15	0.0026	1		
C ₉ H ₂₀ O	5-Nonanol	15	0.0032	1		
C ₁₀ F ₂₂	Perfluorodecane	20	0.000031	25		
C ₁₀ H ₇ Cl	1-Chloronaphthalene	25	0.00224	5	0.0363	28
C ₁₀ H ₇ Cl	2-Chloronaphthalene	25	0.00117	5	0.0335	28
C ₁₀ H ₈	Naphthalene	10	0.0019	4		
		25	0.00316	22	0.043	22
		50	0.0082	4		
C ₁₀ H ₈ O	2-Naphthol		0.1	30		
C ₁₀ H ₉ N	3-Methylisoquinoline	20	0.092	6		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	<i>S</i> /mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate	25	0.40	15		
C ₁₀ H ₁₂ N ₄ O ₅	Inosine	20	1.6	29		
C ₁₀ H ₁₃ N ₅ O ₃	2'-Deoxyadenosine	25	0.67	29		
C ₁₀ H ₁₃ N ₅ O ₄	Adenosine	25	0.51	29		
C ₁₀ H ₁₃ N ₅ O ₅	Guanosine	25	0.0500	29		
C ₁₀ H ₁₄	Butylbenzene	25	0.00138	22	1.33	22
C ₁₀ H ₁₄	<i>sec</i> -Butylbenzene	25	0.0014	4	1.89	11
C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	25	0.0032	4	1.28	11
C ₁₀ H ₁₄	Isobutylbenzene	25	0.0010	4	3.32	11
C ₁₀ H ₁₄	<i>p</i> -Cymene	25	0.0051	23	0.80	5
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	25	0.000348	4	2.55	11
C ₁₀ H ₁₄ N ₂ O ₅	Thymidine	25	5.1	29		
C ₁₀ H ₁₄ O	Carvone	15	0.13	27		
C ₁₀ H ₁₄ O	Thymol		0.1	30		
C ₁₀ H ₁₆	<i>d</i> -Limonene	0	0.00097	4		
		25	0.00138	4		
C ₁₀ H ₁₆ O	Camphor	20	0.01	10		
C ₁₀ H ₁₆ O	Carvenone	15	0.22	27		
C ₁₀ H ₁₆ O ₄	<i>trans</i> -Camphoric acid	25	0.8	27		
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	25	0.000089	4	3	13
C ₁₀ H ₁₈ O	Borneol	25	0.074	27		
C ₁₀ H ₁₈ O	α -Terpineol	15	0.20	27		
C ₁₀ H ₂₀	1-Decene	25	0.00057	4		
C ₁₀ H ₂₀	Pentylcyclopentane	25	0.0000115	4	185	5
C ₁₀ H ₂₀ O ₂	Decanoic acid	20	0.015	26		
C ₁₀ H ₂₀ O ₂	Ethyl octanoate	20	0.007	27		
C ₁₀ H ₂₂	Decane	0	0.0000015	4	479	13
C ₁₀ H ₂₂ O	1-Decanol	25	0.0037	1		
C ₁₀ H ₂₂ O	Diisopentyl ether	20	0.02	10		
C ₁₁ H ₈ O ₂	1-Naphthalenecarboxylic acid	25	0.0058	27		
C ₁₁ H ₁₀	1-Methylnaphthalene	25	0.00281	22	0.045	22
C ₁₁ H ₁₀	2-Methylnaphthalene	25	0.0025	4	0.051	12
C ₁₁ H ₁₂ N ₂ O ₂	Tryptophan	25	1.30	26		
C ₁₁ H ₁₆	Pentylbenzene	25	0.00105	5	1.69	11
C ₁₁ H ₂₂ O ₂	Ethyl nonanoate	20	0.003	27		
C ₁₂ Cl ₁₀	Decachlorobiphenyl	25	0.0000000012	7	0.0208	7
C ₁₂ F ₂₆	Hexacosafuorododecane	20	0.00000096	25		
C ₁₂ HCl ₉	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	25	0.0000000018	7		
C ₁₂ H ₃ Cl ₈	2,2',3,3',5,5',6,6'-Octachlorobiphenyl	25	0.0000003	7	0.0381	7
C ₁₂ H ₃ Cl ₇	2,2',3,3',4,4',6-Heptachlorobiphenyl	25	0.0000002	7	0.0054	7
C ₁₂ H ₄ Cl ₆	2,2',3,3',4,4'-Hexachlorobiphenyl	25	0.00000006	7	0.0354	31
C ₁₂ H ₄ Cl ₆	2,2',4,4',6,6'-Hexachlorobiphenyl	25	0.00000007	7	0.818	7
C ₁₂ H ₄ Cl ₆	2,2',3,3',6,6'-Hexachlorobiphenyl	25	0.00000008	7		
C ₁₂ H ₅ Cl ₅	2,3,4,5,6-Pentachlorobiphenyl	25	0.0000008	7		
C ₁₂ H ₅ Cl ₅	2,2',4,5,5'-Pentachlorobiphenyl	25	0.000001	7	0.0421	31
C ₁₂ H ₆ Cl ₄	2,3,4,5-Tetrachlorobiphenyl	25	0.000002	7		
C ₁₂ H ₆ Cl ₄	2,2',4',5-Tetrachlorobiphenyl	25	0.0000016	9		
C ₁₂ H ₇ Cl ₃	2,4,5-Trichlorobiphenyl	25	0.000014	7	0.0379	31
C ₁₂ H ₇ Cl ₃	2,4,6-Trichlorobiphenyl	25	0.00002	7	0.0495	7
C ₁₂ H ₈	Acenaphthylene	20	0.0016	28	0.012	28
C ₁₂ H ₈ Cl ₂	2,5-Dichlorobiphenyl	25	0.0002	7	0.0201	7
C ₁₂ H ₈ Cl ₂	2,6-Dichlorobiphenyl	25	0.00014	7		
C ₁₂ H ₈ O	Dibenzofuran	25	0.000656	6	0.011	12
C ₁₂ H ₈ S	Dibenzothiophene	25	0.000103	6		
C ₁₂ H ₉ Cl	2-Chlorobiphenyl	25	0.00055	7	0.0701	7
C ₁₂ H ₉ N	Carbazole	22	0.000120	6		
C ₁₂ H ₁₀	Acenaphthene	0	0.00015	4		
		25	0.000380	22	0.01217	22
		50	0.00092	4		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₁₂ H ₁₀	Biphenyl	0	0.000272	4		
		25	0.00072	22	0.0280	22
		50	0.0022	4		
C ₁₂ H ₁₀ N ₂	Azobenzene	20	0.03	27		
C ₁₂ H ₁₀ N ₂ O	<i>N</i> -Nitrosodiphenylamine	25	0.0035	17		
C ₁₂ H ₁₀ O	Diphenyl ether	25	0.00180	6	0.027	13
C ₁₂ H ₁₂	1-Ethyl-naphthalene	25	0.00101	4	0.039	12
C ₁₂ H ₁₂	2-Ethyl-naphthalene	25	0.00080	4	0.078	12
C ₁₂ H ₁₂	1,3-Dimethylnaphthalene	25	0.0008	4		
C ₁₂ H ₁₂	1,4-Dimethylnaphthalene	25	0.00114	4		
C ₁₂ H ₁₂	1,5-Dimethylnaphthalene	25	0.00031	4	0.036	28
C ₁₂ H ₁₂	2,3-Dimethylnaphthalene	25	0.00025	4		
C ₁₂ H ₁₂	2,6-Dimethylnaphthalene	25	0.00017	4		
C ₁₂ H ₁₈	Hexylbenzene	25	0.00021	4		
C ₁₂ H ₂₂ O ₁₁	Sucrose	20	67.1	27		
		50	72.3	27		
		100	83.0	27		
C ₁₂ H ₂₂ O ₁₁	α -Maltose	20	51.9	27		
C ₁₂ H ₂₄ O ₂	Dodecanoic acid	20	0.0055	26		
C ₁₂ H ₂₄ O ₂	Ethyl decanoate	20	0.0015	27		
C ₁₂ H ₂₆	Dodecane	25	0.00000037	4	750	5
C ₁₂ H ₂₆ O	1-Dodecanol	25	0.0004	1		
C ₁₂ H ₂₇ O ₄ P	Tributyl phosphate	25	0.039	10		
C ₁₃ H ₆ N	Acridine	25	0.00466	6		
C ₁₃ H ₉ N	Benzo[f]quinoline	25	0.0079	6		
C ₁₃ H ₁₀	9H-Fluorene	0	0.00007	4		
		25	0.00019	22	0.00787	22
		50	0.00063	4		
C ₁₃ H ₁₂	Diphenylmethane	25	0.000141	4	0.001	12
C ₁₃ H ₁₄	1,4,5-Trimethylnaphthalene	25	0.00021	4		
C ₁₃ H ₂₆ O ₂	Tridecanoic acid	20	0.0033	26		
C ₁₄ H ₁₀	Anthracene	0	0.0000022	4		
		25	0.0000045	22	0.00396	22
		50	0.000050	4		
C ₁₄ H ₁₀	Phenanthrene	25	0.00011	22	0.00324	22
		50	0.00041	4		
		25	0.000029	4	0.040	12
C ₁₄ H ₁₄	1,2-Diphenylethane	25	0.00044	6	0.017	12
C ₁₄ H ₁₄ O	Dibenzyl ether	35	0.0040	10		
C ₁₄ H ₂₈ O ₂	Tetradecanoic acid	20	0.0020	26		
C ₁₄ H ₂₉ Cl	1-Chlorotetradecane	25	0.0232	25		
C ₁₄ H ₃₀	Tetradecane	25	0.000012	5		
C ₁₄ H ₃₀ O	1-Tetradecanol	25	0.000031	1		
C ₁₅ H ₁₂	1-Methylphenanthrene	25	0.0000269	4		
C ₁₅ H ₁₂	2-Methylanthracene	25	0.00003	22		
C ₁₅ H ₁₂	9-Methylanthracene	25	0.000026	4		
C ₁₅ H ₃₀ O ₂	Pentadecanoic acid	20	0.0012	26		
C ₁₅ H ₃₂ O	1-Pentadecanol	25	0.000010	1		
C ₁₆ H ₁₀	Fluoranthene	25	0.000026	22	0.00096	22
		25	0.000013	22	0.00092	22
		50	0.00009	4		
C ₁₆ H ₁₄	9,10-Dimethylanthracene	25	0.0000056	4		
C ₁₆ H ₁₅ NO ₃	<i>N</i> -Benzoyl- <i>L</i> -phenylalanine	25	0.085	29		
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate	25	0.00112	15		
C ₁₆ H ₃₂ O ₂	Hexadecanoic acid	20	0.00072	26		
C ₁₆ H ₃₄ O	1-Hexadecanol	25	0.000003	1		
C ₁₇ H ₁₂	11H-Benzo[a]fluorene	25	0.0000045	4		
C ₁₇ H ₁₂	11H-Benzo[b]fluorene	25	0.0000002	4		
C ₁₇ H ₁₉ NO ₃	Morphine	20	0.015	27		

AQUEOUS SOLUBILITY AND HENRY'S LAW CONSTANTS OF ORGANIC COMPOUNDS (continued)

Mol. Form	Name	<i>t</i> /°C	S/mass %	Ref.	<i>k</i> _H /kPa m ³ mol ⁻¹	Ref.
C ₁₇ H ₂₁ NO ₄	Cocaine	25	0.17	27		
C ₁₇ H ₃₄ O ₂	Heptadecanoic acid	20	0.00042	26		
C ₁₈ H ₁₂	Benzo[a]anthracene	25	0.0000011	22	0.00058	22
C ₁₈ H ₁₂	Chrysene	25	0.0000002	22	0.000065	22
C ₁₈ H ₁₂	Naphthacene	25	0.00000006	4	0.000004	12
C ₁₈ H ₁₂	Triphenylene	25	0.0000041	4	0.00001	12
C ₁₈ H ₁₂ N ₂	2,2'-Biquinoline	24	0.000102	6		
C ₁₈ H ₂₁ NO ₃	Codeine	25	0.79	27		
C ₁₈ H ₃₂ O ₁₆	Raffinose	20	12.5	27		
C ₁₈ H ₃₄ O ₄	Dibutyl sebacate	20	0.004	10		
C ₁₈ H ₃₆ O ₂	Octadecanoic acid	20	0.00029	26		
C ₁₈ H ₃₈ O	1-Octadecanol	34	0.000011	1		
C ₁₉ H ₁₄	9-Methylbenz[a]anthracene	27	0.0000066	4		
C ₁₉ H ₁₄	10-Methylbenz[a]anthracene	25	0.0000055	4		
C ₁₉ H ₁₄	5-Methylchrysene	27	0.0000062	4		
C ₂₀ H ₁₂	Perylene	25	0.00000004	4	0.000003	12
C ₂₀ H ₁₂	Benzo[a]pyrene	25	0.0000003	22	0.0000465	22
C ₂₀ H ₁₂	Benzo[e]pyrene	20	0.0000005	22	0.0000467	22
C ₂₀ H ₁₂ O ₅	Fluorescein	20	0.005	27		
C ₂₀ H ₁₃ N	13H-Dibenzo[a,i]carbazole	24	0.00000104	6		
C ₂₀ H ₁₄	1,2-Dihydrobenz[j]aceanthrylene	25	0.00000036	6		
C ₂₀ H ₁₄ O ₄	Phenolphthalein	20	0.018	27		
C ₂₀ H ₂₄ N ₂ O ₂	Quinine	25	0.057	27		
C ₂₀ H ₂₄ N ₂ O ₂	Quinidine	20	0.020	27		
C ₂₀ H ₄₂	Eicosane	25	0.00000019	4		
C ₂₁ H ₁₃ N	Dibenz[a,j]acridine	25	0.000016	6		
C ₂₁ H ₁₆	1,2-Dihydro-3-methylbenz[j]aceanthrylene	25	0.00000022	6		
C ₂₁ H ₂₂ N ₂ O ₂	Strychnine	20	0.013	27		
C ₂₁ H ₂₈ O ₅	17,21-Dihydroxypregn-4-ene-3,11,20-trione	25	0.028	30		
C ₂₂ H ₁₂	Benzo[ghi]perylene	25	0.000000026	4	0.000075	12
C ₂₂ H ₁₄	Picene	25	0.00000025	4		
C ₂₂ H ₁₄	Benzo[b]triphenylene	25	0.0000027	4		
C ₂₂ H ₁₄	Dibenz[a,h]anthracene	25	0.00000006	4		
C ₂₂ H ₁₄	Dibenz[a,j]anthracene	25	0.0000012	4		
C ₂₂ H ₄₄ O ₂	Butyl stearate	25	0.2	10		
C ₂₃ H ₂₆ N ₂ O ₄	Brucine	20	0.012	27		
C ₂₃ H ₂₇ NO ₈	Narceine	13	0.078	27		
C ₂₄ H ₁₂	Coronene	25	0.000000014	4		

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES

The solubility of over 300 common inorganic compounds in water is tabulated here as a function of temperature. Solubility is defined as the concentration of the compound in a solution that is in equilibrium with a solid phase at the specified temperature. In this table the solid phase is generally the most stable crystalline phase at the temperature in question. An asterisk * on solubility values in adjacent columns indicates that the solid phase changes between those two temperatures (usually from one hydrated phase to another or from a hydrate to the anhydrous solid). In such cases the slope of the solubility vs. temperature curve may show a discontinuity.

All solubility values are expressed as mass percent of solute, $100 \cdot w_2$, where

$$w_2 = m_2 / (m_1 + m_2)$$

and m_2 is the mass of solute and m_1 the mass of water. This quantity is related to other common measures of solubility as follows:

Molarity: $c_2 = 1000 \rho w_2 / M_2$

Molality: $m_2 = 1000 w_2 / M_2 (1 - w_2)$

Mole fraction: $x_2 = (w_2 / M_2) / \{ (w_2 / M_2) + (1 - w_2) / M_1 \}$

Mass of solute per 100 g of H₂O: $r_2 = 100 w_2 / (1 - w_2)$

Here M_2 is the molar mass of the solute and $M_1 = 18.015$ g/mol is the molar mass of water. ρ is the density of the solution in g cm⁻³.

The data in the table have been derived from the references indicated; in many cases the data have been refitted or interpolated in order to present solubility at rounded values of temperature. Where available, values were taken from the IUPAC *Solubility Data Series* (Reference 1) or the related papers in the *Journal of Physical and Chemical Reference Data* (References 2 to 5), which present carefully evaluated data.

The solubility of sparingly soluble compounds that do not appear in this table may be calculated from the data in the table "Solubility Product Constants". Solubility of inorganic gases may be found in the table "Solubility of Selected Gases in Water".

Compounds are listed alphabetically by chemical formula in the most commonly used form (e.g., NaCl, NH₄NO₃, etc.).

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AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
AgBrO ₃				0.193							1.32		7
AgClO ₂	0.17	0.31	0.47	0.55	0.64	0.82	1.02	1.22	1.44	1.66	1.88	2.11	7
AgClO ₃				15									7
AgClO ₄	81.6	83.0	84.2	84.8	85.3	86.3	86.9	87.5	87.9	88.3	88.6	88.8	6
AgNO ₂	0.155			0.413									7
AgNO ₃	55.9	62.3	67.8	70.1	72.3	76.1	79.2	81.7	83.8	85.4	86.7	87.8	6
Ag ₂ SO ₄	0.56	0.67	0.78	0.83	0.88	0.97	1.05	1.13	1.20	1.26	1.32	1.39	7
AlCl ₃	30.84	30.91	31.03	31.10	31.18	31.37	31.60	31.87	32.17	32.51	32.90	33.32	7
Al(ClO ₄) ₃	54.9										64.4		7
AlF ₃	0.25	0.34	0.44	0.50	0.56	0.68	0.81	0.96	1.11	1.28	1.45	1.64	7
Al(NO ₃) ₃	37.0	38.2	39.9	40.8	42.0	44.5	47.3	50.4	53.8*			61.5*	6
Al ₂ (SO ₄) ₃	27.5			27.8	28.2	29.2	30.7	32.6	34.9	37.6	40.7	44.2	7
As ₂ O ₃	1.19	1.48	1.80	2.01	2.27	2.86	3.43	4.11	4.89	5.77	6.72	7.71	10
BaBr ₂	47.6	48.5	49.5	50.0	50.4	51.4	52.5	53.5	54.5	55.5	56.6	57.6	6
Ba(BrO ₃) ₂	0.285	0.442	0.656	0.788	0.935	1.30	1.74	2.27	2.90	3.61	4.40	5.25	1:14
Ba(C ₂ H ₃ O ₂) ₂	37.0			44.2									7
BaCl ₂	23.30	24.88	26.33	27.03	27.70	29.00	30.27	31.53	32.81	34.14	35.54	37.05	8
Ba(ClO ₂) ₂	30.5			31.3								44.7	7
Ba(ClO ₃) ₂	16.90	21.23	23.66	27.50	29.43	33.16	36.69	40.05	43.04	45.90	48.70	51.17	1:14
Ba(ClO ₄) ₂	67.30	70.96	74.30	75.75	77.05	79.23	80.92	82.21	83.16	83.88	84.43	84.90	7
BaF ₂		0.158		0.161									7
BaI ₂	62.5	64.7	67.3	68.8	69.1	69.5	70.1	70.7	71.3	72.0	72.7	73.4	6
Ba(IO ₃) ₂	0.0182	0.0262	0.0342	0.0396	0.045*	0.058*	0.073	0.090	0.109	0.131	0.156	0.182	1:14
Ba(NO ₂) ₂	31.1	36.6	41.8	44.3	46.8	51.6	56.2	60.5	64.6	68.5	72.1	75.6	10
Ba(NO ₃) ₂	4.7	6.3	8.2	9.3	10.2	12.4	14.7	17.0	19.3	21.5	23.5	25.5	6
Ba(OH) ₂	1.67			4.68	8.4	19	33	52	74	100			7
BaS	2.79	4.78	6.97	8.21	9.58	12.67	16.18	20.05	24.19	28.55	33.04	37.61	7
Ba(SCN) ₂				62.6									7
BaSO ₃				0.0011									1:26
BeCl ₂	40.5			41.7									7
Be(ClO ₄) ₂				59.5									7
BeSO ₄	26.69	27.58	28.61	29.22	29.90	31.51	33.39	35.50	37.78	40.21	42.72	45.28	7
CaBr ₂	55	56	59	61	63	68	71	73					10
CaCl ₂	36.70	39.19	42.13	44.83*	49.12*	52.85*	56.05*	56.73	57.44	58.21	59.04	59.94	8
Ca(ClO ₃) ₂	63.2	64.2	65.5	66.3	67.2	69.0	71.0	73.2	75.5*	77.4*	77.7	78.0	1:14
Ca(ClO ₄) ₂				65.3									7
CaF ₂	0.0013			0.0016									10
CaI ₂	64.6	66.0	67.6	68.3	69.0	70.8	72.4	74.0	76.0	78.0	79.6	81.0	7
Ca(IO ₃) ₂	0.082	0.155	0.243	0.305	0.384*	0.517*	0.590	0.652	0.811*	0.665*	0.668		1:14
Ca(NO ₂) ₂	38.6	39.5	44.5	48.6									7
Ca(NO ₃) ₂	50.1	53.1	56.7	59.0	60.9	65.4	77.8	78.1	78.2	78.3	78.4	78.5	6
CaSO ₃			0.0059	0.0054	0.0049	0.0041	0.0035	0.0030	0.0026	0.0023	0.0020	0.0019	1:26
CaSO ₄	0.174	0.191	0.202	0.205	0.208	0.210	0.207	0.201	0.193	0.184	0.173	0.163	9

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
CdBr ₂	36.0	43.0	49.9	53.4	56.4	60.3*	60.3*	60.5	60.7	60.9	61.3	61.6	6
CdC ₂ O ₄				0.0060									5
CdCl ₂	47.2	50.1	53.2	54.6	56.3*	57.3*	57.5	57.8	58.1	58.51	58.98	59.5	6
Cd(ClO ₄) ₂				58.7								66.9	7
CdF ₂		5.82	4.65	4.18	3.76								5
CdI ₂	44.1	44.9	45.8	46.3	46.8	47.9	49.0	50.2	51.5	52.7	54.1	55.4	6
Cd(IO ₃) ₂				0.091									5
Cd(NO ₃) ₂	55.4	57.1	59.6	61.0	62.8	66.5	70.6	86.1	86.5	86.8	87.1	87.4	6
CdSO ₄	43.1	43.1	43.2	43.4	43.6	44.1	43.5	42.5	41.4	40.2	38.5	36.7	6
CdSeO ₄	42.04	40.59	39.02	38.18	37.29	35.35	33.15	30.65	27.84	24.69	21.24	17.49	5
Ce(NO ₃) ₃	57.99	59.80	61.89	63.05	64.31*	67.0*	68.6	71.1*	74.9*	79.2	80.9	83.1	1:13
CoCl ₂	30.30	32.60	34.87	35.99	37.10	39.27	41.38	43.46	45.50	47.51	49.51	51.50	7
Co(ClO ₄) ₂	50.0			53.0									7
CoF ₂				1.4									7
CoI ₂	58.00	61.78	65.35	66.99	68.51	71.17	73.41	75.29	76.89	78.28	79.52	80.70	7
Co(NO ₂) ₂	0.076			0.49									7
Co(NO ₃) ₂	45.5	47.0	49.4	50.8	52.4	56.0	60.1	62.6	64.9	67.7			6
CoSO ₄	19.9	23.0	26.1	27.7	29.2	32.3	34.4	35.9	35.5	33.2	30.6	27.8	6
Co(SCN) ₂				50.7									7
CrO ₃	62.2	62.3	62.6	62.8	63.0	63.5	64.1	64.7	65.5	66.2	67.1	67.9	6
CsBr				55.2									7
CsBrO ₃	1.16	1.93	3.01	3.69	4.46	6.32	8.60	11.32	14.45	17.96	21.83	25.98	1:30
CsCl	61.83	63.48	64.96	65.64	66.29	67.50	68.60	69.61	70.54	71.40	72.21	72.96	1:47
CsClO ₃	2.40	3.87	5.94	7.22	8.69	12.15	16.33	21.14	26.45	32.10	37.89	43.42	1:30
CsClO ₄	0.79	1.01	1.51	1.96	2.57	4.28	6.55	9.29	12.41	15.80	19.39	23.07	7
CsI	30.9	37.2	43.2	45.9	48.6	53.3	57.3	60.7	63.6	65.9	67.7	69.2	6
CsIO ₃	1.08	1.58	2.21	2.59	3.02	3.96	5.06	6.29	7.70	9.20	10.79	12.45	1:30
CsNO ₃	8.46	13.0	18.6	21.8	25.1	32.0	39.0	45.7	51.9	57.3	62.1	66.2	6
CsOH					75								7
Cs ₂ SO ₄	62.6	63.4	64.1	64.5	64.8	65.5	66.1	66.7	67.3	67.8	68.3	68.8	6
CuBr ₂				55.8									7
CuCl ₂	40.8	41.7	42.6	43.1	43.7	44.8	46.0	47.2	48.5	49.9	51.3	52.7	6
Cu(ClO ₄) ₂	54.3				59.3								7
CuF ₂				0.075									7
Cu(NO ₃) ₂	45.2	49.8	56.3	59.2	61.1	62.0	63.1	64.5	65.9	67.5	69.2	71.0	6
CuSO ₄	12.4	14.4	16.7	18.0	19.3	22.2	25.4	28.8	32.4	36.3	40.3	43.5	6
CuSeO ₄	10.6			16.0									7
Dy(NO ₃) ₃	58.79	59.99	61.49	62.35	63.29	65.43	68.04	71.58					1:13
Er(NO ₃) ₃	61.58	63.15	64.84	65.75	66.69	68.70	70.96	73.64	77.75				1:13
Eu(NO ₃) ₃	55.2	56.7	58.5	59.4	60.4	62.5	64.6						1:13
FeBr ₂				54.6								64.8*	7
FeCl ₂	33.2*			39.4*								48.7*	7
FeCl ₃	42.7	44.9	47.9	47.7	51.6	74.8	76.7	84.6	84.3	84.3	84.4	84.7	6

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
Fe(ClO ₄) ₂	63.39			67.76									7
FeF ₃				5.59									7
Fe(NO ₃) ₃	40.15			46.57									7
Fe(NO ₃) ₂	41.44			46.67									7
FeSO ₄	13.5	17.0	20.8	22.8	24.8	28.8	32.8	35.5	33.6	30.4	27.1	24.0	6
Gd(NO ₃) ₃	56.3	57.7	59.2	60.1	61.0	62.9	65.2	67.9	71.5				1:13
HIO ₃	73.45	74.10	74.98	75.48	76.03	77.20	78.46	79.78	81.13	82.48	83.82	85.14	1:30
H ₃ BO ₃	2.61	3.57	4.77	5.48	6.27	8.10	10.3	12.9	15.9	19.3	23.1	27.3	6
HgBr ₂	0.26	0.37	0.52	0.61	0.72	0.96	1.26	1.63	2.08	2.61	3.23	3.95	4
Hg(CN) ₂	6.57	7.83	9.33	10.2	11.1	13.1	15.5	18.2	21.2	24.6	28.3	32.3	6
HgCl ₂	4.24	5.05	6.17	6.81	7.62	9.53	12.02	15.18	19.16	24.06	29.90	36.62	4
HgI ₂			0.0041	0.0055	0.0072	0.0122	0.0199						4
Hg(SCN) ₂				0.070									4
Hg ₂ Cl ₂				0.0004									3
Hg ₂ (ClO ₄) ₂	73.8			79.8*								85.3*	7
Hg ₂ SO ₄	0.038	0.043	0.048	0.051	0.054	0.059	0.065	0.070	0.076	0.082	0.088	0.093	4
Ho(NO ₃) ₃				63.8									1:13
KBF ₄	0.28	0.34	0.45	0.55	0.75	1.38	2.09	2.82	3.58	4.34	5.12	5.90	10
KBr	35.0	37.3	39.4	40.4	41.4	43.2	44.8	46.2	47.6	48.8	49.8	50.8	6
KBrO ₃	2.97	4.48	6.42	7.55	8.79	11.57	14.71	18.14	21.79	25.57	29.42	33.28	1:30
KC ₂ H ₃ O ₂	68.40	70.29	72.09	72.92	73.70	75.08	76.27	77.31	78.22	79.04	79.80	80.55	7
KCl	21.74	23.61	25.39	26.22	27.04	28.59	30.04	31.40	32.66	33.86	34.99	36.05	1:47
KClO ₃	3.03	4.67	6.74	7.93	9.21	12.06	15.26	18.78	22.65	26.88	31.53	36.65	1:30
KClO ₄	0.70	1.10	1.67	2.04	2.47	3.54	4.94	6.74	8.99	11.71	14.94	18.67	6
KF	30.90	39.8	47.3	50.41	53.2					60.0			7
KHCO ₃	18.62	21.73	24.92	26.6	28.13	31.32	34.46	37.51	40.45				6
KHSO ₄	27.1	29.7	32.3	33.6	35.0	37.8	40.5	43.4	46.2	49.02	51.82	54.6	6
KH ₂ PO ₄	11.74	14.91	18.25	19.97	21.77	25.28	28.95	32.76	36.75	40.96	45.41	50.12	1:31
KI	56.0	57.6	59.0	59.7	60.4	61.6	62.8	63.8	64.8	65.7	66.6	67.4	6
KIO ₃	4.53	5.96	7.57	8.44	9.34	11.09	13.22	15.29	17.41	19.58	21.78	24.03	1:30
KIO ₄	0.16	0.22	0.37	0.51	0.70	1.24	1.96	2.83	3.82	4.89	6.02	7.17	7
KMnO ₄	2.74	4.12	5.96	7.06	8.28	11.11	14.42	18.16					6
KNO ₂	73.7	74.6	75.3	75.7	76.0	76.7	77.4	78.0	78.5	79.1	79.6	80.1	6
KNO ₃	12.0	17.6	24.2	27.7	31.3	38.6	45.7	52.2	58.0	63.0	67.3	70.8	6
KOH	48.7	50.8	53.2	54.7	56.1	57.9	58.6	59.5	60.6	61.8	63.1	64.6	6
KSCN	63.8	66.4	69.1	70.4	71.6	74.1	76.5	78.9	81.1	83.3	85.3	87.3	6
K ₂ CO ₃	51.3	51.7	52.3	52.7	53.1	54.0	54.9	56.0	57.2	58.4	59.6	61.0	6
K ₂ CrO ₄	37.1	38.1	38.9	39.4	39.8	40.5	41.3	41.9	42.6	43.2	43.8	44.3	6
K ₂ Cr ₂ O ₇	4.30	7.12	10.9	13.1	15.5	20.8	26.3	31.7	36.9	41.5	45.5	48.9	6
K ₂ HAsO ₄	48.5*			63.6*								79.8*	7
K ₂ HPO ₄	57.0	59.1	61.5	62.7	64.1	67.7*		72.7*			66.5		1:31
K ₂ MoO ₄				64.7									7
K ₂ SO ₃	51.30	51.39	51.49	51.55	51.62	51.76	51.93	52.11	52.32	52.54	52.79	53.06	1:26

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
K ₂ SO ₄	7.11	8.46	9.95	10.7	11.4	12.9	14.2	15.5	16.7	17.7	18.6	19.3	6
K ₂ S ₂ O ₃	49.0*			62.3*							75.7*		7
K ₂ S ₂ O ₅	22.1	26.7	31.1	33.1	35.2	39.0	42.6	46.0	49.1	52.0	54.6		1:26
K ₂ SeO ₃	68.4*			68.5*								68.5*	7
K ₂ SeO ₄	52.70	52.93	53.17	53.30	53.43	53.70	53.99	54.30	54.61	54.94	55.26	55.60	7
K ₃ AsO ₄	51.5*			55.6*								73*	7
K ₃ Fe(CN) ₆	23.9	27.6	31.1	32.8	34.3	37.2	39.6	41.7	43.5	45.0	46.1	47.0	6
K ₃ PO ₄	44.3			51.4									7
K ₄ Fe(CN) ₆	12.5	17.3	22.0	23.9	25.6	29.2	32.5	35.5	38.2	40.6	41.4	43.1	6
LaCl ₃	49.0	48.5	48.6	48.9	49.3	50.5	52.1	54.0	56.3	58.9	61.7		6
La(NO ₃) ₃	55.0	56.9	58.9	60.0	61.1	63.6	66.3	69.9*	74.1*				1:13
LiBr	58.4	60.1	62.7	64.4	65.9	67.8	68.3	69.0	69.8	70.7	71.7	72.8	6
LiBrO ₃	61.03	62.62	64.44	65.44	66.51	68.90	71.68*	73.24*	74.43	75.66	76.93	78.32	1:30
LiC ₂ H ₃ O ₂	23.76	26.49	29.42	31.02	32.72	36.48	40.65	45.15	49.93	54.91	60.04	65.26	7
LiCl	40.45	42.46*	45.29*	45.81	46.25	47.30	48.47	49.78	51.27	52.98	54.98*	56.34*	1:47
LiClO ₃	73.2	75.6*	80.8*	82.1	83.4	85.9*	87.1*	88.2	89.6	91.3	93.4	95.7	1:30
LiClO ₄	30.1	32.6	35.5	37.0	38.6	41.9	45.5	49.2	53.2	57.2	61.3	71.4	6
LiF	0.120	0.126	0.131	0.134									7
LiH ₂ PO ₄	55.8												7
LiI	59.4	60.5	61.7	62.3	63.0	64.3	65.8	67.3	68.8	81.3	81.7	82.6	6
LiIO ₃				43.8									1:30
LiNO ₂	41	45	49	51	53	56	60	63	66	68			10
LiNO ₃	34.8	37.6	42.7	50.5	57.9	60.1	62.2	64.0	65.7	67.2	68.5	69.7	6
LiOH	10.8	10.8	11.0	11.1	11.3	11.7	12.2	12.7	13.4	14.2	15.1	16.1	6
LiSCN				54.5									7
Li ₂ CO ₃	1.54	1.43	1.33	1.28	1.24	1.15	1.07	0.99	0.92	0.85	0.78	0.72	7
Li ₂ C ₂ O ₄				5.87									7
Li ₂ HPO ₃	9.07	8.40	7.77	7.47	7.18	6.64	6.16	5.71	5.30	4.91	4.53	4.16	7
Li ₂ SO ₄	26.3	25.9	25.6	25.5	25.3	25.0	24.8	24.5	24.3	24.0	23.8	23.6	6
Li ₃ PO ₄				0.027									1:31
Lu(NO ₃) ₃				71.1									1:13
MgBr ₂	49.3	49.8	50.3	50.6	50.9	51.5	52.1	52.8	53.5	54.2	55.0	55.7	6
Mg(BrO ₃) ₂	43.0	45.2	48.0	49.4	51.0	54.3	57.9	61.6	65.3	69.0*	70.9*	71.7	1:14
Mg(C ₂ H ₃ O ₂) ₂	36.18	37.55	38.92	39.61									7
MgC ₂ O ₄				0.038									7
MgCl ₂	33.96	34.85	35.58	35.90	36.20	36.77	37.34	37.97	38.71	39.62	40.75	42.15	8
Mg(ClO ₃) ₂	53.35	54.40	56.81	58.66	60.91*	65.46*	67.33	69.27	71.01	72.44	73.48		1:14
Mg(ClO ₄) ₂	47.8	48.7	49.6	50.1	50.5	51.3	52.1						6
MgCrO ₄	32.06*			35.39*									7
MgCr ₂ O ₇				58.9						67.0			7
MgF ₂				0.013									7
MgI ₂	54.7	56.1	58.2	59.4	60.8	63.9	65.0	65.0	65.0	65.0	65.1	65.2	6
Mg(IO ₃) ₂	3.19*	6.70*	7.92	8.52	9.11	10.45	11.99	13.7	15.6	17.6	19.6		1:14

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
Mg(NO ₂) ₂				47									7
Mg(NO ₃) ₂	38.4	39.5	40.8	41.6	42.4	44.1	45.9	47.9	50.0	52.2	70.6	72.0	6
MgSO ₃	0.32	0.37	0.46	0.52	0.61	0.87*	0.85*	0.76	0.69	0.64	0.62	0.60	1:26
MgSO ₄	18.2	21.7	25.1	26.3	28.2	30.9	33.4	35.6	36.9	35.9	34.7	33.3	6
MgS ₂ O ₃	30.7			34.1									7
MgSeO ₄	31.4*			35.7*								47*	7
MnBr ₂	56.00	57.72	59.39	60.19	60.96	62.41	63.75	65.01	66.19	67.32	68.42	69.50	7
MnCl ₂	38.7	40.6	42.5	43.6	44.7	47.0	49.4	54.1	54.7	55.2	55.7	56.1	6
MnF ₂	0.80*			1.01*								0.48	7
Mn(IO ₃) ₂				0.27							0.34		7
Mn(NO ₃) ₂	50.5			61.7									7
MnSO ₄	34.6	37.3	38.6	38.9	38.9	37.7	36.3	34.6	32.8	30.8	28.8	26.7	6
NH ₄ Br	37.5	40.2	42.7	43.9	45.1	47.3	49.4	51.3	53.0	54.6	56.1	57.4	7
NH ₄ Cl	22.92	25.12	27.27	28.34	29.39	31.46	33.50	35.49	37.46	39.40	41.33	43.24	1:47
NH ₄ ClO ₄	10.8	14.1	17.8	19.7	21.7	25.8	29.8	33.6	37.3	40.7	43.8	46.6	6
NH ₄ F	41.7	43.2	44.7	45.5	46.3	47.8	49.3	50.9	52.5	54.1			7
NH ₄ HCO ₃	10.6	13.7	17.6	19.9	22.4	27.9	34.2	41.4	49.3	58.1	67.6	78.0	7
NH ₄ H ₂ AsO ₄	25.2	29.0	32.7	34.5	36.3	39.7	43.1	46.2	49.3	52.2	55.0		7
NH ₄ H ₂ PO ₄	17.8	22.0	26.4	28.8	31.2	36.2	41.6	47.2	53.0	59.2	65.7	72.4	7
NH ₄ I	60.7	62.1	63.4	64.0	64.6	65.8	66.8	67.8	68.7	69.6	70.4	71.1	6
NH ₄ IO ₃				3.70	4.20	5.64	7.63						1:30
NH ₄ NO ₂	55.7	59.0	64.9	68.8									7
NH ₄ NO ₃	54.0	60.1	65.5	68.0	70.3	74.3	77.7	80.8	83.4	85.8	88.2	90.3	6
NH ₄ SCN				64.4					81.1				7
(NH ₄) ₂ C ₂ O ₄	2.31	3.11	4.25	4.94	5.73	7.56	9.73	12.2	15.1	18.3	21.8	25.7	7
(NH ₄) ₂ HPO ₄	36.4	38.2	40.0	41.0	42.0	44.1	46.2	48.5	50.9	53.3	55.9	58.6	7
(NH ₄) ₂ S ₂ O ₅	65.5	67.9	69.8	70.5	71.3	72.3	72.9	73.1					1:26
(NH ₄) ₂ S ₂ O ₈	37.00	40.45	43.84	45.49	47.11	50.25	53.28	56.23	59.13	62.00			7
(NH ₄) ₂ SO ₃	32.2	34.9	37.7	39.1	40.6	43.7	47.0	50.6	54.5	58.9			1:26
(NH ₄) ₂ SO ₄	41.3	42.1	42.9	43.3	43.8	44.7	45.6	46.6	47.5	48.5	49.5	50.5	6
(NH ₄) ₂ SeO ₃	49.0	51.1	53.4	54.7	56.0	58.9	62.0	65.4	69.1				7
(NH ₄) ₂ SeO ₄				54.02									7
(NH ₄) ₃ PO ₄				15.5									7
NaBr	44.4	45.9	47.7	48.6	49.6	51.6	53.7	54.1	54.3	54.5	54.7	54.9	6
NaBrO ₃	20.0	23.22	26.65	28.28	29.86	32.83	35.55	38.05	40.37	42.52			1:30
NaCHO ₂	30.8	37.9	45.7	48.7	50.6	52.0	53.5	55.0					6
NaC ₂ H ₃ O ₂	26.5	28.8	31.8	33.5	35.5	39.9	45.1	58.3	59.3	60.5	61.7	62.9	6
NaCl	26.28	26.32	26.41	26.45	26.52	26.67	26.84	27.03	27.25	27.50	27.78	28.05	1:47
NaClO	22.7			44.4									7
NaClO ₂				97.0*				95.3*					7
NaClO ₃	44.27	46.67	49.3	50.1	51.2	53.6	55.5	57.0	58.5	60.5	63.3	67.1	1:30
NaClO ₄	61.9	64.1	66.2	67.2	68.3	70.4	72.5	74.1	74.7	75.4	76.1	76.7	6
NaF	3.52	3.72	3.89	3.97	4.05	4.20	4.34	4.46	4.57	4.66	4.75	4.82	6

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
NaHCO ₃	6.48	7.59	8.73	9.32	9.91	11.13	12.40	13.70	15.02	16.37	17.73	19.10	7
NaHSO ₄				22.2								33.3	10
NaH ₂ PO ₄	36.54	41.07	46.00	48.68	51.54	57.89*	61.7*	62.3*	65.9	68.7			1:31
NaI	61.2	62.4	63.9	64.8	65.7	67.7	69.8	72.0	74.7	74.8	74.9	75.1	6
NaIO ₃	2.43	4.40	7.78*	8.65*	9.60	11.67	13.99	16.52	19.25*	21.1*	22.9	24.7	1:30
NaIO ₄				12.62									7
NaNO ₂	41.9	43.4	45.1	45.9	46.8	48.7	50.7	52.8	55.0	57.2	59.5	61.8	6
NaNO ₃	42.2	44.4	46.6	47.7	48.8	51.0	53.2	55.3	57.5	59.6	61.7	63.8	6
NaOH	30	39	46	50	53	58	63	67	71	74	76	79	10
NaSCN		52.9	57.1	60.2	62.7	63.5	64.2	65.0	65.9	66.9	67.9	69.0	6
Na ₂ B ₄ O ₇	1.23	1.71	2.50	3.07	3.82	6.02	9.7	14.9	17.1	19.9	23.5	28.0	6
Na ₂ CO ₃	6.44	10.8	17.9	23.5	28.7	32.8	32.2	31.7	31.3	31.1	30.9	30.9	6
Na ₂ C ₂ O ₄	2.62	2.95	3.30	3.48	3.65	4.00	4.36	4.71	5.06	5.41	5.75	6.08	6
Na ₂ CrO ₄	22.6	32.3	44.6	46.7	46.9	48.9	51.0	53.4	55.3	55.5	55.8	56.1	6
Na ₂ Cr ₂ O ₇	62.1	63.1	64.4	65.2	66.1	68.0	70.1	72.3	74.6	77.0	79.6	80.7	6
Na ₂ HAsO ₄	5.6*			29.3*								67*	7
Na ₂ HPO ₄	1.66	4.19	7.51	10.55	16.34*	35.17*	44.64*	45.20	46.81	48.78	50.52	51.53	1:31
Na ₂ MoO ₄	30.6	38.8	39.4	39.4	39.8	40.3	41.0	41.7	42.6	43.5	44.5	45.5	6
Na ₂ S	11.1	13.2	15.7	17.1	18.6	22.1	26.7	28.1	30.2	33.0	36.4	41.0	6
Na ₂ SO ₃	12.0	16.1	20.9	23.5	26.3*	27.3*	25.9	24.8	23.7	22.8	22.1	21.5	1:26
Na ₂ SO ₄			16.13	21.94	29.22*	32.35*	31.55	30.90	30.39	30.02	29.79	29.67	8
Na ₂ S ₂ O ₃	33.1	36.3	40.6	43.3	45.9	52.0	62.3	65.7	68.8	69.4	70.1	71.0	6
Na ₂ S ₂ O ₅		38.4	39.5	40.0	40.6	41.8	43.0	44.2	45.5	46.8	48.1	49.5	1:26
Na ₂ SeO ₃				47.3*								45*	7
Na ₂ SeO ₄	11.7			36.9*								42.1*	7
Na ₂ WO ₄	41.6	41.9	42.3	42.6	42.9	43.6	44.4	45.3	46.2	47.3	48.4	49.5	6
Na ₃ PO ₄	4.28	7.30	10.8	12.6	14.1	16.6	22.9	28.4	32.4	37.6	40.4	43.5	6
Na ₄ P ₂ O ₇	2.23	3.28	4.81	6.62	7.00	10.10	14.38	20.07	27.31	36.03	32.37	30.67	6
NdCl ₃	49.0	49.3	49.7	50.0	50.4	51.2	52.2	53.3	54.5	55.8	57.1	58.5	6
Nd(NO ₃) ₃	55.76	57.49	59.37	60.38	61.43	63.69	66.27	69.47					1:13
NiCl ₂	34.7	36.1	38.5	40.3	41.7	42.1	43.2	45.0	46.1	46.2	46.4	46.6	6
Ni(ClO ₄) ₂	51.1			52.8									7
NiF ₂				2.50							2.52		7
NiI ₂	55.40	57.68	59.78	60.69	61.50	62.80	63.73	64.38	64.80	65.09	65.30		7
Ni(NO ₃) ₂	44.1	46.0	48.4	49.8	51.3	54.6	58.3	61.0	63.1	65.6	67.9	69.0	6
NiSO ₄	21.4	24.4	27.4	28.8	30.3*	32.0*	34.1	35.8	37.7	39.9	42.3	44.8	6
Ni(SCN) ₂				35.48									7
NiSeO ₄	21.6		26.2*									45.6*	7
PbBr ₂	0.449	0.620	0.841	0.966	1.118	1.46	1.89						2
PbCl ₂	0.66	0.81	0.98	1.07	1.17	1.39	1.64	1.93	2.24	2.60	2.99	3.42	2
Pb(ClO ₄) ₂				81.5									7
PbF ₂		0.0603	0.0649	0.0670	0.0693								2
PbI ₂	0.041	0.052	0.067	0.076	0.086	0.112	0.144	0.187	0.243	0.315			2

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
Pb(IO ₃) ₂				0.0025									7
Pb(NO ₃) ₂	28.46	32.13	35.67	37.38	39.05	42.22	45.17	47.90	50.42	52.72	54.82	56.75	2
PbSO ₄	0.0033	0.0038	0.0042	0.0044	0.0047	0.0052	0.0058						2
PrCl ₃	48.0	48.1	48.6	49.0	49.5	50.8	52.3	54.1	56.1	58.3			6
Pr(NO ₃) ₃	57.50	59.20	61.16	62.24	63.40*	65.7*	67.8	70.2	73.4				1:13
RbBr	47.4	50.1	52.6	53.8	54.9	57.0	58.8	60.6	62.1	63.5	64.8	65.9	6
RbBrO ₃	0.97	1.55	2.36	2.87	3.45	4.87	6.64	8.78	11.29	14.15	17.32	20.76	1:30
RbCl	43.58	45.65	47.53	48.42	49.27	50.86	52.34	53.67	54.92	56.08	57.16	58.15	1:47
RbClO ₃	2.10	3.38	5.14	6.22	7.45	10.35	13.85	17.93	22.53	27.57	32.96	38.60	1:30
RbClO ₄	1			1.5								17	7
RbF			75										7
RbHCO ₃			53.7										7
RbI	55.8	58.6	61.1	62.3	63.4	65.4	67.2	68.8	70.3	71.6	72.7	73.8	6
RbIO ₃	1.09	1.53	2.07	2.38	2.74	3.52	4.41	5.42	6.52	7.74	9.00	10.36	1:30
RbNO ₃	16.4	25.0	34.6	39.4	44.2	53.1	60.8	67.2	72.2	76.1	79.0	81.2	6
RbOH					63.4								7
Rb ₂ CrO ₄	38.27			43.26									7
Rb ₂ SO ₄	27.3	30.0	32.5	33.7	34.8	36.9	38.7	40.3	41.8	43.0	44.1	44.9	6
SbCl ₃	85.7			90.8									7
SbF ₃	79.4			83.1									7
Sc(NO ₃) ₃	57.0	59.3	61.6	62.8	63.9	66.2	68.5						1:13
Sm(NO ₃) ₃	54.83	56.33	58.08	59.05	60.08	62.38	65.05*	68.1*	70.8	74.2			1:13
SmCl ₃		48.0	48.2	48.4	48.6	49.2	50.0						6
SnCl ₂	46	64											7
SnI ₂			0.97									3.87	7
SrBr ₂	46.0	48.3	50.6	51.7	52.9	55.2	57.6	59.9	62.3	64.6	66.8	69.0	6
Sr(BrO ₃) ₂	18.53	22.00	25.39	27.02	28.59	31.55	34.21	36.57	38.64*	40.2*	40.8	41.0	1:14
SrCl ₂	31.94	32.93	34.43	35.37	36.43	38.93	41.94	45.44*	46.81*	47.69	48.70	49.87	8
Sr(ClO ₂) ₂	13.0	13.6	14.1	14.3	14.5	14.9	15.3	15.6	15.9				7
Sr(ClO ₃) ₂	63.29	63.42	63.64	63.77	63.93	64.29	64.70	65.16	65.65	66.18	66.74	67.31	1:14
Sr(ClO ₄) ₂	70.04*			75.35*		78.44*							7
SrF ₂	0.011			0.021									7
SrI ₂	62.5	62.8	63.5	63.9	64.5	65.8	67.3	69.0	70.8	72.7	74.7	79.2	6
Sr(IO ₃) ₂	0.102	0.126	0.152	0.165	0.179	0.206	0.233	0.259	0.284	0.307	0.328	0.346	1:14
Sr(MnO ₄) ₂	2.5												7
Sr(NO ₂) ₂					41.9	44.3						58.6	7
Sr(NO ₃) ₂	28.2	34.6	41.0	44.5	47.0	47.4	47.9	48.4	48.9	49.5	50.1	50.7	6
Sr(OH) ₂	0.9			2.2									7
SrSO ₃				0.0015									1:26
SrSO ₄				0.0135									7
SrS ₂ O ₃	8.8	13.2	17.7	20.0	22.2	26.8							7
Tb(NO ₃) ₃			60.6	61.02									1:13
Tl ₂ SO ₄	2.65	3.56	4.61	5.19	5.80	7.09	8.46	9.89	11.33	12.77	14.18	15.53	6

AQUEOUS SOLUBILITY OF INORGANIC COMPOUNDS AT VARIOUS TEMPERATURES (continued)

Compound	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	Ref.
Tm(NO ₃) ₃				67.9									1:13
UO ₂ (NO ₃) ₂	49.52	51.82	54.42	55.85	57.55	61.59	67.07						1:55
Y(NO ₃) ₃	55.57	56.93	58.75	59.86	61.11*	63.3*	64.9	67.9	72.5				1:13
Yb(NO ₃) ₃				70.5									1:13
ZnBr ₂	79.3	80.1	81.8	83.0	84.1	85.6	85.8	86.1	86.3	86.6	86.8	87.1	6
ZnC ₂ O ₄		0.0010	0.0019	0.0026									5
ZnCl ₂		76.6	79.0	80.3	81.4	81.8	82.4	83.0	83.7	84.4	85.2	86.0	6
Zn(ClO ₄) ₂	44.29*			46.27*			48.70						7
ZnF ₂				1.53									5
ZnI ₂	81.1	81.2	81.3	81.4	81.5	81.7	82.0	82.3	82.6	83.0	83.3	83.7	6
Zn(IO ₃) ₂			0.58	0.64	0.69	0.77	0.82						5
Zn(NO ₃) ₂	47.8	50.8	54.4	54.6	58.5	79.1	80.1	87.5	89.9				6
ZnSO ₃			0.1786	0.1790	0.1794	0.1803	0.1812						5
ZnSO ₄	29.1	32.0	35.0	36.6	38.2	41.3	43.0	42.1	41.0	39.9	38.8	37.6	6
ZnSeO ₄	33.06	34.98	37.38	38.79	40.34								5

SOLUBILITY PRODUCT CONSTANTS

The solubility product constant K_{sp} is a useful parameter for calculating the aqueous solubility of sparingly soluble compounds under various conditions. It may be determined by direct measurement or calculated from the standard Gibbs energies of formation $\Delta_f G^\circ$ of the species involved at their standard states. Thus if $K_{sp} = [M^+]^m [A^-]^n$ is the equilibrium constant for the reaction



where $M_m A_n$ is the slightly soluble substance and M^+ and A^- are the ions produced in solution by the dissociation of $M_m A_n$, then the Gibbs energy change is

$$\Delta G^\circ = m \Delta_f G^\circ (M^+, aq) + n \Delta_f G^\circ (A^-, aq) - \Delta_f G^\circ (M_m A_n, s)$$

The solubility product constant is calculated from the equation

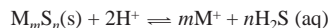
$$\ln K_{sp} = -\Delta G^\circ / RT$$

The first table below gives selected values of K_{sp} at 25°C. Many of these have been calculated from standard state thermodynamic data in References 1 and 2; other values are taken from publications of the IUPAC Solubility Data Project (References 3 to 7).

The above formulation is not convenient for treating sulfides because the S^{2-} ion is usually not present in significant concentrations (see Reference 8). This is due to the hydrolysis reaction



which is strongly shifted to the right except in very basic solutions. Furthermore, the equilibrium constant for this reaction, which depends on the second ionization constant of H_2S , is poorly known. Therefore it is more useful in the case of sulfides to define a different solubility product K_{spa} based on the reaction



Values of K_{spa} , taken from Reference 8, are given for several sulfides in the auxiliary table following the main table. Additional discussion of sulfide equilibria may be found in References 7 and 9.

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Compound	Formula	K_{sp}
Aluminum phosphate	AlPO ₄	9.84 · 10 ⁻²¹
Barium bromate	Ba(BrO ₃) ₂	2.43 · 10 ⁻⁴
Barium carbonate	BaCO ₃	2.58 · 10 ⁻⁹
Barium chromate	BaCrO ₄	1.17 · 10 ⁻¹⁰
Barium fluoride	BaF ₂	1.84 · 10 ⁻⁷
Barium hydroxide octahydrate	Ba(OH) ₂ · 8H ₂ O	2.55 · 10 ⁻⁴
Barium iodate	Ba(IO ₃) ₂	4.01 · 10 ⁻⁹
Barium iodate monohydrate	Ba(IO ₃) ₂ · H ₂ O	1.67 · 10 ⁻⁹
Barium molybdate	BaMoO ₄	3.54 · 10 ⁻⁸
Barium nitrate	Ba(NO ₃) ₂	4.64 · 10 ⁻³
Barium selenate	BaSeO ₄	3.40 · 10 ⁻⁸
Barium sulfate	BaSO ₄	1.08 · 10 ⁻¹⁰
Barium sulfite	BaSO ₃	5.0 · 10 ⁻¹⁰
Beryllium hydroxide	Be(OH) ₂	6.92 · 10 ⁻²²
Bismuth arsenate	BiAsO ₄	4.43 · 10 ⁻¹⁰

SOLUBILITY PRODUCT CONSTANTS (continued)

Compound	Formula	K_{sp}
Bismuth iodide	BiI_3	$7.71 \cdot 10^{-19}$
Cadmium arsenate	$\text{Cd}_3(\text{AsO}_4)_2$	$2.2 \cdot 10^{-33}$
Cadmium carbonate	CdCO_3	$1.0 \cdot 10^{-12}$
Cadmium fluoride	CdF_2	$6.44 \cdot 10^{-3}$
Cadmium hydroxide	$\text{Cd}(\text{OH})_2$	$7.2 \cdot 10^{-15}$
Cadmium iodate	$\text{Cd}(\text{IO}_3)_2$	$2.5 \cdot 10^{-8}$
Cadmium oxalate trihydrate	$\text{CdC}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$	$1.42 \cdot 10^{-8}$
Cadmium phosphate	$\text{Cd}_3(\text{PO}_4)_2$	$2.53 \cdot 10^{-33}$
Calcium carbonate (calcite)	CaCO_3	$3.36 \cdot 10^{-9}$
Calcium fluoride	CaF_2	$3.45 \cdot 10^{-11}$
Calcium hydroxide	$\text{Ca}(\text{OH})_2$	$5.02 \cdot 10^{-6}$
Calcium iodate	$\text{Ca}(\text{IO}_3)_2$	$6.47 \cdot 10^{-6}$
Calcium iodate hexahydrate	$\text{Ca}(\text{IO}_3)_2 \cdot 6\text{H}_2\text{O}$	$7.10 \cdot 10^{-7}$
Calcium molybdate	CaMoO_4	$1.46 \cdot 10^{-8}$
Calcium oxalate monohydrate	$\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$	$2.32 \cdot 10^{-9}$
Calcium phosphate	$\text{Ca}_3(\text{PO}_4)_2$	$2.07 \cdot 10^{-33}$
Calcium sulfate	CaSO_4	$4.93 \cdot 10^{-5}$
Calcium sulfate dihydrate	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	$3.14 \cdot 10^{-5}$
Calcium sulfite hemihydrate	$\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$	$3.1 \cdot 10^{-7}$
Cesium perchlorate	CsClO_4	$3.95 \cdot 10^{-3}$
Cesium periodate	CsIO_4	$5.16 \cdot 10^{-6}$
Cobalt(II) arsenate	$\text{Co}_3(\text{AsO}_4)_2$	$6.80 \cdot 10^{-29}$
Cobalt(II) hydroxide (blue)	$\text{Co}(\text{OH})_2$	$5.92 \cdot 10^{-15}$
Cobalt(II) iodate dihydrate	$\text{Co}(\text{IO}_3)_2 \cdot 2\text{H}_2\text{O}$	$1.21 \cdot 10^{-2}$
Cobalt(II) phosphate	$\text{Co}_3(\text{PO}_4)_2$	$2.05 \cdot 10^{-35}$
Copper(I) bromide	CuBr	$6.27 \cdot 10^{-9}$
Copper(I) chloride	CuCl	$1.72 \cdot 10^{-7}$
Copper(I) cyanide	CuCN	$3.47 \cdot 10^{-20}$
Copper(I) iodide	CuI	$1.27 \cdot 10^{-12}$
Copper(I) thiocyanate	CuSCN	$1.77 \cdot 10^{-13}$
Copper(II) arsenate	$\text{Cu}_3(\text{AsO}_4)_2$	$7.95 \cdot 10^{-36}$
Copper(II) iodate monohydrate	$\text{Cu}(\text{IO}_3)_2 \cdot \text{H}_2\text{O}$	$6.94 \cdot 10^{-8}$
Copper(II) oxalate	CuC_2O_4	$4.43 \cdot 10^{-10}$
Copper(II) phosphate	$\text{Cu}_3(\text{PO}_4)_2$	$1.40 \cdot 10^{-37}$
Europium(III) hydroxide	$\text{Eu}(\text{OH})_3$	$9.38 \cdot 10^{-27}$
Gallium(III) hydroxide	$\text{Ga}(\text{OH})_3$	$7.28 \cdot 10^{-36}$
Iron(II) carbonate	FeCO_3	$3.13 \cdot 10^{-11}$
Iron(II) fluoride	FeF_2	$2.36 \cdot 10^{-6}$
Iron(II) hydroxide	$\text{Fe}(\text{OH})_2$	$4.87 \cdot 10^{-17}$
Iron(III) hydroxide	$\text{Fe}(\text{OH})_3$	$2.79 \cdot 10^{-39}$
Iron(III) phosphate dihydrate	$\text{FePO}_4 \cdot 2\text{H}_2\text{O}$	$9.91 \cdot 10^{-16}$
Lanthanum iodate	$\text{La}(\text{IO}_3)_3$	$7.50 \cdot 10^{-12}$
Lead(II) bromide	PbBr_2	$6.60 \cdot 10^{-6}$
Lead(II) carbonate	PbCO_3	$7.40 \cdot 10^{-14}$
Lead(II) chloride	PbCl_2	$1.70 \cdot 10^{-5}$
Lead(II) fluoride	PbF_2	$3.3 \cdot 10^{-8}$
Lead(II) hydroxide	$\text{Pb}(\text{OH})_2$	$1.43 \cdot 10^{-20}$
Lead(II) iodate	$\text{Pb}(\text{IO}_3)_2$	$3.69 \cdot 10^{-13}$
Lead(II) iodide	PbI_2	$9.8 \cdot 10^{-9}$
Lead(II) selenate	PbSeO_4	$1.37 \cdot 10^{-7}$
Lead(II) sulfate	PbSO_4	$2.53 \cdot 10^{-8}$
Lithium carbonate	Li_2CO_3	$8.15 \cdot 10^{-4}$
Lithium fluoride	LiF	$1.84 \cdot 10^{-3}$
Lithium phosphate	Li_3PO_4	$2.37 \cdot 10^{-11}$
Magnesium carbonate	MgCO_3	$6.82 \cdot 10^{-6}$
Magnesium carbonate trihydrate	$\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$	$2.38 \cdot 10^{-6}$
Magnesium carbonate pentahydrate	$\text{MgCO}_3 \cdot 5\text{H}_2\text{O}$	$3.79 \cdot 10^{-6}$
Magnesium fluoride	MgF_2	$5.16 \cdot 10^{-11}$
Magnesium hydroxide	$\text{Mg}(\text{OH})_2$	$5.61 \cdot 10^{-12}$
Magnesium oxalate dihydrate	$\text{MgC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	$4.83 \cdot 10^{-6}$

SOLUBILITY PRODUCT CONSTANTS (continued)

Compound	Formula	K_{sp}
Magnesium phosphate	$Mg_3(PO_4)_2$	$1.04 \cdot 10^{-24}$
Manganese(II) carbonate	$MnCO_3$	$2.24 \cdot 10^{-11}$
Manganese(II) iodate	$Mn(IO_3)_2$	$4.37 \cdot 10^{-7}$
Manganese(II) oxalate dihydrate	$MnC_2O_4 \cdot 2H_2O$	$1.70 \cdot 10^{-7}$
Mercury(I) bromide	Hg_2Br_2	$6.40 \cdot 10^{-23}$
Mercury(I) carbonate	Hg_2CO_3	$3.6 \cdot 10^{-17}$
Mercury(I) chloride	Hg_2Cl_2	$1.43 \cdot 10^{-18}$
Mercury(I) fluoride	Hg_2F_2	$3.10 \cdot 10^{-6}$
Mercury(I) iodide	Hg_2I_2	$5.2 \cdot 10^{-29}$
Mercury(I) oxalate	$Hg_2C_2O_4$	$1.75 \cdot 10^{-13}$
Mercury(I) sulfate	Hg_2SO_4	$6.5 \cdot 10^{-7}$
Mercury(I) thiocyanate	$Hg_2(SCN)_2$	$3.2 \cdot 10^{-20}$
Mercury(II) bromide	$HgBr_2$	$6.2 \cdot 10^{-20}$
Mercury(II) iodide	HgI_2	$2.9 \cdot 10^{-29}$
Neodymium carbonate	$Nd_2(CO_3)_3$	$1.08 \cdot 10^{-33}$
Nickel(II) carbonate	$NiCO_3$	$1.42 \cdot 10^{-7}$
Nickel(II) hydroxide	$Ni(OH)_2$	$5.48 \cdot 10^{-16}$
Nickel(II) iodate	$Ni(IO_3)_2$	$4.71 \cdot 10^{-5}$
Nickel(II) phosphate	$Ni_3(PO_4)_2$	$4.74 \cdot 10^{-32}$
Palladium(II) thiocyanate	$Pd(SCN)_2$	$4.39 \cdot 10^{-23}$
Potassium hexachloroplatinate	K_2PtCl_6	$7.48 \cdot 10^{-6}$
Potassium perchlorate	$KClO_4$	$1.05 \cdot 10^{-2}$
Potassium periodate	KIO_4	$3.71 \cdot 10^{-4}$
Praseodymium hydroxide	$Pr(OH)_3$	$3.39 \cdot 10^{-24}$
Radium iodate	$Ra(IO_3)_2$	$1.16 \cdot 10^{-9}$
Radium sulfate	$RaSO_4$	$3.66 \cdot 10^{-11}$
Rubidium perchlorate	$RbClO_4$	$3.00 \cdot 10^{-3}$
Scandium fluoride	ScF_3	$5.81 \cdot 10^{-24}$
Scandium hydroxide	$Sc(OH)_3$	$2.22 \cdot 10^{-31}$
Silver(I) acetate	$AgCH_3COO$	$1.94 \cdot 10^{-3}$
Silver(I) arsenate	Ag_3AsO_4	$1.03 \cdot 10^{-22}$
Silver(I) bromate	$AgBrO_3$	$5.38 \cdot 10^{-5}$
Silver(I) bromide	$AgBr$	$5.35 \cdot 10^{-13}$
Silver(I) carbonate	Ag_2CO_3	$8.46 \cdot 10^{-12}$
Silver(I) chloride	$AgCl$	$1.77 \cdot 10^{-10}$
Silver(I) chromate	Ag_2CrO_4	$1.12 \cdot 10^{-12}$
Silver(I) cyanide	$AgCN$	$5.97 \cdot 10^{-17}$
Silver(I) iodate	$AgIO_3$	$3.17 \cdot 10^{-8}$
Silver(I) iodide	AgI	$8.52 \cdot 10^{-17}$
Silver(I) oxalate	$Ag_2C_2O_4$	$5.40 \cdot 10^{-12}$
Silver(I) phosphate	Ag_3PO_4	$8.89 \cdot 10^{-17}$
Silver(I) sulfate	Ag_2SO_4	$1.20 \cdot 10^{-5}$
Silver(I) sulfite	Ag_2SO_3	$1.50 \cdot 10^{-14}$
Silver(I) thiocyanate	$AgSCN$	$1.03 \cdot 10^{-12}$
Strontium arsenate	$Sr_3(AsO_4)_2$	$4.29 \cdot 10^{-19}$
Strontium carbonate	$SrCO_3$	$5.60 \cdot 10^{-10}$
Strontium fluoride	SrF_2	$4.33 \cdot 10^{-9}$
Strontium iodate	$Sr(IO_3)_2$	$1.14 \cdot 10^{-7}$
Strontium iodate monohydrate	$Sr(IO_3)_2 \cdot H_2O$	$3.77 \cdot 10^{-7}$
Strontium iodate hexahydrate	$Sr(IO_3)_2 \cdot 6H_2O$	$4.55 \cdot 10^{-7}$
Strontium sulfate	$SrSO_4$	$3.44 \cdot 10^{-7}$
Thallium(I) bromate	$TlBrO_3$	$1.10 \cdot 10^{-4}$
Thallium(I) bromide	$TlBr$	$3.71 \cdot 10^{-6}$
Thallium(I) chloride	$TlCl$	$1.86 \cdot 10^{-4}$
Thallium(I) chromate	Tl_2CrO_4	$8.67 \cdot 10^{-13}$
Thallium(I) iodate	$TlIO_3$	$3.12 \cdot 10^{-6}$
Thallium(I) iodide	TlI	$5.54 \cdot 10^{-8}$
Thallium(I) thiocyanate	$TlSCN$	$1.57 \cdot 10^{-4}$
Thallium(III) hydroxide	$Tl(OH)_3$	$1.68 \cdot 10^{-44}$
Tin(II) hydroxide	$Sn(OH)_2$	$5.45 \cdot 10^{-27}$

SOLUBILITY PRODUCT CONSTANTS (continued)

Compound	Formula	K_{sp}
Yttrium carbonate	$Y_2(CO_3)_3$	$1.03 \cdot 10^{-31}$
Yttrium fluoride	YF_3	$8.62 \cdot 10^{-21}$
Yttrium hydroxide	$Y(OH)_3$	$1.00 \cdot 10^{-22}$
Yttrium iodate	$Y(IO_3)_3$	$1.12 \cdot 10^{-10}$
Zinc arsenate	$Zn_3(AsO_4)_2$	$2.8 \cdot 10^{-28}$
Zinc carbonate	$ZnCO_3$	$1.46 \cdot 10^{-10}$
Zinc carbonate monohydrate	$ZnCO_3 \cdot H_2O$	$5.42 \cdot 10^{-11}$
Zinc fluoride	ZnF_2	$3.04 \cdot 10^{-2}$
Zinc hydroxide	$Zn(OH)_2$	$3 \cdot 10^{-17}$
Zinc iodate dihydrate	$Zn(IO_3)_2 \cdot 2H_2O$	$4.1 \cdot 10^{-6}$
Zinc oxalate dihydrate	$ZnC_2O_4 \cdot 2H_2O$	$1.38 \cdot 10^{-9}$
Zinc selenide	$ZnSe$	$3.6 \cdot 10^{-26}$
Zinc selenite monohydrate	$ZnSeO_3 \cdot H_2O$	$1.59 \cdot 10^{-7}$

Sulfides

Compound	Formula	K_{spa}
Cadmium sulfide	CdS	$8 \cdot 10^{-7}$
Copper(II) sulfide	CuS	$6 \cdot 10^{-16}$
Iron(II) sulfide	FeS	$6 \cdot 10^{-2}$
Lead(II) sulfide	PbS	$3 \cdot 10^{-7}$
Manganese(II) sulfide (green)	MnS	$3 \cdot 10^7$
Mercury(II) sulfide (red)	HgS	$4 \cdot 10^{-33}$
Mercury(II) sulfide (black)	HgS	$2 \cdot 10^{-32}$
Silver(I) sulfide	Ag_2S	$6 \cdot 10^{-30}$
Tin(II) sulfide	SnS	$1 \cdot 10^{-5}$
Zinc sulfide (sphalerite)	ZnS	$2 \cdot 10^{-4}$
Zinc sulfide (wurtzite)	ZnS	$3 \cdot 10^{-2}$

SOLUBILITY CHART

Abbreviations: **W**, soluble in water; **A**, insoluble in water but soluble in acids; **w**, sparingly soluble in water but soluble in acids; **a**, insoluble in water and only sparingly soluble in acids; **I**, insoluble in water and acids; **d**, decomposes in water. * Indicates two modifications of the salt

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No.		Al	NH ₄	Sb	Ba	Bi	Cd	Ca	Cr	Co	Cu	Au (I)	Au (II)	H	Fe (II)	Fe (III)	
1	Acetate	W	W		W	W	W	W	W	W	W	W	W	W			
	—(C ₂ H ₃ O ₂)	Al(—) ₃	NH ₄ (—)		Ba(—) ₂	Bi(—) ₃	Cd(—) ₂	Ca(—) ₂	Cr(—) ₃	Co(—) ₂	Cu(—) ₂				C ₂ H ₄ O ₂	Fe(—) ₂	Fe ₂ (—) ₆
2	Arsenate	a	W	A	w	A	A	w		A	A				W	A	A
	—(AsO ₄)	Al(—)	(NH ₄) ₃ (—)	Sb(—)	Ba ₃ (—) ₂	Bi(—)	Cd ₃ (—) ₂	Ca ₃ (—) ₂		Co ₃ (—) ₂	Cu ₃ (—) ₂				H ₃ AsO ₄	Fe ₃ (—) ₂	Fe(—)
3	Arsenite		W	A				w		A	A						
	—(AsO ₃)		NH ₄ AsO ₂	Sb(—)				Ca ₃ (—) ₂		Co ₃ H ₆ (—) ₄	CuH(—)						
4	Benzoate		W		W	A	W	W		W	w				W	W	A
	—(C ₇ H ₅ O ₂)		NH ₄ (—)		Ba(—) ₂	Bi(—) ₃	Cd(—) ₂	Ca(—) ₂		Co(—) ₂	Cu(—) ₂				C ₇ H ₆ O ₂	Fe(—) ₂	Fe ₂ (—) ₆
5	Bromide	W	W	d	W	d	W	W	W(I)*	W	W	w	W		W	W	W
		AlBr ₂	NH ₄ Br	SbBr ₃	BaBr ₂	BiBr ₃	CdBr ₂	CaBr ₂	CrBr ₃	CoBr ₂	CuBr ₂	AuBr	AuBr ₃	HBr	FeBr ₂	FeBr ₃	
6	Carbonate		W		w		A	w	W	A					w		
			(NH ₄) ₂ CO ₃		BaCO ₃		CdCO ₃	CaCO ₃	CrCO ₃	CoCO ₃					FeCO ₃		
7	Chlorate	W	W		W	W	W	W		W	W			W	W	W	
	—(ClO ₃)	Al(—) ₃	NH ₄ (—)		Ba(—) ₂	Bi(—) ₃	Cd(—) ₂	Ca(—) ₂		Co(—) ₂	Cu(—) ₂			HClO ₃	Fe(—) ₂	Fe(—) ₃	
8	Chloride	W	W	W	W	d	W	W	I	W	W	w	W	W	W	W	
		AlCl ₃	NH ₄ Cl	SbCl ₃	BaCl ₂	BiCl ₃	CdCl ₂	CaCl ₂	CrCl ₃	CoCl ₂	CuCl ₂	AuCl	AuCl ₃	HCl	FeCl ₂	FeCl ₃	
9	Chromate		W		A		A	W		A							
	—(CrO ₄)		(NH ₄) ₂ (—)		Ba(—)		Cd(—)	Ca(—)		Co(—)							Fe ₂ (—) ₃
10	Citrate	W	W		w	A	A	w		w				W		W	
	—(C ₆ H ₅ O ₇)	Al(—)	(NH ₄) ₃ (—)		Ba ₃ (—) ₂	Bi(—)	Cd ₃ (—) ₂	Ca ₃ (—) ₂		Co ₃ (—) ₂				C ₆ H ₈ O ₇		Fe(—)	
11	Cyanide		W		W	w	W	W	A	W	A	w	W	W	a		
			NH ₄ CN		Ba(CN) ₂	Bi(CN) ₃	Cd(CN) ₂	Ca(CN) ₂	Cr(CN) ₃	Co(CN) ₂	Cu(CN) ₂	AuCN	Au(CN) ₃	HCN	Fe(CN) ₂		
12	Ferricy'de		W		w	A	A	W	I	I	I			W	I		
	—(Fe(CN) ₆)		(NH ₄) ₃ (—)		Ba ₃ (—) ₂		Cd ₃ (—) ₂	Ca ₃ (—) ₂		Co ₃ (—) ₂	Cu ₃ (—) ₂			H ₃ (—)	Fe ₃ (—) ₂		
13	Ferroc'y'de	w	W		W		A	W		I	I			W	I	a	
	—(Fe(CN) ₆)	Al ₄ (—) ₃	(NH ₄) ₄ (—)		Ba ₂ (—)		Cd ₂ (—)	Ca ₂ (—)		Co ₂ (—)	Cu ₂ (—)			H ₄ (—)	Fe ₂ (—)	Fe ₄ (—) ₃	
14	Fluoride	W	W	W	w	W	W	w	W(a)*	W	w			W	w	w	
		AlF ₃	NH ₄ F	SbF ₃	BaF ₂	BiF ₃	CdF ₂	CaF ₂	CrF ₃	CoF ₂	CuF ₂			HF	FeF ₂	FeF ₃	
15	Formate	W	W		W	W	W	W		W	W			W	W	W	
	—(CHO ₂)	Al(—) ₃	NH ₄ (—)		Ba(—) ₂	Bi(—) ₃	Cd(—) ₂	Ca(—) ₂		Co(—) ₂	Cu(—) ₂			CH ₂ O ₂	Fe(—) ₂	Fe(—) ₃	
16	Hydroxide	A	W		W	A	A	W	A	A	A	W	A		A	A	
		Al(OH) ₃	NH ₄ OH		Ba(OH) ₂	Bi(OH) ₃	Cd(OH) ₂	Ca(OH) ₂	Cr(OH) ₃	Co(OH) ₂	Cu(OH) ₂	AuOH	Au(OH) ₃		Fe(OH) ₂	Fe(OH) ₃	
17	Iodide	W	W	d	W	A	W	W	W	W	a	a	a	W	W	W	
		AlI ₃	NH ₄ I	SbI ₃	BaI ₂	BiI ₃	CdI ₂	CaI ₂	CrI ₃	CoI ₂	CuI	AuI	AuI ₃	HI	FeI ₂	FeI ₃	
18	Nitrate	W	W		W	d	W	W	W	W	W			W	W	W	
		Al(NO ₃) ₃	NH ₄ NO ₃		Ba(NO ₃) ₂	Bi(NO ₃) ₃	Cd(NO ₃) ₂	Ca(NO ₃) ₂	Cr(NO ₃) ₃	Co(NO ₃) ₂	Cu(NO ₃) ₂			HNO ₃	Fe(NO ₃) ₂	Fe(NO ₃) ₃	
19	Oxalate	A	W		w	A	w	A	W	A	A			W	A	W	
	—(C ₂ O ₄)	Al ₂ (—) ₃	(NH ₄) ₂ (—)		Ba(—)	Bi ₂ (—) ₃	Cd(—)	Ca(—)	Cr(—)	Co(—)	Cu(—)			C ₂ H ₂ O ₄	Fe(—)	Fe ₂ (—) ₃	
20	Oxide	a		w	W	A	A	w	a	A	A		A	W	A	A	
		Al ₂ O ₃		Sb ₂ O ₃	BaO	Bi ₂ O ₃	CdO	CaO	Cr ₂ O ₃	CoO	CuO	Au ₂ O	Au ₂ O ₃	H ₂ O ₂	FeO	Fe ₂ O ₃	
21	Phosphate	A	W		A	A	A	w	w	A	A			W	A	w	
		AlPO ₄	NH ₄ H ₂ PO ₄		Ba ₃ (PO ₄) ₂	BiPO ₄	Cd ₃ (PO ₄) ₂	Ca ₃ (PO ₄) ₂	Cr ₂ (PO ₄) ₂	Co ₃ (PO ₄) ₂	Cu ₃ (PO ₄) ₂		H ₃ PO ₄	Fe ₃ (PO ₄) ₂	FePO ₄		
22	Silicate,	I			W		A	w		A	A			I			
	—(SiO ₃)	Al ₂ (—) ₃			Ba(—)		Cd(—)	Ca(—)		Co ₂ SiO ₄	Cu(—)			H ₂ SiO ₃			
23	Sulfate	W	W	A	a	d	W	w	W(I)*	W	W			W	W	w	
		Al ₂ (SO ₄) ₃	(NH ₄) ₂ SO ₄	Sb ₂ (SO ₄) ₃	BaSO ₄	Bi ₂ (SO ₄) ₃	CdSO ₄	CaSO ₄	Cr ₂ (SO ₄) ₃	CoSO ₄	CuSO ₄			H ₂ SO ₄	FeSO ₄	Fe(SO ₄) ₃	
24	Sulfide	d	W	A	d	A	A	w	d	A	A			W	A	d	
		Al ₂ S ₃	(NH ₄) ₂ S	Sb ₂ S ₃	BaS	Bi ₂ S ₃	CdS	CaS	Cr ₂ S ₃	CoS	CuS	Au ₂ S	Au ₂ S ₃	H ₂ S	FeS	Fe ₂ S ₃	
25	Tartrate	w	W	W	w	A	A	w	d	A	A	I	I	W	A	d	
	—(C ₄ H ₄ O ₆)	Al ₂ (—) ₃	(NH ₄) ₂ (—)	Sb ₂ (—) ₃	Ba(—)	Bi ₂ (—) ₃	Cd(—)	Ca(—)		Co(—)	Cu(—)			C ₄ H ₆ O ₆	Fe(—)	Fe ₂ (—) ₃	

SOLUBILITY CHART (continued)

No.		Al	NH ₄	Sb	Ba	Bi	Cd	Ca	Cr	Co	Cu	Au (I)	Au (II)	H	Fe (II)	Fe (III)
26	Thiocy'te		W NH ₄ CNS		W Ba(CNS) ₂			W Ca(CNS)		W Co(CNS) ₂	d CuCNS			W CNSH	W Fe(CNS) ₂	W Fe(CNS) ₃
No.		Pb	Mg	Mn	Hg (I)	Hg (II)	Ni	K	Pt	Ag	Na	Sn (IV)	Sn (II)	Sr	Zn	
1	Acetate	W	W	W	w	W	W	W		w	W	W	d	W	W	
	—(C ₂ H ₃ O ₂)	Pb(—) ₂	Mg(—) ₂	Mn(—) ₂	Hg(—)	Hg(—) ₂	Ni(—) ₂	K(—)		Ag(—)	Na(—)	Sn(—) ₄	Sn(—) ₂	Sr(—) ₂	Zn(—) ₂	
2	Arsenate	A	A	w	A	w	A	W		A	W			w	A	
	—(AsO ₄)	PbH(—)	Mg ₃ (—)	MnH(—)	Hg ₃ (—)	Hg ₃ (—) ₂	Ni ₃ (—) ₂	K ₃ (—)		Ag ₃ (—)	Na ₃ (—)			SrH(—)	Zn ₃ (—) ₂	
3	Arsenite	W	W	A	A	A	A	W		A	W		A	w		
	—(AsO ₃)		Mg ₃ (—) ₂	Mn ₃ H ₆ (—) ₄	Hg ₃ (—)	Hg ₃ (—)	Ni ₃ H ₆ (—) ₄	K ₃ AsO ₃		Ag ₃ (—)	Na ₂ H(—)		Sn ₃ (—) ₂	Sr ₃ (—) ₂		
4	Benzoate	w	W	W	W	w	W	W		w	W				W	
	—(C ₇ H ₅ O ₂)	Pb(—) ₂	Mg(—) ₂	Mn(—) ₂	Hg ₂ (—) ₂	Hg(—) ₂	Ni(—) ₂	K(—)		Ag(—)	Na(—)				Zn(—) ₂	
5	Bromide	W	W	W	A	W	W	W	w	a	W	W	W	W	W	
		PbBr ₂	MgBr ₂	MnBr ₂	HgBr	HgBr ₂	NiBr ₂	KBr	PtBr ₄	AgBr	NaBr	SnBr ₄	SnBr ₂	SrBr ₂	ZnBr ₂	
6	Carbonate	A	w	w	A	w	w	W		A	W			w	w	
		PbCO ₃	MgCO ₃	MnCO ₃	Hg ₂ CO ₃		NiCO ₃	K ₂ CO ₃		Ag ₂ CO ₃	Na ₂ CO ₃			SrCO ₃	ZnCO ₃	
7	Chlorate	W	W	W	W	W	W	W		W	W		W	W	W	
	—(ClO ₃)	Pb(—) ₂	Mg(—) ₂	Mn(—) ₂	Hg(—)	Hg(—) ₂	Ni(—) ₂	K(—)		Ag(—)	Na(—)		Sn(—) ₂	Sr(—) ₂	Zn(—) ₂	
8	Chloride	W	W	W	a	W	W	W	W	a	W	W	W	W	W	
		PbCl ₂	MgCl ₂	MnCl ₂	HgCl	HgCl ₂	NiCl ₂	KCl	PtCl ₄	AgCl	NaCl	SnCl ₄	SnCl ₂	SrCl ₂	ZnCl ₂	
9	Chromate	A	W	W	w	w	w	W		w	W	W	A	w	w	
	—(CrO ₄)	Pb(—)	Mg(—)		Hg ₂ (—)	Hg(—)	Ni(—)	K ₂ (—)		Ag ₂ (—)	Ma ₂ (—)	Sn(—) ₂	Sn(—)	Sr(—)	Zn(—)	
10	Citrate	W	W	w	w	W	W	W		w	W			A	w	
	—(C ₆ H ₅ O ₇)	Pb ₃ (—) ₂	Mg ₃ (—) ₂	MnH(—)	Hg ₃ (—)		Ni ₃ (—) ₂	K ₃ (—)		Ag ₃ (—)	Na ₃ (—)			SrH(—)	Zn ₃ (—) ₂	
11	Cyanide	w	W		A	W	a	W	I	a	W			W	A	
		Pb(CN) ₂	Mg(CN) ₂		HgCN	Hg(CN) ₂	Ni(CN) ₂	KCN	Pt(CN) ₂	AgCN	NaCN			Sr(CN) ₂	Zn(CN) ₂	
12	Ferricy' de	w	W		W	I	I	W		I	W		A	W	A	
	—Fe(CN) ₆	Pb ₃ (—) ₂	Mg ₃ (—) ₂			Hg ₃ (—) ₂	Ni ₃ (—) ₂	K ₃ (—)		Ag ₃ (—)	Na ₃ (—)		Sn ₃ (—) ₂	Sr ₃ (—) ₂	Zn ₃ (—) ₂	
13	Ferrocyy' de	a	W	A		I	I	W		I	W		a	W	I	
	—Fe(CN) ₆	Pb ₂ (—)	Mg ₂ (—)	Mn ₂ (—)		Hg ₂ (—)	Ni ₂ (—)	K ₄ (—)		Ag ₄ (—)	Na ₄ (—)		Sn ₂ (—)	Sr ₂ (—)	Zn ₂ (—)	
14	Fluoride	w	w	A	d	d	w	W	W	W	W	W	W	w	w	
		PbF ₂	MgF ₂	MnF ₂	HgF	HgF ₂	NiF ₂	KF	PtF ₄	AgF	NaF	SnF ₄	SnF ₂	SrF ₂	ZnF ₂	
15	Formate	W	W	W	w	W	W	W		W	W			W	W	
	—(CHO ₂)	Pb(—) ₂	Mg(—) ₂	Mn(—) ₂	Hg(—)	Hg(—) ₂	Ni(—) ₂	K(—)		Ag(—)	Na(—)			Sr(—) ₂	Zn(—) ₂	
16	Hydroxide	w	A	A	A	w	w	W	A	W	W	w	A	W	A	
		Pb(OH) ₂	Mg(OH) ₂	Mn(OH) ₂		Hg(OH) ₂	Ni(OH) ₂	KOH	Pt(OH) ₄		NaOH	Sn(OH) ₄	Sn(OH) ₂	Sr(OH) ₂	Zn(OH) ₂	
17	Iodide	w	W	W	A	w	W	W	I	I	W	d	W	W	W	
		PbI ₂	MgI ₂	MnI ₂	HgI	HgI ₂	NiI ₂	KI	PtI ₂	AgI	NaI	SnI ₄	SnI ₂	SrI ₂	ZnI ₂	
18	Nitrate	W	W	W	W	W	W	W	W	W	W		d	W	W	
		Pb(NO ₃) ₂	Mg(NO ₃) ₂	Mn(NO ₃) ₂	HgNO ₃	Hg(NO ₃) ₂	Ni(NO ₃) ₂	KNO ₃	Pt(NO ₃) ₄	AgNO ₃	NaNO ₃		Sn(NO ₃) ₂	Sr(NO ₃) ₂	Zn(NO ₃) ₂	
19	Oxalate	A	w	w	a	A	A	W		a	W		A	w	A	
	—(C ₂ O ₄)	Pb(—)	Mg(—)	Mn(—)	Hg ₂ (—)	Hg(—)	Ni(—)	K ₂ (—)		Ag ₂ (—)	Na ₂ (—)		Sn(—)	Sr(—)	Zn(—)	
20	Oxide	w	A	A	A	w	A	W	A	w	d	A	A	W	w	
		PbO	MgO	MnO	Hg ₂ O	HgO	NiO	K ₂ O	PtO	Ag ₂ O	Na ₂ O	SnO ₂	SnO	SrO	ZnO	
21	Phosphate	A	w	w	A	A	A	W		A	W		A	A	A	
		Pb ₃ (PO ₄) ₂	Mg ₃ (PO ₄) ₂	Mn ₃ (PO ₄) ₂	Hg ₃ PO ₄	Hg ₃ (PO ₄) ₂	Ni ₃ (PO ₄) ₂	K ₃ PO ₄		Ag ₃ PO ₄	Na ₃ PO ₄		Sn ₃ (PO ₄)	Sr ₃ (PO ₄) ₂	Zn ₃ (PO ₄) ₂	
22	Silicate	A	A	I				W			W			A	A	
	—(SiO ₃)	Pb(—)	Mg(—)	Mn(—)				K ₂ (—)			Na ₂ (—)			Sr(—)	Zn(—)	
23	Sulfate	w	W	W	w	d	W	W	W	w	W	W	W	w	W	
		PbSO ₄	MgSO ₄	MnSO ₄	Hg ₂ SO ₄	HgSO ₄	NiSO ₄	K ₂ SO ₄	Pt(SO ₄) ₂	Ag ₂ SO ₄	Na ₂ SO ₄	Sn(SO ₄) ₂	SnSO ₄	SrSO ₄	ZnSO ₄	

SOLUBILITY CHART (continued)

No.		Pb	Mg	Mn	Hg (I)	Hg (II)	Ni	K	Pt	Ag	Na	Sn (IV)	Sn (II)	Sr	Zn
24	Sulfide	A PbS	d MgS	A MnS	I Hg ₂ S	I HgS	A NiS	W K ₂ S	I PtS	A Ag ₂ S	W Na ₂ S	A SnS ₂	A SnS	W SrS	A ZnS
25	Tartrate (C ₄ H ₄ O ₆)	A Pb(—)	w Mg(—)	w Mn(—)	I Hg ₂ (—)	I A	A Ni(—)	W K ₂ (—)	I A	A Ag ₂ (—)	W Na ₂ (—)	A A	A Sn(—)	W Sr(—)	A Zn(—)
26	Thiocy'te	w Pb(CNS) ₂	W Mg(CNS) ₂	W Mn(CNS) ₂	A HgCNS	A Hg(CNS) ₂	W A	W KCNS	W A	I AgCNS	W NaCNS	W A	W A	W Sr(CNS) ₂	W Zn(CNS) ₂

REDUCTION OF WEIGHINGS IN AIR TO VACUO

When the mass M of a body is determined in air, a correction is necessary for the buoyancy of the air. The corrected mass is given by $M + kM/1000$, where k is a function of the material used for the weights, given by

$$k = 1000\rho_{\text{air}}(1/\rho_{\text{body}} - 1/\rho_{\text{weight}})$$

and ρ is density. The table below is computed for an air density of 0.0012 g/cm³ and for densities of three common weights: platinum-iridium (21.6 g/cm³), brass (8.5 g/cm³), and aluminum or quartz (2.65 g/cm³).

REFERENCES

1. Kaye, G. W. C., and Laby, T. H., *Tables of Physical and Chemical Constants, 16th Edition*, pp. 25-28, Longman, London, 1995.
2. Giacomo, P., *Metrologia* 18, 33, 1982.
3. Davis, R. S., *Metrologia* 29, 67, 1992.

Density of body (g/cm ³)	Value of k for weights of:			Density of body (g/cm ³)	Value of k for weights of:		
	Pt-Ir	Brass	Quartz or Al		Pt-Ir	Brass	Quartz or Al
0.5	2.34	2.26	1.95	1.8	0.61	0.53	0.21
0.6	1.94	1.86	1.55	1.9	0.58	0.49	0.18
0.7	1.66	1.57	1.26	2.0	0.54	0.46	0.15
0.8	1.44	1.36	1.05	2.5	0.42	0.34	0.03
0.9	1.28	1.19	0.88	3.0	0.34	0.26	-0.05
1.0	1.14	1.06	0.75	4.0	0.24	0.16	-0.15
1.1	1.04	0.95	0.64	6.0	0.14	0.06	-0.25
1.2	0.94	0.86	0.55	8.0	0.09	0.01	-0.30
1.3	0.87	0.78	0.47	10.0	0.06	-0.02	-0.33
1.4	0.80	0.72	0.40	15.0	0.02	-0.06	-0.37
1.5	0.74	0.66	0.35	20.0	0.00	-0.08	-0.39
1.6	0.69	0.61	0.30	22.0	0.00	-0.09	-0.40
1.7	0.65	0.56	0.25				

For a more accurate calculation, use the following values of the density of air (assuming 50% relative humidity and 0.04% CO₂):

P/kPa	Air temperature		
	10°C	20°C	30°C
85	0.001043	0.001005	0.000968
90	0.001105	0.001065	0.001025
95	0.001166	0.001124	0.001083
100	0.001228	0.001184	0.001140
105	0.001290	0.001243	0.001198

Formulas for calculating the density of air over more extended ranges of temperature, pressure, and humidity may be found in the references.

VOLUME OF ONE GRAM OF WATER

The following table, which is designed for gravimetric calibration of volumetric apparatus, gives the specific volume of water at standard atmospheric pressure as a function of temperature.

REFERENCE

Marsh, K. N., Editor, *Recommended Reference Materials for the Realization of Physicochemical Properties*, pp. 25-27, Blackwell Scientific Publications, Oxford, 1987.

t/°C	Volume of 1 g H₂O in cm³	t/°C	Volume of 1 g H₂O in cm³	t/°C	Volume of 1 g H₂O in cm³
10	1.0002980	17	1.0012246	24	1.0027079
11	1.0003928	18	1.0014044	25	1.0029607
12	1.0005007	19	1.0015952	26	1.0032234
13	1.0006212	20	1.0017969	27	1.0034956
14	1.0007542	21	1.0020092	28	1.0037771
15	1.0008992	22	1.0022320	29	1.0040679
16	1.0010561	23	1.0024649	30	1.0043679

PROPERTIES OF CARRIER GASES FOR GAS CHROMATOGRAPHY

The following is a list of carrier gases sometimes used in gas chromatography, with properties relevant to the design of chromatographic systems. All data refer to normal atmospheric pressure (101.325 kPa).

M_r : Molecular weight (relative molar mass)
 ρ_{25} : Density at 25°C in g/L
 λ : Thermal conductivity in mW/m °C
 η : Viscosity in $\mu\text{Pa s}$ (equal to 10^{-3} cp)
 c_p : Specific heat at 25°C in J/g °C

REFERENCES

1. Lide, D. R., and Kehiaian, H. V., *CRC Handbook of Thermophysical and Thermochemical Data*, CRC Press, Boca Raton, FL, 1994.
2. Bruno, T. J., and Svoronos, P. D. N., *CRC Handbook of Basic Tables for Chemical Analysis*, CRC Press, Boca Raton, FL, 1989

Gas	M_r	ρ_{25} g L ⁻¹	At 25°C		At 250°C		$c_p(25^\circ\text{C})$ J/g °C
			λ mW/m °C	η $\mu\text{Pa s}$	λ mW/m °C	η $\mu\text{Pa s}$	
Hydrogen	2.016	0.0824	185.9	8.9	280	13.1	14.3
Helium	4.003	0.1636	154.6	19.9	230	29.5	5.20
Argon	39.95	1.6329	17.8	22.7	27.7	35.3	0.521
Nitrogen	28.01	1.1449	25.9	17.9	39.6	26.8	1.039
Oxygen	32.00	1.3080	26.2	20.7	42.6	31.8	0.919
Carbon monoxide	28.01	1.1449	24.8	17.8	40.7	26.5	1.039
Carbon dioxide	44.01	1.7989	16.7	14.9	35.5	24.9	0.843
Sulfur hexafluoride	146.05	5.9696	13.1	28.1	15.3	24.8	0.664
Methane	16.04	0.6556	34.5	11.1	75.0	17.6	2.23
Ethane	30.07	1.2291	20.9	9.4	57.7	15.5	1.75
Ethylene	28.05	1.1465	20.5	10.3	53.8	17.2	1.53
Propane	44.10	1.8025	17.9	8.3	49.2	14.0	1.67

SOLVENTS FOR ULTRAVIOLET SPECTROPHOTOMETRY

This table lists some solvents commonly used for sample preparation for ultraviolet spectrophotometry. The properties given are:

- λ_c : cutoff wavelength, below which the solvent absorption becomes excessive.
 ϵ : dielectric constant (relative permittivity); the temperature in °C is given as a superscript.
 t_b : normal boiling point.

REFERENCES

1. Bruno, T. J., and Svoronos, P. D. N., *CRC Handbook of Basic Tables for Chemical Analysis*, CRC Press, Boca Raton, FL, 1989.
2. *Landolt-Börnstein, Numerical Data and Functional Relationships in Science and Technology, New Series, IV/6, Static Dielectric Constants of Pure Liquids and Binary Liquid Mixtures*, Springer-Verlag, Heidelberg, 1991.

Name	λ_c/nm	ϵ	$t_b/^\circ\text{C}$
Acetic acid	260	6.20 ²⁰	117.9
Acetone	330	21.01 ²⁰	56.0
Acetonitrile	190	36.64 ²⁰	81.6
Benzene	280	2.28 ²⁰	80.0
2-Butanol	260	17.26 ²⁰	99.5
Butyl acetate	254	5.07 ²⁰	126.1
Carbon disulfide	380	2.63 ²⁰	46
Carbon tetrachloride	265	2.24 ²⁰	76.8
1-Chlorobutane	220	7.28 ²⁰	78.6
Chloroform	245	4.81 ²⁰	61.1
Cyclohexane	210	2.02 ²⁰	80.7
1,2-Dichloroethane	226	10.42 ²⁰	83.5
Dichloromethane	235	8.93 ²⁵	40
Diethyl ether	218	4.27 ²⁰	34.5
<i>N,N</i> -Dimethylacetamide	268	38.85 ²¹	165
<i>N,N</i> -Dimethylformamide	270	38.25 ²⁰	153
Dimethyl sulfoxide	265	47.24 ²⁰	189
1,4-Dioxane	215	2.22 ²⁰	101.5
Ethanol	210	25.3 ²⁰	78.2
Ethyl acetate	255	6.08 ²⁰	77.1
Ethylene glycol dimethyl ether	240	7.30 ²⁴	85
Ethylene glycol monoethyl ether	210	13.38 ²⁵	135
Ethylene glycol monomethyl ether	210	17.2 ²⁵	124.1
Glycerol	207	46.53 ²⁰	290
Heptane	197	1.92 ²⁰	98.5
Hexadecane	200	2.05 ²⁰	286.8
Hexane	210	1.89 ²⁰	68.7
Methanol	210	33.0 ²⁰	64.6
Methylcyclohexane	210	2.02 ²⁰	100.9
Methyl ethyl ketone	330	18.56 ²⁰	79.5
Methyl isobutyl ketone	335	13.11 ²⁰	116.5
2-Methyl-1-propanol	230	17.93 ²⁰	107.8
<i>N</i> -Methyl-2-pyrrolidone	285	32.55 ²⁰	202
Nitromethane	380	37.27 ²⁰	101.1
Pentane	210	1.84 ²⁰	36.0
Pentyl acetate	212	4.79 ²⁰	149.2
1-Propanol	210	20.8 ²⁰	97.2
2-Propanol	210	20.18 ²⁰	82.3
Pyridine	330	13.26 ²⁰	115.2
Tetrachloroethylene	290	2.27 ³⁰	121.3
Tetrahydrofuran	220	7.52 ²²	65
Toluene	286	2.38 ²³	110.6
1,1,2-Trichloro-1,2,2-trifluoroethane	231	2.41 ²⁵	47.7
2,2,4-Trimethylpentane	215	1.94 ²⁰	99.2
Water	191	80.10 ²⁰	100.0
<i>o</i> -Xylene	290	2.56 ²⁰	144.5
<i>m</i> -Xylene	290	2.36 ²⁰	139.1
<i>p</i> -Xylene	290	2.27 ²⁰	138.3

¹³C CHEMICAL SHIFTS OF USEFUL NMR SOLVENTS

The following table gives the expected carbon-13 chemical shifts, relative to tetramethylsilane, for various useful NMR solvents. In some solvents, slight changes can occur with change of concentration.^{2,3}

REFERENCES

1. Bruno, T. J. and Svoronos, P. D. N., *CRC Handbook of Basic Tables for Chemical Analysis*, CRC Press, Boca Raton, FL, 1989.
2. Silverstein, R. M., Bassler, G. C., and Morrill, T. C., *Spectrometric Identification of Organic Compounds*, John Wiley & Sons, New York, 1981.
3. Rahman, A. U., *Nuclear Magnetic Resonance. Basic Principles*, Springer-Verlag, New York, 1986.
4. Pretsch, E., Clerc, T., Seibl, J., and Simon, W., *Spectral Data for Structure Determination of Organic Compounds, Second Edition*, Springer-Verlag, Heidelberg, 1989.

Solvent	Formula	Chemical shift (ppm)
Acetic acid- <i>d</i> ₄	CD ₃ COOD	20.0 (CD ₃) 205.8 (C=O)
Acetone	(CH ₃) ₂ C=O	30.7 (CH ₃) 206.7 (C=O)
Acetone- <i>d</i> ₆	(CD ₃) ₂ C=O	29.2 (CD ₃) 204.1 (C=O)
Acetonitrile- <i>d</i> ₃	CD ₃ C≡N	1.3 (CD ₃) 117.1 (C≡N)
Benzene	C ₆ H ₆	128.5
Benzene- <i>d</i> ₆	C ₆ D ₆	128.4
Carbon disulfide	CS ₂	192.3
Carbon tetrachloride	CCl ₄	96.0
Chloroform	CHCl ₃	77.2
Chloroform- <i>d</i> ₃	CDCl ₃	77.05
Cyclohexane- <i>d</i> ₁₂	C ₆ D ₁₂	27.5
Dichloromethane- <i>d</i> ₂	CD ₂ Cl ₂	53.6
Dimethylformamide- <i>d</i> ₇	(CD ₃) ₂ NCDO	31 (CD ₃) 36 (CD ₃) 162.4 (C=O)
Dimethylsulfoxide- <i>d</i> ₆	(CD ₃) ₂ S=O	39.6
Dioxane- <i>d</i> ₈	C ₄ D ₃ O ₂	67.4
Formic acid- <i>d</i> ₂	DCOOD	165.5
Methanol- <i>d</i> ₄	CD ₃ OD	49.3
Nitromethane- <i>d</i> ₃	CD ₃ NO ₂	57.3
Pyridine	C ₅ H ₅ N	123.6 (C ₃) 135.7 (C ₄) 149.8 (C ₂)
Pyridine- <i>d</i> ₅	C ₅ D ₅ N	123.9 (C ₃) 135.9 (C ₄) 150.2 (C ₂)
1,1,2,2-Tetrachloroethane- <i>d</i> ₂	CDCl ₂ CDCl ₂	75.5
Tetrahydrofuran- <i>d</i> ₈	C ₄ D ₈ O	25.8 (C ₂) 67.9 (C ₁)
Trichlorofluoromethane	CFCl ₃	117.6

MASS SPECTRAL PEAKS OF COMMON ORGANIC SOLVENTS

The strongest peaks in the mass spectra of 200 important solvents are listed in this table. The m/z value for each peak is followed by the relative intensity in parentheses, with the strongest peak assigned an intensity of 100. The peaks for each compound are listed in order of decreasing intensity. Solvents are listed in alphabetical order by common name.

Data on the physical properties of the same compounds may be found in Section 15 in the table "Properties of Common Laboratory Solvents".

REFERENCES

1. NIST/EPA/NIH Mass Spectral Database, National Institute of Standards and Technology, Gaithersburg, MD, 20899.
2. Lide, D.R., and Milne, G.W.A., Editors, *Handbook of Data on Organic Compounds, Third Edition*, CRC Press, Boca Raton, FL, 1994. (Also available as a CD ROM database.)

MASS SPECTRAL PEAKS OF COMMON ORGANIC SOLVENTS (continued)

Compound	<i>m/e</i> (intensity)									
Acetal (1,1-Diethoxyethane)	44(100)	43(92)	29(77)	31(76)	45(74)	27(52)	72(48)	73(23)	28(17)	46(15)
Acetic acid	43(100)	45(87)	60(57)	15(42)	42(14)	29(13)	14(13)	28(7)	18(6)	16(6)
Acetone	43(100)	15(34)	58(23)	27(9)	14(9)	42(8)	26(7)	29(5)	28(5)	39(4)
Acetonitrile	41(100)	40(46)	39(13)	14(9)	38(6)	28(4)	26(4)	25(3)	42(2)	27(2)
Acetylacetone	43(100)	85(31)	100(20)	27(12)	42(10)	29(10)	41(7)	39(7)	31(5)	26(5)
Acrylonitrile	53(100)	26(85)	52(79)	51(34)	27(13)	50(8)	25(7)	38(5)	54(3)	37(3)
Adiponitrile	41(100)	68(50)	54(42)	40(21)	55(20)	27(17)	39(16)	28(13)	52(7)	42(6)
Allyl alcohol	57(100)	31(34)	29(32)	28(31)	58(25)	39(22)	27(20)	30(16)	32(14)	26(11)
Allylamine	30(100)	56(80)	28(76)	57(33)	39(21)	29(20)	27(18)	26(13)	41(8)	18(8)
2-Aminoisobutanol	58(100)	41(18)	18(17)	42(13)	28(11)	56(10)	30(10)	29(8)	43(6)	59(5)
Benzal chloride	125(100)	127(32)	160(14)	89(13)	162(9)	63(9)	126(8)	62(7)	105(5)	39(5)
Benzaldehyde	51(100)	77(81)	50(55)	106(44)	105(43)	52(26)	78(16)	39(13)	27(10)	74(8)
Benzene	78(100)	77(20)	52(19)	51(17)	50(15)	39(12)	79(6)	76(5)	74(4)	38(4)
Benzonitrile	103(100)	76(34)	50(13)	104(9)	75(7)	51(7)	77(5)	52(4)	39(4)	74(3)
Benzyl chloride	91(100)	126(20)	65(14)	92(9)	39(9)	63(8)	128(6)	45(6)	89(5)	125(3)
Bromochloromethane	49(100)	130(67)	128(52)	51(31)	93(23)	81(20)	79(20)	95(17)	132(16)	47(8)
Bromoform (Tribromomethane)	173(100)	171(50)	175(49)	93(22)	91(22)	79(18)	81(17)	94(13)	92(13)	254(11)
Butyl acetate	43(100)	56(34)	41(17)	27(16)	29(15)	73(11)	61(10)	28(7)	55(6)	39(6)
Butyl alcohol	31(100)	56(81)	41(62)	43(60)	27(50)	42(31)	29(31)	28(17)	39(16)	55(12)
<i>sec</i> -Butyl alcohol	45(100)	31(22)	27(22)	59(20)	29(18)	43(13)	41(12)	44(8)	18(8)	28(5)
<i>tert</i> -Butyl alcohol	59(100)	31(33)	41(22)	43(18)	29(13)	27(11)	57(10)	42(4)	60(3)	28(3)
Butylamine	30(100)	73(10)	28(5)	41(3)	27(3)	44(2)	42(2)	31(2)	29(2)	29(2)
<i>tert</i> -Butylamine	58(100)	41(21)	42(15)	18(9)	30(8)	15(8)	39(7)	57(6)	28(6)	59(4)
Butyl methyl ketone	43(100)	58(60)	57(17)	100(16)	29(15)	41(13)	85(8)	27(8)	71(7)	59(5)
<i>p-tert</i> -Butyltoluene	133(100)	105(38)	41(23)	148(18)	93(16)	91(14)	115(13)	134(11)	39(11)	116(10)
γ -Butyrolactone	28(100)	42(74)	29(48)	27(33)	41(27)	56(25)	86(24)	26(18)	85(10)	39(10)
Caprolactam	55(100)	113(87)	30(81)	56(66)	84(60)	85(57)	42(51)	41(33)	28(26)	43(17)
Carbon disulfide	76(100)	32(22)	44(17)	78(9)	38(6)	28(5)	77(3)	64(1)	46(1)	39(1)
Carbon tetrachloride	117(100)	119(98)	121(31)	82(24)	47(23)	84(16)	35(14)	49(8)	28(8)	36(6)
1-Chloro-1,1-difluoroethane	65(100)	45(31)	85(14)	31(10)	64(8)	44(7)	35(6)	26(6)	87(5)	81(4)
Chlorobenzene	112(100)	77(63)	114(33)	51(29)	50(14)	75(8)	113(7)	78(5)	76(5)	28(4)
Chloroform	83(100)	85(64)	47(35)	35(19)	48(16)	49(12)	87(10)	37(6)	50(5)	84(4)
Chloropentafluoroethane	85(100)	69(61)	31(38)	87(32)	50(17)	35(8)	119(6)	66(4)	100(3)	47(3)
Cumene (Isopropylbenzene)	105(100)	120(25)	77(13)	51(12)	79(10)	106(9)	39(9)	27(8)	103(6)	91(5)
Cyclohexane	56(100)	84(71)	41(70)	27(37)	55(36)	39(35)	42(30)	69(23)	28(18)	43(14)
Cyclohexanol	57(100)	44(68)	41(68)	39(51)	32(40)	43(38)	31(32)	42(22)	67(18)	82(16)
Cyclohexanone	55(100)	42(85)	41(34)	27(33)	98(31)	39(27)	69(26)	70(20)	43(14)	28(14)
Cyclohexylamine	56(100)	43(23)	28(17)	99(10)	70(8)	57(6)	30(6)	93(5)	54(4)	41(4)
Cyclopentane	42(100)	70(30)	55(29)	41(29)	39(22)	27(15)	40(7)	29(5)	28(4)	43(3)
Cyclopentanone	55(100)	28(50)	84(42)	41(38)	56(29)	27(24)	39(19)	42(15)	26(9)	29(7)
<i>p</i> -Cymene (1-Methyl-4-isopropylbenzene)	119(100)	91(42)	134(33)	39(27)	41(20)	117(18)	65(18)	77(17)	27(16)	120(15)
<i>cis</i> -Decalin	67(100)	81(87)	41(81)	138(67)	96(62)	82(62)	39(50)	55(45)	27(44)	95(42)
<i>trans</i> -Decalin	41(100)	68(91)	67(88)	82(67)	27(65)	96(61)	95(55)	138(51)	81(51)	29(51)

MASS SPECTRAL PEAKS OF COMMON ORGANIC SOLVENTS (continued)

Compound	<i>m/e</i> (intensity)									
Diacetone alcohol	43(100)	59(41)	58(17)	101(10)	41(9)	31(9)	83(6)	56(6)	55(6)	29(6)
1,2-Dibromoethane	27(100)	107(77)	109(72)	26(24)	28(10)	81(5)	79(5)	25(5)	95(4)	93(4)
Dibromofluoromethane	111(100)	113(98)	192(29)	43(16)	41(16)	190(15)	194(14)	81(9)	79(9)	122(7)
Dibromomethane	174(100)	93(96)	95(84)	172(53)	176(50)	91(11)	81(9)	79(9)	94(5)	65(5)
1,2-Dibromotetrafluoroethane	179(100)	181(97)	129(34)	131(33)	100(17)	31(13)	260(12)	50(8)	69(7)	262(6)
Dibutylamine	86(100)	72(52)	30(48)	44(40)	29(31)	57(24)	41(21)	73(15)	28(15)	43(13)
<i>o</i> -Dichlorobenzene	146(100)	148(64)	111(38)	75(23)	113(12)	74(12)	50(11)	150(10)	73(9)	147(7)
1,1-Dichloroethane (Ethylidene dichloride)	63(100)	27(71)	65(31)	26(19)	83(11)	85(7)	61(7)	35(6)	98(5)	62(5)
1,2-Dichloroethane (Ethylene dichloride)	62(100)	27(91)	49(40)	64(32)	26(31)	63(19)	98(14)	51(13)	61(12)	100(9)
1,1-Dichloroethylene	61(100)	96(61)	98(38)	63(32)	26(16)	60(15)	62(7)	25(7)	100(6)	35(6)
<i>cis</i> -1,2-Dichloroethylene	61(100)	96(73)	98(47)	63(32)	26(30)	60(21)	25(13)	35(12)	62(9)	100(8)
<i>trans</i> -1,2-Dichloroethylene	61(100)	96(67)	98(43)	26(34)	63(32)	60(24)	25(15)	62(10)	100(7)	47(7)
Dichloroethyl ether	93(100)	63(74)	27(38)	95(32)	65(24)	31(9)	49(4)	28(4)	94(3)	62(3)
Dichloromethane (Methylene chloride)	49(100)	84(64)	86(39)	51(31)	47(14)	48(8)	88(6)	50(3)	85(2)	83(2)
1,2-Dichloropropane	63(100)	62(71)	27(57)	41(49)	39(32)	65(31)	76(27)	64(25)	49(13)	77(12)
1,2-Dichlorotetrafluoroethane	85(100)	135(52)	87(33)	137(17)	101(9)	31(9)	103(6)	100(6)	50(5)	69(4)
Diethanolamine	30(100)	74(82)	28(77)	56(69)	18(50)	42(46)	29(36)	27(34)	45(30)	43(19)
Diethylamine	30(100)	58(81)	44(28)	73(18)	29(18)	28(17)	72(12)	42(11)	27(11)	59(4)
Diethyl carbonate	29(100)	45(70)	31(53)	27(39)	91(24)	28(15)	63(11)	26(10)	30(6)	43(5)
Diethylene glycol	45(100)	75(23)	31(20)	44(16)	27(14)	76(12)	29(12)	43(11)	42(9)	41(4)
Diethylene glycol dimethyl ether (Diglyme)	59(100)	58(43)	31(34)	29(32)	45(28)	28(19)	89(15)	43(9)	27(5)	60(4)
Diethylene glycol monoethyl ether (Carbitol)	45(100)	59(56)	72(37)	73(22)	60(14)	31(13)	75(11)	44(9)	104(8)	103(7)
Diethylene glycol monoethyl ether acetate	43(100)	29(51)	31(42)	45(40)	59(24)	72(18)	44(10)	73(9)	42(9)	30(6)
Diethylene glycol monomethyl ether	45(100)	31(42)	59(41)	29(38)	28(32)	58(21)	43(14)	27(13)	44(11)	32(10)
Diethylenetriamine	44(100)	73(59)	30(35)	19(18)	56(16)	28(16)	27(16)	42(11)	99(8)	43(8)
Diethyl ether	31(100)	29(63)	59(40)	27(35)	45(33)	74(23)	15(17)	43(9)	28(9)	26(9)
Diisobutyl ketone (Isovalerone)	57(100)	85(82)	41(46)	43(39)	58(33)	28(30)	26(30)	39(22)	42(12)	142(11)
Diisopropyl ether	45(100)	43(39)	87(15)	41(12)	59(10)	27(8)	39(4)	69(3)	42(3)	31(3)
<i>N,N</i> -Dimethylacetamide	44(100)	87(69)	43(46)	45(23)	42(19)	72(15)	15(11)	30(8)	28(5)	88(4)
Dimethylamine	44(100)	45(81)	18(32)	28(30)	43(19)	42(15)	15(9)	46(5)	41(5)	27(5)
Dimethyl disulfide	94(100)	45(63)	79(59)	46(38)	47(26)	15(18)	48(14)	61(12)	64(11)	96(9)
<i>N,N</i> -Dimethylformamide	73(100)	44(86)	42(36)	30(22)	28(20)	29(8)	43(7)	72(6)	58(5)	74(4)
Dimethyl sulfoxide	63(100)	78(70)	15(40)	45(35)	29(16)	61(13)	46(12)	31(11)	48(10)	47(10)
1,4-Dioxane	28(100)	29(37)	88(31)	58(24)	31(17)	15(17)	27(15)	30(13)	43(11)	26(9)
1,3-Dioxolane	73(100)	29(56)	44(53)	45(28)	28(21)	43(20)	27(13)	31(7)	74(5)	42(3)
Dipentene	68(100)	93(50)	67(44)	94(22)	39(22)	107(18)	92(18)	53(18)	136(16)	79(16)
Epichlorohydrin	57(100)	27(39)	29(32)	49(25)	31(22)	62(18)	28(16)	92(1)		

MASS SPECTRAL PEAKS OF COMMON ORGANIC SOLVENTS (continued)

Compound	<i>m/e</i> (intensity)									
Ethanolamine (Glycinol)	30(100)	18(30)	28(15)	42(7)	31(6)	17(6)	61(5)	15(5)	43(3)	29(3)
Ethyl acetate	43(100)	29(46)	27(33)	45(32)	61(28)	28(25)	42(18)	73(11)	88(10)	70(10)
Ethyl acetoacetate	43(100)	29(24)	88(18)	28(16)	85(14)	27(12)	42(11)	60(9)	130(6)	45(6)
Ethyl alcohol	31(100)	45(44)	46(18)	27(18)	29(15)	43(14)	30(6)	42(3)	19(3)	14(3)
Ethylamine	30(100)	28(32)	44(20)	45(19)	27(13)	15(10)	42(9)	29(8)	41(5)	40(5)
Ethylbenzene	91(100)	106(31)	51(14)	39(10)	77(8)	65(8)	105(7)	92(7)	78(7)	27(6)
Ethyl bromide (Bromoethane)	108(100)	110(97)	29(62)	27(51)	28(35)	26(14)	93(6)	32(6)	95(5)	81(5)
Ethyl chloride (Chloroethane)	64(100)	28(91)	29(84)	27(75)	66(32)	26(28)	49(25)	51(8)	63(6)	65(4)
Ethylene carbonate	29(100)	44(62)	43(54)	88(40)	30(16)	28(11)	45(7)	58(6)	42(6)	73(4)
Ethylenediamine (1,2-Ethane- diamine)	30(100)	18(13)	42(6)	43(5)	27(5)	44(4)	29(4)	17(4)	15(4)	41(3)
Ethylene glycol	31(100)	33(35)	29(13)	32(11)	43(6)	27(5)	28(4)	62(3)	30(3)	44(2)
Ethylene glycol diethyl ether	31(100)	59(71)	29(58)	45(43)	27(33)	74(27)	43(15)	15(14)	28(12)	44(10)
Ethylene glycol dimethyl ether	45(100)	60(13)	29(13)	90(7)	58(6)	31(5)	28(5)	43(4)	59(3)	46(2)
Ethylene glycol monobutyl ether	57(100)	45(38)	29(35)	41(31)	87(16)	27(12)	56(11)	31(9)	75(7)	28(7)
Ethylene glycol monoethyl ether (Cellosolve)	31(100)	29(52)	59(50)	27(27)	45(26)	72(14)	43(14)	15(14)	28(8)	26(6)
Ethylene glycol monoethyl ether acetate	43(100)	31(34)	59(31)	72(28)	44(25)	29(24)	45(12)	27(11)	15(11)	87(7)
8-126 Ethylene glycol monomethyl ether	45(100)	31(15)	29(14)	28(11)	47(9)	76(6)	43(6)	58(4)	46(4)	27(4)
Ethylene glycol monomethyl ether acetate	43(100)	45(48)	58(42)	29(10)	42(4)	31(4)	73(3)	27(3)	59(2)	26(2)
Ethyl formate	31(100)	28(73)	27(51)	29(38)	45(34)	26(17)	74(11)	43(9)	47(8)	56(4)
Furan	68(100)	39(64)	40(9)	38(9)	42(6)	29(6)	37(5)	69(4)	34(2)	67(1)
Furfural	39(100)	96(55)	95(52)	38(38)	29(35)	37(29)	40(11)	97(9)	50(7)	42(7)
Furfuryl alcohol	98(100)	41(65)	39(59)	81(55)	53(53)	97(51)	42(49)	69(39)	70(36)	29(28)
Glycerol	61(100)	43(90)	31(57)	44(54)	29(38)	18(32)	27(12)	42(11)	60(10)	45(10)
Heptane	43(100)	41(56)	29(49)	57(47)	27(46)	71(45)	56(27)	42(26)	39(23)	70(18)
1-Heptanol	41(100)	70(87)	56(86)	31(78)	43(72)	29(70)	55(67)	27(65)	42(54)	69(41)
Hexane	57(100)	43(78)	41(77)	29(61)	27(57)	56(45)	42(39)	39(27)	28(16)	86(14)
1-Hexanol (Caproyl alcohol)	56(100)	43(78)	31(74)	41(71)	27(64)	29(59)	55(58)	42(53)	39(37)	69(27)
Hexylene glycol	59(100)	43(61)	56(25)	45(17)	41(16)	57(13)	42(13)	85(11)	61(10)	31(10)
Hexyl methyl ketone	43(100)	58(79)	41(56)	59(52)	71(49)	27(46)	29(36)	39(27)	57(18)	55(17)
Isobutyl acetate	43(100)	56(26)	73(15)	41(10)	29(5)	71(3)	57(3)	39(3)	27(3)	86(2)
Isobutyl alcohol	43(100)	33(73)	31(72)	41(66)	42(60)	27(43)	29(18)	39(17)	28(8)	74(6)
Isobutylamine	30(100)	28(9)	41(6)	73(5)	27(5)	39(4)	29(3)	15(3)	58(2)	56(2)
Isopentyl acetate	43(100)	70(49)	55(38)	61(15)	42(15)	41(14)	27(12)	87(11)	29(10)	73(9)
Isophorone	82(100)	39(20)	138(17)	54(13)	27(12)	41(10)	53(8)	83(7)	29(7)	55(6)
Isopropyl acetate	43(100)	61(17)	41(14)	87(9)	59(8)	27(8)	42(7)	39(4)	45(3)	44(2)
Isopropyl alcohol	45(100)	43(19)	27(17)	29(12)	41(7)	31(6)	19(6)	42(5)	44(4)	59(3)
Isoquinoline	129(100)	102(26)	51(20)	128(18)	50(11)	130(10)	75(10)	76(9)	103(8)	74(7)
<i>d</i> -Limonene (Citrene)	68(100)	93(50)	67(49)	41(22)	94(21)	79(21)	39(21)	136(20)	53(19)	121(16)
2,6-Lutidine (2,6-Dimethyl- pyridine)	107(100)	39(39)	106(29)	66(22)	92(18)	65(18)	38(12)	27(11)	79(9)	63(9)

MASS SPECTRAL PEAKS OF COMMON ORGANIC SOLVENTS (continued)

Compound	<i>m/z</i> (intensity)									
Mesitylene (1,3,5-Trimethylbenzene)	105(100)	120(64)	119(15)	77(13)	39(11)	106(9)	91(9)	51(8)	27(7)	121(6)
Mesityl oxide	55(100)	83(89)	43(73)	29(42)	98(36)	39(32)	27(28)	53(11)	41(10)	56(5)
Methyl acetate	43(100)	74(52)	28(38)	42(19)	59(17)	44(8)	32(8)	29(6)	31(4)	75(2)
Methylal (Dimethoxymethane)	45(100)	75(61)	29(59)	31(13)	30(6)	15(6)	47(5)	76(2)	46(2)	44(2)
Methyl alcohol	31(100)	29(72)	32(67)	15(42)	28(12)	14(10)	30(9)	13(6)	12(3)	16(2)
Methylamine	30(100)	31(87)	28(56)	29(19)	32(15)	15(12)	27(9)			
Methyl benzoate	105(100)	77(81)	51(45)	136(24)	50(18)	106(8)	78(6)	28(6)	39(5)	27(5)
Methylcyclohexane	83(100)	55(82)	41(60)	98(44)	42(35)	56(30)	27(29)	39(27)	69(23)	70(22)
Methyl ethyl ketone	43(100)	72(24)	29(19)	27(12)	57(7)	42(5)	26(4)	28(3)	44(2)	39(2)
<i>N</i> -Methylformamide	59(100)	30(54)	28(34)	29(13)	58(8)	15(7)	60(3)	41(3)	27(3)	31(2)
Methyl formate	31(100)	29(63)	32(34)	60(28)	30(7)	28(7)	44(2)	18(2)	61(1)	59(1)
Methyl iodide (Iodomethane)	142(100)	127(38)	141(14)	15(13)	139(5)	140(4)	128(3)	14(1)	13(1)	71(0)
Methyl isobutyl ketone	43(100)	58(84)	29(65)	41(56)	57(44)	27(42)	39(31)	85(19)	100(14)	42(14)
Methyl isopentyl ketone	43(100)	58(34)	27(14)	41(13)	15(13)	57(11)	39(9)	71(8)	59(8)	29(8)
2-Methylpentane	43(100)	42(53)	41(35)	27(31)	71(29)	39(20)	29(18)	57(11)	15(10)	70(7)
4-Methyl-2-pentanol	45(100)	43(47)	69(30)	41(27)	27(19)	39(13)	29(12)	87(11)	84(10)	57(10)
Methyl pentyl ketone	43(100)	58(60)	71(14)	41(11)	27(11)	59(9)	39(8)	29(8)	42(5)	114(4)
Methyl propyl ketone	43(100)	41(17)	86(12)	42(12)	27(11)	39(8)	71(7)	58(7)	45(7)	44(3)
<i>N</i> -Methyl-2-pyrrolidone	99(100)	44(89)	98(80)	42(60)	41(38)	43(17)	28(17)	71(13)	39(11)	70(10)
Morpholine	57(100)	29(100)	87(69)	28(69)	30(38)	56(33)	86(28)	31(28)	27(12)	15(7)
Nitrobenzene	77(100)	51(59)	123(42)	50(25)	30(15)	65(14)	39(10)	93(9)	74(7)	78(6)
Nitroethane	29(100)	30(12)	28(11)	26(9)	27(8)	43(5)	41(5)	14(5)	15(3)	46(2)
Nitromethane	30(100)	61(64)	46(39)	28(30)	45(8)	27(8)	44(7)	29(7)	60(5)	43(4)
1-Nitropropane	43(100)	27(93)	41(90)	39(34)	30(25)	44(20)	42(20)	26(20)	28(13)	54(12)
2-Nitropropane	43(100)	41(73)	27(71)	39(30)	30(18)	15(11)	42(9)	28(8)	26(8)	38(6)
Octane	43(100)	57(30)	85(25)	41(25)	71(19)	29(17)	56(14)	70(10)	42(10)	27(10)
1-Octanol	41(100)	56(85)	43(82)	55(81)	31(69)	27(69)	29(68)	42(62)	70(53)	69(48)
Pentachloroethane	167(100)	165(91)	117(90)	119(89)	83(58)	169(54)	130(43)	132(42)	60(40)	85(37)
Pentamethylene glycol (1,5-Pentanediol)	31(100)	56(85)	41(67)	57(59)	55(51)	44(45)	29(37)	43(31)	68(29)	27(26)
Pentane	43(100)	42(55)	41(45)	27(42)	29(26)	39(19)	57(13)	28(9)	15(9)	72(8)
1-Pentanol (Amyl alcohol)	42(100)	70(72)	55(65)	41(56)	31(47)	29(41)	27(26)	57(22)	28(22)	43(21)
Pentyl acetate (Amyl acetate)	43(100)	70(90)	42(52)	28(51)	61(50)	55(41)	73(21)	41(20)	29(14)	69(11)
2-Picoline (2-Methylpyridine)	93(100)	66(41)	39(31)	92(20)	78(19)	51(19)	65(16)	38(13)	50(12)	52(11)
α -Pinene	93(100)	92(30)	39(24)	41(23)	77(22)	91(21)	27(21)	79(18)	121(13)	53(10)
β -Pinene	93(100)	41(64)	69(47)	39(33)	27(31)	79(20)	77(18)	53(14)	94(13)	91(13)
Piperidine (Hexahydropyridine)	84(100)	85(53)	56(46)	57(43)	28(41)	29(37)	44(34)	42(30)	30(30)	43(25)
Propanenitrile	28(100)	54(63)	26(20)	27(17)	52(11)	55(10)	51(9)	15(9)	53(7)	25(7)
Propyl acetate	43(100)	61(19)	31(18)	27(15)	42(11)	59(9)	41(9)	29(9)	59(5)	39(5)
Propyl alcohol	31(100)	27(19)	29(18)	59(11)	42(9)	60(7)	41(7)	28(7)	43(3)	32(3)
Propylamine	30(100)	28(13)	59(8)	27(7)	41(5)	42(3)	39(3)	29(3)	26(3)	18(3)
Propylbenzene	91(100)	120(21)	92(10)	38(10)	65(9)	78(6)	51(6)	27(5)	63(4)	105(3)
1,2-Propylene glycol	45(100)	18(46)	29(21)	43(19)	31(18)	27(17)	28(11)	19(8)	44(6)	61(5)

MASS SPECTRAL PEAKS OF COMMON ORGANIC SOLVENTS (continued)

Compound	<i>m/e</i> (intensity)									
Pseudocumene (1,2,4-Trimethylbenzene)	105(100)	120(56)	119(17)	77(15)	39(15)	51(11)	91(10)	27(10)	106(9)	79(7)
Pyridine	79(100)	52(62)	51(31)	50(19)	78(11)	53(7)	39(7)	80(6)	27(3)	77(2)
Pyrrole	67(100)	41(58)	39(58)	40(51)	28(42)	38(20)	37(12)	66(7)	68(5)	27(3)
Pyrrolidine	43(100)	28(52)	70(33)	71(26)	42(22)	41(20)	27(16)	39(15)	29(10)	30(9)
2-Pyrrolidone	85(100)	42(43)	41(36)	28(33)	30(29)	56(16)	84(14)	40(12)	27(12)	29(9)
Quinoline	129(100)	51(28)	76(25)	128(24)	44(24)	50(20)	32(19)	75(18)	74(12)	103(11)
Styrene	104(100)	103(41)	78(32)	51(28)	77(23)	105(12)	50(12)	52(11)	39(11)	102(10)
Sulfolane	41(100)	28(94)	56(82)	55(72)	120(37)	27(32)	39(19)	29(17)	26(11)	48(5)
α -Terpinene	121(100)	93(85)	136(43)	91(40)	77(34)	39(33)	27(33)	79(27)	41(26)	43(18)
1,1,1,2-Tetrachloro-2,2-difluoroethane	167(100)	169(96)	117(85)	119(82)	171(31)	85(29)	121(26)	82(14)	47(14)	101(13)
Tetrachloro-1,2-difluoroethane	101(100)	103(64)	167(54)	169(52)	117(19)	119(18)	171(17)	105(11)	31(11)	132(9)
1,1,1,2-Tetrachloroethane	131(100)	133(96)	117(76)	119(73)	95(34)	135(31)	121(23)	97(23)	61(19)	60(18)
1,1,2,2-Tetrachloroethane	83(100)	85(63)	95(11)	87(10)	168(8)	133(8)	131(8)	96(8)	61(8)	60(8)
Tetrachloroethylene	166(100)	164(82)	131(71)	129(71)	168(45)	94(38)	47(31)	96(24)	133(20)	59(17)
Tetraethylene glycol	45(100)	89(10)	44(8)	43(6)	31(6)	29(6)	27(6)	101(5)	75(5)	28(5)
Tetrahydrofuran	42(100)	41(52)	27(33)	72(29)	71(27)	39(24)	43(22)	29(22)	40(13)	15(10)
1,2,3,4-Tetrahydronaphthalene	104(100)	132(53)	91(43)	51(17)	39(17)	131(15)	117(15)	115(14)	78(13)	77(13)
Tetrahydropyran	41(100)	28(64)	56(57)	45(57)	29(51)	27(49)	85(47)	86(42)	39(28)	55(23)
Tetramethylsilane	73(100)	43(14)	45(12)	74(8)	29(7)	15(5)	75(4)	44(4)	42(4)	31(4)
Toluene	91(100)	92(73)	39(20)	65(14)	63(11)	51(11)	50(7)	27(6)	93(5)	90(5)
<i>o</i> -Toluidine	106(100)	107(83)	77(17)	79(13)	39(12)	53(10)	52(10)	54(9)	51(9)	28(9)
Triacetin	43(100)	103(44)	145(34)	116(17)	115(13)	44(10)	86(9)	28(8)	73(7)	42(7)
Tributylamine	142(100)	100(19)	143(11)	29(8)	185(7)	57(6)	44(6)	41(6)	30(5)	86(4)
1,1,1-Trichloroethane	97(100)	99(64)	61(58)	26(31)	27(24)	117(19)	63(19)	119(18)	35(17)	62(11)
1,1,2-Trichloroethane	97(100)	83(95)	99(62)	85(60)	61(58)	26(23)	96(21)	63(19)	27(17)	98(15)
Trichloroethylene	95(100)	130(90)	132(85)	60(65)	97(64)	35(40)	134(27)	47(26)	62(21)	59(13)
Trichlorofluoromethane	101(100)	103(66)	66(13)	105(11)	35(11)	47(9)	31(8)	82(4)	68(4)	37(4)
1,1,2-Trichlorotrifluoroethane	101(100)	151(68)	103(64)	85(45)	31(45)	153(44)	35(20)	66(19)	47(18)	87(14)
Triethanolamine	118(100)	56(69)	45(60)	42(56)	44(27)	43(25)	41(14)	116(8)	57(8)	86(7)
Triethylamine	86(100)	30(68)	58(37)	28(24)	29(23)	27(19)	44(18)	101(17)	42(16)	56(8)
Triethylene glycol	45(100)	58(11)	89(9)	31(8)	29(8)	75(7)	44(7)	43(7)	27(7)	28(5)
Triethyl phosphate	99(100)	81(71)	155(56)	82(45)	45(45)	109(44)	127(41)	43(24)	125(16)	111(14)
Trimethylamine	58(100)	59(47)	30(29)	42(26)	44(17)	15(14)	28(10)	18(10)	43(8)	57(7)
Trimethylene glycol (1,3-Propanediol)	28(100)	58(93)	31(76)	57(70)	29(40)	27(26)	45(24)	43(23)	19(18)	30(17)
Trimethyl phosphate	110(100)	109(35)	79(34)	95(25)	80(23)	15(20)	140(18)	47(10)	31(7)	139(5)
Veratrole	138(100)	95(65)	77(48)	123(44)	52(42)	41(33)	65(30)	51(29)	39(19)	63(17)
<i>o</i> -Xylene	91(100)	106(40)	39(21)	105(17)	51(17)	77(15)	27(12)	65(10)	92(8)	79(8)
<i>m</i> -Xylene	91(100)	106(65)	105(29)	39(18)	51(15)	77(14)	27(10)	92(8)	79(8)	78(8)
<i>p</i> -Xylene	91(100)	106(62)	105(30)	51(16)	39(16)	77(13)	27(11)	92(7)	78(7)	65(7)

SOLUBILITY OF COMMON SALTS AT AMBIENT TEMPERATURES

This table gives the aqueous solubility of selected salts at temperatures from 10°C to 40°C. Values are given in molality terms.

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2. Apelblat, A., *J. Chem. Thermodynamics*, 25, 63, 1993.
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Salt	10°C	15°C	20°C	25°C	30°C	35°C	40°C	Ref.
BaCl ₂	1.603	1.659	1.716	1.774	1.834	1.895	1.958	1
Ca(NO ₃) ₂	6.896	7.398	7.986	8.675	9.480	10.421		1
CuSO ₄	1.055	1.153	1.260	1.376	1.502	1.639		3
FeSO ₄	1.352	1.533	1.729	1.940	2.165	2.405		3
KBr	5.002	5.237	5.471	5.703	5.932	6.157		3
KIO ₃	0.291	0.333	0.378	0.426	0.478	0.534	0.593	4
K ₂ CO ₃	7.756	7.846	7.948	8.063	8.191	8.331	8.483	1
LiCl	19.296	19.456	19.670	19.935				2
Mg(NO ₃) ₂	4.403	4.523	4.656	4.800	4.958	5.130	5.314	1
MnCl ₂	5.421	5.644	5.884	6.143	6.422	6.721		3
NH ₄ Cl	6.199	6.566	6.943	7.331				2
NH ₄ NO ₃	18.809	21.163	23.721	26.496				2
(NH ₄) ₂ SO ₄	5.494	5.589	5.688	5.790	5.896	6.005		3
NaBr	8.258	8.546	8.856	9.191	9.550	9.937	10.351	4
NaCl	6.110	6.121	6.136	6.153	6.174	6.197	6.222	4
NaNO ₂	11.111	11.484	11.883	12.310	12.766	13.253	13.772	4
NaNO ₃	9.395	9.819	10.261	10.723	11.204	11.706	12.230	4
RbCl	6.911	7.180	7.449	7.717	7.986	8.253	8.520	4
ZnSO ₄	2.911	3.116	3.336	3.573	3.827	4.099	4.194	1

FLAME AND BEAD TESTS

Flame Colorations

Violet

Potassium compounds. Purple red through blue glass. Easily obscured by sodium flame. Bluish-green through green glass. Rubidium and cesium compounds impart same flame as potassium compounds.

Blues

Azure — Copper chloride. Copper bromide gives azure blue followed by green. Other copper compounds give same coloration when moistened with hydrochloric acid.

Light blue — Lead, arsenic, selenium.

Greens

Emerald — Copper compounds except the halides, and when not moistened with hydrochloric acid.

Pure green — Compounds of thallium and tellurium.

Yellowish — Barium compounds. Some molybdenum compounds. Borates, especially when treated with sulfuric acid or when burned with alcohol.

Bluish — Phosphates with sulfuric acid.

Feeble — Antimony compounds. Ammonium compounds.

Whitish — Zinc.

Reds

Carmine — Lithium compounds. Violet through blue glass. Invisible through green glass. Masked by barium flame.

Scarlet — Strontium compounds. Violet through blue glass. Yellowish through green glass. Masked by barium flame.

Yellowish — Calcium compounds. Greenish through blue glass. Green through green glass. Masked by barium flame.

Yellow

Yellow — All sodium compounds. Invisible with blue glass.

Bead Tests

Abbreviations employed: s = saturated; ss = supersaturated; ns = not saturated; h = hot; c = cold

Borax Beads

Substance	Oxidizing flame	Reducing flame
Aluminum	Colorless (h, c, ns); opaque (ss)	Colorless; opaque (s)
Antimony	Colorless; yellow or brownish (h, ss)	Gray and opaque
Barium	Colorless (ns)	
Bismuth	Colorless; yellow or brownish (h, ss)	Gray and opaque
Cadmium	Colorless	Gray and opaque
Calcium	Colorless (ns)	
Cerium	Red (h)	Colorless (h, c)
Chromium	Green (c)	Green
Cobalt	Blue (h, c)	Blue (h, c)
Copper	Green (h); blue (c)	Red (c); opaque (ss); colorless (h)
Iron	Yellow or brownish red (h, ns)	Green (ss)
Lead	Colorless; yellow or brownish (h, ss)	Gray and opaque
Magnesium	Colorless (ns)	
Manganese	Violet (h, c)	Colorless (h, c)
Molybdenum	Colorless	Yellow or brown (h)
Nickel	Brown; red (c)	Gray and opaque
Silicon	Colorless (h, c); opaque (ss)	Colorless; opaque (s)
Silver	Colorless (ns)	Gray and opaque
Strontium	Colorless (ns)	
Tin	Colorless (h, c); opaque (ss)	Colorless; opaque (s)
Titanium	Colorless	Yellow (h); violet (c)
Tungsten	Colorless	Brown
Uranium	Yellow or brownish (h, ns)	Green
Vanadium	Colorless	Green

FLAME AND BEAD TESTS (continued)

Beads of Microcosmic Salt



Substance	Oxidizing flame	Reducing flame
Aluminum	Colorless; opaque (s)	Colorless; not clear (ss)
Antimony	Colorless (ns)	Gray and opaque
Barium	Colorless; opaque (s)	Colorless; not clear (ss)
Bismuth	Colorless (ns)	Gray and opaque
Cadmium	Colorless (ns)	Gray and opaque
Calcium	Colorless; opaque (s)	Colorless; not clear (ss)
Cerium	Yellow or brownish red (h, s)	Colorless
Chromium	Red (h, s); green (c)	Green (c)
Cobalt	Blue (h, c)	Blue (h, c)
Copper	Blue (c); green (h)	Red and opaque (c)
Iron	Yellow or brown (h, s)	Colorless; yellow or brownish (h)
Lead	Colorless (ns)	Gray and opaque
Magnesium	Colorless; opaque (s)	Colorless; not clear (ss)
Manganese	Violet (h, c)	Colorless
Molybdenum	Colorless; green (h)	Green (h)
Nickel	Yellow (c); red (h, s)	Yellow (c); red (h); gray and opaque
Silver		Gray and opaque
Strontium	Colorless; opaque (s)	Colorless; not clear (ss)
Tin	Colorless; opaque (s)	Colorless
Titanium	Colorless (ns)	Violet (c); yellow or brownish (h)
Uranium	Green; yellow or brownish	Green (h) (h, s)
Vanadium	Yellow	Green
Zinc	Colorless (ns)	Gray and opaque

Sodium Carbonate Bead

Substance	Oxidizing flame	Reducing flame
Manganese	Green	Colorless

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS

The following table gives average interatomic distances for bonds between the elements H, B, C, N, O, F, Si, P, S, Cl, As, Se, Br, Te, and I as determined from X-ray and neutron diffraction measurements on organic crystals. The table has been derived from an analysis of high-precision structure data on about 10,000 crystals contained in the 1985 version of the Cambridge Structural Database, which is maintained by the Cambridge Crystallographic Data Center. The explanation of the columns is:

- Column 1: Specification of elements in the bond, with coordination number given in parentheses, and bond type (single, double, etc.). For carbon, the hybridization state is given.
- Column 2: Substructure in which the bond is found. The target bond is set in boldface. Where X is not specified, it denotes any element type. C# indicates any sp³ carbon atom, and C* denotes an sp³ carbon whose bonds, in addition to those specified in the linear formulation, are to C and H atoms only.
- Column 3: *d* is the unweighted mean in Å units of all the values for that bond length found in the sample.
- Column 4: *m* is the median in Å units of all values.
- Column 5: σ is the standard deviation in the sample.
- Column 6: *q*₁ is the lower quartile for the sample (i.e., 25% of values are less than *q*₁ and 75% exceed it).
- Column 7: *q*₂ is the upper quartile for the sample.
- Column 8: *n* is number of observations in the sample.
- Column 9: Notes refer to the footnotes in Appendix 1.

References to special cases are given in a shorthand form and listed in Appendix 2. Further information on the method of analysis of the data may be found in the reference cited below.

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Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> ₂	<i>n</i>	Note
As(3)-As(3)	X₂-As-As-X₂	2.459	2.457	0.011	2.456	2.466	8	
As-B	see CUDLOC (2.065), CUDLUI (2.041)							
As-Br	see CODDEE, CODDII (2.346—3.203)							
As(4)-C	X₃-As-CH₃	1.903	1.907	0.016	1.893	1.916	12	
	(X) ₂ (C,O,S)=As-Csp ³	1.927	1.929	0.017	1.921	1.937	16	
	As-Car in Ph ₄ As ⁺	1.905	1.909	0.012	1.897	1.912	108	
	(X) ₂ (C,O,S)=As-Car	1.922	1.927	0.016	1.908	1.934	36	
As(3)-C	X₂-As-Csp³	1.963	1.965	0.017	1.948	1.978	6	
	X ₂ -As-Car	1.956	1.956	0.015	1.944	1.964	41	
As(3)-Cl	X₂-As-Cl	2.268	2.256	0.039	2.247	2.281	10	
As(6)-F	in AsF ₆ ⁻	1.678	1.676	0.020	1.659	1.695	36	
As(3)-I	see OPIMAS (2.579, 2.590)							
As(3)-N(3)	X₂-As-N-X₂	1.858	1.858	0.029	1.839	1.873	19	
As(4)=N(2)	see TPASSN (1.837)							
As(4)-O	(X) ₂ (O)=As-OH	1.710	1.712	0.017	1.695	1.726	6	
As(3)-O	see ASAZOC, PHASOC01 (1.787—1.845)							
As(4)=O	X₃-As=O	1.661	1.661	0.016	1.652	1.667	9	
As(3)=P(3)	see BELNIP (2.350, 2.362)							†
As(3)-P(3)	see BUTHAZ10 (2.124)							†
As(3)-S	X₂-As-S	2.275	2.266	0.032	2.247	2.298	14	
As(4)=S	X₃-As=S	2.083	2.082	0.004	2.080	2.086	9	
As(3)-Se(2)	see COSDIX, ESEARS (2.355—2.401)							†
As(3)-Si(4)	see BICGEZ, MESIAD (2.351—2.365)							†
As(3)-Te(2)	see ETEARS (2.571, 2.576)							†
B(n)-B(n)	<i>n</i> = 5—7 in boron cages	1.775	1.773	0.031	1.763	1.786	688	
B(4)-B(4)	see CETTAW (2.041)							
B(4)-B(3)	see COFVOI (1.698)							
B(3)-B(3)	X₂-B-B-X₂	1.701	1.700	0.014	1.691	1.712	8	
B(6)-Br		1.967	1.971	0.014	1.954	1.979	7	†
B(4)-Br		2.017	2.008	0.031	1.990	2.044	15	†
B(n)-C	<i>n</i> = 5—7: B-C in cages	1.716	1.717	0.020	1.707	1.728	96	
	<i>n</i> = 3—4: B-Csp ³ not cages	1.597	1.599	0.022	1.585	1.611	29	1
	<i>n</i> = 4: B-Car	1.606	1.607	0.012	1.596	1.615	41	
	<i>n</i> = 4: B-Car in Ph ₄ B ⁻	1.643	1.643	0.006	1.641	1.645	16	
B(n)-C	<i>n</i> = 3: B-Car	1.556	1.552	0.015	1.546	1.566	24	
B(n)-Cl	B(5)-Cl and B(3)-Cl	1.751	1.751	0.011	1.743	1.761	14	
	B(4)-Cl	1.833	1.833	0.013	1.821	1.843	22	
B(4)-F	B-F (B neutral)	1.366	1.368	0.017	1.356	1.375	25	
	B ⁻ -F in BF ₄ ⁻	1.365	1.372	0.029	1.352	1.390	84	
B(4)-I	see TMPBTI (2.220, 2.253)							
B(4)-N(3)	X₃-B-N(-C)(X)	1.611	1.617	0.013	1.601	1.625	8	
	in pyrazaboles	1.549	1.552	0.015	1.536	1.560	10	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> _v	<i>n</i>	Note
B(3)-N(3)	X ₂ -B-N-C ₂ : all coplanar for $\tau(\text{BN}) > 30^\circ$ see BOGSUL, BUSHAY, CILRUK (1.434-1.530)	1.404	1.404	0.014	1.389	1.408	40	2
B(4)-O	S ₂ -B-N-X ₂ B ⁻ -O in BO ₄ for neutral B-O see Note 3	1.447 1.468	1.443 1.468	0.013 0.022	1.435 1.453	1.470 1.479	14 24	3
B(3)-O(2)	X ₂ -B-O-X	1.367	1.367	0.024	1.349	1.382	35	
B(<i>n</i>)-P	<i>n</i> = 4: B-P <i>n</i> = 3: see BUPSIB10 (1.892, 1.893)	1.922	1.927	0.027	1.900	1.954	10	
B(4)-S	B(4)-S(3) B(4)-S(2)	1.930 1.896	1.927 1.896	0.009 0.004	1.925 1.893	1.934 1.899	10 6	
B(3)-S	N-B-S ₂ (=X)-(N)-B-S	1.806 1.851	1.806 1.854	0.010 0.013	1.799 1.842	1.816 1.859	28 10	
Br-Br	see BEPZEB, TPASTB	2.542	2.548	0.015	2.526	2.551	4	
Br-C	Br-C* Br-Csp ³ (cyclopropane) Br-Csp ² Br-Car (mono-Br + <i>m,p</i> -Br ₂) Br-Car (<i>o</i> -Br ₂)	1.966 1.910 1.883 1.899 1.875	1.967 1.910 1.881 1.899 1.872	0.029 0.010 0.015 0.012 0.011	1.951 1.900 1.874 1.892 1.864	1.983 1.914 1.894 1.906 1.884	100 8 31 119 8	4 4 4 4 4
⁻ Br(2)-Cl	see TEACBR (2.362-2.402)							†
Br-I	see DTHIBR10 (2.646), TPHOSI (2.695)							
Br-N	see NBBZAM (1.843)							
Br-O	see CIYFOF	1.581	1.581	0.007	1.574	1.587	4	
Br-P	see CISTED (2.366)							
Br-S(2)	see BEMLIO (2.206)							†
Br-S(3)	see CIWYIQ (2.435, 2.453)							†
Br-S(3) ⁺	see THINBR (2.321)							†
Br-Se	see CIFZUM (2.508, 2.619)							
Br-Si	see BIZJAV (2.284)							
Br-Te	In Br ₆ Te ²⁻ see CUGBAH (2.692-2.716) Br-Te(4) see BETUTE10 (3.079, 3.015) Br-Te(3) see BTUPT (2.835)							
Csp ³ -Csp ³	C#-CH ₂ -CH ₃ (C#) ₂ -CH-CH ₃ (C#) ₂ -C-CH ₃ C#-CH ₂ -CH ₂ -C# (C#) ₂ -CH-CH ₂ -C# (C#) ₃ -C-CH ₂ -C# (C#) ₂ -CH-CH-(C#) ₂ (C#) ₃ -C-CH-(C#) ₂ (C#) ₃ -C-C-(C#) ₃ C*-C* (overall) in cyclopropane (any subst.) in cyclobutane (any subst.) in cyclopentane (C,H-subst.) in cyclohexane (C,H-subst.) cyclopropyl-C* (exocyclic) cyclobutyl-C* (exocyclic) cyclopentyl-C* (exocyclic) cyclohexyl-C* (exocyclic) in cyclobutene (any subst.) in cyclopentene (C,H-subst.) in cyclohexene (C,H-subst.) in oxirane (epoxide) in aziridine in oxetane in azetidene oxiranyl-C* (exocyclic) aziridinyl-C* (exocyclic)	1.513 1.524 1.534 1.524 1.531 1.538 1.542 1.556 1.588 1.530 1.510 1.554 1.543 1.535 1.518 1.529 1.540 1.539 1.573 1.541 1.541 1.466 1.480 1.541 1.548 1.509 1.512	1.514 1.526 1.534 1.524 1.531 1.539 1.542 1.556 1.580 1.530 1.509 1.553 1.543 1.535 1.518 1.529 1.541 1.538 1.574 1.539 1.541 1.466 1.481 1.541 1.543 1.507 1.512	0.014 0.015 0.011 0.014 0.012 0.010 0.011 0.011 0.025 0.015 0.026 0.021 0.018 0.016 0.019 0.016 0.017 0.016 0.017 0.015 0.021 0.019 0.018 0.018 0.018	1.507 1.518 1.527 1.516 1.524 1.533 1.536 1.549 1.566 1.521 1.497 1.540 1.532 1.525 1.505 1.519 1.527 1.549 1.566 1.532 1.549 1.458 1.465 1.527 1.536 1.497 1.496	1.523 1.534 1.541 1.532 1.538 1.544 1.549 1.562 1.610 1.539 1.523 1.567 1.554 1.545 1.531 1.539 1.549 1.586 1.549 1.554 1.474 1.496 1.557 1.558 1.519 1.526	192 226 825 2 459 1 217 330 321 215 21 5 777 888 679 1 641 2 814 366 376 956 2 682 25 208 586 249 67 16 22 333 13	5.6 7 8 7 8 9 9 9 9
Csp ³ -Csp ²	CH ₃ -C=C C#-CH ₂ -C=C (C#) ₂ -CH-C=C (C#) ₃ -C-C=C	1.503 1.502 1.510 1.522	1.504 1.502 1.510 1.522	0.011 0.013 0.014 0.016	1.497 1.494 1.501 1.511	1.509 1.510 1.518 1.533	215 483 564 193	
Csp ³ -Csp ⁴	C*-C=C (overall) C*-C=C (endocyclic) in cyclopropene in cyclobutene in cyclopentene in cyclohexene in cyclopentadiene in cyclohexa-1,3-diene C*-C=C (exocyclic): cyclopropenyl-C* cyclobutenyl-C*	1.507 1.509 1.513 1.512 1.506 1.502 1.504	1.507 1.508 1.512 1.512 1.505 1.503 1.504	0.015 0.016 0.018 0.018 0.016 0.019 0.017	1.499 1.500 1.500 1.502 1.495 1.490 1.491	1.517 1.516 1.525 1.521 1.516 1.515 1.517	1 456 20 50 208 391 18 56	5 10 8
		1.478 1.489	1.475 1.483	0.012 0.015	1.470 1.479	1.485 1.496	7 11	10 8

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> ₀	<i>n</i>	Note
	cyclopentenyl-C*	1.504	1.506	0.012	1.495	1.512	115	
	cyclohexenyl-C*	1.511	1.511	0.013	1.502	1.519	292	
	C*-CH=O in aldehydes	1.510	1.510	0.008	1.501	1.518	7	
	(C*) ₂ -C=O							
	in ketones	1.511	1.511	0.015	1.501	1.521	952	11
	in cyclobutanone	1.529	1.530	0.016	1.514	1.545	18	
	in cyclopentanone	1.514	1.514	0.016	1.505	1.523	312	
	acyclic and 6+ rings	1.509	1.509	0.016	1.499	1.519	626	
	C*-COOH in carboxylic acids	1.502	1.502	0.014	1.495	1.510	176	
	C*-COO ⁻ in carboxylate anions	1.520	1.521	0.011	1.516	1.528	57	
	C*-C(=O)(-OC*)							
	in acyclic esters	1.497	1.496	0.018	1.484	1.509	553	12
	in β -lactones	1.519	1.519	0.020	1.500	1.538	4	13
	in γ -lactones	1.512	1.512	0.015	1.501	1.521	110	12
	in δ -lactones	1.504	1.502	0.013	1.495	1.517	27	12
	cyclopropyl (C)-C=O in ketones, acids and esters	1.486	1.485	0.018	1.474	1.497	105	7
	C*-C(=O)(-NH ₂) in acyclic amides	1.514	1.512	0.016	1.506	1.526	32	14
	C*-C(=O)(-NHC*) in acyclic amides	1.506	1.505	0.012	1.498	1.515	78	14
	C*-C(=O)[-N(C*) ₂] in acyclic amides	1.505	1.505	0.011	1.496	1.517	15	14
<i>Csp</i> ³ - <i>Car</i>	CH ₃ - <i>Car</i>	1.506	1.507	0.011	1.501	1.513	454	
	C#-CH ₂ - <i>Car</i>	1.510	1.510	0.009	1.505	1.516	674	
	(C#) ₂ -CH- <i>Car</i>	1.515	1.515	0.011	1.508	1.522	363	
	(C#) ₃ -C- <i>Car</i>	1.527	1.530	0.016	1.517	1.539	308	
	C*- <i>Car</i> (overall)	1.513	1.513	0.014	1.505	1.521	1 813	
<i>Csp</i> ³ - <i>Csp</i> ¹	cyclopropyl (C)- <i>Car</i>	1.490	1.490	0.015	1.479	1.503	90	7
	C*-C=C	1.466	1.465	0.010	1.460	1.469	21	15
	C#-C=C	1.472	1.472	0.012	1.464	1.481	88	15
	C*-C=N	1.470	1.469	0.013	1.463	1.479	106	7b
<i>Csp</i> ² - <i>Csp</i> ²	cyclopropyl (C)-C \equiv N	1.444	1.447	0.010	1.436	1.451	38	7
	C=C-C=C							
	(conjugated)	1.455	1.455	0.011	1.447	1.463	30	16,18
	(unconjugated)	1.478	1.476	0.012	1.470	1.479	8	17,18
	(overall)	1.460	1.460	0.015	1.450	1.470	38	
	C=C-C=C-C=C	1.443	1.445	0.013	1.431	1.454	29	18
	C=C-C=C (endocyclic in TCNQ)	1.432	1.433	0.012	1.424	1.441	280	19
	C=C-C(=O)(-C*)							
	(conjugated)	1.464	1.462	0.018	1.453	1.476	211	16,18
	(unconjugated)	1.484	1.486	0.017	1.475	1.497	14	17,18
	(overall)	1.465	1.462	0.018	1.453	1.478	226	
	C=C-C(=O)-C=C							
	in benzoquinone (C,H-subst. only)	1.478	1.476	0.011	1.469	1.488	28	
	in benzoquinone (any subst.)	1.478	1.478	0.031	1.464	1.498	172	
	non-quinonoid	1.456	1.455	0.012	1.447	1.464	28	
	C=C-COOH	1.475	1.476	0.015	1.461	1.488	22	
	C=C-COOC*	1.488	1.489	0.014	1.478	1.497	113	
	C=C-COO ⁻	1.502	1.499	0.017	1.488	1.510	11	
	HOOC-COOH	1.538	1.537	0.007	1.535	1.541	9	
	HOOC-COO ⁻	1.549	1.552	0.009	1.546	1.553	13	
	⁻ OOC-COO ⁻	1.564	1.559	0.022	1.554	1.568	9	
	formal <i>Csp</i> ² - <i>Csp</i> ² single bond in selected non-fused heterocycles:							
	in 1 <i>H</i> -pyrrole (C3-C4)	1.412	1.410	0.016	1.401	1.427	29	
	in furan (C3-C4)	1.423	1.423	0.016	1.412	1.433	62	
	in thiophene (C3-C4)	1.424	1.425	0.015	1.415	1.433	40	
	in pyrazole (C3-C4)	1.410	1.412	0.016	1.400	1.418	20	
	in isoxazole (C3-C4)	1.425	1.425	0.016	1.413	1.438	9	
	in furazan (C3-C4)	1.428	1.427	0.007	1.422	1.435	6	
	in furoxan (C3-C4)	1.417	1.417	0.006	1.412	1.422	14	
<i>Csp</i> ² - <i>Car</i>	C=C- <i>Car</i>							
	(conjugated)	1.470	1.470	0.015	1.463	1.480	37	16,18
	(overall)	1.488	1.490	0.012	1.480	1.496	87	17,18
<i>Csp</i> ² - <i>Car</i>	cyclopropenyl (C=C)- <i>Car</i>	1.447	1.448	0.006	1.441	1.452	8	10
	<i>Car</i> -C(=O)-C*	1.488	1.489	0.016	1.478	1.500	84	
	<i>Car</i> -C(=O)- <i>Car</i>	1.480	1.481	0.017	1.468	1.494	58	
	<i>Car</i> -COOH	1.484	1.485	0.014	1.474	1.491	75	
	<i>Car</i> -C(=O)(-OC*)	1.487	1.487	0.012	1.480	1.494	218	
	<i>Car</i> -COO ⁻	1.504	1.509	0.014	1.495	1.512	26	
	<i>Car</i> -C(=O)-NH ₂	1.500	1.503	0.020	1.498	1.510	19	
	<i>Car</i> -C=N-C#							
	(conjugated)	1.476	1.478	0.014	1.466	1.486	27	16
	(unconjugated)	1.491	1.490	0.008	1.485	1.496	48	17
	(overall)	1.485	1.487	0.013	1.481	1.493	75	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> _u	<i>n</i>	Note
<i>Csp</i> ² - <i>Csp</i> ¹	in indole (C3-C3a)	1.434	1.434	0.011	1.428	1.439	40	
	C=C-C≡C	1.431	1.427	0.014	1.425	1.441	11	7b
<i>Car</i> - <i>Car</i>	C=C-C≡N in TCNQ	1.427	1.427	0.010	1.420	1.433	280	19
	in biphenyls (<i>ortho</i> subst. all H) (≥1 non-H <i>ortho</i> -subst.)	1.487 1.490	1.488 1.491	0.007 0.010	1.484 1.486	1.493 1.495	30 212	
<i>Car</i> - <i>Csp</i> ¹	<i>Car</i> -C≡C	1.434	1.436	0.006	1.430	1.437	37	
	<i>Car</i> -C≡N	1.443	1.444	0.008	1.436	1.448	31	
<i>Csp</i> ¹ - <i>Csp</i> ¹	C≡C-C=C	1.377	1.378	0.012	1.374	1.384	21	
<i>Csp</i> ² = <i>Csp</i> ²	C*-CH=CH ₂	1.299	1.300	0.027	1.280	1.311	42	
	(C*) ₂ -C=CH ₂ C*-CH=CH-C* (<i>cis</i>) (<i>trans</i>) (overall)	1.321 1.317 1.312 1.316	1.321 1.318 1.311 1.317	0.013 0.013 0.011 0.015	1.313 1.310 1.304 1.309	1.328 1.323 1.320 1.323	77 106 19 127	
	(C*) ₂ -C=CH-C* (C*) ₂ -C=C-(C*) ₂	1.326 1.331	1.328 1.330	0.011 0.009	1.319 1.326	1.334 1.334	168 89	
	(C*H) ₂ -C=C-(C*H) ₂ (overall)	1.322	1.323	0.014	1.315	1.331	493	5
	in cyclopropene (any subst.)	1.294	1.288	0.017	1.284	1.302	10	10
	in cyclobutene (any subst.)	1.335	1.335	0.019	1.324	1.347	25	8
	in cyclopentene (C,H-subst.)	1.323	1.324	0.013	1.314	1.331	104	
	in cyclohexene (C,H-subst.)	1.326	1.325	0.012	1.318	1.334	196	
	C=C=C (allenes, any subst.)	1.307	1.307	0.005	1.303	1.310	18	
	C=C-C=C (C,H subst., conjugated)	1.330	1.330	0.014	1.322	1.338	76	16
	C=C-C=C-C=C (C,H subst., conjugated)	1.345	1.345	0.012	1.337	1.350	58	16
	C=C- <i>Car</i> (C,H subst., conjugated)	1.339	1.340	0.011	1.334	1.346	124	16
	C=C in cyclopenta-1,3-diene (any subst.)	1.341	1.341	0.017	1.328	1.356	18	
	C=C in cyclohexa-1,3-diene (any subst.)	1.332	1.332	0.013	1.323	1.341	56	
	in C=C-C=O (C,H subst., conjugated)	1.340	1.340	0.013	1.332	1.348	211	16,18
	(C,H subst., unconjugated)	1.331	1.330	0.008	1.326	1.339	14	17,18
	(C,H subst., overall)	1.340	1.339	0.013	1.332	1.348	226	
	in cyclohexa-2,5-dien-1-ones	1.329	1.327	0.011	1.321	1.335	28	
	in <i>p</i> -benzoquinones (C*H subst.)	1.333	1.337	0.011	1.325	1.338	14	
	(any subst.)	1.349	1.339	0.030	1.330	1.364	86	
	in TCNQ (endocyclic)	1.352	1.353	0.010	1.345	1.358	142	19
	(exocyclic)	1.392	1.391	0.017	1.379	1.405	139	19
	C=C-OH in enol tautomers in heterocycles (any subst.):	1.362	1.360	0.020	1.349	1.370	54	
	1 <i>H</i> -pyrrole (C2-C3, C4-C5)	1.375	1.377	0.018	1.361	1.388	58	
	furan (C2-C3, C4-C5)	1.341	1.342	0.021	1.329	1.351	125	
	thiophene (C2-C3, C4-C5)	1.362	1.359	0.025	1.346	1.377	60	
	pyrazole (C4-C5)	1.369	1.372	0.019	1.362	1.383	20	
	imidazole (C4-C5)	1.360	1.361	0.014	1.352	1.367	44	
	isoxazole (C4-C5)	1.341	1.336	0.012	1.331	1.355	9	
	indole (C2-C3)	1.364	1.363	0.012	1.355	1.371	40	
<i>Car</i> ≈ <i>Car</i>	in phenyl rings with C*H subst. only H-C≈C-H	1.380	1.381	0.013	1.372	1.388	2 191	
	C*-C≈C-H	1.387	1.388	0.010	1.382	1.393	891	
	C*-C≈C-C*	1.397	1.397	0.009	1.392	1.403	182	
	C≈C (overall)	1.384	1.384	0.013	1.375	1.391	3 264	
	F-C≈C-F	1.372	1.374	0.011	1.366	1.380	84	4
	Cl-C≈C-Cl	1.388	1.389	0.014	1.380	1.398	152	4
	in naphthalene (<i>D</i> _{2h} , any subst.) C1-C2	1.364	1.364	0.014	1.356	1.373	440	
	C2-C3	1.406	1.406	0.014	1.397	1.415	218	
	C1-C8a	1.420	1.419	0.012	1.412	1.426	440	
	C4a-C8a	1.422	1.424	0.011	1.417	1.429	109	
<i>Car</i> ≈ <i>Car</i>	in anthracene (<i>D</i> _{2h} , any subst.) C1-C2	1.356	1.356	0.009	1.350	1.360	56	
	C2-C3	1.410	1.410	0.010	1.401	1.416	34	
	C1-C9a	1.430	1.430	0.006	1.426	1.434	56	
	C4a-C9a	1.435	1.436	0.007	1.429	1.440	34	
	C9-C9a	1.400	1.402	0.009	1.395	1.406	68	
	in pyridine (C,H subst.) (any subst.)	1.379 1.380	1.381 1.380	0.012 0.015	1.371 1.371	1.387 1.389	276 537	20 20
	in pyridinium cation (N ⁺ -H; C,H subst. on C)							
	C2-C3	1.373	1.375	0.012	1.368	1.380	30	
	C3-C4	1.379	1.380	0.011	1.371	1.388	30	
	(N ⁺ -X; C,H subst. on C)							
	C2-C3	1.373	1.372	0.019	1.362	1.382	151	
	C3-C4	1.383	1.385	0.019	1.372	1.394	151	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	q_1	q_u	<i>n</i>	Note
	in pyrazine (H subst. on C)	1.379	1.377	0.010	1.370	1.388	10	
	(any subst. on C)	1.405	1.405	0.024	1.388	1.420	60	
	in pyrimidine (C,H subst. on C)	1.387	1.389	0.018	1.379	1.400	28	
$Csp^1 \equiv Csp^1$	X-C \equiv C-X	1.183	1.183	0.014	1.174	1.193	119	15
	C,H-C \equiv C-C,H	1.181	1.181	0.014	1.173	1.192	104	15
	in C \equiv C-C(<i>sp</i> ² , <i>ar</i>)	1.189	1.193	0.010	1.181	1.195	38	15
	in C \equiv C-C \equiv C	1.192	1.192	0.010	1.187	1.197	42	15
	in CH \equiv C-C#	1.174	1.174	0.011	1.167	1.180	42	15
Csp^3 -Cl	Omitting 1,2-dichlorides:							
	C-CH ₂ -Cl	1.790	1.790	0.007	1.783	1.795	13	4
	C ₂ -CH-Cl	1.803	1.802	0.003	1.800	1.807	8	4
	C ₃ -C-Cl	1.849	1.856	0.011	1.837	1.858	5	4
	X-CH ₂ -Cl (X = C,H,N,O)	1.790	1.791	0.011	1.783	1.797	37	4
	X ₂ -CH-Cl (X = C,H,N,O)	1.805	1.803	0.014	1.800	1.812	26	4
	X ₃ -C-Cl (X = C,H,N,O)	1.843	1.838	0.014	1.835	1.858	7	4
	X ₂ -C-Cl ₂ (X = C,H,N,O)	1.779	1.776	0.015	1.769	1.790	18	4
	X-C-Cl ₂ (X = C,H,N,O)	1.768	1.765	0.011	1.761	1.776	33	4
	Cl-CH(-C)-CH(-C)-Cl	1.793	1.793	0.013	1.786	1.800	66	4
	Cl-C(-C ₂)-Cl(-C ₂)-Cl	1.762	1.760	0.010	1.757	1.765	54	4
	cyclopropyl-Cl	1.755	1.756	0.011	1.749	1.763	64	4
Csp^2 -Cl	C=C-Cl (C,H,N,O subst. on C)	1.734	1.729	0.019	1.719	1.748	63	4
	C=C-Cl ₂ (C,H,N,O subst. on C)	1.720	1.716	0.013	1.708	1.729	20	4
	Cl-C=C-Cl	1.713	1.711	0.011	1.705	1.720	80	4
<i>Car</i> -Cl	<i>Car</i> -Cl (mono-Cl + <i>m,p</i> -Cl ₂)	1.739	1.741	0.010	1.734	1.745	340	4
	<i>Car</i> -Cl (<i>o</i> -Cl ₂)	1.720	1.720	0.010	1.713	1.717	364	4
Csp^1 -Cl	see HCLENE10 (1.634, 1.646)							
Csp^3 -F	Omitting 1,2-difluorides							
	C-CH ₂ -F and C ₂ -CH-F	1.399	1.399	0.017	1.389	1.408	25	4
	C ₃ -C-F	1.428	1.431	0.009	1.421	1.435	11	4
	(C*,H) ₂ -C-F ₂	1.349	1.347	0.012	1.342	1.356	58	4
	C*-C-F ₃	1.336	1.334	0.007	1.330	1.344	12	4
	F-C*-C*-F	1.371	1.374	0.007	1.362	1.375	26	4
	X ₃ -C-F (X = C,H,N,O)	1.386	1.389	0.033	1.373	1.408	70	4
	X ₂ -C-F ₂ (X = C,H,N,O)	1.351	1.349	0.013	1.342	1.356	58	4
	X-C-F ₂ (X = C,H,N,O)	1.322	1.323	0.015	1.314	1.332	309	4
	F-C(-X) ₂ -C(-X) ₂ -F (X = C,H,N,O)	1.373	1.374	0.009	1.362	1.377	30	4
	F-C(-X) ₂ -NO ₂ (X = any subst.)	1.320	1.319	0.009	1.312	1.327	18	
Csp^2 -F	C=C-F (C,H,N,O subst. on C)	1.340	1.340	0.013	1.334	1.346	34	4
<i>Car</i> -F	<i>Car</i> -F (mono-F + <i>m,p</i> -F ₂)	1.363	1.362	0.008	1.357	1.368	38	4
	<i>Car</i> -F (<i>o</i> -F ₂)	1.340	1.340	0.009	1.336	1.344	167	4
Csp^3 -H	C-C-H ₃ (methyl)	1.059	1.061	0.030	1.039	1.083	83	21
	C ₂ -C-H ₂ (primary)	1.092	1.095	0.013	1.088	1.099	100	21
	C ₃ -C-H (secondary)	1.099	1.097	0.004	1.095	1.103	14	21
	C _{2,3} -C-H (primary and secondary)	1.093	1.095	0.012	1.089	1.100	118	21
	X-C-H ₃ (methyl)	1.066	1.074	0.028	1.049	1.087	160	21
	X ₂ -C-H ₂ (primary)	1.092	1.095	0.012	1.088	1.099	230	21
	X ₃ -C-H (secondary)	1.099	1.099	0.007	1.095	1.103	117	21
	X _{2,3} -C-H (primary and secondary)	1.094	1.096	0.011	1.091	1.100	348	21
Csp^2 -H	C=C=C-H	1.077	1.079	0.012	1.074	1.085	14	21
<i>Car</i> -H	<i>Car</i> -H	1.083	1.083	0.011	1.080	1.087	218	21
Csp^3 -I	C*-I	2.162	2.159	0.015	2.149	2.179	15	4
<i>Car</i> -I	<i>Car</i> -I	2.095	2.095	0.015	2.089	2.104	51	4
Csp^3 -N(4)	C*-NH ₃ ⁺	1.488	1.488	0.013	1.482	1.495	298	
	(C*) ₂ -NH ₂ ⁺	1.494	1.493	0.016	1.484	1.503	249	
	(C*) ₃ -NH ⁺	1.502	1.502	0.015	1.491	1.512	509	
	(C*) ₄ -N ⁺	1.510	1.509	0.020	1.496	1.523	319	
	C*-N ⁺ (overall)	1.499	1.498	0.018	1.488	1.510	1 370	
Csp^3 -N(3)	C*-N ⁺ in N-subst. pyridinium	1.485	1.484	0.009	1.477	1.490	32	
	C*-NH ₂ (N sp^3 : pyramidal)	1.469	1.470	0.010	1.462	1.474	19	22
	(C*) ₂ -NH (N sp^3 : pyramidal)	1.469	1.467	0.012	1.461	1.477	152	5,22
	(C*) ₃ -N (N sp^3 : pyramidal)	1.469	1.468	0.014	1.460	1.476	1 042	5,22
	C*-N sp^3 (overall)	1.469	1.468	0.014	1.460	1.476	1 201	
	Csp^3 -N sp^3							
	in aziridine	1.472	1.471	0.016	1.464	1.482	134	
	in azetidine	1.484	1.481	0.018	1.472	1.495	21	
	in tetrahydropyrrrole	1.475	1.473	0.016	1.464	1.483	66	
	in piperidine	1.473	1.473	0.013	1.460	1.479	240	
	Csp^3 -N sp^2 (N planar) in:							
	acyclic amides C*-NH-C=O	1.454	1.451	0.011	1.446	1.461	78	14
	β -lactams C*-N(-X)-C=O (endo)	1.464	1.465	0.012	1.458	1.475	23	13
	γ -lactams							
	C*-NH-C=O (endo)	1.457	1.458	0.011	1.449	1.465	20	13
	C*-N(-C*)-C=O (endo)	1.462	1.461	0.010	1.453	1.466	15	13
	C*-N(-C*)-C=O (exo)	1.458	1.456	0.014	1.448	1.465	15	13

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> ₀	<i>n</i>	Note
	δ -lactams							
	C*-NH-C=O (endo)	1.478	1.472	0.016	1.467	1.491	6	14
	C*-N(-C*)-C=O (endo)	1.479	1.476	0.007	1.475	1.482	15	14
	C*-N(-C*)-C=O (exo)	1.468	1.471	0.009	1.462	1.477	15	14
	nitro compounds (1,2-dinitro omitted):							
	C-CH ₂ -NO ₂	1.485	1.483	0.020	1.478	1.502	8	
	C ₂ -CH-NO ₂	1.509	1.509	0.011	1.502	1.511	12	
	C ₃ -C-NO ₂	1.533	1.533	0.013	1.530	1.539	17	
	C ₂ -C-(NO ₂) ₂	1.537	1.536	0.016	1.525	1.550	19	
	1,2-dinitro: NO ₂ -C*-C*-NO ₂	1.552	1.550	0.023	1.536	1.572	32	
Csp ³ -N(2)	C#-N=N	1.493	1.493	0.020	1.477	1.506	54	
	C*-N=C-Car	1.465	1.468	0.011	1.461	1.472	75	
Csp ² -N(3)	C=C-NH ₂ Nsp ² planar	1.336	1.344	0.017	1.317	1.348	10	23
	C=C-NH-C# Nsp ² planar	1.339	1.340	0.016	1.327	1.351	17	23
	C=C-N-(C#) ₂							
	Nsp ² planar	1.355	1.358	0.014	1.341	1.363	22	23
	Nsp ³ pyramidal	1.416	1.418	0.018	1.397	1.432	18	22
	Csp ² -Nsp ² (N planar) in:							23
	acyclic amides							
	NH ₂ -C=O	1.325	1.323	0.009	1.318	1.331	32	14
	C*-NH-C=O	1.334	1.333	0.011	1.326	1.343	78	14
	(C*) ₂ -N-C=O	1.346	1.342	0.011	1.339	1.356	5	14
	β -lactams C*-NH-C=O	1.385	1.388	0.019	1.374	1.396	23	13
	γ -lactams							
	C*-NH-C=O	1.331	1.331	0.011	1.326	1.337	20	13
	C*-N(-C*)-C=O	1.347	1.344	0.014	1.335	1.359	15	13
	δ -lactams							
	C*-NH-C=O	1.334	1.334	0.006	1.330	1.339	6	14
	C*-N(-C*)-C=O	1.352	1.353	0.010	1.344	1.356	15	14
	peptides C#-N(-X)-C(-C#)(=O)	1.333	1.334	0.013	1.326	1.340	380	24
	ureas							
	(NH ₂) ₂ -C=O	1.334	1.334	0.008	1.329	1.339	48	25,26
	(C#-NH) ₂ -C=O	1.347	1.345	0.010	1.341	1.354	26	25
	[(C#) _n -N] ₂ -C=O	1.363	1.359	0.014	1.354	1.370	40	25,27
	thioureas							
	(X ₂ N) ₂ -C=S	1.346	1.343	0.023	1.328	1.361	192	
	imides							
	[C#-C(=O)] ₂ -NH	1.376	1.377	0.012	1.369	1.383	64	
	[C#-C(=O)] ₂ -N-C#	1.389	1.383	0.017	1.376	1.404	38	
	[Csp ² -C(=O)] ₂ -N-C#	1.396	1.396	0.010	1.389	1.403	46	
	[Csp ² -C(=O)] ₂ -N-Csp ²	1.409	1.406	0.020	1.391	1.419	28	
	guanidinium [C-(NH ₂) ₃] ⁺ (unsubst.)	1.321	1.320	0.008	1.314	1.327	39	
	(any subst.)	1.328	1.325	0.015	1.317	1.333	140	
	in heterocyclic systems (any subst.)							
	1 <i>H</i> -pyrrole (N1-C2, N1-C5)	1.372	1.374	0.016	1.363	1.384	58	
	indole (N1-C2)	1.370	1.370	0.012	1.364	1.377	40	
	pyrazole (N1-C5)	1.357	1.359	0.012	1.347	1.365	20	
	imidazole (N1-C2)	1.349	1.349	0.018	1.338	1.358	44	
	imidazole (N1-C5)	1.370	1.370	0.010	1.365	1.377	44	
Csp ² -N(2)	in imidazole (N3-C4)	1.376	1.377	0.011	1.369	1.384	44	
Car-N(4)	Car-N ⁺ -(C,H) ₃	1.465	1.466	0.007	1.461	1.470	23	
Car-N(3)	Car-NH ₂							
	(Nsp ² : planar)	1.355	1.360	0.020	1.340	1.372	33	23
	(Nsp ³ : pyramidal)	1.394	1.396	0.011	1.385	1.403	25	22
	(overall)	1.375	1.377	0.025	1.363	1.394	98	28
Car-N(3)	Car-NH-C#							
	(Nsp ² : planar)	1.353	1.353	0.007	1.347	1.359	16	23
	(Nsp ³ : pyramidal)	1.419	1.423	0.017	1.412	1.432	8	22
	(overall)	1.380	1.364	0.032	1.353	1.412	31	28
	Car-N-(C#) ₂							
	(Nsp ² : planar)	1.371	1.370	0.016	1.363	1.382	41	23
	(Nsp ³ : pyramidal)	1.426	1.425	0.011	1.421	1.431	22	22
	(overall)	1.390	1.385	0.030	1.366	1.420	69	28
	in indole (N1-C7a)	1.372	1.372	0.007	1.367	1.376	40	
	Car-NO ₂	1.468	1.469	0.014	1.460	1.476	556	
Car-N(2)	Car-N=N	1.431	1.435	0.020	1.422	1.442	26	
Csp ² =N(3)	in furoxan (*N2=C3)	1.316	1.316	0.009	1.311	1.324	14	
Csp ² =N(2)	Car-C=N-C#	1.279	1.279	0.008	1.275	1.285	75	
	(C,H) ₂ -C=N-OH in oximes	1.281	1.280	0.013	1.273	1.288	67	
	S=C=N-X	1.302	1.302	0.021	1.285	1.319	36	
	in pyrazole (N2=C3)	1.329	1.331	0.014	1.315	1.339	20	
	in imidazole (C2=N3)	1.313	1.314	0.011	1.307	1.319	44	
	in isoxazole (N2=C3)	1.314	1.315	0.009	1.305	1.320	9	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> _u	<i>n</i>	Note	
<i>Car</i> ≈ N(3)	in furazan (N2=C3, C4=N5)	1.298	1.299	0.006	1.294	1.303	12		
	in furoxan (C4=N5)	1.304	1.306	0.008	1.300	1.308	14		
	C ≈ N ⁺ -H (pyrimidinium)	1.335	1.334	0.015	1.325	1.342	30		
	C ≈ N ⁺ -C* (pyrimidinium)	1.346	1.346	0.010	1.340	1.352	64		
	C ≈ N ⁺ -O ⁻ (pyrimidinium)	1.362	1.359	0.013	1.353	1.369	56		
<i>Car</i> ≈ N(2)	C ≈ N (pyridine)	1.337	1.338	0.012	1.330	1.344	269		
	C ≈ N (pyrazine)	1.336	1.335	0.022	1.319	1.347	120		
	C ≈ N ≈ C (pyrimidine)	1.339	1.338	0.015	1.333	1.342	28		
	N ≈ C ≈ N (pyrimidine)	1.333	1.335	0.013	1.326	1.337	28		
	C ≈ N (pyrimidine) (overall)	1.336	1.337	0.014	1.331	1.339	56		
	in any 6-membered N-containing aromatic ring:								
	H-C ≈ N ≈ C-H	1.334	1.334	0.014	1.327	1.341	146		
	H-C ≈ N ≈ C-C*	1.339	1.341	0.013	1.336	1.345	38		
	C*-C ≈ N ≈ C-C*	1.345	1.345	0.008	1.342	1.348	24		
	C ≈ N ≈ C (overall)	1.336	1.337	0.014	1.329	1.344	204		
<i>Csp</i> ¹ ≈ N(2)	X-S-N ≈ C ⁻ (isothiocyanide)	1.144	1.147	0.006	1.140	1.148	6		
	C*-C ≈ N	1.136	1.137	0.010	1.131	1.142	140		
<i>Csp</i> ¹ ≈ N(1)	C=C-C ≈ N in TCNQ	1.144	1.144	0.008	1.139	1.149	284	19	
	<i>Car</i> -C ≈ N	1.138	1.138	0.007	1.133	1.143	31		
	X-C ≈ N	1.144	1.141	0.012	1.138	1.151	10		
	(S-C ≈ N) ⁻	1.155	1.156	0.012	1.147	1.165	14		
	<i>Csp</i> ³ -O(2)	in alcohols							
CH ₃ -OH		1.413	1.414	0.018	1.395	1.425	17		
C-CH ₂ -OH		1.426	1.426	0.011	1.420	1.431	75		
C ₂ -CH-OH		1.432	1.431	0.011	1.425	1.439	266		
C ₃ -C-OH		1.440	1.440	0.012	1.432	1.449	106		
C*-OH (overall)		1.432	1.431	0.013	1.424	1.441	464		
in dialkyl ethers									
CH ₃ -O-C*		1.416	1.418	0.016	1.405	1.426	110		
C-CH ₂ -O-C*		1.426	1.424	0.011	1.418	1.435	34		
C ₂ -CH-O-C*		1.429	1.430	0.010	1.420	1.437	53		
C ₃ -C-O-C*	1.452	1.450	0.011	1.445	1.458	39			
C*-O-C* (overall)	1.426	1.425	0.019	1.414	1.437	236			
in aryl alkyl ethers									
CH ₃ -O- <i>Car</i>	1.424	1.424	0.012	1.417	1.431	616			
C-CH ₂ -O- <i>Car</i>	1.431	1.430	0.013	1.422	1.438	188			
C ₂ -CH-O- <i>Car</i>	1.447	1.446	0.020	1.435	1.466	58			
C ₃ -C-O- <i>Car</i>	1.470	1.469	0.018	1.456	1.483	55			
C*-O- <i>Car</i> (overall)	1.429	1.427	0.018	1.419	1.436	917			
in alkyl esters of carboxylic acids									
CH ₃ -O-C(=O)-C*	1.448	1.449	0.010	1.442	1.455	200			
C-CH ₂ -O-C(=O)-C*	1.452	1.453	0.009	1.445	1.458	32			
C ₂ -CH-O-C(=O)-C*	1.460	1.460	0.010	1.454	1.465	78			
C ₃ -C-O-C(=O)-C*	1.477	1.475	0.008	1.472	1.484	6			
C*-O-C(=O)-C* (overall)	1.450	1.451	0.014	1.442	1.459	314			
in alkyl esters of α,β-unsaturated acids:									
C*-O-C(=O)-C=C (overall)	1.453	1.452	0.013	1.444	1.459	112			
in alkyl esters of benzoic acid									
C*-O-C(=O)-C(phenyl) (overall)	1.454	1.454	0.012	1.446	1.463	219			
in ring systems									
oxirane (epoxides) (any subst.)	1.446	1.446	0.014	1.438	1.456	498	9		
oxetane (any subst.)	1.463	1.460	0.015	1.451	1.474	16			
tetrahydrofuran (C,H subst.)	1.442	1.441	0.017	1.430	1.451	154			
tetrahydropyran (C,H subst.)	1.441	1.442	0.015	1.431	1.451	22			
β-lactones: C*-O-C(=O)	1.492	1.494	0.010	1.481	1.501	4	16		
γ-lactones: C*-O-C(=O)	1.464	1.464	0.012	1.455	1.473	110	12		
δ-lactones: C*-O-C(=O)	1.461	1.464	0.017	1.452	1.473	27	12		
O-C-O system in <i>gem</i> -diols, and pyranose and furanose sugars:									
HO-C*-OH	1.397	1.401	0.012	1.388	1.405	18	30,31		
<i>C</i> ₅ -O ₅ -C ₁ -O ₁ H in pyranoses									
O ₁ axial (α):									
C ₅ -O ₅	1.439	1.440	0.008	1.432	1.445	29			
O ₅ -C ₁	1.427	1.426	0.012	1.421	1.432	29			
C ₁ -O ₁	1.403	1.400	0.012	1.391	1.412	29			
O ₁ equatorial (β):									
C ₅ -O ₅	1.435	1.436	0.008	1.429	1.440	17			
O ₅ -C ₁	1.430	1.431	0.010	1.424	1.436	17			
C ₁ -O ₁	1.393	1.393	0.007	1.386	1.399	17			
α + β (overall):									
C ₅ -O ₅	1.439	1.440	0.008	1.432	1.446	60			
O ₅ -C ₁	1.430	1.429	0.012	1.421	1.436	60			
C ₁ -O ₁	1.401	1.399	0.011	1.392	1.407	60			

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> ₀	<i>n</i>	Note
	C₄-O₄-C₁-O₁H in furanoses (overall values)							
	C ₄ -O ₄	1.442	1.446	0.012	1.436	1.449	18	
	O ₄ -C ₁	1.432	1.432	0.012	1.421	1.443	18	
	C ₁ -O ₁	1.404	1.405	0.013	1.397	1.409	18	
	C₅-O₅-C₁-O₁-C* in pyranoses							
	O ₁ axial (α):							
	C ₅ -O ₅	1.439	1.438	0.010	1.433	1.446	67	
	O ₅ -C ₁	1.417	1.417	0.009	1.410	1.424	67	
	C ₁ -O ₁	1.409	1.409	0.014	1.401	1.417	67	
	O ₁ -C*	1.435	1.435	0.013	1.427	1.443	67	
	O ₁ equatorial (β):							
	C ₅ -O ₅	1.434	1.435	0.006	1.429	1.439	39	
	O ₅ -C ₁	1.424	1.424	0.008	1.418	1.431	39	
	C ₁ -O ₁	1.390	1.390	0.011	1.381	1.400	39	
	O ₁ -C*	1.437	1.438	0.013	1.428	1.445	39	
	$\alpha + \beta$ (overall):							
	C ₅ -O ₅	1.436	1.436	0.009	1.431	1.442	126	
	O ₅ -C ₁	1.419	1.419	0.011	1.412	1.426	126	
	C ₁ -O ₁	1.402	1.403	0.016	1.391	1.413	126	
	O ₁ -C*	1.436	1.436	0.013	1.428	1.445	126	
	C₄-O₄-C₁-O₁-C* in furanoses (overall values)							
	C ₄ -O ₄	1.443	1.445	0.013	1.429	1.453	23	
	O ₄ -C ₁	1.421	1.418	0.012	1.413	1.431	23	
	C ₁ -O ₁	1.410	1.409	0.014	1.401	1.420	23	
	O ₁ -C*	1.439	1.437	0.014	1.429	1.449	23	
	Miscellaneous:							
	C#-O-SiX ₃	1.416	1.416	0.017	1.405	1.428	29	
	C*-O-SO ₂ -C	1.465	1.461	0.014	1.454	1.475	33	
C _{sp} ² -O(2)	in enols: C=C-OH	1.333	1.331	0.017	1.324	1.342	53	
	in enol esters: C=C-O-C*	1.354	1.353	0.016	1.341	1.363	40	
	in acids:							
	C*-C(=O)-OH	1.308	1.311	0.019	1.298	1.320	174	
	C=C-C(=O)-OH	1.293	1.295	0.019	1.279	1.307	22	
	Car-C(=O)-OH	1.305	1.311	0.020	1.291	1.317	75	
	in esters:							
	C*-C(=O)-O-C*	1.336	1.337	0.014	1.328	1.346	551	12,29
	C=C-C(=O)-O-C*	1.332	1.331	0.011	1.324	1.339	112	
	Car-C(=O)-O-C*	1.337	1.335	0.013	1.329	1.344	219	12
	C*-C(=O)-O-C=C	1.362	1.359	0.018	1.351	1.374	26	
	C*-C(=O)-O-C=C	1.407	1.405	0.017	1.394	1.420	26	
	C*-C(=O)-O-Car	1.360	1.359	0.011	1.355	1.367	40	12
	in anhydrides: O=C-O-C=O	1.386	1.386	0.011	1.379	1.393	70	
	in ring systems:							
	furan (O1-C2, O1-C5)	1.368	1.369	0.015	1.359	1.377	125	
	isoxazole (O1-C5)	1.354	1.354	0.010	1.345	1.360	9	
	β -lactones: C*-C(=O)-O-C*	1.359	1.359	0.013	1.348	1.371	4	13
	γ -lactones: C*-C(=O)-O-C*	1.350	1.349	0.012	1.342	1.359	110	12
	δ -lactones: C*-C(=O)-O-C*	1.339	1.339	0.016	1.332	1.347	27	12
Car-O(2)	in phenols: Car-OH	1.362	1.364	0.015	1.353	1.373	551	
	in aryl alkyl ethers: Car-O-C*	1.370	1.370	0.011	1.363	1.377	920	29,32
Car-O(2)	in diaryl ethers: Car-O-Car	1.384	1.381	0.014	1.375	1.391	132	
	in esters: Car-O-C(=O)-C*	1.401	1.401	0.010	1.394	1.408	40	12
C _{sp} ² =O(1)	in aldehydes and ketones:							
	C*-CH=O	1.192	1.192	0.005	1.188	1.197	7	
	(C*) ₂ -C=O	1.210	1.210	0.008	1.206	1.215	474	5
	(C#) ₂ -C=O							
	in cyclobutanones	1.198	1.198	0.007	1.194	1.204	12	
	in cyclopentanones	1.208	1.208	0.007	1.203	1.212	155	
	in cyclohexanones	1.211	1.211	0.009	1.207	1.216	312	
	C=C-C=O	1.222	1.222	0.010	1.216	1.229	225	
	(C=C) ₂ -C=O	1.233	1.229	0.010	1.226	1.242	28	
	Car-C=O	1.221	1.218	0.014	1.212	1.229	85	
	(Car) ₂ -C=O	1.230	1.226	0.015	1.220	1.238	66	
	C=O in benzoquinones	1.222	1.220	0.013	1.211	1.231	86	
	delocalized double bonds in carboxylate anions:							
	H-C \approx O ₂ ⁻ (formate)	1.242	1.243	0.012	1.234	1.252	24	
	C*-C \approx O ₂ ⁻	1.254	1.253	0.010	1.247	1.261	114	
	C=C-C \approx O ₂ ⁻	1.250	1.248	0.017	1.238	1.261	52	
	Car-C \approx O ₂ ⁻	1.255	1.253	0.010	1.249	1.262	22	
	HOOC-C \approx O ₂ ⁻ (hydrogen oxalate)	1.243	1.247	0.015	1.232	1.256	26	
	⁻ O ₂ -C-C \approx O ₂ ⁻ (oxalate)	1.251	1.251	0.007	1.248	1.254	18	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> _u	<i>n</i>	Note
	in carboxylic acids (X-COOH)							
	C*-C(=O)-OH	1.214	1.214	0.019	1.203	1.224	175	
	C=C-C(=O)-OH	1.229	1.226	0.017	1.218	1.237	22	
	Car-C(=O)-OH	1.226	1.223	0.020	1.211	1.241	75	
	in esters:							
	C*-C(=O)-O-C*	1.196	1.196	0.010	1.190	1.202	551	12
	C=C-C(=O)-O-C*	1.199	1.198	0.009	1.193	1.203	113	
	Car-C(=O)-O-C*	1.202	1.201	0.009	1.196	1.207	218	12
	C*-C(=O)-O-C=C	1.190	1.190	0.014	1.184	1.198	26	
	C*-C(=O)-O-Car	1.187	1.188	0.011	1.181	1.195	40	12
	in anhydrides: O=C-O-C=O	1.187	1.187	0.010	1.184	1.193	70	
	in β -lactones: C*-C(=O)-O-C*	1.193	1.193	0.006	1.187	1.198	4	13
	γ -lactones: C*-C(=O)-O-C*	1.201	1.202	0.009	1.196	1.206	109	12
	δ -lactones: C*-C(=O)-O-C*	1.205	1.207	0.008	1.201	1.209	27	12
	in amides:							
	NH ₂ -C(-C*)=O	1.234	1.233	0.012	1.225	1.243	32	14
	(C*)(C*(H)-)N-C(-C*)=O	1.231	1.231	0.012	1.224	1.238	378	14
	β -lactams: C*-NH-C=O	1.198	1.200	0.012	1.193	1.204	23	13
	γ -lactams:							
	C*-NH-C=O	1.235	1.235	0.008	1.232	1.240	20	13
	C*-N(-C*)-C=O	1.225	1.226	0.011	1.217	1.233	15	13
	δ -lactams:							
	C*-NH-C=O	1.240	1.241	0.003	1.237	1.243	6	14
	C*-N(-C*)-C=O	1.233	1.233	0.007	1.229	1.239	15	14
	in ureas:							
	(NH ₂) ₂ -C=O	1.256	1.256	0.007	1.249	1.261	24	25,26
	(C#-NH) ₂ -C=O	1.241	1.237	0.011	1.235	1.245	13	25
	[(C#) _n -N] ₂ -C=O	1.230	1.230	0.007	1.224	1.234	20	25,27
C ₃ sp ³ -P(4)	C ₃ -P ⁺ -C*	1.800	1.802	0.015	1.790	1.812	35	33
	C ₂ -P(=O)-CH ₃	1.791	1.790	0.006	1.786	1.795	10	
	C ₂ -P(=O)-CH ₂ -C	1.806	1.806	0.009	1.801	1.813	45	
	C ₂ -P(=O)-CH-C ₂	1.821	1.821	0.009	1.815	1.828	15	
	C ₂ -P(=O)-C-C ₃	1.841	1.842	0.008	1.835	1.847	14	
	C ₂ -P(=O)-C* (overall)	1.813	1.811	0.017	1.800	1.822	84	
C ₃ sp ³ -P(3)	C ₂ -P-C*	1.855	1.857	0.019	1.840	1.870	23	
Car-P(4)	C ₃ -P ⁺ -Car	1.793	1.792	0.011	1.786	1.800	276	
	C ₂ -P(=O)-Car	1.801	1.802	0.011	1.796	1.807	98	
	Ph ₃ -P=N ⁺ =P-Ph ₃	1.795	1.795	0.008	1.789	1.800	197	
Car-P(3)	C ₂ -P-Car	1.836	1.837	0.010	1.830	1.844	102	
	(N \approx) ₂ P-Car (P \approx N aromatic)	1.795	1.793	0.011	1.788	1.803	43	
C ₃ sp ³ -S(4)	C*-SO ₂ -C (C* = CH ₃ excluded)	1.786	1.782	0.018	1.774	1.797	75	
	C*-SO ₂ -C (overall)	1.779	1.778	0.020	1.764	1.790	94	
	C*-SO ₂ -O-X	1.745	1.744	0.009	1.738	1.754	7	34
	C*-SO ₂ -N-X ₂	1.758	1.756	0.018	1.746	1.773	17	34
C ₃ sp ³ -S(3)	C*-S(=O)-C (C* = CH ₃ excluded)	1.818	1.814	0.024	1.802	1.829	69	
	C*-S(=O)-C (overall)	1.809	1.806	0.025	1.793	1.820	88	
	CH ₃ -S ⁺ -X ₂	1.786	1.787	0.007	1.779	1.792	21	
	C*-S ⁺ -X ₂ (C* = CH ₃ excluded)	1.823	1.820	0.016	1.812	1.834	18	
	C*-S ⁺ -X ₂ (overall)	1.804	1.794	0.025	1.788	1.820	41	
C ₃ sp ³ -S(2)	C*-SH	1.808	1.805	0.010	1.800	1.819	6	
	CH ₃ -S-C*	1.789	1.787	0.008	1.784	1.794	9	
C ₃ sp ³ -S(2)	C-CH ₂ -S-C*	1.817	1.816	0.013	1.808	1.824	92	
	C ₂ -CH-S-C*	1.819	1.819	0.011	1.811	1.825	32	
	C ₃ -C-S-C*	1.856	1.860	0.011	1.854	1.863	26	
	C*-S-C* (overall)	1.819	1.817	0.019	1.809	1.827	242	
	in thiirane	1.834	1.835	0.025	1.810	1.858	4	9
	in thietane: see ZCMXSP (1.817, 1.844)							
	in tetrahydrothiophene	1.827	1.826	0.018	1.811	1.837	20	
	in tetrahydrothiopyran	1.823	1.821	0.014	1.812	1.832	24	
	C-CH ₂ -S-S-X	1.823	1.820	0.014	1.813	1.832	41	
	C ₃ -C-S-S-X	1.863	1.865	0.015	1.848	1.878	11	
	C*-S-S-X (overall)	1.833	1.828	0.022	1.818	1.848	59	
C ₃ sp ² -S(2)	C=C-S-C*	1.751	1.755	0.017	1.740	1.764	61	
	C=C-S-C=C (in tetrathiafulvalene)	1.741	1.741	0.011	1.733	1.750	88	
	C=C-S-C=C (in thiophene)	1.712	1.712	0.013	1.703	1.722	60	
	O=C-S-C#	1.762	1.759	0.018	1.747	1.778	20	
Car-S(4)	Car-SO ₂ -C	1.763	1.764	0.009	1.756	1.769	96	
	Car-SO ₂ -O-X	1.752	1.750	0.008	1.749	1.756	27	
	Car-SO ₂ -N-X ₂	1.758	1.759	0.013	1.749	1.765	106	35
Car-S(3)	Car-S(=O)-C	1.790	1.790	0.010	1.783	1.798	41	
	Car-S ⁺ -X ₂	1.778	1.779	0.010	1.771	1.787	10	
Car-S(2)	Car-S-C*	1.773	1.774	0.009	1.765	1.779	44	
	Car-S-Car	1.768	1.767	0.010	1.762	1.774	158	
	Car-S-Car (in phenothiazine)	1.764	1.764	0.008	1.760	1.769	48	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> ₀	<i>n</i>	Note
<i>Csp</i> ¹ -S(2)	Car-S-S-X	1.777	1.777	0.012	1.767	1.785	47	
<i>Csp</i> ¹ -S(1)	N≡C-S-X	1.679	1.683	0.026	1.645	1.698	10	
<i>Csp</i> ² =S(1)	(N≡C-S) ⁻	1.630	1.630	0.014	1.619	1.641	14	
	(C*) ₂ -C=S: see IPMUDS (1.599)							
	(Car) ₂ -C=S: see CELDOM (1.611)							
	(X) ₂ -C=S (X = C, N, O, S)	1.671	1.675	0.024	1.656	1.689	245	
	X ₂ N-C(=S)-S-X	1.660	1.660	0.016	1.648	1.674	38	
	(X ₂ N) ₂ -C=S (thioureas)	1.681	1.684	0.020	1.669	1.693	96	
	N-C(≈S) ₂	1.720	1.721	0.012	1.709	1.731	20	
<i>Csp</i> ³ -Se	C#-Se	1.970	1.967	0.032	1.948	1.998	21	
<i>Csp</i> ² -Se(2)	C=C-Se-C=C (in tetraselenafulvalene)	1.893	1.895	0.013	1.882	1.902	32	
Car-Se(3)	Ph ₃ -Se ⁺	1.930	1.929	0.006	1.924	1.936	13	
<i>Csp</i> ³ -Si(5)	C#-Si ⁻ -X ₄	1.874	1.876	0.015	1.859	1.884	9	
<i>Csp</i> ³ -Si(4)	CH ₃ -Si-X ₃	1.857	1.857	0.018	1.848	1.869	552	
	C*-Si-X ₃ (C* = CH ₃ excluded)	1.888	1.887	0.023	1.872	1.905	124	
	C*-Si-X ₃ (overall)	1.863	1.861	0.024	1.850	1.875	681	
Car-Si(4)	Car-Si-X ₃	1.868	1.868	0.014	1.857	1.878	178	
<i>Csp</i> ¹ -Si(4)	C≡C-Si-X ₃	1.837	1.840	0.012	1.824	1.849	8	
<i>Csp</i> ³ -Te	C#-Te	2.158	2.159	0.030	2.128	2.177	13	
Car-Te	Car-Te	2.116	2.115	0.020	2.104	2.130	72	
<i>Csp</i> ² =Te	see CEDCUJ (2.044)							
Cl-Cl	see PHASCL (2.306, 2.227)							
Cl-I	see CMBIDZ (2.563), HXPASC (2.541, 2.513), METAMM (2.552), BQUINI (2.416, 2.718)							
Cl-N	see BECTAE (1.743—1.757), BOGPOC (1.705)							
Cl-O(1)	in ClO ₄ ⁻	1.414	1.419	0.026	1.403	1.431	252	
Cl-P	(N≈) ₂ P-Cl (N≈P aromatic)	1.997	1.994	0.015	1.989	2.004	46	
	Cl-P (overall)	2.008	2.001	0.035	1.986	2.028	111	
Cl-S	Cl-S (overall)	2.072	2.079	0.023	2.047	2.091	6	
	see also longer bonds in CILSAR (2.283), BIHXIZ (2.357), CANLUY (2.749)							
Cl-Se	see BIRGUE10, BIRHAL10, CTCNSE (2.234—2.851)							
Cl-Si(4)	Cl-Si-X ₃ (monochloro)	2.072	2.075	0.009	2.066	2.078	5	
	Cl ₂ -Si-X ₂ and Cl ₃ -Si-X	2.020	2.012	0.015	2.007	2.036	5	
Cl-Te	Cl-Te in range 2.34—2.60	2.520	2.515	0.034	2.493	2.537	22	36
	see also longer bonds in BARRIV, BOJPUL, CETUTE, EPHTEA, OPNTEC10 (2.73—2.94)							
F-N(3)	F-N-C ₂ and F ₂ -N-C	1.406	1.404	0.016	1.395	1.416	9	
F-P(6)	in hexafluorophosphate, PF ₆ ⁻	1.579	1.587	0.025	1.563	1.598	72	
F-P(3)	(N≈) ₂ P-F (N≈P aromatic)	1.495	1.497	0.016	1.481	1.510	10	
F-S	43 observations in range 1.409—1.770 in a wide variety of environments; F-S(6) in F ₂ -SO ₂ -C ₂ (see FPSULF10, BETJOZ)	1.640	1.646	0.011	1.626	1.649	6	
	F-S(4) in F ₂ -S(=O)-N (see BUDTEZ)	1.527	1.528	0.004	1.524	1.530	24	37
F-Si(6)	in SiF ₆ ²⁻	1.694	1.701	0.013	1.677	1.703	6	
F-Si(5)	F-Si ⁻ -X ₄	1.636	1.639	0.035	1.602	1.657	10	
F-Si(4)	F-Si-X ₃	1.588	1.587	0.014	1.581	1.599	24	
F-Te	see CUCPIZ (F-Te(6) = 1.942, 1.937), FPHTEL (F-Te(4) = 2.006)							
H-N(4)	X ₃ -N ⁺ -H	1.033	1.036	0.022	1.026	1.045	87	21
H-N(3)	X ₂ -N-H	1.009	1.010	0.019	0.997	1.023	95	21
H-O(2)	in alcohols C*-O-H	0.967	0.969	0.010	0.959	0.974	63	21
	C#-O-H	0.967	0.970	0.010	0.959	0.974	73	21
	in acids O=C-O-H	1.015	1.017	0.017	1.001	1.031	16	21,38
I-I	in I ₃ ⁻	2.917	2.918	0.011	2.907	2.927	6	
I-N	see BZPRIB, CMBIDZ, HMTITI, HMTNTI, IFORAM, IODMAM (2.042—2.475)							
I-O	X-I-O (see BZPRIB, CAJMAB, IBZDAC11) for IO ₆ ⁻ see BOVMEE (1.829—1.912)	2.144	2.144	0.028	2.127	2.164	6	
I-P(3)	see CEHKAB (2.490—2.493)							†
I-S	see DTHIBR10 (2.687), ISUREA10 (2.629), BZTPPI (3.251)							
I-Te(4)	I-Te-X ₃	2.926	2.928	0.026	2.902	2.944	8	
N(4)-N(3)	X ₃ -N ⁺ -N ⁰ -X ₂ (N ⁰ planar)	1.414	1.414	0.005	1.412	1.418	13	
N(3)-N(3)	(C)(C,H)-N _a -N _b -(C)(C,H)							5,39
	N _a , N _b pyramidal	1.454	1.452	0.021	1.444	1.457	44	40
	N _a pyramidal, N _b planar	1.420	1.420	0.015	1.407	1.433	68	40
	N _a , N _b planar	1.401	1.401	0.018	1.384	1.418	40	40
	overall	1.425	1.425	0.027	1.407	1.443	139	
N(3)-N(2)	in pyrazole (N1-N2)	1.366	1.366	0.019	1.350	1.375	20	
	in pyridazinium (N1 ⁺ ≈N2)	1.350	1.349	0.010	1.345	1.361	7	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> _u	<i>n</i>	Note
N(2)≈N(2)	N≈N (aromatic) in pyridazine with C,H as <i>ortho</i> substituents with N,Cl as <i>ortho</i> substituents	1.304 1.368	1.300 1.373	0.019 0.011	1.287 1.362	1.326 1.375	6 9	
N(2)=N(2)	C#-N=N-C#							
	<i>cis</i>	1.245	1.244	0.009	1.239	1.252	21	
	<i>trans</i>	1.222	1.222	0.006	1.218	1.227	6	
	(overall)	1.240	1.241	0.012	1.230	1.251	27	
	Car-N=N-Car	1.255	1.253	0.016	1.247	1.262	13	
	X-N=N=N (azides)	1.216	1.226	0.028	1.202	1.237	19	
N(2)=N(1)	X-N=N=N (azides)	1.124	1.128	0.015	1.114	1.137	19	
N(3)-O(2)	(C,H) ₂ -N-OH (Nsp ² : planar)	1.396	1.394	0.012	1.390	1.401	28	
	C ₂ -N-O-C							
	(Nsp ³ : pyramidal)	1.463	1.465	0.012	1.457	1.468	22	
	(Nsp ² : planar)	1.397	1.394	0.011	1.388	1.409	12	
	in furoxan (N2-O1)	1.438	1.436	0.009	1.430	1.447	14	
N(3)-O(1)	(C≈) ₂ N ⁺ -O ⁻ in pyridine <i>N</i> -oxides in furoxan (⁺ N2-O6 ⁻)	1.304 1.234	1.299 1.234	0.015 0.008	1.291 1.228	1.316 1.240	11 14	
N(2)-O(2)	in oximes							
	(C#) ₂ -C=N-OH	1.416	1.418	0.006	1.416	1.420	7	
	(H)(Csp ²)-C=N-OH	1.390	1.390	0.011	1.380	1.401	20	
	(C#)(Csp ²)-C=N-OH	1.402	1.403	0.010	1.393	1.410	18	
	(Csp ²) ₂ -C=N-OH	1.378	1.377	0.017	1.365	1.393	16	
	(C,H) ₂ -C=N-OH (overall)	1.394	1.395	0.018	1.379	1.408	67	
	in furazan (O1-N2, O1-N5)	1.385	1.383	0.013	1.378	1.392	12	
	in furoxan (O1-N5)	1.380	1.380	0.011	1.370	1.388	14	
	in isoxazole (O1-N2)	1.425	1.425	0.010	1.417	1.434	9	
N(3)=O(1)	in nitrate ions NO ₃ ⁻ in nitro groups	1.239	1.240	0.020	1.227	1.251	105	
	C ⁺ -NO ₂	1.212	1.214	0.012	1.206	1.221	84	
	C#-NO ₂	1.210	1.210	0.011	1.203	1.218	251	
	Car-NO ₂	1.217	1.218	0.011	1.211	1.215	1 116	
	C-NO ₂ (overall)	1.218	1.219	0.013	1.210	1.226	1 733	
N(3)-P(4)	X ₂ -P(=X)-NX ₂							
	Nsp ² : planar	1.652	1.651	0.024	1.634	1.670	205	
	Nsp ³ : pyramidal	1.683	1.683	0.005	1.680	1.686	6	
	(overall)	1.662	1.662	0.029	1.639	1.682	358	
	subsets of this group are:							
	O ₂ -P(=S)-NX ₂	1.628	1.624	0.015	1.615	1.634	9	
	C-P(=S)-(NX ₂) ₂	1.691	1.694	0.018	1.678	1.703	28	
	O-P(=S)-(NX ₂) ₂	1.652	1.654	0.014	1.642	1.664	28	
	P(=O)-(NX ₂) ₃	1.663	1.668	0.026	1.640	1.679	78	
N(3)-P(3)	-NX-P(X)-NX-P(X)- (P ₂ N ₂ ring) -NX-P(=S)-NX-P(=S)- (P ₂ N ₂ ring) in <i>P</i> -substituted phosphazenes: (N≈) ₂ P-N (amino) (aziridinyl)	1.730 1.697 1.637 1.672	1.721 1.697 1.638 1.674	0.017 0.015 0.014 0.010	1.716 1.690 1.625 1.665	1.748 1.703 1.651 1.676	20 44 16 15	
N(2)=P(4)	Ph ₃ -P=N ⁺ =P-Ph ₃	1.571	1.573	0.013	1.563	1.580	66	
N(2)=P(3)	Ph ₃ -P=N-C,S	1.599	1.597	0.018	1.580	1.615	7	
N(2)≈P(3)	N≈P aromatic in phosphazenes in P≈N≈S	1.582 1.604	1.582 1.606	0.019 0.009	1.571 1.594	1.594 1.612	126 36	
N(3)-S(4)	C-SO ₂ -NH ₂ C-SO ₂ -NH-C# C-SO ₂ -N-C(#) ₂	1.600 1.633 1.642	1.601 1.633 1.641	0.012 0.019 0.024	1.591 1.615 1.623	1.610 1.652 1.659	14 47 38	35 35
N(3)-S(2)	C-S-NX ₂ Nsp ² : planar (for Nsp ³ pyramidal see MODIAZ: 1.765)	1.710	1.707	0.019	1.698	1.722	22	23
	X-S-NX ₂ Nsp ² : planar	1.707	1.705	0.012	1.699	1.715	30	23
N(2)-S(2)	C=N-S-X	1.656	1.663	0.027	1.632	1.677	36	
N(2)≈S(2)	N≈S aromatic in P≈N≈S	1.560	1.558	0.011	1.554	1.563	37	
N(2)=S(2)	N=S in N=S=N and N=S=S	1.541	1.546	0.022	1.521	1.558	37	
N(3)-Se	see COJCUZ (1.830), DSEMOR10 (1.846, 1.852), MORTRS10 (1.841)							
N(2)-Se	see SEBZQ1 (1.805), NAPSEZ10 (1.809, 1.820)							
N(2)=Se	see CISMUM (1.790, 1.791)							
N(3)-Si(5)	see DMESIP01, BOJLER, CASSAQ, CASYOK, CECKEN, CINTEY, CIPBUY, FMESIB, MNPSIL, PNPOSI (1.973—2.344)							
N(3)-Si(4)	X ₃ -Si-NX ₂ (overall) subsets of this group are:	1.748	1.746	0.022	1.735	1.757	170	
	X ₃ -Si-NHX	1.714	1.719	0.014	1.702	1.727	16	
	X ₃ -Si-NX-Si-X ₃ acyclic	1.743	1.744	0.016	1.731	1.755	45	
	N-Si-N in 4-membered rings	1.742	1.742	0.009	1.735	1.748	53	
	N-Si-N in 5-membered rings	1.741	1.742	0.019	1.726	1.749	33	
N(2)-Si(4)	X ₃ -Si-N ⁻ -Si-X ₃	1.711	1.712	0.019	1.693	1.729	15	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> ₀	<i>n</i>	Note
N-Te	see ACLTEP (2.402), BIBLAZ (1.980), CESSAU (2.023)							
O(2)-O(2)	C*-O-O-C*,H $\tau(\text{OO}) = 70-85^\circ$ $\tau(\text{OO}) \text{ ca. } 180^\circ$ overall	1.464 1.482 1.469	1.464 1.480 1.471	0.009 0.005 0.012	1.458 1.478 1.461	1.472 1.486 1.478	12 5 17	
O(2)-P(5)	O=C-O-O-C=O see ACBZPO01 (1.446), CEYLUN (1.452), CIMHIP (1.454) Si-O-O-Si X-P-(OX) ₄ trigonal bipyramidal: axial equatorial square pyramidal	1.496 1.689 1.619 1.662	1.499 1.685 1.622 1.661	0.005 0.024 0.024 0.020	1.490 1.675 1.604 1.649	1.499 1.712 1.628 1.673	10 20 20 28	41
O(2)-P(4)	C-O-P(\approx O) ₃ ²⁻ (H-O) ₂ -P(\approx O) ₂ ⁻ (C-O) ₂ -P(\approx O) ₂ ⁻ (C#-O) ₃ -P=O (Car-O) ₃ -P=O X-O-P(=O)-(C,N) ₂ (X-O) ₂ -P(=O)-(C,N)	1.621 1.560 1.608 1.558 1.587 1.590 1.571	1.622 1.561 1.607 1.554 1.588 1.585 1.572	0.007 0.009 0.013 0.011 0.014 0.016 0.013	1.615 1.555 1.599 1.550 1.572 1.577 1.563	1.628 1.566 1.615 1.564 1.599 1.601 1.579	12 16 16 30 19 33 70	
O(2)-P(3)	(N \approx) ₂ P-O-C (N \approx P aromatic)	1.573	1.573	0.011	1.563	1.584	16	
O(1)=P(4)	C-O-P(\approx O) ₃ ²⁻ (delocalized) (H-O) ₂ -P(\approx O) ₂ ⁻ (delocalized) (C-O) ₂ -P(\approx O) ₂ ⁻ (delocalized) (C-O) ₃ -P=O C ₃ -P=O N ₃ -P=O (C ₂ (N))-P=O (C,N) ₂ (O)-P=O (C,N)(O) ₂ -P=O	1.513 1.503 1.483 1.449 1.489 1.461 1.487 1.467 1.457	1.512 1.503 1.485 1.448 1.486 1.462 1.489 1.465 1.458	0.008 0.005 0.008 0.007 0.010 0.014 0.007 0.007 0.009	1.508 1.499 1.474 1.446 1.481 1.449 1.479 1.462 1.454	1.518 1.508 1.490 1.452 1.496 1.470 1.493 1.472 1.462	42 16 16 18 72 26 5 33 35	
O(2)-S(4)	C-O-SO ₂ -C C-O-SO ₂ -CH ₃ C-O-SO ₂ -Car	1.577 1.569 1.580	1.576 1.569 1.578	0.015 0.013 0.015	1.566 1.556 1.571	1.584 1.582 1.588	41 7 27	
O(1)=S(4)	C-SO ₂ -C X-SO ₂ -NX ₂ C-SO ₂ -N-(C,H) ₂ C-SO ₂ -O-C in SO ₄ ²⁻	1.436 1.428 1.430 1.423 1.472	1.437 1.428 1.430 1.423 1.473	0.010 0.010 0.009 0.008 0.013	1.431 1.422 1.425 1.418 1.463	1.442 1.434 1.435 1.428 1.481	316 326 206 82 104	42
O(1)=S(3)	C-S(=O)-C	1.497	1.498	0.013	1.489	1.505	90	5
O-Se	see BAPPAJ, BIRGUE10, BIRHAL10, CXMSEO, DGLYSE, SPSEBU (1.597 for O=Se to 1.974 for O-Se)							
O(2)-Si(5)	(X-O) ₃ -Si-(N)(C)	1.663	1.658	0.023	1.650	1.665	21	
O(2)-Si(4)	X ₃ -Si-O-X (overall)	1.631	1.630	0.022	1.617	1.646	191	
O(2)-Si(4)	subsets of this group are: X ₃ -Si-O-C# X ₃ -Si-O-Si-X ₃ X ₃ -Si-O-O-Si-X ₃	1.645 1.622 1.680	1.647 1.625 1.676	0.012 0.014 0.008	1.634 1.614 1.673	1.652 1.631 1.688	29 70 10	
O(2)-Te(6)	(X-O) ₆ -Te	1.927	1.927	0.020	1.908	1.942	16	
O(2)-Te(4)	(X-O) ₂ -Te-X ₂	2.133	2.136	0.054	2.078	2.177	12	
P(4)-P(4)	X ₃ -P-P-X ₃	2.256	2.259	0.025	2.243	2.277	6	
P(4)-P(3)	see CECHEX (2.197), COZPIQ (2.249)							
P(3)-P(3)	X ₂ -P-P-X ₂	2.214	2.210	0.022	2.200	2.224	41	
P(4)=P(4)	see BUTSUE (2.054)							
P(3)=P(3)	see BALXOB (2.034)							
P(4)=S(1)	C ₃ -P=S (N,O) ₂ (C)-P=S (N,O) ₃ -P=S	1.954 1.922 1.913	1.952 1.924 1.914	0.005 0.014 0.014	1.950 1.913 1.906	1.957 1.927 1.921	13 26 50	
P(4)=Se(1)	X ₃ -P=Se	2.093	2.099	0.019	2.075	2.108	12	
P(3)-Si(4)	X ₂ -P-Si-X ₃ : 3- and 4-rings excluded (see BOFFER, BOPFIV, CASTOF10, COZVIW: 2.201-2.317)	2.264	2.260	0.019	2.249	2.283	22	
P(4)=Te(1)	see MOPHTE (2.356), TTEBPZ (2.327)							
S(2)-S(2)	C-S-S-C $\tau(\text{SS}) = 75-105^\circ$ $\tau(\text{SS}) = 0-20^\circ$ (overall) in polysulphide chain-S-S-S-	2.031 2.070 2.048 2.051	2.029 2.068 2.045 2.050	0.015 0.022 0.026 0.022	2.021 2.057 2.028 2.037	2.038 2.077 2.068 2.065	46 28 99 126	
S(2)-S(1)	X-N=S-S	1.897	1.896	0.012	1.887	1.908	5	
S-Se(4)	see BUWZUO (2.264, 2.269)							
S-Se(2)	X-Se-S (any)	2.193	2.195	0.015	2.174	2.207	9	
S(2)-Si(4)	X ₃ -Si-S-X	2.145	2.138	0.020	2.130	2.158	19	

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

Bond	Substructure	<i>d</i>	<i>m</i>	σ	<i>q</i> ₁	<i>q</i> _u	<i>n</i>	Note
S(2)-Te	X-S-Te (any)	2.405	2.406	0.022	2.383	2.424	10	
	X-S-Te (any)	2.682	2.686	0.035	2.673	2.694	28	
Se(2)-Se(2)	X-Se-Se-X	2.340	2.340	0.024	2.315	2.361	15	
Se(2)-Te(2)	see BAWFUA, BAWGAH (2.524—2.561)							†
Si(4)-Si(4)	X ₃ -Si-Si-X ₃ 3-membered rings excluded: see CIHRAM (2.511)	2.359	2.359	0.012	2.349	2.366	42	
Te-Te	see CAHJOK (2.751, 2.704)							

Appendix 1. (Footnotes to Table)

1. Sample dominated by B-CH₃. For longer bonds in B⁻-CH₃ see LITMEB10 [B(4)-CH₃ = 1.621—1.644Å].
2. *p*(π)-*p*(π) Bonding with Bsp² and Nsp² coplanar (τ BN = 0 ± 15°) predominates. See G. Schmidt, R. Boese, and D. Bläser, *Z. Naturforsch.*, 1982, 37b, 1230.
3. 84 observations range from 1.38 to 1.61 Å and individual values depend on substituents on B and O. For a discussion of borinic acid adducts see S. J. Rettig and J. Trotter, *Can. J. Chem.*, 1982, 60, 2957.
4. See M. Kaftory in 'The Chemistry of Functional Groups, Supplement D: The Chemistry of Halides, Pseudohalides, and Azides' eds. S. Patai and Z. Rappoport, Wiley: New York, 1983, Part 2, ch. 24.
5. Bonds which are endocyclic or exocyclic to any 3- or 4-membered rings have been omitted from all averages in this section.
6. The overall average given here is for Csp³-Csp³ bonds which carry only C or H substituents. The value cited reflects the relative abundance of each 'substitution' group. The 'mean of means' for the 9 subgroups is 1.538 (σ = 0.022) Å.
7. See F. H. Allen, (a) *Acta Crystallogr.*, 1980, B36, 81; (b) 1981, B37, 890.
8. See F. H. Allen, *Acta Crystallogr.*, 1984, B40, 64.
9. See F. H. Allen, *Tetrahedron*, 1982, 38, 2843.
10. See F. H. Allen, *Tetrahedron*, 1982, 38, 645.
11. Cyclopropanones and cyclobutanones excluded.
12. See W. B. Schweizer and J. D. Dunitz, *Helv. Chim. Acta*, 1982, 65, 1547.
13. See L. Norskov-Lauritsen, H.-B. Bürgi, P. Hoffmann, and H. R. Schmidt, *Helv. Chim. Acta*, 1985, 68, 76.
14. See P. Chakrabarti and J. D. Dunitz, *Helv. Chim. Acta*, 1982, 65, 1555.
15. See J. L. Hencher in 'The Chemistry of the C≡C Triple Bond,' ed. S. Patai, Wiley, New York, 1978, ch. 2.
16. Conjugated: torsion angle about central C-C single bond is 0 ± 20° (*cis*) or 180 ± 20° (*trans*).
17. Unconjugated: torsion angle about central C-C single bond is 20—160°.
18. Other conjugative substituents excluded.
19. TCNQ is tetracyanoquinodimethane.
20. No difference detected between C2≈C3 and C3≈C4 bonds.
21. Derived from neutron diffraction results only.
22. Nsp³: pyramidal; mean valence angle at N is in range 108—114°.
23. Nsp²: planar; mean valence angle at N is ≥ 117.5°.
24. Cyclic and acyclic peptides.
25. See R. H. Blessing, *J. Am. Chem. Soc.*, 1983, 105, 2776.
26. See L. Lebioda, *Acta Crystallogr.*, 1980, B36, 271.
27. *n* = 3 or 4, i.e. tri- or tetra-substituted ureas.
28. Overall value also includes structures with mean valence angle at N in the range 115—118°.
29. See F. H. Allen and A. J. Kirby, *J. Am. Chem. Soc.*, 1984, 106, 6197.
30. See A. J. Kirby, 'The Anomeric Effect and Related Stereoelectronic Effects at Oxygen,' Springer, Berlin, 1983.
31. See B. Fuchs, L. Schleifer, and E. Tartakovsky, *Nouv. J. Chim.*, 1984, 8, 275.
32. See S. C. Nyburg and C. H. Faerman, *J. Mol. Struct.*, 1986, 140, 347.
33. Sample dominated by P-CH₃ and P-CH₂-C.
34. Sample dominated by C* = methyl.
35. See A. Kalman, M. Czugler, and G. Argay, *Acta Crystallogr.*, 1981, B37, 868.
36. Bimodal distribution resolved into 22 'short' bonds and 5 longer outliers.
37. All 24 observations come from BUDTEZ.
38. 'Long' O-H bonds in centrosymmetric O --- H --- O H-bonded dimers are excluded.
39. N-N bond length also dependent on torsion angle about N-N bond and on nature of substituent C atoms; these effects are ignored here.
40. N pyramidal has average angle at N in range 100—113.5°; N planar has average angle of ≥ 117.5°.
41. See R. R. Holmes and J. A. Deiters, *J. Amer. Chem. Soc.*, 1977, 99, 3318.
42. No detectable variation in S=O bond length with type of C-substituent.

Appendix 2.

Short-form references to individual CSD entries cited by reference code in the Table. A full list of CSD bibliographic entries is given in SUP 56701.

ACBZPO01	<i>J. Am. Chem. Soc.</i> , 1975, 97, 6729.	BIBLAZ	<i>Zh. Strukt. Khim.</i> , 1981, 22, 118.
ACLTEP	<i>J. Organomet. Chem.</i> , 1980, 184, 417.	BICGEZ	<i>Z. Anorg. Allg. Chem.</i> , 1982, 486, 90.
ASAZOC	<i>Dokl. Akad. Nauk SSSR</i> , 1979, 249, 120.	BIHXIZ	<i>J. Chem. Soc., Chem. Commun.</i> , 1982, 982.
BALXOB	<i>J. Am. Chem. Soc.</i> , 1981, 103, 4587.	BIRGUE10	<i>Z. Naturforsch., Teil B</i> , 1983, 38, 20.
BAPPAJ	<i>Inorg. Chem.</i> , 1981, 20, 3071.	BIRHAL10	<i>Z. Naturforsch., Teil B</i> , 1982, 37, 1410.
BARRIV	<i>Acta Chem. Scand., Ser. A</i> , 1981, 35, 443.	BIZJAV	<i>J. Organomet. Chem.</i> , 1982, 238, C1.
BAWFUA	<i>Cryst. Struct. Commun.</i> , 1981, 10, 1345.	BOGPOC	<i>Z. Naturforsch., Teil B</i> , 1982, 37, 1402.
BAWGAH	<i>Cryst. Struct. Commun.</i> , 1981, 10, 1353.	BOGSUL	<i>Z. Naturforsch., Teil B</i> , 1982, 37, 1230.
BECTAE	<i>J. Org. Chem.</i> , 1981, 46, 5048, 1981.	BOJLER	<i>Z. Anorg. Allg. Chem.</i> , 1982, 493, 53.
BELNIP	<i>Z. Naturforsch., Teil B</i> , 1982, 37, 299.	BOJPUL	<i>Acta Chem. Scand., Ser. A</i> , 1982, 36, 829.
BEMLIO	<i>Chem. Ber.</i> , 1982, 115, 1126.	BOPFER	<i>Chem. Ber.</i> , 1983, 116, 146.
BEPZEB	<i>Cryst. Struct. Commun.</i> , 1982, 11, 175.	BOPFIV	<i>Chem. Ber.</i> , 1983, 116, 146.
BETJOZ	<i>J. Am. Chem. Soc.</i> , 1982, 104, 1683.	BOVMEE	<i>Acta Crystallogr., Sect. B</i> , 1982, 38, 1048.
BETUTE10	<i>Acta Chem. Scand., Ser. A</i> , 1976, 30, 719.	BQUINI	<i>Acta Crystallogr., Sect. B</i> , 1979, 35, 1930.

BOND LENGTHS IN CRYSTALLINE ORGANIC COMPOUNDS (continued)

- BTUPT** *Acta Chem. Scand., Ser. A*, 1975, **29**, 738.
BUDTEZ *Z. Naturforsch., Teil B*, 1983, **38**, 454.
BUPSIB10 *Z. Anorg. Allg. Chem.*, 1981, **474**, 31.
BUSHAY *Z. Naturforsch., Teil B*, 1983, **38**, 692.
BUTHAZ10 *Inorg. Chem.*, 1984, **23**, 2582.
BUTSUE *J. Chem. Soc., Chem. Commun.*, 1983, 862.
BUWZUO *Acta Chem. Scand., Ser. A*, 1983, **37**, 219.
BZPRIB *Z. Naturforsch., Teil B*, 1981, **36**, 922.
BZTPPI *Inorg. Chem.*, 1978, **17**, 894.
CAHJOK *Inorg. Chem.*, 1983, **22**, 1809.
CAJMAB *Chem. Z.*, 1983, **107**, 169.
CANLUY *Tetrahedron Lett.*, 1983, **24**, 4337.
CASSAQ *J. Struct. Chem.*, 1983, **2**, 101.
CASTOF10 *Acta Crystallogr., Sect. C*, 1984, **40**, 1879.
CASYOK *J. Struct. Chem.*, 1983, **2**, 107.
CECHEX *Z. Anorg. Allg. Chem.*, 1984, **508**, 61.
CECXEN *J. Struct. Chem.*, 1983, **2**, 207.
CEDCUJ *J. Org. Chem.*, 1983, **48**, 5149.
CEHKAB *Z. Naturforsch., Teil B*, 1984, **39**, 139.
CELDOM *Acta Crystallogr., Sect. C*, 1984, **40**, 556.
CESSAU *Acta Crystallogr., Sect. C*, 1984, **40**, 653.
CETTAW *Chem. Ber.*, 1984, **117**, 1089.
CETUTE *Acta Chem. Scand., Ser. A*, 1975, **29**, 763.
CEYLUN *Izv. Akad. Nauk SSSR, Ser. Khim.*, 1983, 2744.
CIFZUM *Acta Chem. Scand., Ser. A*, 1984, **38**, 289.
CIHRAM *Angew. Chem., Int. Ed. Engl.*, 1984, **23**, 302.
CILRUK *J. Chem. Soc., Chem. Commun.*, 1984, 1023.
CILSAR *J. Chem. Soc., Chem. Commun.*, 1984, 1021.
CIMHIP *Acta Crystallogr., C*, 1984, **40**, 1458.
CINTEY *Dokl. Akad. Nauk SSSR*, 1984, **274**, 615.
CIPBUY *J. Struct. Chem.*, 1983, **2**, 281.
CISMUM *Z. Naturforsch., Teil B*, 1984, **39**, 485.
CISTED *Z. Anorg. Allg. Chem.*, 1984, **511**, 95.
CIWYIQ *Inorg. Chem.*, 1984, **23**, 1946.
CIYFOF *Inorg. Chem.*, 1984, **23**, 1790.
CMBIDZ *J. Org. Chem.*, 1979, **44**, 1447.
CODDEE *Z. Naturforsch., Teil B*, 1984, **39**, 1257.
CODDII *Z. Naturforsch., Teil B*, 1984, **39**, 1257.
COFVOI *Z. Naturforsch., Teil B*, 1984, **39**, 1027.
COJCUZ *Chem. Ber.*, 1984, **117**, 2686.
COSDIX *Z. Naturforsch., Teil B*, 1984, **39**, 1344.
COZPIQ *Chem. Ber.*, 1984, **117**, 2063.
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BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES

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Internuclear distances and bond angles are represented in units of Å (1 Å = 10⁻¹⁰ m) and degrees, respectively. The same but inequivalent atoms are discriminated by subscripts a, b, etc. In some molecules ax for axial and eq for equatorial are also used. All measurements were made in the gas phase. The methods used are abbreviated as follows. UV: ultraviolet (including visible) spectroscopy; IR: infrared spectroscopy; R: Raman spectroscopy; MW: microwave spectroscopy; ED: electron diffraction; NMR: nuclear magnetic resonance; LMR: laser magnetic resonance; EPR: electron paramagnetic resonance; MBE: molecular beam electric resonance. If two methods were used jointly for structure determination, they are listed together, as (ED, MW). If the numerical values listed refer to the equilibrium values, they are specified by r_e and θ_e . In other cases the listed values represent various average values in vibrational states; it is frequently the case that they represent the r_s structure derived from several isotopic species for MW or the r_g structure (i.e., the average internuclear distances at thermal equilibrium) for ED. These internuclear distances for the same atom pair with different definitions may sometimes differ as much as 0.01 Å. Appropriate comments are made on the symmetry and conformation in the equilibrium structure.

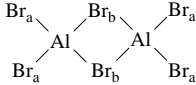
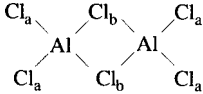
In general, the numerical values listed in the following tables contain uncertainties in the last digits. However, for certain molecules such as diatomic molecules, with experimental uncertainties of the order of 10⁻⁵ Å or smaller, numerical values are listed to four decimal places.

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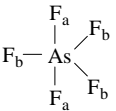
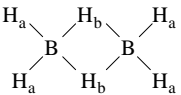
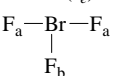
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STRUCTURES OF ELEMENTS AND INORGANIC COMPOUNDS

Compounds are Arranged in Alphabetical Order by their Chemical Formulas
(Lengths in Å and Angles in Degrees)

Compound	Structure	Method
AgBr	Ag—Br (r_e) 2.3931	MW
AgCl	Ag—Cl (r_e) 2.2808	MW
AgF	Ag—F (r_e) 1.9832	MW
AgH	Ag—H (r_e) 1.617	UV
AgI	Ag—I (r_e) 2.5446	MW
AgO	Ag—O (r_e) 2.0030	UV
AlBr	Al—Br (r_e) 2.295	UV
AlCl	Al—Cl (r_e) 2.1301	MW
AlF	Al—F (r_e) 1.6544	MW
AlH	Al—H (r_e) 1.6482	UV
AlI	Al—I (r_e) 2.5371	MW
AlO	Al—O (r_e) 1.6176	UV
Al ₂ Br ₆	 Al—Br _a 2.22 Al—Br _b 2.38 $\angle Br_b Al Br_b$ 82 $\angle Br_a Al Br_a$ 118 (D _{2h})	ED
Al ₂ Cl ₆	 Al—Cl _a 2.04 Al—Cl _b 2.24 $\angle Cl_b Al Cl_b$ 87 $\angle Cl_a Al Cl_a$ 122 (D _{2h})	ED
AsBr ₃	As—Br 2.324	ED
AsCl ₃	As—Cl 2.165	ED, MW
AsF ₃	As—F 1.710	ED, MW

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure		Method
AsF ₅		As—F _a 1.711	As—F _b 1.656 (D _{3h})
AsH ₃	As—H (<i>r_e</i>)	1.511	∠HAsH (<i>θ_e</i>) 92.1
AsI ₃	As—I	2.557	∠IAsI 100.2
AuH	Au—H (<i>r_e</i>)	1.5237	
BBr ₃	B—Br	1.893	(D _{3h})
BCl ₃	B—Cl	1.742	(D _{3h})
BF	B—F (<i>r_e</i>)	1.2626	
BF ₂ H	B—H 1.189	B—F 1.311	∠FBF 118.3
BF ₂ OH	B—F 1.32	B—O 1.34	O—H 0.941
	∠FBF 118	∠FBO 123	∠BOH 114.1
BF ₃	B—F	1.313	(D _{3h})
BH	B—H (<i>r_e</i>)	1.2325	
BH ₃ PH ₃	B—P 1.937	B—H 1.212	P—H 1.399
	∠PBH 103.6	∠BPH 116.9	∠HBH 114.6
	∠HPH 101.3	staggered form	
BI ₃	B—I	2.118	(D _{3h})
BN	B—N (<i>r_e</i>)	1.281	
BO	B—O (<i>r_e</i>)	1.2045	
BO ₂	B—O	1.265	linear
BS	B—S	1.6091	
B ₂ H ₆			B—H _a 1.19 B—H _b 1.33 B···B 1.77 ∠H _a BH _a 122 ∠H _b BH _b 97 ∠BOB≡∠OBO 120
B ₃ H ₃ O ₃	B—O	1.376	
B ₃ H ₆ N ₃	B—N 1.435	B—H 1.26	N—H 1.05
	∠NBN 118	∠BNB 121	(C ₂)
BaH	Ba—H (<i>r_e</i>)	2.2318	
BaO	Ba—O (<i>r_e</i>)	1.9397	
BaS	Ba—S (<i>r_e</i>)	2.5074	
BeF	Be—F (<i>r_e</i>)	1.3609	
BeH	Be—H (<i>r_e</i>)	1.3431	
BeO	Be—O (<i>r_e</i>)	1.3308	
BiBr	Bi—Br (<i>r_e</i>)	2.6095	
BiBr ₃	Bi—Br	2.63	∠BrBiBr 90 (C _{3v})
BiCl	Bi—Cl (<i>r_e</i>)	2.4716	
BiCl ₃	Bi—Cl	2.423	∠ClBiCl 100 (C _{3v})
BiF	Bi—F (<i>r_e</i>)	2.0516	
BiH	Bi—H (<i>r_e</i>)	1.805	
BiI	Bi—I (<i>r_e</i>)	2.8005	
BiO	Bi—O (<i>r_e</i>)	1.934	
BrCN	C—N (<i>r_e</i>)	1.157	C—Br (<i>r_e</i>) 1.790
BrCl	Br—Cl (<i>r_e</i>)	2.1361	
BrF	Br—F (<i>r_e</i>)	1.7590	
BrF ₃		Br—F _a 1.810	Br—F _b 1.721
		∠F _a BrF _b 86.2	(C _{2v})
BrF ₅	Br—F (average) 1.753		
	(Br—F _{eq}) - (Br—F _{ax}) = 0.069		
	∠F _{ax} BrF _{eq} 85.1		(C _{4v})
BrO	Br—O (<i>r_e</i>)	1.7172	
Br ₂	Br—Br (<i>r_e</i>)	2.2811	
CBr ₄	C—Br	1.935	(T _d)
CCl	C—Cl	1.6512	

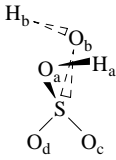
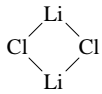
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound			Structure			Method	
CClF ₃	C—Cl	1.752	C—F	1.325	∠FCF	108.6	ED, MW
CCl ₃ F	C—Cl	1.754	C—F	1.362	∠CICCl	111	MW
					(C _{3v})		
CCl ₄	C—Cl	1.767			(T _d)		ED
CF	C—F (<i>r_e</i>)	1.2718					EPR
CF ₃ I	C—I	2.138	C—F	1.330	∠FCF	108.1	ED, MW
CF ₄	C—F	1.323			(T _d)		ED
CH	C—H (<i>r_e</i>)	1.1199					UV
Cl ₄	C—I	2.15			(T _d)		ED
CN	C—N (<i>r_e</i>)	1.1718					MW
CO	C—O (<i>r_e</i>)	1.1283					MW
COBr ₂	C—O	1.178	C—Br	1.923			ED, MW
	∠BrCBr	112.3					
COCIF	C—F	1.334	C—O	1.173	C—Cl	1.725	ED, MW
	∠FCCl	108.8	∠ClCO	127.5			
COCl ₂	C—O	1.179	C—Cl	1.742			ED, MW
	∠ClCCl	111.8					
COF ₂	C—F	1.3157	C—O	1.172			ED, MW
	∠FCF	107.71					
CO ₂	C—O (<i>r_e</i>)	1.1600					IR
CP	C—P (<i>r_e</i>)	1.562					UV
CS	C—S (<i>r_e</i>)	1.5349					MW
CS ₂	C—S (<i>r_e</i>)	1.5526					IR
C ₂	C—C (<i>r_e</i>)	1.2425					UV
C ₃ O ₂	C—O	1.163	C—C	1.289			ED
	linear (large-amplitude bending vibration)						
CaH	Ca—H (<i>r_e</i>)	2.002					UV
CaO	Ca—O (<i>r_e</i>)	1.8221					UV
CaS	Ca—S (<i>r_e</i>)	2.3178					UV
CdH	Cd—H (<i>r_e</i>)	1.781					EPR
CdBr ₂	Cd—Br	2.35			linear		ED
CdCl ₂	Cd—Cl	2.24			linear		ED
CdI ₂	Cd—I	2.56			linear		ED
ClCN	C—Cl (<i>r_e</i>)	1.629	C—N (<i>r_e</i>)	1.160			MW
ClF	Cl—F (<i>r_e</i>)	1.6283					MW
ClF ₃	F _a —Cl—F _a		Cl—F _a	1.698	Cl—F _b	1.598	MW
	|		∠F _a ClF _b	87.5	(C _{2v})		
	F _b						
ClO	Cl—O (<i>r_e</i>)	1.5696					MW, UV
ClOH	O—Cl	1.690	O—H	0.975	∠HOCl	102.5	MW, IR
ClO ₂	Cl—O	1.470			∠OCIO	117.38	MW
ClO ₃ (OH)	O _a —Cl	1.407			O _b —Cl	1.639	ED
			∠O _a ClO _a	114.3	∠O _a ClO _b	104.1	
Cl ₂	Cl—Cl (<i>r_e</i>)	1.9878					UV
Cl ₂ O	Cl—O	1.6959			∠ClOCl	110.89	MW
CoH	Co—H (<i>r_e</i>)	1.542					UV
Cr(CO) ₆	C—O	1.16	Cr—C	1.92			ED
	∠CrCO	180					
CrO	Cr—O (<i>r_e</i>)	1.615					UV
CsBr	Cs—Br (<i>r_e</i>)	3.0723					MW
CsCl	Cs—Cl (<i>r_e</i>)	2.9063					MW
CsF	Cs—F (<i>r_e</i>)	2.3454					MW
CsH	Cs—H (<i>r_e</i>)	2.4938					UV
CsI	Cs—I (<i>r_e</i>)	3.3152					MW

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound			Structure				Method
CsOH	Cs—O (r_e)	2.395		O—H (r_e)	0.97		MW
CuBr	Cu—Br (r_e)	2.1734					MW
CuCl	Cu—Cl (r_e)	2.0512					MW
CuF	Cu—F (r_e)	1.7449					MW
CuH	Cu—H (r_e)	1.4626					UV
CuI	Cu—I (r_e)	2.3383					MW
FCN	C—F	1.262		C—N	1.159		MW
FOH	O—H	0.96	O—F	1.442	\angle HOF	97.2	MW
F ₂	F—F (r_e)	1.4119					R
Fe(CO) ₅	Fe—C (average)	1.821					ED
	(Fe—C) _{eq} — (Fe—C) _{ax}		0.020				
	C—O (average)	1.153		(D _{3h})			
GaBr	Ga—Br (r_e)	2.3525					MW
GaCl	Ga—Cl (r_e)	2.2017					MW
GaF	Ga—F (r_e)	1.7744					MW
GaF ₃	Ga—F	1.88		(D _{3h})			ED
GaI	Ga—I (r_e)	2.5747					MW
GaI ₃	Ga—I	2.458		(D _{3h})			ED
GdI ₃	Gd—I	2.841		\angle IGdI	108	(C _{3v})	ED
GeBrH ₃	Ge—H	1.526		Ge—Br	2.299		MW, IR
	\angle HGeH	106.2					
GeBr ₄	Ge—Br	2.272		(T _d)			ED
GeClH ₃	Ge—H	1.537		Ge—Cl	2.150		IR, MW
	\angle HGeH	111.0					
GeCl ₂	Ge—Cl	2.183		\angle ClGeCl	100.3		ED
GeCl ₄	Ge—Cl	2.113		(T _d)			ED
GeFH ₃	Ge—H	1.522		Ge—F	1.732		MW, IR
	\angle HGeH	113.0					
GeF ₂	Ge—F (r_e)	1.7321		\angle FGeF (θ_e)	97.17		MW
GeH	Ge—H (r_e)	1.5880					UV
GeH ₄	Ge—H	1.5251		(T _d)			IR, R
GeO	Ge—O (r_e)	1.6246					MW
GeS	Ge—S (r_e)	2.0121					MW
GeSe	Ge—Se (r_e)	2.1346					MW
GeTe	Ge—Te (r_e)	2.3402					MW
Ge ₂ H ₆	Ge—H	1.541		Ge—Ge	2.403		ED
	\angle HGeH	106.4		\angle GeGeH	112.5		
HBr	H—Br (r_e)	1.4145					MW
HCN	C—H (r_e)	1.0655		C—N (r_e)	1.1532		MW, IR
				linear			
HCNO	H—C	1.027	C—N	1.161	N—O	1.207	MW
					linear		
HCl	H—Cl (r_e)	1.2746					MW
HF	H—F (r_e)	0.9169					MW
HI	H—I (r_e)	1.6090					MW
HNCO	N—H	0.986	N—C	1.209	C—O	1.166	MW
	\angle HNC	128.0					
HNCS	N—H	0.989	N—C	1.216	C—S	1.561	MW
	\angle HNC	135.0	\angle NCS	180			
HNO	N—H	1.063	N—O	1.212	\angle HNO	108.6	UV
HNO ₂			<i>s-trans</i> conformer		<i>s-cis</i> conformer		MW
			O _b —H	0.958		0.98	
			N—O _b	1.432		1.39	
			N—O _a	1.170		1.19	
			\angle O _a NO _b	110.7		114	
			\angle NO _b H	102.1		104	
HNO ₃			O _c —H	0.96	N—O _c	1.41	MW
			N—O _a	1.20	N—O _b	1.21	
			\angle HO _c N	102.2	\angle O _c NO _a	113.9	
			\angle O _c NO _b	115.9	planar		

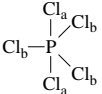
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure		Method	
HNSO	N—H 1.029 ∠HNS 115.8	N—S 1.512 ∠NSO 120.4 planar	S—O 1.451	MW
H ₂	H—H (<i>r_e</i>) 0.7414			UV
H ₂ O	O—H (<i>r_e</i>) 0.9575	∠HOH (<i>θ_e</i>) 104.51		MW, IR
H ₂ O ₂	O—O 1.475 dihedral angle of internal rotation 119.8	∠OOH 94.8 (C ₂)		IR
H ₂ S	H—S (<i>r_e</i>) 1.3356	∠HSH (<i>θ_e</i>) 92.12		MW, IR
H ₂ SO ₄		O—H 0.97 S—O _c 1.422 ∠O _a SO _b 101.3 ∠O _a SO _c 108.6 dihedral angle between the H _a O _a S and O _a SO _c planes 20.8 dihedral angle between the H _a O _a S and O _a SO _b planes 90.9 dihedral angle between the H _a O _a S and O _c SO _d planes 88.4	S—O _a 1.574 ∠H _a O _a S 108.5 ∠O _c SO _d 123.3 ∠O _a SO _d 106.4	MW (C ₂)
H ₂ S ₂	S—S 2.055 dihedral angle of internal rotation 90.6	S—H 1.327 (C ₂)	∠SSH 91.3	ED, MW
HfCl ₄	Hf—Cl 2.33	(T _d)		ED
HgCl ₂	Hg—Cl 2.252	linear		ED
HgH	Hg—H (<i>r_e</i>) 1.7404			UV
HgI ₂	Hg—I 2.553	linear		ED
I ₂	I—I (<i>r_e</i>) 2.4691			MW
ICN	C—I 1.995	C—N 1.159		MW
ICl	I—Cl (<i>r_e</i>) 2.3210			MW
IF ₅	I—F (average) 1.860 ∠F _{ax} IF _{eq} 82.1	(I—F) _{eq} — (I—F) _{ax} 0.03 (C _{4v})		ED, MW
IO	I—O (<i>r_e</i>) 1.8676			MW
I ₂	I—I (<i>r_e</i>) 2.6663			R
InBr	In—Br (<i>r_e</i>) 2.5432			MW
InCl	In—Cl (<i>r_e</i>) 2.4012			MW
InF	In—F (<i>r_e</i>) 1.9854			MW
InH	In—H (<i>r_e</i>) 1.8376			UV
InI	In—I (<i>r_e</i>) 2.7537			MW
IrF ₆	Ir—F 1.830	(O _h)		ED
KBr	K—Br (<i>r_e</i>) 2.8208			MW
KCl	K—Cl (<i>r_e</i>) 2.6667			MW
KF	K—F (<i>r_e</i>) 2.1716			MW
KH	K—H (<i>r_e</i>) 2.244			UV
KI	K—I (<i>r_e</i>) 3.0478			MW
KOH	O—H 0.91	K—O 2.212 linear		MW
K ₂	K—K (<i>r_e</i>) 3.9051			UV
KrF ₂	Kr—F 1.89	linear		ED
LiBr	Li—Br (<i>r_e</i>) 2.1704			MW
LiCl	Li—Cl (<i>r_e</i>) 2.0207			MW
LiF	Li—F (<i>r_e</i>) 1.5639			MW
LiH	Li—H (<i>r_e</i>) 1.5949			MW
LiI	Li—I (<i>r_e</i>) 2.3919			MW
Li ₂	Li—Li (<i>r_e</i>) 2.6729			UV
Li ₂ Cl ₂		Li—Cl 2.23 Cl—Cl 3.61 ∠CLiCl 108		ED
LuCl ₃	Lu—Cl 2.417	∠CLuCl 112	(C _{3v})	ED
MgF	Mg—F (<i>r_e</i>) 1.7500			UV
MgH	Mg—H (<i>r_e</i>) 1.7297			UV
MgO	Mg—O (<i>r_e</i>) 1.749			UV
MnH	Mn—H (<i>r_e</i>) 1.7308			UV
Mo(CO) ₆	Mo—C 2.063	C—O 1.145	(O _h)	ED
MoCl ₄ O	Mo—Cl 2.279 ∠ClMoCl 87.2	Mo—O 1.658 (C _{4v})		ED


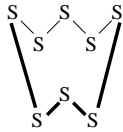
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure		Method
MoF ₆	Mo—F	1.820	(O _h) ED
NClH ₂	N—H	1.017	N—Cl 1.748 MW, IR
	∠HNCI	103.7	∠HNNH 107
NCl ₃	N—Cl	1.759	∠CINCl 107.1 ED
NF ₂	N—F	1.3528	∠FNF 103.18 MW
NH ₂	N—H	1.024	∠HNNH 103.3 UV
NH ₂ CN	N—H	1.00	N _a —C 1.35 MW
		C—N _b 1.160	∠HNNH 114
		angle between the NH ₂ plane and the N—C bond	142
NH ₂ NO ₂	N—N	1.427	N—H 1.005 MW
	∠HNNH	115.2	∠ONO 130.1
	dihedral angle between the NH ₂ and NNO ₂ planes		128.2
NH ₃	N—H (<i>r_e</i>)	1.012	∠HNNH (<i>θ_e</i>) 106.7 IR
NH ₄ Cl	N—H 1.22	N—Cl 2.54	(C _{3v}) ED
NF ₂ CN	F ₂ N _b —C≡N _a	C—N _a 1.158	C—N _b 1.386 MW
	N _b —F 1.399	∠N _a CN _b 174	
	∠CN _b F 105.4	∠FN _b F 102.8	
NH	N—H (<i>r_e</i>)	1.0362	
NH ₂ OH	N—H 1.02	N—O 1.453	O—H 0.962 MW
	∠HNNH 107	∠HNO 103.3	∠NOH 101.4
	The bisector of H—N—H angle is <i>trans</i> to the O—H bond		
NO	N—O (<i>r_e</i>)	1.1506	IR
NOCl	N—Cl 1.975	N—O 1.14	∠ONCl 113 MW
NOF	O—N 1.136	N—F 1.512	∠FNO 110.1 MW
NO ₂	N—O	1.193	∠ONO 134.1 MW
NO ₂ Cl	N—Cl	1.840	N—O 1.202 MW
	∠ONO	130.6	(C _{2v})
NO ₂ F	N—O	1.1798	N—F 1.467 MW
	∠ONO	136	(C _{2v})
NS	N—S (<i>r_e</i>)	1.4940	IR
N ₂	N—N (<i>r_e</i>)	1.0977	UV
N ₂ H ₄	N—H	1.021	N—N 1.449 ED, MW
	∠HNNH	106.6 (assumed)	∠NNH _a 112
	∠NNH _b 106	dihedral angle of internal rotation	91
	H _a : the H atom closer to the C ₂ axis, H _b : the H atom farther from the C ₂ axis		
N ₂ O	N—N (<i>r_e</i>)	1.1284	N—O (<i>r_e</i>) 1.1841 MW, IR
N ₂ O ₃		N _a —N _b 1.864	N _a —O _a 1.142 MW
		N _b —O _b 1.202	N _b —O _c 1.217
		∠O _a N _a N _b 105.05	
		∠N _a N _b O _b 112.72	
		∠N _a N _b O _c 117.47	
N ₂ O ₄		N—N 1.782	N—O 1.190 ED
		∠ONO 135.4	(D _{2h})
NaBr	Na—Br (<i>r_e</i>)	2.5020	MW
NaCl	Na—Cl (<i>r_e</i>)	2.3609	MW
NaF	Na—F (<i>r_e</i>)	1.9260	MW
NaH	Na—H (<i>r_e</i>)	1.8873	UV
NaI	Na—I (<i>r_e</i>)	2.7115	MW
Na ₂	Na—Na (<i>r_e</i>)	3.0789	UV
NbCl ₅	Nb—Cl _{eq} 2.241	Nb—Cl _{ax} 2.338 (D _{3h})	ED
NbO	Nb—O (<i>r_e</i>)	1.691	UV
Ni(CO) ₄	Ni—C 1.838	C—O 1.141	(T _d) ED
NiH	Ni—H (<i>r_e</i>)	1.476	UV
NpF ₆	Np—F	1.981	(O _h) ED
OCS	C—O (<i>r_e</i>)	1.1578	C—S (<i>r_e</i>) 1.5601 MW

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound		Structure				Method
OCS _e	C—O	1.159	C—Se	1.709		MW
OF	O—F (<i>r_e</i>)	1.3579				LMR
OF ₂	O—F (<i>r_e</i>)	1.4053	∠FOF (<i>θ_e</i>)	103.07	(C _{2v})	MW
O(SiH ₃) ₂	Si—H	1.486	Si—O	1.634		ED
	∠SiOSi	144.1				
O ₂	O—O (<i>r_e</i>)	1.2074				MW
O ₂ F ₂	O—O	1.217	F—O	1.575		MW
	∠OOF	109.5	dihedral angle of internal rotation	87.5	(C ₂)	
O ₃	O—O (<i>r_e</i>)	1.2716	∠OOO (<i>θ_e</i>)	117.47	(C _{2v})	MW
OsF ₆	Os—F	1.831	(O _h)			ED
OsO ₄	Os—O	1.712	(T _d)			ED
PBr ₃	P—Br	2.220	∠BrPBr	101.0		ED
PCl ₃	P—Cl	2.039	∠ClPCl	100.27		ED
PCl ₅			P—Cl _a 2.124	P—Cl _b 2.020	(D _{3h})	ED
PF	P—F (<i>r_e</i>)	1.5896				UV
PF ₃	P—F	1.570	∠FPF	97.8		ED, MW
PF ₅	P—F _{ax} 1.577		P—F _{eq} 1.534		(D _{3h})	ED
PH	P—H (<i>r_e</i>)	1.4223				LMR
PH ₂	P—H	1.418	∠HPH	91.70		UV
PH ₃	P—H	1.4200	∠HPH	93.345		MW
PN	N—P (<i>r_e</i>)	1.4909				MW
PO	O—P (<i>r_e</i>)	1.4759				UV
POCl ₃	P—O	1.449	P—Cl	1.993		ED
	∠ClPCl	103.3				
POF ₃	P—O 1.436		P—F 1.524	∠FPF 101.3		ED, MW
P ₂	P—P (<i>r_e</i>)	1.8931				UV
P ₂ F ₄	P—F	1.587	P—P	2.281		ED
	∠PPF	95.4	∠FPF	99.1		
	The two PF ₂ planes are <i>trans</i> to each other (the <i>gauche</i> conformer is less than 10%)					
P ₄	P—P	2.21	(T _d)			ED
P ₄ O ₆	P—O 1.638		∠POP 126.4		(T _d)	ED
PbH	Pb—H (<i>r_e</i>)	1.839				UV
PbO	Pb—O (<i>r_e</i>)	1.9218				MW
PbS	Pb—S (<i>r_e</i>)	2.2869				MW
PbSe	Pb—Se (<i>r_e</i>)	2.4022				MW
PbTe	Pb—Te (<i>r_e</i>)	2.5950				MW
PrI ₃	Pr—I 2.904		∠IPrI 113		(C _{3v})	ED
PtO	Pt—O (<i>r_e</i>)	1.7273				UV
PuF ₆	Pu—F	1.971	(O _h)			ED
RbBr	Rb—Br (<i>r_e</i>)	2.9447				MW
RbCl	Rb—Cl (<i>r_e</i>)	2.7869				MW
RbF	Rb—F (<i>r_e</i>)	2.2703				MW
RbH	Rb—H (<i>r_e</i>)	2.367				UV
RbI	Rb—I (<i>r_e</i>)	3.1768				MW
RbOH	Rb—O 2.301		O—H 0.957		linear	MW
ReClO ₃	Re—O	1.702	Re—Cl	2.229		MW
	∠ClReO	109.4	(C _{3v})			
ReF ₆	Re—F	1.832	(O _h)			ED
RuO ₄	Ru—O	1.706	(T _d)			ED
SCSe	C—Se	1.693	C—S	1.553		MW
SCTe	C—S	1.557	C—Te	1.904		MW
SCl ₂	S—Cl 2.006		∠ClSCl 103.0		(C _{2v})	ED
SF	S—F (<i>r_e</i>)	1.6006				MW
SF ₂	S—F	1.5921	∠FSF	98.20		MW
SF ₆	S—F	1.561	(O _h)			ED

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure		Method		
SO	S—O (r_e)	1.4811	MW		
SOCl ₂	S—O	1.44	S—Cl 2.072 ∠OSCl 108.0		
	∠ClSCl	97.2			
SOF ₂	S—O	1.420	S—F 1.583 ∠FSF 92.2		
	∠OSF	106.2			
SOF ₄			S—O 1.403	S—F _a 1.575	ED
			S—F _b 1.552	∠OSF _a 90.7	
			∠OSF _b 124.9	∠F _a SF _b 89.6	
			∠F _b SF _b 110.2	(C _{2v})	
				119.329	
SO ₂	S—O (r_e)	1.4308	∠OSO (θ_e)	119.329	MW
SO ₂ Cl ₂	S—O	1.404	S—Cl 2.011	∠OSO 123.5	ED
	∠ClSCl	100.0			
SO ₂ F ₂	S—O	1.397	S—F 1.530	∠OSO 123	ED
	∠FSF	97			
SO ₃	S—O	1.4198	(D _{3h})		IR
S(SiH ₃) ₂	Si—H	1.494	Si—S 2.136	∠SiSSi 97.4	ED
S ₂	S—S (r_e)	1.8892			R
S ₂ Br ₂	S—Br	2.24	S—S	1.98	ED
	∠SSBr	105	dihedral angle of internal rotation	83.5	
S ₂ Cl ₂	S—Cl	2.057	S—S	1.931	ED
	∠SSCl	108.2	dihedral angle of internal rotation	84.1	
S ₂ O ₂	S—O	1.458	S—S 2.025	∠OSS 112.8	MW
				planar <i>cis</i> form	
S ₈			S—S 2.07		ED
			∠SSS 105		
			(D _{4d})		
SbCl ₃	Sb—Cl	2.333	∠ClSbCl	97.2	ED
SbH ₃	Sb—H	1.704	∠HSbH	91.6	MW
SeF	Se—F	1.742			MW
SeF ₆	Se—F	1.69	(O _h)		ED
SeO	Se—O (r_e)	1.6393			MW
	Se—O	1.576	Se—F 1.730		
	∠OSeF	104.82	∠FSeF 92.22		
SeO ₂	Se—O (r_e)	1.6076	∠OSeO (θ_e)	113.83	MW
SeO ₃	Se—O	1.69	(D _{3h})		ED
Se ₂	Se—Se (r_e)	2.1660			UV
Se ₆	Se—Se	2.34	∠SeSeSe	102	ED
			six-membered ring with chair conformation		
SiBrF ₃	Si—F	1.560	Si—Br	2.153	MW
	∠FSiBr	108.5	(C _{3v})		
SiBrH ₃	Si—H	1.485	Si—Br	2.210	MW
	∠HSiBr	107.8	(C _{3v})		
SiClH ₃	Si—H	1.482	Si—Cl	2.048	MW
	∠HSiCl	107.9	(C _{3v})		
SiCl ₄	Si—Cl	2.019	(T _d)		ED
SiF	Si—F	1.6008			UV
SiFH ₃	Si—H	1.484	Si—F	1.593	MW, IR
	∠HSiH	110.63	(C _{3v})		
	Si—F (r_e)	1.590	∠FSiF (θ_e)	100.8	
SiF ₃ H	Si—H (r_e)	1.4468	Si—F (r_e)	1.5624	MW
	∠HSiF (θ_e)	110.64			
SiF ₄	Si—F	1.553	(T _d)		ED
SiH	Si—H (r_e)	1.5201			UV
SiH ₃ I	Si—H	1.485	Si—I	2.437	MW
	∠HSI	107.8			
SiH ₄	Si—H	1.4798	(T _d)		IR
SiN	N—Si (r_e)	1.572			UV
SiO	Si—O (r_e)	1.5097			MW

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure		Method
SiS	Si—S (r_e)	1.9293	MW
SiSe	Se—Si (r_e)	2.0583	MW
Si ₂	Si—Si (r_e)	2.246	UV
Si ₂ Cl ₆	Si—Si	2.32	ED
	Si—Cl	2.009	
	∠ClSiCl	109.7	
Si ₂ F ₆	Si—Si	2.317	ED
	Si—F	1.564	
	∠FSiF	108.6	
Si ₂ H ₆	Si—H	1.492	ED
	Si—Si	2.331	
	∠HSiH	108.6	
	staggered form (assumed)		
SnCl ₄	Sn—Cl	2.280	ED
	(T _d)		
SnH	Sn—H (r_e)	1.7815	UV
SnH ₄	Sn—H	1.711	R, IR
	(T _d)		
SnO	Sn—O	1.8325	MW
SnS	S—Sn (r_e)	2.2090	MW
SnSe	Se—Sn (r_e)	2.3256	MW
SnTe	Sn—Te (r_e)	2.5228	MW
SrH	Sr—H (r_e)	2.1455	UV
SrO	Sr—O (r_e)	1.9198	MW
SrS	S—Sr (r_e)	2.4405	UV
TaCl ₅	Ta—Cl _{eq}	2.227	ED
	Ta—Cl _{ax}	2.369	(D _{3h})
TaO	Ta—O (r_e)	1.6875	UV
TeF ₆	Te—F	1.815	ED
	(O _h)		
Te ₂	Te—Te (r_e)	2.5574	UV
ThCl ₄	Th—Cl	2.58	ED
	(T _d)		
ThF ₄	Th—F	2.14	ED
	(T _d)		
TlBr	Tl—Br (r_e)	2.6182	MW
TlCl	Tl—Cl (r_e)	2.4848	MW
TlF	Tl—F (r_e)	2.0844	MW
TlH	Tl—H (r_e)	1.870	UV
TlI	Tl—I (r_e)	2.8137	MW
TiBr ₄	Ti—Br	2.339	ED
	(T _d)		
TiCl ₄	Ti—Cl	2.170	ED
	(T _d)		
TiO	Ti—O (r_e)	1.620	UV
TiS	Ti—S (r_e)	2.0825	UV
UF ₆	U—F	1.996	ED
	(O _h)		
V(CO) ₆	V—C	2.015	ED
	C—O	1.138	
	(O _h , involving dynamic Jahn-Teller effect)		
VCl ₃ O	V—O	1.570	ED, MW
	V—Cl	2.142	
	∠ClVCl	111.3	
VCl ₄	V—Cl	2.138	ED
	(T _d , involving dynamic Jahn-Teller effect)		
VF ₅	V—F (average)	1.71	ED
VO	V—O (r_e)	1.5893	UV
W(CO) ₆	W—C	2.059	ED
	C—O	1.149	(O _h)
WClF ₅	W—Cl	2.251	MW
	W—F (average)	1.836	
	∠F _a WF _b	88.7	
WF ₄ O	W—O	1.666	ED
	W—F	1.847	
	∠FWF	86.2	(C _{4v})
WF ₆	W—F	1.832	ED
	(O _h)		
XeF ₂	Xe—F	1.977	IR
	linear		
XeF ₄	Xe—F	1.94	ED
	(D _{4h})		
XeF ₆	Xe—F	1.890	ED
	(large-amplitude bending vibration around the O _h structure)		
XeO ₄	Xe—O	1.736	ED
	(T _d)		
ZnH	Zn—H (r_e)	1.5949	UV
ZrCl ₄	Zr—Cl	2.32	ED
	(T _d)		
ZrF ₄	Zr—F	1.902	ED
	(T _d)		
ZrO	Zr—O (r_e)	1.7116	UV

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

STRUCTURES OF ORGANIC MOLECULES

Compounds are Arranged in Alphabetical Order by Chemical Name; Cross References are Given for
Common Synonyms (Lengths in Å and Angles in Degrees)

Compound	Structure			Method		
Acetaldehyde		C _a —O	1.210	ED, MW		
		C _b —H	1.107			
Acetamide CH ₃ CONH ₂		C _a —C _b	1.515	∠C _b C _a O	124.1	ED
		∠HC _b H	109.8	∠C _b C _a H	115.3	
		C—O	1.220	C—N	1.380	
		C—C	1.519	N—H	1.022	
		C—H	1.124	∠NCO	122.0	
		∠CCN	115.1			
Acetic acid		C—C	1.520	ED		
		C—O _a	1.214			
		C—O _b	1.364			
		∠CCO _a	126.6			
Acetone (CH ₃) ₂ CO		C—O	1.213	ED, MW		
		C—H	1.103			
		∠CCC	116.0			
		∠HCH	108.5			
		symmetry axis of each methyl group is tilted 2° from the C—C bond				
Acetonitrile CH ₃ CN		C—H	1.107	ED, MW		
		C—N	1.159			
Acetonitrile oxide CH ₃ CNO		C—C	1.442	MW		
		N—O	1.217			
Acetyl chloride CH ₃ COCl		C—H	1.105	ED, MW		
		C—C	1.506			
		∠HCH	108.6			
Acetyl cyanide → Pyruvitrile		∠CCC	111.6			
		∠CCCl	111.6			
Acetylene HC≡CH	C—H (<i>r_e</i>)	1.060	C—C (<i>r_e</i>)	1.203	IR	
Acrolein → Acrylaldehyde		C _b —C _c	1.484	ED, MW		
C _a —C _b		1.345				
C _c —O		1.217				
C _a —H		1.10				
C _c —H		1.13				
∠C _a C _b C _c		120.3				
∠HC _c C _b	114	other CCH angles (average)	122			
planar <i>s-trans</i> form						
Acrylonitrile		C _a —C _b	1.343	ED, MW		
		C _b —C _c	1.438			
		C _c —N	1.167			
		C _a —H	1.114			
		∠C _a C _b C _c	121.7			
∠C _b C _c N	178	∠HCC	120			
Acryloyl chloride		C—H	1.086 (assumed)	MW		
		C—Cl	1.82			
		C _b —C _c	1.48			
		C _a —C _b	1.35			
		C—O	1.19			
		∠C _a C _b H	120 (assumed)			
∠C _b C _a H	121.5 (assumed)					
∠C _a C _b C _c	123					
∠C _b C _c Cl	116					
∠C _b C _c O	127					

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method
Allene CH ₂ =C=CH ₂	C—C	1.3084	C—H	1.087	IR
Allyl chloride	∠HCH	118.2			
			<i>cis conformer</i>	C—Cl 1.811	MW
			<i>skew conformer</i>	∠CCCl 115.2	
	∠CCCl	109.6	CCCCl	1.809	dihedral angle of internal rotation 122.4
Aniline C ₆ H ₅ NH ₂	C—C	1.392	C—N	1.431	MW
	N—H	0.998	∠HNH	113.9	
	dihedral angle between the NH ₂ plane and the N—C bond			140.6	
Azetidine	CH ₂ —CH ₂		C—N	1.482	ED
			C—C	1.553	
	CH ₂ —NH		C—H	1.107	
	N—H	1.03	∠CNC	92.2	
	∠CCC	86.9	∠CCN	85.8	
	dihedral angle between the CCC and CNC planes			147	
Aziridine			N—H	1.016	MW
			N—C	1.475	
			C—C	1.481	
			C—H	1.084	
			∠CNC	60.3	
			∠H _a NC	109.3	
			∠H _b CC	117.8	
	∠H _b CH _c	115.7	∠H _c CC	119.3	
	∠H _b CN	118.3			
	∠H _c CN	114.3			
Azomethane CH ₃ N=NCH ₃	C—N	1.482	N—N	1.247	ED
	∠CNN	112.3	<i>trans conformer</i>		
Benzene C ₆ H ₆	C—C	1.399	C—H	1.101	ED, IR
<i>p</i> -Benzoquinone			C _a —O	1.225	ED
			C _b —C _b	1.344	
			C _a —C _b	1.481	
			∠C _b C _a C _b	118.1	
Biacetyl CH ₃ COCOCH ₃	C—O	1.215	C—C (average)	1.524	ED
	C—H	1.108	∠CCO	119.5	
	∠CCC	116.2	<i>trans conformer</i>		
Bicyclo[1.1.0]butane			C _a —C _a	1.497	MW
			C _a —C _b	1.498	
			C _a —H _a	1.071	
			C _b —H _b , C _b —H _c	1.093	
			∠H _b C _b H _c	115.6	
	∠C _b C _a H _a	130.4	∠C _a C _b C _a	60.0	
	∠C _a C _a H _a	128.4	dihedral angle between the two C _a C _a C _b planes 121.7		
Bicyclo[2.2.1]hepta-2,5-diene			C _a —C _b	1.535	ED
			C _b —C _b	1.343	
			C _a —C _c	1.573	
			C—H	1.12	
			∠C _a C _c C _a	94	
		dihedral angle between the two C _a C _b C _b C _a planes (C _{2v})			115.6
Bicyclo[2.2.1]heptane C ₇ H ₁₂	See the preceding molecule for the labels of the C atoms				
	C _a —C _b	1.54	C _b —C _b	1.56	ED
	C _a —C _c	1.56	C—C (average)	1.549	
	—C _a C _c C _a	93.1	dihedral angle between the two C _a C _b C _b C _a planes		113.1

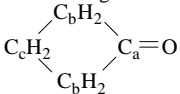
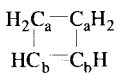
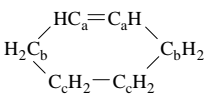
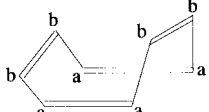
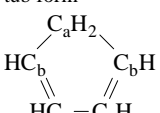
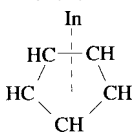
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure			Method
Bicyclo[2.2.0]hexa-2,5-diene		C_b-C_b C_a-C_a C_a-C_b	1.345 1.574 1.524	ED
	dihedral angle between the two $C_aC_bC_bC_a$ planes		117.3	
Bicyclo[2.2.2]octane	$HC_a(C_bH_2C_bH_2)_3C_aH$	C_a-C_b $\angle C_aC_bC_b$	1.54 109.7	ED
	C—C (average)	1.542		
	large-amplitude torsional motion about the D_{3h} symmetry axis			
Bicyclo[1.1.1]pentane	C—C	1.557	$\angle CCC$ 74.2	ED
C_5H_8				
Bicyclo[2.1.0]pentane		C_a-C_a C_b-C_b C_a-C_b C_a-C_c	1.536 1.565 1.528 1.507	MW
	Dihedral angle between the $C_aC_aC_bC_b$ and $C_aC_aC_cC_c$ planes		112.7	
Biphenyl		$C-C$ (intra-ring) (inter-ring)	1.396 1.49	ED
	torsional dihedral angle between the two rings		~40	
4,4'-Bipyridyl	C—C, C—N (intra-ring)		1.375	ED
		C—C (inter-ring)	1.465	
	torsional dihedral angle between the two rings		~37	
Bis (cyclopentadienyl) beryllium	Be—(cyclopentadienyl plane)		1.470, 1.92	ED
$(C_5H_5)_2Be$	C—C	1.423 (C_{5v})	(The Be atom has two equilibrium positions)	
Bis (cyclopentadienyl) iron → Ferrocene				
Bis (cyclopentadienyl) lead	C—C	1.430	Pb—C 2.79	ED
$(C_5H_5)_2Pb$			dihedral angle between the two C_5H_5 planes 40–50 (The two rings are not parallel.)	
Bis (cyclopentadienyl) manganese	Mn—C	2.383	C—C 1.429 (D_{5h})	ED
$(C_5H_5)_2Mn$				
Bis (cyclopentadienyl) nickel	Ni—C	2.196	C—C 1.430 (D_{5h})	ED
$(C_5H_5)_2Ni$				
Bis (cyclopentadienyl) ruthenium	C—C	1.439	Ru—C 2.196	ED
$(C_5H_5)_2Ru$				
Bis (cyclopentadienyl) tin	C—C	1.431	Sn—C 2.71	ED
$(C_5H_5)_2Sn$	C—H	1.14	(D_{5h})	
Bis (trifluoromethyl) peroxide	O—O	1.42	C—O 1.399	ED
CF_3OOCF_3	C—F	1.320	$\angle COO$ 107	
	$\angle FCF$	109.0	COOC dihedral angle of internal rotation 123	
Borine carbonyl	B—H	1.194	B—C 1.540	MW
BH_3CO	C—O	1.131	$\angle HBH$ 113.9	
	$\angle BCO$	180	(C_{3v})	
Bromobenzene		$C-H$ C_c-C_d C_b-C_c $C-Br$ C_a-C_b $\angle C_bC_aC_b$	1.072 1.401 1.375 1.85 1.42 117.4	MW
Bromoform	C—Br	1.924	C—H 1.11	ED, MW
$CHBr_3$	$\angle BrCBr$	111.7	(C_{3v})	
Bromoiodoacetylene	C—I	1.972	C—C 1.206	ED
$IC\equiv CBr$	C—Br	1.795		

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure			Method
1,3-Butadiene	$\begin{array}{c} C_a H_2 \\ \diagdown \\ C_b H - C_b H \\ \diagup \\ C_a H_2 \end{array}$	$C_b - C_b$ 1.467 $C_a - C_b$ 1.349 $C - H$ (average) 1.108 $\angle CCC$ 124.4	ED	
1,3-Butadiyne	$\angle C_b C_a H$ 120.9 $H C_a \equiv C_b - C_b \equiv C_a H$ $C_a - C_b$ 1.218	$C - H$ 1.09 $C_b - C_b$ 1.384 linear	ED	
Butane $CH_3CH_2CH_2CH_3$	$C - C$ 1.531 $\angle CCC$ 113.8 <i>trans</i> conformer 54%	$C - H$ 1.117 $\angle CCH$ 111.0 dihedral angle for the <i>gauche</i> conformer 65	ED	
2-Butanone → Ethyl methyl ketone				
Butatriene	$H_2 C_a = C_b = C_b = C_a H_2$ $C_a - C_b$ 1.32	$C - H$ 1.08 $C_b - C_b$ 1.28 ED <i>trans</i> conformer 1.508 $\angle C_a C_b C_b$ 125.4	ED	
2-Butene	$C_a H_3 - C_b H = C_b H - C_a H_3$ <i>cis</i> conformer $C_a - C_b$ 1.346 $C_b - C_b$ 1.347 $\angle C_a C_b C_b$ 123.8			
3-Buten-1-yne → Vinylacetylene				
<i>tert</i> -Butyl chloride $(CH_3)_3CCl$	$C - H$ 1.102 $C - Cl$ 1.828 $\angle CCH$ 110.8	$C - C$ 1.528 $\angle CCCl$ 107.3 $\angle CCC$ 111.6	ED, MW	
<i>tert</i> -Butyl cyanide → Pivalonitrile				
2-Butyne	$C_a H_3 - C_b \equiv C_b - C_a H_3$ $C_b - C_b$ 1.214 $\angle C_b C_a H$ 110.7 $C - C$ (r_e) 1.3119 $C - C$ 1.277	$C - H$ 1.116 $C_a - C_b$ 1.468 linear	ED	
Carbon C_2			UV	
Carbon C_3			UV	
Carbon suboxide → Tricarbon dioxide				
Carbon tetrabromide CBr_4	$C - Br$ 1.935	(T_d)	ED	
Carbon tetrachloride CCl_4	$C - Cl$ 1.767	(T_d)	ED	
Carbon tetrafluoride CF_4	$C - F$ 1.323	(T_d)	ED	
Carbon tetraiodide CI_4	$C - I$ 2.15	(T_d)	ED	
Carbonyl cyanide $CO(CN)_2$	$C - O$ 1.209 $C - N$ 1.153 $\angle CCN$ 180	$C - C$ 1.466 $\angle CCC$ 115	ED, MW	
Chloroacetylene $HC \equiv CCl$	$C - H$ 1.0550 $C - Cl$ 1.6368	$C - C$ 1.2033	MW	
Chlorobenzene C_6H_5Cl	$C - C$ 1.400 $C - H$ 1.083 $\angle CC(H)C$ 120	$C - Cl$ 1.737 $\angle CC(Cl)C$ 121.7	ED	
Chlorobromoacetylene $ClC \equiv CBr$	$Cl - C$ 1.636 $C - Br$ 1.784	$C - C$ 1.206	ED	
Chlorocyanoacetylene $ClC \equiv CCN$	$C - Cl$ 1.624 $C - CN$ 1.362	$C - C$ 1.205 $C - N$ 1.160	ED	
Chloroethane → Ethyl chloride				
2-Chloroethanol $ClCH_2CH_2OH$	$C - O$ 1.413 $C - Cl$ 1.801 $O - H$ 1.033	$\angle CCCl$ 110.7 $\angle CCO$ 113.8 fraction of the <i>gauche</i> conformer at 37°C is 92 ~ 94%, dihedral angle of internal rotation 62.4	ED	
Chloroethylene → Vinyl chloride				
Chloroform $CHCl_3$	$C - H$ 1.100 $\angle ClCCl$ 111.3	$C - Cl$ 1.758 (C_{3v})	MW	

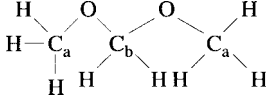
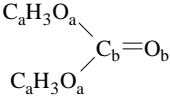
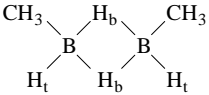
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure		Method			
Chloroiodoacetylene	C—Cl	1.63	C—I	1.99	MW	
ClC≡Cl	C—C	1.209 (assumed)				
Chloromethane → Methyl chloride						
3-Chloropropene → Allyl chloride						
Cyanamide	N _a —C	1.346	C—N _b	1.160	MW	
H ₂ N _a CN _b	N—H	1.00	∠H _a NH	114		
			dihedral angle between the NH ₂ plane and the N—C bond	142		
Cyanoacetylene	C _b —H	1.058	C _a —C _b	1.205	MW	
H—C _b ≡C _a —C≡N	C _a —C _c	1.378	C _c —N	1.159		
Cyanocyclopropane	C—C (ring)	1.513	C—C _a	1.472	MW	
C ₃ H ₅ C _a N	C—H	1.107	C _a —N	1.157		
	∠HCH	114.6	∠C _a CH	119.6		
Cyanogen	C—N	1.163	C—C	1.393	ED	
(CN) ₂			linear			
Cyclobutane	C—H	1.113	C—C	1.555	ED	
(CH ₂) ₄			dihedral angle between the two CCC planes	145		
Cyclobutanone			C _a —C _b	1.527	MW	
			C _b —C _c	1.556		
			∠C _b C _a C _b	93.1		
			∠C _a C _b C _c	88.0		
Cyclobutene		C _b —C _b	1.342	C _a —C _a	1.566	MW
		C _a —C _b	1.517	C _a —H	1.094	
		C _b —H	1.083			
	∠C _a C _b C _b	94.2	∠C _b C _b H	133.5		
	∠C _a C _a H	114.5	∠C _a C _a C _b	85.8		
	∠HC _a H	109.2	dihedral angle between the CH ₂ plane and the C _a —C _a bond	135.8		
Cyclohexane	C—C	1.536	C—H	1.119	ED	
C ₆ H ₁₂	∠CCC	111.3	chair form			
Cyclohexene			C _a —C _a	1.334	ED	
			C _a —C _b	1.50		
			C _b —C _c	1.52		
			C _c —C _c	1.54		
	∠C _a C _a C _b	123.4	∠C _a C _b C _c	112.0		
	∠C _b C _c C _c	110.9	(C ₂)	half-chair form		
Cyclooctatetraene			C _a —C _b	1.476	ED	
			C—H	1.100		
			C _a —C _a , C _b —C _b	1.340		
			∠C _b C _a C _a , ∠C _a C _b C _b	126.1		
			dihedral angle between the C _a C _a C _a C _a and C _a C _b C _b C _a planes	136.9		
	tub form	(D _{2d})				
1,3-Cyclopentadiene			C _a —C _b	1.509	MW	
			C _b —C _c	1.342		
			C _c —C _c	1.469		
			∠C _a C _b C _c	109.3		
	∠C _b C _c C _c	109.4	∠C _b C _a C _b	102.8		
Cyclopentadienylindium			In—C	2.621	ED	
			C—C	1.426		
			(C _{5v})			
Cyclopentane	C—H	1.114	C—C	1.546	ED	
(CH ₂) ₅	∠CCH	111.7				
			(The out-of-plane vibration of the C atoms is essentially free pseudorotation; average value of the displacements of the C atoms from the molecular plane 0.43)			

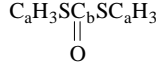
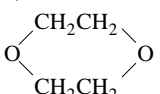
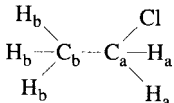
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure			Method	
Cyclopentene		C_a-C_b	1.546	ED	
		C_b-C_c	1.519		
		C_c-C_c	1.342		
		$\angle C_b C_a C_b$	104.0		
		$\angle C_b C_c C_c$	110.0		
		dihedral angle between the $C_b C_a C_b$ and $C_b C_c C_c$ planes	151.2		
Cyclopropane (CH_2) ₃		$C-C$	1.512	R	
		$C-H$	1.083		
Cyclopropanone		$C-H$	1.086	MW	
		C_a-C_b	1.575		
		C_a-O	1.191		
		$\angle C_a C_b C_b$	57.7		
Cyclopropene		$\angle HC_b H$	114	ED	
		dihedral angle between the CH_2 plane and the C_b-C_b bond	151		
		C_b-C_b	1.304		
		C_a-C_b	1.519		
		C_b-H	1.077		
Decalin $C_{10}H_{18}$		$C-H$	1.112	ED	
		$\angle HC_a H$	118		
		$C-C$ (average)	1.530		
		$C-H$ (average)	1.113		
Dewer benzene \rightarrow Bicyclo[2.2.0]hexa-2,5-diene		$C-C$ (average)	1.530	ED	
		$\angle CCC$ (average)	111.4		
		$C-N$	1.472		
		$C-C$	1.562		
		$\angle NCC$	110.2		
Diacetylene \rightarrow 1,3-Butadiyne 1,4-Diazabicyclo[2.2.2]octane		$\angle CNC$	108.7	ED	
		large-amplitude torsional motion about the D_{3h} symmetry axis			
		$C-N$	1.472		
		$C-C$	1.562		
		$\angle NCC$	110.2		
2,3-Diaza-1,3-butadiene \rightarrow Formaldehyde azine		$C-H$	1.09	MW	
		$C-N$	1.482		
		$N-N$	1.228		
		$\angle HCH$	117		
Diazoacetonitrile		C_b-N_b	1.280	MW	
		N_b-N_c	1.132		
		C_a-N_a	1.165		
		$C-H$	1.082		
		C_a-C_b	1.424		
		$\angle C_a C_b H$	117		
Diazomethane CH_2N_2		$\angle C_a C_b N_b$	119.5	MW, IR	
		$C-N$	1.32		
1,2-Dibromoethane CH_2BrCH_2Br		$C-N$	1.32	ED	
		$\angle HCH$	126.0 linear		
Dibromomethane CH_2Br_2		$C-Br$	1.950	ED	
		$\angle CCH$	109.5		
		$\angle CCH$	110		
		fraction of the <i>trans</i> conformer at 25°C			95%
		$C-Br$	1.924		
2,2'-Dichlorobiphenyl $C_6H_4Cl-C_6H_4Cl$		$\angle BrCBr$	113.2	ED	
		$C-C$ inter-ring	1.495		
		$C-Cl$	1.732		
<i>trans</i> -1,4-Dichlorocyclohexane $C_6H_{10}Cl_2$		$C-H$	1.108	ED	
		$\angle CCH$	126		
		dihedral angle between the two aromatic rings 74 (defined to be 0 for that of the <i>cis</i> conformer)			
		$C-Cl$	1.810		
		$C-C$	1.530		
		$\angle CCC$	111.5		
		$\angle CCCl$ (<i>ee</i>)	108.6		
$\angle CCCl$ (<i>aa</i>)	110.6				
$\angle HCCl$ (<i>ee</i>)	111.5				
$\angle HCCl$ (<i>aa</i>)	107.6				
<i>ee</i> 49%		<i>aa</i> 51%	e: equatorial, a: axial		


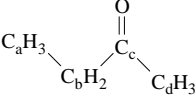
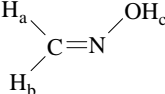
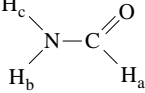
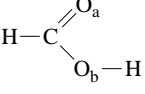
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method
1,1-Dichloroethane	C—Cl	1.766	C—C	1.540	MW
CHCl ₂ CH ₃	∠ClCCl	112.0	∠CCCl	111.0	
1,2-Dichloroethane	C—C	1.531	C—Cl	1.790	ED
CH ₂ ClCH ₂ Cl	C—H	1.11	∠CCCl	109.0	
	∠CCH	113			
	fraction of the <i>trans</i> conformer at room temperature 73%, that of the <i>gauche</i> conformer 27%				
1,1-Dichloroethylene	C—C	1.32 (assumed)	C—Cl	1.73	MW
CH ₂ =CCl ₂	∠ClCC	123	(C _{2v})		
<i>cis</i> -1,2-Dichloroethylene	C—Cl	1.718	C—C	1.354	ED
CHCl=CHCl	∠ClCC	123.8			
Dichloromethane	C—H (<i>r_e</i>)	1.087	C—Cl (<i>r_e</i>)	1.765	MW, IR
CH ₂ Cl ₂	∠HCH (<i>θ_e</i>)	111.5	∠ClCCl (<i>θ_e</i>)	112.0	
1,1-Difluoroethane	C—C	1.498	C—H (average)	1.081	ED
CH ₃ CHF ₂	C—F	1.364	∠CCH (average)	111.0	
	∠CCF	110.7	dihedral angle between the two CCF planes	118.9	
1,2-Difluoroethane	C—F	1.389	C—C	1.503	ED
CH ₂ FCH ₂ F	C—H	1.103	∠CCF	110.3	
	∠CCH	111	dihedral angle of internal rotation	109	
	fraction of the <i>gauche</i> conformer at 22°C 94%				
1,1-Difluoroethane	C—C	1.340	C—F	1.315	ED, MW
CH ₂ =CF ₂	C—H	1.091	∠CCF	124.7	
	∠CCH	119.0			
<i>cis</i> -1,2-Difluoroethylene	C—C	1.33	C—F	1.342	ED, MW
CHF=CHF	C—H	1.099	∠CCF	122.0	
	∠CCH	124.1			
Difluoromethane	C—H	1.093	C—F	1.357	MW
CH ₂ F ₂	∠HCH	113.7	∠FCF	108.3	
Dimethoxymethane			C _a —O	1.432	ED
			C _b —O	1.382	
			C—H (average)	1.108	
	∠COC	114.6	∠OCO	114.3	
	∠OCH	110.3			
Dimethylacetylene → 2-Butyne					
Dimethylamine	C—H	1.106	N—H	1.00	ED
(CH) ₂ NH	C—N	1.455	∠CNC	111.8	
	∠CNH	107	∠NCH	112	
	∠HCH	107			
Dimethylberyllium	Be—C	1.698	C—H	1.127	ED
(CH ₃) ₂ Be	∠BeCH	113.9	CBeC linear		
Dimethylcadmium	C—Cd	2.112	∠HCH	108.4	R
(CH ₃) ₂ Cd					
Dimethyl carbonate			C _b —O _b	1.209	ED
			C _b —O _a	1.34	
			C _a —O _a	1.42	
	∠O _a C _b O _a	107	∠C _b O _a C _a	114.5	
Dimethylcyanamide	C _b —N _b	1.161	C _b —N _a	1.338	ED
(C _a H ₃) ₂ N _a —C _b ≡N _b	C _a —N _a	1.463	∠C _a NC _a	115.5	
	∠C _a NC _b	116.0			
1,2-Dimethyldiborane			B—B	1.799	ED
			B—C	1.580	
			B—H _b	1.358 (<i>cis</i>), 1.365 (<i>trans</i>)	
	B—H _t	1.24			
	∠BBC	122.6 (<i>cis</i>), 121.8 (<i>trans</i>)			
Dimethyl diselenide	C—H	1.13	C—Se	1.95	ED
(CH ₃) ₂ Se ₂	Se—Se	2.326	∠CSeSe	98.9	
	∠HCSe	108	dihedral angle between the CSeSe and SeSeC planes	88	

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method
Dimethyl disulfide (CH ₃) ₂ S ₂	C—S	1.816	S—S	2.029	ED
	C—H	1.105	∠SSC	103.2	
	∠SCH	111.3	CSSC dihedral angle of internal rotation	85	
<i>S,S'</i> -Dimethyl dithiocarbonate	C _a H ₃ SC _b SC _a H ₃		C _b —O	1.206	ED
			C _b —S	1.777	
	∠OCS	124.9	C _a —S	1.802	
			∠CSC	99.3	
Dimethyl ether (CH ₃) ₂ O	C—O	1.416	<i>syn-syn</i> conformer		ED
	∠COC	112	C—H	1.121	
Dimethylglyoxal → Biacetyl <i>N,N'</i> -Dimethylhydrazine CH ₃ NH—NHCH ₃	C—H	1.108	∠HCH	108	ED
	N—N	1.42	C—N	1.46	
	N—H	1.03	C—H	1.12	
Dimethylmercury (CH ₃) ₂ Hg	∠NNC	112	CNNC dihedral angle of internal rotation	90	ED
	C—Hg	2.083	C—H	1.160 (assumed)	
	Hg···H	2.71			
Dimethylphosphine (CH ₃) ₂ PH	C—P	1.848	P—H	1.419	MW
	∠CPC	99.7	∠CPH	97.0	
Dimethyl selenide (CH ₃) ₂ Se	C—H	1.093	Se—C	1.943	MW
	∠CSeC	96.2	∠SeCH	108.7	
	∠HCH	110.3			
Dimethyl sulfide (CH ₃) ₂ S	C—S	1.807	C—H	1.116	ED, MW
	∠CSC	99.05	∠HCH	109.3	
Dimethyl sulfone (CH ₃) ₂ SO ₂	C—H	1.114	S—O	1.435	ED
	S—C	1.771	∠CSC	102	
	∠OSO	121			
Dimethyl sulfoxide (CH ₃) ₂ SO	C—H	1.081	C—S	1.799	MW
	S—O	1.485	∠CSC	96.6	
	∠CSO	106.7	∠HCH	110.3	
	dihedral angle between the SCC plane and the S—O bond			115.5	
Dimethylzinc (CH ₃) ₂ Zn	Zn—C	1.929	∠HCH	107.7	R
1,4-Dioxane 	C—C	1.523	C—O	1.423	ED
	C—H	1.112	∠COC	112.45	
	∠CCO	109.2	chair form		
Ethanal → Acetaldehyde					
Ethane C ₂ H ₆	C—C	1.5351	C—H	1.0940	MW
	∠CCH	111.17	staggered conformation		
Ethanethiol C _b H ₃ —C _a H ₂ —SH	C _a —H	1.093	C _a —H	1.090	MW
	C _b —H	1.093	C _a —C _b	1.530	
	C _a —S	1.829	S—H	1.350	
	∠C _b C _a H	109.6	∠C _a C _b H	109.7	
	∠C _b C _a S	108.3	∠C _a SH	96.4	
Ethanol C _b H ₃ C _a H ₂ OH	C—C	1.512	C—C	1.512	MW
	C—O	1.431	O—H	0.971	
	C _a —H	1.10	C _b —H	1.09	
	∠CCO	107.8	∠COH	105	
	∠C _b C _a H	111	∠C _a C _b H	110	
staggered conformation					
Ethyl chloride 	C—C	1.528	C—C	1.528	ED, MW
	C—Cl	1.802	C—Cl	1.802	
	C—H	1.103	C—H	1.103	
	C _a —H _a =C _b —H _b (assumed)		C _a —H _a =C _b —H _b (assumed)		
	∠CCCl	110.7	∠CCCl	110.7	
	∠H _b C _b H _b	109.8	∠H _a C _a H _a	109.2	
Ethylene CH ₂ =CH ₂	∠C _b C _a H _a	110.6			MW
	C—H	1.087	C—C	1.339	
	∠CCH	121.3			

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method
Ethylenediamine H ₂ NCH ₂ CH ₂ NH ₂	C—N C—H <i>gauche</i> conformer	1.469 1.11	C—C ∠CCN dihedral angle between the NCC and CCN planes	1.545 110.2	ED 64
Ethylene dibromide → 1,2-Dibromoethane Ethylene dichloride → 1,2-Dichloroethane Ethyleneimine → Aziridine					
Ethylene oxide 	C—C C—O dihedral angle between the NH ₂ plane and the N—C bond	1.466 1.431	C—H ∠HCH	1.085 116.6 158.0	MW
Ethylene sulfide → Thiirane					
Ethyl methyl ether C ₂ H ₅ OCH ₃	C—O (average) C—H (average) ∠OCC fraction of the <i>trans</i> conformer at 20°C	1.418 1.118 109.4	C—C ∠COC ∠HCH 80%	1.520 111.9 109.0	ED
Ethyl methyl ketone 	∠C _b C _c O, ∠C _d C _c O C—S (average) C—H ∠SCC fraction of the <i>gauche</i> conformer at 20°C	121.9 1.813 1.111 114.0	C—C (average) C _c —O C—H (average) ∠C _a C _b C _c <i>trans</i> conformer 75%	1.518 1.219 1.102 113.5 95%	ED
Ethyl methyl sulfide C ₂ H ₅ SCH ₃	C—S (average) C—H ∠SCC fraction of the <i>gauche</i> conformer at 20°C	1.813 1.111 114.0	C—C ∠CSC ∠HCH	1.536 97 110	ED
Ferrocene (C ₅ H ₅) ₂ Fe	C—C Fe—C	1.440 2.064	C—H (D _{5h})	1.104	ED
Fluoroform CHF ₃	C—H ∠FCF	1.098 108.8	C—F (C _{3v})	1.332	MW
Formaldehyde H ₂ CO	C—H ∠HCH	1.116 116.5	C—O	1.208	MW
Formaldehyde azine H ₂ C=N—N=CH ₂	N—N C—N ∠CNN fraction of the <i>trans</i> conformer at -30°C	1.418 1.277 111.4	C—H ∠HCN	1.094 120.7	ED
Formaldehyde dimethylacetal → Dimethoxy-methane					
Formaldoxime 	N—O ∠H _b CN ∠H _a CN	1.408 115.6 121.8	O—H _c ∠CNO ∠NOH _c	0.956 110.2 102.7	MW
Formamide 	C—O ∠CNH (average)	1.212 119.2	C—H _a N—H C—N ∠NCO	1.125 1.027 1.368 125.0	ED, MW
Formic acid 	O _b —H ∠HCO _a ∠CO _b H	0.972 124.1 106.3	C—H ∠O _a CO _b planar	1.097 124.9	MW

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method
Formic acid dimer		$O_a \cdots O_b$	2.703		ED
		$C-O_a$	1.220		
		$C-O_b$	1.323		
		$\angle O_a C O_b$	126.2		
		$\angle C O_a O_b$	108.5		
Formyl radical		$C-H$	1.110	$C-O$	1.1712
		$\angle HCO$	127.43		MW
Fulvene		C_a-C_d	1.349		MW
		C_a-C_b	1.470		
		C_b-C_c	1.355		
		C_c-C_c	1.476		
		C_b-H	1.078		
		C_c-H	1.080		
		C_d-H	1.13	$\angle C_b C_a C_b$	106.6
		$\angle C_a C_b C_c$	107.7	$\angle C_b C_c C_c$	109
		$\angle C_a C_b H$	124.7	$\angle C_b C_c H$	126.4
		$\angle H C_d H$	117		
2-Furaldehyde		C_a-C_e	1.458		MW
		C_e-O_b	1.250		
		C_e-H	1.088		
		$\angle C_c C_a C_b$	133.9		
		$\angle C_a C_c H$	116.9	$\angle C_a C_e O$	121.6
		<i>trans</i> conformer (with respect to the O_a and O_b atoms)			
Furan		C_b-C_b	1.431		MW
		C_a-C_b	1.361		
		C_a-O	1.362		
		C_a-H_a	1.075		
		C_b-H_b	1.077		
		$\angle C_a C_b C_b$	106.1	$\angle C_a O C_a$	106.6
		$\angle C_b C_a O$	110.7	$\angle O C_a H_a$	115.9
		$\angle C_b C_b H_b$	128.0		
Furfural \rightarrow 2-Furaldehyde					
Glycolaldehyde		C_b-O_b	1.209		MW
		C_a-O_a	1.437		
		C_a-C_b	1.499		
		O_a-H_a	1.051		
		C_b-H_c	1.102		
		C_a-H_b	1.093		
		$\angle C_a C_b O_b$	122.7	$\angle C_a C_b H_c$	115.3
		$\angle C_b C_a O_a$	111.5	$\angle C_a O_a H_a$	101.6
		$\angle C_b C_a H_b$	109.2	$\angle H_b C_a H_b$	107.6
		$\angle H_b C_a O_a$	109.7		
Glyoxal		$C-C$	1.526	$C-O$	1.212
CHOCHO		$C-H$	1.132	$\angle CCO$	121.2
		$\angle HCO$	112	<i>trans</i> conformer	(C_{2h} (assumed))
Hexachloroethane		$C-C$	1.56	$C-Cl$	1.769
Cl_3CCl_3		$\angle CClCl$	110.0		ED
2,4-Hexadiyne	$C_a H_3-C_b \equiv C_c-C_c \equiv C_b-C_d H_3$				ED
	C_a-C_b	1.450	C_b-C_c	1.208	
	C_c-C_c	1.377	C_a-H	1.09	
Hexafluoroethane	$C-C$	1.545	$C-F$	1.326	ED
F_3CCF_3	$\angle CCF$	109.8	staggered conformation		
Hexafluoropropene	average value of the $C=C$ and $C-F$ distances		1.329		ED
$CF_2=CF_2$	$C-C$	1.513	$\angle CCC$	127.8	
	$\angle FCC (CF_2)$	124	$\angle FCC (CF)$	120	
	$\angle FCC (CF_3)$	110			

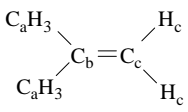
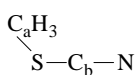
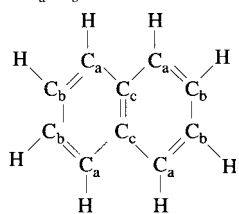
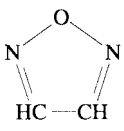
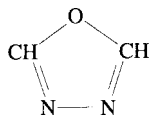
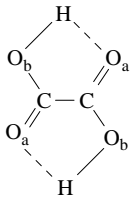
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method
1,3,5-Hexatriene	$H_2C_a=C_bH-C_cH=C_cH-C_bH=C_aH_2$				ED
	C_a-C_b	1.337	C_b-C_c	1.458	
	C_c-C_c	1.368	$\angle C_aC_bC_c$	121.7	
	$\angle C_bC_cC_c$	124.4			
Iminocyanide radical	$N-H$				UV
$H\dot{N}CN$	$\angle HNC$	116.5	$N\cdots N$	2.470	
			$\angle NCN$	~ 180	
Iodocyanoacetylene	$I-C_a$				MW
$I-C_a\equiv C_b-C_c\equiv N$	C_b-C_c	1.370	C_a-C_b	1.207	
	C_a-H	1.122	C_c-N	1.160	
Isobutane	C_a-C_b	1.535	C_b-H	1.113	ED, MW
$(C_bH_3)_3C_aH$	$\angle C_aC_bH$	111.4	$\angle C_bC_aC_b$	110.8	
Isobutylene \rightarrow 2-Methylpropene					
Ketene	$C-C$	1.317	$C-O$	1.161	MW
$CH_2=C=O$	$C-H$	1.080	$\angle HCH$	123.0	
Malononitrile	$C-H$	1.091	$C-C$	1.480	MW
$C_aH_2(C_bN)_2$	$C-N$	1.147	$\angle CCC$	110.4	
	$\angle HCH$	108.4	$\angle CCN$	176.6	
	(The two N atoms are bent away from each other in the plane of $C_b-C_a-C_b$)				
Methane	$C-H (r_e)$	1.0870	(T_d)		MW
CH_4					
Methanethiol	$C-H$	1.09	$C-S$	1.819	MW
CH_3SH	$S-H$	1.34	$\angle HSC$	96.5	
	$\angle HCH$	109.8	angle between the CH_3 symmetry axis and the $C-S$ bond 2.2.		
	(The axis of the CH_3 group is tilted away from the H atom with respect to the $C-S$ bond.)				
Methanol	$C-H$	1.0936	$C-O$	1.4246	MW
CH_3OH	$O-H$	0.9451	$\angle HCH$	108.63	
	$\angle COH$	108.53	angle between the CH_3 symmetry axis and the $C-O$ bond		
	(The axis of the CH_3 group is tilted away from the H atom with respect to the $C-O$ bond.)				
				3.27	
Methyl radical	$C-H$	1.08	planar		UV
$\cdot CH_3$					
<i>N</i> -Methylacetamide					ED
	C_a-C_b		C_a-C_b	1.520	
	$N-C_c$		$N-C_c$	1.469	
	$C-H$		$C-H$	1.107	
	C_b-N	1.386	C_b-O	1.225	
	$\angle C_bNC_c$	119.7			
	$\angle NC_bO$	121.8			
	$\angle C_aC_bN$	114.1			
Methylacetylene \rightarrow Propyne					
Methylal \rightarrow Dimethoxymethane					
Methylamine	$N-H$	1.010	$C-N$	1.471	MW
CH_3NH_2	$C-H$	1.099	$\angle NHN$	107.1	
	$\angle HNC$	110.3	$\angle HCH$	108.0	
	dihedral angle between the CH_3 symmetry axis and the $C-N$ bond (The axis of the CH_3 group is tilted away from the NH_2 group with respect to the $C-N$ bond.)				2.9
Methyl azide	CH_3		$C-H$	1.09	ED
	$N_a-N_b-N_c$		$C-N_a$	1.468	
			N_a-N_b	1.216	
	N_b-N_c	1.113	$\angle CN_aN_b$	116.8	
	NNN linear				
Methyl bromide	$C-H (r_e)$	1.086	$C-Br (r_e)$	1.933	MW, IR
CH_3Br	$\angle HCH (\theta_e)$	111.2	(C_{3v})		
Methyl chloride	$C-H$	1.090	$C-Cl$	1.785	MW, IR
CH_3Cl	$\angle HCH$	110.8			

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure					Method
Methyldiazirine		C—N	1.481	C—C	1.501	MW
		N—N	1.235	∠NCN	49.3	
		dihedral angle between the CNN plane and the C—C bond				
Methylene :CH ₂	C—H	1.078	∠HCH	130		LMR
Methylenecyclopropane		C _a —C _b	1.332			MW
		C _b —C _c	1.457			
		C _c —C _c	1.542			
	C _c —H	1.09	∠C _c C _b C _c	63.9		MW
	∠HC _a H	114.3	∠HC _c H	113.5		
	dihedral angle between the C _c H ₂ plane and the C _c —C _c bond				150.8	
3-Methyleneoxetane		C _b —C _c	1.52			MW
		C _c —O	1.45			
		C _a —C _b	1.33			
	C—H	1.09 (assumed)	∠C _c C _b C _c	87		MW, IR
	∠HC _c H	114 (assumed)	∠HC _a H	120 (assumed)		
	C—H (r _e)	1.095	∠HCH (θ _e)	110.45 (C _{3v})		
Methyl fluoride CH ₃ F	C—F (r _e)	1.382				ED
Methyl formate		C _a —H	1.08			
		C _b —O _b	1.206			
			C—O (average)	1.393		MW, IR
			C _b —H	1.101 (assumed)		
	∠O _a C _b O _b	127	∠COC	114		
	∠O _a C _a H	110				MW
Methylgermane CH ₃ GeH ₃	C—H	1.083	Ge—H	1.529		
	C—Ge	1.945	∠HCH	108.4		
	∠HGeH	109.3				MW
Methyl hypochlorite CH ₃ OCl	C—H	1.103	O—Cl	1.674		
	O—C	1.389	∠HCH	109.6		
	∠COCl	112.8				UV
Methyldyne radical :CH	C—H (r _e)	1.1198				
Methyldyne phosphide HCP	H—C (r _e)	1.0692	C—P (r _e)	1.5398		
Methyl iodide CH ₃ I	C—H (r _e)	1.084	C—I (r _e)	2.132		MW, IR
	∠HCH (θ _e)	111.2	(C _{3v})			
Methyl isocyanide	C _a H ₃ —N≡C _b	C _a —H	1.102	C _a —N	1.424	
	N—C _b	1.166	∠NC _a H	109.12		MW
Methylketene		O—C _a	1.171			
		C _b —C _c	1.518			
			C _c —H	1.10		MW
	C _a —C _b	1.306	C _b —H	1.083		
	∠OC _a C _b	180.5	∠C _a C _b C _c	122.6		
	∠C _a C _b H	113.7	∠C _c C _b H	123.7		MW, NMR
	∠HCH	109.2				
Methylmercury chloride CH ₃ HgCl	Hg—Cl	2.282	C—H	1.15		
	Hg—C	1.99	(C _{3v})			
Methyl nitrate		C—H _a	1.10			MW
		C—H _b	1.09			
		C—O	1.437			
			O—N	1.402		MW
	N—O _a	1.205	N—O _b	1.208		
	∠OCH _a	110	∠OCH _b	103		
	∠CON	112.7	∠ONO _a	118.1		
	∠ONO _b	112.4				

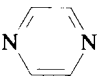
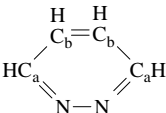
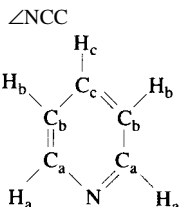

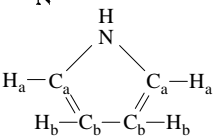
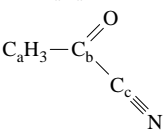
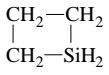
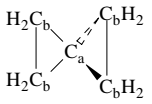
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method
Methylphosphine CH ₃ PH ₂	C—P	1.858	C—H	1.094	ED
2-Methylpropane → Isobutane 2-Methylpropene			C _a —H	1.119	ED, MW
			C _c —H _c	1.10	
			C _a —C _b	1.508	
			C _b —C _c	1.342	
	∠HC _a C _b (average)	111.4	∠H _c C _c H _c	118.5	
	∠C _a C _b C _a	115.6	∠C _a C _b C _c	122.2	
	∠HC _a H	107.9	∠C _b C _c H	121	
Methylsilane CH ₃ SiH ₃	C—H	1.093	C—Si	1.867	MW
	Si—H	1.485	∠HCH	107.7	
	∠HSiH	108.3	(C _{3v})		
Methylstannane CH ₃ SnH ₃	C—Sn	2.143	Sn—H	1.700	MW
			(C _{3v})		
Methyl thiocyanate			S—C _b	1.684	MW
			C _b —N	1.170	
			S—C _a	1.824	ED
			C—H	1.081	
	∠C _a SC _b	99.0	∠HCH	110.6	
			∠HCS	108.3	
			C _a —C _b	1.37	
			C _b —C _b	1.41	
			C _a —C _c	1.42	
			C _c —C _c	1.42	
			C—C (average)	1.40	
			∠C _a C _c C _c	119.4	
Naphthalene					ED
Neopentane C(CH ₃) ₄	C—C	1.537	C—H	1.114	ED
	∠CCH	112			
Nickelocene → Bis (cyclopentadienyl) nickel					
Nitromethane CH ₃ NO ₂	C—H	1.088 (assumed)	C—N	1.489	MW
	N—O	1.224	∠NCH	107	
	∠ONO	125.3			
<i>N</i> -Nitrosodimethylamine (CH ₃) ₂ NNO	N—O	1.235	N—N	1.344	ED
	C—N	1.461	∠ONN	113.6	
	∠CNC	123.2	∠CNN	116.4	
Nitrosomethane CH ₃ NO	C—N	1.49	N—O	1.22	MW
	C—H	1.084	∠CNO	112.6	
	∠NCH	109.0			
Norbornane → Bicyclo[2.2.1]heptane Norbornadiene → Bicyclo[2.2.1]hepta-2,5-diene					
1,2,5-Oxadiazole			O—N	1.380	MW
			C—N	1.300	
			C—C	1.421	
			C—H	1.076	
			∠CCH	130.2	
			∠NCH	120.9	
				planar	
1,3,4-Oxadiazole			O—C	1.348	MW
			C—N	1.297	
			∠OCN	113.4	
			N—N	1.399	
			∠CNN	105.6	
			C—H	1.075	
			∠OCH	118.1	
				planar	
Oxalic acid			C—C	1.544	ED
			C—O _a	1.205	
			C—O _b	1.336	
			O _b —H	1.05	
			∠CCO _a	123.1	
			∠O _a CO _b	125.0	
			∠CO _b H	104	

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure			Method
Oxalyl dichloride		C—O	1.182	ED
		C—C	1.534	
		C—Cl	1.744	
		∠CCO	124.2	
		∠CCCl	111.7	
		fraction of the <i>trans</i> conformer at 0°C 68%, that of the <i>gauche</i> conformer 32%		
Oxetane		C—O	1.448	MW
		C—C	1.546	
		C—H (average)	1.090	
		∠COC	92	
		∠OCC	92	
		∠CCC	85	
		∠HCH (average)	109.9	
Oxirane → Ethylene oxide				
Phenol		C—C (average)	1.397	MW
		C _b —H	1.084	
		C _c —H	1.076	
		C _d —H	1.082	
		C _a —O	1.364	
		O—H	0.956	
		∠COH	109.0	
Phosphirane		C—P	1.867	P—H 1.43
		C—C	1.502	C—H 1.09
		∠CPC	47.4	∠HCH 114.4
		∠HPC	95.2	
		∠CCH	118	
		dihedral angle between the PCC plane and the PH bond 95.7		
Piperazine		C—C	1.540	ED
		C—N	1.467	
		C—H	1.110	
		∠CNC	109.0	
		∠CCN	110.4	
		(C _{2h})		
Pivalonitrile		C _a —C _b	1.495	C _a —N 1.159
(C _t H ₃) ₃ C _b —C _a ≡N		C _b —C _c	1.536	∠C _c C _b C _c 110.5
Propadiene → Allene				
Propane		C—C	1.532	C—H 1.107
C ₃ H ₈		∠CCC	112	∠HCH 107
Propenal → Acrylaldehyde				
Propene		C _a —H _a	1.104	ED, MW
		C _a —C _b	1.341	
		C _c —H _d	1.117	
		C _b —C _c	1.506	
		∠C _b C _a H _{a,b,c}	121.3	
		∠C _b C _c H _d	110.7	
		∠C _a C _b C _c	124.3	
l-Propenyl chloride		CH ₃ —C _b H=C _a H—Cl	C _a —Cl 1.728	MW
		∠C _b C _a Cl	121.9	
		<i>trans</i> conformer		
Propiolaldehyde		C _a —H _a	1.085	ED, MW
		C _b —C _c	1.453	
		C _c —H _c	1.130	C _c —O 1.214
		∠C _b C _c O	124.2	∠C _b C _c H _c 113.7
		∠C _a C _b C _c	178.6	planar
Propylene → Propene				
Propylene oxide		C _a —C _b	1.51	MW
		∠C _a C _b C _c	121.0	
		dihedral angle between the C _b C _c O plane and the C _a C _b bond 123.8		

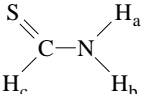
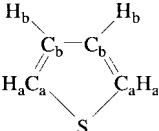

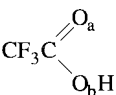
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure			Method
Propynal → Propiolaldehyde				
Propyne	$\text{H}_3\text{C}_c-\text{C}_b\equiv\text{C}_a\text{H}$	C_c-H	1.105	MW
		C_c-C_b	1.459	
		C_a-H	1.056	
		C_b-C_a	1.206	
		$\angle\text{HC}_c\text{C}_b$	110.2	
Pyrazine		$\text{C}-\text{C}$	1.339	$\text{C}-\text{N}$ 1.403
		$\text{C}-\text{H}$	1.115	$\angle\text{CCN}$ 115.6
		$\angle\text{CCH}$	123.9	
Pyridazine		$\text{N}-\text{C}_a$	1.341	ED, MW
		C_a-C_b	1.393	
		$\text{N}-\text{N}$	1.330	
		C_b-C_b	1.375	
Pyridine		$\angle\text{NCC}$	123.7	$\angle\text{NNC}$ 119.3
		$\text{N}-\text{C}_a$	1.340	MW
		C_b-C_c	1.394	
		C_b-H_b	1.081	
		C_a-C_b	1.395	
		C_a-H_a	1.084	
		C_c-H_c	1.077	
		$\angle\text{C}_a\text{NC}_a$	116.8	$\angle\text{NC}_a\text{C}_b$ 123.9
		$\angle\text{C}_a\text{C}_b\text{C}_c$	118.5	$\angle\text{C}_b\text{C}_c\text{C}_b$ 118.3
		$\angle\text{NC}_a\text{H}_a$	115.9	$\angle\text{C}_c\text{C}_b\text{H}_b$ 121.3
Pyrimidine		$\text{N}-\text{C}$	1.340	$\text{C}-\text{C}$ 1.393
		$\angle\text{NCN}$	127.6	$\angle\text{CNC}$ 115.5
		(C_{2v} assumed)		
Pyrrole		$\text{N}-\text{C}_a$	1.370	MW
		C_b-C_b	1.417	
		C_a-C_b	1.382	
		$\text{N}-\text{H}$	0.996	
		C_a-H_a	1.076	
		$\angle\text{C}_a\text{NC}_a$	109.8	
		$\angle\text{C}_a\text{C}_b\text{C}_b$	107.4	
		$\angle\text{C}_b\text{C}_b\text{H}$	127.1	
Pyruvitrile		$\text{C}-\text{H}$	1.12	ED, MW
		$\text{C}-\text{N}$	1.17	
		$\text{C}-\text{O}$	1.208	
		C_b-C_c	1.477	
		C_a-C_b	1.518	$\angle\text{HCH}$ 109.2
		$\angle\text{C}_a\text{C}_b\text{O}$	124.5	$\angle\text{C}_a\text{C}_b\text{C}_c$ 114.2
		$\angle\text{CCN}$	179	
Ruthenocene → Bis (cyclopentadienyl) ruthenium				
Silacyclobutane		$\text{Si}-\text{C}$	1.892	ED
		$\text{C}-\text{C}$	1.600	
		$\text{Si}-\text{H}$	1.47	
		$\text{C}-\text{H}$	1.14	$\angle\text{CSiC}$ 80.7
		$\angle\text{SiCC}$	84.8	$\angle\text{CCC}$ 99.8
		dihedral angle between the CCC and CSiC planes	146	
Spiropentane		C_b-C_b	1.52	ED
		C_a-C_b	1.47	
		$\text{C}-\text{H}$	1.09	
		$\angle\text{C}_b\text{C}_a\text{C}_b$	62	
		$\angle\text{HCH}$	118	(D_{2d})

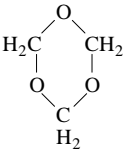
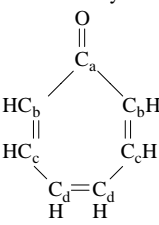
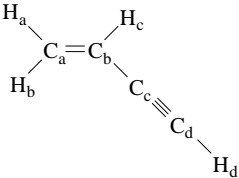
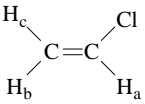
BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure					Method
Succinonitrile	$\begin{array}{c} \text{CH}_2\text{CN} \\ | \\ \text{CH}_2\text{CN} \end{array}$	C—C	1.561	C—C(N)	1.465	ED
		C—N	1.161	C—H	1.09	
		$\angle\text{CCC}$	110.4			
		fraction of the <i>anti</i> conformer at 170°C 74%, dihedral angle of CCCC for the <i>gauche</i> conformer				
					75	
Tetrachloroethylene	$\begin{array}{c} \text{C—Cl} \\ | \\ \text{C—Cl} \\ | \\ \text{C—Cl} \\ | \\ \text{C—Cl} \end{array}$	1.718	C—C	1.354	ED	
	$\angle\text{ClCCl}$	115.7				
Tetracyanoethylene	$\begin{array}{c} \text{C—N} \\ | \\ \text{C} \\ | \\ \text{C=C} \\ | \\ \text{C—N} \end{array}$	1.162	C—C	1.435	ED	
	$\angle\text{CC=C}$	1.357		121.1		
Tetrafluoro-1,3-dithietane	$\begin{array}{c} \text{S} \\ / \quad \backslash \\ \text{F}_2\text{C} \quad \text{CF}_2 \\ \backslash \quad / \\ \text{S} \end{array}$		C—S	1.785	ED	
	$\angle\text{FCS}$	113.7	C—F	1.314		
			$\angle\text{CSC}$	83.2		
			(D _{2h} assumed)			
Tetrafluoroethylene	$\begin{array}{c} \text{C—C} \\ | \\ \text{CF}_2=\text{CF}_2 \end{array}$	1.31	C—F	1.319	ED	
	$\angle\text{CCF}$	123.8				
			(D _{2h} assumed)			
Tetrahydrofuran	$\begin{array}{c} \text{C—H} \\ | \\ \text{C—C} \\ | \\ \text{O} \end{array}$	1.115	C—O	1.428	ED	
	$\angle\text{C—C—O}$	1.536				
		The skeletal bending vibration of the molecular plane is essentially free pseudorotation				
Tetrahydropyran	$\begin{array}{c} \text{H}_2 \\ | \\ \text{C} \\ / \quad \backslash \\ \text{H}_2\text{C} \quad \text{CH}_2 \\ | \quad \quad | \\ \text{H}_2\text{C} \quad \text{CH}_2 \\ \backslash \quad / \\ \text{O} \end{array}$		C—O	1.420	ED	
			C—C	1.531		
			C—H	1.116		
			$\angle\text{COC}$	111.5		
			$\angle\text{OCC}$	111.8		
		$\angle\text{CCC (C)}$	108	$\angle\text{CCC (O)}$	111	
		chair form				
Tetrahydrothiophene	$\begin{array}{c} \text{CH}_2\text{CH}_2 \\ | \quad \quad | \\ \text{S} \\ | \quad \quad | \\ \text{CH}_2\text{CH}_2 \end{array}$	C—S	1.839	C—H	1.120	
		C—C	1.536	$\angle\text{CSC}$	93.4	
		$\angle\text{SCC}$	106.1	$\angle\text{CCC}$	105.0	
Tetramethylgermane	Ge—C	1.945	C—H	1.12	ED	
	$\angle\text{GeCH}$	108	(T _d excluding the H atoms)			
Tetramethyllead	Pb—C	2.238	(T _d excluding the H atoms)		ED	
Tetramethylsilane	C—H	1.115	C—Si	1.875	ED	
	$\angle\text{HCH}$	109.8	(T _d excluding the H atoms)			
Tetramethylstannane	C—Sn	2.144			ED	
	C—H	1.12	(T _d excluding the H atoms)			
1,2,5-Thiadiazole	$\begin{array}{c} \text{S} \\ // \quad \backslash \\ \text{N} \quad \text{N} \\ | \quad \quad | \\ \text{HC} \quad \text{CH} \end{array}$	S—N	1.631	$\angle\text{NSN}$	99.6	MW
		C—N	1.328	$\angle\text{CCN}$	113.8	
		C—C	1.420	$\angle\text{CCH}$	126.2	
		C—H	1.079	planar		
1,3,4-Thiadiazole	$\begin{array}{c} \text{S} \\ // \quad \backslash \\ \text{HC} \quad \text{CH} \\ | \quad \quad | \\ \text{N} \quad \text{N} \end{array}$	S—C	1.721	$\angle\text{CSC}$	86.4	MW
		N—N	1.371	$\angle\text{SCN}$	114.6	
		C—N	1.302	$\angle\text{CCN}$	112.2	
		C—H	1.08	$\angle\text{SCH}$	121.9	
		$\angle\text{NCH}$	123.5	planar		
Thietane	$\begin{array}{c} \text{CH}_2 \quad \text{CH}_2 \\ | \quad \quad | \\ \text{CH}_2 \quad \text{S} \end{array}$	C—S	1.847		ED, MW	
		C—C	1.549			
		C—H (average)	1.100			
	$\angle\text{CSC}$	76.8	$\angle\text{HCH (average)}$	112		
		dihedral angle between the CCC and CSC planes				
					154	
Thiirane	$\begin{array}{c} \text{H}_2\text{C} \\ | \\ \text{S} \\ | \\ \text{H}_2\text{C} \end{array}$	C—C	1.484	$\angle\text{HCH}$	116	MW
		C—H	1.083	$\angle\text{CSC}$	48.3	
		C—S	1.815	$\angle\text{CCS}$	65.9	
		dihedral angle between the CH ₂ plane and the C—C bond				
					152	

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure				Method	
Thioformaldehyde CH ₂ S	C—S ∠HCH	1.611 116.9	C—H	1.093	MW	
Thioformamide			N—H _a N—H _b C—N	1.002 1.007 1.358	MW	
Thiolane → Tetrahydrothiophene Thiophene		C—S ∠H _a NH _b ∠H _b NC ∠NCH _c	1.626 121.7 120.4 108	C—H _c ∠H _a NC ∠NCS ∠SCH _c	1.10 117.9 125.3 127	
			C _a —H _a C _b —H _b C _a —S C _a —C _b C _b —C _b ∠C _a SC _a ∠C _a C _b C _b ∠C _b C _b H _b	1.078 1.081 1.714 1.370 1.423 92.2 112.5 124.3	MW	
Toluene		∠SC _a C _b ∠SC _a H _a	115.5 119.9	C—C (ring) 1.399 C—H (average) 1.11 C—CH ₃ 1.524	ED	
				the difference between the C—H(CH ₃) and C—H(ring): about 0.01		
1,1,1-Tribromoethane CH ₃ CBBr ₃	C—Br C—C ∠BrCBr	1.93 1.51 (assumed) 111	C—H ∠CCBr ∠CCH	1.095 (assumed) 108 109.0 (assumed)	MW	
Tribromomethane → Bromoform						
Tri- <i>tert</i> -butyl methane HC _a [C _b (C _c H ₃) ₃] ₃	C _a —C _b C _b —C _c	1.611 1.548	C—H ∠C _a C _b C _c	1.111 113.0	ED	
Tricarbon dioxide OCCCO	C—O	1.163	C—C	1.289	ED	
				linear (with a large-amplitude bending vibration)		
Trichloroacetonitrile CCl ₃ CN	C—N C—Cl	1.165 1.763	C—C ∠ClCCl	1.460 110.0	ED	
1,1,1-Trichloroethane CH ₃ CCl ₃	C—H C—Cl ∠CCH ∠CCCl	1.090 1.771 108.9 109.6	C—C ∠HCH ∠ClCCl	1.541 110.0 109.4	MW	
Trichloro(methyl)germane CH ₃ GeCl ₃	Ge—Cl C—H ∠GeCH	2.132 1.103 (assumed) 110.5 (assumed)	Ge—C ∠ClGeCl	1.89 106.4	ED, MW	
Trichloro(methyl)silane CH ₃ SiCl ₃	C—Si	1.876	Si—Cl (C _{3v})	2.021	MW	
Trichloro(methyl)stannane CH ₃ SnCl ₃	Sn—Cl C—H ∠ClSnCl	2.304 1.100 104.7	Sn—C ∠CSnCl ∠SnCH	2.10 113.9 108	ED	
Triethylenediamine → 1,4-Diazabicyclo [2.2.2]octane						
Trifluoroacetic acid			C—F C—C C—O _a	1.325 1.546 1.192	ED	
		C—O _b ∠CCO _a ∠CCF	1.35 126.8 109.5	O—H ∠CCO _b	0.96 (assumed) 111.1	
1,1,1-Trifluoroethane CH ₃ CF ₃	C—C C—H ∠CCH	1.494 1.081 112	C—F ∠CCF	1.340 119.2	ED	
Trifluoromethane → Fluoroform						

BOND LENGTHS AND ANGLES IN GAS-PHASE MOLECULES (continued)

Compound	Structure		Structure		Method	
1,1,1-Trifluoro-2,2,2-trichloroethane CF ₃ CCl ₃	C—C	1.54	C—F	1.33	MW	
	C—Cl	1.77	∠CCF	110		
	∠CCCl	109.6	staggered conformation			
Trimethylaluminium (CH ₃) ₃ Al	C—H	1.113	Al—C	1.957	ED	
	∠AlCH	111.7	∠CAIC	120		
	C—N	1.458	C—H	1.100		
Trimethylamine (CH ₃) ₃ N	∠CNC	110.9	∠HCH	110	ED	
	C—As	1.979	∠CAsC	98.8		
Trimethylarsine (CH ₃) ₃ As	∠AsCH	111.4			ED	
	Bi—C	2.263	C—H	1.07		
Trimethylbismuth (CH ₃) ₃ Bi	∠CBiC	97.1			ED	
	C—B	1.578	C—H	1.114		
Trimethylborane (CH ₃) ₃ B	∠CBC	120.0	∠BCH	112.5	ED	
	C—P	1.847	C—H	1.091		
Trimethylphosphine (CH ₃) ₃ P	∠CPC	98.6	∠PCH	110.7	ED	
	1,3,5-Trioxane		C—O	1.422		MW
∠OCO			112.2			
∠COC			110.3			
Triphenylamine (C ₆ H ₅) ₃ N	C—C	1.392	C—N	1.42	ED	
	∠CNC	116	(C ₃)			
Tropone	torsional dihedral angle of the two phenyl rings 47° (defined to be 0 when the symmetry axis is contained in the phenyl planes)				ED	
		C _a —O	1.23			
		C _a —C _b	1.45			
		C _b —C _c	1.36			
		C _c —C _d	1.46			
		C _d —C _d	1.34			
		∠C _b C _a C _b	122			
	∠C _a C _b C _c	133				
	∠C _b C _c C _d	126	∠C _c C _d C _d	130		
			(C _{2v})			
	Vinylacetylene		C _b —C _c	1.434		ED, MW
			C _a —C _b	1.344		
C _c —C _d			1.215			
C _a —H _a			1.11			
C _d —H _d			1.09			
∠C _a C _b C _c			123.1			
∠C _b C _c C _d			178	∠H _a C _a C _b	119	
∠H _b C _a C _b	122	∠H _c C _b C _a	122			
∠C _c C _d H _d	182					
Vinyl chloride		C—C	1.342	ED, MW		
		C—Cl	1.730			
		C—H	1.09			
		∠CCCl	122.5		∠CCH _a	124
		∠CCH _b	120		∠CCH _c	121.1

DIPOLE MOMENTS

This table gives values of the electric dipole moment for about 800 molecules. When available, values determined by microwave spectroscopy, molecular beam electric resonance, and other high-resolution spectroscopic techniques were selected. Otherwise, the values come from measurements of the dielectric constant in the gas phase or, if these do not exist, in the liquid phase. Compounds are listed by molecular formula in Hill order; compounds not containing carbon are listed first, followed by compounds containing carbon.

The dipole moment μ is given in debye units (D). The conversion factor to SI units is $1 \text{ D} = 3.33564 \times 10^{-30} \text{ C m}$.

Dipole moments of individual conformers (rotational isomers) are given when they have been measured. The conformers are designated as *gauche*, *trans*, *axial*, etc. The meaning of these terms can be found in the references. In some cases an average value, obtained from measurements on the bulk gas, is also given. Other information on molecules that have been studied by spectroscopy, such as the components of the dipole moment in the molecular framework and the variation with vibrational state and isotopic species, is given in References 1 and 2.

When the accuracy of a value is explicitly stated (i.e., 1.234 ± 0.005), the stated uncertainty generally indicates two or three standard deviations. When no uncertainty is given, the value may be assumed to be precise to a few units in the last decimal place. However, if more than three decimal places are given, the exact interpretation of the final digits may require analysis of the vibrational averaging.

Values measured in the gas phase that are questionable because of undetermined error sources are indicated as approximate (\approx). Values obtained by liquid phase measurements, which sometimes have large errors because of association effects, are enclosed in brackets, e.g., [1.8].

REFERENCES

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Mol. Form.	Name	μ/D	Mol. Form.	Name	μ/D
Compounds not containing carbon					
AgBr	Silver(I) bromide	5.62 ± 0.03	ClF ₃ Si	Chlorotrifluorosilane	0.636 ± 0.004
AgCl	Silver(I) chloride	6.08 ± 0.06	ClGeH ₃	Chlorogermane	2.13 ± 0.02
AgF	Silver(I) fluoride	6.22 ± 0.30	ClH	Hydrogen chloride	1.1086 ± 0.0003
AgI	Silver(I) iodide	4.55 ± 0.05	ClHO	Hypochlorous acid	≈ 1.3
AlF	Aluminum monofluoride	1.53 ± 0.15	ClH ₃ Si	Chlorosilane	1.31 ± 0.01
AsCl ₃	Arsenic(III) chloride	1.59 ± 0.08	ClI	Iodine chloride	1.24 ± 0.02
AsF ₃	Arsenic(III) fluoride	2.59 ± 0.05	ClIn	Indium(I) chloride	3.79 ± 0.19
AsH ₃	Arsine	0.217 ± 0.003	ClK	Potassium chloride	10.269 ± 0.001
BClH ₂	Chloroborane	0.75 ± 0.05	ClLi	Lithium chloride	7.12887
BF	Fluoroborane(1)	≈ 0.5	ClNO ₂	Nitryl chloride	0.53
BF ₂ H	Difluoroborane	0.971 ± 0.010	CINS	Thionitrosyl chloride	1.87 ± 0.02
B ₄ H ₁₀	Tetraborane	0.486 ± 0.002	ClNa	Sodium chloride	9.00117
B ₅ H ₉	Pentaborane(9)	2.13 ± 0.04	ClO	Chlorine oxide	1.297 ± 0.001
B ₆ H ₁₀	Hexaborane	2.50 ± 0.05	ClRb	Rubidium chloride	10.510 ± 0.005
BaO	Barium oxide	7.954 ± 0.003	ClTI	Thallium(I) chloride	4.54299
BaS	Barium sulfide	10.86 ± 0.02	Cl ₂ H ₂ Si	Dichlorosilane	1.17 ± 0.02
BrCl	Bromine chloride	0.519 ± 0.004	Cl ₂ OS	Thionyl chloride	1.45 ± 0.03
BrF	Bromine fluoride	1.422 ± 0.016	Cl ₂ O ₂ S	Sulfuryl chloride	1.81 ± 0.04
BrF ₃ Si	Bromotrifluorosilane	0.83 ± 0.01	Cl ₂ S	Sulfur dichloride	0.36 ± 0.01
BrF ₅	Bromine pentafluoride	1.51 ± 0.15	Cl ₃ FSi	Trichlorofluorosilane	0.49 ± 0.01
BrH	Hydrogen bromide	0.8272 ± 0.0003	Cl ₃ HSi	Trichlorosilane	0.86 ± 0.01
BrH ₃ Si	Bromosilane	1.319	Cl ₃ N	Nitrogen trichloride	0.39 ± 0.01
BrI	Iodine bromide	0.726 ± 0.003	Cl ₃ OP	Phosphorus(V) oxychloride	2.54 ± 0.05
BrK	Potassium bromide	10.628 ± 0.001	Cl ₃ P	Phosphorus(III) chloride	0.56 ± 0.02
BrLi	Lithium bromide	7.268 ± 0.001	CrO	Chromium monoxide	3.88 ± 0.13
BrNO	Nitrosyl bromide	≈ 1.8	CsF	Cesium fluoride	7.884 ± 0.001
BrNa	Sodium bromide	9.1183 ± 0.0006	CsNa	Cesium sodium	4.75 ± 0.20
BrO	Bromine monoxide	1.76 ± 0.04	CuF	Copper(I) fluoride	5.77 ± 0.29
BrO ₂	Bromine dioxide	2.8 ± 0.3	CuO	Copper(II) oxide	4.5 ± 0.5
BrRb	Rubidium bromide	≈ 10.9	FGa	Gallium monofluoride	2.45 ± 0.05
BrTI	Thallium(I) bromide	4.49 ± 0.05	FGeH ₃	Fluorogermane	2.33 ± 0.12
CaCl	Calcium monochloride	≈ 3.6	FH	Hydrogen fluoride	1.826178
ClCs	Cesium chloride	10.387 ± 0.004	FHO	Hypofluorous acid	2.23 ± 0.11
ClF	Chlorine fluoride	0.888061	FH ₂ N	Fluoramide	2.27 ± 0.18
ClFO ₃	Perchloryl fluoride	0.023 ± 0.001	FH ₃ Si	Fluorosilane	1.2969 ± 0.0006
ClF ₃	Chlorine trifluoride	0.6 ± 0.10	FI	Iodine fluoride	1.948 ± 0.020

DIPOLE MOMENTS (continued)

Mol. Form.	Name	μ/D	Mol. Form.	Name	μ/D
Fln	Indium(I) fluoride	3.40 ± 0.07	ILi	Lithium iodide	7.428 ± 0.001
FK	Potassium fluoride	8.585 ± 0.003	INa	Sodium iodide	9.236 ± 0.003
FLi	Lithium fluoride	6.3274 ± 0.0002	IO	Iodine monoxide	2.45 ± 0.05
FNO	Nitrosyl fluoride	1.730 ± 0.003	IRb	Rubidium iodide	≈11.5
FNO ₂	Nitryl fluoride	0.466 ± 0.005	ITl	Thallium(I) iodide	4.61 ± 0.07
FNS	Thionitrosyl fluoride (NSF)	1.902 ± 0.012	KLi	Lithium potassium	3.45 ± 0.20
FN ₃	Fluorine azide	≈1.3	KNa	Potassium sodium	2.693 ± 0.014
FNa	Sodium fluoride	8.156 ± 0.001	LaO	Lanthanum monoxide	3.207 ± 0.011
FO	Fluorine oxide	0.0043 ± 0.0004	LiNa	Lithium sodium	0.463 ± 0.002
FRb	Rubidium fluoride	8.5465 ± 0.0005	LiO	Lithium monoxide	6.84 ± 0.03
FS	Sulfur monofluoride	0.794 ± 0.02	LiRb	Lithium rubidium	4.0 ± 0.1
FTl	Thallium(I) fluoride	4.2282 ± 0.0008	MgO	Magnesium oxide	6.2 ± 0.6
F ₂ Ge	Germanium(II) fluoride	2.61 ± 0.02	NO	Nitric oxide	0.15872
F ₂ HN	Difluoramine	1.92 ± 0.02	NO ₂	Nitrogen dioxide	0.316 ± 0.010
F ₂ H ₂ Si	Difluorosilane	1.55 ± 0.02	NP	Phosphorus nitride	2.7470 ± 0.0001
F ₂ N ₂	<i>cis</i> -Difluorodiazine	0.16 ± 0.01	NS	Nitrogen sulfide	1.81 ± 0.02
F ₂ O	Fluorine monoxide	0.308180	N ₂ O	Nitrous oxide	0.16083
F ₂ OS	Thionyl fluoride	1.63 ± 0.01	N ₂ O ₃	Nitrogen trioxide	2.122 ± 0.010
F ₂ O ₂	Fluorine dioxide	1.44 ± 0.07	NaRb	Rubidium sodium	3.1 ± 0.3
F ₂ O ₂ S	Sulfuryl fluoride	1.12 ± 0.02	OP	Phosphorus monoxide	1.88 ± 0.07
F ₂ S	Sulfur difluoride	1.05 ± 0.05	OPb	Lead(II) oxide	4.64 ± 0.50
F ₂ Si	Difluorosilylene	1.23 ± 0.02	OS	Sulfur monoxide	1.55 ± 0.02
F ₃ HSi	Trifluorosilane	1.27 ± 0.03	OS ₂	Sulfur oxide (SSO)	1.47 ± 0.03
F ₃ H ₃ Si ₂	1,1,1-Trifluorodisilane	2.03 ± 0.10	OSi	Silicon monoxide	3.0982
F ₃ ISi	Trifluoroiodosilane	1.11 ± 0.03	OSn	Tin(II) oxide	4.32 ± 0.22
F ₃ N	Nitrogen trifluoride	0.235 ± 0.004	OSr	Strontium oxide	8.900 ± 0.003
F ₃ NO	Trifluoramine oxide	0.0390 ± 0.0004	OTi	Titanium(II) oxide	2.96 ± 0.05
F ₃ OP	Phosphorus(V) oxyfluoride	1.8685 ± 0.0001	OY	Yttrium monoxide	4.524 ± 0.007
F ₃ P	Phosphorus(III) fluoride	1.03 ± 0.01	OZr	Zirconium(II) oxide	2.55 ± 0.01
F ₃ PS	Phosphorus(V) sulfide trifluoride	0.64 ± 0.02	O ₂ S	Sulfur dioxide	1.63305
F ₄ N ₂	Tetrafluorohydrazine (<i>gauche</i>)	0.257 ± 0.002	O ₂ Se	Selenium dioxide	2.62 ± 0.05
F ₄ S	Sulfur tetrafluoride	0.632 ± 0.003	O ₂ Zr	Zirconium(IV) oxide	7.80 ± 0.02
F ₄ Se	Selenium tetrafluoride	1.78 ± 0.09	O ₃	Ozone	0.53373
F ₅ I	Iodine pentafluoride	2.18 ± 0.11	PbS	Lead(II) sulfide	3.59 ± 0.18
GeH ₃ N ₃	Germylazide	2.579 ± 0.003	SSi	Silicon monosulfide	1.73 ± 0.09
GeO	Germanium(II) oxide	3.2823 ± 0.0001	SSn	Tin(II) sulfide	3.18 ± 0.16
GeS	Germanium(II) sulfide	2.00 ± 0.06			
GeSe	Germanium(II) selenide	1.65 ± 0.05		Compounds containing carbon	
GeTe	Germanium(II) telluride	1.06 ± 0.07	CB _r F ₃	Bromotrifluoromethane	0.65 ± 0.05
HI	Hydrogen iodide	0.448 ± 0.001	CB _r ₂ F ₂	Dibromodifluoromethane	0.66 ± 0.05
HKO	Potassium hydroxide	7.415 ± 0.002	CCIF ₃	Chlorotrifluoromethane	0.50 ± 0.01
HLi	Lithium hydride	5.884 ± 0.001	CCIN	Cyanogen chloride	2.8331 ± 0.0002
HLiO	Lithium hydroxide	4.754 ± 0.002	CCl ₂ F ₂	Dichlorodifluoromethane	0.51 ± 0.05
HN	Imidogen	1.39 ± 0.07	CCl ₂ O	Carbonyl chloride	1.17 ± 0.01
HNO	Nitrosyl hydride	1.62 ± 0.03	CCl ₃ F	Trichlorofluoromethane	0.46 ± 0.02
HNO ₂	Nitrous acid (<i>cis</i>)	1.423 ± 0.005	CF	Fluoromethylidyne	0.645 ± 0.005
HNO ₂	Nitrous acid (<i>trans</i>)	1.855 ± 0.016	CFN	Cyanogen fluoride	2.120 ± 0.001
HNO ₃	Nitric acid	2.17 ± 0.02	CF ₂	Difluoromethylene	0.47 ± 0.02
HN ₃	Hydrazoic acid	1.70 ± 0.09	CF ₂ O	Carbonyl fluoride	0.95 ± 0.01
HO	Hydroxyl	1.655 ± 0.001	CF ₃ I	Trifluoroiodomethane	1.048 ± 0.003
HS	Mercapto	0.7580 ± 0.0001	CH	Methylidyne	≈1.46
H ₂ O	Water	1.8546 ± 0.0040	CHBrCIF	Bromochlorofluoromethane	1.5 ± 0.3
H ₂ O ₂	Hydrogen peroxide	1.573 ± 0.001	CHBr ₃	Tribromomethane	0.99 ± 0.02
H ₂ S	Hydrogen sulfide	0.97833	CHClF ₂	Chlorodifluoromethane	1.42 ± 0.03
H ₃ N	Ammonia	1.4718 ± 0.0002	CHCl ₂ F	Dichlorofluoromethane	1.29 ± 0.03
H ₃ NO	Hydroxylamine	0.59 ± 0.05	CHCl ₃	Trichloromethane	1.04 ± 0.02
H ₃ P	Phosphine	0.5740 ± 0.0003	CHFO	Formyl fluoride	2.081 ± 0.001
H ₃ Sb	Stibine	0.12 ± 0.05	CHF ₂ N	Carboimidic difluoride	1.393 ± 0.001
H ₄ N ₂	Hydrazine	1.75 ± 0.09	CHF ₃	Trifluoromethane	1.65150
H ₆ OSi ₂	Disiloxane	0.24 ± 0.02	CHN	Hydrogen cyanide	2.985188
IK	Potassium iodide	≈10.8			

DIPOLE MOMENTS (continued)

Mol. Form.	Name	μ/D	Mol. Form.	Name	μ/D
CHN	Hydrogen isocyanide	3.05 ± 0.15	C ₂ HI	Iodoacetylene	0.02525
CHNO	Isocyanic acid (HNCO)	≈1.6	C ₂ H ₂ Br ₄	1,1,2,2-Tetrabromoethane	[1.38]
CHNO	Fulminic acid	3.09934	C ₂ H ₂ Cl ₂	1,1-Dichloroethene	1.34 ± 0.01
CH ₂ BrCl	Bromochloromethane	[1.66]	C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethene	1.90 ± 0.04
CH ₂ Br ₂	Dibromomethane	1.43 ± 0.03	C ₂ H ₂ Cl ₂ O	Chloroacetyl chloride	2.23 ± 0.11
CH ₂ ClF	Chlorofluoromethane	1.82 ± 0.04	C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	1.32 ± 0.07
CH ₂ Cl ₂	Dichloromethane	1.60 ± 0.03	C ₂ H ₂ F ₂	1,1-Difluoroethene	1.3893 ± 0.0002
CH ₂ F ₂	Difluoromethane	1.9785 ± 0.02	C ₂ H ₂ F ₂	<i>cis</i> -1,2-Difluoroethene	2.42 ± 0.02
CH ₂ I ₂	Diiodomethane	[1.08]	C ₂ H ₂ F ₄	1,1,1,2-Tetrafluoroethane	1.80 ± 0.22
CH ₂ N ₂	Diazomethane	1.50 ± 0.01	C ₂ H ₂ N ₂ S	1,2,5-Thiadiazole	1.579 ± 0.007
CH ₂ N ₂	Cyanamide	4.28 ± 0.10	C ₂ H ₂ O	Ketene	1.42215
CH ₂ N ₄	1H-Tetrazole	2.19 ± 0.05	C ₂ H ₂ O ₂	Glyoxal (<i>cis</i>)	4.8 ± 0.2
CH ₂ O	Formaldehyde	2.332 ± 0.002	C ₂ H ₃ Br	Bromoethene	1.42 ± 0.03
CH ₂ O ₂	Formic acid	1.425 ± 0.002	C ₂ H ₃ Cl	Chloroethene	1.45 ± 0.03
CH ₂ S	Thioformaldehyde	1.6491 ± 0.0004	C ₂ H ₃ ClF ₂	1-Chloro-1,1-difluoroethane	2.14 ± 0.04
CH ₂ Se	Selenoformaldehyde	1.41 ± 0.01	C ₂ H ₃ ClO	Acetyl chloride	2.72 ± 0.14
CH ₃ BCl ₂	Dichloromethylborane	1.419 ± 0.013	C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	1.755 ± 0.015
CH ₃ BF ₂	Difluoromethylborane	1.668 ± 0.003	C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	[1.4]
CH ₃ BO	Borane carbonyl	1.698 ± 0.020	C ₂ H ₃ F	Fluoroethene	1.468 ± 0.003
CH ₃ Br	Bromomethane	1.8203 ± 0.0004	C ₂ H ₃ FO	Acetyl fluoride	2.96 ± 0.03
CH ₃ Cl	Chloromethane	1.8963 ± 0.0002	C ₂ H ₃ F ₃	1,1,1-Trifluoroethane	2.3470 ± 0.005
CH ₃ Cl ₃ Si	Methyltrichlorosilane	1.91 ± 0.01	C ₂ H ₃ HgN	Cyanomethylmercury	4.7 ± 0.1
CH ₃ F	Fluoromethane	1.858 ± 0.002	C ₂ H ₃ I	Iodoethene	1.311 ± 0.005
CH ₃ F ₂ OP	Methylphosphonic difluoride	3.69 ± 0.26	C ₂ H ₃ N	Acetonitrile	3.92519
CH ₃ F ₂ P	Methyldifluorophosphine	2.056 ± 0.006	C ₂ H ₃ NO	Methyl cyanate	4.26 ± 0.18
CH ₃ F ₃ Si	Trifluoromethylsilane	2.3394 ± 0.0002	C ₂ H ₃ NO	Methyl isocyanate	≈2.8
CH ₃ F ₃ Si	(Trifluoromethyl)silane	2.32 ± 0.02	C ₂ H ₃ NS	Methyl isothiocyanate	3.453 ± 0.003
CH ₃ I	Iodomethane	1.6406 ± 0.0004	C ₂ H ₃ N ₃	1H-1,2,4-Triazole	2.7 ± 0.1
CH ₃ NO	Formamide	3.73 ± 0.07	C ₂ H ₄ BrCl	1-Bromo-2-chloroethane	[1.2]
CH ₃ NO ₂	Nitromethane	3.46 ± 0.02	C ₂ H ₄ Br ₂	1,2-Dibromoethane	[1.19]
CH ₃ N ₃	Methyl azide	2.17 ± 0.04	C ₂ H ₄ ClF	1-Chloro-1-fluoroethane	2.068 ± 0.014
CH ₄ O	Methanol	1.70 ± 0.02	C ₂ H ₄ Cl ₂	1,1-Dichloroethane	2.06 ± 0.04
CH ₄ O ₂	Methylhydroperoxide	≈0.65	C ₂ H ₄ Cl ₂	1,2-Dichloroethane	[1.83]
CH ₄ S	Methanethiol	1.52 ± 0.08	C ₂ H ₄ F ₂	1,1-Difluoroethane	2.27 ± 0.05
CH ₄ FSi	Fluoromethylsilane	1.700 ± 0.008	C ₂ H ₄ F ₂	1,2-Difluoroethane (<i>gauche</i>)	2.67 ± 0.13
CH ₄ ISi	Iodomethylsilane	1.862 ± 0.005	C ₂ H ₄ O	Acetaldehyde	2.750 ± 0.006
CH ₅ N	Methylamine	1.31 ± 0.03	C ₂ H ₄ O	Ethylene oxide	1.89 ± 0.01
CH ₆ OSi	Methyl silyl ether	1.15 ± 0.02	C ₂ H ₄ O ₂	Acetic acid	1.70 ± 0.03
CH ₆ Si	Methylsilane	0.73456	C ₂ H ₄ O ₂	Methyl formate	1.77 ± 0.04
CH ₃ B ₂	Methyldiborane(6)	0.566 ± 0.006	C ₂ H ₄ O ₂	Glycolaldehyde	2.73 ± 0.05
CIN	Cyanogen iodide	3.67 ± 0.02	C ₂ H ₅ Br	Bromoethane	2.04 ± 0.02
CO	Carbon monoxide	0.10980	C ₂ H ₅ Cl	Chloroethane	2.05 ± 0.02
COS	Carbon oxysulfide	0.715189	C ₂ H ₅ ClO	2-Chloroethanol	1.78 ± 0.09
COSe	Carbon oxyselenide	0.73 ± 0.02	C ₂ H ₅ Cl ₃ Si	Trichloroethylsilane	[2.04]
CS	Carbon monosulfide	1.958 ± 0.005	C ₂ H ₅ F	Fluoroethane	1.937 ± 0.007
CSe	Carbon monoselenide	1.99 ± 0.04	C ₂ H ₅ I	Iodoethane	1.976 ± 0.002
C ₂ BrF	Bromofluoroacetylene	0.448 ± 0.002	C ₂ H ₅ N	Ethyleneimine	1.90 ± 0.01
C ₂ ClF ₃	Chlorotrifluoroethene	0.40 ± 0.10	C ₂ H ₅ NO	Acetamide	3.68 ± 0.03
C ₂ ClF ₅	Chloropentafluoroethane	0.52 ± 0.05	C ₂ H ₅ NO	<i>N</i> -Methylformamide	3.83 ± 0.08
C ₂ Cl ₂ F ₂	1,1-Dichloro-2,2-difluoroethene	0.50	C ₂ H ₅ NO ₂	Nitroethane	3.23 ± 0.03
C ₂ Cl ₂ F ₄	1,2-Dichloro-1,1,2,2-tetrafluoroethane	≈0.5	C ₂ H ₆ O	Ethanol (<i>gauche</i>)	1.68 ± 0.03
C ₂ F ₃ N	Trifluoroacetonitrile	1.262 ± 0.010	C ₂ H ₆ O	Ethanol (<i>trans</i>)	1.44 ± 0.03
C ₂ F ₃ N	Trifluoroisocyanomethane	1.153 ± 0.010	C ₂ H ₆ O	Ethanol (<i>average</i>)	1.69 ± 0.03
C ₂ HBr	Bromoacetylene	0.22962	C ₂ H ₆ O	Dimethyl ether	1.30 ± 0.01
C ₂ HCl	Chloroacetylene	0.44408	C ₂ H ₆ OS	Dimethyl sulfoxide	3.96 ± 0.04
C ₂ HCl ₃	Trichloroethene	[0.8]	C ₂ H ₆ O ₂	Ethylene glycol (<i>average</i>)	2.36 ± 0.10
C ₂ HCl ₅	Pentachloroethane	0.92 ± 0.05	C ₂ H ₆ S	Ethanethiol (<i>gauche</i>)	1.61 ± 0.08
C ₂ HF	Fluoroacetylene	0.7207 ± 0.0003	C ₂ H ₆ S	Ethanethiol (<i>trans</i>)	1.58 ± 0.08
C ₂ HF ₃	Trifluoroethene	1.32 ± 0.03	C ₂ H ₆ S	Dimethyl sulfide	1.554 ± 0.004
C ₂ HF ₃ O ₂	Trifluoroacetic acid	2.28 ± 0.25	C ₂ H ₆ S ₂	1,2-Ethanedithiol	2.03 ± 0.08
			C ₂ H ₆ S ₂	Dimethyl disulfide	[1.85]

DIPOLE MOMENTS (continued)

Mol. Form.	Name	μ/D	Mol. Form.	Name	μ/D
C ₂ H ₆ Si	Vinylsilane	0.657 ± 0.002	C ₃ H ₆ O ₂	Ethyl formate (<i>gauche</i>)	1.81 ± 0.02
C ₂ H ₇ N	Ethylamine (<i>gauche</i>)	1.210 ± 0.015	C ₃ H ₆ O ₂	Ethyl formate (<i>trans</i>)	1.98 ± 0.02
C ₂ H ₇ N	Ethylamine (<i>trans</i>)	1.304 ± 0.011	C ₃ H ₆ O ₂	Ethyl formate (<i>average</i>)	1.93
C ₂ H ₇ N	Ethylamine (<i>average</i>)	1.22 ± 0.10	C ₃ H ₆ O ₂	Methyl acetate	1.72 ± 0.09
C ₂ H ₇ N	Dimethylamine	1.01 ± 0.02	C ₃ H ₆ O ₂	1,3-Dioxolane	1.19 ± 0.06
C ₂ H ₇ NO	Ethanolamine	[2.27]	C ₃ H ₆ O ₂ S	Thietane 1,1-dioxide	4.8 ± 0.1
C ₂ H ₈ N ₂	1,2-Ethanediamine	1.99 ± 0.10	C ₃ H ₆ O ₃	1,3,5-Trioxane	2.08 ± 0.02
C ₃ HF ₃	3,3,3-Trifluoro-1-propyne	2.317 ± 0.013	C ₃ H ₆ S	Thietane	1.85 ± 0.09
C ₃ HN	Cyanoacetylene	3.73172	C ₃ H ₇ Br	1-Bromopropane	2.18 ± 0.11
C ₃ H ₂ F ₂	3,3-Difluorocyclopropene	2.98 ± 0.02	C ₃ H ₇ Br	2-Bromopropane	2.21 ± 0.11
C ₃ H ₂ O	2-Propynal	2.78 ± 0.02	C ₃ H ₇ Cl	1-Chloropropane (<i>gauche</i>)	2.02 ± 0.03
C ₃ H ₃ Cl ₂ F	1,1-Dichloro-2-fluoropropene	2.43 ± 0.02	C ₃ H ₇ Cl	1-Chloropropane (<i>trans</i>)	1.95 ± 0.02
C ₃ H ₃ F	3-Fluoropropyne	1.73 ± 0.02	C ₃ H ₇ Cl	1-Chloropropane (<i>average</i>)	2.05 ± 0.04
C ₃ H ₃ F ₃	3,3,3-Trifluoropropene	2.45 ± 0.05	C ₃ H ₇ Cl	2-Chloropropane	2.17 ± 0.11
C ₃ H ₃ N	Acrylonitrile	3.92 ± 0.07	C ₃ H ₇ F	1-Fluoropropane (<i>gauche</i>)	1.90 ± 0.10
C ₃ H ₃ NO	Oxazole	1.503 ± 0.030	C ₃ H ₇ F	1-Fluoropropane (<i>trans</i>)	2.05 ± 0.04
C ₃ H ₃ NO	Isoxazole	2.95 ± 0.04	C ₃ H ₇ F	2-Fluoropropane	1.958 ± 0.001
C ₃ H ₄	Propyne	0.784 ± 0.001	C ₃ H ₇ I	1-Iodopropane	2.04 ± 0.10
C ₃ H ₄	Cyclopropene	0.454 ± 0.010	C ₃ H ₇ I	2-Iodopropane	[1.95]
C ₃ H ₄ F ₂	1,1-Difluoro-1-propene	0.889 ± 0.007	C ₃ H ₇ N	Allylamine	≈ 1.2
C ₃ H ₄ N ₂	1 <i>H</i> -Pyrazole	2.20 ± 0.01	C ₃ H ₇ N	Cyclopropylamine	1.19 ± 0.01
C ₃ H ₄ N ₂	Imidazole	3.8 ± 0.4	C ₃ H ₇ N	Propyleneimine (<i>cis</i>)	1.77 ± 0.09
C ₃ H ₄ O	Propargyl alcohol	1.13 ± 0.06	C ₃ H ₇ N	Propyleneimine (<i>trans</i>)	1.57 ± 0.03
C ₃ H ₄ O	Acrolein (<i>trans</i>)	3.117 ± 0.004	C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide	3.82 ± 0.08
C ₃ H ₄ O	Acrolein (<i>cis</i>)	2.552 ± 0.003	C ₃ H ₇ NO	<i>N</i> -Methylacetamide	[4.3]
C ₃ H ₄ O	Cyclopropanone	2.67 ± 0.13	C ₃ H ₇ NO ₂	1-Nitropropane	3.66 ± 0.07
C ₃ H ₄ O ₂	Vinyl formate	1.49 ± 0.01	C ₃ H ₇ NO ₂	2-Nitropropane	3.73 ± 0.07
C ₃ H ₄ O ₂	2-Oxetanone	4.18 ± 0.03	C ₃ H ₈	Propane	0.084 ± 0.001
C ₃ H ₄ O ₂	3-Oxetanone	0.887 ± 0.005	C ₃ H ₈ O	1-Propanol (<i>gauche</i>)	1.58 ± 0.03
C ₃ H ₄ O ₃	Ethylene carbonate	[4.9]	C ₃ H ₈ O	1-Propanol (<i>trans</i>)	1.55 ± 0.03
C ₃ H ₅ Br	2-Bromopropene	[1.51]	C ₃ H ₈ O	2-Propanol (<i>trans</i>)	1.58 ± 0.03
C ₃ H ₅ Br	3-Bromopropene	≈ 1.9	C ₃ H ₈ O	Ethyl methyl ether (<i>trans</i>)	1.17 ± 0.02
C ₃ H ₅ Cl	<i>cis</i> -1-Chloropropene	1.67 ± 0.08	C ₃ H ₈ O ₂	1,2-Propylene glycol	[2.25]
C ₃ H ₅ Cl	<i>trans</i> -1-Chloropropene	1.97 ± 0.10	C ₃ H ₈ O ₂	1,3-Propylene glycol	[2.55]
C ₃ H ₅ Cl	2-Chloropropene	1.647 ± 0.010	C ₃ H ₈ O ₂	Ethylene glycol monomethyl ether (<i>gauche</i>)	2.36 ± 0.05
C ₃ H ₅ Cl	3-Chloropropene	1.94 ± 0.10	C ₃ H ₈ O ₂	Dimethoxymethane	[0.74]
C ₃ H ₅ ClO	Epichlorohydrin	[1.8]	C ₃ H ₈ O ₃	Glycerol	[2.56]
C ₃ H ₅ F	<i>cis</i> -1-Fluoropropene	1.46 ± 0.03	C ₃ H ₈ S	1-Propanethiol (<i>gauche</i>)	1.683 ± 0.010
C ₃ H ₅ F	<i>trans</i> -1-Fluoropropene	≈ 1.9	C ₃ H ₈ S	1-Propanethiol (<i>trans</i>)	1.60 ± 0.08
C ₃ H ₅ F	2-Fluoropropene	1.61 ± 0.03	C ₃ H ₈ S	2-Propanethiol (<i>gauche</i>)	1.53 ± 0.03
C ₃ H ₅ F	3-Fluoropropene (<i>gauche</i>)	1.939 ± 0.015	C ₃ H ₈ S	2-Propanethiol (<i>trans</i>)	1.61 ± 0.03
C ₃ H ₅ F	3-Fluoropropene (<i>cis</i>)	1.765 ± 0.014	C ₃ H ₈ S	Ethyl methyl sulfide (<i>gauche</i>)	1.593 ± 0.004
C ₃ H ₅ N	Propanenitrile	4.05 ± 0.03	C ₃ H ₈ S	Ethyl methyl sulfide (<i>trans</i>)	1.56 ± 0.03
C ₃ H ₅ NO	Ethyl cyanate	4.72 ± 0.09	C ₃ H ₉ N	Propylamine	1.17 ± 0.06
C ₃ H ₅ NO	3-Hydroxypropanenitrile (<i>gauche</i>)	3.17 ± 0.02	C ₃ H ₉ N	Isopropylamine	1.19 ± 0.06
C ₃ H ₆	Propene	0.366 ± 0.001	C ₃ H ₉ N	Trimethylamine	0.612 ± 0.003
C ₃ H ₆ Br ₂	1,2-Dibromopropane	[1.2]	C ₃ H ₉ O ₄ P	Trimethyl phosphate	[3.18]
C ₃ H ₆ Cl ₂	1,2-Dichloropropane	[1.85]	C ₄ H ₄	1-Buten-3-yne	0.22 ± 0.02
C ₃ H ₆ Cl ₂	1,3-Dichloropropane	2.08 ± 0.04	C ₄ H ₄	Methylenecyclopropene	1.90 ± 0.01
C ₃ H ₆ O	Acetone	2.88 ± 0.03	C ₄ H ₄ N ₂	Succinonitrile	[3.7]
C ₃ H ₆ O	Propanal (<i>gauche</i>)	2.86 ± 0.01	C ₄ H ₄ N ₂	Pyrimidine	2.334 ± 0.010
C ₃ H ₆ O	Propanal (<i>cis</i>)	2.52 ± 0.05	C ₄ H ₄ N ₂	Pyridazine	4.22 ± 0.02
C ₃ H ₆ O	Propanal (<i>average</i>)	2.72	C ₄ H ₄ O	Furan	0.66 ± 0.01
C ₃ H ₆ O	Allyl alcohol (<i>gauche</i>)	1.55 ± 0.08	C ₄ H ₄ O ₂	Diketene	3.53 ± 0.07
C ₃ H ₆ O	Allyl alcohol (<i>average</i>)	1.60 ± 0.08	C ₄ H ₄ S	Thiophene	0.55 ± 0.01
C ₃ H ₆ O	Methyl vinyl ether	0.965 ± 0.002	C ₄ H ₅ N	2-Methylacrylonitrile	3.69 ± 0.18
C ₃ H ₆ O	Methyloxirane	2.01 ± 0.02	C ₄ H ₅ N	Pyrrole	1.767 ± 0.001
C ₃ H ₆ O	Oxetane	1.94 ± 0.01	C ₄ H ₅ N	Isocyanocyclopropane	4.03 ± 0.10
C ₃ H ₆ O ₂	Propanoic acid (<i>cis</i>)	1.46 ± 0.07	C ₄ H ₅ NO	2-Methyloxazole	1.37 ± 0.07
C ₃ H ₆ O ₂	Propanoic acid (<i>average</i>)	1.75 ± 0.09	C ₄ H ₅ NO	4-Methyloxazole	1.08 ± 0.05

DIPOLE MOMENTS (continued)

Mol. Form.	Name	μ/D	Mol. Form.	Name	μ/D
C ₄ H ₅ NO	5-Methyloxazole	2.16 ± 0.04	C ₄ H ₉ Cl	2-Chlorobutane	2.04 ± 0.10
C ₄ H ₅ NO	4-Methylisoxazole	3.583 ± 0.005	C ₄ H ₉ Cl	1-Chloro-2-methylpropane	2.00 ± 0.10
C ₄ H ₆	1,2-Butadiene	0.403 ± 0.002	C ₄ H ₉ Cl	2-Chloro-2-methylpropane	2.13 ± 0.04
C ₄ H ₆	1-Butyne	0.782 ± 0.004	C ₄ H ₉ I	1-Iodobutane	[1.93]
C ₄ H ₆	Cyclobutene	0.132 ± 0.001	C ₄ H ₉ I	2-Iodobutane	2.12 ± 0.11
C ₄ H ₆ O	Divinyl ether	0.78 ± 0.05	C ₄ H ₉ I	1-Iodo-2-methylpropane	[1.87]
C ₄ H ₆ O	3-Methoxy-1,2-propadiene	0.963 ± 0.020	C ₄ H ₉ N	Pyrrolidine	[1.57]
C ₄ H ₆ O	<i>trans</i> -2-Butenal	3.67 ± 0.07	C ₄ H ₉ NO	<i>N</i> -Methylpropanamide	3.61
C ₄ H ₆ O	2-Methylpropenal	2.68 ± 0.13	C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide	[3.7]
C ₄ H ₆ O	Cyclobutanone	2.89 ± 0.03	C ₄ H ₉ NO	Morpholine	1.55 ± 0.03
C ₄ H ₆ O	2,3-Dihydrofuran	1.32 ± 0.03	C ₄ H ₁₀	Isobutane	0.132 ± 0.002
C ₄ H ₆ O	2,5-Dihydrofuran	1.63 ± 0.01	C ₄ H ₁₀ O	1-Butanol	1.66 ± 0.03
C ₄ H ₆ O ₂	<i>trans</i> -Crotonic acid	[2.13]	C ₄ H ₁₀ O	2-Butanol	[1.8]
C ₄ H ₆ O ₂	Methacrylic acid	[1.65]	C ₄ H ₁₀ O	2-Methyl-1-propanol	1.64 ± 0.08
C ₄ H ₆ O ₂	Vinyl acetate	[1.79]	C ₄ H ₁₀ O	2-Methyl-2-propanol	[1.66]
C ₄ H ₆ O ₂	Methyl acrylate	[1.77]	C ₄ H ₁₀ O	Diethyl ether	1.15 ± 0.02
C ₄ H ₆ O ₂	γ -Butyrolactone	4.27 ± 0.03	C ₄ H ₁₀ O	Methyl propyl ether (<i>trans-trans</i>)	1.107 ± 0.013
C ₄ H ₆ O ₂	2,3-Dihydro-1,4-dioxin	0.939 ± 0.008	C ₄ H ₁₀ O	Isopropyl methyl ether	1.247 ± 0.003
C ₄ H ₆ O ₂	3,6-Dihydro-1,2-dioxin	2.329 ± 0.001	C ₄ H ₁₀ O ₂	1,4-Butanediol	[2.58]
C ₄ H ₆ O ₃	Acetic anhydride	≈2.8	C ₄ H ₁₀ O ₂	Ethylene glycol monoethyl ether	[2.08]
C ₄ H ₆ O ₃	Propylene carbonate	[4.9]	C ₄ H ₁₀ O ₃	Diethylene glycol	[2.31]
C ₄ H ₆ S	2,3-Dihydrothiophene	1.61 ± 0.20	C ₄ H ₁₀ S	1-Butanethiol	[1.53]
C ₄ H ₆ S	2,5-Dihydrothiophene	1.75 ± 0.01	C ₄ H ₁₀ S	2-Methyl-2-propanethiol	1.66 ± 0.03
C ₄ H ₇ N	Butanenitrile (<i>gauche</i>)	3.91 ± 0.04	C ₄ H ₁₀ S	Diethyl sulfide	1.54 ± 0.08
C ₄ H ₇ N	Butanenitrile (<i>anti</i>)	3.73 ± 0.06	C ₄ H ₁₁ N	Butylamine	≈1.0
C ₄ H ₇ N	2-Methylpropanenitrile	4.29 ± 0.09	C ₄ H ₁₁ N	<i>sec</i> -Butylamine	[1.28]
C ₄ H ₇ N	2-Isocyanopropane	4.055 ± 0.001	C ₄ H ₁₁ N	<i>tert</i> -Butylamine	[1.29]
C ₄ H ₇ NO	2-Pyrrolidone	[3.5]	C ₄ H ₁₁ N	Isobutylamine	[1.27]
C ₄ H ₈	1-Butene (<i>cis</i>)	0.438 ± 0.007	C ₄ H ₁₁ N	Diethylamine	0.92 ± 0.05
C ₄ H ₈	1-Butene (<i>skew</i>)	0.359 ± 0.011	C ₄ H ₁₁ NO ₂	Diethanolamine	[2.8]
C ₄ H ₈	<i>cis</i> -2-Butene	0.253 ± 0.005	C ₄ H ₁₃ N ₃	Diethylenetriamine	[1.89]
C ₄ H ₈	Isobutene	0.503 ± 0.010	C ₅ F ₅ N	Perfluoropyridine	0.98 ± 0.08
C ₄ H ₈	Methylcyclopropane	0.139 ± 0.004	C ₅ H ₃ NS	2-Thiophenecarbonitrile	4.59 ± 0.02
C ₄ H ₈ Cl ₂	1,4-Dichlorobutane	2.22 ± 0.11	C ₅ H ₃ NS	3-Thiophenecarbonitrile	4.13 ± 0.02
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether	[2.58]	C ₅ H ₄	1,3-Pentadiyne	1.207 ± 0.001
C ₄ H ₈ O	<i>cis</i> -2-Buten-1-ol	1.96 ± 0.03	C ₅ H ₄ CIN	4-Chloropyridine	0.756 ± 0.005
C ₄ H ₈ O	<i>trans</i> -2-Buten-1-ol	1.90 ± 0.02	C ₅ H ₄ FN	3-Fluoropyridine	2.09 ± 0.26
C ₄ H ₈ O	2-Methyl-2-propenol (<i>skew</i>)	1.295 ± 0.022	C ₅ H ₄ O	2,4-Cyclopentadien-1-one	3.132 ± 0.007
C ₄ H ₈ O	Ethyl vinyl ether	[1.26]	C ₅ H ₄ OS	4H-Pyran-4-thione	3.95 ± 0.05
C ₄ H ₈ O	1,2-Epoxybutane	1.891 ± 0.011	C ₅ H ₄ O ₂	Furfural	[3.54]
C ₄ H ₈ O	Butanal	2.72 ± 0.05	C ₅ H ₄ O ₂	4H-Pyran-4-one	3.79 ± 0.02
C ₄ H ₈ O	Isobutanal (<i>gauche</i>)	2.69 ± 0.01	C ₅ H ₄ S ₂	4H-Thiopyran-4-thione	3.9 ± 0.2
C ₄ H ₈ O	Isobutanal (<i>trans</i>)	2.86 ± 0.01	C ₅ H ₅ N	Pyridine	2.215 ± 0.010
C ₄ H ₈ O	2-Butanone	2.779 ± 0.015	C ₅ H ₆	1,2,3-Pentatriene	0.51 ± 0.05
C ₄ H ₈ O	Tetrahydrofuran	1.75 ± 0.04	C ₅ H ₆	1-Penten-3-yne	0.66 ± 0.02
C ₄ H ₈ OS	1,4-Oxathiane	0.295 ± 0.003	C ₅ H ₆	<i>cis</i> -3-Penten-1-yne	0.78 ± 0.02
C ₄ H ₈ O ₂	Butanoic acid	[1.65]	C ₅ H ₆	<i>trans</i> -3-Penten-1-yne	1.06 ± 0.05
C ₄ H ₈ O ₂	2-Methylpropanoic acid	[1.08]	C ₅ H ₆	2-Methyl-1-buten-3-yne	0.513 ± 0.02
C ₄ H ₈ O ₂	Propyl formate	[1.89]	C ₅ H ₆	1,3-Cyclopentadiene	0.419 ± 0.004
C ₄ H ₈ O ₂	Ethyl acetate	1.78 ± 0.09	C ₅ H ₆ N ₂	2-Methylpyrimidine	1.676 ± 0.010
C ₄ H ₈ O ₂	<i>cis</i> -2-Butene-1,4-diol	[2.48]	C ₅ H ₆ N ₂	5-Methylpyrimidine	2.881 ± 0.006
C ₄ H ₈ O ₂	<i>trans</i> -2-Butene-1,4-diol	[2.45]	C ₅ H ₆ O	2-Methylfuran	0.65 ± 0.05
C ₄ H ₈ O ₂	1,3-Dioxane	2.06 ± 0.04	C ₅ H ₆ O	3-Methylfuran	1.03 ± 0.02
C ₄ H ₈ O ₂ S	Sulfolane	[4.8]	C ₅ H ₆ O	3-Cyclopenten-1-one	2.79 ± 0.03
C ₄ H ₈ S	3-Methylthietane	2.046 ± 0.009	C ₅ H ₆ O ₂	5-Methyl-2(3H)-furanone	4.08 ± 0.02
C ₄ H ₈ S	Tetrahydrothiophene	[1.90]	C ₅ H ₆ O ₂	Furfuryl alcohol	[1.92]
C ₄ H ₈ S ₂	1,3-Dithiane	2.14 ± 0.04	C ₅ H ₆ S	2-Methylthiophene	0.674 ± 0.005
C ₄ H ₉ Br	1-Bromobutane	2.08 ± 0.10	C ₅ H ₆ S	3-Methylthiophene	0.914 ± 0.015
C ₄ H ₉ Br	2-Bromobutane	2.23 ± 0.11	C ₅ H ₇ N	3-Methyl-2-butenenitrile	4.61 ± 0.13
C ₄ H ₉ Br	2-Bromo-2-methylpropane	[2.17]	C ₅ H ₇ N	Cyclobutanecarbonitrile	4.04 ± 0.04
C ₄ H ₉ Cl	1-Chlorobutane	2.05 ± 0.04	C ₅ H ₇ NO ₂	Ethyl cyanoacetate	[2.17]

DIPOLE MOMENTS (continued)

Mol. Form.	Name	μ/D	Mol. Form.	Name	μ/D
C ₅ H ₈	<i>cis</i> -1,3-Pentadiene	0.500 ± 0.015	C ₆ H ₄ CINO ₂	1-Chloro-2-nitrobenzene	4.64 ± 0.09
C ₅ H ₈	<i>trans</i> -1,3-Pentadiene	0.585 ± 0.010	C ₆ H ₄ CINO ₂	1-Chloro-3-nitrobenzene	3.73 ± 0.07
C ₅ H ₈	2-Methyl-1,3-butadiene	0.25 ± 0.01	C ₆ H ₄ CINO ₂	1-Chloro-4-nitrobenzene	2.83 ± 0.06
C ₅ H ₈	1-Pentyne (<i>gauche</i>)	0.769 ± 0.028	C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	2.50 ± 0.05
C ₅ H ₈	1-Pentyne (<i>trans</i>)	0.842 ± 0.010	C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	1.72 ± 0.09
C ₅ H ₈	Cyclopentene	0.20 ± 0.02	C ₆ H ₄ FNO ₂	1-Fluoro-4-nitrobenzene	2.87 ± 0.06
C ₅ H ₈	3,3-Dimethylcyclopropene	0.287 ± 0.003	C ₆ H ₄ F ₂	<i>o</i> -Difluorobenzene	2.46 ± 0.05
C ₅ H ₈ O	Cyclopropyl methyl ketone	2.62 ± 0.25	C ₆ H ₄ F ₂	<i>m</i> -Difluorobenzene	1.51 ± 0.02
C ₅ H ₈ O	Cyclopentanone	≈3.3	C ₆ H ₄ N ₂	2-Pyridinecarbonitrile	5.78 ± 0.11
C ₅ H ₈ O	3,4-Dihydro-2H-pyran	1.400 ± 0.008	C ₆ H ₄ N ₂	3-Pyridinecarbonitrile	3.66 ± 0.11
C ₅ H ₈ O	3,6-Dihydro-2H-pyran	1.283 ± 0.005	C ₆ H ₄ N ₂	4-Pyridinecarbonitrile	1.96 ± 0.03
C ₅ H ₈ O ₂	Ethyl acrylate	[1.96]	C ₆ H ₄ O ₂	3,5-Cyclohexadiene-1,2-dione	4.23 ± 0.02
C ₅ H ₈ O ₂	Methyl methacrylate	[1.67]	C ₆ H ₅ Br	Bromobenzene	1.70 ± 0.03
C ₅ H ₈ O ₂	2,4-Pentanedione	[2.78]	C ₆ H ₅ Cl	Chlorobenzene	1.69 ± 0.03
C ₅ H ₈ O ₂	Dihydro-3-methyl-2(3H)-furanone	4.56 ± 0.02	C ₆ H ₅ ClO	<i>p</i> -Chlorophenol	2.11 ± 0.11
C ₅ H ₈ O ₂	Dihydro-5-methyl-2(3H)-furanone	4.71 ± 0.05	C ₆ H ₅ F	Fluorobenzene	1.60 ± 0.08
C ₅ H ₈ O ₂	Tetrahydro-4H-pyran-4-one	1.720 ± 0.003	C ₆ H ₅ I	Iodobenzene	1.70 ± 0.09
C ₅ H ₉ N	Pentanenitrile	4.12 ± 0.08	C ₆ H ₅ NO	2-Pyridinecarboxaldehyde	3.56 ± 0.07
C ₅ H ₉ N	2,2-Dimethylpropanenitrile	3.95 ± 0.04	C ₆ H ₅ NO	3-Pyridinecarboxaldehyde	1.44
C ₅ H ₉ N	1,2,5,6-Tetrahydropyridine	1.007 ± 0.003	C ₆ H ₅ NO	4-Pyridinecarboxaldehyde	1.66
C ₅ H ₉ NO	<i>N</i> -Methyl-2-pyrrolidone	[4.1]	C ₆ H ₅ NO ₂	Nitrobenzene	4.22 ± 0.08
C ₅ H ₁₀	1-Pentene	≈0.5	C ₆ H ₆	Fulvene	0.4236 ± 0.013
C ₅ H ₁₀	3-Methyl-1-butene (<i>gauche</i>)	0.398 ± 0.004	C ₆ H ₆ CIN	<i>o</i> -Chloroaniline	[1.77]
C ₅ H ₁₀	3-Methyl-1-butene (<i>trans</i>)	0.320 ± 0.010	C ₆ H ₆ O	Phenol	1.224 ± 0.008
C ₅ H ₁₀	1,1-Dimethylcyclopropane	0.142 ± 0.001	C ₆ H ₆ O	2-Vinylfuran	0.69 ± 0.07
C ₅ H ₁₀ O	2,2-Dimethylpropanal	2.66 ± 0.05	C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	2.38 ± 0.05
C ₅ H ₁₀ O	2-Pentanone	[2.70]	C ₆ H ₆ S	Benzenethiol	[1.23]
C ₅ H ₁₀ O	3-Pentanone	[2.82]	C ₆ H ₇ N	Aniline	1.13 ± 0.02
C ₅ H ₁₀ O	Tetrahydropyran (<i>chair</i>)	1.58 ± 0.03	C ₆ H ₇ N	2-Methylpyridine	1.85 ± 0.04
C ₅ H ₁₀ O ₂	Pentanoic acid	[1.61]	C ₆ H ₇ N	3-Methylpyridine	[2.40]
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid	[0.63]	C ₆ H ₇ N	4-Methylpyridine	2.70 ± 0.02
C ₅ H ₁₀ O ₂	Butyl formate	[2.03]	C ₆ H ₈ O	3-Methyl-2-cyclopenten-1-one	4.33 ± 0.002
C ₅ H ₁₀ O ₂	Isobutyl formate	[1.88]	C ₆ H ₈ O ₄	Dimethyl maleate	[2.48]
C ₅ H ₁₀ O ₂	Propyl acetate	[1.78]	C ₆ H ₈ Si	Phenylsilane	0.845 ± 0.012
C ₅ H ₁₀ O ₂	Ethyl propanoate	[1.74]	C ₆ H ₉ F	1-Fluorocyclohexene	1.942 ± 0.010
C ₅ H ₁₀ O ₂	Tetrahydrofurfuryl alcohol	[2.1]	C ₆ H ₁₀	1-Hexyne	0.83 ± 0.05
C ₅ H ₁₀ O ₃	Diethyl carbonate	1.10 ± 0.06	C ₆ H ₁₀	3,3-Dimethyl-1-butyne	0.661 ± 0.004
C ₅ H ₁₀ O ₃	Ethylene glycol monomethyl ether acetate	[2.13]	C ₆ H ₁₀	Cyclohexene (<i>half-chair</i>)	0.332 ± 0.012
C ₅ H ₁₀ O ₃	Ethyl lactate	[2.4]	C ₆ H ₁₀ F ₂	1,1-Difluorocyclohexane	2.556 ± 0.010
C ₅ H ₁₀ S	Thiacyclohexane	1.781 ± 0.010	C ₆ H ₁₀ O	3-Methylcyclopentanone	3.14 ± 0.03
C ₅ H ₁₁ Br	1-Bromopentane	2.20 ± 0.11	C ₆ H ₁₀ O	Cyclohexanone	3.246 ± 0.006
C ₅ H ₁₁ Cl	1-Chloropentane	2.16 ± 0.11	C ₆ H ₁₀ O	Mesityl oxide	[2.79]
C ₅ H ₁₁ Cl	1-Chloro-3-methylbutane	[1.92]	C ₆ H ₁₀ O ₄	Diethyl oxalate	[2.49]
C ₅ H ₁₁ N	Piperidine (<i>equatorial</i>)	0.82 ± 0.02	C ₆ H ₁₀ O ₄	Ethylene glycol diacetate	[2.34]
C ₅ H ₁₁ N	Piperidine (<i>axial</i>)	1.19 ± 0.02	C ₆ H ₁₁ Cl	Chlorocyclohexane (<i>equatorial</i>)	2.44 ± 0.07
C ₅ H ₁₁ N	Piperidine (<i>average</i>)	[1.19]	C ₆ H ₁₁ Cl	Chlorocyclohexane (<i>axial</i>)	1.91 ± 0.02
C ₅ H ₁₁ N	<i>N</i> -Methylpyrrolidine	0.572 ± 0.003	C ₆ H ₁₁ F	Fluorocyclohexane (<i>equatorial</i>)	2.11 ± 0.04
C ₅ H ₁₂	Isopentane	0.13 ± 0.05	C ₆ H ₁₁ F	Fluorocyclohexane (<i>axial</i>)	1.81 ± 0.04
C ₅ H ₁₂ N ₂ O	Tetramethylurea	[3.5]	C ₆ H ₁₁ N	4-Methylpentanenitrile	[3.5]
C ₅ H ₁₂ O	1-Pentanol	[1.7]	C ₆ H ₁₁ NO	Caprolactam	[3.9]
C ₅ H ₁₂ O	2-Pentanol	[1.66]	C ₆ H ₁₂ O	Butyl vinyl ether	[1.25]
C ₅ H ₁₂ O	3-Pentanol	[1.64]	C ₆ H ₁₂ O	2-Hexanone	[2.66]
C ₅ H ₁₂ O	2-Methyl-1-butanol	[1.88]	C ₆ H ₁₂ O ₂	Hexanoic acid	[1.13]
C ₅ H ₁₂ O	2-Methyl-2-butanol	[1.82]	C ₆ H ₁₂ O ₂	Pentyl formate	1.90 ± 0.10
C ₅ H ₁₂ O ₂	1,5-Pentenediol	[2.5]	C ₆ H ₁₂ O ₂	Butyl acetate	[1.87]
C ₅ H ₁₂ O ₃	Diethylene glycol monomethyl ether	[1.6]	C ₆ H ₁₂ O ₂	<i>sec</i> -Butyl acetate	[1.87]
C ₆ H ₂ F ₄	1,2,3,4-Tetrafluorobenzene	2.42 ± 0.05	C ₆ H ₁₂ O ₂	Isobutyl acetate	[1.86]
C ₆ H ₂ F ₄	1,2,3,5-Tetrafluorobenzene	1.46 ± 0.06	C ₆ H ₁₂ O ₂	Ethyl butanoate	[1.74]
C ₆ H ₃ F ₃	1,2,4-Trifluorobenzene	1.402 ± 0.009	C ₆ H ₁₂ O ₂	Diacetone alcohol	[3.24]
			C ₆ H ₁₂ O ₃	Ethylene glycol monoethyl ether acetate	[2.25]

DIPOLE MOMENTS (continued)

Mol. Form.	Name	μ/D	Mol. Form.	Name	μ/D
C ₆ H ₁₂ O ₃	Paraldehyde	1.43 ± 0.07	C ₈ H ₈	Styrene	0.123 ± 0.003
C ₆ H ₁₃ N	Cyclohexylamine	[1.26]	C ₈ H ₈ O	Acetophenone	3.02 ± 0.06
C ₆ H ₁₄ O	Dipropyl ether	1.21 ± 0.06	C ₈ H ₈ O ₂	Methyl benzoate	[1.94]
C ₆ H ₁₄ O	Diisopropyl ether	1.13 ± 0.10	C ₈ H ₈ O ₃	Methyl salicylate	[2.47]
C ₆ H ₁₄ O	Butyl ethyl ether	[1.24]	C ₈ H ₁₀	Ethylbenzene	0.59 ± 0.05
C ₆ H ₁₄ O ₂	2-Methyl-2,4-pentanediol	[2.9]	C ₈ H ₁₀	<i>o</i> -Xylene	0.640 ± 0.005
C ₆ H ₁₄ O ₂	Ethylene glycol monobutyl ether	[2.08]	C ₈ H ₁₀ O	2,4-Xylenol	[1.4]
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane	[1.38]	C ₈ H ₁₀ O	2,5-Xylenol	[1.45]
C ₆ H ₁₄ O ₃	Diethylene glycol monoethyl ether	[1.6]	C ₈ H ₁₀ O	2,6-Xylenol	[1.40]
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether	[1.97]	C ₈ H ₁₀ O	3,4-Xylenol	[1.56]
C ₆ H ₁₅ N	Dipropylamine	[1.03]	C ₈ H ₁₀ O	3,5-Xylenol	[1.55]
C ₆ H ₁₅ N	Diisopropylamine	[1.15]	C ₈ H ₁₀ O	Phenetole	1.45 ± 0.15
C ₆ H ₁₅ N	Triethylamine	0.66 ± 0.05	C ₈ H ₁₀ O ₂	1,2-Dimethoxybenzene	[1.29]
C ₆ H ₁₅ NO ₃	Triethanolamine	[3.57]	C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	1.68 ± 0.17
C ₆ H ₁₅ O ₄ P	Triethyl phosphate	[3.12]	C ₈ H ₁₁ N	2,4-Dimethylaniline	[1.40]
C ₆ H ₁₈ N ₃ OP	Hexamethylphosphoric triamide	[5.5]	C ₈ H ₁₁ N	2,6-Dimethylaniline	[1.63]
C ₇ H ₅ Cl ₃	(Trichloromethyl)benzene	[2.03]	C ₈ H ₁₁ N	2,4,6-Trimethylpyridine	[2.05]
C ₇ H ₅ F ₃	(Trifluoromethyl)benzene	2.86 ± 0.06	C ₈ H ₁₆ O	2-Octanone	[2.70]
C ₇ H ₅ N	Benzonitrile	4.18 ± 0.08	C ₈ H ₁₆ O ₂	Octanoic acid	[1.15]
C ₇ H ₅ N	Isocyanobenzene	4.018 ± 0.003	C ₈ H ₁₆ O ₂	<i>sec</i> -Hexyl acetate	[1.9]
C ₇ H ₆ Cl ₂	2,4-Dichlorotoluene	[1.70]	C ₈ H ₁₆ O ₂	Isobutyl isobutanoate	[1.9]
C ₇ H ₆ Cl ₂	3,4-Dichlorotoluene	[2.95]	C ₈ H ₁₆ O ₄	Diethylene glycol monoethyl ether acetate	[1.8]
C ₇ H ₆ Cl ₂	(Dichloromethyl)benzene	[2.07]	C ₈ H ₁₇ Cl	1-Chlorooctane	[2.00]
C ₇ H ₆ O	2,4,6-Cycloheptatrien-1-one	4.1 ± 0.3	C ₈ H ₁₈ O	1-Octanol	[1.76]
C ₇ H ₆ O	Benzaldehyde	[3.0]	C ₈ H ₁₈ O	2-Octanol	[1.71]
C ₇ H ₆ O ₂	Salicylaldehyde	[2.86]	C ₈ H ₁₈ O	2-Ethyl-1-hexanol	[1.74]
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene	1.56 ± 0.08	C ₈ H ₁₈ O	Dibutyl ether	1.17 ± 0.06
C ₇ H ₇ Cl	<i>m</i> -Chlorotoluene	[1.82]	C ₈ H ₁₈ S	Dibutyl sulfide	[1.61]
C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene	2.21 ± 0.04	C ₈ H ₁₉ N	Dibutylamine	[0.98]
C ₇ H ₇ Cl	(Chloromethyl)benzene	[1.82]	C ₉ H ₇ N	Quinoline	2.29 ± 0.11
C ₇ H ₇ F	<i>o</i> -Fluorotoluene	1.37 ± 0.07	C ₉ H ₇ N	Isoquinoline	2.73 ± 0.14
C ₇ H ₇ F	<i>m</i> -Fluorotoluene	1.82 ± 0.04	C ₉ H ₁₀ O ₂	Ethyl benzoate	2.00 ± 0.10
C ₇ H ₇ F	<i>p</i> -Fluorotoluene	2.00 ± 0.10	C ₉ H ₁₀ O ₂	Benzyl acetate	[1.22]
C ₇ H ₇ NO ₃	2-Nitroanisole	[5.0]	C ₉ H ₁₂	Isopropylbenzene	≈0.79
C ₇ H ₈	Toluene	0.375 ± 0.010	C ₉ H ₁₈ O	2,6-Dimethyl-4-heptanone	[2.66]
C ₇ H ₈	2,5-Norbornadiene	0.0587 ± 0.0001	C ₉ H ₁₈ O ₂	Nonanoic acid	[0.79]
C ₇ H ₈ O	<i>o</i> -Cresol	[1.45]	C ₁₀ H ₇ Br	1-Bromonaphthalene	[1.55]
C ₇ H ₈ O	<i>m</i> -Cresol	[1.48]	C ₁₀ H ₇ Cl	1-Chloronaphthalene	[1.57]
C ₇ H ₈ O	<i>p</i> -Cresol	[1.48]	C ₁₀ H ₈	Azulene	0.80 ± 0.02
C ₇ H ₈ O	Benzyl alcohol	1.71 ± 0.09	C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	≈0.83
C ₇ H ₈ O	Anisole	1.38 ± 0.07	C ₁₀ H ₁₆ O	Camphor. (+)	[3.1]
C ₇ H ₉ N	<i>o</i> -Methylaniline	[1.60]	C ₁₀ H ₂₀ O ₂	2-Ethylhexyl acetate	[1.8]
C ₇ H ₉ N	<i>m</i> -Methylaniline	[1.45]	C ₁₀ H ₂₁ Br	1-Bromodecane	[1.93]
C ₇ H ₉ N	<i>p</i> -Methylaniline	[1.52]	C ₁₀ H ₂₂ O	Dipentyl ether	[1.20]
C ₇ H ₉ N	2,4-Dimethylpyridine	[2.30]	C ₁₀ H ₂₂ O	Diisopentyl ether	[1.23]
C ₇ H ₉ N	2,6-Dimethylpyridine	[1.66]	C ₁₁ H ₁₂ O ₂	Ethyl <i>trans</i> -cinnamate	[1.84]
C ₇ H ₁₀	1,3-Cycloheptadiene	0.740	C ₁₂ H ₁₀	Acenaphthene	≈0.85
C ₇ H ₁₂	Methylenecyclohexane	0.62 ± 0.01	C ₁₂ H ₁₀ O	Diphenyl ether	≈1.3
C ₇ H ₁₂ O ₄	Diethyl malonate	[2.54]	C ₁₂ H ₂₇ BO ₃	Tributyl borate	[0.77]
C ₇ H ₁₄ O	2-Heptanone	[2.59]	C ₁₂ H ₂₇ N	Tributylamine	[0.78]
C ₇ H ₁₄ O	3-Heptanone	[2.78]	C ₁₂ H ₂₇ O ₄ P	Tributyl phosphate	[3.07]
C ₇ H ₁₄ O	2,4-Dimethyl-3-pentanone	[2.74]	C ₁₄ H ₁₂ O ₂	Benzyl benzoate	[2.06]
C ₇ H ₁₄ O	<i>cis</i> -3-Methylcyclohexanol	[1.91]	C ₁₆ H ₂₂ O ₄	Dibutyl phthalate	[2.82]
C ₇ H ₁₄ O	<i>trans</i> -3-Methylcyclohexanol	[1.75]	C ₁₈ H ₃₄ O ₂	Oleic acid	[1.18]
C ₇ H ₁₄ O ₂	Pentyl acetate	1.75 ± 0.10	C ₁₈ H ₃₄ O ₄	Dibutyl sebacate	[2.48]
C ₇ H ₁₄ O ₂	Isopentyl acetate	[1.86]	C ₂₁ H ₂₁ O ₄ P	Tri- <i>o</i> -cresyl phosphate	[2.87]
C ₇ H ₁₅ Br	1-Bromoheptane	2.16 ± 0.11	C ₂₁ H ₂₁ O ₄ P	Tri- <i>m</i> -cresyl phosphate	[3.05]
C ₇ H ₁₆ O	2-Heptanol	[1.71]	C ₂₁ H ₂₁ O ₄ P	Tri- <i>p</i> -cresyl phosphate	[3.18]
C ₇ H ₁₆ O	3-Heptanol	[1.71]	C ₂₂ H ₄₄ O ₂	Butyl stearate	[1.88]
C ₈ H ₆	Phenylacetylene	0.656 ± 0.005	C ₂₄ H ₃₈ O ₄	Bis(2-ethylhexyl) phthalate	[2.84]
C ₈ H ₇ N	Benzeneacetonitrile	[3.5]			

STRENGTHS OF CHEMICAL BONDS*

J. Alistair Kerr

The strength of a chemical bond, $D^\circ(\text{R-X})$, often known as the bond dissociation energy, is defined as the standard enthalpy change of the reaction in which the bond is broken: $\text{RX} \rightarrow \text{R} + \text{X}$. It is given by the thermochemical equation, $D^\circ(\text{R-X}) = \Delta_f H^\circ(\text{R}) + \Delta_f H^\circ(\text{X}) - \Delta_f H^\circ(\text{RX})$. Some authors list bond strengths at a temperature of absolute zero but here the values at 298 K are given because more thermodynamic data are available for this temperature. Bond strengths or bond dissociation energies are not equal to, and may differ considerably from, mean bond energies determined solely from thermochemical data on atoms and molecules.

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES

These have usually been measured spectroscopically or by mass spectrometric analysis of hot gases effusing a Knudsen cell. Excellent accounts of these and other methods are given in (i) *Dissociation Energies and Spectra of Diatomic Molecules*, by A. G. Gaydon, 3rd. ed., Chapman & Hall, London, 1968 and (ii) "Mass Spectrometric Determination of Bond Energies of High-Temperature Molecules", K. A. Gingerich, *Chimia*, 26, 619, 1972. The errors quoted in the table are those given in the original paper or review article. The references have been chosen primarily as a key to the literature. It should not be assumed that the author referred to was responsible for the value quoted, as the reference may be to a review article.

Bond strengths reported at a temperature of absolute zero, D°_0 , have been converted to D°_{298} by the use of enthalpy functions taken mainly from the JANAF Thermochemical Tables, Third Edition, *J. Phys. Chem. Ref. Data*, 14, Suppl. 1, 1985, wherever possible. For most bonds, however, this data is not available and the conversion has been made by the approximate relation:

$$D^\circ_{298} = D^\circ_0 + (3/2)RT$$

The list below does not include the increasing number of bond strengths of diatomic molecules now being calculated by *ab initio* methods. The Table has been arranged in an alphabetical order of the atoms.

Molecule	$D^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^\circ_{298}/\text{kJ mol}^{-1}$	Ref.
Ag-Ag	160.3 ± 3.4	314	Al-Cl	511.3 ± 0.8	312	As-Ga	209.6 ± 1.2	83
Ag-Al	183.7 ± 9.2	79	Al-Co	181.6 ± 0.2	22	As-H	274.0 ± 2.9	29
Ag-Au	202.9 ± 9.2	4	Al-Cr	223.6 ± 0.6	19	As-I	296.6 ± 28.0	325
Ag-Bi	193 ± 42	246	Al-Cu	227.1 ± 1.2	21	As-In	201	297
Ag-Br	293 ± 29	120	Al-D	290.8	246	As-N	489 ± 2	310
Ag-Cl	314.2	184	Al-F	663.6 ± 6.3	80	As-O	481 ± 8	262
Ag-Cu	174.1 ± 9.2	136	Al-H	284.9 ± 6.3	80	As-P	433.5 ± 12.6	137
Ag-D	226.8	205	Al-I	369.9 ± 2.1	267	As-S	379.5 ± 6.3	262
Ag-Dy	130 ± 19	203	Al-Kr	6.047 ± 0.001	180	As-Sb	330.5 ± 5.4	94
Ag-Eu	129.7 ± 12.6	66	Al-Li	76.5	39	As-Se	96	288
Ag-F	354.4 ± 16.3	120	Al-N	297 ± 96	120	As-Tl	198.3 ± 14.6	300
Ag-Ga	180 ± 15	44	Al-Ni	225 ± 5	20	At-At	~80	89
Ag-Ge	174.5 ± 20.9	135	Al-O	511 ± 3	56,74	Au-Au	226.2 ± 0.5	210
Ag-H	215.1 ± 8	217	Al-P	216.7 ± 12.6	80	Au-B	367.8 ± 10.5	145
Ag-Ho	123.4 ± 16.7	62	Al-Pd	254.4 ± 12.1	64	Au-Ba	254.8 ± 10.0	135
Ag-I	234 ± 29	120	Al-S	373.6 ± 7.9	376	Au-Be	285 ± 8	120
Ag-In	166.5 ± 4.9	13	Al-Sb	216.3 ± 5.9	293	Au-Bi	297 ± 8.4	135
Ag-Li	173.6 ± 6.3	276,303	Al-Se	337.6 ± 10.0	376	Au-Ca	243	135
Ag-Mn	100 ± 21	246	Al-Si	229.3 ± 30.1	51	Au-Ce	339 ± 21	135
Ag-Na	138.1 ± 8.4	291,298	Al-Te	267.8 ± 10.0	376	Au-Cl	343 ± 9.6	120
Ag-Nd	<209	221	Al-U	326 ± 29	123	Au-Co	222 ± 17	135
Ag-O	220.1 ± 20.9	287	Al-V	147.4 ± 1.0	22	Au-Cr	213 ± 17	135
Ag-S	217.1	349	Al-Xe	7.43 ± 0.69	43	Au-Cs	255 ± 3.3	41
Ag-Se	202.5	349	Ar-Ar	4.73 ± 0.04	181	Au-Cu	228.0 ± 5.0	34,135
Ag-Si	177.8 ± 10.0	320	Ar-He	3.89	246	Au-D	318.4	205
Ag-Sn	136.0 ± 20.9	3	Ar-Hg	6.15	246	Au-Dy	259 ± 21	203
Ag-Te	195.8	349	Ar-I	10.0	40	Au-Eu	241.0 ± 10.5	66
Al-Al	133 ± 6	118	Ar-K	4.2	205	Au-Fe	187.0 ± 16.7	220
Al-Ar	5.182 ± 0.005	180	As-As	382.0 ± 10.5	247	Au-Ga	234 ± 38	135
Al-As	202.9 ± 7.1	294,301	As-Cl	448	80	Au-Ge	274.1 ± 5.0	135
Al-Au	325.9 ± 6.3	124	As-D	270.3	205	Au-H	292.0 ± 8	217
Al-Br	429 ± 6	186	As-F	410	205	Au-Ho	267.4 ± 16.7	62,250

* Revised to October 2001.

STRENGTHS OF CHEMICAL BONDS (continued)

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
Au-In	286.0 ± 5.7	13	Ba-H	176 ± 14.6	120	Br-Ni	360 ± 13	120
Au-La	336.4 ± 20.9	127	Ba-I	320.8 ± 6.3	188	Br-O	235.5 ± 2.4	46
Au-Li	284.5 ± 6.7	276	Ba-O	561.9 ± 13.4	287	Br-Pb	247 ± 38	120
Au-Lu	332.2 ± 16.7	132	Ba-Pd	221.8 ± 5.0	125	Br-Rb	380.7 ± 4	362
Au-Mg	243 ± 42	246	Ba-Rh	259.4 ± 25.1	125	Br-Sb	314 ± 59	120
Au-Mn	185.4 ± 12.6	342	Ba-S	400.0 ± 18.8	70	Br-Sc	444 ± 63	246
Au-Na	215.1 ± 12.6	298	Be-Be	59	35,87	Br-Se	297 ± 84	246
Au-Nd	299.2 ± 20.9	127	Be-Br	381 ± 84	246	Br-Si	367.8 ± 10.0	106
Au-Ni	247 ± 16	352	Be-Cl	388.3 ± 9.2	108,191,382	Br-Sn	≥552	286
Au-O	221.8 ± 20.9	287	Be-D	203.05	205	Br-Sr	333.0 ± 9.2	199
Au-Pb	130 ± 42	246	Be-F	577 ± 42	80,108	Br-Th	364	187
Au-Pd	155 ± 21	135	Be-H	200.0 ± 1.3	67	Br-Ti	439	246
Au-Pr	310 ± 21	135	Be-O	434.7 ± 13.4	287	Br-Tl	333.9 ± 1.7	28
Au-Rb	243 ± 2.9	41	Be-S	372 ± 59	120	Br-U	377.4 ± 6.3	260
Au-Rh	231.0 ± 29	66	Bi-Bi	200.4 ± 7.5	307,324	Br-V	439 ± 42	246
Au-S	418 ± 25	131	Bi-Br	267.4 ± 4.2	76	Br-W	329.3	223
Au-Sc	280.3 ± 16.7	128	Bi-Cl	301 ± 4	78	Br-Xe	5.94 ± 0.02	58
Au-Se	243.1	349	Bi-D	283.7	266	Br-Y	485 ± 84	246
Au-Si	305.4 ± 5.9	139	Bi-F	367 ± 13	400	Br-Zn	142 ± 29	246
Au-Sn	254.8 ± 7.1	233	Bi-Ga	159 ± 17	296	C-C	610 ± 2.0	373
Au-Sr	264 ± 42	246	Bi-H	≤283.3	266	C-Ce	444 ± 13	236
Au-Tb	289.5 ± 33.5	152,250	Bi-I	218.0 ± 4.6	77	C-Cl	397 ± 29	283
Au-Te	317.6	349	Bi-In	153.6 ± 1.7	321	C-D	341.4	205
Au-U	318 ± 29	123	Bi-Li	154.0 ± 5.0	277,305	C-F	552	193
Au-V	240.6 ± 12.1	172	Bi-O	337.2 ± 12.6	287	C-Ge	460 ± 21	120
Au-Y	307.1 ± 8.4	177	Bi-P	280 ± 13	137	C-H	338.4 ± 1.2	205
B-B	297 ± 21	80	Bi-Pb	141.8 ± 14.6	324	C-Hf	540 ± 25	357
B-Br	396	32	Bi-S	315.5 ± 4.6	375	C-I	209 ± 21	120
B-C	448 ± 29	246	Bi-Sb	251 ± 4	244	C-Ir	632 ± 4	171
B-Ce	305 ± 21	246	Bi-Se	280.3 ± 5.9	375	C-La	462 ± 20	290
B-Cl	511.3 ± 4	195	Bi-Sn	210.0 ± 8.4	135	C-Mo	481 ± 15.9	167
B-D	341.0 ± 6.3	246	Bi-Te	232.2 ± 11.3	375	C-N	748.0 ± 10	42
B-F	757	257	Bi-Tl	121 ± 13	84	C-Nb	569 ± 13.0	167
B-H	340	302	Br-Br	192.807	1	C-O	1076.5 ± 0.4	80
B-I	220.5 ± 0.8	315	Br-C	280 ± 21	120	C-Os	≥594	126
B-Ir	514.2 ± 17.2	381	Br-Ca	310.9 ± 9.2	319	C-P	513.4 ± 8	350
B-La	339 ± 63	246	Br-Cd	159 ± 96	120	C-Pt	598 ± 5.9	171,379
B-N	389 ± 21	80	Br-Cl	217.53 ± 0.29	59	C-Rh	580.0 ± 3.8	332
B-O	808.8 ± 20.9	287	Br-Co	331 ± 42	246	C-Ru	616.2 ± 10.5	333
B-P	346.9 ± 16.7	147	Br-Cr	328.0 ± 24.3	120	C-S	714.1 ± 1.2	71,354
B-Pd	329.3 ± 20.9	381	Br-Cs	389.1 ± 4	285,362	C-Sc	≤444	148
B-Pt	477.8 ± 16.7	268	Br-Cu	331 ± 25	120	C-Se	590.4 ± 5.9	343
B-Rh	475.7 ± 20.9	381	Br-D	370.74	205	C-Si	451.5	91,387
B-Ru	446.9 ± 20.9	381	Br-F	280 ± 12	211	C-Tc	565 ± 29	322
B-S	580.7 ± 9.2	374	Br-Fe	247 ± 96	120	C-Th	453 ± 17	166,357
B-Sc	276 ± 63	246	Br-Ga	444 ± 17	80	C-Ti	423 ± 29	162,357
B-Se	461.9 ± 14.6	374	Br-Ge	255 ± 29	120	C-U	454.8 ± 15.1	165,169
B-Si	317 ± 7	390	Br-H	366.35	205	C-V	427 ± 23.8	167
B-Te	354.4 ± 20.1	374	Br-Hg	72.8 ± 4	80	C-Y	418 ± 14	338
B-Th	297	140	Br-I	179.1 ± 0.4	120,309	C-Zr	561 ± 25	357
B-Ti	276 ± 63	246	Br-In	414 ± 21	80	Ca-Ca	~17	153
B-U	322 ± 33	246	Br-K	379.9 ± 0.8	362,378	Ca-Cl	409 ± 9	269
B-Y	293 ± 63	246	Br-Li	418.8 ± 4	362	Ca-D	≤169.9	205
Ba-Br	362.8 ± 8.4	104,199,230	Br-Mg	≤327.2	205	Ca-F	527 ± 21	101,190
Ba-Cl	436.0 ± 8.4	197,199	Br-Mn	314.2 ± 9.6	120	Ca-H	167.8	120
Ba-D	≤193.7	205	Br-N	276 ± 21	120	Ca-I	284.7 ± 8.4	188
Ba-F	587.0 ± 6.7	101,196	Br-Na	367.4 ± 0.8	362,378	Ca-Li	84.9 ± 8.4	397

STRENGTHS OF CHEMICAL BONDS (continued)

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
Ca-O	402.1 ± 16.7	287,326	Cl-Si	406	308,385	Cu-I	197 ± 21	120
Ca-S	337.6 ± 18.8	70,205	Cl-Sm	≥423	399	Cu-In	187.4 ± 7.9	13
Cd-Cd	7.36	251	Cl-Sn	414 ± 17	246	Cu-Li	192.9 ± 8.8	276
Cd-Cl	208.4	205	Cl-Sr	406 ± 13	197,199	Cu-Mn	158.6 ± 17	222
Cd-F	305 ± 21	31	Cl-Ta	544	23	Cu-Na	176.1 ± 16.7	299
Cd-H	69.0 ± 0.4	120	Cl-Th	489	261	Cu-Ni	202 ± 10	117
Cd-I	97.23	215	Cl-Ti	405.4 ± 10.5	192	Cu-O	269.0 ± 20.9	287
Cd-In	138	246	Cl-Tl	372.8 ± 2.1	28	Cu-S	276	349
Cd-O	235.6 ± 83.7	158,287	Cl-U	452 ± 8	259	Cu-Se	251	349
Cd-S	208.4 ± 20.9	158	Cl-V	477 ± 63	246	Cu-Si	221.3 ± 6.3	320
Cd-Se	127.6 ± 25.1	158	Cl-W	423 ± 42	246	Cu-Sn	169.5 ± 6.7	3,237
Cd-Te	100.0 ± 15.1	158	Cl-Xe	6.7	205	Cu-Tb	193 ± 19	203
Ce-Ce	245.2	127	Cl-Y	527 ± 84	246	Cu-Te	278.7	1
Ce-F	582 ± 42	246	Cl-Yb	~322	113	D-D	443.533	205
Ce-Ir	586	149	Cl-Zn	228.9 ± 19.7	73	D-F	576.6	205
Ce-N	519 ± 21	146	Cm-O	736	341	D-Ga	<272.8	253
Ce-O	795 ± 8	95	Co-Co	167 ± 25	218	D-Ge	≤322	205
Ce-Os	506 ± 33	126	Co-Cu	167 ± 17	135	D-H	439.433	205
Ce-Pd	322.2	63	Co-F	435 ± 63	246	D-Hg	42.05	205
Ce-Pt	556	149	Co-Ge	234 ± 21	135	D-In	246.0	205
Ce-Rh	548	149	Co-H	226 ± 42	369	D-Li	240.1892 ± 0.0046	207,360
Ce-Ru	531 ± 25	126	Co-I	285 ± 21	246	D-Lu	302	308
Ce-S	569	24	Co-Nb	267.0 ± 0.1	8	D-Mg	135.1	205
Ce-Se	494.5 ± 14.6	271	Co-O	384.5 ± 13.4	287	D-Ni	≤302.9	205
Ce-Te	189.4 ± 12.8	252	Co-S	331	349	D-Pt	≤350.2	205
Cl-Cl	242.580 ± 0.004	205	Co-Si	276 ± 17	380	D-S	351	205
Cl-Co	337.6 ± 6.7	194	Co-Ti	235.4 ± 0.1	353	D-Si	302.5	205
Cl-Cr	377.8 ± 6.7	194	Co-Y	253.7 ± 0.1	8	D-Sr	≥275.7	205
Cl-Cs	448 ± 8	285,363	Co-Zr	306.4 ± 0.1	8	D-Zn	88.7	205
Cl-Cu	377.8 ± 7.5	184	Cr-Cr	142.9 ± 5.4	201	Dy-F	531	406
Cl-D	436.47	205	Cr-Cu	155 ± 21	222	Dy-O	607 ± 17	95
Cl-Eu	~326	113	Cr-F	444.8 ± 19.7	227	Dy-S	414 ± 42	246
Cl-F	256.23	205,279	Cr-Ge	154 ± 7	202	Dy-Se	322 ± 42	246
Cl-Fe	329.7 ± 6.7	194	Cr-H	190.3 ± 7.0	53	Dy-Te	234 ± 42	246
Cl-Ga	481 ± 13	80	Cr-I	287.0 ± 24.3	120	Er-F	565 ± 17	406
Cl-Ge	~431	205	Cr-N	377.8 ± 18.8	152,355	Er-O	615 ± 13	95
Cl-H	431.62	205	Cr-O	461 ± 9	179	Er-S	418 ± 42	246
Cl-Hg	100 ± 8	120	Cr-Pb	105 ± 2	202	Er-Se	326 ± 42	246
Cl-I	211.3 ± 0.4	120	Cr-S	331	93	Er-Te	238 ± 42	246
Cl-In	439 ± 8	80	Cr-Sn	141 ± 3	202	Eu-Eu	33.5 ± 17	66
Cl-K	433.0 ± 8	363	Cs-Cs	43.919 ± 0.010	394	Eu-F	544	242
Cl-Li	469 ± 13	80	Cs-F	519 ± 8	285	Eu-Li	66.9 ± 2.9	275
Cl-Mg	327.6 ± 2.1	105,197,382	Cs-H	175.364	401	Eu-O	479 ± 10	95
Cl-Mn	338.5 ± 6.7	194	Cs-Hg	8	205	Eu-Rh	233.9 ± 33	66
Cl-N	333.9 ± 9.6	54	Cs-I	337.2 ± 2.1	285,361	Eu-S	362.3 ± 13.0	271,347
Cl-Na	412.1 ± 8	363	Cs-Na	63.2 ± 1.3	86	Eu-Se	301 ± 14.6	25,178,271
Cl-Ni	377.0 ± 6.7	194	Cs-O	295.8 ± 62.8	287	Eu-Te	243 ± 14.6	25,271
Cl-O	268.85 ± 0.10	2	Cs-Rb	49.57 ± 0.01	174	F-F	158.78	205
Cl-P	289 ± 42	246	Cu-Cu	176.52 ± 2.38	135,323	F-Ga	577 ± 14.6	270
Cl-Pb	301 ± 29	120	Cu-D	270.3	205	F-Gd	590.4 ± 27.2	405
Cl-Ra	343 ± 75	120	Cu-Dy	142 ± 21	203	F-Ge	485 ± 21	98
Cl-Rb	427.6 ± 8	363	Cu-F	413.4 ± 13	99	F-H	569.87 ± 0.06	402
Cl-S	277.0	224	Cu-Ga	215.9 ± 15.1	44	F-Hf	650 ± 15	16
Cl-Sb	360 ± 50	120	Cu-Ge	208.8 ± 21	273	F-Hg	~180	205
Cl-Sc	331	386	Cu-H	277.8	217,318	F-Ho	540	406
Cl-Se	322	246	Cu-Ho	142 ± 21	203	F-I	≤271.5	7,33,60,75

STRENGTHS OF CHEMICAL BONDS (continued)

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
F-In	506 ± 14.6	270	Gd-S	526.8 ± 10.5	116,345	Hg-S	217.1 ± 22.2	158
F-K	497.5 ± 2.5	17	Gd-Se	431 ± 14.6	25	Hg-Se	144.3 ± 30.1	158
F-La	598 ± 42	246	Gd-Te	343 ± 14.6	25	Hg-Te	≤142	246
F-Li	577 ± 21	80	Ge-Ge	263.6 ± 7.1	238	Hg-Tl	4	183
F-Lu	333.5	208	Ge-H	≤321.7	243	Ho-Ho	84 ± 17	62
F-Mg	461.9 ± 5.0	101,196	Ge-Ni	290.3 ± 10.9	335	Ho-O	611 ± 17	95
F-Mn	423.4 ± 14.6	228	Ge-O	659.4 ± 12.6	226,287	Ho-S	428.4 ± 14.6	345
F-Mo	464.8	198	Ge-Pd	254.7 ± 10.5	334	Ho-Se	335 ± 17	25
F-N	343	205	Ge-S	534 ± 3	280	Ho-Te	259 ± 17	25
F-Na	519	205	Ge-Sc	271.0 ± 11	234	I-I	151.088	205,371
F-Nd	545.2 ± 12.6	403	Ge-Se	484.7 ± 1.7	282	I-In	331	384
F-Ni	430 ± 20	85	Ge-Si	296.4 ± 8.6	391	I-K	325.1 ± 0.8	361,378
F-O	219.54 ± 10	48	Ge-Te	397 ± 3	282	I-Li	345.2 ± 4.2	361
F-P	439 ± 96	120	Ge-Y	279.8 ± 11.4	235	I-Mg	~285	26
F-Pb	356 ± 8	408	H-H	435.990	205	I-Mn	282.8 ± 9.6	120
F-Pm	540 ± 42	246	H-Hg	39.844	205	I-N	159 ± 17	246
F-Pr	582 ± 46	246	H-I	298.407	205	I-Na	304.2 ± 2.1	361,378
F-Pu	538.5 ± 29	229	H-In	243.1	205	I-Ni	293 ± 21	120
F-Rb	494 ± 21	80	H-K	174.576	206,401	I-O	230	47
F-Ru	402	185	H-Li	238.049 ± 0.004	393	I-Pb	193 ± 4	340
F-S	342.7 ± 5.0	30,200,231	H-Mg	126.4 ± 2.9	14,15,100	I-Rb	318.8 ± 2.1	361
F-Sb	439 ± 96	120	H-Mn	234 ± 29	120	I-Si	293	205
F-Sc	589.1 ± 13	404	H-N	≤339	205	I-Sn	234 ± 42	246
F-Se	339 ± 42	246	H-Na	185.69 ± 0.25	274,316	I-Sr	269.9 ± 5.9	239
F-Si	552.7 ± 2.1	109	H-Ni	252.3 ± 8	217	I-Te	192 ± 42	246
F-Sm	565	242	H-O	429.99 ± 0.38	412	I-Ti	310 ± 42	246
F-Sn	466.5 ± 13	408	H-P	297	205	I-Tl	272 ± 8	26
F-Sr	541.8 ± 6.7	101,196	H-Pb	≤157	205	I-Zn	108.29	215
F-Ta	573 ± 13	256	H-Pd	234 ± 25	369	I-Zr	305	241
F-Tb	561 ± 42	246	H-Pt	≤335	205	In-In	100 ± 8	246
F-Th	652	263	H-Rb	167 ± 21	120	In-Li	92.5 ± 14.6	160
F-Ti	569 ± 33	407	H-Rh	247 ± 21	369	In-O	<320.1	287
F-Tl	445.2 ± 19.2	28	H-Ru	234 ± 21	369	In-P	197.9 ± 8.4	291
F-Tm	510	242	H-S	344.3 ± 12.1	212	In-S	289 ± 17	69
F-U	659.0 ± 10.5	157,258	H-Sc	~180	329	In-Sb	151.9 ± 10.5	81
F-V	590 ± 63	246	H-Se	314.47 ± 0.96	122	In-Se	247 ± 17	69
F-W	548 ± 63	246	H-Si	≤299.2	205	In-Te	218 ± 17	69
F-Xe	15.77	317,368	H-Sn	264 ± 17	120	Ir-La	577 ± 13	176
F-Y	605.0 ± 20.9	404	H-Sr	163 ± 8	120	Ir-O	414.6 ± 42.3	287
F-Yb	≥521.3	18,113,399	H-Te	268 ± 2.1	119	Ir-Si	462.8 ± 20.9	381
F-Zn	368 ± 63	246	H-Ti	204.6 ± 8.8	52	Ir-Th	573	133
F-Zr	616 ± 15	16	H-Tl	188 ± 8	120	Ir-Ti	422 ± 13	289
Fe-Fe	75 ± 17	330	H-V	208.7 ± 7.0	53	Ir-Y	456.1 ± 16.7	177
Fe-Ge	210.9 ± 29	219	H-Yb	159 ± 38	120	K-K	54.63 ± 0.02	6,265
Fe-H	180 ± 25	369	H-Zn	85.8 ± 2.1	120	K-Kr	4.6	205
Fe-O	390.4 ± 17.2	287	He-He	3.8	205	K-Li	82.0 ± 4.2	103,410
Fe-S	322	93	He-Hg	6.61	246	K-Na	65.994 ± 0.008	36,410
Fe-Si	297 ± 25	380	Hf-C	548 ± 63	246	K-O	277.8 ± 20.9	287
Ga-Ga	112.1 ± 7	337	Hf-N	536 ± 29	152,245	K-Xe	5.0	205
Ga-H	<274.1	253	Hf-O	801.7 ± 13.4	287	Kr-Kr	5.23	50,205
Ga-I	339 ± 9.6	120	Hg-Hg	8 ± 2	204	Kr-O	<8	246
Ga-Li	133.1 ± 14.6	160	Hg-I	34.69 ± 0.96	388	Kr-Xe	5.505 ± 0.002	9
Ga-O	353.5 ± 41.8	287	Hg-K	8.24 ± 0.21	246	La-La	247 ± 21	386
Ga-P	229.7 ± 12.6	130	Hg-Li	13.8	205	La-N	519 ± 42	246
Ga-Sb	192.0 ± 12.6	295	Hg-Na	9.2	205,411	La-O	799 ± 4	95
Ga-Te	251 ± 25	377	Hg-O	220.9 ± 33.1	158	La-Pt	502 ± 21	272
Gd-O	719 ± 10	95	Hg-Rb	8.4	205	La-Rh	527 ± 17	65

STRENGTHS OF CHEMICAL BONDS (continued)

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
La-S	573.2 ± 1.7	214,359	Nd-Se	385 ± 17	25,156,271	P-Tl	209 ± 13	293
La-Se	477 ± 17	25,271	Nd-Te	305 ± 17	25	P-U	297 ± 21	246
La-Te	381 ± 17	25,154	Ne-Ne	3.93	365	P-W	305 ± 4	150
La-Y	202.1	386	Ni-Ni	200.7 ± 0.2	304	Pb-Pb	86.6 ± 0.8	138,305
Li-Li	110.21 ± 4	383,398	Ni-O	382.0 ± 16.7	287	Pb-S	346.0 ± 1.7	375
Li-Mg	67.4 ± 6.3	396	Ni-Pt	273.7 ± 0.3	367	Pb-Sb	161.5 ± 10.5	409
Li-Na	87.181 ± 0.001	102,111	Ni-S	344.3	93	Pb-Se	302.9 ± 4	375
Li-O	333.5 ± 8.4	287	Ni-Si	318 ± 17	380	Pb-Te	251 ± 13	375
Li-Pb	78.7 ± 7.9	277	Ni-V	206.3 ± 0.1	353	Pd-Pd	100 ± 15	331
Li-S	312.5 ± 7.5	232	Ni-Y	283.9 ± 0.1	8	Pd-Si	261 ± 12	336
Li-Sb	172.8 ± 10.0	278	Ni-Zr	279.7 ± 0.1	8	Pd-Y	238 ± 17	313
Li-Sm	49.0 ± 4.2	275	Np-O	718.4 ± 41.8	287	Pm-S	423 ± 63	246
Li-Tm	69.0 ± 3.3	275	O-O	498.36 ± 0.17	38,205	Pm-Se	339 ± 63	246
Li-Yb	37.2 ± 2.9	275	O-Os	575	189	Pm-Te	255 ± 63	246
Lu-Lu	142 ± 33	246	O-P	599.1 ± 12.6	287	Po-Po	187.0	205
Lu-O	678 ± 8	95	O-Pa	788.3 ± 17.2	240	Pr-S	492.5 ± 4.6	112
Lu-Pt	402 ± 33	141	O-Pb	382.0 ± 12.6	287	Pr-Se	446.4 ± 23.0	155,271
Lu-S	507.1 ± 14.6	114,345	O-Pd	380.7 ± 83.7	287	Pr-Te	326 ± 42	246
Lu-Se	418 ± 17	25	O-Pm	674 ± 63	246	Pt-Pt	307 ± 2	366
Lu-Te	326 ± 17	25	O-Pr	753 ± 13	95	Pt-Si	501.2 ± 18.0	381
Mg-Mg	8.552 ± 0.004	264,397	O-Pt	391.6 ± 41.8	287	Pt-Th	552	133
Mg-O	363.2 ± 12.6	287	O-Pu	715.9 ± 33.9	287	Pt-Ti	397 ± 13	173
Mg-S	234	70	O-Rb	255 ± 84	37	Pt-Y	474.0 ± 12.1	170
Mn-Mn	25.9	221	O-Re	626.8 ± 83.7	287	Rb-Rb	48.898 ± 0.005	5
Mn-O	402.9 ± 41.8	225,287	O-Rh	405.0 ± 41.8	287	Rh-Rh	285.3 ± 0.05	255
Mn-S	301 ± 17	395	O-Ru	528.4 ± 41.8	287	Rh-Sc	443.9 ± 10.5	175
Mn-Se	239.3 ± 9.2	351	O-S	517.90 ± 0.05	57	Rh-Si	395.0 ± 18.0	381
Mo-Mo	406 ± 21	168	O-Sb	434.3 ± 41.8	287	Rh-Th	515 ± 21	129
Mo-Nb	456 ± 25	163	O-Sc	681.6 ± 11.3	287	Rh-Ti	390.8 ± 14.6	61
Mo-O	560.2 ± 20.9	287	O-Se	464.8 ± 21.3	287,344	Rh-U	519 ± 17	129
N-N	945.33 ± 0.59	205	O-Si	799.6 ± 13.4	287	Rh-V	364 ± 29	135
N-O	630.57 ± 0.13	205	O-Sm	565 ± 13	95	Rh-Y	445.2 ± 10.5	175
N-P	617.1 ± 20.9	72,151	O-Sn	531.8 ± 12.6	287	Ru-Si	397.1 ± 20.9	381
N-Pu	473 ± 63	246	O-Sr	426.3 ± 6.3	327	Ru-Th	591.6 ± 42	134
N-S	464 ± 21	246	O-Ta	799.1 ± 12.6	287	Ru-V	414 ± 29	135
N-Sb	301 ± 50	120	O-Tb	711 ± 13	95	S-S	425.30	205
N-Sc	469 ± 84	246	O-Te	376.1 ± 20.9	287	S-Sb	378.7	110
N-Se	370 ± 11	254	O-Th	878.6 ± 12.1	287	S-Sc	477 ± 13	359,372
N-Si	470 ± 15	311	O-Ti	672.4 ± 9.2	287	S-Se	371.1 ± 6.7	90
N-Ta	611 ± 84	246	O-Tm	502 ± 13	95	S-Si	623	205
N-Th	577.4 ± 33.1	144,152	O-U	759.4 ± 13.4	287	S-Sm	389	112
N-Ti	476.1 ± 33.1	152,356	O-V	626.8 ± 18.8	12,287	S-Sn	464 ± 3.3	88
N-U	531.4 ± 2.1	142	O-W	672.0 ± 41.8	287	S-Sr	339	45
N-V	477.4 ± 17.2	107,152	O-Xe	36.4	246	S-Tb	515 ± 42	246
N-Xe	23.0	182	O-Y	719.6 ± 11.3	209,287	S-Te	339 ± 21	88
N-Y	481 ± 63	246	O-Yb	397 ± 17	95	S-Ti	418 ± 3	96,292
N-Zr	564.8 ± 25.1	143,152	O-Zn	159 ± 4	55	S-Tm	368 ± 42	246
Na-Na	73.0813 ± 0.0001	213	O-Zr	776.1 ± 13.4	287	S-U	522.6 ± 9.6	359
Na-O	256.1 ± 16.7	287	P-P	489.5 ± 10.5	151	S-V	450	97,205
Na-Rb	63.25	392	P-Pt	≤416.7	348	S-Y	528.4 ± 10.5	358
Nb-Nb	510 ± 10.0	164	P-Rh	353.1 ± 17	348	S-Yb	167	246
Nb-Ni	271.9 ± 0.1	8	P-S	444 ± 8	92	S-Zn	205 ± 13	82,158
Nb-O	771.5 ± 25.1	287	P-Sb	356.9	249	S-Zr	575.3 ± 16.7	359
Nb-Ti	302.0 ± 0.1	254	P-Se	363.6 ± 10.0	92	Sb-Sb	299.2 ± 6.3	81,248
Nd-Nd	<163	246	P-Si	363.6	346	Sb-Te	277.4 ± 3.8	306,364
Nd-O	703 ± 13	95	P-Te	297.9 ± 10.0	92	Sb-Tl	126.8 ± 10.5	11,293
Nd-S	471.5	25	P-Th	550.2 ± 42	135	Sc-Sc	162.8 ± 21	136

STRENGTHS OF CHEMICAL BONDS (continued)

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Molecule	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
Sc-Sc	385 ± 17	246	Se-Zn	170.7 ± 25.9	82,158	Te-Zn	117.6 ± 18.0	158
Sc-Si	228.7 ± 14	234	Si-Si	325 ± 7	328	Th-Th	≤289	140
Sc-Te	289 ± 17	246	Si-Te	452 ± 8	205,281	Ti-Ti	141.4 ± 21	216
Se-Se	332.6 ± 0.4	90,375	Si-Y	258.8 ± 17.3	235	Ti-V	203.2 ± 0.1	353
Se-Si	538 ± 13	370	Sm-Te	272.4 ± 14.6	271	Ti-Zr	214.3 ± 0.1	254
Se-Sm	331.0 ± 14.6	271	Sn-Sn	187.1 ± 0.3	284	Tl-Tl	64.4 ± 17	10
Se-Sn	401.2 ± 5.9	68	Sn-Te	359.8	205	U-U	222 ± 21	246
Se-Sr	~285	27	Sr-Sr	15.5 ± 0.4	121	V-V	269.3 ± 0.1	353
Se-Tb	423 ± 42	246	Tb-Tb	131.4 ± 25.1	250	V-Zr	260.6 ± 0.3	254
Se-Te	291.6 ± 4	88,90,159	Tb-Te	339 ± 42	246	Xe-Xe	6.138 ± 0.001	49,115
Se-Ti	381 ± 42	246	Te-Te	257.6 ± 4.1	389	Y-Y	159 ± 21	246
Se-Tm	276 ± 42	246	Te-Ti	289 ± 17	246	Yb-Yb	20.5 ± 17	161
Se-V	347 ± 21	246	Te-Tm	276 ± 42	246	Zn-Zn	29	339
Se-Y	435 ± 13	246	Te-Y	339 ± 13	246	Zr-Zr	298.2 ± 0.1	8

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STRENGTHS OF CHEMICAL BONDS (continued)

Table 1
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Table 2
ENTHALPY OF FORMATION OF GASEOUS ATOMS FROM ELEMENTS IN THEIR STANDARD STATES

For elements that are diatomic gases in their standard states these are readily obtained from the bond strength. For elements that are crystalline in their standard states they are derived from vapor pressure data.

Atom	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Atom	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Atom	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.
Ag	284.9 ± 0.8	2	Hf	619 ± 4	1	Re	774 ± 6.3	1
Al	330.0 ± 4.0	2	Hg	61.38 ± 0.04	2	Rh	556 ± 4	1
As	302.5 ± 13	1	I	106.76 ± 0.04	2	Ru	650.6 ± 6.3	1
Au	368.2 ± 2.1	1	In	243 ± 4	1	S	277.17 ± 0.15	2
B	565 ± 5	2	Ir	669 ± 4	1	Sb	264.4 ± 2.5	1
Ba	177.8 ± 4	1	K	89.0 ± 0.8	2	Sc	377.8 ± 4	1
Be	324 ± 5	2	Li	159.3 ± 1.0	2	Se	227.2 ± 4	1
Bi	209.6 ± 2.1	1	Mg	147.1 ± 0.8	2	Si	450 ± 8	2
Br	111.87 ± 0.12	2	Mn	283.3 ± 4	1	Sn	301.2 ± 1.5	2
C	716.68 ± 0.45	2	Mo	658.1 ± 2.1	1	Sr	163.6 ± 2.1	1
Ca	177.8 ± 0.8	2	N	472.68 ± 0.40	2	Ta	782.0 ± 2.5	1
Cd	111.80 ± 0.20	2	Na	107.5 ± 0.7	2	Te	196.6 ± 2.1	1
Ce	423 ± 13	1	Nb	721.3 ± 4	1	Th	602 ± 6	2
Cl	121.301 ± 0.008	2	Ni	430.1 ± 2.1	1	Ti	473 ± 3	2
Co	428.4 ± 4	1	O	249.18 ± 0.10	2	Tl	182.21 ± 0.4	1
Cr	397 ± 4	1	Os	787 ± 6.3	1	U	533 ± 8	2
Cs	76.5 ± 1.0	2	P	316.5 ± 1.0	2	V	514.2 ± 1.3	1
Cu	337.4 ± 1.2	2	Pb	195.2 ± 0.8	2	W	849.8 ± 4	1
Er	317.1 ± 4	1	Pd	376.6 ± 2.1	1	Y	424.7 ± 2.1	1
F	79.38 ± 0.30	2	Pt	565.7 ± 1.3	1	Yb	152.09 ± 0.8	1
Ge	372 ± 3	2	Pu	364.4 ± 17	1	Zn	130.40 ± 0.40	2
H	217.998 ± 0.006	2	Rb	80.9 ± 0.8	2	Zr	608.8 ± 4	1

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STRENGTHS OF CHEMICAL BONDS (continued)

Table 3
BOND STRENGTHS IN POLYATOMIC MOLECULES

The values below refer to a temperature of 298 K and have mostly been determined by kinetic methods (see (i) S. W. Benson, *J. Chem. Educ.*, 42, 502, 1965, (ii) J. A. Kerr, *Chem. Rev.*, 66, 465, 1966 and (iii) D. F. McMillen and D. M. Golden, *Ann. Rev. Phys. Chem.*, 33, 493, 1982, for a full description of the methods). An increasing number of bond strengths are being determined from gas-phase acidity cycles and from photoionization mass spectrometry (see J. Berkowitz, G. B. Ellison and D. Gutman, *J. Phys. Chem.*, 98, 2744, 1994).

Bond strengths in polyatomic molecules are notoriously difficult to measure accurately since the mechanisms of the kinetic systems involved in many of the measurements are seldom straightforward. Thus much controversy has taken place in the literature over the past 15 years concerning C-H bond strengths in simple alkanes, for which we recommend data based largely on kinetic studies involving time-resolved flow tube experiments with mass spectrometric determination of reactant radical concentrations (see Berkowitz, J., Ellison, G. B., and Gutman, D., *J. Phys. Chem.*, 98, 2744, 1994.). These alkane bond strengths and the enthalpies of formation of the corresponding radicals are significantly larger than values derived from experiments in very low pressure reactors (see Dobis, O. and Benson, S. W., *J. Phys. Chem.*, 101, 6030, 1997; and Benson, S. W. and Dobis, O., *J. Phys. Chem.*, 102, 5175, 1998). Other examples illustrating the difficulties involved are concerned with the C-H bond strengths in ethene and methanol or the corresponding enthalpies of formation of the vinyl and hydroxymethyl radicals and changes to the recommendations could well arise.

Some of the bond strengths have been calculated from the enthalpies of formation of the species involved according to the equations:

$$D^\circ(\text{R-X}) = \Delta_f H^\circ(\text{R}) + \Delta_f H^\circ(\text{X}) - \Delta_f H^\circ(\text{RX})$$

$$D^\circ(\text{R-R}) = 2 \Delta_f H^\circ(\text{R}) - \Delta_f H^\circ(\text{RR})$$

The enthalpies of formation of the atoms and radicals are taken from Tables 2 and 4 and for the molecules from the appropriate References following Table 3.

An attempt has been made to list all the important values obtained by methods that are considered to be valid. The references are intended to serve as a guide to the literature.

Bond	$D^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Bond	$D^\circ_{298}/\text{kJ mol}^{-1}$	Ref.
H-CH	424.0 ± 4.2	1	H-C ₆ H ₅	473.1 ± 3.0	46
H-CH ₂	462.0 ± 4.0	1	H-Cyclohexa-1,3-dien-5-yl	305 ± 21	63
H-CH ₃	438.9 ± 0.4	16	H-Cyclohexa-1,4-dien-3-yl	305.4 ± 8.4	45
H-CCH	556.1 ± 2.9	4,37	H-Cyclohexyl	399.6 ± 4	63
H-CHCH ₂	465.3 ± 3.4	37,81	H-C(CH ₃) ₂ CCCH ₃	344.3 ± 11.3	63
H-C ₂ H ₅	423.0 ± 1.6	16	H-CH ₂ C(CH ₃)C(CH ₃) ₂	326.4 ± 4.6	63
H-Cycloprop-2-en-1-yl	379.1 ± 17	63	H-C(CH ₃) ₂ C(CH ₃)CH ₂	319.2 ± 4.6	63
H-CH ₂ CCH	374.0 ± 8	63	H-CH ₂ C ₆ H ₅	375.7 ± 1.7	35
H-CH ₂ CHCH ₂	361.9 ± 8.8	16,35	H-Cyclohepta-1,3,5-trien-7-yl	305.4 ± 8	63
H-Cyclopropyl	444.8 ± 1.3	63	H-Norbornyl	404.6 ± 10.5	63
H-n-C ₃ H ₇	423.3 ± 2.1	82	H-Cycloheptyl	387.0 ± 4	63
H-i-C ₃ H ₇	409.1 ± 2.0	82	H-CH(CH ₃)C ₆ H ₅	357.3 ± 6.3	63
H-CH ₂ CCCH ₃	364.8 ± 8	63	H-Inden-1-yl	351 ± 13	63
H-CH(CH ₃)CCH	347.7 ± 9.2	63	H-C(CH ₃) ₂ C ₆ H ₅	353.1 ± 6.3	63
H-Cyclobutyl	403.8 ± 4	63	H-1-Naphthylmethyl	356.1 ± 6.3	63
H-Cyclopropylmethyl	407.5 ± 6.7	63	H-C(C ₆ H ₅) ₂	340.6	80
H-CH(CH ₃)CHCH ₂	345.2 ± 5.4	63	H-9,10-Dihydroanthracen-9-yl	315.1 ± 6.3	63
H-CH ₂ CHCHCH ₃	358.2 ± 6.3	63	H-C(CH ₃)(C ₆ H ₅) ₂	339 ± 8	63
H-CH ₂ C(CH ₃)CH ₂	358.2 ± 4	91,95	H-9-Anthracenylmethyl	342.3 ± 6.3	63
H-n-C ₄ H ₉	425.4 ± 2.1	82	H-9-Phenanthrenylmethyl	356.1 ± 6.3	63
H-i-C ₄ H ₉	425.2 ± 2.1	82	H-CN	527.6 ± 1.7	16
H-s-C ₄ H ₉	411.2 ± 2.0	82	H-CH ₂ CN	392.9 ± 8.4	16
H-t-C ₄ H ₉	404.3 ± 1.3	82	H-CH ₂ NC	380.7 ± 8.8	16
H-Cyclopenta-1,3-dien-5-yl	346.7	1,12	H-CH(CH ₃)CN	376.1 ± 9.6	63
H-Spiropentyl	413.4 ± 4	63	H-C(CH ₃) ₂ CN	361.9 ± 8.4	63
H-Cyclopent-1-en-3-yl	344.3 ± 4	63	H-CH ₂ NH ₂	390.4 ± 8.4	63
H-CH ₂ CHCHCH ₂	347 ± 13	63	H-CH ₂ NHCH ₃	364 ± 8	63
H-CH(C ₂ H ₅) ₂	319.7	63,92	H-CH ₂ N(CH ₃) ₂	351 ± 8	63
H-CH(CH ₃)CCCH ₃	365.3 ± 11.3	63	H-CHO	368.5 ± 1.0	23
H-C(CH ₃) ₂ CCH	338.9 ± 9.6	63	H-CHCO	440.6 ± 8.8	16
H-C(CH ₃) ₂ CHCH ₂	323.0 ± 6.3	63	H-COCH ₃	373.8 ± 1.5	67
H-Cyclopentyl	403.5 ± 2.5	22,74	H-COCHCH ₂	364.4 ± 4.2	63
H-CH ₂ C(CH ₃) ₃	418 ± 8	63	H-COC ₂ H ₅	371.3	1,12
H-C(CH ₃) ₂ C ₂ H ₅	404.0 ± 6.3	1,74,89	H-COC ₆ H ₅	363.6 ± 4	63

STRENGTHS OF CHEMICAL BONDS (continued)

Table 3
BOND STRENGTHS IN POLYATOMIC MOLECULES (continued)

Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
H-COCF ₃	380.7 ± 8	63	H-N(CH ₃)C ₆ H ₅	366.1 ± 8	63
H-CH ₂ CHO	394.6 ± 9.2	16	H-NO	195.35 ± 0.25	32
H-CH ₂ COCH ₃	411.3 ± 7.5	63	H-NO ₂	327.6 ± 2.1	63
H-CH(CH ₃)COCH ₃	386.2 ± 5.9	63	H-NF ₂	316.7 ± 10.5	63
H-CH ₂ OCH ₃	402.2	1,12	H-NHNH ₂	366.1	44
H-CH(CH ₃)OC ₂ H ₅	383.7 ± 1.7	55	H-NH ₃	385 ± 21	63
H-Tetrahydrofuran-2-yl	385 ± 4	63	H-OH	497.02 ± 0.38	104
H-2-Furylmethyl	361.9 ± 8	63	H-OCH ₃	436.0 ± 3.8	16
H-CH ₂ OH	401.8 ± 1.5	50	H-OC ₂ H ₅	437.7 ± 3.4	16
H-CH(CH ₃)OH	401.4	1,12	H-OC(CH ₃) ₃	439.7 ± 4	63
H-CH(OH)CHCH ₂	341.4 ± 7.5	63	H-OCH ₂ C(CH ₃) ₃	428.0 ± 6.3	63
H-C(CH ₃) ₂ OH	381 ± 4	63	H-OC ₆ H ₅	361.9 ± 8	63
H-CH ₂ OCOC ₆ H ₅	419.2 ± 5.4	63	H-O ₂ H	369.0 ± 4.2	88
H-COOCH ₃	387.9 ± 4	63	H-O ₂ CH ₃	370.3 ± 2.1	56
H-CH ₂ F	423.8 ± 4	77	H-O ₂ C(CH ₃) ₃	374.0 ± 0.8	47
H-CHF ₂	431.8 ± 4	77	H-OCOCH ₃	442.7 ± 8	63
H-CF ₃	449.5	3,61	H-OCOC ₂ H ₅	445.2 ± 8	63
H-CHFCI	421.7 ± 5.4	97	H-OCO-n-C ₃ H ₇	443.1 ± 8	63
H-CF ₂ Cl	421.3 ± 8.3	64	H-ONO	327.6 ± 2.1	15
H-CHFCI ₂	413.8 ± 5.0	97	H-ONO ₂	423.4 ± 2.1	15
H-CH ₂ Cl	419.0 ± 2.3	84	H-SiH	351	63
H-CHCl ₂	402.5 ± 2.7	84	H-SiH ₂	268	63
H-CH ₂ CH ₂ Cl	423.1 ± 2.4	85	H-SiH ₃	384.1 ± 2.0	83
H-CH(CH ₃)Cl	406.6 ± 1.5	84	H-SiH ₂ CH ₃	374.9	99
H-C(CH ₃)Cl ₂	390.6 ± 1.5	84	H-SiH(CH ₃) ₂	374.0	99
H-CCl ₃	392.5 ± 2.5	48	H-Si(CH ₃) ₃	377.8	63,99
H-CH ₂ Br	425.1 ± 4.2	97	D-Si(CH ₃) ₃	389 ± 7.1	36
H-CHBr ₂	417.2 ± 7.5	97	H-SiH ₂ C ₆ H ₅	369.0	63,99
H-CBr ₃	401.7 ± 6.7	63	H-SiF ₃	418.8	63,99
H-CH ₂ I	431 ± 8	63	H-SiCl ₃	382.0	63,99
H-CHI ₂	431 ± 8	63	H-Si ₂ H ₅	361.1	63
H-CHCF ₂	448 ± 8	90	H-Si(CH ₃) ₂ Si(CH ₃) ₃	356.9 ± 8.4	45
H-CFCFH	448 ± 8	90	H-Si(CH ₃) ₃	330.5 ± 8.4	45
H-CFCF ₂	452 ± 8	90	H-PH ₂	351.0 ± 2.1	16
H-CH ₂ CF ₃	446.4 ± 4.6	63	H-SH	381.6 ± 2.9	65
H-CF ₂ CH ₃	416.3 ± 10.5	63	H-SCH ₃	365.3 ± 2.5	65
H-C ₂ F ₅	429.7 ± 2.1	63	H-SC ₆ H ₅	348.5 ± 8	63
H-CFCFCI	444 ± 8	90	H-SO	172.8	100
H-CHClCF ₃	425.9 ± 6.3	63	H-GeH ₃	349.0 ± 8	16
H-CClCFCl	439 ± 8	90	H-GeH ₂ I	331 ± 8	68
H-CClCH ₂	>433.5	81	H-Ge(CH ₃) ₃	339 ± 8	34
H-CClCHCl	435 ± 8	90	H-AsH ₂	319.2 ± 0.8	16
H-CCl ₂ CHCl ₂	393 ± 8	63	H-SeH	334.93 ± 0.75	16
H-C ₂ Cl ₅	393.5 ± 6.0	66	H-Sn(n-C ₄ H ₉) ₃	308.4 ± 8.4	19
H-CClBrCF ₃	404.2 ± 6.3	63	H-SbH ₂	288.3 ± 2.1	16
H-n-C ₃ F ₇	435 ± 8	63	H-TeH	277.0 ± 5.0	16
H-i-C ₃ F ₇	433.5 ± 2.5	38	HC≡CH	965 ± 8	1,24,74
H-CHClCHCH ₂	370.7 ± 5.9	63	H ₂ C=CH ₂	728.3 ± 6	1,74
H-C ₆ F ₅	476.6	63	CH ₃ -CH ₃	376.0 ± 2.1	1,74,86
H-CH ₂ Si(CH ₃) ₃	415.1 ± 4	99	CH ₃ -CH ₂ CCH	318.0 ± 8	63
H-CSH	399.6 ± 5.0	16	CH ₃ -CH ₂ CCCH ₃	308.4 ± 6.3	63
H-CH ₂ SH	392.9 ± 8.4	16	CH ₃ -CH(CH ₃)CCH	305.4	63
H-CH ₂ SCH ₃	384.9 ± 5.9	49	CH ₃ -C(CH ₃)CCH ₂	320.1 ± 9.2	63
H-NH ₂	452.7 ± 1.3	16	CH ₃ -CH ₂ CHCHCH ₃	305.0 ± 3.3	63
H-NHCH ₃	418.4 ± 10.5	63	CH ₃ -CH ₂ C(CH ₃)CH ₂	301.2 ± 3.3	91
H-N(CH ₃) ₂	382.8 ± 8	63	CH ₃ -CH(CH ₃)CCCH ₃	320.9 ± 6.3	63
H-NHC ₆ H ₅	368.2 ± 8	63	CH ₃ -C(CH ₃) ₂ CCH	295.8 ± 6.3	63

STRENGTHS OF CHEMICAL BONDS (continued)

Table 3
BOND STRENGTHS IN POLYATOMIC MOLECULES (continued)

Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
n-C ₃ H ₇ -CH ₂ CCH	306.3 ± 6.3	63	s-C ₄ H ₉ -N ₂ s-C ₄ H ₉	195.4	13
CH ₃ -C(CH ₃) ₂ CHCH ₂	284.9 ± 6.3	63	t-C ₄ H ₉ -N ₂ t-C ₄ H ₉	182.0	13
n-C ₃ H ₇ -CH ₂ CHCH ₂	295.8	96	C ₆ H ₅ CH ₂ -N ₂ CH ₂ C ₆ H ₅	157.3	13
CH ₃ -C(CH ₃) ₂ CCCH ₃	303.3 ± 6.3	63	CF ₃ -N ₂ CF ₃	231.0	13
CHCCH ₂ -s-C ₄ H ₉	300.0 ± 6.3	63	CH ₃ -NO	167.4 ± 3.3	63
CH ₃ -CH ₂ C ₆ H ₅	332.2 ± 4	63	i-C ₃ H ₇ -NO	152.7 ± 13	63
CH ₃ -CH(CH ₃)C ₆ H ₅	312.1 ± 6.3	63	t-C ₄ H ₉ -NO	165.3 ± 6.3	63
C ₂ H ₅ -CH ₂ C ₆ H ₅	294.1 ± 4	63	C ₆ H ₅ -NO	212.5 ± 4	63
CH ₃ -1-Naphthylmethyl	305.0 ± 6.3	63	NC-NO	120.5 ± 10.5	43
CH ₃ -C(CH ₃) ₂ C ₆ H ₅	308.4 ± 6.3	63	CF ₃ -NO	179.1 ± 8	63
CHCCH ₂ -CH ₂ C ₆ H ₅	256.9 ± 8	63	C ₆ F ₅ -NO	208.4 ± 4	63
n-C ₃ H ₇ -CH ₂ C ₆ H ₅	292.9 ± 4	63	CCl ₃ -NO	134 ± 13	63
CH ₃ -9-Anthracenylmethyl	282.8 ± 6.3	63	t-C ₄ H ₉ -NOt-C ₄ H ₉	121	21
CH ₃ -9-Phenanthrenylmethyl	305.0 ± 6.3	63	CH ₃ -NO ₂	254.4	63
CH ₃ -CH(C ₆ H ₅) ₂	301 ± 8	63	CH ₂ C(CH ₃)-NO ₂	245.2	63
CH ₃ -C(CH ₃)(C ₆ H ₅) ₂	289 ± 8	63	i-C ₃ H ₇ -NO ₂	246.9	63
CH ₃ -CN	509.6 ± 8	63	t-C ₄ H ₉ -NO ₂	244.8	63
C ₂ H-CN	602 ± 4	70	C ₆ H ₅ -NO ₂	298.3 ± 4	63
C ₂ H ₅ -CH ₂ NH ₂	332.2 ± 8	63	C(NO ₂) ₃ -NO ₂	169.5 ± 4	63
CH ₃ -CH ₂ CN	336.4 ± 4	93	CH ₃ -OC(CH ₃)CH ₂	277.4	101
C ₂ H ₅ -CH ₂ CN	321.7 ± 7.1	63	CH ₃ -OC ₆ H ₅	238 ± 8	73
CH ₃ -CH(CH ₃)CN	329.7 ± 8	63	CH ₃ -OCH ₂ C ₆ H ₅	280.3	26
C ₂ H ₅ -CH ₂ CN	321.7 ± 7.1	63	C ₂ H ₅ -OC ₆ H ₅	264 ± 6.3	63
CH ₃ -C(CH ₃) ₂ CN	312.5 ± 6.7	63	CH ₂ CHCH ₂ -OC ₆ H ₅	208.4 ± 8	63
CH ₃ -C(CH ₃)(CN)C ₆ H ₅	250.6	63	O=CO	532.2 ± 0.4	29
C ₆ H ₅ CH ₂ -CH ₂ NH ₂	284.5 ± 8	63	CH ₃ -O ₂	137.0 ± 3.8	53
C ₆ H ₅ CH ₂ -C ₅ H ₄ N	362.8	80	C ₂ H ₅ -O ₂	148.4 ± 8.4	53
CN-CN	536 ± 4	30	CH ₂ CHCH ₂ -O ₂	76.2 ± 2.1	62
CH ₃ -2-Furylmethyl	314 ± 8	63	i-C ₃ H ₇ -O ₂	155.4 ± 9.6	53
CH ₃ -COC ₆ H ₅	355.6 ± 9.2	102	t-C ₄ H ₉ -O ₂	152.8 ± 7.4	53
C ₆ H ₅ CH ₂ -COCH ₂ C ₆ H ₅	273.6 ± 8	63	C ₆ H ₅ CH ₂ -O ₂ CCH ₃	280 ± 8	63
CH ₂ CO-COCH ₃	282.0 ± 9.6	63	C ₆ H ₅ CH ₂ -O ₂ CC ₆ H ₅	289	13
C ₆ H ₅ CH ₂ -COOH	280	63	CH ₃ -O ₂ SCH ₃	279.5	63
C ₆ H ₅ CO-COC ₆ H ₅	277.8	63	CH ₂ CHCH ₂ -O ₂ SCH ₃	207.5	63
(C ₆ H ₅) ₂ CH-COOH	248.5 ± 13	63	C ₆ H ₅ CH ₂ -O ₂ SCH ₃	221.3	63
CF ₃ -COC ₆ H ₅	308.8 ± 8	63	CF ₃ -O ₂ CF ₃	361.5	10
CF ₂ =CF ₂	319.2 ± 13	103	CH ₂ Cl-O ₂	122.4 ± 10.5	53
CH ₂ F-CH ₂ F	368 ± 8	51	CHCl ₂ -O ₂	108.2 ± 8.2	53
CH ₃ -CF ₃	423.4 ± 4.6	79	CCl ₃ -O ₂	92.0 ± 6.4	53
CF ₃ -CF ₃	413.0 ± 10.5	63	CH ₃ CHCl-O ₂	131.2 ± 1.8	53
C ₆ F ₅ -C ₆ F ₅	487.9 ± 24.7	78	CH ₃ CCl ₂ -O ₂	112.2 ± 2.2	53
CH ₃ -BF ₂	~473	63	(CH ₃) ₂ CCl-O ₂	136.0 ± 3.8	53
C ₆ H ₅ -BCl ₂	~510	63	CH ₃ -SH	312.5 ± 4.2	65
CH ₂ CHCH ₂ -Si(CH ₃) ₃	293	63	t-C ₄ H ₉ -SH	286.2 ± 6.3	63
s-C ₄ H ₉ -Si(CH ₃) ₃	414	63	C ₆ H ₅ -SH	361.9 ± 8	63
CH ₃ -NHC ₆ H ₅	298.7 ± 8	63	CH ₃ -SCH ₃	307.9 ± 3.3	65
C ₆ H ₅ CH ₂ -NH ₂	297.5 ± 4	63	CH ₃ -SC ₆ H ₅	290.4 ± 8	63
CH ₃ -N(CH ₃)C ₆ H ₅	296.2 ± 8	63	C ₆ H ₅ CH ₂ -SCH ₃	256.9 ± 8	63
C ₆ H ₅ CH ₂ -NHCH ₃	287.4 ± 8	63	S-CS	430.5 ± 13	63
C ₆ H ₅ CH ₂ -N(CH ₃) ₂	259.8 ± 8	63	F-CH ₃	472	1,61
CH ₂ =N ₂	<175	58	F-CN	469.9 ± 5.0	63
CH ₃ -N ₂ CH ₃	219.7	13	F-COF	535 ± 12	18
C ₂ H ₅ -N ₂ C ₂ H ₅	209.2	13	F-CHFCl	465.3 ± 9.6	97
i-C ₃ H ₇ -N ₂ i-C ₃ H ₇	198.7	13	F-CF ₂ Cl	490 ± 25	41
n-C ₄ H ₉ -N ₂ n-C ₄ H ₉	209.2	13	F-CFCl ₂	462.3 ± 10.0	97
i-C ₄ H ₉ -N ₂ i-C ₄ H ₉	205.0	13	F-CF ₂ CH ₃	522.2 ± 8	63

STRENGTHS OF CHEMICAL BONDS (continued)

Table 3
BOND STRENGTHS IN POLYATOMIC MOLECULES (continued)

Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
F-C ₂ F ₅	530.5 ± 7.5	63	CH ₃ -In(CH ₃) ₂	205 ± 17	63
Cl-CN	421.7 ± 5.0	63	CH ₃ -Sn(CH ₃) ₃	297 ± 17	63
Cl-COC ₆ H ₅	310 ± 13	63	C ₂ H ₅ -Sn(C ₂ H ₅) ₃	264 ± 17	63
Cl-CSCl	265.3 ± 2.1	71	CH ₃ -Sb(CH ₃) ₂	255 ± 17	63
Cl-CF ₃	360.2 ± 3.3	27	C ₂ H ₅ -Sb(C ₂ H ₅) ₂	243 ± 17	63
Cl-CHFCl	354.4 ± 11.7	97	CH ₃ -HgCH ₃	255 ± 17	63
Cl-CF ₂ Cl	346.0 ± 13.4	97	C ₂ H ₅ -HgC ₂ H ₅	205 ± 17	63
Cl-CFCl ₂	305 ± 8	40	CH ₃ -Tl(CH ₃) ₂	167 ± 17	63
Cl-CH ₂ Cl	350.2 ± 0.8	97	CH ₃ -Pb(CH ₃) ₃	238 ± 17	63
Cl-CHCl ₂	338.5 ± 4.2	97	C ₂ H ₅ -Pb(C ₂ H ₅) ₃	230 ± 17	63
Cl-CCl ₃	305.9 ± 7.5	63	CH ₃ -Bi(CH ₃) ₂	218 ± 17	63
Cl-C ₂ F ₅	346.0 ± 7.1	27	CO-Cr(CO) ₅	155 ± 8	60
Cl-CF ₂ CF ₂ Cl	326 ± 8	63	CO-Fe(CO) ₄	172 ± 8	60
Cl-SiCl ₃	464	99	CO-Mo(CO) ₅	167 ± 8	60
Br-CH ₃	292.9 ± 5.0	39	CO-W(CO) ₅	192 ± 8	60
Br-C ₆ H ₅	336.8 ± 8	63	BH ₃ -BH ₃	146	13
Br-CN	367.4 ± 5.0	63	NH ₂ -NH ₂	275.3	63
Br-CH ₂ COCH ₃	261.5	101	NH ₂ -NHCH ₃	268.2 ± 8	63
Br-COC ₆ H ₅	268.6	13	NH ₂ -N(CH ₃) ₂	246.9 ± 8	63
Br-CHF ₂	289 ± 8	63	NH ₂ -NHC ₆ H ₅	218.8 ± 8	63
Br-CF ₃	296.2 ± 1.3	3	ON-NO ₂	40.6 ± 2.1	63
Br-CF ₂ CH ₃	287.0 ± 5.4	76	O ₂ N-NO ₂	56.9	63
Br-C ₂ F ₅	287.4 ± 6.3	63	NF ₂ -NF ₂	88 ± 4	63
Br-n-C ₃ F ₇	278.2 ± 10.5	63	O-N ₂	167	1,14
Br-i-C ₃ F ₇	274.1 ± 4.6	63	O-NO	305	1,14
Br-CH ₂ C ₆ F ₅	225 ± 6	54	O-NO ₂	208.7 ± 1.1	31
Br-CHClCF ₃	274.9 ± 6.3	63	HO-NO	206.3	63
Br-CCl ₃	231.4 ± 4	63	HO-NO ₂	206.7	63
Br-CClBrCF ₃	251.0 ± 6.3	63	HO ₂ -NO ₂	96 ± 8	63
Br-CH ₂ Br	296.7 ± 1.3	97	CH ₃ O-NO	174.9 ± 3.8	9,11
Br-CHBr ₂	292.0 ± 8	97	C ₂ H ₅ O-NO	175.7 ± 5.4	8,11
Br-CBr ₃	235.1 ± 7.5	63	CH ₃ COO ₂ -NO ₂	118.8 ± 3.0	17
Br-NO ₂	82.0 ± 7.1	57	n-C ₃ H ₇ O-NO	167.8 ± 7.5	11
Br-NF ₂	≤222	25	i-C ₃ H ₇ O-NO	171.5 ± 5.4	7,11
I-CHCH ₂	259.0 ± 4.2	20	n-C ₄ H ₉ O-NO	177.8 ± 6.3	11
I-n-C ₄ H ₉	205.0 ± 4	63	i-C ₄ H ₉ O-NO	175.7 ± 6.3	11
I-Norbornyl	261.5 ± 10.5	69	s-C ₄ H ₉ O-NO	173.6 ± 3.3	5,11
I-CN	305 ± 4	30	t-C ₄ H ₉ O-NO	171.1 ± 3.3	6,11
I-CF ₃	227.2 ± 1.3	3	HO-NCHCH ₃	207.9	13
I-CF ₂ CH ₃	218.0 ± 4.2	63	Cl-NF ₂	~134	1,75
I-CH ₂ CF ₃	235.6 ± 4	63	I-NO	77.8 ± 0.4	42
I-C ₂ F ₅	218.8 ± 2.9	2	I-NO ₂	76.6 ± 4	98
I-n-C ₃ F ₇	208.4 ± 4.2	63	HO-OH	213 ± 4	63
I-i-C ₃ F ₇	215.1 ± 2.9	2	HO-OCH ₂ C(CH ₃) ₃	193.7 ± 7.9	63
I-n-C ₄ F ₉	205.0 ± 4.2	72	CH ₃ O-OCH ₃	157.3 ± 8	63
I-C(CF ₃) ₃	206	33	C ₂ H ₅ O-OC ₂ H ₅	158.6 ± 4	63
I-C ₆ H ₅	273.6 ± 8	63	n-C ₃ H ₇ O-On-C ₃ H ₇	155.2 ± 4	63
I-C ₆ F ₅	277.0	63	i-C ₃ H ₇ O-Oi-C ₃ H ₇	157.7 ± 4	63
C ₃ H ₅ -FeC ₅ H ₅	381 ± 13	59	s-C ₄ H ₉ O-Os-C ₄ H ₉	152.3 ± 4	63
CH ₃ -ZnCH ₃	285 ± 17	63	t-C ₄ H ₉ O-Ot-C ₄ H ₉	159.0 ± 4	63
C ₂ H ₅ -ZnC ₂ H ₅	238 ± 17	63	C ₂ H ₅ C(CH ₃) ₂ O-OC(CH ₃) ₂ C ₂ H ₅	164.4 ± 4	63
CH ₃ -Ga(CH ₃) ₂	264 ± 17	63	(CH ₃) ₃ CCH ₂ O-OCH ₂ C(CH ₃) ₃	152.3 ± 4	63
C ₂ H ₅ -Ga(C ₂ H ₅) ₂	209 ± 17	63	CF ₃ O-OCF ₃	193.3	63
CH ₃ -Ge(CH ₃) ₃	347 ± 17	63	(CF ₃) ₃ CO-OC(CF ₃) ₃	148.5 ± 4.6	63
CH ₃ -As(CH ₃) ₂	280 ± 17	63	t-C ₄ H ₉ O-OSi(CH ₃) ₃	197	63
CH ₃ -CdCH ₃	251 ± 17	63	SF ₅ O-OSF ₅	155.6	63

STRENGTHS OF CHEMICAL BONDS (continued)

Table 3
BOND STRENGTHS IN POLYATOMIC MOLECULES (continued)

Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.	Bond	$D^{\circ}_{298}/\text{kJ mol}^{-1}$	Ref.
t-C ₄ H ₉ O-Ge(C ₂ H ₅) ₃	192	63	O=PF ₃	544 ± 21	52
t-C ₄ H ₉ O-Sn(C ₂ H ₅) ₃	192	63	O=PCl ₃	510 ± 21	52
FCIO ₂ -O	244.3	13	O=PBr ₃	498 ± 21	52
CF ₃ O-O ₂ CF ₃	126.8 ± 8	63	HO-Si(CH ₃) ₃	536	63
SF ₃ O-O ₂ SF ₃	126.8	63	HS-SH	276 ± 8	63
CH ₃ CO ₂ -O ₂ CCH ₃	127.2 ± 8	63	CH ₃ S-SCH ₃	272.8 ± 3.8	65
C ₂ H ₅ CO ₂ -O ₂ CC ₂ H ₅	127.2 ± 8	63	F-SF ₃	420 ± 10	94
n-C ₃ H ₇ CO ₂ -O ₂ Cn-C ₃ H ₇	127.2 ± 8	63	I-SH	206.7 ± 8	63
O-SO	552 ± 8	29	I-SO	180	63
F-OCF ₃	182.0 ± 2.1	28	I-SCH ₃	206.3 ± 7.1	87
HO-Cl	251 ± 13	52	I-Si(CH ₃) ₃	322	99
O-ClO	247 ± 13	29	H ₃ Si-SiH ₃	310	63,99
HO-Br	234 ± 13	52	(CH ₃) ₃ Si-Si(CH ₃) ₃	336.8	63,99
HO-I	234 ± 13	52	(C ₆ H ₅) ₃ Si-Si(C ₆ H ₅) ₃	368 ± 29	63,99

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STRENGTHS OF CHEMICAL BONDS (continued)

Table 3
BOND STRENGTHS IN POLYATOMIC MOLECULES (continued)

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STRENGTHS OF CHEMICAL BONDS (continued)

Table 3
BOND STRENGTHS IN POLYATOMIC MOLECULES (continued)

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Table 4
ENTHALPIES OF FORMATION OF FREE RADICALS

The enthalpies of formation of the free radicals are related to the corresponding bond strengths by the equations

$$D^\circ(\text{R-X}) = \Delta_f H^\circ(\text{R}) + \Delta_f H^\circ(\text{X}) - \Delta_f H^\circ(\text{RX})$$

or

$$D^\circ(\text{R-R}) = 2\Delta_f H^\circ(\text{R}) - \Delta_f H^\circ(\text{RR})$$

For an excellent review of the methods of determining the enthalpies of formation of free radicals the reader is referred to "Thermochemistry of Free Radicals" by H. E. O'Neal and S. W. Benson in *Free Radicals*, Kochi, J. K., Ed., John Wiley & Sons, New York, 1973, 275 and the article by J. Berkowitz, G. B. Ellison, and D. Gutman, *J. Phys. Chem.*, 98, 2744, 1994.

Radical	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Radical	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.
CH	596.4 ± 1.2	6	Spiropentyl	380.7 ± 4	48
CH ₂ (triplet)	390.4 ± 4	15,34	Cyclopent-1-en-3-yl	160.7 ± 4	48
CH ₂ (singlet)	428.3 ± 4	15	CH ₂ =CHCH=CHCH ₂	205 ± 13	48
CH ₃	146.4 ± 0.4	10	(C ₂ H ₅) ₂ CH	205 ± 13	48
CH≡C	566.1 ± 2.9	5,27	CH ₂ C≡CCHCH ₃	272.8 ± 9.6	48
CH ₂ =CH	300.0 ± 3.4	27,64	CH≡CC(CH ₃) ₂	257.3 ± 8.4	48
C ₂ H ₅	120.9 ± 1.6	10	CH ₂ =CHC(CH ₃) ₂	77.4 ± 6.3	48
Cycloprop-2-en-1-yl	439.7 ± 17.2	48	Cyclopentyl	107.1 ± 2.5	17
CH≡CCH ₂	340.6 ± 8.4	48	(CH ₃) ₃ CCH ₂	36.4 ± 8	48
CH ₂ =CHCH ₂	170.7 ± 8.8	10,26	C ₂ H ₅ C(CH ₃) ₂	32.2 ± 6.3	71
CH ₃ CH=CH	262.7	77	C ₆ H ₅	338 ± 3	35
Cyclopropyl	279.9 ± 1.1	48	Cyclohexa-1,3-dien-5-yl	197 ± 21	48
n-C ₃ H ₇	100.8 ± 2.1	65	Cyclohexyl	58.2 ± 4	48
i-C ₃ H ₇	86.6 ± 2.0	65	CH ₃ C≡CC(CH ₃) ₂	221.8 ± 9.6	48
CH ₃ C≡CCH ₂	293.7	48	(CH ₃) ₂ C=C(CH ₃)CH ₂	39.8 ± 6.3	48
CH ₂ =CHCHCH ₃	125.5 ± 6.3	48	CH ₂ =C(CH ₃)C(CH ₃) ₂	37.7 ± 6.3	48
CH≡CCHCH ₃	295.0 ± 9.2	48	C ₆ H ₅ CH ₂	208.0 ± 2.5	26
Cyclobutyl	214.2 ± 4.2	48	Cyclohepta-1,3,5-trien-7-yl	271.1 ± 8	48
Cyclopropylmethyl	213.8 ± 6.7	48	CH ₃ CH ₂ CH ₂ C(CH ₃) ₂	3.4 ± 8.4	69
CH ₂ =C(CH ₃)CH ₂	127.2 ± 5.4	48	Norbornyl	136.4 ± 10.5	48
CH ₃ CH=CHCH ₂	125.5 ± 6.3	48	Cycloheptyl	51.1 ± 4	48
n-C ₄ H ₉	80.9 ± 2.2	65	C ₆ H ₅ CHCH ₃	169.0	48
i-C ₄ H ₉	72.7 ± 2.2	65	C ₆ H ₅ C(CH ₃) ₂	134.7	48
s-C ₄ H ₉	66.7 ± 2.1	65	1-Naphthylmethyl	252.7	48
t-C ₄ H ₉	51.8 ± 1.3	65	(C ₆ H ₅) ₂ CH	289	63
Cyclopenta-1,3-dien-5-yl	263.0	8	9,10-Dihydroanthracen-9-yl	256.9 ± 6.3	48

STRENGTHS OF CHEMICAL BONDS (continued)

Table 4
ENTHALPIES OF FORMATION OF FREE RADICALS (continued)

Radical	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Radical	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.
9-Anthracenylmethyl	337.6	48	CF ₃ CH ₂	-517.1 ± 5.0	48
9-Phenanthrenylmethyl	311.3	48	C ₂ F ₅	-892.9 ± 4	48
CH ₂ CN	243.1 ± 11.3	10	CCl=CH ₂	>251	64
CH ₂ NC	326.4 ± 11.3	10	CH ₃ CHCl	76.5 ± 1.6	67
CH ₂ CHCN	209.2 ± 9.6	48	CH ₃ CCl ₂	48.4 ± 7.6	40,67
(CH ₃) ₂ CCN	166.5 ± 8.4	48	CH ₃ CH ₂ Cl	93.0 ± 3.4	68
C ₆ H ₅ C(CH ₃)CN	248.5	48	CHCl ₂ CCl ₂	23.4 ± 8	48
CH ₂ NH ₂	149.4 ± 8	48	CF ₂ ClCF ₂	-686 ± 17	48
CH ₂ NHCH ₂	126 ± 8	48	C ₂ Cl ₃	33.5 ± 5.4	54
(CH ₃) ₂ NCH ₂	109 ± 8	48	C ₆ F ₅	-547.7 ± 8	48
CN	441.4 ± 4.6	10	(CH ₃) ₃ SiCH ₂	-34.7	48
CHN ₂	494.42	30	CS	278.5 ± 3.8	62
CHO	43.1	9,22	HCS	300.4 ± 8.4	10
CHCO	175.3 ± 8.4	10	CH ₂ SH	151.9 ± 8.4	10
CH ₂ CO	-10.0 ± 1.2	56	CH ₂ SCH ₂	136.8 ± 5.9	38
CH ₂ =CHCO	72.4	48	NH	352.3 ± 9.6	60
C ₆ H ₅ CO	-32.3	8	NH ₂	188.7 ± 1.3	10
C ₆ H ₅ CO	123.0 ± 9.6	78	HNO	112.9	25
CH ₂ CHO	10.5 ± 9.2	10	NF ₂	34 ± 4	48
CH ₃ COCH ₂	-23.9 ± 10.9	48	N ₂ H ₃	243.5	33
CH ₃ COCHCH ₃	-70.3 ± 7.1	48	N ₃	469 ± 21	48
CH ₃ OCH ₂	-0.1	8	CH ₂ NH	104.6 ± 13	33
C ₆ H ₅ OCHCH ₃	-84.5	42	CH ₃ NH	177.4 ± 8	48
Tetrahydrofuran-2-yl	-18.0 ± 6.3	48	(CH ₃) ₃ N	145.2 ± 8	48
CH ₂ OH	-17.8 ± 1.3	39	C ₆ H ₅ NH	237.2 ± 8	48
CH ₂ CH ₂ OH	-36.0	31	C ₆ H ₅ NCH ₃	233.5 ± 8	48
CH=CHOH	113.0	31	NCO	127.0	13,79
CH ₃ CHOH	-51.6	8	CNO	407.01	41
CH ₂ =CHCHOH	0.0	48	CH ₂ N ₂	215.5 ± 7.5	2
(CH ₃) ₂ COH	-111.3 ± 4.6	48	C ₂ H ₅ N ₂	187.4 ± 10.5	2
COOH	-217 ± 10	32	i-C ₃ H ₇ N ₂	158.6 ± 9.2	2
COOCH ₃	-169.0 ± 4	48	OH	37.20 ± 0.38	80
C ₆ H ₅ COOCH ₂	-69.9 ± 8.4	48	CH ₂ O	17.2 ± 3.8	10
CF	261.5 ± 4.6	3	C ₂ H ₅ O	-15.5 ± 3.4	10
CHF	143.1 ± 12.6	61	n-C ₃ H ₇ O	-41.4	48
CH ₂ F	-31.8 ± 8.4	59	i-C ₃ H ₇ O	-52.3	48
FCO	-152.1 ± 12	14	n-C ₄ H ₉ O	-62.8	48
CHF ₂	-238.9 ± 4	59	s-C ₄ H ₉ O	-69.5 ± 3.3	48
CF ₂	-184.1 ± 8.4	61	t-C ₄ H ₉ O	-90.8	48
CF ₃	-466.1 ± 3.8	3	C ₆ H ₅ O	47.7	48
CHCl	336.4 ± 11.7	61	CF ₃ O	-655.6	7
CH ₂ Cl	117.3 ± 3.1	67	FO	109 ± 10	21
CFCI	31.0 ± 13.4	61	ClO	101.63 ± 0.1	1
CHFCl	-60.7 ± 10.0	73	BrO	125.8 ± 2.4	19
CF ₂ Cl	-279.1 ± 8.3	49	IO	126 ± 18	20
ClCO	-21.8	55	HO ₂	14.6	70
CHCl ₂	89.0 ± 3.0	67	CH ₂ O ₂	9.0 ± 5.1	40
CFCl ₂	-89.1 ± 10.0	73	C ₂ H ₅ O ₂	-27.4 ± 9.9	40
CCl ₂	230.1 ± 8.4	61	CH ₂ =CHCH ₂ O ₂	87.9 ± 5.5	43
CCl ₃	71.1 ± 2.5	37	i-C ₃ H ₇ O ₂	-68.8 ± 11.3	16,40
CH ₂ Br	169.0 ± 4.2	73	t-C ₄ H ₉ O ₂	-101.0 ± 9.2	40
CHBr ₂	188.3 ± 9.2	73	HOCH ₂ O ₂	-162.1 ± 2.1	43
CBr ₃	207.1 ± 8	73	CF ₃ O ₂	-614.0	43
CH ₂ I	230.1 ± 6.7	48	CF ₂ ClO ₂	-406.5	43
CHI ₂	333.9 ± 9.2	48	CFCl ₂ O ₂	-213.7	43
CH ₃ CF ₂	-302.5 ± 8	48	CH ₂ ClO ₂	-5.1 ± 13.6	40

STRENGTHS OF CHEMICAL BONDS (continued)

Table 4
ENTHALPIES OF FORMATION OF FREE RADICALS (continued)

Radical	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.	Radical	$\Delta_f H^\circ_{298}/\text{kJ mol}^{-1}$	Ref.
CHCl ₂ O ₂	-19.2 ± 11.2	40	SiF ₃	-1025	48,76
CCl ₃ O ₂	-20.9 ± 8.9	40	SiCl	195.8	48,76
CH ₃ CHClO ₂	-54.7 ± 3.4	40	SiCl ₂	-163.6	48,76
CH ₂ CCl ₂ O ₂	-63.8 ± 9.8	40	SiCl ₃	-318	48,76
CH ₃ CO ₂	-207.5 ± 4	48	SiH ₃ SiH	269.9 ± 14.6	74
CH ₃ COO ₂	-172 ± 20	12	Si ₂ H ₅	223.0	48,76
C ₂ H ₅ CO ₂	-228.5 ± 4	48	PH ₂	138.5 ± 2.5	10
n-C ₃ H ₇ CO ₂	-249.4 ± 4	48	HS	143.0 ± 2.8	53
FO ₂	26.1	45,58	CH ₃ S	124.6 ± 1.8	53
ClO ₂	97.5	4,52	C ₂ H ₅ S	229.7 ± 8	48
OCIO	95.6	28,51	SO	5.0	18
NO ₃	73.7 ± 1.4	24	HSO	-4	44
sym-ClO ₃	232.6	23	HSO ₂	-222	11
SiH	377	48,76	CH ₃ SO ₂	-239.3	57
SiH ₂	269.0 ± 1.3	29,47	HOSO ₂	-385	46
SiH ₃	200.5 ± 2.5	66	SO ₃	-395.7	75
CH ₃ Si	310	76	SF ₄	-746 ± 12	72
CH ₃ SiH	213.0 ± 14.6	74	SF ₅	-879.9 ± 20	72
CH ₃ SiH ₂	152.7	48,76	CH ₃ S ₂	68.6 ± 8	36
(CH ₃) ₂ Si	109	76	C ₂ H ₃ S ₂	43.5 ± 8	36
(CH ₃) ₂ SiH	59.8	48,76	i-C ₃ H ₇ S ₂	13.8 ± 8	36
(CH ₃) ₃ Si	-3.3	48,76	t-C ₄ H ₉ S ₂	-19.3 ± 8	36
C ₆ H ₅ Si(CH ₃) ₂	163	57	HOCS ₂	110.5	50
(C ₆ H ₅) ₂ SiCH ₃	326	57	GeH ₃	222 ± 8	10
(C ₆ H ₅) ₃ Si	486.2	57	AsH ₂	167.8 ± 1.3	10
SiF	-19.3	48,76	HSe	144.8 ± 2.1	10
SiF ₂	-587.9	48,76	SbH ₂	215.5 ± 2.5	10
			HTe	158.6 ± 5.0	10

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STRENGTHS OF CHEMICAL BONDS (continued)

Table 4
ENTHALPIES OF FORMATION OF FREE RADICALS (continued)

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STRENGTHS OF CHEMICAL BONDS (continued)

Table 5
BOND STRENGTHS OF SOME ORGANIC MOLECULES

Bond strengths at 298 K expressed in kJ/mol^{-1} for some organic molecules of the general formula R-X are presented below. Some are experimental values taken from the preceding tables; the remainder are calculated from the enthalpies of formation of atoms (Table 2) and of radicals (Table 4), and the enthalpies of formation of the parent compounds from sources indicated by the references below. The table also includes bond strengths for the inorganic molecules, hydrogen, the hydrogen halides, water and ammonia.

	H	F	Cl	Br	I	OH	NH ₂	CH ₃ O	CH ₃	CH ₃ CO	NO	CF ₃	CCl ₃
H	435.990	569.87	431.62	366.35	298.407	497	453	436	439	374	195	450	393
CH ₃	439	472	350 ^e	293	239 ^e	385 ^e	358 ^e	348 ^e	377 ^e	354 ^e	167	423	362 ^e
C ₂ H ₅	423	463 ^d	354 ^e	295 ^e	236 ^e	393 ^e	357 ^e	355 ^e	371 ^e	349 ^e	—	—	—
i-C ₃ H ₇	409	460 ^e	353 ^e	298 ^e	234 ^e	396 ^e	359 ^e	356 ^e	367 ^e	339 ^e	153	—	—
t-C ₄ H ₉	404	—	355 ^e	296 ^e	231 ^e	402 ^e	362 ^e	353 ^e	366 ^e	332 ^e	165	—	—
C ₆ H ₅	473	533 ^e	407 ^e	346 ^f	280 ^e	472 ^e	439 ^e	423 ^e	434 ^e	415 ^e	213	—	—
C ₆ H ₅ CH ₂	376	—	310 ^e	256 ^f	215 ^f	346 ^e	302 ^e	—	332	297 ^e	—	—	—
CCl ₃	393	419 ^e	288 ^e	224 ^e	167 ^e	—	—	—	362 ^e	—	134	335 ^b	286 ^e
CF ₃	450	547 ^e	362 ^e	294 ^e	227	—	—	—	423	—	179	413	335 ^b
C ₂ F ₅	430	531 ^e	347 ^e	283 ^e	219	—	—	—	—	—	—	—	—
CH ₃ CO	374	512 ^e	354 ^f	292 ^e	223 ^e	459 ^e	417 ^e	421 ^e	354 ^e	282	—	—	—
CN	528	470	422	367	305	—	—	—	514 ^e	—	121	—	—
C ₆ F ₅	473	487 ^e	383 ^e	—	277 ^a	497 ^e	—	—	441 ^e	—	208 ^a	—	—

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ELECTRONEGATIVITY

Electronegativity is a parameter originally introduced by Pauling which describes, on a relative basis, the tendency of an atom in a molecule to attract bonding electrons. While electronegativity is not a precisely defined molecular property, the electronegativity difference between two atoms provides a useful measure of the polarity and ionic character of the bond between them. This table gives the electronegativity X , on the Pauling scale, for the most common oxidation state. Other scales are described in the references.

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Z	Symbol	X	Z	Symbol	X	Z	Symbol	X
1	H	2.20	33	As	2.18	65	Tb	—
2	He	—	34	Se	2.55	66	Dy	1.22
3	Li	0.98	35	Br	2.96	67	Ho	1.23
4	Be	1.57	36	Kr	—	68	Er	1.24
5	B	2.04	37	Rb	0.82	69	Tm	1.25
6	C	2.55	38	Sr	0.95	70	Yb	—
7	N	3.04	39	Y	1.22	71	Lu	1.0
8	O	3.44	40	Zr	1.33	72	Hf	1.3
9	F	3.98	41	Nb	1.6	73	Ta	1.5
10	Ne	—	42	Mo	2.16	74	W	1.7
11	Na	0.93	43	Tc	2.10	75	Re	1.9
12	Mg	1.31	44	Ru	2.2	76	Os	2.2
13	Al	1.61	45	Rh	2.28	77	Ir	2.2
14	Si	1.90	46	Pd	2.20	78	Pt	2.2
15	P	2.19	47	Ag	1.93	79	Au	2.4
16	S	2.58	48	Cd	1.69	80	Hg	1.9
17	Cl	3.16	49	In	1.78	81	Tl	1.8
18	Ar	—	50	Sn	1.96	82	Pb	1.8
19	K	0.82	51	Sb	2.05	83	Bi	1.9
20	Ca	1.00	52	Te	2.1	84	Po	2.0
21	Sc	1.36	53	I	2.66	85	At	2.2
22	Ti	1.54	54	Xe	2.60	86	Rn	—
23	V	1.63	55	Cs	0.79	87	Fr	0.7
24	Cr	1.66	56	Ba	0.89	88	Ra	0.9
25	Mn	1.55	57	La	1.10	89	Ac	1.1
26	Fe	1.83	58	Ce	1.12	90	Th	1.3
27	Co	1.88	59	Pr	1.13	91	Pa	1.5
28	Ni	1.91	60	Nd	1.14	92	U	1.7
29	Cu	1.90	61	Pm	—	93	Np	1.3
30	Zn	1.65	62	Sm	1.17	94	Pu	1.3
31	Ga	1.81	63	Eu	—			
32	Ge	2.01	64	Gd	1.20			

FORCE CONSTANTS FOR BOND STRETCHING

Representative force constants (f) for stretching of chemical bonds are listed in this table. Except where noted, all force constants are derived from values of the harmonic vibrational frequencies ω_c . Values derived from the observed vibrational fundamentals ν , which are noted by a, are lower than the harmonic force constants, typically by 2 to 3% in the case of heavy atoms (often by 5 to 10% if one of the atoms is hydrogen). Values are given in the SI unit newton per centimeter (N/cm), which is identical to the commonly used cgs unit mdyn/Å.

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Bond	Molecule	f /(N/cm)	Note	Bond	Molecule	f /(N/cm)	Note
H-H	H ₂	5.75			OCS	7.44	
Be-H	BeH	2.27		C-N	CN	16.29	
B-H	BH	3.05			HCN	18.78	
C-H	CH	4.48			CH ₃ CN	18.33	
	CH ₄	5.44	b		CH ₃ NH ₂	5.12	a,c
	C ₂ H ₆	4.83	a,b,c	C-P	CP	7.83	
	CH ₃ CN	5.33	b	Si-Si	Si ₂	2.15	
	CH ₃ Cl	5.02	a,b,c	Si-O	SiO	9.24	
	CCl ₂ =CH ₂	5.57	b	Si-F	SiF	4.90	
	HCN	6.22		Si-Cl	SiCl	2.63	
N-H	NH	5.97		N-N	N ₂	22.95	
O-H	OH	7.80			N ₂ O	18.72	
	H ₂ O	8.45		N-O	NO	15.95	
P-H	PH	3.22			N ₂ O	11.70	
S-H	SH	4.23		P-P	P ₂	5.56	
	H ₂ S	4.28		P-O	PO	9.45	
F-H	HF	9.66		O-O	O ₂	11.77	
Cl-H	HCl	5.16			O ₃	5.74	a
Br-H	HBr	4.12		S-O	SO	8.30	
I-H	HI	3.14			SO ₂	10.33	a
Li-H	LiH	1.03		S-S	S ₂	4.96	
Na-H	NaH	0.78		F-F	F ₂	4.70	
K-H	KH	0.56		Cl-F	ClF	4.48	
Rb-H	RbH	0.52		Br-F	BrF	4.06	
Cs-H	CsH	0.47		Cl-Cl	Cl ₂	3.23	
C-C	C ₂	12.16		Br-Cl	BrCl	2.82	
	CCl ₂ =CH ₂	8.43		Br-Br	Br ₂	2.46	
	C ₂ H ₆	4.50	a,c	I-I	I ₂	1.72	
	CH ₃ CN	5.16		Li-Li	Li ₂	0.26	
C-F	CF	7.42		Li-Na	LiNa	0.21	
	CH ₃ F	5.71	a,c	Na-Na	Na ₂	0.17	
C-Cl	CCl	3.95		Li-F	LiF	2.50	
	CH ₃ Cl	3.44	a,c	Li-Cl	LiCl	1.43	
	CCl ₂ =CH ₂	4.02	b	Li-Br	LiBr	1.20	
C-Br	CH ₃ Br	2.89	a,c	Li-I	LiI	0.97	
C-I	CH ₃ I	2.34	a,c	Na-F	NaF	1.76	
C-O	CO	19.02		Na-Cl	NaCl	1.09	
	CO ₂	16.00		Na-Br	NaBr	0.94	
	OCS	16.14		Na-I	NaI	0.76	
	CH ₃ OH	5.42	a,c	Be-O	BeO	7.51	
C-S	CS	8.49		Mg-O	MgO	3.48	
	CS ₂	7.88		Ca-O	CaO	3.61	

^a Derived from fundamental frequency, without anharmonicity correction.

^b Average of symmetric and antisymmetric (or degenerate) modes.

^c Calculated from Local Symmetry Force Field (see Reference 2).

FUNDAMENTAL VIBRATIONAL FREQUENCIES OF SMALL MOLECULES

This table lists the fundamental vibrational frequencies of selected three-, four-, and five-atom molecules. Both stable molecules and transient free radicals are included. The data have been taken from evaluated sources. In general, the selected values are based on gas-phase infrared, Raman, or ultraviolet spectra; when these were not available, liquid-phase or matrix-isolation spectra were used.

Molecules are grouped by structural type. Within each group, related molecules appear together for convenient comparison.

The vibrational modes are described by their approximate character in terms of stretching, bending, deformation, etc. However, it should be emphasized that most such descriptions are only approximate, and that the true normal mode usually involves a mixture of motions. Abbreviations are:

sym.	symmetric
antisym.	antisymmetric
str.	stretch
deform.	deformation
scis.	scissors
rock.	rocking
deg.	degenerate

In the case of free radicals, strong interactions may exist between the electronic and bending vibrational motions. Details can be found in References 3 and 4. The references should be consulted for information on the accuracy of the data and for data on other molecules not listed here.

All fundamental frequencies (more precisely, wavenumbers) are given in units of cm^{-1} .

XY₂ Molecules Point groups D_{∞h}(linear) and C_{2v}(bent)

Molecule	Structure	Sym. str.	Bend	Antisym. str.
CO ₂	Linear	1333	667	2349
CS ₂	Linear	658	397	1535
C ₃	Linear	1224	63	2040
CNC	Linear		321	1453
NCN	Linear	1197	423	1476
BO ₂	Linear	1056	447	1278
BS ₂	Linear	510	120	1015
KrF ₂	Linear	449	233	590
XeF ₂	Linear	515	213	555
XeCl ₂	Linear	316		481
H ₂ O	Bent	3657	1595	3756
D ₂ O	Bent	2671	1178	2788
F ₂ O	Bent	928	461	831
Cl ₂ O	Bent	639	296	686
O ₃	Bent	1103	701	1042
H ₂ S	Bent	2615	1183	2626
D ₂ S	Bent	1896	855	1999
SF ₂	Bent	838	357	813
SCl ₂	Bent	525	208	535
SO ₂	Bent	1151	518	1362
H ₂ Se	Bent	2345	1034	2358
D ₂ Se	Bent	1630	745	1696
NH ₂	Bent	3219	1497	3301
NO ₂	Bent	1318	750	1618
NF ₂	Bent	1075	573	942
ClO ₂	Bent	945	445	1111
CH ₂	Bent		963	
CD ₂	Bent		752	
CF ₂	Bent	1225	667	1114
CCl ₂	Bent	721	333	748
CBr ₂	Bent	595	196	641
SiH ₂	Bent	2032	990	2022
SiD ₂	Bent	1472	729	1468
SiF ₂	Bent	855	345	870

FUNDAMENTAL VIBRATIONAL FREQUENCIES OF SMALL MOLECULES (continued)

Molecule	Structure	Sym. str.	Bend	Antisym. str.
SiCl ₂	Bent	515		505
SiBr ₂	Bent	403		400
GeH ₂	Bent	1887	920	1864
GeCl ₂	Bent	399	159	374
SnF ₂	Bent	593	197	571
SnCl ₂	Bent	352	120	334
SnBr ₂	Bent	244	80	231
PbF ₂	Bent	531	165	507
PbCl ₂	Bent	314	99	299
ClF ₂	Bent	500		576

XYZ Molecules
Point Groups C_{∞v} (linear) and C_s (bent)

Molecule	Structure	XY str.	Bend	YZ str.
HCN	Linear	3311	712	2097
DCN	Linear	2630	569	1925
FCN	Linear	1077	451	2323
CICN	Linear	744	378	2216
BrCN	Linear	575	342	2198
ICN	Linear	486	305	2188
CCN	Linear	1060	230	1917
CCO	Linear	1063	379	1967
HCO	Bent	2485	1081	1868
HCC	Linear	3612		1848
OCS	Linear	2062	520	859
NCO	Linear	1270	535	1921
NNO	Linear	2224	589	1285
HNB	Linear	3675		2035
HNC	Linear	3653		2032
HNSi	Linear	3583	523	1198
HBO	Linear		754	1817
FBO	Linear		500	2075
CIBO	Linear	676	404	1958
BrBO	Linear	535	374	1937
FNO	Bent	766	520	1844
CINO	Bent	596	332	1800
BrNO	Bent	542	266	1799
HNF	Bent		1419	1000
HNO	Bent	2684	1501	1565
HPO	Bent	2095	983	1179
HOF	Bent	3537	886	1393
HOCl	Bent	3609	1242	725
HOO	Bent	3436	1392	1098
FOO	Bent	579	376	1490
ClOO	Bent	407	373	1443
BrOO	Bent			1487
HSO	Bent		1063	1009
NSF	Bent	1372	366	640
NSCl	Bent	1325	273	414
HCF	Bent		1407	1181
HCCl	Bent		1201	815
HSiF	Bent	1913	860	834
HSiCl	Bent		808	522
HSiBr	Bent	1548	774	408

FUNDAMENTAL VIBRATIONAL FREQUENCIES OF SMALL MOLECULES (continued)

**Symmetric XY₃ Molecules
Point Groups D_{3h} (planar) and C_{3v} (pyramidal)**

Molecule	Structure	Sym. str.	Sym. deform.	Deg. str.	Deg. deform.
NH ₃	Pyram.	3337	950	3444	1627
ND ₃	Pyram.	2420	748	2564	1191
PH ₃	Pyram.	2323	992	2328	1118
AsH ₃	Pyram.	2116	906	2123	1003
SbH ₃	Pyram.	1891	782	1894	831
NF ₃	Pyram.	1032	647	907	492
PF ₃	Pyram.	892	487	860	344
AsF ₃	Pyram.	741	337	702	262
PCl ₃	Pyram.	504	252	482	198
PI ₃	Pyram.	303	111	325	79
AsI ₃	Pyram.	219	94	224	71
AlCl ₃	Pyram.	375	183	595	150
SO ₃	Planar	1065	498	1391	530
BF ₃	Planar	888	691	1449	480
BH ₃	Planar		1125	2808	1640
CH ₃	Planar		606	3161	1396
CD ₃	Planar		453	2369	1029
CF ₃	Pyram.	1090	701	1260	510
SiF ₃	Pyram.	830	427	937	290

**Linear XYYX Molecules
Point Group D_{∞h}**

Molecule	Sym. XY str.	Antisym. XY str.	YY str.	Bend	Bend
C ₂ H ₂	3374	3289	1974	612	730
C ₂ D ₂	2701	2439	1762	505	537
C ₂ N ₂	2330	2158	851	507	233

**Planar X₂YZ Molecules
Point Group C_{2v}**

Molecule	Sym.XY str.	YZ str.	YX ₂ scis.	Antisym. XY str.	YX ₂ rock	YX ₂ wag
H ₂ CO	2783	1746	1500	2843	1249	1167
D ₂ CO	2056	1700	1106	2160	990	938
F ₂ CO	965	1928	584	1249	626	774
Cl ₂ CO	567	1827	285	849	440	580
O ₂ NF	1310	822	568	1792	560	742
O ₂ NCl	1286	793	370	1685	408	652

**Tetrahedral XY₄ Molecules
Point Group T_d**

Molecule	Sym. str.	Deg. deform.(e)	Deg. str.(f)	Deg. deform.(f)
CH ₄	2917	1534	3019	1306
CD ₄	2109	1092	2259	996
CF ₄	909	435	1281	632
CCl ₄	459	217	776	314

FUNDAMENTAL VIBRATIONAL FREQUENCIES OF SMALL MOLECULES (continued)

Molecule	Sym. str.	Deg. deform.(e)	Deg. str.(f)	Deg. deform.(f)
CBr ₄	267	122	672	182
Cl ₄	178	90	555	125
SiH ₄	2187	975	2191	914
SiD ₄	1558	700	1597	681
SiF ₄	800	268	1032	389
SiCl ₄	424	150	621	221
GeH ₄	2106	931	2114	819
GeD ₄	1504	665	1522	596
GeCl ₄	396	134	453	172
SnCl ₄	366	104	403	134
TiCl ₄	389	114	498	136
ZrCl ₄	377	98	418	113
HfCl ₄	382	102	390	112
RuO ₄	885	322	921	336
OsO ₄	965	333	960	329

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SPECTROSCOPIC CONSTANTS OF DIATOMIC MOLECULES

This table lists the leading spectroscopic constants and equilibrium internuclear distance r_e in the ground electronic state for selected diatomic molecules. The constants are those describing the vibrational and rotational energy through the expressions:

$$E_{\text{vib}}/hc = \omega_e(v+1/2) - \omega_e x_e(v+1/2)^2 + \dots$$

$$E_{\text{rot}}/hc = B_v J(J+1) - D_v [J(J+1)]^2 + \dots$$

where

$$B_v = B_e - \alpha_e(v+1/2) + \dots$$

$$D_v = D_e + \dots$$

Here v and J are the vibrational and rotational quantum numbers, respectively, h is Planck's constant, and c is the speed of light. In this customary formulation the constants ω_e , B_e , etc. have dimensions of inverse length; in this table they are given in units of cm^{-1} .

Users should note that higher order terms in the above energy expressions are required for very precise calculations; constants for many of these terms can be found in the references. Also, if the ground electronic state is not $^1\Sigma$, additional terms are needed to account for the interaction between electronic and pure rotational angular momentum. For some molecules in the table the data have been analyzed in terms of the Dunham series expansion:

$$E/hc = \sum_{lm} Y_{lm}(v+1/2)^l J^m(J+1)^m$$

In such cases it has been assumed that $Y_{10} = \omega_e$, $Y_{01} = B_e$, etc., although in the highest approximations these identities are not precisely correct. Some of the values of r_e in the table have been corrected for breakdown of the Born-Oppenheimer approximation, which can affect the last decimal place. Because of differences in the method of data analysis and limitations in the model, care should be taken in comparing r_e values for different molecules to a precision beyond 0.001 Å.

Molecules are listed in alphabetical order by formula as written in the most common form. In most cases this form places the more electropositive element first, but there are exceptions such as OH, NH, CH, etc.

* Indicates a value for the interval between $v = 0$ and $v = 1$ states instead of a value of ω_e .

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Molecule	State	ω_e cm^{-1}	$\omega_e x_e$ cm^{-1}	B_e cm^{-1}	α_e cm^{-1}	D_e 10^{-6}cm^{-1}	r_e Å
¹⁰⁷ Ag ⁷⁹ Br	¹ Σ ⁺	249.57	0.63	0.064833	0.0002361	0.0175	2.39311
¹⁰⁷ Ag ³⁵ Cl	¹ Σ ⁺	343.49	1.17	0.12298388	0.00059541	0.06305	2.28079
¹⁰⁷ Ag ¹⁹ F	¹ Σ ⁺	513.45	2.59	0.2657020	0.0019206	0.284	1.98318
¹⁰⁷ Ag ¹ H	¹ Σ ⁺	1759.9	34.06	6.449	0.201	344	1.618
¹⁰⁷ Ag ² H	¹ Σ ⁺	1250.70	17.17	3.2572	0.0722	85.9	1.6180
¹⁰⁷ Ag ¹²⁷ I	¹ Σ ⁺	206.50	0.46	0.04486821	0.0001414	0.00847	2.54463
¹⁰⁷ Ag ¹⁶ O	² Π _{1/2}	490.2	3.1	0.3020	0.0025	0.45	2.003
²⁷ Al ₂	³ Σ _g ⁻	350.01	2.02	0.2054	0.0012	0.31	2.466
²⁷ Al ⁷⁹ Br	¹ Σ ⁺	378.0	1.28	0.15919713	0.00086045	0.11285	2.29481
²⁷ Al ³⁵ Cl	¹ Σ ⁺	481.30	1.95	0.24393012	0.00161113	0.2503	2.13011
²⁷ Al ¹⁹ F	¹ Σ ⁺	802.3	4.77	0.5524798	0.0049841	1.0464	1.65437
²⁷ Al ¹ H	¹ Σ ⁺	1682.56	29.09	6.3907	0.1858	356.5	1.6478
²⁷ Al ² H	¹ Σ ⁺	1211.95	15.14	3.3186	0.0697	97	1.6463
²⁷ Al ¹²⁷ I	¹ Σ ⁺	316.1	1.0	0.11769985	0.00055859		2.53710
²⁷ Al ¹⁶ O	² Σ ⁺	979.23	6.97	0.6414	0.0058	1.08	1.6179
²⁷ Al ³² S	² Σ ⁺	617.1	3.33	0.2799	0.0018	0.22	2.029
⁷⁵ As ₂	¹ Σ _g ⁺	429.55	1.12	0.10179	0.000333		2.1026
⁷⁵ As ¹ H	³ Σ ⁻	2130*		7.3067	0.2117	327	1.52315
⁷⁵ As ² H	³ Σ ⁻	1484*		3.6688		90	1.5306
⁷⁵ As ¹⁴ N	¹ Σ ⁺	1068.54	5.41	0.54551	0.003366	0.53	1.6184
⁷⁵ As ¹⁶ O	² Π _{1/2}	967.08	4.85	0.48482	0.003299	0.49	1.6236

SPECTROSCOPIC CONSTANTS OF DIATOMIC MOLECULES (continued)

Molecule	State	ω_e cm ⁻¹	$\omega_e x_e$ cm ⁻¹	B_e cm ⁻¹	α_e cm ⁻¹	D_e 10 ⁻⁶ cm ⁻¹	r_e Å
¹⁹⁷ Au ₂	1Σ _g ⁺	190.9	0.42	0.028013	0.0000723	0.00250	2.4719
¹⁹⁷ Au ¹ H	1Σ ⁺	2305.01	43.12	7.2401	0.2136	279	1.5239
¹⁹⁷ Au ² H	1Σ ⁺	1634.98	21.65	3.6415	0.07614	70.9	1.5238
¹¹ B ₂	3Σ _g ⁻	1051.3	9.35	1.212	0.014		1.590
¹¹ B ⁷⁹ Br	1Σ ⁺	684.31	3.52	0.4894	0.0035	1.00	1.888
¹¹ B ³⁵ Cl	1Σ ⁺	840.29	5.49	0.684282	0.006812	1.84	1.71528
¹¹ B ¹⁹ F	1Σ ⁺	1402.1	11.8	1.516950	0.019056	7.105	1.26267
¹¹ B ¹ H	1Σ ⁺	2366.9	49.40	12.021	0.412	1242	1.2324
¹¹ B ² H	1Σ ⁺	1703.3	28	6.54	0.17	400	1.2324
¹¹ B ¹⁴ N	3Π	1514.6	12.3	1.666	0.025	8.1	1.281
¹¹ B ¹⁶ O	2Σ ⁺	1885.69	11.81	1.7820	0.0166	6.32	1.2045
¹¹ B ³² S	2Σ ⁺	1180.17	6.31	0.7949	0.0061	1.40	1.6092
¹³⁸ Ba ⁷⁹ Br	2Σ ⁺	193.77	0.41	0.0415082	0.0001219	0.00762	2.84449
¹³⁸ Ba ³⁵ Cl	2Σ ⁺	279.92	0.82	0.08396717	0.00033429	0.03022	2.68276
¹³⁸ Ba ¹⁹ F	2Σ ⁺	468.9	1.79	0.2159	0.0012	0.175	2.163
¹³⁸ Ba ¹ H	2Σ ⁺	1168.31	14.50	3.38285	0.06599	112.67	2.23175
¹³⁸ Ba ² H	2Σ ⁺	829.77	7.32	1.7071	0.02363	28.77	2.2304
¹³⁸ Ba ¹²⁷ I	2Σ ⁺	152.14	0.27	0.02680587	0.00006634	0.00333	3.08476
¹³⁸ Ba ¹⁶ O	1Σ ⁺	669.76	2.03	0.3126140	0.0013921	0.2724	1.93969
¹³⁸ Ba ³² S	1Σ ⁺	379.42	0.88	0.10331	0.0003188	0.0306	2.5074
⁹ Be ¹⁹ F	2Σ ⁺	1247.36	9.12	1.4889	0.0176	8.28	1.3610
⁹ Be ¹ H	2Σ ⁺	2060.78	36.31	10.3164	0.3030	1022.1	1.3426
⁹ Be ² H	2Σ ⁺	1530.32	20.71	5.6872	0.1225	313.8	1.3419
⁹ Be ¹⁶ O	1Σ ⁺	1487.32	11.83	1.6510	0.0190	8.20	1.3309
⁹ Be ³² S	1Σ ⁺	997.94	6.14	0.79059	0.00664	2.00	1.7415
²⁰⁹ Bi ₂	1Σ _g ⁺	172.71	0.34	0.022781	0.000055	0.00150	2.6596
²⁰⁹ Bi ¹ H	3Σ ⁻	1635.73	31.6	5.137	0.148	183	1.805
²⁰⁹ Bi ² H	3Σ ⁻	1173.32	16.1	2.592	0.054	50.6	1.804
⁷⁹ Br ₂	1Σ _g ⁺	325.32	1.08	0.082107	0.0003187	0.02092	2.2811
⁷⁹ Br ³⁵ Cl	1Σ ⁺	444.28	1.84	0.152470	0.000770	0.07183	2.13607
⁷⁹ Br ¹⁹ F	1Σ ⁺	670.75	4.05	0.35584	0.00261	0.401	1.75894
⁷⁹ Br ¹⁶ O	2Π _{3/2}	779	6.8	0.429598	0.003639	0.523	1.717
¹² C ₂	1Σ _g ⁺	1854.71	13.34	1.8198	0.0177	6.92	1.2425
¹² C ³⁵ Cl	2Π _{1/2}	866.72*	6.2	0.6936	0.00672	1.9	1.6450
¹² C ¹⁹ F	2Π _{1/2}	1308.1	11.10	1.4172	0.0184	6.5	1.2718
¹² C ¹ H	2Π _{1/2}	2858.5	63.0	14.457	0.534	1450	1.1199
¹² C ² H	2Π _{1/2}	2099.8	34.02	7.806	0.208	420	1.1190
¹² C ¹⁴ N	2Σ ⁺	2068.59	13.09	1.8997830	0.0173717	6.4034	1.17181
¹² C ¹⁶ O	1Σ ⁺	2169.81	13.29	1.93128075	0.01750390	6.1216	1.12823
¹² C ³¹ P	2Σ ⁺	1239.67	6.86	0.7986	0.00597	1.33	1.562
¹² C ³² S	1Σ ⁺	1285.15	6.50	0.8200434	0.0059182	1.336	1.53482
¹² C ⁸⁰ Se	1Σ ⁺	1035.36	4.86	0.5750	0.00379	0.71	1.67609
⁴⁰ Ca ³⁵ Cl	2Σ ⁺	367.53	1.31	0.1522302	0.0007990	0.1029	2.43676
⁴⁰ Ca ¹⁹ F	2Σ ⁺	581.1	2.74	0.339	0.0026	0.45	1.967
⁴⁰ Ca ¹ H	2Σ ⁺	1298.34	19.10	4.2766	0.0970	183.7	2.0025
⁴⁰ Ca ² H	2Σ ⁺	910*		2.1769	0.035	47.9	2.002
⁴⁰ Ca ¹²⁷ I	2Σ ⁺	238.70	0.63	0.0693263	0.0002634	0.0234	2.82859
⁴⁰ Ca ¹⁶ O	1Σ ⁺	732.03	4.83	0.444441	0.003282	0.6541	1.8221
⁴⁰ Ca ³² S	1Σ ⁺	462.23	1.78	0.1766757	0.0008270	0.1032	2.31775
¹¹⁴ Cd ¹ H	2Σ ⁺	1337.1*		5.323		314	1.781
¹¹⁴ Cd ² H	2Σ ⁺			2.704		76	1.775
³⁵ Cl ₂	1Σ _g ⁺	559.7	2.68	0.2440	0.0015	0.186	1.988
³⁵ Cl ¹⁹ F	1Σ ⁺	786.15	6.16	0.516479	0.004358	0.88	1.62831
³⁵ Cl ¹⁶ O	2Π _{3/2}	853.8	5.5	0.62345	0.0058	1.33	1.56963
⁵² Cr ¹ H	6Σ ⁺	1581*	32	6.220	0.179	347	1.656
⁵² Cr ² H	6Σ ⁺	1182*		3.14		88.8	1.664
⁵² Cr ¹⁶ O	5Π	898.4	6.8	0.5231	0.0070		1.615
¹³³ Cs ₂	1Σ _g ⁺	42.02	0.08	0.0127	0.0000264	0.00464	4.47

SPECTROSCOPIC CONSTANTS OF DIATOMIC MOLECULES (continued)

Molecule	State	ω_e cm ⁻¹	$\omega_e x_e$ cm ⁻¹	B_e cm ⁻¹	α_e cm ⁻¹	D_e 10 ⁻⁶ cm ⁻¹	r_e Å
¹³³ Cs ⁷⁹ Br	1Σ ⁺	149.66	0.37	0.03606925	0.00012401	0.00838	3.07225
¹³³ Cs ³⁵ Cl	1Σ ⁺	214.17	0.73	0.07209149	0.00033756	0.03268	2.90627
¹³³ Cs ¹⁹ F	1Σ ⁺	352.56	1.62	0.18436969	0.0011756	0.20168	1.34535
¹³³ Cs ¹ H	1Σ ⁺	891.0	12.9	2.7099	0.0579	113	2.4938
¹³³ Cs ² H	1Σ ⁺	619.1*		1.354		20	2.505
¹³³ Cs ¹²⁷ I	1Σ ⁺	119.18	0.25	0.02362736	0.00006826	0.00371	3.31519
¹³³ Cs ¹⁶ O	2Σ ⁺	357.5*		0.223073	0.001303	0.348	2.3007
⁶³ Cu ₂	1Σ _g ⁺	264.55	1.02	0.10874	0.000614	0.0716	2.2197
⁶³ Cu ⁷⁹ Br	1Σ ⁺	314.8	0.96	0.10192625	0.00045214	0.04274	2.17344
⁶⁵ Cu ³⁵ Cl	1Σ ⁺	415.29	1.58	0.17628802	0.00099647	0.12706	2.05118
⁶³ Cu ¹⁹ F	1Σ ⁺	622.7	3.95	0.3794029	0.0032298	0.563	1.74493
⁶³ Cu ¹ H	1Σ ⁺	1941.26	37.51	7.9441	0.2563	520	1.46263
⁶³ Cu ² H	1Σ ⁺	1384.14	18.97	4.0381	0.0917	136.2	1.4626
⁶³ Cu ¹²⁷ I	1Σ ⁺	264.5	0.60	0.07328742	0.00028390	0.02244	2.33832
⁶³ Cu ¹⁶ O	2Π _{3/2}	640.17	4.43	0.44454	0.00456	0.85	1.7244
⁶³ Cu ³² S	2Π _{3/2}	415.0	1.75	0.1891	0.001891	0.18	2.051
¹⁹ F ₂	1Σ _g ⁺	916.64	11.24	0.89019	0.013847	3.3	1.41193
⁵⁶ Fe ¹⁶ O	5Δ	965*		0.650		0.72	1.444
⁶⁹ Ga ⁸¹ Br	1Σ ⁺	263.0	0.81	0.081839	0.0003207	0.032	2.35248
⁶⁹ Ga ³⁵ Cl	1Σ ⁺	365.67	1.25	0.1499046	0.0007936	0.1008	2.20169
⁶⁹ Ga ¹⁹ F	1Σ ⁺	622.2	3.2	0.3595161	0.0028642	0.50	1.77437
⁶⁹ Ga ¹ H	1Σ ⁺	1604.52	28.77	6.137	0.181	342	1.663
⁶⁹ Ga ² H	1Σ ⁺			3.083	0.06	84	1.663
⁶⁹ Ga ¹²⁷ I	1Σ ⁺	216.38	0.47	0.0569359	0.0001897	0.015770	2.57464
⁶⁹ Ga ¹⁶ O	2Σ	767.5	6.24	0.4271		0.37	1.744
⁷⁴ Ge ⁷⁹ Br	2Π _{1/2}	295	0.7				
⁷⁴ Ge ³⁵ Cl	2Π _{1/2}	407.6	1.36				
⁷² Ge ¹ H	2Π _{1/2}	1833.77	37	6.726	0.192	326	1.5880
⁷² Ge ² H	2Π _{1/2}	1320.09	19	3.415	0.070	83.2	1.5874
⁷⁴ Ge ¹⁶ O	1Σ ⁺	986.49	4.47	0.4856981	0.0030787	0.4709	1.62464
⁷⁴ Ge ³² S	1Σ ⁺	575.8	1.80	0.18656576	0.00074910	0.07883	2.01209
⁷⁴ Ge ⁸⁰ Se	1Σ ⁺	408.7	1.36	0.09634051	0.00028904	0.02207	2.13463
⁷⁴ Ge ¹³⁰ Te	1Σ ⁺	323.9	0.75	0.06533821	0.00017246	0.012	2.34017
¹ H ₂	1Σ _g ⁺	4401.21	121.34	60.853	3.062	47100	0.74144
² H ₂	1Σ _g ⁺	3115.50	61.82	30.444	1.0786	11410	0.74152
³ H ₂	1Σ _g ⁺	2546.5	41.23	20.335	0.5887		0.74142
¹ H ⁸¹ Br	1Σ ⁺	2648.97	45.22	8.46488	0.23328	345.8	1.41444
² H ⁸¹ Br	1Σ ⁺	1884.75	22.72	4.245596	0.084	88.32	1.4145
¹ H ³⁵ Cl	1Σ ⁺	2990.95	52.82	10.59342	0.30718	531.94	1.27455
² H ³⁵ Cl	1Σ ⁺	2145.16	27.18	5.448796	0.113292	140	1.27458
¹ H ¹⁹ F	1Σ ⁺	4138.32	89.88	20.9557	0.798	2151	0.91681
² H ¹⁹ F	1Σ ⁺	2998.19	45.76	11.0102	0.3017	594	0.91694
¹ H ¹²⁷ I	1Σ ⁺	2309.01	39.64	6.4263650	0.1689	206.9	1.60916
²⁰² Hg ¹ H	2Σ ⁺	1203.24*		5.3888		395.3	1.7662
²⁰² Hg ² H	2Σ ⁺	896.12*		2.739		91	1.757
¹²⁷ I ₂	1Σ _g ⁺	214.50	0.61	0.03737	0.000114	0.0043	2.666
¹²⁷ I ⁷⁹ Br	1Σ ⁺	268.64	0.81	0.0568325	0.0001969	0.0102	2.46899
¹²⁷ I ³⁵ Cl	1Σ ⁺	384.29	1.50	0.1141587	0.0005354	0.0403	2.32088
¹²⁷ I ¹⁹ F	1Σ ⁺	610.24	3.12	0.2797111	0.0018738	0.2356	1.90976
¹²⁷ I ¹⁶ O	2Π _{3/2}	681.5	4.3	0.34026	0.00270	0.36	1.8676
¹¹⁵ In ⁸¹ Br	1Σ ⁺	221.0	0.65	0.05489468	0.00018672	0.01350	2.54315
¹¹⁵ In ³⁵ Cl	1Σ ⁺	317.39	1.03	0.1090583	0.0005177	0.0515	2.40117
¹¹⁵ In ¹⁹ F	1Σ ⁺	535.4	2.6	0.2623241	0.0018798	0.252	1.98540
¹¹⁵ In ¹ H	1Σ ⁺	1476.0	25.61	4.995	0.143	223	1.8380
¹¹⁵ In ² H	1Σ ⁺	1048.2	12.4	2.523	0.051	58	1.837
¹¹⁵ In ¹²⁷ I	1Σ ⁺	177.08	0.34	0.03686702	0.00010411	0.00639	2.75364
³⁹ K ₂	1Σ _g ⁺	92.02	0.28	0.056743	0.000165	0.0863	3.9051
³⁹ K ⁷⁹ Br	1Σ ⁺	213	0.80	0.08122109	0.00040481	0.04462	2.82078

SPECTROSCOPIC CONSTANTS OF DIATOMIC MOLECULES (continued)

Molecule	State	ω_e cm ⁻¹	$\omega_e x_e$ cm ⁻¹	B_e cm ⁻¹	α_e cm ⁻¹	D_e 10 ⁻⁶ cm ⁻¹	r_e Å
³⁹ K ³⁵ Cl	1 Σ^+	281	1.30	0.1286348	0.0007899	0.1087	2.66665
³⁹ K ¹⁹ F	1 Σ^+	426.26	2.45	0.27993741	0.00233492	0.4829	2.17146
³⁹ K ¹ H	1 Σ^+	983.6	14.3	3.416400	0.085313	163.55	2.243
³⁹ K ² H	1 Σ^+	707	7.7	1.754	0.0318	50	2.240
³⁹ K ¹²⁷ I	1 Σ^+	186.53	0.57	0.06087473	0.00026776	0.02593	3.04784
¹³⁹ La ¹⁶ O	2 Σ^+	812.8	2.22	0.35252001	0.00142365	0.2626	1.82591
⁷ Li ₂	1 Σ_g^+	351.43	2.61	0.67264	0.00704	9.87	2.6729
⁷ Li ⁷⁹ Br	1 Σ^+	563.2	3.5	0.555399	0.005644	2.159	2.17043
⁷ Li ³⁵ Cl	1 Σ^+	642.95	4.47	0.7065225	0.0080102	3.409	2.02067
⁷ Li ¹⁹ F	1 Σ^+	910.57	8.21	1.3452583	0.0202887	11.745	1.56386
⁷ Li ¹ H	1 Σ^+	1405.65	23.20	7.51373	0.21665	862	1.59490
⁷ Li ² H	1 Σ^+	1054.80	12.94	4.23310	0.09155	276	1.5941
⁷ Li ¹²⁷ I	1 Σ^+	496.85	2.85	0.4431766	0.0040862	1.4104	2.39192
⁷ Li ¹⁶ O	2 Π	814.62	7.78	1.212830	0.017899	0.1079	1.68822
²⁴ Mg ₂	1 Σ_g^+	51.12	1.64	0.09287	0.00378	1.22	3.891
²⁴ Mg ³⁵ Cl	2 Σ^+	462.12*	2.1	0.2456154	0.0016204	0.2723	2.19639
²⁴ Mg ¹⁹ F	2 Σ^+	711.69*	4.9	0.51922	0.00470	1.080	1.7500
²⁴ Mg ¹ H	2 Σ^+	1495.20	31.89	5.8257	0.1859	344	1.7297
²⁴ Mg ² H	2 Σ^+	1077.9	16.1	3.0306	0.06289	92	1.7302
²⁴ Mg ¹⁶ O	1 Σ^+	784.78	5.26	0.57470436	0.00532377	1.2328	1.74838
⁵⁵ Mn ¹ H	7 Σ	1548.0	28.8	5.6841	0.1570	303.9	1.7311
⁵⁵ Mn ² H	7 Σ	1103	13.9	2.8957	0.051	79.5	1.7310
¹⁴ N ₂	1 Σ_g^+	2358.57	14.32	1.99824	0.017318	5.76	1.09769
¹⁴ N ⁷⁹ Br	3 Σ^-	691.75	4.72	0.444	0.0040		1.79
¹⁴ N ³⁵ Cl	3 Σ^-	827.96	5.30	0.649770	0.006414	1.598	1.61071
¹⁴ N ¹⁹ F	3 Σ^-	1141.37	8.99	1.2057	0.01492	5.39	1.3170
¹⁴ N ¹ H	3 Σ^-	3282.3	78.4	16.6993	0.6490	1709.7	1.0362
¹⁴ N ² H	3 Σ^-	2398	42	8.7913	0.2531	490.4	1.0361
¹⁴ N ¹⁶ O	2 $\Pi_{1/2}$	1904.20	14.07	1.67195	0.0171	0.5	1.15077
¹⁴ N ³² S	2 $\Pi_{1/2}$	1218.7	7.28	0.769602	0.0064	1.2	1.4940
²³ Na ₂	1 Σ_g^+	159.13	0.72	0.154707	0.008736	0.581	3.0789
²³ Na ⁷⁹ Br	1 Σ^+	302	1.5	0.1512533	0.0009410	0.1554	2.50204
²³ Na ³⁵ Cl	1 Σ^+	366	2.05	0.2180631	0.0016248	0.3120	2.36080
²³ Na ¹⁹ F	1 Σ^+	535.66	3.57	0.4369011	0.0045580	1.163	1.92595
²³ Na ¹ H	1 Σ^+	1172.2	19.72	4.9033634	0.1370919	343.40	1.88654
²³ Na ² H	1 Σ^+	826.1*		2.557089	0.051600	93.46	1.88654
²³ Na ¹²⁷ I	1 Σ^+	258	1.1	0.1178056	0.0006478	0.0973	2.71145
²³ Na ¹⁶ O	2 Π	492.3		0.424630	0.004506	1.2638	2.05155
⁹³ Nb ¹⁶ O	4 Σ^-	989.0	3.8	0.4321	0.0021	0.22	1.691
⁵⁸ Ni ¹ H	2 $\Delta_{5/2}$	1926.6	38	7.700	0.23	481	1.476
⁵⁸ Ni ² H	2 $\Delta_{5/2}$	1390.1	19	3.992	0.092	130	1.465
¹⁶ O ₂	3 Σ_g^-	1580.19	11.98	1.44563	0.0159	4.839	1.20752
¹⁶ O ¹ H	2 $\Pi_{3/2}$	3737.76	84.88	18.911	0.7242	1938	0.96966
¹⁶ O ² H	2 $\Pi_{3/2}$	2720.24	44.05	10.021	0.276	537.4	0.9698
³¹ P ₂	1 Σ_g^+	780.77	2.84	0.30362	0.00149	0.188	1.8934
³¹ P ³⁵ Cl	3 Σ^-	551.38	2.23	0.2528748	0.0015119	0.2124	2.01461
³¹ P ¹⁹ F	3 Σ^-	846.75	4.49	0.5665	0.00456		1.58938
³¹ P ¹ H	3 Σ^-	2365.2	44.5	8.5371	0.2514	436	1.42140
³¹ P ² H	3 Σ^-	1699.2	23.0	4.4081	0.0928	116	1.4220
³¹ P ¹⁴ N	1 Σ^+	1337.24	6.98	0.7864854	0.0055364	1.091	1.49087
³¹ P ¹⁶ O	2 $\Pi_{1/2}$	1233.34	6.56	0.7337	0.0055	1.3	1.4759
²⁰⁸ Pb ₂		110.5	0.35				
²⁰⁸ Pb ⁷⁹ Br	2 $\Pi_{1/2}$	207.5	0.50				
²⁰⁸ Pb ³⁵ Cl	2 $\Pi_{1/2}$	303.9	0.88				
²⁰⁸ Pb ¹⁹ F	2 $\Pi_{1/2}$	502.73	2.28	0.22875	0.001473	0.183	2.0575
²⁰⁸ Pb ¹ H	2 $\Pi_{1/2}$	1564.1	29.75	4.971	0.144	201	1.839
²⁰⁸ Pb ¹⁶ O	1 Σ^+	720.96	3.52	0.30730373	0.00190977	0.2138	1.92181
²⁰⁸ Pb ³² S	1 Σ^+	429.17	1.26	0.11632307	0.00043510	0.03418	2.28678

SPECTROSCOPIC CONSTANTS OF DIATOMIC MOLECULES (continued)

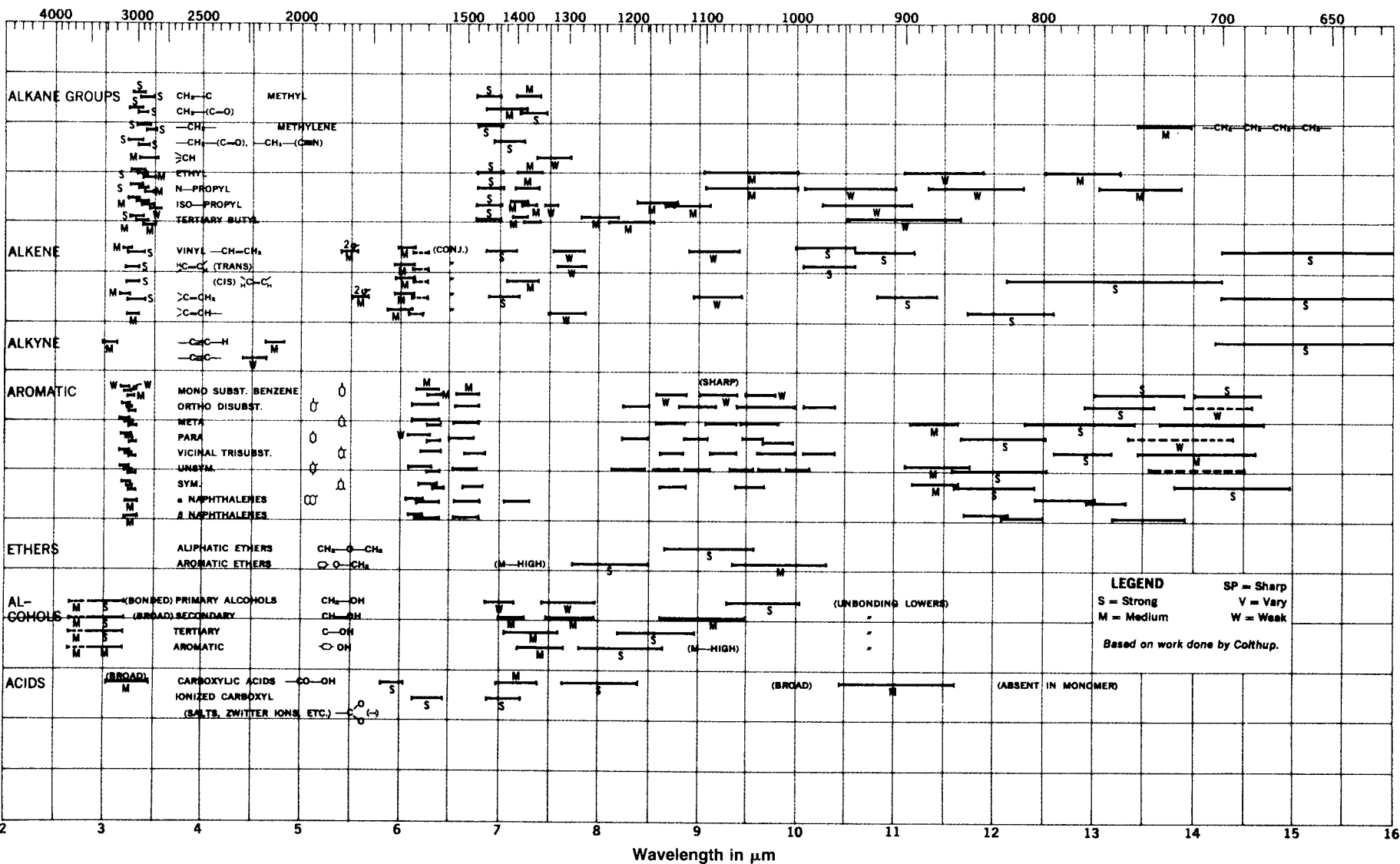
Molecule	State	ω_e cm ⁻¹	$\omega_e x_e$ cm ⁻¹	B_e cm ⁻¹	α_e cm ⁻¹	D_e 10 ⁻⁶ cm ⁻¹	r_e Å
²⁰⁸ Pb ⁸⁰ Se	1 Σ^+	277.6	0.51	0.05059953	0.00012993	0.0070	2.40218
²⁰⁸ Pb ¹³⁰ Te	1 Σ^+	212.0	0.43	0.03130774	0.00006743	0.0027	2.59492
¹⁹⁵ Pt ¹² C	1 Σ^+	1051.13	4.86	0.53044	0.003273	0.546	1.6767
¹⁹⁵ Pt ¹ H	2 $\Delta_{5/2}$	2294.68*	46	7.1963	0.1996	261	1.52852
¹⁹⁵ Pt ² H	2 $\Delta_{5/2}$	1644.3*	23	3.640	0.071	66	1.524
⁸⁵ Rb ⁷⁹ Br	1 Σ^+	169.46	0.46	0.04752798	0.00018596	0.01496	2.94474
⁸⁵ Rb ³⁵ Cl	1 Σ^+	228	0.92	0.0876404	0.0004537	0.04947	2.78673
⁸⁵ Rb ¹⁹ F	1 Σ^+	376	1.9	0.2106640	0.0015228	0.2684	2.27033
⁸⁵ Rb ¹ H	1 Σ^+	936.9	14.21	3.020	0.072	123	2.367
⁸⁵ Rb ¹²⁷ I	1 Σ^+	138.51	0.33	0.03283293	0.00010946	0.00738	3.17688
⁸⁵ Rb ¹⁶ O	2 Σ^+	388.4*		0.246481	0.002174	0.397	2.25420
³² S ₂	3 Σ_g^-	725.65	2.84	0.2955	0.001570	0.19	1.8892
³² S ¹⁹ F	2 $\Pi_{3/2}$			0.552174			1.60058
³² S ¹ H	2 $\Pi_{3/2}$	2711.6	59.9	9.5995	0.2785	480.6	1.34066
³² S ² H	2 $\Pi_{3/2}$	1885	31	4.95130	0.10308	130	1.34049
³² S ¹⁶ O	3 Σ^-	1149.2	5.6	0.7208171	0.005737	1.134	1.48109
¹²¹ Sb ³⁵ Cl	3 Σ^-	374.7	0.6				
¹²¹ Sb ¹⁹ F	3 Σ^-	605.0	2.6	0.2792	0.0020	0.23	1.918
¹²¹ Sb ¹ H	3 Σ^-			5.684		240	1.723
¹²¹ Sb ² H	3 Σ^-			2.8782		45	1.7194
¹²¹ Sb ¹⁴ N	1 Σ^+	942.0	5.6				
¹²¹ Sb ¹⁶ O	2 $\Pi_{1/2}$	816	4.2	0.3580	0.0022	0.270	1.826
⁴⁵ Sc ¹⁹ F	1 Σ^+	735.6	3.8	0.3950	0.00266		1.788
⁸⁰ Se ₂	3 Σ_g^-	385.30	0.96	0.08992	0.000288	0.024	2.166
⁸⁰ Se ¹ H	2 $\Pi_{3/2}$	2400*		8.02	0.23	330	1.48
⁸⁰ Se ² H	2 $\Pi_{3/2}$	1708*		3.94			1.48
⁸⁰ Se ¹⁶ O	3 Σ^-	914.69	4.52	0.4655	0.00323	0.5	1.648
²⁸ Si ₂	3 Σ_g^-	510.98	2.02	0.2390	0.0014	0.21	2.246
²⁸ Si ³⁵ Cl	2 $\Pi_{1/2}$	535.60	2.17	0.2561	0.0016	0.25	2.058
²⁸ Si ¹⁹ F	2 $\Pi_{1/2}$	857.19	4.73	0.5812	0.00494	1.07	1.6011
²⁸ Si ¹ H	2 $\Pi_{1/2}$	2041.80	35.51	7.4996	0.2190	397	1.5201
²⁸ Si ² H	2 $\Pi_{1/2}$	1469.32	18.23	3.8840	0.0781	105.4	1.5199
²⁸ Si ¹⁴ N	2 Σ^+	1151.4	6.47	0.7311	0.00565	1.2	1.572
²⁸ Si ¹⁶ O	1 Σ^+	1241.54	5.97	0.7267521	0.0050379	0.9923	1.50975
²⁸ Si ³² S	1 Σ^+	749.64	2.58	0.30352788	0.00147308	0.201	1.92926
²⁸ Si ⁸⁰ Se	1 Σ^+	580.0	1.78	0.1920117	0.0007767	0.0842	2.05832
¹²⁰ Sn ⁷⁹ Br	2 $\Pi_{1/2}$	247.2	0.6				
¹²⁰ Sn ³⁵ Cl	2 $\Pi_{1/2}$	351.1	1.06	0.1117	0.0004		2.361
¹¹⁸ Sn ¹⁹ F	2 $\Pi_{1/2}$	577.6	2.69	0.2727	0.0014	0.26	1.944
¹²⁰ Sn ¹ H	2 $\Pi_{1/2}$			5.31488		207.5	1.78146
¹²⁰ Sn ² H	2 $\Pi_{1/2}$	1188.0*		2.6950	0.049	53.4	1.7770
¹²⁰ Sn ¹²⁷ I	2 $\Pi_{1/2}$	199.0	0.6				
¹²⁰ Sn ¹⁶ O	1 Σ^+	822.13	3.72	0.35571998	0.00214432	0.26638	1.83251
¹²⁰ Sn ³² S	1 Σ^+	487.26	1.36	0.13686139	0.00050563	0.0424	2.20898
¹²⁰ Sn ⁸⁰ Se	1 Σ^+	331.2	0.74	0.0649978	0.0001705	0.011	2.32557
¹²⁰ Sn ¹³⁰ Te	1 Σ^+	259.5	0.50	0.04247917	0.00009543	0.0055	2.52280
⁸⁸ Sr ⁷⁹ Br	2 Σ^+	216.60	0.52	0.0541847	0.0001827	0.01356	2.73522
⁸⁸ Sr ³⁵ Cl	2 Σ^+	302.3	0.95				
⁸⁸ Sr ¹⁹ F	2 Σ^+	502.4	2.3	0.2505346	0.0015513	0.2498	2.07537
⁸⁸ Sr ¹ H	2 Σ^+	1206.2	17.0	3.6751	0.0814	135	2.1456
⁸⁸ Sr ² H	2 Σ^+	841	8.6	1.8609	0.0292	34.7	2.1449
⁸⁸ Sr ¹²⁷ I	2 Σ^+	173.77	0.35	0.0367097	0.0001060	0.00655	2.94364
⁸⁸ Sr ¹⁶ O	1 Σ^+	653.5	3.96	0.33798	0.00219	0.36	1.91983
¹⁸¹ Ta ¹⁶ O	2 $\Delta_{3/2}$	1028.69	3.51	0.40284	0.00182	0.2450	1.68746
¹³⁰ Te ₂	3 Σ_g^-	247.07	0.51	0.039681	0.000106	0.0044	2.5574
¹³⁰ Te ¹ H	2 $\Pi_{3/2}$			5.56			1.74
¹³⁰ Te ¹⁶ O	0 ⁺	797.11	4.00	0.3554	0.00237	0.27	1.825
²³² Th ¹⁶ O	1 Σ^+	895.77	2.39	0.332644	0.001302	0.1833	1.84032

SPECTROSCOPIC CONSTANTS OF DIATOMIC MOLECULES (continued)

Molecule	State	ω_e cm ⁻¹	$\omega_e x_e$ cm ⁻¹	B_e cm ⁻¹	α_e cm ⁻¹	D_e 10 ⁻⁶ cm ⁻¹	r_e Å
⁴⁸ Tl ¹⁶ O	³ Δ ₁	1009.02	4.50	0.53541	0.00301	0.603	1.6202
²⁰⁵ Tl ⁸¹ Br	¹ Σ ⁺	192.10	0.39	0.0423899	0.0001276	0.0083	1.61817
²⁰⁵ Tl ³⁵ Cl	¹ Σ ⁺	284.71	0.86	0.09139702	0.00039784	0.0377	2.48483
²⁰⁵ Tl ¹⁹ F	¹ Σ ⁺	476.86	2.24	0.22315014	0.00150380	0.1955	2.08439
²⁰⁵ Tl ¹ H	¹ Σ ⁺	1390.7	22.7	4.806	0.154	254	1.870
²⁰⁵ Tl ² H	¹ Σ ⁺	987.7	12.04	2.419	0.057	60	1.869
²⁰⁵ Tl ¹²⁷ I	¹ Σ ⁺	150*		0.0271676	0.0000664	0.0036	2.81361
⁵¹ V ¹⁶ O	⁴ Σ ⁻	1011.3	4.86	0.54825	0.00352	0.6	1.5893
⁸⁹ Y ³⁵ Cl	¹ Σ ⁺	380.7	1.3	0.1160	0.0003	0.09	2.41
⁸⁹ Y ¹⁹ F	¹ Σ ⁺	631.29	2.50	0.29042	0.00163	0.237	1.9257
⁸⁹ Y ¹⁶ O	² Σ ⁺	861.0	2.9	0.3881	0.0018	0.32	1.790
¹⁷⁴ Yb ¹ H	² Σ ⁺	1249.54	21.06	3.9931	0.0957	161.8	2.0526
¹⁷⁴ Yb ² H	² Σ ⁺	886.6	10.57	2.01162	0.03425	41.60	2.0516
⁶⁴ Zn ³⁵ Cl	² Σ ⁺	390.5	1.6				
⁶⁴ Zn ¹⁹ F	² Σ ⁺	628	3.5				
⁶⁴ Zn ¹ H	² Σ ⁺	1607.6	55.14	6.6794	0.2500	466	1.5949
⁶⁴ Zn ² H	² Σ ⁺	1072	28	3.350		124	1.6054
⁶⁴ Zn ¹²⁷ I	² Σ ⁺	223.4	0.6				
⁹⁰ Zr ¹⁶ O	¹ Σ ⁺	969.8	4.9	0.42263	0.0023	0.319	1.7116

INFRARED CORRELATION CHARTS

Wavenumber in cm^{-1}

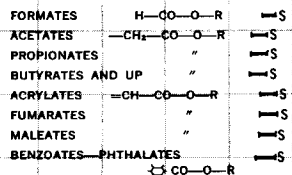


INFRARED CORRELATION CHARTS (continued)

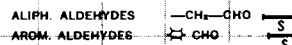
Wavenumber in cm^{-1}

4000 3000 2500 2000 1500 1400 1300 1200 1100 1000 900 800 700 650

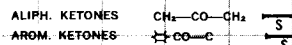
ESTERS



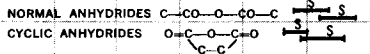
ALDEHYDES



KETONES



ANHYDRIDES



AMIDES



AMINES



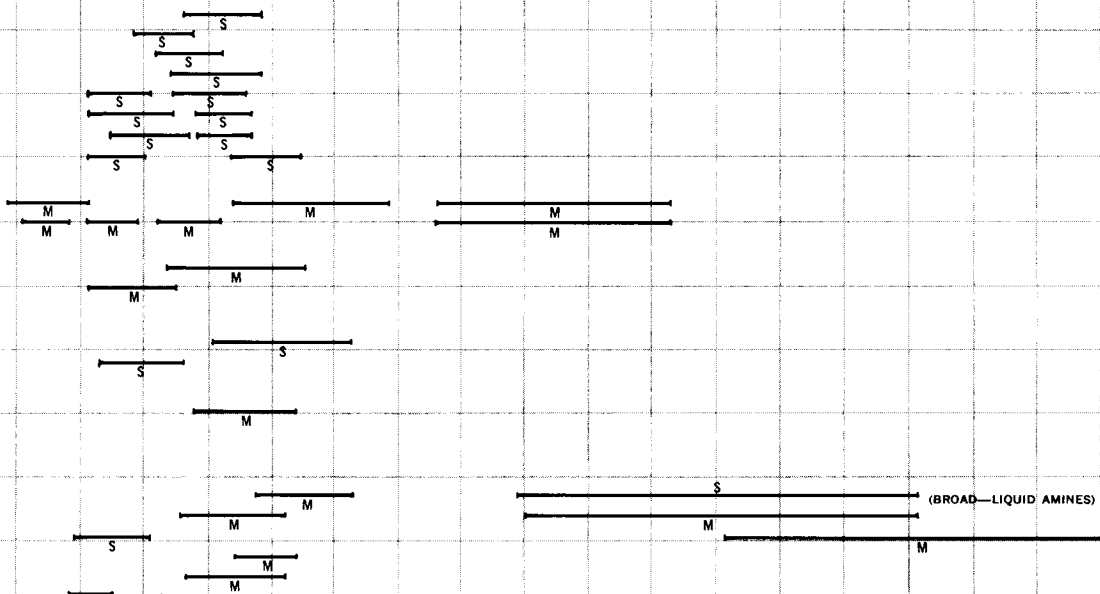
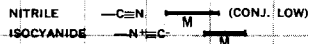
HYDROCHLORIDE



IMINES



NITRILES



LEGEND
 S = Strong
 M = Medium
 SP = Sharp
 V = Vary
 W = Weak

Based on work done by Colthup.

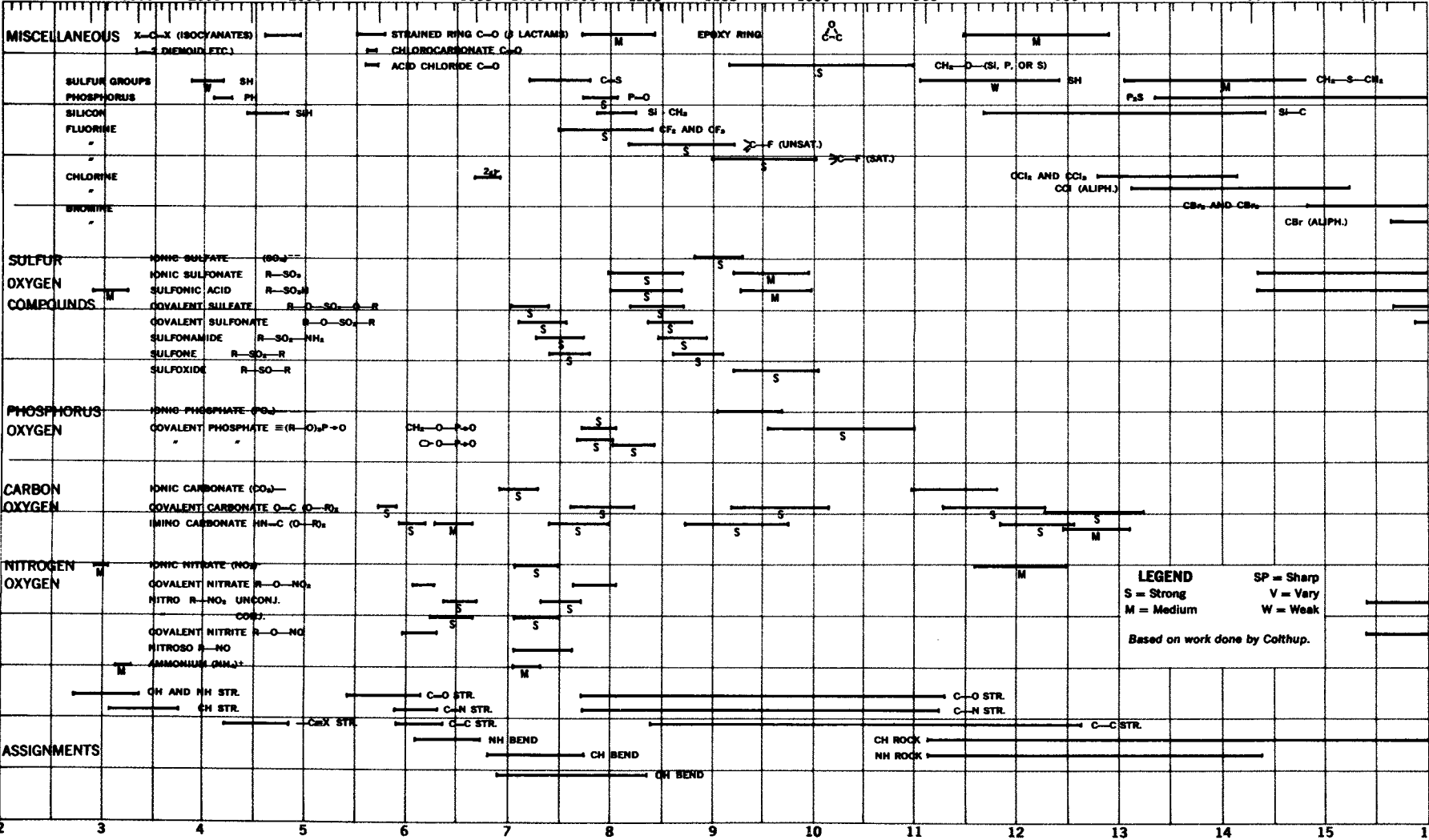
Wavelength in μm

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

INFRARED CORRELATION CHARTS (continued)

Wavenumber in cm^{-1}

4000 3000 2500 2000 1500 1400 1300 1200 1100 1000 900 800 700 650

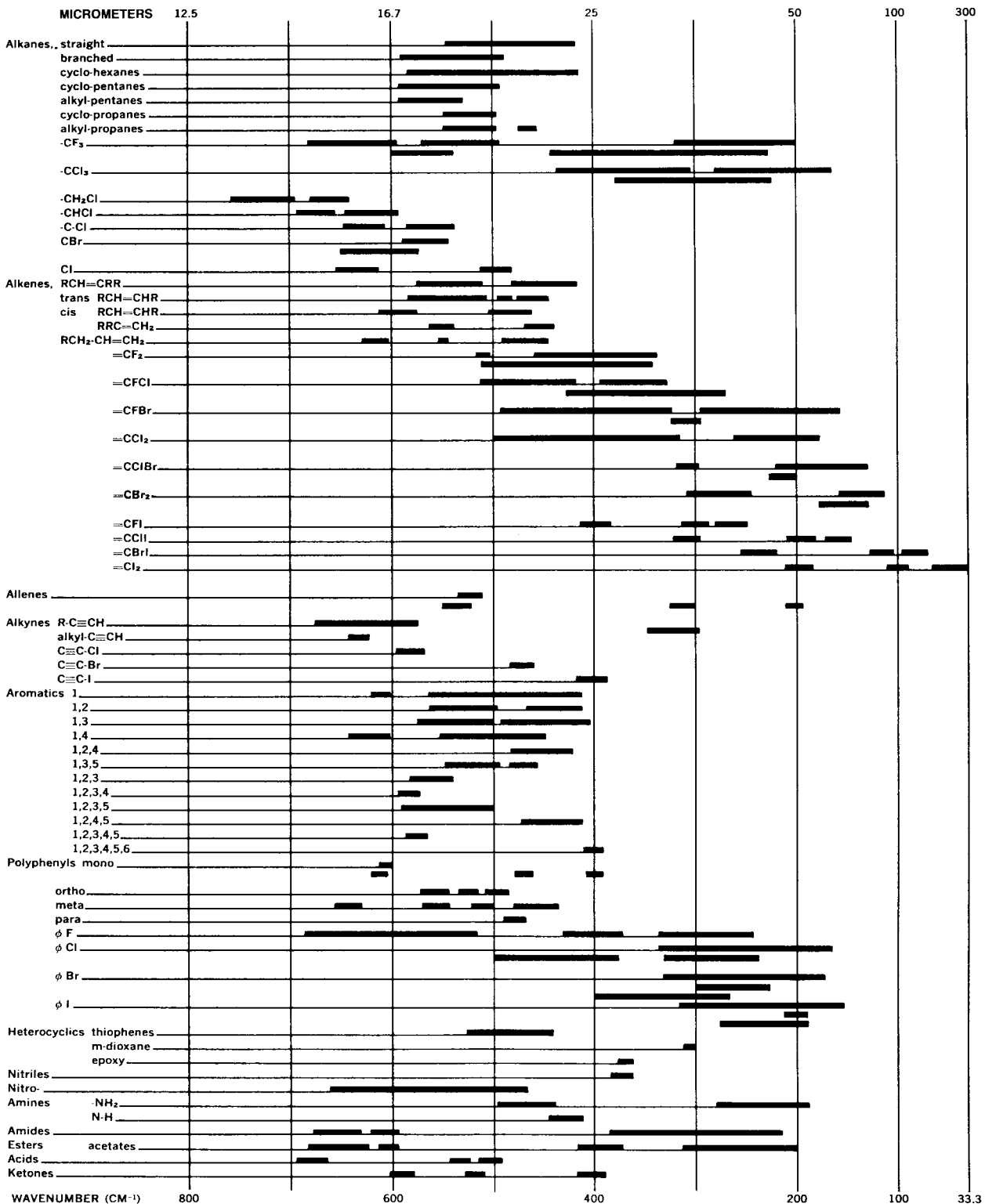


Wavelength in μm

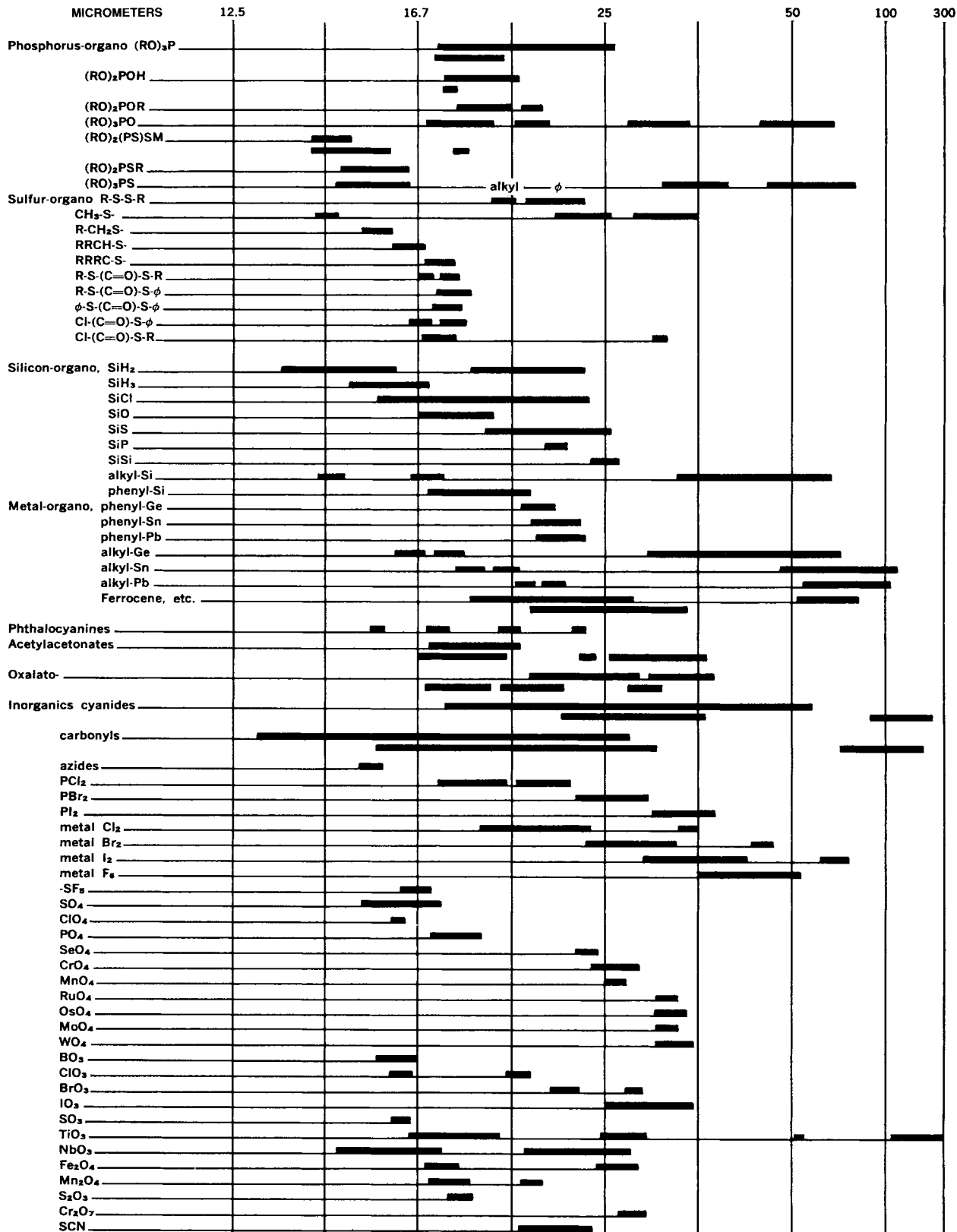
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

INFRARED CORRELATION CHARTS (continued)

Far Infrared Region



INFRARED CORRELATION CHARTS (continued)



NUCLEAR SPINS, MOMENTS, AND OTHER DATA RELATED TO NMR SPECTROSCOPY

This table presents the following data relevant to nuclear magnetic resonance spectroscopy:

Z: Atomic number

Isotope: Element symbol and mass number

Abundance: Natural abundance of the isotope in percent. An * indicates a radioactive nuclide; if no value is given, the nuclide is not present in nature or its abundance is highly variable.

I: Nuclear spin

v: Resonant frequency in megahertz for an applied field H_0 of 1 tesla (in cgs units, 10 kilogauss)

Relative sensitivity: Sensitivity relative to ^1H (=1) assuming an equal number of nuclei and constant temperature. Values were calculated from the expressions:

$$\text{For constant } H_0: 0.0076508(\mu/\mu_N)^3(I+1)/I^2$$

$$\text{For constant v: } 0.23871(\mu/\mu_N)(I+1)$$

μ/μ_N : Nuclear magnetic moment in units of the nuclear magneton μ_N

Q: Nuclear quadrupole moment in units of femtometers squared ($1 \text{ fm}^2 = 10^{-2} \text{ barn}$)

The table includes all stable nuclides of non-zero spin for which spin and magnetic moment values have been measured, as well as selected radioactive nuclides of current or potential interest. At least one isotope is included for each element through $Z = 95$ for which data are available. See Reference 1 for a complete listing of spins and moments.

The assistance of P. Pyykko in providing data on nuclear quadrupole moments is gratefully acknowledged.

REFERENCES

- Holden, N. E., "Table of the Isotopes", in Lide, D. R., Ed., *CRC Handbook of Chemistry and Physics*, 83th Ed., CRC Press, Boca Raton, FL, 2002.
- Raghavan, P., *At. Data Nuc. Data Tables*, 42, 189, 1989.
- Pyykko, P., *Mol. Phys.* 19, 1617-1629, 2001.
- Stone, N. J., <www.nndc.bnl.gov/nndc/stone_moments/>

Z	Isotope	Abundance %	I	v/MHz for $H_0 = 1 \text{ T}$	Relative sensitivity		μ/μ_N	Q/fm ²
					Const. H_0	Const. v		
1	¹ n	*	1/2	29.1647	0.32139	0.6850	-1.91304272	
1	¹ H	99.9850	1/2	42.5775	1.00000	1.0000	+2.792847337	
1	² H	0.0115	1	6.5359	0.00965	0.4093	+0.857438228	+0.2860
1	³ He	*	1/2	45.4148	1.21354	1.0666	+2.9789625	
2	³ He	0.000137	1/2	32.4360	0.44212	0.7618	-2.1276248	
3	⁶ Li	7.59	1	6.2661	0.00850	0.3925	+0.8220467	-0.0808
3	⁷ Li	92.41	3/2	16.5483	0.29356	1.9433	+3.25644	-4.01
4	⁹ Be	100	3/2	5.9842	0.01388	0.7027	-1.1776	+5.288
5	¹⁰ B	19.9	3	4.5752	0.01985	1.7193	+1.800645	+8.459
5	¹¹ B	80.1	3/2	13.6630	0.16522	1.6045	+2.688649	+4.059
6	¹³ C	1.07	1/2	10.7084	0.01591	0.2515	+0.7024118	
7	¹⁴ N	99.632	1	3.0777	0.00101	0.1928	+0.4037610	+2.044
7	¹⁵ N	0.368	1/2	4.3173	0.00104	0.1014	-0.2831888	
8	¹⁷ O	0.038	5/2	5.7742	0.02910	1.5822	-1.89379	-2.558
9	¹⁹ F	100	1/2	40.0776	0.83400	0.9413	+2.628868	
10	²¹ Ne	0.27	3/2	3.3631	0.00246	0.3949	-0.661797	+10.155
11	²³ Na	100	3/2	11.2688	0.09270	1.3233	+2.217522	+10.4
12	²⁵ Mg	10.00	5/2	2.6083	0.00268	0.7147	-0.85545	+19.94
13	²⁷ Al	100	5/2	11.1031	0.20689	3.0424	+3.641507	+14.66
14	²⁹ Si	4.6832	1/2	8.4655	0.00786	0.1988	-0.55529	
15	³¹ P	100	1/2	17.2515	0.06652	0.4052	+1.13160	
16	³³ S	0.76	3/2	3.2717	0.00227	0.3842	+0.6438212	-6.78
17	³⁵ Cl	75.78	3/2	4.1765	0.00472	0.4905	+0.8218743	-8.165
17	³⁷ Cl	24.22	3/2	3.4765	0.00272	0.4083	+0.6841236	-6.435
18	³⁷ Ar	*	3/2	5.819	0.01276	0.6833	+1.145	
18	³⁹ Ar	*	7/2	3.46	0.01130	1.7079	-1.59	
19	³⁹ K	93.2581	3/2	1.9893	0.00051	0.2336	+0.3914662	+5.85

NUCLEAR SPINS, MOMENTS, AND OTHER DATA RELATED TO NMR SPECTROSCOPY (continued)

Z	Isotope	Abundance %	I	ν /MHz for $H_0 = 1$ T	Relative sensitivity		μ/μ_N	Q/fm ²
					Const. H_0	Const. ν		
19	⁴⁰ K	0.0117	4	2.4737	0.00523	1.5493	-1.298100	-7.3
19	⁴¹ K	6.7302	3/2	1.0919	0.00008	0.1282	+0.2148701	+7.11
20	⁴³ Ca	0.135	7/2	2.8688	0.00642	1.4150	-1.31726	-4.08
21	⁴⁵ Sc	100	7/2	10.3591	0.30244	5.1093	+4.756487	-22.0
22	⁴⁷ Ti	7.44	5/2	2.4041	0.00210	0.6587	-0.78848	+30.2
22	⁴⁹ Ti	5.41	7/2	2.4048	0.00378	1.1861	-1.10417	+24.7
23	⁵⁰ V	0.250	6	4.2505	0.05571	5.5904	+3.345689	+21
23	⁵¹ V	99.750	7/2	11.2133	0.38360	5.5306	+5.1487057	-5.2
24	⁵³ Cr	9.501	3/2	2.4115	0.00091	0.2832	-0.47454	-15
25	⁵⁵ Mn	100	5/2	10.5763	0.17881	2.8980	+3.46872	+33
26	⁵⁷ Fe	2.119	1/2	1.3816	0.00003	0.0324	+0.0906230	
27	⁵⁹ Co	100	7/2	10.077	0.27841	4.9702	+4.627	+42
28	⁶¹ Ni	1.1399	3/2	3.8114	0.00359	0.4476	-0.75002	+16.2
29	⁶³ Cu	69.17	3/2	11.2982	0.09342	1.3268	+2.22329	-22.0
29	⁶⁵ Cu	30.83	3/2	12.1030	0.11484	1.4213	+2.38167	-20.4
30	⁶⁷ Zn	4.10	5/2	2.6694	0.00287	0.7314	+0.875479	+15.0
31	⁶⁹ Ga	60.108	3/2	10.2478	0.06971	1.2034	+2.01659	+17.1
31	⁷¹ Ga	39.892	3/2	13.0208	0.14300	1.5291	+2.56227	+10.7
32	⁷³ Ge	7.73	9/2	1.4897	0.00141	1.1546	-0.8794677	-19.6
33	⁷⁵ As	100	3/2	7.3150	0.02536	0.8590	+1.439475	+31.4
34	⁷⁷ Se	7.63	1/2	8.1571	0.00703	0.1916	+0.53506	
35	⁷⁹ Br	50.69	3/2	10.7042	0.07945	1.2570	+2.106400	+31.3
35	⁸¹ Br	49.31	3/2	11.5384	0.09951	1.3550	+2.270562	+26.2
36	⁸³ Kr	11.49	9/2	1.6442	0.00190	1.2744	-0.970669	+25.9
37	⁸⁵ Rb	72.17	5/2	4.1254	0.01061	1.1304	+1.35303	+27.6
37	⁸⁷ Rb	27.83	3/2	13.9811	0.17703	1.6418	+2.75124	+13.35
38	⁸⁷ Sr	7.00	9/2	1.8525	0.00272	1.4358	-1.093603	+33.5
39	⁸⁹ Y	100	1/2	2.0949	0.00012	0.0492	-0.1374154	
40	⁹¹ Zr	11.22	5/2	3.9748	0.00949	1.0891	-1.30362	-17.6
41	⁹³ Nb	100	9/2	10.4523	0.48821	8.1011	+6.1705	-32
42	⁹⁵ Mo	15.92	5/2	2.7874	0.00327	0.7638	-0.9142	-2.2
42	⁹⁷ Mo	9.55	5/2	2.8463	0.00349	0.7799	-0.9335	+25.5
43	⁹⁹ Tc	*	9/2	9.6294	0.38174	7.4633	+5.6847	-12.9
44	⁹⁹ Ru	12.76	5/2	1.9553	0.00113	0.5358	-0.6413	+7.9
44	¹⁰¹ Ru	17.06	5/2	2.1916	0.00159	0.6005	-0.7188	+45.7
45	¹⁰³ Rh	100	1/2	1.3477	0.00003	0.0317	-0.08840	
46	¹⁰⁵ Pd	22.33	5/2	1.957	0.00113	0.5364	-0.642	+66.0
47	¹⁰⁷ Ag	51.839	1/2	1.7331	0.00007	0.0407	-0.1136796	
47	¹⁰⁹ Ag	48.161	1/2	1.9924	0.00010	0.0468	-0.1306906	
48	¹¹¹ Cd	12.80	1/2	9.0692	0.00966	0.2130	-0.5948861	
48	¹¹³ Cd	12.22	1/2	9.4871	0.01106	0.2228	-0.6223009	
49	¹¹³ In	4.29	9/2	9.3655	0.35121	7.2588	+5.5289	+79.9
49	¹¹⁵ In	95.71	9/2	9.3856	0.35348	7.2744	+5.5408	+81
50	¹¹⁵ Sn	0.34	1/2	14.0077	0.03561	0.3290	-0.91883	
50	¹¹⁷ Sn	7.68	1/2	15.2610	0.04605	0.3584	-1.00104	
50	¹¹⁹ Sn	8.59	1/2	15.9660	0.05273	0.3750	-1.04728	
51	¹²¹ Sb	57.21	5/2	10.2551	0.16302	2.8100	+3.3634	-36
51	¹²³ Sb	42.79	7/2	5.5532	0.04659	2.7389	+2.5498	-49
52	¹²³ Te	0.89	1/2	11.2349	0.01837	0.2639	-0.7369478	
52	¹²⁵ Te	7.07	1/2	13.5454	0.03220	0.3181	-0.8885051	
53	¹²⁷ I	100	5/2	8.5778	0.09540	2.3504	+2.813273	-71.0
54	¹²⁹ Xe	26.44	1/2	11.8604	0.02162	0.2786	-0.7779763	
54	¹³¹ Xe	21.18	3/2	3.5159	0.00282	0.4129	+0.6918619	-11.4
55	¹³³ Cs	100	7/2	5.6234	0.04838	2.7735	+2.582025	-0.343
56	¹³⁵ Ba	6.592	3/2	4.2582	0.00500	0.5001	+0.837943	+16.0
56	¹³⁷ Ba	11.232	3/2	4.7634	0.00700	0.5594	+0.937365	+24.5
57	¹³⁸ La	0.090	5	5.6615	0.09404	5.3188	+3.713646	+45

NUCLEAR SPINS, MOMENTS, AND OTHER DATA RELATED TO NMR SPECTROSCOPY (continued)

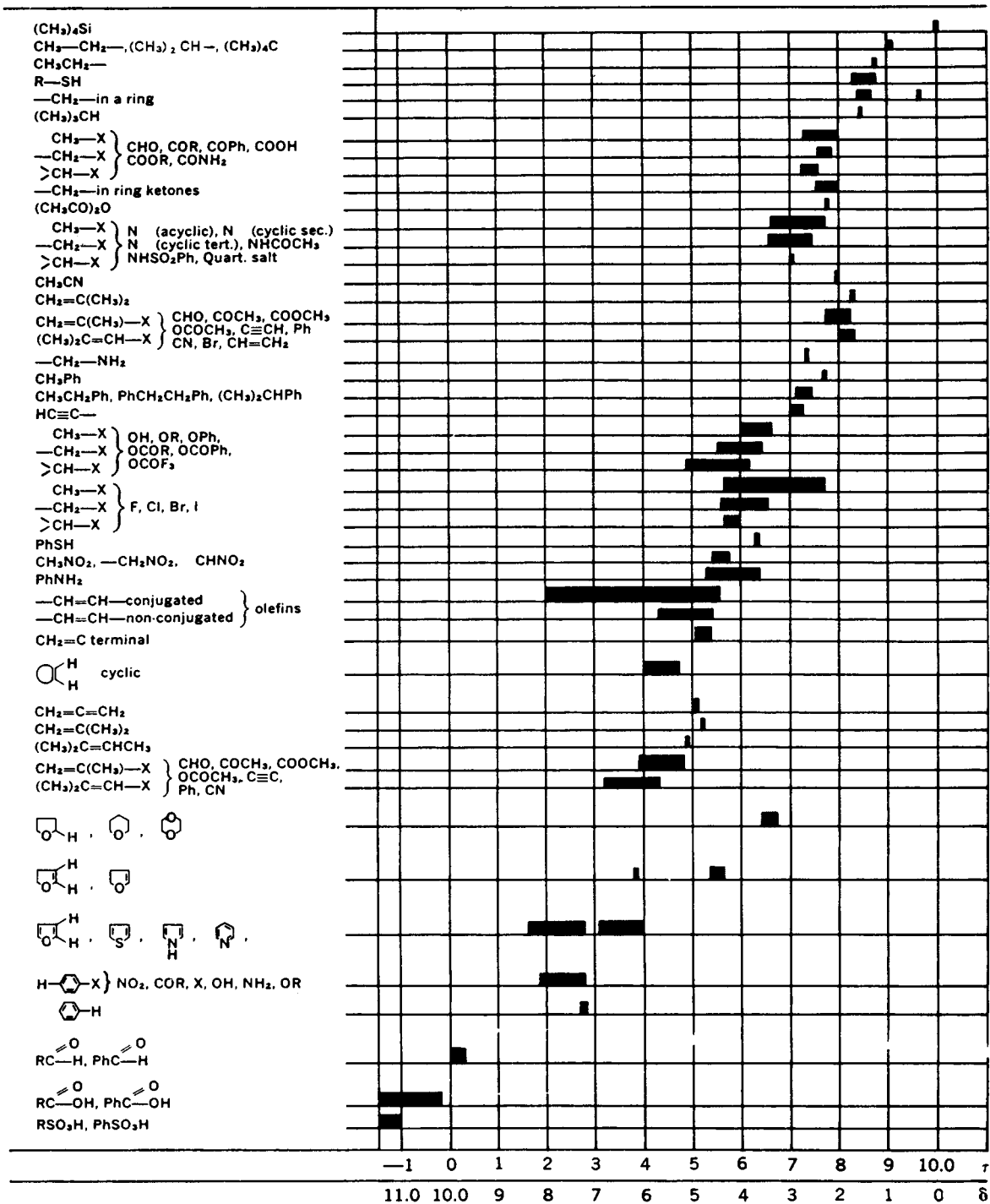
Z	Isotope	Abundance %	I	ν /MHz for $H_0 = 1$ T	Relative sensitivity		μ/μ_N	Q/fm ²
					Const. H_0	Const. ν		
57	¹³⁹ La	99.910	7/2	6.0612	0.06058	2.9895	+2.7830455	+20
58	¹³⁷ Ce	*	3/2	4.88	0.00752	0.5729	0.96	
58	¹³⁹ Ce	*	3/2	5.39	0.01012	0.6326	1.06	
58	¹⁴¹ Ce	*	7/2	2.37	0.00364	1.1708	1.09	
59	¹⁴¹ Pr	100	5/2	13.0359	0.33483	3.5720	+4.2754	-5.9
60	¹⁴³ Nd	12.2	7/2	2.319	0.00339	1.1440	-1.065	-63
60	¹⁴⁵ Nd	8.3	7/2	1.429	0.00079	0.7047	-0.656	-33
61	¹⁴³ Pm	*	5/2	11.59	0.23510	3.1748	+3.80	
61	¹⁴⁷ Pm	*	7/2	5.62	0.04827	2.7714	+2.58	+74
62	¹⁴⁷ Sm	14.99	7/2	1.7748	0.00152	0.8753	-0.8149	-26
62	¹⁴⁹ Sm	13.82	7/2	1.4631	0.00085	0.7216	-0.6718	+7.4
63	¹⁵¹ Eu	47.81	5/2	10.5856	0.17929	2.9006	+3.4718	+90.3
63	¹⁵³ Eu	52.19	5/2	4.6745	0.01544	1.2809	+1.5331	+241
64	¹⁵⁵ Gd	14.80	3/2	1.312	0.00015	0.1541	-0.2582	+127
64	¹⁵⁷ Gd	15.65	3/2	1.720	0.00033	0.2020	-0.3385	+135
65	¹⁵⁹ Tb	100	3/2	10.23	0.06945	1.2019	+2.014	+143.2
66	¹⁶¹ Dy	18.91	5/2	1.4654	0.00048	0.4015	-0.4806	+250.7
66	¹⁶³ Dy	24.90	5/2	2.0508	0.00130	0.5619	+0.6726	+265
67	¹⁶⁵ Ho	100	7/2	9.0883	0.20423	4.4825	+4.173	+358
68	¹⁶⁷ Er	22.93	7/2	1.2281	0.00050	0.6057	-0.5639	+356.5
69	¹⁶⁹ Tm	100	1/2	3.531	0.00057	0.0829	-0.2316	
70	¹⁷¹ Yb	14.28	1/2	7.5261	0.00552	0.1768	+0.49367	
70	¹⁷³ Yb	16.13	5/2	2.0730	0.00135	0.5680	-0.67989	+280
71	¹⁷⁵ Lu	97.41	7/2	4.8626	0.03128	2.3983	+2.2327	+349
71	¹⁷⁶ Lu	2.59	7	3.451	0.03975	6.0516	+3.169	+497
72	¹⁷⁷ Hf	18.60	7/2	1.7282	0.00140	0.8524	+0.7935	+336.5
72	¹⁷⁹ Hf	13.62	9/2	1.0856	0.00055	0.8414	-0.6409	+379.3
73	¹⁸⁰ Ta	0.012	9	4.087	0.10610	11.5175	+4.825	
73	¹⁸¹ Ta	99.988	7/2	5.1627	0.03744	2.5463	+2.3705	+317
74	¹⁸³ W	14.31	1/2	1.7957	0.00008	0.0422	+0.1177848	
75	¹⁸⁵ Re	37.40	5/2	9.7176	0.13870	2.6627	+3.1871	+218
75	¹⁸⁷ Re	62.60	5/2	9.8170	0.14300	2.6900	+3.2197	+207
76	¹⁸⁷ Os	1.96	1/2	0.9856	0.00001	0.0231	+0.06465189	
76	¹⁸⁹ Os	16.15	3/2	3.3536	0.00244	0.3938	+0.659933	+85.6
77	¹⁹¹ Ir	37.3	3/2	0.7658	0.00003	0.0899	+0.1507	+81.6
77	¹⁹³ Ir	62.7	3/2	0.8319	0.00004	0.0977	+0.1637	+75.1
78	¹⁹⁵ Pt	33.832	1/2	9.2922	0.01039	0.2182	+0.60952	
79	¹⁹⁷ Au	100	3/2	0.7406	0.00003	0.0870	+0.145746	+54.7
80	¹⁹⁹ Hg	16.87	1/2	7.7123	0.00594	0.1811	+0.5058855	
80	²⁰¹ Hg	13.18	3/2	2.8469	0.00149	0.3343	-0.5602257	+38.6
81	²⁰³ Tl	29.524	1/2	24.7316	0.19598	0.5809	+1.6222579	
81	²⁰⁵ Tl	70.476	1/2	24.9749	0.20182	0.5866	+1.6382146	
82	²⁰⁷ Pb	22.1	1/2	9.0340	0.00955	0.2122	+0.59258	
83	²⁰⁹ Bi	100	9/2	6.9630	0.14433	5.3967	+4.1106	-51.6
84	²⁰⁹ Po	*	1/2	11.7	0.02096	0.2757	+0.77	
86	²¹¹ Rn	*	1/2	9.16	0.00997	0.2152	+0.601	
87	²²³ Fr	*	3/2	5.95	0.01362	0.6982	+1.17	+117
88	²²³ Ra	*	3/2	1.3746	0.00017	0.1614	+0.2705	+125
88	²²⁵ Ra	*	1/2	11.187	0.01814	0.2627	-0.7338	
89	²²⁷ Ac	*	3/2	5.6	0.01131	0.6564	+1.1	+170
90	²²⁹ Th	*	5/2	1.40	0.00042	0.3843	+0.46	+430
91	²³¹ Pa	*100	3/2	10.2	0.06903	1.1995	2.01	-172
92	²³⁵ U	*0.7200	7/2	0.83	0.00015	0.4082	-0.38	+493.6
93	²³⁷ Np	*	5/2	9.57	0.13264	2.6234	+3.14	+388.6
94	²³⁹ Pu	*	1/2	3.09	0.00038	0.0727	+0.203	
95	²⁴³ Am	*	5/2	4.6	0.01446	1.2532	+1.5	+421

PROTON NMR CHEMICAL SHIFTS FOR CHARACTERISTIC ORGANIC STRUCTURES

The chart below summarizes the range of chemical shifts for protons in several classes of organic compounds and substituent groups. The chemical shifts δ are given in parts per million relative to tetramethylsilane.

REFERENCE

Mohacsi, E., *J. Chem. Edu.*, 41, 38, 1964 (with permission).



¹³C-NMR ABSORPTIONS OF MAJOR FUNCTIONAL GROUPS

The table below lists the range of ¹³C chemical shifts δ in parts per million relative to tetramethylsilane, in descending order, for various functional groups. Examples of simple compounds for each family are given to illustrate the correlations. The shifts for the carbons of interest, which are italicized, are given in parentheses; when two or more values appear, they refer to the sequence of italicized carbon atoms from left to right in the formula.

REFERENCES

1. Yoder, C. H. and Schaeffer, C. D., Jr., *Introduction to Multinuclear NMR: Theory and Application*, Benjamin/Cummings, Menlo Park, CA, 1987.
2. Silverstein, R. M., Bassler, G. C., and Morrill, T. C., *Spectrometric Identification of Organic Compounds*, John Wiley & Sons, New York, 1981.
3. Brown, D. W., A Short Set of ¹³C NMR Correlation Tables, *J. Chem. Educ.*, 62, 209, 1985.

δ (ppm)	Group	Family	Example (δ of italicized carbon)
220-165	>C=O	Ketones	(CH ₃) ₂ CO (206.0)
			(CH ₃) ₂ CHCOCH ₃ (212.1)
			CH ₃ CHO (199.7)
		Aldehydes	CH ₃ CH=CHCHO (192.4)
			CH ₂ =CHCOCH ₃ (169.9)
		α,β -Unsaturated carbonyls	HCO ₂ H (166.0)
			CH ₃ CO ₂ H (178.1)
		Carboxylic acids	HCONH ₂ (165.0)
			CH ₃ CONH ₂ (172.7)
		Amides	CH ₃ CO ₂ CH ₂ CH ₃ (170.3)
			CH ₂ =CHCO ₂ CH ₃ (165.5)
C ₆ H ₆ (128.5)			
140-120	>C=C<	Aromatic	CH ₂ =CH ₂ (123.2)
			CH ₂ =CHCH ₃ (115.9, 136.2)
		Alkenes	CH ₂ =CHCH ₂ Cl (117.5, 133.7)
			CH ₃ CH=CHCH ₂ CH ₃ (132.7)
			CH ₃ -CN (117.7)
125-115	-CN	Nitriles	HCCl (71.9)
80-70	-CC-	Alkynes	CH ₃ CCH ₃ (73.9)
70-45	-C-O	Esters	CH ₃ OOCH ₂ CH ₃ (57.6, 67.9)
			Alcohols	HOCH_{3} (49.0)
40-20	-C-NH ₂	Amines	HOCH ₂ CH ₃ (57.0)
			CH ₃ NH ₂ (26.9)
			CH ₃ CH ₂ NH ₂ (35.9)
30-15	-S-CH ₃	Sulfides (thioethers)	C ₆ H ₅ -S-CH ₃ 15.6
30-(-2.3)	-C-H	Alkanes, cycloalkanes	CH ₄ (-2.3)
			CH ₃ CH ₃ (5.7)
			CH ₃ CH ₂ CH ₃ (15.8, 16.3)
			CH ₃ CH ₂ CH ₂ CH ₃ (13.4, 25.2)
			CH ₃ CH ₂ CH ₂ CH ₂ CH ₃ (13.9, 22.8, 34.7)
			Cyclohexane (26.9)

BOND LENGTHS IN ORGANOMETALLIC COMPOUNDS

This table summarizes the average values of interatomic distances of representative metal-ligand bonds. Sigma bonds between *d*- and *f*-block metals and the elements C, N, O, P, S, and As are included. The values are extracted from a much larger list in Reference 1. The tabulated values are the unweighted means of reported measurements on compounds in each category. If four or more measurements are available, the standard deviation is given in parentheses. All values are in Ångstrom units (10^{-10} m).

The first part of the table covers metal-carbon bonds in different ligand categories, while the second part covers metal bonds to other elements. R stands for any alkyl group; Me for a CH_3 group; C_6R_5 indicates an aryl group; and $\text{C}(=\text{O})\text{R}$ an acyl group. Metals are listed in atomic number order.

REFERENCE

1. Orpen, A. G., Brammer, L., Allen, F.H., Kennard, O., Watson, D. G., and Taylor, R., *J. Chem. Soc. Dalton Trans.*, 1989, S1-S83.

M	M- CH_3	M- CH_2R	M-CR=CR ₂	M-C ₆ R ₅	M-C(=O)R
Ti		2.167	2.215(0.042)	2.148	
V				2.114(0.012)	
Cr	2.168		2.035(0.009)	2.075(0.019)	
Mn	2.095(0.030)	2.176(0.024)	2.007	2.064(0.021)	2.044
Fe	2.074	2.091(0.030)	1.991(0.039)	2.031(0.062)	1.997(0.033)
Co	2.014(0.023)	2.039(0.032)	1.934(0.019)	1.974	1.990
Ni	2.029	1.964	1.892(0.017)	1.917(0.038)	1.850(0.059)
Cu				2.020	
Zn		1.964			
Zr	2.292(0.049)		2.257		
Nb	2.336	1.319			
Mo	2.254(0.065)	2.250(0.061)	2.204(0.049)	2.193(0.054)	2.109
Ru	2.179(0.045)	2.036(0.010)	2.063	2.092(0.057)	2.091
Rh	2.092(0.027)	2.100	2.040(0.054)	2.011(0.026)	1.995(0.031)
Pd		2.028	2.000(0.024)	1.981(0.032)	1.982(0.029)
Hf	2.275(0.049)		2.205		
Ta	2.217(0.035)	2.225(0.056)		2.199(0.073)	
W	2.189(0.039)	2.175	2.224		
Re	2.173(0.051)	2.290		2.027	2.190(0.027)
Os		2.221	2.052	2.090(0.032)	2.161
Ir	2.175		2.071(0.044)	2.070(0.038)	2.019
Pt	2.083(0.045)	2.062(0.031)	2.024(0.037)	2.049(0.046)	1.991(0.025)
Au	2.066(0.045)		2.042	2.059(0.024)	
Hg	2.072(0.026)	2.125		2.086(0.040)	
Th	2.567				

M	M-NH ₃	M-OH ₂	M-PMe ₃	M-SR	M-AsR ₃
Ti		2.066(0.052)		2.369	2.686
V		2.129(0.131)	2.510(0.010)	2.378(0.007)	
Cr	2.069(0.008)	1.997(0.070)	2.389(0.069)	2.362	2.460(0.040)
Mn		2.189(0.040)	2.455(0.164)	2.366(0.054)	2.400(0.013)
Fe		2.085(0.066)	2.246(0.042)	2.271(0.028)	2.352(0.043)
Co	1.965(0.021)	2.085(0.064)	2.217(0.043)	2.254(0.025)	2.323(0.021)
Ni	2.074(0.093)	2.079(0.038)	2.204(0.031)	2.187(0.007)	2.333(0.035)
Cu	1.987(0.017)	2.186(0.215)			2.367(0.016)
Zn	2.044	2.090(0.061)		2.295	
Y		2.398(0.068)			
Zr			2.692		
Nb		2.248(0.137)			2.741(0.008)
Mo	2.217	2.201(0.094)	2.462(0.046)	2.401(0.050)	2.582(0.036)
Ru	2.126(0.024)	2.074(0.051)	2.307(0.050)		2.446(0.031)
Rh	2.114(0.018)	2.190(0.096)	2.266(0.036)		2.416(0.039)
Pd	2.032	2.200	2.287(0.018)		2.386(0.052)
Ag		2.350			
Cd		2.318(0.065)		2.444	

BOND LENGTHS IN ORGANOMETALLIC COMPOUNDS (continued)

M	M-NH ₃	M-OH ₂	M-PMe ₃	M-SR	M-AsR ₃
La		2.556(0.062)			
Ce		2.565(0.063)			
Pr		2.518(0.038)			
Nd		2.533(0.058)			
Sm		2.459(0.050)			
Eu		2.441(0.055)			
Gd		2.443(0.074)			
Tb		2.455			
Dy		2.409(0.074)			
Ho		2.407(0.069)			
Er		2.404(0.083)			
Yb		2.353(0.066)			
Lu		2.404(0.116)			
Ta			2.589(0.044)		
W		2.115(0.065)	2.485(0.039)		
Re	2.253	2.199(0.091)	2.369(0.065)		2.575(0.006)
Os	2.136	2.166	2.328(0.029)		
Ir	2.050(0.021)		2.323(0.028)	2.461	
Pt			2.295(0.036)	2.320(0.015)	2.366(0.058)
Au		2.157		2.293	
Hg		2.690(0.083)		2.402(0.065)	
Th		2.483(0.032)			
U		2.455(0.047)			

CHARACTERISTIC BOND LENGTHS IN FREE MOLECULES

This is a summary of typical bond lengths in gas-phase molecules. The value given for each bond is near the mid-range of values found in simple molecules. Bond lengths usually vary by 1 or 2%, and often by more, depending on the nature of the other bonds attached to the two atoms in question. References 1 and 2 give bond lengths in individual gas-phase molecules, as determined by spectroscopic and electron diffraction methods.

All bond distances are given in Å (1 Å = 10⁻¹⁰ m).

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3. Lide, D. R., "A Survey of Carbon-Carbon Bond Lengths", *Tetrahedron* 17, 125, 1962.

A. Characteristic lengths of single bonds.

	As	Br	C	Cl	F	Ge	H	I	N	O	P	S	Sb	Se	Si
As	2.10														
Br	2.32	2.28													
C	1.96	1.94	1.53												
Cl	2.17	2.14	1.79	1.99											
F	1.71	1.76	1.39	1.63	1.41										
Ge		2.30	1.95	2.15	1.73	2.40									
H	1.51	1.41	1.09	1.28	0.92	1.53	0.74								
I		2.47	2.13	2.32	1.91	2.51	1.61	2.67							
N			1.46	1.90	1.37		1.02		1.45						
O			1.42	1.70	1.42		0.96		1.43	1.48					
P		2.22	1.85	2.04	1.57		1.42		1.65		2.25				
S		2.24	1.82	2.05	1.56		1.34					2.00			
Sb				2.33			1.70								
Se			1.95		1.71		1.47							2.33	
Si		2.21	1.87	2.05	1.58		1.48	2.44		1.63		2.14			2.33
Sn			2.14	2.28			1.71	2.67							
Te					1.82		1.66								

B. Lengths of multiple bonds (non-ring molecules).

C=C	1.34
C≡C	1.20
C=N	1.21
C≡N	1.16
C=O	1.21
C=S	1.61
N=N	1.24
N≡N	1.13
N=O	1.18
O=O	1.21

C. Effect of environment on carbon-carbon single bonds (other single bonds not shown). From Reference 3.

Configuration	C-C length	Examples of molecules
C-C	1.526	H ₃ C-CH ₃
C-C=	1.501	H ₃ C-CH=CH ₂
C-C≡	1.459	H ₃ C-C≡CH
=C-C=	1.467	H ₂ C=CH-CH=CH ₂
≡C-C=	1.445	HC≡C-CH=CH ₂
≡C-C≡	1.378	HC≡C-C≡CH

D. Some metal-carbon bond lengths in gas-phase molecules.

Al-C	1.96	Bi-C	2.26	Pb-C	2.24
B-C	1.58	Cd-C	2.11	Sn-C	2.14
Be-C	1.70	Hg-C	2.08	Zn-C	1.93

LINE SPECTRA OF THE ELEMENTS

Joseph Reader and Charles H. Corliss

The original tables from which this table was derived were prepared under the auspices of the Committee on Line Spectra of the Elements of the National Academy of Sciences-National Research Council. The table contains the outstanding spectral lines of neutral (I) and singly ionized (II) atoms of the elements from hydrogen through plutonium ($Z = 1-94$); selected strong lines from doubly ionized (III), triply ionized (IV), and quadruply ionized (V) atoms are also included. Listed are lines that appear in emission from the vacuum ultraviolet to the far infrared. These lines were selected from much larger lists in such a way as to include the stronger observed lines in each spectral region. A more extensive list may be found in Reference 1.

The data were compiled by the following contributors.

J. G. Conway - Lawrence Berkeley Laboratory
C. H. Corliss - National Bureau of Standards
R. D. Cowan - Los Alamos Scientific Laboratory
C. R. Cowley - University of Michigan
Henry M. and Hannah Crosswhite - Argonne National Laboratory
S. P. Davis - University of California, Berkeley
V. Kaufman - National Bureau of Standards
R. L. Kelly - Naval Postgraduate School
J. F. Kielkopf - University of Louisville
W. C. Martin - National Bureau of Standards
T. K. McCubbin - Pennsylvania State University
L. J. Radziemski - Los Alamos Scientific Laboratory
J. Reader - National Bureau of Standards
C. J. Sansonetti - National Bureau of Standards
G. V. Shalimoff - Lawrence Berkeley Laboratory
R. W. Stanley - Purdue University
J. O. Stoner, Jr. - University of Arizona
H. H. Stroke - New York University
D. R. Wood - Wright State University
E. F. Worden - Lawrence Livermore Laboratory
J. J. Wynne - International Business Machines Corporation
R. Zalubas - National Bureau of Standards

All wavelengths are given in Angstrom units (10^{-10} m). Below 2000 Å, the wavelengths are in vacuum; above 2000 Å, the wavelengths are in air. Wavelengths given to three decimal places have an uncertainty of less than 0.001 Å and are therefore suitable for calibration purposes. In the air region, the elements used most commonly for calibration are Ne, Ar, Kr, Fe, Th, and Hg; in the vacuum region, the most common are C, N, O, Si, Cu.

All data refer to natural isotopic abundance of the elements except that Kr I and Kr II lines below 11,000 Å given to three decimal places are for ^{86}Kr . Also, Hg I lines given to three decimal places are for ^{198}Hg ; these are frequently used for calibration.

A large number of the lines for neutral and singly ionized atoms were extracted from the National Bureau of Standards (NBS) *Tables of Spectral-Line Intensities* (Reference 2). The intensities of these lines represent quantitative estimates of relative line strengths that take account of varying detection sensitivity at different wavelengths. They are on a linear scale. For nearly all of the other lines the intensities represent qualitative estimates of the relative strengths of lines not greatly separated in wavelength. Because different observers frequently use different scales for their intensity estimates, these intensities are useful only as a rough indication of the appearance of a spectrum. In some cases the intensity scale is not intended to be linear. In the first and second spectra the intensities of the lines of the singly ionized atom (II) relative to those of the neutral atom (I) should be used with caution, inasmuch as the concentration of ions in a light source depends greatly on the excitation conditions.

The default order of the table is alphabetical by element name (not symbol); for each element the lines are then listed by wavelength. The table can be sorted on wavelength to produce a finding list for identifying unknown lines. References to the sources of data for each element are given below.

GENERAL REFERENCES

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2. Meggers, W. F., Corliss, C. H., and Scribner, B. F., *Tables of Spectral Line Intensities, Part 1. Arranged by Elements*, Nat. Bur. Stand. (U.S.), Monograph 145, 1975.
3. Fuhr, J. R., Martin, W. C., Musgrove, A., Sugar, J., and Wiese, W. L., "NIST Atomic Spectroscopic Database" ver. 1.1, January 1996. NIST Physical Reference Data, National Institute of Standards and Technology, Gaithersburg, MD. Available at the WWW address: <http://physics.nist.gov/PhysRefData/contents.html>

SOURCES OF DATA FOR EACH ELEMENT

Numbers following the element name refer to the references below.

Actinium: 193

Aluminum: 6,8,81,89,127,144,146,227,228,282

Americium: 92

Antimony: 164,167,194,386,406

Argon: 190,203,204,219,367,368,372,373,374,375,414,421

Arsenic: 163,168,197,244,280

Astatine: 188

Barium: 1,78,111,252,259,277,279

Berkelium: 53,339
Beryllium: 15,44,73,102,115,134,135,171,175,198,335
Bismuth: 1,357,358,359,360,361
Boron: 66,69,74,94,104,171,221,222
Bromine: 42,122,124,139,142,240,243,246,248,249,250,316
Cadmium: 44,285,296,353,399
Calcium: 16,25,70,150,270
Californium: 52,331
Carbon: 22,66,211
Cerium: 1,136,166,261,305
Cesium: 78,82,154,155,200,201,259,263,325
Chlorine: 11,28,30,31,85,233,238,239
Chromium: 1,379,380,412
Cobalt: 1,100,125,159,236,276,291
Copper: 199,273,290,295,324
Curium: 51,332
Dysprosium: 1
Einsteinium: 333
Erbium: 1,301
Europium: 1,312
Fluorine: 68,169,224,225,226
Francium: 408
Gadolinium: 1,46,137,151,152
Gallium: 2,19,62,132,140,141,143,195,281
Germanium: 5,119,293,340,341,342
Gold: 38,72,234,393,395
Hafnium: 1,369,404,410,425
Helium: 16,94,173,183,317
Holmium: 1
Hydrogen: 214
Indium: 1,132,348,349,350,351,352,353,435,436
Iodine: 20,21,58,84,124,153,161,176,184
Iridium: 1
Iron: 56,63,71,101,105,138,174,278,381,382
Krypton: 61,121,123,147,208,232,366,390,409,417,421
Lanthanum: 1,78,79,220,309
Lead: 54,64,106,256,274,297,283,329,330
Lithium: 3,15,17,18,37,44,112,284,321,335
Lutetium: 1,148,310,401
Magnesium: 4,7,49,83,103,128,129,177,217,269,315,335
Manganese: 1,126,385,405,433
Mercury (198): 43,50,69,145,229,242
Mercury (Natural): 34,45,90,117,133,189,235,304,327,328,343
Molybdenum: 1,383,420
Neodymium: 1
Neon: 56,58,69,118,150,230,364,365,371,388,389,400,402,413,430

Neptunium: 93
Nickel: 1,294,415,416,422
Niobium: 1,392,407,431
Nitrogen: 66,107,108,212,213,318
Osmium: 1
Oxygen: 23,24,36,66,69,209,210,215
Palladium: 1,287,424
Phosphorus: 179,180,182,336
Platinum: 1,288
Plutonium: 91
Polonium: 47,48
Potassium: 32,59,60,75,76,86,150,160,172,268,314,322
Praseodymium: 1,149,306,308,337,338
Promethium: 196,260
Protactinium: 96
Radium: 253,254
Radon: 251
Rhenium: 1
Rhodium: 1,396
Rubidium: 12,109,130,241,257,258,262,264
Ruthenium: 1,423
Samarium: 1
Scandium: 1,88,150,298,323
Selenium: 9,80,181,216,245,247,275
Silicon: 87,170,237,292,319,320
Silver: 13,99,255,286,289,363,387,398
Sodium: 178,205,206,207,268,299,334
Strontium: 1,109,110,218,231,265,279,313
Sulfur: 29,144,202,209,210,266
Tantalum: 1,411,426
Technetium: 35
Tellurium: 1,344,345,346,347
Terbium: 1,302
Thallium: 1,195,348,354,355,356
Thorium: 1,97,98,156,157,165,434
Thulium: 1,307
Tin: 187,191,399,423
Titanium: 1,378,427,428
Tungsten: 1
Uranium: 1,303
Vanadium: 1,394,397,432
Xenon: 33,116,118,120,232,384,391,429
Ytterbium: 1,40,192,311
Yttrium: 1,77,265,419
Zinc: 39,55,113,131,185,186,370,376,377
Zirconium: 1,362,403,418

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NIST ATOMIC TRANSITION PROBABILITY TABLES

J.R. Fuhr and W.L. Wiese

These tables substantially update and enlarge our earlier tables in this *Handbook*. The new tables contain critically evaluated atomic transition probabilities for about 9000 selected lines of all elements for which reliable data are available on an absolute scale. The material is largely for neutral and singly ionized spectra, but also includes a number of prominent lines of more highly charged ions of important elements.

Many of the data are obtained from comprehensive compilations of the Data Center on Atomic Transition Probabilities at the National Institute of Standards and Technology (formerly the National Bureau of Standards). Specifically, data have been taken from three recent comprehensive critical compilations on C, N and O,¹ on Sc through Mn,² and Fe through Ni.³ Material from earlier compilations for the elements H through Ne⁴ and Na through Ca⁵ was supplemented by more recent material taken directly from the original literature. For the highly charged ions, some of the data were derived from studies of the systematic behavior of transition probabilities.⁶⁻⁸ Most of the original literature is cited in the above tables and in recent bibliographies^{9,10}; for lack of space, individual literature references are not cited here.

The wavelength range for the neutral species is normally the visible spectrum or shorter wavelengths; only the very prominent near infrared lines are included. For the higher ions, most of the strong lines are located in the far UV. The tabulation is limited to electric dipole — including intercombination — lines and comprises essentially the fairly strong transitions with estimated uncertainties of 50% or less. With the exception of hydrogen, helium, and the alkalis, most transitions are between states with low principal quantum numbers.

The transition probability, A , is given in units of 10^8 s^{-1} and is listed to as many digits as is consistent with the indicated accuracy. The power of 10 is indicated by the E notation (i.e., E-02 means 10^{-2}). Generally, the estimated uncertainties of the A -values are ± 25 to 50% for two-digit numbers, ± 10 to 25% for three-digit numbers and $\pm 1\%$ or better for four- and five-digit numbers.

Each transition is identified by the wavelength, λ , in angstroms; and the statistical weights, g_i and g_k , of the lower (i) and upper (k) states [the product $g_k A$ (or $g_i f$) is needed for many applications]. Whenever the wavelengths of individual lines within a multiplet are extremely close, only an average wavelength for the multiplet as well as the multiplet A -value are given, and this is indicated by an asterisk (*) to the left of the wavelength. This also has been done when the transition probability for an entire multiplet has been taken from the literature and values for individual lines cannot be determined because of insufficient knowledge of the coupling of electrons. The wavelength data have been taken either from recent compilations or from the original literature cited in bibliographies published by the Atomic Energy Levels Data Center^{11,12} at the National Institute of Standards and Technology. Wavelength values are consistent with those given in the table "Line Spectra of the Elements", which appears elsewhere in this *Handbook*.

The transition probabilities for hydrogen and hydrogen-like ions are known precisely. Because of the hydrogen degeneracy, a "transition" is actually the sum of all fine-structure transitions between the principal quantum numbers listed in the transition column; therefore, the special hydrogen table which appears below gives weighted average A -values.

In addition to the transition probability A , the atomic oscillator strength f and the line strength S are often used in the literature. The conversion factors between these quantities are (for electric-dipole transitions):

$$g_i f = 1.499 \times 10^{-8} \lambda^2 g_k A = 303.8 \lambda^{-1} S$$

where λ is in angstroms, A is in 10^8 s^{-1} , and S is in atomic units, which are $a_0^2 e^2 = 7.188 \times 10^{-59} \text{ m}^2 \text{ C}^2$.

After the special table for hydrogen, the tables for other elements appear in alphabetical sequence by element name (not symbol). Within each element, the tables are ordered by increasing ionization stage (e.g., Al I, Al II, etc.).

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Transition Probabilities for Allowed Lines of Hydrogen

λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹
	g_i	g_k			g_i	g_k			g_i	g_k	
Hydrogen				3664.68	8	1568	4.022E-06	8598.40	18	392	9.211E-05
HI				3666.10	8	1458	4.826E-06	8665.02	18	338	1.343E-04
912.768	2	1800	5.167E-06	3667.68	8	1352	5.830E-06	8750.48	18	288	2.021E-04
912.839	2	1682	6.122E-06	3669.46	8	1250	7.096E-06	8862.79	18	242	3.156E-04
912.918	2	1568	7.297E-06	3671.48	8	1152	8.707E-06	9014.91	18	200	5.156E-04
913.006	2	1458	8.753E-06	3673.76	8	1058	1.078E-05	9229.02	18	162	8.905E-04
913.104	2	1352	1.057E-05	3676.36	8	968	1.347E-05	9545.97	18	128	1.651E-03
913.215	2	1250	1.286E-05	3679.35	8	882	1.700E-05	10049.4	18	98	3.358E-03
913.339	2	1152	1.578E-05	3682.81	8	800	2.172E-05	10938.1	18	72	7.783E-03
913.480	2	1058	1.952E-05	3686.83	8	722	2.809E-05	12818.1	18	50	2.201E-02
913.641	2	968	2.438E-05	3691.55	8	648	3.685E-05	16407.2	32	288	1.620E-04
913.826	2	882	3.077E-05	3697.15	8	578	4.910E-05	16806.5	32	242	2.556E-04
914.039	2	800	3.928E-05	3703.85	8	512	6.658E-05	17362.1	32	200	4.235E-04
914.286	2	722	5.077E-05	3711.97	8	450	9.210E-05	18174.1	32	162	7.459E-04
914.576	2	648	6.654E-05	3721.94	8	392	1.303E-04	18751.0	18	32	8.986E-02
914.919	2	578	8.858E-05	3734.37	8	338	1.893E-04	19445.6	32	128	1.424E-03
915.329	2	512	1.200E-04	3750.15	8	288	2.834E-04	21655.3	32	98	3.041E-03
915.824	2	450	1.657E-04	3770.63	8	242	4.397E-04	26251.5	32	72	7.711E-03
916.429	2	392	2.341E-04	3797.90	8	200	7.122E-04	27575	50	288	1.402E-04
917.181	2	338	3.393E-04	3835.38	8	162	1.216E-03	28722	50	242	2.246E-04
918.129	2	288	5.066E-04	3889.05	8	128	2.215E-03	30384	50	200	3.800E-04
919.351	2	242	7.834E-04	3970.07	8	98	4.389E-03	32961	50	162	6.908E-04
920.963	2	200	1.263E-03	4101.73	8	72	9.732E-03	37395	50	128	1.388E-03
923.150	2	162	2.143E-03	4340.46	8	50	2.530E-02	40511.5	32	50	2.699E-02
926.226	2	128	3.869E-03	4861.32	8	32	8.419E-02	43753	72	288	1.288E-04
930.748	2	98	7.568E-03	6562.80	8	18	4.410E-01	46525	50	98	3.253E-03
937.803	2	72	1.644E-02	8392.40	18	800	1.517E-05	46712	72	242	2.110E-04
949.743	2	50	4.125E-02	8413.32	18	722	1.964E-05	51273	72	200	3.688E-04
972.537	2	32	1.278E-01	8437.96	18	648	2.580E-05	59066	72	162	7.065E-04
1025.72	2	18	5.575E-01	8467.26	18	578	3.444E-05	74578	50	72	1.025E-02
1215.67	2	8	4.699E+00	8502.49	18	512	4.680E-05	75004	72	128	1.561E-03
3662.26	8	1800	2.847E-06	8545.39	18	450	6.490E-05	123680	72	98	4.561E-03
3663.40	8	1682	3.374E-06								

For hydrogen-like ions of nuclear charge Z, the following scaling laws hold:

$$A_Z = Z^4 A_{\text{Hydrogen}}; f_Z = f_{\text{H}}; S_Z = Z^{-2} S_{\text{H}}$$

(For wavelengths, $\lambda_Z = Z^{-2} \lambda_{\text{H}}$)

For very highly charged hydrogen-like ions, starting at about Z>25, relativistic corrections¹³ must be applied.

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4628.44	3	5	3.83E-04	5473.46	5	3	2.0E-03	6025.15	5	3	9.0E-03
4642.15	3	5	9.6E-04	5490.12	5	5	8.5E-04	6043.22	5	7	1.47E-02
4647.49	3	3	1.2E-03	5492.09	3	1	5.6E-03	6052.73	3	5	1.9E-03
4702.32	3	3	1.09E-03	5495.87	7	9	1.69E-02	6064.76	5	7	5.8E-04
4746.82	3	1	3.6E-03	5506.11	5	7	3.6E-03	6081.25	3	3	7.5E-04
4752.94	3	3	4.5E-03	5524.96	7	7	1.7E-03	6085.86	3	3	9.0E-05
4768.68	3	5	8.6E-03	5528.97	1	3	1.2E-03	6090.79	1	3	3.0E-03
4798.74	7	9	8.8E-04	5534.49	5	3	2.7E-03	6098.81	3	3	5.2E-03
4835.97	7	9	9.3E-04	5540.87	7	5	4.1E-04	6101.16	3	3	3.3E-03
4836.70	3	5	1.02E-03	5552.77	3	3	7.9E-04	6104.58	3	1	3.4E-03
4876.26	3	5	7.8E-03	5558.70	3	5	1.42E-02	6105.64	3	5	1.21E-02
4886.29	7	9	1.2E-03	5559.66	3	5	2.2E-03	6113.46	3	5	4.7E-04
4887.95	3	3	1.3E-02	5572.54	5	7	6.6E-03	6119.66	3	3	5.1E-04
4894.69	3	1	1.8E-02	5574.22	3	5	4.6E-04	6121.86	3	5	1.3E-04
4921.04	5	7	5.9E-04	5581.87	7	5	5.6E-04	6127.42	5	3	1.1E-03
4937.72	7	5	3.6E-04	5588.72	5	5	1.5E-03	6128.73	3	5	8.6E-04
4956.75	7	9	1.8E-03	5597.48	5	7	4.2E-03	6145.44	5	7	7.6E-03
4989.95	5	7	1.1E-03	5606.73	3	3	2.20E-02	6155.24	5	3	5.1E-03
5032.03	7	5	8.2E-04	5618.01	3	3	2.1E-03	6165.12	5	5	9.89E-04
5048.81	3	5	4.6E-03	5620.92	3	1	3.6E-03	6170.17	5	5	5.0E-03
5054.18	3	3	4.5E-03	5623.78	5	5	1.4E-03	6173.10	3	5	6.7E-03
5056.53	3	1	5.7E-03	5635.58	3	5	9.6E-04	6179.41	5	3	6.6E-04
5060.08	7	9	3.7E-03	5637.33	1	3	9.1E-04	6212.50	5	7	3.9E-03
5070.99	5	3	2.6E-03	5639.12	1	3	2.1E-03	6215.94	5	5	5.7E-03
5073.08	3	5	5.9E-04	5641.39	3	5	8.7E-04	6230.93	5	5	1.2E-04
5078.03	7	7	4.7E-04	5648.69	5	3	1.2E-03	6243.40	3	1	1.3E-03
5087.09	5	7	1.6E-03	5650.70	3	1	3.20E-02	6244.73	3	5	2.0E-04
5104.74	3	5	8.7E-04	5659.13	5	5	2.6E-03	6248.41	3	5	6.8E-04
5118.21	5	7	2.7E-03	5681.90	5	7	2.0E-03	6278.65	5	7	2.0E-04
5127.80	5	5	3.3E-04	5683.73	5	5	2.0E-03	6296.87	3	5	9.0E-03
5151.39	3	1	2.39E-02	5700.87	5	7	5.9E-03	6307.66	5	5	6.0E-03
5152.30	3	5	1.1E-03	5712.51	1	3	8.7E-04	6309.14	3	3	7.6E-04
5162.29	3	3	1.90E-02	5739.52	3	5	8.7E-03	6364.89	3	1	5.6E-03
5177.54	7	5	2.4E-03	5772.11	5	7	2.0E-03	6369.58	5	3	4.2E-03
5192.72	7	7	1.2E-04	5773.99	5	5	1.1E-03	6384.72	3	3	4.21E-03
5194.02	3	1	7.8E-03	5783.54	3	5	8.1E-04	6416.31	3	5	1.16E-02
5210.49	7	7	1.1E-03	5789.48	5	5	4.6E-04	6431.56	5	3	5.1E-04
5214.77	5	3	2.1E-03	5790.40	5	3	3.4E-04	6466.55	1	3	1.5E-03
5216.28	5	3	1.3E-03	5802.08	5	3	4.2E-03	6481.14	1	3	9.4E-04
5221.27	7	9	8.8E-03	5843.77	3	5	3.3E-04	6513.85	3	3	5.4E-04
5241.09	5	5	1.3E-03	5882.62	3	1	1.23E-02	6538.11	7	7	1.1E-03
5246.24	5	7	1.2E-03	5888.58	7	5	1.29E-02	6596.12	7	5	2.3E-04
5249.20	5	5	7.9E-04	5916.58	5	3	5.9E-04	6598.68	5	5	3.6E-04
5252.79	5	7	5.4E-03	5927.11	7	7	3.7E-04	6604.02	7	5	2.8E-03
5254.47	3	5	3.6E-03	5928.81	5	3	1.1E-02	6604.85	5	7	1.3E-04
5286.07	5	7	9.6E-04	5940.86	1	3	1.2E-03	6632.09	3	3	5.3E-04
5290.00	5	3	9.0E-04	5942.67	5	5	1.8E-03	6656.88	3	3	3.1E-04
5309.52	5	5	1.2E-03	5943.89	7	5	3.6E-04	6660.68	3	1	7.8E-03
5317.73	5	7	2.6E-03	5949.26	3	3	1.5E-03	6664.05	5	5	1.5E-03
5373.50	3	5	2.7E-03	5964.48	1	3	7.7E-04	6677.28	3	1	2.36E-03
5393.27	5	5	9.6E-04	5968.32	3	3	1.8E-03	6684.73	3	5	3.9E-04
5410.48	5	7	2.0E-03	5971.60	3	1	1.1E-02	6698.47	3	3	2.5E-04
5421.35	7	5	6.0E-03	5981.90	5	7	1.2E-04	6698.88	5	3	1.6E-03
5439.99	3	3	1.9E-03	5987.30	7	7	1.2E-03	6719.22	1	3	2.4E-03
5442.24	7	7	9.3E-04	5988.13	3	5	6.1E-04	6722.88	5	7	3.2E-04
5451.65	3	5	4.7E-03	5994.66	3	5	2.6E-04	6752.84	3	5	1.93E-02
5457.42	5	3	3.6E-03	5999.00	5	5	1.4E-03	6754.37	3	3	2.1E-03
5459.65	7	7	3.8E-04	6005.73	5	3	1.4E-03	6756.10	5	5	3.6E-03
5467.16	5	5	7.6E-04	6013.68	7	5	1.4E-03	6766.61	5	3	4.0E-03

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
6779.93	1	3	1.21E-03	8014.79	5	5	9.28E-02	13622.4	3	5	7.3E-02
6818.29	3	1	2.0E-03	8037.23	1	3	3.59E-03	13678.5	3	5	6.2E-02
6827.25	5	3	2.4E-03	8046.13	3	1	1.12E-02	14093.6	1	3	4.3E-02
6851.88	3	5	6.7E-04	8053.31	5	3	8.6E-03	14739.1	5	7	8.8E-04
6871.29	3	3	2.78E-02	8066.60	5	5	1.4E-03	15046.4	1	3	5.2E-02
6879.59	3	5	1.8E-03	8103.69	3	3	2.5E-01	15172.3	1	3	1.3E-02
6887.10	5	7	1.3E-03	8115.31	5	7	3.31E-01	15329.6	5	5	1.2E-03
6888.17	3	5	2.5E-03	8264.52	3	3	1.53E-01	15555.5	5	7	9.8E-05
6925.01	3	3	1.2E-03	8384.73	5	7	2.4E-03	15734.9	5	3	2.9E-04
6937.67	3	1	3.08E-02	8408.21	3	5	2.23E-01	15816.8	5	3	8.7E-04
6951.46	5	5	2.2E-03	8424.65	3	5	2.15E-01	15989.3	1	3	1.9E-02
6960.23	5	5	2.4E-03	8490.30	3	5	9.6E-04	16122.7	5	3	3.9E-04
6965.43	5	3	6.39E-02	8521.44	3	3	1.39E-01	16180.0	5	5	1.2E-03
6992.17	3	1	7.5E-03	8605.78	5	5	1.04E-02	16264.1	3	3	3.0E-04
7030.25	7	5	2.67E-02	8620.46	1	3	9.2E-03	16520.1	3	5	2.6E-03
7067.22	5	5	3.80E-02	8667.94	1	3	2.43E-02	16739.8	3	5	3.1E-03
7068.73	5	3	2.0E-02	8761.69	3	5	9.5E-03	16940.4	5	5	2.5E-02
7086.70	1	3	1.5E-03	8784.61	3	1	2.4E-03	20317.0	1	3	1.6E-03
7107.48	5	5	4.5E-03	8799.08	5	3	4.6E-03	20616.5	5	5	3.9E-03
7125.83	3	3	6.0E-03	8962.19	3	3	1.6E-03	20812.0	5	7	7.6E-04
7147.04	5	3	6.25E-03	9075.42	3	1	1.2E-02	21332.2	3	3	3.2E-04
7158.83	3	1	2.1E-02	9122.97	5	3	1.89E-01	21534.9	3	5	1.1E-03
7162.57	1	3	5.8E-04	9194.64	3	3	1.76E-02	22039.2	3	1	1.2E-03
7206.98	5	3	2.48E-02	9224.50	3	5	5.03E-02	22077.4	5	3	1.4E-03
7229.93	5	5	6.6E-04	9291.53	3	1	3.26E-02	23133.4	3	3	1.7E-03
7265.17	3	3	1.7E-03	9354.22	3	3	1.06E-02	23844.8	9	7	1.1E-02
7270.66	7	7	1.1E-03	9657.78	3	3	5.43E-02	23967.5	3	1	3.6E-03
7272.93	3	3	1.83E-02	9784.50	3	5	1.47E-02				
7285.44	5	3	1.2E-03	10470.05	1	3	9.8E-03	Ar II			
7311.72	3	3	1.7E-02	10478.0	3	3	2.44E-02	2317.7	6	4	1.4E-01
7316.01	3	3	9.6E-03	10950.7	5	3	3.96E-03	2891.6	4	2	1.82E-01
7350.78	3	1	1.2E-02	11078.9	5	5	8.3E-03	2942.9	4	4	5.3E-01
7353.32	5	7	9.6E-03	11393.7	3	1	2.22E-02	2979.1	2	2	4.16E-01
7372.12	7	9	1.9E-02	11441.8	5	3	1.39E-02	3033.5	2	4	9.9E-02
7383.98	3	5	8.47E-02	11467.5	3	5	3.69E-03	3139.0	6	6	5.2E-01
7392.97	5	3	7.2E-03	11488.11	3	3	1.9E-03	3169.7	4	6	4.9E-01
7412.33	3	5	3.9E-03	11668.7	5	5	3.76E-02	3181.0	6	4	3.7E-01
7422.26	3	5	6.6E-04	11719.5	5	3	9.52E-03	3212.5	4	4	5.2E-02
7425.29	5	7	3.1E-03	12026.6	1	3	4.2E-03	3221.6	6	6	1.8E-02
7435.33	5	5	9.0E-03	12112.2	7	7	3.1E-02	3226.0	4	4	2.1E-02
7436.25	7	5	2.7E-03	12139.8	3	3	4.5E-02	3243.7	4	2	1.06E+00
7471.17	3	3	2.2E-04	12343.7	5	7	2.0E-02	3249.8	2	4	6.3E-01
7484.24	3	5	3.4E-03	12402.9	3	3	1.1E-01	3263.6	2	4	1.55E-01
7503.84	3	1	4.45E-01	12439.2	3	5	4.9E-02	3281.7	2	2	4.2E-01
7510.42	5	5	4.5E-03	12456.1	5	3	8.9E-02	3430.4	6	8	6.2E-02
7514.65	3	1	4.02E-01	12487.6	7	5	1.1E-01	3454.1	6	4	3.14E-01
7618.33	3	5	2.9E-03	12554.4	7	5	1.2E-03	3466.3	8	6	3.0E-02
7628.86	3	5	2.9E-03	12702.4	3	3	7.1E-02	3476.7	6	6	1.25E+00
7635.11	5	5	2.45E-01	12733.6	5	5	1.1E-02	3491.2	4	4	1.79E+00
7670.04	5	3	2.8E-03	12746.3	3	3	2.0E-02	3491.5	6	8	2.31E+00
7704.81	5	7	6.3E-04	12802.7	5	5	5.7E-02	3509.8	2	2	2.55E+00
7723.76	5	3	5.18E-02	12933.3	3	1	1.0E-01	3514.4	4	6	1.36E+00
7724.21	1	3	1.17E-01	12956.6	3	3	7.4E-02	3520.0	6	6	5.2E-01
7798.55	3	5	8.7E-04	13008.5	5	3	8.9E-02	3521.3	8	8	2.27E-01
7868.20	1	3	3.50E-03	13214.7	3	1	8.1E-02	3535.3	2	4	5.7E-01
7891.08	5	5	9.5E-03	13273.1	5	7	1.5E-01	3548.5	4	4	8.7E-01
7916.45	3	3	1.2E-03	13313.4	3	5	1.3E-01	3550.0	6	6	2.6E-02
7948.18	1	3	1.86E-01	13504.0	5	7	1.1E-01	3556.9	2	2	5.0E-02
8006.16	3	5	4.90E-02	13599.2	5	5	2.2E-02	3559.5	6	8	2.88E+00

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3565.0	2	4	5.5E-01	4228.2	4	6	1.31E-01	6483.1	4	2	1.06E-01
3576.6	6	8	2.75E+00	4237.2	4	4	1.12E-01	6638.2	6	4	1.37E-01
3581.6	2	4	1.76E+00	4266.5	6	6	1.64E-01	6639.7	4	2	1.69E-01
3582.4	4	6	2.53E+00	4277.5	6	4	8.0E-01	6643.7	10	8	1.47E-01
3588.4	8	10	3.03E+00	4282.9	4	2	1.32E-01	6666.4	2	2	8.8E-02
3605.9	4	6	4.4E-02	4300.6	6	6	5.7E-02	6684.3	8	6	1.07E-01
3656.0	6	6	7.6E-02	4331.2	4	4	5.74E-01	6756.6	4	4	2.0E-02
3682.5	4	2	1.7E-02	4332.0	4	2	1.92E-01	6863.5	6	6	2.5E-02
3709.9	4	4	4.7E-02	4348.1	6	8	1.17E+00	7233.5	2	4	3.7E-02
3717.2	6	8	5.2E-02	4352.2	2	2	2.12E-01	7380.4	4	4	5.6E-02
3729.3	6	4	4.80E-01	4362.1	4	6	5.5E-02	7589.3	6	4	1.07E-01
3746.9	4	6	2.1E-02	4370.8	4	4	6.6E-01				
3763.5	8	6	1.78E-01	4371.3	6	4	2.21E-01	Ar III			
3766.1	4	4	7.4E-02	4376.0	4	2	2.05E-01	769.15	5	3	6.0E+00
3777.5	2	2	1.1E-02	4379.7	2	2	1.00E+00	871.10	5	3	1.59E+00
3780.8	8	8	7.7E-01	4383.8	4	4	1.1E-02	875.53	3	1	3.74E+00
3786.4	8	6	1.5E-02	4400.1	4	4	1.60E-01	878.73	5	5	2.79E+00
3799.4	6	4	1.7E-01	4401.0	8	6	3.04E-01	879.62	3	3	9.2E-01
3808.6	6	6	1.0E-02	4412.9	6	8	6.1E-02	883.18	1	3	1.22E+00
3826.8	6	6	2.81E-01	4420.9	2	4	3.1E-02	887.40	3	5	9.0E-01
3841.5	4	2	2.69E-01	4426.0	4	6	8.17E-01	3024.1	5	7	2.6E+00
3844.7	6	8	4.8E-02	4430.2	2	4	5.69E-01	3027.2	5	5	6.4E-01
3845.4	6	4	1.6E-02	4431.0	6	6	1.09E-01	3054.8	3	5	1.9E+00
3850.6	4	4	3.87E-01	4460.6	4	6	1.5E-02	3064.8	3	3	1.0E+00
3868.5	4	6	1.4E+00	4474.8	4	2	2.90E-01	3078.2	1	3	1.4E+00
3872.1	4	4	1.5E-01	4481.8	6	6	4.55E-01	3285.9	5	7	2.0E+00
3875.3	4	2	8.2E-02	4491.0	6	4	4.6E-02	3301.9	5	5	2.0E+00
3880.3	2	2	2.32E-01	4530.5	6	4	2.1E-02	3311.3	5	3	2.0E+00
3891.4	2	2	4.3E-02	4545.1	4	4	4.71E-01	3336.1	7	9	2.0E+00
3892.0	6	4	6.3E-02	4579.4	2	2	8.0E-01	3344.7	5	7	1.8E+00
3900.6	4	6	7.2E-02	4589.9	4	6	6.64E-01	3352.1	7	7	2.2E-01
3911.6	2	4	7.7E-02	4598.8	4	4	6.7E-02	3358.5	3	5	1.6E+00
3914.8	4	4	3.7E-02	4609.6	6	8	7.89E-01	3361.3	5	5	3.0E-01
3928.6	2	4	2.44E-01	4637.2	6	6	7.1E-02	3472.6	5	7	2.0E-01
3931.2	2	4	2.0E-02	4657.9	4	2	8.92E-01	3480.6	7	7	1.6E+00
3932.5	4	4	9.3E-01	4726.9	4	4	5.88E-01	3499.7	3	3	1.3E+00
3944.3	8	6	4.1E-02	4732.1	6	4	6.7E-02	3500.6	3	5	2.6E-01
3952.7	4	4	2.08E-01	4735.9	6	4	5.80E-01	3502.7	5	3	4.3E-01
3958.4	6	4	3.8E-02	4764.9	2	4	6.4E-01	3503.6	5	5	1.2E+00
3968.4	6	6	4.8E-02	4806.0	6	6	7.80E-01	3511.7	7	5	2.6E-01
3979.4	4	2	9.8E-01	4847.8	4	2	8.49E-01				
3988.2	6	6	4.1E-02	4879.9	4	6	8.23E-01	Ar IV			
3992.1	4	6	1.6E-02	4889.0	2	2	1.9E-01	840.03	4	2	2.73E+00
4013.9	8	8	1.05E-01	4904.8	6	8	3.7E-02	843.77	4	4	2.70E+00
4031.4	4	2	7.5E-02	4933.2	4	4	1.44E-01	850.60	4	6	2.63E+00
4035.5	4	6	4.4E-02	4965.1	2	4	3.94E-01				
4038.8	6	8	1.2E-02	4972.2	2	2	9.7E-02	Ar VI			
4042.9	4	4	4.06E-01	5009.3	4	6	1.51E-01	292.15	2	2	6.9E+01
4045.7	4	4	1.6E-02	5017.2	4	6	2.07E-01	294.05	4	2	1.36E+02
4052.9	2	4	6.7E-01	5017.6	4	4	1.1E-02				
4065.1	4	4	1.1E-02	5062.0	2	4	2.23E-01	Ar VII			
4072.0	6	6	5.8E-01	5141.8	6	8	8.1E-02	*250.41	9	3	2.78E+02
4079.6	6	4	1.19E-01	5145.3	4	6	1.06E-01	*477.54	9	15	9.92E+01
4082.4	6	6	2.9E-02	5176.2	6	6	1.7E-02	585.75	1	3	7.83E+01
4112.8	4	4	1.1E-02	6103.5	2	2	1.7E-02	*637.30	9	9	6.7E+01
4128.6	8	6	1.4E-02	6114.9	10	8	2.00E-01				
4131.7	4	2	8.5E-01	6138.7	6	4	1.2E-02	Ar VIII			
4178.4	6	4	1.2E-02	6172.3	8	6	2.00E-01	158.92	2	4	1.1E+02
4202.0	2	4	2.1E-02	6243.1	8	6	3.0E-02	159.18	2	2	1.11E+02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
229.44	2	2	1.12E+02	2860.4	2	2	5.5E-01	5777.6	5	7	6.5E-01
230.88	4	2	2.21E+02	2898.7	4	2	9.9E-02	5784.0	3	5	2.1E-01
337.09	4	4	1.2E+01					5800.2	5	5	9.9E-02
337.26	6	4	1.0E+02					5805.7	7	7	1.1E-02
338.22	4	2	1.1E+02	Barium				5826.3	5	3	5.6E-01
519.43	2	4	6.3E+01	Ba I				5907.6	3	5	1.5E-02
526.46	4	6	7.2E+01	2409.2	1	3	8.6E-04	5971.7	5	5	1.8E-01
526.87	4	4	1.2E+01	2414.1	1	3	1.5E-03	5997.1	3	3	2.7E-01
700.24	2	4	2.55E+01	2420.1	1	3	2.3E-03	6019.5	3	1	1.4E+00
713.81	2	2	2.4E+01	2427.4	1	3	5.6E-03	6063.1	5	3	5.7E-01
Ar IX				2432.5	1	3	7.2E-03	6083.4	3	1	1.1E-01
48.739	1	3	1.69E+03	2438.8	1	3	1.4E-03	6110.8	7	5	5.5E-01
Ar XIII				2444.6	1	3	4.5E-03	6129.2	3	1	6.0E-02
162.96	5	3	3.4E+02	2452.4	1	3	8.1E-04	6341.7	5	7	1.9E-01
*163.08	9	3	5.3E+02	2473.2	1	3	4.6E-03	6450.9	3	5	1.1E-01
184.90	5	5	1.66E+02	2500.2	1	3	1.5E-02	6482.9	5	7	4.4E-01
186.38	1	3	8.8E+01	2543.2	1	3	4.1E-02	6498.8	7	7	8.6E-01
*207.89	9	9	9.5E+01	2596.6	1	3	1.2E-01	6527.3	5	5	5.9E-01
*245.10	9	15	3.7E+01	2646.5	1	3	1.1E-02	6595.3	3	3	3.9E-01
Ar XIV				2702.6	1	3	2.5E-02	6675.3	5	3	1.9E-01
180.29	2	4	4.5E+01	2739.2	1	3	9.1E-03	6693.8	7	5	2.8E-01
183.41	2	2	1.69E+02	2785.3	1	3	2.8E-02	6865.7	5	5	2.3E-02
187.95	4	4	1.97E+02	3071.6	1	3	4.1E-01	7059.9	7	9	7.1E-01
191.35	4	2	7.5E+01	3501.1	1	3	1.9E-01	7120.3	3	5	2.1E-01
194.39	2	2	4.6E+01	3889.3	1	3	8.8E-03	7195.2	1	3	2.4E-01
203.35	4	2	7.8E+01	3909.9	3	5	4.9E-01	7280.3	5	7	5.3E-01
Ar XV				3935.7	5	7	4.7E-01	7392.4	3	3	5.0E-01
25.05	1	3	1.7E+04	3937.9	5	5	1.1E-01	7417.5	7	5	2.5E-02
221.10	1	3	9.55E+01	3993.4	7	9	5.5E-01	7488.1	7	7	1.0E-01
*265.3	9	9	8.1E+01	3995.7	7	7	8.8E-02	7528.2	5	5	2.7E-02
Ar XVI				4132.4	1	3	7.1E-03	7672.1	3	5	3.1E-01
*23.52	2	6	1.43E+04	4239.6	5	3	2.4E-01	7780.5	5	5	1.3E-01
*24.96	6	10	4.4E+04	4242.6	3	5	5.6E-02	7905.8	5	3	6.3E-01
353.88	2	4	1.5E+01	4264.4	1	3	1.5E-01	7911.3	1	3	2.98E-03
389.11	2	2	1.1E+01	4283.1	5	7	6.4E-01	8147.7	5	5	6.3E-02
1268	2	4	1.9E+00	4323.0	3	5	1.5E-01	9645.6	7	5	1.1E-01
1401	2	2	1.4E+00	4325.2	5	7	7.1E-02	9704.3	3	1	1.6E-01
2975	2	4	9.0E-02	4332.9	3	3	1.5E-01	9821.5	3	1	5.5E-02
3514	4	6	6.5E-02	4350.3	3	5	6.0E-01	10370.3	3	5	1.3E-02
Arsenic				4402.5	3	5	2.7E-01	10649.1	5	5	2.7E-02
As I				4406.8	5	5	1.0E-01	11075.7	3	3	3.6E-05
1890.4	4	6	2.0E+00	4431.9	1	3	1.2E+00	11303.1	5	3	1.2E-03
1937.6	4	4	2.0E+00	4467.1	5	7	6.6E-02	11373.8	3	1	1.3E-01
1972.6	4	2	2.0E+00	4489.0	5	7	4.2E-01	14158.4	9	7	2.0E-03
2288.1	6	4	2.8E+00	4493.6	5	5	3.6E-01	14723.2	3	5	8.6E-03
2344.0	2	4	3.5E-01	4505.9	3	3	1.1E+00	14999.9	5	3	2.8E-03
2349.8	4	2	3.1E+00	4523.2	5	5	9.6E-01	17123.7	7	7	3.3E-03
2369.7	4	4	6.0E-01	4573.9	3	1	1.21E+00	17187.1	3	1	2.7E-02
2370.8	4	6	4.2E-01	4579.6	5	5	7.0E-01	20563.9	5	7	2.6E-03
2456.5	6	4	7.2E-02	4591.8	5	5	1.6E-02				
2492.9	4	2	1.2E-01	4599.7	3	1	4.07E-01				
2745.0	2	4	2.6E-01	4605.0	3	1	7.7E-02	Ba II			
2780.2	4	4	7.8E-01	4619.9	1	3	9.3E-02	1413.4	6	8	1.7E-02
				4628.3	5	3	6.0E-02	1417.1	4	6	3.8E-02
				4673.6	7	5	6.5E-02	1444.9	4	6	8.1E-02
				4691.6	5	3	1.6E+00	1461.5	6	8	8.7E-02
				4700.4	3	3	2.4E-01	1487.0	4	6	1.4E-01
				4726.4	5	3	4.6E-01	1503.9	6	8	1.5E-01
				5519.1	3	5	5.0E-01	1554.4	4	6	2.6E-01
				5535.5	1	3	1.19E+00	1572.7	6	8	2.4E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
1573.9	6	6	1.6E-02	5428.8	6	4	2.3E-02	2061.7	4	6	9.9E-01
1630.4	2	2	1.7E-02	5480.3	8	6	1.8E-02	2110.3	4	2	9.1E-01
1674.5	4	6	2.2E-01	5784.2	2	4	2.0E-01	2177.3	4	2	2.6E-02
1694.4	6	8	2.1E-01	5853.7	4	4	4.8E-02	2228.3	4	4	8.9E-01
1697.2	6	6	1.7E-02	5981.3	4	6	1.6E-01	2230.6	4	6	2.6E+00
1761.8	4	4	3.9E-03	5999.9	4	4	2.6E-02	2276.6	4	4	2.5E-01
1771.0	4	2	3.4E-02	6135.8	2	2	8.5E-02	2515.7	4	6	4.3E-02
1786.9	6	4	4.4E-02	6141.7	6	4	3.7E-01	2627.9	4	4	4.7E-01
1892.7	2	4	9.0E-02	6363.2	6	4	2.9E-03	2696.8	4	6	6.4E-02
1904.2	4	6	1.1E-02	6372.9	4	4	6.7E-04	2780.5	4	2	3.09E-01
1906.8	2	2	5.1E-02	6378.9	4	2	9.9E-02	2798.7	6	6	3.6E-02
1924.7	6	8	3.1E-02	6457.7	6	4	3.0E-03	2898.0	4	2	1.53E+00
1954.2	4	6	1.3E-01	6496.9	4	2	3.32E-01	2938.3	6	4	1.23E+00
1955.1	4	4	1.8E-02	7556.8	6	4	1.6E-03	2989.0	4	4	5.5E-01
1970.2	4	2	6.7E-02	7678.2	8	6	6.6E-04	2993.3	4	6	1.6E-01
1985.6	2	4	2.5E-01	8710.7	6	8	8.0E-01	3024.6	6	6	8.8E-01
1999.5	2	4	1.0E-01	8737.7	4	6	9.3E-01	3067.7	4	2	2.07E+00
2009.2	2	2	8.6E-02					3076.7	4	4	3.5E-02
2052.7	4	6	2.0E-01	Beryllium				3397.2	6	4	1.81E-01
2054.6	4	4	2.9E-02	Be I				3402.9	6	6	1.6E-02
2080.0	4	2	1.0E-01	1491.8	1	3	1.3E-02	3510.9	6	4	6.8E-02
2153.9	2	4	5.3E-01	1661.5	1	3	2.0E-01	3596.1	2	4	1.98E-01
2200.9	2	2	2.0E-01	2348.6	1	3	5.55E+00	3888.2	2	2	6.9E-02
2232.8	4	6	2.9E-01	*2494.7	9	15	1.6E+00	4121.5	2	2	1.64E-01
2235.4	4	4	4.4E-02	*2650.6	9	9	4.24E+00	4308.5	2	4	1.6E-02
2286.0	4	2	1.3E-01	4572.7	3	5	7.9E-01	4493.0	2	4	1.5E-02
2528.5	2	4	7.1E-01					4722.5	4	2	1.17E-01
2634.8	4	6	7.6E-01	Be II				6134.8	4	4	1.8E-02
2641.4	4	4	1.2E-01	1197.1	2	2	4.7E-01				
2647.3	2	2	2.0E-01	1197.2	4	2	9.4E-01	Boron			
2771.4	4	2	4.0E-01	1512.3	2	4	9.2E+00	B I			
3816.7	4	6	2.3E-03	1512.4	4	6	1.1E+01	1378.6	2	4	3.50E+00
3842.8	6	8	2.2E-03	1776.1	2	2	1.4E+00	1378.9	2	2	1.40E+01
3891.8	2	4	1.67E+00	1776.3	4	2	2.9E+00	1378.9	4	4	1.75E+01
4024.1	6	4	5.3E-03	*2453.8	2	6	1.42E-01	1379.2	4	2	7.0E+00
4057.5	8	6	1.2E-02	3046.5	2	4	4.8E-01	1465.5	2	4	3.34E+00
4130.7	4	6	1.80E+00	3046.7	4	6	5.9E-01	1465.7	4	4	6.7E+00
4166.0	4	4	3.7E-01	3130.4	2	4	1.14E+00	1465.8	6	4	1.00E+01
4216.0	2	4	5.8E-02	3131.1	2	2	1.15E+00	1825.9	2	4	1.76E+00
4287.8	2	2	2.4E-02	3241.6	2	2	1.41E-01	1826.4	4	6	2.11E+00
4325.7	4	6	5.9E-02	3241.8	4	2	2.8E-01	2088.9	2	4	2.8E-01
4329.6	4	4	8.8E-03	3274.6	2	4	1.9E-01	2089.6	4	6	3.3E-01
4405.2	4	2	3.9E-02	3274.7	2	2	1.9E-01	2496.8	2	2	8.64E-01
4470.7	6	4	1.4E-02	4360.7	2	4	9.2E-01	2497.7	4	2	1.73E+00
4509.6	8	6	1.2E-02	4361.0	4	6	1.1E+00				
4524.9	2	2	7.2E-01	*5255.9	2	6	2.56E-02	Bromine			
4554.0	2	4	1.17E+00	5270.3	2	2	3.30E-01	Br I			
4708.9	2	4	9.7E-02	5270.8	4	2	6.6E-01	1488.5	4	4	1.2E+00
4843.5	4	6	9.3E-02	6279.4	2	4	1.2E-01	1540.7	4	4	1.4E+00
4847.1	2	2	4.1E-02	6279.7	4	6	1.43E-01	1574.8	2	4	2.0E-01
4850.8	4	4	1.4E-02	6756.7	2	2	5.1E-02	1576.4	4	6	2.1E-02
4900.0	4	2	7.75E-01	6757.1	4	2	1.02E-01	1633.4	2	4	8.1E-02
4934.1	2	2	9.55E-01	7401.2	2	4	3.0E-02	4365.1	2	4	7.5E-03
4997.8	4	2	6.1E-02	7401.4	2	2	3.0E-02	4425.1	4	2	4.2E-03
5185.0	2	4	1.8E-02					4441.7	6	4	7.5E-03
5361.4	4	6	4.8E-02	Bismuth				4472.6	4	4	9.3E-03
5391.6	6	8	5.2E-02	Bi I				4477.7	6	8	1.3E-02
5413.6	6	6	8.4E-04	1954.5	4	6	1.2E+00	4513.4	6	4	2.8E-03
5421.1	6	6	1.9E-03	2021.2	4	4	6.0E-02				

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4525.6	6	6	7.2E-03	3361.9	5	7	2.23E-01	6493.8	3	5	4.4E-01
4575.7	4	4	1.6E-02	3624.1	1	3	2.12E-01	6499.7	5	5	8.1E-02
4614.6	4	6	5.4E-03	3630.8	3	5	2.97E-01				
4979.8	4	4	2.6E-03	3631.0	3	3	1.53E-01				
5245.1	2	4	3.1E-03	3644.4	5	7	3.55E-01	Ca II			
5345.4	2	4	7.6E-03	3644.8	5	5	9.4E-02	1341.9	2	4	1.5E-02
7348.5	4	6	1.2E-01	3870.5	3	5	7.2E-02	1342.5	2	2	1.5E-02
7513.0	6	4	1.2E-01	3957.1	3	3	9.8E-02	1649.9	2	4	3.2E-03
7803.0	2	4	5.3E-02	3973.7	5	3	1.75E-01	1652.0	2	2	3.1E-03
7938.7	6	6	1.9E-01	4092.6	3	5	1.1E-01	1673.9	2	4	2.24E-01
8131.5	2	4	3.8E-02	4094.9	5	7	1.2E-01	1680.1	4	6	2.65E-01
8343.7	2	2	2.2E-01	4098.5	7	9	1.3E-01	1680.1	4	4	4.41E-02
8446.6	4	4	1.2E-01	4108.5	5	7	9.0E-01	1807.3	2	4	3.54E-01
8638.7	6	4	9.7E-02	4226.7	1	3	2.18E+00	1814.5	4	6	4.2E-01
				4283.0	3	5	4.34E-01	1814.7	4	4	7.0E-02
Br II				4289.4	1	3	6.0E-01	1843.1	2	2	1.6E-01
4704.9	5	7	1.1E+00	4299.0	3	3	4.66E-01	1850.7	4	2	3.08E-01
4785.5	5	5	9.4E-01	4302.5	5	5	1.36E+00	2103.2	2	4	8.2E-01
4816.7	5	3	1.1E+00	4307.7	3	1	1.99E+00	2112.8	4	6	9.7E-01
				4318.7	5	3	7.4E-01	2113.2	4	4	1.6E-01
Cadmium				4355.1	5	7	1.9E-01	2197.8	2	2	3.1E-01
Cd I				4425.4	1	3	4.98E-01	2208.6	4	2	6.2E-01
2288.0	1	3	5.3E+00	4435.0	3	5	6.7E-01	3158.9	2	4	3.1E+00
2836.9	1	3	2.8E-01	4435.7	3	3	3.42E-01	3179.3	4	6	3.6E+00
2880.8	3	5	4.2E-01	4454.8	5	7	8.7E-01	3181.3	4	4	5.8E-01
2881.2	3	3	2.4E-01	4455.9	5	5	2.0E-01	3706.0	2	2	8.8E-01
2980.6	5	7	5.9E-01	4526.9	5	3	4.1E-01	3736.9	4	2	1.7E+00
2981.4	5	5	1.5E-01	4578.6	3	5	1.76E-01	3933.7	2	4	1.47E+00
3261.1	1	3	4.06E-03	4581.4	5	7	2.09E-01	3968.5	2	2	1.4E+00
3403.7	1	3	7.7E-01	4585.9	7	9	2.29E-01				
3466.2	3	5	1.2E+00	4685.3	3	5	8.0E-02	Ca III			
3467.7	3	3	6.7E-01	4878.1	5	7	1.88E-01	357.97	1	3	8.8E+02
3610.5	5	7	1.3E+00	5041.6	5	3	3.3E-01	439.69	1	3	1.9E-01
3612.9	5	5	3.5E-01	5188.9	3	5	4.0E-01	490.55	1	3	1.6E-02
4140.5	3	5	4.7E-02	5261.7	3	3	1.5E-01				
4662.4	3	5	5.5E-02	5262.2	3	1	6.0E-01	Ca V			
4678.1	1	3	1.3E-01	5264.2	5	5	9.1E-02	558.60	5	3	2.2E+01
4799.9	3	3	4.1E-01	5265.6	5	3	4.4E-01	637.93	5	3	3.9E+00
5085.8	5	3	5.6E-01	5270.3	7	5	5.0E-01	643.12	3	1	9.1E+00
6438.5	3	5	5.9E-01	5582.0	5	7	6.0E-02	646.57	5	5	6.9E+00
				5588.8	7	7	4.9E-01	647.88	3	3	2.3E+00
Cd II				5590.1	3	5	8.3E-02	651.55	1	3	2.9E+00
2144.4	2	4	2.8E+00	5594.5	5	5	3.8E-01	656.76	3	5	2.1E+00
2265.0	2	2	3.0E+00	5598.5	3	3	4.3E-01				
2572.9	2	2	1.7E+00	5601.3	7	5	8.6E-02	Ca VII			
2748.5	4	2	2.8E+00	5602.9	5	3	1.4E-01	550.20	5	5	1.8E+01
4415.6	4	6	1.4E-02	5857.5	3	5	6.6E-01	624.39	1	3	3.3E+00
				6102.7	1	3	9.6E-02	630.54	3	5	4.5E+00
Calcium				6122.2	3	3	2.87E-01	630.79	3	3	2.2E+00
Ca I				6161.3	5	5	3.3E-02	639.15	5	7	5.7E+00
2275.5	1	3	3.01E-01	6162.2	5	3	3.54E-01	640.41	5	5	1.3E+00
2995.0	1	3	3.67E-01	6163.8	3	3	5.6E-02				
2997.3	3	5	2.41E-01	6166.4	3	1	2.2E-01	Ca VIII			
2999.6	3	3	2.79E-01	6169.1	5	3	1.7E-01	182.71	2	2	1.6E+02
3000.9	3	1	1.58E+00	6169.6	7	5	1.9E-01	184.16	4	2	3.2E+02
3006.9	5	5	7.5E-01	6439.1	7	9	5.3E-01				
3009.2	5	3	4.30E-01	6449.8	3	5	9.0E-02	Ca IX			
3344.5	1	3	1.51E-01	6462.6	5	7	4.7E-01	163.23	5	3	3.76E+02
3350.2	3	5	1.78E-01	6471.7	7	7	5.9E-02	371.89	1	3	8.8E+01
								373.81	3	5	1.16E+02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
378.08	5	7	1.5E+02	1261.00	3	3	4.42E-01	4817.37	3	3	8.76E-04
395.03	3	5	2.2E+02	1261.12	3	5	3.71E-01	4826.80	5	3	6.28E-04
466.24	1	3	1.12E+02	1261.43	5	3	7.06E-01	4932.05	3	1	6.02E-02
498.01	3	5	2.49E+01	1261.55	5	5	1.27E+00	5023.84	7	9	1.81E-03
506.18	5	5	7.2E+01	1274.11	5	7	1.03E-02	5039.06	7	9	4.73E-03
515.57	5	3	3.75E+01	1277.25	1	3	1.27E+00	5041.48	3	5	5.25E-03
				1277.28	3	5	1.73E+00	5041.79	5	7	3.28E-03
				1277.51	3	3	9.12E-01	5052.17	3	5	2.60E-02
Ca X				1277.55	5	7	2.31E+00	5380.34	3	3	1.86E-02
110.96	2	4	2.9E+02	1277.72	5	5	6.35E-01	5545.05	3	3	3.04E-03
111.20	2	2	2.92E+02	1277.95	5	3	5.56E-02	5668.94	3	3	2.35E-02
151.84	2	2	2.3E+02	1279.23	5	7	1.10E-01	5793.12	7	5	3.44E-03
153.02	4	2	4.5E+02	1279.89	3	5	3.08E-01	5794.47	5	5	6.44E-04
206.57	4	4	2.9E+01	1280.14	1	3	3.11E-01	5800.23	3	3	1.04E-03
206.75	6	4	2.6E+02	1280.33	5	5	5.77E-01	5800.60	5	3	3.04E-03
207.39	4	2	2.8E+02	1280.40	3	3	1.73E-01	5805.20	3	1	4.12E-03
411.70	2	4	8.3E+01	1280.60	3	1	8.22E-01	6001.12	5	5	3.22E-03
419.75	4	6	9.5E+01	1280.85	5	3	3.33E-01	6006.02	7	5	1.79E-02
420.47	4	4	1.6E+01	1328.83	1	3	7.95E-01	6007.18	3	3	5.34E-03
557.76	2	4	3.50E+01	1329.09	3	1	2.41E+00	6010.68	3	1	2.13E-02
574.01	2	2	3.2E+01	1329.58	5	5	1.79E+00	6013.17	7	5	1.79E-02
				1329.60	5	3	1.00E+00	6013.21	7	9	4.35E-03
Ca XI				1355.84	5	7	1.04E+00	6014.83	5	3	1.60E-02
30.448	1	3	6.2E+03	1364.16	5	5	1.57E-01	6016.45	5	7	3.86E-03
30.867	1	3	4.9E+04	1431.60	5	7	2.11E+00	6587.61	3	3	5.09E-02
35.212	1	3	2.0E+03	1432.10	5	5	2.01E+00	6655.52	3	3	5.03E-03
				1432.53	5	3	2.11E+00	6828.12	3	5	9.89E-03
Ca XII				1459.03	5	3	4.76E-01	7111.47	3	5	2.17E-02
140.05	4	2	3.7E+02	1463.34	5	7	1.88E+00	7113.18	7	9	2.47E-02
147.27	2	2	1.6E+02	1467.40	5	3	5.49E-01	7115.17	5	7	2.19E-02
				1468.41	5	3	3.90E-02	7115.18	3	1	4.43E-02
Ca XV				1470.09	5	7	1.37E-02	7116.99	7	5	3.26E-02
141.69	5	3	4.08E+02	1472.23	5	3	8.01E-03	7119.66	5	3	3.12E-02
*142.23	9	3	6.3E+02	1481.76	5	5	3.92E-01	7860.88	5	5	1.53E-02
161.00	5	5	1.9E+02	1560.31	1	3	6.57E-01	8058.62	5	5	1.09E-02
				1561.34	5	5	2.94E-01	8335.15	3	1	3.51E-01
Ca XVII				1561.44	5	7	1.18E+00	9061.44	3	5	7.31E-02
19.558	1	3	3.8E+04	1656.27	3	5	8.58E-01	9062.49	1	3	9.48E-02
21.198	3	5	4.9E+04	1656.93	1	3	1.13E+00	9078.29	3	3	7.07E-02
192.82	1	3	1.21E+02	1657.01	5	5	2.52E+00	9088.51	3	1	3.00E-01
218.82	3	5	2.76E+01	1657.38	3	3	8.64E-01	9094.83	5	5	2.28E-01
223.02	1	3	3.44E+01	1657.91	3	1	3.43E+00	9111.81	5	3	1.35E-01
228.72	3	3	2.37E+01	1658.12	5	3	1.44E+00	9405.73	3	5	2.91E-01
232.83	5	5	6.5E+01	1751.83	1	3	9.07E-01	9603.03	1	3	3.06E-02
244.06	5	3	3.28E+01	1763.91	1	3	3.59E-02	9620.78	3	3	8.62E-02
				1765.37	1	3	1.04E-02	9658.43	5	3	1.25E-01
Ca XVIII				1930.90	5	3	3.51E+00				
*18.71	2	6	2.31E+04	2478.56	1	3	3.40E-01	C II			
*19.74	6	10	7.0E+04	2902.23	1	3	4.32E-03	687.345	4	6	2.84E+01
302.19	2	4	2.0E+01	2903.27	3	3	1.29E-02	858.092	2	2	1.18E+00
344.76	2	2	1.3E+01	2905.00	5	3	2.15E-02	858.559	4	2	2.35E+00
				4371.37	3	3	1.27E-02	903.623	2	4	6.85E+00
Carbon				4762.31	1	3	3.37E-03	903.962	2	2	2.74E+01
C I				4762.53	3	5	2.72E-03	904.142	4	4	3.42E+01
945.191	1	3	3.79E+00	4766.67	3	3	2.36E-03	904.480	4	2	1.37E+01
945.338	3	3	1.14E+01	4770.03	3	1	1.07E-02	1009.86	2	4	5.71E+00
945.579	5	3	1.89E+01	4771.74	5	5	7.97E-03	1010.08	4	4	1.14E+01
1193.24	5	7	1.22E+00	4775.90	5	3	4.84E-03	1010.37	6	4	1.71E+01
1260.74	1	3	5.32E-01	4812.92	1	3	4.03E-04	1036.34	2	2	7.61E+00
1260.93	3	1	1.70E+00								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
1037.02	4	2	1.52E+01	7046.25	4	2	3.20E-01	5695.92	3	5	4.27E-01
1323.91	4	4	4.33E+00	7053.09	4	4	3.19E-01	5858.34	3	1	1.34E-01
1323.95	6	6	4.49E+00	7063.68	4	6	3.17E-01	5863.25	3	3	3.35E-02
1334.53	2	4	2.37E+00	7112.48	2	4	2.94E-01	5871.68	5	3	1.00E-01
1335.71	4	6	2.84E+00	7113.04	4	6	3.15E-01	5880.56	5	5	1.99E-02
2091.14	2	4	1.00E-01	7115.63	6	8	3.60E-01	5894.07	7	5	1.11E-01
2091.19	4	6	1.69E-01	7119.76	4	4	1.17E-01	6727.48	1	3	1.12E-01
2091.65	6	8	2.41E-01	7119.91	8	10	4.19E-01	6731.04	3	5	1.50E-01
2093.16	6	6	7.20E-02	7125.72	6	6	1.02E-01	6742.15	3	3	8.32E-02
2173.85	2	4	2.31E-01	7132.47	6	4	8.33E-03	6744.39	5	7	1.99E-01
2174.17	2	2	2.31E-01	7134.10	8	8	5.93E-02	6762.17	5	5	4.95E-02
2509.13	2	4	4.53E-01	7231.33	2	4	3.52E-01	6773.39	5	3	5.47E-03
2511.74	4	4	9.04E-02	7236.42	4	6	4.22E-01	6851.18	3	5	7.60E-03
2512.06	4	6	5.42E-01	7237.17	4	4	7.03E-02	6853.68	5	7	5.64E-02
2727.31	2	4	6.63E-02	8028.85	2	2	1.71E-02	6857.24	3	3	3.79E-03
2728.72	4	4	3.31E-01	8037.73	2	4	4.26E-02	6862.69	5	5	3.51E-02
2729.21	2	2	2.65E-01	8039.40	4	2	8.51E-02	6868.78	5	3	1.26E-02
2730.63	4	2	1.32E-01	8048.31	4	4	1.36E-02	6872.04	7	7	4.46E-02
5132.95	2	4	3.89E-01	8062.10	4	6	3.04E-02	6881.10	7	5	7.80E-03
5133.28	4	6	2.80E-01	8062.80	6	4	4.56E-02	7353.88	5	3	3.09E-02
5137.26	2	2	1.55E-01	8076.64	6	6	7.05E-02	7707.43	3	5	1.30E-01
5139.17	4	4	1.24E-01	9238.30	4	6	3.34E-02	7771.76	3	1	1.77E-01
5143.49	4	2	7.73E-01	9251.01	2	4	2.77E-02	7780.41	3	3	1.76E-01
5145.16	6	6	6.49E-01	9863.06	2	4	5.56E-02	7796.00	3	5	1.75E-01
5151.08	6	4	4.16E-01	9870.78	4	6	9.31E-02	8500.32	1	3	1.01E-01
5640.55	2	4	9.89E-02	9882.68	6	8	1.33E-01	9593.32	3	3	5.32E-03
5648.07	4	4	1.97E-01					9651.47	5	5	1.57E-02
5662.46	6	4	2.93E-01	C III				9696.48	5	7	7.53E-03
5818.31	2	2	3.38E-02	310.170	1	3	6.56E+00	9696.54	3	5	7.12E-03
5822.98	2	4	3.38E-03	386.203	1	3	3.46E+01	9699.57	7	9	8.47E-03
5823.18	4	2	3.38E-02	459.466	1	3	5.91E+01	9701.10	1	3	4.40E-02
5827.85	4	4	2.16E-02	459.514	3	5	7.97E+01	9705.41	3	5	5.93E-02
5836.37	6	4	4.22E-02	459.627	5	7	1.06E+02	9706.44	3	3	3.29E-02
5843.62	6	6	1.20E-02	574.281	3	5	6.24E+01	9715.09	5	7	7.88E-02
5856.06	8	6	5.31E-02	977.020	1	3	1.767E+01	9717.75	5	5	1.97E-02
6095.29	2	4	4.20E-01	1174.93	3	5	3.293E+00	9718.79	5	3	2.19E-03
6098.51	4	6	5.03E-01	1175.26	1	3	4.385E+00				
6102.56	4	4	8.37E-02	1175.59	3	3	3.287E+00	C IV			
6578.05	2	4	3.63E-01	1175.71	5	5	9.856E+00	*312.43	2	6	4.63E+01
6582.88	2	2	3.62E-01	1175.99	3	1	1.313E+01	*384.13	6	10	1.76E+02
6724.56	2	4	3.17E-02	1176.37	5	3	5.468E+00	1548.19	2	4	2.65E+00
6727.07	2	2	6.34E-02	1247.38	3	1	2.082E+01	1550.77	2	2	2.64E+00
6727.26	4	6	2.96E-02	2296.87	3	5	1.376E+00	5801.31	2	4	3.17E-01
6731.07	4	4	5.06E-02	2849.05	3	1	1.95E-01	5811.97	2	2	3.16E-01
6733.58	4	2	6.32E-02	3703.70	3	3	5.90E-01				
6734.00	6	8	1.80E-02	4325.56	3	5	1.24E-01	C V			
6738.61	6	6	7.23E-02	4647.42	3	5	7.26E-01	34.9728	1	3	2.554E+03
6742.43	6	4	4.41E-02	4650.25	3	3	7.25E-01	40.2678	1	3	8.873E+03
6750.54	8	8	1.08E-01	4651.02	3	5	2.28E-01	*227.19	3	9	1.363E+02
6755.16	8	6	2.38E-02	4651.47	3	1	7.24E-01	247.315	1	3	1.278E+02
6779.94	4	6	2.56E-01	4652.05	1	3	3.04E-01	*248.71	9	15	4.247E+02
6780.59	2	4	1.52E-01	4659.06	3	3	2.27E-01	*260.19	9	3	6.680E+01
6783.91	6	8	3.65E-01	4663.64	3	1	9.05E-01	267.267	3	5	3.947E+02
6787.21	2	2	3.04E-01	4665.86	5	5	6.78E-01	*2273.9	3	9	5.646E-01
6791.47	4	4	1.94E-01	4673.95	5	3	3.75E-01	3526.66	1	3	1.663E-01
6798.10	4	2	6.04E-02	5244.66	1	3	5.30E-02	8420.72	3	5	6.898E-02
6800.69	6	6	1.09E-01	5253.58	3	3	1.58E-01	*8433.2	3	9	6.868E-02
6812.28	6	4	1.80E-02	5272.52	5	3	2.61E-01	8448.12	3	1	6.832E-02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹	
	g_i	g_k			g_i	g_k			g_i	g_k		
8449.19	3	3	6.829E-02	7256.6	6	4	1.5E-01	3530.0	6	8	1.8E+00	
Cesium Cs I				7414.1	6	4	4.7E-02	3560.7	4	6	1.7E+00	
				7547.1	4	4	1.2E-01	3602.1	6	8	1.7E+00	
	3203.5	2	4	7.6E-06	7717.6	4	4	3.0E-02	3612.9	4	6	1.2E+00
	3205.3	2	4	7.9E-06	7745.0	2	4	6.3E-02	3720.5	4	6	1.7E+00
	3207.5	2	4	8.5E-06	7769.2	6	6	6.0E-02				
	3210.0	2	4	9.4E-06	7821.4	6	8	9.8E-02	Chromium Cr I			
	3212.8	2	4	1.19E-05	7830.8	4	4	9.7E-02	1999.95	9	9	1.4E+00
	3216.2	2	4	1.49E-05	7878.2	6	6	1.8E-02	2383.30	9	11	4.1E-01
	3220.1	2	4	1.7E-05	7899.3	4	6	5.1E-02	2389.21	3	5	2.3E-01
	3220.2	2	2	1.07E-07	7924.6	2	4	2.1E-02	2408.60	9	7	6.7E-01
	3224.8	2	4	2.0E-05	7935.0	6	8	3.9E-02	2408.72	7	5	2.9E-01
	3225.0	2	2	1.43E-07	7997.9	4	4	2.1E-02	2492.57	3	5	4.5E-01
	3230.5	2	4	2.5E-05	Cl II				2495.08	3	3	2.7E-01
	3230.7	2	2	1.97E-07	3329.1	5	7	1.5E+00	2496.30	5	7	5.6E-01
	3237.4	2	4	2.8E-05	3522.1	7	7	1.4E+00	2502.55	7	9	2.2E-01
	3237.6	2	2	2.63E-07	3798.8	5	7	1.6E+00	2504.31	7	9	4.5E-01
3245.9	2	4	3.45E-05	3805.2	7	9	1.8E+00	2508.11	5	5	2.1E-01	
3246.2	2	2	3.7E-07	3809.5	3	5	1.5E+00	2508.97	5	3	3.8E-01	
3256.7	2	4	4.25E-05	3851.0	5	7	1.8E+00	2527.11	9	9	5.3E-01	
3257.1	2	2	7.0E-07	3851.4	5	5	1.6E+00	2549.55	3	3	4.8E-01	
3270.5	2	4	5.6E-05	3854.7	3	5	2.2E+00	2560.70	5	5	4.3E-01	
3271.0	2	2	9.8E-07	3861.9	5	7	2.4E+00	2571.74	7	5	6.4E-01	
3288.6	2	4	1.0E-04	3868.6	7	9	2.7E+00	2577.66	7	7	2.6E-01	
3289.3	2	2	2.7E-06	3913.9	9	9	8.2E-01	2591.84	9	7	6.5E-01	
3313.1	2	4	1.6E-04	3990.2	5	7	8.4E-01	2620.48	5	3	1.9E-01	
3314.0	2	2	5.2E-06	4132.5	5	5	1.6E+00	2673.64	3	3	1.8E-01	
3347.5	2	4	2.2E-04	4276.5	9	7	7.6E-01	2701.99	9	11	2.1E-01	
3348.8	2	2	1.1E-05	4768.7	3	5	7.7E-01	2726.50	5	7	7.5E-01	
3397.9	2	4	4.0E-04	4781.3	5	7	1.0E+00	2731.90	5	5	7.8E-01	
3400.0	2	2	2.4E-05	4794.6	5	7	1.04E+00	2736.46	5	3	7.5E-01	
3476.8	2	4	6.6E-04	4810.1	5	5	9.9E-01	2752.85	3	3	8.7E-01	
3480.0	2	2	6.6E-05	4819.5	5	3	1.00E+00	2757.09	5	5	6.8E-01	
3611.4	2	4	1.5E-03	4904.8	5	7	8.1E-01	2761.74	5	3	6.8E-01	
3617.3	2	2	2.5E-04	4917.7	3	5	7.5E-01	2764.36	7	7	3.7E-01	
3876.1	2	4	3.8E-03	5078.3	7	7	7.7E-01	2769.90	7	5	1.1E+00	
3888.6	2	2	9.7E-04	5219.1	3	9	8.6E-01	2780.70	9	7	1.4E+00	
4555.3	2	4	1.88E-02	5392.1	5	7	1.0E+00	2879.27	5	7	2.1E-01	
4593.2	2	2	8.0E-03	Cl III				2887.00	3	5	2.7E-01	
8521.1	2	4	3.276E-01	2298.5	4	4	4.2E+00	2889.22	9	9	6.6E-01	
8943.5	2	2	2.87E-01	2340.6	6	6	4.2E+00	2893.25	7	7	5.2E-01	
Chlorine Cl I				2370.4	8	6	2.8E+00	2894.17	1	3	3.3E-01	
	1188.8	4	6	2.33E+00	2531.8	2	4	4.4E+00	2896.76	5	5	3.0E-01
	1188.8	4	4	2.71E-01	2532.5	4	6	5.3E+00	2905.48	3	1	1.3E+00
	1201.4	2	4	2.39E+00	2577.1	4	6	4.3E+00	2909.05	5	3	6.8E-01
	1335.7	4	2	1.74E+00	2580.7	6	8	4.7E+00	2910.89	7	5	3.4E-01
	1347.2	4	4	4.19E+00	2601.2	2	4	4.6E+00	2911.15	9	7	2.6E-01
	1351.7	2	2	3.23E+00	2603.6	4	6	5.0E+00	2967.64	7	9	3.9E-01
	1363.4	2	4	7.5E-01	2609.5	6	8	5.7E+00	2971.10	5	7	7.1E-01
	4323.3	4	4	1.1E-02	2617.0	8	10	6.6E+00	2975.48	3	5	8.9E-01
	4363.3	4	6	6.8E-03	2661.6	4	6	3.4E+00	2980.78	1	3	5.10E-01
	4379.9	4	4	1.4E-02	2665.5	6	8	4.8E+00	2988.64	5	7	5.2E-01
	4389.8	6	8	1.4E-02	2691.5	4	4	3.5E+00	2991.88	3	1	3.0E+00
	4526.2	4	4	5.1E-02	2691.5	4	4	3.5E+00	2994.06	5	5	2.5E-01
	4601.0	2	2	4.2E-02	2710.4	4	6	3.5E+00	2995.09	5	5	4.3E-01
	4661.2	2	4	1.2E-02	3340.4	6	6	1.5E+00	2996.57	5	3	2.0E+00
					3392.9	4	4	1.9E+00	2998.78	5	3	4.07E-01
				3393.5	6	6	1.9E+00	3000.88	7	5	1.6E+00	

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3005.06	9	7	9.2E-01	4432.77	15	15	4.9E-01	2857.40	6	8	2.8E-01
3013.72	3	5	8.3E-01	4443.72	3	1	4.5E-01	2860.92	2	4	6.9E-01
3015.20	1	3	1.63E+00	4482.88	3	3	3.0E-01	2862.57	8	8	6.3E-01
3020.67	3	3	1.5E+00	4490.55	9	7	3.9E-01	2866.72	4	4	1.2E+00
3021.58	9	11	2.91E+00	4492.31	5	3	4.47E-01	2867.09	4	4	1.1E+00
3024.36	5	5	1.27E+00	4495.28	9	7	2.0E-01	2867.65	2	2	1.1E+00
3029.17	5	3	3.8E-01	4500.29	7	7	2.1E-01	2870.43	6	6	1.3E+00
3030.25	7	7	1.1E+00	4506.84	13	11	2.7E-01	2873.81	4	2	8.8E-01
3031.35	5	3	3.1E-01	4540.72	11	11	3.14E-01	2880.86	6	4	7.9E-01
3034.19	7	7	3.5E-01	4564.17	11	13	5.1E-01	2898.53	10	12	1.2E+00
3037.05	9	9	5.4E-01	4595.60	13	13	4.7E-01	2921.81	8	10	9.0E-01
3040.84	7	5	7.4E-01	4622.47	7	7	4.1E-01	2930.83	2	4	1.1E+00
3053.87	9	7	7.97E-01	4663.33	3	3	2.0E-01	2935.12	6	8	1.8E+00
3148.44	9	11	5.6E-01	4665.90	3	3	3.0E-01	2953.34	2	2	1.8E+00
3155.16	11	13	5.7E-01	4689.38	7	5	2.3E-01	2966.03	10	8	5.4E-01
3163.76	13	15	6.0E-01	4698.46	9	7	2.2E-01	2971.90	14	14	2.0E+00
3237.73	9	9	1.3E+00	4708.02	11	9	4.31E-01	2979.73	12	12	1.8E+00
3238.09	11	11	2.0E-01	4718.43	13	11	3.4E-01	2985.32	10	10	2.2E+00
3578.68	7	9	1.48E+00	4730.69	7	5	3.83E-01	2989.18	8	8	2.2E+00
3593.48	7	7	1.50E+00	4737.33	9	7	3.38E-01	3118.64	2	4	1.7E+00
3605.32	7	5	1.62E+00	4741.09	3	5	2.2E-01	3120.36	4	6	1.5E+00
3639.80	13	11	1.8E+00	4752.07	13	13	6.2E-01	3122.59	12	12	4.4E-01
3743.89	13	13	7.61E-01	4756.09	11	9	4.0E-01	3128.69	4	4	8.1E-01
3757.66	7	7	4.13E-01	4792.49	7	5	2.6E-01	3136.68	6	6	6.4E-01
3768.24	5	5	5.10E-01	4801.02	9	7	3.06E-01	4588.22	8	6	1.2E-01
3804.80	9	9	6.9E-01	4816.13	9	9	1.8E-01				
3963.69	13	15	1.3E+00	4870.79	7	9	3.5E-01	Cr V			
3969.75	11	13	1.2E+00	4887.01	9	11	3.2E-01	434.306	9	9	1.5E+01
3983.90	7	9	1.05E+00	4922.28	11	13	4.0E-01	436.351	9	7	2.4E+01
3991.12	5	7	1.07E+00	4966.80	3	1	3.0E-01	436.601	7	5	2.1E+01
4001.44	9	11	6.8E-01	5204.51	5	3	5.09E-01	437.420	7	7	1.4E+01
4039.10	15	15	6.7E-01	5206.02	5	5	5.14E-01	437.655	5	5	1.3E+01
4048.78	13	13	6.4E-01	5208.42	5	7	5.06E-01	441.056	5	3	2.3E+01
4058.78	11	11	6.7E-01	5243.38	5	3	2.19E-01	456.357	1	3	9.5E+00
4065.71	9	11	3.5E-01	5297.37	7	9	3.88E-01	456.637	3	1	3.3E+01
4165.52	11	13	7.5E-01	5297.99	7	7	3.0E-01	456.743	3	3	9.1E+00
4204.48	13	11	3.1E-01	5328.36	9	11	6.2E-01	457.028	5	5	2.7E+01
4254.33	7	9	3.15E-01	5329.17	9	9	2.25E-01	457.504	5	3	1.2E+01
4263.15	15	17	6.4E-01	5783.11	3	3	2.1E-01	464.015	9	7	3.6E+01
4274.81	7	7	3.07E-01	5783.89	5	5	2.02E-01	469.634	5	5	2.3E+01
4275.98	11	11	2.2E-01	5787.97	5	7	2.35E-01	1106.25	7	9	1.2E+01
4280.42	13	15	4.7E-01					1121.07	7	9	2.1E+01
4289.73	7	5	3.16E-01	Cr II				1127.63	9	11	3.5E+01
4291.97	7	5	2.4E-01	2653.57	4	6	3.5E-01	1465.86	5	3	1.1E+01
4297.75	11	13	4.9E-01	2658.59	2	4	5.8E-01	1481.65	3	1	1.0E+01
4298.05	9	9	2.6E-01	2666.02	6	8	5.9E-01	1519.03	5	7	9.5E+00
4300.52	9	7	1.9E-01	2668.71	4	2	1.4E+00	1579.70	7	9	8.6E+00
4301.19	11	9	2.6E-01	2671.80	6	4	1.0E+00				
4302.78	11	11	2.5E-01	2672.83	8	6	5.5E-01	Cr VI			
4319.66	5	3	1.8E-01	2744.97	4	6	8.5E-01	161.687	6	6	1.7E+02
4337.25	5	7	2.0E-01	2787.61	6	6	1.5E+00	168.088	4	6	2.0E+02
4373.65	9	9	2.8E-01	2822.38	14	16	2.3E+00	201.007	4	4	2.5E+03
4376.80	13	13	3.2E-01	2835.63	10	12	2.0E+00	201.224	4	6	1.8E+02
4413.86	7	5	2.7E-01	2840.01	10	12	2.7E+00	201.388	6	4	2.7E+02
4422.70	5	5	2.7E-01	2843.24	8	10	6.4E-01	201.606	6	6	2.6E+03
4424.29	9	7	2.1E-01	2849.83	6	8	9.2E-01	202.442	6	4	1.0E+03
4429.93	3	3	2.4E-01	2851.35	8	10	2.2E+00	202.739	4	2	1.2E+03
4432.16	1	3	1.8E-01	2856.77	4	6	4.3E-01	226.241	6	8	7.2E+02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
227.202	4	6	6.6E+02	270	3	1	1.7E+02	346.5	6	8	2.5E+02
Cr X				276.4	5	7	2.2E+02				
216.72	6	8	9.0E+02	277	1	3	2.1E+02	Cr XV			
223.86	4	2	7.7E+02	279.32	3	5	3.5E+02	18.497	1	3	1.62E+05
224.74	4	4	7.6E+02	286	3	1	4.6E+02	18.782	1	3	2.8E+04
226.24	4	6	7.3E+02	328.29	1	3	1.86E+02	19.015	1	3	6.3E+02
227.42	4	4	5.2E+02	345	7	9	1.74E+02	20.863	1	3	6.0E+03
227.50	4	6	1.8E+01	Cr XIV				21.153	1	3	5.6E+03
228.63	6	4	8.1E+01	*38.036	2	6	2.47E+02	102	3	3	1.6E+02
228.71	6	6	4.5E+02	39.796	2	4	3.05E+02	102.18	5	3	7.0E+02
231.21	2	4	1.2E+02	40.018	4	6	3.6E+02	103	3	1	3.8E+02
232.96	4	4	4.4E+02	40.782	2	4	3.9E+02	105	7	5	5.3E+02
242.20	2	4	5.0E+01	40.800	2	2	3.9E+02	111.27	3	3	1.7E+02
244.19	4	6	5.8E+01	41.556	2	4	4.5E+02	Cr XVI			
395.984	4	4	2.4E+01	41.788	4	6	5.3E+02	17.073	4	6	1.2E+04
398.150	6	6	2.1E+01	44.597	2	4	7.1E+02	17.242	2	4	8.6E+04
Cr XI				44.869	4	6	8.3E+02	17.299	4	4	2.5E+04
214.31	5	7	1.4E+01	46.125	4	2	3.1E+02	17.372	4	4	1.4E+05
226.45	5	7	6.0E+02	46.468	2	4	6.6E+02	17.438	4	2	1.1E+05
232	3	1	4.1E+02	46.527	2	2	6.7E+02	17.514	2	4	1.1E+05
235.53	5	7	5.5E+02	48.300	4	6	5.9E+02	17.587	2	4	2.0E+04
240.76	1	3	4.8E+02	48.338	6	8	6.3E+02	17.656	2	2	2.0E+04
250.28	5	7	1.0E+01	50.821	2	4	1.2E+03	19.442	4	2	9.9E+03
366.491	3	3	1.2E+01	51.172	4	6	1.4E+03	19.714	2	2	1.1E+04
366.942	3	1	3.0E+01	51.180	4	4	2.3E+02	Cr XVII			
374.927	5	5	2.3E+01	52.321	4	6	1.0E+03	16.31	5	3	9.6E+03
422.083	3	5	1.0E+01	52.363	6	8	1.1E+03	16.32	5	7	3.2E+04
Cr XII				53.760	2	2	3.0E+02	16.37	3	1	9.7E+04
216	4	6	2.4E+02	54.164	4	2	5.9E+02	16.44	5	7	1.3E+05
218	6	8	2.4E+02	60.699	4	6	2.05E+03	16.44	5	7	1.3E+05
239	2	2	1.6E+02	60.756	6	8	2.19E+03	16.59	3	1	5.7E+04
244.70	2	4	3.0E+02	63.324	2	4	1.07E+03	16.65	5	5	1.1E+04
247	4	2	2.4E+02	63.539	2	2	1.13E+03	16.66	1	3	1.8E+05
247	2	2	3.3E+02	68.594	2	4	1.98E+03	16.68	5	7	6.8E+04
248	6	8	1.4E+02	69.213	4	6	2.31E+03	16.80	5	7	4.4E+04
250	6	8	3.5E+02	69.247	4	4	3.8E+02	16.97	1	3	2.63E+04
250	6	6	2.2E+02	86.060	4	6	5.3E+03	16.97	3	3	1.5E+04
251.52	4	6	3.4E+02	86.169	6	8	5.9E+03	17.968	5	3	8.6E+03
252	4	6	2.0E+02	86.185	6	6	3.9E+02	18.336	5	3	1.7E+04
256	2	2	1.5E+02	101.05	6	4	4.4E+02	18.336	5	5	1.6E+04
259	2	4	3.2E+02	101.42	4	2	4.83E+02	18.389	1	3	9.2E+03
269	2	2	2.1E+02	104.4	4	6	3.0E+02	Cr XVIII			
300.32	2	2	1.4E+02	104.5	6	8	3.1E+02	95.77	4	2	3.08E+02
305.81	4	4	2.76E+02	109.8	2	4	2.3E+02	102.32	4	4	1.54E+02
309	4	2	2.7E+02	110.4	4	6	2.8E+02	104.98	6	4	8.7E+02
309	6	6	1.6E+02	118.3	4	2	2.1E+02	106.84	4	2	3.4E+02
311.55	4	2	1.6E+02	125.2	4	6	5.0E+02	110.41	4	2	7.9E+02
324	4	6	2.2E+02	125.3	6	8	5.4E+02	112.27	4	2	4.24E+02
327	6	8	2.2E+02	148.5	2	4	2.18E+02	119.62	2	2	3.2E+02
332.06	6	4	1.4E+02	149.1	2	2	2.1E+02	123.87	6	4	3.9E+02
Cr XIII				157.1	2	4	3.3E+02	125.51	4	4	3.4E+02
49.59	1	3	9.9E+02	158.4	4	6	3.7E+02	125.51	4	4	3.4E+02
67.01	1	3	1.67E+03	187.02	4	6	9.3E+02	128.10	6	6	2.8E+02
228	5	7	1.8E+02	187.30	6	8	9.6E+02	136.52	4	2	1.66E+02
267.73	5	7	1.9E+02	189.1	2	2	2.13E+02	139.87	4	4	1.49E+02
				191.0	4	2	4.11E+02	140.82	4	2	2.66E+02
				222.9	4	2	2.2E+02	155.46	2	2	2.84E+02
				346.3	4	6	2.4E+02	157.40	4	4	2.83E+02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
Cr XIX				14.04	3	5	1.2E+05	2467.69	6	8	7.0E-02
14.73	3	3	7.1E+04	14.24	1	3	1.41E+05	2470.27	10	12	1.5E-01
14.80	1	3	1.3E+05					2476.64	10	8	2.2E-01
14.81	5	3	3.4E+04	Cr XXII				2504.52	10	8	1.8E-01
14.84	5	7	1.3E+05	2.190	4	2	1.7E+06	2511.02	10	10	9.2E-01
109.64	3	3	2.46E+02	2.191	2	2	2.5E+06	2521.36	10	8	3.0E+00
110.37	5	3	6.0E+02	2.198	4	4	4.5E+06	2528.97	8	6	2.8E+00
113.97	5	3	5.5E+02	2.199	2	4	2.3E+06	2530.13	6	6	7.1E-02
118.31	3	1	3.29E+02	2.202	4	6	1.6E+06	2535.96	6	4	1.9E+00
118.67	5	3	2.1E+02	2.203	4	2	1.3E+06	2536.50	8	8	3.0E-01
118.83	3	3	1.35E+02	13.149	2	4	1.29E+05	2544.25	4	2	3.0E+00
126.30	1	3	1.56E+02	13.292	4	6	1.54E+05	2562.12	4	4	3.9E-01
126.33	5	5	4.35E+02					2567.34	6	6	3.0E-01
130.99	7	5	2.9E+02	Cr XXIII				2574.35	8	8	1.7E-01
134.89	3	1	1.98E+02	1.7632	1	3	3.68E+05	2685.34	6	8	5.5E-02
138.15	3	1	1.75E+02	1.8557	1	3	8.97E+05	3017.55	8	6	6.9E-02
138.45	5	5	1.71E+02	2.095	3	1	3.5E+06	3044.00	10	10	1.9E-01
140.92	5	3	1.38E+02	2.101	1	3	2.0E+06	3048.89	6	4	7.5E-02
143.57	3	1	7.2E+02	2.101	5	5	7.9E+05	3061.82	8	8	1.6E-01
163.94	5	5	3.1E+02	2.102	3	5	2.1E+06	3072.34	6	6	1.5E-01
179.18	3	1	1.45E+02	2.103	3	5	1.2E+06	3086.78	4	4	1.9E-01
				2.104	1	3	1.4E+06	3354.37	8	6	1.1E-01
Cr XX				2.105	3	3	9.6E+05	3367.11	10	8	6.0E-02
14.13	2	4	1.1E+05	2.106	3	3	2.0E+06	3385.22	8	6	1.1E-01
14.26	4	6	1.3E+05	2.107	5	5	2.3E+06	3388.16	6	4	2.4E-01
128.42	4	4	3.8E+02	2.107	3	5	3.3E+06	3395.37	6	8	2.9E-01
131.31	6	4	1.27E+02	2.109	5	3	1.7E+06	3405.12	10	10	1.0E+00
133.82	2	4	8.3E+01	2.113	3	5	5.9E+05	3409.17	8	8	4.2E-01
135.26	4	2	2.41E+02	2.119	3	1	2.7E+05	3412.34	8	10	6.1E-01
140.75	4	4	1.35E+02	2.129	3	1	5.1E+05	3412.63	10	8	1.2E-01
148.99	6	4	1.75E+02	2.1818	1	3	3.37E+06	3414.74	4	4	8.8E-02
156.00	2	4	8.4E+01	2.1923	1	3	2.34E+05	3417.15	6	6	3.2E-01
167.97	6	6	1.12E+02					3431.58	8	6	1.1E-01
180.85	4	4	1.6E+02	Cobalt				3433.05	4	4	1.0E+00
				Co I				3442.92	6	4	1.2E-01
Cr XXI				2287.80	8	8	8.6E-01	3443.64	8	8	6.9E-01
12.97	3	1	4.8E+04	2295.22	10	8	2.2E-01	3449.17	6	6	7.6E-01
12.98	5	5	3.9E+04	2309.03	10	10	5.6E-01	3449.44	10	10	1.8E-01
13.02	3	5	3.8E+04	2323.13	8	8	5.0E-01	3453.51	10	12	1.1E+00
13.02	5	7	3.9E+04	2325.53	6	8	1.1E-01	3455.24	4	2	1.9E-01
13.08	1	3	5.2E+04	2335.98	6	6	5.1E-01	3462.80	4	6	7.9E-01
13.22	3	1	4.6E+04	2338.66	4	4	7.7E-01	3465.79	10	12	9.2E-02
13.34	3	5	5.2E+04	2353.36	8	10	1.5E-01	3474.02	6	8	5.6E-01
13.49	1	3	9.0E+04	2355.48	6	8	1.3E-01	3483.41	8	10	5.5E-02
13.53	3	3	6.6E+04	2358.18	4	6	1.4E-01	3489.40	8	6	1.3E+00
13.55	3	5	1.2E+05	2365.06	10	10	1.3E-01	3491.32	4	4	5.0E-02
13.65	5	7	1.5E+05	2371.85	6	8	7.3E-02	3495.68	4	6	4.9E-01
13.66	3	1	1.2E+05	2384.86	10	8	2.4E-01	3502.28	10	8	8.0E-01
13.67	5	5	3.9E+04	2392.03	6	6	4.0E-01	3502.63	6	6	5.2E-02
13.68	3	3	8.2E+04	2402.06	8	6	5.1E-01	3506.32	8	6	8.2E-01
13.75	5	3	4.5E+04	2407.25	10	12	3.6E+00	3509.84	6	8	3.2E-01
13.75	5	5	9.5E+04	2412.76	4	6	6.5E-01	3512.64	6	4	1.0E+00
13.76	1	3	1.51E+05	2414.46	6	8	3.4E+00	3513.48	8	10	7.8E-02
13.78	5	7	1.7E+05	2415.29	4	6	3.6E+00	3518.34	6	4	1.6E+00
13.84	5	7	2.59E+05	2424.93	10	10	3.2E+00	3521.58	10	8	1.8E-01
13.87	3	5	8.5E+04	2432.21	8	8	2.6E+00	3523.42	4	2	9.8E-01
13.92	3	5	8.5E+04	2436.66	6	6	2.6E+00	3526.85	10	10	1.3E-01
13.93	5	7	4.2E+04	2439.04	4	4	2.7E+00	3529.03	6	8	8.8E-02
13.95	5	5	3.8E+04	2460.80	4	6	1.2E-01	3529.82	8	10	4.6E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3533.36	4	6	9.1E-02	Copper			3868.8	17	17	3.1E+00	
3560.89	4	4	2.3E-01	Cu I			3967.5	17	19	8.7E-01	
3564.95	6	8	7.0E-02	*2024.3	2	6	9.8E-02	4046.0	17	15	1.5E+00
3569.37	8	8	1.6E+00	2165.1	2	4	5.1E-01	4103.9	13	11	1.7E+00
3574.97	6	6	1.5E-01	2178.9	2	4	9.13E-01	4186.8	17	17	1.32E+00
3575.36	8	8	9.6E-02	2181.7	2	2	1.0E+00	4194.8	17	17	7.2E-01
3585.15	8	8	7.1E-02	2225.7	2	2	4.6E-01	4211.7	17	19	2.08E+00
3587.19	6	6	1.4E+00	2244.3	2	4	1.19E-02	4218.1	15	15	1.85E+00
3594.87	6	6	9.2E-02	2441.6	2	2	2.0E-02	4221.1	15	17	1.52E+00
3602.08	4	4	1.0E-01	2492.2	2	4	3.11E-02	4225.2	13	15	4.5E+00
3704.06	6	8	1.2E-01	2618.4	6	4	3.07E-01	4268.3	15	15	3.6E-02
3745.49	8	8	7.5E-02	2766.4	4	4	9.6E-02	4276.7	13	13	7.3E-01
3842.05	8	6	1.3E-01	2824.4	6	6	7.8E-02	4292.0	15	15	5.8E-02
3845.47	8	10	4.6E-01	2961.2	6	8	3.76E-02	4577.8	17	19	2.2E-02
3861.16	6	4	1.4E-01	3063.4	4	4	1.55E-02	4589.4	17	15	1.3E-01
3873.12	10	8	1.2E-01	3194.1	4	4	1.55E-02	4612.3	17	15	8.2E-02
3873.95	8	6	1.0E-01	3247.5	2	4	1.39E+00	5077.7	17	17	5.7E-03
3881.87	6	4	8.2E-02	3274.0	2	2	1.37E+00	5301.6	17	15	1.1E-02
3894.07	6	8	6.9E-01	3337.8	6	8	3.8E-03	5547.3	17	17	2.7E-03
3894.98	4	2	8.8E-02	4022.6	2	4	1.90E-01	5639.5	17	19	4.7E-03
3935.96	8	10	6.2E-02	4062.6	4	6	2.10E-01	5974.5	17	17	4.0E-03
3995.31	8	10	2.5E-01	4249.0	2	2	1.95E-01	5988.6	17	15	5.3E-03
3997.90	6	8	7.0E-02	4275.1	6	8	3.45E-01	6010.8	15	15	2.6E-02
4092.39	8	8	5.7E-02	4480.4	2	2	3.0E-02	6088.3	15	13	3.5E-02
4110.53	6	6	5.5E-02	4509.4	4	2	2.75E-01	6168.4	15	17	2.5E-02
4118.77	6	8	1.6E-01	4530.8	4	2	8.4E-02	6259.1	17	19	8.5E-03
4121.32	8	10	1.9E-01	4539.7	6	4	2.12E-01	6579.4	17	15	7.5E-03
5146.75	8	8	1.5E-01	4587.0	8	6	3.20E-01	Erbium			
5212.70	10	10	1.9E-01	4651.1	10	8	3.80E-01	Er I			
5265.79	6	8	5.0E-02	4704.6	8	8	5.5E-02	3862.9	13	13	2.5E+00
5280.63	10	8	2.8E-01	5105.5	6	4	2.0E-02	4008.0	13	15	2.6E+00
5352.05	12	10	2.7E-01	5153.2	2	4	6.0E-01	4151.1	13	11	1.8E+00
5477.09	6	8	6.8E-02	5218.2	4	6	7.5E-01	Europium			
5483.96	8	10	7.3E-02	5220.1	4	4	1.50E-01	Eu I			
6082.43	10	10	5.4E-02	5292.5	8	8	1.09E-01	2372.9	8	6	1.9E-01
6455.00	8	10	9.0E-02	5700.2	4	4	2.4E-03	2375.3	8	8	2.0E-01
7838.12	8	10	5.4E-02	5782.1	4	2	1.65E-02	2379.7	8	10	2.0E-01
8093.93	12	10	2.0E-01	Cu II			2619.3	8	10	7.0E-03	
8372.79	10	10	8.7E-02	2489.7	5	5	1.5E-02	2643.8	8	8	6.6E-03
Co II			2544.8	9	7	1.1E+00	2659.4	8	10	1.2E-02	
2286.15	11	13	3.3E+00	2689.3	7	7	4.1E-01	2682.6	8	6	1.2E-02
2307.85	9	11	2.6E+00	2701.0	5	5	6.7E-01	2710.0	8	10	1.4E-01
2311.61	7	9	2.8E+00	2703.2	3	3	1.2E+00	2724.0	8	8	1.2E-01
2314.05	5	7	2.8E+00	2713.5	5	5	6.8E-01	2731.4	8	8	3.1E-02
2314.97	3	5	2.7E+00	2769.7	7	7	6.1E-01	2732.6	8	6	3.7E-02
2330.36	5	3	1.32E+00	Dysprosium			2735.3	8	10	4.7E-02	
2344.28	3	3	1.5E+00	Dy I			2738.6	8	10	1.3E-02	
2353.41	7	7	1.9E+00	2862.7	17	15	6.5E-02	2743.3	8	6	1.1E-01
2363.80	9	9	2.1E+00	2964.6	17	17	6.5E-02	2745.6	8	6	5.0E-02
2378.62	11	9	1.9E+00	3147.7	15	17	1.1E-01	2747.8	8	8	5.2E-02
2383.45	9	7	1.8E+00	3263.2	15	13	1.4E-01	2772.9	8	6	1.0E-02
2388.92	11	11	2.8E+00	3511.0	15	13	3.1E-01	2878.9	8	10	2.8E-02
2389.54	5	3	1.5E+00	3571.4	15	13	2.0E-01	2892.5	8	8	1.0E-01
2404.17	3	3	1.5E+00	3757.1	17	19	3.0E+00	2893.0	8	6	1.0E-01
2417.66	9	9	8.5E-01								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
2909.0	8	10	6.9E-02	7425.7	4	2	3.4E-01	2754.6	5	3	1.1E+00
2958.9	8	6	1.6E-02	7482.7	4	4	5.6E-02	3039.1	5	3	2.8E+00
3059.0	8	8	3.8E-02	7489.2	2	2	1.1E-01	3124.8	5	5	3.1E-02
3067.0	8	10	9.1E-03	7514.9	2	2	5.2E-02	3269.5	5	3	2.9E-01
3106.2	8	10	5.5E-02	7552.2	4	6	7.8E-02	4226.6	1	3	2.1E-01
3111.4	8	10	3.0E-01	7573.4	2	4	1.0E-01	4685.8	1	3	9.5E-02
3168.3	8	10	6.9E-02	7607.2	4	4	7.0E-02				
3185.5	8	10	5.8E-03	7754.7	4	6	3.82E-01	Ge II			
3210.6	8	8	1.1E-01	7800.2	2	4	2.1E-01	999.10	2	4	1.9E+00
3212.8	8	8	2.9E-01					1016.6	4	6	2.1E+00
3213.8	8	6	1.8E-01	Gallium				1017.1	4	4	3.5E-01
3235.1	8	10	1.0E-02	Ga I				1055.0	2	2	6.9E-01
3241.4	8	8	2.3E-02	2195.4	2	2	1.9E-02	1075.1	4	2	1.3E+00
3246.0	8	6	1.4E-02	2199.7	4	2	3.3E-02	1237.1	2	4	1.9E+01
3247.6	8	8	2.3E-02	2214.4	4	6	1.2E-02	1261.9	4	6	2.2E+01
3322.3	8	6	3.5E-02	2235.9	4	2	4.3E-02	1264.7	4	4	3.5E+00
3334.3	8	6	3.4E-01	2255.0	2	2	3.1E-02	1602.5	2	2	3.4E+00
3350.4	8	10	1.5E-02	2259.2	4	6	3.1E-02	1649.2	4	2	6.5E+00
3353.7	8	8	5.8E-03	2294.2	2	4	7.0E-02	4741.8	2	4	4.6E-01
3457.1	8	8	8.4E-03	2297.9	4	2	5.8E-02	4814.6	4	6	5.1E-01
3467.9	8	8	1.0E-02	2338.2	4	6	9.8E-02	4824.1	4	4	8.6E-02
3589.3	8	6	6.9E-03	2371.3	2	2	5.7E-02	5131.8	4	6	1.9E+00
4594.0	8	10	1.4E+00	2418.7	4	2	1.0E-01	5178.5	6	6	1.3E-01
4627.2	8	8	1.3E+00	2450.1	2	4	2.8E-01	5178.6	6	8	2.0E+00
4661.9	8	6	1.3E+00	2500.2	4	6	3.4E-01	5893.4	2	4	9.2E-01
5645.8	8	6	5.4E-03	2659.9	2	2	1.2E-01	6021.0	2	2	8.4E-01
5765.2	8	8	1.1E-02	2719.7	4	2	2.3E-01	6336.4	2	2	4.4E-01
6018.2	8	10	8.5E-03	2874.2	2	4	1.2E+00	6484.2	4	2	8.5E-01
6291.3	8	6	1.8E-03	2943.6	4	6	1.4E+00				
6864.5	8	10	5.8E-03	2944.2	4	4	2.7E-01	Gold			
7106.5	8	8	2.6E-03	4033.0	2	2	4.9E-01	Au I			
				4172.0	4	2	9.2E-01	2427.95	2	4	1.99E+00
Fluorine								2675.95	2	2	1.64E+00
F I				Ga II				3122.78	6	4	1.90E-01
806.96	4	6	3.3E+00	829.60	1	3	2.2E-01	6278.30	4	2	3.4E-02
809.60	2	4	2.8E+00	1414.4	1	3	1.88E+01				
951.87	4	2	2.6E+00					Helium			
954.83	4	4	5.77E+00	Germanium				He I			
955.55	2	2	5.1E+00	Ge I				510.00	1	3	4.6224E-01
958.52	2	4	1.3E+00	1944.7	3	1	7.0E-01	512.10	1	3	7.3174E-01
6239.7	6	4	2.5E-01	1955.1	3	3	2.8E-01	515.62	1	3	1.2582E+00
6348.5	4	4	1.8E-01	1988.3	5	3	2.5E-01	522.21	1	3	2.4356E+00
6413.7	2	4	1.1E-01	1998.9	5	5	5.5E-01	537.03	1	3	5.6634E+00
6708.3	6	4	1.4E-02	2041.7	1	3	1.1E+00	584.33	1	3	1.7989E+01
6774.0	6	6	1.0E-01	2065.2	3	3	8.5E-01	*2677.1	3	9	4.4174E-03
6795.5	4	2	5.2E-02	2068.7	3	5	1.2E+00	*2696.1	3	9	6.0234E-03
6834.3	4	4	2.1E-01	2086.0	3	5	4.0E-01	*2723.2	3	9	8.4996E-03
6856.0	6	8	4.94E-01	2094.3	5	7	9.7E-01	*2763.8	3	9	1.2508E-02
6870.2	2	2	3.8E-01	2105.8	5	5	1.7E-01	*2829.1	3	9	1.9389E-02
6902.5	4	6	3.2E-01	2256.0	5	5	3.2E-02	*2945.1	3	9	3.2006E-02
6909.8	2	4	2.2E-01	2417.4	5	5	9.6E-01	*3187.7	3	9	5.6361E-02
6966.4	4	2	1.1E-01	2498.0	1	3	1.3E-01	3231.3	1	3	5.1015E-03
7037.5	4	4	3.0E-01	2533.2	3	3	1.0E-01	3258.3	1	3	6.9627E-03
7127.9	2	2	3.8E-01	2589.2	5	3	5.1E-02	3296.8	1	3	9.8432E-03
7309.0	6	8	4.7E-01	2592.5	3	5	7.1E-01	3354.6	1	3	1.4537E-02
7311.0	4	2	3.9E-01	2651.2	5	5	2.0E+00	3447.6	1	3	2.2691E-02
7314.3	4	6	4.8E-01	2651.6	1	3	8.5E-01	*3554.4	9	15	7.5971E-03
7332.0	6	4	3.1E-01	2691.3	3	3	6.1E-01	*3563.0	9	3	4.8362E-03
7398.7	6	6	2.85E-01	2709.6	3	1	2.8E+00	*3587.3	9	15	1.8107E-02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹
	g_i	g_k			g_i	g_k			g_i	g_k	
3613.6	1	3	3.8022E-02	In II				2276.03	9	7	1.7E-01
*3634.2	9	15	2.6062E-02	2941.1	3	1	1.4E+00	2277.11	7	5	3.7E+01
*3652.0	9	3	9.7444E-03					2287.25	5	3	3.4E-01
*3705.0	9	15	3.9528E-02	Iodine				2292.52	7	9	4.3E-02
*3819.6	9	15	6.4351E-02	I I				2294.41	3	1	6.1E-01
3833.6	3	5	9.6470E-03	1782.8	4	4	2.71E+00	2300.14	5	7	8.0E-02
*3867.5	9	3	2.4465E-02	1830.4	4	6	1.6E-01	2301.68	1	3	1.3E-01
3871.8	3	5	1.3386E-02					2303.42	1	3	9.4E-02
*3888.7	3	9	9.4746E-02	Iridium				2303.58	3	5	7.6E-02
3926.5	3	5	1.9371E-02	Ir I				2309.00	3	5	1.5E-01
3935.9	3	1	7.4475E-03	2475.12	10	10	2.1E-01	2313.10	5	7	1.4E-01
3964.7	1	3	6.9507E-02	2502.98	10	12	3.2E-01	2320.36	7	9	1.2E-01
4009.3	3	5	2.9612E-02	2639.71	10	10	4.7E-01	2371.43	5	5	5.2E-02
4024.0	3	1	1.1281E-02	2661.98	10	10	2.5E-01	2373.62	7	7	6.7E-02
*4026.2	9	15	1.1600E-01	2664.79	10	8	4.0E-01	2374.52	1	3	2.9E-01
*4120.8	9	3	4.4529E-02	2694.23	10	12	4.8E-01	2381.83	3	5	5.4E-02
4143.8	3	5	4.8812E-02	2849.72	10	10	2.2E-01	2389.97	5	7	5.0E-02
4169.0	3	1	1.8298E-02	2853.31	10	10	2.0E-03	2462.18	7	5	1.5E-01
4387.9	3	5	8.9889E-02	2882.64	10	8	7.2E-02	2462.65	9	9	5.8E-01
4437.6	3	1	3.2689E-02	2924.79	10	12	1.42E-01	2479.78	5	5	1.8E+00
*4471.5	9	15	2.4578E-01	2934.64	8	10	2.0E-01	2483.27	9	11	4.9E+00
*4713.2	9	3	9.5209E-02	2951.22	10	8	2.8E-02	2488.14	7	9	4.7E+00
4921.9	3	5	1.9863E-01	3003.63	8	10	5.9E-02	2490.64	5	7	3.8E+00
5015.7	1	3	1.3372E-01	3168.88	8	10	5.47E-02	2491.15	3	5	3.0E+00
5047.7	3	1	6.7712E-02	3220.78	10	8	2.4E-01	2501.13	9	7	6.8E-01
*5875.7	9	15	7.0703E-01	3558.99	6	8	1.5E-02	2510.83	7	5	1.3E+00
6678.2	3	5	6.3705E-01	3573.72	8	10	5.4E-02	2518.10	5	3	1.9E+00
*7065.2	9	3	2.7853E-01	3617.21	6	8	2.0E-02	2522.85	9	9	2.9E+00
7281.4	3	1	1.8299E-01	3628.67	8	8	2.8E-02	2524.29	3	1	3.4E+00
*8361.7	3	9	3.8126E-03	3661.71	8	10	4.0E-02	2527.43	7	7	1.9E+00
*9463.6	3	9	5.6868E-03	3734.77	8	8	2.7E-02	2529.13	5	5	9.8E-01
9603.4	1	3	5.8286E-03	4033.76	8	10	2.7E-02	2535.61	1	3	9.7E-01
*9702.6	9	3	8.6511E-03	4069.92	6	8	3.6E-02	2540.97	3	5	9.2E-01
*10311	9	15	1.9945E-02	4913.35	12	12	3.3E-02	2545.98	5	7	6.7E-01
*10668	9	3	1.4471E-02	4939.24	10	12	2.5E-03	2549.61	7	9	3.6E-01
*10830	3	9	1.0216E-01					2584.54	11	13	4.6E-01
*10913	15	21	1.9801E-02	Iron				2606.83	9	11	4.2E-01
10917	5	7	1.6083E-02	Fe I				2618.02	7	7	4.0E-01
*10997	15	9	1.4253E-03	1934.54	9	7	2.5E-01	2623.53	7	9	3.3E-01
11013	1	3	9.2496E-03	1937.27	9	7	2.2E-01	2656.15	13	15	2.8E-01
11045	3	5	1.8457E-02	1940.66	7	5	2.6E-01	2669.49	11	13	1.7E-01
11226	3	1	1.1168E-02	2084.12	9	7	3.7E-01	2679.06	11	11	1.9E-01
*11969	9	15	3.4781E-02	2102.35	7	7	8.8E-02	2719.03	9	7	1.4E+00
*12528	3	9	7.0932E-03	2112.97	1	3	1.9E-01	2720.90	7	5	1.1E+00
12756	5	3	1.2754E-03	2132.02	9	9	7.6E-02	2723.58	5	3	6.4E-01
*12785	15	21	4.1339E-02	2145.19	7	7	5.7E-02	2733.58	11	9	8.6E-01
12791	5	7	3.2475E-02	2153.01	5	5	6.9E-02	2735.48	9	7	6.2E-01
*12846	9	3	2.7317E-02	2161.58	3	5	5.0E-02	2737.31	3	3	8.5E-01
12968	3	5	3.3615E-02	2166.77	9	7	2.7E+00	2742.41	5	5	6.3E-01
*12985	15	9	2.7292E-03	2171.30	5	7	5.1E-02	2744.07	1	3	3.5E-01
				2173.21	3	5	8.3E-02	2750.14	7	7	3.9E-01
				2176.84	1	3	1.0E-01	2756.33	3	5	2.0E-01
				2191.20	1	3	7.3E-02	2788.10	11	13	6.3E-01
				2191.84	5	5	1.2E+00	2894.50	5	5	6.2E-01
				2196.04	3	3	1.2E+00	2899.42	5	3	5.9E-01
				2200.72	3	5	2.8E-01	2920.69	5	5	5.2E-02
				2259.51	9	11	7.0E-02	2923.29	11	11	1.6E+00
				2267.08	7	5	7.1E-02	2925.36	7	9	1.8E-01
				2272.07	7	9	3.8E-02	2929.01	7	5	7.3E-02
Indium											
In I											
2560.2	2	4	4.0E-01								
2710.3	4	6	4.0E-01								
3039.4	2	4	1.3E+00								
3256.1	4	6	1.3E+00								
4101.8	2	2	5.6E-01								
4511.3	4	2	1.02E+00								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
2936.90	9	9	1.3E-01	3215.94	5	5	8.0E-01	3442.36	5	5	4.55E-02
2941.34	5	3	5.6E-02	3217.38	11	9	2.2E-01	3443.88	5	3	6.2E-02
2947.88	7	7	2.0E-01	3219.58	7	9	6.2E-01	3445.15	5	7	2.8E-01
2953.94	5	5	1.89E-01	3222.07	11	11	3.3E-01	3447.28	5	5	9.1E-02
2954.65	5	7	1.0E-01	3225.79	11	13	8.8E-01	3450.33	3	3	2.0E-01
2957.36	3	3	1.77E-01	3227.80	9	7	1.4E+00	3476.70	1	3	5.4E-02
2965.25	1	3	1.16E-01	3228.25	5	3	4.5E-01	3477.85	3	1	4.2E-02
2966.90	9	11	2.72E-01	3229.99	9	11	4.5E-01	3485.34	5	3	1.4E-01
2969.36	3	1	3.66E-02	3230.21	5	5	1.9E-01	3495.29	9	7	9.46E-02
2973.13	5	7	1.35E-01	3230.96	7	5	3.9E-01	3497.10	7	7	1.4E-01
2973.24	7	9	1.83E-01	3233.05	13	15	5.4E-01	3505.07	5	3	9.9E-02
2980.53	7	7	2.2E-01	3233.97	9	9	2.0E-01	3506.50	5	5	7.1E-02
2981.45	7	5	6.54E-02	3246.96	5	3	9.9E-02	3508.49	9	11	5.7E-02
2983.57	9	7	2.80E-01	3248.20	7	7	2.2E-01	3510.44	1	3	4.4E-02
2987.29	9	7	6.6E-02	3253.60	7	9	1.8E-01	3516.56	7	5	3.7E-02
2990.39	9	11	3.9E-01	3254.36	11	13	5.1E-01	3521.84	3	5	9.6E-02
2994.43	7	5	4.4E-01	3257.59	7	5	1.4E-01	3523.31	5	3	7.6E-02
2996.39	3	5	1.6E-01	3265.62	7	5	3.8E-01	3524.08	7	5	7.5E-02
2999.51	11	11	2.3E-01	3268.23	3	3	5.9E-02	3524.24	5	7	4.2E-02
3000.95	5	3	6.42E-01	3271.00	5	3	6.6E-01	3527.79	9	9	2.0E-01
3008.14	3	1	1.07E+00	3280.26	9	11	5.4E-01	3529.82	3	3	7.6E-01
3009.09	13	11	6.7E-02	3282.89	3	5	3.0E-01	3536.56	5	7	7.8E-01
3009.57	9	9	1.7E-01	3284.59	5	5	5.4E-02	3537.73	5	3	1.1E-01
3011.48	7	9	4.7E-01	3290.99	3	5	6.0E-02	3537.90	11	11	8.4E-02
3015.92	11	9	5.9E-02	3292.02	7	9	6.1E-01	3540.12	7	9	1.2E-01
3016.18	5	3	8.5E-02	3292.59	3	3	2.6E-01	3541.08	9	11	6.2E-01
3017.63	3	3	6.82E-02	3298.13	3	5	8.1E-02	3542.08	7	9	7.4E-01
3018.98	7	7	1.3E-01	3305.97	5	7	4.7E-01	3543.67	3	5	1.8E-01
3021.07	7	7	4.56E-01	3306.36	3	5	6.1E-01	3548.02	5	3	9.7E-02
3024.03	3	5	4.88E-02	3307.23	13	13	2.0E-01	3552.11	3	5	4.5E-02
3025.84	1	3	3.48E-01	3314.74	5	7	6.9E-01	3552.83	5	5	1.5E-01
3026.46	5	5	1.1E-01	3322.47	9	11	6.2E-02	3553.74	11	9	8.1E-01
3031.63	3	3	1.5E-01	3323.74	5	5	3.0E-01	3556.88	9	11	4.4E-01
3037.39	3	5	3.2E-01	3328.87	11	11	2.7E-01	3559.50	3	3	1.9E-01
3042.02	3	5	4.9E-02	3337.66	11	9	5.7E-02	3560.70	7	9	6.5E-02
3042.66	5	7	5.7E-02	3347.93	5	5	4.0E-02	3565.38	7	9	3.8E-01
3047.60	5	7	2.84E-01	3354.06	1	3	7.7E-02	3567.03	5	7	6.5E-02
3053.07	3	5	1.5E-01	3355.23	9	9	3.2E-01	3568.42	5	3	5.3E-02
3057.45	11	9	4.4E-01	3369.55	9	9	2.4E-01	3568.82	7	9	5.6E-02
3059.09	7	9	1.7E-01	3370.78	11	11	3.3E-01	3570.10	9	11	6.77E-01
3067.24	9	7	3.4E-01	3380.11	7	7	2.4E-01	3572.00	11	11	2.4E-01
3068.17	5	3	9.8E-02	3383.98	7	7	9.3E-02	3573.39	5	7	7.5E-02
3075.72	7	5	2.9E-01	3392.65	7	7	2.6E-01	3576.76	11	9	9.6E-02
3083.74	5	3	3.0E-01	3394.58	5	3	9.9E-02	3578.38	1	3	6.3E-02
3091.58	3	1	5.4E-01	3399.33	5	5	3.8E-01	3581.19	11	13	1.02E+00
3098.19	11	11	1.1E-01	3402.26	13	13	2.8E-01	3582.20	13	11	2.5E-01
3100.67	7	7	1.4E-01	3406.44	3	5	3.0E-01	3583.33	1	3	2.3E-01
3119.49	11	9	8.2E-02	3407.46	7	9	5.8E-01	3585.32	7	7	1.3E-01
3120.43	9	7	8.9E-02	3410.17	3	5	4.7E-01	3585.71	9	9	3.75E-02
3156.27	7	7	5.4E-01	3411.35	9	9	5.5E-02	3586.98	5	5	1.6E-01
3160.66	9	9	1.9E-01	3413.13	5	7	3.6E-01	3591.48	1	3	6.0E-02
3161.95	11	13	1.2E-01	3417.84	3	3	5.1E-01	3592.67	7	5	4.0E-02
3166.44	9	7	1.14E-01	3418.51	3	1	1.3E+00	3594.63	9	9	2.7E-01
3168.85	5	7	5.7E-02	3424.28	7	7	2.0E-01	3595.30	5	5	5.4E-02
3175.45	11	11	1.3E-01	3425.01	9	7	2.8E-01	3597.02	5	3	1.7E-01
3176.36	5	3	9.2E-02	3427.12	7	9	5.5E-01	3599.62	11	9	1.8E-01
3196.93	9	11	9.0E-01	3428.19	5	5	2.1E-01	3603.20	11	11	2.6E-01
3199.53	9	9	2.6E-01	3428.75	7	5	2.7E-01	3603.82	3	3	1.7E-01
3205.40	3	3	1.2E+00	3440.99	7	5	8.4E-02	3605.45	9	9	6.4E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3606.68	11	13	8.2E-01	3724.38	5	7	1.3E-01	3820.43	11	9	6.68E-01
3608.86	3	5	8.14E-01	3726.93	5	5	4.6E-01	3821.18	11	13	7.0E-01
3610.16	13	13	4.8E-01	3727.09	9	7	2.0E-01	3821.83	5	5	7.8E-02
3610.70	5	3	7.1E-02	3727.62	7	5	2.25E-01	3825.88	9	7	5.98E-01
3612.07	11	13	7.5E-02	3730.39	9	11	1.3E-01	3827.82	7	5	1.05E+00
3613.45	7	7	6.7E-02	3730.95	5	7	3.8E-02	3833.31	9	9	4.69E-02
3615.19	3	3	5.8E-02	3732.40	5	5	2.8E-01	3834.22	7	5	4.53E-01
3617.79	5	7	6.5E-01	3733.32	3	3	6.2E-02	3836.33	5	5	3.7E-01
3618.77	5	7	7.3E-01	3734.86	11	11	9.02E-01	3839.26	9	9	2.8E-01
3621.46	9	11	5.1E-01	3735.32	9	9	2.4E-01	3839.61	3	5	3.9E-01
3622.00	7	7	5.1E-01	3737.13	7	9	1.42E-01	3840.44	5	3	4.70E-01
3623.19	13	13	7.4E-02	3738.31	11	13	3.8E-01	3841.05	5	3	1.3E+00
3624.06	5	3	5.4E-02	3740.24	7	9	1.4E-01	3843.26	9	7	4.7E-01
3630.35	9	7	7.6E-02	3742.62	9	9	1.0E-01	3845.17	3	3	6.8E-02
3631.46	7	9	5.17E-01	3743.36	5	3	2.60E-01	3845.69	5	7	4.9E-02
3632.04	3	5	4.8E-01	3744.10	5	3	3.6E-01	3846.00	9	7	4.3E-02
3632.55	11	9	5.2E-02	3745.56	5	7	1.15E-01	3846.41	11	9	1.9E-01
3635.19	5	3	1.4E-01	3745.90	1	3	7.33E-02	3846.80	7	7	6.6E-01
3637.86	9	9	5.5E-02	3746.93	7	7	2.2E-01	3849.96	3	1	6.06E-01
3638.30	7	9	2.6E-01	3748.26	3	5	9.15E-02	3856.37	7	5	4.64E-02
3640.39	9	11	3.8E-01	3749.48	9	9	7.64E-01	3859.21	13	11	8.5E-02
3644.80	7	5	7.8E-02	3753.61	7	5	9.3E-02	3859.91	9	9	9.70E-02
3645.82	1	3	5.7E-01	3756.94	11	11	2.4E-01	3865.52	3	3	1.55E-01
3647.84	9	11	2.92E-01	3757.45	5	3	1.2E-01	3867.22	5	5	3.4E-01
3649.51	11	9	4.2E-01	3758.23	7	7	6.34E-01	3871.75	11	11	6.7E-02
3650.03	7	7	9.9E-02	3760.05	13	15	4.47E-02	3872.50	5	5	1.05E-01
3651.47	7	9	6.2E-01	3760.53	3	5	4.8E-02	3873.76	11	9	8.0E-02
3655.46	5	5	1.0E-01	3763.79	5	5	5.44E-01	3878.02	7	7	7.72E-02
3659.52	9	9	5.8E-02	3765.54	13	15	9.8E-01	3878.57	5	3	6.6E-02
3667.25	9	7	1.4E-01	3766.67	5	3	9.7E-02	3883.28	7	7	1.6E-01
3669.15	9	7	7.4E-02	3767.19	3	3	6.40E-01	3884.36	11	9	3.5E-02
3669.52	9	7	3.0E-01	3768.03	3	1	8.4E-02	3885.51	3	5	5.8E-02
3670.09	11	13	7.6E-02	3774.82	3	3	4.7E-02	3886.28	7	7	5.30E-02
3674.77	5	3	6.7E-02	3778.51	7	5	1.2E-01	3887.05	9	9	3.52E-02
3676.31	9	11	4.63E-02	3781.94	5	7	3.7E-02	3888.51	5	5	2.6E-01
3677.31	5	7	3.1E-01	3785.95	11	13	4.2E-02	3888.82	5	3	2.7E-01
3677.63	7	5	8.0E-01	3786.19	5	5	1.2E-01	3891.93	3	3	4.0E-01
3678.86	3	5	4.1E-02	3787.16	5	5	1.0E-01	3893.39	11	11	1.3E-01
3682.24	5	5	1.7E+00	3787.88	3	5	1.29E-01	3895.66	3	1	9.40E-02
3684.11	9	7	3.4E-01	3789.82	9	7	3.9E-02	3900.52	7	7	7.5E-02
3686.00	9	11	2.6E-01	3791.73	5	3	6.3E-02	3902.95	7	7	2.14E-01
3686.26	3	1	1.2E-01	3793.87	3	3	7.4E-02	3903.90	9	9	9.6E-02
3687.46	11	9	8.01E-02	3794.34	9	11	3.8E-02	3906.75	5	7	6.7E-02
3688.48	7	9	6.9E-02	3795.00	5	7	1.15E-01	3907.93	7	5	6.7E-02
3690.73	11	11	2.7E-01	3799.55	7	9	7.32E-02	3909.66	3	5	5.3E-02
3694.01	5	7	6.8E-01	3801.68	5	7	6.6E-02	3909.83	3	3	6.5E-02
3697.43	7	7	2.1E-01	3802.00	11	13	3.5E-02	3914.27	3	3	5.4E-02
3698.60	5	7	3.8E-02	3802.28	5	5	5.0E-02	3916.73	13	11	1.2E-01
3699.15	5	7	4.5E-02	3804.01	11	9	4.7E-02	3919.07	9	9	3.9E-02
3701.09	7	9	4.8E-01	3805.35	9	11	9.8E-01	3925.20	1	3	5.7E-02
3702.03	3	1	3.5E-01	3806.22	3	3	2.3E-01	3931.12	5	7	4.5E-02
3703.69	9	11	5.3E-02	3806.70	11	11	5.4E-01	3941.28	5	5	8.4E-02
3703.82	1	3	1.2E-01	3807.54	3	5	8.0E-02	3942.44	3	5	9.0E-02
3704.46	11	9	1.3E-01	3808.73	9	9	3.54E-02	3946.99	9	11	4.4E-02
3709.25	9	7	1.56E-01	3810.76	5	3	2.0E-01	3948.77	11	9	2.2E-01
3711.41	3	5	7.3E-02	3813.88	13	11	8.7E-02	3949.14	3	3	3.9E-02
3718.41	7	7	5.3E-02	3815.84	9	7	1.3E+00	3949.95	7	5	5.9E-02
3719.93	9	11	1.62E-01	3817.64	11	11	8.3E-02	3951.16	3	5	3.6E-01
3722.56	5	5	4.97E-02	3819.50	7	5	4.6E-02	3952.60	11	11	4.1E-02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3953.15	7	9	3.7E-02	4109.07	1	3	4.5E-02	4250.79	7	7	1.0E-01
3955.34	3	3	1.4E-01	4109.80	3	3	1.6E-01	4260.47	11	11	3.2E-01
3955.96	3	3	5.7E-02	4112.96	11	13	1.4E-01	4267.83	1	3	9.4E-02
3956.45	13	11	2.1E-01	4114.45	5	5	4.7E-02	4268.75	5	3	4.2E-02
3957.02	5	7	1.6E-01	4118.54	11	13	5.8E-01	4271.15	7	9	1.82E-01
3960.28	5	7	4.2E-02	4126.18	11	11	3.9E-02	4271.76	9	11	2.28E-01
3963.10	3	5	1.7E-01	4127.61	1	3	1.3E-01	4282.40	7	5	1.1E-01
3967.42	9	7	2.3E-01	4132.06	5	7	1.2E-01	4300.83	5	5	4.7E-02
3967.96	7	9	6.3E-02	4132.90	3	5	9.4E-02	4305.45	5	3	6.0E-02
3969.26	9	7	2.3E-01	4134.68	5	7	1.8E-01	4307.90	7	9	3.4E-01
3970.39	3	1	3.5E-01	4137.00	3	5	2.2E-01	4315.08	5	5	7.7E-02
3971.32	11	9	5.7E-02	4137.42	5	7	6.1E-02	4325.76	5	7	5.0E-01
3973.65	5	7	6.6E-02	4142.63	3	5	7.4E-02	4327.09	5	5	7.8E-02
3976.61	3	5	1.8E-01	4143.87	7	9	1.5E-01	4352.73	3	5	3.9E-02
3977.74	5	5	7.0E-02	4149.37	11	13	3.6E-02	4369.77	9	9	7.2E-02
3981.77	9	9	3.9E-02	4150.25	3	3	7.1E-02	4383.54	9	11	5.00E-01
3983.96	9	7	7.6E-02	4153.90	7	9	2.3E-01	4387.89	3	3	3.9E-02
3985.39	5	5	6.7E-02	4154.80	9	11	1.5E-01	4388.41	7	7	1.3E-01
3989.86	5	7	5.0E-02	4156.80	5	5	1.9E-01	4401.29	7	7	5.9E-02
3996.97	9	9	6.7E-02	4158.79	3	5	1.6E-01	4404.75	7	9	2.75E-01
3997.39	9	11	1.5E-01	4170.90	5	5	6.1E-02	4415.12	5	7	1.19E-01
3998.05	11	9	6.6E-02	4172.12	7	5	9.7E-02	4422.57	3	3	8.8E-02
4003.76	3	3	7.1E-02	4175.64	3	5	1.6E-01	4430.61	3	1	7.45E-02
4005.24	7	5	2.04E-01	4181.75	5	7	3.6E-01	4433.22	5	3	2.3E-01
4006.31	11	9	4.7E-02	4182.38	5	5	4.9E-02	4438.34	3	1	7.9E-02
4007.27	7	5	4.2E-02	4184.89	5	5	1.1E-01	4442.34	5	5	3.76E-02
4009.71	3	5	5.2E-02	4187.04	7	5	2.15E-01	4443.19	1	3	1.1E-01
4014.53	11	11	2.4E-01	4187.79	9	7	1.52E-01	4446.83	3	3	5.3E-02
4017.15	9	11	4.5E-02	4191.68	1	3	4.8E-02	4447.72	3	3	5.11E-02
4021.87	7	9	1.0E-01	4196.21	7	7	9.8E-02	4454.38	5	5	3.8E-02
4024.72	7	9	8.9E-02	4198.30	11	9	8.03E-02	4455.03	9	7	3.9E-02
4031.96	3	5	7.1E-02	4198.64	5	5	1.3E-01	4466.55	5	7	1.2E-01
4040.64	5	7	4.4E-02	4199.09	9	11	6.1E-01	4469.37	5	7	2.6E-01
4044.61	5	3	1.1E-01	4200.09	7	7	4.0E-02	4481.61	3	3	4.2E-02
4045.81	9	9	8.63E-01	4200.92	7	9	4.2E-02	4484.22	7	9	7.0E-02
4054.87	5	3	1.6E-01	4202.03	9	9	8.22E-02	4485.67	3	3	1.1E-01
4058.22	9	7	4.9E-02	4203.67	7	9	8.6E-02	4528.61	7	9	5.44E-02
4059.73	5	3	8.1E-02	4203.94	13	13	1.3E-01	4533.13	3	1	3.7E-02
4062.44	3	3	2.2E-01	4205.54	5	5	3.6E-02	4547.85	5	7	7.6E-02
4063.59	7	7	6.8E-01	4207.13	5	3	4.3E-02	4619.29	7	5	4.7E-02
4065.40	3	1	1.9E-01	4210.34	3	3	1.7E-01	4669.17	5	3	4.0E-02
4067.98	9	9	1.7E-01	4213.65	3	1	1.9E-01	4673.16	5	7	4.6E-02
4070.77	7	5	1.3E-01	4217.55	3	5	2.3E-01	4678.85	7	9	7.4E-02
4071.74	5	5	7.65E-01	4219.36	11	13	3.8E-01	4704.95	3	1	8.1E-02
4073.76	5	3	1.6E-01	4220.34	3	1	1.9E-01	4736.77	9	11	4.9E-02
4074.79	9	9	4.8E-02	4222.21	7	7	5.77E-02	4789.65	5	5	7.2E-02
4076.63	9	9	1.9E-01	4224.17	9	11	1.3E-01	4859.74	5	3	1.3E-01
4078.35	5	3	4.2E-02	4224.51	3	5	7.1E-02	4871.32	7	5	2.2E-01
4079.18	5	5	5.1E-02	4225.45	5	7	1.7E-01	4872.14	3	3	2.4E-01
4079.84	1	3	6.3E-02	4226.42	3	3	3.7E-02	4878.21	1	3	9.1E-02
4080.21	3	1	2.4E-01	4233.60	3	5	1.85E-01	4890.75	5	5	2.1E-01
4082.44	3	3	3.8E-02	4235.94	9	9	1.88E-01	4891.49	9	7	2.9E-01
4084.49	11	9	1.1E-01	4238.81	7	9	2.2E-01	4892.87	3	3	4.8E-02
4085.00	3	5	4.2E-02	4240.37	5	3	5.7E-02	4903.31	3	5	4.7E-02
4085.30	7	7	1.1E-01	4245.26	1	3	8.3E-02	4917.23	5	3	6.1E-02
4085.98	7	5	5.0E-02	4246.08	7	5	5.7E-02	4918.01	1	3	4.0E-02
4088.57	5	3	3.9E-02	4247.43	9	11	2.0E-01	4918.99	7	7	1.7E-01
4098.18	7	7	6.8E-02	4248.22	3	5	3.5E-02	4920.50	11	9	3.5E-01
4107.49	5	3	2.5E-01	4250.12	5	7	2.08E-01	4930.31	3	3	4.1E-02

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4969.92	3	3	1.8E-01	5679.02	5	7	3.6E-02	2370.50	4	4	1.4E-01
4973.10	3	3	1.0E-01	5686.53	9	11	4.4E-02	2373.74	10	10	3.3E-01
4978.60	5	3	1.1E-01	5691.51	3	1	6.2E-02	2375.19	4	2	9.8E-01
4988.95	7	7	4.9E-02	5705.99	7	9	6.7E-02	2379.27	8	8	1.5E-01
4991.27	5	7	8.2E-02	5717.85	1	3	5.0E-02	2380.76	6	8	3.1E-01
5001.86	9	7	3.9E-01	5753.12	3	5	7.0E-02	2382.04	10	12	3.8E+00
5004.04	5	3	3.5E-02	5762.99	5	7	1.0E-01	2382.90	12	14	2.2E-01
5014.94	7	5	3.0E-01	5816.36	9	11	3.7E-02	2383.25	6	6	3.4E-01
5022.24	5	3	2.6E-01	5905.67	5	3	1.2E-01	2384.39	4	4	2.3E-01
5074.75	9	11	1.5E-01	5927.80	5	3	5.1E-02	2388.37	10	12	2.2E-01
5090.78	7	5	2.0E-01	5930.17	5	7	1.6E-01	2388.63	8	8	1.0E+00
5109.65	3	5	5.4E-02	6020.17	7	9	1.1E-01	2390.10	14	16	5.5E+00
5121.64	5	5	7.9E-02	6024.07	9	11	1.3E-01	2390.77	6	6	9.3E-01
5125.11	9	7	2.6E-01	6055.99	7	9	7.0E-02	2395.42	6	4	3.3E-01
5133.69	11	13	2.7E-01	6170.49	5	5	1.3E-01	2395.62	8	10	2.5E+00
5137.38	11	9	1.1E-01	6336.84	3	3	4.9E-02	2399.24	6	6	1.4E+00
5159.06	5	3	1.3E-01	6338.90	5	3	4.8E-02	2400.06	12	14	5.2E+00
5162.27	11	11	2.4E-01	6400.00	7	9	5.5E-02	2401.29	6	8	2.5E+00
5184.26	5	7	3.5E-02	6411.65	5	7	3.5E-02	2404.43	4	2	7.1E-01
5208.59	7	5	5.2E-02	6419.98	7	7	1.3E-01	2404.89	6	8	1.7E+00
5232.94	9	11	1.4E-01	6469.21	3	3	9.0E-02	2406.66	4	4	1.6E+00
5263.30	5	5	5.2E-02	6495.78	3	3	6.0E-02	2410.52	4	6	1.5E+00
5266.55	7	9	8.6E-02	6496.46	5	5	8.5E-02	2411.07	2	2	2.4E+00
5283.62	7	7	8.0E-02	6569.23	7	9	6.5E-02	2413.31	2	4	1.1E+00
5302.30	3	5	6.3E-02	6633.76	7	7	3.6E-02	2416.45	8	10	1.6E+00
5324.18	9	9	1.5E-01	6733.16	3	1	3.9E-02	2418.44	6	8	1.6E+00
5339.93	5	7	7.0E-02	6841.35	5	7	3.6E-02	2423.21	4	6	1.4E+00
5353.39	9	7	4.8E-02	7130.94	3	5	4.3E-02	2428.36	8	10	2.7E+00
5364.87	5	7	5.5E-01					2432.87	14	14	3.2E+00
5367.47	7	9	5.8E-01	Fe II				2434.06	8	6	7.0E-01
5369.96	9	11	4.7E-01	1144.94	10	12	4.8E+00	2434.24	8	10	2.0E+00
5373.71	7	9	3.5E-02	1635.40	8	6	2.4E+00	2434.73	12	12	3.2E+00
5383.37	11	13	5.6E-01	1641.76	6	4	1.8E+00	2439.30	12	14	2.8E+00
5389.48	7	7	1.3E-01	1647.16	6	6	5.2E-01	2445.11	12	12	1.9E+00
5398.29	5	5	9.8E-02	2208.41	10	10	1.8E+00	2445.80	4	6	1.5E+00
5400.50	9	9	1.8E-01	2213.66	14	14	4.4E-01	2446.47	12	14	2.9E-01
5410.91	7	9	4.8E-01	2218.27	8	10	1.9E+00	2447.20	6	6	1.2E+00
5415.20	11	13	5.6E-01	2327.40	6	4	5.9E-01	2453.98	8	10	7.3E-01
5424.07	13	15	5.0E-01	2331.31	10	8	2.9E-01	2455.71	8	8	1.0E+00
5432.95	5	5	4.1E-02	2332.80	8	6	1.5E+00	2458.78	10	12	2.7E+00
5445.04	11	11	2.0E-01	2338.01	4	4	1.1E+00	2458.97	6	4	2.0E+00
5463.27	9	9	3.2E-01	2343.49	10	8	1.7E+00	2460.44	10	12	5.3E+00
5466.39	9	7	7.5E-02	2343.96	8	6	2.9E-01	2461.28	6	8	2.6E+00
5473.90	7	7	5.5E-02	2344.28	2	4	8.2E-01	2461.86	8	10	2.6E+00
5480.87	3	1	1.2E-01	2348.11	10	8	5.1E-01	2466.52	2	4	2.1E+00
5487.74	7	5	8.6E-02	2348.30	6	6	1.2E+00	2469.51	8	6	2.8E+00
5554.89	9	9	8.7E-02	2351.67	6	6	1.7E+00	2472.61	8	10	3.7E+00
5569.62	5	3	2.1E-01	2352.31	2	4	4.2E+00	2475.12	4	6	3.9E+00
5572.84	7	5	2.1E-01	2353.68	8	8	1.3E+00	2475.54	6	8	3.5E+00
5576.09	3	1	2.1E-01	2354.89	6	4	2.4E-01	2481.05	12	12	1.9E-01
5586.76	9	7	1.9E-01	2360.00	10	10	2.4E-01	2484.44	8	8	2.3E+00
5598.30	5	5	1.8E-01	2360.29	8	6	5.9E-01	2492.34	10	12	1.6E-01
5615.64	11	9	1.7E-01	2362.02	8	8	1.3E-01	2493.26	14	16	3.4E+00
5624.54	5	5	5.3E-02	2363.86	8	10	5.1E+00	2501.31	2	2	1.4E+00
5633.97	11	13	8.7E-02	2364.83	8	8	6.1E-01	2503.87	10	10	2.4E+00
5638.27	9	7	4.0E-02	2365.77	6	6	2.1E+00	2508.34	8	10	2.7E+00
5650.01	3	5	5.0E-02	2366.59	6	6	9.9E-02	2533.63	12	12	1.3E+00
5655.18	7	9	5.3E-02	2368.60	6	4	5.9E-01	2534.42	8	8	1.2E+00
5658.82	7	7	3.6E-02	2369.95	10	12	5.7E+00	2535.36	6	4	3.3E+00

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
2535.49	10	8	5.4E-01	2592.78	14	16	2.1E+00	2712.39	10	12	1.3E-01
2536.67	12	12	4.0E-01	2593.72	2	4	1.3E-01	2714.41	8	6	5.5E-01
2537.14	10	10	1.4E+00	2594.96	8	8	1.0E-01	2716.22	6	6	1.1E+00
2538.20	14	12	1.2E+00	2598.37	8	6	1.3E+00	2716.56	14	12	1.6E+00
2538.50	8	6	3.3E-01	2599.40	10	10	2.2E+00	2717.87	16	14	1.4E+00
2538.80	12	10	8.2E-01	2604.05	8	8	1.1E-01	2718.64	10	8	1.3E+00
2538.91	10	8	7.8E-01	2605.04	6	8	2.1E+00	2719.30	6	8	3.7E-01
2538.99	14	12	1.2E+00	2605.34	4	4	1.6E+00	2722.06	8	8	1.1E-01
2540.52	2	2	1.5E+00	2605.42	6	6	2.6E-01	2722.74	6	8	7.8E-01
2541.10	8	6	7.3E-01	2605.90	4	2	1.2E+00	2724.88	6	6	9.7E-01
2541.84	8	6	7.7E-01	2606.51	6	6	1.8E+00	2727.38	12	10	3.2E-01
2542.73	2	2	1.9E+00	2607.09	6	4	1.7E+00	2727.54	6	4	8.5E-01
2543.38	10	12	4.4E-01	2609.13	8	10	3.0E-01	2728.91	8	10	8.8E-02
2543.43	6	4	7.1E-01	2609.87	8	8	1.8E-01	2730.73	4	4	2.5E-01
2544.97	4	6	4.0E-01	2611.87	8	8	1.1E+00	2732.94	8	6	7.8E-01
2545.22	8	10	3.3E-01	2613.82	4	2	2.0E+00	2739.55	8	8	1.9E+00
2545.44	8	10	1.4E-01	2617.62	6	6	4.4E-01	2741.40	6	6	1.7E-01
2546.67	8	8	6.2E-01	2619.07	10	10	2.7E-01	2743.20	2	4	1.8E+00
2547.34	8	8	2.0E-01	2620.17	6	6	1.3E-01	2746.48	4	6	1.9E+00
2548.33	4	6	2.0E-01	2620.70	8	8	3.3E-01	2746.98	6	6	1.6E+00
2548.59	10	10	1.9E-01	2621.67	2	2	4.9E-01	2749.18	4	4	1.1E+00
2548.74	4	2	1.7E+00	2623.11	14	14	1.1E-01	2749.32	6	8	2.1E+00
2548.92	12	10	4.8E-01	2623.73	6	6	2.2E-01	2749.49	2	2	1.1E+00
2549.08	10	8	1.5E+00	2625.49	12	14	2.2E+00	2753.29	10	12	1.2E+00
2549.40	4	4	1.3E+00	2625.67	8	10	3.4E-01	2754.91	8	6	8.4E-01
2549.46	6	6	8.0E-01	2626.50	4	6	3.4E-01	2755.73	8	10	2.1E+00
2549.77	8	6	2.5E-01	2628.29	2	4	8.6E-01	2761.81	2	4	1.1E-01
2550.03	10	10	1.2E+00	2629.59	6	8	6.2E-01	2762.34	6	6	3.7E-01
2550.15	8	10	4.0E-01	2630.07	4	6	5.7E-01	2763.66	14	12	1.3E+00
2550.68	12	12	8.9E-01	2631.05	4	6	7.7E-01	2765.13	10	8	1.2E+00
2551.21	10	8	3.2E-01	2631.32	6	8	6.0E-01	2767.50	12	14	1.9E+00
2555.07	6	8	1.8E-01	2631.61	10	12	5.3E-01	2769.36	12	14	1.6E-01
2555.45	4	6	2.5E-01	2633.20	6	4	1.7E+00	2774.69	2	4	2.4E-01
2557.51	10	8	1.3E-01	2636.69	4	4	1.2E-01	2776.91	8	8	3.0E-01
2559.77	6	8	2.4E-01	2637.50	6	6	5.2E-01	2779.30	10	8	7.6E-01
2559.92	6	8	2.4E-01	2637.64	2	4	8.3E-01	2779.91	2	4	2.3E-01
2560.28	4	4	1.5E+00	2639.56	2	2	1.1E+00	2780.04	2	2	2.9E-01
2562.09	4	2	1.5E+00	2642.01	6	6	3.6E-01	2783.69	12	10	7.0E-01
2562.54	8	6	1.5E+00	2649.47	6	8	1.8E+00	2785.19	12	10	1.0E+00
2563.48	6	4	1.3E+00	2650.48	6	8	1.6E+00	2787.24	8	6	1.3E-01
2566.22	8	10	2.5E+00	2654.63	4	4	7.7E-01	2793.89	10	12	9.6E-02
2566.40	8	6	2.1E+00	2658.25	8	8	3.2E-01	2796.63	10	10	1.0E-01
2566.91	4	2	1.1E+00	2662.56	2	2	9.6E-01	2799.29	10	8	1.1E-01
2568.41	2	4	4.4E-01	2664.66	8	10	1.5E+00	2809.78	8	8	1.6E-01
2569.78	2	4	1.2E+00	2666.64	6	8	1.7E+00	2817.09	6	4	2.1E-01
2570.53	6	8	1.2E+00	2667.22	4	6	9.2E-01	2831.56	4	6	5.8E-01
2570.85	8	6	1.7E+00	2669.93	2	4	4.7E-01	2833.09	6	6	2.7E-01
2573.21	8	10	1.4E-01	2671.40	2	4	5.6E-01	2835.71	4	6	3.1E-01
2574.36	6	4	1.6E+00	2682.51	8	10	7.0E-01	2838.22	4	2	4.2E-01
2576.86	10	12	1.1E+00	2683.00	4	6	6.4E-01	2839.51	10	8	9.9E-01
2577.92	2	2	1.3E+00	2684.75	8	10	1.4E+00	2839.80	8	10	4.1E-01
2582.41	6	8	2.4E-01	2692.60	10	12	1.2E+00	2840.65	2	4	5.3E-01
2582.58	4	4	7.7E-01	2697.33	4	4	2.7E-01	2840.76	10	12	1.1E-01
2585.63	10	10	3.6E-01	2697.46	4	2	1.8E+00	2844.96	2	2	4.5E-01
2585.88	10	8	8.1E-01	2699.20	4	4	6.6E-01	2847.77	4	4	3.3E-01
2587.95	8	10	1.4E+00	2703.99	8	8	1.2E+00	2848.11	6	6	7.0E-01
2588.18	2	2	1.6E-01	2707.13	4	6	8.5E-01	2848.32	6	4	1.1E+00
2590.55	4	6	9.1E-02	2709.05	4	6	3.7E-01	2855.69	8	10	1.0E-01
2591.54	6	6	5.1E-01	2711.84	12	14	3.8E-01	2856.38	6	8	2.7E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
2856.91	8	8	8.7E-01	Fe VII			175.266	2	4	1.72E+03	
2857.17	6	8	9.5E-02	150.807	5	7	1.3E+03	Fe XI			
2872.39	10	8	1.5E-01	150.852	7	9	1.3E+03	72.166	5	7	2.9E+03
2873.40	8	10	3.4E-01	151.023	9	11	1.6E+03	72.310	5	5	1.5E+03
2875.35	8	10	9.5E-02	151.046	7	7	2.2E+02	72.635	5	7	1.6E+03
2883.71	12	14	1.0E-01	151.145	9	9	2.1E+02	91.394	5	7	2.6E+03
2884.77	6	8	1.4E-01	151.432	5	7	2.2E+02	91.472	7	9	2.5E+03
2895.22	8	10	8.0E-02	151.512	5	5	5.3E+02	91.63	3	5	2.3E+03
2897.27	6	4	1.4E-01	151.675	7	7	3.9E+02	91.63	7	9	3.4E+03
2944.40	4	2	4.6E-01	151.782	9	9	2.4E+02	91.63	5	7	2.8E+03
2947.66	6	4	2.0E-01	154.307	3	1	8.9E+02	91.733	9	11	4.1E+03
2949.18	10	8	2.0E-01	154.335	5	7	1.2E+03	92.81	9	11	3.7E+03
2959.84	8	6	1.6E-01	154.363	3	3	4.2E+02	92.87	11	13	3.9E+03
2964.63	2	2	9.3E-02	154.565	5	3	3.5E+02	93.433	9	11	3.2E+03
2969.93	8	6	1.8E-01	154.650	5	5	8.8E+02	179.762	5	7	1.67E+03
2982.06	4	6	2.1E-01	154.848	1	3	7.7E+02	Fe XII			
2984.82	6	6	3.6E-01	154.921	3	5	9.7E+02	65.905	4	4	2.0E+03
2985.55	2	4	1.8E-01	154.941	3	3	2.4E+02	66.526	6	8	1.7E+03
2997.30	6	8	8.3E-02	154.949	5	7	1.0E+03	66.960	4	6	1.6E+03
3002.65	4	6	1.4E-01	155.994	9	11	1.8E+03	67.164	4	2	1.1E+03
3036.96	6	6	1.6E-01	158.481	9	9	2.3E+02	67.821	4	6	1.4E+03
3048.99	4	4	2.8E-01	165.087	1	3	6.9E+02	68.382	2	4	1.7E+03
3062.23	12	10	1.2E-01	165.919	7	5	2.8E+03	80.541	6	6	8.7E+02
3071.12	2	4	1.9E-01	166.365	9	7	2.9E+03	81.943	6	4	1.4E+03
3076.44	4	6	2.8E-01	173.441	9	9	3.6E+03	82.226	4	2	1.9E+03
3077.17	14	12	1.1E-01	176.744	9	9	2.7E+03	84.48	4	6	4.5E+03
3078.68	6	8	4.2E-01	176.928	7	7	2.4E+03	84.48	8	10	4.9E+03
3135.36	6	6	8.4E-02	177.172	5	5	1.5E+03	84.52	10	12	5.2E+03
3154.20	10	10	1.5E-01	235.221	5	3	1.7E+02	84.52	6	8	4.0E+03
3167.86	8	8	1.3E-01	240.053	3	1	1.3E+02	84.85	6	8	2.3E+03
3177.54	8	8	8.1E-02	243.379	9	7	2.1E+02	85.14	8	10	3.4E+03
3179.50	6	8	9.9E-02	Fe VIII			85.477	10	12	4.6E+03	
5247.95	4	6	1.7E+00	112.472	4	4	3.6E+02	186.880	6	8	1.0E+03
5506.20	12	14	1.4E+00	112.486	6	6	4.3E+02	192.394	4	2	9.0E+02
5961.71	10	12	7.7E-01	116.196	4	6	4.5E+02	193.509	4	4	9.1E+02
Fe III				117.197	6	8	3.8E+02	195.119	4	6	8.6E+02
1843.4	9	7	4.8E+00	167.486	4	4	3.0E+03	Fe XIII			
1844.3	7	5	4.9E+00	168.172	6	6	3.1E+03	62.353	1	3	2.0E+03
1846.9	5	3	5.5E+00	168.545	6	4	2.0E+03	62.46	5	7	1.2E+03
1854.38	3	1	5.7E+00	168.929	4	2	2.1E+03	62.699	3	5	2.3E+03
1865.20	7	7	6.1E+00	185.213	6	8	1.0E+03	63.188	5	7	3.9E+03
1893.98	11	9	5.5E+00	186.601	4	6	9.4E+02	64.139	1	3	2.1E+03
1896.80	13	11	5.0E+00	Fe X			74.845	5	5	1.0E+03	
1904.3	5	5	5.7E+00	76.822	2	2	1.8E+03	75.892	5	3	7.7E+02
1907.58	15	13	5.3E+00	77.865	4	6	1.6E+03	76.117	5	3	2.1E+03
1915.08	13	15	6.0E+00	100.026	8	10	2.6E+03	78.452	9	11	6.3E+03
1922.79	11	13	5.5E+00	101.733	6	8	1.8E+03	84.270	7	9	5.5E+03
1930.39	9	11	5.1E+00	101.846	4	6	1.7E+03	107.384	7	5	1.8E+03
1931.51	9	11	5.3E+00	102.095	10	12	2.9E+03	Fe XIV			
1937.35	7	9	5.1E+00	102.192	10	12	2.9E+03	58.963	2	4	2.7E+03
1943.48	5	7	5.0E+00	102.829	4	6	2.1E+03	59.579	4	6	3.1E+03
1950.33	13	15	5.5E+00	103.319	6	8	2.6E+03	69.176	4	6	5.6E+02
1951.01	11	11	5.3E+00	103.724	6	8	1.7E+03	69.386	2	4	7.6E+02
1952.65	9	9	4.9E+00	104.638	8	10	2.1E+03				
1953.32	7	7	5.1E+00	174.534	4	6	1.8E+03				
1987.50	13	13	4.9E+00								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
69.66	2	2	8.9E+02	248	3	1	5.4E+02	12.264	1	3	5.9E+04
69.66	6	6	1.3E+03	284.160	1	3	2.28E+02	12.526	1	3	3.0E+03
70.251	6	4	8.1E+02					12.681	1	3	3.5E+03
70.613	4	2	1.7E+03	Fe XVI				13.823	1	3	3.3E+04
72.80	10	12	7.9E+03	31.041	2	4	5.2E+02	13.891	1	3	3.4E+03
76.022	4	6	6.6E+03	31.242	4	6	6.1E+02	15.015	1	3	2.28E+05
76.152	6	8	7.0E+03	32.166	2	4	6.8E+02	15.262	1	3	6.0E+04
91.009	6	4	5.1E+02	32.192	2	2	6.7E+02	16.777	1	3	8.29E+03
91.273	4	2	5.6E+02	32.433	2	4	7.7E+02	17.054	1	3	9.33E+03
188	4	6	2.7E+02	32.652	4	6	9.1E+02	41.37	9	11	4.8E+03
190	6	8	2.8E+02	34.857	2	4	1.23E+03	49.427	3	3	4.0E+03
207	2	2	2.1E+02	35.106	4	6	1.44E+03	50.26	7	9	6.0E+03
211.316	2	4	3.6E+02	35.333	4	6	6.4E+02	58.76	9	11	1.2E+04
213	4	2	2.8E+02	35.368	6	8	6.8E+02				
214	2	2	4.0E+02	36.01	4	2	5.0E+02	Fe XIX			
216	6	8	1.7E+02	36.749	2	4	1.1E+03	13.413	5	3	1.3E+04
217	6	8	4.0E+02	36.803	2	2	1.2E+03	13.426	5	7	4.8E+04
217	6	6	2.6E+02	37.096	4	6	1.0E+03	13.47	3	1	1.5E+05
219	2	4	4.8E+02	37.138	6	8	1.07E+03	13.520	5	7	2.0E+05
219	4	6	2.4E+02	39.827	2	4	2.1E+03	13.56	3	5	1.0E+04
219.123	4	6	3.9E+02	40.153	4	6	2.5E+03	13.68	3	1	8.0E+04
220	4	4	3.2E+02	40.161	4	4	4.1E+02	13.69	5	7	2.3E+04
221	4	6	5.9E+02	40.199	4	6	1.7E+03	13.700	1	3	2.7E+05
226	2	4	3.9E+02	40.245	6	8	1.8E+03	13.71	5	5	2.2E+04
234	2	2	2.8E+02	41.91	2	2	4.72E+02	13.738	5	7	1.0E+04
264.787	4	4	3.38E+02	42.30	4	2	9.2E+02	13.796	5	7	7.0E+04
265	4	4	1.5E+02	46.661	4	6	3.46E+03	13.83	5	5	1.4E+04
266	6	4	1.7E+02	46.718	6	8	3.7E+03	13.934	1	3	4.51E+04
268	6	6	2.1E+02	50.350	2	4	1.86E+03	13.961	3	3	2.0E+04
268	4	2	3.3E+02	50.555	2	2	1.98E+03	14.668	5	7	1.1E+04
270.524	4	2	2.1E+02	54.142	2	4	3.41E+03	14.671	5	3	1.1E+04
274.203	2	2	1.8E+02	54.728	4	6	4.16E+03	14.929	3	3	1.2E+04
280	4	6	2.8E+02	54.769	4	4	6.97E+02	14.966	5	3	2.5E+04
283	6	8	2.7E+02	62.879	2	2	1.05E+03	14.995	5	5	2.2E+04
288.45	6	4	1.6E+02	63.719	4	2	2.18E+03	15.015	1	3	1.4E+04
				66.263	4	6	9.39E+03	16.668	3	1	1.1E+04
Fe XV				66.368	6	8	1.00E+04				
38.95	1	3	1.69E+03	66.392	6	6	6.69E+02	Fe XX			
52.911	1	3	2.94E+03	76.502	6	4	6.7E+02	12.67	6	6	1.0E+04
59.404	3	5	3.4E+03	76.796	4	2	7.72E+02	12.69	4	6	1.2E+04
63.959	5	7	1.6E+03	80.192	4	6	5.2E+02	12.73	4	2	4.0E+04
65.370	1	3	3.2E+02	80.270	6	8	5.4E+02	12.77	4	4	2.1E+05
65.612	3	3	9.8E+02	85.587	2	4	4.0E+02	12.78	4	2	6.9E+04
66.238	5	3	1.6E+03	86.133	4	6	4.8E+02	12.78	2	4	1.4E+05
68.860	9	11	9.2E+03	96.256	4	6	8.7E+02	12.79	6	4	1.7E+04
69.7	3	1	1.9E+03	96.348	6	8	9.3E+02	12.82	4	4	1.1E+05
69.942	3	5	7.4E+03	117.2	2	4	3.93E+02	12.88	6	4	2.7E+04
69.989	5	7	7.9E+03	117.7	2	2	3.9E+02	12.89	4	4	4.4E+04
70.052	7	9	8.8E+03	123.4	2	4	5.9E+02	12.90	4	2	6.2E+03
70.224	1	3	4.13E+03	124.5	4	6	7.0E+02	12.90	4	6	1.4E+05
70.53	7	5	2.6E+02	144.06	4	6	1.6E+03	12.92	2	4	1.7E+04
70.59	7	7	1.7E+03	144.25	6	8	1.6E+03	12.93	4	6	1.6E+05
73.199	7	9	8.8E+03	148	4	2	6.5E+02	12.93	2	2	1.2E+04
73.473	5	7	6.2E+03	266.7	4	6	3.9E+02	12.98	2	2	6.7E+04
233.857	5	7	2.2E+02	267.0	6	8	4.3E+02	12.99	6	6	5.1E+04
235	1	3	2.5E+02					13.00	6	4	1.1E+04
243	1	3	2.4E+02	Fe XVII				13.01	2	4	3.0E+04
243	5	7	2.3E+02	11.023	1	3	2.1E+04	13.03	4	2	8.6E+04
243.790	3	5	4.2E+02	12.123	1	3	8.0E+04	13.07	6	4	8.2E+03

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
13.13	2	4	8.9E+04	13.14	3	1	2.0E+04	11.325	3	5	1.7E+05
13.24	4	4	1.2E+04	13.41	1	3	7.3E+03	11.338	3	3	9.3E+04
13.28	4	4	6.1E+03					11.429	3	1	1.7E+05
13.70	4	6	1.1E+04	Fe XXII				11.433	3	3	1.2E+05
13.71	2	2	9.9E+03	9.002	4	6	5.5E+04	11.441	5	7	2.2E+05
13.78	4	4	1.0E+04	9.006	6	8	5.7E+04	11.445	5	5	5.6E+04
13.79	6	6	1.2E+04	9.006	6	6	5.3E+04	11.485	3	5	1.40E+05
13.83	4	2	9.8E+03	9.163	4	6	6.9E+04	11.491	5	3	5.9E+04
13.90	4	2	1.2E+04	9.183	6	8	8.3E+04	11.519	5	5	1.16E+05
13.98	6	4	1.6E+04	9.241	4	6	5.1E+04	11.520	1	3	2.16E+05
13.99	4	2	2.2E+04	11.748	4	4	1.2E+05	11.524	5	7	2.3E+05
14.05	4	4	1.7E+04	11.748	4	6	1.6E+05	11.593	5	7	3.58E+05
14.23	2	2	6.3E+03	11.748	4	2	1.8E+05	11.613	3	5	1.0E+05
				11.763	2	4	1.6E+05	11.615	3	3	4.4E+04
Fe XXI				11.789	2	2	2.6E+05	11.691	5	7	7.7E+04
8.53	3	1	1.8E+04	11.789	6	8	1.2E+05	11.698	5	5	7.3E+04
8.53	3	5	6.1E+03	11.797	2	4	1.7E+05	11.737	3	5	1.8E+05
8.53	3	3	1.5E+04	11.823	6	4	7.9E+04	11.898	1	3	2.03E+05
8.56	5	7	2.0E+04	11.837	6	8	2.3E+05				
8.56	1	3	2.1E+04	11.837	6	6	1.7E+05	Fe XXIV			
8.56	5	3	6.5E+03	11.886	4	6	1.3E+05	1.8523	2	2	1.0E+05
8.64	5	7	1.5E+04	11.898	2	4	8.2E+04	1.8552	2	4	4.82E+06
8.65	5	7	3.9E+04	11.922	4	6	1.8E+05	1.8563	4	2	2.43E+06
8.66	5	5	4.4E+03	11.976	6	8	5.9E+04	1.8572	2	2	3.06E+06
8.74	1	3	2.5E+04	12.027	2	4	6.9E+04	1.858	2	4	1.2E+05
9.42	3	1	4.3E+04	12.045	6	8	2.4E+05	1.8614	4	4	6.24E+06
9.42	3	3	3.3E+04	12.045	4	4	9.7E+04	1.8626	2	4	3.16E+06
9.44	3	5	1.7E+04	12.053	4	6	6.1E+04	1.8627	2	2	5.47E+06
9.45	1	3	5.2E+04	12.077	2	4	1.0E+05	1.8637	2	2	1.91E+06
9.46	5	3	1.5E+04	12.077	4	6	2.4E+05	1.8655	4	6	2.14E+06
9.47	5	7	4.9E+04	12.095	6	6	7.8E+04	1.8672	4	2	1.63E+06
9.47	5	5	6.1E+03	12.193	2	4	7.2E+04	1.8678	4	4	3.5E+05
9.52	3	3	8.1E+03	12.193	4	6	9.9E+04	1.8721	4	6	3.2E+05
9.58	5	5	5.2E+03	12.325	2	2	1.5E+05	1.8721	2	2	2.0E+05
9.59	5	5	1.0E+04					1.8730	2	4	1.5E+05
9.67	1	3	5.7E+04	Fe XXIII				1.8739	4	4	8.3E+04
9.68	5	7	4.0E+03	7.733	5	7	3.0E+04	1.891	2	2	9.7E+04
9.74	5	3	5.3E+03	7.849	5	7	4.9E+04	1.897	4	2	9.8E+04
12.02	1	3	1.3E+04	8.307	1	3	4.8E+04	8.231	2	4	6.10E+04
12.13	3	3	1.8E+04	8.529	1	3	4.3E+04	8.316	4	6	7.07E+04
12.18	5	7	2.2E+04	8.550	3	5	6.0E+04	10.619	2	4	7.28E+04
12.19	5	3	6.4E+03	8.552	3	3	3.2E+04	10.663	2	2	7.51E+04
12.21	3	1	1.5E+05	8.614	5	7	7.7E+04	11.030	2	4	1.84E+05
12.21	3	3	1.2E+05	8.664	3	3	4.4E+04	11.171	4	6	2.18E+05
12.25	1	3	2.1E+05	8.669	5	7	6.1E+04				
12.28	5	3	5.2E+04	8.672	1	3	6.8E+04	Fe XXV			
12.30	5	7	2.1E+05	8.752	5	7	1.2E+05	1.4607	1	3	2.54E+05
12.36	3	3	3.6E+04	8.764	5	7	4.6E+04	1.4945	1	3	5.05E+05
12.37	5	7	3.1E+05	8.814	3	5	6.2E+04	1.5730	1	3	1.24E+06
12.38	5	3	6.9E+03	10.902	5	5	5.3E+04	1.5749	1	3	1.5E+05
12.47	5	7	5.8E+04	10.910	3	1	6.7E+04	1.778	3	3	8.7E+04
12.47	5	3	1.3E+04	10.927	5	7	6.0E+04	1.782	3	1	4.69E+06
12.49	5	7	1.3E+04	10.934	3	5	5.4E+04	1.787	1	3	2.57E+06
12.53	5	5	1.5E+04	10.979	1	3	7.9E+04	1.787	5	5	1.19E+06
12.57	1	3	7.2E+04	11.018	1	3	4.9E+04	1.788	3	5	2.68E+06
12.73	5	5	8.2E+03	11.086	3	1	6.5E+04	1.788	3	5	1.63E+06
12.95	3	5	6.2E+03	11.165	3	5	6.7E+04	1.789	1	3	1.78E+06
13.00	1	3	7.2E+03	11.255	3	3	3.7E+04	1.790	3	3	1.23E+06
13.03	5	5	1.3E+04	11.298	1	3	1.3E+05	1.791	3	5	4.10E+06

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
1.791	3	3	2.59E+06	4619.2	4	6	8.1E-01	Magnesium			
1.792	3	1	4.92E+06	4633.9	4	6	7.1E-01				
1.792	5	5	2.81E+06	4658.9	6	4	6.5E-01				
1.793	3	1	2.67E+06	4739.0	6	6	7.6E-01				
1.794	5	3	2.22E+06	4762.4	2	4	4.2E-01				
1.797	3	5	8.8E+05	4765.7	4	6	6.7E-01				
1.798	3	3	1.0E+05	4811.8	2	4	1.7E-01				
1.800	1	3	8.6E+04	4825.2	2	4	1.9E-01				
1.802	3	1	4.1E+05	4832.1	4	2	7.3E-01				
1.810	3	1	5.9E+05	5208.3	4	4	1.4E-01				
1.8502	1	3	4.57E+06	5308.7	4	6	2.4E-02	2025.8	1	3	8.4E-01
1.8593	1	3	4.42E+05	7407.0	6	6	7.0E-02	*2779.8	9	9	5.2E+00
10.038	3	3	8.08E+04					*2850.0	9	15	2.3E-01
Krypton				Lead							
Kr I				Pb I							
1164.9	1	3	3.16E+00	2022.0	1	3	5.2E-02	5172.7	1	3	1.16E-01
1235.8	1	3	3.12E+00	2053.3	1	3	1.2E-01	5172.7	3	3	3.46E-01
4274.0	5	5	2.6E-02	2170.0	1	3	1.5E+00	5183.6	5	3	5.75E-01
4351.4	3	1	3.2E-02	2401.9	3	3	1.9E-01	5528.4	3	5	1.99E-01
4362.6	5	3	8.4E-03	2446.2	3	3	2.5E-01	Mg II			
4376.1	3	1	5.6E-02	2476.4	3	5	2.8E-01	1239.9	2	4	1.4E-02
4400.0	3	5	2.0E-02	2577.3	5	3	5.0E-01	1240.4	2	2	1.4E-02
4410.4	3	3	4.4E-03	2613.7	3	3	2.7E-01	*2660.8	10	14	3.8E-01
4425.2	3	3	9.7E-03	2614.2	3	5	1.9E+00	2790.8	2	4	4.0E+00
4453.9	3	5	7.8E-03	2628.3	5	3	3.1E-02	2795.5	2	4	2.6E+00
4463.7	3	3	2.3E-02	2628.3	5	3	3.1E-02	2797.9	4	4	7.9E-01
4502.4	3	5	9.2E-03	2657.1	3	5	9.8E-04	2798.1	4	6	4.8E+00
5562.2	5	5	2.8E-03	2663.2	5	5	7.1E-01	2802.7	2	2	2.6E+00
5570.3	5	3	2.1E-02	2802.0	5	7	1.6E+00	2928.8	2	2	1.2E+00
5649.6	1	3	3.7E-03	2823.2	5	5	2.6E-01	2936.5	4	2	2.3E+00
5870.9	3	5	1.8E-02	2833.1	1	3	5.8E-01	*3104.8	10	14	8.1E-01
6904.7	3	5	1.3E-02	2873.3	5	5	3.7E-01	3848.2	6	4	2.8E-02
7224.1	3	5	1.4E-02	3572.7	5	3	9.9E-01	3848.3	4	4	3.0E-02
7587.4	3	1	5.1E-01	3639.6	3	3	3.4E-01	3850.4	4	2	3.0E-03
7601.5	5	5	3.1E-01	3671.5	5	3	4.4E-01	*4481.2	10	14	2.23E+00
7685.2	3	1	4.9E-01	3683.5	3	1	1.5E+00	9218.3	2	4	3.6E-01
7694.5	5	3	5.6E-02	3739.9	5	5	7.3E-01	9244.3	2	2	3.6E-01
7854.8	1	3	2.3E-01	4019.6	5	7	3.5E-02	Mg IV			
8059.5	1	3	1.9E-01	4057.8	5	3	8.9E-01	320.99	4	2	1.2E+02
8104.4	5	5	1.3E-01	4062.1	5	3	9.2E-01	323.31	2	2	5.9E+01
8112.9	5	7	3.6E-01	4168.0	5	5	1.2E-02	1219.0	6	6	5.9E+00
8190.1	3	5	1.1E-01	5005.4	1	3	2.7E-01	1375.5	4	4	4.5E+00
8263.2	3	5	3.5E-01	5201.4	1	3	1.9E-01	1459.6	6	4	4.6E+00
8281.1	3	3	1.9E-01	7229.0	5	3	8.9E-03	1495.5	4	6	6.4E+00
8298.1	3	3	3.2E-01	Lithium				1510.7	4	4	6.7E+00
8508.9	3	3	2.4E-01	Li I				1683.0	6	8	5.8E+00
8776.7	3	5	2.7E-01	*2741.2	2	6	1.3E-02	1698.8	4	6	3.9E+00
8928.7	5	3	3.7E-01	*3232.7	2	6	1.17E-02	1893.9	6	6	2.8E+00
Kr II				*4602.9	6	10	2.23E-01	Mg VI			
4250.6	4	4	1.2E-01	*6103.6	6	10	6.860E-01	*269.92	10	6	3.1E+02
4292.9	4	4	9.6E-01	*6707.8	2	6	3.691E-01	*292.53	6	6	9.0E+01
4355.5	6	8	1.0E+00	Lutetium				*314.64	6	2	1.8E+02
4431.7	2	2	1.8E+00	Lu I				*349.15	10	10	6.1E+01
4436.8	2	4	6.6E-01	3376.5	4	4	2.23E+00	*387.94	6	10	1.3E+01
4577.2	6	8	9.6E-01	3567.8	4	6	5.9E-01	399.29	4	2	2.8E+01
4583.0	6	4	7.6E-01	3620.3	6	4	1.1E-02	400.68	4	4	2.8E+01
4615.3	4	4	5.4E-01	3841.2	6	6	2.5E-01	403.32	4	6	2.7E+01
				4518.6	4	4	2.1E-01				

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹
	g_i	g_k			g_i	g_k			g_i	g_k	
Mg VII											
277.01	3	3	9.5E+01	3007.65	6	8	1.8E-01	3773.86	12	12	2.5E-01
278.41	5	3	1.5E+02	3011.38	8	10	3.1E-01	3800.55	6	8	2.7E-01
280.74	5	3	2.0E+02	3016.45	10	12	2.9E-01	3806.72	10	12	5.9E-01
319.02	5	5	8.9E+01	3043.36	8	8	5.9E-01	3823.51	8	10	5.21E-01
*366.42	9	9	4.4E+01	3044.57	10	8	5.7E-01	3823.89	6	6	2.31E-01
*433.04	9	15	1.6E+01	3045.59	10	10	6.7E-01	3833.87	4	4	3.14E-01
1334.3	5	5	5.3E+00	3045.80	8	10	1.7E-01	3834.37	6	8	4.29E-01
1410.0	5	5	2.57E+00	3047.03	12	12	6.1E-01	3839.78	2	2	4.64E-01
1487.0	3	5	3.02E+00	3054.36	8	6	4.6E-01	3841.07	4	6	3.3E-01
1487.9	5	7	3.66E+00	3070.27	6	6	1.9E-01	3843.99	2	4	2.11E-01
				3073.18	4	4	3.7E-01	3889.46	12	14	3.1E-01
				3082.71	14	14	2.9E-01	3898.37	6	8	1.7E-01
Mg VIII											
*74.976	6	10	4.3E+03	3110.68	6	8	2.7E-01	3899.34	4	6	2.4E-01
315.02	4	4	1.2E+02	3113.80	12	10	2.6E-01	3924.08	2	4	9.4E-01
*342.29	10	6	6.3E+01	3118.10	4	6	1.7E-01	3926.48	6	8	5.4E-01
353.86	4	4	3.89E+01	3122.88	10	10	1.9E-01	3951.98	2	2	3.1E-01
356.00	6	4	5.7E+01	3126.85	8	6	2.3E-01	3952.84	6	6	4.1E-01
*428.52	10	10	3.24E+01	3132.28	10	10	2.1E-01	3975.88	2	4	1.8E-01
*434.62	6	10	1.6E+01	3132.79	8	8	2.7E-01	3982.16	4	2	3.5E-01
*489.33	6	6	3.9E+01	3175.58	8	10	1.8E-01	3982.58	6	4	2.3E-01
*686.92	6	10	9.4E+00	3201.11	4	6	2.2E-01	3982.90	6	4	5.5E-01
				3228.09	10	12	6.4E-01	3991.60	2	2	2.1E-01
				3230.23	10	12	1.9E-01	4011.91	8	8	2.3E-01
				3230.72	8	8	3.5E-01	4018.11	10	8	2.54E-01
Mg IX											
62.751	1	3	2.87E+03	3240.88	6	4	2.2E-01	4030.76	6	8	1.7E-01
*67.189	9	15	6.20E+03	3243.78	6	6	5.3E-01	4033.07	6	6	1.65E-01
*71.965	9	3	1.22E+03	3251.13	4	2	2.3E-01	4034.49	6	4	1.58E-01
72.312	3	5	4.43E+03	3252.95	4	4	1.8E-01	4041.36	10	10	7.87E-01
77.737	3	1	3.92E+02	3256.14	4	6	5.0E-01	4048.75	6	4	7.5E-01
368.07	1	3	5.27E+01	3258.41	2	2	9.7E-01	4052.48	6	8	3.8E-01
438.69	3	1	7.9E+01	3260.24	2	4	3.8E-01	4055.55	8	8	4.31E-01
*443.74	9	9	4.19E+01	3267.79	14	14	3.5E-01	4058.94	4	2	7.25E-01
749.55	3	5	8.2E+00	3268.72	6	8	3.3E-01	4061.74	8	6	1.9E-01
1639.8	3	5	2.1E+00	3270.35	12	12	2.6E-01	4063.53	6	6	1.69E-01
2814.2	1	3	3.35E-01	3273.02	10	10	2.7E-01	4065.08	12	14	2.5E-01
				3298.23	6	4	2.8E-01	4066.24	10	8	2.2E-01
				3303.28	4	4	1.9E-01	4070.28	2	2	2.3E-01
Mg X											
57.876	2	4	2.09E+03	3463.66	8	8	3.2E-01	4079.42	2	4	3.8E-01
57.920	2	2	2.09E+03	3470.01	6	8	2.4E-01	4082.95	4	6	2.95E-01
63.152	2	4	5.6E+03	3511.83	12	12	2.7E-01	4083.63	6	8	2.8E-01
63.295	4	6	6.7E+03	3535.30	10	10	1.7E-01	4089.94	8	10	1.7E-01
609.79	2	4	7.53E+00	3559.81	6	6	2.1E-01	4105.37	10	8	1.7E-01
624.94	2	2	7.01E+00	3577.87	10	8	9.4E-01	4135.03	12	12	3.0E-01
2212.5	2	4	9.64E-01	3595.11	6	4	1.8E-01	4141.06	10	10	2.6E-01
2278.7	2	2	8.82E-01	3601.27	12	10	2.3E-01	4148.80	8	8	2.3E-01
5918.7	2	4	3.20E-02	3607.53	8	8	2.3E-01	4176.61	14	12	2.4E-01
6229.6	4	6	3.30E-02	3608.49	6	6	3.6E-01	4189.99	12	10	2.0E-01
				3610.30	4	4	4.2E-01	4201.78	10	8	2.3E-01
				3635.70	10	8	2.1E-01	4235.30	8	6	9.17E-01
Mg XI											
7.310	1	3	1.15E+04	3660.40	12	14	9.1E-01	4239.74	4	2	3.9E-01
7.473	1	3	2.27E+04	3675.67	6	8	2.2E-01	4257.67	2	2	3.7E-01
7.850	1	3	5.50E+04	3676.96	10	12	7.3E-01	4265.93	4	4	4.92E-01
9.169	1	3	1.97E+05	3680.15	12	10	1.9E-01	4281.10	6	6	2.3E-01
				3682.09	8	10	7.6E-01	4411.87	12	10	2.6E-01
				3684.87	6	8	2.6E-01	4414.89	8	6	2.93E-01
				3706.08	12	14	1.4E+00	4419.77	10	8	2.1E-01
Manganese											
Mn I											
2794.82	6	8	3.7E+00	3718.92	10	12	9.6E-01	4436.36	6	4	4.37E-01
2798.27	6	6	3.6E+00	3731.94	8	10	1.0E+00	4451.58	8	8	7.98E-01
2801.08	6	4	3.7E+00	3771.44	14	14	1.9E-01	4453.01	4	2	5.44E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4455.82	4	6	1.7E-01	1285.10	5	7	1.1E+01	2751.47	7	9	2.54E-01
4457.04	6	4	2.34E-01	1333.87	7	9	1.0E+01	2756.26	5	3	1.18E-01
4457.55	6	6	4.27E-01					2761.53	9	11	2.06E-01
4458.26	6	8	4.62E-01					2763.02	3	1	4.44E-01
4461.09	8	8	1.7E-01	Mercury				2766.25	3	5	1.17E-01
4462.03	8	10	7.00E-01	Hg I				2787.83	9	7	2.85E-01
4464.68	6	6	4.39E-01	2536.52	1	3	8.00E-02	2792.96	5	3	1.53E-01
4470.14	4	4	3.00E-01	2652.04	3	5	3.88E-01	2798.02	7	5	1.22E-01
4472.79	2	2	4.35E-01	2655.13	3	5	1.1E-01	2801.47	5	7	1.24E-01
4479.40	8	10	3.4E-01	2752.78	1	3	6.10E-02	2825.68	5	7	2.53E-01
4490.08	2	4	2.49E-01	2856.94	3	1	1.1E-02	2826.75	7	7	4.23E-01
4498.90	4	6	2.49E-01	2893.60	3	3	1.6E-01	2876.54	9	9	2.84E-01
4502.22	6	8	1.86E-01	2925.4	5	3	7.7E-02	2886.60	11	11	4.74E-01
4605.37	10	12	3.6E-01	2967.3	1	3	4.5E-01	2906.06	3	3	8.04E-01
4626.54	12	14	3.6E-01	3021.50	5	7	5.09E-01	2913.52	5	3	1.38E-01
4709.71	8	8	1.72E-01	3023.48	5	5	9.4E-02	2915.38	5	3	7.31E-01
4727.46	6	6	1.7E-01	3027.49	5	5	2.0E-02	2918.84	5	3	3.79E-01
4739.11	4	4	2.40E-01	3125.66	3	5	6.56E-01	2930.39	1	3	1.91E-01
4754.05	6	8	3.03E-01	3341.48	5	3	1.68E-01	2936.50	11	11	2.33E-01
4761.53	2	4	5.35E-01	3650.15	5	7	1.3E+00	2945.43	7	7	3.66E-01
4762.38	8	10	7.83E-01	3654.83	5	5	1.8E-01	2946.66	3	3	4.08E-01
4765.86	4	6	4.1E-01	4046.56	1	3	2.1E-01	2946.01	5	5	1.68E-01
4766.43	6	8	4.6E-01	4077.81	3	1	4.0E-02	2951.45	9	9	1.43E-01
4783.43	8	8	4.01E-01	4108.1	3	1	3.0E-02	2959.48	9	11	1.75E-01
4823.53	10	8	4.99E-01	4339.22	3	5	2.88E-02	2972.96	5	3	2.69E-01
6013.48	4	6	1.72E-01	4347.50	3	5	8.4E-02	2977.27	9	7	3.28E-01
6021.79	8	6	3.32E-01	4358.34	3	3	5.57E-01	2978.28	7	5	1.50E-01
				4916.07	3	1	5.8E-02	2983.04	1	3	2.82E-01
				5025.64	3	3	2.7E-04	2987.92	3	5	8.43E-01
				5460.75	5	3	4.87E-01	2988.23	5	7	4.28E-01
Mn II				5769.59	3	5	2.36E-01	2988.68	7	9	1.61E-01
2593.72	7	7	2.6E+00	6234.4	1	3	5.3E-03	2989.80	9	7	9.27E-01
2605.68	7	5	2.7E+00	6716.4	1	3	4.3E-03	3000.24	9	9	1.40E-01
2933.05	5	3	2.0E+00	6907.5	3	5	2.8E-02	3000.44	5	5	1.25E-01
2939.31	5	5	1.9E+00	7728.8	1	3	9.7E-03	3000.85	5	7	2.58E-01
2949.20	5	7	1.9E+00	10139.79	3	1	2.71E-01	3001.43	5	5	2.31E-01
3441.99	9	7	4.3E-01					3007.71	7	5	1.90E-01
3460.32	7	5	3.2E-01	Molybdenum				3013.39	7	5	6.06E-01
3474.13	5	3	1.5E-01	Mo I				3016.78	9	9	2.75E-01
3482.90	5	5	2.0E-01	2616.79	3	5	7.34E-01	3025.00	5	5	8.49E-01
3488.68	3	3	2.5E-01	2621.06	7	7	1.16E-01	3036.31	3	5	5.81E-01
				2628.96	3	3	2.81E-01	3041.70	13	11	5.94E-01
Mn VI				2629.85	5	7	7.75E-01	3046.80	13	11	1.63E-01
307.999	9	9	3.7E+01	2631.50	1	3	2.54E-01	3047.31	11	9	5.01E-01
309.440	9	7	5.7E+01	2638.30	5	5	7.57E-01	3055.32	9	7	4.29E-01
309.579	7	5	4.4E+01	2640.98	7	5	1.20E+00	3057.56	7	5	2.64E-01
310.058	7	7	3.4E+01	2644.36	5	7	1.96E-01	3061.59	7	5	4.41E-01
310.182	5	5	2.8E+01	2649.46	7	9	9.84E-01	3064.27	13	13	8.46E-01
311.748	5	3	5.7E+01	2655.02	9	7	4.08E-01	3065.04	13	13	3.08E-01
320.598	3	5	1.5E+01	2658.11	7	7	6.43E-01	3069.51	5	5	1.52E-01
320.681	1	3	2.2E+01	2665.09	7	9	1.32E-01	3069.96	11	11	2.72E-01
320.874	3	1	7.8E+01	2679.85	9	11	1.31E+00	3070.89	9	11	1.87E-01
320.979	3	3	2.2E+01	2684.16	9	9	4.18E-01	3074.37	11	11	1.42E+00
321.176	5	5	6.0E+01	2706.11	3	5	2.03E-01	3079.88	9	11	9.55E-01
321.541	5	3	2.7E+01	2710.74	3	3	1.57E-01	3080.40	7	9	3.61E-01
325.146	9	7	1.3E+02	2725.15	3	5	2.79E-01	3081.16	3	5	2.35E-01
328.431	5	5	4.4E+01	2728.71	3	3	1.26E-01	3085.62	9	9	1.63E+00
328.558	3	5	1.2E+01	2733.39	5	7	2.95E-01	3089.13	11	9	1.53E-01
329.043	1	3	1.1E+01	2743.71	1	3	2.47E-01	3089.71	5	7	2.34E-01
1236.23	5	3	1.3E+01	2745.38	13	11	1.29E-01				
1255.77	3	1	1.2E+01								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3094.66	7	7	1.63E+00	3285.35	9	7	4.49E-01	3456.52	3	3	2.96E-01
3099.92	9	7	1.45E-01	3287.38	5	5	1.38E-01	3460.22	5	3	2.77E-01
3100.88	7	9	1.20E+00	3289.01	9	9	5.08E-01	3460.78	9	7	6.03E-01
3101.34	5	5	1.92E+00	3290.82	7	5	5.44E-01	3465.84	3	1	9.99E-01
3106.34	7	5	2.21E-01	3305.56	5	3	1.74E-01	3466.19	9	7	2.11E-01
3117.54	13	13	1.89E-01	3305.91	7	9	3.06E-01	3466.96	7	7	1.52E-01
3123.03	3	3	2.81E-01	3307.13	7	9	1.25E-01	3467.85	5	7	2.63E-01
3125.03	5	3	1.98E-01	3312.33	7	5	1.62E-01	3469.22	5	3	6.96E-01
3132.59	7	9	1.79E+00	3323.95	9	7	2.82E-01	3469.63	13	15	1.51E-01
3135.90	9	11	3.68E-01	3325.13	5	3	2.26E-01	3470.92	3	5	2.91E-01
3136.75	9	11	1.57E-01	3325.67	5	5	1.72E-01	3475.03	3	3	4.68E-01
3142.75	3	5	4.10E-01	3327.30	1	3	2.88E-01	3479.42	7	5	2.26E-01
3147.35	13	11	2.41E-01	3336.56	9	9	1.64E-01	3483.67	7	7	1.13E-01
3155.19	7	7	2.75E-01	3340.16	5	3	1.20E-01	3483.83	7	5	1.41E-01
3158.17	7	7	4.63E-01	3344.73	3	5	6.04E-01	3489.43	7	7	3.27E-01
3170.34	7	7	1.37E+00	3346.83	11	11	1.13E-01	3504.41	7	9	8.06E-01
3171.38	5	7	2.03E-01	3347.00	3	3	2.72E-01	3505.31	7	9	2.25E-01
3175.59	13	11	8.40E-01	3358.12	5	7	7.59E-01	3508.11	9	9	1.59E-01
3179.78	11	13	2.33E-01	3361.37	9	9	1.38E-01	3510.77	13	13	4.75E-01
3183.03	11	9	3.98E-01	3363.78	5	7	2.74E-01	3517.55	11	11	5.41E-01
3184.58	7	5	2.77E-01	3363.87	5	7	1.39E-01	3518.21	3	3	3.64E-01
3185.10	7	7	2.54E-01	3373.81	3	3	2.03E-01	3521.38	9	9	1.39E-01
3185.71	5	3	6.10E-01	3375.22	7	7	1.38E-01	3521.41	9	11	6.06E-01
3188.10	7	9	3.45E-01	3375.65	7	9	1.56E-01	3524.65	5	3	3.10E-01
3188.41	5	7	4.40E-01	3378.19	3	1	1.88E-01	3524.98	7	9	2.25E-01
3192.79	9	11	1.88E-01	3378.46	13	13	3.75E-01	3538.92	11	11	2.24E-01
3193.98	7	5	1.53E+00	3379.96	5	5	4.11E-01	3540.57	5	3	4.46E-01
3194.88	9	11	1.75E-01	3382.48	3	3	2.66E-01	3542.17	7	5	4.93E-01
3195.96	9	7	4.10E-01	3384.61	7	9	7.32E-01	3552.71	9	7	3.64E-01
3197.18	1	3	1.47E-01	3385.87	9	11	3.30E-01	3555.64	3	3	3.46E-01
3198.85	15	13	7.22E-01	3389.79	5	7	1.85E-01	3558.09	5	7	5.43E-01
3200.89	3	5	1.82E-01	3392.17	9	9	1.97E-01	3563.75	1	3	1.53E-01
3205.22	1	3	4.27E-01	3393.65	11	11	2.08E-01	3566.05	9	9	2.67E-01
3205.43	9	11	2.55E-01	3404.33	7	7	2.10E-01	3566.74	7	7	1.43E-01
3205.89	9	9	5.35E-01	3413.37	11	11	1.25E-01	3570.64	15	15	7.18E-01
3208.84	7	5	2.77E-01	3415.27	9	9	1.83E-01	3573.88	3	5	3.58E-01
3210.97	7	5	6.94E-01	3415.61	7	9	1.29E-01	3580.54	13	11	5.49E-01
3214.44	9	7	2.01E-01	3416.14	9	11	2.45E-01	3581.88	11	13	3.81E-01
3215.07	3	5	4.20E-01	3418.52	5	3	1.41E-01	3584.25	3	3	1.73E-01
3216.78	15	13	2.10E-01	3419.69	7	7	1.15E-01	3585.57	7	5	3.95E-01
3221.73	3	1	1.41E+00	3420.04	5	5	3.28E-01	3588.95	7	7	1.18E-01
3228.21	5	7	3.85E-01	3422.31	9	9	2.52E-01	3590.74	7	9	2.23E-01
3229.79	9	11	1.44E-01	3425.13	11	11	2.29E-01	3595.55	5	5	2.32E-01
3233.14	13	13	6.33E-01	3427.90	11	13	4.09E-01	3598.88	13	11	5.67E-01
3237.06	7	9	2.95E-01	3434.79	7	7	1.75E-01	3600.73	9	9	2.07E-01
3244.47	5	3	2.80E-01	3435.45	15	15	1.50E+00	3601.88	7	9	1.15E-01
3247.61	5	5	1.71E-01	3437.21	11	9	8.06E-01	3602.94	5	7	2.96E-01
3249.93	5	3	1.87E-01	3438.87	1	3	2.34E-01	3604.07	9	7	3.25E-01
3251.65	3	5	3.05E-01	3441.87	5	3	1.34E-01	3610.61	5	3	1.78E-01
3256.21	5	3	6.89E-01	3442.66	3	3	2.94E-01	3611.99	7	7	1.16E-01
3256.72	3	3	1.31E-01	3445.03	7	9	1.53E-01	3615.16	7	9	1.96E-01
3259.16	11	13	1.62E-01	3445.26	7	5	2.96E-01	3623.22	11	9	5.58E-01
3262.63	7	9	3.62E-01	3445.80	9	9	1.14E-01	3624.46	9	11	5.27E-01
3264.40	11	9	5.42E-01	3447.12	9	11	8.75E-01	3624.62	5	7	1.37E-01
3265.14	5	7	2.60E-01	3447.29	5	3	1.79E-01	3638.20	5	3	3.51E-01
3266.16	9	11	1.95E-01	3449.07	7	9	1.52E-01	3638.21	5	3	3.33E-01
3270.90	7	7	3.59E-01	3449.85	5	7	1.65E-01	3640.62	7	5	1.94E-01
3276.07	11	9	1.18E-01	3452.60	7	7	2.48E-01	3647.84	7	7	2.11E-01
3285.03	1	3	1.41E-01	3456.15	5	5	3.60E-01	3648.70	7	5	1.15E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3654.58	3	3	1.80E-01	3834.64	3	5	1.20E-01	4536.80	13	15	5.03E-01
3657.36	5	7	2.03E-01	3846.18	7	7	1.26E-01	4598.23	1	3	1.47E-01
3658.13	9	9	1.86E-01	3847.25	3	1	2.41E-01	4624.23	9	9	1.32E-01
3659.36	7	9	6.70E-01	3848.30	9	9	1.26E-01	4633.08	3	5	2.35E-01
3660.92	3	5	1.34E-01	3851.99	11	9	1.78E-01	4649.06	3	1	1.25E-01
3662.15	7	9	1.45E-01	3864.10	7	7	6.24E-01	4652.24	5	7	1.55E-01
3662.99	11	11	3.48E-01	3866.69	3	5	1.74E-01	4686.08	3	3	1.72E-01
3663.27	7	5	2.30E-01	3867.67	5	3	2.22E-01	4688.21	13	15	1.54E-01
3664.81	11	13	9.54E-01	3869.08	5	3	1.35E-01	4707.25	7	9	3.63E-01
3664.88	1	3	1.92E-01	3874.15	7	5	1.67E-01	4718.86	5	5	2.17E-01
3669.34	9	7	2.16E-01	3902.95	7	5	6.17E-01	4723.05	9	9	1.23E-01
3672.81	9	11	1.95E-01	3909.54	9	7	1.13E-01	4731.44	9	11	4.49E-01
3672.82	9	9	1.13E-01	3911.94	5	5	1.15E-01	4758.50	11	9	3.01E-01
3676.23	3	1	5.22E-01	3915.43	5	5	1.40E-01	4760.18	11	13	4.67E-01
3680.68	11	11	2.96E-01	3916.43	5	3	1.78E-01	4764.11	9	7	2.16E-01
3681.72	9	7	1.68E-01	3919.55	11	13	2.24E-01	4811.05	13	11	4.36E-01
3683.01	3	5	1.20E-01	3955.48	13	11	1.71E-01	4819.25	11	9	2.71E-01
3687.96	5	7	2.12E-01	3973.76	11	13	4.39E-01	4830.51	9	7	4.07E-01
3688.97	11	9	3.26E-01	3977.90	9	7	1.35E-01	4858.39	13	11	1.24E-01
3690.59	11	9	2.07E-01	3980.20	5	3	2.70E-01	4868.02	7	5	3.11E-01
3694.94	5	7	6.36E-01	3991.85	11	9	1.29E-01	5037.18	9	7	1.14E-01
3696.04	11	11	3.59E-01	4010.13	5	3	4.38E-01	5044.36	7	5	1.31E-01
3698.07	7	5	1.48E-01	4021.01	9	11	2.65E-01	5047.70	3	1	2.61E-01
3708.55	7	9	1.28E-01	4051.18	13	11	1.36E-01	5163.18	9	11	2.03E-01
3715.75	9	7	2.38E-01	4062.08	11	9	1.96E-01	5171.06	5	7	1.84E-01
3718.48	5	7	1.34E-01	4069.88	13	11	3.25E-01	5172.94	5	5	4.11E-01
3720.25	7	9	2.86E-01	4076.19	9	9	1.16E-01	5174.18	5	3	5.83E-01
3725.55	7	7	1.60E-01	4084.37	9	7	1.94E-01	5191.45	7	9	1.62E-01
3727.68	9	11	1.51E-01	4102.15	5	3	1.22E-01	5238.21	7	9	3.74E-01
3728.30	7	5	1.55E-01	4107.46	7	5	2.02E-01	5240.87	7	7	3.89E-01
3728.50	7	9	2.20E-01	4120.09	13	15	6.05E-01	5242.80	7	5	2.01E-01
3733.02	7	7	1.45E-01	4131.92	9	11	1.56E-01	5261.53	5	7	1.13E-01
3733.41	13	13	2.80E-01	4148.98	9	11	1.56E-01	5280.85	5	5	1.28E-01
3735.62	11	11	1.66E-01	4157.40	13	11	2.17E-01	5355.52	9	9	1.21E-01
3742.28	7	7	1.56E-01	4157.90	9	11	1.60E-01	5356.46	11	11	2.11E-01
3747.19	5	7	3.07E-01	4185.82	11	13	3.82E-01	5360.51	9	11	6.19E-01
3748.48	9	11	3.95E-01	4188.32	11	13	3.32E-01	5364.28	9	9	2.26E-01
3755.10	3	5	1.41E-01	4194.56	11	11	2.70E-01	5460.50	5	3	3.46E-01
3755.16	9	9	2.48E-01	4232.59	9	11	3.17E-01	5493.76	7	5	2.13E-01
3758.52	9	9	1.22E-01	4240.83	5	5	1.68E-01	5506.49	5	7	3.61E-01
3759.60	9	7	1.82E-01	4246.02	11	13	2.00E-01	5533.03	5	5	3.72E-01
3760.88	9	9	2.16E-01	4251.88	13	11	1.76E-01	5570.44	5	3	3.30E-01
3768.73	9	9	2.88E-01	4254.95	7	9	2.01E-01	5849.71	3	3	3.02E-01
3769.99	7	9	2.46E-01	4269.28	11	11	1.36E-01	5851.50	3	5	1.55E-01
3777.72	13	11	1.66E-01	4276.91	7	9	2.85E-01	5893.36	5	5	2.60E-01
3788.25	7	9	2.87E-01	4277.24	9	11	1.35E-01	5895.93	5	7	3.12E-01
3794.43	9	9	1.22E-01	4317.92	15	15	1.28E-01	5926.37	7	7	1.63E-01
3797.47	7	5	1.48E-01	4325.80	3	3	1.84E-01	5928.88	7	9	5.32E-01
3798.25	7	9	6.90E-01	4326.14	5	7	2.56E-01	7154.11	9	9	3.45E-01
3801.84	9	7	3.16E-01	4340.74	5	7	1.23E-01				
3805.99	5	5	2.44E-01	4381.63	13	13	2.93E-01				
3819.78	9	11	1.47E-01	4382.41	11	13	3.83E-01				
3824.78	5	7	1.40E-01	4409.94	13	13	1.38E-01				
3827.15	7	7	1.94E-01	4411.69	11	11	2.63E-01				
3828.88	7	7	1.35E-01	4434.95	9	9	2.51E-01				
3830.81	5	5	1.83E-01	4446.42	11	11	1.90E-01				
3831.07	7	9	1.20E-01	4457.35	7	7	1.28E-01				
3832.11	9	9	3.05E-01	4474.57	5	5	2.10E-01				
3833.75	9	9	1.70E-01	4491.65	11	11	2.09E-01				
								Neodymium			
								Nd II			
								3780.4	16	18	1.4E-01
								3805.4	14	16	6.9E-01
								3807.2	10	12	4.9E-02
								3863.3	8	10	1.5E-01
								3941.5	10	10	6.1E-01
								3951.2	12	12	6.0E-01
								3973.3	18	18	6.3E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3979.5	10	12	2.7E-01	3464.3	5	5	6.7E-03	6402.2	5	7	5.14E-01
3990.1	16	16	5.2E-01	3466.6	1	3	1.3E-02	6506.5	3	5	3.00E-01
4012.3	18	20	5.5E-01	3472.6	5	7	1.7E-02	6532.9	1	3	1.08E-01
4061.1	16	18	4.4E-01	3498.1	3	5	5.1E-03	6599.0	3	3	2.32E-01
4106.6	14	16	6.8E-02	3501.2	3	3	1.2E-02	6602.9	3	3	5.9E-03
4109.5	14	16	3.7E-01	3510.7	5	3	2.2E-03	6652.1	3	1	2.9E-03
4133.4	14	12	1.5E-01	3515.2	3	5	6.9E-03	6678.3	3	5	2.33E-01
4156.1	12	14	3.4E-01	3520.5	3	1	9.3E-02	6717.0	3	3	2.17E-01
4205.6	18	16	1.8E-01	3593.5	3	5	9.9E-03	6721.1	3	3	4.9E-04
4284.5	18	18	8.5E-02	3593.6	3	3	6.6E-03	6929.5	3	5	1.74E-01
4303.6	8	10	4.7E-01	3600.2	3	3	4.3E-03	7024.1	3	3	1.89E-02
4325.8	16	16	1.6E-01	3633.7	3	1	1.1E-02	7032.4	5	3	2.53E-01
4358.2	14	14	1.5E-01	3682.2	3	5	1.6E-03	7051.3	3	3	3.0E-02
4382.7	12	10	4.0E-02	3685.7	3	3	3.9E-03	7059.1	3	5	6.8E-02
4400.8	10	10	6.8E-02	3701.2	3	5	2.2E-03	7173.9	3	5	2.87E-02
4451.6	12	14	2.5E-01	4536.3	3	3	5.0E-03	7245.2	3	3	9.35E-02
4456.4	16	18	6.4E-02	4702.5	3	3	2.1E-03	7304.8	1	3	2.55E-03
4463.0	14	16	1.8E-01	4708.9	3	3	4.2E-02	7438.9	1	3	2.31E-02
4958.1	12	10	1.2E-02	4955.4	3	3	3.3E-03	7472.4	3	3	4.0E-02
5130.6	22	20	1.6E-01	5113.7	3	3	1.0E-02	7535.8	3	3	4.3E-01
5192.6	20	18	1.7E-01	5120.5	3	3	5.6E-03	7937.0	5	5	7.8E-03
5249.6	18	16	1.8E-01	5154.4	3	3	1.9E-02	8082.5	3	3	1.2E-03
5276.9	12	10	1.2E-01	5191.3	3	3	1.3E-02	8118.5	3	3	4.9E-02
5293.2	16	14	1.2E-01	5326.4	3	3	6.8E-03	8128.9	3	5	7.2E-03
5302.3	20	18	1.1E-01	5333.3	3	3	5.3E-03	8259.4	5	5	2.03E-02
5311.5	14	12	1.1E-01	5341.1	3	3	1.1E-01	8571.4	3	3	5.5E-02
5319.8	12	10	1.6E-01	5400.6	3	1	9.0E-03	8582.9	3	5	1.00E-02
5357.0	18	16	1.8E-01	5418.6	3	3	5.2E-03	8647.0	5	5	3.91E-02
5371.9	20	20	5.1E-02	5433.7	3	3	2.83E-03	8681.9	3	3	2.1E-01
5485.7	18	18	5.7E-02	5652.6	3	3	8.9E-03	8767.5	3	3	1.1E-03
5594.4	16	16	7.0E-02	5662.5	3	3	6.9E-03	8771.7	3	3	1.6E-01
5620.6	18	18	1.3E-01	5852.5	3	1	6.82E-01	8783.8	3	5	3.13E-01
5688.5	14	14	5.9E-02	5868.4	3	3	1.4E-02	8865.3	3	3	9.4E-03
5718.1	16	16	8.7E-02	5881.9	5	3	1.15E-01	9201.8	3	3	9.1E-02
5726.8	10	10	5.6E-02	5913.6	3	3	4.8E-02	9433.0	3	3	1.1E-03
5740.9	12	12	7.2E-02	5939.3	5	3	2.00E-03	9486.7	3	3	2.5E-02
5804.0	10	10	4.6E-02	5944.8	5	5	1.13E-01	9534.2	3	3	6.3E-02
5865.1	16	18	1.3E-02	5961.6	3	3	3.3E-02	10621	3	3	2.4E-03
6051.9	12	10	1.1E-02	5975.5	5	3	3.51E-02	11409	3	3	4.2E-02
				6030.0	3	3	5.61E-02	11525	3	3	8.4E-02
				6046.1	3	3	2.26E-03	11767	3	3	6.9E-02
Neon				6074.3	3	1	6.03E-01	12459	3	3	1.5E-02
Ne I				6096.2	3	5	1.81E-01				
615.63	1	3	3.8E-01	6118.0	5	3	6.09E-03	Ne II			
618.67	1	3	9.3E-01	6128.5	3	3	6.7E-03	*357.03	6	10	3.8E+01
619.10	1	3	3.3E-01	6143.1	5	5	2.82E-01	*361.77	6	2	1.6E+01
626.82	1	3	7.4E-01	6150.3	3	3	1.5E-02	*406.28	6	10	1.8E+01
629.74	1	3	4.8E-01	6163.6	1	3	1.46E-01	*446.37	6	6	4.07E+01
735.90	1	3	6.11E+00	6217.3	5	3	6.37E-02	460.73	4	2	4.7E+01
743.72	1	3	4.86E-01	6266.5	1	3	2.49E-01	462.39	2	2	2.3E+01
3369.8	5	5	1.0E-03	6273.0	3	3	9.7E-03	1907.5	4	2	2.8E-01
3369.9	5	3	7.6E-03	6293.7	3	3	6.39E-03	1916.1	4	4	6.9E-01
3375.6	5	3	2.2E-03	6304.8	3	5	4.16E-02	1930.0	2	2	5.7E-01
3417.9	3	5	9.2E-03	6328.2	5	3	3.39E-02	1938.8	2	4	1.3E-01
3418.0	3	3	2.2E-03	6330.9	3	3	2.3E-02	2858.0	6	6	7.9E-01
3423.9	3	3	1.0E-03	6334.4	5	5	1.61E-01	2870.0	6	6	1.7E-01
3447.7	5	5	2.1E-02	6351.9	1	3	3.45E-03	2873.0	6	4	3.8E-01
3450.8	5	3	4.9E-03	6383.0	3	3	3.21E-01	2876.3	4	6	7.8E-01
3454.2	3	1	3.7E-02	6401.1	3	3	1.39E-02	2876.5	6	4	3.3E-01
3460.5	1	3	7.0E-03								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
2878.1	2	2	6.9E-02	3309.7	4	2	3.1E-01	3568.5	6	8	1.4E+00
2888.4	4	6	7.0E-02	3310.5	4	4	6.9E-02	3571.2	4	4	6.3E-01
2891.5	4	4	6.1E-02	3311.3	4	2	2.6E-01	3574.2	6	6	1.0E-01
2897.0	6	8	5.2E-02	3314.7	6	6	4.4E-02	3574.6	4	6	1.3E+00
2906.8	2	4	5.5E-01	3319.7	4	2	1.6E+00	3590.4	4	6	3.6E-02
2910.1	4	2	1.7E+00	3320.2	8	6	2.1E-01	3594.2	4	2	1.3E+00
2910.4	2	4	5.9E-01	3323.7	4	4	1.6E+00	3612.3	2	4	2.6E-01
2916.2	6	4	9.6E-02	3327.2	4	4	9.1E-01	3628.0	4	4	6.0E-01
2925.6	2	2	5.6E-01	3329.2	8	8	8.8E-01	3632.7	4	4	1.3E-01
2933.7	6	6	6.9E-02	3330.7	6	6	3.9E-02	3643.9	4	4	3.2E-01
2955.7	6	4	1.2E+00	3334.8	6	8	1.8E+00	3644.9	2	4	9.9E-01
3001.7	4	4	8.7E-01	3336.1	4	6	1.1E+00	3659.9	4	6	6.7E-02
3017.3	6	4	3.5E-01	3344.4	2	2	1.5E+00	3664.1	6	4	7.0E-01
3027.0	6	6	1.4E+00	3345.5	6	4	1.4E+00	3679.8	4	2	3.2E-01
3028.7	4	2	8.5E-01	3345.8	4	4	2.2E-01	3694.2	6	6	1.0E+00
3028.9	2	4	4.7E-01	3353.6	4	2	1.2E-01	3697.1	2	2	2.8E-01
3034.5	6	8	3.1E+00	3355.0	4	6	1.3E+00	3701.8	4	6	2.7E-01
3037.7	4	4	2.1E+00	3356.3	6	6	2.0E-01	3709.6	4	2	1.1E+00
3045.6	2	2	2.5E+00	3357.8	6	6	5.0E-01	3713.1	4	6	1.3E+00
3047.6	4	6	1.8E+00	3360.3	2	4	8.6E-01	3721.8	4	6	2.0E-01
3054.7	2	4	9.4E-01	3360.6	2	4	8.2E-01	3726.9	4	4	1.2E-01
3092.9	6	6	1.3E+00	3362.9	4	2	3.5E-01	3727.1	2	4	9.8E-01
3097.1	8	8	1.3E+00	3371.8	4	6	2.2E-01	3734.9	4	4	1.9E-01
3118.0	8	6	4.2E-02	3374.1	4	4	3.0E-01	3744.6	2	4	2.6E-01
3134.1	6	4	2.6E-01	3378.2	2	2	1.7E+00	3751.2	2	2	1.8E-01
3140.4	8	6	2.4E-01	3379.3	2	2	3.0E-01	3753.8	4	6	4.5E-01
3151.1	6	6	4.8E-02	3386.2	4	6	5.5E-02	3766.3	4	6	2.9E-01
3154.8	8	6	1.8E-02	3388.4	4	6	2.2E+00	3777.1	2	4	4.2E-01
3164.4	8	8	1.6E-01	3390.6	2	4	7.7E-02	3800.0	4	4	3.7E-01
3165.7	6	6	1.2E-01	3392.8	2	4	4.4E-01	3818.4	2	4	6.1E-01
3173.6	6	4	4.5E-02	3404.8	4	6	1.9E+00	3829.8	4	6	8.4E-01
3176.1	4	6	6.0E-02	3407.0	6	8	2.3E+00	3942.3	4	6	1.0E-02
3187.6	4	6	1.4E-02	3411.4	4	2	6.1E-01				
3188.7	6	6	3.9E-01	3413.2	4	4	1.8E+00	Ne V			
3190.9	4	6	1.5E-01	3414.9	4	6	1.8E-02	*142.61	9	9	6.7E+02
3194.6	4	4	5.2E-01	3416.9	6	6	6.4E-01	*143.32	9	15	1.2E+03
3198.6	6	8	1.7E+00	3417.7	6	8	1.6E+00	147.13	5	7	1.5E+03
3198.9	4	4	2.3E-01	3438.9	2	2	1.4E+00	151.23	5	5	3.38E+02
3209.0	8	8	1.6E-01	3440.7	2	4	3.5E-01	154.50	1	3	7.0E+02
3209.4	2	4	6.0E-01	3453.1	4	4	4.6E-01	*167.69	9	9	1.5E+02
3213.7	2	4	1.7E+00	3454.8	4	4	1.6E+00	*358.93	9	3	2.1E+02
3214.3	4	6	2.2E+00	3456.6	2	4	9.6E-01	365.59	5	3	1.35E+02
3218.2	8	10	3.6E+00	3457.1	4	6	9.9E-02	*482.15	9	9	3.01E+01
3224.8	6	8	3.5E+00	3459.3	6	6	1.6E+00	*571.04	9	15	1.0E+01
3229.5	8	8	1.3E-01	3475.2	4	4	1.2E-02	2259.6	3	5	1.9E+00
3229.6	8	10	3.6E+00	3477.6	4	6	4.3E-01	2265.7	5	7	2.4E+00
3230.1	6	6	1.8E+00	3481.9	4	2	1.4E+00				
3230.4	4	6	1.4E-01	3503.6	2	2	2.0E+00	Ne VII			
3232.0	6	4	2.7E-01	3522.7	4	2	2.3E-02	97.502	1	3	1.07E+03
3232.4	4	4	1.6E+00	3538.0	4	2	7.6E-01	*115.46	9	3	4.8E+02
3243.4	6	6	2.3E-01	3539.9	4	4	3.6E-02	116.69	3	5	1.6E+03
3244.1	6	8	1.5E+00	3542.2	6	4	6.0E-01	127.66	3	1	1.9E+02
3248.1	4	4	2.4E-01	3542.9	4	6	1.2E+00	465.22	1	3	4.09E+01
3255.4	6	4	3.8E-02	3546.2	2	4	6.3E-02	558.61	3	5	8.11E+00
3263.4	2	4	3.9E-01	3551.6	2	4	3.7E-02	559.95	1	3	1.07E+01
3269.9	4	6	5.1E-01	3557.8	2	2	1.9E-01	561.38	3	3	7.99E+00
3270.8	6	4	5.7E-02	3561.2	4	6	2.1E-01	561.73	5	5	2.39E+01
3297.7	6	6	4.3E-01	3565.8	4	4	6.2E-01	562.99	3	1	3.17E+01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	
	g_i	g_k			g_i	g_k			g_i	g_k		
564.53	5	3	1.31E+01	2313.98	5	5	5.0E+00	4752.43	3	3	2.0E-01	
Ne VIII				2317.16	7	5	3.8E+00	4756.52	9	9	1.5E-01	
				2320.03	9	11	6.9E+00	4786.54	11	11	1.8E-01	
	*88.09	2	6	8.4E+02	2321.38	5	7	5.6E+00	4812.00	3	1	9.5E-02
	*98.208	6	10	2.77E+03	2324.65	7	9	1.8E-01	4829.03	5	7	1.9E-01
	770.41	2	4	5.90E+00	2325.79	7	9	3.5E+00	4831.18	9	7	1.6E-01
	780.32	2	2	5.69E+00	2329.96	5	3	5.3E+00	4838.64	9	7	2.2E-01
	2820.7	2	4	7.20E-01	2345.54	9	7	2.2E+00	4855.41	5	5	5.7E-01
	2860.1	2	2	6.88E-01	2346.63	7	5	5.5E-01	4904.41	5	3	6.2E-01
					2347.51	9	9	2.2E-01	4912.03	3	3	1.5E-01
					2348.73	7	7	2.2E-01	4913.97	1	3	2.2E-01
Nickel				2419.31	7	5	2.0E-01	4918.36	9	7	2.3E-01	
				2943.91	7	5	1.1E-01	4935.83	7	5	2.4E-01	
	1963.85	7	7	1.1E-01	2981.65	5	3	2.8E-01	4937.34	9	9	1.2E-01
	1976.87	7	9	1.1E+00	3002.48	7	7	8.0E-01	4953.20	5	5	1.2E-01
	1981.61	5	5	1.3E-01	3003.62	5	5	6.9E-01	4980.17	9	11	1.9E-01
	1990.25	5	7	8.3E-01	3012.00	5	5	1.3E+00	5000.34	7	7	1.4E-01
	2007.01	5	5	1.7E-01	3037.93	7	7	2.8E-01	5012.46	7	7	1.1E-01
	2007.69	7	7	9.0E-02	3050.82	7	9	6.0E-01	5017.58	11	11	2.0E-01
	2014.25	3	5	9.3E-01	3054.31	5	5	4.0E-01	5035.37	7	9	5.7E-01
	2025.40	7	5	2.3E-01	3057.64	3	3	1.0E+00	5042.20	3	5	1.4E-01
2026.62	9	7	2.4E-01	3064.62	5	7	1.1E-01	5048.85	7	7	1.6E-01	
2047.35	7	5	1.8E-01	3101.56	5	7	6.3E-01	5080.53	9	11	3.2E-01	
2052.04	9	9	9.7E-02	3101.88	5	7	4.9E-01	5081.11	7	9	5.7E-01	
2055.50	5	3	3.3E-01	3134.11	3	5	7.3E-01	5082.35	3	3	2.5E-01	
2059.92	7	5	2.1E-01	3225.02	5	3	9.3E-02	5084.08	7	9	3.1E-01	
2060.20	5	3	2.3E-01	3369.56	9	7	1.8E-01	5099.95	7	7	2.9E-01	
2064.39	3	1	4.0E-01	3380.57	5	3	1.3E+00	5115.40	11	9	2.2E-01	
2069.52	5	5	1.1E-01	3392.98	7	7	2.4E-01	5129.37	7	5	1.2E-01	
2085.57	5	5	2.6E+00	3414.76	7	9	5.5E-01	5155.14	5	5	1.1E-01	
2089.09	7	5	9.7E-02	3423.71	3	3	3.3E-01	5155.76	5	7	2.9E-01	
2095.13	5	7	1.1E-01	3433.56	7	7	1.7E-01	5176.57	5	5	1.8E-01	
2114.43	5	5	9.7E-02	3446.26	5	5	4.4E-01	5371.33	7	7	1.6E-01	
2121.40	7	5	2.8E-01	3452.88	5	7	9.8E-02	5476.91	1	3	9.5E-02	
2124.80	5	3	3.8E-01	3458.46	3	5	6.1E-01	5637.12	3	3	1.1E-01	
2147.80	5	3	4.7E-01	3461.66	7	9	2.7E-01	5664.02	5	7	1.1E-01	
2157.83	5	3	4.1E-01	3472.55	5	7	1.2E-01	5695.00	3	3	1.7E-01	
2158.31	7	5	6.9E-01	3483.77	5	3	1.4E-01	6086.29	3	5	1.1E-01	
2161.04	5	5	1.3E-01	3492.96	5	3	9.8E-01	6175.42	3	3	1.7E-01	
2173.54	5	3	1.5E-01	3510.33	3	1	1.2E+00	7122.24	5	7	2.1E-01	
2174.48	3	1	8.9E-01	3515.05	5	7	4.2E-01	7381.94	9	11	9.7E-02	
2182.38	7	5	1.3E-01	3524.54	7	5	1.0E+00	7422.30	7	5	1.8E-01	
2183.91	5	5	1.2E-01	3566.37	5	5	5.6E-01	7727.66	7	7	1.1E-01	
2190.22	5	5	3.0E-01	3597.70	3	3	1.4E-01					
2197.35	3	3	7.8E-01	3619.39	5	7	6.6E-01	Ni II				
2201.59	5	3	7.3E-01	4027.67	5	7	1.3E-01	2165.55	10	10	2.4E+00	
2221.94	5	3	2.2E-01	4295.88	9	7	1.7E-01	2169.10	8	8	1.58E+00	
2244.46	5	5	3.8E-01	4401.54	9	11	3.8E-01	2174.67	8	10	1.43E+00	
2253.57	7	7	1.9E-01	4462.46	3	5	1.7E-01	2175.15	6	6	1.77E+00	
2254.81	9	9	9.6E-02	4470.48	5	7	1.9E-01	2184.61	4	4	2.90E+00	
2258.15	7	5	1.7E-01	4600.37	5	3	2.6E-01	2201.41	4	6	1.3E+00	
2259.56	5	3	2.0E-01	4604.99	9	7	2.3E-01	2206.72	6	8	1.66E+00	
2261.42	9	7	9.1E-02	4606.23	5	3	1.0E-01	2216.48	10	12	3.4E+00	
2287.32	3	5	1.8E-01	4648.66	11	9	2.4E-01	2220.40	6	8	2.3E+00	
2289.98	9	7	2.1E+00	4686.22	5	5	1.4E-01	2222.96	10	10	9.8E-01	
2293.11	5	5	3.8E-01	4701.54	9	9	1.4E-01	2224.86	8	8	1.55E+00	
2300.77	7	7	7.5E-01	4714.42	13	11	4.6E-01	2226.33	6	6	1.3E+00	
2302.97	3	3	4.5E-01	4715.78	7	7	2.0E-01	2253.85	4	6	1.98E+00	
2307.35	5	7	1.6E-01	4732.47	7	9	9.3E-02	2264.46	6	8	1.43E+00	
2312.34	7	7	5.5E+00									

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹
	g_i	g_k			g_i	g_k			g_i	g_k	
Ni XXI											
11.13	3	3	1.7E+04	103.53	4	2	4.17E+02	1.539	1	3	2.6E+06
11.23	5	3	1.7E+04	104.64	2	2	4.7E+02	1.539	3	5	2.6E+06
11.239	5	7	5.7E+04	106.68	4	2	3.67E+02	1.540	3	3	1.7E+06
11.28	3	1	2.2E+05	113.14	4	4	1.65E+02	1.541	3	5	5.5E+06
11.318	5	7	2.8E+05	118.52	2	4	1.5E+02	1.542	3	3	3.6E+06
11.48	3	1	1.1E+05	122.72	6	4	2.17E+02	1.542	5	5	3.5E+06
11.48	1	3	4.0E+05	134.73	6	6	1.44E+02	1.544	5	3	3.2E+06
11.517	5	7	1.4E+05	135.47	4	4	8.0E+01	1.546	3	5	1.6E+06
11.539	5	7	1.2E+05	137.01	4	4	2.6E+02	1.547	3	3	2.1E+05
11.67	1	3	8.0E+04	138.80	4	6	7.2E+01	1.549	1	3	2.0E+05
11.72	3	3	2.3E+04	153.47	2	2	1.27E+02	1.551	3	1	8.2E+05
12.454	5	3	3.3E+04	159.69	2	4	8.9E+01	1.558	3	1	6.5E+05
12.472	3	3	1.8E+04					1.5883	1	3	6.02E+06
12.502	5	5	2.8E+04	Ni XXV				1.5963	1	3	7.70E+05
Ni XXII				9.30	3	1	9.3E+04	Nitrogen			
72.52	4	2	2.84E+02	9.31	5	7	8.2E+04	N I			
84.06	6	4	1.2E+03	9.32	3	5	7.8E+04	1163.88	6	6	7.52E-01
84.24	4	2	5.6E+02	9.34	1	3	1.1E+05	1164.00	4	6	1.27E-02
85.86	4	2	4.9E+02	9.42	3	1	9.0E+04	1164.21	6	4	5.17E-02
88.00	4	2	1.2E+03	9.49	3	5	8.9E+04	1164.32	4	4	6.94E-01
95.95	2	2	4.4E+02	9.60	1	3	1.8E+05	1167.45	6	8	1.29E+00
98.16	4	4	5.2E+02	9.63	3	5	2.4E+05	1168.42	6	6	4.24E-02
98.58	4	4	2.45E+02	9.64	3	3	1.3E+05	1168.54	4	6	1.24E+00
100.60	6	6	3.9E+02	9.71	3	1	2.3E+05	1176.51	6	4	9.22E-01
101.31	6	4	4.83E+02	9.71	3	3	1.8E+05	1176.63	4	4	1.02E-01
103.31	4	2	2.66E+02	9.74	5	7	3.0E+05	1177.69	4	2	1.02E+00
106.04	4	4	2.36E+02	9.75	3	5	1.3E+05	1199.55	4	6	4.01E+00
106.16	4	2	5.1E+02	9.76	1	3	3.03E+05	1200.22	4	4	3.99E+00
124.31	2	2	3.7E+02	9.76	5	3	7.5E+04	1200.71	4	2	3.98E+00
126.32	4	4	3.3E+02	9.78	5	7	2.9E+05	1310.54	4	6	8.42E-01
Ni XXIII				9.86	5	7	4.8E+05	1316.29	4	6	1.42E-02
87.66	3	3	2.8E+02	9.87	3	5	2.03E+05	1492.63	6	4	3.13E+00
88.11	5	3	8.3E+02	9.92	5	5	1.3E+05	1492.82	4	4	3.51E-01
90.49	3	3	1.77E+02	9.94	5	7	1.29E+05	1494.68	4	2	3.72E+00
90.96	5	3	2.5E+02	9.97	3	5	2.5E+05	3822.03	2	2	3.70E-02
91.83	5	3	7.5E+02	10.08	1	3	2.80E+05	3830.43	4	4	4.67E-02
92.32	3	1	4.39E+02	Ni XXVI				3834.22	4	2	1.89E-02
100.42	1	3	2.1E+02	1.5930	4	2	3.4E+06	4099.94	2	4	3.48E-02
102.08	5	5	5.3E+02	1.5935	2	2	4.0E+06	4109.95	4	6	3.90E-02
103.23	3	3	2.4E+02	1.5973	4	4	8.1E+06	4113.97	4	4	6.62E-03
103.67	5	5	1.78E+02	1.5977	2	4	4.4E+06	4137.64	2	4	2.80E-03
104.70	3	1	2.94E+02	1.5982	2	2	7.3E+06	4143.43	4	4	6.09E-03
106.02	5	5	2.87E+02	1.5996	2	2	2.7E+06	4151.48	6	4	1.01E-02
108.27	7	5	3.32E+02	1.6005	4	6	2.7E+06	4249.87	4	2	2.59E-02
111.23	3	1	2.26E+02	1.6036	4	2	2.1E+06	4264.00	6	4	2.26E-02
111.78	5	3	2.19E+02	9.390	2	4	2.59E+05	4356.29	6	8	5.10E-02
111.86	1	3	1.7E+02	9.535	4	6	2.96E+05	4385.54	2	2	8.84E-03
112.55	3	1	1.0E+03	Ni XXVII				4392.41	4	2	1.76E-02
128.87	5	5	4.02E+02	1.2534	1	3	3.35E+05	4435.43	2	4	7.51E-03
133.54	3	3	1.86E+02	1.2824	1	3	6.38E+05	4442.45	4	4	3.81E-02
137.55	3	1	2.53E+02	1.3500	1	3	1.63E+06	4669.89	4	4	7.49E-03
Ni XXIV				1.3516	1	3	2.4E+05	4914.94	2	2	8.08E-03
101.13	6	4	1.63E+02	1.531	3	3	2.0E+05	4935.12	4	2	1.76E-02
102.11	4	4	5.4E+02	1.534	3	1	6.9E+06	5199.84	2	2	1.87E-02
103.43	2	4	1.3E+02	1.537	5	5	2.3E+06	5201.61	2	4	1.87E-02
				1.537	1	3	3.7E+06	5281.20	6	6	2.45E-03
				1.538	3	5	3.9E+06	5344.05	6	6	6.10E-04
								5356.62	4	6	1.41E-03

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
5367.01	4	4	1.07E-03	9810.01	4	2	5.30E-02	1085.55	5	5	9.47E-01
5372.61	2	4	8.34E-04	9814.02	6	8	6.56E-03	1085.70	5	7	3.87E+00
5378.27	2	2	1.66E-03	9822.75	6	6	4.95E-02	3408.13	3	1	2.19E-01
6606.18	4	6	8.87E-04	9834.61	6	4	4.50E-02	3437.14	3	1	2.07E+00
6622.54	6	6	7.93E-03	9863.33	8	8	9.62E-02	3593.60	3	5	1.21E-01
6626.99	2	4	2.20E-03	9872.15	8	6	2.97E-02	3609.10	3	3	1.41E-01
6636.94	4	4	1.40E-02	9883.38	2	2	2.93E-02	3615.86	3	1	1.53E-01
6644.96	8	6	3.49E-02	9905.52	4	2	3.11E-03	3829.80	3	5	2.42E-01
6646.50	2	2	2.18E-02	9909.22	2	4	7.58E-03	3838.37	5	5	6.98E-01
6653.46	6	4	2.74E-02	9931.47	4	4	3.64E-02	3842.19	1	3	3.06E-01
6656.51	4	2	2.17E-02	9947.07	6	8	1.08E-02	3847.40	3	3	2.22E-01
6926.67	4	6	7.75E-03	9965.75	4	6	7.60E-03	3855.10	3	1	8.82E-01
6945.18	6	6	1.83E-02	9968.51	6	4	4.50E-03	3856.06	5	3	3.71E-01
6951.60	2	4	1.03E-02	9980.42	4	6	8.10E-03	3919.00	3	3	6.76E-01
6960.50	4	4	4.67E-03	9997.73	8	8	9.20E-03	3955.85	3	5	1.31E-01
6973.07	2	2	3.83E-03					3995.00	3	5	1.35E+00
6979.18	6	4	9.83E-03	N II				4114.33	3	3	1.42E-03
6982.03	4	2	2.04E-02	474.891	5	5	9.66E+00	4124.08	3	5	3.20E-01
7423.64	2	4	5.95E-02	475.647	1	3	1.17E+01	4133.67	5	5	5.30E-01
7442.30	4	4	1.24E-01	475.698	3	5	1.58E+01	4145.77	7	5	7.36E-01
7468.31	6	4	1.93E-01	475.757	3	3	8.75E+00	4374.99	3	5	5.55E-03
7898.98	6	4	2.82E-01	475.803	5	7	2.10E+01	4447.03	3	5	1.14E+00
7899.28	4	4	3.28E-02	475.884	5	5	5.25E+00	4459.94	3	1	1.12E-01
7915.42	4	2	3.13E-01	508.697	5	5	1.91E+00	4465.53	3	3	2.36E-02
8184.86	4	6	8.58E-02	510.758	5	7	1.87E+01	4477.68	5	3	8.85E-02
8188.01	2	4	1.27E-01	513.849	5	5	1.24E+01	4488.09	5	5	1.30E-02
8200.36	2	2	4.95E-02	529.355	1	3	7.23E+00	4507.56	7	5	1.00E-01
8210.72	4	4	4.84E-02	529.413	3	1	2.43E+01	4564.76	3	5	1.41E-02
8216.34	6	6	2.23E-01	529.491	3	3	6.75E+00	4601.48	3	5	2.35E-01
8223.13	4	2	2.64E-01	529.637	3	5	4.92E+00	4607.15	1	3	3.26E-01
8242.39	6	4	1.36E-01	529.722	5	3	1.03E+01	4613.87	3	3	2.26E-01
8567.74	2	4	4.92E-02	529.867	5	5	1.94E+01	4621.39	3	1	9.55E-01
8594.00	2	2	2.09E-01	533.511	1	3	2.39E+01	4630.54	5	5	7.72E-01
8629.24	4	4	2.66E-01	533.581	3	5	3.20E+01	4643.09	5	3	4.51E-01
8655.88	4	2	1.05E-01	533.650	3	3	1.66E+01	4654.53	3	5	2.43E-02
8680.28	6	8	2.46E-01	533.729	5	7	4.13E+01	4667.21	3	3	2.99E-02
8683.40	4	6	1.80E-01	533.815	5	5	9.19E+00	4674.91	3	1	1.05E-01
8686.15	2	4	1.09E-01	547.818	5	3	2.16E+00	4694.27	1	3	1.23E-01
8703.25	2	2	2.10E-01	559.762	1	3	1.14E+01	4695.90	3	5	1.29E-01
8711.70	4	4	1.28E-01	574.650	5	7	3.60E+01	4697.64	3	3	3.06E-02
8718.84	6	6	6.75E-02	582.156	5	5	2.85E+01	4698.55	3	1	3.67E-01
8728.90	4	2	3.76E-02	635.197	1	3	2.33E+01	4700.03	5	7	1.05E-01
8747.37	6	4	1.04E-02	644.634	1	3	1.21E+01	4702.50	5	5	9.15E-02
9028.92	2	2	3.02E-01	644.837	3	3	3.64E+01	4704.25	5	3	2.13E-01
9045.88	6	8	2.80E-01	645.178	5	3	6.07E+01	4706.40	7	9	6.09E-02
9049.49	6	6	1.88E-02	660.286	5	3	3.69E+01	4709.58	7	7	1.82E-01
9049.89	4	6	2.60E-01	671.016	3	5	2.47E+00	4712.07	7	5	1.46E-01
9060.48	2	4	2.95E-01	671.386	5	5	7.40E+00	4718.38	9	9	3.02E-01
9187.45	6	6	2.44E-01	671.411	1	3	3.04E+00	4721.58	9	7	7.75E-02
9187.86	4	6	1.76E-02	671.630	3	3	2.27E+00	4774.24	3	5	3.24E-02
9207.59	6	4	2.70E-02	671.773	3	1	9.85E+00	4779.72	3	3	2.52E-01
9208.00	4	4	2.33E-01	672.001	5	3	3.87E+00	4781.19	5	7	2.05E-02
9386.81	2	4	2.24E-01	745.841	1	3	1.25E+01	4788.14	5	5	2.52E-01
9392.79	4	6	2.63E-01	746.984	5	3	3.85E+01	4793.65	5	3	7.77E-02
9460.68	4	4	3.98E-02	748.369	5	3	3.83E+00	4803.29	7	7	3.18E-01
9776.90	2	4	1.18E-02	775.965	5	5	3.08E+01	4810.30	7	5	4.75E-02
9786.78	4	6	1.13E-02	915.612	1	3	4.38E+00	4860.17	3	5	1.61E-01
9788.29	2	2	2.99E-02	915.962	3	1	1.32E+01	4987.38	3	1	7.48E-01
9798.56	4	4	2.75E-02	1083.99	1	3	2.18E+00	4991.24	3	5	3.54E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s ⁻¹	λ Å	Weights		A 10^8 s ⁻¹	λ Å	Weights		A 10^8 s ⁻¹
	g_i	g_k			g_i	g_k			g_i	g_k	
4994.36	5	7	2.62E-01	5551.92	7	7	2.00E-01	2978.84	2	4	1.66E-01
4994.37	3	3	7.60E-01	5552.68	5	3	1.50E-01	2983.64	4	4	8.24E-01
4997.22	3	3	1.96E-01	5565.26	7	5	3.97E-02	3342.76	2	2	3.80E-01
5001.13	3	5	9.76E-01	5666.63	3	5	3.74E-01	3353.98	2	4	7.66E-01
5001.47	5	7	1.05E+00	5676.02	1	3	2.96E-01	3354.32	4	6	5.51E-01
5002.70	1	3	8.45E-02	5679.56	5	7	5.25E-01	3355.46	4	2	7.51E-01
5005.15	7	9	1.16E+00	5686.21	3	3	1.94E-01	3358.78	2	2	3.05E-01
5005.30	5	5	6.51E-02	5710.77	5	5	1.24E-01	3360.98	4	4	2.44E-01
5007.33	3	5	7.89E-01	5730.66	5	3	1.34E-02	3365.80	4	2	1.52E+00
5010.62	3	3	2.19E-01	5747.30	3	5	3.40E-02	3367.36	6	6	1.27E+00
5011.31	5	3	5.84E-01	5767.45	3	3	2.44E-02	3374.07	6	4	8.13E-01
5012.04	7	7	5.19E-01	5893.15	5	7	2.88E-01	3745.95	2	4	1.90E-01
5016.38	5	5	1.62E-01	5897.25	3	5	2.16E-01	3752.63	2	2	6.67E-02
5023.05	7	5	3.61E-01	5899.83	1	3	1.60E-01	3754.69	4	4	3.78E-01
5025.66	7	7	1.07E-01	5927.81	1	3	3.22E-01	3762.60	4	4	4.24E-02
5040.71	7	5	3.78E-03	5931.78	3	5	4.27E-01	3771.03	6	4	5.59E-01
5045.10	5	3	3.42E-01	5940.24	3	3	2.26E-01	3771.36	6	4	8.28E-02
5073.59	3	3	2.59E-02	5941.65	5	7	5.54E-01	3792.97	8	6	1.03E-01
5168.05	3	5	3.06E-01	5952.39	5	5	1.27E-01	3934.50	2	4	7.49E-01
5170.16	3	3	6.54E-01	5960.91	5	3	1.34E-02	3938.51	4	6	8.96E-01
5171.27	3	1	8.71E-01	6065.00	3	5	2.21E-03	3942.88	4	4	1.49E-01
5171.47	5	7	5.81E-01	6284.32	5	3	7.74E-02	4097.36	2	4	8.70E-01
5172.34	3	5	6.01E-01	6379.62	3	3	6.11E-02	4103.39	2	2	8.67E-01
5172.97	1	3	5.01E-01	6482.05	3	3	3.01E-01	4195.74	2	4	9.37E-01
5173.39	5	7	7.36E-01	6610.56	5	7	6.34E-01	4200.07	4	6	1.12E+00
5174.46	5	5	5.07E-01	6857.03	5	3	2.53E-01	4215.77	4	4	1.85E-01
5175.89	7	9	8.93E-01	6869.58	5	5	2.51E-01	4318.78	2	4	5.40E-02
5176.57	5	3	2.17E-01	6887.83	5	7	2.49E-01	4321.22	2	2	1.08E-01
5177.06	3	3	5.00E-01	7762.24	5	5	8.74E-02	4321.39	4	6	5.03E-02
5179.34	7	9	8.67E-01	8438.74	1	3	2.24E-01	4325.43	4	4	8.60E-02
5179.52	9	11	1.07E+00	8831.75	1	3	8.42E-03	4327.69	6	8	3.06E-02
5180.36	5	5	4.28E-01	8855.30	3	3	2.51E-02	4327.88	4	2	1.07E-01
5183.20	7	7	2.88E-01	8893.29	5	3	4.12E-02	4332.95	6	6	1.23E-01
5184.96	7	7	3.20E-01					4337.01	6	4	7.47E-02
5185.09	5	3	7.11E-02	N III				4345.81	8	8	1.82E-01
5186.21	7	5	5.76E-02	374.198	2	4	9.89E+01	4351.11	8	6	4.01E-02
5190.38	9	9	1.77E-01	451.871	2	2	1.03E+01	4510.88	2	4	2.84E-01
5191.96	7	5	4.25E-02	452.227	4	2	2.05E+01	4510.96	4	6	4.77E-01
5199.50	9	7	1.51E-02	684.998	2	4	9.63E+00	4514.85	6	8	6.80E-01
5313.42	3	3	1.41E-01	685.515	2	2	3.83E+01	4518.14	2	2	5.65E-01
5320.20	5	3	4.20E-01	685.817	4	4	4.54E+01	4523.56	4	4	3.61E-01
5320.96	3	5	2.52E-01	686.336	4	2	1.95E+01	4530.86	4	2	1.12E-01
5327.76	5	5	4.65E-02	763.334	2	2	9.58E+00	4534.58	6	6	2.01E-01
5338.73	5	7	1.85E-01	764.351	4	2	1.85E+01	4547.30	6	4	3.33E-02
5340.21	7	5	2.59E-01	771.545	2	4	8.19E+00	4634.13	2	4	6.36E-01
5351.23	7	7	3.67E-01	771.901	4	4	1.64E+01	4640.64	4	6	7.60E-01
5383.72	3	5	3.31E-03	772.384	6	4	2.45E+01	4641.85	4	4	1.26E-01
5452.07	1	3	8.89E-02	772.889	6	4	2.09E+01	4858.70	2	4	4.35E-01
5454.22	3	1	3.34E-01	772.955	4	2	2.34E+01	4858.98	4	6	4.66E-01
5462.58	3	3	1.00E-01	979.832	4	4	8.84E+00	4861.27	6	8	5.32E-01
5478.09	3	5	4.75E-02	979.905	6	6	9.21E+00	4867.12	4	4	1.73E-01
5480.05	5	3	1.30E-01	989.799	2	4	4.18E+00	4867.17	8	10	6.18E-01
5495.65	5	5	2.40E-01	991.511	4	4	8.17E-01	4873.60	6	6	1.50E-01
5526.23	3	5	2.13E-01	991.577	4	6	4.97E+00	4881.78	6	4	1.22E-02
5530.24	5	7	4.04E-01	1747.85	2	4	1.28E+00	4884.14	8	8	8.71E-02
5535.35	7	9	6.04E-01	1751.22	4	4	2.48E-01	4896.58	8	6	5.86E-02
5535.38	3	3	4.53E-01	1751.66	4	6	1.51E+00	5260.86	2	2	2.80E-03
5540.06	3	1	6.03E-01	2972.55	2	2	6.67E-01	5270.57	2	4	6.95E-02
5543.47	5	5	3.51E-01	2977.33	4	2	3.32E-01	5272.68	4	2	1.39E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
5282.43	4	4	2.21E-02	4769.86	5	3	2.50E-02	935.193	5	5	1.33E+00
5297.75	4	6	4.93E-02	4786.92	7	7	8.79E-02	1028.16	1	3	4.22E-01
5298.95	6	4	7.38E-02	4796.66	7	5	1.53E-02	1152.15	5	5	5.28E+00
5314.36	6	6	1.14E-01	5200.41	3	5	2.67E-01	1217.65	1	3	2.06E+00
5320.87	6	8	5.68E-01	5204.28	5	7	3.55E-01	1302.17	5	3	3.41E+00
5327.19	4	6	5.29E-01	5205.15	1	3	1.97E-01	1304.86	3	3	2.03E+00
5352.46	6	6	3.72E-02	5226.70	3	3	1.46E-01	1306.03	1	3	6.76E-01
6365.84	2	2	2.18E-01	5245.60	5	5	8.66E-02	3823.41	7	7	6.63E-03
6394.75	2	4	2.15E-01	5272.35	5	3	9.48E-03	3823.87	5	3	1.87E-02
6445.34	2	4	8.89E-02	5288.25	5	3	3.22E-02	3824.35	5	5	5.19E-03
6450.79	2	2	1.77E-01	5736.93	3	5	1.84E-01	3825.02	3	3	5.59E-03
6454.08	4	6	1.49E-01	5776.31	1	3	1.85E-02	3825.19	5	7	8.31E-04
6463.09	4	4	1.13E-01	5784.76	3	1	5.51E-02	3855.01	5	5	1.63E-02
6467.02	6	8	2.11E-01	5795.09	3	3	1.37E-02	3947.29	5	7	4.91E-03
6468.57	4	2	3.52E-02	5812.31	3	5	1.36E-02	3947.48	5	5	4.88E-02
6478.76	6	6	6.31E-02	5826.43	5	3	2.25E-02	3947.59	5	3	4.87E-03
6487.84	6	4	1.05E-02	5843.84	5	5	4.01E-02	3951.93	3	1	3.10E-03
7371.51	4	4	3.53E-02	6380.75	1	3	1.42E-01	3952.98	5	3	1.29E-03
7404.54	6	6	3.61E-02	7103.24	1	3	6.28E-02	3953.00	1	3	1.03E-03
8307.51	2	4	1.65E-02	7109.35	3	5	8.46E-02	3954.52	3	5	7.73E-04
8344.95	2	2	6.52E-02	7111.28	3	3	4.70E-02	3954.61	5	5	2.32E-02
8386.39	4	4	8.03E-02	*7116.8	9	15	1.12E-01	3997.95	5	3	2.41E-02
8424.56	4	2	3.17E-02	7122.98	5	7	1.12E-01	4217.09	3	1	5.44E-03
				7127.25	5	5	2.80E-02	4222.77	5	3	2.26E-03
				7127.25	5	3	3.11E-03	4222.82	1	3	1.81E-03
N IV				9165.07	3	5	4.23E-02	4233.27	5	5	4.04E-03
247.205	1	3	1.19E+02	9182.16	5	7	4.45E-02	4368.19	3	1	7.56E-02
*283.52	9	15	3.05E+02	9222.99	7	9	4.95E-02	4368.24	3	5	7.59E-03
*322.64	9	3	8.99E+01	9247.04	5	5	7.66E-03	4967.38	3	5	4.43E-03
335.047	3	5	1.845E+02	9311.55	7	7	5.36E-03	4967.88	5	7	8.44E-03
387.356	3	1	2.55E+01					4968.79	7	9	1.27E-02
765.147	1	3	2.320E+01	N V				5019.29	5	5	7.13E-03
*923.16	9	9	1.759E+01	*209.29	2	6	1.21E+02	5020.22	7	5	9.98E-02
955.334	3	1	2.919E+01	*247.66	6	10	4.26E+02	5329.11	3	5	9.48E-03
1718.55	3	5	2.321E+00	1238.82	2	4	3.40E+00	5329.69	5	7	1.81E-02
2649.88	3	3	1.07E+00	1242.80	2	2	3.37E+00	5330.74	7	9	2.71E-02
3052.20	1	3	1.33E-01	4603.74	2	4	4.14E-01	5435.18	3	5	7.74E-03
3059.60	3	3	3.95E-01	4619.97	2	2	4.10E-01	5435.77	5	5	1.29E-02
3075.19	5	3	6.48E-01					5436.86	7	5	1.80E-02
3443.61	3	5	3.46E-01	N VI				5512.60	3	5	2.69E-03
3445.22	1	3	4.60E-01	24.8980	1	3	5.158E+03	5512.77	5	7	3.58E-03
3454.65	3	3	3.42E-01	28.7870	1	3	1.809E+04	5554.83	3	3	5.83E-03
3461.36	3	1	1.36E+00	*161.220	3	9	2.859E+02	5555.00	5	3	9.71E-03
3463.36	5	5	1.02E+00	173.275	1	3	2.697E+02	5958.39	3	5	6.80E-03
3474.53	5	3	5.61E-01	*173.93	9	15	8.756E+02	5958.58	5	7	9.06E-03
3478.72	3	5	1.06E+00	185.192	3	5	8.205E+02	6046.23	3	3	1.05E-02
*3480.8	3	9	1.06E+00	*1901	3	9	6.780E-01	6046.44	5	3	1.75E-02
3483.00	3	3	1.06E+00	2896.4	1	3	2.079E-01	6046.49	1	3	3.50E-03
3484.93	3	1	1.06E+00	*6991.1	3	9	8.384E-02	6155.99	3	5	2.67E-02
3689.94	3	1	9.10E-02	9622.0	1	3	3.276E-02	6156.78	5	7	5.08E-02
3694.14	3	3	2.27E-02					6158.19	7	9	7.62E-02
3707.39	5	3	6.73E-02	Oxygen				6324.84	7	5	3.76E-05
3714.43	5	5	1.34E-02	O I				6453.60	3	5	1.65E-02
3735.43	7	5	7.37E-02	791.973	5	5	4.94E+00	6454.44	5	5	2.75E-02
3747.54	3	5	9.92E-01	792.938	1	3	2.19E+00	6455.98	7	5	3.85E-02
4057.76	3	5	6.62E-01	792.967	3	5	1.64E+00	6726.28	5	5	1.18E-05
4740.26	3	5	1.53E-02	877.798	5	3	2.85E+00	6726.54	5	3	6.44E-06
4747.96	3	3	7.60E-02	877.879	5	5	5.12E+00	7001.92	3	5	2.65E-02
4752.49	5	7	1.13E-02	922.008	5	7	1.23E+00	7002.23	5	7	3.53E-02
4762.09	5	5	6.99E-02								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
7254.15	3	3	2.24E-02	2418.46	6	6	2.30E-01	4104.72	4	6	3.14E-01
7254.45	5	3	3.73E-02	2425.57	6	6	1.77E-01	4104.99	4	4	9.14E-01
7254.53	1	3	7.45E-03	2433.54	2	4	4.21E-01	4106.02	8	6	1.70E-02
7771.94	5	7	3.69E-01	2436.06	4	4	1.69E-01	4109.84	6	6	1.21E-02
7774.17	5	5	3.69E-01	2444.25	4	4	7.56E-02	4110.19	6	4	2.54E-01
7775.39	5	3	3.69E-01	2445.53	4	6	4.98E-01	4110.79	4	2	7.70E-01
7981.94	3	3	2.33E-04	2517.96	4	6	7.72E-02	4112.02	6	6	1.81E-01
7982.40	1	3	3.09E-04	2523.21	2	2	9.63E-02	4113.83	8	6	2.41E-01
7986.98	3	5	4.19E-04	2526.87	4	4	1.20E-01	4119.22	6	8	1.33E+00
7987.33	5	5	1.41E-04	2530.28	6	8	8.16E-02	4120.28	6	6	2.15E-01
7995.07	5	7	5.63E-04	2571.46	2	4	1.15E-01	4120.55	6	4	2.60E-01
8221.82	7	7	2.89E-01	2575.28	4	6	1.37E-01	4121.46	2	2	5.60E-01
8227.65	5	3	8.13E-02	3134.73	8	6	1.23E+00	4129.32	4	2	1.79E-01
8230.00	5	5	2.26E-01	3273.43	8	6	9.99E-01	4132.80	2	4	9.13E-01
8233.00	3	3	2.43E-01	3377.15	2	2	1.27E+00	4140.70	4	4	4.09E-02
8235.35	3	5	4.86E-02	3390.21	2	4	1.22E+00	4153.30	4	6	7.91E-01
8446.25	3	1	3.22E-01	3407.28	6	6	1.02E+00	4156.53	6	4	2.11E-01
8446.36	3	5	3.22E-01	3712.74	2	4	2.84E-01	4169.22	6	6	2.71E-01
8446.76	3	3	3.22E-01	3727.32	4	4	5.81E-01	4185.44	6	8	1.91E+00
8820.42	5	7	2.93E-01	3749.48	6	4	9.31E-01	4189.58	8	8	7.06E-02
9260.81	3	1	4.46E-01	3833.07	6	8	1.02E-02	4189.79	8	10	1.98E+00
9260.85	3	3	3.34E-01	3842.81	2	4	7.45E-02	4192.51	6	4	3.21E-01
9260.94	3	5	1.56E-01	3843.58	4	6	3.55E-02	4196.27	4	4	3.56E-02
9262.58	5	3	1.11E-01	3847.89	2	2	1.95E-01	4196.70	4	2	3.56E-01
9262.67	5	5	2.60E-01	3850.80	4	6	6.00E-03	4317.14	2	4	3.70E-01
9262.78	5	7	2.97E-01	3851.03	4	4	1.59E-01	4319.63	4	6	2.55E-01
9265.83	7	5	2.97E-02	3851.47	8	8	2.72E-02	4319.87	2	2	5.62E-01
9265.93	7	7	1.48E-01	3856.13	4	2	2.28E-01	4325.76	2	2	1.47E-01
9266.01	7	9	4.45E-01	3857.16	6	6	6.59E-02	4327.46	6	6	6.76E-01
9482.89	5	3	2.34E-01	3863.50	6	8	6.49E-02	4327.85	6	4	7.24E-02
9622.11	5	3	5.22E-04	3864.13	2	2	9.12E-02	4328.59	4	2	1.12E+00
9622.16	3	3	1.57E-03	3864.43	6	6	2.15E-01	4331.47	4	6	4.82E-02
9625.26	7	5	3.25E-04	3864.67	6	4	1.80E-01	4331.86	4	4	6.50E-01
9625.30	7	7	1.85E-03	3874.09	2	4	3.26E-02	4336.86	4	4	1.57E-01
9694.66	5	7	4.54E-04	3875.80	8	6	3.38E-02	4345.56	4	2	8.31E-01
9694.91	5	5	4.54E-04	3882.19	8	8	5.50E-01	4347.22	6	4	1.19E-01
9695.06	5	3	4.54E-04	3882.45	4	4	8.94E-02	4347.41	4	4	9.32E-01
				3883.14	8	6	1.13E-01	4349.43	6	6	6.91E-01
				3893.52	4	6	1.89E-02	4351.26	6	6	6.89E-01
O II				3907.45	6	6	8.64E-02	4351.46	4	6	5.82E-02
429.918	4	2	4.25E+01	3911.96	6	4	1.09E+00	4359.40	4	6	1.44E-02
430.041	4	4	4.13E+01	3912.12	4	4	1.41E-01	4366.89	6	4	3.98E-01
430.176	4	6	4.36E+01	3919.27	4	2	1.22E+00	4369.27	4	4	3.57E-01
483.760	4	2	2.05E+01	3945.04	2	4	2.05E-01	4395.93	6	6	3.91E-01
483.980	6	4	1.80E+01	3954.36	2	2	8.57E-01	4405.98	6	4	4.30E-02
484.027	4	4	3.22E+00	3973.26	4	4	1.04E+00	4414.90	4	6	8.34E-01
485.087	6	8	2.60E+01	3982.71	4	2	4.27E-01	4416.97	2	4	7.13E-01
485.470	6	6	1.20E+00	4069.62	2	4	1.52E+00	4443.01	6	6	5.05E-01
485.518	4	6	1.93E+01	4069.88	4	6	1.53E+00	4443.52	6	8	1.89E-02
2290.85	2	4	7.41E-02	4072.15	6	8	1.98E+00	4447.68	8	6	2.52E-02
2293.30	2	2	3.25E-01	4075.86	8	10	2.11E+00	4448.19	8	8	5.10E-01
2300.33	4	4	4.17E-01	4078.84	4	4	5.52E-01	4452.38	4	4	1.37E-01
2302.81	4	2	1.67E-01	4084.65	6	8	7.28E-02	4466.24	2	4	9.00E-01
2365.14	4	2	1.52E-01	4085.11	6	6	4.55E-01	4467.46	2	2	9.00E-01
2375.72	6	4	1.35E-01	4092.93	8	8	2.65E-01	4563.18	4	4	7.18E-03
2406.38	6	4	1.85E-01	4094.14	6	4	4.70E-02	4590.97	6	8	8.85E-01
2407.48	4	4	2.25E-01	4096.53	4	6	1.73E-01	4595.96	6	6	4.87E-02
2411.60	4	2	2.05E-01	4097.22	2	4	3.62E-01	4596.18	4	6	8.34E-01
2411.64	2	2	1.10E-01	4103.00	2	2	5.09E-01	4638.86	2	4	3.71E-01
2415.13	4	2	2.20E-01								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4641.81	4	6	5.96E-01	263.817	5	7	5.97E+01	3017.62	7	7	5.38E-01
4649.13	6	8	7.81E-01	263.861	5	5	1.49E+01	3023.43	3	5	4.79E-01
4650.84	2	2	6.86E-01	277.386	5	7	9.43E+01	3024.36	7	5	9.39E-02
4661.63	4	4	4.10E-01	279.788	5	5	4.25E+01	3024.54	1	3	6.16E-01
4673.73	4	2	1.35E-01	295.942	1	3	5.56E+01	3035.41	3	3	4.59E-01
4676.23	6	6	2.05E-01	303.413	1	3	4.29E+01	3042.07	3	1	1.94E+00
4690.89	2	4	1.86E-01	303.461	3	1	1.29E+02	3047.10	5	5	1.49E+00
4691.42	2	2	7.43E-01	303.517	3	3	3.21E+01	3059.28	5	3	8.72E-01
4696.35	6	4	3.25E-02	303.622	3	5	3.21E+01	3064.98	1	3	2.17E-01
4698.44	6	6	6.59E-02	303.695	5	3	5.34E+01	3068.13	3	1	6.49E-01
4699.01	6	8	9.88E-01	303.800	5	5	9.61E+01	3068.26	3	3	5.41E-02
4699.22	4	6	9.36E-01	305.596	1	3	1.20E+02	3068.67	3	5	2.27E-01
4701.18	4	4	9.23E-01	305.656	3	5	1.62E+02	3074.14	5	7	1.84E-01
4701.71	4	2	3.69E-01	305.702	3	3	9.01E+01	3074.72	5	3	3.76E-01
4703.16	4	6	9.20E-01	305.767	5	7	2.16E+02	3075.13	5	5	1.61E-01
4705.35	6	8	1.10E+00	305.836	5	5	5.40E+01	3075.95	7	9	1.07E-01
4710.01	4	6	2.98E-01	320.978	5	7	2.17E+02	3083.65	7	7	3.20E-01
4741.70	6	6	4.71E-02	328.448	5	5	1.04E+02	3084.64	7	5	2.55E-01
4751.28	6	8	6.39E-02	345.312	1	3	1.35E+02	3088.04	9	9	5.30E-01
4752.69	6	6	1.45E-02	374.073	5	5	2.85E+01	3095.79	9	7	1.35E-01
4844.92	4	6	1.02E-02	395.557	5	3	2.80E+01	3115.67	3	1	1.39E+00
4856.39	4	6	5.58E-02	507.388	1	3	1.61E+01	3121.63	3	3	1.38E+00
4856.76	4	4	1.00E-01	507.680	3	3	4.82E+01	3132.79	3	5	1.37E+00
4860.97	2	4	4.70E-01	508.178	5	3	8.04E+01	3198.18	3	5	9.57E-02
4864.88	4	2	8.07E-02	525.794	5	3	9.60E+01	3201.14	3	3	4.77E-01
4871.52	4	6	5.60E-01	597.814	1	3	1.49E+01	3202.51	5	7	7.08E-02
4872.02	4	4	9.34E-02	599.590	5	5	5.41E+01	3207.61	5	5	4.40E-01
4890.86	4	2	4.80E-01	702.337	1	3	6.06E+00	3210.58	5	3	1.58E-01
4906.83	4	4	4.54E-01	702.838	3	1	1.83E+01	3216.07	7	7	5.58E-01
4924.53	4	6	5.43E-01	832.929	1	3	3.41E+00	3221.21	7	5	9.75E-02
4941.07	2	4	5.87E-01	835.092	5	5	1.44E+00	3260.86	5	7	1.68E+00
4943.01	4	6	7.78E-01	835.289	5	7	5.99E+00	3265.33	7	9	1.88E+00
4955.71	4	4	1.82E-01	1679.03	3	5	6.57E-01	3267.20	3	5	1.58E+00
5159.94	2	2	3.29E-01	1686.73	3	3	6.48E-01	3281.83	5	5	2.89E-01
5175.90	4	2	1.49E-01	1760.41	3	5	8.38E-01	3284.45	7	7	2.06E-01
5190.50	2	4	1.26E-01	1764.46	5	5	2.50E+00	3299.39	1	3	1.64E-01
5206.65	4	4	3.58E-01	1766.63	1	3	1.11E+00	3312.33	3	3	4.60E-01
5583.22	2	4	2.17E-02	1772.28	3	1	3.29E+00	3326.06	3	3	2.65E-01
5611.07	2	2	2.14E-02	1772.97	5	3	1.37E+00	3330.30	3	5	6.81E-01
6627.37	4	4	1.73E-01	2390.43	3	3	1.62E+00	3330.32	3	5	4.76E-01
6641.03	2	2	9.88E-02	2454.97	3	1	3.43E+00	3332.41	5	3	7.92E-01
6666.66	4	2	6.78E-02	2665.68	3	5	6.75E-01	3332.93	5	7	5.04E-01
6677.87	2	4	3.37E-02	2674.58	5	5	1.11E+00	3336.67	3	3	3.76E-01
6717.75	2	2	1.33E-01	2683.66	3	1	1.85E+00	3336.69	5	5	8.77E-02
6721.39	4	2	1.81E-01	2686.15	7	5	1.54E+00	3340.76	5	3	6.57E-01
6810.48	6	8	1.64E-03	2687.55	3	3	1.84E+00	3344.20	5	5	1.25E-01
6844.10	4	6	2.97E-03	2695.48	3	5	1.82E+00	3344.51	5	7	3.48E-01
6846.80	8	8	3.17E-02	2794.14	3	1	1.82E-01	3347.98	7	5	4.86E-01
6869.48	6	6	5.35E-02	2798.93	3	3	4.52E-02	3350.62	5	3	1.12E+00
6884.88	4	4	6.12E-02	2809.66	5	3	1.34E-01	3350.92	7	7	9.91E-01
6895.10	10	8	2.72E-01	2818.70	5	5	2.66E-02	3355.86	7	7	6.89E-01
6906.44	8	6	2.48E-01	2836.31	7	5	1.46E-01	3362.31	7	5	6.87E-01
6907.87	4	2	3.03E-01	2959.69	3	5	1.83E+00	3376.61	3	1	1.49E+00
6910.56	6	4	2.43E-01	2983.78	3	5	2.15E+00	3376.76	3	3	1.12E+00
				2992.08	3	5	9.32E-02	3377.26	3	5	5.20E-01
				2996.48	3	3	4.64E-01	3382.61	5	7	9.86E-01
O III				2997.69	5	7	6.88E-02	3383.31	5	3	3.70E-01
263.694	1	3	3.32E+01	3004.34	5	5	4.27E-01	3383.81	5	5	8.62E-01
263.727	3	5	4.48E+01	3008.78	5	3	1.53E-01	3384.90	7	9	1.48E+00
263.773	3	3	2.49E+01								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3394.22	7	7	4.88E-01	4440.09	5	3	4.42E-01	2816.53	4	4	5.74E-01
3395.43	7	5	9.75E-02	4447.69	5	5	4.40E-01	2829.17	8	6	1.56E-01
3406.88	1	3	1.93E-01	4461.61	5	7	4.36E-01	2836.27	6	4	8.43E-01
3408.13	3	1	5.79E-01	4524.22	3	1	3.38E-01	2916.31	2	4	1.06E+00
3415.26	3	3	1.44E-01	4532.78	5	3	1.40E-01	2921.46	4	6	1.27E+00
3428.63	3	5	1.42E-01	4535.29	3	3	8.40E-02	2926.18	4	4	2.11E-01
3430.57	5	3	2.37E-01	4555.39	5	5	2.49E-01	3063.43	2	4	1.30E+00
3444.05	5	5	4.21E-01	4557.91	3	5	8.27E-02	3071.60	2	2	1.29E+00
3446.68	3	5	9.71E-01	5268.30	1	3	3.50E-01	3177.89	2	4	7.59E-02
3447.15	1	3	8.09E-01	5508.24	5	5	1.06E-01	3180.77	2	2	1.51E-01
3447.97	5	7	1.19E+00	5592.25	3	3	3.27E-01	3180.99	4	6	7.06E-02
3450.91	7	9	1.44E+00					3185.74	4	4	1.21E-01
3451.30	3	3	8.06E-01	O IV				3188.22	6	8	4.28E-02
3454.84	5	5	6.89E-01	238.360	2	4	2.96E+02	3188.64	4	2	1.50E-01
3454.99	9	11	1.72E+00	238.570	4	6	3.54E+02	3194.78	6	6	1.71E-01
3459.48	5	3	1.14E-01	238.579	4	4	5.90E+01	3199.58	6	4	1.04E-01
3459.94	7	7	5.14E-01	279.631	2	2	2.68E+01	3209.65	8	8	2.53E-01
3466.13	9	9	2.84E-01	279.933	4	2	5.34E+01	3216.31	8	6	5.56E-02
3466.85	7	5	6.82E-02	553.329	2	4	1.22E+01	3348.06	2	4	8.51E-01
3475.24	9	7	2.42E-02	554.076	2	2	4.86E+01	3349.11	4	6	1.02E+00
3520.94	1	3	1.50E-01	554.513	4	4	6.06E+01	3354.27	4	2	7.71E-01
3531.22	3	1	4.45E-01	555.263	4	2	2.41E+01	3362.55	4	4	7.65E-01
3533.38	3	3	1.11E-01	608.397	2	2	1.21E+01	3375.40	4	6	7.56E-01
3534.90	3	5	1.11E-01	609.829	4	2	2.40E+01	3378.02	4	4	1.66E-01
3555.24	5	3	1.82E-01	616.952	6	4	2.60E+01	3381.21	4	6	7.19E-01
3556.78	5	5	3.26E-01	617.005	4	4	2.89E+00	3381.30	2	4	4.28E-01
3695.38	3	5	4.01E-01	617.036	4	2	2.89E+01	3385.52	6	8	1.02E+00
3698.72	5	7	7.62E-01	624.619	2	4	1.07E+01	3390.19	2	2	8.49E-01
3703.36	7	9	1.14E+00	625.127	4	4	2.13E+01	3396.80	4	4	5.40E-01
3704.75	3	3	8.53E-01	625.853	6	4	3.19E+01	3405.77	4	2	1.67E-01
3707.27	3	5	7.34E-01	779.736	6	4	1.46E+00	3409.70	6	6	3.00E-01
3709.54	3	1	1.13E+00	779.820	4	4	1.31E+01	3411.30	4	4	1.69E-01
3712.49	5	5	6.59E-01	779.912	6	6	1.36E+01	3411.69	4	6	1.02E+00
3714.03	3	3	4.06E-01	779.997	4	6	9.70E-01	3425.55	6	4	4.94E-02
3715.09	5	7	9.73E-01	787.710	2	4	5.95E+00	3489.89	4	6	7.29E-01
3720.89	7	7	3.74E-01	790.112	4	4	1.18E+00	3492.21	2	4	6.06E-01
3721.95	5	3	2.80E-01	790.199	4	6	7.08E+00	3493.43	4	4	1.21E-01
3725.31	5	5	2.41E-01	921.296	2	4	2.21E+00	3560.39	4	6	1.03E+00
3728.51	5	7	1.29E+00	921.365	2	2	8.83E+00	3563.33	6	8	1.10E+00
3728.84	7	9	1.45E+00	923.367	4	4	1.10E+01	3593.08	6	6	7.15E-02
3729.80	3	5	1.22E+00	923.436	4	2	4.39E+00	3725.89	2	4	5.61E-01
3732.13	5	3	2.67E-02	1338.61	2	4	2.17E+00	3725.94	4	6	6.01E-01
3734.83	7	5	7.40E-02	1342.99	4	4	4.29E-01	3729.03	6	8	6.86E-01
3742.63	5	5	2.24E-01	1343.51	4	6	2.57E+00	3736.68	4	4	2.23E-01
3746.90	7	7	1.59E-01	2120.58	2	2	1.05E+00	3736.85	8	10	7.95E-01
3754.70	3	5	7.53E-01	2132.64	4	4	1.29E+00	3744.89	6	6	1.92E-01
3757.23	1	3	5.56E-01	2493.39	2	4	1.18E+00	3758.39	8	8	1.11E-01
3759.88	5	7	9.79E-01	2493.75	4	6	8.48E-01	3930.68	2	2	3.80E-02
3774.03	3	3	3.91E-01	2493.99	2	2	6.09E-01	3942.06	2	4	9.42E-02
3791.28	5	5	2.24E-01	2499.27	2	2	4.68E-01	3945.31	4	2	1.88E-01
3810.98	5	3	2.37E-02	2501.81	4	4	3.73E-01	3956.77	4	4	2.98E-02
3816.75	5	3	9.63E-02	2507.73	4	2	2.32E+00	3974.58	4	6	6.62E-02
3961.57	5	7	1.25E+00	2509.22	6	6	1.94E+00	3977.09	6	4	9.91E-02
4072.64	1	3	3.37E-01	2510.58	4	2	1.19E+00	3995.08	6	6	1.52E-01
4073.98	3	5	4.54E-01	2517.37	6	4	1.24E+00	4687.03	2	4	2.79E-01
4081.02	5	7	6.02E-01	2781.22	2	2	1.03E-01	4772.60	2	4	1.23E-01
4089.30	3	3	2.49E-01	2803.57	6	4	1.26E-01	4779.10	2	2	2.45E-01
4103.07	5	5	1.48E-01	2805.87	2	4	2.90E-01	4783.42	4	6	2.06E-01
4118.60	5	3	1.63E-02	2812.50	6	6	3.58E-02	4794.18	4	4	1.56E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4798.27	6	8	2.91E-01	4213.35	5	3	1.19E-02	2149.1	4	2	3.18E+00
4813.15	6	6	8.65E-02	4522.66	5	3	1.02E-02	2152.9	2	4	4.85E-01
5305.51	4	4	6.10E-02	4554.53	3	5	2.41E-01	2154.1	4	4	1.73E-01
5362.51	6	6	6.12E-02	5114.06	1	3	1.80E-01	2154.1	4	6	5.8E-01
6876.49	2	4	1.88E-02	5339.94	1	3	1.85E-02	2534.0	2	4	2.00E-01
6931.60	2	2	7.35E-02	5349.74	3	1	7.04E-02	2535.6	4	4	9.5E-01
7004.11	4	4	8.90E-02	5372.71	3	3	1.42E-02	2553.3	2	2	7.1E-01
7061.30	4	2	3.48E-02	5414.59	3	5	9.29E-03	2554.9	4	2	3.00E-01
				5428.38	5	3	2.68E-02				
				5471.12	5	5	4.86E-02				
O V				5571.81	1	3	8.33E-02	P II			
172.169	1	3	2.94E+02	5580.12	3	5	1.11E-01	1301.9	1	3	5.0E-01
*192.85	9	15	6.90E+02	5583.23	3	3	6.20E-02	1304.5	3	1	1.5E+00
*215.17	9	3	1.83E+02	*5589.9	9	15	1.49E-01	1304.7	3	3	3.7E-01
220.353	3	5	4.292E+02	5597.89	5	7	1.48E-01	1305.5	3	5	3.8E-01
248.460	3	1	5.59E+01	5604.27	5	5	3.68E-02	1309.9	5	3	6.2E-01
629.732	1	3	2.872E+01	5607.41	5	3	4.08E-03	1310.7	5	5	1.1E+00
758.677	3	5	5.547E+00	6330.05	5	7	1.21E-01	4475.3	5	7	1.3E+00
759.442	1	3	7.373E+00	6460.12	3	5	9.37E-02	4499.2	5	7	1.4E+00
760.227	3	3	5.514E+00	6466.14	5	7	1.01E-01	4530.8	3	5	1.0E+00
760.446	5	5	1.652E+01	6500.24	7	9	1.11E-01	4554.8	3	5	9.6E-01
761.128	3	1	2.197E+01	6543.77	5	5	1.64E-02	4588.0	5	7	1.7E+00
762.004	5	3	9.125E+00	6601.28	7	7	1.14E-02	4589.9	3	5	1.6E+00
774.518	3	1	3.804E+01	6764.72	1	3	4.37E-02	4602.1	7	9	1.9E+00
1371.30	3	5	3.336E+00	6789.62	3	5	5.79E-02	4943.5	7	5	6.3E-01
2729.31	3	5	4.52E-01	6817.40	3	3	3.00E-02	5253.5	3	5	1.0E+00
2731.45	1	3	5.90E-01	6828.95	5	7	7.35E-02	5425.9	5	5	6.9E-01
2743.61	3	3	4.38E-01	6878.76	5	5	1.65E-02	6024.2	3	5	5.1E-01
2752.23	3	1	1.82E+00					6043.1	5	7	6.8E-01
2755.13	5	5	1.37E+00	O VI							
2769.69	5	3	7.88E-01	*150.10	2	6	2.62E+02	P III			
2781.01	3	5	1.40E+00	*173.03	6	10	8.78E+02	1334.8	2	4	5.5E-01
*2784.0	3	9	1.40E+00	1031.91	2	4	4.16E+00	1344.3	4	6	6.4E-01
2786.99	3	3	1.39E+00	1037.61	2	2	4.09E+00	1344.8	4	4	1.1E-01
2789.85	3	1	1.38E+00	3811.35	2	4	5.14E-01	4057.4	4	4	1.0E-01
3058.68	3	5	1.39E+00	3834.24	2	2	5.05E-01	4059.3	6	4	9.0E-01
3144.66	3	5	8.86E-01					4080.1	4	2	9.9E-01
3219.24	3	1	1.54E-01	O VII				Potassium			
3222.29	1	3	1.16E-01	18.6270	1	3	9.365E+03	K I			
3227.54	3	3	3.38E-02	21.6020	1	3	3.309E+04	4044.1	2	4	1.24E-02
3239.21	3	3	3.28E-01	*120.33	3	9	5.334E+02	4047.2	2	2	1.24E-02
3248.28	5	3	1.18E-01	128.411	1	3	8.982E+02	5084.2	2	2	3.50E-03
3263.54	5	5	1.86E-02	*128.46	9	15	1.615E+03	5099.2	4	2	7.0E-03
3275.64	5	3	4.76E-01	135.820	3	5	1.523E+03	5323.3	2	2	6.3E-03
3297.62	7	5	1.30E-01	*1630.3	3	9	7.935E-01	5339.7	4	2	1.26E-02
3690.17	3	5	1.97E-02	2448.98	1	3	2.514E-01	5343.0	2	4	4.0E-03
3698.36	3	3	1.03E-01	*5933.1	3	9	1.002E-01	5359.6	4	6	4.6E-03
3702.72	5	7	1.41E-02	8241.76	1	3	3.864E-02	5782.4	2	2	1.23E-02
3717.31	5	5	9.63E-02					5801.8	4	2	2.46E-02
3725.63	5	3	2.91E-02	Phosphorus				5812.2	2	4	2.8E-03
3746.64	7	7	1.18E-01	P I				5831.9	4	6	3.2E-03
3761.58	7	5	1.61E-02	1671.7	4	2	3.9E-01	6911.1	2	2	2.72E-02
4119.37	3	5	3.66E-01	1674.6	4	4	4.0E-01	6938.8	4	2	5.4E-02
4120.49	3	1	3.33E-01	1679.7	4	6	3.9E-01	7664.9	2	4	3.87E-01
4123.96	5	7	4.81E-01	1775.0	4	6	2.17E+00	7699.0	2	2	3.82E-01
4125.49	1	3	2.70E-01	1782.9	4	4	2.14E+00				
4134.11	3	3	3.34E-01	1787.7	4	2	2.13E+00	K II			
4153.27	3	3	1.92E-01	2135.5	4	4	2.11E-01	607.93	1	3	1.3E-02
4158.86	3	5	3.39E-01	2136.2	6	4	2.83E+00				
4178.46	5	5	1.12E-01								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
K III				3121.76	6	6	1.1E-01	4056.34	6	4	9.5E-03
2550.0	6	4	2.0E+00	3123.70	10	8	4.6E-02	4082.78	6	4	1.4E-01
2635.1	4	4	1.2E+00	3137.71	4	6	3.3E-02	4097.52	2	4	7.0E-02
2992.4	6	8	2.5E+00	3189.05	6	6	3.03E-01	4121.68	6	6	9.8E-02
3052.1	4	6	1.7E+00	3197.13	6	4	4.35E-02	4128.87	6	8	1.73E-01
3202.0	4	4	1.8E+00	3263.14	6	6	1.3E-01	4135.27	8	8	1.0E-01
3289.1	4	6	2.0E+00	3271.61	6	4	2.0E-01	4196.50	6	8	3.9E-02
3322.4	6	6	1.3E+00	3280.55	8	8	2.36E-01	4211.14	8	10	1.62E-01
3421.8	2	4	1.5E+00	3283.57	6	8	4.4E-01	4244.44	4	4	6.5E-03
K XVI				3289.14	4	4	1.0E-01	4278.60	4	6	9.2E-03
206.27	1	3	9.4E+01	3323.09	8	10	6.3E-01	4288.71	6	8	6.1E-02
K XVII				3331.09	4	2	5.40E-02	4373.04	2	4	1.8E-02
22.020	2	4	4.7E+04	3338.54	8	6	3.5E-02	4374.80	8	10	1.64E-01
22.163	4	6	5.6E+04	3360.80	4	4	1.2E-01	4379.92	6	6	2.48E-02
22.18	4	4	9.3E+03	3368.38	6	4	1.1E-01	4492.47	6	6	4.5E-03
22.60	2	2	2.5E+03	3396.82	10	10	6.5E-01	4528.72	6	8	1.35E-02
22.76	4	2	4.7E+03	3399.70	6	8	1.2E-01	4548.73	4	6	5.5E-03
Praseodymium				3462.04	6	6	6.2E-01	4551.64	4	4	4.00E-02
Pr II				3470.66	4	4	8.5E-01	4565.19	4	4	1.1E-02
3997.0	15	15	1.87E-01	3478.91	6	6	3.32E-01	4569.00	6	8	1.0E-02
4062.8	13	15	1.00E+00	3484.04	6	8	9.3E-03	4608.12	2	2	2.1E-02
4100.7	17	19	8.4E-01	3498.73	4	6	2.12E-01	4675.03	8	8	6.4E-03
4143.1	15	17	5.8E-01	3502.52	10	10	4.3E-01	4721.00	6	4	3.43E-03
4179.4	13	15	5.2E-01	3507.32	6	8	3.4E-01	4745.11	6	6	5.2E-03
4222.9	11	13	3.91E-01	3528.02	8	8	8.5E-01	4755.58	4	4	6.0E-03
4241.0	17	15	2.30E-01	3543.95	4	4	4.65E-01	4842.43	6	8	1.6E-03
4359.8	15	15	1.1E-01	3549.54	6	6	2.22E-01	4963.71	2	2	3.0E-02
4405.8	17	17	9.0E-02	3570.18	4	6	1.82E-01	4977.75	4	4	9.8E-03
4429.3	15	15	2.28E-01	3583.10	8	10	2.6E-01	4979.18	4	6	1.0E-02
4449.8	13	13	1.24E-01	3596.19	6	4	5.5E-01	5090.63	6	6	5.0E-03
4468.7	11	13	1.54E-01	3597.15	6	8	5.9E-01	5120.69	6	8	3.1E-03
4510.2	13	15	1.16E-01	3612.47	4	2	8.90E-01	5130.76	4	4	4.35E-03
4534.2	15	17	4.9E-02	3620.46	6	4	8.5E-02	5155.54	2	4	9.8E-03
4734.2	15	13	2.5E-02	3654.87	8	8	6.0E-02	5184.19	6	8	1.6E-03
4879.1	15	15	1.8E-02	3657.99	8	6	8.8E-01	5212.73	4	2	5.95E-03
4886.0	15	15	1.3E-02	3666.22	6	8	8.4E-02	5292.14	10	10	3.7E-03
4912.6	17	15	5.7E-02	3690.70	6	4	3.23E-01	5390.44	4	6	9.5E-03
5034.4	19	19	1.1E-01	3692.36	10	8	9.1E-01	5424.72	4	4	5.0E-03
5110.8	21	19	2.78E-01	3700.91	8	10	3.9E-01	5599.42	6	8	1.3E-02
5135.1	17	17	1.25E-01	3713.02	4	4	8.3E-02	5983.60	10	10	2.1E-02
5173.9	19	17	3.18E-01	3788.47	4	6	1.4E-01	Rubidium			
5219.1	15	15	9.5E-02	3793.22	8	6	4.2E-01	Rb I			
5220.1	17	15	2.35E-01	3799.31	8	8	5.5E-01	3022.5	2	4	4.13E-05
5251.7	15	13	1.1E-02	3806.76	6	6	6.2E-02	3032.0	2	4	4.93E-05
5259.7	15	13	2.24E-01	3818.19	6	4	5.8E-01	3044.2	2	4	8.2E-05
5292.6	13	13	9.3E-02	3822.26	6	6	8.5E-01	3060.2	2	4	1.05E-04
5810.6	17	19	2.3E-02	3828.48	6	6	6.2E-01	3082.0	2	4	1.49E-04
5879.3	15	15	7.6E-02	3833.89	6	4	5.8E-01	3112.6	2	4	2.5E-04
6200.8	15	17	1.8E-02	3856.52	8	10	5.9E-01	3113.1	2	2	1.3E-04
6278.7	13	15	2.6E-02	3872.39	4	6	6.7E-03	3157.5	2	4	3.38E-04
6398.0	11	13	1.9E-02	3877.34	8	6	3.7E-02	3158.3	2	2	2.0E-04
Rhodium				3913.51	8	8	2.5E-03	3228.0	2	4	6.4E-04
Rh I				3922.19	4	2	6.25E-02	3229.2	2	2	3.8E-04
3083.96	8	6	4.8E-02	3934.23	8	8	1.58E-01	3348.7	2	4	1.37E-03
3114.91	6	4	4.45E-02	3942.72	4	2	7.15E-01	3350.8	2	2	8.9E-04
				3958.86	6	8	5.5E-01	3357.1	2	4	3.97E-03
				3984.40	4	4	1.1E-01	3591.6	2	2	2.9E-03
				3995.61	4	6	4.7E-02	4201.8	2	4	1.8E-02
				4053.44	2	2	2.8E-02				

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4215.5	2	2	1.5E-02	4093.12	4	4	1.23E-01	5339.43	6	6	1.06E-01
7800.3	2	4	3.70E-01	4094.86	6	6	1.44E-01	5341.07	4	2	3.8E-01
7947.6	2	2	3.40E-01	4098.36	8	8	8.7E-02	5349.34	6	4	5.9E-01
				4132.98	4	6	1.19E+00	5350.28	8	8	6.8E-02
				4140.27	6	8	1.17E+00	5355.79	6	4	3.0E-01
				4147.38	6	6	1.74E-01	5356.10	8	6	5.7E-01
				4161.85	8	8	1.77E-01	5375.37	8	6	3.4E-01
				4171.53	6	4	1.36E-01	5392.06	10	8	4.2E-01
				4186.42	6	8	8.4E-02	5416.16	4	6	4.4E-02
				4187.61	8	6	1.28E-01	5416.41	6	6	2.0E-02
				4193.53	4	6	6.1E-02	5425.55	6	8	4.5E-02
				4204.52	6	8	3.5E-02	5429.42	2	4	9.0E-02
				4205.20	10	8	1.12E-01	5432.98	4	4	5.4E-02
				4212.32	4	6	1.58E-01	5433.25	6	4	9.7E-02
				4212.48	6	6	8.6E-02	5438.28	4	6	3.4E-02
				4216.08	2	4	2.36E-01	5439.04	2	2	1.74E-01
				4218.23	4	4	2.26E-01	5442.62	4	2	2.15E-01
				4225.54	6	8	9.5E-02	5446.20	8	8	2.8E-01
				4225.69	4	6	7.6E-02	5451.37	6	6	1.50E-01
				4231.64	4	4	1.31E-01	5455.24	4	4	6.6E-02
				4233.59	6	6	4.0E-01	5464.95	4	2	3.2E-02
				4238.05	8	8	7.1E-01	5468.40	6	4	9.7E-02
				4239.55	6	4	2.27E-01	5472.19	8	6	9.7E-02
				4246.14	8	6	1.15E-01	5482.01	8	8	5.2E-01
				4542.55	6	4	1.28E-01	5484.63	6	6	5.2E-01
				4544.67	8	6	1.33E-01	5514.23	6	8	4.1E-01
				4706.94	4	6	2.81E-01	5520.52	8	10	4.3E-01
				4709.31	6	8	4.0E-01	5526.10	4	4	7.1E-02
				4711.72	2	4	1.81E-01	5541.07	6	6	5.5E-02
				4714.30	4	4	2.14E-01	5631.04	2	4	3.0E-02
				4719.31	6	6	1.04E-01	5671.83	10	12	5.4E-01
				4728.77	8	8	1.16E-01	5686.86	8	10	4.9E-01
				4729.20	4	4	2.20E-01	5700.19	6	8	4.6E-01
				4729.24	6	6	1.93E-01	5708.64	10	10	4.7E-02
				4734.11	4	2	1.10E+00	5711.79	4	6	4.5E-01
				4737.65	6	4	8.8E-01	5717.31	8	8	7.5E-02
				4741.02	8	6	9.1E-01	5724.13	6	6	7.4E-02
				4743.82	10	8	9.8E-01	5988.43	6	6	6.6E-02
				4973.67	4	2	8.4E-01	6026.16	4	4	7.2E-02
				4980.36	6	4	5.6E-01	6146.20	6	8	4.2E-02
				4983.43	4	4	2.58E-01	6198.43	4	6	3.5E-02
				4991.91	6	6	3.8E-01	6249.96	6	8	3.2E-02
				4995.00	4	6	5.9E-02	6262.22	4	6	8.4E-02
				5018.41	6	4	2.09E-01	6280.16	2	4	4.0E-02
				5021.52	4	4	2.30E-01	6284.16	6	6	3.9E-02
				5064.31	8	10	7.3E-02	6284.73	4	4	7.1E-02
				5066.38	6	6	3.6E-02	6293.02	2	2	1.04E-01
				5070.17	6	8	1.16E-01	7741.16	10	10	3.8E-02
				5072.71	2	4	2.0E-02	7800.42	8	8	5.1E-02
				5075.82	4	6	1.15E-01				
				5080.22	4	4	4.1E-02				
				5081.56	10	10	7.6E-01	Sc II			
				5083.72	8	8	6.2E-01	1880.6	5	3	5.0E+00
				5085.55	6	6	5.7E-01	2064.3	7	5	2.2E+00
				5086.94	4	4	6.6E-01	2068.0	5	3	2.0E+00
				5096.72	6	4	1.69E-01	2273.1	1	3	7.7E+00
				5099.27	4	6	1.50E-01	2545.20	5	5	4.0E-01
				5101.12	10	8	8.8E-02	2552.35	7	5	2.21E+00
				5331.79	4	4	1.11E-01	2555.79	3	3	6.9E-01
								2560.23	5	3	2.01E+00

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
2563.19	3	1	2.70E+00	5526.79	9	7	3.3E-01	1260.4	2	4	2.0E+01
2611.19	5	5	2.2E+00	5657.91	5	5	1.04E-01	1264.7	4	6	2.3E+01
2667.70	3	5	1.5E+00	5669.06	3	1	1.31E-01	1304.4	2	2	3.6E+00
2746.36	3	1	3.9E+00					1309.3	4	2	7.0E+00
2782.31	5	5	1.3E+00	Silicon				1526.7	2	2	3.73E+00
2789.15	7	7	1.3E+00	Si I				1533.5	4	2	7.4E+00
2801.31	9	9	1.3E+00	1977.6	1	3	1.8E-01	1808.0	2	4	3.7E-02
2819.49	3	5	2.3E+00	1979.2	3	1	5.1E-01	2904.3	4	6	6.7E-01
2822.12	5	7	2.5E+00	1980.6	3	3	1.3E-01	2905.7	6	8	7.1E-01
2826.64	7	9	2.8E+00	1983.2	3	5	1.4E-01	3210.0	4	6	4.6E-01
2870.85	5	3	1.1E+00	1986.4	5	3	2.1E-01	4128.1	4	6	1.32E+00
2912.98	5	3	1.1E+00	1989.0	5	5	4.1E-01	4130.9	6	8	1.42E+00
2979.68	3	5	1.2E+00	2208.0	1	3	3.11E-01	5041.0	2	4	9.8E-01
2988.92	5	7	2.9E+00	2210.9	3	5	4.16E-01	5056.0	4	6	1.2E+00
3039.92	7	9	3.5E+00	2211.7	3	3	2.32E-01	5957.6	2	2	4.2E-01
3045.73	5	7	3.68E+00	2216.7	5	7	5.5E-01	5978.9	4	2	8.1E-01
3052.92	7	9	3.92E+00	2218.1	5	5	1.38E-01	6347.1	2	4	7.0E-01
3060.54	7	7	3.0E-01	2506.9	3	5	4.66E-01	6371.4	2	2	6.9E-01
3065.12	9	11	4.00E+00	2514.3	1	3	6.1E-01	7848.8	4	6	3.9E-01
3075.36	9	9	2.5E-01	2516.1	5	5	1.21E+00	7849.7	6	8	4.2E-01
3128.27	3	3	1.9E+00	2519.2	3	3	4.56E-01				
3133.07	5	5	1.8E+00	2524.1	3	1	1.81E+00	Si III			
3139.72	7	7	2.1E+00	2528.5	5	3	7.7E-01	883.40	5	7	6.3E+01
3190.98	3	3	1.1E+00	2532.4	1	3	2.6E-01	994.79	3	3	7.89E+00
3199.33	5	3	1.9E+00	2631.3	1	3	9.7E-01	997.39	5	3	1.31E+01
3312.72	5	7	1.2E+00	2881.6	5	3	1.89E+00	1141.6	3	5	3.0E+01
3320.40	5	3	1.2E+00	3905.5	1	3	1.18E-01	1144.3	5	7	3.9E+01
3343.23	9	7	1.1E+00	4738.8	3	3	1.0E-02	1161.6	5	5	1.6E+01
3353.72	5	7	1.51E+00	4783.0	5	3	1.7E-02	1206.5	1	3	2.59E+01
3359.67	5	5	2.16E-01	4792.3	5	5	1.7E-02	1206.5	3	5	4.89E+01
3361.26	3	3	3.4E-01	4818.1	5	7	1.1E-02	1207.5	5	5	1.9E+01
3361.93	3	1	1.17E+00	4821.2	3	5	8.0E-03	1294.5	3	5	5.42E+00
3368.94	5	3	8.3E-01	4947.6	3	1	4.2E-02	1296.7	1	3	7.19E+00
3372.15	7	5	9.9E-01	5006.1	3	5	2.8E-02	1298.9	3	3	5.36E+00
3379.16	3	3	2.5E+00	5622.2	3	3	1.6E-02	1299.0	5	5	1.61E+01
3535.71	5	3	6.1E-01	5690.4	3	3	1.2E-02	1301.2	3	1	2.13E+01
3558.53	5	7	3.0E-01	5708.4	5	5	1.4E-02	1303.3	5	3	8.85E+00
3567.70	3	5	3.5E-01	5754.2	5	3	1.5E-02	1328.8	1	3	2.7E+01
3572.53	7	7	1.38E+00	5772.1	3	1	3.6E-02	1417.2	3	1	2.60E+01
3576.34	5	5	1.06E+00	5948.5	3	5	2.2E-02	1435.8	5	7	2.1E+01
3580.93	3	3	1.23E+00	7226.2	3	5	7.9E-03	1589.0	5	3	1.1E+01
3589.63	5	3	4.6E-01	7405.8	3	5	3.7E-02	1778.7	7	9	4.4E+00
3590.47	7	5	2.9E-01	7409.1	5	7	2.3E-02	1783.1	5	7	3.8E+00
3613.83	7	9	1.48E+00	7680.3	3	5	4.6E-02	3241.6	5	3	2.3E+00
3630.74	5	7	1.20E+00	7918.4	3	5	5.2E-02	*3486.9	15	21	1.8E+00
3642.78	3	5	1.13E+00	7932.3	5	7	5.1E-02	3590.5	3	5	3.9E+00
3645.31	7	7	2.74E-01	7944.0	7	9	5.8E-02	4552.6	3	5	1.26E+00
3651.80	5	5	3.0E-01	7970.3	5	5	7.1E-03	4554.0	5	3	7.6E-01
3859.59	7	5	1.1E+00					4567.8	3	3	1.25E+00
4246.82	5	5	1.29E+00	Si II				4683.0	5	5	9.5E-01
4314.08	9	7	4.1E-01	989.87	2	4	6.7E+00	4716.7	5	7	2.8E+00
4320.75	7	5	4.0E-01	992.68	4	6	8.0E+00	5451.5	3	5	6.0E-01
4325.00	5	3	4.3E-01	1020.7	2	2	1.3E+00	5473.1	5	7	7.9E-01
4374.46	9	9	1.48E-01	1190.4	2	4	6.9E+00	5716.3	9	7	1.9E-01
4400.39	7	7	1.43E-01	1193.3	2	2	2.8E+01	5739.7	1	3	4.7E-01
4415.54	5	5	1.47E-01	1194.5	4	4	3.6E+01	7462.6	5	3	4.9E-01
4670.41	5	7	1.16E-01	1197.4	4	2	1.4E+01	7466.3	7	5	5.4E-01
5031.01	5	3	3.5E-01	1248.4	4	4	1.3E+01	7612.4	3	5	1.1E+00
5239.81	1	3	1.39E-01	1251.2	6	4	1.9E+01				

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	
	g_i	g_k			g_i	g_k			g_i	g_k		
Si IV			258.35	4	4	1.4E+02	4747.9	2	2	6.3E-03		
457.82	2	4	3.6E+00	261.05	4	2	5.4E+01	4751.8	4	2	1.27E-02	
458.16	2	2	3.6E+00	272.00	2	2	3.0E+01	4978.5	2	4	4.1E-02	
515.12	2	2	4.1E+00	277.26	4	2	5.7E+01	4982.8	4	4	8.2E-03	
516.35	4	2	8.2E+00	287.08	2	4	2.6E+01	4982.8	4	6	4.89E-02	
*560.50	6	10	1.0E+00	289.19	4	4	5.0E+01	5148.8	2	2	1.17E-02	
*749.94	10	14	1.45E+01	292.22	6	4	7.3E+01	5153.4	4	2	2.33E-02	
815.05	2	2	1.23E+01	*347.73	10	10	4.3E+01	5682.6	2	4	1.03E-01	
818.13	4	2	2.44E+01	*353.09	6	10	2.1E+01	5688.2	4	6	1.2E-01	
*860.74	10	6	1.8E+00	Si XI			5688.2	4	4	2.1E-02		
*1066.6	10	14	3.91E+01	43.763	1	3	6.11E+03	5890.0	2	4	6.11E-01	
1122.5	2	4	2.05E+01	*49.116	9	3	2.45E+03	5895.9	2	2	6.10E-01	
1128.3	4	4	4.03E+00	49.222	3	5	8.9E+03	6154.2	2	2	2.6E-02	
1128.3	4	6	2.42E+01	52.296	3	1	7.6E+02	6160.8	4	2	5.2E-02	
1393.8	2	4	7.73E+00	303.30	1	3	6.42E+01	8183.3	2	4	4.53E-01	
1402.8	2	2	7.58E+00	358.29	3	1	1.03E+02	8194.8	4	6	5.4E-01	
*1724.1	10	6	5.5E+00	358.63	3	5	1.38E+01	8194.8	4	4	9.0E-02	
Si V			361.41	1	3	1.80E+01	11381	2	2	8.9E-02		
96.439	1	3	4.8E+02	364.50	3	3	1.32E+01	11404	4	2	1.76E-01	
97.143	1	3	2.0E+03	365.42	5	5	3.90E+01	Na II				
117.86	1	3	3.0E+02	368.28	3	1	5.1E+01	300.15	1	3	3.0E+01	
Si VI			371.48	5	3	2.07E+01	301.44	1	3	4.9E+01		
246.00	4	2	1.7E+02	604.14	3	5	1.12E+01	372.08	1	3	3.4E+01	
249.12	2	2	8.5E+01	2300.8	1	3	4.34E-01	Na III				
Si VII			Si XII			378.14	4	2	7.7E+01			
217.83	5	3	4.3E+02	*40.924	2	6	4.42E+03	380.10	2	2	3.7E+01	
272.64	5	3	5.1E+01	*44.118	6	10	1.4E+04	1991.0	4	6	8.3E+00	
274.18	3	1	1.2E+02	499.43	2	4	9.56E+00	2004.2	2	4	4.6E+00	
275.35	5	5	8.9E+01	520.72	2	2	8.47E+00	2011.9	6	8	8.4E+00	
275.67	3	3	3.0E+01	1862	2	4	1.15E+00	2151.5	2	4	4.4E+00	
276.84	1	3	3.9E+01	1949	2	2	1.0E+00	2174.5	4	6	5.3E+00	
278.45	3	5	2.9E+01	4620	2	4	4.6E-02	2230.3	6	8	3.7E+00	
Si VIII			4942	4	6	4.5E-02	2232.2	4	4	3.3E+00		
214.76	4	2	4.1E+02	Silver			2246.7	4	6	2.4E+00		
216.92	6	4	3.6E+02	Ag I			2459.3	4	6	3.0E+00		
232.86	2	2	8.0E+01	2061.2	2	4	3.1E-02	2468.9	2	4	2.4E+00	
235.56	4	4	9.7E+01	2069.9	2	2	1.5E-02	2497.0	6	6	1.7E+00	
250.45	2	2	7.7E+01	3280.7	2	4	1.4E+00	Na V				
250.79	4	2	1.6E+02	3382.9	2	2	1.3E+00	*307.89	10	6	2.0E+02	
314.31	4	2	5.2E+01	5209.1	2	4	7.5E-01	*333.46	6	6	5.6E+01	
316.20	4	4	5.0E+01	5465.5	4	6	8.6E-01	*369.01	10	6	1.2E+02	
319.83	4	6	4.9E+01	5471.6	4	4	1.4E-01	*400.72	10	10	5.0E+01	
Si IX			Sodium			Na V			*445.14	6	10	7.1E+00
223.73	1	3	4.2E+01	Na I			459.90	4	2	2.3E+01		
225.03	3	3	1.2E+02	3302.4	2	4	2.81E-02	461.05	4	4	2.3E+01	
227.01	5	3	2.0E+02	3303.0	2	2	2.81E-02	463.26	4	6	2.2E+01	
227.30	5	3	2.3E+02	4390.0	2	4	7.7E-03	510.10	2	2	5.6E+01	
258.10	5	5	1.04E+02	4393.3	4	4	1.6E-03	511.19	4	4	6.8E+01	
*294.37	9	9	5.9E+01	4393.3	4	6	9.2E-03	Na VI				
*347.36	9	15	2.2E+01	4494.2	2	4	1.2E-02	313.75	5	3	1.3E+02	
Si X			4497.7	4	6	1.4E-02	361.25	5	5	7.7E+01		
253.77	2	4	2.9E+01	4497.7	4	4	2.4E-03	*416.53	9	9	3.7E+01	
256.57	2	2	1.1E+02	4664.8	2	4	2.33E-02	*492.80	9	15	1.3E+01	
				4668.6	4	4	4.1E-03	1550.6	5	5	4.35E+00	
				4668.6	4	6	2.5E-02	1567.8	5	3	2.68E+00	

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
1608.5	3	1	2.6E+00	4607.3	1	3	2.01E+00	4694.1	5	7	6.7E-03
1649.4	5	5	2.05E+00					4695.4	5	5	6.7E-03
1741.5	3	5	2.59E+00	Sr II				4696.2	5	3	6.5E-03
1747.5	5	7	3.1E+00	2018.7	2	2	1.2E-01	6403.6	3	5	5.7E-03
Na VII				2051.9	4	2	2.4E-01	6408.1	5	5	9.5E-03
*94.409	6	10	2.7E+03	2282.0	2	4	8.3E-01	6415.5	7	5	1.3E-02
*105.27	6	2	4.5E+02	2322.4	4	6	9.1E-01	*6751.2	15	25	7.9E-02
353.29	4	4	1.0E+02	2324.5	4	4	1.5E-01	7679.6	3	5	1.2E-02
381.30	4	2	4.0E+01	2423.5	2	2	2.4E-01	7686.1	5	5	2.0E-02
397.49	4	4	3.5E+01	2471.6	4	2	4.8E-01	7696.7	7	5	2.8E-02
399.18	6	4	5.2E+01	3464.5	4	6	3.1E+00				
*483.28	10	10	2.9E+01	3474.9	4	4	5.1E-01	S II			
486.74	2	4	1.1E+01	4077.7	2	4	1.42E+00	1124.4	2	4	1.0E+00
491.95	4	6	1.3E+01	4161.8	2	2	6.5E-01	1125.0	4	4	4.6E+00
555.80	4	4	2.3E+01	4215.5	2	2	1.27E+00	1131.0	2	2	3.5E+00
777.83	4	6	6.8E+00	4305.5	4	2	1.4E+00	1131.6	4	2	1.4E+00
				4414.8	4	6	1.1E-01	1250.5	4	2	4.6E-01
Na VIII				4417.5	4	4	1.8E-02	1253.8	4	4	4.2E-01
*83.34	9	15	3.94E+03	4585.9	4	2	7.0E-02	1259.5	4	6	3.4E-01
*89.88	9	3	8.09E+02	5303.1	2	4	1.9E-01	4463.6	8	6	5.3E-01
90.536	3	5	2.86E+03	5379.1	4	6	2.2E-01	4483.4	6	4	3.1E-01
411.15	1	3	4.42E+01	5385.5	4	4	3.7E-02	4486.7	4	2	6.6E-01
1239.4	3	3	3.02E+00	5723.7	2	2	7.1E-02	4524.7	4	4	9.3E-02
1802.7	3	1	2.70E+00	5819.0	4	2	1.4E-01	4525.0	6	4	1.2E+00
1867.7	3	5	2.01E+00	8688.9	4	6	5.5E-01	4552.4	4	2	1.2E+00
2059.1	3	5	1.80E+00	8719.6	4	4	9.7E-02	4656.7	2	4	9.0E-02
2558.2	5	3	2.26E-02					4716.2	4	4	2.9E-01
2772.0	3	5	4.19E-01	Sulfur				4815.5	6	4	8.8E-01
3021.0	5	7	4.90E-01	S I				4885.6	2	4	1.7E-01
3108.9	1	3	2.58E-01	1295.7	5	5	4.9E+00	4917.2	2	2	6.6E-01
3182.3	1	3	2.92E-01	1296.2	5	3	2.7E+00	4924.1	4	6	2.2E-01
Na IX				1302.3	3	5	1.8E+00	4925.3	2	4	2.4E-01
70.615	2	4	1.35E+03	1302.9	3	3	1.6E+00	4942.5	2	2	1.5E-01
70.653	2	2	1.35E+03	1303.1	3	1	6.6E+00	4991.9	4	4	1.5E-01
77.764	2	4	3.6E+03	1303.4	5	3	1.9E+00	5009.5	4	2	7.0E-01
77.911	4	6	4.3E+03	1305.9	1	3	2.4E+00	5014.0	4	4	8.4E-01
681.72	2	4	6.63E+00	1401.5	5	3	9.1E-01	5027.2	4	2	2.6E-01
694.17	2	2	6.30E+00	1409.3	3	3	5.0E-01	5032.4	6	6	8.1E-01
2487.7	2	4	8.32E-01	1412.9	1	3	1.6E-01	5047.3	4	2	3.6E-01
2535.8	2	2	7.89E-01	1425.0	5	7	4.5E+00	5103.3	6	4	5.0E-01
6841.8	2	4	2.59E-02	1425.2	5	5	1.2E+00	5142.3	2	2	1.9E-01
7103.4	4	6	2.78E-02	1433.3	3	5	3.3E+00	5201.0	4	4	7.5E-01
				1433.3	3	3	1.9E+00	5201.3	6	4	6.5E-02
				1437.0	1	3	2.4E+00	5212.6	4	6	9.8E-02
				1448.2	5	3	7.3E+00	5212.6	6	6	8.5E-01
Strontium				1473.0	5	7	4.2E-01	5320.7	6	8	9.2E-01
Sr I				1474.0	5	7	1.6E+00	5345.7	4	6	8.8E-01
2206.2	1	3	6.6E-03	1474.4	5	5	5.0E-01	5345.7	6	6	1.1E-01
2211.3	1	3	8.5E-03	1474.6	5	3	6.2E-02	5428.6	2	4	4.2E-01
2217.8	1	3	1.2E-02	1481.7	3	5	1.7E-01	5432.8	4	6	6.8E-01
2226.3	1	3	1.6E-02	1483.0	3	5	1.2E+00	5453.8	6	8	8.5E-01
2237.7	1	3	2.3E-02	1483.2	3	3	7.5E-01	5473.6	2	2	7.3E-01
2253.3	1	3	3.7E-02	1487.2	1	3	8.7E-01	5509.7	4	4	4.0E-01
2275.3	1	3	6.7E-02	1666.7	5	5	6.3E+00	5526.2	8	8	8.1E-02
2307.3	1	3	1.2E-01	1687.5	1	3	9.4E-01	5536.8	4	6	6.6E-02
2354.3	1	3	1.8E-01	1782.3	1	3	1.9E+00	5556.0	4	2	1.1E-01
2428.1	1	3	1.7E-01	1807.3	5	3	3.8E+00	5564.9	6	6	1.7E-01
2569.5	1	3	5.3E-02	1820.3	3	3	2.2E+00	5578.8	6	6	1.1E-01
2931.8	1	3	1.9E-02	1826.2	1	3	7.2E-01	5606.1	10	8	5.4E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
5658.3	6	8	1.0E-02	6073.5	3	1	6.3E-02	3642.68	7	9	7.74E-01
5675.8	8	10	1.3E-02	6171.5	3	3	4.9E-02	3653.50	9	11	7.54E-01
5760.2	6	6	1.3E-02					3724.57	9	9	9.1E-01
				Sn II				3725.16	5	3	7.3E-01
Tin				2368.3	4	2	4.4E-03	3729.81	5	5	4.27E-01
Sn I				2449.0	4	6	3.7E-01	3741.06	7	7	4.17E-01
2073.1	1	3	3.6E-02	2487.0	6	8	5.5E-01	3752.86	9	9	5.04E-01
2199.3	3	5	2.9E-01	3283.2	4	6	1.0E+00	3786.04	5	3	1.4E+00
2209.7	5	5	5.6E-01	3352.0	6	8	1.0E+00	3948.67	5	3	4.85E-01
2246.1	1	3	1.6E+00	3472.5	2	4	1.6E-01	3956.34	7	5	3.00E-01
2268.9	5	7	1.2E+00	3575.5	4	6	1.3E-01	3958.21	9	7	4.05E-01
2286.7	5	5	3.1E-01	5332.4	2	4	8.6E-01	3981.76	5	5	3.76E-01
2317.2	5	7	2.0E+00	5562.0	4	6	1.2E+00	3989.76	7	7	3.79E-01
2334.8	3	3	6.6E-01	5588.9	4	6	8.5E-01	3998.64	9	9	4.08E-01
2354.8	3	5	1.7E+00	5596.2	4	4	1.5E-01	4013.24	7	5	2.0E-01
2380.7	3	5	3.1E-02	5797.2	6	6	2.8E-01	4055.01	1	3	2.8E-01
2408.2	5	3	1.8E-01	5799.2	6	8	8.1E-01	4060.26	3	5	2.4E-01
2421.7	5	7	2.5E+00	6453.5	2	4	1.2E+00	4064.20	3	3	2.4E-01
2429.5	5	7	1.5E+00	6761.5	2	2	3.2E-01	4065.09	3	1	7.0E-01
2433.5	5	3	8.0E-03	6844.1	2	2	6.6E-01	4186.12	9	9	2.10E-01
2455.2	5	5	1.1E-02					4266.23	5	5	3.1E-01
2476.4	5	3	1.1E-02	Titanium				4284.99	5	5	3.2E-01
2483.4	5	5	2.1E-01	Ti I				4289.07	5	5	3.0E-01
2491.8	1	3	1.7E-01	2276.75	7	5	1.3E+00	4290.93	3	3	4.5E-01
2495.7	5	5	6.2E-01	2280.00	9	7	9.4E-01	4295.75	3	1	1.3E+00
2523.9	5	3	7.4E-02	2299.86	5	5	6.9E-01	4393.93	9	11	3.3E-01
2546.6	1	3	2.1E-01	2302.75	7	7	5.7E-01	4417.27	11	9	3.6E-01
2558.0	1	3	3.4E-01	2305.69	9	9	5.2E-01	4449.14	11	11	9.7E-01
2571.6	5	7	4.5E-01	2424.26	9	9	1.7E-01	4450.90	9	9	9.6E-01
2594.4	5	5	3.0E-01	2520.54	5	3	3.8E-01	4453.31	5	5	5.98E-01
2636.9	1	3	1.1E-01	2529.87	7	5	3.8E-01	4453.71	7	7	4.7E-01
2661.2	3	3	1.1E-01	2541.92	9	7	4.3E-01	4455.32	7	7	4.8E-01
2706.5	3	5	6.6E-01	2599.91	5	5	6.7E-01	4457.43	9	9	5.6E-01
2761.8	5	5	3.7E-03	2605.16	7	7	6.4E-01	4465.81	5	7	3.28E-01
2779.8	5	7	1.8E-01	2611.29	9	9	6.4E-01	4481.26	7	7	5.7E-01
2785.0	5	3	1.4E-01	2611.47	7	5	3.3E-01	4496.15	7	5	4.4E-01
2788.0	1	3	1.4E-01	2619.94	9	7	2.1E-01	4518.02	7	9	1.72E-01
2812.6	1	3	2.3E-01	2631.55	7	7	1.7E-01	4522.80	5	7	1.9E-01
2813.6	5	5	1.2E-01	2632.42	5	5	2.7E-01	4527.31	3	5	2.2E-01
2840.0	5	5	1.7E+00	2641.12	5	3	1.8E+00	4533.24	11	11	8.83E-01
2850.6	5	5	3.3E-01	2644.28	7	5	1.4E+00	4534.78	9	9	6.87E-01
2863.3	1	3	5.4E-01	2646.65	9	7	1.5E+00	4544.69	5	3	3.3E-01
2913.5	1	3	8.3E-01	2733.27	5	5	1.9E+00	4548.76	7	5	2.85E-01
3009.1	3	3	3.8E-01	2735.30	3	1	4.1E+00	4552.45	9	7	2.1E-01
3032.8	1	3	6.2E-01	2912.07	5	7	1.3E+00	4563.43	9	11	2.1E-01
3034.1	3	1	2.0E+00	2942.00	5	5	1.0E+00	4617.27	7	9	8.51E-01
3141.8	1	3	1.9E-01	2948.26	7	7	9.3E-01	4623.10	5	7	5.74E-01
3175.1	5	3	1.0E+00	2956.13	9	9	9.7E-01	4639.94	3	3	6.64E-01
3218.7	1	3	4.7E-02	2956.80	7	5	1.8E-01	4640.43	3	1	5.0E-01
3223.6	5	5	1.2E-03	3186.45	5	7	8.0E-01	4645.19	3	1	8.57E-01
3262.3	5	3	2.7E+00	3191.99	7	9	8.5E-01	4650.02	5	3	2.6E-01
3330.6	5	5	2.0E-01	3199.92	9	11	9.4E-01	4742.79	9	9	5.3E-01
3655.8	1	3	4.1E-02	3341.88	5	7	6.5E-01	4758.12	11	11	7.13E-01
3801.0	5	3	2.8E-01	3354.63	7	9	6.9E-01	4759.27	13	13	7.40E-01
4524.7	1	3	2.6E-01	3370.44	5	3	7.6E-01	4778.26	9	9	2.0E-01
5631.7	1	3	2.4E-02	3371.45	9	11	7.2E-01	4805.42	5	7	5.8E-01
5970.3	5	3	9.6E-02	3377.58	7	5	6.9E-01	4840.87	5	5	1.76E-01
6037.7	5	5	5.0E-02	3385.94	9	7	5.0E-01	4856.01	13	15	5.2E-01
6069.0	1	3	4.6E-02	3635.46	5	7	8.04E-01	4885.08	11	13	4.90E-01

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4913.62	7	9	4.44E-01	2877.47	8	8	5.7E-01	3278.91	6	4	1.0E+00
4928.34	3	5	6.2E-01	2884.13	10	10	5.2E-01	3282.32	2	2	1.6E+00
4981.73	11	13	6.60E-01	2910.65	8	8	4.6E-01	3287.66	8	10	1.4E+00
4989.14	7	5	3.25E-01	2926.64	10	8	8.9E-01	3315.32	2	4	3.8E-01
4991.07	9	11	5.84E-01	2931.10	6	6	3.2E+00	3321.70	4	4	7.2E-01
4999.50	7	9	5.27E-01	2936.02	4	6	2.7E+00	3322.94	10	10	3.96E-01
5000.99	9	7	3.52E-01	2938.57	6	8	2.4E+00	3329.46	8	8	3.25E-01
5007.21	5	7	4.92E-01	2941.90	8	10	1.8E+00	3332.11	6	4	1.1E+00
5014.28	3	5	6.8E-01	2942.97	8	8	1.1E+00	3340.34	4	4	3.6E-01
5036.47	7	9	3.94E-01	2945.30	10	12	2.7E+00	3361.23	8	10	1.1E+00
5038.40	5	7	3.87E-01	2952.00	8	8	3.0E-01	3372.80	6	8	1.11E+00
5062.11	5	3	2.98E-01	2954.59	10	12	4.0E+00	3383.77	4	6	1.09E+00
5210.39	9	9	3.57E-02	2958.80	8	10	4.0E+00	3452.49	2	2	7.7E-01
5222.69	3	3	1.95E-01	2979.06	4	6	1.2E+00	3456.40	4	4	8.2E-01
5224.30	11	11	3.6E-01	2990.06	6	8	5.6E-01	3465.56	4	2	4.1E-01
5259.98	5	7	2.3E-01	3017.17	12	12	3.6E-01	3483.63	10	8	9.7E-01
5351.07	7	7	3.4E-01	3022.64	10	10	1.2E+00	3492.37	8	6	9.8E-01
5503.90	11	9	2.6E-01	3023.67	8	8	1.0E+00	3504.90	10	10	8.2E-01
5774.04	9	11	5.5E-01	3029.76	10	10	3.5E-01	3510.86	8	8	9.3E-01
5785.98	11	13	6.1E-01	3056.75	2	4	3.2E-01	3520.27	2	4	4.8E-01
5804.27	13	15	6.8E-01	3058.08	6	6	5.0E-01	3535.41	4	6	5.5E-01
6098.66	9	7	2.5E-01	3066.34	4	4	3.3E-01	3641.33	4	2	4.9E-01
6220.46	9	7	1.8E-01	3071.25	6	4	3.6E-01	3706.23	4	4	3.1E-01
				3072.99	4	2	1.6E+00	3741.64	6	6	6.2E-01
				3075.23	6	4	1.13E+00	3757.70	4	4	4.1E-01
Ti II				3078.65	8	6	1.09E+00	3759.30	8	8	9.4E-01
2440.91	4	4	5.1E-01	3081.52	10	8	1.1E+00	3761.33	6	6	9.9E-01
2451.18	6	6	4.5E-01	3088.04	10	8	1.25E+00	4911.18	6	4	3.2E-01
2525.59	10	8	5.6E-01	3089.44	8	6	1.3E+00				
2531.28	8	6	4.9E-01	3097.20	4	6	4.4E-01	Ti III			
2534.63	6	4	5.4E-01	3103.81	10	8	1.1E+00	865.79	5	3	6.6E+01
2535.89	4	2	6.8E-01	3105.10	2	4	6.3E-01	1002.37	5	5	7.6E+00
2555.99	6	8	3.2E-01	3106.26	6	6	7.8E-01	1004.67	7	5	4.3E+01
2635.44	4	4	1.9E+00	3117.67	4	2	1.1E+00	1005.80	3	3	1.3E+01
2638.56	6	6	1.7E+00	3119.83	6	4	5.9E-01	1007.16	5	3	3.8E+01
2642.02	8	8	1.9E+00	3127.86	6	6	1.6E+00	1008.12	3	1	5.1E+01
2645.86	10	10	2.7E+00	3128.50	8	8	1.1E+00	1286.37	9	9	2.0E+00
2746.54	6	8	2.6E+00	3161.23	4	2	5.9E-01	1289.30	7	7	2.2E+00
2751.59	8	10	3.7E+00	3161.80	6	4	4.6E-01	1291.62	5	5	2.4E+00
2752.68	8	10	1.1E+00	3162.59	8	6	3.9E-01	1293.23	9	7	1.0E+00
2757.62	6	8	7.2E-01	3168.55	10	8	4.1E-01	1298.97	7	5	4.9E+00
2758.35	4	6	9.9E-01	3181.73	6	8	4.6E-01	1327.59	5	3	3.2E+00
2758.79	2	4	4.4E-01	3182.54	4	6	4.3E-01	1420.44	1	3	1.2E+00
2764.28	4	4	7.4E-01	3189.49	4	4	9.2E-01	1421.63	3	1	4.0E+00
2804.82	6	8	4.6E+00	3190.91	6	8	1.3E+00	1422.41	5	5	3.0E+00
2810.30	8	10	5.1E+00	3202.56	4	6	1.1E+00	1424.14	5	3	1.6E+00
2817.83	10	12	3.8E+00	3224.25	12	10	7.0E-01	1455.19	9	7	6.4E+00
2819.87	8	8	6.5E-01	3228.62	4	2	2.0E+00	1498.70	5	5	2.8E+00
2821.26	6	8	7.9E-01	3232.29	8	6	6.0E-01	2007.36	3	3	3.4E+00
2827.12	8	10	1.0E+00	3234.51	10	10	1.38E+00	2007.60	1	3	1.2E+00
2828.06	12	14	4.4E+00	3236.13	4	4	7.0E-01	2010.80	5	3	5.4E+00
2828.64	6	6	1.2E+00	3236.58	8	8	1.11E+00	2097.30	5	7	3.3E+00
2828.83	10	10	9.1E-01	3239.04	6	6	9.87E-01	2099.86	3	5	2.5E+00
2834.02	10	12	7.9E-01	3239.66	6	4	9.4E-01	2104.86	3	3	1.1E+00
2836.47	8	8	1.2E+00	3241.99	4	4	1.16E+00	2105.09	1	3	1.7E+00
2839.64	12	12	8.3E-01	3251.91	6	4	3.38E-01	2199.22	3	3	5.7E+00
2845.93	10	10	1.2E+00	3252.92	8	6	3.9E-01	2237.77	7	7	2.4E+00
2851.11	2	4	4.1E-01	3272.07	2	4	3.2E-01	2331.35	3	1	4.3E+00
2856.10	12	12	1.5E+00	3278.28	4	4	9.6E-01	2331.66	3	3	1.2E+00
2862.33	4	6	4.0E-01								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
2339.00	5	3	3.0E+00	2862.60	4	2	4.1E+00	308.250	3	5	1.3E+02
2346.79	7	5	3.3E+00	3576.44	4	6	4.6E+00	313.229	5	7	1.6E+02
2374.99	5	3	4.0E+00					318	3	1	1.4E+02
2413.99	5	7	3.8E+00	Ti VIII				322.75	5	7	1.99E+02
2516.05	7	9	3.4E+00	249	6	4	1.0E+01	323	1	3	1.8E+02
2567.56	3	3	2.3E+00	258.610	6	8	7.5E+02	327.192	3	5	2.9E+02
2984.75	5	5	1.9E+00	269.533	4	6	6.0E+02	332	3	1	3.25E+02
3066.51	3	3	2.5E+00	272.037	4	4	4.3E+02	386.140	1	3	1.48E+02
3228.89	3	3	1.5E+00	272.843	6	4	6.2E+01	408	7	9	1.37E+02
3278.31	7	9	3.4E+00	276.701	2	4	9.3E+01	425.74	3	1	1.2E+02
3320.94	3	5	2.8E+00	277.813	4	4	3.8E+02	446.69	3	1	1.2E+02
3340.20	7	9	3.7E+00	289.375	2	4	3.6E+01	453	5	7	1.3E+02
3346.18	9	11	3.7E+00	478.971	4	4	1.7E+01				
3354.71	11	13	4.4E+00	480.376	6	6	1.5E+01	Ti XII			
3397.24	3	1	1.8E+00					52.896	2	4	1.61E+02
3404.46	3	3	1.8E+00	Ti IX				53.140	4	6	1.9E+02
3417.62	3	5	1.9E+00	267.941	5	7	5.1E+02	53.433	2	4	2.1E+02
3915.47	9	11	2.1E+00	278.713	5	7	4.7E+02	53.457	2	2	2.1E+02
4119.14	5	5	9.9E-01	281.446	3	1	3.2E+02	55.181	2	4	2.4E+02
4213.26	9	11	2.2E+00	285.128	1	3	4.1E+02	55.443	4	6	2.81E+02
4215.53	9	11	2.2E+00	433.567	1	3	6.9E+00	59.133	2	4	3.72E+02
4247.62	11	13	1.1E+00	439.513	3	3	7.5E+00	59.435	4	6	4.41E+02
4248.54	5	7	2.3E+00	439.745	3	1	2.1E+01	60.701	2	4	3.4E+02
4250.09	3	5	9.5E-01	447.484	5	5	1.6E+01	60.762	2	2	3.5E+02
4259.01	11	13	9.4E-01	447.701	5	3	6.5E+00	61.286	4	2	1.8E+02
4269.84	9	11	1.7E+00	507.174	3	5	6.5E+00	62.433	4	6	2.08E+02
4285.61	13	15	3.0E+00	516.215	5	7	6.9E+00	62.470	6	8	2.22E+02
4288.66	11	13	1.1E+00					65.540	4	6	3.2E+02
4296.70	11	13	1.6E+00	Ti X				65.577	6	8	3.5E+02
4319.56	9	11	1.1E+00	253	4	6	2.1E+02	67.171	2	4	6.2E+02
4343.25	3	1	1.0E+00	254	6	8	2.3E+02	67.555	4	6	7.2E+02
4378.94	3	5	1.6E+00	281	2	2	1.1E+02	70.986	4	6	5.7E+02
4433.91	11	13	1.8E+00	289.579	2	4	2.5E+02	71.031	6	8	6.1E+02
4440.66	1	3	1.2E+00	290.294	4	6	1.1E+02	71.545	2	2	1.8E+02
4533.26	3	5	1.5E+00	291	4	2	1.8E+02	71.987	4	2	3.48E+02
4576.53	9	7	1.3E+00	291	2	2	2.3E+02	82.121	2	4	5.9E+02
4628.07	3	1	1.5E+00	292	6	8	1.1E+02	82.307	4	6	1.13E+03
4652.86	7	9	2.6E+00	293.684	6	8	2.97E+02	82.344	2	2	5.8E+02
4874.00	5	7	1.5E+00	293.798	6	6	1.7E+02	82.368	6	8	1.2E+03
4914.32	3	3	1.1E+00	295.584	4	6	2.9E+02	89.844	2	4	9.9E+02
4971.19	9	11	2.1E+00	296	4	6	1.4E+02	90.512	4	6	1.16E+03
5083.80	5	3	9.7E-01	297	4	6	9.9E+01	90.547	4	4	1.9E+02
5278.33	3	3	9.4E-01	298	4	6	4.3E+02	116.497	4	6	3.0E+03
7506.87	11	13	1.1E+00	302	2	2	1.6E+02	116.597	6	8	3.2E+03
				305	2	4	2.5E+02	116.62	6	6	2.1E+02
Ti IV				317	2	2	1.5E+02	139.884	6	4	2.6E+02
423.49	4	6	4.9E+01	355.815	2	2	1.3E+02	140.361	4	2	2.9E+02
424.16	6	8	5.3E+01	360.133	4	4	2.19E+02	141.6	4	6	1.7E+02
433.63	4	2	5.5E+00	363	4	2	2.1E+02	141.7	6	8	1.7E+02
433.76	6	4	5.0E+00	363	6	6	1.3E+02	169.7	4	6	2.8E+02
729.36	4	2	5.7E+00	365.628	4	2	1.2E+02	169.8	6	8	2.9E+02
1183.64	2	2	6.9E+00	382	4	6	1.8E+02	207.2	2	4	1.5E+02
1195.21	4	2	1.4E+01	385	6	8	1.8E+02	208.5	4	6	1.8E+02
1451.74	2	4	1.8E+01	389.99	6	4	1.1E+02	252.8	4	6	4.8E+02
1467.34	4	6	2.1E+01					253.1	6	8	5.2E+02
2067.56	2	4	5.1E+00	Ti XI				257.5	4	2	2.4E+02
2103.16	2	2	5.0E+00	65.403	1	3	5.1E+02				
2541.79	4	6	6.9E+00	87.725	1	3	8.5E+02	Ti XIII			
2546.88	6	8	7.4E+00	266	5	7	1.8E+02	23.356	1	3	1.02E+05

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹	λ Å	Weights		A 10 ⁸ s ⁻¹
	g_i	g_k			g_i	g_k			g_i	g_k	
23.698	1	3	1.2E+04	145.665	6	6	2.3E+02	16.46	3	3	4.4E+04
23.991	1	3	3.4E+02	157.812	4	2	1.32E+02	16.51	5	7	1.0E+05
26.641	1	3	4.06E+03	161.168	4	4	1.2E+02	16.55	5	5	2.7E+04
26.960	1	3	3.06E+03	163.610	4	2	1.92E+02	16.61	3	1	8.0E+04
117.1	3	3	1.3E+02	169.740	4	6	1.0E+02	16.64	3	3	5.3E+04
117.3	3	1	2.8E+02	176.267	2	2	2.45E+02	16.69	1	3	1.02E+05
120.2	5	3	5.4E+02	178.240	4	4	2.52E+02	16.71	3	5	7.3E+04
120.2	7	5	4.4E+02					16.72	5	3	3.3E+04
128.7	3	3	1.2E+02					16.72	5	5	7.3E+04
				Ti XVII				16.74	5	7	1.2E+05
Ti XIV				18.05	3	3	4.5E+04	16.77	3	3	2.6E+04
21.341	4	6	9.8E+03	18.13	5	3	2.4E+04	16.80	5	7	1.81E+05
21.522	2	4	4.5E+04	18.13	1	3	8.1E+04	16.85	3	5	4.4E+04
21.657	4	4	1.3E+04	18.176	5	7	9.2E+04	17.08	3	5	8.3E+04
21.733	4	4	8.8E+04	123.654	3	3	2.3E+02	17.36	1	3	9.5E+04
21.82	4	2	6.4E+04	124.553	5	3	5.2E+02				
21.883	2	4	7.0E+04	127.782	5	3	4.6E+02				
21.958	2	4	1.2E+04	135.202	3	1	2.93E+02	Ti XX			
22.05	2	2	1.4E+04	136.160	5	3	1.95E+02	2.629	2	4	4.9E+04
24.592	4	2	6.1E+03	136.393	3	3	1.14E+02	2.6295	4	4	3.2E+06
24.891	2	2	7.5E+03	141.948	5	5	3.87E+02	2.631	2	2	6.1E+05
				142.589	1	3	1.35E+02	2.6319	2	4	1.5E+06
				144.405	5	5	9.4E+01	2.632	2	2	2.7E+06
Ti XV				146.067	7	5	2.6E+02	2.6355	4	6	1.2E+06
20.19	5	7	6.9E+03	154.133	3	1	1.63E+02	8.621	4	2	1.1E+06
20.234	5	7	1.9E+04	156.54	3	1	1.44E+02	9.788	4	6	5.26E+03
20.234	3	3	4.9E+04	158.469	5	5	1.4E+02	10.046	2	4	7.29E+03
20.246	1	3	4.2E+04	159.62	5	3	1.03E+02	10.109	4	6	8.6E+03
20.250	5	3	6.5E+03	163.049	3	1	6.2E+02	*10.278	2	6	8.4E+03
20.29	3	3	1.1E+04	186.863	5	5	2.66E+02	10.620	2	4	1.34E+04
20.30	1	3	3.4E+04	207.73	3	1	1.07E+02	10.690	4	6	1.58E+04
20.30	1	1	5.8E+04					*11.452	2	6	1.7E+04
20.313	5	3	7.5E+04	Ti XVIII				11.872	2	4	2.8E+04
20.418	5	7	8.0E+04	17.22	2	4	7.3E+04	11.958	4	6	3.4E+04
20.538	3	3	3.8E+04	17.365	4	6	8.6E+04	11.958	4	4	5.6E+03
20.54	3	1	4.1E+04	17.39	4	4	1.4E+04	15.211	2	4	3.50E+04
20.551	1	3	1.3E+04	133.852	2	4	5.2E+01	15.253	2	2	3.58E+04
20.689	5	7	4.3E+04	144.759	4	4	3.2E+02	15.907	2	4	8.84E+04
20.698	1	3	1.1E+05	150.15	6	4	1.15E+02	16.049	4	6	1.05E+05
20.771	5	3	1.1E+04	153.15	4	2	1.97E+02	16.067	4	4	1.8E+04
20.897	5	7	2.85E+04	153.23	2	4	6.7E+01	31.586	4	6	5.49E+03
20.928	5	5	8.4E+03	159.00	4	4	1.16E+02	45.650	2	4	9.6E+03
21.065	3	3	1.1E+04	166.225	6	4	1.54E+02	45.996	4	6	1.1E+04
21.079	1	3	1.58E+04	179.902	2	4	6.3E+01				
21.102	3	5	1.3E+04	189.663	6	6	9.6E+01	Ti XXI			
22.482	5	3	6.4E+03	191.23	4	4	6.6E+01	2.0633	1	3	1.32E+05
22.936	5	5	1.1E+04	197.838	4	6	4.56E+01	2.1108	1	3	2.60E+05
22.966	5	3	1.1E+04	208.07	4	4	1.2E+02	2.2211	1	3	6.35E+05
23.034	1	3	6.3E+03					2.497	3	1	2.4E+06
				Ti XIX				2.505	5	5	3.5E+05
Ti XVI				15.67	3	1	3.3E+04	2.505	1	3	1.4E+06
110.561	4	2	3.36E+02	15.68	5	5	2.7E+04	2.507	3	5	1.4E+06
116.198	4	4	1.45E+02	15.74	5	7	2.7E+04	2.508	3	5	7.9E+05
118.215	6	4	7.4E+02	15.75	3	5	2.4E+04	2.510	3	3	6.9E+05
121.382	4	2	2.4E+02	15.83	1	3	3.2E+04	2.510	1	3	9.6E+05
124.805	4	2	6.1E+02	15.86	1	3	2.9E+04	2.511	3	3	1.4E+06
129.075	4	2	3.81E+02	16.02	3	1	3.1E+04	2.512	5	5	1.8E+06
134.724	2	2	2.6E+02	16.18	3	5	3.8E+04	2.512	3	1	1.4E+06
138.800	6	4	3.5E+02	16.41	1	3	6.1E+04	2.513	3	1	2.7E+06
143.459	4	4	2.8E+02	16.43	3	5	8.2E+04	2.513	3	5	2.4E+06

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
3557.8	13	13	2.9E-02	3075.93	4	6	2.8E-01	3818.24	4	2	6.73E-01
3558.0	11	13	1.6E-02	3080.33	2	4	2.7E-01	3828.56	6	4	5.33E-01
3558.6	9	7	3.9E-02	3083.54	6	8	2.5E-01	3840.75	8	6	5.48E-01
3559.4	7	9	1.5E-02	3087.06	2	2	9.2E-01	3855.36	4	4	3.30E-01
3560.3	9	7	6.4E-02	3088.11	4	6	4.9E-01	3855.85	10	8	5.78E-01
3561.4	15	13	5.5E-02	3089.13	4	4	5.3E-01	3863.86	8	6	3.1E-01
3561.5	9	9	2.5E-02	3093.79	6	6	4.1E-01	3864.86	6	6	2.70E-01
3561.8	13	11	5.7E-02	3094.69	2	4	4.3E-01	3871.07	10	8	2.8E-01
3563.7	13	13	2.9E-02	3112.92	4	2	5.0E-01	3875.07	8	8	2.36E-01
3563.8	7	7	1.1E-02	3183.41	6	8	2.4E+00	3902.26	10	10	2.68E-01
3565.0	13	11	2.9E-02	3183.96	8	10	2.5E+00	3921.86	4	2	2.7E-01
3566.0	13	15	1.7E-02	3183.98	4	6	2.4E+00	3922.43	6	6	2.6E-01
3566.6	11	11	2.4E-01	3185.38	10	12	2.7E+00	3930.02	10	10	3.3E-01
3568.8	13	13	3.8E-02	3198.01	6	6	3.9E-01	3934.01	8	8	6.2E-01
3569.1	17	15	1.1E-01	3202.39	8	8	4.0E-01	3992.80	12	10	1.2E+00
3569.4	9	9	1.5E-02	3205.58	8	10	1.3E+00	3998.73	14	12	1.0E+00
3570.1	13	11	1.3E-02	3207.41	10	10	2.6E-01	4050.96	10	10	1.4E+00
3570.2	11	9	5.3E-03	3212.43	10	12	1.4E+00	4051.35	12	12	1.3E+00
3570.6	13	15	2.7E-02	3218.87	8	6	3.5E-01	4090.57	8	10	8.5E-01
3570.7	15	15	1.2E-02	3233.19	10	8	3.2E-01	4092.68	8	10	2.30E-01
3571.2	11	11	6.3E-03	3273.03	8	8	2.7E-01	4095.48	6	8	7.2E-01
3571.6	17	15	1.3E-01	3284.36	10	10	2.8E-01	4099.78	6	8	4.10E-01
3572.9	13	15	1.5E-02	3309.18	4	4	3.2E-01	4102.15	4	6	7.1E-01
3573.9	13	11	4.0E-02	3329.85	6	4	7.7E-01	4104.77	10	8	2.1E+00
3574.1	13	15	3.5E-02	3356.35	4	6	3.1E-01	4105.16	4	6	4.9E-01
3574.8	13	15	1.9E-02	3365.55	2	4	4.8E-01	4109.78	2	4	5.00E-01
3577.1	17	15	4.3E-02	3376.05	4	4	3.2E-01	4111.78	10	10	1.01E+00
3577.5	15	13	7.8E-03	3377.39	4	2	9.0E-01	4115.18	8	8	5.80E-01
3577.8	11	11	8.3E-03	3377.62	6	6	6.0E-01	4116.47	6	6	3.2E-01
3577.9	13	13	2.3E-02	3397.58	6	4	2.3E-01	4116.59	2	2	2.90E-01
3578.3	13	11	2.0E-02	3400.39	8	8	2.5E-01	4123.50	4	2	1.00E+00
3580.0	9	9	1.2E-02	3529.73	4	6	4.1E-01	4128.06	6	4	7.70E-01
3580.2	11	9	2.9E-02	3533.68	6	8	5.2E-01	4131.99	8	6	5.5E-01
3580.4	11	13	7.5E-03	3533.76	2	4	3.7E-01	4134.49	10	8	2.90E-01
3580.9	13	13	2.1E-02	3543.49	2	2	6.7E-01	4232.46	10	10	9.8E-01
3582.6	13	13	2.9E-02	3545.33	4	4	3.7E-01	4232.95	8	8	7.7E-01
3584.6	7	5	2.4E-02	3553.27	6	6	2.2E-01	4268.64	14	14	1.2E+00
3584.9	13	15	1.8E-01	3555.14	4	2	2.6E-01	4271.55	12	12	9.6E-01
3585.4	11	11	1.9E-02	3663.60	4	6	3.1E+00	4276.95	10	10	9.4E-01
3585.8	11	9	2.8E-02	3667.74	6	8	2.7E+00	4284.05	8	8	1.2E+00
3587.8	9	11	1.3E-02	3672.41	12	12	9.2E-01	4291.82	12	14	8.8E-01
3588.3	7	9	1.8E-02	3673.41	8	10	2.7E+00	4296.10	10	12	7.7E-01
3589.7	11	13	2.1E-02	3676.70	14	14	1.3E+00	4297.67	8	10	7.0E-01
3589.8	15	13	5.9E-02	3680.12	10	12	2.2E+00	4298.03	6	8	7.8E-01
3590.7	9	7	2.2E-02	3686.26	10	12	2.3E-01	4379.23	10	12	1.1E+00
3591.7	11	9	5.3E-02	3687.50	12	14	2.9E+00	4384.71	8	10	1.1E+00
3593.0	11	11	1.4E-02	3688.07	8	8	3.5E-01	4389.98	6	8	6.9E-01
3593.2	13	15	4.2E-02	3690.28	2	4	4.5E-01	4395.22	4	6	5.5E-01
3593.7	11	11	7.2E-02	3692.22	6	6	5.4E-01	4400.57	2	4	3.4E-01
				3695.34	14	16	2.8E+00	4406.64	10	10	2.2E-01
				3695.86	4	4	6.6E-01	4407.63	8	8	4.4E-01
				3703.57	10	8	9.2E-01	4408.20	6	6	6.0E-01
				3704.70	8	6	6.6E-01	4416.47	4	2	2.6E-01
				3705.04	6	4	3.6E-01	4452.01	14	16	9.2E-01
				3706.03	10	10	5.2E-01	4457.75	10	12	2.7E-01
				3708.71	12	12	4.4E-01	4460.33	10	8	3.0E-01
				3790.46	10	8	2.3E-01	4462.36	12	14	7.6E-01
				3794.96	10	10	2.3E-01	4468.00	8	10	2.3E-01
				3806.79	10	10	2.5E-01	4469.71	10	12	6.2E-01
Vanadium											
VI											
3043.12	6	8	2.3E-01								
3050.39	10	8	5.3E-01								
3053.65	4	4	1.3E+00								
3056.33	6	6	1.3E+00								
3060.46	8	8	1.4E+00								
3066.37	10	10	2.1E+00								
3066.53	6	4	3.2E-01								

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
4474.04	10	8	4.7E-01	2893.31	9	7	1.2E+00	2371.06	10	12	5.2E+00
4496.06	8	6	4.0E-01	2903.07	3	5	3.4E-01	2373.06	4	6	2.9E+00
4514.18	6	4	3.3E-01	2906.45	7	7	7.8E-01	2382.46	8	10	5.0E+00
4524.21	12	10	3.0E-01	2908.81	11	9	1.6E+00	2393.58	6	8	4.3E+00
4525.17	4	2	4.1E-01	2910.01	5	5	1.1E+00	2404.18	4	6	2.5E+00
4529.58	10	8	2.4E-01	2910.38	3	3	1.2E+00	2516.14	10	10	3.7E+00
4545.40	10	12	7.6E-01	2911.05	7	9	3.7E-01	2521.55	8	8	3.5E+00
4560.72	8	10	7.0E-01	2912.46	11	9	5.0E-01	2548.21	6	4	2.0E+00
4571.79	6	8	6.0E-01	2915.88	9	7	4.9E-01	2554.22	8	6	1.2E+00
4578.73	4	6	6.8E-01	2924.02	11	11	1.7E+00	2593.05	6	6	2.8E+00
4706.16	6	4	2.4E-01	2924.63	9	9	1.2E+00	2595.10	8	8	2.8E+00
4757.47	4	2	7.6E-01	2930.80	7	7	5.8E-01				
4766.62	6	4	5.6E-01	2941.37	11	9	3.5E-01	V IV			
4776.36	8	6	5.1E-01	2944.57	9	7	7.6E-01	677.345	9	9	6.7E+00
4786.50	10	8	4.7E-01	2948.08	9	11	4.0E-01	680.632	9	7	1.2E+01
4796.92	12	10	4.8E-01	2952.07	7	5	7.2E-01	681.145	7	5	1.1E+01
4807.52	14	12	5.8E-01	2955.58	7	9	3.3E-01	682.455	7	7	6.5E+00
5193.00	12	12	4.0E-01	2968.37	7	9	7.0E-01	682.923	5	5	6.9E+00
5195.39	8	8	2.3E-01	2972.26	5	7	5.2E-01	684.450	7	5	7.7E+00
5234.08	10	10	4.9E-01	2973.98	9	11	3.5E-01	691.530	5	3	1.1E+01
5240.87	12	12	4.3E-01	2985.18	7	9	4.4E-01	723.537	3	1	1.5E+01
5415.25	12	14	3.1E-01	3001.20	7	7	7.5E-01	724.068	5	5	1.1E+01
5487.91	12	10	2.9E-01	3014.82	5	3	8.9E-01	724.809	5	3	5.6E+00
5507.75	10	8	3.5E-01	3016.78	7	5	5.0E-01	737.854	9	7	2.4E+01
6090.21	8	6	2.60E-01	3020.21	9	7	5.0E-01	750.110	5	5	1.0E+01
				3048.21	11	13	7.0E-01	884.146	1	3	4.7E+00
V II				3063.25	9	11	1.0E+00	1071.05	5	5	6.1E+00
2527.90	13	13	6.1E-01	3100.94	7	7	5.8E-01	1110.72	3	3	5.0E+00
2528.47	9	9	5.2E-01	3113.56	11	11	5.0E-01	1112.20	7	7	6.3E+00
2528.83	11	11	5.3E-01	3122.89	11	13	7.6E-01	1112.44	5	5	5.0E+00
2554.04	9	9	5.4E-01	3134.93	13	13	5.9E-01	1127.84	7	5	8.9E+00
2589.10	9	9	7.7E-01	3136.50	11	11	5.3E-01	1131.26	9	7	9.4E+00
2640.86	5	7	1.2E+00	3139.73	9	9	5.2E-01	1194.46	7	5	1.0E+01
2677.80	3	5	3.4E-01	3151.32	3	5	4.4E-01	1226.52	5	5	1.5E+01
2679.33	7	7	3.4E-01	3190.69	9	9	3.3E-01	1243.72	3	1	9.4E+00
2683.09	1	3	3.4E-01	3250.78	11	9	5.2E-01	1247.07	5	3	4.7E+00
2687.96	9	9	7.6E-01	3251.87	5	7	3.5E-01	1272.97	3	1	2.7E+01
2689.88	3	1	9.2E-01	3271.12	7	9	6.9E-01	1304.17	3	5	1.5E+01
2690.25	7	5	3.4E-01	3276.12	9	11	5.2E-01	1305.42	5	7	7.0E+00
2690.79	5	3	5.2E-01	3279.84	9	11	5.8E-01	1308.06	7	9	7.9E+00
2700.94	9	11	3.5E-01	3287.71	5	7	7.5E-01	1309.50	5	5	8.7E+00
2706.17	7	9	3.4E-01	3337.85	5	7	5.3E-01	1312.72	7	7	8.6E+00
2734.22	9	7	6.2E-01	3517.30	9	7	3.8E-01	1317.57	5	7	8.7E+00
2753.41	13	11	4.2E-01	3530.77	5	3	4.5E-01	1321.92	7	9	9.9E+00
2784.20	9	9	1.3E+00	3545.19	7	5	4.3E-01	1326.81	3	5	4.0E+00
2787.91	7	9	5.0E-01	3556.80	9	7	5.1E-01	1329.29	5	5	1.5E+01
2825.86	9	7	1.2E+00	3592.01	7	5	4.4E-01	1329.97	3	3	4.8E+00
2843.82	7	5	9.9E-01	3618.92	3	5	3.3E-01	1330.36	1	3	6.0E+00
2847.57	9	7	4.6E-01					1331.67	3	1	1.7E+01
2854.34	11	9	5.0E-01	V III				1332.46	5	3	7.5E+00
2862.31	11	11	3.6E-01	2318.06	8	10	4.6E+00	1334.49	9	9	8.3E+00
2868.11	5	3	2.1E+00	2323.82	6	8	3.8E+00	1355.13	7	9	2.5E+01
2869.13	13	11	4.8E-01	2330.42	10	10	3.2E+00	1356.53	5	3	4.9E+00
2882.49	5	5	4.2E-01	2331.75	8	8	2.5E+00	1395.00	5	7	1.4E+01
2884.78	3	3	5.6E-01	2334.21	6	6	2.2E+00	1400.42	5	7	7.5E+00
2889.61	3	1	1.9E+00	2337.13	4	4	2.7E+00	1403.62	7	9	8.4E+00
2891.64	5	3	1.4E+00	2343.10	6	8	3.6E+00	1412.69	3	3	1.1E+01
2892.43	9	9	3.6E-01	2358.73	6	8	4.2E+00	1414.41	5	7	1.2E+01
2892.65	7	5	1.3E+00	2366.31	8	10	4.2E+00	1414.84	5	5	4.6E+00

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
1418.53	7	7	5.2E+00	Xe II				4128.30	6	6	1.6E+00
1419.58	7	9	1.3E+01	4180.1	4	4	2.2E+00	4142.84	4	4	1.6E+00
1423.72	3	5	7.1E+00	4330.5	6	8	1.4E+00	4167.51	6	6	2.38E-01
1426.65	9	11	2.2E+01	4414.8	6	6	1.0E+00	4235.93	6	4	3.0E-01
1429.11	5	5	5.0E+00	4603.0	4	4	8.2E-01	4352.40	4	4	6.7E-03
1434.84	7	7	5.4E+00	4844.3	6	8	1.1E+00	4379.33	6	4	7.83E-01
1451.04	3	3	7.0E+00	4876.5	6	8	6.3E-01	4385.47	4	4	6.9E-02
1454.00	5	3	1.1E+01	5260.4	2	4	2.2E-01	4394.01	8	8	1.9E-02
1520.14	5	7	7.2E+00	5262.0	4	4	8.5E-01	4409.70	4	6	2.7E-03
1522.49	3	5	5.5E+00	5292.2	6	6	8.9E-01	4417.43	10	8	3.2E-02
1601.92	3	3	1.2E+01	5372.4	4	2	7.1E-01	4437.34	6	6	8.64E-02
1611.88	7	7	5.2E+00	5419.2	4	6	6.2E-01	4443.65	10	8	1.1E-01
1806.18	5	3	7.3E+00	5439.0	4	2	7.4E-01	4459.01	4	6	1.8E-02
1809.85	3	1	7.2E+00	5472.6	8	8	9.9E-02	4476.95	8	6	2.8E-01
1817.68	5	3	4.8E+00	5531.1	8	6	8.8E-02	4491.74	10	10	2.3E-02
1825.84	7	5	5.3E+00	5719.6	4	6	6.1E-02	4514.01	4	6	3.34E-01
1861.56	5	7	6.6E+00	5976.5	4	4	2.8E-01	4527.78	8	6	8.33E-01
1939.07	7	9	5.8E+00	6036.2	6	6	7.5E-02	4534.09	6	8	4.4E-02
1951.43	5	7	5.0E+00	6051.2	8	6	1.7E-01	4544.31	6	6	4.10E-01
1963.10	3	5	4.8E+00	6097.6	6	4	2.6E-01	4559.36	2	4	4.0E-01
1997.72	7	7	4.7E+00	6270.8	4	6	1.8E-01	4581.33	6	4	1.5E-01
2084.43	5	5	4.0E+00	6277.5	4	6	3.6E-02	4613.00	6	4	1.8E-01
2120.05	7	9	8.1E+00	6805.7	8	6	6.1E-02	4643.70	4	6	1.8E-01
2141.20	3	5	7.0E+00	6990.9	10	8	2.7E-01	4653.78	4	6	1.6E-01
2146.83	7	9	6.6E+00					4674.85	6	8	1.3E-01
2149.85	5	7	5.1E+00	Ytterbium				4725.84	4	4	1.5E-01
2151.09	7	9	4.3E+00	Yb I				4762.96	6	4	4.2E-02
2155.34	11	13	1.2E+01	2464.5	1	3	9.1E-01	4780.16	2	4	8.9E-02
2446.80	9	11	5.3E+00	2672.0	1	3	1.18E-01	4781.03	8	10	1.0E-01
2570.72	9	11	7.6E+00	3464.4	1	3	6.2E-01	4799.30	6	8	1.6E-01
3284.56	7	9	5.3E+00	3988.0	1	3	1.76E+00	4804.31	6	4	2.6E-01
3496.42	7	9	4.4E+00	5556.5	1	3	1.14E-02	4804.80	4	4	3.84E-01
3514.25	9	11	4.7E+00					4821.63	6	6	1.0E-01
				Yb II				4845.67	8	8	6.8E-01
Xenon				3289.4	2	4	1.8E+00	4852.68	6	6	6.2E-01
Xe I				3694.2	2	2	1.4E+00	4856.71	6	6	2.0E-01
1043.8	1	3	5.9E-01					4859.84	4	4	7.26E-01
1047.1	1	3	1.3E+00	Yttrium				4893.44	6	4	2.2E-01
1050.1	1	3	8.5E-02	Y I				4900.08	8	6	2.0E-01
1056.1	1	3	2.45E+00	2948.41	4	4	3.5E-01	4906.11	10	8	1.2E-01
1061.2	1	3	1.9E-01	2974.59	4	6	3.5E-01	4950.01	8	6	2.0E-02
1068.2	1	3	3.99E+00	2984.25	6	8	4.8E-01	4963.49	4	4	1.4E-02
1085.4	1	3	4.10E-01	2995.26	6	4	5.1E-02	4981.97	4	6	4.7E-03
1099.7	1	3	4.34E-01	2996.94	4	6	8.4E-02	5004.44	6	4	1.2E-02
1110.7	1	3	1.5E+00	3005.26	4	4	4.8E-02	5205.01	4	4	8.4E-03
1129.3	1	3	4.4E-02	3022.28	6	6	6.6E-02	5258.47	6	6	2.9E-03
1170.4	1	3	1.6E+00	3045.36	6	6	1.07E-01	5271.82	8	6	1.1E-02
1192.0	1	3	6.2E+00	3053.95	6	4	1.9E-03	5380.63	6	4	3.2E-01
1250.2	1	3	1.4E-01	3155.65	4	6	2.7E-03	5381.24	4	4	9.9E-03
1295.6	1	3	2.46E+00	3172.84	4	4	9.9E-03	5388.39	6	8	1.1E-02
1469.6	1	3	2.81E+00	3185.96	6	8	1.2E-03	5390.81	8	6	2.9E-02
4501.0	5	3	6.2E-03	3209.38	6	6	3.0E-03	5401.88	6	8	6.0E-03
4524.7	5	5	2.1E-03	3227.16	6	4	1.10E-03	5424.36	6	4	3.47E-01
4624.3	5	5	7.2E-03	3484.05	4	6	1.2E-02	5466.24	4	4	1.0E-01
4671.2	5	7	1.0E-02	3549.66	6	6	1.0E-03	5466.47	10	12	6.3E-01
4807.0	3	1	2.4E-02	3552.69	4	4	2.3E-01	5469.10	4	6	3.6E-03
7119.6	7	9	6.6E-02	4077.36	4	6	1.1E+00	5513.65	6	6	2.39E-01
7967.3	1	3	3.0E-03	4083.71	4	4	2.5E-01	5519.88	4	6	1.2E-02
8409.2	5	3	1.0E-02	4102.36	6	8	1.3E+00	5526.43	6	4	3.9E-03

NIST ATOMIC TRANSITION PROBABILITY TABLES (continued)

λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}	λ Å	Weights		A 10^8 s^{-1}
	g_i	g_k			g_i	g_k			g_i	g_k	
5527.56	8	10	5.4E-01	3448.81	5	5	4.1E-02	5119.11	5	7	1.6E-02
5541.63	8	8	5.2E-02	3467.88	5	3	2.7E-02	5200.41	5	5	1.3E-01
5551.00	4	4	6.9E-02	3496.08	1	3	3.49E-01	5205.73	7	7	1.6E-01
5573.03	6	4	1.8E-02	3549.01	5	7	3.97E-01	5289.82	7	5	6.7E-03
5594.12	6	8	5.0E-02	3584.51	3	5	4.02E-01	5320.78	9	7	3.9E-03
5606.34	10	10	5.84E-02	3600.74	7	7	1.4E+00	5473.39	3	5	4.3E-02
5619.96	6	4	2.0E-02	3601.91	3	3	1.13E+00	5480.73	1	3	7.62E-02
5630.14	4	6	4.9E-01	3611.04	5	5	1.04E+00	5497.41	5	5	1.2E-01
5641.78	2	4	1.9E-02	3628.70	5	3	3.3E-01	5509.90	5	5	4.24E-02
5675.27	6	6	9.3E-02	3664.62	7	5	3.7E-01	5544.61	3	1	1.8E-01
5675.64	4	6	4.3E-02	3710.29	7	9	1.5E+00	5546.01	5	3	5.8E-02
5693.63	4	4	1.1E-01	3747.55	3	3	1.9E-01	5728.89	5	5	3.0E-02
5714.94	8	6	2.0E-02	3774.34	5	7	1.1E+00	6613.74	5	7	1.7E-02
5729.25	6	6	2.2E-03	3776.56	5	3	2.42E-01	6832.48	5	5	3.3E-03
5732.09	6	6	7.5E-02	3788.70	3	5	8.1E-01	7264.16	5	3	1.3E-02
5740.22	8	6	4.0E-02	3818.34	5	5	9.70E-02				
5757.59	4	6	7.6E-03	3832.90	7	7	3.0E-01				
5788.36	4	4	9.4E-03	3878.29	7	5	2.9E-02				
5844.13	6	4	5.6E-03	3930.66	5	5	2.1E-02	Zinc			
5879.93	4	2	8.5E-02	3950.36	3	5	2.80E-01	Zn I			
5902.91	6	8	4.0E-02	3951.59	5	3	1.5E-02	748.29	1	3	6.0E-02
6087.94	6	4	1.1E-01	3982.60	5	5	2.7E-01	765.60	1	3	7.6E-02
6191.72	4	4	4.7E-02	4124.91	5	7	1.8E-02	792.05	1	3	5.7E-02
6222.58	4	6	5.9E-03	4177.54	5	5	5.27E-01	793.85	1	3	1.8E-01
6402.01	6	4	2.7E-03	4199.27	3	5	5.36E-03	809.92	1	3	2.6E-01
6435.02	6	6	4.0E-02	4204.69	1	3	2.20E-02	1109.1	1	3	3.05E-01
6437.17	10	8	4.8E-02	4235.73	5	5	2.3E-02	2138.6	1	3	7.09E+00
6538.57	10	10	1.5E-01	4309.62	7	5	1.29E-01	3075.9	1	3	3.29E-04
6622.48	8	6	4.5E-03	4358.73	3	3	5.55E-02	3282.3	1	3	9.0E-01
6815.15	2	4	7.18E-02	4374.95	5	5	9.97E-01	3302.6	3	5	1.2E+00
7009.89	2	4	4.4E-02	4398.01	5	3	1.16E-01	3302.9	3	3	6.7E-01
7035.15	4	4	6.3E-02	4422.59	3	1	1.83E-01	3345.0	5	7	1.7E+00
				4682.33	5	5	1.9E-02	3345.6	5	5	4.0E-01
Y II				4786.58	7	7	2.1E-02	3345.9	5	3	4.5E-02
3112.03	1	3	1.3E-02	4823.31	5	5	4.3E-02	6362.3	3	5	4.74E-01
3179.42	3	5	3.8E-02	4854.87	5	3	3.9E-01	11054	3	1	2.43E-01
3195.62	3	3	8.23E-01	4881.44	5	3	1.5E-03				
3200.27	5	5	4.8E-01	4883.69	9	7	4.7E-01	Zn II			
3203.32	3	1	2.77E+00	4900.11	7	5	4.51E-01	2025.5	2	4	3.3E+00
3216.69	5	3	2.0E+00	4982.13	7	9	1.5E-02	2064.2	2	4	4.6E+00
3242.28	7	5	2.0E+00	5087.42	9	9	2.0E-01	2099.9	4	6	5.6E+00
								2102.2	4	4	9.3E-01
								4911.6	4	6	1.6E+00

ELECTRON AFFINITIES

Thomas M. Miller

Electron affinity is defined as the energy difference between the lowest (ground) state of the neutral and the lowest state of the corresponding negative ion. The accuracy of electron affinity measurements has been greatly improved since the advent of laser photodetachment experiments with negative ions. Electron affinities can be determined with optical precision, though a detailed understanding of atomic and molecular states and splittings is required to specify the photodetachment threshold corresponding to the electron affinity.

Atomic and molecular electron affinities are discussed in two excellent articles reviewing photodetachment studies which appear in *Gas Phase Ion Chemistry*, Vol. 3, Bowers, M. T., Ed., Academic Press, Orlando, 1984: Chapter 21 by Drzaic, P. S., Marks, J., and Brauman, J. I., "Electron Photodetachment from Gas Phase Negative Ions," p. 167, and Chapter 22 by Mead, R. D., Stevens, A. E., and Lineberger, W. C., "Photodetachment in Negative Ion Beams," p. 213. Persons interested in photodetachment details should consult these articles and the critical review of Hotop, H., and Lineberger, W. C., *J. Phys. Chem. Ref. Data*, 14, 731, 1985. For simplicity in the tables below, any electron affinity which was discussed in the articles by Drzaic *et al.* or Hotop and Lineberger is referenced to these sources, where original references are given. A great many additional electron affinities have been provided here by G. B. Ellison, W. C. Lineberger, H. Hotop, D. G. Leopold, and K. H. Bowen. Little work has been done on electron affinities for the lanthanides and actinides, but theoretical estimates have been made by Bratch, S. G., *Chem. Phys. Lett.*, 98, 113, 1983, and Bratch, S. G., and Lagowski, J. J., *Chem. Phys. Lett.*, 107, 136, 1984. The development of cluster-ion photodetachment apparatuses has brought an explosion of electron affinity estimates for atomic and molecular clusters. [See Arnold, S. T., Eaton, J. G., Patel-Mistra, D., Sarkas, H. W., and Bowen, K. H., in *Ion and Cluster Ion Spectroscopy and Structure*, Maier, J. P., Ed., Elsevier Science, New York, 1989, p. 417.] The policy in this tabulation is to list the electron affinities for the atoms, diatoms, and triatoms, if adiabatic electron affinities have been determined, but to refer the reader to original sources for higher-order clusters. Additional data on molecular electron affinities may be found in Lias, S. G., Bartmess, J. E., Liebman, J. F., Holmes, J. L., Levin, R. D., and Mallard, W. G., *Gas Phase Ion and Neutral Thermochemistry*, *J. Phys. Chem. Ref. Data*, 17, (Supplement No. 1), 1988.

For the present tabulation the 1998 CODATA value $elhc = 8065.54477 \pm 0.00032 \text{ cm}^{-1} \text{ eV}^{-1}$ (<http://physics.nist.gov>) has been used to convert electron affinities from the units used in spectroscopic work, cm^{-1} , into eV for these tables. The 40 ppb uncertainty in $elhc$ is insignificant compared to uncertainties in the electron affinity measurements.

Abbreviations used in the tables: calc = calculated value; PT = photodetachment threshold using a lamp as a light source; LPT = laser photodetachment threshold; LPES = laser photoelectron spectroscopy; DA = dissociative attachment; e-scat = electron scattering or attachment; kinetic = dissociation kinetics; Knud=Knudsen cell; CT = charge transfer; CD = collisional detachment; and ZEKE = zero electron kinetic energy spectroscopy.

Table 1
Atomic Electron Affinities

Atomic number	Atom	Electron affinity in eV	Uncertainty in eV	Method	Ref.	
1	H	0.754195	0.000019	LPT	89	
		0.75420812	—	calc	205	
	D	0.754593	0.000074	LPT	89	deuterium
		0.75465624	—	calc	205	deuterium
	T	0.75480540	—	calc	205	tritium
2	He	not stable	—	calc	1	
3	Li	0.618049	0.000020	LPT	185	
4	Be	not stable	—	calc	1	
5	B	0.279723	0.000025	LPES	207	
6	C	1.262119	0.000020	LPT	28	
7	N	not stable	—	DA	1	
8	O	1.4611096	0.0000007	LPT	4	
9	F	3.401189	0.000003	LPT	74	
10	Ne	not stable	—	calc	1	
11	Na	0.547926	0.000025	LPT	1	
12	Mg	not stable	—	e-scat	1	
13	Al	0.43283	0.00005	LPES	208	
14	Si	1.389521	0.000020	LPES	28	
15	P	0.7465	0.0003	LPT	1	
16	S	2.077103	0.000001	LPT	1	
17	Cl	3.612724	0.000027	LPT	52	
18	Ar	not stable	—	calc	1	
19	K	0.50147	0.00010	LPT	1	
20	Ca	0.02455	0.00010	LPT	44	
21	Sc	0.188	0.020	LPES	1	
22	Ti	0.079	0.014	LPES	1	
23	V	0.525	0.012	LPES	1	

ELECTRON AFFINITIES (continued)

Table 1
Atomic Electron Affinities (continued)

Atomic number	Atom	Electron affinity in eV	Uncertainty in eV	Method	Ref.
24	Cr	0.666	0.012	LPES	1
25	Mn	not stable	—	calc	1
26	Fe	0.151	0.003	LPES	27
27	Co	0.662	0.003	LPES	27
28	Ni	1.156	0.010	LPES	1
29	Cu	1.235	0.005	LPES	37
30	Zn	not stable	—	e-scat	1
31	Ga	0.43	0.03	LPES	183
32	Ge	1.232712	0.000015	LPES	28
33	As	0.814	0.008	LPES	200
34	Se	2.020670	0.000025	LPT	1
35	Br	3.363588	0.000002	LPT	74
36	Kr	not stable	—	calc	1
37	Rb	0.48592	0.00002	LPT	1
38	Sr	0.048	0.006	LPT	122
39	Y	0.307	0.012	LPES	1
40	Zr	0.426	0.014	LPES	1
41	Nb	0.893	0.025	LPES	1
42	Mo	0.748	0.002	LPES	127
43	Tc	0.55	0.20	calc	1
44	Ru	1.05	0.15	calc	1
45	Rh	1.137	0.008	LPES	1
46	Pd	0.562	0.005	LPES	116
47	Ag	1.302	0.007	LPES	1
48	Cd	not stable	—	e-scat	1
49	In	0.3	0.2	PT	1
50	Sn	1.112067	0.000015	LPES	28
51	Sb	1.046	0.005	LPES	108
52	Te	1.9708	0.0003	LPT	1
53	I	3.059037	0.000010	LPT	92
54	Xe	not stable	—	calc	1
55	Cs	0.471626	0.000025	LPT	1
56	Ba	0.14462	0.00006	LPT	195
57	La	0.47	0.02	LPT	184
70	Yb	-0.020	—	calc	196
72	Hf	≈0	—	calc	1
73	Ta	0.322	0.012	LPES	1
74	W	0.815	0.002	LPES	37
75	Re	0.15	0.15	calc	1
76	Os	1.1	0.2	calc	1
77	Ir	1.5638	0.0005	LPT	141
78	Pt	2.128	0.002	LPT	1
79	Au	2.30863	0.00003	LPT	1
80	Hg	not stable	—	e-scat	1
81	Tl	0.2	0.2	PT	1
82	Pb	0.364	0.008	LPES	1
83	Bi	0.946	0.010	LPES	1
84	Po	1.9	0.3	calc	1
85	At	2.8	0.2	calc	1
86	Rn	not stable	—	calc	1
87	Fr	0.46	—	calc	82
89	Ac	0.35	—	calc	207
118	ekaradon	0.056	0.01	calc	140
121	ekaactinium	0.57	—	calc	207

ELECTRON AFFINITIES (continued)

Table 2
Electron Affinities for Diatomic Molecules

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.
Ag ₂	1.023	0.007	LPES	37	MgCl	1.589	0.011	LPES	31
Al ₂	1.10	0.15	LPES	68	MgH	1.05	0.06	PT	2
AlO	2.60	0.02	LPES	143	MgI	1.899	0.018	LPES	31
AlS	2.60	0.03	LPES	129	MgO	1.630	0.025	LPES	178
As ₂	0.739	0.008	LPES	200	MnD	0.866	0.010	LPES	9
AsH	1.0	0.1	PT	2	MnH	0.869	0.010	LPES	9
AsO	1.286	0.008	LPES	198	MnO	1.375	0.010	LPES	158
Au ₂	1.938	0.007	LPES	37	MoO	1.290	0.006	LPES	127
BN	3.160	0.005	LPES	189	NH	0.370	0.004	LPT	32
BO	2.508	0.008	LPES	6	NO	0.026	0.005	LPES	73
BeH	0.7	0.1	PT	2	NRh	1.51	0.02	LPES	206
Bi ₂	1.271	0.008	LPES	119	NS	1.194	0.011	LPES	2
Br ₂	2.55	0.10	CT	2	Na ₂	0.430	0.015	LPES	104
BrO	2.353	0.006	LPES	88	NaBr	0.788	0.010	LPES	30
C ₂	3.269	0.006	LPES	87	NaCl	0.727	0.010	LPES	30
CH	1.238	0.008	LPES	2	NaF	0.520	0.010	LPES	30
CN	3.862	0.004	LPES	111	NaI	0.865	0.010	LPES	30
CRh	1.46	0.02	LPES	206	NaK	0.465	0.030	LPES	104
CS	0.205	0.021	LPES	2	NbO	1.29	0.02	LPES	174
CaH	0.93	0.05	PT	2	Ni ₂	0.926	0.010	LPES	112
Cl ₂	2.38	0.10	CT	2	NiCu	0.889	0.010	LPES	128
ClO	2.275	0.006	LPES	88	NiAg	0.979	0.010	LPES	128
Co ₂	1.110	0.008	LPES	27	NiD	0.477	0.007	LPES	29
CoD	0.680	0.010	LPES	29	NiH	0.481	0.007	LPES	29
CoH	0.671	0.010	LPES	29	NiO	1.470	0.003	LPES	146
Cr ₂	0.505	0.005	LPES	114	O ₂	0.451	0.007	LPES	73
CrD	0.568	0.010	LPES	29	OD	1.825533	0.000037	LPT	142
CrH	0.563	0.010	LPES	29	OH	1.8276534	0.0000037	LPT	142
CrO	1.221	0.006	LPES	5	ORh	1.58	0.02	LPES	206
Cs ₂	0.469	0.015	LPES	104	P ₂	0.589	0.025	LPES	42
CsCl	0.455	0.010	LPES	30	PH	1.028	0.010	LPES	2
CsO	0.273	0.012	LPES	133	PO	1.092	0.010	LPES	2
Cu ₂	0.836	0.006	LPES	37	Pb ₂	1.366	0.010	LPES	117
CuO	1.777	0.006	LPES	118	PbO	0.722	0.006	LPES	105
F ₂	3.08	0.10	CT	2	Pd ₂	1.685	0.008	LPES	112
FO	2.272	0.006	LPES	88	PdCO	0.604	0.010	LPES	160
Fe ₂	0.902	0.008	LPES	27	Pt ₂	1.898	0.008	LPES	112
FeD	0.932	0.015	LPES	9	PtN	1.240	0.010	LPES	46
FeH	0.934	0.011	LPES	9	Rb ₂	0.498	0.015	LPES	104
FeO	1.493	0.005	LPES	45	RbCl	0.544	0.010	LPES	30
Ge ₂	2.035	0.001	LPES	123	RbCs	0.478	0.020	LPES	104
I ₂	2.55	0.05	CT	2	Re ₂	1.571	0.008	LPES	33
IBr	2.55	0.10	CT	2	S ₂	1.670	0.015	LPES	53
IO	2.378	0.006	LPES	88	SD	2.315	0.002	LPES	10
InP	1.95	0.05	LPES	137	SF	2.285	0.006	LPES	93
K ₂	0.497	0.012	LPES	104	SH	2.314343	0.000004	LPT	47
KBr	0.642	0.010	LPES	30	SO	1.125	0.005	LPES	84
KCl	0.582	0.010	LPES	30	Sb ₂	1.282	0.008	LPES	108
KCs	0.471	0.020	LPES	104	ScO	1.35	0.02	LPES	171
KI	0.728	0.010	LPES	30	Se ₂	1.94	0.07	LPES	38
KRb	0.486	0.020	LPES	104	SeH	2.212519	0.000025	LPT	48
LiCl	0.593	0.010	LPES	30	SeO	1.456	0.020	LPES	41
LiD	0.337	0.012	LPES	102	Si ₂	2.201	0.010	LPES	100
LiH	0.342	0.012	LPES	102	SiH	1.277	0.009	LPES	2

ELECTRON AFFINITIES (continued)

Table 2
Electron Affinities for Diatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.
Sn ₂	1.962	0.010	LPES	117	TiO	1.30	0.03	LPES	172
SnO	0.598	0.006	LPES	168	VO	1.229	0.008	LPES	170
SnPb	1.569	0.008	LPES	117	YO	1.35	0.02	LPES	171
Te ₂	1.92	0.07	LPES	38	ZnH	<0.95	—	PT	2
TeH	2.102	0.015	LPES	39	ZnO	2.088	0.010	LPES	179
TeO	1.697	0.022	LPES	40	ZrO	1.3	0.3	LPES	173

Table 3
Electron Affinities for Triatomic Molecules

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.
Ag ₃	2.32	0.05	LPES	37	CuBr ₂	4.35	0.05	LPES	177
AgCN	1.588	0.010	LPES	163	DCO	0.301	0.005	LPES	35
Al ₃	1.4	0.15	LPES	68	DNO	0.330	0.015	LPES	14
AlO ₂	4.23	0.02	LPES	143	DO ₂	1.089	0.017	LPES	15
AlP ₂	1.933	0.007	LPES	191	DS ₂	1.912	0.015	LPES	53
Al ₂ P	2.513	0.020	LPES	191	HS ₂	1.907	0.015	LPES	53
Al ₂ S	0.80	0.12	LPES	129	Fe ₃	1.47	0.08	LPES	149
As ₃	1.45	0.03	LPES	200	FeCO	1.157	0.005	LPES	103
AsH ₂	1.27	0.03	PT	2	FeD ₂	1.038	0.013	LPES	34
Au ₃	3.7	0.3	LPES	37	FeH ₂	1.049	0.014	LPES	34
BO ₂	4.3	0.2	CT	98	FeO ₂	2.358	0.030	LPES	130
B ₂ N	3.098	0.005	LPES	193	GaAs ₂	1.894	0.022	LPES	192
Bi ₃	1.60	0.03	LPES	119	GaP ₂	1.666	0.027	LPES	192
C ₃	1.981	0.020	LPES	11	Ga ₂ As	2.428	0.020	LPES	192
CCl ₂	1.591	0.010	LPES	95	Ga ₂ P	2.481	0.020	LPES	192
CD ₂	0.645	0.006	LPES	12	Ge ₃	2.23	0.01	LPES	123
CDF	0.535	0.005	LPES	95	GeH ₂	1.097	0.015	LPES	28
CF ₂	0.165	0.010	LPES	95	HCO	0.313	0.005	LPES	35
CH ₂	0.652	0.006	LPES	12	HCl ₂	4.896	0.005	LPES	69
CHBr	1.454	0.005	LPES	95	HNO	0.338	0.015	LPES	14
CHCl	1.210	0.005	LPES	95	HO ₂	1.078	0.017	LPES	15
CHF	0.542	0.005	LPES	95	I ₃	4.226	0.013	LPES	162
CHI	1.42	0.17	LPES	95	InP ₂	1.61	0.05	LPES	137
C ₂ H	2.969	0.006	LPES	87	In ₂ P	2.36	0.05	LPES	137
C ₂ O	2.289	0.018	LPES	180	K ₃	0.956	0.050	LPES	18
COS	0.46	0.20	CD	2	MnD ₂	0.465	0.014	LPES	34
CS ₂	0.895	0.020	LPES	11	MnH ₂	0.444	0.016	LPES	34
C ₂ Ti	1.542	0.020	LPES	147	MnO ₂	2.06	0.03	LPES	158
CoD ₂	1.465	0.013	LPES	34	N ₃	2.70	0.12	PT	2
CoH ₂	1.450	0.014	LPES	34	NCN	2.484	0.006	LPES	154
CrH ₂	>2.5	—	LPES	34	NCO	3.609	0.005	LPES	111
Cr ₂ D	1.464	0.005	LPES	107	NCS	3.537	0.005	LPES	111
Cr ₂ H	1.474	0.005	LPES	107	NH ₂	0.771	0.005	LPES	58
CrO ₂	2.413	0.008	LPES	144	N ₂ O	-0.03	0.10	calc	59
CS ₃	0.864	0.030	LPES	18	NO ₂	2.273	0.005	LPES	63
Cu ₃	2.11	0.05	LPES	37	(NO)R	R = Ar, Kr, Xe	—	LPES	90
CuCN	1.466	0.010	LPES	163	Na ₃	1.019	0.060	LPES	18
CuCl ₂	4.35	0.05	LPES	177	Nb ₃	1.032	0.010	LPES	175

ELECTRON AFFINITIES (continued)

Table 3
Electron Affinities for Triatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.
Ni ₃	1.41	0.05	LPES	55	Pt ₃	1.87	0.02	LPES	55
NiCO	0.804	0.012	LPES	2	Pd ₃	<1.5	0.1	LPES	55
NiD ₂	1.926	0.007	LPES	34	Rb ₃	0.920	0.030	LPES	18
NiH ₂	1.934	0.008	LPES	34	S ₃	2.093	0.025	LPES	16
NiO ₂	3.05	0.01	LPES	214	SO ₂	1.107	0.008	LPES	16
ONiO					S ₂ O	1.877	0.008	LPES	16
NiO ₂	0.82	0.03	LPES	214	Sb ₃	1.85	0.03	LPES	108
Ni(O ₂)					SeO ₂	1.823	0.050	LPES	38
O ₃	2.1028	0.0025	LPT	2	SiH ₂	1.124	0.020	LPES	2
O ₂ Ar	0.52	0.02	LPES	75	Si ₂ H	2.31	0.01	LPES	182
OCIO	2.140	0.008	LPES	88	Si ₃	2.29	0.02	LPES	110
OIO	2.577	0.008	LPES	88	Ta ₃	1.36	0.03	LPES	169
PH ₂	1.271	0.010	LPES	2	TiO ₂	1.59	0.03	LPES	172
PO ₂	3.42	0.01	LPES	124	V ₃	1.107	0.010	LPES	176
					VO ₂	2.3	0.2	CT	101

Table 4
Electron Affinities for Larger Polyatomic Molecules

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.
Ag _n	$n = 1-10$	—	LPES	37
Al _n	$n = 3-32$	—	LPES	68
Al ₃ C	2.56	0.06	LPES	161
Al _n O _m	$n = 1,2$	$m = 1-5$	LPES	143
Al ₃ O	1.00	0.15	LPES	68
Al _n S _m	$n = 1-5$	$m = 1-3$	LPES	129
Ar(H ₂ O) _n	$n = 2,6,7$	—	LPES	77
Ar _n Br	$n = 2-9$	—	ZEKE	212
Ar _n I	$n = 2-19$	—	ZEKE	212
As ₄	<0.8	—	LPES	200
As ₅	≈1.7	—	LPES	200
Au _n	$n = 2-5$	—	LPES	37
AuF ₆	7.5	estimate	CT	98
BD ₃	0.027	0.014	LPES	62
BH ₃	0.038	0.015	LPES	62
B ₃ N	2.098	0.035	LPES	193
Bi _n	$n = 2-9$	—	LPES	213
Bi ₄	1.05	0.010	LPES	119
Br(CO ₂)	3.582	0.017	LPES	131
C _n	$n = 2-84$	—	LPES	70
(CO ₂) _n	$n = 1,2$	—	LPES	75
(CS) _n	$n = 2$	—	LPES	75
(CS ₂) _n	$n = 1,2$	—	LPES	75
CCoNO ₃	1.73	0.03	LPES	199
CDO ₂	3.510	0.015	LPES	109
CF ₃	1.82	0.05	LPES	187
CHO ₂	3.498	0.015	LPES	109
CH ₃ S	0.465	0.023	LPES	53
CD ₃ NO ₂	0.24	0.08	LPES	211

Co(CO₂)NO

ELECTRON AFFINITIES (continued)

Table 4
Electron Affinities for Larger Polyatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	
CH ₃	0.08	0.03	LPES	2	
CH ₃ I	0.2	0.1	CT	2	
CH ₃ NO ₂	0.26	0.08	LPES	211	
CH ₃ Si	0.852	0.010	LPES	97	CH ₃ -Si
CH ₃ Si	2.010	0.010	LPES	97	CH ₂ =SiH
CD ₃ O	1.559	0.004	LPES	194	
CD ₃ O ₂	1.150	0.005	LPES	188	methy- <i>d</i> ₃ peroxy radical
CH ₃ O	1.572	0.004	LPES	194	
CH ₃ O ₂	1.162	0.005	LPES	188	methyl peroxy radical
CD ₃ S	1.856	0.006	LPT	2	
CD ₃ S ₂	1.748	0.022	LPES	53	
CFO ₂	4.277	0.030	LPES	131	
CF ₃ Br	0.91	0.2	CD	2	
CF ₃ I	1.57	0.2	CD	2	
CH ₃ S	1.867	0.004	LPES	166	
CH ₃ S ₂	1.757	0.022	LPES	53	
CH ₃ SiH ₂	1.19	0.04	LPT	65	
CO ₃	2.69	0.14	LPES	2	
CO ₃ (H ₂ O)	2.1	0.2	PT	2	
C ₂ F ₂	2.255	0.006	LPES	106	difluorovinylidene
C ₂ DO	2.350	0.020	LPES	13	
C ₂ HF	1.718	0.006	LPES	106	fluorovinylidene
C ₂ HO	2.338	0.008	LPES	190	
C ₂ D ₂	0.492	0.006	LPES	83	vinylidene- <i>d</i> ₂
C ₂ HD	0.489	0.006	LPES	83	vinylidene- <i>d</i> ₁
C ₂ H ₂	0.490	0.006	LPES	83	vinylidene
C ₂ H ₂ FO	2.22	0.09	PT	2	acetyl fluoride enolate
C ₂ D ₂ N	1.538	0.012	LPES	21	cyanomethyl- <i>d</i> ₂ radical
C ₂ D ₂ N	1.070	0.024	LPES	21	isocyanomethyl- <i>d</i> ₂ radical
C ₂ H ₂ N	1.543	0.014	LPES	21	cyanomethyl radical
C ₂ H ₂ N	1.059	0.024	LPES	21	isocyanomethyl radical
C ₂ H ₃	0.667	0.024	LPES	90	vinyl
C ₂ D ₃ O	1.81897	0.00012	LPT	22	acetaldehyde- <i>d</i> ₃ enolate
C ₂ H ₃ O	1.82476	0.00012	LPT	22	acetaldehyde enolate
C ₂ D ₅ O	1.699	0.004	LPES	194	ethoxide- <i>d</i> ₃
C ₂ H ₅ N	0.56	0.01	PT	2	ethyl nitrine
C ₂ H ₅ O	1.712	0.004	LPES	194	ethoxide
C ₂ H ₅ O ₂	1.182	0.006	LPES	188	ethyl peroxy radical
C ₂ H ₅ S	1.953	0.006	LPT	2	ethyl sulfide
C ₂ H ₅ S	0.868	0.051	LPES	53	CH ₃ SCH ₂
C ₂ H ₇ O ₂	2.26	0.08	PT	50	MeOHOMe
C ₃ Fe	1.69	0.08	LPES	132	
C ₃ H	1.858	0.023	LPES	11	
C ₃ HFe	1.58	0.06	LPES	132	
C ₃ H ₂	1.794	0.008	LPES	153	
C ₃ H ₂ F ₃ O	2.625	0.010	LPT	113	1,1,1-trifluoroacetone enolate
C ₃ H ₃	0.893	0.025	LPES	24	propargyl radical
C ₃ H ₂ D	0.88	0.15	LPES	24	propargyl- <i>d</i> ₁ radical
C ₃ D ₂ H	0.907	0.023	LPES	24	propargyl- <i>d</i> ₂ radical
C ₃ H ₃ N	1.247	0.012	LPES	21	CH ₃ CH-CN
C ₃ D ₅	0.464	0.006	LPES	138	allyl- <i>d</i> ₅
C ₃ H ₅	0.481	0.008	LPES	138	allyl
C ₃ H ₅	0.397	0.069	kinetic	155	cyclopropyl
C ₃ H ₄ D	0.373	0.019	LPES	25	allyl- <i>d</i> ₁

ELECTRON AFFINITIES (continued)

Table 4
Electron Affinities for Larger Polyatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	
C ₃ H ₅ O	1.758	0.019	LPT	113	acetone enolate
C ₃ H ₅ O	1.621	0.006	LPT	113	propionaldehyde enolate
C ₃ H ₅ O ₂	1.80	0.06	PT	2	methyl acetate enolate
C ₃ H ₇ O	1.789	0.033	LPES	23	propyl oxide
C ₃ H ₇ O	1.847	0.004	LPES	194	isopropyl oxide
C ₃ H ₇ S	2.00	0.02	PT	2	propyl sulfide
C ₃ H ₇ S	2.02	0.02	PT	2	isopropyl sulfide
C ₃ O	1.34	0.15	LPES	11	
C ₃ O ₂	0.85	0.15	LPES	11	
C ₃ Ti	1.561	0.015	LPES	147	
C ₄ F ₄ O ₃	0.5	0.2	CD	2	tetrafluorosuccinic anhydride
C ₄ Fe	<2.2	0.2	LPES	132	
C ₄ HFe	1.67	0.06	LPES	132	
C ₄ H ₂ O ₃	1.44	0.10	CT	61	maleic anhydride
C ₄ D ₄	0.909	0.015	LPES	125	vinylvinylidene- <i>d</i> ₄
C ₄ H ₄	0.914	0.015	LPES	125	vinylvinylidene
C ₄ H ₄ N	2.39	0.13	PT	2	pyrrolate
C ₄ H ₅ O	1.801	0.008	LPT	113	cyclobutanone enolate
C ₄ H ₆	0.431	0.006	LPES	135	trimethylenemethane
C ₄ H ₆ O ₂	0.69	0.10	CT	61	2,3-butanedione
C ₄ H ₆ D	0.493	0.008	LPES	138	2-methylallyl- <i>d</i> ₇
C ₄ H ₇	0.505	0.006	LPES	138	2-methylallyl
C ₄ H ₇ O	1.67	0.05	PT	2	butyraldehyde enolate
C ₄ H ₅ DO	1.67	0.05	PT	2	2-butanone-3- <i>d</i> ₁ enolate
C ₄ H ₅ D ₂ O	1.75	0.06	PT	2	2-butanone-3,3- <i>d</i> ₂ enolate
C ₄ H ₉ O	1.909	0.004	LPES	194	<i>tert</i> -butoxyl
C ₄ H ₉ S	2.03	0.02	PT	2	butyl sulfide
C ₄ H ₉ S	2.07	0.02	PT	2	<i>tert</i> -butyl sulfide
C ₄ O	2.05	0.15	LPES	11	
C ₄ O ₂	2.0	0.2	LPES	11	
C ₄ Ti	1.494	0.020	LPES	147	
C ₅	2.853	0.001	LPT	99	
C ₅ F ₅ N	0.68	0.11	CT	67	pentafluoropyridine
C ₅ F ₆ O ₃	1.5	0.2	CD	2	hexafluoroglutaric anhydride
C ₅ D ₅	1.790	0.008	LPES	11	cyclopentadienyl- <i>d</i> ₅
C ₅ H ₅	1.804	0.007	LPES	11	cyclopentadienyl
C ₅ H ₇	0.91	0.03	PT	2	pentadienyl
C ₅ H ₇ O	1.598	0.007	LPT	113	cyclopentanone enolate
C ₅ H ₉ O	1.69	0.05	PT	2	3-pentanone enolate
C ₅ H ₁₁ O	1.93	0.05	LPT	2	neopentoxyl
C ₅ H ₁₁ S	2.09	0.02	PT	2	n-pentyl sulfide
C ₅ O ₂	1.2	0.2	LPES	11	
C ₅ Ti	1.748	0.050	LPES	147	
C ₆	4.180	0.001	LPT	8	
C ₆ Br ₄ O ₂	2.44	0.20	CT	2	tetrabromo-BQ
C ₆ Cl ₄ O ₂	2.78	0.10	CT	61	tetrachloro-BQ
C ₆ F ₄ O ₂	2.70	0.10	CT	61	tetrafluoro-BQ
C ₆ F ₅ Br	1.15	0.11	CT	67	pentafluorobromobenzene
C ₆ F ₅ Cl	0.82	0.11	CT	67	pentafluorochlorobenzene
C ₆ F ₅ I	1.41	0.11	CT	67	pentafluoroiodobenzene
C ₆ F ₅ NO ₂	1.52	0.11	CT	67	pentafluoro-NB
C ₆ F ₆	0.52	0.10	CT	51	hexafluorobenzene
C ₆ F ₁₀	>1.4	0.3	CT	2	perfluorocyclohexane
C ₆ H ₂ Cl ₂ O ₂	2.48	0.10	CT	61	2,6-dichloro-BQ

ELECTRON AFFINITIES (continued)

Table 4
Electron Affinities for Larger Polyatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	
C ₆ H ₃ F ₂ NO ₂	1.17	0.10	CT	61	2,4-difluoro-NB
C ₆ D ₄	0.551	0.010	LPES	36	<i>o</i> -benzyne- <i>d</i> ₄
C ₆ H ₄	0.560	0.010	LPES	36	<i>o</i> -benzyne
C ₆ H ₄ BrNO ₂	1.16	0.10	CT	61	<i>o</i> -bromo-NB
C ₆ H ₄ BrNO ₂	1.32	0.10	CT	61	<i>m</i> -bromo-NB
C ₆ H ₄ BrNO ₂	1.29	0.10	CT	61	<i>p</i> -bromo-NB
C ₆ H ₄ ClNO ₂	1.14	0.10	CT	61	<i>o</i> -chloro-NB
C ₆ H ₄ ClNO ₂	1.28	0.10	CT	61	<i>m</i> -chloro-NB
C ₆ H ₄ ClNO ₂	1.26	0.10	CT	61	<i>p</i> -chloro-NB
C ₆ H ₄ ClO	<2.58	0.08	PT	2	<i>o</i> -chloroperoxide
C ₆ H ₄ FNO ₂	1.07	0.10	CT	61	<i>o</i> -fluoro-NB
C ₆ H ₄ FNO ₂	1.23	0.10	CT	61	<i>m</i> -fluoro-NB
C ₆ H ₄ FNO ₂	1.12	0.10	CT	61	<i>p</i> -fluoro-NB
C ₆ H ₄ N ₂ O ₄	1.65	0.10	CT	61	<i>o</i> -diNB
C ₆ H ₄ N ₂ O ₄	1.65	0.10	CT	61	<i>m</i> -diNB
C ₆ H ₄ N ₂ O ₄	2.00	0.10	CT	61	<i>p</i> -diNB
C ₆ H ₄ O ₂	1.91	0.10	CT	61	1,4-benzoquinone (BQ)
C ₆ D ₅	1.092	0.020	LPES	26	phenyl- <i>d</i> ₅
C ₆ D ₅ N	1.44	0.02	LPES	96	phenylnitrene- <i>d</i> ₅
C ₆ H ₅	1.096	0.006	LPES	26	phenyl
C ₆ H ₅ N	1.429	0.011	LPT	115	phenylnitrene
C ₆ H ₅ NO ₂	1.00	0.01	LPES	164	nitrobenzene (NB)
C ₆ H ₅ O	2.253	0.006	LPES	26	phenoxy
C ₆ H ₅ S	<2.47	0.06	PT	2	thiophenoxide
C ₆ H ₅ NH	1.70	0.03	PT	2	anilide
C ₆ H ₇	<1.67	0.04	PT	2	methylcyclopentadienyl
C ₆ H ₈	0.855	0.010	LPES	203	(CH ₂) ₂ C-C(CH ₂) ₂
C ₆ H ₈ Si	1.435	0.004	LPT	65	C ₆ H ₅ SiH ₃
C ₆ H ₉	0.654	0.010	LPES	203	CH ₂ =C(CH ₃)-C(CH ₂) ₂
C ₆ H ₉ O	1.526	0.010	LPT	113	cyclohexanone enolate
C ₆ H ₁₀	0.645	0.015	LPES	126	<i>tert</i> -butyl vinylidene
C ₆ H ₁₁ O	1.755	+0.05/-0.005	LPT	113	pinacolone enolate
C ₆ H ₁₁ O	1.82	0.06	PT	2	3,3-dimethylbutan-1-yl enolate
C ₆ N ₄	2.3	0.3	PT	2	TCNE
C ₇ F ₅ N	1.11	0.11	CT	67	pentafluorobenzonitrile
C ₇ F ₈	0.86	0.11	CT	67	octafluorotoluene
C ₇ F ₁₄	1.08	0.10	CT	61	perfluoromethylcyclohexane
C ₇ HF ₅ O	1.10	0.11	CT	67	pentafluorobenzaldehyde
C ₇ H ₃ N ₃ O ₄	2.16	0.10	CT	61	3,5-(NO ₂) ₂ benzonitrile
C ₇ H ₄ F ₃ NO ₂	1.41	0.10	CT	61	<i>m</i> -trifluoromethyl-NB
C ₇ H ₄ N ₂ O ₂	1.61	0.10	CT	61	<i>o</i> -cyano-NB
C ₇ H ₄ N ₂ O ₂	1.56	0.10	CT	61	<i>m</i> -cyano-NB
C ₇ H ₄ N ₂ O ₂	1.72	0.10	CT	61	<i>p</i> -cyano-NB
C ₇ H ₆ Br	1.308	0.008	LPES	167	<i>o</i> -bromobenzyl
C ₇ H ₆ Br	1.307	0.008	LPES	167	<i>m</i> -bromobenzyl
C ₇ H ₆ Br	1.229	0.008	LPES	167	<i>p</i> -bromobenzyl
C ₇ H ₆ Cl	1.257	0.008	LPES	167	<i>o</i> -chlorobenzyl
C ₇ H ₆ Cl	1.272	0.008	LPES	167	<i>m</i> -chlorobenzyl
C ₇ H ₆ Cl	1.174	0.008	LPES	167	<i>p</i> -chlorobenzyl
C ₇ H ₆ F	1.091	0.008	LPES	167	<i>o</i> -fluorobenzyl
C ₇ H ₆ F	1.173	0.008	LPES	167	<i>m</i> -fluorobenzyl
C ₇ H ₆ F	0.937	0.008	LPES	167	<i>p</i> -fluorobenzyl
C ₇ H ₆ FO	2.218	0.010	LPT	2	<i>m</i> -fluoroacetophenone enolate
C ₇ H ₆ FO	2.176	0.010	LPT	2	<i>p</i> -fluoroacetophenone enolate

ELECTRON AFFINITIES (continued)

Table 4
Electron Affinities for Larger Polyatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	
C ₇ H ₆ FeO ₃	0.990	0.10	CT	120	<i>h</i> ₄ -1,3-butadiene-Fe(CO) ₃
C ₇ H ₆ N ₂ O ₄	1.77	0.05	PT	60	3,4-dinitrotoluene
C ₇ H ₆ N ₂ O ₄	1.77	0.05	PT	60	2,3-dinitrotoluene
C ₇ H ₆ N ₂ O ₄	1.60	0.05	PT	60	2,4-dinitrotoluene
C ₇ H ₆ N ₂ O ₄	1.55	0.05	PT	60	2,6-dinitrotoluene
C ₇ H ₇	0.912	0.006	LPES	26	benzyl
C ₇ H ₇	0.868	0.006	LPES	136	1-quadricyclanide
C ₇ H ₇	0.962	0.006	LPES	136	2-quadricyclanide
C ₇ H ₇	1.286	0.006	LPES	136	norbornadienide
C ₇ H ₇	0.39	0.04	LPES	136	cycloheptatrienide
C ₇ H ₇	3.046	0.006	LPES	136	1-(1,6-heptadiynide)
C ₇ H ₇	>1.140	0.006	LPES	136	3-(1,6-heptadiynide)
C ₇ H ₇ NO ₂	0.92	0.10	CT	61	<i>o</i> -methyl-NB
C ₇ H ₇ NO ₂	0.99	0.10	CT	61	<i>m</i> -methyl-NB
C ₇ H ₇ NO ₂	0.95	0.10	CT	61	<i>p</i> -methyl-NB
C ₇ H ₇ NO ₃	1.04	0.10	CT	61	<i>m</i> -OCH ₃ -NB
C ₇ H ₇ NO ₃	0.91	0.10	CT	61	<i>p</i> -OCH ₃ -NB
C ₇ H ₇ O	<2.36	0.06	PT	2	<i>o</i> -methyl phenoxide
C ₇ H ₇ O	2.14	0.02	PT	50	benzyloxide
C ₇ H ₇ O ₂	1.85	0.10	CT	61	<i>o</i> -CH ₃ -BQ
C ₇ H ₈ FO	<3.05	0.06	PT	50	PhCH ₂ OHF
C ₇ H ₉	1.27	0.03	PT	2	heptatrienyl
C ₇ H ₉ O	1.61	0.05	PT	2	2-norbornanone enolate
C ₇ H ₉ Si	1.33	0.04	LPT	65	C ₆ H ₅ (CH ₃)SiH
C ₇ H ₁₁ O	1.598	0.007	LPT	113	cycloheptanone enolate
C ₇ H ₁₁ O	1.49	0.04	PT	2	2,5-dimethyl-cyclopentanone enolate
C ₇ H ₁₃ O	1.72	0.06	PT	2	4-heptanone enolate
C ₇ H ₁₃ O	1.46	0.04	PT	2	diisopropyl ketone enolate
C ₈ F ₁₄ N ₂	1.89	0.10	CT	51	1,4-(CN) ₂ C ₆ F ₄
C ₈ H ₃ F ₅ O	0.88	0.11	CT	67	pentafluoroacetophenone
C ₈ H ₃ F ₆ NO ₂	1.79	0.10	CT	61	3,5-(CF ₃) ₂ -NB
C ₈ H ₄ O ₃	1.21	0.10	CT	61	phthalic anhydride
C ₈ H ₆	1.044	0.008	LPES	148	
C ₈ H ₇	1.091	0.008	LPES	134	
C ₈ H ₇ O	2.057	0.010	PT	2	acetophenone enolate
C ₈ H ₇ O	2.10	0.08	LPT	2	phenylacetaldehyde enolate
C ₈ H ₈	0.55	0.02	CT	134	cyclooctatetraene
C ₈ H ₈	0.919	0.008	LPES	139	<i>m</i> -xylylene
C ₈ H ₉ NO ₂	1.21	0.05	PT	60	3,5-dimethyl-NB
C ₈ H ₉ NO ₂	2.61	0.05	PT	60	2,6-dimethyl-NB
C ₈ H ₉ NO ₂	0.86	0.10	CT	61	2,3-dimethyl-NB
C ₈ H ₁₃ O	1.63	0.06	PT	2	cyclooctanone enolate
C ₉ H ₈ FeO ₃	0.76	0.10	CT	120	<i>h</i> ₄ -1,3-cyclohexadiene-Fe(CO) ₃
C ₉ H ₉ O	2.030	0.010	LPT	2	<i>m</i> -methylacetophenone enolate
C ₉ H ₉ SiN	1.43	0.10	PT	2	trimethylsilylnitrene
C ₉ H ₁₁ NO ₂	0.70	0.10	CT	61	2,4,6-trimethyl-NB
C ₉ H ₁₅ O	1.69	0.06	PT	2	cyclononanone enolate
C ₁₀ H ₄ C ₁₂ O ₂	2.19	0.10	CT	61	2,3-dichloro-1,4-naphthoquinone
C ₁₀ H ₆ N ₂ O ₄	1.78	0.10	CT	61	1,3-dinitronaphthalene
C ₁₀ H ₆ N ₂ O ₄	1.77	0.10	CT	61	1,5-dinitronaphthalene
C ₁₀ H ₆ O ₂	1.81	0.10	CT	61	1,4-naphthoquinone
C ₁₀ H ₇	1.403	0.015	LPES	197	1-naphthyl radical
C ₁₀ H ₇ NO ₂	1.23	0.10	CT	61	1-nitronaphthalene
C ₁₀ H ₇ NO ₂	1.18	0.10	CT	61	2-nitronaphthalene

ELECTRON AFFINITIES (continued)

Table 4
Electron Affinities for Larger Polyatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	
C ₁₀ H ₈	0.69	0.10	CT	61	azulene
C ₁₀ H ₈ CrO ₃	0.93	0.10	CT	120	<i>h</i> ₄ -1,3,5-cycloheptatriene Cr(CO) ₃
C ₁₀ H ₈ FeO ₃	0.98	0.10	CT	120	<i>h</i> ₄ -1,3,5-cycloheptatriene-Fe(CO) ₃
C ₁₀ H ₁₇ O	1.83	0.06	PT	2	cyclodecanone enolate
C ₁₁ H ₈ FeO ₃	1.29	0.10	CT	120	<i>h</i> ₄ -1,3-butadiene- Fe(CO) ₃
C ₁₂ F ₁₀	0.82	0.11	CT	67	decafluorobiphenyl
C ₁₂ H ₄ N ₄	2.8	0.3	CD	2	TCNQ
C ₁₂ H ₉	1.07	0.10	PT	2	perinaphthenyl
C ₁₂ H ₁₅ O	2.032	0.010	LPT	2	<i>tert</i> -butylacetophenone enolate
C ₁₂ H ₂₁ O	1.90	0.07	PT	2	cyclododecanone enolate
C ₁₃ F ₁₀ O	1.52	0.11	CT	67	decafluorobenzophenone
C ₁₃ H ₉ F	0.64	0.10	CT	61	4-fluorobenzophenone
C ₁₃ H ₁₀ O	0.62	0.10	CT	61	benzophenone
C ₁₄ H ₉ NO ₂	1.43	0.10	CT	61	9-nitroanthracene
C ₁₄ H ₁₀	0.57	0.10	CT	66	anthracene
C ₁₈ H ₁₂	1.04	0.10	CT	66	tetracene
C ₂₀ H ₁₂	0.79	0.10	CT	66	benz[a]pyrene
C ₂₀ H ₁₂	0.97	0.10	CT	66	perylene
C ₂₂ H ₁₄	1.35	0.10	CT	66	pentacene
C ₄₄ Cl ₂₈ FeN ₄	2.59	0.11	CT	186	FeTPPCl ₂₈
C ₄₄ Cl ₈ F ₂₀ FeN ₄	3.21	0.03	CT	186	FeTPPβCl ₈
C ₄₄ Cl ₉ F ₂₀ FeN ₄	3.35	0.03	CT	186	FeTPPF ₂₀ βCl ₈ Cl
C ₄₄ H ₈ F ₂₀ FeN ₄	2.15	0.15	CT	186	FeTPPF ₂₀
C ₄₄ H ₈ ClF ₂₀ FeN ₄	3.14	0.03	CT	186	FeTPPF ₂₀ Cl
C ₄₄ H ₈ Cl ₂₁ FeN ₄	2.93	0.23	CT	186	FeTPPoCl ₂₀ Cl
C ₄₄ H ₁₂ Cl ₁₇ FeN ₄	3.14	0.03	CT	186	FeTPPoCl ₈ bCl ₈ Cl
C ₄₄ H ₂₀ Cl ₈ FeN ₄	1.86	0.03	CT	186	FeTPPoCl ₈
C ₄₄ H ₂₀ Cl ₉ FeN ₄	2.10	0.19	CT	186	FeTPPoCl ₈ Cl
C ₄₄ H ₂₈ FeN ₄	1.87	0.03	CT	186	iron tetraphenylporphyrin (FeTPP)
C ₄₄ H ₂₈ NiN ₄	1.51	0.01	CT	186	nickel tetraphenylporphyrin (NiTPP)
C ₄₄ H ₂₈ ClFeN ₄	2.15	0.15	CT	186	FeTPPCL
C ₄₄ H ₃₀ N ₄	1.69	0.01	CT	186	H ₂ tetraphenylporphyrin
C ₄₅ H ₂₉ NiN ₄ O	1.74	0.01	CT	186	NiTPPCHO
C ₅₂ H ₃₉ FeN ₇ O	1.97	0.03	CT	186	FeTPP-val
C ₆₀	2.65	0.05	LPT	201	
C ₆₀ F ₂	2.74	0.07	Knud	202	
C ₆₄ H ₆₄ FeN ₈ O ₄	2.07	0.03	CT	186	FeTPP-piv
C ₇₀ F ₂	2.80	0.07	Knud	202	
CeF ₄	3.8	0.4	CT	98	
Cl(CO ₂)	3.907	0.010	LPES	131	
CoF ₄	6.4	0.3	CT	98	
Cr(CO) ₃	1.349	0.006	LPES	94	
CrO ₃	3.6	0.2	CT	98	
Cu _{<i>n</i>}	<i>n</i> = 1-41	—	LPES	37	
Cu _{<i>n</i>} (CN) _{<i>m</i>}	<i>n</i> = 1-6	<i>m</i> = 1-6	LPES	159	
Fe _{<i>n</i>}	<i>n</i> = 3-24	—	LPES	149	
Fe(CO) ₂	1.22	0.02	LPES	2	
Fe(CO) ₃	1.8	0.2	LPES	2	
Fe(CO) ₄	2.4	0.3	LPES	2	
FeF ₃	3.6	0.1	CT	98	
FeF ₄	6.0	estimate	CT	98	
Fe _{<i>n</i>} O _{<i>m</i>}	<i>n</i> = 1-4	<i>m</i> = 1-6	LPES	152	
Ga ₂ As ₃	2.783	0.024	LPES	192	
Ga ₂ P ₃	2.991	0.026	LPES	192	

ELECTRON AFFINITIES (continued)

Table 4
Electron Affinities for Larger Polyatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.	
Ge _n	$n = 3-15$	—	LPES	71	
Ge _x As _y	$n = 5-30$	$n = x+y$	LPES	72	
GeH ₃	<1.74	0.04	PT	2	
H(NH ₃) _n	$n = 1,2$	—	LPES	76	
HNO ₃	0.57	0.15	CD	2	
(H ₂ O) _n	$n = 2-19$	—	LPES	77	
I(CO ₂)	3.225	0.001	LPES	131	
In _x P _y	$n = 2-8$	$n = x+y$	LPES	137	
IrF ₄	4.7	0.3	CT	98	
IrF ₆	6.5	0.4	CT	98	
K _n	$n = 2-7$	—	LPES	18	
MnF ₄	5.5	0.2	CT	98	
MnO ₃	3.335	0.010	LPES	158	
Mo(CO) ₃	1.337	0.006	LPES	94	
MoF ₅	3.5	0.2	CT	98	
MoF ₆	3.8	0.2	CT	98	
MoO ₃	2.9	0.2	CT	98	
N ₂ CD	2.622	0.005	LPES	154	NCND
N ₂ CH	2.622	0.005	LPES	154	NCNH
(NH ₃) _n	$n = 41-1100$	—	LPES	77	
NH ₂ (NH ₃) _n	$n = 1,2$	—	LPES	78	
NO(H ₂ O) _n	$n = 1,2$	—	LPES	75	
NO ₃	3.937	0.014	LPES	85	
NO(N ₂ O) _n	$n = 1,2$	—	LPES	79	
(NO) ₂	>2.1	—	LPES	75	
(N ₂ O) _n	$n = 1,2$	—	LPES	81	
Na _n	$n = 2-5$	—	LPES	18	
(NaF) _n	$n = 1-7,12$	—	LPES	64	
Na(NaF) _n	$n = 5,7-12$	—	LPES	64	
Nb _n	$n = 6-17$	—	LPES	181	
Nb ₈	1.513	0.008	LPES	157	
Nb ₃ O	1.393	0.006	LPES	169	
Ni(CO) ₂	0.643	0.014	LPES	2	
Ni(CO) ₃	1.077	0.013	LPES	2	
NiO ₂	3.05	0.01	LPES	145	ONiO
NiO ₂	0.82	0.03	LPES	145	Ni(O ₂)
OH(H ₂ O)	<2.95	0.15	PT	2	
OH(N ₂ O)	2.14	0.02	LPES	209	
OH(N ₂ O) _n	$n = 1-5$	—	LPES	209	
OsF ₄	3.9	0.3	CT	98	
OsF ₆	6.0	0.3	CT	98	
PBr ₃	1.59	0.15	CD	2	
PBr ₂ Cl	1.63	0.20	CD	2	
PCl ₂ Br	1.52	0.20	CD	2	
PCl ₃	0.82	0.10	CD	2	
PF ₅	0.75	0.15	CT	121	
PO ₃	4.95	0.03	CT	156	
POCl ₂	3.83	0.25	CD	2	
POCl ₃	1.41	0.20	CD	2	
PtF ₄	5.5	0.3	CT	98	
PtF ₆	7.0	0.4	CT	98	
ReF ₆	4.7	estimate	CT	98	
RhF ₄	5.4	0.3	CT	98	
RuF ₄	4.8	0.3	CT	98	

ELECTRON AFFINITIES (continued)

Table 4
Electron Affinities for Larger Polyatomic Molecules (continued)

Molecule	Electron affinity in eV	Uncertainty in eV	Method	Ref.
RuF ₅	5.2	0.4	CT	98
RuF ₆	7.5	0.3	CT	98
SF ₄	1.5	0.2	CT	91
SF ₅	4.23	0.12	e-scat	204
SF ₆	1.05	0.10	CT	56
SO ₃	1.97	0.10	LPES	165
(SO ₂) ₂	0.6	0.2	LPES	80
Sb _n	$n = 2-9$	—	LPES	213
SeF ₆	2.9	0.2	CD	2
Si ₄	2.13	0.01	LPES	110
Si ₅	2.59	0.02	LPES	110
Si ₇	1.85	0.02	LPES	110
Si _n	$n = 3-20$	—	LPES	71
SiD ₃	1.386	0.022	LPES	43
SiF ₃	<2.95	0.10	PT	17
SiH ₃	1.406	0.014	LPES	43
Si ₃ H	2.53	0.01	LPES	182
Si ₄ H	2.68	0.01	LPES	182
Si _n Na _m	$n = 4-11$	$m = 1-3$	LPES	210
Ta ₃ O	1.583	0.010	LPES	169
TeF ₆	3.34	0.17	CD	2
Ti _n	$n = 3-65$	—	LPES	151
TiO ₃	4.2	—	LPES	172
UF ₅	3.7	0.2	CT	98
UF ₆	5.1	0.2	CT	98
UO ₃	<2.1	—	CT	98
V _n	$n = 3-65$	—	LPES	150
VF ₄	3.5	0.2	CT	98
V ₃ O	1.218	0.008	LPES	169
V ₄ O ₁₀	4.2	0.6	CT	101
W(CO) ₃	1.859	0.006	LPES	94
WF ₅	1.25	0.3	CD	18
WF ₆	>3.5	—	CT	19
WO ₃	3.33	+0.04/-0.15	LPT	86
WO ₃	3.9	0.2	CT	98

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ATOMIC AND MOLECULAR POLARIZABILITIES

Thomas M. Miller

The *polarizability* of an atom or molecule describes the response of the electron cloud to an external field. The atomic or molecular energy shift ΔW due to an external electric field E is proportional to E^2 for external fields which are weak compared to the internal electric fields between the nucleus and electron cloud. The *electric dipole polarizability* α is the constant of proportionality defined by $\Delta W = -\alpha E^2/2$. The induced electric dipole moment is αE . *Hyperpolarizabilities*, coefficients of higher powers of E , are less often required. Technically, the polarizability is a tensor quantity but for spherically symmetric charge distributions reduces to a single number. In any case, an *average polarizability* is usually adequate in calculations. Frequency-dependent or *dynamic polarizabilities* are needed for electric fields which vary in time, except for frequencies which are much lower than electron orbital frequencies, where *static polarizabilities* suffice.

Polarizabilities for atoms and molecules in excited states are found to be larger than for ground states and may be positive or negative. Molecular polarizabilities are very slightly temperature dependent since the size of the molecule depends on its rovibrational state. Only in the case of dihydrogen has this effect been studied enough to warrant consideration in Table 3.

Polarizabilities are normally expressed in cgs units of cm^3 . Ground state polarizabilities are in the range of $10^{-24} \text{ cm}^3 = 1 \text{ \AA}^3$ and hence are often given in \AA^3 units. Theorists tend to use atomic units of a_0^3 where a_0 is the Bohr radius. The conversion is $\alpha(\text{cm}^3) = 0.148184 \times 10^{-24} \times \alpha(a_0^3)$. Polarizabilities are only recently encountered in SI units, $\text{C}\cdot\text{m}^2/\text{V} = \text{J}/(\text{V}/\text{m})^2$. The conversion from cgs units to SI units is $\alpha(\text{C}\cdot\text{m}^2/\text{V}) = 4\pi\epsilon_0 \times 10^{-6} \times \alpha(\text{cm}^3)$, where ϵ_0 is the permittivity of free space in SI units and the factor 10^{-6} simply converts cm^3 into m^3 . Thus, $\alpha(\text{C}\cdot\text{m}^2/\text{V}) = 1.11265 \times 10^{-16} \times \alpha(\text{cm}^3)$. Persons measuring excited state polarizabilities by optical methods tend to use units of $\text{MHz}/(\text{V}/\text{cm})^2$, where the energy shift, ΔW , is expressed in frequency units with a factor of h understood. The polarizability is $-2 \Delta W/E^2$. The conversion into cgs units is $\alpha(\text{cm}^3) = 5.95531 \times 10^{-16} \times \alpha[\text{MHz}/(\text{V}/\text{cm})^2]$.

The polarizability appears in many formulas for low-energy processes involving the valence electrons of atoms or molecules. These formulas are given below in cgs units: the polarizability α is in cm^3 ; masses m or μ are in grams; energies are in ergs; and electric charges are in esu, where $e = 4.8032 \times 10^{-10}$ esu. The symbol $\alpha(\nu)$ denotes a frequency (ν) dependent polarizability, where $\alpha(\nu)$ reduces to the static polarizability α for $\nu = 0$. For further information and references, see Miller, T. M., and Bederson, B., *Advances in Atomic and Molecular Physics*, 13, 1, 1977. Details on polarizability-related interactions, especially in regard to hyperpolarizabilities and nonlinear optical phenomena, are given by Bogaard, M. P., and Orr, B. J., in *Physical Chemistry, Series Two, Vol. 2, Molecular Structure and Properties*, Buckingham, A. D., Ed., Butterworths, London, 1975, pp. 149-194. A tabulation of tensor and hyperpolarizabilities is included. The gas number density, n , in Table 1 is usually taken to be that of 1 atm at 0°C in reporting experimental data.

Table 1
Formulas Involving Polarizability

Description	Formula	Remarks
Lorentz-Lorenz relation	$\alpha(\nu) = \frac{3}{4\pi n} \left[\frac{\eta^2(\nu) - 1}{\eta^2(\nu) + 2} \right]$	For a gas of atoms or nonpolar molecules; the index of refraction is $\eta(\nu)$
Refraction by polar molecules	$\alpha(\nu) + \frac{d^2}{3kT} = \frac{3}{4\pi n} \left[\frac{\eta^2(\nu) - 1}{\eta^2(\nu) + 2} \right]$	The dipole moment is d , in esu cm ($= 10^{-18}$ D)
Dielectric constant (dimensionless)	$\kappa(\nu) = 1 + 4\pi n \alpha(\nu)$	From the Lorentz-Lorenz relation for the usual case of $\kappa(\nu) \approx 1$
Index of refraction (dimensionless)	$\eta(\nu) = 1 + 2\pi n \alpha(\nu)$	From $\eta^2(\nu) = \kappa(\nu)$
Diamagnetic susceptibility	$\chi_m = e^2 (a_0 N \alpha)^{1/2} / 4m_e c^2$	From the approximation that the static polarizability is given by the variational formula $\alpha = (4/9a_0) \sum (N_i r_i^2)^2$; N is the number of electrons, m_e is the electron mass; a crude approximation is $\chi_m = (E_i/4m_e c^2) \alpha$, where E_i is the ionization energy
Long-range electron- or ion-molecule interaction energy	$V(r) = -e^2 \alpha / 2r^4$	The target molecule polarizability is α
Ion mobility in a gas	$\kappa = 13.87 / (\alpha \mu)^{1/2} \text{ cm}^2 / \text{V} \cdot \text{s}$	This one formula is not in cgs units. Enter α in \AA^3 or 10^{-24} cm^3 units and the reduced mass μ of the ion-molecule pair in amu. Classical limit; pure polarization potential

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 1
Formulas Involving Polarizability (continued)

Description	Formula	Remarks
Langevin capture cross section	$\sigma(v_o) = (2\pi e/v_o)(\alpha/\mu)^{1/2}$	The relative velocity of approach for an ion-molecule pair is v_o ; the target molecular polarizability is α and the reduced mass of the ion-molecule pair is μ
Langevin reaction rate coefficient	$k = 2\pi e(\alpha/\mu)^{1/2}$	Collisional rate coefficient for an ion-molecule reaction
Rate coefficient for polar molecules	$k_d = 2\pi e\left[(\alpha/\mu)^{1/2} + cd(2/\mu\pi kT)^{1/2}\right]$	The dipole moment of the neutral is d in esu-cm; the number c is a "locking factor" that depends on α and d , and is between 0 and 1
Modified effective range cross section for electron-neutral scattering	$\begin{aligned} \sigma(k) &= 4\pi A^2 \\ &+ 32\pi^4 \mu e^2 \alpha A k / 3h^2 \\ &+ \dots \end{aligned}$	Here, k is the electron momentum divided by $h/2\pi$, where h is Planck's constant; A is called the "scattering length"; the reduced mass is μ
van der Waals constant between two systems A, B	$C_6 = \frac{3}{2} \left[\frac{\alpha^A \alpha^B E^A E^B}{E^A + E^B} \right]$	For the interaction potential term $V_6(r) = -C_6/r^6$; $E^{A,B}$ represents average dipole transition energies and $\alpha^{A,B}$ the respective polarizabilities of A, B
Dipole-quadrupole constant between two systems A, B	$\begin{aligned} C_8 &= \frac{15}{4} \left[\frac{\alpha^A \alpha_q^B E^A E_q^B}{E^A + E_q^B} \right] \\ &+ \frac{15}{4} \left[\frac{\alpha_q^A \alpha^B E_q^A E^B}{E_q^A + E^B} \right] \end{aligned}$	For the interaction potential term $V_8(r) = -C_8/r^8$; $E_q^{A,B}$ represents average quadrupole transition energies and $\alpha_q^{A,B}$ are the respective quadrupole polarizabilities of A, B
van der Waals constant between an atom and a surface	$C_3 = \frac{\alpha g E^A E^S}{8(E^A + E^S)}$	For an interaction potential $V_3(r) = -C_3/r^3$; $E^{A,S}$ are characteristic energies of the atom and surface; $g = 1$ for a free-electron metal and $g = (\epsilon_\infty - 1)/(\epsilon_\infty + 1)$ for an ionic crystal
Relation between $\alpha(v)$ and oscillator strengths	$\alpha(v) = \frac{e^2 h^2}{4\pi^2 m_e} \sum \frac{f_k}{E_k^2 - (hv)^2}$	Here, f_k is the oscillator strength from the ground state to an excited state k , with excitation energy E_k . This formula is often used to estimate static polarizabilities ($v=0$)
Dynamic polarizability	$\alpha(v) = \frac{\alpha E_r^2}{E_r^2 - (hv)^2}$	Approximate variation of the frequency-dependent polarizability $\alpha(v)$ from $v=0$ up to the first dipole-allowed electronic transition, of energy E_r ; the static dipole polarizability is $\alpha(0)$; infrared contributions ignored
Rayleigh scattering cross section	$\begin{aligned} \alpha(v) &= \frac{8\pi}{9c^4} (2\pi v)^4 \\ &\times [3\alpha^2(v) + 2\gamma^2(v)/3] \end{aligned}$	The photon frequency is v ; the polarizability anisotropy (the difference between polarizabilities parallel and perpendicular to the molecular axis) is $\gamma(v)$
Verdet constant	$V(v) = \frac{vn}{2m_e c^2} \left[\frac{d\alpha(v)}{dv} \right]$	Defined from $\theta = V(v)B$, where θ is the angle of rotation of linearly polarized light through a medium of number density n , per unit length, for a longitudinal magnetic field strength B (Faraday effect)

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 2
Static Average Electric Dipole Polarizabilities for Ground State Atoms (in Units of 10^{-24} cm³)

Atomic number	Atom	Polarizability	Estimated accuracy (%)	Method	Ref.
1	H	0.666793	"exact"	calc	MB77
2	He	0.204956	"exact"	calc	MB77
		0.2050	0.1	index/diel	NB65/OC67
3	Li	24.3	2	beam	MB77
4	Be	5.60	2	calc	MB77
5	B	3.03	2	calc	MB77
6	C	1.76	2	calc	MB77
7	N	1.10	2	calc/index	MB77
8	O	0.802	2	calc/index	MB77
9	F	0.557	2	calc	MB77
10	Ne	0.3956	0.1	diel	OC67
11	Na	24.08	0.4	interferom	ESCHP94
12	Mg	10.6	2	calc	MB77
13	Al	6.8	4.4	beam	MMD90
14	Si	5.38	2	calc	MB77
15	P	3.63	2	calc	MB77
16	S	2.90	2	calc	MB77
17	Cl	2.18	2	calc	MB77
18	Ar	1.6411	0.05	index/diel	NB65/OC67
19	K	43.4	2	beam	MB77
20	Ca	22.8	2	calc	MB77
		25.0	8	beam	MB77
21	Sc	17.8	25	calc	D84
22	Ti	14.6	25	calc	D84
23	V	12.4	25	calc	D84
24	Cr	11.6	25	calc	D84
25	Mn	9.4	25	calc	D84
26	Fe	8.4	25	calc	D84
27	Co	7.5	25	calc	D84
28	Ni	6.8	25	calc	D84
29	Cu	6.1	25	calc	D84
30	Zn	5.75	0.12	index	GHM96
		5.6	25	calc	D84
31	Ga	8.12	2	calc	MB77
32	Ge	6.07	2	calc	MB77
33	As	4.31	2	calc	MB77
34	Se	3.77	2	calc	MB77
35	Br	3.05	2	calc	MB77
36	Kr	2.4844	0.05	diel	OC67
37	Rb	47.3	2	beam	MB77
38	Sr	27.6	8	beam	MB77
39	Y	22.7	25	calc	D84
40	Zr	17.9	25	calc	D84
41	Nb	15.7	25	calc	D84
42	Mo	12.8	25	calc	D84
43	Tc	11.4	25	calc	D84
44	Ru	9.6	25	calc	D84
45	Rh	8.6	25	calc	D84
46	Pd	4.8	25	calc	D84
47	Ag	7.2	25	calc	D84
48	Cd	7.36	0.24	index	GH95
		7.2	25	calc	D84
49	In	10.2	12	beam	GMBSJ84
		9.1	25	calc	D84

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 2
Static Average Electric Dipole Polarizabilities for Ground State Atoms (in Units of 10^{-24} cm³)
(continued)

Atomic number	Atom	Polarizability	Estimated accuracy (%)	Method	Ref.
50	Sn	7.7	25	calc	D84
51	Sb	6.6	25	calc	D84
52	Te	5.5	25	calc	D84
53	I	5.35	25	index	A56
		4.7	25	calc	D84
54	Xe	4.044	0.5	diel	MB77
55	Cs	59.6	2	beam	MB77
56	Ba	39.7	8	beam	MB77
57	La	31.1	25	calc	D84
58	Ce	29.6	25	calc	D84
59	Pr	28.2	25	calc	D84
60	Nd	31.4	25	calc	D84
61	Pm	30.1	25	calc	D84
62	Sm	28.8	25	calc	D84
63	Eu	27.7	25	calc	D84
64	Gd	23.5	25	calc	D84
65	Tb	25.5	25	calc	D84
66	Dy	24.5	25	calc	D84
67	Ho	23.6	25	calc	D84
68	Er	22.7	25	calc	D84
69	Tm	21.8	25	calc	D84
70	Yb	21.0	25	calc	D84
71	Lu	21.9	25	calc	D84
72	Hf	16.2	25	calc	D84
73	Ta	13.1	25	calc	D84
74	W	11.1	25	calc	D84
75	Re	9.7	25	calc	D84
76	Os	8.5	25	calc	D84
77	Ir	7.6	25	calc	D84
78	Pt	6.5	25	calc	D84
79	Au	5.8	25	calc	D84
80	Hg	5.02	0.05	index	GH96
		5.7	25	calc	D84
81	Tl	7.6	15	beam	NYU84
		7.5	25	calc	D84
82	Pb	6.8	25	calc	D84
83	Bi	7.4	25	calc	D84
84	Po	6.8	25	calc	D84
85	At	6.0	25	calc	D84
86	Rn	5.3	25	calc	D84
87	Fr	48.7	25	calc	D84
88	Ra	38.3	25	calc	D84
89	Ac	32.1	25	calc	D84
90	Th	32.1	25	calc	D84
91	Pa	25.4	25	calc	D84
92	U	24.9	6	beam	KB94
93	Np	24.8	25	calc	D84
94	Pu	24.5	25	calc	D84
95	Am	23.3	25	calc	D84
96	Cm	23.0	25	calc	D84
97	Bk	22.7	25	calc	D84
98	Cf	20.5	25	calc	D84
99	Es	19.7	25	calc	D84

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 2
Static Average Electric Dipole Polarizabilities for Ground State Atoms (in Units of 10^{-24} cm³)
(continued)

Atomic number	Atom	Polarizability	Estimated accuracy (%)	Method	Ref.
100	Fm	23.8	25	calc	D84
101	Md	18.2	25	calc	D84
102	No	17.5	25	calc	D84

Note: calc = calculated value; beam = atomic beam deflection technique; interferom = atomic beam interference; index = determination based on the measured index of refraction; diel = determination based on the measured dielectric constant.

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Table 3
Average Electric Dipole Polarizabilities for Ground State Diatomic Molecules (in Units of 10^{-24} cm³)

Molecule	Polarizability	Ref.	Molecule	Polarizability	Ref.
Al ₂	19	23	HI	5.44	3
BH	3.32*	1		5.35	2
Br ₂	7.02	2	HgCl	7.4*	9
CO	1.95	3	ICl	12.3	2
Cl ₂	4.61	3	K ₂	77	22
Cs ₂	104	22		72	21
CsK	89	22	Li ₂	34	22
D ₂ (v = 0, J = 0)	0.7921*	5	LiCl	3.46*	10
D ₂ (293 K)	0.7954	6	LiF	10.8*	11
DCI	2.84	2	LiH	3.84*	12
F ₂	1.38*	7		3.68*	13
H ₂ (v = 0, J = 0)	0.8023*	5		3.88*	14
H ₂ (293 K)	0.8045*	5	N ₂	1.7403	6,8
H ₂ (293 K)	0.8042	6	NO	1.70	2
H ₂ (322 K)	0.8059	8	Na ₂	40	22
HBr	3.61	3		38	21
HCl	2.63	3	NaK	51	22
	2.77	2	NaLi	40	4
HD (v = 0, J = 0)	0.7976*	5	O ₂	1.5812	6
HF	0.80	27	Rb ₂	79	22

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 4
Average Electric Dipole Polarizabilities for Ground State Triatomic Molecules (in Units of 10^{-24} cm^3)

Molecule	Polarizability	Ref.	Molecule	Polarizability	Ref.	Molecule	Polarizability	Ref.
BeH ₂	4.34*	14	HCN	2.59	3	O ₃	3.21	2
CO ₂	2.911	8		2.46	2	OCS	5.71	2
CS ₂	8.74	3	HgBr ₂	14.5	2		5.2	15
	8.86	2	HgCl ₂	11.6	2	SO ₂	3.72	3
D ₂ O	1.26	2	HgI ₂	19.1	2		4.28	2
H ₂ O	1.45	2	N ₂ O	3.03	8			
H ₂ S	3.78	3	NO ₂	3.02	2†			
	3.95	2	Na ₃	70	21			

Table 5
Average Electric Dipole Polarizabilities for Ground State Inorganic Polyatomic Molecules (Larger than Triatomic) (in Units of 10^{-24} cm^3)

Molecule	Polarizability	Ref.	Molecule	Polarizability	Ref.
AsCl ₃	14.9	2	Na _n	$n = 1-40$	21
AsN ₃	5.75	2	(NaBr) ₂	26.8	16
BCl ₃	9.38	20	(NaCl) ₂	23.4	16
BF ₃	3.31	2	(NaF) ₂	20.7	16
(BN ₃) ₂	5.73	2	(NaI) ₂	26.9	16
(BH ₂ N) ₃	8.0	2†	OsO ₄	8.17	2
ClF ₃	6.32	2	PCl ₃	12.8	2
(CsBr) ₂	54.5	16	PF ₅	6.10	2
(CsCl) ₂	42.4	16	PH ₃	4.84	2
(CsF) ₂	28.4	16	(RbBr) ₂	48.2	16
(CsI) ₂	51.8	16	(RbCl) ₂	43.2	16
Ga _n As _m	$n + m = 4-30$	28	(RbF) ₂	40.7	16
GeCl ₄	15.1	2	(RbI) ₂	46.3	16
GeH ₃ Cl	6.7	2†	SF ₆	6.54	8
(HgCl) ₂	14.7	9	(SF ₅) ₂	13.2	2
K _n	$n = 2,5,7-9,11,20$	21	SO ₃	4.84	2
(KBr) ₂	42.0	16	SO ₂ Cl ₂	10.5	2
(KCl) ₂	32.1	16	SeF ₆	7.33	2
(KF) ₂	21.0	16	SiF ₄	5.45	2
(KI) ₂	36.3	16	SiH ₄	5.44	2
(LiBr) ₂	18.9	16	(SiH ₃) ₂	11.1	2
(LiCl) ₂	13.1	16	SiHCl ₃	10.7	2
(LiF) ₂	6.9	16	SiH ₂ Cl ₂	8.92	2
(LiI) ₂	23.4	16	SiH ₃ Cl	7.02	2
ND ₃	1.70	2	SnBr ₄	22.0	2
NF ₃	3.62	2	SnCl ₄	18.0	2
NH ₃	2.81	20		13.8	15
	2.10	2	SnI ₄	32.3	2
	2.26	3	TeF ₆	9.00	2
(NO ₂) ₂	6.69	2	TiCl ₄	16.4	2
			UF ₆	12.5	2

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 6
 Average Electric Dipole Polarizabilities for Ground State Hydrocarbon Molecules (in Units of 10^{-24} cm³)

Molecule	Name	Polarizability	Ref.	Molecule	Name	Polarizability	Ref.
CH ₄	methane	2.593	8	C ₈ H ₁₀	ethylbenzene	14.2	2
C ₂ H ₂	acetylene	3.33	3		<i>o</i> -xylene	14.9	2
		3.93	2			14.1	15
C ₂ H ₄	ethylene	4.252	8		<i>p</i> -xylene	13.7	25
C ₂ H ₆	ethane	4.47	3			14.2	15
		4.43	2			14.9	2
C ₃ H ₄	propyne	6.18	2		<i>m</i> -xylene	14.2	15
C ₃ H ₆	propene	6.26	2	C ₈ H ₁₆	ethylcyclohexane	15.9	2
	cyclopropane	5.66	2	C ₈ H ₁₈	<i>n</i> -octane	15.9	2
C ₃ H ₈	propane	6.29	3		3-methylheptane	15.4	27
		6.37	2		2,2,4-trimethylpentane	15.4	27
C ₄ H ₆	1-butyne	7.41	2 [†]	C ₉ H ₁₀	α -methylstyrene	16.05	27
	1,3-butadiene	8.64	2	C ₉ H ₁₂	isopropylbenzene	16.0	2-
C ₄ H ₈	1-butene	7.97	2		mesitylene	15.5	25
		8.52	2			16.1	27
	<i>trans</i> -2-butene	8.49	2	C ₉ H ₁₈	isopropylcyclohexane	17.2	2
	2-methylpropene	8.29	2	C ₉ H ₂₀	nonane	17.4	27
C ₄ H ₁₀	butane	8.20	2	C ₁₀ H ₈	naphthalene	16.5	17
	isobutane	8.14	27			17.5	27
C ₅ H ₆	1,3-cyclopentadiene	8.64	2	C ₁₀ H ₁₄	durene	17.3	25
C ₅ H ₈	1-pentyne	9.12	2		<i>tert</i> -butylbenzene	17.2	25
	<i>trans</i> -1,3-pentadiene	10.0	2			17.8	2 [†]
	isoprene	9.99	2	C ₁₀ H ₂₀	<i>tert</i> -butylcyclohexane	19.8	2
C ₅ H ₁₀	cyclopentane	9.15	18	C ₁₀ H ₂₂	decane	19.1	27
	1-pentene	9.65	27	C ₁₁ H ₁₀	α -methylnaphthalene	19.35	27
	2-pentene	9.84	27		β -methylnaphthalene	19.52	27
C ₅ H ₁₂	pentane	9.99	2	C ₁₁ H ₁₄	α,β,β -trimethylstyrene	19.64	27
	neopentane	10.20	18	C ₁₁ H ₁₆	pentamethylbenzene	19.1	25
C ₆ H ₆	benzene	10.0	25	C ₁₁ H ₂₄	undecane	21.0	27
		10.32	3	C ₁₂ H ₁₀	acenaphthene	20.6	27
		10.74	2	C ₁₂ H ₁₂	α -ethylnaphthalene	21.19	27
C ₆ H ₁₀	1-hexyne	10.9	2 [†]		β -ethylnaphthalene	21.36	27
	2-ethyl-1,3-butadiene	11.8	2 [†]	C ₁₂ H ₁₈	hexamethylbenzene	20.9	25
	3-methyl-1,3-pentadiene	11.8	2 [†]	C ₁₂ H ₂₆	dodecane	22.8	27
	2-methyl-1,3-pentadiene	12.1	2 [†]	C ₁₃ H ₁₀	fluorene	21.7	27
	2,3-dimethyl-1,3-butadiene	11.8	2 [†]	C ₁₄ H ₁₀	anthracene	25.4	17
	cyclohexene	10.7	2 [†]			25.9	27
C ₆ H ₁₂	cyclohexane	11.0	18		phenanthrene	36.8*	17
		10.87	15			24.7	27
	1-hexene	11.7	27	C ₁₄ H ₂₂	<i>p</i> -di- <i>tert</i> -butylbenzene	24.5	25
C ₆ H ₁₄	hexane	11.9	2	C ₁₆ H ₁₀	pyrene	28.2	27
C ₇ H ₈	toluene	11.8	25	C ₁₇ H ₁₂	2,3-benzfluorene	30.2	27
		12.26	15	C ₁₈ H ₁₂	naphthacene	32.3	27
		12.3	2		1,2-benzanthracene	32.9	27
C ₇ H ₁₂	1-heptyne	12.8	2 [†]		chrysene	33.1	27
C ₇ H ₁₄	methylcyclohexane	13.1	2		triphenylene	31.1	27
	1-heptene	13.5	27	C ₁₈ H ₃₀	1,3,5-tri- <i>tert</i> -butylbenzene	31.8	25
C ₇ H ₁₆	heptane	13.7	2	C ₂₄ H ₁₂	coronene	42.50	27
C ₈ H ₈	styrene	15.0	2				
		14.4	27				

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 7
Average Electric Dipole Polarizabilities for Ground State Organic Halides (in Units of 10^{-24} cm^3)

Molecule	Name	Polarizability	Ref.
CBr_2F_2	dibromodifluoromethane	9.0	2 [†]
CClF_3	chlorotrifluoromethane	5.72	20
		5.59	2
CCl_2F_2	dichlorodifluoromethane	7.93	20
		7.81	2
CCl_2O	phosgene	7.29	2
CCl_2S	thiophosgene	10.2	2
CCl_3F	trichlorofluoromethane	9.47	2
CCl_3NO_2	trichloronitromethane	10.8	2 [†]
CCl_4	carbon tetrachloride	11.2	2
		10.5	3
CF_4	carbon tetrafluoride	3.838	8
CF_2O	carbonyl fluoride	1.88*	17
CHBr_3	bromoform	11.8	27
CHBrF_2	bromodifluoromethane	5.7	2 [†]
CHClF_2	chlorodifluoromethane	6.38	20
		5.91	2
CHCl_2F	dichlorofluoromethane	6.82	2
CHCl_3	chloroform	9.5	8
		8.23	27
CHF_3	fluoroform	3.52	20
		3.57	8
CHFO	fluoroformaldehyde	1.76*	17
CHI_3	iodoform	18.0	17
CH_2Br_2	dibromomethane	9.32	2
		8.62	27
CH_2ClNO_2	chloronitromethane	6.9	2 [†]
CH_2Cl_2	dichloromethane	6.48	3
		7.93	2
CH_2I_2	diiodomethane	12.90	27
CH_3Br	bromomethane	5.87	20
		6.03	2
		5.55	15
CH_3Cl	chloromethane	5.35	20
		4.72	8
CH_3F	fluoromethane	2.97	8
CH_3I	iodomethane	7.97	2
C_2ClF_5	chloropentafluoroethane	6.3	2 [†]
$\text{C}_2\text{Cl}_2\text{F}_4$	1,2-dichlorotetrafluoroethane	8.5	2 [†]
$\text{C}_2\text{Cl}_3\text{N}$	trichloroacetonitrile	10.42	18
C_2F_6	hexafluoroethane	6.82	2
C_2HBr	bromoacetylene	7.39	2
C_2HCl	chloroacetylene	6.07	2
C_2HCl_5	pentachloroethane	14.0	2
$\text{C}_2\text{H}_2\text{Cl}_2$	1,1-dichloroethylene	7.83	27
	<i>trans</i> -1,2-dichloroethylene	8.15	27
	<i>cis</i> -1,2-dichloroethylene	8.03	27
$\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$	1,1-dichloro-2,2-difluoroethane	8.4	2 [†]
$\text{C}_2\text{H}_2\text{Cl}_2\text{O}$	chloroacetyl chloride	8.92	2
$\text{C}_2\text{H}_2\text{Cl}_3\text{F}$	1,2,2-trichloro-1-fluoroethane	10.2	2 [†]
$\text{C}_2\text{H}_2\text{Cl}_4$	1,1,2,2-tetrachloroethane	12.1	2 [†]
$\text{C}_2\text{H}_2\text{ClN}$	chloroacetonitrile	6.10	18
$\text{C}_2\text{H}_2\text{F}_2$	1,1-difluoroethylene	5.01	20
$\text{C}_2\text{H}_3\text{Br}$	bromoethylene	7.59	2
$\text{C}_2\text{H}_3\text{Cl}$	chloroethylene	6.41	2

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 7
Average Electric Dipole Polarizabilities for Ground State Organic
Halides (in Units of 10^{-24} cm³) (continued)

Molecule	Name	Polarizability	Ref.
C ₂ H ₃ ClF ₂	1-chloro-1,1-difluoroethane	8.05	2
C ₂ H ₃ ClO	acetyl chloride	6.62	2
C ₂ H ₃ ClO ₂	methyl chloroformate	7.1	2 [†]
C ₂ H ₃ Cl ₃	1,1,1-trichloroethane	10.7	2
C ₂ H ₃ F ₃	1,1,1-trifluoroethane	4.4	2 [†]
C ₂ H ₃ I	iodoethylene	9.3	2 [†]
C ₂ H ₃ BrCl	1-bromo-2-chloroethane	9.5	2 [†]
C ₂ H ₄ Br ₂	1,2-dibromomethane	10.7	2 [†]
C ₂ H ₄ ClF	1-chloro-2-fluoroethane	6.5	2 [†]
C ₂ H ₄ ClNO ₂	1-chloro-1-nitroethane	10.9	2
C ₂ H ₄ Cl ₂	1,1-dichloroethane	8.64	2
	1,2-dichloroethane	8.0	2 [†]
C ₂ H ₅ Br	bromoethane	8.05	2
		7.28	27
C ₂ H ₅ Cl	chloroethane	7.27	20
		8.29	2
		6.4	15
C ₂ H ₅ ClO	2-chloroethanol	7.1	2 [†]
		6.88	27
	chloromethyl methyl ether	7.1	2 [†]
C ₂ H ₅ F	fluoroethane	4.96	2
C ₂ H ₅ I	iodoethane	10.0	2
C ₃ H ₄ Cl ₂	dichloropropene	10.1	2 [†]
C ₃ H ₅ Cl	chloropropene	8.3	2
C ₃ H ₅ ClO	chloroacetone	8.4	2 [†]
C ₃ H ₅ ClO ₂	ethyl chloroformate	9.0	2 [†]
C ₃ H ₆ ClNO ₂	1-chloro-1-nitropropane	10.4	2 [†]
C ₃ H ₆ Cl ₂	dichloropropane	10.9	2 [†]
C ₃ H ₇ Br	1-bromopropane	9.4	2 [†]
		9.07	27
	2-bromopropane	9.6	2 [†]
C ₃ H ₇ Cl	chloropropane	10.0	2
C ₃ H ₇ ClO	β-chloroethyl methyl ether	8.71	27
	2-chloro-1-propanol	8.89	27
	3-chloro-1-propanol	8.84	27
C ₃ H ₇ I	1-iodopropane	11.5	2 [†]
C ₄ H ₅ Cl	4-chloro-1,2-butadiene	10.0	2 [†]
C ₄ H ₇ Cl	1-chloro-2-methylpropene	10.8	2
C ₄ H ₇ ClO ₂	2-chlorobutyric acid	10.7	27
	3-chlorobutyric acid	10.7	27
	4-chlorobutyric acid	10.6	27
C ₄ H ₈ Cl ₂	1,4-dichlorobutane	12.0	2 [†]
C ₄ H ₉ Br	bromobutane	13.9	2
		10.86	27
C ₄ H ₉ Cl	1-chlorobutane	11.3	2
	1-chloro-2-methylpropane	11.1	2
	2-chloro-2-methylpropane	12.5	2 [†]
	2-chlorobutane	12.4	2
C ₄ H ₉ ClO	β-chloroethyl ethyl ether	10.56	27
	2-chloro-1-butanol	10.70	27
	3-chloro-1-butanol	10.38	27
C ₄ H ₉ I	1-iodobutane	13.3	2 [†]
		12.65	27
C ₅ H ₉ ClO ₂	methyl 2-chlorobutanoate	12.33	27
	methyl 3-chlorobutanoate	12.31	27

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 7
Average Electric Dipole Polarizabilities for Ground State Organic Halides (in Units of 10^{-24} cm³) (continued)

Molecule	Name	Polarizability	Ref.
	methyl 4-chlorobutanoate	12.27	27
	2-chloropentanoic acid	12.69	27
	3-chloropentanoic acid	12.57	27
	4-chloropentanoic acid	12.53	27
C ₅ H ₁₁ Br	1-bromopentane	13.1	2 [†]
C ₅ H ₁₁ Cl	1-chloropentane	12.0	2 [†]
C ₅ H ₁₁ F	fluoropentane	9.95	27
C ₆ F ₆	hexafluorobenzene	9.58	27
C ₆ HF ₅	pentafluorobenzene	9.63	27
C ₆ H ₂ Cl ₂ O ₂	2,5-dichloro-1,4-benzoquinone	18.4	2
C ₆ H ₂ F ₄	1,2,3,4-tetrafluorobenzene	9.69	27
	1,2,4,5-tetrafluorobenzene	9.69	27
C ₆ H ₃ F ₃	1,3,5-trifluorobenzene	9.74	27
C ₆ H ₄ BrF	<i>p</i> -bromofluorobenzene	13.4	2 [†]
C ₆ H ₄ ClNO ₂	chloronitrobenzene	14.6	2 [†]
C ₆ H ₄ Cl ₂	<i>o</i> -dichlorobenzene	14.17	27
	<i>m</i> -dichlorobenzene	14.23	27
	<i>p</i> -dichlorobenzene	14.20	27
C ₆ H ₄ FI	<i>p</i> -fluoroiodobenzene	15.5	2 [†]
C ₆ H ₄ FNO ₂	<i>p</i> -fluoronitrobenzene	12.8	2 [†]
C ₆ H ₄ F ₂	<i>o</i> -difluorobenzene	9.80	27
	<i>m</i> -difluorobenzene	10.3	2 [†]
	<i>p</i> -difluorobenzene	9.80	27
C ₆ H ₅ Br	bromobenzene	14.7	2
		13.62	27
C ₆ H ₅ Cl	chlorobenzene	14.1	2
		12.3	15
C ₆ H ₅ ClO	chlorophenol	13.0	2 [†]
C ₆ H ₅ F	fluorobenzene	10.3	2
C ₆ H ₅ I	iodobenzene	15.5	2 [†]
C ₆ H ₁₁ ClO ₂	ethyl 2-chlorobutanoate	14.16	27
	ethyl 3-chlorobutanoate	14.13	27
	ethyl 4-chlorobutanoate	14.11	27
C ₆ H ₁₃ Br	bromohexane	14.44	27
C ₆ H ₁₃ F	fluorohexane	11.80	27
C ₇ H ₇ Br	<i>p</i> -bromotoluene	14.80	27
C ₇ H ₇ Cl	<i>p</i> -chlorotoluene	13.70	27
C ₇ H ₇ F	<i>p</i> -fluorotoluene	11.70	27
C ₇ H ₇ I	<i>p</i> -iodotoluene	17.10	27
C ₇ H ₁₅ Br	1-bromoheptane	16.8	2 [†]
		16.23	27
C ₇ H ₁₅ F	fluoroheptane	13.66	27
C ₈ H ₁₇ Br	bromooctane	18.02	27
C ₈ H ₁₇ F	fluorooctane	15.46	27
C ₉ H ₁₉ Br	bromononane	19.81	27
C ₉ H ₁₉ F	fluorononane	17.34	27
C ₁₀ F ₈	octafluoronaphthalene	17.64	27
C ₁₀ H ₇ Br	α -bromonaphthalene	20.34	27
C ₁₀ H ₇ Cl	α -chloronaphthalene	19.30	27
	β -chloronaphthalene	19.58	27
C ₁₀ H ₇ I	α -iodonaphthalene	22.41	27
	β -iodonaphthalene	22.95	27
C ₁₀ H ₂₁ Br	bromodecane	21.60	27
C ₁₀ H ₂₁ F	fluorodecane	19.18	27

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 7
Average Electric Dipole Polarizabilities for Ground State Organic Halides (in Units of 10^{-24} cm³) (continued)

Molecule	Name	Polarizability	Ref.
C ₁₁ H ₂₃ F	fluoroundecane	21.00	27
C ₁₂ H ₂₅ Br	bromododecane	25.18	27
C ₁₂ H ₂₅ F	fluorododecane	22.83	27
C ₁₂ H ₈ Br ₂ O	4,4'-dibromodiphenyl ether	27.8	2 [†]
C ₁₂ H ₉ BrO	4-bromodiphenyl ether	24.2	2 [†]
C ₁₃ H ₁₁ BrO	<i>p</i> -bromophenyl- <i>p</i> -tolyl ether	26.6	2 [†]
C ₁₄ H ₉ Br	9-bromoanthracene	28.32	27
C ₁₄ H ₉ Cl	9-chloroanthracene	27.35	27
C ₁₄ H ₉ F	fluoroanthracene	28.34	27
C ₁₄ H ₂₉ F	fluorotetradecane	26.57	27
C ₁₆ H ₃₃ Br	bromohexadecane	32.34	27
C ₁₈ H ₃₇ Br	bromooctadecane	35.92	27

Table 8
Static Average Electric Dipole Polarizabilities for Other Ground State Organic Molecules (in Units of 10^{-24} cm³)

Molecule	Name	Polarizability	Ref.
CN ₄ O ₈	tetranitromethane	15.3	2
CH ₂ O	formaldehyde	2.8	2 [†]
		2.45	18
CH ₂ O ₂	formic acid	3.4	2 [†]
CH ₃ NO	formamide	4.2	2 [†]
		4.08	18
CH ₃ NO ₂	nitromethane	7.37	2
CH ₄ O	methanol	3.29	2
		3.23	15
		3.32	18
CH ₅ N	methyl amine	4.7	2
		4.01	19
C ₂ N ₂	cyanogen	7.99	2
C ₂ H ₂ O	ketene	4.4	2 [†]
C ₂ H ₃ N	acetonitrile	4.40	2 [†]
		4.48	18
C ₂ H ₄ O	acetaldehyde	4.6	2 [†]
		4.59	18
	ethylene oxide	4.43	18
C ₂ H ₄ O ₂	acetic acid	5.1	2 [†]
	methyl formate	5.05	27
C ₂ H ₄ O ₄	formic acid dimer	12.7	2
C ₂ H ₅ NO	acetamide	5.67	18
	<i>N</i> -methyl formamide	5.91	18
C ₂ H ₅ NO ₂	nitroethane	9.63	2
	ethyl nitrite	7.0	15
C ₂ H ₆ O	ethanol	5.41	2
		5.11	18
	methyl ether	5.29	20
		5.84	2
		5.16	15
C ₂ H ₆ O ₂	ethylene glycol	5.7	2 [†]
		5.61	27
C ₂ H ₆ O ₂ S	dimethyl sulfone	7.3	2 [†]

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 8
Static Average Electric Dipole Polarizabilities for Other Ground State
Organic Molecules (in Units of 10^{-24} cm³) (continued)

Molecule	Name	Polarizability	Ref.
C ₂ H ₆ S	ethanethiol	7.41	2
C ₂ H ₇ N	ethyl amine	7.10	2
	dimethyl amine	6.37	2
C ₂ H ₈ N ₂	ethylene diamine	7.2	2 [†]
C ₃ H ₂ N ₂	malononitrile	5.79	18
C ₃ H ₃ N	acrylonitrile	8.05	2
C ₃ H ₄ N ₂	pyrazole	7.23	27
C ₃ H ₄ O	propenal	6.38	2 [†]
C ₃ H ₅ N	propionitrile	6.70	2
		6.24	18
C ₃ H ₆ O	acetone	6.33	15
		6.4	2 [†]
		6.39	18
	allyl alcohol	7.65	2
	propionaldehyde	6.50	2
C ₃ H ₆ O ₂	propionic acid	6.9	2 [†]
	ethyl formate	8.01	2
		6.88	27
	methyl acetate	6.94	2
		6.81	27
C ₃ H ₆ O ₃	dimethyl carbonate	7.7	2 [†]
C ₃ H ₇ NO	<i>N</i> -methyl acetamide	7.82	18
	<i>N,N</i> -dimethyl formamide	7.81	18
C ₃ H ₇ NO ₂	nitropropane	8.5	2 [†]
C ₃ H ₈ O	2-propanol	7.61	2
		6.97	18
	1-propanol	6.74	2
	ethyl methyl ether	7.93	2
C ₃ H ₈ O ₂	dimethoxymethane	7.7	2 [†]
	ethylene glycol monoethyl ether	7.44	27
C ₃ H ₉ N	propylamine	7.70	27
		9.20	2
	isopropylamine	7.77	27
	trimethylamine	8.15	2
C ₄ H ₂ N ₂	fumaronitrile	11.8	2
C ₄ H ₄ N ₂	succinonitrile	8.1	2 [†]
	pyrimidene	8.53*	17
	pyridazine	9.27*	17
C ₄ H ₄ O ₂	diketene	8.0	2 [†]
C ₄ H ₄ S	thiophene	9.67	2
C ₄ H ₅ N	methacrylonitrile	8.0	2 [†]
	<i>trans</i> -crotononitrile	8.2	2 [†]
C ₄ H ₆ N ₂	<i>N</i> -methylpyrazole	8.99	27
C ₄ H ₆ O	crotonaldehyde	8.5	2 [†]
	methacrylaldehyde	8.3	2 [†]
C ₄ H ₆ O ₂	biacetyl	8.2	2 [†]
C ₄ H ₆ O ₃	acetic anhydride	8.9	2 [†]
C ₄ H ₆ S	divinyl sulfide	10.9	2 [†]
C ₄ H ₇ N	butyronitrile	8.4	2 [†]
	isobutyronitrile	8.05	18
C ₄ H ₈ O	butanal	8.2	2 [†]
	methyl ethyl ketone	8.13	15
	<i>trans</i> -2,3-epoxy butane	8.22 [†]	17
C ₄ H ₈ O ₂	ethyl acetate	9.7	2
		8.62	27

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 8
Static Average Electric Dipole Polarizabilities for Other Ground State
Organic Molecules (in Units of 10^{-24} cm³) (continued)

Molecule	Name	Polarizability	Ref.
	1,4-dioxane	10.0	2
	<i>p</i> -dioxane	8.60	18
	2-methyl-1,3-dioxolane	9.44	15
	butyric acid	8.38	27
	methyl propionate	8.97	27
C ₄ H ₉ NO ₂	1-nitrobutane	10.4	2 [†]
	2-methyl-2-nitropropane	10.3	2 [†]
C ₄ H ₁₀ O	ethyl ether	10.2	2
		8.73	15
	1-butanol	8.88	2
	2-methylpropanol	8.92	2
	methyl propyl ether	8.86	27
C ₄ H ₁₀ O ₂	ethylene glycol monoethyl ether	9.28	27
C ₄ H ₁₀ S	ethyl sulfide	10.8	2
C ₄ H ₁₁ N	butylamine	13.5	2
	diethylamine	10.2	2
		9.61	27
C ₅ H ₅ N	pyridine	9.5	15
		9.18	27
	4-cyano-1,2-butadiene	10.5	2 [†]
C ₅ H ₈ N ₂	1,5-dimethylpyrazole	10.72	27
C ₅ H ₈ O ₂	acetyl acetone	10.5	2 [†]
C ₅ H ₉ N	valeronitrile	10.4	2
	22-DMPN	9.59	18
C ₅ H ₁₀ O	diethyl ketone	9.93	15
	methyl propyl ketone	9.93	15
C ₅ H ₁₀ O ₂	ethyl propionate	10.41	27
	methyl butanoate	10.41	27
C ₅ H ₁₀ O ₃	diethyl carbonate	11.3	2
C ₅ H ₁₂ O	ethyl propyl ether	10.68	27
C ₅ H ₁₂ O ₄	tetramethyl orthocarbonate	13.0	2 [†]
C ₆ H ₄ N ₂ O ₄	<i>p</i> -dinitrobenzene	18.4	2
C ₆ H ₄ O ₂	<i>p</i> -benzoquinone	14.5	2
C ₆ H ₅ NO ₂	nitrobenzene	14.7	2
		12.92	15
C ₆ H ₆ O	phenol	11.1	2 [†]
		9.94*	17
C ₆ H ₇ N	aniline	12.1	2 [†]
C ₆ H ₈ N ₂	phenylenediamine	13.8	2 [†]
	phenylhydrazine	12.91	27
C ₆ H ₁₀ N ₂	1-ethyl-5-methylpyrazole	12.50	27
C ₆ H ₁₀ O ₃	ethyl acetoacetate	12.9	2 [†]
C ₆ H ₁₂ N ₂	dimethylketazine	15.6	2
C ₆ H ₁₂ O	cyclohexanol	11.56	18
C ₆ H ₁₂ O ₂	amyl formate	14.2	2
C ₆ H ₁₂ O ₃	paraldehyde	17.9	2
C ₆ H ₁₄ O	propyl ether	12.8	2
		12.5	15
C ₆ H ₁₄ O ₂	1,1-diethoxyethane	13.2	2 [†]
	1,2-diethoxyethane	11.3	2 [†]
C ₆ H ₁₅ N	triethylamine	13.1	2
		13.38	27
	dipropylamine	13.29	27
C ₇ H ₄ N ₂ O ₂	<i>p</i> -cyanonitrobenzene	19.0	2
C ₇ H ₅ N	benzonitrile	12.5	2 [†]

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

Table 8
Static Average Electric Dipole Polarizabilities for Other Ground
State Organic Molecules (in Units of 10^{-24} cm³) (continued)

Molecule	Name	Polarizability	Ref.
C ₇ H ₇ NO ₃	nitroanisole	15.7	2 [†]
C ₇ H ₈ O	anisole	13.1	2 [†]
C ₇ H ₉ NO	<i>o</i> -anisidine	14.2	2 [†]
C ₇ H ₁₀ N ₂	1,1-methylphenylhydrazine	14.81	27
C ₇ H ₁₄ O	cyclohexyl methyl ether	13.4	2 [†]
	2,4-dimethyl-3-pentanone	13.5	15
C ₇ H ₁₄ O ₂	pentyl acetate	14.9	2
C ₈ H ₄ N ₂	<i>p</i> -dicyanobenzene	19.2	2
C ₈ H ₆ N ₂	quinoxaline	15.13	27
C ₈ H ₈ O	acetophenone	15.0	2
C ₈ H ₈ O ₂	2,5-dimethyl-1,4-benzoquinone	18.8	2
C ₈ H ₁₀ O	phenetole	14.9	2
C ₈ H ₁₁ N	<i>N</i> -dimethylaniline	16.2	2 [†]
C ₈ H ₁₂ N ₂	1,1-ethylphenylhydrazine	16.62	27
C ₈ H ₁₂ O ₂	ethyl sorbate	17.2	2 [†]
	tetramethylcyclobutane-1,3-dione	18.6	2
C ₈ H ₁₄ O ₄	diethyl succinate	16.8	2 [†]
C ₈ H ₁₈ O	butyl ether	17.2	2
C ₉ H ₇ N	quinoline	15.70	27
	isoquinoline	16.43	27
C ₉ H ₁₀ O ₂	ethyl benzoate	16.9	2 [†]
C ₉ H ₂₁ N	tripropylamine	18.87	27
C ₁₀ H ₉ N	α -naphthylamine	19.50	27
	β -naphthylamine	19.73	27
	1-methylquinoline	18.65	27
	1-methylisoquinoline	18.28	27
C ₁₀ H ₁₀ Fe	ferrocene	17.1	26
C ₁₀ H ₁₀ N ₂	2,3-dimethylquinoxaline	18.70	27
C ₁₀ H ₁₄ BeO ₄	beryllium acetylacetonate	34.1	2
C ₁₁ H ₈ O	1-naphthaldehyde	19.75	27
	2-naphthaldehyde	20.06	27
C ₁₄ H ₈ O ₂	anthraquinone	24.46	27
C ₁₂ H ₈ N ₂	phenazine	23.43	27
C ₁₂ H ₉ NO ₃	4-nitrodiphenyl ether	24.7	2 [†]
C ₁₄ H ₁₄ O	di- <i>p</i> -tolyl ether	24.9	2 [†]
C ₁₅ H ₂₁ AlO ₆	aluminum acetylacetonate	51.9	2
C ₁₅ H ₂₁ CrO ₆	chromium acetylacetonate	53.7	2
C ₁₅ H ₂₁ FeO ₆	ferric acetylacetonate	58.1	2
C ₂₀ H ₂₈ O ₈ Th	thorium acetylacetonate	79.0	2
C ₆₀	buckminsterfullerene	-80	24

Note: All polarizabilities in the tables are experimental values except those values marked by an asterisk (*), which indicates a calculated result. The experimental polarizabilities are mostly determined by measurements of a dielectric constant or refractive index which are quite accurate (0.5% or better). However, one should treat many of the results with several percent of caution because of the age of the data and because some of the results refer to optical frequencies rather than static. Comments given with the references are intended to allow one to judge the degree of caution required. Interested persons should consult these references. In many cases, the reference given is to a theoretical paper in which the experimental results are quoted. These papers, noted in the References, contain valuable information on polarizability calculations and experimental data which often includes the tensor components of the polarizability.

ATOMIC AND MOLECULAR POLARIZABILITIES (continued)

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IONIZATION POTENTIALS OF ATOMS AND ATOMIC IONS

The ionization potentials of neutral and partially ionized atoms are listed in this table. Data were obtained from the compilations cited below, supplemented by results from the recent research literature. All values have been corrected to the currently recommended value of the conversion factor from wave number to energy, namely $1 \text{ eV} = 8065.541 \text{ cm}^{-1}$ (Reference 5). Values are given in eV.

Following the traditional spectroscopic notation, columns are headed I, II, III, etc. up to VIII, where I indicates the neutral atom, II the singly ionized atom, III the doubly ionized atom, etc. The first section of the table includes spectra I to VIII of all the elements; subsequent sections cover higher spectra (ionization stages) for those elements for which data are available.

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Neutral Atoms to +7 Ions

Z	Element	I	II	III	IV	V	VI	VII	VIII
1	H	13.59844							
2	He	24.58741	54.41778						
3	Li	5.39172	75.64018	122.45429					
4	Be	9.3227	18.21116	153.89661	217.71865				
5	B	8.29803	25.15484	37.93064	259.37521	340.22580			
6	C	11.26030	24.38332	47.8878	64.4939	392.087	489.99334		
7	N	14.53414	29.6013	47.44924	77.4735	97.8902	552.0718	667.046	
8	O	13.61806	35.11730	54.9355	77.41353	113.8990	138.1197	739.29	871.4101
9	F	17.42282	34.97082	62.7084	87.1398	114.2428	157.1651	185.186	953.9112
10	Ne	21.5646	40.96328	63.45	97.12	126.21	157.93	207.2759	239.0989
11	Na	5.13908	47.2864	71.6200	98.91	138.40	172.18	208.50	264.25
12	Mg	7.64624	15.03528	80.1437	109.2655	141.27	186.76	225.02	265.96
13	Al	5.98577	18.82856	28.44765	119.992	153.825	190.49	241.76	284.66
14	Si	8.15169	16.34585	33.49302	45.14181	166.767	205.27	246.5	303.54
15	P	10.48669	19.7694	30.2027	51.4439	65.0251	220.421	263.57	309.60
16	S	10.36001	23.3379	34.79	47.222	72.5945	88.0530	280.948	328.75
17	Cl	12.96764	23.814	39.61	53.4652	67.8	97.03	114.1958	348.28
18	Ar	15.75962	27.62967	40.74	59.81	75.02	91.009	124.323	143.460
19	K	4.34066	31.63	45.806	60.91	82.66	99.4	117.56	154.88
20	Ca	6.11316	11.87172	50.9131	67.27	84.50	108.78	127.2	147.24
21	Sc	6.5615	12.79967	24.75666	73.4894	91.65	110.68	138.0	158.1
22	Ti	6.8281	13.5755	27.4917	43.2672	99.30	119.53	140.8	170.4
23	V	6.7462	14.66	29.311	46.709	65.2817	128.13	150.6	173.4
24	Cr	6.7665	16.4857	30.96	49.16	69.46	90.6349	160.18	184.7
25	Mn	7.43402	15.63999	33.668	51.2	72.4	95.6	119.203	194.5
26	Fe	7.9024	16.1878	30.652	54.8	75.0	99.1	124.98	151.06
27	Co	7.8810	17.083	33.50	51.3	79.5	102.0	128.9	157.8
28	Ni	7.6398	18.16884	35.19	54.9	76.06	108	133	162
29	Cu	7.72638	20.29240	36.841	57.38	79.8	103	139	166
30	Zn	9.3942	17.96440	39.723	59.4	82.6	108	134	174
31	Ga	5.99930	20.5142	30.71	64				
32	Ge	7.8994	15.93462	34.2241	45.7131	93.5			
33	As	9.7886	18.633	28.351	50.13	62.63	127.6		
34	Se	9.75238	21.19	30.8204	42.9450	68.3	81.7	155.4	
35	Br	11.81381	21.8	36	47.3	59.7	88.6	103.0	192.8
36	Kr	13.99961	24.35985	36.950	52.5	64.7	78.5	111.0	125.802
37	Rb	4.17713	27.285	40	52.6	71.0	84.4	99.2	136
38	Sr	5.6949	11.03013	42.89	57	71.6	90.8	106	122.3
39	Y	6.2171	12.24	20.52	60.597	77.0	93.0	116	129
40	Zr	6.63390	13.13	22.99	34.34	80.348			

IONIZATION POTENTIALS OF ATOMS AND ATOMIC IONS (continued)

Z	Element	I	II	III	IV	V	VI	VII	VIII
41	Nb	6.75885	14.32	25.04	38.3	50.55	102.057	125	
42	Mo	7.09243	16.16	27.13	46.4	54.49	68.8276	125.664	143.6
43	Tc	7.28	15.26	29.54					
44	Ru	7.36050	16.76	28.47					
45	Rh	7.45890	18.08	31.06					
46	Pd	8.3369	19.43	32.93					
47	Ag	7.5762	21.49	34.83					
48	Cd	8.9938	16.90832	37.48					
49	In	5.78636	18.8698	28.03	54				
50	Sn	7.3439	14.63225	30.50260	40.73502	72.28			
51	Sb	8.6084	16.53051	25.3	44.2	56	108		
52	Te	9.0096	18.6	27.96	37.41	58.75	70.7	137	
53	I	10.45126	19.1313	33					
54	Xe	12.1298	21.20979	32.1230					
55	Cs	3.89390	23.15745						
56	Ba	5.21170	10.00390						
57	La	5.5769	11.060	19.1773	49.95	61.6			
58	Ce	5.5387	10.85	20.198	36.758	65.55	77.6		
59	Pr	5.473	10.55	21.624	38.98	57.53			
60	Nd	5.5250	10.73	22.1	40.41				
61	Pm	5.582	10.90	22.3	41.1				
62	Sm	5.6436	11.07	23.4	41.4				
63	Eu	5.6704	11.241	24.92	42.7				
64	Gd	6.1501	12.09	20.63	44.0				
65	Tb	5.8638	11.52	21.91	39.79				
66	Dy	5.9389	11.67	22.8	41.47				
67	Ho	6.0215	11.80	22.84	42.5				
68	Er	6.1077	11.93	22.74	42.7				
69	Tm	6.18431	12.05	23.68	42.7				
70	Yb	6.25416	12.1761	25.05	43.56				
71	Lu	5.4259	13.9	20.9594	45.25	66.8			
72	Hf	6.82507	14.9	23.3	33.33				
73	Ta	7.5496							
74	W	7.8640							
75	Re	7.8335							
76	Os	8.4382							
77	Ir	8.9670							
78	Pt	8.9587	18.563						
79	Au	9.2255	20.5						
80	Hg	10.43750	18.756	34.2					
81	Tl	6.1082	20.428	29.83					
82	Pb	7.41666	15.0322	31.9373	42.32	68.8			
83	Bi	7.2856	16.69	25.56	45.3	56.0	88.3		
84	Po	8.417							
85	At								
86	Rn	10.74850							
87	Fr	4.0727							
88	Ra	5.2784	10.14716						
89	Ac	5.17	12.1						
90	Th	6.3067	11.5	20.0	28.8				
91	Pa	5.89							
92	U	6.19405							
93	Np	6.2657							
94	Pu	6.0262							
95	Am	5.9738							
96	Cm	5.9915							
97	Bk	6.1979							
98	Cf	6.2817							
99	Es	6.42							
100	Fm	6.50							
101	Md	6.58							
102	No	6.65							
103	Lr	4.9							
104	Rf	6.0							

IONIZATION POTENTIALS OF ATOMS AND ATOMIC IONS (continued)

+8 Ions to +15 Ions

Z	Element	IX	X	XI	XII	XIII	XIV	XV	XVI
9	F	1103.1176							
10	Ne	1195.8286	1362.1995						
11	Na	299.864	1465.121	1648.702					
12	Mg	328.06	367.50	1761.805	1962.6650				
13	Al	330.13	398.75	442.00	2085.98	2304.1410			
14	Si	351.12	401.37	476.36	523.42	2437.63	2673.182		
15	P	372.13	424.4	479.46	560.8	611.74	2816.91	3069.842	
16	S	379.55	447.5	504.8	564.44	652.2	707.01	3223.78	3494.1892
17	Cl	400.06	455.63	529.28	591.99	656.71	749.76	809.40	3658.521
18	Ar	422.45	478.69	538.96	618.26	686.10	755.74	854.77	918.03
19	K	175.8174	503.8	564.7	629.4	714.6	786.6	861.1	968
20	Ca	188.54	211.275	591.9	657.2	726.6	817.6	894.5	974
21	Sc	180.03	225.18	249.798	687.36	756.7	830.8	927.5	1009
22	Ti	192.1	215.92	265.07	291.500	787.84	863.1	941.9	1044
23	V	205.8	230.5	255.7	308.1	336.277	896.0	976	1060
24	Cr	209.3	244.4	270.8	298.0	354.8	384.168	1010.6	1097
25	Mn	221.8	248.3	286.0	314.4	343.6	403.0	435.163	1134.7
26	Fe	233.6	262.1	290.2	330.8	361.0	392.2	457	489.256
27	Co	186.13	275.4	305	336	379	411	444	511.96
28	Ni	193	224.6	321.0	352	384	430	464	499
29	Cu	199	232	265.3	369	401	435	484	520
30	Zn	203	238	274	310.8	419.7	454	490	542
36	Kr	230.85	268.2	308	350	391	447	492	541
37	Rb	150	277.1						
38	Sr	162	177	324.1					
39	Y	146.2	191	206	374.0				
42	Mo	164.12	186.4	209.3	230.28	279.1	302.60	544.0	570

+16 Ions to +23 Ions

Z	Element	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV
17	Cl	3946.2960							
18	Ar	4120.8857	4426.2296						
19	K	1033.4	4610.8	4934.046					
20	Ca	1087	1157.8	5128.8	5469.864				
21	Sc	1094	1213	1287.97	5674.8	6033.712			
22	Ti	1131	1221	1346	1425.4	6249.0	6625.82		
23	V	1168	1260	1355	1486	1569.6	6851.3	7246.12	
24	Cr	1185	1299	1396	1496	1634	1721.4	7481.7	7894.81
25	Mn	1224	1317	1437	1539	1644	1788	1879.9	8140.6
26	Fe	1266	1358	1456	1582	1689	1799	1950	2023
27	Co	546.58	1397.2	1504.6	1603	1735	1846	1962	2119
28	Ni	571.08	607.06	1541	1648	1756	1894	2011	2131
29	Cu	557	633	670.588	1697	1804	1916	2060	2182
30	Zn	579	619	698	738	1856			
36	Kr	592	641	786	833	884	937	998	1051
42	Mo	636	702	767	833	902	968	1020	1082

+24 Ions to +29 Ions

Z	Element	XXV	XXVI	XXVII	XXVIII	XXIX	XXX
25	Mn	8571.94					
26	Fe	8828	9277.69				
27	Co	2219.0	9544.1	10012.12			
28	Ni	2295	2399.2	10288.8	10775.40		
29	Cu	2308	2478	2587.5	11062.38	11567.617	
36	Kr	1151	1205.3	2928	3070	3227	3381
42	Mo	1263	1323	1387	1449	1535	1601

IONIZATION ENERGIES OF GAS-PHASE MOLECULES

Sharon G. Lias

This table presents values for the first ionization energies (IP) of approximately 1000 molecules and atoms. Substances are listed by molecular formula in the modified Hill order (see introduction). Values enclosed in parentheses are considered not to be well established. Data appearing in the 1988 reference, were updated in 1996 for inclusion in the database of ionization energies available at the Internet site of the Standard Reference Data program of the National Institute of Standards and Technology (<http://webbook.nist.gov>). The list appearing here includes these updates.

The list also includes values for enthalpies of formation of the ions at 298 K, $\Delta_f H_{ion}$, given according to the ion convention used by mass spectrometrists; to convert these values to the electron convention used by thermodynamicists, add 6 kJ/mol. Details on the calculation of $\Delta_f H_{ion}$ as well as data for a much larger number of molecules, may be found in the reference and on the Internet site.

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Lias, S.G., Bartmess, J.E., Liebman, J.F., Holmes, J.L., Levin, R.D., and Mallard, W.G., *Gas-Phase Ion and Neutral Thermochemistry, J. Phys. Chem. Ref. Data*, Vol. 17, Suppl. No. 1, 1988.

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
Substances not containing carbon			
Ac	Actinium	5.17	905
Ag	Silver	7.57624	1016
AgCl	Silver(I) chloride	(≤ 10.08)	≤ 1065
AgF	Silver(I) fluoride	(11.0 ± 0.3)	1071
Al	Aluminum	5.98577	905
AlBr	Aluminum monobromide	(9.3)	913
AlBr ₃	Aluminum tribromide	(10.4)	593
AlCl	Aluminum monochloride	9.4	855
AlCl ₃	Aluminum trichloride	(12.01)	573
AlF	Aluminum monofluoride	9.73 ± 0.01	673
AlF ₃	Aluminum trifluoride	≤ 15.45	≤ 282
AlI	Aluminum monoiodide	9.3 ± 0.3	965
AlI ₃	Aluminum triiodide	(9.1)	673
Am	Americium	5.9738 ± 0.0002	860
Ar	Argon	15.75962	1521
As	Arsenic	9.8152	1250
AsCl ₃	Arsenic(III) chloride	(10.55 ± 0.025)	754
AsF ₃	Arsenic(III) fluoride	(12.84 ± 0.05)	452
AsH ₃	Arsine	(9.89)	1021
Au	Gold	9.22567	1254
B	Boron	8.29803	1363
BBr ₃	Boron tribromide	(10.51)	809
BCl ₃	Boron trichloride	11.60 ± 0.02	718
BF	Fluoroborane	11.12 ± 0.01	957
	Difluoroborane	(9.4)	317
BF ₃	Boron trifluoride	15.7 ± 0.3	365
BH	Boron monohydride	(9.77)	1385
BH ₃	Borane	12.026 ± 0.024	1261
BI ₃	Boron triiodide	(9.25 ± 0.03)	964
BO ₂	Boron dioxide	(13.5 ± 0.3)	1001
B ₂ H ₆	Diborane	11.38 ± 0.05	1134
B ₂ O ₃	Boron oxide	13.5 ± 0.15	460
B ₄ H ₁₀	Tetraborane	10.76 ± 0.04	1105
B ₅ H ₉	Pentaborane(9)	9.90 ± 0.04	1028
B ₆ H ₁₀	Hexaborane	(9.0)	965
Ba	Barium	5.21170	683
BaO	Barium oxide	6.91 ± 0.06	543
Be	Beryllium	9.32263	1224
BeO	Beryllium oxide	(10.1 ± 0.4)	1111
Bi	Bismuth	7.2855	908
BiCl ₃	Bismuth trichloride	(10.4)	736
Bk	Berkelium	6.23	911

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
Br	Bromine (atomic)	11.81381	1252
BrCl	Bromine chloride	11.01	1079
BrF	Bromine fluoride	11.86	1086
BrF ₅	Bromine pentafluoride	13.172 ± 0.002	840
BrH	Hydrogen bromide	11.66 ± 0.03	1087
BrH ₃ Si	Bromosilane	10.6	943
BrI	Iodine bromide	9.790 ± 0.004	986
BrK	Potassium bromide	7.85 ± 0.1	578
BrLi	Lithium bromide	(8.7)	685
BrNO	Nitrosyl bromide	10.17 ± 0.03	1065
BrNa	Sodium bromide	8.31 ± 0.1	660
BrO	Bromine monoxide	10.46 ± 0.02	1135
BrRb	Rubidium bromide	7.94 ± 0.03	583
BrTl	Thallium(I) bromide	9.14 ± 0.02	844
Br ₂	Bromine	10.516 ± 0.005	1046
Br ₂ Hg	Mercury(II) bromide	10.560 ± 0.003	935
Br ₂ Sn	Tin(II) bromide	9.0	839
Br ₃ Ga	Gallium(III) bromide	10.40	711
Br ₃ P	Phosphorus(III) bromide	9.7	798
Br ₄ Hf	Hafnium(IV) bromide	(10.9)	366
Br ₄ Sn	Tin(IV) bromide	10.6	709
Br ₄ Ti	Titanium(IV) bromide	10.3	375
Br ₄ Zr	Zirconium(IV) bromide	(10.7)	388
Ca	Calcium	6.11316	768
CaCl	Calcium monochloride	5.86 ± 0.07	462
CaO	Calcium oxide	6.66 ± 0.18	668
Cd	Cadmium	8.99367	980
Ce	Cerium	5.5387	957
Cf	Californium	6.30	805
Cl	Chlorine (atomic)	12.96764	1373
ClCs	Cesium chloride	(7.84 ± 0.05)	510
ClF	Chlorine fluoride	12.66 ± 0.01	1171
ClFO ₃	Perchloryl fluoride	(12.945 ± 0.005)	1224
ClF ₂	Chlorine difluoride	(12.77 ± 0.05)	1128
ClF ₃	Chlorine trifluoride	(12.65 ± 0.05)	1057
ClF ₃ S	Sulfur chloride pentafluoride	(12.335 ± 0.005)	144
ClH	Hydrogen chloride	12.749 ± 0.009	1137
ClHO	Hypochlorous acid	(11.12 ± 0.01)	993
ClH ₃ Si	Chlorosilane	11.4	899
ClI	Iodine chloride	10.088 ± 0.01	991
ClIn	Indium(I) chloride	(9.51)	842
ClK	Potassium chloride	(8.0 ± 0.4)	557
ClLi	Lithium chloride	9.57	727
ClNO	Nitrosyl chloride	10.87 ± 0.01	1099
ClNO ₂	Nitryl chloride	(11.84)	1155
ClNa	Sodium chloride	8.92 ± 0.06	681
ClO	Chlorine monoxide	10.95	1159
ClO ₂	Chlorine dioxide	10.33 ± 0.02	1093
ClRb	Rubidium chloride	(8.50 ± 0.03)	590
ClTl	Thallium(I) chloride	9.70 ± 0.03	869
Cl ₂	Chlorine	11.480 ± 0.005	1108
Cl ₂ CrO ₂	Chromyl chloride	11.6	580
Cl ₂ Ge	Germanium(II) chloride	(10.20 ± 0.05)	813
Cl ₂ H ₂ Si	Dichlorosilane	11.4	765
Cl ₂ Hg	Mercury(II) chloride	11.380 ± 0.003	952
Cl ₂ O	Chlorine oxide	10.94	1135
Cl ₂ OS	Thionyl chloride	10.96	844
Cl ₂ O ₂ S	Sulfuryl chloride	12.05	807
Cl ₂ Pb	Lead(II) chloride	(10.2)	791
Cl ₂ S	Sulfur dichloride	9.45 ± 0.03	895

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{\text{ion}}$ kJ/mol
Cl ₂ Si	Dichlorosilylene	(10.93 ± 0.10)	887
Cl ₂ Sn	Tin(II) chloride	(10.0)	760
Cl ₃ Ga	Gallium(III) chloride	11.52	664
Cl ₃ HSi	Trichlorosilane	(11.7)	648
Cl ₃ N	Nitrogen trichloride	(10.12 ± 0.1)	1244
Cl ₃ OP	Phosphorus(V) oxychloride	11.36 ± 0.02	540
Cl ₃ OV	Vanadyl trichloride	(11.6)	425
Cl ₃ P	Phosphorus(III) chloride	9.91	668
Cl ₃ PS	Phosphorus(V) sulfide trichloride	9.71 ± 0.03	573
Cl ₃ Sb	Antimony(III) chloride	(≤ 10.7)	5719
Cl ₄ Ge	Germanium(IV) chloride	11.68 ± 0.05	629
Cl ₄ Hf	Hafnium(IV) chloride	(11.7)	246
Cl ₄ Si	Tetrachlorosilane	11.79 ± 0.01	527
Cl ₄ Sn	Tin(IV) chloride	11.7 ± 0.2	656
Cl ₄ Ti	Titanium(IV) chloride	(11.5)	349
Cl ₄ V	Vanadium(IV) chloride	(9.2)	361
Cl ₄ Zr	Zirconium(IV) chloride	(11.2)	210
Cl ₅ Mo	Molybdenum(V) chloride	(8.7)	392
Cl ₅ Nb	Niobium(V) chloride	(10.97)	356
Cl ₅ P	Phosphorus(V) chloride	(10.2)	608
Cl ₅ Ta	Tantalum(V) chloride	(11.08)	303
Cl ₆ W	Tungsten(VI) chloride	(9.5)	348
Cm	Curium	6.02	966
Co	Cobalt	7.8810	1187
Cr	Chromium	6.76664	1050
Cs	Cesium	3.89390	452
CsF	Cesium fluoride	(8.80 ± 0.10)	489
CsNa	Cesium sodium	(4.05 ± 0.04)	535
Cu	Copper	7.72638	1084
CuF	Copper(I) fluoride	10.15 ± 0.02	984
Dy	Dysprosium	5.9389	862
Er	Erbium	6.1078	907
Es	Einsteinium	6.42	753
Eu	Europium	5.6704	723
F	Fluorine (atomic)	17.42282	1761
FGa	Gallium monofluoride	(9.6 ± 0.5)	700
FH	Hydrogen fluoride	16.044 ± 0.003	1276
FHO	Hypofluorous acid	12.71 ± 0.01	1130
FH ₃ Si	Fluorosilane	11.7	752
FI	Iodine fluoride	10.54 ± 0.01	922
FIn	Indium monofluoride	(9.6 ± 0.5)	740
FNO	Nitrosyl fluoride	12.63 ± 0.03	1152
FNO ₂	Nitryl fluoride	(13.09)	1154
FNS	Thionitrosyl fluoride (NSF)	11.51 ± 0.04	1090
FO	Fluorine monoxide	12.78 ± 0.03	1342
FO ₂	Fluorine superoxide (FOO)	(12.6 ± 0.2)	1228
FS	Sulfur fluoride	10.09	986
FTl	Thallium(I) fluoride	10.52	835
F ₂	Fluorine	15.697 ± 0.003	1515
F ₂ Ge	Germanium(II) fluoride	(≤ 11.65)	551
F ₂ HN	Difluoramine	(11.53 ± 0.08)	1046
F ₂ H ₂ Si	Difluorosilane	(12.2)	386
F ₂ Mg	Magnesium fluoride	(13.6 ± 0.3)	588
F ₂ N	Difluoroamidogen	11.628 ± 0.01	1155
F ₂ N ₂	<i>trans</i> -Difluorodiazine	(12.8)	1315
F ₂ O	Fluorine monoxide	13.11 ± 0.01	1290
F ₂ OS	Thionyl fluoride	12.25	688
F ₂ O ₂ S	Sulfuryl fluoride	13.04 ± 0.01	501
F ₂ Pb	Lead(II) fluoride	(11.5)	679
F ₂ S	Sulfur difluoride	(10.08)	676

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
F ₂ Si	Difluorosilylene	10.78 ± 0.05	450
F ₂ Sn	Tin(II) fluoride	(11.1)	586
F ₂ Xe	Xenon difluoride	12.35 ± 0.01	1083
F ₃ HSi	Trifluorosilane	(14.0)	150
F ₃ N	Nitrogen trifluoride	13.00 ± 0.02	1125
F ₃ NO	Trifluoramine oxide	13.31 ± 0.06	1121
F ₃ OP	Phosphorus(V) oxyfluoride	12.76 ± 0.01	-24
F ₃ P	Phosphorus(III) fluoride	11.60 ± 0.05	161
F ₃ PS	Phosphorus(V) sulfide trifluoride	≤ 11.05 ± 0.035	≤ 58
F ₃ Si	Trifluorosilyl	(9.99)	- 32
F ₄ Ge	Germanium(IV) fluoride	(15.5)	307
F ₄ N ₂	Tetrafluorohydrazine	11.94 ± 0.03	1119
F ₄ S	Sulfur tetrafluoride	12.0 ± 0.3	399
F ₄ Si	Tetrafluorosilane	15.24 ± 0.14	-144
F ₄ Xe	Xenon tetrafluoride	12.65 ± 0.1	1016
F ₅ I	Iodine pentafluoride	12.943 ± 0.005	408
F ₅ P	Phosphorus(V) fluoride	(15.1)	-137
F ₅ S	Sulfur pentafluoride	9.60 ± 0.05	10
F ₆ Mo	Molybdenum(VI) fluoride	(14.5 ± 0.1)	-159
F ₆ S	Sulfur hexafluoride	15.32 ± 0.02	258
F ₆ U	Uranium(VI) fluoride	14.00 ± 0.10	-796
Fe	Iron	7.9024	1177
Fm	Fermium	6.50	627
Ga	Gallium	5.99930	851
GaI ₃	Gallium(III) iodide	9.40	765
Gd	Gadolinium	6.1500	991
Ge	Germanium	7.900	1139
GeH ₄	Germane	≤ 10.53	≤ 1108
GeI ₄	Germanium(IV) iodide	(9.42)	850
GeO	Germanium(II) oxide	11.25 ± 0.01	1044
GeS	Germanium(II) sulfide	(9.98)	1055
H	Hydrogen (atomic)	13.59844	1530
HI	Hydrogen iodide	10.386 ± 0.001	1028
HLi	Lithium hydride	7.7	882
HN	Imidogen	≤ 13.49 ± 0.01	1678
HNO	Nitrosyl hydride	(10.1)	1075
HNO ₂	Nitrous acid	≤ 11.3	≤ 1011
HNO ₃	Nitric acid	11.95 ± 0.01	1019
HN ₃	Hydrazoic acid	10.72 ± 0.025	1328
HO	Hydroxyl	13.0170 ± 0.0002	1294
HO ₂	Hydroperoxy	11.35 ± 0.01	1106
HS	Mercapto	10.4219 ± 0.0004	1145
H ₂	Hydrogen	15.42593 ± 0.00005	1488
H ₂ N	Amidogen	11.14 ± 0.01	1264
H ₂ O	Water	12.6206 ± 0.0020	976
H ₂ O ₂	Hydrogen peroxide	10.58 ± 0.04	885
H ₂ S	Hydrogen sulfide	10.457 ± 0.012	989
H ₂ Se	Hydrogen selenide	9.892 ± 0.005	984
H ₂ Si	Silylene	8.244 ± 0.025	1084
H ₃ N	Ammonia	10.070 ± 0.020	925
H ₃ NO	Hydroxylamine	(10.00)	923
H ₃ P	Phosphine	9.869 ± 0.002	958
H ₃ Sb	Stibine	9.54 ± 0.03	1067
H ₄ N ₂	Hydrazine	8.1 ± 0.15	877
H ₄ Si	Silane	11.00 ± 0.02	1095
H ₄ Sn	Stannane	(10.75)	1200
H ₆ Si ₂	Disilane	9.74 ± 0.02	1019
H ₈ Si ₃	Trisilane	(9.2)	1009
He	Helium	24.58741	2372
Hf	Hafnium	6.82507 ± 0.00004	1278

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
Hg	Mercury	10.43750	1069
HgI ₂	Mercury(II) iodide	9.5088 ± 0.0022	900
Ho	Holmium	6.0216	882
I	Iodine (atomic)	10.45126	1115
IK	Potassium iodide	(7.21 ± 0.3)	570
ILi	Lithium iodide	(7.5)	633
INa	Sodium iodide	7.64 ± 0.02	659
ITl	Thallium(I) iodide	8.47 ± 0.02	826
I ₂	Iodine	9.3074 ± 0.0002	960
I ₄ Ti	Titanium(IV) iodide	(9.1)	602
I ₄ Zr	Zirconium(IV) iodide	(9.3)	500
In	Indium	5.78636	802
Ir	Iridium	9.1	1543
K	Potassium	4.34066	508
KLi	Lithium potassium	4.57 ± 0.04	512
KNa	Potassium sodium	4.41636 ± 0.00017	561
K ₂	Dipotassium	4.0637 ± 0.0002	519
Kr	Krypton	13.99961	1351
La	Lanthanum	5.5770	969
Li	Lithium	5.39172	680
LiNa	Lithium sodium	5.05 ± 0.04	571
LiO	Lithium monoxide	(8.44)	894
LiRb	Lithium rubidium	4.3 ± 0.1	486
Li ₂	Dilithium	5.1127 ± 0.0003	709
Lu	Lutetium	5.42585	950
Md	Mendelevium	6.58	635
Mg	Magnesium	7.64624	885
MgO	Magnesium oxide	(8.76 ± 0.22)	901
Mn	Manganese	7.43402	998
Mo	Molybdenum	7.09243	1343
N	Nitrogen (atomic)	14.53414	1875
NO	Nitric oxide	9.26438 ± 0.00005	985
NO ₂	Nitrogen dioxide	9.586 ± 0.002	958
NP	Phosphorus nitride	11.84 ± 0.04	1247
NS	Nitrogen sulfide	8.87 ± 0.01	1119
N ₂	Nitrogen	15.5808	1503
N ₂ O	Nitrous oxide	12.886	1325
N ₂ O ₄	Nitrogen tetroxide	(10.8)	1050
N ₂ O ₅	Nitrogen pentoxide	(11.9)	1161
Na	Sodium	5.13908	603
NaRb	Rubidium sodium	4.32 ± 0.04	480
Na ₂	Disodium	4.894 ± 0.003	614
Nb	Niobium	6.75885	1384
Nd	Neodymium	5.5250	859
Ne	Neon	21.56454	2081
Ni	Nickel	7.6398	1167
No	Nobelium	6.65	642
Np	Neptunium	6.2657 ± 0.0003	1069
O	Oxygen (atomic)	13.61806	1563
OPb	Lead(II) oxide	9.08 ± 0.10	939
OS	Sulfur monoxide	10.294 ± 0.004	998
OS ₂	Sulfur oxide (SSO)	10.584 ± 0.005	971
OSi	Silicon monoxide	11.49 ± 0.20	1008
OSn	Tin(II) oxide	9.60 ± 0.02	944
OSr	Strontium oxide	6.6 ± 0.2	623
O ₂	Oxygen	12.0697 ± 0.0002	1165
O ₂ S	Sulfur dioxide	12.349 ± 0.001	894
O ₂ Th	Thorium(IV) oxide	(8.7 ± 0.15)	342
O ₂ Ti	Titanium(IV) oxide	(9.54 ± 0.1)	623
O ₂ U	Uranium(IV) oxide	(5.4 ± 0.1)	57

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
O ₃	Ozone	12.43	1342
O ₃ S	Sulfur trioxide	12.82 ± 0.03	841
O ₃ U	Uranium(VI) oxide	(10.5 ± 0.5)	214
O ₄ Os	Osmium(VIII) oxide	(12.32)	850
O ₄ Ru	Ruthenium(VIII) oxide	12.15 ± 0.03	988
O ₇ Re ₂	Rhenium(VII) oxide	(12.7 ± 0.2)	125
Os	Osmium	8.7	1630
P	Phosphorus	10.48669	1328
P ₂	Diphosphorus	10.53	1160
Pa	Protactinium	5.89	1133
Pb	Lead	7.41666	911
PbS	Lead(II) sulfide	(8.5 ± 0.5)	954
Pd	Palladium	8.3367	1181
Pm	Promethium	5.55	536
Pr	Praseodymium	5.464	883
Pt	Platinum	9.0	1433
Pu	Plutonium	6.025	926
Ra	Radium	5.27892	668
Rb	Rubidium	4.17713	484
Re	Rhenium	7.88	1530
Rh	Rhodium	7.45890	1276
Rn	Radon	10.74850	1037
Ru	Ruthenium	7.36050	1355
S	Sulfur	10.36001	1277
SSn	Tin(II) sulfide	(8.8)	966
S ₂	Disulfur	9.356 ± 0.002	1031
Sb	Antimony	8.64	1096
Sc	Scandium	6.56144	1010
Se	Selenium	9.75238	1168
Si	Silicon	8.15169	1238
Sm	Samarium	5.6437	751
Sn	Tin	7.34381	1011
Sr	Strontium	5.69484	713
Ta	Tantalum	7.89	1544
Tb	Terbium	5.8639	955
Tc	Technetium	7.28	1380
Te	Tellurium	9.0096	1066
Th	Thorium	6.308 ± 0.003	1207
Ti	Titanium	6.8282	1127
Tl	Thallium	6.10829	771
Tm	Thulium	6.18431	827
U	Uranium	6.19405	1129
V	Vanadium	6.746 ± 0.002	1166
W	Tungsten	7.98	1621
Xe	Xenon	12.12987	1170
Y	Yttrium	6.217	1022
Yb	Ytterbium	6.25416	754
Zn	Zinc	9.39405	1037
Zr	Zirconium	6.63390	1251

Substances containing carbon

C	Carbon	11.26030	1803
CBrClF ₂	Bromochlorodifluoromethane	(11.21)	642
CBrCl ₃	Bromotrichloromethane	(10.6)	980
CBrF ₃	Bromotrifluoromethane	(11.40)	451
CBr ₂ F ₂	Dibromodifluoromethane	11.03 ± 0.04	683
CBr ₄	Tetrabromomethane	(10.31 ± 0.02)	1079
CCl	Chloromethylidyne	(8.9 ± 0.2)	1244
CClF ₃	Chlorotrifluoromethane	12.6 ± 0.2	505

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
CCIN	Cyanogen chloride	12.34 ±0.01	1329
CCl ₂	Dichloromethylene	(9.27)	1058
CCl ₂ F ₂	Dichlorodifluoromethane	12.05 ±0.24	685
CCl ₂ O	Carbonyl chloride	(11.5)	888
CCl ₃ F	Trichlorofluoromethane	11.77 ±0.02	868
CCl ₄	Tetrachloromethane	11.47 ±0.01	1010
CF	Fluoromethylidyne	9.11 ±0.01	1134
CFN	Cyanogen fluoride	13.34 ±0.02	1325
CF ₂	Difluoromethylene	11.44 ±0.03	899
CF ₂ O	Carbonyl fluoride	13.035 ±0.030	617
CF ₃	Trifluoromethyl	8.7 ±0.2	379
CF ₃ I	Trifluoroiodomethane	10.23	397
CH	Methylidyne	10.64 ±0.01	1622
CHBrCl ₂	Bromodichloromethane	10.6	973
CHBr ₂ Cl	Chlorodibromomethane	10.59 ±0.01	1030
CHBr ₃	Tribromomethane	10.48 ±0.02	1035
CHCl	Chloromethylene	9.84	1247
CHClF ₂	Chlorodifluoromethane	(12.2)	693
CHCl ₂ F	Dichlorofluoromethane	(11.5)	829
CHCl ₃	Trichloromethane	11.37 ±0.02	992
CHF	Fluoromethylene	10.06 ±0.05	1121
CHF ₃	Trifluoromethane	(13.86)	643
CHI ₃	Triiodomethane	9.25 ±0.02	1010
CHN	Hydrogen cyanide	13.60 ±0.01	1447
CHN	Hydrogen isocyanide	(12.5 ±0.1)	1407
CHNO	Isocyanic acid	11.595 ±0.005	1016
CHNO	Fulminic acid	(10.83)	1263
CHO	Oxomethyl (HCO)	(8.55)	826
CH ₂	Methylene	10.396 ±0.003	1392
CH ₂ BrCl	Bromochloromethane	10.77 ±0.01	1085
CH ₂ Br ₂	Dibromomethane	(10.50 ±0.02)	1013
CH ₂ ClF	Chlorofluoromethane	11.71 ±0.01	870
CH ₂ Cl ₂	Dichloromethane	11.32 ±.01	996
CH ₂ F ₂	Difluoromethane	12.71	774
CH ₂ I ₂	Diiodomethane	9.46 ±0.02	1030
CH ₂ N ₂	Diazomethane	8.999 ±0.001	1098
CH ₂ N ₂	Cyanamide	(10.4)	1137
CH ₂ O	Formaldehyde	10.88 ±0.01	941
CH ₂ O ₂	Formic acid	11.33 ±0.01	715
CH ₃	Methyl	9.843 ±0.002	1095
CH ₃ BO	Borane carbonyl	11.14 ±0.02	962
CH ₃ Br	Bromomethane	10.541 ±0.003	979
CH ₃ Cl	Chloromethane	11.22 ±0.01	1001
CH ₃ Cl ₃ Si	Methyltrichlorosilane	(11.36 ±0.03)	548
CH ₃ F	Fluoromethane	12.47 ±0.02	956
CH ₃ I	Iodomethane	9.538	936
CH ₃ NO	Formamide	10.16 ±0.06	796
CH ₃ NO ₂	Nitromethane	11.08 ±0.07	994
CH ₃ N ₃	Methyl azide	9.81 ±0.02	1227
CH ₃ O	Methoxy	(10.72)	1050
CH ₄	Methane	12.61 ±0.01	1143
CH ₄ N ₂ O	Urea	9.7	690
CH ₄ O	Methanol	10.85 ±0.01	845
CH ₄ S	Methanethiol	9.44 ±0.005	888
CH ₅ N	Methylamine	(8.80)	826
CH ₆ N ₂	Methylhydrazine	7.7 ±0.15	835
CH ₆ Si	Methylsilane	(10.7)	1003
CN	Cyanide	13.5984	1748
CNO	Cyanate	11.76 ±0.01	1290
CO	Carbon monoxide	14.014 ±0.0003	1242

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
COS	Carbon oxysulfide	11.18 ±0.01	936
COSe	Carbon oxyselenide	10.36 ±0.01	929
CO ₂	Carbon dioxide	13.773 ±0.002	935
CS	Carbon sulfide	11.33 ±0.01	1361
CS ₂	Carbon disulfide	10.0685 ±0.0020	1089
C ₂	Dicarbon	(11.4 ±0.3)	2000
C ₂ Br ₂ F ₄	1,2-Dibromotetrafluoroethane	(11.1)	280
C ₂ ClF ₃	Chlorotrifluoroethylene	9.81 ±0.03	373
C ₂ ClF ₅	Chloropentafluoroethane	(12.6)	99
C ₂ Cl ₂	Dichloroacetylene	9.9	1165
C ₂ Cl ₂ F ₄	1,2-Dichlorotetrafluoroethane	12.2	252
C ₂ Cl ₃ F ₃	1,1,1-Trichlorotrifluoroethane	11.5	386
C ₂ Cl ₃ F ₃	1,1,2-Trichlorotrifluoroethane	11.99 ±0.02	429
C ₂ Cl ₄	Tetrachloroethylene	9.326 ±0.001	887
C ₂ Cl ₄ F ₂	1,1,2,2-Tetrachloro-1,2-difluoroethane	(11.3)	563
C ₂ Cl ₄ O	Trichloroacetyl chloride	(11.0)	827
C ₂ Cl ₆	Hexachloroethane	(11.1)	920
C ₂ F ₃ N	Trifluoroacetonitrile	13.93 ±0.07	845
C ₂ F ₄	Tetrafluoroethylene	10.12 ±0.02	315
C ₂ F ₆	Hexafluoroethane	(13.6)	-30
C ₂ H	Ethynyl	(11.61 ±0.07)	1685
C ₂ HBr	Bromoacetylene	10.31 ±0.02	1242
C ₂ HBrClF ₃	2-Bromo-2-chloro-1,1,1-trifluoroethane	(11.0)	363
C ₂ HCl	Chloroacetylene	10.58 ±0.02	1276
C ₂ HClF ₂	1-Chloro-2,2-difluoroethylene	9.80 ±0.04	628
C ₂ HCl ₃	Trichloroethylene	9.46 ±0.02	894
C ₂ HCl ₃ O	Dichloroacetyl chloride	(10.9)	809
C ₂ HCl ₅	Pentachloroethane	(11.0)	919
C ₂ HF	Fluoroacetylene	11.26	1195
C ₂ HF ₃	Trifluoroethylene	10.14	489
C ₂ HF ₃ O ₂	Trifluoroacetic acid	11.46	75
C ₂ H ₂	Acetylene	11.400 ±0.002	1328
C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	9.81 ±0.04	949
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	9.66 ±0.01	936
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	9.64 ±0.02	934
C ₂ H ₂ Cl ₂ O	Chloroacetyl chloride	(≤ 10.3)	815
C ₂ H ₂ Cl ₄	1,1,1,2-Tetrachloroethane	(11.1)	920
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	(≤ 11.62)	≤ 971
C ₂ H ₂ F ₂	1,1-Difluoroethylene	10.29 ±0.01	650
C ₂ H ₂ F ₂	<i>cis</i> -1,2-Difluoroethylene	10.23 ±0.02	690
C ₂ H ₂ O	Ketene	9.617 ±0.003	880
C ₂ H ₂ O ₂	Glyoxal	10.2	773
C ₂ H ₂ S ₂	Thiirene	8.61	892
C ₂ H ₃ Br	Bromoethylene	9.83 ±0.02	1028
C ₂ H ₃ Cl	Chloroethylene	9.99 ±0.02	985
C ₂ H ₃ ClF ₂	1-Chloro-1,1-difluoroethane	(11.98)	626
C ₂ H ₃ ClO	Acetyl chloride	10.82 ±0.04	801
C ₂ H ₃ ClO	Chloroacetaldehyde	(10.48)	815
C ₂ H ₃ ClO ₂	Chloroacetic acid	(10.7)	597
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	(11.0)	917
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	(11.0)	911
C ₂ H ₃ F	Fluoroethylene	10.36 ±0.01	861
C ₂ H ₃ FO	Acetyl fluoride	(11.5)	667
C ₂ H ₃ F ₃	1,1,1-Trifluoroethane	13.3 ±0.5	536
C ₂ H ₃ N	Acetonitrile	12.20 ±0.01	1253
C ₂ H ₃ NO	Methylisocyanate	(10.67)	900
C ₂ H ₄	Ethylene	10.5138 ±0.0006	1067
C ₂ H ₄ Br ₂	1,2-Dibromoethane	10.35 ±0.04	961
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	11.04 ±0.02	935
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	11.04 ±0.02	931

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{\text{ion}}$ kJ/mol
C ₂ H ₄ F ₂	1,1-Difluoroethane	(11.87)	643
C ₂ H ₄ O	Acetaldehyde	10.229 ± 0.0007	821
C ₂ H ₄ O	Ethylene oxide	10.56 ± 0.01	966
C ₂ H ₄ O ₂	Acetic acid	10.65 ± 0.02	595
C ₂ H ₄ O ₂	Methyl formate	10.835 ± 0.005	690
C ₂ H ₅ Br	Bromoethane	10.29 ± 0.01	931
C ₂ H ₅ Cl	Chloroethane	10.98 ± 0.02	947
C ₂ H ₅ ClO	2-Chloroethanol	(10.5)	756
C ₂ H ₅ F	Fluoroethane	(11.78)	873
C ₂ H ₅ I	Iodoethane	9.3492 ± 0.0006	893
C ₂ H ₅ N	Ethyleneimine	(9.5 ± 0.3)	1044
C ₂ H ₅ NO	Acetamide	9.65 ± 0.03	693
C ₂ H ₅ NO	<i>N</i> -Methylformamide	9.83 ± 0.04	760
C ₂ H ₅ NO ₂	Nitroethane	10.88 ± 0.05	948
C ₂ H ₆	Ethane	11.56 ± 0.02	1031
C ₂ H ₆ Cl ₂ Si	Dichlorodimethylsilane	(10.7)	576
C ₂ H ₆ O	Ethanol	10.43 ± 0.05	772
C ₂ H ₆ O	Dimethyl ether	10.025 ± 0.025	783
C ₂ H ₆ OS	Dimethyl sulfoxide	9.10 ± 0.03	727
C ₂ H ₆ O ₂	Ethylene glycol	10.16	593
C ₂ H ₆ S	Ethaneithiol	9.31 ± 0.03	851
C ₂ H ₆ S	Dimethyl sulfide	8.69 ± 0.02	801
C ₂ H ₆ S ₂	Dimethyl disulfide	(7.4 ± 0.3)	690
C ₂ H ₇ N	Ethylamine	8.86 ± 0.02	808
C ₂ H ₇ N	Dimethylamine	8.24 ± 0.08	777
C ₂ H ₇ NO	Ethanolamine	8.96	664
C ₂ H ₈ N ₂	1,2-Ethanediamine	(8.6)	812
C ₂ H ₈ N ₂	1,1-Dimethylhydrazine	7.29 ± 0.05	787
C ₂ N ₂	Cyanogen	13.37 ± 0.01	1597
C ₃ F ₆	Perfluoropropene	10.60 ± 0.03	-103
C ₃ F ₆ O	Perfluoroacetone	(11.57 ± 0.13)	-282
C ₃ F ₈	Perfluoropropane	(13.38)	-491
C ₃ HN	Cyanoacetylene	11.64 ± 0.01	1475
C ₃ H ₂ O	2-Propynal	(10.7 ± 0.1)	1145
C ₃ H ₃ F ₃	3,3,3-Trifluoropropene	(10.9)	437
C ₃ H ₃ N	2-Propenenitrile	10.91 ± 0.01	1237
C ₃ H ₃ NO	Oxazole	(9.9)	940
C ₃ H ₃ NO	Isoxazole	(9.93)	1038
C ₃ H ₄	Allene	9.692 ± 0.004	1126
C ₃ H ₄	Propyne	10.37 ± 0.01	1187
C ₃ H ₄	Cyclopropene	9.67 ± 0.01	1209
C ₃ H ₄ N ₂	Imidazole	(8.81)	997
C ₃ H ₄ O	Propargyl alcohol	10.49 ± 0.02	1060
C ₃ H ₄ O	Acrolein	10.103 ± 0.006	900
C ₃ H ₄ O	Cyclopropanone	(9.1 ± 0.1)	895
C ₃ H ₄ O ₂	Propenoic acid	10.60	701
C ₃ H ₄ O ₂	2-Oxetanone	(9.70 ± 0.01)	653
C ₃ H ₅ Br	3-Bromopropene	(9.96)	1008
C ₃ H ₅ Cl	3-Chloropropene	10.04 ± 0.01	965
C ₃ H ₅ ClO	Epichlorohydrin	(10.64)	919
C ₃ H ₅ ClO ₂	Methyl chloroacetate	(10.3)	575
C ₃ H ₅ F	3-Fluoropropene	(10.11)	821
C ₃ H ₅ N	Propanenitrile	11.84 ± 0.02	1194
C ₃ H ₅ NO	Acrylamide	(9.5)	720
C ₃ H ₆	Propene	9.73 ± 0.02	959
C ₃ H ₆	Cyclopropane	9.86	1005
C ₃ H ₆ Br ₂	1,2-Dibromopropane	(10.1)	903
C ₃ H ₆ Br ₂	1,3-Dibromopropane	(≤ 10.2)	≤ 919
C ₃ H ₆ Cl ₂	1,2-Dichloropropane	10.8 ± 0.1	886
C ₃ H ₆ Cl ₂	1,3-Dichloropropane	10.89 ± 0.04	892

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{\text{ion}}$ kJ/mol
C ₃ H ₆ O	Allyl alcohol	9.67 ± 0.05	808
C ₃ H ₆ O	Methyl vinyl ether	8.95 ± 0.01	763
C ₃ H ₆ O	Propanal	9.96 ± 0.01	772
C ₃ H ₆ O	Acetone	9.703 ± 0.006	719
C ₃ H ₆ O	Methyloxirane	(10.22)	892
C ₃ H ₆ O	Oxetane	9.65 ± 0.01	851
C ₃ H ₆ O ₂	Propanoic acid	10.525 ± 0.003	568
C ₃ H ₆ O ₂	Ethyl formate	10.61 ± 0.01	639
C ₃ H ₆ O ₂	Methyl acetate	10.25 ± 0.02	579
C ₃ H ₆ O ₂	1,3-Dioxolane	(9.9)	658
C ₃ H ₆ O ₃	1,3,5-Trioxane	(10.3)	528
C ₃ H ₇ Br	1-Bromopropane	10.18 ± 0.01	898
C ₃ H ₇ Br	2-Bromopropane	10.10 ± 0.03	877
C ₃ H ₇ Cl	1-Chloropropane	10.81 ± 0.01	911
C ₃ H ₇ Cl	2-Chloropropane	10.79 ± 0.02	896
C ₃ H ₇ F	1-Fluoropropane	(11.3)	806
C ₃ H ₇ F	2-Fluoropropane	(11.08)	776
C ₃ H ₇ I	1-Iodopropane	9.25 ± 0.01	860
C ₃ H ₇ I	2-Iodopropane	9.19 ± 0.02	845
C ₃ H ₇ N	Allylamine	(8.76)	891
C ₃ H ₇ N	Cyclopropylamine	(8.8)	926
C ₃ H ₇ N	Propyleneimine	(9.0)	960
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide	(9.12)	688
C ₃ H ₇ NO ₂	1-Nitropropane	(10.81)	919
C ₃ H ₇ NO ₂	2-Nitropropane	(10.71)	894
C ₃ H ₈	Propane	10.95 ± 0.05	952
C ₃ H ₈ O	1-Propanol	10.18 ± 0.06	727
C ₃ H ₈ O	2-Propanol	10.17 ± 0.02	709
C ₃ H ₈ O	Ethyl methyl ether	9.72 ± 0.07	722
C ₃ H ₈ O ₂	Dimethoxymethane	9.7	588
C ₃ H ₈ S	1-Propanethiol	9.20 ± 0.01	819
C ₃ H ₈ S	2-Propanethiol	9.145 ± 0.005	806
C ₃ H ₈ S	Ethyl methyl sulfide	(8.55)	765
C ₃ H ₉ BO ₃	Trimethyl borate	(10.0)	65
C ₃ H ₉ ClSi	Trimethylchlorosilane	(10.15)	624
C ₃ H ₉ N	Propylamine	(8.78)	777
C ₃ H ₉ N	Isopropylamine	(8.72)	758
C ₃ H ₉ N	Trimethylamine	7.82 ± 0.06	731
C ₃ H ₉ NO	3-Amino-1-propanol	(9.0)	651
C ₄ H ₂ O ₃	Maleic anhydride	(10.8)	645
C ₄ H ₄	1-Buten-3-yne	9.58 ± 0.02	1230
C ₄ H ₄ N ₂	Succinonitrile	(12.1 ± 0.25)	1377
C ₄ H ₄ N ₂	Pyrimidine	9.23	1087
C ₄ H ₄ N ₂	Pyridazine	8.67 ± 0.03	1112
C ₄ H ₄ O	Furan	8.883 ± 0.003	822
C ₄ H ₄ O ₂	Diketene	(9.6 ± 0.02)	736
C ₄ H ₄ O ₃	Succinic anhydride	(10.6)	500
C ₄ H ₄ O ₄	Fumaric acid	(10.7)	355
C ₄ H ₄ S	Thiophene	8.86 ± 0.02	970
C ₄ H ₅ N	Methylacrylonitrile	10.34	1127
C ₄ H ₅ N	Pyrrrole	8.207 ± 0.005	900
C ₄ H ₅ N	Cyclopropanecarbonitrile	(10.25)	1173
C ₄ H ₆	1,2-Butadiene	(9.03)	1034
C ₄ H ₆	1,3-Butadiene	9.082 ± 0.004	986
C ₄ H ₆	1-Butyne	10.19 ± 0.02	1148
C ₄ H ₆	2-Butyne	9.59 ± 0.03	1071
C ₄ H ₆	Cyclobutene	9.43 ± 0.02	1067
C ₄ H ₆ O	Divinyl ether	(8.7)	827
C ₄ H ₆ O	<i>trans</i> -2-Butenal	9.73 ± 0.01	835
C ₄ H ₆ O	2-Methylpropenal	(9.92)	834

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{\text{ion}}$ kJ/mol
C ₄ H ₆ O	Cyclobutanone	(9.35)	815
C ₄ H ₆ O ₂	<i>cis</i> -Crotonic acid	(10.08)	625
C ₄ H ₆ O ₂	<i>trans</i> -Crotonic acid	(9.9)	604
C ₄ H ₆ O ₂	Methacrylic acid	(10.15)	611
C ₄ H ₆ O ₂	Vinyl acetate	9.19 ± 0.05	572
C ₄ H ₆ O ₂	Methyl acrylate	(9.9)	641
C ₄ H ₆ O ₃	Acetic anhydride	(10.0)	398
C ₄ H ₆ O ₄	Dimethyl oxalate	(10.0)	287
C ₄ H ₆ S	2,5-Dihydrothiophene	(8.4)	898
C ₄ H ₇ N	Butanenitrile	(11.2)	1110
C ₄ H ₇ N	2-Methylpropanenitrile	(11.3)	1115
C ₄ H ₇ NO	2-Pyrrolidone	(9.2)	674
C ₄ H ₈	1-Butene	9.55 ± 0.06	921
C ₄ H ₈	<i>cis</i> -2-Butene	9.11 ± 0.01	871
C ₄ H ₈	<i>trans</i> -2-Butene	9.10 ± 0.01	866
C ₄ H ₈	Isobutene	9.239 ± 0.003	875
C ₄ H ₈	Cyclobutane	(9.82 ± 0.05)	976
C ₄ H ₈	Methylcyclopropane	(9.46)	936
C ₄ H ₈ Br ₂	1,4-Dibromobutane	(10.15)	879
C ₄ H ₈ O	Ethyl vinyl ether	(8.98)	709
C ₄ H ₈ O	1,2-Epoxybutane	(≤ 10.15)	862
C ₄ H ₈ O	Butanal	9.84 ± 0.02	742
C ₄ H ₈ O	Isobutanal	9.71 ± 0.01	721
C ₄ H ₈ O	2-Butanone	9.52 ± 0.04	678
C ₄ H ₈ O	Tetrahydrofuran	9.38 ± 0.05	721
C ₄ H ₈ O ₂	Butanoic acid	10.17 ± 0.05	509
C ₄ H ₈ O ₂	2-Methylpropanoic acid	10.33 ± 0.03	516
C ₄ H ₈ O ₂	Propyl formate	10.52 ± 0.02	555
C ₄ H ₈ O ₂	Ethyl acetate	10.01 ± 0.05	522
C ₄ H ₈ O ₂	Methyl propanoate	10.15 ± 0.03	548
C ₄ H ₈ O ₂	1,3-Dioxane	9.8	607
C ₄ H ₈ O ₂	1,4-Dioxane	9.19 ± 0.01	571
C ₄ H ₈ O ₂ S	Sulfolane	(9.8)	577
C ₄ H ₈ S	Tetrahydrothiophene	8.38	774
C ₄ H ₉ Br	1-Bromobutane	(10.12)	869
C ₄ H ₉ Br	2-Bromobutane	10.01 ± 0.02	845
C ₄ H ₉ Br	1-Bromo-2-methylpropane	10.09 ± 0.02	861
C ₄ H ₉ Br	2-Bromo-2-methylpropane	9.92 ± 0.03	823
C ₄ H ₉ Cl	1-Chlorobutane	10.67 ± 0.03	875
C ₄ H ₉ Cl	2-Chlorobutane	10.53	857
C ₄ H ₉ Cl	1-Chloro-2-methylpropane	10.73 ± 0.07	877
C ₄ H ₉ Cl	2-Chloro-2-methylpropane	(10.61)	842
C ₄ H ₉ I	1-Iodobutane	9.23 ± 0.01	840
C ₄ H ₉ I	2-Iodobutane	9.10 ± 0.02	815
C ₄ H ₉ I	1-Iodo-2-methylpropane	9.19 ± 0.01	824
C ₄ H ₉ I	2-Iodo-2-methylpropane	(9.02)	798
C ₄ H ₉ N	Pyrrolidine	(8.0)	769
C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide	8.81 ± 0.03	616
C ₄ H ₉ NO	Morpholine	(8.2)	841
C ₄ H ₁₀	Butane	10.53 ± 0.10	890
C ₄ H ₁₀	Isobutane	(10.57)	886
C ₄ H ₁₀ O	1-Butanol	9.99 ± 0.05	689
C ₄ H ₁₀ O	2-Butanol	9.88 ± 0.03	658
C ₄ H ₁₀ O	2-Methyl-1-propanol	10.02 ± 0.04	683
C ₄ H ₁₀ O	2-Methyl-2-propanol	9.90 ± 0.02	642
C ₄ H ₁₀ O	Diethyl ether	9.51 ± 0.03	666
C ₄ H ₁₀ O	Methyl propyl ether	9.41 ± 0.07	670
C ₄ H ₁₀ O	Isopropyl methyl ether	9.45 ± 0.04	661
C ₄ H ₁₀ O ₂	Ethylene glycol monoethyl ether	(9.6)	529
C ₄ H ₁₀ O ₂	Ethylene glycol dimethyl ether	(9.3)	558

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
C ₄ H ₁₀ S	1-Butanethiol	9.14 ± 0.01	794
C ₄ H ₁₀ S	2-Butanethiol	(9.10)	781
C ₄ H ₁₀ S	2-Methyl-1-propanethiol	(9.12)	783
C ₄ H ₁₀ S	2-Methyl-2-propanethiol	(9.03)	762
C ₄ H ₁₀ S	Diethyl sulfide	(8.43)	730
C ₄ H ₁₀ S	Methyl propyl sulfide	(8.8)	767
C ₄ H ₁₀ S	Isopropyl methyl sulfide	(8.7)	749
C ₄ H ₁₀ S ₂	Diethyl disulfide	(8.27)	724
C ₄ H ₁₁ N	Butylamine	8.7 ± 0.1	748
C ₄ H ₁₁ N	<i>sec</i> -Butylamine	8.46 ± 0.1	711
C ₄ H ₁₁ N	<i>tert</i> -Butylamine	8.46 ± 0.1	695
C ₄ H ₁₁ N	Isobutylamine	8.50 ± 0.1	721
C ₄ H ₁₁ N	Diethylamine	7.85 ± 0.1	684
C ₄ H ₁₂ Si	Tetramethylsilane	9.80 ± 0.04	713
C ₄ H ₁₂ Sn	Tetramethylstannane	8.89 ± 0.05	837
C ₄ NiO ₄	Nickel carbonyl	8.27 ± 0.04	200
C ₅ H ₄ O ₂	Furfural	9.22 ± 0.01	739
C ₅ H ₅ N	Pyridine	9.25	1031
C ₅ H ₆	1-Penten-3-yne	9.00 ± 0.01	1119
C ₅ H ₆	<i>cis</i> -3-Penten-1-yne	9.14 ± 0.04	1137
C ₅ H ₆	<i>trans</i> -3-Penten-1-yne	9.05 ± 0.01	1128
C ₅ H ₆	2-Methyl-1-buten-3-yne	9.25 ± 0.02	1152
C ₅ H ₆	1,3-Cyclopentadiene	8.55 ± 0.02	955
C ₅ H ₆ O	2-Methylfuran	8.38 ± 0.02	729
C ₅ H ₆ O	3-Methylfuran	(8.64)	763
C ₅ H ₆ S	2-Methylthiophene	(8.14)	867
C ₅ H ₆ S	3-Methylthiophene	(8.40)	893
C ₅ H ₈	<i>cis</i> -1,3-Pentadiene	8.63 ± 0.03	914
C ₅ H ₈	<i>trans</i> -1,3-Pentadiene	8.59 ± 0.02	905
C ₅ H ₈	1,4-Pentadiene	9.60 ± 0.02	1032
C ₅ H ₈	2-Methyl-1,3-butadiene	8.84 ± 0.01	928
C ₅ H ₈	1-Pentyne	10.10 ± 0.01	1119
C ₅ H ₈	Cyclopentene	9.01 ± 0.01	905
C ₅ H ₈	Spiropentane	(9.26)	1078
C ₅ H ₈ O	Cyclopropyl methyl ketone	(≤ 9.46)	796
C ₅ H ₈ O	Cyclopentanone	9.26 ± 0.01	701
C ₅ H ₈ O	3,4-Dihydro-2H-pyran	8.35 ± 0.01	681
C ₅ H ₈ O ₂	Ethyl acrylate	(≤ 10.3)	617
C ₅ H ₈ O ₂	Methyl methacrylate	(9.7)	589
C ₅ H ₈ O ₂	2,4-Pentanedione	8.85 ± 0.01	469
C ₅ H ₉ NO	<i>N</i> -Methyl-2-pyrrolidone	(≤ 9.17)	≤ 676
C ₅ H ₁₀	1-Pentene	9.51 ± 0.01	896
C ₅ H ₁₀	<i>cis</i> -2-Pentene	9.01 ± 0.03	843
C ₅ H ₁₀	<i>trans</i> -2-Pentene	9.04 ± 0.01	841
C ₅ H ₁₀	2-Methyl-1-butene	9.12 ± 0.01	844
C ₅ H ₁₀	3-Methyl-1-butene	9.52 ± 0.01	891
C ₅ H ₁₀	2-Methyl-2-butene	8.69 ± 0.01	796
C ₅ H ₁₀	Cyclopentane	(10.33 ± 0.15)	918
C ₅ H ₁₀ O	2,2-Dimethylpropanal	9.51 ± 0.01	675
C ₅ H ₁₀ O	Cyclopentanol	(9.72)	695
C ₅ H ₁₀ O	Pentanal	9.74 ± 0.04	709
C ₅ H ₁₀ O	2-Pentanone	9.38 ± 0.01	646
C ₅ H ₁₀ O	3-Pentanone	9.31 ± 0.01	640
C ₅ H ₁₀ O	3-Methyl-2-butanone	9.30 ± 0.01	635
C ₅ H ₁₀ O	Tetrahydropyran	9.25 ± 0.01	670
C ₅ H ₁₀ O ₂	Pentanoic acid	(≤ 10.53)	≤ 527
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid	(≤ 10.51)	≤ 499
C ₅ H ₁₀ O ₂	Butyl formate	10.52 ± 0.02	584
C ₅ H ₁₀ O ₂	Propyl acetate	(≤ 9.92)	501
C ₅ H ₁₀ O ₂	Isopropyl acetate	9.99 ± 0.03	482

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
C ₅ H ₁₀ O ₂	Ethyl propanoate	(10.00)	500
C ₅ H ₁₀ O ₂	Methyl butanoate	(10.07)	520
C ₅ H ₁₀ S	Thiacyclohexane	(8.2)	728
C ₅ H ₁₁ Br	1-Bromopentane	10.10 ± 0.01	846
C ₅ H ₁₁ I	1-Iodopentane	9.20 ± 0.01	817
C ₅ H ₁₁ N	Piperidine	8.03 ± 0.11	726
C ₅ H ₁₁ N	<i>N</i> -Methylpyrrolidine	≤ 8.41 ± 0.02	≤ 809
C ₅ H ₁₂	Pentane	10.28 ± 0.10	845
C ₅ H ₁₂	Isopentane	10.32 ± 0.05	843
C ₅ H ₁₂	Neopentane	(≤ 10.2)	≤ 818
C ₅ H ₁₂ O	1-Pentanol	(10.00)	668
C ₅ H ₁₂ O	2-Pentanol	(9.78)	630
C ₅ H ₁₂ O	3-Pentanol	9.78	628
C ₅ H ₁₂ O	2-Methyl-1-butanol	(9.86)	649
C ₅ H ₁₂ O	2-Methyl-2-butanol	(9.8)	615
C ₅ H ₁₂ O	3-Methyl-2-butanol	(9.88 ± 0.13)	637
C ₅ H ₁₂ O	Butyl methyl ether	(9.4 ± 0.1)	648
C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether	(9.24)	608
C ₅ H ₁₂ O	Ethyl propyl ether	(9.45)	640
C ₅ H ₁₂ S	<i>tert</i> -Butyl methyl sulfide	(8.38)	687
C ₅ H ₁₂ S	Ethyl propyl sulfide	(8.50)	716
C ₅ H ₁₂ S	Ethyl isopropyl sulfide	(8.35)	689
C ₆ BrF ₅	Bromopentafluorobenzene	(9.67)	222
C ₆ ClF ₅	Chloropentafluorobenzene	(9.72)	126
C ₆ Cl ₆	Hexachlorobenzene	(8.98)	822
C ₆ F ₆	Hexafluorobenzene	9.89 ± 0.04	8
C ₆ F ₁₂	Perfluorocyclohexane	(13.2)	-1095
C ₆ HF ₅	Pentafluorobenzene	(9.63)	122
C ₆ HF ₅ O	Pentafluorophenol	(9.20)	-71
C ₆ H ₂ F ₄	1,2,3,4-Tetrafluorobenzene	(9.53)	284
C ₆ H ₂ F ₄	1,2,3,5-Tetrafluorobenzene	(9.53)	263
C ₆ H ₂ F ₄	1,2,4,5-Tetrafluorobenzene	(9.35)	254
C ₆ H ₃ Cl ₃	1,2,4-Trichlorobenzene	(9.04)	880
C ₆ H ₃ Cl ₃	1,3,5-Trichlorobenzene	9.32 ± 0.02	899
C ₆ H ₄ CINO ₂	1-Chloro-3-nitrobenzene	(9.92 ± 0.1)	995
C ₆ H ₄ CINO ₂	1-Chloro-4-nitrobenzene	(9.96 ± 0.1)	999
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	9.06 ± 0.02	907
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	9.10 ± 0.02	906
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	8.92 ± 0.02	885
C ₆ H ₄ FNO ₂	1-Fluoro-4-nitrobenzene	(9.90)	826
C ₆ H ₄ F ₂	<i>o</i> -Difluorobenzene	9.29 ± 0.01	602
C ₆ H ₄ F ₂	<i>m</i> -Difluorobenzene	9.33 ± 0.01	591
C ₆ H ₄ F ₂	<i>p</i> -Difluorobenzene	9.1589 ± 0.0003	577
C ₆ H ₄ O ₂	<i>p</i> -Benzoquinone	10.01 ± 0.06	844
C ₆ H ₅ Br	Bromobenzene	9.00 ± 0.02	971
C ₆ H ₅ Cl	Chlorobenzene	9.07 ± 0.02	930
C ₆ H ₅ ClO	<i>m</i> -Chlorophenol	8.655 ± 0.001	680
C ₆ H ₅ ClO	<i>p</i> -Chlorophenol	(≤ 8.69)	≤ 692
C ₆ H ₅ F	Fluorobenzene	9.20 ± 0.01	772
C ₆ H ₅ I	Iodobenzene	8.685	1003
C ₆ H ₅ NO ₂	Nitrobenzene	9.86 ± 0.02	1019
C ₆ H ₅ NO ₃	<i>o</i> -Nitrophenol	(9.1)	782
C ₆ H ₅ NO ₃	<i>m</i> -Nitrophenol	(9.0)	755
C ₆ H ₅ NO ₃	<i>p</i> -Nitrophenol	(9.1)	761
C ₆ H ₆	Benzene	9.24378 ± 0.00007	975
C ₆ H ₆	Fulvene	(8.36)	1031
C ₆ H ₆ CIN	<i>o</i> -Chloroaniline	(8.50)	883
C ₆ H ₆ CIN	<i>m</i> -Chloroaniline	(8.09)	835
C ₆ H ₆ CIN	<i>p</i> -Chloroaniline	(≤ 8.18)	≤ 844
C ₆ H ₆ N ₂ O ₂	<i>o</i> -Nitroaniline	(8.27)	861

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{\text{ion}}$ kJ/mol
C ₆ H ₆ N ₂ O ₂	<i>m</i> -Nitroaniline	(8.31)	865
C ₆ H ₆ N ₂ O ₂	<i>p</i> -Nitroaniline	(8.34)	859
C ₆ H ₆ O	Phenol	8.49 ± 0.02	723
C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	7.94 ± 0.01	503
C ₆ H ₆ S	Benzenethiol	(8.32)	915
C ₆ H ₇ N	Aniline	7.720 ± 0.002	832
C ₆ H ₇ N	2-Methylpyridine	(9.02)	970
C ₆ H ₇ N	3-Methylpyridine	(9.04)	979
C ₆ H ₇ N	4-Methylpyridine	(9.04)	976
C ₆ H ₈ N ₂	<i>o</i> -Phenylenediamine	(7.2)	787
C ₆ H ₈ N ₂	<i>m</i> -Phenylenediamine	(7.14)	777
C ₆ H ₈ N ₂	<i>p</i> -Phenylenediamine	(6.87 ± 0.05)	759
C ₆ H ₁₀	1,5-Hexadiene	9.27 ± 0.05	978
C ₆ H ₁₀	1-Hexyne	10.03 ± 0.05	1089
C ₆ H ₁₀	3,3-Dimethyl-1-butyne	9.90 ± 0.04	1060
C ₆ H ₁₀	Cyclohexene	8.945 ± 0.01	859
C ₆ H ₁₀ O	Cyclohexanone	9.14 ± 0.01	656
C ₆ H ₁₀ O	Mesityl oxide	9.10 ± 0.01	694
C ₆ H ₁₀ O ₄	Diethyl oxalate	(9.8)	205
C ₆ H ₁₁ NO	Caprolactam	(9.07 ± 0.02)	629
C ₆ H ₁₂	1-Hexene	9.44 ± 0.04	869
C ₆ H ₁₂	<i>cis</i> -2-Hexene	(8.97 ± 0.01)	818
C ₆ H ₁₂	<i>trans</i> -2-Hexene	(8.97 ± 0.01)	814
C ₆ H ₁₂	2-Methyl-1-pentene	(9.08 ± 0.01)	817
C ₆ H ₁₂	4-Methyl-1-pentene	9.45 ± 0.01	862
C ₆ H ₁₂	2-Methyl-2-pentene	(8.58)	761
C ₆ H ₁₂	4-Methyl- <i>cis</i> -2-pentene	8.98 ± 0.01	809
C ₆ H ₁₂	4-Methyl- <i>trans</i> -2-pentene	(8.97 ± 0.01)	804
C ₆ H ₁₂	2-Ethyl-1-butene	(9.06 ± 0.02)	818
C ₆ H ₁₂	2,3-Dimethyl-1-butene	(9.07 ± 0.01)	812
C ₆ H ₁₂	2,3-Dimethyl-2-butene	8.27 ± 0.01	729
C ₆ H ₁₂	Cyclohexane	9.86 ± 0.03	828
C ₆ H ₁₂	Methylcyclopentane	(9.85)	845
C ₆ H ₁₂ O	Hexanal	9.72 ± 0.05	691
C ₆ H ₁₂ O	2-Hexanone	9.3 ± 0.1	626
C ₆ H ₁₂ O	3-Hexanone	9.12 ± 0.02	600
C ₆ H ₁₂ O	3-Methyl-2-pentanone	9.21 ± 0.01	600
C ₆ H ₁₂ O	4-Methyl-2-pentanone	9.30 ± 0.01	609
C ₆ H ₁₂ O	2-Methyl-3-pentanone	9.10 ± 0.01	592
C ₆ H ₁₂ O	3,3-Dimethyl-2-butanone	9.12 ± 0.02	589
C ₆ H ₁₂ O	Cyclohexanol	(9.75)	651
C ₆ H ₁₂ O ₂	Hexanoic acid	≤ 10.12	≤ 463
C ₆ H ₁₂ O ₂	Butyl acetate	(9.92 ± .05)	471
C ₆ H ₁₂ O ₂	<i>sec</i> -Butyl acetate	9.90	453
C ₆ H ₁₂ O ₂	Methyl 2,2-dimethylpropanoate	(9.90 ± 0.04)	466
C ₆ H ₁₃ I	1-Iodohexane	9.179	794
C ₆ H ₁₃ N	Cyclohexylamine	(8.86)	750
C ₆ H ₁₄	Hexane	10.13	810
C ₆ H ₁₄	2-Methylpentane	(10.12)	802
C ₆ H ₁₄	3-Methylpentane	(10.08)	801
C ₆ H ₁₄	2,2-Dimethylbutane	(10.06)	787
C ₆ H ₁₄	2,3-Dimethylbutane	(10.02)	791
C ₆ H ₁₄ O	1-Hexanol	(9.89)	639
C ₆ H ₁₄ O	2-Hexanol	(9.80 ± 0.03)	611
C ₆ H ₁₄ O	3-Hexanol	(9.63 ± 0.03)	599
C ₆ H ₁₄ O	Dipropyl ether	(9.27)	602
C ₆ H ₁₄ O	Diisopropyl ether	9.20 ± 0.05	569
C ₆ H ₁₄ O	Butyl ethyl ether	(9.36)	610
C ₆ H ₁₄ O	Methyl pentyl ether	(≤ 9.67)	≤ 657
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane	(9.2)	434

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether	≤ 9.8	≤ 448
C ₆ H ₁₄ S	Dipropyl sulfide	8.30 ± 0.02	676
C ₆ H ₁₄ S	Diisopropyl sulfide	(8.2 ± 0.2)	649
C ₆ H ₁₅ N	Hexylamine	(8.63 ± 0.05)	699
C ₆ H ₁₅ N	Dipropylamine	(7.84 ± 0.02)	641
C ₆ H ₁₅ N	Diisopropylamine	(7.73 ± 0.03)	602
C ₆ H ₁₅ N	Triethylamine	(7.50 ± 0.02)	631
C ₆ H ₁₅ NO ₃	Triethanolamine	(7.9)	206
C ₇ H ₃ F ₅	2,3,4,5,6-Pentafluorotoluene	(9.4)	64
C ₇ H ₅ ClO	Benzoyl chloride	(9.53)	815
C ₇ H ₅ Cl ₃	(Trichloromethyl)benzene	(≤ 9.60)	≤ 914
C ₇ H ₅ F ₃	(Trifluoromethyl)benzene	9.685 ± 0.005	335
C ₇ H ₅ N	Benzonitrile	9.70 ± 0.01	1154
C ₇ H ₆ O	Benzaldehyde	9.49 ± 0.02	878
C ₇ H ₆ O ₂	Benzoic acid	(9.3)	604
C ₇ H ₇ Br	<i>p</i> -Bromotoluene	8.67 ± 0.02	908
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene	(8.7 ± 0.1)	856
C ₇ H ₇ Cl	<i>m</i> -Chlorotoluene	(8.83)	869
C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene	(8.69)	855
C ₇ H ₇ Cl	(Chloromethyl)benzene	9.10 ± 0.02	897
C ₇ H ₇ F	<i>o</i> -Fluorotoluene	8.91 ± 0.01	709
C ₇ H ₇ F	<i>m</i> -Fluorotoluene	8.91 ± 0.01	709
C ₇ H ₇ F	<i>p</i> -Fluorotoluene	8.79 ± 0.01	701
C ₇ H ₇ NO	Benzamide	(9.25)	792
C ₇ H ₇ NO ₂	<i>o</i> -Nitrotoluene	9.24	946
C ₇ H ₇ NO ₂	<i>m</i> -Nitrotoluene	9.45 ± 0.1	941
C ₇ H ₇ NO ₂	<i>p</i> -Nitrotoluene	9.46 ± 0.05	942
C ₇ H ₈	Toluene	8.8276 ± 0.0006	901
C ₇ H ₈ O	<i>o</i> -Cresol	(8.24)	670
C ₇ H ₈ O	<i>m</i> -Cresol	8.29 ± 0.07	668
C ₇ H ₈ O	<i>p</i> -Cresol	(8.3)	675
C ₇ H ₈ O	Benzyl alcohol	(8.3)	701
C ₇ H ₈ O	Anisole	8.22 ± 0.03	725
C ₇ H ₉ N	Benzylamine	(8.64)	917
C ₇ H ₉ N	<i>o</i> -Methylaniline	(7.44 ± 0.02)	772
C ₇ H ₉ N	<i>m</i> -Methylaniline	(7.50 ± 0.02)	778
C ₇ H ₉ N	<i>p</i> -Methylaniline	(7.24 ± 0.02)	753
C ₇ H ₉ N	<i>N</i> -Methylaniline	7.34 ± 0.04	792
C ₇ H ₉ N	2,3-Dimethylpyridine	(8.85 ± 0.02)	922
C ₇ H ₉ N	2,4-Dimethylpyridine	(8.85 ± 0.03)	918
C ₇ H ₉ N	2,5-Dimethylpyridine	(≤ 8.80 ± 0.05)	≤ 916
C ₇ H ₉ N	2,6-Dimethylpyridine	8.86 ± 0.03	913
C ₇ H ₉ N	3,4-Dimethylpyridine	(≤ 9.15)	≤ 953
C ₇ H ₉ N	3,5-Dimethylpyridine	(≤ 9.25)	≤ 965
C ₇ H ₁₀ O	Dicyclopropyl ketone	(9.1)	1041
C ₇ H ₁₄	1-Heptene	9.34 ± 0.10	839
C ₇ H ₁₄	<i>trans</i> -3-Heptene	(8.92)	790
C ₇ H ₁₄	Cycloheptane	9.97	844
C ₇ H ₁₄	Methylcyclohexane	9.64	775
C ₇ H ₁₄	<i>cis</i> -1,2-Dimethylcyclopentane	(9.92 ± 0.05)	828
C ₇ H ₁₄	<i>trans</i> -1,2-Dimethylcyclopentane	9.7 ± 0.2	799
C ₇ H ₁₄ O	1-Heptanal	(9.65)	668
C ₇ H ₁₄ O	2-Heptanone	9.28 ± 0.10	594
C ₇ H ₁₄ O	3-Heptanone	9.18 ± 0.08	589
C ₇ H ₁₄ O	4-Heptanone	9.10 ± 0.06	577
C ₇ H ₁₄ O	5-Methyl-2-hexanone	(9.28)	586
C ₇ H ₁₄ O	2,4-Dimethyl-3-pentanone	8.95 ± 0.01	552
C ₇ H ₁₄ O	1-Methylcyclohexanol	(9.8 ± 0.2)	586
C ₇ H ₁₆	Heptane	9.93 ± 0.10	771
C ₇ H ₁₆ O	1-Heptanol	(9.84)	614

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{\text{ion}}$ kJ/mol
C ₇ H ₁₆ O	2-Heptanol	(9.70)	580
C ₇ H ₁₆ O	3-Heptanol	(9.68)	578
C ₇ H ₁₆ O	4-Heptanol	(9.61)	572
C ₇ H ₁₆ O	Ethyl pentyl ether	(≤ 9.49)	≤ 602
C ₈ H ₄ O ₃	Phthalic anhydride	(10.1)	603
C ₈ H ₆ O ₄	Isophthalic acid	(9.98)	268
C ₈ H ₆ O ₄	Terephthalic acid	(9.86)	232
C ₈ H ₇ N	2-Methylbenzotrile	(≤ 9.38)	1085
C ₈ H ₇ N	3-Methylbenzotrile	(≤ 9.34)	1085
C ₈ H ₇ N	4-Methylbenzotrile	9.32 \pm 0.02	1083
C ₈ H ₇ N	Indole	7.7602 \pm 0.0006	908
C ₈ H ₈	Styrene	8.464 \pm 0.001	964
C ₈ H ₈ O	<i>p</i> -Tolualdehyde	(9.33)	825
C ₈ H ₈ O	Acetophenone	9.29 \pm 0.03	810
C ₈ H ₈ O ₂	<i>o</i> -Toluic acid	(9.1)	558
C ₈ H ₈ O ₂	<i>m</i> -Toluic acid	(9.43)	579
C ₈ H ₈ O ₂	<i>p</i> -Toluic acid	(9.23)	560
C ₈ H ₈ O ₂	Benzeneacetic acid	(8.26)	479
C ₈ H ₈ O ₂	Methyl benzoate	9.32 \pm 0.03	611
C ₈ H ₁₀	Ethylbenzene	8.77 \pm 0.01	876
C ₈ H ₁₀	<i>o</i> -Xylene	8.56 \pm 0.01	844
C ₈ H ₁₀	<i>m</i> -Xylene	8.56 \pm 0.01	843
C ₈ H ₁₀	<i>p</i> -Xylene	8.44 \pm 0.01	832
C ₈ H ₁₀ O	<i>p</i> -Ethylphenol	(7.84)	613
C ₈ H ₁₀ O	2,3-Xylenol	(8.26)	640
C ₈ H ₁₀ O	2,4-Xylenol	(8.0)	609
C ₈ H ₁₀ O	2,6-Xylenol	(8.05)	615
C ₈ H ₁₀ O	3,4-Xylenol	(8.09)	624
C ₈ H ₁₀ O	Phenetole	(8.13)	683
C ₈ H ₁₁ N	2,4,6-Trimethylpyridine	(≤ 8.9)	≤ 880
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline	(≤ 7.67)	≤ 794
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	7.12 \pm 0.02	787
C ₈ H ₁₄	1-Octyne	(9.95 \pm 0.02)	1040
C ₈ H ₁₄	2-Octyne	9.31 \pm 0.01	961
C ₈ H ₁₄	3-Octyne	9.22 \pm 0.01	952
C ₈ H ₁₄	4-Octyne	9.20 \pm 0.01	946
C ₈ H ₁₆	1-Octene	9.43 \pm 0.01	829
C ₈ H ₁₆	Cyclooctane	9.75 \pm 0.05	816
C ₈ H ₁₆	Ethylcyclohexane	(9.54)	748
C ₈ H ₁₆	1,1-Dimethylcyclohexane	(9.42)	728
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane	(<9.78)	772
C ₈ H ₁₆	<i>trans</i> -1,2-Dimethylcyclohexane	9.41	728
C ₈ H ₁₆	<i>cis</i> -1,3-Dimethylcyclohexane	(<9.98)	778
C ₈ H ₁₆	<i>trans</i> -1,3-Dimethylcyclohexane	9.53	743
C ₈ H ₁₆	<i>cis</i> -1,4-Dimethylcyclohexane	(<9.93)	782
C ₈ H ₁₆	<i>trans</i> -1,4-Dimethylcyclohexane	(9.56)	738
C ₈ H ₁₆	Propylcyclopentane	(9.34)	753
C ₈ H ₁₆ O	2,2,4-Trimethyl-3-pentanone	(8.80)	511
C ₈ H ₁₈	Octane	9.80 \pm 0.10	737
C ₈ H ₁₈	2-Methylheptane	(9.84)	734
C ₈ H ₁₈	2,2,4-Trimethylpentane	(9.86)	713
C ₈ H ₁₈	2,2,3,3-Tetramethylbutane	9.8	720
C ₈ H ₁₈ O	Dibutyl ether	(9.28)	s 560
C ₈ H ₁₈ O	Di- <i>sec</i> -butyl ether	(9.11)	511
C ₈ H ₁₈ O	Di- <i>tert</i> -butyl ether	8.88 \pm 0.07	493
C ₈ H ₁₈ S	Dibutyl sulfide	(8.2)	624
C ₈ H ₁₈ S	Di- <i>tert</i> -butyl sulfide	(8.0)	583
C ₈ H ₁₈ S	Diisobutyl sulfide	(8.34)	625
C ₈ H ₁₉ N	Dibutylamine	(7.69)	586
C ₈ H ₁₉ N	Diisobutylamine	(7.8)	574

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{ion}$ kJ/mol
C ₈ H ₂₀ Si	Tetraethylsilane	(8.9)	595
C ₉ H ₇ N	Quinoline	8.62 ± 0.01	1041
C ₉ H ₇ N	Isoquinoline	8.53 ± 0.03	1032
C ₉ H ₈	Indene	8.14 ± 0.01	949
C ₉ H ₁₀	<i>o</i> -Methylstyrene	(8.20)	908
C ₉ H ₁₀	<i>m</i> -Methylstyrene	(8.15)	899
C ₉ H ₁₀	<i>p</i> -Methylstyrene	(8.1)	895
C ₉ H ₁₀	Cyclopropylbenzene	(8.35)	956
C ₉ H ₁₀	Indan	(8.3)	864
C ₉ H ₁₀ O ₂	Ethyl benzoate	(8.9)	537
C ₉ H ₁₂	Propylbenzene	8.713 ± 0.010	848
C ₉ H ₁₂	Isopropylbenzene	8.73 ± 0.01	847
C ₉ H ₁₂	1,2,3-Trimethylbenzene	8.42 ± 0.02	803
C ₉ H ₁₂	1,2,4-Trimethylbenzene	8.27 ± 0.01	784
C ₉ H ₁₂	1,3,5-Trimethylbenzene	8.41 ± 0.01	796
C ₉ H ₁₃ N	<i>N,N</i> -Dimethyl- <i>o</i> -toluidine	7.40 ± 0.02	814
C ₉ H ₁₄ O	Isophorone	(≤ 9.07)	≤ 670
C ₉ H ₁₈	Butylcyclopentane	(9.95)	793
C ₉ H ₁₈	Propylcyclohexane	(9.46)	720
C ₉ H ₁₈	Isopropylcyclohexane	(9.33)	704
C ₉ H ₁₈ O	2-Nonanone	(9.16)	545
C ₉ H ₁₈ O	5-Nonanone	(9.07)	530
C ₉ H ₁₈ O	2,6-Dimethyl-4-heptanone	9.01 ± 0.06	512
C ₉ H ₂₀	Nonane	9.71 ± 0.10	709
C ₁₀ F ₈	Perfluoronaphthalene	8.85	-368
C ₁₀ H ₇ Br	1-Bromonaphthalene	8.08 ± 0.03	955
C ₁₀ H ₇ Cl	1-Chloronaphthalene	(8.13)	906
C ₁₀ H ₈	Naphthalene	8.1442 ± 0.0009	936
C ₁₀ H ₈	Azulene	7.38 ± 0.05	1001
C ₁₀ H ₈ O	1-Naphthol	7.76 ± 0.03	719
C ₁₀ H ₈ O	2-Naphthol	7.87 ± 0.06	729
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate	(9.64 ± 0.07)	277
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene	8.46 ± 0.02	841
C ₁₀ H ₁₄	Butylbenzene	8.69 ± 0.02	826
C ₁₀ H ₁₄	<i>sec</i> -Butylbenzene	8.68 ± 0.02	820
C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	8.68 ± 0.05	816
C ₁₀ H ₁₄	Isobutylbenzene	8.69 ± 0.02	817
C ₁₀ H ₁₄	<i>p</i> -Cymene	(8.29)	771
C ₁₀ H ₁₄	<i>o</i> -Diethylbenzene	(≤ 8.51)	≤ 804
C ₁₀ H ₁₄	<i>m</i> -Diethylbenzene	(8.49)	798
C ₁₀ H ₁₄	<i>p</i> -Diethylbenzene	(8.40)	790
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	8.04 ± 0.02	730
C ₁₀ H ₁₄ O	<i>p-tert</i> -Butylphenol	(7.8)	552
C ₁₀ H ₁₆	α -Pinene	(8.07)	808
C ₁₀ H ₁₆ O	Camphor	(8.76)	577
C ₁₀ H ₁₈	<i>cis</i> -Decahydronaphthalene	9.36 ± 0.04	734
C ₁₀ H ₁₈	<i>trans</i> -Decahydronaphthalene	9.34 ± 0.04	720
C ₁₀ H ₂₀	1-Decene	9.42 ± 0.05	786
C ₁₀ H ₂₀	Butylcyclohexane	(9.41)	695
C ₁₀ H ₂₂	Decane	(9.65)	682
C ₁₁ H ₁₀	1-Methylnaphthalene	7.97 ± 0.03	882
C ₁₁ H ₁₀	2-Methylnaphthalene	7.91 ± 0.08	877
C ₁₁ H ₁₆	<i>p-tert</i> -Butyltoluene	(8.12)	730
C ₁₁ H ₂₄	Undecane	(9.56)	650
C ₁₁ H ₂₄	2-Methyldecane	(9.7)	658
C ₁₂ H ₈	Acenaphthylene	(8.22)	1053
C ₁₂ H ₆ N	Carbazole	(7.57)	961
C ₁₂ H ₁₀	Acenaphthene	7.75 ± 0.07	903
C ₁₂ H ₁₀	Biphenyl	8.23 ± 0.10	977
C ₁₂ H ₁₀ N ₂ O	<i>trans</i> -Azoxybenzene	(8.1)	1123

IONIZATION ENERGIES OF GAS-PHASE MOLECULES (continued)

Mol. Form.	Name	IP/eV	$\Delta_f H_{\text{ion}}$ kJ/mol
C ₁₂ H ₁₀ O	Diphenyl ether	(8.09)	766
C ₁₂ H ₁₁ N	Diphenylamine	7.16 ± 0.04	908
C ₁₂ H ₁₈	5,7-Dodecadiyne	(8.67)	1079
C ₁₂ H ₁₈	Hexamethylbenzene	7.85 ± 0.01	670
C ₁₂ H ₂₂	Cyclohexylcyclohexane	(9.41)	690
C ₁₂ H ₂₇ N	Tributylamine	(7.4)	492
C ₁₃ H ₁₀	9H-Fluorene	7.91 ± 0.02	952
C ₁₃ H ₁₀ O	Benzophenone	9.08 ± 0.05	926
C ₁₃ H ₁₂	Diphenylmethane	(8.55)	963
C ₁₄ H ₁₀	Anthracene	7.439 ± 0.006	948
C ₁₄ H ₁₀	Phenanthrene	7.8914 ± 0.0006	966
C ₁₄ H ₁₀	Diphenylacetylene	7.94 ± 0.03	1168
C ₁₄ H ₁₂	<i>cis</i> -Stilbene	(7.80)	1005
C ₁₄ H ₁₂	<i>trans</i> -Stilbene	7.656 ± 0.001	973
C ₁₄ H ₁₄	1,2-Diphenylethane	8.9 ± 0.1	1002
C ₁₆ H ₁₀	Fluoranthene	7.9 ± 0.1	1052
C ₁₆ H ₁₀	Pyrene	7.4256 ± 0.0006	935
C ₁₈ H ₁₂	Chrysene	7.60 ± 0.01	1017
C ₁₈ H ₁₄	<i>o</i> -Terphenyl	(7.99)	1056
C ₁₈ H ₁₄	<i>m</i> -Terphenyl	(8.01)	1057
C ₁₈ H ₁₄	<i>p</i> -Terphenyl	7.80 ± 0.03	1037
C ₂₀ H ₁₂	Perylene	6.960 ± 0.001	981
C ₂₄ H ₁₂	Coronene	7.29 ± 0.01	1026

X-RAY ATOMIC ENERGY LEVELS

The energy levels in this tables are the values recommended by Bearden and Burr on the basis of a thorough review of the literature on x-ray wavelengths and related data. All values are in electron volts (eV). Values in parentheses are interpolated, and an asterisk * indicates a level which is not resolved from the level above it. See Reference 1 for uncertainties in the levels and a complete description of how the recommended values were obtained.

REFERENCES

1. Bearden, J. A., and Burr, A. F., *Rev. Mod. Phys.*, 39, 125, 1967; also published as *X-Ray Wavelengths and X-Ray Atomic Energy Levels*, Natl. Stand. Ref. Data Sys.- Natl. Bur. Standards (U.S.), No. 14, 1967.
2. Gray, D. E., Editor, *American Institute of Physics Handbook, Third Edition*, pp. 7-158 to 7-167, McGraw-Hill, New York, 1972.

Level	¹ H	² He	³ Li	⁴ Be	⁵ B	⁶ C	⁷ N	⁸ O
K	13.59811	24.58678	54.75	111.0	188.0	283.8	401.6	532.0
L _I								23.7
L _{II,III}					4.7	6.4	9.2	7.1
Level	⁹ F	¹⁰ Ne	¹¹ Na	¹² Mg	¹³ Al	¹⁴ Si	¹⁵ P	¹⁶ S
K	685.4	866.9	1072.1	1305.0	1559.6	1838.9	2145.5	2472.0
L _I	(31)	(45)	63.3	89.4	117.7	148.7	189.3	229.2
L _{II,III}	8.6	18.3	31.1	51.4	73.1	99.2	132.2	164.8
Level	¹⁷ Cl	¹⁸ Ar	¹⁹ K	²⁰ Ca	²¹ Sc	²² Ti	²³ V	²⁴ Cr
K	2822.4	3202.9	3607.4	4038.1	4492.8	4966.4	5465.1	5989.2
L _I	270.2	320	377.1	437.8	500.4	563.7	628.2	694.6
L _{II}	201.6	247.3	296.3	350.0	406.7	461.5	520.5	583.7
L _{III}	200.0	245.2	293.6	346.4	402.2	455.5	512.9	574.5
M _I	17.5	25.3	33.9	43.7	53.8	60.3	66.5	74.1
M _{II,III}	6.8	12.4	17.8	25.4	32.3	34.6	37.8	42.5
M _{IV,V}					6.6	3.7	2.2	2.3
Level	²⁵ Mn	²⁶ Fe	²⁷ Co	²⁸ Ni	²⁹ Cu	³⁰ Zn	³¹ Ga	³² Ge
K	6539.0	7112.0	7708.9	8332.8	8978.9	9658.6	10367.1	11103.1
L _I	769.0	846.1	925.6	1008.1	1096.1	1193.6	1297.7	1414.3
L _{II}	651.4	721.1	793.6	871.9	951.0	1042.8	1142.3	1247.8
L _{III}	640.3	708.1	778.6	854.7	931.1	1019.7	1115.4	1216.7
M _I	83.9	92.9	100.7	111.8	119.8	135.9	158.1	180.0
M _{II}	48.6	54.0	59.5	68.1	73.6	86.6	106.8	127.9
M _{III}	48.6*	54.0*	59.5*	68.1*	73.6*	86.6*	102.9	120.8
M _{IV,V}	3.3	3.6	2.9	3.6	1.6	8.1	17.4	28.7
Level	³³ As	³⁴ Se	³⁵ Br	³⁶ Kr	³⁷ Rb	³⁸ Sr	³⁹ Y	⁴⁰ Zr
K	11866.7	12657.8	13473.7	14325.6	15199.7	16104.6	17038.4	17997.6
L _I	1526.5	1653.9	1782.0	1921.0	2065.1	2216.3	2372.5	2531.6
L _{II}	1358.6	1476.2	1596.0	1727.2	1863.9	2006.8	2155.5	2306.7
L _{III}	1323.1	1435.8	1549.9	1674.9	1804.4	1939.6	2080.0	2222.3
M _I	203.5	231.5	256.5	322.1	357.5	393.6	430.3	474.3
M _{II}	146.4	168.2	189.3	222.7	247.4	279.8	312.4	344.2
M _{III}	140.5	161.9	181.5	213.8	238.5	269.1	300.3	330.5
M _{IV}	41.2	56.7	70.1	88.9	111.8	135.0	159.6	182.4
M _V	41.2*	56.7*	69.0	88.9*	110.3	133.1	157.4	180.0
N _I			27.3	24.0	29.3	37.7	45.4	51.3
N _{II}	2.5	5.6	5.2	10.6	14.8	19.9	25.6	28.7
N _{III}	2.5*	5.6*	4.6	10.6*	14.0	19.9*	25.6*	28.7*

X-RAY ATOMIC ENERGY LEVELS (continued)

Level	⁴¹Nb	⁴²Mo	⁴³Tc	⁴⁴Ru	⁴⁵Rh	⁴⁶Pd	⁴⁷Ag	⁴⁸Cd
K	18985.6	19999.5	21044.0	22117.2	23219.9	24350.3	25514.0	26711.2
L _I	2697.7	2865.5	3042.5	3224.0	3411.9	3604.3	3805.8	4018.0
L _{II}	2464.7	2625.1	2793.2	2966.9	3146.1	3330.3	3523.7	3727.0
L _{III}	2370.5	2520.2	2676.9	2837.9	3003.8	3173.3	3351.1	3537.5
M _I	468.4	504.6		585.0	627.1	669.9	717.5	770.2
M _{II}	378.4	409.7	444.9	482.8	521.0	559.1	602.4	650.7
M _{III}	363.0	392.3	425.0	460.6	496.2	531.5	571.4	616.5
M _{IV}	207.4	230.3	256.4	283.6	311.7	340.0	372.8	410.5
M _V	204.6	227.0	252.9	279.4	307.0	334.7	366.7	403.7
N _I	58.1	61.8		74.9	81.0	86.4	95.2	107.6
N _{II}	33.9	34.8	38.9	43.1	47.9	51.1	62.6	66.9
N _{III}	33.9*	34.8*	38.9*	43.1*	47.9*	51.1*	55.9	66.9*
N _{IV,V}	3.2	1.8		2.0	2.5	1.5	3.3	9.3
Level	⁴⁹In	⁵⁰Sn	⁵¹Sb	⁵²Te	⁵³I	⁵⁴Xe	⁵⁵Cs	⁵⁶Ba
K	27939.9	29200.1	30491.2	31813.8	33169.4	34561.4	35984.6	37440.6
L _I	4237.5	4464.7	4698.3	4939.2	5188.1	5452.8	5714.3	5988.8
L _{II}	3938.0	4156.1	4380.4	4612.0	4852.1	5103.7	5359.4	5623.6
L _{III}	3730.1	3928.8	4132.2	4341.4	4557.1	4782.2	5011.9	5247.0
M _I	825.6	883.8	943.7	1006.0	1072.1		1217.1	1292.8
M _{II}	702.2	756.4	811.9	869.7	930.5	999.0	1065.0	1136.7
M _{III}	664.3	714.4	765.6	818.7	874.6	937.0	997.6	1062.2
M _{IV}	450.8	493.3	536.9	582.5	631.3		739.5	796.1
M _V	443.1	484.8	527.5	572.1	619.4	672.3	725.5	780.7
N _I	121.9	136.5	152.0	168.3	186.4		230.8	253.0
N _{II}	77.4	88.6	98.4	110.2	122.7	146.7	172.3	191.8
N _{III}	77.4*	88.6*	98.4*	110.2*	122.7*	146.7*	161.6	179.7
N _{IV}	16.2	23.9	31.4	39.8	49.6		78.8	92.5
N _V	16.2*	23.9*	31.4*	39.8*	49.6*		76.5	89.9
O _I	0.1	0.9	6.7	11.6	13.6		22.7	39.1
O _{II}	0.8	1.1	2.1	2.3	3.3		13.1	16.6
O _{III}	0.8*	1.1*	2.1*	2.3*	3.3*		11.4	14.6
Level	⁵⁷La	⁵⁸Ce	⁵⁹Pr	⁶⁰Nd	⁶¹Pm	⁶²Sm	⁶³Eu	⁶⁴Gd
K	38924.6	40443.0	41990.6	43568.9	45184.0	46834.2	48519.0	50239.1
L _I	6266.3	6548.8	6834.8	7126.0	7427.9	7736.8	8052.0	8375.6
L _{II}	5890.6	6164.2	6440.4	6721.5	7012.8	7311.8	7617.1	7930.3
L _{III}	5482.7	5723.4	5964.3	6207.9	6459.3	6716.2	6976.9	7242.8
M _I	1361.3	1434.6	1511.0	1575.3		1722.8	1800.0	1880.8
M _{II}	1204.4	1272.8	1337.4	1402.8	1471.4	1540.7	1613.9	1688.3
M _{III}	1123.4	1185.4	1242.2	1297.4	1356.9	1419.8	1480.6	1544.0
M _{IV}	848.5	901.3	951.1	999.9	1051.5	1106.0	1160.6	1217.2
M _V	831.7	883.3	931.0	977.7	1026.9	1080.2	1130.9	1185.2
N _I	270.4	289.6	304.5	315.2		345.7	360.2	375.8
N _{II}	205.8	223.3	236.3	243.3	242	265.6	283.9	288.5
N _{III}	191.4	207.2	217.6	224.6	242*	247.4	256.6	270.9
N _{IV,V}	98.9	110.0	113.2	117.5	120.4	129.0	133.2	140.5
N _{VI,VII}		0.1	2.0	1.5		5.5	0.0	0.1
O _I	32.3	37.8	37.4	37.5		37.4	31.8	36.1
O _{II,III}	14.4	19.8	22.3	21.1		21.3	22.0	20.3
Level	⁶⁵Tb	⁶⁶Dy	⁶⁷Ho	⁶⁸Er	⁶⁹Tm	⁷⁰Yb	⁷¹Lu	⁷²Hf
K	51995.7	53788.5	55617.7	57485.5	59389.6	61332.3	63313.8	65350.8
L _I	8708.0	9045.8	9394.2	9751.3	10115.7	10486.4	10870.4	11270.7
L _{II}	8251.6	8580.6	8917.8	9264.3	9616.9	9978.2	10348.6	10739.4
L _{III}	7514.0	7790.1	8071.1	8357.9	8648.0	8943.6	9244.1	9560.7
M _I	1967.5	2046.8	2128.3	2206.5	2306.8	2398.1	2491.2	2600.9

X-RAY ATOMIC ENERGY LEVELS (continued)

Level	⁶⁵Tb	⁶⁶Dy	⁶⁷Ho	⁶⁸Er	⁶⁹Tm	⁷⁰Yb	⁷¹Lu	⁷²Hf
M _{II}	1767.7	1841.8	1922.8	2005.8	2089.8	2173.0	2263.5	2365.4
M _{III}	1611.3	1675.6	1741.2	1811.8	1884.5	1949.8	2023.6	2107.6
M _{IV}	1275.0	1332.5	1391.5	1453.3	1514.6	1576.3	1639.4	1716.4
M _V	1241.2	1294.9	1351.4	1409.3	1467.7	1527.8	1588.5	1661.7
N _I	397.9	416.3	435.7	449.1	471.7	487.2	506.2	538.1
N _{II}	310.2	331.8	343.5	366.2	385.9	396.7	410.1	437.0
N _{III}	385.0	292.9	306.6	320.0	336.6	343.5	359.3	380.4
N _{IV}	147.0	154.2	161.0	176.7	179.6	198.1	204.8	223.8
N _V	147.0*	154.2*	161.0*	167.6	179.6*	184.9	195.0	213.7
N _{VI,VII}	2.6	4.2	3.7	4.3	5.3	6.3	6.9	17.1
O _I	39.0	62.9	51.2	59.8	53.2	54.1	56.8	64.9
O _{II}	25.4	26.3	20.3	29.4	32.3	23.4	28.0	38.1
O _{III}	25.4*	26.3*	20.3*	29.4*	32.3*	23.4*	28.0*	30.6

Level	⁷³Ta	⁷⁴W	⁷⁵Re	⁷⁶Os	⁷⁷Ir	⁷⁸Pt	⁷⁹Au	⁸⁰Hg
K	67416.4	69525.0	71676.4	73870.8	76111.0	78394.8	80724.9	83102.3
L _I	11681.5	12099.8	12526.7	12968.0	13418.5	13879.9	14352.8	14839.3
L _{II}	11136.1	11544.0	11958.7	12385.0	12824.1	13272.6	13733.6	14208.7
L _{III}	9881.1	10206.8	10535.3	10870.9	11215.2	11563.7	11918.7	12283.9
M _I	2708.0	2819.6	2931.7	3048.5	3173.7	3296.0	3424.9	3561.6
M _{II}	2468.7	2574.9	2681.6	2792.2	2908.7	3026.5	3147.8	3278.5
M _{III}	2194.0	2281.0	2367.3	2457.2	2550.7	2645.4	2743.0	2847.1
M _{IV}	1793.2	1871.6	1948.9	2030.8	2116.1	2201.9	2291.1	2384.9
M _V	1735.1	1809.2	1882.9	1960.1	2040.4	2121.6	2205.7	2294.9
N _I	565.5	595.0	625.0	654.3	690.1	722.0	758.8	800.3
N _{II}	464.8	491.6	517.9	546.5	577.1	609.2	643.7	676.9
N _{III}	404.5	425.3	444.4	468.2	494.3	519.0	545.4	571.0
N _{IV}	241.3	258.8	273.7	289.4	311.4	330.8	352.0	378.3
N _V	229.3	245.4	260.2	272.8	294.9	313.3	333.9	359.8
N _{VI}	25.0	36.5	40.6	46.3	63.4	74.3	86.4	102.2
N _{VII}	25.0*	33.6	40.6*	46.3*	60.5	71.1	82.8	98.5
O _I	71.1	77.1	82.8	83.7	95.2	101.7	107.8	120.3
O _{II}	44.9	46.8	45.6	58.0	63.0	65.3	71.7	80.5
O _{III}	36.4	35.6	34.6	45.4	50.5	51.7	53.7	57.6
O _{IV,V}	5.7	6.1	3.5		3.8	2.2	2.5	6.4

Level	⁸¹Tl	⁸²Pb	⁸³Bi	⁸⁴Po	⁸⁵At	⁸⁶Rn	⁸⁷Fr	⁸⁸Ra
K	85530.4	88004.5	90525.9	93105.0	95729.9	98404	101137	103921.9
L _I	15346.7	15860.8	16387.5	16939.3	17493	18049	18639	19236.7
L _{II}	14697.9	15200.0	15711.1	16244.3	16784.7	17337.1	17906.5	18484.3
L _{III}	12657.5	13035.2	13418.6	13813.8	14213.5	14619.4	15031.2	15444.4
M _I	3704.1	3850.7	3999.1	4149.4	(4317)	(4482)	(4652)	4822.0
M _{II}	3415.7	3554.2	3696.3	3854.1	4008	4159	4327	4489.5
M _{III}	2956.6	3066.4	3176.9	3301.9	3426	3538	3663	3791.8
M _{IV}	2485.1	2585.6	2687.6	2798.0	2908.7	3021.5	3136.2	3248.4
M _V	2389.3	2484.0	2579.6	2683.0	2786.7	2892.4	2999.9	3104.9
N _I	845.5	893.6	938.2	995.3	(1042)	(1097)	(1153)	1208.4
N _{II}	721.3	763.9	805.3	851	886	929	980	1057.6
N _{III}	609.0	644.5	678.9	705	740	768	810	879.1
N _{IV}	406.6	435.2	463.6	500.2	533.2	566.6	603.3	635.9
N _V	386.2	412.9	440.0	473.4			577	602.7
N _{VI}	122.8	142.9	161.9					298.9
N _{VII}	118.5	138.1	157.4					298.9*
O _I	136.3	147.3	159.3					254.4
O _{II}	99.6	104.8	116.8					200.4
O _{III}	75.4	86.0	92.8					152.8

X-RAY ATOMIC ENERGY LEVELS (continued)

Level	⁸¹ Tl	⁸² Pb	⁸³ Bi	⁸⁴ Po	⁸⁵ At	⁸⁶ Rn	⁸⁷ Fr	⁸⁸ Ra
O _{IV}	15.3	21.8	26.5	31.4				67.2
O _V	13.1	19.2	24.4	31.4*				67.2*
P _I		3.1						43.5
P _{II,III}		0.7	2.7					18.8
Level	⁸⁹ Ac	⁹⁰ Th	⁹¹ Pa	⁹² U	⁹³ Np	⁹⁴ Pu	⁹⁵ Am	⁹⁶ Cm
K	106755.3	109650.9	112601.4	115606.1	118678	121818	125027	128220
L _I	19840	20472.1	21104.6	21757.4	22426.8	23097.2	23772.9	24460
L _{II}	19083.2	19693.2	20313.7	20947.6	21600.5	22266.2	22944.0	23779
L _{III}	15871.0	16300.3	16733.1	17166.3	17610.0	18056.8	18504.1	18930
M _I	(5002)	5182.3	5366.9	5548.0	5723.2	5932.9	6120.5	6288
M _{II}	4656	4830.4	5000.9	5182.2	5366.2	5541.2	5710.2	5895
M _{III}	3909	4046.1	4173.8	4303.4	4434.7	4556.6	4667.0	4797
M _{IV}	3370.2	3490.8	3611.2	3727.6	3850.3	3972.6	4092.1	4227
M _V	3219.0	3332.0	3441.8	3551.7	3665.8	3778.1	3886.9	3971
N _I	(1269)	1329.5	1387.1	1440.8	1500.7	1558.6	1617.1	1643
N _{II}	1080	1168.2	1224.3	1272.6	1327.7	1372.1	1411.8	1440
N _{III}	890	967.3	1006.7	1044.9	1086.8	1114.8	(1135.7)	1154
N _{IV}	674.9	714.1	743.4	780.4	815.9	848.9	878.7	
N _V		676.4	708.2	737.7	770.3	801.4	827.6	
N _{VI}		344.4	371.2	391.3	415.0	445.8		
N _{VII}		335.2	359.5	380.9	404.4	432.4		
O _I		290.2	309.6	323.7		351.9		385
O _{II}		229.4	222.9	259.3	283.4	274.1		
O _{III}		181.8	222.9*	195.1	206.1	206.5		
O _{IV}		94.3	94.1	105.0	109.3	116.0	115.8	
O _V		87.9	94.1*	96.3	101.3	105.4	103.3	
P _I		59.5		70.7				
P _{II}		49.0		42.3				
P _{III}		43.0		32.3				
Level	⁹⁷ Bk	⁹⁸ Cf	⁹⁹ Es	¹⁰⁰ Fm	¹⁰¹ Md	¹⁰² No	¹⁰³ Lr	
K	131590	135960	139490	143090	146780	150540	154380	
L _I	25275	26110	26900	27700	28530	29380	30240	
L _{II}	24385	25250	26020	26810	27610	28440	29280	
L _{III}	19452	19930	20410	20900	21390	21880	22360	
M _I	6556	6754	6977	7205	7441	7675	7900	
M _{II}	6147	6359	6574	6793	7019	7245	7460	
M _{III}	4977	5109	5252	5397	5546	5688	5710	
M _{IV}	4366	4497	4630	4766	4903	5037	5150	
M _V	4132	4253	4374	4498	4622	4741	4860	
N _I	1755	1799	1868	1937	2010	2078	2140	
N _{II}	1554	1616	1680	1747	1814	1876	1930	
N _{III}	1235	1279	1321	1366	1410	1448	1480	
O _I	398	419	435	454	472	484	490	

ELECTRON BINDING ENERGIES OF THE ELEMENTS

Gwyn P. Williams

This table gives the binding energies in electron volts (eV) for selected electronic levels of the elements. For metallic elements the binding energy is referred to the Fermi level; for semiconductors, to the valence band maximum; and for gases and insulators, to the vacuum level. The atomic number is listed after the element name.

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2. Cardona, M. and Ley, L., *Photoemission from Solids*, Springer Verlag, Heidelberg, 1978.
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Actinium (89)

K	1s	106755
L I	2s	19840
L II	2p _{1/2}	19083
L III	2p _{3/2}	15871
M I	3s	5002
M II	3p _{1/2}	4656
M III	3p _{3/2}	3909
M IV	3d _{3/2}	3370
M V	3d _{5/2}	3219
N I	4s	1269 ^a
N II	4p _{1/2}	1080 ^a
N III	4p _{3/2}	890 ^a
N IV	4d _{3/2}	675 ^a
N V	4d _{5/2}	639 ^a
N VI	4f _{5/2}	319 ^a
N VII	4f _{7/2}	319 ^a
O I	5s	272 ^a
O II	5p _{1/2}	215 ^a
O III	5p _{3/2}	167 ^a
O IV	5d _{3/2}	80 ^a
O V	5d _{5/2}	80 ^a
P I	6s	—
P II	6p _{1/2}	—
P III	6p _{3/2}	—

Aluminum (13)

K	1s	1559.0
L I	2s	117.8 ^a
L II	2p _{1/2}	72.9 ^a
L III	2p _{3/2}	72.5 ^a

Antimony (51)

K	1s	30419
L I	2s	4698
L II	2p _{1/2}	4380
L III	2p _{3/2}	4132
M I	3s	946 ^b
M II	3p _{1/2}	812.7 ^b
M III	3p _{3/2}	766.4 ^b
M IV	3d _{3/2}	537.5 ^b
M V	3d _{5/2}	528.2 ^b
N I	4s	153.2 ^b
N II	4p _{1/2}	95.6 ^{b,c}
N III	4p _{3/2}	95.6 ^b
N IV	4d _{3/2}	33.3 ^b
N V	4d _{5/2}	32.1 ^b

Argon (18)

K	1s	3205.9 ^a
L I	2s	326.3 ^a
L II	2p _{1/2}	250.6 ^a
L III	2p _{3/2}	248.4 ^a
M I	3s	29.3 ^a
M II	3p _{1/2}	15.9 ^a
M III	3p _{3/2}	15.7 ^a

Arsenic (33)

K	1s	11867
L I	2s	1527.0 ^{a,d}
L II	2p _{1/2}	1359.1 ^{a,d}
L III	2p _{3/2}	1323.6 ^{a,d}
M I	3s	204.7 ^a
M II	3p _{1/2}	146.2 ^a
M III	3p _{3/2}	141.2 ^a
M IV	3d _{3/2}	41.7 ^a
M V	3d _{5/2}	41.7 ^a

Astatine (85)

K	1s	95730
L I	2s	17493
L II	2p _{1/2}	16785
L III	2p _{3/2}	14214
M I	3s	4317
M II	3p _{1/2}	4008
M III	3p _{3/2}	3426
M IV	3d _{3/2}	2909
M V	3d _{5/2}	2787
N I	4s	1042 ^a
N II	4p _{1/2}	886 ^a
N III	4p _{3/2}	740 ^a
N IV	4d _{3/2}	533 ^a
N V	4d _{5/2}	507 ^a
N VI	4f _{5/2}	210 ^a
N VII	4f _{7/2}	210 ^a
O I	5s	195 ^a
O II	5p _{1/2}	148 ^a
O III	5p _{3/2}	115 ^a
O IV	5d _{3/2}	40 ^a
O V	5d _{5/2}	40 ^a

Barium (56)

K	1s	37441
L I	2s	5989
L II	2p _{1/2}	5624

L III	2p _{3/2}	5247
M I	3s	1293 ^{a,d}
M II	3p _{1/2}	1137 ^{a,d}
M III	3p _{3/2}	1063 ^{a,d}
M IV	3d _{3/2}	795.7 ^a
M V	3d _{5/2}	780.5 ^a
N I	4s	253.5 ^b
N II	4p _{1/2}	192
N III	4p _{3/2}	178.6 ^b
N IV	4d _{3/2}	92.6 ^b
N V	4d _{5/2}	89.9 ^b
N VI	4f _{5/2}	—
N VII	4f _{7/2}	—
O I	5s	30.3 ^b
O II	5p _{1/2}	17.0 ^b
O III	5p _{3/2}	14.8 ^b

Beryllium (4)

K	1s	111.5 ^a
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Bismuth (83)

K	1s	90526
L I	2s	16388
L II	2p _{1/2}	15711
L III	2p _{3/2}	13419
M I	3s	3999
M II	3p _{1/2}	3696
M III	3p _{3/2}	3177
M IV	3d _{3/2}	2688
M V	3d _{5/2}	2580
N I	4s	939 ^b
N II	4p _{1/2}	805.2 ^b
N III	4p _{3/2}	678.8 ^b
N IV	4d _{3/2}	464.0 ^b
N V	4d _{5/2}	440.1 ^b
N VI	4f _{5/2}	162.3 ^b
N VII	4f _{7/2}	157.0 ^b
O I	5s	159.3 ^{a,d}
O II	5p _{1/2}	119.0 ^b
O III	5p _{3/2}	92.6 ^b
O IV	5d _{3/2}	26.9 ^b
O V	5d _{5/2}	23.8 ^b

Boron (5)

K	1s	188 ^a
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Bromine (35)

K	1s	13474
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L I	2s	1782 ^a
L II	2p _{1/2}	1596 ^a
L III	2p _{3/2}	1550 ^a
M I	3s	257 ^a
M II	3p _{1/2}	189 ^a
M III	3p _{3/2}	182 ^a
M IV	3d _{3/2}	70 ^a
M V	3d _{5/2}	69 ^a

Cadmium (48)

K	1s	26711
L I	2s	4018
L II	2p _{1/2}	3727
L III	2p _{3/2}	3538
M I	3s	772.0 ^b
M II	3p _{1/2}	652.6 ^b
M III	3p _{3/2}	618.4 ^b
M IV	3d _{3/2}	411.9 ^b
M V	3d _{5/2}	405.2 ^b
N I	4s	109.8 ^b
N II	4p _{1/2}	63.9 ^{b,c}
N III	4p _{3/2}	63.9 ^{b,c}
N IV	4d _{3/2}	11.7 ^b
N V	4d _{5/2}	10.7 ^b

Calcium (20)

K	1s	4038.5 ^a
L I	2s	438.4 ^b
L II	2p _{1/2}	349.7 ^b
L III	2p _{3/2}	346.2 ^b
M I	3s	44.3 ^b
M II	3p _{1/2}	25.4 ^b
M III	3p _{3/2}	25.4 ^b

Carbon (6)

K	1s	284.2 ^a
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Cerium (58)

K	1s	40443
L I	2s	6548
L II	2p _{1/2}	6164
L III	2p _{3/2}	5723
M I	3s	1436 ^{a,d}
M II	3p _{1/2}	1274 ^{a,d}
M III	3p _{3/2}	1187 ^{a,d}
M IV	3d _{3/2}	902.4 ^a
M V	3d _{5/2}	883.8 ^a

ELECTRON BINDING ENERGIES OF THE ELEMENTS (continued)

N I	4s	291.0 ^a
N II	4p _{1/2}	223.3
N III	4p _{3/2}	206.5 ^a
N IV	4d _{3/2}	109 ^a
N V	4d _{5/2}	—
N VI	4f _{5/2}	0.1
N VII	4f _{7/2}	0.1
O I	5s	37.8
O II	5p _{1/2}	19.8 ^a
O III	5p _{3/2}	17.0 ^a

Cesium (55)

K	1s	35985
L I	2s	5714
L II	2p _{1/2}	5359
L III	2p _{3/2}	5012
M I	3s	1211 ^{a,d}
M II	3p _{1/2}	1071 ^a
M III	3p _{3/2}	1003 ^a
M IV	3d _{3/2}	740.5 ^a
M V	3d _{5/2}	726.6 ^a
N I	4s	232.3 ^a
N II	4p _{1/2}	172.4 ^a
N III	4p _{3/2}	161.3 ^a
N IV	4d _{3/2}	79.8 ^a
N V	4d _{5/2}	77.5 ^a
N VI	4f _{5/2}	—
N VII	4f _{7/2}	—
O I	5s	22.7
O II	5p _{1/2}	14.2 ^a
O III	5p _{3/2}	12.1 ^a

Chlorine (17)

K	1s	2822.0
L I	2s	270 ^a
L II	2p _{1/2}	202 ^a
L III	2p _{3/2}	200 ^a

Chromium(24)

K	1s	5989
L I	2s	696.0 ^b
L II	2p _{1/2}	583.8 ^b
L III	2p _{3/2}	574.1 ^b
M I	3s	74.1 ^b
M II	3p _{1/2}	42.2 ^b
M III	3p _{3/2}	42.2 ^b

Cobalt (27)

K	1s	7709
L I	2s	925.1 ^b
L II	2p _{1/2}	793.2 ^b
L III	2p _{3/2}	778.1 ^b
M I	3s	101.0 ^b
M II	3p _{1/2}	58.9 ^b
M III	3p _{3/2}	58.9 ^b

Copper (29)

K	1s	8979
L I	2s	1096.7 ^b

L II	2p _{1/2}	952.3 ^b
L III	2p _{3/2}	932.5 ^b
M I	3s	122.5 ^b
M II	3p _{1/2}	77.3 ^b
M III	3p _{3/2}	75.1 ^b

Dysprosium (66)

K	1s	53789
L I	2s	9046
L II	2p _{1/2}	8581
L III	2p _{3/2}	7790
M I	3s	2047
M II	3p _{1/2}	1842
M III	3p _{3/2}	1676
M IV	3d _{3/2}	1333
M V	3d _{5/2}	1292 ^a
N I	4s	414.2 ^a
N II	4p _{1/2}	333.5 ^a
N III	4p _{3/2}	293.2 ^a
N IV	4d _{3/2}	153.6 ^a
N V	4d _{5/2}	153.6 ^a
N VI	4f _{5/2}	8.0 ^a
N VII	4f _{7/2}	4.3 ^a
O I	5s	49.9 ^a
O II	5p _{1/2}	26.3
O III	5p _{3/2}	26.3

Erbium (68)

K	1s	57486
L I	2s	9751
L II	2p _{1/2}	9264
L III	2p _{3/2}	8358
M I	3s	2206
M II	3p _{1/2}	2006
M III	3p _{3/2}	1812
M IV	3d _{3/2}	1453
M V	3d _{5/2}	1409
N I	4s	449.8 ^a
N II	4p _{1/2}	366.2
N III	4p _{3/2}	320.2 ^a
N IV	4d _{3/2}	167.6 ^a
N V	4d _{5/2}	167.6 ^a
N VI	4f _{5/2}	—
N VII	4f _{7/2}	4.7 ^a
O I	5s	50.6 ^a
O II	5p _{1/2}	31.4 ^a
O III	5p _{3/2}	24.7 ^a

Europium (63)

K	1s	48519
L I	2s	8052
L II	2p _{1/2}	7617
L III	2p _{3/2}	6977
M I	3s	1800
M II	3p _{1/2}	1614
M III	3p _{3/2}	1481
M IV	3d _{3/2}	1158.6 ^a
M V	3d _{5/2}	1127.5 ^a
N I	4s	360

N II	4p _{1/2}	284
N III	4p _{3/2}	257
N IV	4d _{3/2}	133
N V	4d _{5/2}	1227 ^a
N VI	4f _{5/2}	0
N VII	4f _{7/2}	0
O I	5s	32
O II	5p _{1/2}	22
O III	5p _{3/2}	22

Fluorine (9)

K	1s	696.7 ^a
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Francium (87)

K	1s	101137
L I	2s	18639
L II	2p _{1/2}	17907
L III	2p _{3/2}	15031
M I	3s	4652
M II	3p _{1/2}	4327
M III	3p _{3/2}	3663
M IV	3d _{3/2}	3136
M V	3d _{5/2}	3000
N I	4s	1153 ^a
N II	4p _{1/2}	980 ^a
N III	4p _{3/2}	810 ^a
N IV	4d _{3/2}	603 ^a
N V	4d _{5/2}	577 ^a
N VI	4f _{5/2}	268 ^a
N VII	4f _{7/2}	268 ^a
O I	5s	234 ^a
O II	5p _{1/2}	182 ^a
O III	5p _{3/2}	140 ^a
O IV	5d _{3/2}	58 ^a
O V	5d _{5/2}	58 ^a
P I	6s	34
P II	6p _{1/2}	15
P III	6p _{3/2}	15

Gadolinium (64)

K	1s	50239
L I	2s	8376
L II	2p _{1/2}	7930
L III	2p _{3/2}	7243
M I	3s	1881
M II	3p _{1/2}	1688
M III	3p _{3/2}	1544
M IV	3d _{3/2}	1221.9 ^a
M V	3d _{5/2}	1189.6 ^a
N I	4s	378.6 ^a
N II	4p _{1/2}	286
N III	4p _{3/2}	271
N IV	4d _{3/2}	—
N V	4d _{5/2}	142.6 ^a
N VI	4f _{5/2}	8.6 ^a
N VII	4f _{7/2}	8.6 ^a
O I	5s	36
O II	5p _{1/2}	20
O III	5p _{3/2}	20

Gallium (31)

K	1s	10367
L I	2s	1299.0 ^{a,d}
L II	2p _{1/2}	1143.2 ^b
L III	2p _{3/2}	1116.4 ^b
M I	3s	159.5 ^b
M II	3p _{1/2}	103.5 ^b
M III	3p _{3/2}	100.0 ^b
M IV	3d _{3/2}	18.7 ^b
M V	3d _{5/2}	18.7 ^b

Germanium (32)

K	1s	11103
L I	2s	1414.6 ^{a,d}
L II	2p _{1/2}	1248.1 ^{a,d}
L III	2p _{3/2}	1217.0 ^{a,d}
M I	3s	180.1 ^a
M II	3p _{1/2}	124.9 ^a
M III	3p _{3/2}	120.8 ^a
M IV	3d _{3/2}	29.8 ^a
M V	3d _{5/2}	29.2 ^a

Gold (79)

K	1s	80725
L I	2s	14353
L II	2p _{1/2}	13734
L III	2p _{3/2}	11919
M I	3s	3425
M II	3p _{1/2}	3148
M III	3p _{3/2}	2743
M IV	3d _{3/2}	2291
M V	3d _{5/2}	2206
N I	4s	762.1 ^b
N II	4p _{1/2}	642.7 ^b
N III	4p _{3/2}	546.3 ^b
N IV	4d _{3/2}	353.2 ^b
N V	4d _{5/2}	335.1 ^b
N VI	4f _{5/2}	87.6 ^b
N VII	4f _{7/2}	83.9 ^b
O I	5s	107.2 ^{a,d}
O II	5p _{1/2}	74.2 ^b
O III	5p _{3/2}	57.2 ^b

Hafnium (72)

K	1s	65351
L I	2s	11271
L II	2p _{1/2}	10739
L III	2p _{3/2}	9561
M I	3s	2601
M II	3p _{1/2}	2365
M III	3p _{3/2}	2107
M IV	3d _{3/2}	1176
M V	3d _{5/2}	1662
N I	4s	538 ^a
N II	4p _{1/2}	438.2 ^b
N III	4p _{3/2}	380.7 ^b
N IV	4d _{3/2}	220.0 ^b
N V	4d _{5/2}	211.5 ^b
N VI	4f _{5/2}	15.9 ^b

ELECTRON BINDING ENERGIES OF THE ELEMENTS (continued)

N VII	4f _{7/2}	14.2 ^b
O I	5s	64.2 ^b
O II	5p _{1/2}	38 ^a
O III	5p _{3/2}	29.9 ^b

Helium (2)

K	1s	24.6 ^a
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Holmium (67)

K	1s	55618
L I	2s	9394
L II	2p _{1/2}	8918
L III	2p _{3/2}	8071
M I	3s	2128
M II	3p _{1/2}	1923
M III	3p _{3/2}	1741
M IV	3d _{3/2}	1392
M V	3d _{5/2}	1351
N I	4s	432.4 ^a
N II	4p _{1/2}	343.5
N III	4p _{3/2}	308.2 ^a
N IV	4d _{3/2}	160 ^a
N V	4d _{5/2}	160 ^a
N VI	4f _{5/2}	8.6 ^a
N VII	4f _{7/2}	5.2 ^a
O I	5s	49.3 ^a
O II	5p _{1/2}	30.8 ^a
O III	5p _{3/2}	24.1 ^a

Hydrogen (1)

K	1s	13.6
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Indium (49)

K	1s	27940
L I	2s	4238
L II	2p _{1/2}	3938
L III	2p _{3/2}	3730
M I	3s	827.2 ^b
M II	3p _{1/2}	703.2 ^b
M III	3p _{3/2}	665.3 ^b
M IV	3d _{3/2}	451.4 ^b
M V	3d _{5/2}	443.9 ^b
N I	4s	122.9 ^b
N II	4p _{1/2}	73.5 ^{b,c}
N III	4p _{3/2}	73.5 ^{b,c}
N IV	4d _{3/2}	17.7 ^b
N V	4d _{5/2}	16.9 ^b

Iodine (53)

K	1s	33169
L I	2s	5188
L II	2p _{1/2}	4852
L III	2p _{3/2}	4557
M I	3s	1072 ^a
M II	3p _{1/2}	931 ^a
M III	3p _{3/2}	875 ^a
M IV	3d _{3/2}	631 ^a
M V	3d _{5/2}	620 ^a
N I	4s	186 ^a
N II	4p _{1/2}	123 ^a

N III	4p _{3/2}	123 ^a
N IV	4d _{3/2}	50 ^a
N V	4d _{5/2}	50 ^a

Iridium (77)

K	1s	76111
L I	2s	13419
L II	2p _{1/2}	12824
L III	2p _{3/2}	11215
M I	3s	3174
M II	3p _{1/2}	2909
M III	3p _{3/2}	2551
M IV	3d _{3/2}	2116
M V	3d _{5/2}	2040
N I	4s	691.1 ^b
N II	4p _{1/2}	577.8 ^b
N III	4p _{3/2}	495.8 ^b
N IV	4d _{3/2}	311.9 ^b
N V	4d _{5/2}	296.3 ^b
N VI	4f _{5/2}	63.8 ^b
N VII	4f _{7/2}	60.8 ^b
O I	5s	95.2 ^{a,d}
O II	5p _{1/2}	63.0 ^{a,d}
O III	5p _{3/2}	48.0 ^b

Iron (26)

K	1s	7112
L I	2s	844.6 ^b
L II	2p _{1/2}	719.9 ^b
L III	2p _{3/2}	706.8 ^b
M I	3s	91.3 ^b
M II	3p _{1/2}	52.7 ^b
M III	3p _{3/2}	52.7 ^b

Krypton (36)

K	1s	14326
L I	2s	1921
L II	2p _{1/2}	1730.9 ^a
L III	2p _{3/2}	1678.4 ^a
M I	3s	292.8 ^a
M II	3p _{1/2}	222.2 ^a
M III	3p _{3/2}	214.4 ^a
M IV	3d _{3/2}	95.0 ^a
M V	3d _{5/2}	93.8 ^a
N I	4s	27.5 ^a
N II	4p _{1/2}	14.1 ^a
N III	4p _{3/2}	14.1 ^a

Lanthanum (57)

K	1s	38925
L I	2s	6266
L II	2p _{1/2}	5891
L III	2p _{3/2}	5483
M I	3s	1362 ^{a,d}
M II	3p _{1/2}	1209 ^{a,d}
M III	3p _{3/2}	1128 ^{a,d}
M IV	3d _{3/2}	853 ^a
M V	3d _{5/2}	836 ^a
N I	4s	247.7 ^a
N II	4p _{1/2}	205.8

N III	4p _{3/2}	196.0 ^a
N IV	4d _{3/2}	105.3 ^a
N V	4d _{5/2}	102.5 ^a
N VI	4f _{5/2}	—
N VII	4f _{7/2}	—
O I	5s	34.3 ^a
O II	5p _{1/2}	19.3 ^a
O III	5p _{3/2}	16.8 ^a

Lead (82)

K	1s	88005
L I	2s	15861
L II	2p _{1/2}	15200
L III	2p _{3/2}	13055
M I	3s	3851
M II	3p _{1/2}	3554
M III	3p _{3/2}	3066
M IV	3d _{3/2}	2586
M V	3d _{5/2}	2484
N I	4s	891.8 ^b
N II	4p _{1/2}	761.9 ^b
N III	4p _{3/2}	643.5 ^b
N IV	4d _{3/2}	434.3 ^b
N V	4d _{5/2}	412.2 ^b
N VI	4f _{5/2}	141.7 ^b
N VII	4f _{7/2}	136.9 ^b
O I	5s	147 ^{a,d}
O II	5p _{1/2}	106.4 ^b
O III	5p _{3/2}	83.3 ^b
O IV	5d _{3/2}	20.7 ^b
O V	5d _{5/2}	18.1 ^b

Lithium (3)

K	1s	54.7 ^a
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Lutetium

K	1s	63314
L I	2s	10870
L II	2p _{1/2}	10349
L III	2p _{3/2}	9244
M I	3s	2491
M II	3p _{1/2}	2264
M III	3p _{3/2}	2024
M IV	3d _{3/2}	1639
M V	3d _{5/2}	1589
N I	4s	506.8 ^a
N II	4p _{1/2}	412.4 ^a
N III	4p _{3/2}	359.2 ^a
N IV	4d _{3/2}	206.1 ^a
N V	4d _{5/2}	196.3 ^a
N VI	4f _{5/2}	8.9 ^a
N VII	4f _{7/2}	7.5 ^a
O I	5s	57.3 ^a
O II	5p _{1/2}	33.6 ^a
O III	5p _{3/2}	26.7 ^a

Magnesium (12)

K	1s	1303.0 ^b
L I	2s	88.6 ^a
L II	2p _{1/2}	49.6 ^b
L III	2p _{3/2}	49.2 ^a

Manganese (25)

K	1s	6539
L I	2s	769.1 ^b
L II	2p _{1/2}	649.9 ^b
L III	2p _{3/2}	638.7 ^b
M I	3s	82.3 ^b
M II	3p _{1/2}	47.2 ^b
M III	3p _{3/2}	47.2 ^b

Mercury (80)

K	1s	83102
L I	2s	14839
L II	2p _{1/2}	14209
L III	2p _{3/2}	12284
M I	3s	3562
M II	3p _{1/2}	3279
M III	3p _{3/2}	2847
M IV	3d _{3/2}	2385
M V	3d _{5/2}	2295
N I	4s	802.2 ^b
N II	4p _{1/2}	680.2 ^b
N III	4p _{3/2}	576.6 ^b
N IV	4d _{3/2}	378.2 ^b
N V	4d _{5/2}	358.8 ^b
N VI	4f _{5/2}	104.0 ^b
N VII	4f _{7/2}	99.9 ^b
O I	5s	127 ^b
O II	5p _{3/2}	83.1 ^b
O III	5p _{3/2}	64.5 ^b
O IV	5d _{3/2}	9.6 ^b
O V	5d _{5/2}	7.8 ^b

Molybdenum (42)

K	1s	20000
L I	2s	2866
L II	2p _{1/2}	2625
L III	2p _{3/2}	2520
M I	3s	506.3 ^b
M II	3p _{1/2}	411.6 ^b
M III	3p _{3/2}	394.0 ^b
M IV	3d _{3/2}	231.1 ^b
M V	3d _{5/2}	227.9 ^b
N I	4s	63.2 ^b
N II	4p _{1/2}	37.6 ^b
N III	4p _{3/2}	35.5 ^b

Neodymium (60)

K	1s	43569
L I	2s	7126
L II	2p _{1/2}	6722
L III	2p _{3/2}	6208
M I	3s	1575
M II	3p _{1/2}	1403
M III	3p _{3/2}	1297
M IV	3d _{3/2}	1003.3 ^a
M V	3d _{5/2}	980.4 ^a
N I	4s	319.2 ^a
N II	4p _{1/2}	243.3
N III	4p _{3/2}	224.6
N IV	4d _{3/2}	120.5 ^a

ELECTRON BINDING ENERGIES OF THE ELEMENTS (continued)

N V	4d _{5/2}	120.5 ^a	O III	5p _{3/2}	44.5 ^b	N II	4p _{1/2}	851 ^a	L I	2s	21105
N VI	4f _{5/2}	1.5				N III	4p _{3/2}	705 ^a	L II	2p _{1/2}	20314
N VII	4f _{7/2}	1.5				N IV	4d _{3/2}	500 ^a	L III	2p _{3/2}	16733
O I	5s	37.5	Oxygen (8)			N V	4d _{5/2}	473 ^a	M I	3s	5367
O II	5p _{1/2}	21.1	K	1s	543.1 ^a	N VI	4f _{5/2}	184 ^a	M II	3p _{1/2}	5001
O III	5p _{3/2}	21.1	L I	2s	41.6 ^a	N VII	4f _{7/2}	184 ^a	M III	3p _{3/2}	4174
Neon (10)			Palladium (46)			O I	5s	177 ^a	M IV	3d _{3/2}	3611
K	1s	870.2 ^a	K	1s	24350	O II	5p _{1/2}	132 ^a	M V	3d _{5/2}	3442
L I	2s	48.5 ^a	L I	2s	3604	O III	5p _{3/2}	104 ^a	N I	4s	1387 ^a
L II	2p _{1/2}	21.7 ^a	L II	2p _{1/2}	3330	O IV	5d _{3/2}	31 ^a	N II	4p _{1/2}	1224 ^a
L III	2p _{3/2}	21.6 ^a	L III	2p _{3/2}	3173	O V	5d _{5/2}	31 ^a	N III	4p _{3/2}	1007 ^a
Nickel (28)			M I	3s	671.6 ^b	Potassium (19)			N IV	4d _{3/2}	743 ^a
K	1s	8333	M II	3p _{1/2}	559.9 ^b	K	1s	3608.4 ^a	N V	4d _{5/2}	708 ^a
L I	2s	1008.6 ^b	M III	3p _{3/2}	532.3 ^b	L I	2s	378.6 ^a	N VI	4f _{5/2}	371 ^a
L II	2p _{1/2}	870.0 ^b	M IV	3d _{3/2}	340.5 ^b	L II	2p _{1/2}	297.3 ^a	N VII	4f _{7/2}	360 ^a
L III	2p _{3/2}	852.7 ^b	M V	3d _{5/2}	335.2 ^b	L III	2p _{3/2}	294.6 ^a	O I	5s	310 ^a
M I	3s	110.8 ^b	N I	4s	87.1 ^{a,d}	M I	3s	34.8 ^a	O II	5p _{1/2}	232 ^a
M II	3p _{1/2}	68.0 ^b	N II	4p _{1/2}	55.7 ^{b,c}	M II	3p _{1/2}	18.3 ^a	O III	5p _{3/2}	232 ^a
M III	3p _{3/2}	66.2 ^b	N III	4p _{3/2}	50.9 ^{b,c}	M III	3p _{3/2}	18.3 ^a	O IV	5d _{3/2}	94 ^a
Niobium (41)			Phosphorus (15)			Praseodymium (59)			O V	5d _{5/2}	94 ^a
K	1s	18986	K	1s	2145.5	K	1s	41991	P I	6s	—
L I	2s	2698	L I	2s	189 ^a	L I	2s	6835	P II	6p _{1/2}	—
L II	2p _{1/2}	2465	L II	2p _{1/2}	136 ^a	L II	2p _{1/2}	6440	P III	6p _{3/2}	—
L III	2p _{3/2}	2371	L III	2p _{3/2}	135 ^a	L III	2p _{3/2}	5964	Radium (88)		
M I	3s	466.6 ^b	Platinum (78)			M I	3s	1511	K	1s	103922
M II	3p _{1/2}	376.1 ^b	K	1s	78395	M II	3p _{1/2}	1337	L I	2s	19237
M III	3p _{3/2}	360.6 ^b	L I	2s	13880	M III	3p _{3/2}	1242	L II	2p _{1/2}	18484
M IV	3d _{3/2}	205.0 ^b	L II	2p _{1/2}	13273	M IV	3d _{3/2}	948.3 ^a	L III	2p _{3/2}	15444
M V	3d _{5/2}	202.3 ^b	L III	2p _{3/2}	11564	M V	3d _{5/2}	928.8 ^a	M I	3s	4822
N I	4s	56.4 ^b	M I	3s	3296	N I	4s	304.5	M II	3p _{1/2}	4490
N II	4p _{1/2}	32.6 ^b	M II	3p _{1/2}	3027	N II	4p _{1/2}	236.3	M III	3p _{3/2}	3792
N III	4p _{3/2}	30.8 ^b	M III	3p _{3/2}	2645	N III	4p _{3/2}	217.6	M IV	3d _{3/2}	3248
Nitrogen (7)			M IV	3d _{3/2}	2202	N IV	4d _{3/2}	115.1 ^a	M V	3d _{5/2}	3105
K	1s	409.9 ^a	M V	3d _{5/2}	2122	N V	4d _{5/2}	115.1 ^a	N I	4s	1208 ^a
L I	2s	37.3 ^a	N I	4s	725.4 ^b	N VI	4f _{5/2}	2.0	N II	4p _{1/2}	1058
Osmium (76)			N II	4p _{1/2}	609.1 ^b	N VII	4f _{7/2}	2.0	N III	4p _{3/2}	879 ^a
K	1s	73871	N III	4p _{3/2}	519.4 ^b	O I	5s	37.4	N IV	4d _{3/2}	636 ^a
L I	2s	12968	N IV	4d _{3/2}	331.6 ^b	O II	5p _{1/2}	22.3	N V	4d _{5/2}	603 ^a
L II	2p _{1/2}	12385	N V	4d _{5/2}	314.6 ^b	O III	5p _{3/2}	22.3	N VI	4f _{5/2}	299 ^a
L III	2p _{3/2}	10871	N VI	4f _{5/2}	74.5 ^b	Promethium (61)			N VII	4f _{7/2}	299 ^a
M I	3s	3049	N VII	4f _{7/2}	71.2 ^b	K	1s	45184	O I	5s	254 ^a
M II	3p _{1/2}	2792	O I	5s	101.7 ^{a,d}	L I	2s	7428	O II	5p _{1/2}	200 ^a
M III	3p _{3/2}	2457	O II	5p _{1/2}	65.3 ^{a,b}	L II	2p _{1/2}	7013	O III	5p _{3/2}	153 ^a
M IV	3d _{3/2}	2031	O III	5p _{3/2}	51.7 ^b	L III	2p _{3/2}	6459	O IV	5d _{3/2}	68 ^a
M V	3d _{5/2}	1960	Polonium (84)			M I	3s	—	O V	5d _{5/2}	68 ^a
N I	4s	658.2 ^b	K	1s	93105	M II	3p _{1/2}	1471.4	P I	6s	44
N II	4p _{1/2}	549.1 ^b	L I	2s	16939	M III	3p _{3/2}	1357	P II	6p _{1/2}	19
N III	4p _{3/2}	470.7 ^b	L II	2p _{1/2}	16244	M IV	3d _{3/2}	1052	P III	6p _{3/2}	19
N IV	4d _{3/2}	293.1 ^b	L III	2p _{3/2}	13814	M V	3d _{5/2}	1027	Radon (86)		
N V	4d _{5/2}	278.5 ^b	M I	3s	4149	N I	4s	—	K	1s	98404
N VI	4f _{5/2}	53.4 ^b	M II	3p _{1/2}	3854	N II	4p _{1/2}	242	L I	2s	18049
N VII	4f _{7/2}	50.7 ^b	M III	3p _{3/2}	3302	N III	4p _{3/2}	242	L II	2p _{1/2}	17337
O I	5s	84 ^a	M IV	3d _{3/2}	2798	N IV	4d _{3/2}	120	L III	2p _{3/2}	14619
O II	5p _{1/2}	58 ^a	M V	3d _{5/2}	2683	N V	4d _{5/2}	120	M I	3s	4482
			N I	4s	995 ^a	Protactinium (91)			M II	3p _{1/2}	4159
						K	1s	112601	M III	3p _{3/2}	3538
									M IV	3d _{3/2}	3022
									M V	3d _{5/2}	2892

ELECTRON BINDING ENERGIES OF THE ELEMENTS (continued)

N I	4s	1097 ^a
N II	4p _{1/2}	929 ^a
N III	4p _{3/2}	768 ^a
N IV	4d _{3/2}	567 ^a
N V	4d _{5/2}	541 ^a
N VI	4f _{5/2}	238 ^a
N VII	4f _{7/2}	238 ^a
O I	5s	214 ^a
O II	5p _{1/2}	164 ^a
O III	5p _{3/2}	127 ^a
O IV	5d _{3/2}	48 ^a
O V	5d _{5/2}	48 ^a
PI	6s	26

Rhenium (75)

K	1s	71676
L I	2s	12527
L II	2p _{1/2}	11959
L III	2p _{3/2}	10535
M I	3s	2932
M II	3p _{1/2}	2682
M III	3p _{3/2}	2367
M IV	3d _{3/2}	1949
M V	3d _{5/2}	1883
N I	4s	625.4 ^b
N II	4p _{1/2}	518.7 ^b
N III	4p _{3/2}	446.8 ^b
N IV	4d _{3/2}	273.9 ^b
N V	4d _{5/2}	260.5 ^b
N VI	4f _{5/2}	42.9 ^a
N VII	4f _{7/2}	40.5 ^a
O I	5s	83 ^b
O II	5p _{1/2}	45.6 ^b
O III	5p _{3/2}	34.6 ^{a,d}

Rhodium (45)

K	1s	23220
L I	2s	3412
L II	2p _{1/2}	3146
L III	2p _{3/2}	3004
M I	3s	628.1 ^b
M II	3p _{1/2}	521.3 ^b
M III	3p _{3/2}	496.5 ^b
M IV	3d _{3/2}	311.9 ^b
M V	3d _{5/2}	307.2 ^b
N I	4s	81.4 ^{a,d}
N II	4p _{1/2}	50.5 ^b
N III	4p _{3/2}	47.3 ^b

Rubidium (37)

K	1s	15200
L I	2s	2065
L II	2p _{1/2}	1864
L III	2p _{3/2}	1804
M I	3s	326.7 ^a
M II	3p _{1/2}	248.7 ^a
M III	3p _{3/2}	239.1 ^a
M IV	3d _{3/2}	113.0 ^a
M V	3d _{5/2}	112 ^a

N I	4s	30.5 ^a
N II	4p _{1/2}	16.3 ^a
N III	4p _{3/2}	15.3 ^a

Ruthenium (44)

K	1s	22117
L I	2s	3224
L II	2p _{1/2}	2967
L III	2p _{3/2}	2838
M I	3s	586.2 ^b
M II	3p _{1/2}	483.3 ^b
M III	3p _{3/2}	461.5 ^b
M IV	3d _{3/2}	284.2 ^b
M V	3d _{5/2}	280.0 ^b
N I	4s	75.0 ^b
N II	4p _{1/2}	46.5 ^b
N III	4p _{3/2}	43.2 ^b

Samarium (62)

K	1s	46834
L I	2s	7737
L II	2p _{1/2}	7312
L III	2p _{3/2}	6716
M I	3s	1723
M II	3p _{1/2}	1541
M III	3p _{3/2}	1419.8
M IV	3d _{3/2}	1110.9 ^a
M V	3d _{5/2}	1083.4 ^a
N I	4s	347.2 ^a
N II	4p _{1/2}	265.6
N III	4p _{3/2}	247.4
N IV	4d _{3/2}	129.0
N V	4d _{5/2}	129.0
N VI	4f _{5/2}	5.2
N VII	4f _{7/2}	5.2
O I	5s	37.4
O II	5p _{1/2}	21.3
O III	5p _{3/2}	21.3

Scandium (21)

K	1s	4492
L I	2s	498.0 ^a
L II	2p _{1/2}	403.6 ^a
L III	2p _{3/2}	389.7 ^a
M I	3s	51.1 ^a
M II	3p _{1/2}	28.3 ^a
M III	3p _{3/2}	28.3 ^a

Selenium (34)

K	1s	12658
L I	2s	1652.0 ^{a,d}
L II	2p _{1/2}	1474.3 ^{a,d}
L III	2p _{3/2}	1433.9 ^{a,d}
M I	3s	229.6 ^a
M II	3p _{1/2}	166.5 ^a
M III	3p _{3/2}	160.7 ^a
M IV	3d _{3/2}	55.5 ^a
M V	3d _{5/2}	54.6 ^a

Silicon (14)

K	1s	1839
L I	2s	149.7 ^{a,d}
L II	2p _{1/2}	99.8 ^a
L III	2p _{3/2}	99.2 ^a

Silver (47)

K	1s	25514
L I	2s	3806
L II	2p _{1/2}	3524
L III	2p _{3/2}	3351
M I	3s	719.0 ^b
M II	3p _{1/2}	603.8 ^b
M III	3p _{3/2}	573.0 ^b
M IV	3d _{3/2}	374.0 ^b
M V	3d _{5/2}	368.0 ^b
N I	4s	97.0 ^b
N II	4p _{1/2}	63.7 ^b
N III	4p _{3/2}	58.3 ^b

Sodium (11)

K	1s	1070.8 ^b
L I	2s	63.5 ^b
L II	2p _{1/2}	30.4 ^b
L III	2p _{3/2}	30.5 ^a

Strontium (38)

K	1s	16105
L I	2s	2216
L II	2p _{1/2}	2007
L III	2p _{3/2}	1940
M I	3s	358.7 ^b
M II	3p _{1/2}	280.3 ^b
M III	3p _{3/2}	270.0 ^b
M IV	3d _{3/2}	136.0 ^b
M V	3d _{5/2}	134.2 ^b
N I	4s	38.9 ^b
N II	4p _{1/2}	21.6 ^b
N III	4p _{3/2}	20.1 ^b

Sulfur (16)

K	1s	2472
L I	2s	230.9 ^{a,d}
L II	2p _{1/2}	163.6 ^a
L III	2p _{3/2}	162.5 ^a

Tantalum (73)

K	1s	67416
L I	2s	11682
L II	2p _{1/2}	11136
L III	2p _{3/2}	9881
M I	3s	2708
M II	3p _{1/2}	2469
M III	3p _{3/2}	2194
M IV	3d _{3/2}	1793
M V	3d _{5/2}	1735
N I	4s	563.4 ^b
N II	4p _{1/2}	463.4 ^b

N III	4p _{3/2}	400.9 ^b
N IV	4d _{3/2}	237.9 ^b
N V	4d _{5/2}	226.4 ^b
N VI	4f _{5/2}	23.5 ^b
N VII	4f _{7/2}	21.6 ^b
O I	5s	69.7 ^b
O II	5p _{1/2}	42.2 ^a
O III	5p _{3/2}	32.7 ^b

Technetium (43)

K	1s	21044
L I	2s	3043
L II	2p _{1/2}	2793
L III	2p _{3/2}	2677
M I	3s	586.1 ^a
M II	3p _{1/2}	447.6 ^a
M III	3p _{3/2}	417.7 ^a
M IV	3d _{3/2}	257.6 ^a
M V	3d _{5/2}	253.9 ^a
N I	4s	69.5 ^a
N II	4p _{1/2}	42.3 ^a
N III	4p _{3/2}	39.9 ^a

Tellurium (52)

K	1s	31814
L I	2s	4939
L II	2p _{1/2}	4612
L III	2p _{3/2}	4341
M I	3s	1006 ^b
M II	3p _{1/2}	870.8 ^b
M III	3p _{3/2}	820.0 ^b
M IV	3d _{3/2}	583.4 ^b
M V	3d _{5/2}	573.0 ^b
N I	4s	169.4 ^b
N II	4p _{1/2}	103.3 ^{b,c}
N III	4p _{3/2}	103.3 ^{b,c}
N IV	4d _{3/2}	41.9 ^b
N V	4d _{5/2}	40.4 ^b

Terbium (65)

K	1s	51996
L I	2s	8708
L II	2p _{1/2}	8252
L III	2p _{3/2}	7514
M I	3s	1968
M II	3p _{1/2}	1768
M III	3p _{3/2}	1611
M IV	3d _{3/2}	1267.9 ^a
M V	3d _{5/2}	1241.1 ^a
N I	4s	396.0 ^a
N II	4p _{1/2}	322.4 ^a
N III	4p _{3/2}	284.1 ^a
N IV	4d _{3/2}	150.5 ^a
N V	4d _{5/2}	150.5 ^a
N VI	4f _{5/2}	7.7 ^a
N VII	4f _{7/2}	2.4 ^a
O I	5s	45.6 ^a
O II	5p _{1/2}	28.7 ^a
O III	5p _{3/2}	22.6 ^a

ELECTRON BINDING ENERGIES OF THE ELEMENTS (continued)

Thallium (81)

K	1s	85530
L I	2s	15347
L II	2p _{1/2}	14698
L III	2p _{3/2}	12658
M I	3s	3704
M II	3p _{1/2}	3416
M III	3p _{3/2}	2957
M IV	3d _{3/2}	2485
M V	3d _{5/2}	2389
N I	4s	846.2 ^b
N II	4p _{1/2}	720.5 ^b
N III	4p _{3/2}	609.5 ^b
N IV	4d _{3/2}	405.7 ^b
N V	4d _{5/2}	385.0 ^b
N VI	4f _{5/2}	122.2 ^b
N VII	4f _{7/2}	117.8 ^b
O I	5s	136 ^{a,d}
O II	5p _{1/2}	94.6 ^b
O III	5p _{3/2}	73.5 ^b
O IV	5d _{3/2}	14.7 ^b
O V	5d _{5/2}	12.5 ^b

Thorium (90)

K	1s	109651
L I	2s	20472
L II	2p _{1/2}	19693
L III	2p _{3/2}	16300
M I	3s	5182
M II	3p _{1/2}	4830
M III	3p _{3/2}	4046
M IV	3d _{3/2}	3491
M V	3d _{5/2}	3332
N I	4s	1330 ^a
N II	4p _{1/2}	1168 ^a
N III	4p _{3/2}	966.4 ^b
N IV	4d _{3/2}	712.1 ^b
N V	4d _{5/2}	675.2 ^b
N VI	4f _{5/2}	342.4 ^b
N VII	4f _{7/2}	333.1 ^b
O I	5s	290 ^{a,c}
O II	5p _{1/2}	229 ^{a,c}
O III	5p _{3/2}	182 ^{a,c}
O IV	5d _{3/2}	92.5 ^b
O V	5d _{5/2}	85.4 ^b
P I	6s	41.4 ^b
P II	6p _{1/2}	24.5 ^b
P III	6p _{3/2}	16.6 ^b

Thulium (69)

K	1s	59390
L I	2s	10116
L II	2p _{1/2}	9617
L III	2p _{3/2}	8648
M I	3s	2307
M II	3p _{1/2}	2090
M III	3p _{3/2}	1885
M IV	3d _{3/2}	1515

M V	3d _{5/2}	1468
N I	4s	470.9 ^a
N II	4p _{1/2}	385.9 ^a
N III	4p _{3/2}	332.6 ^a
N IV	4d _{3/2}	175.5 ^a
N V	4d _{5/2}	175.5 ^a
N VI	4f _{5/2}	—
N VII	4f _{7/2}	4.6
O I	5s	54.7 ^a
O II	5p _{1/2}	31.8 ^a
O III	5p _{3/2}	25.0 ^a

Tin (50)

K	1s	29200
L I	2s	4465
L II	2p _{1/2}	4156
L III	2p _{3/2}	3929
M I	3s	884.7 ^b
M II	3p _{1/2}	756.5 ^b
M III	3p _{3/2}	714.6 ^b
M IV	3d _{3/2}	493.2 ^b
M V	3d _{5/2}	484.9 ^b
N I	4s	137.1 ^b
N II	4p _{1/2}	83.6 ^{b,c}
N III	4p _{3/2}	83.6 ^{b,c}
N IV	4d _{3/2}	24.9 ^b
N V	4d _{5/2}	23.9 ^b

Titanium (22)

K	1s	4966
L I	2s	560.9 ^b
L II	2p _{1/2}	460.2 ^b
L III	2p _{3/2}	453.8 ^b
M I	3s	58.7 ^b
M II	3p _{1/2}	32.6 ^b
M III	3p _{3/2}	32.6 ^b

Tungsten (74)

K	1s	69525
L I	2s	12100
L II	2p _{1/2}	11544
L III	2p _{3/2}	10207
M I	3s	2820
M II	3p _{1/2}	2575
M III	3p _{3/2}	2281
M IV	3d _{3/2}	1949
M V	3d _{5/2}	1809
N I	4s	594.1 ^b
N II	4p _{1/2}	490.4 ^b
N III	4p _{3/2}	423.6 ^b
N IV	4d _{3/2}	255.9 ^b
N V	4d _{5/2}	243.5 ^b
N VI	4f _{5/2}	33.6 ^a
N VII	4f _{7/2}	31.4 ^b
O I	5s	75.6 ^b
O II	5p _{1/2}	453 ^{a,d}
O III	5p _{3/2}	36.8 ^b

Uranium (92)

K	1s	115606
L I	2s	21757
L II	2p _{1/2}	20948
L III	2p _{3/2}	17166
M I	3s	5548
M II	3p _{1/2}	5182
M III	3p _{3/2}	4303
M IV	3d _{3/2}	3728
M V	3d _{5/2}	3552
N I	4s	1439 ^{a,d}
N II	4p _{1/2}	1271 ^{a,d}
N III	4p _{3/2}	1043 ^b
N IV	4d _{3/2}	778.3 ^b
N V	4d _{5/2}	736.2 ^b
N VI	4f _{5/2}	388.2 ^a
N VII	4f _{7/2}	377.4 ^b
O I	5s	321 ^{a,c,d}
O II	5p _{1/2}	257 ^{a,c,d}
O III	5p _{3/2}	192 ^{a,c,d}
O IV	5d _{3/2}	102.8 ^b
O V	5d _{5/2}	94.2 ^b
P I	6s	43.9 ^b
P II	6p _{1/2}	26.8 ^b
P III	6p _{3/2}	16.8 ^b

Vanadium (23)

K	1s	5465
L I	2s	626.7 ^b
L II	2p _{1/2}	519.8 ^b
L III	2p _{3/2}	521.1 ^b
M I	3s	66.3 ^b
M II	3p _{1/2}	37.2 ^b
M III	3p _{3/2}	37.2 ^b

Xenon (54)

K	1s	34561
L I	2s	5453
L II	2p _{1/2}	5107
L III	2p _{3/2}	4786
M I	3s	1148.7 ^a
M II	3p _{1/2}	1002.1 ^a
M III	3p _{3/2}	940.6 ^a
M IV	3d _{3/2}	689.0 ^a
M V	3d _{5/2}	676.4 ^a
N I	4s	213.2 ^a
N II	4p _{1/2}	146.7
N III	4p _{3/2}	145.5 ^a
N IV	4d _{3/2}	69.5 ^a
N V	4d _{5/2}	67.5 ^a
N VI	4f _{5/2}	—
N VII	4f _{7/2}	—
O I	5s	23.3 ^a
O II	5p _{1/2}	13.4 ^a
O III	5p _{3/2}	12.1 ^a

Ytterbium (70)

K	1s	61332
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L I	2s	10486
L II	2p _{1/2}	9978
L III	2p _{3/2}	8944
M I	3s	2398
M II	3p _{1/2}	2173
M III	3p _{3/2}	1950
M IV	3d _{3/2}	1576
M V	3d _{5/2}	1528
N I	4s	480.5 ^a
N II	4p _{1/2}	388.7 ^a
N III	4p _{3/2}	339.7 ^a
N IV	4d _{3/2}	191.2 ^a
N V	4d _{5/2}	182.4 ^a
N VI	4f _{5/2}	2.5 ^a
N VII	4f _{7/2}	1.3 ^a
O I	5s	52.0 ^a
O II	5p _{1/2}	30.3 ^a
O III	5p _{3/2}	24.1 ^a

Yttrium (39)

K	1s	17038
L I	2s	2373
L II	2p _{1/2}	2156
L III	2p _{3/2}	2080
M I	3s	392.0 ^{a,d}
M II	3p _{1/2}	310.6 ^a
M III	3p _{3/2}	298.8 ^a
M IV	3d _{3/2}	157.7 ^b
M V	3d _{5/2}	155.8 ^b
N I	4s	43.8 ^a
N II	4p _{1/2}	24.4 ^a
N III	4p _{3/2}	23.1 ^a

Zinc (30)

K	1s	9659
L I	2s	1196.2 ^a
L II	2p _{1/2}	1044.9 ^a
L III	2p _{3/2}	1021.8 ^a
M I	3s	139.8 ^a
M II	3p _{1/2}	91.4 ^a
M III	3p _{3/2}	88.6 ^a
M IV	3d _{3/2}	10.2 ^a
M V	3d _{5/2}	10.1 ^a

Zirconium (40)

K	1s	17998
L I	2s	2532
L II	2p _{1/2}	2307
L III	2p _{3/2}	2223
M I	3s	430.3 ^b
M II	3p _{1/2}	343.5 ^b
M III	3p _{3/2}	329.8 ^b
M IV	3d _{3/2}	181.1 ^b
M V	3d _{5/2}	178.8 ^b
N I	4s	50.6 ^b
N II	4p _{1/2}	28.5 ^b
N III	4p _{3/2}	27.1 ^b

^a Reference 1.

^b Reference 2 (remaining values from Reference 3).

^c One-particle approximation not valid.

^d Derived using energy differences from Reference 3.

NATURAL WIDTH OF X-RAY LINES

Natural widths of K X-ray lines in eV:

Element	$K\alpha_1$	$K\alpha_2$	$K\beta_1$	$K\beta_3$	Element	$K\alpha_1$	$K\alpha_2$	$K\beta_1$	$K\beta_3$
Ca	1.00	0.98			Ce	18.60	19.50	20.60	18.60
Ti	1.45	2.13			Nd	21.50	21.50	23.25	21.33
Cr	2.05	2.64			Sm	26.00	24.70	25.65	24.65
Fe	2.45	3.20			Gd	29.50	28.00	29.37	28.00
Ni	3.00	3.70			Dy	33.90	32.20	32.73	32.00
Zn	3.40	3.96			Er	35.00	35.50	36.20	35.70
Ge	3.75	4.18			Yb	38.80	40.60	41.43	41.15
Se	4.10	4.43			Hf	42.70	44.30	46.00	46.10
Kr	4.23	4.62			W	46.80	48.00	51.83	51.50
Sr	5.17	4.97			Os	49.00	49.40	55.90	55.95
Zr	5.70	5.25			Pt	54.10	54.30	59.98	62.13
Mo	6.82	6.80			Hg	64.75	68.20	65.75	68.95
Ru	7.41	7.96			Pb	67.10	72.30	72.20	73.80
Pd	8.80	9.20			Po	73.20	75.10	78.60	80.10
Cd	9.80	10.40			Rn	80.00	81.50	85.50	86.50
Sn	11.20	12.40	11.80	11.00	Ra	87.00	88.20	94.20	95.50
Te	12.80	14.20	13.30	13.10	Th	94.70	95.00	99.70	101.00
Xe	14.20	15.10	15.30	14.50	U	103.00	104.30	105.00	107.30
Ba	16.10	16.80	18.15	16.70					

From Salem, S. I. and Lee, P. L., *At. Data Nucl. Data Tables*, 18, 233, 1976.

Natural widths of L X-ray lines in eV:

Element	$L\alpha_1$	$L\alpha_2$	$L\beta_1$	$L\beta_2$	$L\beta_3$	$L\beta_4$	$L\gamma_1$
Zr	1.68	1.52	1.87	5.13	5.50	5.60	3.34
Mo	1.86	1.80	2.03	5.30	5.90	5.78	3.76
Ru	2.03	1.98	2.18	5.45	6.35	5.96	4.15
Pd	2.21	2.16	2.36	5.63	6.80	6.18	4.50
Gd	2.43	2.40	2.54	5.82	7.23	6.28	4.83
Sn	2.62	2.62	2.75	6.10	7.70	6.60	5.23
Tc	2.88	2.88	2.96	6.25	8.22	6.82	5.60
Xe	3.15	3.15	3.20	6.43	8.70	7.15	5.95
Ba	3.39	3.45	3.45	6.70	9.20	7.42	6.35
Ce	3.70	3.78	3.73	6.86	9.70	7.82	6.75
Nd	3.93	4.08	4.00	7.18	10.30	8.15	7.16
Sm	4.13	4.50	4.33	7.42	10.80	8.60	7.50
Cd	4.46	4.90	4.63	7.70	11.20	9.08	7.83
Dy	4.81	5.35	5.03	7.90	11.50	9.60	8.30
Er	5.17	5.73	5.45	8.28	11.85	10.03	8.75
Yb	5.40	6.22	5.90	8.58	12.20	11.00	9.20
Hf	5.83	6.70	6.36	8.92	12.40	12.80	9.63
W	6.50	7.20	6.90	9.06	13.10	14.60	10.20
Os	7.04	7.70	7.42	9.60	14.60	16.50	10.65
Pt	7.60	8.28	8.00	9.95	16.10	18.00	11.20
Hg	8.10	8.80	8.70	10.40	17.40	19.70	11.80
Pb	8.82	9.35	9.35	10.75	18.65	21.30	12.30
Po	9.50	9.95	10.10	11.25	19.90	22.70	13.05
Rn	10.03	10.50	10.65	11.65	21.00	24.00	13.55
Ra	11.00	11.20	11.60	12.20	22.00	25.20	14.30
Th	11.90	11.80	12.40	12.80	22.85	26.35	15.00
U	12.40	12.40	13.50	13.30	23.70	27.50	15.70
Pu	13.20	13.00	14.10	13.90	24.10	28.30	16.40
Cm	14.80	13.60	15.70	14.60	25.00	29.40	17.10

PHOTON ATTENUATION COEFFICIENTS

Martin J. Berger and John H. Hubbell

This table gives mass attenuation coefficients for photons for all elements at energies between 1 keV (soft x-rays) and 1 GeV (hard gamma rays). The mass attenuation coefficient μ describes the attenuation of radiation as it passes through matter by the relation

$$I(x)/I_0 = e^{-\mu\rho x}$$

where I_0 is the initial intensity, $I(x)$ the intensity after path length x , and ρ is the mass density of the element in question. To a high approximation the mass attenuation coefficient is additive for the elements present, independent of the way in which they are bound in chemical compounds.

The power of ten is indicated beside each number in the table; i.e., $7.41 + 03$ means 7.41×10^3 . A vertical line between two columns indicates that an absorption edge lies between those energy values. The various edges are labeled at the bottom of the table.

The attenuation coefficients were calculated with the computer program XCOM (Reference 1), which uses a cross-section database compiled at the Photon and Charged Particle Data Center at the National Institute of Standards and Technology. Their accuracy has been confirmed at all energies by extensive comparisons with experimental attenuation coefficients. Such comparisons for X-ray energies up to 100 keV can be found in Reference 2.

REFERENCES

1. Berger, M. J. and Hubbell, J. H., National Bureau of Standards Report NBSIR-87-3597, 1987.
2. Saloman, E. B., Hubbell, J. H., and Scofield, J. H., *Atomic Data and Nuclear Data Tables*, 38, 1, 1988.

PHOTON ATTENUATION COEFFICIENTS (continued)

Mass attenuation coefficient, cm²/g

		Photon energy, MeV								
Atomic no.		0.001	0.002	0.005	0.01	0.02	0.05	0.1	0.2	0.5
H	1	7.21 + 00	1.06 + 00	4.19-01	3.85-01	3.69-01	3.36-01	2.94-01	2.43-01	1.73-01
He	2	6.08 + 01	6.86 + 00	5.77-01	2.48-01	1.96-01	1.70-01	1.49-01	1.22-01	8.71-02
Li	3	2.34 + 02	2.71 + 01	1.62 + 00	3.40-01	1.86-01	1.49-01	1.29-01	1.06-01	7.53-02
Be	4	6.04 + 02	7.47 + 01	4.37 + 00	6.47-01	2.25-01	1.55-01	1.33-01	1.09-01	7.74-02
B	5	1.23 + 03	1.60 + 02	9.68 + 00	1.25 + 00	3.01-01	1.66-01	1.39-01	1.14-01	8.07-02
C	6	2.21 + 03	3.03 + 02	1.91 + 01	2.37 + 00	4.42-01	1.87-01	1.51-01	1.23-01	8.72-02
N	7	3.31 + 03	4.77 + 02	3.14 + 01	3.88 + 00	6.18-01	1.98-01	1.53-01	1.23-01	8.72-02
O	8	4.59 + 03	6.95 + 02	4.79 + 01	5.95 + 00	8.65-01	2.13-01	1.55-01	1.24-01	8.73-02
F	9	5.65 + 03	9.05 + 02	6.51 + 01	8.21 + 00	1.13 + 00	2.21-01	1.50-01	1.18-01	8.27-02
Ne	10	7.41 + 03	1.24 + 03	9.34 + 01	1.20 + 01	1.61 + 00	2.58-01	1.60-01	1.24-01	8.66-02
Na	11	6.54 + 02	1.52 + 03	1.19 + 02	1.56 + 01	2.06 + 00	2.80-01	1.59-01	1.20-01	8.37-02
Mg	12	9.22 + 02	1.93 + 03	1.58 + 02	2.11 + 01	2.76 + 00	3.29-01	1.69-01	1.24-01	8.65-02
Al	13	1.19 + 03	2.26 + 03	1.93 + 02	2.62 + 01	3.44 + 00	3.68-01	1.70-01	1.22-01	8.44-02
Si	14	1.57 + 03	2.78 + 03	2.45 + 02	3.39 + 01	4.46 + 00	4.38-01	1.84-01	1.28-01	8.75-02
P	15	1.91 + 03	3.02 + 02	2.86 + 02	4.04 + 01	5.35 + 00	4.92-01	1.87-01	1.25-01	8.51-02
S	16	2.43 + 03	3.85 + 02	3.49 + 02	5.01 + 01	6.71 + 00	5.85-01	2.02-01	1.30-01	8.78-02
Cl	17	2.83 + 03	4.52 + 02	3.90 + 02	5.73 + 01	7.74 + 00	6.48-01	2.05-01	1.27-01	8.45-02
Ar	18	3.18 + 03	5.12 + 02	4.23 + 02	6.32 + 01	8.63 + 00	7.01-01	2.04-01	1.20-01	7.96-02
K	19	4.06 + 03	6.59 + 02	5.19 + 02	7.91 + 01	1.09 + 01	8.68-01	2.34-01	1.32-01	8.60-02
Ca	20	4.87 + 03	8.00 + 02	6.03 + 02	9.34 + 01	1.31 + 01	1.02 + 00	2.57-01	1.38-01	8.85-02
Sc	21	5.24 + 03	8.70 + 02	6.31 + 02	9.95 + 01	1.41 + 01	1.09 + 00	2.58-01	1.31-01	8.31-02
Ti	22	5.87 + 03	9.86 + 02	6.84 + 02	1.11 + 02	1.59 + 01	1.21 + 00	2.72-01	1.31-01	8.19-02
V	23	6.50 + 03	1.11 + 03	9.29 + 01	1.22 + 02	1.77 + 01	1.35 + 00	2.88-01	1.32-01	8.07-02
Cr	24	7.40 + 03	1.28 + 03	1.08 + 02	1.39 + 02	2.04 + 01	1.55 + 00	3.17-01	1.38-01	8.28-02
Mn	25	8.09 + 03	1.42 + 03	1.21 + 02	1.51 + 02	2.25 + 01	1.71 + 00	3.37-01	1.39-01	8.19-02
Fe	26	9.09 + 03	1.63 + 03	1.40 + 02	1.71 + 02	2.57 + 01	1.96 + 00	3.72-01	1.46-01	8.41-02
Co	27	9.80 + 03	1.78 + 03	1.54 + 02	1.84 + 02	2.80 + 01	2.14 + 00	3.95-01	1.48-01	8.32-02
Ni	28	9.86 + 03	2.05 + 03	1.79 + 02	2.09 + 02	3.22 + 01	2.47 + 00	4.44-01	1.58-01	8.70-02
Cu	29	1.06 + 04	2.15 + 03	1.90 + 02	2.16 + 02	3.38 + 01	2.61 + 00	4.58-01	1.56-01	8.36-02
Zn	30	1.55 + 03	2.37 + 03	2.12 + 02	2.33 + 02	3.72 + 01	2.89 + 00	4.97-01	1.62-01	8.45-02
Ga	31	1.70 + 03	2.52 + 03	2.27 + 02	3.42 + 01	3.93 + 01	3.08 + 00	5.20-01	1.62-01	8.24-02
Ge	32	1.89 + 03	2.71 + 03	2.47 + 02	3.74 + 01	4.22 + 01	3.34 + 00	5.55-01	1.66-01	8.21-02
As	33	2.12 + 03	2.93 + 03	2.71 + 02	4.12 + 01	4.56 + 01	3.63 + 00	5.97-01	1.72-01	8.26-02
Se	34	2.32 + 03	3.10 + 03	2.90 + 02	4.41 + 01	4.82 + 01	3.86 + 00	6.28-01	1.74-01	8.13-02
Br	35	2.62 + 03	3.41 + 03	3.21 + 02	4.91 + 01	5.27 + 01	4.26 + 00	6.86-01	1.84-01	8.33-02
Kr	36	2.85 + 03	3.60 + 03	3.43 + 02	5.26 + 01	5.55 + 01	4.52 + 00	7.22-01	1.87-01	8.23-02
Rb	37	3.17 + 03	3.41 + 03	3.74 + 02	5.77 + 01	5.98 + 01	4.92 + 00	7.80-01	1.96-01	8.36-02
Sr	38	3.49 + 03	2.59 + 03	4.06 + 02	6.27 + 01	6.39 + 01	5.31 + 00	8.37-01	2.04-01	8.44-02
Y	39	3.86 + 03	7.42 + 02	4.42 + 02	6.87 + 01	6.86 + 01	5.76 + 00	9.05-01	2.15-01	8.61-02
Zr	40	4.21 + 03	8.12 + 02	4.76 + 02	7.42 + 01	7.24 + 01	6.17 + 00	9.66-01	2.24-01	8.69-02
Nb	41	4.60 + 03	8.89 + 02	5.13 + 02	8.04 + 01	7.71 + 01	6.64 + 00	1.04 + 00	2.34-01	8.83-02
Mo	42	4.94 + 03	9.60 + 02	5.45 + 02	8.58 + 01	1.31 + 01	7.04 + 00	1.10 + 00	2.42-01	8.85-02
Tc	43	5.36 + 03	1.04 + 03	5.84 + 02	9.23 + 01	1.41 + 01	7.52 + 00	1.17 + 00	2.53-01	8.97-02
Ru	44	5.72 + 03	1.12 + 03	6.17 + 02	9.80 + 01	1.50 + 01	7.92 + 00	1.23 + 00	2.62-01	8.99-02
Rh	45	6.17 + 03	1.21 + 03	6.59 + 02	1.05 + 02	1.61 + 01	8.45 + 00	1.31 + 00	2.74-01	9.13-02
Pd	46	6.54 + 03	1.29 + 03	6.91 + 02	1.11 + 02	1.70 + 01	8.85 + 00	1.38 + 00	2.83-01	9.13-02
Ag	47	7.04 + 03	1.40 + 03	7.39 + 02	1.19 + 02	1.84 + 01	9.45 + 00	1.47 + 00	2.97-01	9.32-02
Cd	48	7.35 + 03	1.47 + 03	7.69 + 02	1.24 + 02	1.92 + 01	9.78 + 00	1.52 + 00	3.04-01	9.25-02
In	49	7.81 + 03	1.58 + 03	8.13 + 02	1.32 + 02	2.04 + 01	1.03 + 01	1.61 + 00	3.17-01	9.37-02
Sn	50	8.16 + 03	1.66 + 03	8.47 + 02	1.38 + 02	2.15 + 01	1.07 + 01	1.68 + 00	3.26-01	9.37-02

L₃ L₁
L₂

K EDGE

PHOTON ATTENUATION COEFFICIENTS (continued)

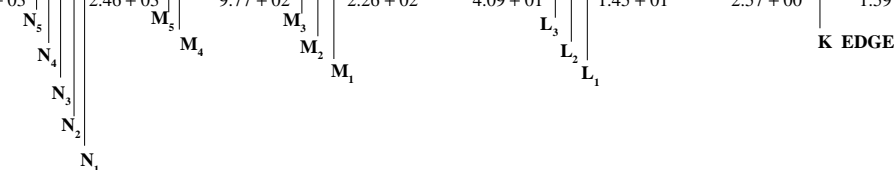
Mass attenuation coefficient, cm²/g

		Photon energy, MeV								
Atomic no.		1.0	2.0	5.0	10.0	20.0	50.0	100.0	500.0	1000.0
H	1	1.26-01	8.77-02	5.05-02	3.25-02	2.15-02	1.42-02	1.19-02	1.14-02	1.16-02
He	2	6.36-02	4.42-02	2.58-02	1.70-02	1.18-02	8.61-03	7.78-03	7.79-03	7.95-03
Li	3	5.50-02	3.83-02	2.26-02	1.53-02	1.11-02	8.68-03	8.21-03	8.61-03	8.87-03
Be	4	5.65-02	3.94-02	2.35-02	1.63-02	1.23-02	1.02-02	9.94-03	1.08-02	1.12-02
B	5	5.89-02	4.11-02	2.48-02	1.76-02	1.37-02	1.19-02	1.19-02	1.32-02	1.37-02
C	6	6.36-02	4.44-02	2.71-02	1.96-02	1.58-02	1.43-02	1.46-02	1.64-02	1.70-02
N	7	6.36-02	4.45-02	2.74-02	2.02-02	1.67-02	1.57-02	1.63-02	1.85-02	1.92-02
O	8	6.37-02	4.46-02	2.78-02	2.09-02	1.77-02	1.71-02	1.79-02	2.06-02	2.13-02
F	9	6.04-02	4.23-02	2.66-02	2.04-02	1.77-02	1.75-02	1.86-02	2.14-02	2.21-02
Ne	10	6.32-02	4.43-02	2.82-02	2.20-02	1.95-02	1.96-02	2.11-02	2.43-02	2.51-02
Na	11	6.10-02	4.28-02	2.75-02	2.18-02	1.97-02	2.03-02	2.19-02	2.53-02	2.62-02
Mg	12	6.30-02	4.43-02	2.87-02	2.31-02	2.13-02	2.23-02	2.42-02	2.81-02	2.90-02
Al	13	6.15-02	4.32-02	2.84-02	2.32-02	2.17-02	2.31-02	2.52-02	2.93-02	3.03-02
Si	14	6.36-02	4.48-02	2.97-02	2.46-02	2.34-02	2.52-02	2.76-02	3.23-02	3.34-02
P	15	6.18-02	4.36-02	2.91-02	2.45-02	2.36-02	2.58-02	2.84-02	3.33-02	3.45-02
S	16	6.37-02	4.50-02	3.04-02	2.59-02	2.53-02	2.79-02	3.08-02	3.62-02	3.75-02
Cl	17	6.13-02	4.33-02	2.95-02	2.55-02	2.52-02	2.81-02	3.11-02	3.67-02	3.80-02
Ar	18	5.76-02	4.07-02	2.80-02	2.45-02	2.45-02	2.76-02	3.07-02	3.62-02	3.75-02
K	19	6.22-02	4.40-02	3.05-02	2.70-02	2.74-02	3.11-02	3.46-02	4.09-02	4.24-02
Ca	20	6.39-02	4.52-02	3.17-02	2.84-02	2.90-02	3.32-02	3.71-02	4.40-02	4.56-02
Sc	21	5.98-02	4.24-02	3.00-02	2.72-02	2.80-02	3.23-02	3.62-02	4.30-02	4.45-02
Ti	22	5.89-02	4.18-02	2.98-02	2.73-02	2.84-02	3.30-02	3.71-02	4.40-02	4.56-02
V	23	5.79-02	4.11-02	2.96-02	2.74-02	2.88-02	3.36-02	3.78-02	4.49-02	4.65-02
Cr	24	5.93-02	4.21-02	3.06-02	2.86-02	3.03-02	3.56-02	4.01-02	4.76-02	4.93-02
Mn	25	5.85-02	4.16-02	3.04-02	2.87-02	3.07-02	3.63-02	4.09-02	4.86-02	5.04-02
Fe	26	5.99-02	4.26-02	3.15-02	2.99-02	3.22-02	3.83-02	4.33-02	5.15-02	5.33-02
Co	27	5.91-02	4.20-02	3.13-02	3.00-02	3.26-02	3.88-02	4.40-02	5.23-02	5.41-02
Ni	28	6.16-02	4.39-02	3.29-02	3.18-02	3.48-02	4.17-02	4.73-02	5.61-02	5.81-02
Cu	29	5.90-02	4.20-02	3.18-02	3.10-02	3.41-02	4.10-02	4.66-02	5.53-02	5.72-02
Zn	30	5.94-02	4.24-02	3.22-02	3.18-02	3.51-02	4.24-02	4.82-02	5.72-02	5.91-02
Ga	31	5.77-02	4.11-02	3.16-02	3.13-02	3.48-02	4.22-02	4.80-02	5.70-02	5.89-02
Ge	32	5.73-02	4.09-02	3.16-02	3.16-02	3.53-02	4.30-02	4.89-02	5.80-02	6.00-02
As	33	5.73-02	4.09-02	3.19-02	3.21-02	3.60-02	4.40-02	5.01-02	5.95-02	6.15-02
Se	34	5.62-02	4.01-02	3.14-02	3.19-02	3.60-02	4.41-02	5.03-02	5.97-02	6.17-02
Br	35	5.73-02	4.09-02	3.23-02	3.29-02	3.74-02	4.60-02	5.24-02	6.22-02	6.43-02
Kr	36	5.63-02	4.02-02	3.20-02	3.28-02	3.74-02	4.61-02	5.26-02	6.25-02	6.46-02
Rb	37	5.69-02	4.06-02	3.25-02	3.36-02	3.85-02	4.75-02	5.43-02	6.45-02	6.67-02
Sr	38	5.71-02	4.08-02	3.29-02	3.41-02	3.93-02	4.87-02	5.56-02	6.61-02	6.83-02
Y	39	5.80-02	4.14-02	3.35-02	3.50-02	4.05-02	5.03-02	5.75-02	6.83-02	7.06-02
Zr	40	5.81-02	4.15-02	3.38-02	3.55-02	4.12-02	5.13-02	5.87-02	6.98-02	7.22-02
Nb	41	5.87-02	4.18-02	3.44-02	3.63-02	4.22-02	5.27-02	6.03-02	7.17-02	7.42-02
Mo	42	5.84-02	4.16-02	3.44-02	3.65-02	4.26-02	5.33-02	6.10-02	7.26-02	7.51-02
Tc	43	5.88-02	4.19-02	3.48-02	3.71-02	4.35-02	5.45-02	6.24-02	7.43-02	7.68-02
Ru	44	5.85-02	4.16-02	3.48-02	3.73-02	4.39-02	5.50-02	6.30-02	7.51-02	7.77-02
Rh	45	5.89-02	4.20-02	3.53-02	3.80-02	4.48-02	5.63-02	6.45-02	7.69-02	7.94-02
Pd	46	5.85-02	4.16-02	3.52-02	3.80-02	4.50-02	5.66-02	6.49-02	7.73-02	8.00-02
Ag	47	5.92-02	4.21-02	3.58-02	3.88-02	4.61-02	5.81-02	6.67-02	7.93-02	8.20-02
Cd	48	5.83-02	4.14-02	3.54-02	3.85-02	4.59-02	5.79-02	6.64-02	7.91-02	8.18-02
In	49	5.85-02	4.15-02	3.56-02	3.90-02	4.65-02	5.88-02	6.75-02	8.04-02	8.32-02
Sn	50	5.80-02	4.11-02	3.55-02	3.90-02	4.66-02	5.90-02	6.78-02	8.07-02	8.35-02

PHOTON ATTENUATION COEFFICIENTS (continued)

Mass attenuation coefficients, cm²/g

Atomic no.		Photon energy, MeV								
		0.001	0.002	0.005	0.01	0.02	0.05	0.1	0.2	0.5
Sb	51	8.58 + 03	1.77 + 03	8.85 + 02	1.46 + 02	2.27 + 01	1.12 + 01	1.76 + 00	3.38-01	9.45-02
Te	52	8.43 + 03	1.83 + 03	9.01 + 02	1.50 + 02	2.34 + 01	1.14 + 01	1.80 + 00	3.43-01	9.33-02
I	53	9.10 + 03	2.00 + 03	8.43 + 02	1.63 + 02	2.54 + 01	1.23 + 01	1.94 + 00	3.66-01	9.70-02
Xe	54	9.41 + 03	2.09 + 03	6.39 + 02	1.69 + 02	2.65 + 01	1.27 + 01	2.01 + 00	3.76-01	9.70-02
Cs	55	9.37 + 03	2.23 + 03	2.30 + 02	1.79 + 02	2.82 + 01	1.34 + 01	2.12 + 00	3.94-01	9.91-02
ZB	56	8.54 + 03	2.32 + 03	2.41 + 02	1.86 + 02	2.94 + 01	1.38 + 01	2.20 + 00	4.05-01	9.92-02
La	57	9.09 + 03	2.46 + 03	2.58 + 02	1.97 + 02	3.12 + 01	1.45 + 01	2.32 + 00	4.24-01	1.01-01
Ce	58	9.71 + 03	2.61 + 03	2.74 + 02	2.08 + 02	3.31 + 01	1.52 + 01	2.45 + 00	4.45-01	1.04-01
Pr	59	1.06 + 04	2.77 + 03	2.92 + 02	2.21 + 02	3.53 + 01	1.60 + 01	2.59 + 00	4.69-01	1.07-01
Nd	60	6.63 + 03	2.88 + 03	3.06 + 02	2.30 + 02	3.68 + 01	1.65 + 01	2.69 + 00	4.84-01	1.08-01
Pm	61	2.06 + 03	3.05 + 03	3.26 + 02	2.44 + 02	3.92 + 01	1.73 + 01	2.84 + 00	5.10-01	1.12-01
Sm	62	2.11 + 03	3.12 + 03	3.36 + 02	2.50 + 02	4.03 + 01	1.77 + 01	2.90 + 00	5.19-01	1.11-01
Eu	63	2.22 + 03	3.28 + 03	3.54 + 02	2.63 + 02	4.24 + 01	1.85 + 01	3.04 + 00	5.43-01	1.14-01
Gd	64	2.29 + 03	3.36 + 03	3.65 + 02	2.69 + 02	4.36 + 01	3.86 + 00	3.11 + 00	5.54-01	1.14-01
Tb	65	2.40 + 03	3.51 + 03	3.84 + 02	2.82 + 02	4.59 + 01	4.06 + 00	3.25 + 00	5.77-01	1.17-01
Dy	66	2.49 + 03	3.47 + 03	3.99 + 02	2.90 + 02	4.76 + 01	4.23 + 00	3.36 + 00	5.95-01	1.18-01
Ho	67	2.62 + 03	3.59 + 03	4.17 + 02	3.01 + 02	4.98 + 01	4.43 + 00	3.49 + 00	6.18-01	1.20-01
Er	68	2.75 + 03	3.52 + 03	4.36 + 02	3.13 + 02	5.20 + 01	4.63 + 00	3.63 + 00	6.41-01	1.23-01
Tm	69	2.90 + 03	3.69 + 03	4.57 + 02	2.83 + 02	5.45 + 01	4.87 + 00	3.78 + 00	6.68-01	1.26-01
Yb	70	3.02 + 03	3.80 + 03	4.72 + 02	2.94 + 02	5.63 + 01	5.04 + 00	3.88 + 00	6.86-01	1.27-01
Lu	71	3.19 + 03	3.45 + 03	4.94 + 02	2.21 + 02	5.88 + 01	5.28 + 00	4.03 + 00	7.13-01	1.30-01
Hf	72	3.34 + 03	3.60 + 03	5.11 + 02	2.30 + 02	6.09 + 01	5.48 + 00	4.15 + 00	7.34-01	1.32-01
Ta	73	3.51 + 03	3.77 + 03	5.33 + 02	2.38 + 02	6.33 + 01	5.72 + 00	4.30 + 00	7.60-01	1.35-01
W	74	3.68 + 03	3.92 + 03	5.53 + 02	9.69 + 01	6.57 + 01	5.95 + 00	4.44 + 00	7.84-01	1.38-01
Re	75	3.87 + 03	3.77 + 03	5.76 + 02	1.01 + 02	6.84 + 01	6.21 + 00	4.59 + 00	8.12-01	1.41-01
Os	76	4.03 + 03	2.22 + 03	5.93 + 02	1.04 + 02	7.04 + 01	6.41 + 00	4.70 + 00	8.33-01	1.43-01
Ir	77	4.24 + 03	1.03 + 03	6.18 + 02	1.09 + 02	7.32 + 01	6.69 + 00	4.86 + 00	8.63-01	1.46-01
Pt	78	4.43 + 03	1.08 + 03	6.40 + 02	1.13 + 02	7.57 + 01	6.95 + 00	4.99 + 00	8.90-01	1.49-01
Au	79	4.65 + 03	1.14 + 03	6.66 + 02	1.18 + 02	7.88 + 01	7.26 + 00	5.16 + 00	9.22-01	1.53-01
Hg	80	4.83 + 03	1.18 + 03	6.87 + 02	1.22 + 02	8.12 + 01	7.50 + 00	5.28 + 00	9.46-01	1.56-01
Tl	81	5.01 + 03	1.23 + 03	7.07 + 02	1.26 + 02	8.36 + 01	7.75 + 00	5.40 + 00	9.69-01	1.58-01
Pb	82	5.21 + 03	1.29 + 03	7.30 + 02	1.31 + 02	8.64 + 01	8.04 + 00	5.55 + 00	9.99-01	1.61-01
Bi	83	5.44 + 03	1.35 + 03	7.58 + 02	1.36 + 02	8.95 + 01	8.38 + 00	5.74 + 00	1.03 + 00	1.66-01
Po	84	5.72 + 03	1.42 + 03	7.93 + 02	1.43 + 02	9.35 + 01	8.80 + 00	5.99 + 00	1.08 + 00	1.71-01
At	85	5.87 + 03	1.49 + 03	8.25 + 02	1.49 + 02	9.70 + 01	9.19 + 00	6.17 + 00	1.12 + 00	1.77-01
Rn	86	5.83 + 03	1.49 + 03	8.16 + 02	1.48 + 02	9.56 + 01	9.12 + 00	6.09 + 00	1.10 + 00	1.73-01
Fr	87	6.08 + 03	1.56 + 03	8.49 + 02	1.54 + 02	9.93 + 01	9.52 + 00	1.66 + 00	1.14 + 00	1.78-01
Ra	88	6.20 + 03	1.62 + 03	8.74 + 02	1.59 + 02	1.02 + 02	9.85 + 00	1.71 + 00	1.17 + 00	1.82-01
Ac	89	6.47 + 03	1.70 + 03	8.69 + 02	1.65 + 02	1.06 + 02	1.03 + 01	1.79 + 00	1.21 + 00	1.87-01
Th	90	6.61 + 03	1.74 + 03	8.88 + 02	1.69 + 02	9.37 + 01	1.05 + 01	1.83 + 00	1.23 + 00	1.90-01
Pa	91	6.53 + 03	1.83 + 03	8.76 + 02	1.77 + 02	7.03 + 01	1.10 + 01	1.92 + 00	1.29 + 00	1.97-01
U	92	6.63 + 03	1.86 + 03	8.89 + 02	1.79 + 02	7.11 + 01	1.12 + 01	1.95 + 00	1.30 + 00	1.98-01
Np	93	6.95 + 03	1.96 + 03	9.32 + 02	1.87 + 02	7.45 + 01	1.18 + 01	2.05 + 00	1.35 + 00	2.05-01
Pu	94	7.19 + 03	2.04 + 03	9.65 + 02	1.94 + 02	7.71 + 01	1.22 + 01	2.13 + 00	1.39 + 00	2.10-01
Am	95	7.37 + 03	2.10 + 03	9.90 + 02	1.98 + 02	7.93 + 01	1.25 + 01	2.19 + 00	1.42 + 00	2.14-01
Cm	96	7.54 + 03	2.15 + 03	1.02 + 03	2.03 + 02	8.14 + 01	1.28 + 01	2.25 + 00	1.44 + 00	2.18-01
Bk	97	7.84 + 03	2.25 + 03	1.06 + 03	2.10 + 02	8.39 + 01	1.34 + 01	2.35 + 00	1.50 + 00	2.25-01
Cf	98	7.89 + 03	2.31 + 03	9.27 + 02	2.15 + 02	8.58 + 01	1.37 + 01	2.41 + 00	1.52 + 00	2.29-01
Es	99	7.79 + 03	2.40 + 03	9.59 + 02	2.22 + 02	4.01 + 01	1.42 + 01	2.51 + 00	1.57 + 00	2.36-01
Fm	100	7.13 + 03	2.46 + 03	9.77 + 02	2.26 + 02	4.09 + 01	1.45 + 01	2.57 + 00	1.59 + 00	2.39-01



PHOTON ATTENUATION COEFFICIENTS (continued)

Mass attenuation coefficients, cm²/g

		Photon Energy, MeV								
Atomic no.		1.0	2.0	5.0	10.0	20.0	50.0	100.0	500.0	1000.0
Sb	51	5.80-02	4.10-02	3.56-02	3.92-02	4.70-02	5.96-02	6.85-02	8.16-02	8.44-02
Te	52	5.67-02	4.01-02	3.49-02	3.86-02	4.64-02	5.89-02	6.77-02	8.07-02	8.35-02
I	53	5.84-02	4.12-02	3.61-02	4.00-02	4.82-02	6.13-02	7.04-02	8.40-02	8.69-02
Xe	54	5.78-02	4.08-02	3.58-02	3.99-02	4.82-02	6.12-02	7.04-02	8.40-02	8.69-02
Cs	55	5.85-02	4.12-02	3.64-02	4.06-02	4.91-02	6.25-02	7.19-02	8.58-02	8.88-02
ZB	56	5.80-02	4.08-02	3.61-02	4.04-02	4.90-02	6.25-02	7.19-02	8.58-02	8.88-02
La	57	5.88-02	4.12-02	3.66-02	4.11-02	5.00-02	6.37-02	7.34-02	8.76-02	9.06-02
Ce	58	5.96-02	4.18-02	3.73-02	4.19-02	5.10-02	6.52-02	7.50-02	8.96-02	9.27-02
Pr	59	6.07-02	4.24-02	3.80-02	4.29-02	5.23-02	6.68-02	7.69-02	9.19-02	9.50-02
Nd	60	6.07-02	4.24-02	3.81-02	4.30-02	5.26-02	6.72-02	7.74-02	9.25-02	9.56-02
Pm	61	6.19-02	4.31-02	3.88-02	4.40-02	5.38-02	6.89-02	7.94-02	9.48-02	9.81-02
Sm	62	6.11-02	4.24-02	3.83-02	4.35-02	5.34-02	6.84-02	7.88-02	9.41-02	9.73-02
Eu	63	6.19-02	4.28-02	3.88-02	4.42-02	5.42-02	6.96-02	8.02-02	9.57-02	9.90-02
Gd	64	6.12-02	4.23-02	3.84-02	4.38-02	5.38-02	6.91-02	7.97-02	9.51-02	9.83-02
Tb	65	6.20-02	4.27-02	3.89-02	4.45-02	5.47-02	7.03-02	8.11-02	9.67-02	1.00-01
Dy	66	6.20-02	4.26-02	3.90-02	4.46-02	5.49-02	7.06-02	8.15-02	9.72-02	1.00-01
Ho	67	6.26-02	4.29-02	3.93-02	4.50-02	5.55-02	7.14-02	8.24-02	9.83-02	1.02-01
Er	68	6.32-02	4.32-02	3.96-02	4.55-02	5.61-02	7.23-02	8.34-02	9.95-02	1.03-01
Tm	69	6.40-02	4.36-02	4.01-02	4.61-02	5.70-02	7.35-02	8.48-02	1.01-01	1.04-01
Yb	70	6.40-02	4.35-02	4.00-02	4.61-02	5.70-02	7.35-02	8.49-02	1.01-01	1.04-01
Lu	71	6.48-02	4.39-02	4.05-02	4.66-02	5.77-02	7.45-02	8.60-02	1.02-01	1.06-01
Hf	72	6.50-02	4.39-02	4.05-02	4.68-02	5.80-02	7.48-02	8.64-02	1.03-01	1.06-01
Ta	73	6.57-02	4.41-02	4.08-02	4.72-02	5.85-02	7.56-02	8.73-02	1.04-01	1.07-01
W	74	6.62-02	4.43-02	4.10-02	4.75-02	5.89-02	7.62-02	8.80-02	1.05-01	1.08-01
Re	75	6.69-02	4.46-02	4.14-02	4.79-02	5.95-02	7.70-02	8.89-02	1.06-01	1.09-01
Os	76	6.71-02	4.46-02	4.13-02	4.79-02	5.96-02	7.71-02	8.90-02	1.06-01	1.10-01
Ir	77	6.79-02	4.50-02	4.17-02	4.84-02	6.02-02	7.80-02	9.01-02	1.07-01	1.11-01
Pt	78	6.86-02	4.52-02	4.20-02	4.87-02	6.06-02	7.86-02	9.08-02	1.08-01	1.12-01
Au	79	6.95-02	4.57-02	4.24-02	4.93-02	6.14-02	7.95-02	9.19-02	1.09-01	1.13-01
Hg	80	6.99-02	4.57-02	4.25-02	4.94-02	6.15-02	7.98-02	9.22-02	1.10-01	1.13-01
Tl	81	7.03-02	4.58-02	4.25-02	4.94-02	6.16-02	8.00-02	9.24-02	1.10-01	1.14-01
Pb	82	7.10-02	4.61-02	4.27-02	4.97-02	6.21-02	8.06-02	9.31-02	1.11-01	1.15-01
Bi	83	7.21-02	4.66-02	4.32-02	5.03-02	6.28-02	8.15-02	9.42-02	1.12-01	1.16-01
Po	84	7.39-02	4.75-02	4.40-02	5.12-02	6.40-02	8.32-02	9.61-02	1.15-01	1.18-01
At	85	7.54-02	4.82-02	4.46-02	5.20-02	6.49-02	8.44-02	9.76-02	1.16-01	1.20-01
Rn	86	7.30-02	4.65-02	4.30-02	5.01-02	6.26-02	8.14-02	9.42-02	1.12-01	1.16-01
Fr	87	7.45-02	4.72-02	4.36-02	5.08-02	6.35-02	8.26-02	9.56-02	1.14-01	1.18-01
Ra	88	7.53-02	4.75-02	4.38-02	5.10-02	6.38-02	8.31-02	9.61-02	1.15-01	1.19-01
Ac	89	7.69-02	4.82-02	4.44-02	5.17-02	6.47-02	8.43-02	9.75-02	1.16-01	1.20-01
Th	90	7.71-02	4.81-02	4.42-02	5.15-02	6.45-02	8.40-02	9.72-02	1.16-01	1.20-01
Pa	91	7.94-02	4.93-02	4.52-02	5.26-02	6.59-02	8.60-02	9.95-02	1.19-01	1.23-01
U	92	7.90-02	4.88-02	4.46-02	5.19-02	6.51-02	8.49-02	9.83-02	1.17-01	1.21-01
Np	93	8.13-02	4.99-02	4.56-02	5.30-02	6.65-02	8.68-02	1.01-01	1.20-01	1.24-01
Pu	94	8.26-02	5.05-02	4.60-02	5.34-02	6.71-02	8.76-02	1.01-01	1.21-01	1.25-01
Am	95	8.33-02	5.06-02	4.60-02	5.34-02	6.70-02	8.77-02	1.02-01	1.21-01	1.25-01
Cm	96	8.41-02	5.08-02	4.60-02	5.34-02	6.70-02	8.77-02	1.02-01	1.21-01	1.26-01
Bk	97	8.62-02	5.18-02	4.68-02	5.42-02	6.81-02	8.92-02	1.03-01	1.24-01	1.28-01
Cf	98	8.70-02	5.20-02	4.68-02	5.42-02	6.81-02	8.92-02	1.04-01	1.24-01	1.28-01
Es	99	8.89-02	5.28-02	4.74-02	5.48-02	6.89-02	9.04-02	1.05-01	1.25-01	1.29-01
Fm	100	8.94-02	5.28-02	4.72-02	5.45-02	6.86-02	9.00-02	1.05-01	1.25-01	1.29-01

CLASSIFICATION OF ELECTROMAGNETIC RADIATION

Hans Dolezalek

Basic Conversions: $c = \lambda\nu = v/k$; $\nu = c/\lambda = ck$; $\lambda = c/\nu = 1/k$; $k = \nu/c = 1/\lambda$
 $c = \text{speed of light} = 2.99792458 \times 10^8 \text{ m/s}$

Frequency (ν)	Wavelength (λ)	Wave number (k)	Names of bands	Approximate photon energies
$3 \times 10^0 - 3 \times 10^1 \text{ Hz}$ 3 — 30 Hz	$10^8 - 10^7 \text{ m}$ 100 — 10 Mm	$10^{-8} - 10^{-7} \text{ m}^{-1}$ 10 — 100 Gm $^{-1}$	ELF-(ELF 1), ITU band no. 1	
$3 \times 10^1 - 3 \times 10^2 \text{ Hz}$ 30 — 300 Hz	$10^7 - 10^6 \text{ m}$ 10 — 1 Mm	$10^{-7} - 10^{-6} \text{ m}^{-1}$ 100 Gm $^{-1}$ — 1 Mm $^{-1}$	SLF-(ELF 2), ITU band no. 2, mega-meter waves	
$3 \times 10^2 - 3 \times 10^3 \text{ Hz}$ 300 Hz — 3 kHz	$10^6 - 10^5 \text{ m}$ 1 Mm — 100 km	$10^{-6} - 10^{-5} \text{ m}^{-1}$ 1 — 10 Mm $^{-1}$	ULF-(ELF 3), ITU band no. 3	
$3 \times 10^3 - 3 \times 10^4 \text{ Hz}$ 3 — 30 kHz	$10^5 - 10^4 \text{ m}$ 100 — 10 km	$10^{-5} - 10^{-4} \text{ m}^{-1}$ 10 — 100 Mm $^{-1}$	VLF, ITU band no. 4, myriameter waves	
$3 \times 10^4 - 3 \times 10^5 \text{ Hz}$ 30 — 300 kHz	$10^4 - 10^3 \text{ m}$ 10 — 1 km	$10^{-4} - 10^{-3} \text{ m}^{-1}$ 100 Mm $^{-1}$ — 1 km $^{-1}$	LF, ITU band no. 5, kilometer waves	
$3 \times 10^5 - 3 \times 10^6 \text{ Hz}$ 300 kHz — 3 MHz	$10^3 - 10^2 \text{ m}$ 1 km — 100 m	$10^{-3} - 10^{-2} \text{ m}^{-1}$ 1 — 10 km $^{-1}$	MF, ITU band no. 6, hectometer waves	
$3 \times 10^6 - 3 \times 10^7 \text{ Hz}$ 3 — 30 MHz	$10^2 - 10^1 \text{ m}$ 100 — 10 m	$10^{-2} - 10^{-1} \text{ m}^{-1}$ 10 — 100 km $^{-1}$	HF, ITU band no. 7, decameter waves	
$3 \times 10^7 - 3 \times 10^8 \text{ Hz}$ 30 — 300 MHz	$10^1 - 10^0 \text{ m}$ 10 — 1 m	$10^{-1} - 10^0 \text{ m}^{-1}$ 100 km $^{-1}$ — 1 m $^{-1}$	VHF, ITU band no. 8, meter waves	
$3 \times 10^8 - 3 \times 10^9 \text{ Hz}$ 300 MHz — 3 GHz	$10^0 - 10^{-1} \text{ m}$ 1 m — 100 mm	$10^0 - 10^1 \text{ m}^{-1}$ 1 — 10 m $^{-1}$	UHF, ITU band no. 9, decimeter waves ^a	
$3 \times 10^9 - 3 \times 10^{10} \text{ Hz}$ 3 — 30 GHz	$10^{-1} - 10^{-2} \text{ m}$ 100 — 10 mm	$10^1 - 10^2 \text{ m}^{-1}$ 10 — 100 m $^{-1}$	SHF, ITU band no. 10, centimeter waves ^a	
$3 \times 10^{10} - 3 \times 10^{11} \text{ Hz}$ 30 — 300 GHz	$10^{-2} - 10^{-3} \text{ m}$ 10 — 1 mm	$10^2 - 10^3 \text{ m}^{-1}$ 100 m $^{-1}$ — 1 mm $^{-1}$ (1 — 10 cm $^{-1}$)	EHF, ITU band no. 11, millimeter waves	
$3 \times 10^{11} - 3 \times 10^{12} \text{ Hz}$ 300 GHz — 3 THz	$10^{-3} - 10^{-4} \text{ m}$ 1 mm — 100 μm	$10^3 - 10^4 \text{ m}^{-1}$ 1 — 10 mm $^{-1}$ (10 — 100 cm $^{-1}$)	Part of micrometer waves, includes part of far or thermal infrared; ITU band no. 12	
$3 \times 10^{12} - 3 \times 10^{13} \text{ Hz}$ 3 — 30 THz	$10^{-4} - 10^{-5} \text{ m}$ 100 — 10 μm	$10^4 - 10^5 \text{ m}^{-1}$ 10 — 100 mm $^{-1}$ (100 — 1000 cm $^{-1}$)	Part of micrometer waves includes part of far (thermal) infrared	
$3 \times 10^{13} - 3 \times 10^{14} \text{ Hz}$ 30 — 300 THz	$10^{-5} - 10^{-6} \text{ m}$ 10 — 1 μm (100,000 — 10,000 Å)	$10^5 - 10^6 \text{ m}^{-1}$ 100 mm $^{-1}$ — 1 μm^{-1}	Part of μm waves, part of infrared	$(1.6-16) \times 10^{-20} \text{ joule}$ {0.1 — 1 eV}
$3 \times 10^{14} - 3 \times 10^{15} \text{ Hz}$ 300 THz — 3 PHz	$10^{-6} - 10^{-7} \text{ m}$ 1 μm — 100 nm (10,000 — 1000 Å)	$10^6 - 10^7 \text{ m}^{-1}$ 1 — 10 μm^{-1}	Near infrared, visible, near ultraviolet	$(1.6-16) \times 10^{-19} \text{ joule}$ {1 — 10 eV}
$3 \times 10^{15} - 3 \times 10^{16} \text{ Hz}$ 3 — 30 PHz	$10^{-7} - 10^{-8} \text{ m}$ 100 — 10 nm (1000 — 100 Å)	$10^7 - 10^8 \text{ m}^{-1}$ 10 — 100 μm^{-1}	Part of "vacuum" - ultraviolet	$(1.6-16) \times 10^{-18} \text{ joule}$ {10 — 100 eV}
$3 \times 10^{16} - 3 \times 10^{17} \text{ Hz}$ 30 — 300 PHz	$10^{-8} - 10^{-9} \text{ m}$ 10 — 1 nm (100 — 10 Å)	$10^8 - 10^9 \text{ m}^{-1}$ 100 μm^{-1} — 1 nm $^{-1}$	Part of soft X-rays	$(1.6-16) \times 10^{-17} \text{ joule}$ {100 — 1000 eV}
$3 \times 10^{17} - 3 \times 10^{18} \text{ Hz}$ 300 PHz — 3 EHz	$10^{-9} - 10^{-10} \text{ m}$ 1 nm — 100 pm (10 — 1 Å)	$10^9 - 10^{10} \text{ m}^{-1}$ 1 — 10 nm $^{-1}$	Part of soft X-rays	$(1.6-16) \times 10^{-16} \text{ joule}$ {1 — 10 keV}
$3 \times 10^{18} - 3 \times 10^{19} \text{ Hz}$ 3 — 30 EHz	$10^{-10} - 10^{-11} \text{ m}$ 100 — 10 pm (1 — 0.1 Å)	$10^{10} - 10^{11} \text{ m}^{-1}$ 10 — 100 nm $^{-1}$	Hard X-rays and part of soft γ -rays	$(1.6-16) \times 10^{-15} \text{ joule}$ {10 — 100 keV}
$3 \times 10^{19} - 3 \times 10^{20} \text{ Hz}$ 30 — 300 EHz	$10^{-11} - 10^{-12} \text{ m}$ 10 — 1 pm (0.1 — 0.01 Å)	$10^{11} - 10^{12} \text{ m}^{-1}$ 100 nm $^{-1}$ — 1 pm $^{-1}$	Part of soft and part of hard γ -rays (limit at 510 keV)	$(1.6-16) \times 10^{-14} \text{ joule}$ {100 keV — 1 MeV}
$3 \times 10^{20} - 3 \times 10^{21} \text{ Hz}$ 300 — 3000 EHz	$10^{-12} - 10^{-13} \text{ m}$ 1 pm — 100 fm (0.01 — 0.001 Å)	$10^{12} - 10^{13} \text{ m}^{-1}$ 1 — 10 pm $^{-1}$	Part of hard γ -rays and part of "cosmic" γ -rays	$(1.6-16) \times 10^{-13} \text{ joule}$ {1 — 10 MeV}
$3 \times 10^{21} - 3 \times 10^{22} \text{ Hz}$ 3000 — 30,000 EHz	$10^{-13} - 10^{-14} \text{ m}$ 100 — 10 fm (0.001 — 0.0001 Å)	$10^{13} - 10^{14} \text{ m}^{-1}$ 10 — 100 pm $^{-1}$	γ -rays produced by cosmic rays	$(1.6-16) \times 10^{-12} \text{ joule}$ {10 — 100 MeV}

CLASSIFICATION OF ELECTROMAGNETIC RADIATION (continued)

Note: Abbreviations used in this table: Å—ångstrom ($1 \text{ \AA} = 10^{-10} \text{ m}$); EHz—exahertz (10^{18} hertz); EHF—extremely high frequency; ELF—extremely low frequency; eV—electron volt ($1 \text{ eV} = 1.60219 \times 10^{-19}$ joule); PHz—petahertz (10^{15} hertz); fm—femtometer (10^{-15} m); GHz—gigahertz (10^9 hertz); Gm—gigameter (10^9 m); HF—high frequency; Hz—hertz (s^{-1}); ITU—International Telecommunications Union; keV—kiloelectron volt (10^3 eV); km—kilometer (10^3 m); LF—low frequency; m—meter; MeV—megaelectron volt (10^6 eV); MF—medium frequency; MHz—megahertz (10^6 hertz); Mm—megameter (10^6 meter); mm—millimeter (10^{-3} meter); μm —micrometer (10^{-6} meter); nm—nanometer (10^{-9} meter); pm—picometer (10^{-12} meter); SHF—super high frequency; SLF—super low frequency; THz—terahertz; UHF—ultra high frequency; ULF—ultra low frequency; VHF—very high frequency; VLF—very low frequency.

• Also called “microwaves”; not to be confused with “micrometer waves”.

LETTER DESIGNATIONS OF MICROWAVE BANDS

Frequency (GHz)	Wavelength (cm)	Wavenumber (cm^{-1})	Band
1—2	30—15	0.033—0.067	L-Band
1—4	15—7.5	0.067—0.133	S-Band
4—8	7.5—3.7	0.133—0.267	C-Band
8—12	3.7—2.5	0.267—0.4	X-Band
12—18	2.5—1.7	0.4—0.6	Ku-Band
18—27	1.7—1.1	0.6—0.9	K-Band
27—40	1.1—0.75	0.9—1.33	Ka-Band

BLACK BODY RADIATION

The total power radiated from an ideal black body and the wavelength corresponding to maximum power are given here as a function of absolute temperature. Constants used in the calculation are taken from the table "Fundamental Physical Constants" in Section 1. The radiated power in a band $\Delta\lambda$ at λ_{\max} may be calculated from:

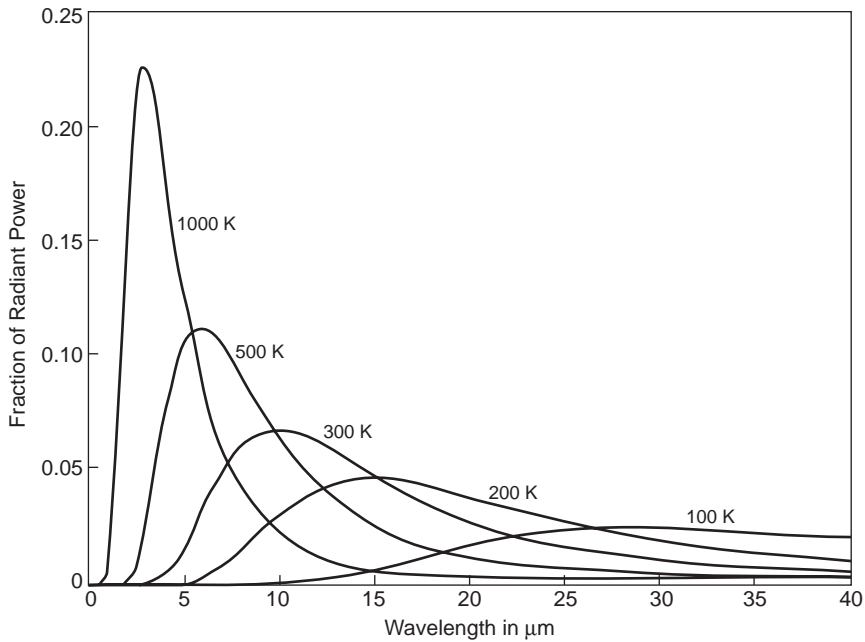
$$P_{\max} = 0.657548 (\Delta\lambda/\lambda_{\max}) P_{\text{tot}}$$

<i>T</i> /K	<i>P</i> _{tot}	λ_{\max} /μm	<i>T</i> /K	<i>P</i> _{tot}	λ_{\max} /μm	<i>T</i> /K	<i>P</i> _{tot}	λ_{\max} /μm
50	0.354 W/m ²	57.955	740	17.004	3.916	1520	302.689	1.906
100	5.671	28.978	750	17.942	3.864	1540	318.937	1.882
150	28.707	19.318	760	18.918	3.813	1560	335.831	1.858
200	90.728	14.489	770	19.934	3.763	1580	353.387	1.834
250	221.504	11.591	780	20.989	3.715	1600	371.623	1.811
273	314.973	10.614	790	22.087	3.668	1620	390.555	1.789
280	348.541	10.349	800	23.226	3.622	1640	410.202	1.767
290	401.064	9.992	810	24.410	3.577	1660	430.581	1.746
300	459.311	9.659	820	25.638	3.534	1680	451.710	1.725
310	523.684	9.348	830	26.911	3.491	1700	473.607	1.705
320	594.596	9.055	840	28.232	3.450	1720	496.290	1.685
330	672.478	8.781	850	29.600	3.409	1740	519.779	1.665
340	757.771	8.523	860	31.018	3.369	1760	544.093	1.646
350	850.931	8.279	870	32.486	3.331	1780	569.249	1.628
360	952.428	8.049	880	34.006	3.293	1800	595.267	1.610
370	1.063 kW/m ²	7.832	890	35.578	3.256	1820	622.168	1.592
380	1.182	7.626	900	37.204	3.220	1840	649.970	1.575
390	1.312	7.430	910	38.886	3.184	1860	678.694	1.558
400	1.452	7.244	920	40.623	3.150	1880	708.359	1.541
410	1.602	7.068	930	42.418	3.116	1900	738.987	1.525
420	1.764	6.899	940	44.272	3.083	1920	770.597	1.509
430	1.939	6.739	950	46.187	3.050	1940	803.210	1.494
440	2.125	6.586	960	48.162	3.018	1960	836.848	1.478
450	2.325	6.439	970	50.201	2.987	1980	871.531	1.464
460	2.539	6.299	980	52.303	2.957	2000	907.282	1.449
470	2.767	6.165	990	54.471	2.927	2020	944.121	1.435
480	3.010	6.037	1000	56.705	2.898	2040	982.071	1.420
490	3.269	5.914	1020	61.379	2.841	2060	1.021 MW/m ²	1.407
500	3.544	5.796	1040	66.337	2.786	2080	1.061	1.393
510	3.836	5.682	1060	71.589	2.734	2100	1.103	1.380
520	4.146	5.573	1080	77.147	2.683	2120	1.145	1.367
530	4.474	5.467	1100	83.022	2.634	2140	1.189	1.354
540	4.822	5.366	1120	89.227	2.587	2160	1.234	1.342
550	5.189	5.269	1140	95.773	2.542	2180	1.281	1.329
560	5.577	5.175	1160	102.672	2.498	2200	1.328	1.317
570	5.986	5.084	1180	109.939	2.456	2220	1.377	1.305
580	6.417	4.996	1200	117.584	2.415	2240	1.428	1.294
590	6.871	4.911	1220	125.621	2.375	2260	1.479	1.282
600	7.349	4.830	1240	134.063	2.337	2280	1.532	1.271
610	7.851	4.750	1260	142.924	2.300	2300	1.587	1.260
620	8.379	4.674	1280	152.217	2.264	2320	1.643	1.249
630	8.933	4.600	1300	161.955	2.229	2340	1.700	1.238
640	9.514	4.528	1320	172.154	2.195	2360	1.759	1.228
650	10.122	4.458	1340	182.827	2.163	2380	1.819	1.218
660	10.760	4.391	1360	193.989	2.131	2400	1.881	1.207
670	11.427	4.325	1380	205.655	2.100	2420	1.945	1.197
680	12.124	4.261	1400	217.838	2.070	2440	2.010	1.188
690	12.853	4.200	1420	230.556	2.041	2460	2.077	1.178
700	13.615	4.140	1440	243.822	2.012	2480	2.145	1.168
710	14.410	4.081	1460	257.652	1.985	2500	2.215	1.159
720	15.239	4.025	1480	272.063	1.958	2550	2.398	1.136
730	16.103	3.970	1500	287.070	1.932	2600	2.591	1.115

BLACK BODY RADIATION (continued)

T/K	P_{tot}	$\lambda_{\text{max}}/\mu\text{m}$	T/K	P_{tot}	$\lambda_{\text{max}}/\mu\text{m}$	T/K	P_{tot}	$\lambda_{\text{max}}/\mu\text{m}$
2650	2.796	1.093	3600	9.524	0.805	5100	38.362	0.568
2700	3.014	1.073	3650	10.065	0.794	5200	41.461	0.557
2750	3.243	1.054	3700	10.627	0.783	5300	44.743	0.547
2800	3.485	1.035	3750	11.214	0.773	5400	48.217	0.537
2850	3.741	1.017	3800	11.824	0.763	5500	51.889	0.527
2900	4.011	0.999	3850	12.458	0.753	5600	55.767	0.517
2950	4.294	0.982	3900	13.118	0.743	5700	59.858	0.508
3000	4.593	0.966	3950	13.804	0.734	5800	64.170	0.500
3050	4.907	0.950	4000	14.517	0.724	5900	68.712	0.491
3100	5.237	0.935	4100	16.024	0.707	6000	73.490	0.483
3150	5.583	0.920	4200	17.645	0.690	6500	101.222	0.446
3200	5.946	0.906	4300	19.386	0.674	7000	136.149	0.414
3250	6.326	0.892	4400	21.254	0.659	7500	179.418	0.386
3300	6.725	0.878	4500	23.253	0.644	8000	232.264	0.362
3350	7.142	0.865	4600	25.389	0.630	8500	296.004	0.341
3400	7.578	0.852	4700	27.670	0.617	9000	372.042	0.322
3450	8.033	0.840	4800	30.101	0.604	9500	461.867	0.305
3500	8.509	0.828	4900	32.689	0.591	10000	567.051	0.290
3550	9.006	0.816	5000	35.441	0.580			

The curves below show, for various temperatures, the fraction of radiant power as a function of wavelength. The function plotted is $P_{\lambda}/\Delta\lambda P_{\text{tot}}$, where P_{λ} is the power at wavelength λ in a small interval $\Delta\lambda$ (in μm), and P_{tot} is the total power.

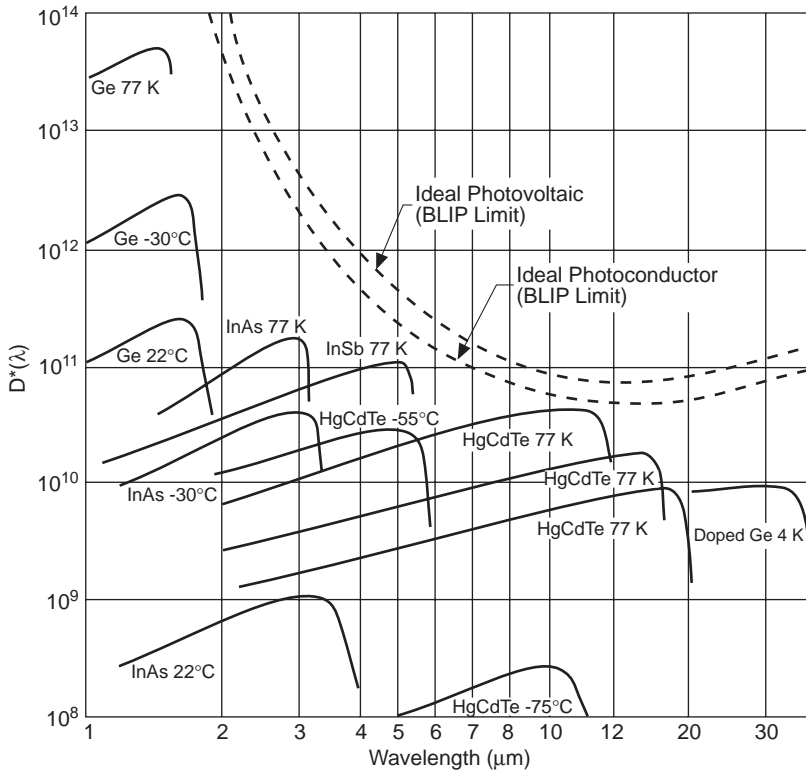


CHARACTERISTICS OF INFRARED DETECTORS

This graph summarizes the wavelength response of some semiconductors used as detectors for infrared radiation. The quantity $D^*(\lambda)$ is the signal to noise ratio for an incident radiant power density of 1 W/cm^2 and a bandwidth of 1 Hz (60° field of view). The Ge, InAs, and InSb detectors are photovoltaics, while the HgCdTe series are photoconductive devices. The cutoff wavelength of the latter can be varied by adjusting the relative amounts of Hg, Cd, and Te (three examples are shown at 77 K). The graph also shows the theoretical background limited sensitivity for ideal detectors which introduce no intrinsic noise.

REFERENCE

Infrared Detectors 1995, EG&G Judson, Montgomeryville, PA.



REFRACTIVE INDEX AND TRANSMITTANCE OF REPRESENTATIVE GLASSES

Typical values of the index of refraction and internal transmittance (fraction of light transmitted through a one centimeter thickness) are tabulated here for selected types of glasses, as well as for synthetic fused (vitreous) silica. Nominal compositions are given in the first part of the table. The second part gives the index of refraction, relative to air, and the internal transmittance for representative samples of each glass at wavelengths in the infrared, visible, and near-ultraviolet regions. It should be emphasized that wide variation of these parameters may be found among subtypes of each glass. More detailed data may be found in Reference 3.

Assuming that the Lambert-Beer Law is followed, the transmittance of a glass plate of thickness d (in centimeters) can be obtained by raising the transmittance value in the table to the power d .

REFERENCES

1. Weber, M.J., *CRC Handbook of Laser Science and Technology*, Vol. IV, Part 2, CRC Press, Boca Raton, FL, 1988.
2. Gray, D.E., Ed., *American Institute of Physics Handbook, Third Edition*, McGraw Hill, New York, 1972.
3. *Schott Optical Glass*, Schott Glass Technologies, Inc., 400 York Ave., Duryea, PA 18642.
4. Kaye, G.W.C., and Laby, T.H., *Tables of Physical and Chemical Constants, 15th Edition*, Longman, London, 1986.

Type	Name	Composition in percent by mass									
		SiO ₂	B ₂ O ₃	Al ₂ O ₃	Na ₂ O	K ₂ O	CaO	BaO	ZnO	PbO	P ₂ O ₅
PK	Phosphate crown		3	10		12	5				70
PSK	Dense phosphate crown		3	5			4	28			60
BK	Borosilicate crown	70	10		8	8	1	3			
K	Crown	74			9	11	6				
ZK	Zinc crown	71			17				12		
BaK	Barium crown	60	3		3	10		19	5		
SK	Dense crown	39	15	5				41			
KF	Crown flint	67		2	16				3	12	
BaLF	Barium light flint	51			6	5		20	14	4	
SSK	Extra dense crown	35	10	5				42	8		
LLF	Extra light flint	63			5	8				24	
BaF	Barium flint	46				8		16	8	22	
LF	Light flint	53			5	8				34	
F	Flint	47			2	7				44	
BaSF	Dense barium flint	43			1	7		11	5	33	
SF	Dense flint	33				5				62	
KzFS	Short flint										
SiO ₂	Fused silica	100									

Type	Index of refraction				Transmittance of 1 cm plate			
	1.060 μm	546.1 nm	365.0 nm	312.6 nm	1.060 μm	546.1 nm	365.0 nm	310 nm
PK	1.51519	1.52736	1.54503	1.5574	0.997	0.998	0.987	0.46
PSK	1.54154	1.55440	1.57342	1.5868	0.996	0.998	0.984	0.46
BK	1.50669	1.51872	1.53627	1.5486	0.999	0.998	0.987	0.35
K	1.50091	1.51314	1.53189	1.5454	0.998	0.998	0.988	0.40
ZK	1.52220	1.53534	1.55588	1.5708	0.996	0.998	0.976	0.27
BaK	1.55695	1.57124	1.59407	1.6108	0.998	0.997	0.986	0.28
SK	1.59490	1.60994	1.63398		0.998	0.998	0.959	0.28
KF	1.50586	1.51978	1.54251	1.5600	0.998	0.996	0.989	0.49
BaLF	1.57579	1.59166	1.61804		0.996	0.998	0.933	0.010
SSK	1.60402	1.61993	1.64595		0.999	0.998	0.915	0.010
LaK	1.69710	1.71616	1.74573		0.999	0.998	0.882	0.17
LLF	1.52775	1.54344	1.57038		0.998	0.997	0.990	0.32
BaF	1.56873	1.58565	1.61524		0.999	0.997	0.992	0.004
LF	1.56594	1.58482	1.61926		0.999	0.998	0.981	0.008
F	1.58636	1.60718	1.64606		0.997	0.998	0.959	
BaSF	1.60889	1.62987	1.66926		0.999	0.998	0.857	
SF	1.71350	1.74620	1.8145		0.998	0.997	0.650	
KzFS	1.59680	1.61639	1.64849	1.6739		0.998	0.672	0.012
SiO ₂	1.44968	1.46008	1.47435 ^a	1.53430 ^b				

^a At 366.3 nm.

^b At 213.9 nm.

INDEX OF REFRACTION OF WATER

This table gives the index of refraction of liquid water at atmospheric pressure, relative to a vacuum, at several temperatures and wavelengths. It is generated from the formulation in Reference 1, which covers a wide range of temperature, pressure, and wavelength. The wavelengths listed here correspond to prominent lines of cadmium (226.50 and 361.05 nm), potassium (404.41 nm), sodium (589.00 nm), Ne (632.80 nm, from a helium - neon laser), and mercury (1.01398 μm).

REFERENCES

1. Schiebener, P., Straub, J., Levelt Sengers, J.M.H., and Gallagher, J.S., *J. Phys. Chem. Ref. Data*, 19, 677 (1990); 19, 1617, 1990.
2. Marsh, K.N., Editor, *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell Scientific Publications, Oxford, 1987.

<i>T</i> /°C	226.50 nm	361.05 nm	404.41 nm	589.00 nm	632.80 nm	1.01398 μm
0	1.39450	1.34896	1.34415	1.33432	1.33306	1.32612
10	1.39422	1.34870	1.34389	1.33408	1.33282	1.32591
20	1.39336	1.34795	1.34315	1.33336	1.33211	1.32524
30	1.39208	1.34682	1.34205	1.33230	1.33105	1.32424
40	1.39046	1.34540	1.34065	1.33095	1.32972	1.32296
50	1.38854	1.34373	1.33901	1.32937	1.32814	1.32145
60	1.38636	1.34184	1.33714	1.32757	1.32636	1.31974
70	1.38395	1.33974	1.33508	1.32559	1.32438	1.31784
80	1.38132	1.33746	1.33284	1.32342	1.32223	1.31576
90	1.37849	1.33501	1.33042	1.32109	1.31991	1.31353
100	1.37547	1.33239	1.32784	1.31861	1.31744	1.31114

INDEX OF REFRACTION OF LIQUIDS FOR CALIBRATION PURPOSES

This table gives the index of refraction of six liquids which are available in highly pure form and whose index of refraction has been accurately measured as a function of wavelength and temperature. They are therefore useful for calibration of refractometers. The estimated uncertainty in the values is:

2,2,4-Trimethylpentane	±0.00003
Hexadecane	±0.00008
<i>trans</i> -Bicyclo[4.0.0]decane	±0.00008
1-Methylnaphthalene	±0.00008
Toluene	±0.00003
Methylcyclohexane	±0.00003

Full details are given in the references. This table is reprinted from Reference 1 by permission of the International Union of Pure and Applied Chemistry.

REFERENCES

1. Marsh, K. N., Editor, *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell Scientific Publications, Oxford, 1987.
2. Tilton, L. W., *J. Opt. Soc. Am.*, 32, 71, 1941.

λ nm	2,2,4-Trimethylpentane			Hexadecane		
	20°C	25°C	30°C	20°C	25°C	30°C
667.81	1.38916	1.38670	1.38424	1.43204	1.43001	1.42798
656.28	1.38945	1.38698	1.38452	1.43235	1.43032	1.42829
589.26	1.39145	1.38898	1.38650	1.43453	1.43250	1.43047
546.07	1.39316	1.39068	1.38820	1.43640	1.43436	1.43232
501.57	1.39544	1.39294	1.39044	1.43888	1.43684	1.43480
486.13	1.39639	1.39389	1.39138	1.43993	1.43788	1.43583
435.83	1.40029	1.39776	1.39523	1.44419	1.44213	1.44007

λ nm	<i>trans</i> -Bicyclo[4.4.0]decane			1-Methylnaphthalene		
	20°C	25°C	30°C	20°C	25°C	30°C
667.81	1.46654	1.46438	1.46222	1.60828	1.60592	1.60360
656.28	1.46688	1.46472	1.46256	1.60940	1.60703	1.60471
589.26	1.46932	1.46715	1.46498	1.61755	1.61512	1.61278
546.07	1.47141	1.46923	1.46705	1.62488	1.62240	1.62005
501.57	1.47420	1.47200	1.46980	1.63513	1.63259	1.63022
486.13	1.47535	1.47315	1.47095	1.63958	1.63701	1.63463
435.83	1.48011	1.47789	1.47567		1.65627	1.65386

λ nm	Toluene			Methylcyclohexane		
	20°C	25°C	30°C	20°C	25°C	30°C
667.81	1.49180	1.48903	1.48619	1.42064	1.41812	1.41560
656.28	1.49243	1.48966	1.48682	1.42094	1.41842	1.41591
589.26	1.49693	1.49413	1.49126	1.42312	1.42058	1.41806
546.07	1.50086	1.49803	1.49514	1.42497	1.42243	1.41989
501.57	1.50620	1.50334	1.50041	1.42744	1.42488	1.42233
486.13	1.50847	1.50559	1.50265	1.42847	1.42590	1.42334
435.83	1.51800	1.51506	1.51206	1.43269	1.43010	1.42752

INDEX OF REFRACTION OF AIR

This is a table of the index of refraction n of dry air at 15°C and a pressure of 101.325 kPa and containing 0.045% by volume of carbon dioxide (“standard air”). The index of refraction is defined by $n = \lambda_{\text{vac}}/\lambda_{\text{air}}$ where λ is the wavelength of the radiation. The index is calculated from the expression

$$(n-1) \times 10^8 = 8342.54 + 2406147(130 - \sigma^2)^{-1} + 15998(38.9 - \sigma^2)^{-1}$$

where $\sigma = 1/\lambda_{\text{vac}}$ and λ_{vac} has units of μm . The equation is valid for λ_{vac} from 200 nm to 2 μm . The table also gives the correction $(n-1)\lambda_{\text{air}}$ which must be added to the wavelength in air to obtain λ_{vac} .

If the air is at a temperature t in °C (ITS-90) and a pressure p in pascals, a value of $(n-1)$ from this table should be multiplied by

$$p[1 + p(60.1 - 0.972t) \times 10^{-10}]/96095.43(1 + 0.003661t)$$

REFERENCES

1. Birch, K. P., and Downs, M. J., *Metrologia*, 31, 315, 1994.
2. Edlen, B., *Metrologia* 2, 71, 1966.

λ_{vac}	$(n-1) \times 10^8$	$\lambda_{\text{vac}} - \lambda_{\text{air}}$	λ_{vac}	$(n-1) \times 10^8$	$\lambda_{\text{vac}} - \lambda_{\text{air}}$	λ_{vac}	$(n-1) \times 10^8$	$\lambda_{\text{vac}} - \lambda_{\text{air}}$
200 nm	32409	0.06480 nm	540	27804	0.15010	880	27462	0.24160
210	31748	0.06665	550	27784	0.15277	890	27458	0.24431
220	31226	0.06868	560	27765	0.15544	900	27454	0.24701
230	30801	0.07082	570	27747	0.15811	910	27449	0.24972
240	30447	0.07305	580	27730	0.16079	920	27445	0.25243
250	30148	0.07535	590	27714	0.16347	930	27441	0.25513
260	29892	0.07769	600	27698	0.16614	940	27437	0.25784
270	29670	0.08009	610	27684	0.16882	950	27434	0.26055
280	29477	0.08251	620	27670	0.17151	960	27430	0.26326
290	29307	0.08497	630	27657	0.17419	970	27427	0.26597
300	29157	0.08745	640	27644	0.17688	980	27423	0.26868
310	29023	0.08995	650	27632	0.17956	990	27420	0.27138
320	28904	0.09247	660	27621	0.18225			
330	28796	0.09500	670	27610	0.18494	1.00 μm	27417	0.0002741 μm
340	28700	0.09755	680	27600	0.18763	1.05	27402	0.0002876
350	28612	0.10011	690	27590	0.19032	1.10	27390	0.0003012
360	28532	0.10269	700	27581	0.19301	1.15	27379	0.0003148
370	28460	0.10527	710	27572	0.19570	1.20	27370	0.0003283
380	28393	0.10786	720	27563	0.19840	1.25	27361	0.0003419
390	28332	0.11046	730	27555	0.20109	1.30	27354	0.0003555
400	28276	0.11307	740	27547	0.20379	1.35	27347	0.0003691
410	28224	0.11569	750	27539	0.20649	1.40	27341	0.0003827
420	28177	0.11831	760	27532	0.20918	1.45	27336	0.0003963
430	28132	0.12094	770	27525	0.21188	1.50	27331	0.0004099
440	28091	0.12357	780	27518	0.21458	1.55	27327	0.0004234
450	28053	0.12620	790	27511	0.21728	1.60	27323	0.0004370
460	28018	0.12885	800	27505	0.21998	1.65	27319	0.0004506
470	27985	0.13149	810	27499	0.22268	1.70	27316	0.0004642
480	27954	0.13414	820	27493	0.22538	1.75	27313	0.0004778
490	27925	0.13679	830	27488	0.22808	1.80	27310	0.0004914
500	27897	0.13945	840	27482	0.23079	1.85	27307	0.0005050
510	27872	0.14211	850	27477	0.23349	1.90	27305	0.0005187
520	27848	0.14477	860	27472	0.23619	1.95	27303	0.0005323
530	27825	0.14743	870	27467	0.23890	2.00	27301	0.0005459

CHARACTERISTICS OF LASER SOURCES

William F. Krupke

Light Amplification by Stimulated Emission of Radiation was first demonstrated by Maiman in 1960, the result of a population inversion produced between energy levels of chromium ions in a ruby crystal when irradiated with a xenon flashlamp. Since then population inversions and coherent emission have been generated in literally thousands of substances (neutral and ionized gases, liquids, and solids) using a variety of incoherent excitation techniques (optical pumping, electrical discharges, gas-dynamic flow, electron-beams, chemical reactions, nuclear decay).

The extrema of laser output parameters which have been demonstrated to date and the laser media used are summarized in Table 1. Note that the extreme power and energy parameters listed in this table were attained with laser *systems* rather than with simple laser oscillators.

Laser sources are commonly classified in terms of the state-of-matter of the active medium: gas, liquid, and solid. Each of these classes is further subdivided into one or more types as shown in Table 2. A well-known representative example of each type of laser is also given in Table 2 together with its nominal operation wavelength and the methods by which it is pumped.

The various lasers together cover a wide spectral range from the far ultraviolet to the far infrared. The particular wavelength of emission (usually a narrow line) is presented for some six dozen lasers in Figures 1A and 1B.

By suitably designing the excitation source and/or by controlling the laser resonator structure, laser systems can provide continuous or pulsed radiation as shown in Table 3.

Besides the method of excitation and the temporal behavior of a laser, there are many other parameters that characterize its operation and efficiency, as shown in Tables 4 and 5.

Although many lasers only emit in one or more narrow spectral "lines", an increasing number of lasers can be tuned by changing the composition or the pressure of the medium, or by varying the wavelength of the pump bands. The spectral regions in which these tunable lasers operate are presented in Figure 2.

REFERENCE

Krupke, W. F., in *Handbook of Laser Science and Technology*, Vol. I, Weber, M. J., Ed., CRC Press, Boca Raton, FL, 1986.

TABLE 1
Extrema of Output Parameters of Laser Devices or Systems

Parameter	Value	Laser medium
Peak power	1×10^{14} W (collimated)	Nd:glass
Peak power density	10^{18} W/cm ² (focused)	Nd:glass
Pulse energy	$>10^5$ J	CO ₂ , Nd:glass
Average power	10^5 W	CO ₂
Pulse duration	3×10^{-15} s continuous wave (cw)	Rh6G dye; various gases, liquids, solids
Wavelength	60 nm \leftrightarrow 385 μ m	Many required
Efficiency (nonlaser pumped)	70%	CO
Beam quality	Diffraction limited	Various gases, liquids, solids
Spectral linewidth	20 Hz (for 10^{-1} s)	Neon-helium
Spatial coherence	10 m	Ruby

TABLE 2
Classes, Types, and Representative Examples of Laser Sources

Class	Type (characteristic)	Representative example	Nominal operating wavelength (nm)	Method(s) of excitation
Gas	Atom, neutral (electronic transition)	Neon-Helium (Ne-He)	633	Glow discharge
	Atom, ionic (electronic transition)	Argon (Ar ⁺)	488	Arc discharge
	Molecule, neutral (electronic transition)	Krypton fluoride (KrF)	248	Glow discharge; e-beam
	Molecule, neutral (vibrational transition)	Carbon dioxide (CO ₂)	10600	Glow discharge; gas-dynamic flow
	Molecule, neutral (rotational transition)	Methyl fluoride (CH ₃ F)	496000	Laser pumping
Liquid	Molecule, ionic (electronic transition)	Nitrogen ion (N ₂ ⁺)	420	E-beam
	Organic solvent (dye-chromophore)	Rhodamine dye (Rh6G)	580–610	Flashlamp; laser pumping
	Organic solvent (rare earth chelate)	Europium:TTF	612	Flashlamp
Solid	Inorganic solvent (trivalent rare earth ion)	Neodymium:POCl ₄	1060	Flashlamp
	Insulator, crystal (impurity)	Neodymium:YAG	1064	Flashlamp, arc lamp
	Insulator, crystal (stoichiometric)	Neodymium:UP(NdP ₅ O ₁₄)	1052	Flashlamp
	Insulator, crystal (color center)	F ₂ ⁻ :LiF	1120	Laser pumping
	Insulator, amorphous (impurity)	Neodymium:glass	1061	Flashlamp
	Semiconductor (p-n junction)	GaAs	820	Injection current
	Semiconductor (electron-hole plasma)	GaAs	890	E-beam, laser pumping

Table 3
Temporal Characteristics of Lasers and Laser Systems

Form	Technique	Pulse width range (s)
Continuous wave	Excitation is continuous; resonator Q is held constant at some moderate value	∞
Pulsed	Excitation is pulsed; resonator Q is held constant at some moderate value	10 ⁻⁸ –10 ⁻³
Q-Switched	Excitation is continuous or pulsed; resonator Q is switched from a very low value to a moderate value	10 ⁻⁸ –10 ⁻⁶
Cavity dumped	Excitation is continuous or pulsed; resonator Q is switched from a very high value to a low value	10 ⁻⁷ –10 ⁻⁵
Mode locked	Excitation is continuous or pulsed; phase or loss of the resonator modes is modulated at a rate related to the resonator transit time	10 ⁻¹² –10 ⁻⁹

Table 4
Properties and Performance of Some Continuous Wave (CW) Lasers

Parameter	Unit	Gas			Liquid	Solid	
		Neon helium	Argon ion	Carbon dioxide	Rhodamine 6G dye	Nd:YAG	GaAs
Excitation method		DC discharge	DC discharge	DC discharge	Ar ⁺ laser pump	Krypton arc lamp	DC injection
Gain medium composition		Neon:helium	Argon	CO ₂ :N ₂ :He	Rh 6G:H ₂ O	Nd:YAG	p:n:GaAs
Gain medium density	Torr	0.1:1.0	0.4	0.4:0.8:5.0			
	ions/cm ³				2(18):2(22)	1.5(20):2(22)	2(19):3(18):3(22)
Wavelength	nm	633	488	10600	590	1064	810
Laser cross-section	cm ⁻²	3(-13)	1.6(-12)	1.5(-16)	1.8(-16)	7(-19)	; 6(-15)
Radiative lifetime (upper level)	s	; 1(-7)	7.5(-9)	4(-3)	6.5(-9)	2.6(-4)	; 1(-9)
Decay lifetime (upper level)	s	; 1(-7)	; 5.0(-9)	; 4(-3)	6.0(-9)	2.3(-4)	; 1(-9)
Gain bandwidth	nm	2(-3)	5(-3)	1.6(-2)	80	0.5	10
Type, gain saturation		Inhomogeneous	Inhomogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Homogeneous saturation flux	W cm ⁻²			; 20	3(5)	2.3(3)	; 2(4)
Decay lifetime (lower level)	s	; 1(-8)	; 4(-10)	; 5(-6) ^b	<1(-12)	<1(-7)	<1(-12)
Inversion density	cm ⁻³	; 1(9)	2(10)	2(15)	2(16)	6(16)	1(16)
Small signal gain coefficient	cm ⁻¹	; 1(-3)	; 3(-2)	1(-2)	4	5(-2)	40
Pump power density	W cm ⁻³	3	900	0.15	1(6)	150	7(7)
Output power density	W cm ⁻³	2.6(-3)	; 1	2(-2)	3(5)	95	5(6)
Laser size (diameter:length)	cm:cm	0.5:100	0.3:100	5.0:600	1(-3):0.3	0.6:10	5(-4):7(-3);2(-2) ^a
Excitation current/voltage	A/V	3(-2):2(3)	30:300	0.1:1.5(4)		90:125	1.0/1.7
Excitation current density	A cm ⁻²	0.15	600	6(-3)		140	4.5(3)
Excitation power	W	60	9(3)	1.5(3)	4	1.1(4)	1.7
Output power	W	0.06	10	240	0.3	300	0.12
Efficiency	%	0.1	0.1	13	7	2.6	7

^a Junction thickness:width:length.

^b Pressure dependent.

Table 5
Properties and Performance of Some Pulsed Lasers

Parameter	Unit	Gas				Liquid	Solid	
		Carbon dioxide		Krypton fluoride		Rhodamine 6G	Nd:YAG	Nd:glass
Excitation method		TEA-discharge	E-beam/sust.	Glow discharge	E-beam	Xenon flashlamp	Xenon flashlamp	Xenon flashlamp
Gain medium composition		CO ₂ :N ₂ :He	CO ₂ :N ₂ :He	He:Kr:F ₂	Ar:Kr:F ₂	Rh6G:alcohol	Nd:YAG	Nd:Glass
Gain medium density	torr ions/cm ³	100:50:600	240:240:320	1070:70:3	1235:52:3			
Wavelength	nm	10600	10600	249	249	1(18):1.5(22)	1.5(20):1(22)	3(20):2(22)
Laser cross-section	cm ⁻²	2(-18)	2(-18)	2(-16)	2(-16)	1.8(-16)	7(-19)	2.8(-20)
Radiative lifetime (upper level)	s	4(-3)	4(-3)	7(-9)	7(-9)	6.5(-9)	2.6(-4)	4.1(-4)
Decay lifetime (upper level)	s	; 1(-4)	5(-5)	2(-9)	3(-9)	6.0(-9)	2.3(-4)	3.7(-4)
Gain bandwidth	nm	1	1	2	2	80	0.5	26
Homogeneous saturation fluence	J/cm ²	0.2	0.2	4(-3)	4(-3)	2(-3)	0.6	; 5
Decay lifetime (lower level)	s	5(-8) ^a	1(-8) ^a	<1(-12)	<1(-12)	<1(-12)	<1(-7)	<1(-8)
Inversion density	cm ⁻³	3(17)	6(17)	4(14)	2(14)	2(16)	4(17)	3(18)
Small signal gain coefficient	cm ⁻¹	2(-2)	4(-2)	8-92)	4(-2)	4	0.3	8(-2)
Medium excitation energy density	J/cm ³	0.1	0.36	0.15	0.13	2.8	0.15	0.6
Output energy density	J/cm ³	2(-2)	1.8(-2)	1.5(-3)	1.2(-2)	0.85	5(-2)	2(-2)
Laser dimensions	cm:cm:cm	4.5:4.5:87	10:10:100	1.5:4.5:100	8.5:10:100	1.2φ25	0.6φ7.5	0.6φ8.3
Excitation current/voltage	A/V	6(4)/3.3(3)	2.4(4)/4(4)	2.5(4)/1.5(5)	1.2(4)/2.5(5)	2(5)/2.5(4)		
Excitation current density	A cm ²	8.5	22	170	11.5	2.6(3)		
Excitation peak power	W	2(8)	9(8)	4(9)	3(9)	5.4(9)	4(4)	9(4)
Output pulse energy	J	35	180	1	102	32	0.1	1.0
Output pulse length	s	1(-6)	4(-6)	2.5(-8)	6(-7)	3.2(-6)	2(-8)	1(-4)
Output pulse power	W	3.5(7)	4(7)	4(7)	2(8)	1(7)	5(6)	1(4)
Efficiency	%	17	5	1	10 ^b	0.2	1.5	3.7

^a Pressure dependent.

^b Intrinsic efficiency = energy output/energy deposited in gas.

CHARACTERISTICS OF LASER SOURCES (continued)

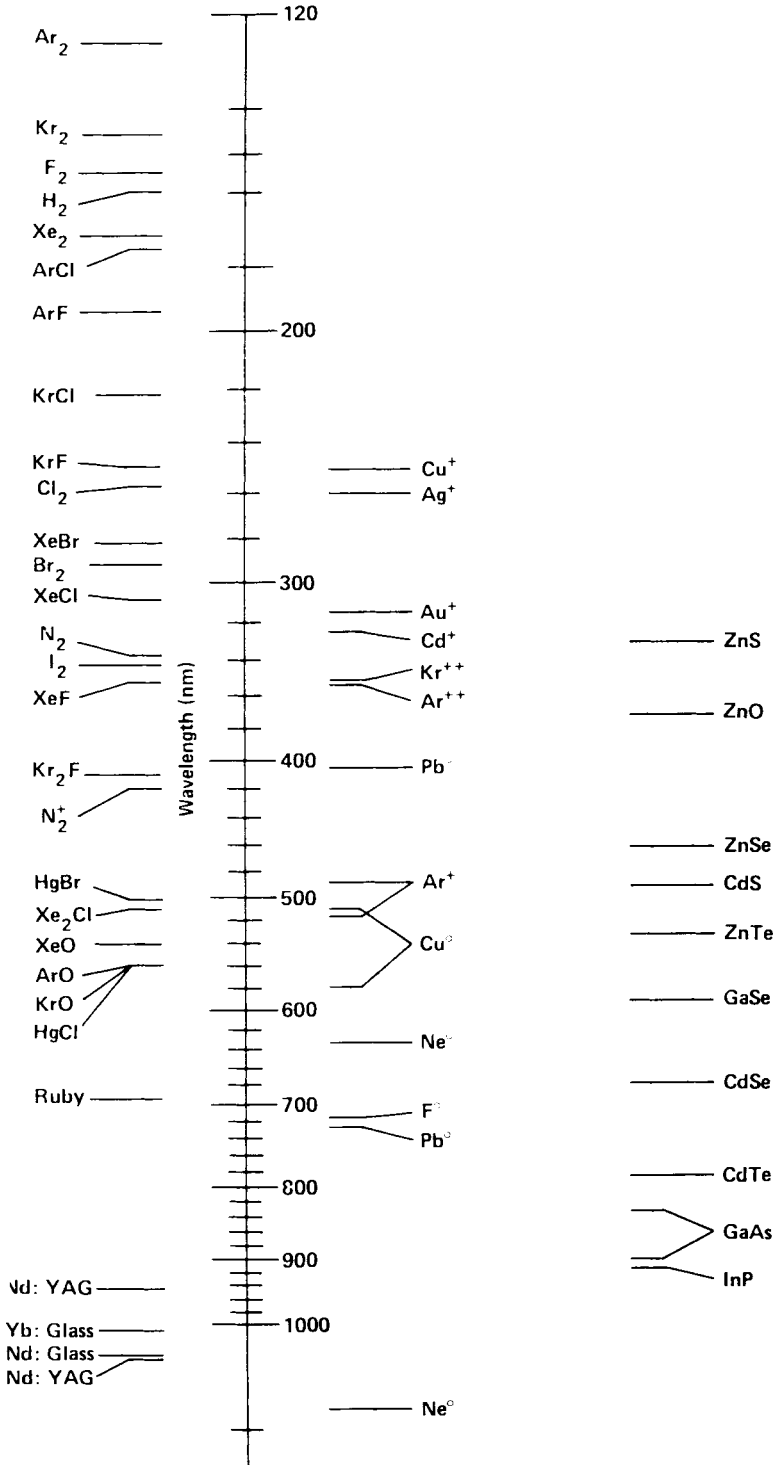


FIGURE 1A. Wavelengths of lasers operating in the 120 to 1200 nm spectral region.

CHARACTERISTICS OF LASER SOURCES (continued)

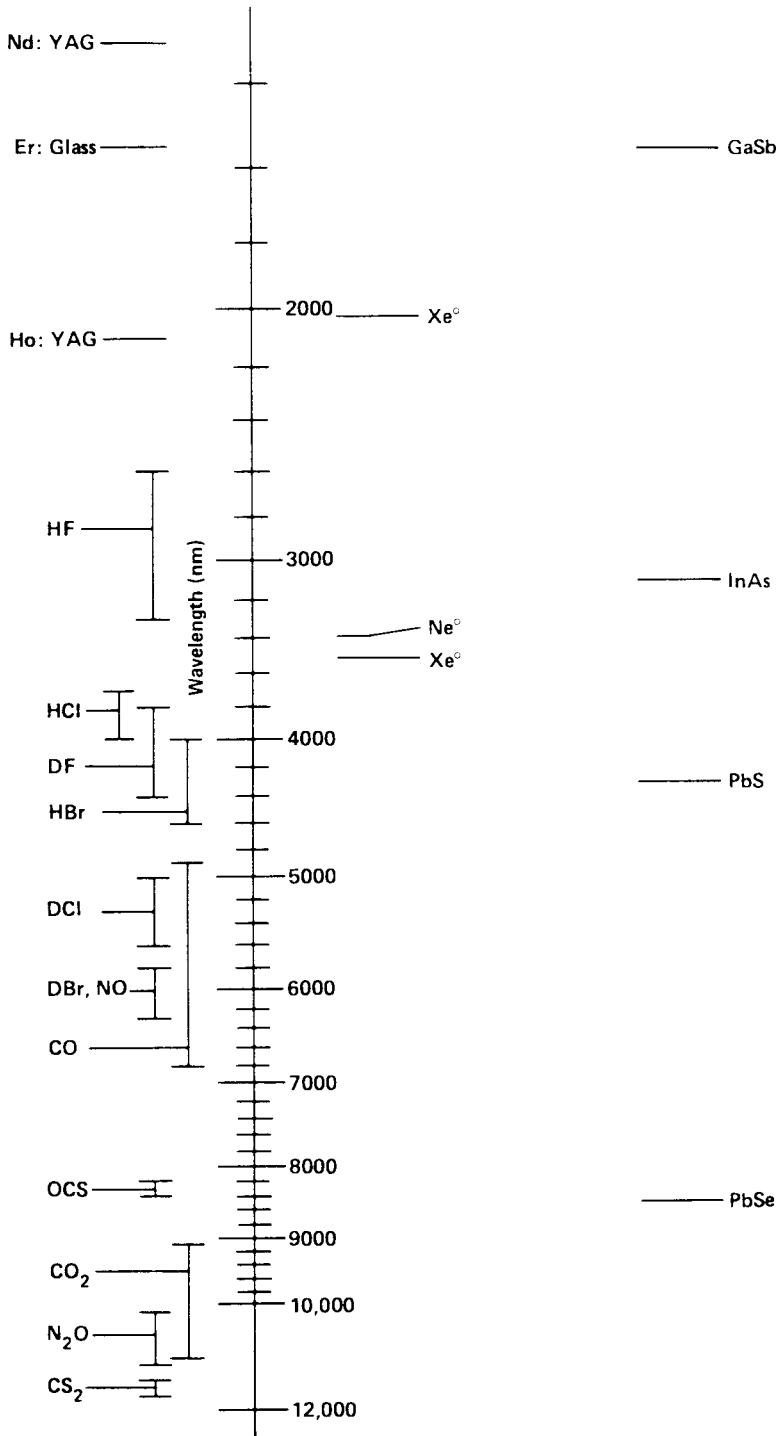


FIGURE 1B. Wavelength of lasers operating in the 1300 to 12,000 nm spectral region.

CHARACTERISTICS OF LASER SOURCES (continued)

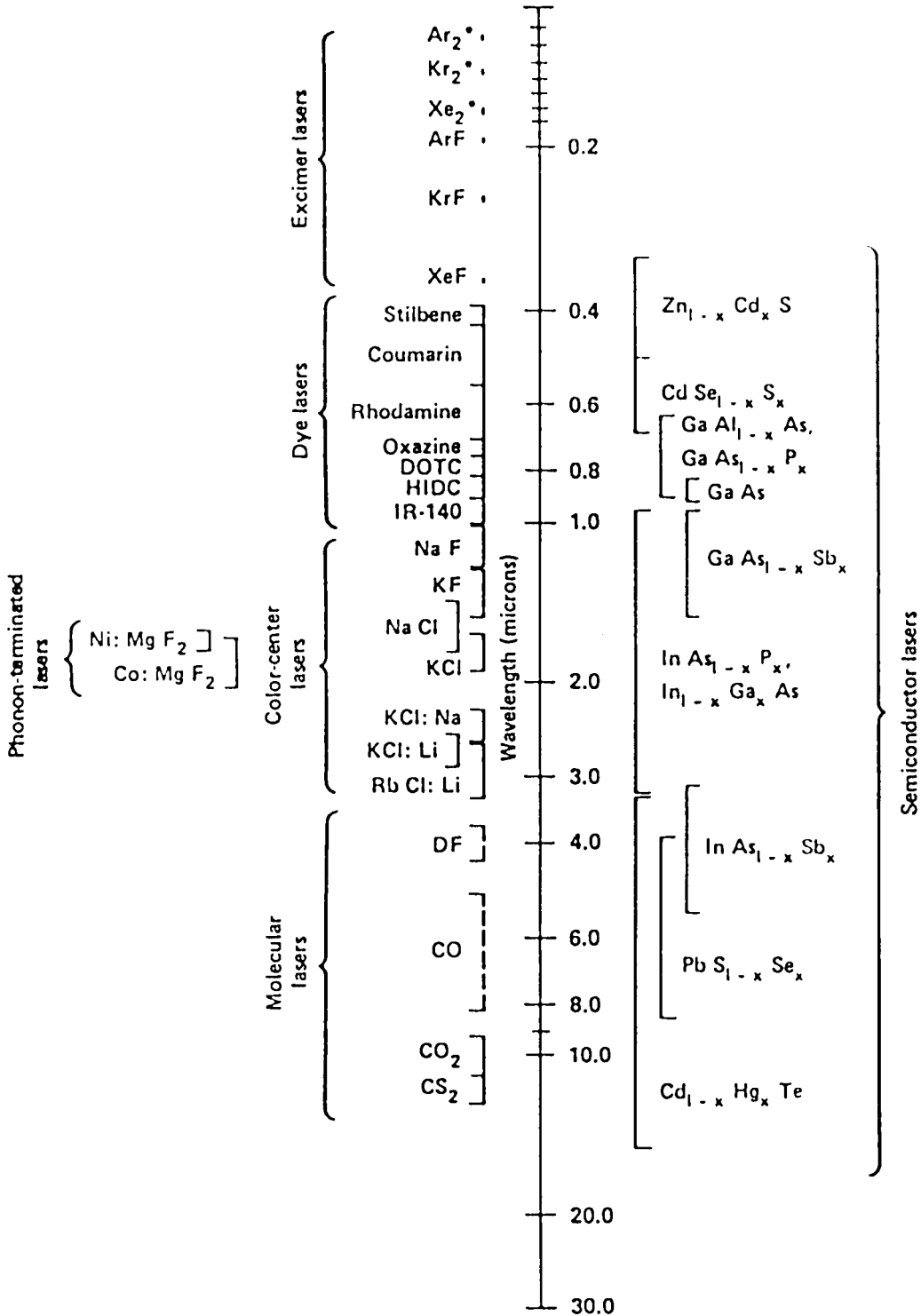


FIGURE 2. Spectral tuning ranges of various types of tunable lasers.

INFRARED LASER FREQUENCIES

Arthur Maki

The CO₂ laser has been the subject of a number of very accurate frequency measurements. Most of the earlier measurements are given by Bradley et al.¹ That analysis was based on a single absolute frequency measurement and many laser frequency differences. New measurements of the methane frequency²⁻⁴ have made it necessary to slightly revise that single absolute frequency measurement. In addition, there have been several other absolute frequency measurements⁵⁻⁷ that have been used here to improve the accuracy of the present tables. New frequency difference measurements have also been added to the database used for the present tables.⁸

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Frequencies for the 00°1-(10°0,02°0)_I and 00°1-(10°0,02°0)_{II} Bands of ¹²C¹⁶O₂ with the Estimated 2-σ Uncertainties

Line	Band I		Line	Band II	
	Frequency (MHz)	Uncertainty (MHz)		Frequency (MHz)	Uncertainty (MHz)
P(70)	26721305.4647	0.1680	P(70)	29789856.3783	0.0308
P(68)	26794232.6712	0.1217	P(68)	29861850.7690	0.0192
P(66)	26866318.8073	0.0867	P(66)	29933216.1760	0.0122
P(64)	26937571.7234	0.0606	P(64)	30003944.2861	0.0086
P(62)	27007998.9216	0.0415	P(62)	30074026.9127	0.0072
P(60)	27077607.5643	0.0279	P(60)	30143456.0039	0.0066
P(58)	27146404.4834	0.0185	P(58)	30212223.6504	0.0061
P(56)	27214396.1873	0.0121	P(56)	30280322.0930	0.0055
P(54)	27281588.8696	0.0081	P(54)	30347743.7306	0.0049
P(52)	27347988.4161	0.0057	P(52)	30414481.1273	0.0044
P(50)	27413600.4119	0.0043	P(50)	30480527.0196	0.0041
P(48)	27478430.1487	0.0036	P(48)	30545874.3239	0.0039
P(46)	27542482.6310	0.0032	P(46)	30610516.1429	0.0039
P(44)	27605762.5826	0.0030	P(44)	30674445.7724	0.0039
P(42)	27668274.4525	0.0028	P(42)	30737656.7080	0.0039
P(40)	27730022.4206	0.0027	P(40)	30800142.6511	0.0039
P(38)	27791010.4036	0.0026	P(38)	30861897.5150	0.0038
P(36)	27851242.0594	0.0025	P(36)	30922915.4310	0.0037
P(34)	27910720.7927	0.0024	P(34)	30983190.7534	0.0037
P(32)	27969449.7593	0.0023	P(32)	31042718.0652	0.0037
P(30)	28027431.8708	0.0022	P(30)	31101492.1833	0.0036
P(28)	28084669.7981	0.0021	P(28)	31159508.1631	0.0037
P(26)	28141165.9762	0.0020	P(26)	31216761.3029	0.0037
P(24)	28196922.6067	0.0019	P(24)	31273247.1487	0.0037
P(22)	28251941.6622	0.0017	P(22)	31328961.4978	0.0037
P(20)	28306224.8888	0.0016	P(20)	31383900.4028	0.0037
P(18)	28359773.8090	0.0014	P(18)	31438060.1749	0.0037
P(16)	28412589.7245	0.0012	P(16)	31491437.3872	0.0036
P(14)	28464673.7184	0.0011	P(14)	31544028.8776	0.0036
P(12)	28516026.6574	0.0009	P(12)	31595831.7516	0.0036
P(10)	28566649.1935	0.0008	P(10)	31646843.3843	0.0035
P(8)	28616541.7661	0.0008	P(8)	31697061.4225	0.0035
P(6)	28665704.6027	0.0008	P(6)	31746483.7868	0.0035

INFRARED LASER FREQUENCIES (continued)

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(4)	28714137.7205	0.0008	P(4)	31795108.6724	0.0035
P(2)	28761840.9272	0.0008	P(2)	31842934.5511	0.0035
R(0)	28832026.2198	0.0008	R(0)	31913172.5691	0.0035
R(2)	28877902.4382	0.0007	R(2)	31958996.0621	0.0034
R(4)	28923046.4303	0.0006	R(4)	32004017.3822	0.0034
R(6)	28967457.0657	0.0005	R(6)	32048236.2498	0.0034
R(8)	29011133.0054	0.0003	R(8)	32091652.6619	0.0034
R(10)	29054072.7010	0.0001	R(10)	32134266.8917	0.0034
R(12)	29096274.3935	0.0003	R(12)	32176079.4878	0.0034
R(14)	29137736.1129	0.0005	R(14)	32217091.2721	0.0035
R(16)	29178455.6759	0.0007	R(16)	32257303.3386	0.0036
R(18)	29218430.6852	0.0009	R(18)	32296717.0510	0.0037
R(20)	29257658.5269	0.0010	R(20)	32335334.0408	0.0038
R(22)	29296136.3689	0.0011	R(22)	32373156.2044	0.0039
R(24)	29333861.1583	0.0012	R(24)	32410185.7003	0.0041
R(26)	29370829.6191	0.0011	R(26)	32446424.9459	0.0042
R(28)	29407038.2491	0.0011	R(28)	32481876.6140	0.0042
R(30)	29442483.3168	0.0011	R(30)	32516543.6293	0.0042
R(32)	29477160.8582	0.0012	R(32)	32550429.1641	0.0042
R(34)	29511066.6733	0.0013	R(34)	32583536.6340	0.0042
R(36)	29544196.3221	0.0015	R(36)	32615869.6937	0.0041
R(38)	29576545.1205	0.0017	R(38)	32647432.2320	0.0040
R(40)	29608108.1360	0.0019	R(40)	32678228.3665	0.0039
R(42)	29638880.1831	0.0022	R(42)	32708262.4386	0.0038
R(44)	29668855.8183	0.0024	R(44)	32737539.0081	0.0039
R(46)	29698029.3350	0.0027	R(46)	32766062.8469	0.0041
R(48)	29726394.7582	0.0032	R(48)	32793838.9334	0.0045
R(50)	29753945.8385	0.0037	R(50)	32820872.4463	0.0055
R(52)	29780676.0464	0.0042	R(52)	32847168.7576	0.0071
R(54)	29806578.5659	0.0047	R(54)	32872733.4269	0.0099
R(56)	29831646.2878	0.0052	R(56)	32897572.1935	0.0141
R(58)	29855871.8032	0.0058	R(58)	32921690.9701	0.0202
R(60)	29879247.3960	0.0074	R(60)	32945095.8355	0.0288
R(62)	29901765.0357	0.0113	R(62)	32967793.0268	0.0407
R(64)	29923416.3695	0.0186	R(64)	32989788.9322	0.0567
R(66)	29944192.7145	0.0302	R(66)	33011090.0831	0.0780
R(68)	29964085.0488	0.0475	R(68)	33031703.1467	0.1060
R(70)	29983084.0036	0.0720	R(70)	33051634.9172	0.1423

Frequencies for the 00°1-(10°0,02°)I and 00°1-(10°0,02°)II Bands of ¹³C¹⁶O₂ with the Estimated 2-σ Uncertainties

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(66)	25523832.1808	0.7836	P(66)	28512082.5283	1.2894
P(64)	25590013.4703	0.5415	P(64)	28585121.9396	0.9194
P(62)	25655543.6502	0.3629	P(62)	28657449.4180	0.6420
P(60)	25720428.2487	0.2339	P(60)	28729056.6374	0.4375
P(58)	25784672.4840	0.1430	P(58)	28799935.4147	0.2897
P(56)	25848281.2771	0.0810	P(56)	28870077.7187	0.1853
P(54)	25911259.2627	0.0405	P(54)	28939475.6771	0.1135
P(52)	25973610.8005	0.0157	P(52)	29008121.5846	0.0659
P(50)	26035339.9857	0.0045	P(50)	29076007.9109	0.0357
P(48)	26096450.6582	0.0079	P(48)	29143127.3077	0.0180
P(46)	26156946.4123	0.0101	P(46)	29209472.6164	0.0090

INFRARED LASER FREQUENCIES (continued)

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(44)	26216830.6053	0.0101	P(44)	29275036.8754	0.0058
P(42)	26276106.3655	0.0090	P(42)	29339813.3270	0.0050
P(40)	26334776.6003	0.0077	P(40)	29403795.4243	0.0044
P(38)	26392844.0030	0.0068	P(38)	29466976.8383	0.0037
P(36)	26450311.0599	0.0063	P(36)	29529351.4635	0.0032
P(34)	26507180.0565	0.0061	P(34)	29590913.4252	0.0029
P(32)	26563453.0836	0.0060	P(32)	29651657.0844	0.0028
P(30)	26619132.0428	0.0058	P(30)	29711577.0447	0.0028
P(28)	26674218.6515	0.0055	P(28)	29770668.1566	0.0031
P(26)	26728714.4479	0.0054	P(26)	29828925.5239	0.0035
P(24)	26782620.7952	0.0054	P(24)	29886344.5074	0.0041
P(22)	26835938.8858	0.0054	P(22)	29942920.7308	0.0046
P(20)	26888669.7451	0.0055	P(20)	29998650.0838	0.0051
P(18)	26940814.2347	0.0055	P(18)	30053528.7271	0.0054
P(16)	26992373.0555	0.0055	P(16)	30107553.0955	0.0055
P(14)	27043346.7508	0.0054	P(14)	30160719.9016	0.0055
P(12)	27093735.7083	0.0052	P(12)	30213026.1388	0.0054
P(10)	27143540.1624	0.0051	P(10)	30264469.0839	0.0054
P(8)	27192760.1962	0.0049	P(8)	30315046.2994	0.0054
P(6)	27241395.7431	0.0048	P(6)	30364755.6359	0.0055
P(4)	27289446.5880	0.0047	P(4)	30413595.2335	0.0056
P(2)	27336912.3682	0.0046	P(2)	30461563.5231	0.0057
R(0)	27407012.8882	0.0045	P(0)	30531879.5415	0.0057
R(2)	27453013.4589	0.0043	P(2)	30577664.6138	0.0056
R(4)	27498426.5430	0.0040	P(4)	30622575.1885	0.0054
R(6)	27543251.1200	0.0037	P(6)	30666611.0128	0.0051
R(8)	27587486.0225	0.0034	P(8)	30709772.1257	0.0047
R(10)	27631129.9356	0.0031	P(10)	30752058.8571	0.0045
R(12)	27674181.3963	0.0029	P(12)	30793471.8269	0.0044
R(14)	27716638.7917	0.0029	P(14)	30834011.9425	0.0043
R(16)	27758500.3577	0.0029	P(16)	30873680.3976	0.0044
R(18)	27799764.1770	0.0029	P(18)	30912478.6694	0.0044
R(20)	27840428.1773	0.0030	P(20)	30950408.5159	0.0044
R(22)	27880490.1283	0.0029	P(22)	30987471.9732	0.0043
R(24)	27919947.6395	0.0029	P(24)	31023671.3517	0.0042
R(26)	27958798.1567	0.0028	P(26)	31059009.2327	0.0042
R(28)	27997038.9591	0.0028	P(28)	31093488.4642	0.0042
R(30)	28034667.1551	0.0027	P(30)	31127112.1569	0.0043
R(32)	28071679.6785	0.0027	P(32)	31159883.6793	0.0045
R(34)	28108073.2842	0.0026	P(34)	31191806.6529	0.0046
R(36)	28143844.5432	0.0026	P(36)	31222884.9469	0.0048
R(38)	28178989.8377	0.0026	P(38)	31253122.6730	0.0053
R(40)	28213505.3554	0.0028	P(40)	31282524.1795	0.0061
R(42)	28247387.0838	0.0033	P(42)	31311094.0452	0.0077
R(44)	28280630.8035	0.0046	P(44)	31338837.0736	0.0108
R(46)	28313232.0818	0.0083	P(46)	31365758.2858	0.0173
R(48)	28345186.2652	0.0161	P(48)	31391862.9147	0.0295
R(50)	28376488.4720	0.0301	P(50)	31417156.3972	0.0505
R(52)	28407133.5839	0.0531	P(52)	31441644.3679	0.0845
R(54)	28437116.2372	0.0887	P(54)	31465332.6516	0.1366
R(56)	28466430.8141	0.1419	P(56)	31488227.2557	0.2138
R(58)	28495071.4324	0.2188	P(58)	31510334.3631	0.3247
R(60)	28523031.9357	0.3271	P(60)	31531660.3243	0.4800
R(62)	28550305.8819	0.4763	P(62)	31552211.6497	0.6932
R(64)	28576886.5323	0.6781	P(64)	31571995.0017	0.9805
R(66)	28602766.8393	0.9467	P(66)	31591017.1868	1.3619

INFRARED LASER FREQUENCIES (continued)

Frequencies for the $00^{\circ}1-(10^{\circ}0,02^{\circ}0)_I$ and $00^{\circ}1-(10^{\circ}0,02^{\circ}0)_{II}$ Bands of $^{12}C^{18}O_2$ with the Estimated 2- σ Uncertainties

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(70)	27045326.3119	0.4540	P(70)	30695237.5856	0.0858
P(68)	27114914.0922	0.3324	P(68)	30755520.2231	0.0570
P(66)	27183635.7945	0.2392	P(66)	30815311.4928	0.0364
P(64)	27251496.4118	0.1688	P(64)	30874607.2084	0.0223
P(62)	27318500.7361	0.1165	P(62)	30933403.2309	0.0131
P(60)	27384653.3618	0.0783	P(60)	30991695.4724	0.0075
P(58)	27449958.6881	0.0510	P(58)	31049479.9009	0.0049
P(56)	27514420.9224	0.0319	P(56)	31106752.5446	0.0041
P(54)	27578044.0828	0.0191	P(54)	31163509.4964	0.0040
P(52)	27640832.0010	0.0108	P(52)	31219746.9183	0.0040
P(50)	27702788.3248	0.0059	P(50)	31275461.0455	0.0039
P(48)	27763916.5206	0.0035	P(48)	31330648.1908	0.0039
P(46)	27824219.8762	0.0028	P(46)	31385304.7490	0.0039
P(44)	27883701.5029	0.0026	P(44)	31439427.2006	0.0039
P(42)	27942364.3379	0.0025	P(42)	31493012.1163	0.0038
P(40)	28000211.1464	0.0024	P(40)	31546056.1605	0.0038
P(38)	28057244.5242	0.0022	P(38)	31598556.0954	0.0037
P(36)	28113466.8992	0.0021	P(36)	31650508.7847	0.0037
P(34)	28168880.5335	0.0020	P(34)	31701911.1970	0.0037
P(32)	28223487.5256	0.0019	P(32)	31752760.4093	0.0037
P(30)	28277289.8118	0.0017	P(30)	31803053.6105	0.0037
P(28)	28330289.1679	0.0016	P(28)	31852788.1043	0.0038
P(26)	28382487.2111	0.0015	P(26)	31901961.3125	0.0038
P(24)	28433885.4012	0.0013	P(24)	31950570.7773	0.0038
P(22)	28484485.0420	0.0012	P(22)	31998614.1649	0.0038
P(20)	28534287.2828	0.0011	P(20)	32046089.2669	0.0037
P(18)	28583293.1193	0.0010	P(18)	32092994.0036	0.0037
P(16)	28631503.3952	0.0010	P(16)	32139326.4254	0.0036
P(14)	28678918.8025	0.0009	P(14)	32185084.7154	0.0036
P(12)	28725539.8830	0.0010	P(12)	32230267.1907	0.0036
P(10)	28771367.0288	0.0010	P(10)	32274872.3041	0.0037
P(8)	28816400.4829	0.0010	P(8)	32318898.6455	0.0038
P(6)	28860640.3403	0.0011	P(6)	32362344.9434	0.0039
P(4)	28904086.5477	0.0011	P(4)	32405210.0652	0.0041
P(2)	28946738.9048	0.0011	P(2)	32447493.0185	0.0041
R(0)	29009228.1702	0.0010	P(0)	32509824.0580	0.0042
R(2)	29049894.0586	0.0010	P(2)	32550648.1723	0.0042
R(4)	29089764.2368	0.0009	P(4)	32590887.7542	0.0042
R(6)	29128837.8426	0.0008	P(6)	32630542.4457	0.0041
R(8)	29167113.8668	0.0008	P(8)	32669612.0295	0.0041
R(10)	29204591.1529	0.0009	P(10)	32708096.4282	0.0040
R(12)	29241268.3964	0.0010	P(12)	32745995.7040	0.0040
R(14)	29277144.1444	0.0011	P(14)	32783310.0573	0.0040
R(16)	29312216.7955	0.0012	P(16)	32820039.8258	0.0040
R(18)	29346484.5984	0.0012	P(18)	32856185.4827	0.0040
R(20)	29379945.6517	0.0013	P(20)	32891747.6358	0.0040
R(22)	29412597.9024	0.0013	P(22)	32926727.0254	0.0040
R(24)	29444439.1458	0.0013	P(24)	32961124.5220	0.0040
R(26)	29475467.0236	0.0014	P(26)	32994941.1249	0.0040
R(28)	29505679.0230	0.0015	P(28)	33028177.9594	0.0040
R(30)	29535072.4755	0.0016	P(30)	33060836.2743	0.0040
R(32)	29563644.5557	0.0018	P(32)	33092917.4394	0.0041
R(34)	29591392.2794	0.0020	P(34)	33124422.9429	0.0043
R(36)	29618312.5023	0.0023	P(36)	33155354.3878	0.0046
R(38)	29644401.9182	0.0028	P(38)	33185713.4894	0.0049

INFRARED LASER FREQUENCIES (continued)

Line	Band I		Line	Band II	
	Frequency (MHz)	Uncertainty (MHz)		Frequency (MHz)	Uncertainty (MHz)
R(40)	29669657.0575	0.0036	P(40)	33215502.0716	0.0056
R(42)	29694074.2853	0.0053	P(42)	33244722.0637	0.0068
R(44)	29717649.7992	0.0082	P(44)	33273375.4969	0.0092
R(46)	29740379.6276	0.0128	P(46)	33301464.5003	0.0134
R(48)	29762259.6274	0.0200	P(48)	33328991.2976	0.0199
R(50)	29783285.4820	0.0307	P(50)	33355958.2027	0.0294
R(52)	29803452.6988	0.0461	P(52)	33382367.6161	0.0427
R(54)	29822756.6072	0.0681	P(54)	33408222.0209	0.0607
R(56)	29841192.3558	0.0985	P(56)	33433523.9780	0.0848
R(58)	29858754.9100	0.1401	P(58)	33458276.1228	0.1165
R(60)	29875439.0495	0.1960	P(60)	33482481.1601	0.1576
R(62)	29891239.3658	0.2702	P(62)	33506141.8605	0.2104
R(64)	29906150.2589	0.3673	P(64)	33529261.0556	0.2775
R(66)	29920165.9352	0.4930	P(66)	33551841.6335	0.3621
R(68)	29933280.4042	0.6540	P(68)	33573886.5352	0.4679
R(70)	29945487.4756	0.8581	P(70)	33595398.7493	0.5992

Frequencies for the 00^o1-(10^o0,02^o)_I and 00^o1-(10^o0,02^o)_{II} Bands of ¹³C¹⁸O₂ with the Estimated 2-σ Uncertainties

Line	Band I		Line	Band II	
	Frequency (MHz)	Uncertainty (MHz)		Frequency (MHz)	Uncertainty (MHz)
P(70)	25967863.7652	1.1146	P(70)	28960476.2278	0.4069
P(68)	26033448.2798	0.8152	P(68)	29022326.9578	0.2861
P(66)	26098273.9159	0.5860	P(66)	29083661.3546	0.1961
P(64)	26162346.4813	0.4129	P(64)	29144473.5795	0.1303
P(62)	26225671.5466	0.2844	P(62)	29204757.8761	0.0833
P(60)	26288254.4494	0.1906	P(60)	29264508.5768	0.0507
P(58)	26350100.2984	0.1237	P(58)	29323720.1086	0.0290
P(56)	26411213.9778	0.0772	P(56)	29382386.9988	0.0152
P(54)	26471600.1504	0.0459	P(54)	29440503.8809	0.0073
P(52)	26531263.2618	0.0258	P(52)	29498065.4997	0.0038
P(50)	26590207.5442	0.0138	P(50)	29555066.7172	0.0032
P(48)	26648437.0195	0.0077	P(48)	29611502.5178	0.0031
P(46)	26705955.5026	0.0057	P(46)	29667368.0132	0.0031
P(44)	26762766.6051	0.0055	P(44)	29722658.4475	0.0034
P(42)	26818873.7378	0.0055	P(42)	29777369.2022	0.0039
P(40)	26874280.1143	0.0056	P(40)	29831495.8006	0.0044
P(38)	26928988.7531	0.0056	P(38)	29885033.9125	0.0049
P(36)	26983002.4809	0.0056	P(36)	29937979.3584	0.0053
P(34)	27036323.9351	0.0055	P(34)	29990328.1139	0.0054
P(32)	27088955.5657	0.0054	P(32)	30042076.3132	0.0055
P(30)	27140899.6384	0.0051	P(30)	30093220.2534	0.0055
P(28)	27192158.2363	0.0049	P(28)	30143756.3978	0.0054
P(26)	27242733.2620	0.0047	P(26)	30193681.3793	0.0053
P(24)	27292626.4396	0.0044	P(24)	30242992.0038	0.0052
P(22)	27341839.3165	0.0042	P(22)	30291685.2529	0.0051
P(20)	27390373.2651	0.0040	P(20)	30339758.2870	0.0049
P(18)	27438229.4843	0.0037	P(18)	30387208.4477	0.0048
P(16)	27485409.0008	0.0035	P(16)	30434033.2603	0.0046
P(14)	27531912.6704	0.0033	P(14)	30480230.4356	0.0045
P(12)	27577741.1795	0.0031	P(12)	30525797.8725	0.0044
P(10)	27622895.0455	0.0031	P(10)	30570733.6593	0.0043
P(8)	27667374.6182	0.0031	P(8)	30615036.0750	0.0043
P(6)	27711180.0803	0.0033	P(6)	30658703.5912	0.0044
P(4)	27754311.4480	0.0034	P(4)	30701734.8727	0.0045

INFRARED LASER FREQUENCIES (continued)

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(2)	27796768.5718	0.0036	P(2)	30744128.7785	0.0045
R(0)	27859189.3155	0.0036	P(0)	30806522.5414	0.0045
R(2)	27899959.0889	0.0035	P(2)	30847319.2956	0.0044
R(4)	27940052.7921	0.0033	P(4)	30887476.2168	0.0043
R(6)	27979469.5315	0.0031	P(6)	30926993.0424	0.0042
R(8)	28018208.2478	0.0028	P(8)	30965869.7046	0.0041
R(10)	28056267.7161	0.0026	P(10)	31004106.3298	0.0040
R(12)	28093646.5448	0.0025	P(12)	31041703.2379	0.0040
R(14)	28130343.1757	0.0025	P(14)	31078660.9408	0.0040
R(16)	28166355.8825	0.0025	P(16)	31114980.1420	0.0040
R(18)	28201682.7706	0.0025	P(18)	31150661.7340	0.0041
R(20)	28236321.7757	0.0025	P(20)	31185706.7976	0.0042
R(22)	28270270.6628	0.0024	P(22)	31220116.5992	0.0043
R(24)	28303527.0249	0.0024	P(24)	31253892.5891	0.0043
R(26)	28336088.2817	0.0023	P(26)	31287036.3991	0.0044
R(28)	28367951.6781	0.0024	P(28)	31319549.8396	0.0043
R(30)	28399114.2823	0.0025	P(30)	31351434.8973	0.0043
R(32)	28429572.9843	0.0026	P(32)	31382693.7318	0.0042
R(34)	28459324.4940	0.0028	P(34)	31413328.6728	0.0042
R(36)	28488365.3390	0.0029	P(36)	31443342.2165	0.0041
R(38)	28516691.8625	0.0029	P(38)	31472737.0219	0.0040
R(40)	28544300.2211	0.0031	P(40)	31501515.9074	0.0039
R(42)	28571186.3823	0.0032	P(42)	31529681.8467	0.0040
R(44)	28597346.1222	0.0032	P(44)	31557237.9646	0.0042
R(46)	28622775.0223	0.0038	P(46)	31584187.5329	0.0046
R(48)	28647468.4672	0.0071	P(48)	31610533.9656	0.0057
R(50)	28671421.6417	0.0148	P(50)	31636280.8146	0.0088
R(52)	28694629.5272	0.0286	P(52)	31661431.7650	0.0151
R(54)	28717086.8993	0.0510	P(54)	31685990.6298	0.0261
R(56)	28738788.3239	0.0852	P(56)	31709961.3449	0.0434
R(58)	28759728.1540	0.1355	P(58)	31733347.9642	0.0693
R(60)	28779900.5263	0.2075	P(60)	31756154.6537	0.1068
R(62)	28799299.3572	0.3078	P(62)	31778385.6867	0.1594
R(64)	28817918.3393	0.4447	P(64)	31800045.4375	0.2317
R(66)	28835750.9374	0.6283	P(66)	31821138.3761	0.3291
R(68)	28852790.3843	0.8707	P(68)	31841669.0622	0.4581
R(70)	28869029.6768	1.1863	P(70)	31861642.1394	0.6268

Frequencies for the 01¹e1-(11¹e0,03¹e0)_I and 01¹e1-(11¹e0,03¹e0)_{II} Bands of ¹²C¹⁶O₂ with the Estimated 2-σ Uncertainties

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(59)	26125213.2723	1.6633	P(59)	30427055.2899	0.1962
P(57)	26191576.6703	1.0880	P(57)	30494640.3229	0.1332
P(55)	26257240.7898	0.6844	P(55)	30561557.5929	0.0865
P(53)	26322208.2302	0.4094	P(53)	30627802.0344	0.0530
P(51)	26386481.4313	0.2286	P(51)	30693368.7014	0.0306
P(49)	26450062.6783	0.1155	P(49)	30758252.7710	0.0175
P(47)	26512954.1076	0.0498	P(47)	30822449.5469	0.0123
P(45)	26575157.7109	0.0191	P(45)	30885954.4624	0.0114
P(43)	26636675.3402	0.0160	P(43)	30948763.0834	0.0109
P(41)	26697508.7115	0.0182	P(41)	31010871.1119	0.0100
P(39)	26757659.4084	0.0177	P(39)	31072274.3882	0.0091
P(37)	26817128.8857	0.0160	P(37)	31132968.8940	0.0091
P(35)	26875918.4726	0.0144	P(35)	31192950.7549	0.0102

INFRARED LASER FREQUENCIES (continued)

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(33)	26934029.3751	0.0131	P(33)	31252216.2430	0.0118
P(31)	26991462.6787	0.0119	P(31)	31310761.7788	0.0134
P(29)	27048219.3509	0.0106	P(29)	31368583.9339	0.0147
P(27)	27104300.2431	0.0096	P(27)	31425679.4328	0.0155
P(25)	27159706.0925	0.0093	P(25)	31482045.1550	0.0157
P(23)	27214437.5237	0.0097	P(23)	31537678.1367	0.0154
P(21)	27268495.0505	0.0104	P(21)	31592575.5725	0.0147
P(19)	27321879.0769	0.0108	P(19)	31646734.8172	0.0137
P(17)	27374589.8987	0.0108	P(17)	31700153.3868	0.0127
P(15)	27426627.7040	0.0104	P(15)	31752828.9602	0.0119
P(13)	27477992.5747	0.0098	P(13)	31804759.3803	0.0113
P(11)	27528684.4867	0.0096	P(11)	31855942.6551	0.0113
P(9)	27578703.3113	0.0101	P(9)	31906376.9582	0.0116
P(7)	27628048.8151	0.0113	P(7)	31956060.6304	0.0122
P(5)	27676720.6609	0.0127	P(5)	32004992.1796	0.0129
P(3)	27724718.4080	0.0141	P(3)	32053170.2819	0.0136
R(1)	27841759.7696	0.0152	P(1)	32170312.0391	0.0149
R(3)	27887393.2105	0.0146	P(3)	32215845.0845	0.0151
R(5)	27932349.2934	0.0135	P(5)	32260620.8121	0.0152
R(7)	27976627.0108	0.0124	P(7)	32304638.8261	0.0152
R(9)	28020225.2521	0.0115	P(9)	32347898.8990	0.0150
R(11)	28063142.8031	0.0110	P(11)	32390400.9714	0.0148
R(13)	28105378.3457	0.0109	P(13)	32432145.1513	0.0145
R(15)	28146930.4576	0.0109	P(15)	32473131.7137	0.0142
R(17)	28187797.6116	0.0107	P(17)	32513361.0997	0.0140
R(19)	28227978.1750	0.0103	P(19)	32552833.9153	0.0140
R(21)	28267470.4088	0.0099	P(21)	32591550.9309	0.0141
R(23)	28306272.4666	0.0099	P(23)	32629513.0796	0.0143
R(25)	28344382.3939	0.0107	P(25)	32666721.4564	0.0144
R(27)	28381798.1267	0.0122	P(27)	32703177.3164	0.0142
R(29)	28418517.4902	0.0141	P(29)	32738882.0732	0.0136
R(31)	28454538.1976	0.0165	P(31)	32773837.2976	0.0136
R(33)	28489857.8477	0.0213	P(33)	32808044.7156	0.0174
R(35)	28524473.9240	0.0312	P(35)	32841506.2063	0.0279
R(37)	28558383.7917	0.0486	P(37)	32874223.8000	0.0462
R(39)	28591584.6963	0.0754	P(39)	32906199.6761	0.0735
R(41)	28624073.7602	0.1131	P(41)	32937436.1606	0.1114
R(43)	28655847.9806	0.1644	P(43)	32967935.7238	0.1624
R(45)	28686904.2261	0.2328	P(45)	32997700.9775	0.2292
R(47)	28717239.2334	0.3239	P(47)	33026734.6728	0.3151
R(49)	28746849.6038	0.4465	P(49)	33055039.6965	0.4238
R(51)	28775731.7988	0.6142	P(51)	33082619.0689	0.5595
R(53)	28803882.1361	0.8465	P(53)	33109475.9403	0.7272

Frequencies for the $01^{1f_1}-(11^{1f_0},03^{1f_0})_I$ and $01^{1f_1}-(11^{1f_0},03^{1f_0})_{II}$ Bands of $^{12}C^{16}O_2$ with the Estimated 2- σ Uncertainties

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(60)	26051570.0104	4.4521	P(60)	30355115.0204	0.2752
P(58)	26120964.4932	3.0629	P(58)	30425283.5969	0.1926
P(56)	26189552.8496	2.0516	P(56)	30494732.8293	0.1301
P(54)	26257339.6006	1.3305	P(54)	30563455.6325	0.0840
P(52)	26324329.0344	0.8289	P(52)	30631445.1076	0.0512
P(50)	26390525.2136	0.4901	P(50)	30698694.5456	0.0292
P(48)	26455931.9824	0.2698	P(48)	30765197.4310	0.0163

INFRARED LASER FREQUENCIES (continued)

Line	Band I Frequency (MHz)	Uncertainty (MHz)	Line	Band II Frequency (MHz)	Uncertainty (MHz)
P(46)	26520552.9722	0.1334	P(46)	30830947.4444	0.0111
P(44)	26584391.6075	0.0551	P(44)	30895938.4662	0.0104
P(42)	26647451.1105	0.0181	P(42)	30960164.5794	0.0105
P(40)	26709734.5057	0.0151	P(40)	31023620.0723	0.0105
P(38)	26771244.6242	0.0174	P(38)	31086299.4415	0.0107
P(36)	26831984.1067	0.0157	P(36)	31148197.3941	0.0114
P(34)	26891955.4069	0.0126	P(34)	31209308.8510	0.0126
P(32)	26951160.7945	0.0105	P(32)	31269628.9481	0.0138
P(30)	27009602.3576	0.0096	P(30)	31329153.0395	0.0147
P(28)	27067282.0045	0.0092	P(28)	31387876.6994	0.0151
P(26)	27124201.4662	0.0090	P(26)	31445795.7236	0.0149
P(24)	27180362.2977	0.0089	P(24)	31502906.1318	0.0141
P(22)	27235765.8792	0.0090	P(22)	31559204.1695	0.0128
P(20)	27290413.4182	0.0093	P(20)	31614686.3091	0.0113
P(18)	27344305.9494	0.0096	P(18)	31669349.2515	0.0098
P(16)	27397444.3368	0.0097	P(16)	31723189.9280	0.0086
P(14)	27449829.2733	0.0096	P(14)	31776205.5007	0.0081
P(12)	27501461.2824	0.0096	P(12)	31828393.3642	0.0085
P(10)	27552340.7179	0.0101	P(10)	31879751.1463	0.0095
P(8)	27602467.7649	0.0111	P(8)	31930276.7092	0.0107
P(6)	27651842.4399	0.0125	P(6)	31979968.1497	0.0120
P(4)	27700464.5912	0.0139	P(4)	32028823.8002	0.0131
P(2)	27748333.8988	0.0148	P(2)	32076842.2290	0.0139
R(2)	27864709.8633	0.0146	P(2)	32193218.1935	0.0150
R(4)	27909939.2762	0.0135	P(4)	32238298.4853	0.0151
R(6)	27954412.3294	0.0122	P(6)	32282538.0393	0.0153
R(8)	27998127.7801	0.0112	P(8)	32325936.7244	0.0153
R(10)	28041084.2173	0.0107	P(10)	32368494.6458	0.0154
R(12)	28083280.0620	0.0108	P(12)	32410212.1438	0.0155
R(14)	28124713.5668	0.0110	P(14)	32451089.7941	0.0155
R(16)	28165382.8151	0.0112	P(16)	32491128.4063	0.0154
R(18)	28205285.7213	0.0111	P(18)	32530329.0234	0.0152
R(20)	28244420.0302	0.0110	P(20)	32568692.9211	0.0149
R(22)	28282783.3158	0.0114	P(22)	32606221.6061	0.0147
R(24)	28320372.9812	0.0129	P(24)	32642916.8154	0.0144
R(26)	28357186.2574	0.0149	P(26)	32678780.5147	0.0140
R(28)	28393220.2023	0.0168	P(28)	32713814.8971	0.0133
R(30)	28428471.6994	0.0175	P(30)	32748022.3813	0.0120
R(32)	28462937.4565	0.0165	P(32)	32781405.6101	0.0106
R(34)	28496614.0042	0.0142	P(34)	32813967.4482	0.0122
R(36)	28529497.6934	0.0163	P(36)	32845710.9809	0.0212
R(38)	28561584.6939	0.0309	P(38)	32876639.5111	0.0385
R(40)	28592870.9914	0.0593	P(40)	32906756.5580	0.0646
R(42)	28623352.3850	0.1054	P(42)	32936065.8540	0.1015
R(44)	28653024.4839	0.1779	P(44)	32964571.3426	0.1518
R(46)	28681882.7038	0.2907	P(46)	32992277.1760	0.2184
R(48)	28709922.2632	0.4635	P(48)	33019187.7118	0.3048
R(50)	28737138.1785	0.7231	P(50)	33045307.5105	0.4152

INFRARED AND FAR-INFRARED ABSORPTION FREQUENCY STANDARDS

Arthur Maki

Aside from the CO₂ laser transitions, the absorption spectrum of CO has been more accurately and thoroughly measured than any other spectrum. A bibliography of earlier measurements on CO is given by Maki and Wells,¹ and the present tables were calculated from the measurements referred to in that work. In addition, some new and very accurate frequency measurements^{2,3} have been made and were incorporated in the present tables. The frequencies of the rotational transitions of HF and HCl were calculated from constants obtained from fitting the measurements of Evenson et al.^{4,5} and Jennings and Wells.⁶

A new report on infrared wavenumber standards from the International Union of Pure and Applied Chemistry, Commission on Molecular Structure and Spectroscopy, may be found in Reference 7.

REFERENCES

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Wavenumbers for the $\nu = 1-0$ Band of CO

Wavenumber (unc)* cm ⁻¹	Transition	Wavenumber (unc) cm ⁻¹	Transition
		2147.081132(01)	R(0)
2139.426071(01)	P(1)	2150.856006(01)	R(1)
2135.546178(01)	P(2)	2154.595581(01)	R(2)
2131.631574(01)	P(3)	2158.299710(01)	R(3)
2127.682404(01)	P(4)	2161.968245(01)	R(4)
2123.698816(01)	P(5)	2165.601041(01)	R(5)
2119.680957(01)	P(6)	2169.197949(01)	R(6)
2115.628973(01)	P(7)	2172.758824(01)	R(7)
2111.543012(01)	P(8)	2176.283519(01)	R(8)
2107.423221(01)	P(9)	2179.771887(01)	R(9)
2103.269746(01)	P(10)	2183.223782(01)	R(10)
2099.082734(01)	P(11)	2186.639057(01)	R(11)
2094.862333(01)	P(12)	2190.017565(01)	R(12)
2090.608688(01)	P(13)	2193.359161(01)	R(13)
2086.321947(01)	P(14)	2196.663698(01)	R(14)
2082.002256(01)	P(15)	2199.931030(01)	R(15)
2077.649762(01)	P(16)	2203.161010(01)	R(16)
2073.264612(01)	P(17)	2206.353492(01)	R(17)
2068.846952(01)	P(18)	2209.508331(02)	R(18)
2064.396929(01)	P(19)	2212.625379(02)	R(19)
2059.914688(02)	P(20)	2215.704492(02)	R(20)
2055.400377(02)	P(21)	2218.745522(02)	R(21)
2050.854140(02)	P(22)	2221.748326(03)	R(22)
2046.276126(03)	P(23)	2224.712755(03)	R(23)
2041.666479(03)	P(24)	2227.638666(03)	R(24)
2037.025345(03)	P(25)	2230.525912(04)	R(25)
2032.352870(04)	P(26)	2233.374349(04)	R(26)
2027.649200(04)	P(27)	2236.183829(04)	R(27)
2022.914480(04)	P(28)	2238.954210(05)	R(28)
2018.148857(05)	P(29)	2241.685344(05)	R(29)
2013.352474(05)	P(30)	2244.377088(06)	R(30)
2008.525477(06)	P(31)	2247.029296(07)	R(31)
2003.668012(06)	P(32)	2249.641824(08)	R(32)
1998.780224(07)	P(33)	2252.214527(10)	R(33)
1993.862257(09)	P(34)	2254.747262(14)	R(34)

INFRARED AND FAR-INFRARED ABSORPTION FREQUENCY STANDARDS (continued)

Wavenumber (unc)* cm ⁻¹	Transition	Wavenumber (unc) cm ⁻¹	Transition
1988.914257(11)	P(35)	2257.239883(18)	R(35)
1983.936367(14)	P(36)	2259.692248(24)	R(36)
1978.928733(18)	P(37)	2262.104213(33)	R(37)
1973.891500(25)	P(38)	2264.475634(45)	R(38)
1968.824811(34)	P(39)	2266.806368(61)	R(39)
1963.728813(46)	P(40)	2269.096273(81)	R(40)
1958.603648(61)	P(41)	2271.345206(106)	R(41)
1953.449462(82)	P(42)	2273.553027(139)	R(42)

* The uncertainty in the last digits (twice the standard error) is given in parentheses.

Wavenumbers for the $\nu = 2-0$ Band of CO

Wavenumber (unc)* cm ⁻¹	Transition	Wavenumber (unc) cm ⁻¹	Transition
4256.217140(02)	P(1)	4263.837198(02)	R(0)
4252.302244(02)	P(2)	4267.542066(02)	R(1)
4248.317633(02)	P(3)	4271.176630(02)	R(2)
4244.263453(02)	P(4)	4274.740746(02)	R(3)
4240.139852(02)	P(5)	4278.234264(02)	R(4)
4235.946975(02)	P(6)	4281.657039(02)	R(5)
4231.684972(02)	P(7)	4285.008924(02)	R(6)
4227.353987(02)	P(8)	4288.289772(02)	R(7)
4222.954169(02)	P(9)	4291.499437(02)	R(8)
4218.485665(02)	P(10)	4294.637773(02)	R(9)
4213.948620(02)	P(11)	4297.704631(02)	R(10)
4209.343182(02)	P(12)	4300.699868(02)	R(11)
4204.669499(02)	P(13)	4303.623334(02)	R(12)
4199.927716(02)	P(14)	4306.474886(02)	R(13)
4195.117980(02)	P(15)	4309.254375(02)	R(14)
4190.240439(02)	P(16)	4311.961657(02)	R(15)
4185.295239(02)	P(17)	4314.596584(02)	R(16)
4180.282526(02)	P(18)	4317.159011(02)	R(17)
4175.202447(02)	P(19)	4319.648791(02)	R(18)
4170.055149(03)	P(20)	4322.065779(03)	R(19)
4164.840777(03)	P(21)	4324.409829(03)	R(20)
4159.559478(03)	P(22)	4326.680794(03)	R(21)
4154.211398(03)	P(23)	4328.878530(03)	R(22)
4148.796683(04)	P(24)	4331.002889(04)	R(23)
4143.315479(04)	P(25)	4333.053728(04)	R(24)
4137.767932(04)	P(26)	4335.030899(05)	R(25)
4132.154187(05)	P(27)	4336.934259(06)	R(26)
4126.474391(06)	P(28)	4338.763661(07)	R(27)
4120.728689(07)	P(29)	4340.518961(09)	R(28)
4114.917226(09)	P(30)	4342.200014(11)	R(29)
4109.040148(12)	P(31)	4343.806675(16)	R(30)
4103.097600(16)	P(32)	4345.338799(21)	R(31)
4097.089728(21)	P(33)	4346.796243(29)	R(32)
4091.016676(29)	P(34)	4348.178862(40)	R(33)
4084.878591(40)	P(35)	4349.486513(54)	R(34)
4078.675618(54)	P(36)	4350.719052(73)	R(35)
4072.407901(73)	P(37)	4351.876336(96)	R(36)
4066.075588(97)	P(38)	4352.958224(127)	R(37)
4059.678822(127)	P(39)	4353.964572(166)	R(38)
		4354.895240(214)	R(39)

* The uncertainty in the last digits (twice the standard error) is given in parentheses.

INFRARED AND FAR-INFRARED ABSORPTION FREQUENCY STANDARDS (continued)

Wavenumbers for the $\nu = 3-0$ Band of CO

Wavenumber (unc)* cm ⁻¹	Transition	Wavenumber (unc) cm ⁻¹	Transition
		6354.179057(13)	R(0)
6346.594000(13)	P(1)	6357.813923(13)	R(1)
6342.644103(13)	P(2)	6361.343487(13)	R(2)
6338.589491(13)	P(3)	6364.767599(13)	R(3)
6334.430309(13)	P(4)	6368.086115(13)	R(4)
6330.166705(13)	P(5)	6371.298887(13)	R(5)
6325.798826(13)	P(6)	6374.405768(12)	R(6)
6321.326819(13)	P(7)	6377.406611(12)	R(7)
6316.750831(12)	P(8)	6380.301271(12)	R(8)
6312.071008(12)	P(9)	6383.089600(12)	R(9)
6307.287498(12)	P(10)	6385.771452(12)	R(10)
6302.400447(12)	P(11)	6388.346680(13)	R(11)
6297.410003(12)	P(12)	6390.815139(13)	R(12)
6292.316311(13)	P(13)	6393.176681(13)	R(13)
6287.119520(13)	P(14)	6395.431160(13)	R(14)
6281.819775(13)	P(15)	6397.578430(13)	R(15)
6276.417224(13)	P(16)	6399.618344(13)	R(16)
6270.912012(13)	P(17)	6401.550757(13)	R(17)
6265.304287(13)	P(18)	6403.375523(13)	R(18)
6259.594194(13)	P(19)	6405.092495(14)	R(19)
6253.781880(13)	P(20)	6406.701527(14)	R(20)
6247.867492(14)	P(21)	6408.202474(14)	R(21)
6241.851176(14)	P(22)	6409.595189(15)	R(22)
6235.733077(14)	P(23)	6410.879527(15)	R(23)
6229.513342(15)	P(24)	6412.055343(16)	R(24)
6223.192117(15)	P(25)	6413.122491(17)	R(25)
6216.769547(16)	P(26)	6414.080825(19)	R(26)
6210.245778(17)	P(27)	6414.930201(23)	R(27)
6203.620957(19)	P(28)	6415.670474(28)	R(28)
6196.895229(23)	P(29)	6416.301500(37)	R(29)
6190.068739(28)	P(30)	6416.823133(50)	R(30)
6183.141633(37)	P(31)	6417.235231(67)	R(31)
6176.114058(50)	P(32)	6417.537649(90)	R(32)
6168.986159(67)	P(33)		
6161.758082(90)	P(34)		

* The uncertainty in the last digits (twice the standard error) is given in parentheses.

Frequencies and Wavenumbers for the Rotational Lines of CO

Frequency MHz	Uncertainty* MHz	J'	J''	Wavenumber cm ⁻¹	Uncertainty* cm ⁻¹
115271.2029	0.0004	1	0	3.84503345	0.00000001
230538.0016	0.0008	2	1	7.68991999	0.00000003
345795.9923	0.0012	3	2	11.53451273	0.00000004
461040.7712	0.0016	4	3	15.37866477	0.00000005
576267.9350	0.0019	5	4	19.22222923	0.00000006
691473.0809	0.0021	6	5	23.06505926	0.00000007
806651.8065	0.0023	7	6	26.90700800	0.00000008
921799.7104	0.0025	8	7	30.74792863	0.00000008
1036912.3919	0.0027	9	8	34.58767438	0.00000009
1151985.4515	0.0029	10	9	38.42609848	0.00000010
1267014.4906	0.0031	11	10	42.26305422	0.00000010
1381995.1119	0.0034	12	11	46.09839491	0.00000011
1496922.9195	0.0038	13	12	49.93197392	0.00000013

INFRARED AND FAR-INFRARED ABSORPTION FREQUENCY STANDARDS (continued)

Frequency MHz	Uncertainty* MHz	<i>J'</i>	<i>J''</i>	Wavenumber cm ⁻¹	Uncertainty* cm ⁻¹
1611793.5189	0.0042	14	13	53.76364468	0.00000014
1726602.5173	0.0047	15	14	57.59326065	0.00000016
1841345.5237	0.0052	16	15	61.42067535	0.00000017
1956018.1486	0.0057	17	16	65.24574239	0.00000019
2070616.0050	0.0061	18	17	69.06831542	0.00000020
2185134.7075	0.0065	19	18	72.88824816	0.00000022
2299569.8733	0.0069	20	19	76.70539441	0.00000023
2413917.1217	0.0071	21	20	80.51960806	0.00000024
2528172.0747	0.0073	22	21	84.33074306	0.00000024
2642330.3567	0.0074	23	22	88.13865346	0.00000025
2756387.5949	0.0075	24	23	91.94319341	0.00000025
2870339.4194	0.0077	25	24	95.74421713	0.00000026
2984181.4631	0.0080	26	25	99.54157896	0.00000027
3097909.3621	0.0085	27	26	103.33513334	0.00000028
3211518.7558	0.0090	28	27	107.12473480	0.00000030
3325005.2869	0.0096	29	28	110.91023800	0.00000032
3438364.6013	0.0102	30	29	114.69149772	0.00000034
3551592.3489	0.0107	31	30	118.46836884	0.00000036
3664684.1829	0.0111	32	31	122.24070637	0.00000037
3777635.7608	0.0118	33	32	126.00836545	0.00000039
3890442.7435	0.0137	34	33	129.77120137	0.00000046
4003100.7965	0.0179	35	34	133.52906952	0.00000060
4115605.5892	0.0254	36	35	137.28182546	0.00000085
4227952.7954	0.0370	37	36	141.02932487	0.00000123
4340138.0932	0.0531	38	37	144.77142361	0.00000177
4452157.1657	0.0746	39	38	148.50797766	0.00000249
4564005.7001	0.1025	40	39	152.23884318	0.00000342

* The uncertainty given is twice the standard error.

Frequencies and Wavenumbers for the Rotational Lines of HF

Frequency MHz	Uncertainty* MHz	<i>J'</i>	<i>J''</i>	Wavenumber cm ⁻¹	Uncertainty* cm ⁻¹
1232476.21	0.12	1	0	41.110981	0.000004
2463428.09	0.19	2	1	82.171116	0.000006
3691334.81	0.25	3	2	123.129676	0.000008
4914682.58	0.51	4	3	163.936165	0.000017
6131968.11	1.10	5	4	204.540439	0.000037
7341702.00	2.00	6	5	244.892818	0.000067
8542412.1	3.21	7	6	284.944197	0.000107
9732646.8	4.72	8	7	324.646153	0.000157
10910978.2	6.51	9	8	363.951056	0.000217
12076004.8	8.55	10	9	402.81216	0.000285
13226355.2	10.81	11	10	441.18372	0.000361
14360689.8	13.25	12	11	479.02105	0.00044
15477704.4	15.86	13	12	516.28065	0.00053
16576131.8	18.61	14	13	552.92024	0.00062
17654744.4	21.48	15	14	588.89888	0.00072
18712356.5	24.44	16	15	624.17703	0.00082
19747825.6	27.43	17	16	658.71656	0.00092
20760054.3	30.32	18	17	692.4809	0.00101
21747991.7	32.91	19	18	725.4349	0.00110
22710634.7	34.94	20	19	757.5452	0.00117
23647028.7	36.08	21	20	788.7800	0.00120
24556268.8	35.93	22	21	819.1090	0.00120
25437499.9	34.12	23	22	848.5037	0.00114

INFRARED AND FAR-INFRARED ABSORPTION FREQUENCY STANDARDS (continued)

Frequency MHz	Uncertainty* MHz	<i>J'</i>	<i>J''</i>	Wavenumber cm ⁻¹	Uncertainty* cm ⁻¹
26289917.4	30.32	24	23	876.9373	0.00101
27112767.2	24.41	25	24	904.38457	0.00081
27905345.6	16.88	26	25	930.82214	0.00056
28666999.3	10.80	27	26	956.22817	0.00036
29397124.8	14.65	28	27	980.58253	0.00049
30095168.2	24.62	29	28	1003.86676	0.00082
30760624.2	33.36	30	29	1026.0640	0.00111
31393035.7	36.17	31	30	1047.1590	0.00121

* The uncertainty given is twice the standard error.

Frequencies and Wavenumbers for the Rotational Lines of H³⁵Cl

Frequency MHz	Uncertainty* MHz	<i>J'</i>	<i>J''</i>	Wavenumber cm ⁻¹	Uncertainty* cm ⁻¹
1876226.517	0.065	3	2	62.584180	0.000002
2499864.439	0.066	4	3	83.386502	0.000002
3121986.563	0.064	5	4	104.138262	0.000002
3742216.601	0.076	6	5	124.826909	0.000003
4360180.042	0.098	7	6	145.439951	0.000003
4975504.51	0.11	8	7	165.964966	0.000004
5587820.10	0.12	9	8	186.389615	0.000004
6196759.76	0.22	10	9	206.701656	0.000007
6801959.63	0.50	11	10	226.888951	0.000017
7403059.41	1.02	12	11	246.939481	0.000034
7999702.7	1.8	13	12	266.841359	0.000062
8591537.3	3.1	14	13	286.582837	0.000103
9178215.8	4.8	15	14	306.152324	0.000161

* The uncertainty given is twice the standard error.

Frequencies and Wavenumbers for the Rotational Lines of H³⁷Cl

Frequency MHz	Uncertainty* MHz	<i>J'</i>	<i>J''</i>	Wavenumber cm ⁻¹	Uncertainty* cm ⁻¹
1873410.72	0.05	3	2	62.490255	0.000002
2496115.33	0.05	4	3	83.261445	0.000002
3117308.69	0.05	5	4	103.982225	0.000002
3736615.64	0.06	6	5	124.640082	0.000002
4353662.84	0.08	7	6	145.222561	0.000003
4968079.04	0.09	8	7	165.717279	0.000003
5579495.53	0.10	9	8	186.111938	0.000003
6187546.42	0.19	10	9	206.394332	0.000006
6791869.04	0.45	11	10	226.552365	0.000015
7392104.3	0.9	12	11	246.574057	0.000030
7987896.9	1.6	13	12	266.447561	0.000054
8578896.1	2.7	14	13	286.161170	0.000089

* The uncertainty given is twice the standard error.

SENSITIVITY OF THE HUMAN EYE TO LIGHT OF DIFFERENT WAVELENGTHS

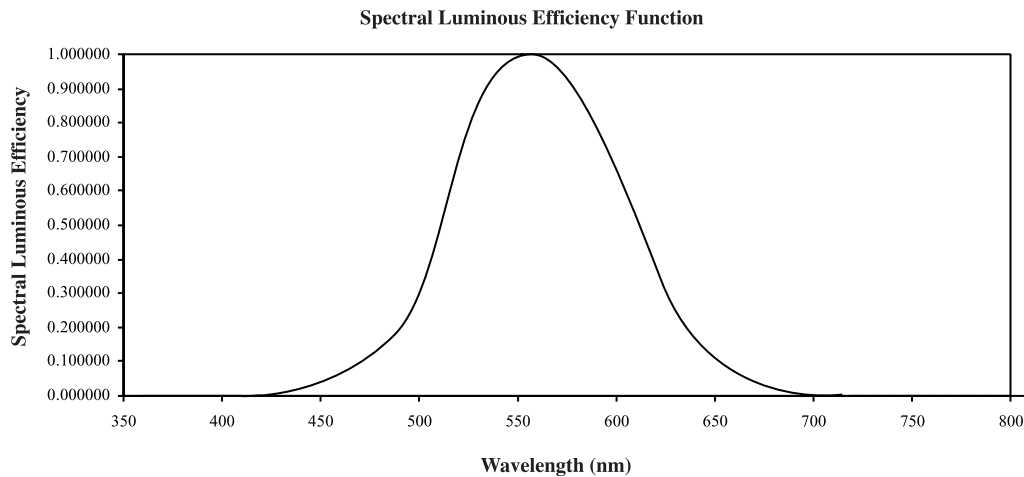
The human eye responds to electromagnetic radiation in the wavelength range from about 360 nm (violet) to 820 nm (red), with a peak sensitivity near 555 nm. While the detailed shape of this response curve depends on the individual person, studies on representative samples of human subjects have led to adoption of a standard function relating the perceived brightness (luminous flux) to the actual power of the spectral radiation. This function is referred to as $V(\lambda)$, the photopic spectral luminous efficiency function, and it plays an important role in photometry.

The function $V(\lambda)$, as adopted by the International Commission on Illumination (CIE) is tabulated and plotted below.

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λ/nm	$V(\lambda)$	λ/nm	$V(\lambda)$	λ/nm	$V(\lambda)$
360	0.000004	520	0.710000	670	0.032000
370	0.000012	530	0.862000	680	0.017000
380	0.000039	540	0.954000	690	0.008210
390	0.000120	550	0.994950	700	0.004102
400	0.000396	555	1.000000	710	0.002091
410	0.001210	560	0.995000	720	0.001047
420	0.004000	570	0.952000	730	0.000520
430	0.011600	580	0.870000	740	0.000249
440	0.023000	590	0.757000	750	0.000120
450	0.038000	600	0.631000	760	0.000060
460	0.060000	610	0.503000	770	0.000030
470	0.090980	620	0.381000	780	0.000015
480	0.139020	630	0.265000	790	0.000007
490	0.208020	640	0.175000	800	0.000004
500	0.323000	650	0.107000	810	0.000002
510	0.503000	660	0.061000	820	0.000001



SUMMARY TABLES OF PARTICLE PROPERTIES

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GAUGE AND HIGGS BOSONS

γ

$$I(J^{PC}) = 0,1(1^{--})$$

Mass $m < 2 \times 10^{-16}$ eV

Charge $q < 5 \times 10^{-30}$ e

Mean life $\tau =$ Stable

g

or gluon

$$I(J^P) = 0(1^-)$$

Mass $m = 0$ [a]

SU(3) color octet

W

$$J = 1$$

Charge = ± 1 e

Mass $m = 80.41 \pm 0.10$ GeV

$m_Z - m_W = 10.78 \pm 0.10$ GeV

$m_{W^+} - m_{W^-} = -0.2 \pm 0.6$ GeV

Full width $\Gamma = 2.06 \pm 0.06$ GeV

W^- modes are charge conjugates of the modes below.

W^+ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\ell^+ \nu$	[b] (10.74 ± 0.33) %		–
$e^+ \nu$	(10.9 ± 0.4) %		40205
$\mu^+ \nu$	(10.2 ± 0.5) %		40205
$\tau^+ \nu$	(11.3 ± 0.8) %		40185
hadrons	(67.8 ± 1.0) %		–
$\pi^+ \gamma$	< 2.2	$\times 10^{-4}$	95% 40205

Z

$$J = 1$$

$$\text{Charge} = 0$$

$$\text{Mass } m = 91.187 \pm 0.007 \text{ GeV } [c]$$

$$\text{Full width } \Gamma = 2.490 \pm 0.007 \text{ GeV}$$

$$\Gamma(\ell^+ \ell^-) = 83.83 \pm 0.27 \text{ MeV } [b]$$

$$\Gamma(\text{invisible}) = 498.3 \pm 4.2 \text{ MeV } [d]$$

$$\Gamma(\text{hadrons}) = 1740.7 \pm 5.9 \text{ MeV}$$

$$\Gamma(\mu^+ \mu^-) / \Gamma(e^+ e^-) = 1.000 \pm 0.005$$

$$\Gamma(\tau^+ \tau^-) / \Gamma(e^+ e^-) = 0.998 \pm 0.005 [e]$$

Average charged multiplicity

$$\langle N_{\text{charged}} \rangle = 21.00 \pm 0.13$$

Couplings to leptons

$$g_V^\ell = -0.0377 \pm 0.0007$$

$$g_A^\ell = -0.5008 \pm 0.0008$$

$$g^{\nu e} = 0.53 \pm 0.09$$

$$g^{\nu \mu} = 0.502 \pm 0.017$$

Asymmetry parameters [f]

$$A_e = 0.1519 \pm 0.0034$$

$$A_\mu = 0.102 \pm 0.034$$

$$A_\tau = 0.143 \pm 0.008$$

$$A_c = 0.59 \pm 0.19$$

$$A_b = 0.89 \pm 0.11$$

Charge asymmetry (%) at Z pole

$$A_{FB}^{(0\ell)} = 1.59 \pm 0.18$$

$$A_{FB}^{(0u)} = 4.0 \pm 7.3$$

$$A_{FB}^{(0s)} = 9.9 \pm 3.1 \quad (S = 1.2)$$

$$A_{FB}^{(0c)} = 7.32 \pm 0.58$$

$$A_{FB}^{(0b)} = 10.02 \pm 0.28$$

Z DECAY MODES	Fraction (Γ_i/Γ)	Confidence level (MeV/c)
$e^+ e^-$	(3.366 \pm 0.008) %	45594
$\mu^+ \mu^-$	(3.367 \pm 0.013) %	45593
$\tau^+ \tau^-$	(3.360 \pm 0.015) %	45559
$\ell^+ \ell^-$	[b] (3.366 \pm 0.006) %	—
invisible	(20.01 \pm 0.16) %	—
hadrons	(69.90 \pm 0.15) %	—
($u\bar{u} + c\bar{c}$)/2	(10.1 \pm 1.1) %	—
($d\bar{d} + s\bar{s} + b\bar{b}$)/3	(16.6 \pm 0.6) %	—
$c\bar{c}$	(12.4 \pm 0.6) %	—
$b\bar{b}$	(15.16 \pm 0.09) %	—
$g g g$	< 1.1 %	95% —
$\pi^0 \gamma$	< 5.2 $\times 10^{-5}$	95% 45593
$\eta \gamma$	< 5.1 $\times 10^{-5}$	95% 45592
$\omega \gamma$	< 6.5 $\times 10^{-4}$	95% 45590
$\eta'(958) \gamma$	< 4.2 $\times 10^{-5}$	95% 45588
$\gamma \gamma$	< 5.2 $\times 10^{-5}$	95% 45594
$\gamma \gamma \gamma$	< 1.0 $\times 10^{-5}$	95% 45594
$\pi^\pm W^\mp$	[g] < 7 $\times 10^{-5}$	95% 10139
$\rho^\pm W^\mp$	[g] < 8.3 $\times 10^{-5}$	95% 10114
$J/\psi(1S) X$	(3.66 \pm 0.23) $\times 10^{-3}$	—
$\psi(2S) X$	(1.60 \pm 0.29) $\times 10^{-3}$	—
$\chi_{c1}(1P) X$	(2.9 \pm 0.7) $\times 10^{-3}$	—
$\chi_{c2}(1P) X$	< 3.2 $\times 10^{-3}$	90% —
$\Upsilon(1S) X + \Upsilon(2S) X$ + $\Upsilon(3S) X$	(1.0 \pm 0.5) $\times 10^{-4}$	—
$\Upsilon(1S) X$	< 5.5 $\times 10^{-5}$	95% —
$\Upsilon(2S) X$	< 1.39 $\times 10^{-4}$	95% —
$\Upsilon(3S) X$	< 9.4 $\times 10^{-5}$	95% —
$(D^0/\bar{D}^0) X$	(20.7 \pm 2.0) %	—
$D^\pm X$	(12.2 \pm 1.7) %	—
$D^*(2010)^\pm X$	[g] (11.4 \pm 1.3) %	—
$B_s^0 X$	seen	—
anomalous γ + hadrons	[h] < 3.2 $\times 10^{-3}$	95% —
$e^+ e^- \gamma$	[h] < 5.2 $\times 10^{-4}$	95% 45594
$\mu^+ \mu^- \gamma$	[h] < 5.6 $\times 10^{-4}$	95% 45593
$\tau^+ \tau^- \gamma$	[h] < 7.3 $\times 10^{-4}$	95% 45559
$\ell^+ \ell^- \gamma \gamma$	[i] < 6.8 $\times 10^{-6}$	95% —
$q\bar{q} \gamma \gamma$	[i] < 5.5 $\times 10^{-6}$	95% —
$\nu\bar{\nu} \gamma \gamma$	[i] < 3.1 $\times 10^{-6}$	95% 45594
$e^\pm \mu^\mp$	LF [g] < 1.7 $\times 10^{-6}$	95% 45593
$e^\pm \tau^\mp$	LF [g] < 9.8 $\times 10^{-6}$	95% 45576
$\mu^\pm \tau^\mp$	LF [g] < 1.2 $\times 10^{-5}$	95% 45576

Higgs Bosons — H^0 and H^\pm , Searches for

H^0 Mass $m > 77.5$ GeV, CL = 95%

H_1^0 in Supersymmetric Models ($m_{H_1^0} < m_{H_2^0}$)

Mass $m > 62.5$ GeV, CL = 95%

A^0 Pseudoscalar Higgs Boson in Supersymmetric Models [j]

Mass $m > 62.5$ GeV, CL = 95% $\tan\beta > 1$

H^\pm Mass $m > 54.5$ GeV, CL = 95%

See the Particle Listings for a Note giving details of Higgs Bosons.

Heavy Bosons Other Than Higgs Bosons, Searches for

Additional W Bosons

W_R — right-handed W

Mass $m > 549$ GeV

(assuming light right-handed neutrino)

W' with standard couplings decaying to $e\nu, \mu\nu$

Mass $m > 720$ GeV, CL = 95%

Additional Z Bosons

Z'_{SM} with standard couplings

Mass $m > 690$ GeV, CL = 95% ($p\bar{p}$ direct search)

Mass $m > 779$ GeV, CL = 95% (electroweak fit)

Z_{LR} of $SU(2)_L \times SU(2)_R \times U(1)$

(with $g_L = g_R$)

Mass $m > 630$ GeV, CL = 95% ($p\bar{p}$ direct search)

Mass $m > 389$ GeV, CL = 95% (electroweak fit)

Z_χ of $SO(10) \rightarrow SU(5) \times U(1)_\chi$

(coupling constant derived from G.U.T.)

Mass $m > 595$ GeV, CL = 95% ($p\bar{p}$ direct search)

Mass $m > 321$ GeV, CL = 95% (electroweak fit)

Z_ψ of $E_6 \rightarrow SO(10) \times U(1)_\psi$

(coupling constant derived from G.U.T.)

Mass $m > 590$ GeV, CL = 95% ($p\bar{p}$ direct search)

Mass $m > 160$ GeV, CL = 95% (electroweak fit)

Z_η of $E_6 \rightarrow SU(3) \times SU(2) \times U(1) \times U(1)_\eta$

(coupling constant derived from G.U.T.);

charges are $Q_\eta = \sqrt{3/8}Q_\chi - \sqrt{5/8}Q_\psi$)

Mass $m > 620$ GeV, CL = 95% ($p\bar{p}$ direct search)

Mass $m > 182$ GeV, CL = 95% (electroweak fit)

Scalar Leptoquarks

Mass $m > 225$ GeV, CL = 95% (1st generation, pair prod.)

Mass $m > 237$ GeV, CL = 95% (1st gener., single prod.)

Mass $m > 119$ GeV, CL = 95% (2nd gener., pair prod.)

Mass $m > 73$ GeV, CL = 95% (2nd gener., single prod.)

Mass $m > 99$ GeV, CL = 95% (3rd gener., pair prod.)

(See the Particle Listings for assumptions on leptoquark quantum numbers and branching fractions.)

Axions (A^0) and Other Very Light Bosons, Searches for

The standard Peccei-Quinn axion is ruled out. Variants with reduced couplings or much smaller masses are constrained by various data. The Particle Listings in the full *Review* contain a Note discussing axion searches.

The best limit for the half-life of neutrinoless double beta decay with Majoron emission is $> 7.2 \times 10^{24}$ years (CL = 90%).

NOTES

- [a] Theoretical value. A mass as large as a few MeV may not be precluded.
- [b] ℓ indicates each type of lepton (e , μ , and τ), not sum over them.
- [c] The Z -boson mass listed here corresponds to a Breit-Wigner resonance parameter. It lies approximately 34 MeV above the real part of the position of the pole (in the energy-squared plane) in the Z -boson propagator.
- [d] This partial width takes into account Z decays into $\nu\bar{\nu}$ and any other possible undetected modes.
- [e] This ratio has not been corrected for the τ mass.
- [f] Here $A \equiv 2g_V g_A / (g_V^2 + g_A^2)$.
- [g] The value is for the sum of the charge states of particle/antiparticle states indicated.
- [h] See the Z Particle Listings for the γ energy range used in this measurement.
- [i] For $m_{\gamma\gamma} = (60 \pm 5)$ GeV.
- [j] The limits assume no invisible decays.

LEPTONS

e

$$J = \frac{1}{2}$$

$$\begin{aligned} \text{Mass } m &= 0.51099907 \pm 0.00000015 \text{ MeV [a]} \\ &= (5.485799111 \pm 0.000000012) \times 10^{-4} \text{ u} \end{aligned}$$

$$(m_{e^+} - m_{e^-})/m < 4 \times 10^{-8}, \text{ CL} = 90\%$$

$$|q_{e^+} + q_{e^-}|/e < 4 \times 10^{-8}$$

$$\text{Magnetic moment } \mu = 1.001159652193 \pm 0.000000000010 \mu_B$$

$$(g_{e^+} - g_{e^-}) / g_{\text{average}} = (-0.5 \pm 2.1) \times 10^{-12}$$

$$\text{Electric dipole moment } d = (0.18 \pm 0.16) \times 10^{-26} \text{ e cm}$$

$$\text{Mean life } \tau > 4.3 \times 10^{23} \text{ yr, CL} = 68\% [b]$$



$$J = \frac{1}{2}$$

$$\begin{aligned} \text{Mass } m &= 105.658389 \pm 0.000034 \text{ MeV [c]} \\ &= 0.113428913 \pm 0.000000017 \text{ u} \end{aligned}$$

$$\text{Mean life } \tau = (2.19703 \pm 0.00004) \times 10^{-6} \text{ s}$$

$$\begin{aligned} \tau_{\mu^+} / \tau_{\mu^-} &= 1.00002 \pm 0.00008 \\ c\tau &= 658.654 \text{ m} \end{aligned}$$

$$\text{Magnetic moment } \mu = 1.0011659230 \pm 0.0000000084 \text{ e}\hbar/2m_{\mu}$$

$$(g_{\mu^+} - g_{\mu^-}) / g_{\text{average}} = (-2.6 \pm 1.6) \times 10^{-8}$$

$$\text{Electric dipole moment } d = (3.7 \pm 3.4) \times 10^{-19} \text{ e cm}$$

Decay parameters ^[d]

$$\rho = 0.7518 \pm 0.0026$$

$$\eta = -0.007 \pm 0.013$$

$$\delta = 0.749 \pm 0.004$$

$$\xi P_{\mu} = 1.003 \pm 0.008 \text{ [e]}$$

$$\xi P_{\mu} \delta / \rho > 0.99682, \text{ CL} = 90\% \text{ [e]}$$

$$\xi' = 1.00 \pm 0.04$$

$$\xi'' = 0.7 \pm 0.4$$

$$\alpha/A = (0 \pm 4) \times 10^{-3}$$

$$\alpha'/A = (0 \pm 4) \times 10^{-3}$$

$$\beta/A = (4 \pm 6) \times 10^{-3}$$

$$\beta'/A = (2 \pm 6) \times 10^{-3}$$

$$\bar{\eta} = 0.02 \pm 0.08$$

μ^+ modes are charge conjugates of the modes below.

μ^- DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$e^- \bar{\nu}_e \nu_{\mu}$	$\approx 100\%$		53
$e^- \bar{\nu}_e \nu_{\mu} \gamma$	[f] $(1.4 \pm 0.4) \%$		53
$e^- \bar{\nu}_e \nu_{\mu} e^+ e^-$	[g] $(3.4 \pm 0.4) \times 10^{-5}$		53
Lepton Family number (LF) violating modes			
$e^- \nu_e \bar{\nu}_{\mu}$	LF [h] < 1.2	%	90% 53
$e^- \gamma$	LF < 4.9	$\times 10^{-11}$	90% 53
$e^- e^+ e^-$	LF < 1.0	$\times 10^{-12}$	90% 53
$e^- 2\gamma$	LF < 7.2	$\times 10^{-11}$	90% 53



$$J = \frac{1}{2}$$

$$\text{Mass } m = 1777.05^{+0.29}_{-0.26} \text{ MeV}$$

$$\text{Mean life } \tau = (290.0 \pm 1.2) \times 10^{-15} \text{ s}$$

$$c\tau = 86.93 \mu\text{m}$$

$$\text{Magnetic moment anomaly } > -0.052 \text{ and } < 0.058, \text{ CL} = 95\%$$

$$\text{Electric dipole moment } d > -3.1 \text{ and } < 3.1 \times 10^{-16} \text{ ecm, CL} = 95\%$$

Weak dipole moment

$$\text{Re}(d_{\tau}^W) < 0.56 \times 10^{-17} \text{ ecm, CL} = 95\%$$

$$\text{Im}(d_{\tau}^W) < 1.5 \times 10^{-17} \text{ ecm, CL} = 95\%$$

Weak anomalous magnetic dipole moment

$$\text{Re}(\alpha_{\tau}^W) < 4.5 \times 10^{-3}, \text{ CL} = 90\%$$

$$\text{Im}(\alpha_{\tau}^W) < 9.9 \times 10^{-3}, \text{ CL} = 90\%$$

Decay parameters

See the τ Particle Listings for a note concerning τ -decay parameters.

$$\rho^{\tau}(e \text{ or } \mu) = 0.748 \pm 0.010$$

$$\rho^{\tau}(e) = 0.745 \pm 0.012$$

$$\rho^{\tau}(\mu) = 0.741 \pm 0.030$$

$$\xi^{\tau}(e \text{ or } \mu) = 1.01 \pm 0.04$$

$$\xi^{\tau}(e) = 0.98 \pm 0.05$$

$$\xi^{\tau}(\mu) = 1.07 \pm 0.08$$

$$\eta^{\tau}(e \text{ or } \mu) = 0.01 \pm 0.07$$

$$\eta^{\tau}(\mu) = -0.10 \pm 0.18$$

$$(\delta\xi)^{\tau}(e \text{ or } \mu) = 0.749 \pm 0.026$$

$$(\delta\xi)^{\tau}(e) = 0.733 \pm 0.033$$

$$(\delta\xi)^{\tau}(\mu) = 0.78 \pm 0.05$$

$$\xi^{\tau}(\pi) = 0.99 \pm 0.05$$

$$\xi^{\tau}(\rho) = 0.996 \pm 0.010$$

$$\xi^{\tau}(a_1) = 1.02 \pm 0.04$$

$$\xi^{\tau}(\text{all hadronic modes}) = 0.997 \pm 0.009$$

τ^+ modes are charge conjugates of the modes below. " h^{\pm} " stands for π^{\pm} or K^{\pm} . " ℓ " stands for e or μ . "Neutral" means neutral hadron whose decay products include γ 's and/or π^0 's.

τ^- DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
Modes with one charged particle			
particle $^- \geq 0$ neutrals $\geq 0K_L^0 \nu_\tau$ ("1-prong")	(84.71 \pm 0.13) %	S=1.2	–
particle $^- \geq 0$ neutrals $\geq 0K^0 \nu_\tau$	(85.30 \pm 0.13) %	S=1.2	–
$\mu^- \bar{\nu}_\mu \nu_\tau$	[i] (17.37 \pm 0.09) %		885
$\mu^- \bar{\nu}_\mu \nu_\tau \gamma$	[g] (3.0 \pm 0.6) $\times 10^{-3}$		–
$e^- \bar{\nu}_e \nu_\tau$	[i] (17.81 \pm 0.07) %		889
$h^- \geq 0$ neutrals $\geq 0K_L^0 \nu_\tau$	(49.52 \pm 0.16) %	S=1.2	–
$h^- \geq 0K_L^0 \nu_\tau$	(12.32 \pm 0.12) %	S=1.5	–
$h^- \nu_\tau$	(11.79 \pm 0.12) %	S=1.5	–
$\pi^- \nu_\tau$	[i] (11.08 \pm 0.13) %	S=1.4	883
$K^- \nu_\tau$	[i] (7.1 \pm 0.5) $\times 10^{-3}$		820
$h^- \geq 1$ neutrals ν_τ	(36.91 \pm 0.17) %	S=1.2	–
$h^- \pi^0 \nu_\tau$	(25.84 \pm 0.14) %	S=1.1	–
$\pi^- \pi^0 \nu_\tau$	[i] (25.32 \pm 0.15) %	S=1.1	878
$\pi^- \pi^0 \text{non-}\rho(770) \nu_\tau$	(3.0 \pm 3.2) $\times 10^{-3}$		878
$K^- \pi^0 \nu_\tau$	[i] (5.2 \pm 0.5) $\times 10^{-3}$		814
$h^- \geq 2\pi^0 \nu_\tau$	(10.79 \pm 0.16) %	S=1.2	–
$h^- 2\pi^0 \nu_\tau$	(9.39 \pm 0.14) %	S=1.2	–
$h^- 2\pi^0 \nu_\tau$ (ex. K^0)	(9.23 \pm 0.14) %	S=1.2	–
$\pi^- 2\pi^0 \nu_\tau$ (ex. K^0)	[i] (9.15 \pm 0.15) %	S=1.2	862
$K^- 2\pi^0 \nu_\tau$ (ex. K^0)	[i] (8.0 \pm 2.7) $\times 10^{-4}$		796
$h^- \geq 3\pi^0 \nu_\tau$	(1.40 \pm 0.11) %	S=1.1	–
$h^- 3\pi^0 \nu_\tau$	(1.23 \pm 0.10) %	S=1.1	–
$\pi^- 3\pi^0 \nu_\tau$ (ex. K^0)	[i] (1.11 \pm 0.14) %		836
$K^- 3\pi^0 \nu_\tau$ (ex. K^0)	[i] (4.3 $^{+10.0}_{-2.9}$) $\times 10^{-4}$		766
$h^- 4\pi^0 \nu_\tau$ (ex. K^0)	(1.7 \pm 0.6) $\times 10^{-3}$		–
$h^- 4\pi^0 \nu_\tau$ (ex. K^0, η)	[i] (1.1 \pm 0.6) $\times 10^{-3}$		–
$K^- \geq 0\pi^0 \geq 0K^0 \nu_\tau$	(1.66 \pm 0.10) %		–
$K^- \geq 1$ (π^0 or K^0) ν_τ	(9.5 \pm 1.0) $\times 10^{-3}$		–

Modes with K^0's			
K^0 (particles) $^- \nu_\tau$	(1.66 ± 0.09) %	S=1.4	—
$h^- \bar{K}^0 \geq 0$ neutrals $\geq 0 K_L^0 \nu_\tau$	(1.62 ± 0.09) %	S=1.4	—
$h^- \bar{K}^0 \nu_\tau$	(9.9 ± 0.8) × 10 ⁻³	S=1.5	—
$\pi^- \bar{K}^0 \nu_\tau$	[i] (8.3 ± 0.8) × 10 ⁻³	S=1.4	812
$\pi^- \bar{K}^0$	< 1.7 × 10 ⁻³	CL=95%	812
(non- $K^*(892)^-$) ν_τ			
$K^- K^0 \nu_\tau$	[i] (1.59 ± 0.24) × 10 ⁻³		737
$h^- \bar{K}^0 \pi^0 \nu_\tau$	(5.5 ± 0.5) × 10 ⁻³		—
$\pi^- \bar{K}^0 \pi^0 \nu_\tau$	[i] (3.9 ± 0.5) × 10 ⁻³		794
$\bar{K}^0 \rho^- \nu_\tau$	(1.9 ± 0.7) × 10 ⁻³		—
$K^- K^0 \pi^0 \nu_\tau$	[i] (1.51 ± 0.29) × 10 ⁻³		685
$\pi^- \bar{K}^0 \pi^0 \pi^0 \nu_\tau$	(6 ± 4) × 10 ⁻⁴		—
$K^- K^0 \pi^0 \pi^0 \nu_\tau$	< 3.9 × 10 ⁻⁴	CL=95%	—
$\pi^- K^0 \bar{K}^0 \nu_\tau$	[i] (1.21 ± 0.21) × 10 ⁻³	S=1.2	682
$\pi^- K_S^0 K_S^0 \nu_\tau$	(3.0 ± 0.5) × 10 ⁻⁴	S=1.2	—
$\pi^- K_S^0 K_L^0 \nu_\tau$	(6.0 ± 1.0) × 10 ⁻⁴	S=1.2	—
$\pi^- K_S^0 K_S^0 \pi^0 \nu_\tau$	< 2.0 × 10 ⁻⁴	CL=95%	—
$\pi^- K_S^0 K_L^0 \pi^0 \nu_\tau$	(3.1 ± 1.2) × 10 ⁻⁴		—
$K^- K^0 \geq 0$ neutrals ν_τ	(3.1 ± 0.4) × 10 ⁻³		—
$K^0 h^+ h^- h^- \geq 0$ neutrals ν_τ	< 1.7 × 10 ⁻³	CL=95%	—
$K^0 h^+ h^- h^- \nu_\tau$	(2.3 ± 2.0) × 10 ⁻⁴		—

Modes with three charged particles			
$h^- h^- h^+ \geq 0$ neut. ν_τ (“3-prong”)	(15.18 ± 0.13) %	S=1.2	—
$h^- h^- h^+ \geq 0$ neutrals ν_τ	(14.60 ± 0.13) %	S=1.2	—
(ex. $K_S^0 \rightarrow \pi^+ \pi^-$)			
$\pi^- \pi^+ \pi^- \geq 0$ neutrals ν_τ	(14.60 ± 0.14) %		—
$h^- h^- h^+ \nu_\tau$	(9.96 ± 0.10) %	S=1.1	—
$h^- h^- h^+ \nu_\tau$ (ex. K^0)	(9.62 ± 0.10) %	S=1.1	—
$h^- h^- h^+ \nu_\tau$ (ex. K^0, ω)	(9.57 ± 0.10) %	S=1.1	—
$\pi^- \pi^+ \pi^- \nu_\tau$	(9.56 ± 0.11) %	S=1.1	—
$\pi^- \pi^+ \pi^- \nu_\tau$ (ex. K^0)	(9.52 ± 0.11) %	S=1.1	—
$\pi^- \pi^+ \pi^- \nu_\tau$ (ex. K^0, ω)	[i] (9.23 ± 0.11) %	S=1.1	—
$h^- h^- h^+ \geq 1$ neutrals ν_τ	(5.18 ± 0.11) %	S=1.2	—

$h^- h^- h^+ \geq 1$ neutrals ν_τ (ex. $K_S^0 \rightarrow \pi^+ \pi^-$)	(4.98 ± 0.11) %	S=1.2	—
$h^- h^- h^+ \pi^0 \nu_\tau$	(4.50 ± 0.09) %	S=1.1	—
$h^- h^- h^+ \pi^0 \nu_\tau$ (ex. K^0)	(4.31 ± 0.09) %	S=1.1	—
$h^- h^- h^+ \pi^0 \nu_\tau$ (ex. K^0, ω)	(2.59 ± 0.09) %		—
$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$	(4.35 ± 0.10) %		—
$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0)	(4.22 ± 0.10) %		—
$\pi^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0, ω) [i]	(2.49 ± 0.10) %		—
$h^- (\rho\pi)^0 \nu_\tau$	(2.88 ± 0.35) %		—
$(a_1(1260) h)^- \nu_\tau$	< 2.0 %	CL=95%	—
$h^- \rho\pi^0 \nu_\tau$	(1.35 ± 0.20) %		—
$h^- \rho^+ h^- \nu_\tau$	(4.5 ± 2.2) × 10 ⁻³		—
$h^- \rho^- h^+ \nu_\tau$	(1.17 ± 0.23) %		—
$h^- h^- h^+ 2\pi^0 \nu_\tau$	(5.4 ± 0.4) × 10 ⁻³		—
$h^- h^- h^+ 2\pi^0 \nu_\tau$ (ex. K^0)	(5.3 ± 0.4) × 10 ⁻³		—
$h^- h^- h^+ 2\pi^0 \nu_\tau$ (ex. K^0, ω, η) [i]	(1.1 ± 0.4) × 10 ⁻³		—
$h^- h^- h^+ \geq 3\pi^0 \nu_\tau$ [i]	(1.4 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 0.9 \\ 0.7 \end{smallmatrix}$) × 10 ⁻³	S=1.5	—
$h^- h^- h^+ 3\pi^0 \nu_\tau$	(2.9 ± 0.8) × 10 ⁻⁴		—
$K^- h^+ h^- \geq 0$ neutrals ν_τ	(5.4 ± 0.7) × 10 ⁻³	S=1.1	—
$K^- \pi^+ \pi^- \geq 0$ neutrals ν_τ	(3.1 ± 0.6) × 10 ⁻³	S=1.1	—
$K^- \pi^+ \pi^- \nu_\tau$	(2.3 ± 0.4) × 10 ⁻³		—
$K^- \pi^+ \pi^- \nu_\tau$ (ex. K^0) [i]	(1.8 ± 0.5) × 10 ⁻³		—
$K^- \pi^+ \pi^- \pi^0 \nu_\tau$	(8 ± 4) × 10 ⁻⁴		—
$K^- \pi^+ \pi^- \pi^0 \nu_\tau$ (ex. K^0) [i]	(2.4 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 4.3 \\ 1.6 \end{smallmatrix}$) × 10 ⁻⁴		—
$K^- \pi^+ K^- \geq 0$ neut. ν_τ	< 9 × 10 ⁻⁴	CL=95%	—
$K^- K^+ \pi^- \geq 0$ neut. ν_τ	(2.3 ± 0.4) × 10 ⁻³		—
$K^- K^+ \pi^- \nu_\tau$ [i]	(1.61 ± 0.26) × 10 ⁻³		685
$K^- K^+ \pi^- \pi^0 \nu_\tau$ [i]	(6.9 ± 3.0) × 10 ⁻⁴		—
$K^- K^+ K^- \geq 0$ neut. ν_τ	< 2.1 × 10 ⁻³	CL=95%	—
$K^- K^+ K^- \nu_\tau$	< 1.9 × 10 ⁻⁴	CL=90%	—
$\pi^- K^+ \pi^- \geq 0$ neut. ν_τ	< 2.5 × 10 ⁻³	CL=95%	—
$e^- e^- e^+ \bar{\nu}_e \nu_\tau$	(2.8 ± 1.5) × 10 ⁻⁵		889
$\mu^- e^- e^+ \bar{\nu}_\mu \nu_\tau$	< 3.6 × 10 ⁻⁵	CL=90%	885

Modes with five charged particles

$3h^- 2h^+ \geq 0$ neutrals ν_τ	(9.7 ± 0.7) × 10 ⁻⁴		—
(ex. $K_S^0 \rightarrow \pi^- \pi^+$)			
("5-prong")			
$3h^- 2h^+ \nu_\tau$ (ex. K^0) [i]	(7.5 ± 0.7) × 10 ⁻⁴		—
$3h^- 2h^+ \pi^0 \nu_\tau$ (ex. K^0) [i]	(2.2 ± 0.5) × 10 ⁻⁴		—
$3h^- 2h^+ 2\pi^0 \nu_\tau$	< 1.1 × 10 ⁻⁴	CL=90%	—

Miscellaneous other allowed modes

$(5\pi)^- \nu_\tau$	$(7.4 \pm 0.7) \times 10^{-3}$		—
$4h^- 3h^+ \geq 0$ neutrals ν_τ	< 2.4	$\times 10^{-6}$	CL=90% —
("7-prong")			
$K^*(892)^- \geq 0(h^0 \neq K_S^0) \nu_\tau$	$(1.94 \pm 0.31) \%$		—
$K^*(892)^- \geq 0$ neutrals ν_τ	$(1.33 \pm 0.13) \%$		—
$K^*(892)^- \nu_\tau$	$(1.28 \pm 0.08) \%$		665
$K^*(892)^0 K^- \geq 0$ neutrals ν_τ	$(3.2 \pm 1.4) \times 10^{-3}$		—
$K^*(892)^0 K^- \nu_\tau$	$(2.1 \pm 0.4) \times 10^{-3}$		539
$\bar{K}^*(892)^0 \pi^- \geq 0$ neutrals ν_τ	$(3.8 \pm 1.7) \times 10^{-3}$		—
$\bar{K}^*(892)^0 \pi^- \nu_\tau$	$(2.2 \pm 0.5) \times 10^{-3}$		653
$(\bar{K}^*(892)\pi)^- \nu_\tau \rightarrow$ $\pi^- \bar{K}^0 \pi^0 \nu_\tau$	$(1.1 \pm 0.5) \times 10^{-3}$		—
$K_1(1270)^- \nu_\tau$	$(4 \pm 4) \times 10^{-3}$		433
$K_1(1400)^- \nu_\tau$	$(8 \pm 4) \times 10^{-3}$		335
$K_2^*(1430)^- \nu_\tau$	< 3	$\times 10^{-3}$	CL=95% 317
$\eta \pi^- \nu_\tau$	< 1.4	$\times 10^{-4}$	CL=95% 798
$\eta \pi^- \pi^0 \nu_\tau$	[i] $(1.74 \pm 0.24) \times 10^{-3}$		778
$\eta \pi^- \pi^0 \pi^0 \nu_\tau$	$(1.4 \pm 0.7) \times 10^{-4}$		746
$\eta K^- \nu_\tau$	$(2.7 \pm 0.6) \times 10^{-4}$		720
$\eta \pi^+ \pi^- \pi^- \geq 0$ neutrals ν_τ	< 3	$\times 10^{-3}$	CL=90% —
$\eta \pi^- \pi^+ \pi^- \nu_\tau$	$(3.4 \pm 0.8) \times 10^{-4}$		—
$\eta a_1(1260)^- \nu_\tau \rightarrow \eta \pi^- \rho^0 \nu_\tau$	< 3.9	$\times 10^{-4}$	CL=90% —
$\eta \eta \pi^- \nu_\tau$	< 1.1	$\times 10^{-4}$	CL=95% 637
$\eta \eta \pi^- \pi^0 \nu_\tau$	< 2.0	$\times 10^{-4}$	CL=95% 559
$\eta'(958) \pi^- \nu_\tau$	< 7.4	$\times 10^{-5}$	CL=90% —
$\eta'(958) \pi^- \pi^0 \nu_\tau$	< 8.0	$\times 10^{-5}$	CL=90% —
$\phi \pi^- \nu_\tau$	< 2.0	$\times 10^{-4}$	CL=90% 585
$\phi K^- \nu_\tau$	< 6.7	$\times 10^{-5}$	CL=90% —
$f_1(1285) \pi^- \nu_\tau$	$(5.8 \pm 2.3) \times 10^{-4}$		—
$f_1(1285) \pi^- \nu_\tau \rightarrow$ $\eta \pi^- \pi^+ \pi^- \nu_\tau$	$(1.9 \pm 0.7) \times 10^{-4}$		—
$h^- \omega \geq 0$ neutrals ν_τ	$(2.36 \pm 0.08) \%$		—
$h^- \omega \nu_\tau$	[i] $(1.93 \pm 0.06) \%$		—
$h^- \omega \pi^0 \nu_\tau$	[i] $(4.3 \pm 0.5) \times 10^{-3}$		—
$h^- \omega 2\pi^0 \nu_\tau$	$(1.9 \pm 0.8) \times 10^{-4}$		—

**Lepton Family number (*LF*), Lepton number (*L*),
or Baryon number (*B*) violating modes**
(In the modes below, ℓ means a sum over e and μ modes)

L means lepton number violation (e.g. $\tau^- \rightarrow e^+ \pi^- \pi^-$). Following common usage, *LF* means lepton family violation *and not* lepton number violation (e.g. $\tau^- \rightarrow e^- \pi^+ \pi^-$). *B* means baryon number violation.

$e^- \gamma$	<i>LF</i>	< 2.7	$\times 10^{-6}$	CL=90%	888
$\mu^- \gamma$	<i>LF</i>	< 3.0	$\times 10^{-6}$	CL=90%	885
$e^- \pi^0$	<i>LF</i>	< 3.7	$\times 10^{-6}$	CL=90%	883
$\mu^- \pi^0$	<i>LF</i>	< 4.0	$\times 10^{-6}$	CL=90%	880
$e^- K^0$	<i>LF</i>	< 1.3	$\times 10^{-3}$	CL=90%	819
$\mu^- K^0$	<i>LF</i>	< 1.0	$\times 10^{-3}$	CL=90%	815
$e^- \eta$	<i>LF</i>	< 8.2	$\times 10^{-6}$	CL=90%	804
$\mu^- \eta$	<i>LF</i>	< 9.6	$\times 10^{-6}$	CL=90%	800
$e^- \rho^0$	<i>LF</i>	< 2.0	$\times 10^{-6}$	CL=90%	722
$\mu^- \rho^0$	<i>LF</i>	< 6.3	$\times 10^{-6}$	CL=90%	718
$e^- K^*(892)^0$	<i>LF</i>	< 5.1	$\times 10^{-6}$	CL=90%	663
$\mu^- K^*(892)^0$	<i>LF</i>	< 7.5	$\times 10^{-6}$	CL=90%	657
$e^- \bar{K}^*(892)^0$	<i>LF</i>	< 7.4	$\times 10^{-6}$	CL=90%	663
$\mu^- \bar{K}^*(892)^0$	<i>LF</i>	< 7.5	$\times 10^{-6}$	CL=90%	657
$e^- \phi$	<i>LF</i>	< 6.9	$\times 10^{-6}$	CL=90%	596
$\mu^- \phi$	<i>LF</i>	< 7.0	$\times 10^{-6}$	CL=90%	590
$\pi^- \gamma$	<i>L</i>	< 2.8	$\times 10^{-4}$	CL=90%	883
$\pi^- \pi^0$	<i>L</i>	< 3.7	$\times 10^{-4}$	CL=90%	878
$e^- e^+ e^-$	<i>LF</i>	< 2.9	$\times 10^{-6}$	CL=90%	888
$e^- \mu^+ \mu^-$	<i>LF</i>	< 1.8	$\times 10^{-6}$	CL=90%	882
$e^+ \mu^- \mu^-$	<i>LF</i>	< 1.5	$\times 10^{-6}$	CL=90%	882
$\mu^- e^+ e^-$	<i>LF</i>	< 1.7	$\times 10^{-6}$	CL=90%	885
$\mu^+ e^- e^-$	<i>LF</i>	< 1.5	$\times 10^{-6}$	CL=90%	885
$\mu^- \mu^+ \mu^-$	<i>LF</i>	< 1.9	$\times 10^{-6}$	CL=90%	873
$e^- \pi^+ \pi^-$	<i>LF</i>	< 2.2	$\times 10^{-6}$	CL=90%	877
$e^+ \pi^- \pi^-$	<i>L</i>	< 1.9	$\times 10^{-6}$	CL=90%	877
$\mu^- \pi^+ \pi^-$	<i>LF</i>	< 8.2	$\times 10^{-6}$	CL=90%	866
$\mu^+ \pi^- \pi^-$	<i>L</i>	< 3.4	$\times 10^{-6}$	CL=90%	866
$e^- \pi^+ K^-$	<i>LF</i>	< 6.4	$\times 10^{-6}$	CL=90%	814
$e^- \pi^- K^+$	<i>LF</i>	< 3.8	$\times 10^{-6}$	CL=90%	814
$e^+ \pi^- K^-$	<i>L</i>	< 2.1	$\times 10^{-6}$	CL=90%	814
$e^- K^+ K^-$	<i>LF</i>	< 6.0	$\times 10^{-6}$	CL=90%	739
$e^+ K^- K^-$	<i>L</i>	< 3.8	$\times 10^{-6}$	CL=90%	739
$\mu^- \pi^+ K^-$	<i>LF</i>	< 7.5	$\times 10^{-6}$	CL=90%	800
$\mu^- \pi^- K^+$	<i>LF</i>	< 7.4	$\times 10^{-6}$	CL=90%	800
$\mu^+ \pi^- K^-$	<i>L</i>	< 7.0	$\times 10^{-6}$	CL=90%	800

$\mu^- K^+ K^-$	LF	< 1.5	$\times 10^{-5}$	CL=90%	699
$\mu^+ K^- K^-$	L	< 6.0	$\times 10^{-6}$	CL=90%	699
$e^- \pi^0 \pi^0$	LF	< 6.5	$\times 10^{-6}$	CL=90%	878
$\mu^- \pi^0 \pi^0$	LF	< 1.4	$\times 10^{-5}$	CL=90%	867
$e^- \eta \eta$	LF	< 3.5	$\times 10^{-5}$	CL=90%	700
$\mu^- \eta \eta$	LF	< 6.0	$\times 10^{-5}$	CL=90%	654
$e^- \pi^0 \eta$	LF	< 2.4	$\times 10^{-5}$	CL=90%	798
$\mu^- \pi^0 \eta$	LF	< 2.2	$\times 10^{-5}$	CL=90%	784
$\bar{p} \gamma$	L,B	< 2.9	$\times 10^{-4}$	CL=90%	641
$\bar{p} \pi^0$	L,B	< 6.6	$\times 10^{-4}$	CL=90%	632
$\bar{p} \eta$	L,B	< 1.30	$\times 10^{-3}$	CL=90%	476
e^- light boson	LF	< 2.7	$\times 10^{-3}$	CL=95%	—
μ^- light boson	LF	< 5	$\times 10^{-3}$	CL=95%	—

Heavy Charged Lepton Searches

L^\pm – charged lepton

Mass $m > 80.2$ GeV, CL = 95% $m_\nu \approx 0$

L^\pm – stable charged heavy lepton

Mass $m > 84.2$ GeV, CL = 95%

Neutrinos

See the Particle Listings for a Note “Neutrino Mass” giving details of neutrinos, masses, mixing, and the status of experimental searches.

ν_e

$$J = \frac{1}{2}$$

Mass m : Unexplained effects have resulted in significantly negative m^2 in the new, precise tritium beta decay experiments.

It is felt that a real neutrino mass as large as 10–15 eV would cause observable spectral distortions even in the presence of the end-point count excesses.

Mean life/mass, $\tau/m_{\nu_e} > 7 \times 10^9$ s/eV (solar)

Mean life/mass, $\tau/m_{\nu_e} > 300$ s/eV, CL = 90% (reactor)

Magnetic moment $\mu < 1.8 \times 10^{-10} \mu_B$, CL = 90%

ν_μ

$$J = \frac{1}{2}$$

Mass $m < 0.17$ MeV, CL = 90%

Mean life/mass, $\tau/m_{\nu_\mu} > 15.4$ s/eV, CL = 90%

Magnetic moment $\mu < 7.4 \times 10^{-10} \mu_B$, CL = 90%

ν_τ

$$J = \frac{1}{2}$$

Mass $m < 18.2$ MeV, CL = 95%

Magnetic moment $\mu < 5.4 \times 10^{-7} \mu_B$, CL = 90%

Electric dipole moment $d < 5.2 \times 10^{-17}$ ecm, CL = 95%

Number of Light Neutrino Types

(including ν_e , ν_μ , and ν_τ)

Number $N = 2.994 \pm 0.012$ (Standard Model fits to LEP data)

Number $N = 3.07 \pm 0.12$ (Direct measurement of invisible Z width)

Massive Neutrinos and Lepton Mixing, Searches for

For excited leptons, see Compositeness Limits below.

See the Particle Listings for a Note "Neutrino Mass" giving details of neutrinos, masses, mixing, and the status of experimental searches.

While no direct, uncontested evidence for massive neutrinos or lepton mixing has been obtained, suggestive evidence has come from solar neutrino observations, from anomalies in the relative fractions of ν_e and ν_μ observed in energetic cosmic-ray air showers, and possibly from a $\bar{\nu}_e$ appearance experiment at Los Alamos. Sample limits are:

Stable Neutral Heavy Lepton Mass Limits

Mass $m > 45.0$ GeV, CL = 95% (Dirac)

Mass $m > 39.5$ GeV, CL = 95% (Majorana)

Neutral Heavy Lepton Mass Limits

Mass $m > 69.0$ GeV, CL = 95% (Dirac ν_L coupling to e, μ, τ with $|U_{\ell j}|^2 > 10^{-12}$)

Mass $m > 58.2$ GeV, CL = 95% (Majorana ν_L coupling to e, μ, τ with $|U_{\ell j}|^2 > 10^{-12}$)

Solar Neutrinos

Detectors using gallium ($E_\nu \gtrsim 0.2$ MeV), chlorine ($E_\nu \gtrsim 0.8$ MeV), and Čerenkov effect in water ($E_\nu \gtrsim 7$ MeV) measure significantly lower neutrino rates than are predicted from solar models. The deficit in the solar neutrino flux compared with solar model calculations could be explained by oscillations with $\Delta m^2 \leq 10^{-5}$ eV² causing the disappearance of ν_e .

Atmospheric Neutrinos

Underground detectors observing neutrinos produced by cosmic rays in the atmosphere have measured a ν_μ/ν_e ratio much less than expected and also a deficiency of upward going ν_μ compared to downward. This could be explained by oscillations leading to the disappearance of ν_μ with $\Delta m^2 \approx 10^{-3}$ to 10^{-2} eV².

ν oscillation: $\bar{\nu}_e \nrightarrow \bar{\nu}_e$ ($\theta =$ mixing angle)

$$\Delta m^2 < 9 \times 10^{-4} \text{ eV}^2, \text{ CL} = 90\% \quad (\text{if } \sin^2 2\theta = 1)$$

$$\sin^2 2\theta < 0.02, \text{ CL} = 90\% \quad (\text{if } \Delta(m^2) \text{ is large})$$

ν oscillation: $\nu_\mu (\bar{\nu}_\mu) \rightarrow \nu_e (\bar{\nu}_e)$ (any combination)

$$\Delta m^2 < 0.075 \text{ eV}^2, \text{ CL} = 90\% \quad (\text{if } \sin^2 2\theta = 1)$$

$$\sin^2 2\theta < 1.8 \times 10^{-3}, \text{ CL} = 90\% \quad (\text{if } \Delta(m^2) \text{ is large})$$

NOTES

- [a] The uncertainty in the electron mass in unified atomic mass units (u) is ten times smaller than that given by the 1986 CODATA adjustment, quoted in the Table of Physical Constants (Section 1). The conversion to MeV via the factor 931.49432(28) MeV/u is more uncertain because of the electron charge uncertainty. Our value in MeV differs slightly from the 1986 CODATA result.
- [b] This is the best “electron disappearance” limit. The best limit for the mode $e^- \rightarrow \nu\gamma$ is $> 2.35 \times 10^{25}$ yr (CL=68%).
- [c] The muon mass is most precisely known in u (unified atomic mass units). The conversion factor to MeV via the factor 931.49432(28) MeV/u is more uncertain because of the electron charge uncertainty.
- [d] See the “Note on Muon Decay Parameters” in the μ Particle Listings for definitions and details.
- [e] P_μ is the longitudinal polarization of the muon from pion decay. In standard $V-A$ theory, $P_\mu = 1$ and $\rho = \delta = 3/4$.
- [f] This only includes events with the γ energy > 10 MeV. Since the $e^- \bar{\nu}_e \nu_\mu$ and $e^- \bar{\nu}_e \nu_\mu \gamma$ modes cannot be clearly separated, we regard the latter mode as a subset of the former.
- [g] See the μ Particle Listings for the energy limits used in this measurement.
- [h] A test of additive vs. multiplicative lepton family number conservation.
- [i] Basis mode for the τ .

QUARKS

The u -, d -, and s -quark masses are estimates of so-called “current-quark masses,” in a mass-independent subtraction scheme such as $\overline{\text{MS}}$ at a scale $\mu \approx 2$ GeV. The c - and b -quark masses are estimated from charmonium, bottomonium, D , and B masses. They are the “running” masses in the $\overline{\text{MS}}$ scheme. These can be different from the heavy quark masses obtained in potential models.

u

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

Mass $m = 1.5$ to 5 MeV ^[a] Charge = $\frac{2}{3} e$ $I_z = +\frac{1}{2}$
 $m_u/m_d = 0.20$ to 0.70

d

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

Mass $m = 3$ to 9 MeV ^[a] Charge = $-\frac{1}{3} e$ $I_z = -\frac{1}{2}$
 $m_s/m_d = 17$ to 25
 $\bar{m} = (m_u + m_d)/2 = 2$ to 6 MeV

s

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass $m = 60$ to 170 MeV ^[a] Charge = $-\frac{1}{3} e$ Strangeness = -1
 $(m_s - (m_u + m_d)/2)/(m_d - m_u) = 34$ to 51

c

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass $m = 1.1$ to 1.4 GeV Charge = $\frac{2}{3} e$ Charm = $+1$

b

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass $m = 4.1$ to 4.4 GeV Charge = $-\frac{1}{3} e$ Bottom = -1

t

$$I(J^P) = 0(\frac{1}{2}^+)$$

$$\text{Charge} = \frac{2}{3} e \quad \text{Top} = +1$$

Mass $m = 173.8 \pm 5.2$ GeV (direct observation of top events)

Mass $m = 170 \pm 7 (+14)$ GeV (Standard Model electroweak fit, assuming $M_H = M_Z$. Number in parentheses is shift from changing M_H to 300 GeV.)

b' (4th Generation) Quark, Searches for

Mass $m > 128$ GeV, CL = 95% ($p\bar{p}$, charged current decays)

Mass $m > 46.0$ GeV, CL = 95% (e^+e^- , all decays)

Free Quark Searches

All searches since 1977 have had negative results.

NOTES

[a] The ratios m_u/m_d and m_s/m_d are extracted from pion and kaon masses using chiral symmetry. The estimates of u and d masses are not without controversy and remain under active investigation. Within the literature there are even suggestions that the u quark could be essentially massless. The s -quark mass is estimated from SU(3) splittings in hadron masses.

LIGHT UNFLAVORED MESONS

($S = C = B = 0$)

For $I = 1$ (π , b , ρ , a): $u\bar{d}$, $(u\bar{u}-d\bar{d})/\sqrt{2}$, $d\bar{u}$;
 for $I = 0$ (η , η' , h , h' , ω , ϕ , f , f'): $c_1(u\bar{u} + d\bar{d}) + c_2(s\bar{s})$

π^\pm

$$I^G(J^P) = 1^-(0^-)$$

Mass $m = 139.56995 \pm 0.00035$ MeV

Mean life $\tau = (2.6033 \pm 0.0005) \times 10^{-8}$ s ($S = 1.2$)

$c\tau = 7.8045$ m

$\pi^\pm \rightarrow \ell^\pm \nu \gamma$ form factors [a]

$$F_V = 0.017 \pm 0.008$$

$$F_A = 0.0116 \pm 0.0016 \quad (S = 1.3)$$

$$R = 0.059^{+0.009}_{-0.008}$$

π^- modes are charge conjugates of the modes below.

π^+ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	ρ (MeV/c)
$\mu^+ \nu_\mu$	[b] (99.98770 \pm 0.00004) %		30
$\mu^+ \nu_\mu \gamma$	[c] (1.24 \pm 0.25) $\times 10^{-4}$		30
$e^+ \nu_e$	[b] (1.230 \pm 0.004) $\times 10^{-4}$		70
$e^+ \nu_e \gamma$	[c] (1.61 \pm 0.23) $\times 10^{-7}$		70
$e^+ \nu_e \pi^0$	(1.025 \pm 0.034) $\times 10^{-8}$		4
$e^+ \nu_e e^+ e^-$	(3.2 \pm 0.5) $\times 10^{-9}$		70
$e^+ \nu_e \nu \bar{\nu}$	< 5 $\times 10^{-6}$	90%	70

Lepton Family number (LF) or Lepton number (L) violating modes

$\mu^+ \bar{\nu}_e$	L	[d] < 1.5	$\times 10^{-3}$ 90%	30
$\mu^+ \nu_e$	LF	[d] < 8.0	$\times 10^{-3}$ 90%	30
$\mu^- e^+ e^+ \nu$	LF	< 1.6	$\times 10^{-6}$ 90%	30



$$I^G(J^{PC}) = 1^-(0^{-+})$$

Mass $m = 134.9764 \pm 0.0006$ MeV

$m_{\pi^\pm} - m_{\pi^0} = 4.5936 \pm 0.0005$ MeV

Mean life $\tau = (8.4 \pm 0.6) \times 10^{-17}$ s (S = 3.0)

$c\tau = 25.1$ nm

π^0 DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
2γ	(98.798 ± 0.032) %	S=1.1	67
$e^+ e^- \gamma$	(1.198 ± 0.032) %	S=1.1	67
γ positronium	$(1.82 \pm 0.29) \times 10^{-9}$		67
$e^+ e^+ e^- e^-$	$(3.14 \pm 0.30) \times 10^{-5}$		67
$e^+ e^-$	$(7.5 \pm 2.0) \times 10^{-8}$		67
4γ	< 2	$\times 10^{-8}$ CL=90%	67
$\nu \bar{\nu}$	[e] < 8.3	$\times 10^{-7}$ CL=90%	67
$\nu_e \bar{\nu}_e$	< 1.7	$\times 10^{-6}$ CL=90%	67
$\nu_\mu \bar{\nu}_\mu$	< 3.1	$\times 10^{-6}$ CL=90%	67
$\nu_\tau \bar{\nu}_\tau$	< 2.1	$\times 10^{-6}$ CL=90%	67
Charge conjugation (C) or Lepton Family number (LF) violating modes			
3γ	C < 3.1	$\times 10^{-8}$ CL=90%	67
$\mu^+ e^- + e^- \mu^+$	LF < 1.72	$\times 10^{-8}$ CL=90%	26

η

$$I^G(J^{PC}) = 0^+(0^{-+})$$

 Mass $m = 547.30 \pm 0.12$ MeV

 Full width $\Gamma = 1.18 \pm 0.11$ keV [*f*] ($S = 1.8$)

C-nonconserving decay parameters

$\pi^+ \pi^- \pi^0$	Left-right asymmetry = $(0.09 \pm 0.17) \times 10^{-2}$
$\pi^+ \pi^- \pi^0$	Sextant asymmetry = $(0.18 \pm 0.16) \times 10^{-2}$
$\pi^+ \pi^- \pi^0$	Quadrant asymmetry = $(-0.17 \pm 0.17) \times 10^{-2}$
$\pi^+ \pi^- \gamma$	Left-right asymmetry = $(0.9 \pm 0.4) \times 10^{-2}$
$\pi^+ \pi^- \gamma$	β (<i>D</i> -wave) = 0.05 ± 0.06 ($S = 1.5$)

Dalitz plot parameter

$$\pi^0 \pi^0 \pi^0 \quad \alpha = -0.039 \pm 0.015$$

η DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
Neutral modes			
neutral modes	(71.5 \pm 0.6) %	S=1.4	–
2 γ	[<i>f</i>] (39.21 \pm 0.34) %	S=1.4	274
3 π^0	(32.2 \pm 0.4) %	S=1.3	178
$\pi^0 2\gamma$	(7.1 \pm 1.4) $\times 10^{-4}$		257
other neutral modes	< 2.8 %	CL=90%	–
Charged modes			
charged modes	(28.5 \pm 0.6) %	S=1.4	–
$\pi^+ \pi^- \pi^0$	(23.1 \pm 0.5) %	S=1.4	173
$\pi^+ \pi^- \gamma$	(4.77 \pm 0.13) %	S=1.3	235
$e^+ e^- \gamma$	(4.9 \pm 1.1) $\times 10^{-3}$		274
$\mu^+ \mu^- \gamma$	(3.1 \pm 0.4) $\times 10^{-4}$		252
$e^+ e^-$	< 7.7 $\times 10^{-5}$	CL=90%	274
$\mu^+ \mu^-$	(5.8 \pm 0.8) $\times 10^{-6}$		252
$\pi^+ \pi^- e^+ e^-$	(1.3 $^{+1.2}_{-0.8}$) $\times 10^{-3}$		235
$\pi^+ \pi^- 2\gamma$	< 2.1 $\times 10^{-3}$		235
$\pi^+ \pi^- \pi^0 \gamma$	< 6 $\times 10^{-4}$	CL=90%	173
$\pi^0 \mu^+ \mu^- \gamma$	< 3 $\times 10^{-6}$	CL=90%	210
Charge conjugation (C), Parity (P), Charge conjugation \times Parity (CP), or Lepton Family number (LF) violating modes			
$\pi^+ \pi^-$	<i>P, CP</i> < 9 $\times 10^{-4}$	CL=90%	235
3 γ	<i>C</i> < 5 $\times 10^{-4}$	CL=95%	274
$\pi^0 e^+ e^-$	<i>C</i> [<i>g</i>] < 4 $\times 10^{-5}$	CL=90%	257
$\pi^0 \mu^+ \mu^-$	<i>C</i> [<i>g</i>] < 5 $\times 10^{-6}$	CL=90%	210
$\mu^+ e^- + \mu^- e^+$	<i>LF</i> < 6 $\times 10^{-6}$	CL=90%	263

$f_0(400-1200)$ ^[h]
 or σ

$$J^{PC} = 0^+(0^{++})$$

 Mass $m = (400-1200)$ MeV

 Full width $\Gamma = (600-1000)$ MeV

$f_0(400-1200)$ DECAY MODES	Fraction (Γ_i/Γ)	ρ (MeV/c)
$\pi\pi$	dominant	—
$\gamma\gamma$	seen	—

$\rho(770)$ ^[j]

$$J^{PC} = 1^+(1^{--})$$

 Mass $m = 770.0 \pm 0.8$ MeV ($S = 1.8$)

 Full width $\Gamma = 150.7 \pm 1.1$ MeV

 $\Gamma_{ee} = 6.77 \pm 0.32$ keV

$\rho(770)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
$\pi\pi$	~ 100	%	358

$\rho(770)^\pm$ decays

$\pi^\pm\gamma$	$(4.5 \pm 0.5) \times 10^{-4}$	S=2.2	372
$\pi^\pm\eta$	$< 6 \times 10^{-3}$	CL=84%	146
$\pi^\pm\pi^+\pi^-\pi^0$	$< 2.0 \times 10^{-3}$	CL=84%	249

$\rho(770)^0$ decays

$\pi^+\pi^-\gamma$	$(9.9 \pm 1.6) \times 10^{-3}$		358
$\pi^0\gamma$	$(6.8 \pm 1.7) \times 10^{-4}$		372
$\eta\gamma$	$(2.4^{+0.8}_{-0.9}) \times 10^{-4}$	S=1.6	189
$\mu^+\mu^-$	[j] $(4.60 \pm 0.28) \times 10^{-5}$		369
e^+e^-	[j] $(4.49 \pm 0.22) \times 10^{-5}$		384
$\pi^+\pi^-\pi^0$	$< 1.2 \times 10^{-4}$	CL=90%	319
$\pi^+\pi^-\pi^+\pi^-$	$< 2 \times 10^{-4}$	CL=90%	246
$\pi^+\pi^-\pi^0\pi^0$	$< 4 \times 10^{-5}$	CL=90%	252

$\omega(782)$

$$J^{PC} = 0^-(1^--)$$

 Mass $m = 781.94 \pm 0.12$ MeV ($S = 1.5$)

 Full width $\Gamma = 8.41 \pm 0.09$ MeV

 $\Gamma_{ee} = 0.60 \pm 0.02$ keV

$\omega(782)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi^+ \pi^- \pi^0$	(88.8 \pm 0.7) %		327
$\pi^0 \gamma$	(8.5 \pm 0.5) %		379
$\pi^+ \pi^-$	(2.21 \pm 0.30) %		365
neutrals (excluding $\pi^0 \gamma$)	(5.3 $^{+8.7}_{-3.5}$) $\times 10^{-3}$		—
$\eta \gamma$	(6.5 \pm 1.0) $\times 10^{-4}$		199
$\pi^0 e^+ e^-$	(5.9 \pm 1.9) $\times 10^{-4}$		379
$\pi^0 \mu^+ \mu^-$	(9.6 \pm 2.3) $\times 10^{-5}$		349
$e^+ e^-$	(7.07 \pm 0.19) $\times 10^{-5}$	S=1.1	391
$\pi^+ \pi^- \pi^0 \pi^0$	< 2 %	CL=90%	261
$\pi^+ \pi^- \gamma$	< 3.6 $\times 10^{-3}$	CL=95%	365
$\pi^+ \pi^- \pi^+ \pi^-$	< 1 $\times 10^{-3}$	CL=90%	256
$\pi^0 \pi^0 \gamma$	(7.2 \pm 2.5) $\times 10^{-5}$		367
$\mu^+ \mu^-$	< 1.8 $\times 10^{-4}$	CL=90%	376
3γ	< 1.9 $\times 10^{-4}$	CL=95%	391
Charge conjugation (C) violating modes			
$\eta \pi^0$	C < 1 $\times 10^{-3}$	CL=90%	162
$3\pi^0$	C < 3 $\times 10^{-4}$	CL=90%	329

$\eta'(958)$

$$I^G(J^{PC}) = 0^+(0^{-+})$$

 Mass $m = 957.78 \pm 0.14$ MeV

 Full width $\Gamma = 0.203 \pm 0.016$ MeV ($S = 1.3$)

$\eta'(958)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
$\pi^+\pi^-\eta$	(43.8 \pm 1.5) %	S=1.1	232
$\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$)	(30.2 \pm 1.3) %	S=1.1	169
$\pi^0\pi^0\eta$	(20.7 \pm 1.3) %	S=1.2	239
$\omega\gamma$	(3.01 \pm 0.30) %		160
$\gamma\gamma$	(2.11 \pm 0.13) %	S=1.2	479
$3\pi^0$	(1.54 \pm 0.26) $\times 10^{-3}$		430
$\mu^+\mu^-\gamma$	(1.03 \pm 0.26) $\times 10^{-4}$		467
$\pi^+\pi^-\pi^0$	< 5 %	CL=90%	427
$\pi^0\rho^0$	< 4 %	CL=90%	118
$\pi^+\pi^+\pi^-\pi^-$	< 1 %	CL=90%	372
$\pi^+\pi^+\pi^-\pi^-$ neutrals	< 1 %	CL=95%	–
$\pi^+\pi^+\pi^-\pi^-\pi^0$	< 1 %	CL=90%	298
6π	< 1 %	CL=90%	189
$\pi^+\pi^-\pi^+e^-e^-$	< 6 $\times 10^{-3}$	CL=90%	458
$\pi^0\gamma\gamma$	< 8 $\times 10^{-4}$	CL=90%	469
$4\pi^0$	< 5 $\times 10^{-4}$	CL=90%	379
e^+e^-	< 2.1 $\times 10^{-7}$	CL=90%	479

Charge conjugation (C) or Parity (P) violating modes

$\pi^+\pi^-$	P, CP	< 2 %	CL=90%	458
$\pi^0\pi^0$	P, CP	< 9 $\times 10^{-4}$	CL=90%	459
$\pi^0e^+e^-$	C [g]	< 1.3 %	CL=90%	469
ηe^+e^-	C [g]	< 1.1 %	CL=90%	322
3γ	C	< 1.0 $\times 10^{-4}$	CL=90%	479
$\mu^+\mu^-\pi^0$	C [g]	< 6.0 $\times 10^{-5}$	CL=90%	445
$\mu^+\mu^-\eta$	C [g]	< 1.5 $\times 10^{-5}$	CL=90%	274

$f_0(980)$ [k]

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass $m = 980 \pm 10$ MeV

Full width $\Gamma = 40$ to 100 MeV

$f_0(980)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\pi\pi$	dominant		470
$K\bar{K}$	seen		—
$\gamma\gamma$	$(1.19 \pm 0.33) \times 10^{-5}$		490
e^+e^-	$< 3 \times 10^{-7}$	90%	490

$a_0(980)$ [k]

$$I^G(J^{PC}) = 1^-(0^{++})$$

Mass $m = 983.4 \pm 0.9$ MeV

Full width $\Gamma = 50$ to 100 MeV

$a_0(980)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\pi$	dominant	321
$K\bar{K}$	seen	—
$\gamma\gamma$	seen	492

$\phi(1020)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

 Mass $m = 1019.413 \pm 0.008$ MeV

 Full width $\Gamma = 4.43 \pm 0.05$ MeV

$\phi(1020)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
$K^+ K^-$	(49.1 \pm 0.8) %	S=1.3	127
$K_L^0 K_S^0$	(34.1 \pm 0.6) %	S=1.2	110
$\rho\pi + \pi^+\pi^-\pi^0$	(15.5 \pm 0.7) %	S=1.5	–
$\eta\gamma$	(1.26 \pm 0.06) %	S=1.1	363
$\pi^0\gamma$	(1.31 \pm 0.13) $\times 10^{-3}$		501
$e^+ e^-$	(2.99 \pm 0.08) $\times 10^{-4}$	S=1.2	510
$\mu^+ \mu^-$	(2.5 \pm 0.4) $\times 10^{-4}$		499
$\eta e^+ e^-$	(1.3 $^{+0.8}_{-0.6}$) $\times 10^{-4}$		363
$\pi^+ \pi^-$	(8 $^{+5}_{-4}$) $\times 10^{-5}$	S=1.5	490
$\omega\gamma$	< 5 %	CL=84%	210
$\rho\gamma$	< 7 $\times 10^{-4}$	CL=90%	219
$\pi^+ \pi^- \gamma$	< 3 $\times 10^{-5}$	CL=90%	490
$f_0(980)\gamma$	< 1 $\times 10^{-4}$	CL=90%	39
$\pi^0\pi^0\gamma$	< 1 $\times 10^{-3}$	CL=90%	492
$\pi^+ \pi^- \pi^+ \pi^-$	< 8.7 $\times 10^{-4}$	CL=90%	410
$\pi^+ \pi^+ \pi^- \pi^- \pi^0$	< 1.5 $\times 10^{-4}$	CL=95%	341
$\pi^0 e^+ e^-$	< 1.2 $\times 10^{-4}$	CL=90%	501
$\pi^0 \eta\gamma$	< 2.5 $\times 10^{-3}$	CL=90%	346
$a_0(980)\gamma$	< 5 $\times 10^{-3}$	CL=90%	36
$\eta'(958)\gamma$	(1.2 $^{+0.7}_{-0.5}$) $\times 10^{-4}$		–
$\mu^+ \mu^- \gamma$	(2.3 \pm 1.0) $\times 10^{-5}$		–

 $h_1(1170)$

$$I^G(J^{PC}) = 0^-(1^{+-})$$

 Mass $m = 1170 \pm 20$ MeV

 Full width $\Gamma = 360 \pm 40$ MeV

$h_1(1170)$ DECAY MODES	Fraction (Γ_i/Γ)	ρ (MeV/c)
$\rho\pi$	seen	310

$b_1(1235)$

$$I^G(J^{PC}) = 1^+(1^{+-})$$

 Mass $m = 1229.5 \pm 3.2$ MeV (S = 1.6)

 Full width $\Gamma = 142 \pm 9$ MeV (S = 1.2)

$b_1(1235)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\omega\pi$	dominant		348
[D/S amplitude ratio = 0.29 ± 0.04]			
$\pi^\pm\gamma$	$(1.6 \pm 0.4) \times 10^{-3}$		608
$\eta\rho$	seen		—
$\pi^+\pi^+\pi^-\pi^0$	< 50 %	84%	536
$(K\bar{K})^\pm\pi^0$	< 8 %	90%	248
$K_S^0 K_L^0 \pi^\pm$	< 6 %	90%	238
$K_S^0 K_S^0 \pi^\pm$	< 2 %	90%	238
$\phi\pi$	< 1.5 %	84%	146

 $a_1(1260)$ [1]

$$I^G(J^{PC}) = 1^-(1^{++})$$

 Mass $m = 1230 \pm 40$ MeV [m]

 Full width $\Gamma = 250$ to 600 MeV

$a_1(1260)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	dominant	356
[D/S amplitude ratio = -0.100 ± 0.028]		
$\pi\gamma$	seen	607
$\pi(\pi\pi)$ S-wave	possibly seen	575

$f_2(1270)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

 Mass $m = 1275.0 \pm 1.2$ MeV

 Full width $\Gamma = 185.5^{+3.8}_{-2.7}$ MeV (S = 1.5)

$f_2(1270)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
$\pi\pi$	(84.6 $^{+2.5}_{-1.3}$) %	S=1.3	622
$\pi^+\pi^-2\pi^0$	(7.2 $^{+1.5}_{-2.7}$) %	S=1.3	562
$K\bar{K}$	(4.6 ± 0.4) %	S=2.8	403
$2\pi^+2\pi^-$	(2.8 ± 0.4) %	S=1.2	559
$\eta\eta$	(4.5 ± 1.0) $\times 10^{-3}$	S=2.4	327
$4\pi^0$	(3.0 ± 1.0) $\times 10^{-3}$		564
$\gamma\gamma$	(1.32 $^{+0.17}_{-0.16}$) $\times 10^{-5}$		637
$\eta\pi\pi$	< 8 $\times 10^{-3}$	CL=95%	475
$K^0K^-\pi^+ + \text{c.c.}$	< 3.4 $\times 10^{-3}$	CL=95%	293
e^+e^-	< 9 $\times 10^{-9}$	CL=90%	637

 $f_1(1285)$

$$I^G(J^{PC}) = 0^+(1^{++})$$

 Mass $m = 1281.9 \pm 0.6$ MeV (S = 1.7)

 Full width $\Gamma = 24.0 \pm 1.2$ MeV (S = 1.4)

 ($4\pi = \rho(\pi\pi)P_{wave}$)

$f_1(1285)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
4π	(35 ± 4) %	S=1.6	563
$\pi^0\pi^0\pi^+\pi^-$	(23.5 ± 3.0) %	S=1.6	566
$2\pi^+2\pi^-$	(11.7 ± 1.5) %	S=1.6	563
$\rho^0\pi^+\pi^-$	(11.7 ± 1.5) %	S=1.6	340
$4\pi^0$	< 7 $\times 10^{-4}$	CL=90%	568
$\eta\pi\pi$	(50 ± 18) %		479
$a_0(980)\pi$ [ignoring $a_0(980) \rightarrow K\bar{K}$]	(34 ± 8) %	S=1.2	234
$\eta\pi\pi$ [excluding $a_0(980)\pi$]	(15 ± 7) %	S=1.1	—
$K\bar{K}\pi$	(9.6 ± 1.2) %	S=1.5	308
$K\bar{K}^*(892)$	not seen		—
$\gamma\rho^0$	(5.4 ± 1.2) %	S=2.3	410
$\phi\gamma$	(7.9 ± 3.0) $\times 10^{-4}$		236

$\eta(1295)$

$$I^G(J^{PC}) = 0^+(0^{-+})$$

 Mass $m = 1297.0 \pm 2.8$ MeV

 Full width $\Gamma = 53 \pm 6$ MeV

$\eta(1295)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\pi^+\pi^-$	seen	488
$a_0(980)\pi$	seen	245
$\eta\pi^0\pi^0$	seen	—
$\eta(\pi\pi)_{S\text{-wave}}$	seen	—

 $\pi(1300)$

$$I^G(J^{PC}) = 1^-(0^{-+})$$

 Mass $m = 1300 \pm 100$ MeV [m]

 Full width $\Gamma = 200$ to 600 MeV

$\pi(1300)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	406
$\pi(\pi\pi)_{S\text{-wave}}$	seen	—

 $a_2(1320)$

$$I^G(J^{PC}) = 1^-(2^{++})$$

 Mass $m = 1318.1 \pm 0.6$ MeV ($S = 1.1$)

 Full width $\Gamma = 107 \pm 5$ MeV [m] ($K^\pm K_S^0$ and $\eta\pi$ modes)

$a_2(1320)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\rho\pi$	$(70.1 \pm 2.7) \%$	S=1.2	419
$\eta\pi$	$(14.5 \pm 1.2) \%$		535
$\omega\pi\pi$	$(10.6 \pm 3.2) \%$	S=1.3	362
$K\bar{K}$	$(4.9 \pm 0.8) \%$		437
$\eta'(958)\pi$	$(5.3 \pm 0.9) \times 10^{-3}$		287
$\pi^\pm\gamma$	$(2.8 \pm 0.6) \times 10^{-3}$		652
$\gamma\gamma$	$(9.4 \pm 0.7) \times 10^{-6}$		659
$\pi^+\pi^-\pi^-$	$< 8 \%$	CL=90%	621
e^+e^-	$< 2.3 \times 10^{-7}$	CL=90%	659

$\mathbf{f_0(1370)} [k]$

$$I^G(J^{PC}) = 0^+(0^{++})$$

 Mass $m = 1200$ to 1500 MeV

 Full width $\Gamma = 200$ to 500 MeV

$\mathbf{f_0(1370)}$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi\pi$	seen	—
4π	seen	—
$4\pi^0$	seen	—
$2\pi^+2\pi^-$	seen	—
$\pi^+\pi^-2\pi^0$	seen	—
$2(\pi\pi)$ S-wave	seen	—
$\eta\eta$	seen	—
$K\bar{K}$	seen	—
$\gamma\gamma$	seen	—
e^+e^-	not seen	—

 $\mathbf{f_1(1420)} [n]$

$$I^G(J^{PC}) = 0^+(1^{++})$$

 Mass $m = 1426.2 \pm 1.2$ MeV ($S = 1.3$)

 Full width $\Gamma = 55.0 \pm 3.0$ MeV

$\mathbf{f_1(1420)}$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\bar{K}\pi$	dominant	439
$K\bar{K}^*(892) + \text{c.c.}$	dominant	155
$\eta\pi\pi$	possibly seen	571

 $\mathbf{\omega(1420)} [o]$

$$I^G(J^{PC}) = 0^-(1^{--})$$

 Mass $m = 1419 \pm 31$ MeV

 Full width $\Gamma = 174 \pm 60$ MeV

$\mathbf{\omega(1420)}$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	dominant	488

$\eta(1440)$ [p]

$$I^G(J^{PC}) = 0^+(0^-+)$$

 Mass $m = 1400 - 1470$ MeV [m]

 Full width $\Gamma = 50 - 80$ MeV [m]

$\eta(1440)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\bar{K}\pi$	seen	—
$K\bar{K}^*(892)+$ c.c.	seen	—
$\eta\pi\pi$	seen	—
$a_0(980)\pi$	seen	—
$\eta(\pi\pi)_{S\text{-wave}}$	seen	—
4π	seen	—

 $a_0(1450)$

$$I^G(J^{PC}) = 1^-(0^{++})$$

 Mass $m = 1474 \pm 19$ MeV

 Full width $\Gamma = 265 \pm 13$ MeV

$a_0(1450)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi\eta$	seen	613
$\pi\eta'(958)$	seen	392
$K\bar{K}$	seen	530

 $\rho(1450)$ [q]

$$I^G(J^{PC}) = 1^+(1^{--})$$

 Mass $m = 1465 \pm 25$ MeV [m]

 Full width $\Gamma = 310 \pm 60$ MeV [m]

$\rho(1450)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\pi\pi$	seen		719
4π	seen		665
$\omega\pi$	<2.0 %	95%	512
e^+e^-	seen		732
$\eta\rho$	<4 %		317
$\phi\pi$	<1 %		358
$K\bar{K}$	< 1.6×10^{-3}	95%	541

$f_0(1500)$ [r]

$$I^G(J^{PC}) = 0^+(0^{++})$$

 Mass $m = 1500 \pm 10$ MeV (S = 1.3)

 Full width $\Gamma = 112 \pm 10$ MeV

$f_0(1500)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\eta'(958)$	seen	—
$\eta\eta$	seen	513
4π	seen	—
$4\pi^0$	seen	690
$2\pi^+ 2\pi^-$	seen	686
2π	seen	—
$\pi^+ \pi^-$	seen	737
$2\pi^0$	seen	738
$K\bar{K}$	seen	563

 $f'_2(1525)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

 Mass $m = 1525 \pm 5$ MeV [m]

 Full width $\Gamma = 76 \pm 10$ MeV [m]

$f'_2(1525)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\bar{K}$	(88.8 \pm 3.1) %	581
$\eta\eta$	(10.3 \pm 3.1) %	531
$\pi\pi$	(8.2 \pm 1.5) $\times 10^{-3}$	750
$\gamma\gamma$	(1.32 \pm 0.21) $\times 10^{-6}$	763

 $\omega(1600)$ [s]

$$I^G(J^{PC}) = 0^-(1^{--})$$

 Mass $m = 1649 \pm 24$ MeV (S = 2.3)

 Full width $\Gamma = 220 \pm 35$ MeV (S = 1.6)

$\omega(1600)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	637
$\omega\pi\pi$	seen	601
$e^+ e^-$	seen	824

$\omega_3(1670)$

$$J^{PC} = 0^-(3^{--})$$

 Mass $m = 1667 \pm 4$ MeV

 Full width $\Gamma = 168 \pm 10$ MeV [m]

$\omega_3(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	647
$\omega\pi\pi$	seen	614
$b_1(1235)\pi$	possibly seen	359

 $\pi_2(1670)$

$$J^{PC} = 1^-(2^{-+})$$

 Mass $m = 1670 \pm 20$ MeV [m]

 Full width $\Gamma = 258 \pm 18$ MeV [m] ($S = 1.7$)

$\pi_2(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
3π	(95.8±1.4) %	806
$f_2(1270)\pi$	(56.2±3.2) %	325
$\rho\pi$	(31 ±4) %	649
$f_0(1370)\pi$	(8.7±3.4) %	—
$K\bar{K}^*(892) + \text{c.c.}$	(4.2±1.4) %	453

 $\phi(1680)$

$$J^{PC} = 0^-(1^{--})$$

 Mass $m = 1680 \pm 20$ MeV [m]

 Full width $\Gamma = 150 \pm 50$ MeV [m]

$\phi(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\bar{K}^*(892) + \text{c.c.}$	dominant	463
$K_S^0 K\pi$	seen	620
$K\bar{K}$	seen	681
e^+e^-	seen	840
$\omega\pi\pi$	not seen	622

$\rho_3(1690)$

$$I^G(J^{PC}) = 1^+(3^{--})$$

 J^P from the 2π and $K\bar{K}$ modes.

 Mass $m = 1691 \pm 5$ MeV [m]

 Full width $\Gamma = 160 \pm 10$ MeV [m] ($S = 1.5$)

$\rho_3(1690)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	ρ (MeV/c)
4π	(71.1 \pm 1.9) %		788
$\pi^\pm \pi^+ \pi^- \pi^0$	(67 \pm 22) %		788
$\omega \pi$	(16 \pm 6) %		656
$\pi \pi$	(23.6 \pm 1.3) %		834
$K\bar{K}\pi$	(3.8 \pm 1.2) %		628
$K\bar{K}$	(1.58 \pm 0.26) %	1.2	686
$\eta \pi^+ \pi^-$	seen		728

 $\rho(1700)$ [q]

$$I^G(J^{PC}) = 1^+(1^{--})$$

 Mass $m = 1700 \pm 20$ MeV [m] ($\eta\rho^0$ and $\pi^+\pi^-$ modes)

 Full width $\Gamma = 240 \pm 60$ MeV [m] ($\eta\rho^0$ and $\pi^+\pi^-$ modes)

$\rho(1700)$ DECAY MODES	Fraction (Γ_i/Γ)	ρ (MeV/c)
$\rho\pi\pi$	dominant	640
$2(\pi^+\pi^-)$	large	792
$\rho^0\pi^+\pi^-$	large	640
$\rho^\pm\pi^\mp\pi^0$	large	642
$\pi^+\pi^-$	seen	838
$\pi^-\pi^0$	seen	839
$K\bar{K}^*(892) + \text{c.c.}$	seen	479
$\eta\rho$	seen	533
$K\bar{K}$	seen	692
e^+e^-	seen	850
$\pi^0\omega$	seen	662

$f_J(1710)$ ^[t]

$$I^G(J^{PC}) = 0^+(\text{even} \ + \ +)$$

 Mass $m = 1712 \pm 5$ MeV (S = 1.1)

 Full width $\Gamma = 133 \pm 14$ MeV (S = 1.2)

$f_J(1710)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K \bar{K}$	seen	690
$\eta \eta$	seen	648
$\pi \pi$	seen	837

 $\pi(1800)$

$$I^G(J^{PC}) = 1^-(0^- \ +)$$

 Mass $m = 1801 \pm 13$ MeV (S = 1.9)

 Full width $\Gamma = 210 \pm 15$ MeV

$\pi(1800)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+ \pi^- \pi^-$	seen	—
$f_0(980) \pi^-$	seen	623
$f_0(1370) \pi^-$	seen	—
$\rho \pi^-$	not seen	728
$\eta \eta \pi^-$	seen	—
$a_0(980) \eta$	seen	459
$f_0(1500) \pi^-$	seen	240
$\eta \eta'(958) \pi^-$	seen	—
$K_0^*(1430) K^-$	seen	—
$K^*(892) K^-$	not seen	560

 $\phi_3(1850)$

$$I^G(J^{PC}) = 0^-(3^- \ -)$$

 Mass $m = 1854 \pm 7$ MeV

 Full width $\Gamma = 87^{+28}_{-23}$ MeV (S = 1.2)

$\phi_3(1850)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K \bar{K}$	seen	785
$K \bar{K}^*(892) + \text{c.c.}$	seen	602

$f_2(2010)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

Seen by one group only.

Mass $m = 2011^{+60}_{-80}$ MeV

Full width $\Gamma = 202 \pm 60$ MeV

$f_2(2010)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\phi\phi$	seen	—

 $a_4(2040)$

$$I^G(J^{PC}) = 1^-(4^{++})$$

Mass $m = 2020 \pm 16$ MeV

Full width $\Gamma = 387 \pm 70$ MeV

$a_4(2040)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\bar{K}$	seen	892
$\pi^+\pi^-\pi^0$	seen	—
$\eta\pi^0$	seen	941

 $f_4(2050)$

$$I^G(J^{PC}) = 0^+(4^{++})$$

Mass $m = 2044 \pm 11$ MeV ($S = 1.4$)

Full width $\Gamma = 208 \pm 13$ MeV ($S = 1.2$)

$f_4(2050)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\omega\omega$	(26 \pm 6) %	658
$\pi\pi$	(17.0 \pm 1.5) %	1012
$K\bar{K}$	(6.8 $^{+3.4}_{-1.8}$) $\times 10^{-3}$	895
$\eta\eta$	(2.1 \pm 0.8) $\times 10^{-3}$	863
$4\pi^0$	< 1.2 %	977

 $f_2(2300)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass $m = 2297 \pm 28$ MeV

Full width $\Gamma = 149 \pm 40$ MeV

$f_2(2300)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\phi\phi$	seen	529

$f_2(2340)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass $m = 2339 \pm 60$ MeV

Full width $\Gamma = 319^{+80}_{-70}$ MeV

$f_2(2340)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\phi\phi$	seen	573

STRANGE MESONS

($S = \pm 1, C = B = 0$)

$$K^+ = u\bar{s}, K^0 = d\bar{s}, \bar{K}^0 = \bar{d}s, K^- = \bar{u}s, \quad \text{similarly for } K^{*'}\text{'s}$$

 K^\pm

$$I(J^P) = \frac{1}{2}(0^-)$$

$$\text{Mass } m = 493.677 \pm 0.016 \text{ MeV } [u] \quad (S = 2.8)$$

$$\text{Mean life } \tau = (1.2386 \pm 0.0024) \times 10^{-8} \text{ s} \quad (S = 2.0)$$

$$c\tau = 3.713 \text{ m}$$

Slope parameter g [v]

(See Particle Listings for quadratic coefficients)

$$K^+ \rightarrow \pi^+ \pi^+ \pi^- = -0.2154 \pm 0.0035 \quad (S = 1.4)$$

$$K^- \rightarrow \pi^- \pi^- \pi^+ = -0.217 \pm 0.007 \quad (S = 2.5)$$

$$K^\pm \rightarrow \pi^\pm \pi^0 \pi^0 = 0.594 \pm 0.019 \quad (S = 1.3)$$

 K^\pm decay form factors [a,w]

$$K_{e3}^+ \quad \lambda_+ = 0.0286 \pm 0.0022$$

$$K_{\mu 3}^+ \quad \lambda_+ = 0.032 \pm 0.008 \quad (S = 1.6)$$

$$K_{\mu 3}^+ \quad \lambda_0 = 0.006 \pm 0.007 \quad (S = 1.6)$$

$$K_{e3}^+ \quad |f_S/f_+| = 0.084 \pm 0.023 \quad (S = 1.2)$$

$$K_{e3}^+ \quad |f_T/f_+| = 0.38 \pm 0.11 \quad (S = 1.1)$$

$$K_{\mu 3}^+ \quad |f_T/f_+| = 0.02 \pm 0.12$$

$$K^+ \rightarrow e^+ \nu_e \gamma \quad |F_A + F_V| = 0.148 \pm 0.010$$

$$K^+ \rightarrow \mu^+ \nu_\mu \gamma \quad |F_A + F_V| < 0.23, \text{ CL} = 90\%$$

$$K^+ \rightarrow e^+ \nu_e \gamma \quad |F_A - F_V| < 0.49$$

$$K^+ \rightarrow \mu^+ \nu_\mu \gamma \quad |F_A - F_V| = -2.2 \text{ to } 0.3$$

 K^- modes are charge conjugates of the modes below.

K^+ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\mu^+ \nu_\mu$	(63.51±0.18) %	S=1.3	236
$e^+ \nu_e$	(1.55±0.07) × 10 ⁻⁵		247
$\pi^+ \pi^0$	(21.16±0.14) %	S=1.1	205
$\pi^+ \pi^+ \pi^-$	(5.59±0.05) %	S=1.8	125
$\pi^+ \pi^0 \pi^0$	(1.73±0.04) %	S=1.2	133
$\pi^0 \mu^+ \nu_\mu$	(3.18±0.08) %	S=1.5	215

 Called $K_{\mu 3}^+$.

$\pi^0 e^+ \nu_e$		(4.82 ± 0.06) %	S=1.3	228
Called K_{e3}^+ .				
$\pi^0 \pi^0 e^+ \nu_e$		(2.1 ± 0.4) × 10 ⁻⁵		206
$\pi^+ \pi^- e^+ \nu_e$		(3.91 ± 0.17) × 10 ⁻⁵		203
$\pi^+ \pi^- \mu^+ \nu_\mu$		(1.4 ± 0.9) × 10 ⁻⁵		151
$\pi^0 \pi^0 \pi^0 e^+ \nu_e$		< 3.5 × 10 ⁻⁶	CL=90%	135
$\pi^+ \gamma \gamma$	[x]	(1.10 ± 0.32) × 10 ⁻⁶		227
$\pi^+ 3\gamma$	[x]	< 1.0 × 10 ⁻⁴	CL=90%	227
$\mu^+ \nu_\mu \nu \bar{\nu}$		< 6.0 × 10 ⁻⁶	CL=90%	236
$e^+ \nu_e \nu \bar{\nu}$		< 6 × 10 ⁻⁵	CL=90%	247
$\mu^+ \nu_\mu e^+ e^-$		(1.3 ± 0.4) × 10 ⁻⁷		236
$e^+ \nu_e e^+ e^-$		(3.0 ^{+3.0} _{-1.5}) × 10 ⁻⁸		247
$\mu^+ \nu_\mu \mu^+ \mu^-$		< 4.1 × 10 ⁻⁷	CL=90%	185
$\mu^+ \nu_\mu \gamma$	[x,y]	(5.50 ± 0.28) × 10 ⁻³		236
$\pi^+ \pi^0 \gamma$	[x,y]	(2.75 ± 0.15) × 10 ⁻⁴		205
$\pi^+ \pi^0 \gamma$ (DE)	[x,z]	(1.8 ± 0.4) × 10 ⁻⁵		205
$\pi^+ \pi^+ \pi^- \gamma$	[x,y]	(1.04 ± 0.31) × 10 ⁻⁴		125
$\pi^+ \pi^0 \pi^0 \gamma$	[x,y]	(7.5 ^{+5.5} _{-3.0}) × 10 ⁻⁶		133
$\pi^0 \mu^+ \nu_\mu \gamma$	[x,y]	< 6.1 × 10 ⁻⁵	CL=90%	215
$\pi^0 e^+ \nu_e \gamma$	[x,y]	(2.62 ± 0.20) × 10 ⁻⁴		228
$\pi^0 e^+ \nu_e \gamma$ (SD)	[aa]	< 5.3 × 10 ⁻⁵	CL=90%	228
$\pi^0 \pi^0 e^+ \nu_e \gamma$		< 5 × 10 ⁻⁶	CL=90%	206

**Lepton Family number (LF), Lepton number (L), $\Delta S = \Delta Q$ (SQ)
violating modes, or $\Delta S = 1$ weak neutral current (S1) modes**

$\pi^+ \pi^+ e^- \bar{\nu}_e$	SQ	< 1.2 × 10 ⁻⁸	CL=90%	203
$\pi^+ \pi^+ \mu^- \bar{\nu}_\mu$	SQ	< 3.0 × 10 ⁻⁶	CL=95%	151
$\pi^+ e^+ e^-$	S1	(2.74 ± 0.23) × 10 ⁻⁷		227
$\pi^+ \mu^+ \mu^-$	S1	(5.0 ± 1.0) × 10 ⁻⁸		172
$\pi^+ \nu \bar{\nu}$	S1	(4.2 ^{+9.7} _{-3.5}) × 10 ⁻¹⁰		227
$\mu^- \nu e^+ e^+$	LF	< 2.0 × 10 ⁻⁸	CL=90%	236
$\mu^+ \nu_e$	LF	[d] < 4 × 10 ⁻³	CL=90%	236
$\pi^+ \mu^+ e^-$	LF	< 2.1 × 10 ⁻¹⁰	CL=90%	214
$\pi^+ \mu^- e^+$	LF	< 7 × 10 ⁻⁹	CL=90%	214
$\pi^- \mu^+ e^+$	L	< 7 × 10 ⁻⁹	CL=90%	214
$\pi^- e^+ e^+$	L	< 1.0 × 10 ⁻⁸	CL=90%	227
$\pi^- \mu^+ \mu^+$	L	[d] < 1.5 × 10 ⁻⁴	CL=90%	172
$\mu^+ \bar{\nu}_e$	L	[d] < 3.3 × 10 ⁻³	CL=90%	236
$\pi^0 e^+ \bar{\nu}_e$	L	< 3 × 10 ⁻³	CL=90%	228

K^0

$$I(J^P) = \frac{1}{2}(0^-)$$

 50% K_S , 50% K_L

Mass $m = 497.672 \pm 0.031$ MeV

$$m_{K^0} - m_{K^\pm} = 3.995 \pm 0.034$$
 MeV ($S = 1.1$)

$$|m_{K^0} - m_{\bar{K}^0}| / m_{\text{average}} < 10^{-18}$$
 [bb]

K_S^0

$$I(J^P) = \frac{1}{2}(0^-)$$

Mean life $\tau = (0.8934 \pm 0.0008) \times 10^{-10}$ s

$$c\tau = 2.6762$$
 cm

CP-violation parameters [cc]

$$\text{Im}(\eta_{+-0}) = -0.002 \pm 0.009$$

$$\text{Im}(\eta_{000})^2 < 0.1, \text{ CL} = 90\%$$

K_S^0 DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi^+ \pi^-$	$(68.61 \pm 0.28) \%$	S=1.2	206
$\pi^0 \pi^0$	$(31.39 \pm 0.28) \%$	S=1.2	209
$\pi^+ \pi^- \gamma$	[y,dd] $(1.78 \pm 0.05) \times 10^{-3}$		206
$\gamma \gamma$	$(2.4 \pm 0.9) \times 10^{-6}$		249
$\pi^+ \pi^- \pi^0$	$(3.2^{+1.2}_{-1.0}) \times 10^{-7}$		133
$3\pi^0$	$< 3.7 \times 10^{-5}$	CL=90%	139
$\pi^\pm e^\mp \nu$	[ee] $(6.70 \pm 0.07) \times 10^{-4}$	S=1.1	229
$\pi^\pm \mu^\mp \nu$	[ee] $(4.69 \pm 0.06) \times 10^{-4}$	S=1.1	216
$\Delta S = 1$ weak neutral current (S1) modes			
$\mu^+ \mu^-$	S1 $< 3.2 \times 10^{-7}$	CL=90%	225
$e^+ e^-$	S1 $< 1.4 \times 10^{-7}$	CL=90%	249
$\pi^0 e^+ e^-$	S1 $< 1.1 \times 10^{-6}$	CL=90%	231

K_L^0

$$I(J^P) = \frac{1}{2}(0^-)$$

$$m_{K_L} - m_{K_S} = (0.5301 \pm 0.0014) \times 10^{10} \hbar s^{-1}$$

$$= (3.489 \pm 0.009) \times 10^{-12} \text{ MeV}$$

$$\text{Mean life } \tau = (5.17 \pm 0.04) \times 10^{-8} \text{ s} \quad (S = 1.1)$$

$$c\tau = 15.51 \text{ m}$$

Slope parameter g ^[v]

(See Particle Listings for quadratic coefficients)

$$K_L^0 \rightarrow \pi^+ \pi^- \pi^0 = 0.670 \pm 0.014 \quad (S = 1.6)$$

K_L decay form factors ^[w]

$$K_{e3}^0 \quad \lambda_+ = 0.0300 \pm 0.0016 \quad (S = 1.2)$$

$$K_{\mu 3}^0 \quad \lambda_+ = 0.034 \pm 0.005 \quad (S = 2.3)$$

$$K_{\mu 3}^0 \quad \lambda_0 = 0.025 \pm 0.006 \quad (S = 2.3)$$

$$K_{e3}^0 \quad |f_S/f_+| < 0.04, \text{ CL} = 68\%$$

$$K_{e3}^0 \quad |f_T/f_+| < 0.23, \text{ CL} = 68\%$$

$$K_{\mu 3}^0 \quad |f_T/f_+| = 0.12 \pm 0.12$$

$$K_L \rightarrow e^+ e^- \gamma: \quad \alpha_{K^*} = -0.28 \pm 0.08$$

CP-violation parameters ^[cc]

$$\delta = (0.327 \pm 0.012)\%$$

$$|\eta_{00}| = (2.275 \pm 0.019) \times 10^{-3} \quad (S = 1.1)$$

$$|\eta_{+-}| = (2.285 \pm 0.019) \times 10^{-3}$$

$$|\eta_{00}/\eta_{+-}| = 0.9956 \pm 0.0023 \text{ [ff]} \quad (S = 1.8)$$

$$\epsilon'/\epsilon = (1.5 \pm 0.8) \times 10^{-3} \text{ [ff]} \quad (S = 1.8)$$

$$\phi_{+-} = (43.5 \pm 0.6)^\circ$$

$$\phi_{00} = (43.4 \pm 1.0)^\circ$$

$$\phi_{00} - \phi_{+-} = (-0.1 \pm 0.8)^\circ$$

$$j \text{ for } K_L^0 \rightarrow \pi^+ \pi^- \pi^0 = 0.0011 \pm 0.0008$$

$$|\eta_{+-\gamma}| = (2.35 \pm 0.07) \times 10^{-3}$$

$$\phi_{+-\gamma} = (44 \pm 4)^\circ$$

$$|\epsilon'_{+-\gamma}|/\epsilon < 0.3, \text{ CL} = 90\%$$

$\Delta S = -\Delta Q$ in $K_{\ell 3}^0$ decay

$$\text{Re } x = 0.006 \pm 0.018 \quad (S = 1.3)$$

$$\text{Im } x = -0.003 \pm 0.026 \quad (S = 1.2)$$

CPT-violation parameters

$$\text{Re } \Delta = 0.018 \pm 0.020$$

$$\text{Im } \Delta = 0.02 \pm 0.04$$

K_L^0 DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$3\pi^0$	(21.12 \pm 0.27) %	S=1.1	139
$\pi^+ \pi^- \pi^0$	(12.56 \pm 0.20) %	S=1.7	133
$\pi^\pm \mu^\mp \nu$	[gg] (27.17 \pm 0.25) %	S=1.1	216
Called $K_{\mu 3}^0$.			
$\pi^\pm e^\mp \nu_e$	[gg] (38.78 \pm 0.27) %	S=1.1	229
Called $K_{e 3}^0$.			
2γ	(5.92 \pm 0.15) $\times 10^{-4}$		249
3γ	< 2.4 $\times 10^{-7}$	CL=90%	249
$\pi^0 2\gamma$	[hh] (1.70 \pm 0.28) $\times 10^{-6}$		231
$\pi^0 \pi^\pm e^\mp \nu$	[gg] (5.18 \pm 0.29) $\times 10^{-5}$		207
($\pi \mu$ atom) ν	(1.06 \pm 0.11) $\times 10^{-7}$		–
$\pi^\pm e^\mp \nu_e \gamma$	[y,gg,hh] (3.62 $^{+0.26}_{-0.21}$) $\times 10^{-3}$		229
$\pi^+ \pi^- \gamma$	[y,hh] (4.61 \pm 0.14) $\times 10^{-5}$		206
$\pi^0 \pi^0 \gamma$	< 5.6 $\times 10^{-6}$		209

Charge conjugation \times Parity (CP, CPV) or Lepton Family number (LF) violating modes, or $\Delta S = 1$ weak neutral current (S1) modes

$\pi^+ \pi^-$	CPV	(2.067 \pm 0.035) $\times 10^{-3}$	S=1.1	206
$\pi^0 \pi^0$	CPV	(9.36 \pm 0.20) $\times 10^{-4}$		209
$\mu^+ \mu^-$	S1	(7.2 \pm 0.5) $\times 10^{-9}$	S=1.4	225
$\mu^+ \mu^- \gamma$	S1	(3.25 \pm 0.28) $\times 10^{-7}$		225
$e^+ e^-$	S1	< 4.1 $\times 10^{-11}$	CL=90%	249
$e^+ e^- \gamma$	S1	(9.1 \pm 0.5) $\times 10^{-6}$		249
$e^+ e^- \gamma \gamma$	S1 [hh]	(6.5 \pm 1.2) $\times 10^{-7}$		249
$\pi^+ \pi^- e^+ e^-$	S1 [hh]	< 4.6 $\times 10^{-7}$	CL=90%	206
$\mu^+ \mu^- e^+ e^-$	S1	(2.9 $^{+6.7}_{-2.4}$) $\times 10^{-9}$		225
$e^+ e^- e^+ e^-$	S1	(4.1 \pm 0.8) $\times 10^{-8}$	S=1.2	249
$\pi^0 \mu^+ \mu^-$	CP,S1 [ii]	< 5.1 $\times 10^{-9}$	CL=90%	177
$\pi^0 e^+ e^-$	CP,S1 [ii]	< 4.3 $\times 10^{-9}$	CL=90%	231
$\pi^0 \nu \bar{\nu}$	CP,S1 [jj]	< 5.8 $\times 10^{-5}$	CL=90%	231
$e^\pm \mu^\mp$	LF [gg]	< 3.3 $\times 10^{-11}$	CL=90%	238
$e^\pm e^\pm \mu^\mp \mu^\mp$	LF [gg]	< 6.1 $\times 10^{-9}$	CL=90%	–

$K^*(892)$

$$I(J^P) = \frac{1}{2}(1^-)$$

 $K^*(892)^\pm$ mass $m = 891.66 \pm 0.26$ MeV

 $K^*(892)^0$ mass $m = 896.10 \pm 0.28$ MeV (S = 1.4)

 $K^*(892)^\pm$ full width $\Gamma = 50.8 \pm 0.9$ MeV

 $K^*(892)^0$ full width $\Gamma = 50.5 \pm 0.6$ MeV (S = 1.1)

$K^*(892)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K\pi$	~ 100	%	291
$K^0\gamma$	$(2.30 \pm 0.20) \times 10^{-3}$		310
$K^\pm\gamma$	$(9.9 \pm 0.9) \times 10^{-4}$		309
$K\pi\pi$	< 7	$\times 10^{-4}$ 95%	224

 $K_1(1270)$

$$I(J^P) = \frac{1}{2}(1^+)$$

 Mass $m = 1273 \pm 7$ MeV [*m*]

 Full width $\Gamma = 90 \pm 20$ MeV [*m*]

$K_1(1270)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\rho$	(42 ± 6) %	76
$K_0^*(1430)\pi$	(28 ± 4) %	—
$K^*(892)\pi$	(16 ± 5) %	301
$K\omega$	(11.0 ± 2.0) %	—
$Kf_0(1370)$	(3.0 ± 2.0) %	—

 $K_1(1400)$

$$I(J^P) = \frac{1}{2}(1^+)$$

 Mass $m = 1402 \pm 7$ MeV

 Full width $\Gamma = 174 \pm 13$ MeV (S = 1.6)

$K_1(1400)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K^*(892)\pi$	(94 ± 6) %	401
$K\rho$	(3.0 ± 3.0) %	298
$Kf_0(1370)$	(2.0 ± 2.0) %	—
$K\omega$	(1.0 ± 1.0) %	285
$K_0^*(1430)\pi$	not seen	—

$K^*(1410)$

$$I(J^P) = \frac{1}{2}(1^-)$$

 Mass $m = 1414 \pm 15$ MeV (S = 1.3)

 Full width $\Gamma = 232 \pm 21$ MeV (S = 1.1)

$K^*(1410)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K^*(892)\pi$	> 40 %	95%	408
$K\pi$	(6.6 ± 1.3) %		611
$K\rho$	< 7 %	95%	309

 $K_0^*(1430)$ ^[kk]

$$I(J^P) = \frac{1}{2}(0^+)$$

 Mass $m = 1429 \pm 6$ MeV

 Full width $\Gamma = 287 \pm 23$ MeV

$K_0^*(1430)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	(93 ± 10) %	621

 $K_2^*(1430)$

$$I(J^P) = \frac{1}{2}(2^+)$$

 $K_2^*(1430)^\pm$ mass $m = 1425.6 \pm 1.5$ MeV (S = 1.1)

 $K_2^*(1430)^0$ mass $m = 1432.4 \pm 1.3$ MeV

 $K_2^*(1430)^\pm$ full width $\Gamma = 98.5 \pm 2.7$ MeV (S = 1.1)

 $K_2^*(1430)^0$ full width $\Gamma = 109 \pm 5$ MeV (S = 1.9)

$K_2^*(1430)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$K\pi$	(49.9 ± 1.2) %		622
$K^*(892)\pi$	(24.7 ± 1.5) %		423
$K^*(892)\pi\pi$	(13.4 ± 2.2) %		375
$K\rho$	(8.7 ± 0.8) %	S=1.2	331
$K\omega$	(2.9 ± 0.8) %		319
$K^+\gamma$	(2.4 ± 0.5) $\times 10^{-3}$	S=1.1	627
$K\eta$	($1.5^{+3.4}_{-1.0}$) $\times 10^{-3}$	S=1.3	492
$K\omega\pi$	< 7.2 $\times 10^{-4}$	CL=95%	110
$K^0\gamma$	< 9 $\times 10^{-4}$	CL=90%	631

$K^*(1680)$

$$I(J^P) = \frac{1}{2}(1^-)$$

Mass $m = 1717 \pm 27$ MeV (S = 1.4)Full width $\Gamma = 322 \pm 110$ MeV (S = 4.2)

$K^*(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	$(38.7 \pm 2.5) \%$	779
$K\rho$	$(31.4^{+4.7}_{-2.1}) \%$	571
$K^*(892)\pi$	$(29.9^{+2.2}_{-4.7}) \%$	615

 $K_2(1770)$ [11]

$$I(J^P) = \frac{1}{2}(2^-)$$

Mass $m = 1773 \pm 8$ MeVFull width $\Gamma = 186 \pm 14$ MeV

$K_2(1770)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi\pi$		—
$K_2^*(1430)\pi$	dominant	287
$K^*(892)\pi$	seen	653
$Kf_2(1270)$	seen	—
$K\phi$	seen	441
$K\omega$	seen	608

 $K_3^*(1780)$

$$I(J^P) = \frac{1}{2}(3^-)$$

Mass $m = 1776 \pm 7$ MeV (S = 1.1)Full width $\Gamma = 159 \pm 21$ MeV (S = 1.3)

$K_3^*(1780)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K\rho$	$(31 \pm 9) \%$		612
$K^*(892)\pi$	$(20 \pm 5) \%$		651
$K\pi$	$(18.8 \pm 1.0) \%$		810
$K\eta$	$(30 \pm 13) \%$		715
$K_2^*(1430)\pi$	< 16 %	95%	284

$K_2(1820)$ [mm]

$$I(J^P) = \frac{1}{2}(2^-)$$

 Mass $m = 1816 \pm 13$ MeV

 Full width $\Gamma = 276 \pm 35$ MeV

$K_2(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K_2^*(1430)\pi$	seen	325
$K^*(892)\pi$	seen	680
$K f_2(1270)$	seen	186
$K\omega$	seen	638

 $K_4^*(2045)$

$$I(J^P) = \frac{1}{2}(4^+)$$

 Mass $m = 2045 \pm 9$ MeV ($S = 1.1$)

 Full width $\Gamma = 198 \pm 30$ MeV

$K_4^*(2045)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	$(9.9 \pm 1.2) \%$	958
$K^*(892)\pi\pi$	$(9 \pm 5) \%$	800
$K^*(892)\pi\pi\pi$	$(7 \pm 5) \%$	764
$\rho K\pi$	$(5.7 \pm 3.2) \%$	742
$\omega K\pi$	$(5.0 \pm 3.0) \%$	736
$\phi K\pi$	$(2.8 \pm 1.4) \%$	591
$\phi K^*(892)$	$(1.4 \pm 0.7) \%$	363

CHARMED MESONS

($C = \pm 1$)

$$D^+ = c\bar{d}, D^0 = c\bar{u}, \bar{D}^0 = \bar{c}u, D^- = \bar{c}d, \text{ similarly for } D^{*'}\text{'s}$$

 D^\pm

$$I(J^P) = \frac{1}{2}(0^-)$$

$$\text{Mass } m = 1869.3 \pm 0.5 \text{ MeV} \quad (S = 1.1)$$

$$\text{Mean life } \tau = (1.057 \pm 0.015) \times 10^{-12} \text{ s}$$

$$c\tau = 317 \mu\text{m}$$

CP-violation decay-rate asymmetries

$$A_{CP}(K^+ K^- \pi^\pm) = -0.017 \pm 0.027$$

$$A_{CP}(K^\pm K^{*0}) = -0.02 \pm 0.05$$

$$A_{CP}(\phi \pi^\pm) = -0.014 \pm 0.033$$

$$A_{CP}(\pi^+ \pi^- \pi^\pm) = -0.02 \pm 0.04$$

$D^+ \rightarrow \bar{K}^*(892)^0 \ell^+ \nu_\ell$ form factors

$$r_2 = 0.72 \pm 0.09$$

$$r_V = 1.85 \pm 0.12$$

$$\Gamma_L/\Gamma_T = 1.23 \pm 0.13$$

$$\Gamma_+/\Gamma_- = 0.16 \pm 0.04$$

D^- modes are charge conjugates of the modes below.

D^+ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
	Inclusive modes		
e^+ anything	(17.2 \pm 1.9) %		—
K^- anything	(24.2 \pm 2.8) %	S=1.4	—
\bar{K}^0 anything + K^0 anything	(59 \pm 7) %		—
K^+ anything	(5.8 \pm 1.4) %		—
η anything	[nn] < 13 %	CL=90%	—

Leptonic and semileptonic modes

$\mu^+ \nu_\mu$	< 7.2	$\times 10^{-4}$	CL=90%	932
$\overline{K}^0 \ell^+ \nu_\ell$	[∞]	(6.8 \pm 0.8) %		868
$\overline{K}^0 e^+ \nu_e$		(6.7 \pm 0.9) %		868
$\overline{K}^0 \mu^+ \nu_\mu$		(7.0 $\begin{smallmatrix} +3.0 \\ -2.0 \end{smallmatrix}$) %		865
$K^- \pi^+ e^+ \nu_e$		(4.1 $\begin{smallmatrix} +0.9 \\ -0.7 \end{smallmatrix}$) %		863
$\overline{K}^*(892)^0 e^+ \nu_e$		(3.2 \pm 0.33) %		720
$\times B(\overline{K}^{*0} \rightarrow K^- \pi^+)$				
$K^- \pi^+ e^+ \nu_e$ nonresonant	< 7	$\times 10^{-3}$	CL=90%	863
$K^- \pi^+ \mu^+ \nu_\mu$		(3.2 \pm 0.4) %	S=1.1	851
$\overline{K}^*(892)^0 \mu^+ \nu_\mu$		(2.9 \pm 0.4) %		715
$\times B(\overline{K}^{*0} \rightarrow K^- \pi^+)$				
$K^- \pi^+ \mu^+ \nu_\mu$ nonresonant		(2.7 \pm 1.1) $\times 10^{-3}$		851
$(\overline{K}^*(892)\pi)^0 e^+ \nu_e$	< 1.2	%	CL=90%	714
$(\overline{K}\pi\pi)^0 e^+ \nu_e$ non- $\overline{K}^*(892)$	< 9	$\times 10^{-3}$	CL=90%	846
$K^- \pi^+ \pi^0 \mu^+ \nu_\mu$	< 1.4	$\times 10^{-3}$	CL=90%	825
$\pi^0 \ell^+ \nu_\ell$	[$\rho\rho$]	(3.1 \pm 1.5) $\times 10^{-3}$		930

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\overline{K}^*(892)^0 \ell^+ \nu_\ell$	[∞]	(4.7 \pm 0.4) %		720
$\overline{K}^*(892)^0 e^+ \nu_e$		(4.8 \pm 0.5) %		720
$\overline{K}^*(892)^0 \mu^+ \nu_\mu$		(4.4 \pm 0.6) %	S=1.1	715
$\rho^0 e^+ \nu_e$		(2.2 \pm 0.8) $\times 10^{-3}$		776
$\rho^0 \mu^+ \nu_\mu$		(2.7 \pm 0.7) $\times 10^{-3}$		772
$\phi e^+ \nu_e$	< 2.09	%	CL=90%	657
$\phi \mu^+ \nu_\mu$	< 3.72	%	CL=90%	651
$\eta \ell^+ \nu_\ell$	< 5	$\times 10^{-3}$	CL=90%	—
$\eta'(958) \mu^+ \nu_\mu$	< 9	$\times 10^{-3}$	CL=90%	684

Hadronic modes with a \bar{K} or $\bar{K}K\bar{K}$

$\bar{K}^0 \pi^+$		(2.89 ± 0.26) %	S=1.1	862
$K^- \pi^+ \pi^+$	[qq]	(9.0 ± 0.6) %		845
$\bar{K}^*(892)^0 \pi^+$		(1.27 ± 0.13) %		712
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$				
$\bar{K}_0^*(1430)^0 \pi^+$		(2.3 ± 0.3) %		368
$\times B(\bar{K}_0^*(1430)^0 \rightarrow K^- \pi^+)$				
$\bar{K}^*(1680)^0 \pi^+$		(3.7 ± 0.8) × 10 ⁻³		65
$\times B(\bar{K}^*(1680)^0 \rightarrow K^- \pi^+)$				
$K^- \pi^+ \pi^+$ nonresonant		(8.5 ± 0.8) %		845
$\bar{K}^0 \pi^+ \pi^0$	[qq]	(9.7 ± 3.0) %	S=1.1	845
$\bar{K}^0 \rho^+$		(6.6 ± 2.5) %		680
$\bar{K}^*(892)^0 \pi^+$		(6.3 ± 0.4) × 10 ⁻³		712
$\times B(\bar{K}^{*0} \rightarrow \bar{K}^0 \pi^0)$				
$\bar{K}^0 \pi^+ \pi^0$ nonresonant		(1.3 ± 1.1) %		845
$K^- \pi^+ \pi^+ \pi^0$	[qq]	(6.4 ± 1.1) %		816
$\bar{K}^*(892)^0 \rho^+$ total		(1.4 ± 0.9) %		423
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$				
$\bar{K}_1(1400)^0 \pi^+$		(2.2 ± 0.6) %		390
$\times B(\bar{K}_1(1400)^0 \rightarrow K^- \pi^+ \pi^0)$				
$K^- \rho^+ \pi^+$ total		(3.1 ± 1.1) %		616
$K^- \rho^+ \pi^+$ 3-body		(1.1 ± 0.4) %		616
$\bar{K}^*(892)^0 \pi^+ \pi^0$ total		(4.5 ± 0.9) %		687
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$				
$\bar{K}^*(892)^0 \pi^+ \pi^0$ 3-body		(2.8 ± 0.9) %		687
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$				
$K^*(892)^- \pi^+ \pi^+$ 3-body		(7 ± 3) × 10 ⁻³		688
$\times B(K^{*-} \rightarrow K^- \pi^0)$				
$K^- \pi^+ \pi^+ \pi^0$ nonresonant	[rr]	(1.2 ± 0.6) %		816
$\bar{K}^0 \pi^+ \pi^+ \pi^-$	[qq]	(7.0 ± 0.9) %		814
$\bar{K}^0 a_1(1260)^+$		(4.0 ± 0.9) %		328
$\times B(a_1(1260)^+ \rightarrow \pi^+ \pi^+ \pi^-)$				
$\bar{K}_1(1400)^0 \pi^+$		(2.2 ± 0.6) %		390
$\times B(\bar{K}_1(1400)^0 \rightarrow \bar{K}^0 \pi^+ \pi^-)$				
$K^*(892)^- \pi^+ \pi^+$ 3-body		(1.4 ± 0.6) %		688
$\times B(K^{*-} \rightarrow \bar{K}^0 \pi^-)$				
$\bar{K}^0 \rho^0 \pi^+$ total		(4.2 ± 0.9) %		614
$\bar{K}^0 \rho^0 \pi^+$ 3-body		(5 ± 5) × 10 ⁻³		614
$\bar{K}^0 \pi^+ \pi^+ \pi^-$ nonresonant		(8 ± 4) × 10 ⁻³		814

$K^- \pi^+ \pi^+ \pi^+ \pi^-$	[qq]	$(7.2 \pm 1.0) \times 10^{-3}$	772
$\bar{K}^*(892)^0 \pi^+ \pi^+ \pi^-$		$(5.4 \pm 2.3) \times 10^{-3}$	642
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$			
$\bar{K}^*(892)^0 \rho^0 \pi^+$		$(1.9 \begin{smallmatrix} +1.1 \\ -1.0 \end{smallmatrix}) \times 10^{-3}$	242
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$			
$\bar{K}^*(892)^0 \pi^+ \pi^+ \pi^- \text{ no-}\rho$		$(2.9 \pm 1.1) \times 10^{-3}$	642
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$			
$K^- \rho^0 \pi^+ \pi^+$		$(3.1 \pm 0.9) \times 10^{-3}$	529
$K^- \pi^+ \pi^+ \pi^+ \pi^- \text{ nonresonant}$		$< 2.3 \times 10^{-3}$	CL=90% 772
$K^- \pi^+ \pi^+ \pi^0 \pi^0$		$(2.2 \begin{smallmatrix} +5.0 \\ -0.9 \end{smallmatrix}) \%$	775
$\bar{K}^0 \pi^+ \pi^+ \pi^- \pi^0$		$(5.4 \begin{smallmatrix} +3.0 \\ -1.4 \end{smallmatrix}) \%$	773
$\bar{K}^0 \pi^+ \pi^+ \pi^+ \pi^- \pi^-$		$(8 \pm 7) \times 10^{-4}$	714
$K^- \pi^+ \pi^+ \pi^+ \pi^- \pi^0$		$(2.0 \pm 1.8) \times 10^{-3}$	718
$\bar{K}^0 \bar{K}^0 K^+$		$(1.8 \pm 0.8) \%$	545

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\bar{K}^0 \rho^+$		$(6.6 \pm 2.5) \%$	680
$\bar{K}^0 a_1(1260)^+$		$(8.0 \pm 1.7) \%$	328
$\bar{K}^0 a_2(1320)^+$		$< 3 \times 10^{-3}$	CL=90% 199
$\bar{K}^*(892)^0 \pi^+$		$(1.90 \pm 0.19) \%$	712
$\bar{K}^*(892)^0 \rho^+ \text{ total}$	[rr]	$(2.1 \pm 1.3) \%$	423
$\bar{K}^*(892)^0 \rho^+ S\text{-wave}$	[rr]	$(1.6 \pm 1.6) \%$	423
$\bar{K}^*(892)^0 \rho^+ P\text{-wave}$		$< 1 \times 10^{-3}$	CL=90% 423
$\bar{K}^*(892)^0 \rho^+ D\text{-wave}$		$(10 \pm 7) \times 10^{-3}$	423
$\bar{K}^*(892)^0 \rho^+ D\text{-wave longitudinal}$		$< 7 \times 10^{-3}$	CL=90% 423
$\bar{K}_1(1270)^0 \pi^+$		$< 7 \times 10^{-3}$	CL=90% 487
$\bar{K}_1(1400)^0 \pi^+$		$(4.9 \pm 1.2) \%$	390
$\bar{K}^*(1410)^0 \pi^+$		$< 7 \times 10^{-3}$	CL=90% 382
$\bar{K}_0^*(1430)^0 \pi^+$		$(3.7 \pm 0.4) \%$	368
$\bar{K}^*(1680)^0 \pi^+$		$(1.43 \pm 0.30) \%$	65
$\bar{K}^*(892)^0 \pi^+ \pi^0 \text{ total}$		$(6.7 \pm 1.4) \%$	687
$\bar{K}^*(892)^0 \pi^+ \pi^0 3\text{-body}$	[rr]	$(4.2 \pm 1.4) \%$	687
$K^*(892)^- \pi^+ \pi^+ 3\text{-body}$		$(2.0 \pm 0.9) \%$	688
$K^- \rho^+ \pi^+ \text{ total}$		$(3.1 \pm 1.1) \%$	616
$K^- \rho^+ \pi^+ 3\text{-body}$		$(1.1 \pm 0.4) \%$	616
$\bar{K}^0 \rho^0 \pi^+ \text{ total}$		$(4.2 \pm 0.9) \%$	CL=90% 614
$\bar{K}^0 \rho^0 \pi^+ 3\text{-body}$		$(5 \pm 5) \times 10^{-3}$	614

$\overline{K}^0 f_0(980) \pi^+$	$< 5 \times 10^{-3}$	CL=90%	461
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$	$(8.1 \pm 3.4) \times 10^{-3}$	S=1.7	642
$\overline{K}^*(892)^0 \rho^0 \pi^+$	$(2.9 \begin{smallmatrix} +1.7 \\ -1.5 \end{smallmatrix}) \times 10^{-3}$	S=1.8	242
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^- \text{ no-}\rho$	$(4.3 \pm 1.7) \times 10^{-3}$		642
$K^- \rho^0 \pi^+ \pi^+$	$(3.1 \pm 0.9) \times 10^{-3}$		529

Pionic modes

$\pi^+ \pi^0$	$(2.5 \pm 0.7) \times 10^{-3}$		925
$\pi^+ \pi^+ \pi^-$	$(3.6 \pm 0.4) \times 10^{-3}$		908
$\rho^0 \pi^+$	$(1.05 \pm 0.31) \times 10^{-3}$		769
$\pi^+ \pi^+ \pi^- \text{ nonresonant}$	$(2.2 \pm 0.4) \times 10^{-3}$		908
$\pi^+ \pi^+ \pi^- \pi^0$	$(1.9 \begin{smallmatrix} +1.5 \\ -1.2 \end{smallmatrix}) \%$		882
$\eta \pi^+ \times B(\eta \rightarrow \pi^+ \pi^- \pi^0)$	$(1.7 \pm 0.6) \times 10^{-3}$		848
$\omega \pi^+ \times B(\omega \rightarrow \pi^+ \pi^- \pi^0)$	$< 6 \times 10^{-3}$	CL=90%	764
$\pi^+ \pi^+ \pi^+ \pi^- \pi^-$	$(2.1 \pm 0.4) \times 10^{-3}$		845
$\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^0$	$(2.9 \begin{smallmatrix} +2.9 \\ -2.0 \end{smallmatrix}) \times 10^{-3}$		799

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\eta \pi^+$	$(7.5 \pm 2.5) \times 10^{-3}$		848
$\rho^0 \pi^+$	$(1.05 \pm 0.31) \times 10^{-3}$		769
$\omega \pi^+$	$< 7 \times 10^{-3}$	CL=90%	764
$\eta \rho^+$	$< 1.2 \%$	CL=90%	658
$\eta'(958) \pi^+$	$< 9 \times 10^{-3}$	CL=90%	680
$\eta'(958) \rho^+$	$< 1.5 \%$	CL=90%	355

Hadronic modes with a $K\bar{K}$ pair

$K^+\bar{K}^0$		$(7.4 \pm 1.0) \times 10^{-3}$		792
$K^+K^-\pi^+$	[<i>qq</i>]	$(8.8 \pm 0.8) \times 10^{-3}$		744
$\phi\pi^+ \times B(\phi \rightarrow K^+K^-)$		$(3.0 \pm 0.3) \times 10^{-3}$		647
$K^+\bar{K}^*(892)^0$		$(2.8 \pm 0.4) \times 10^{-3}$		610
$\times B(\bar{K}^{*0} \rightarrow K^-\pi^+)$				
$K^+K^-\pi^+$ nonresonant		$(4.5 \pm 0.9) \times 10^{-3}$		744
$K^0\bar{K}^0\pi^+$		—		741
$K^*(892)^+\bar{K}^0$		$(2.1 \pm 1.0) \%$		611
$\times B(K^{*+} \rightarrow K^0\pi^+)$				
$K^+K^-\pi^+\pi^0$		—		682
$\phi\pi^+\pi^0 \times B(\phi \rightarrow K^+K^-)$		$(1.1 \pm 0.5) \%$		619
$\phi\rho^+ \times B(\phi \rightarrow K^+K^-)$		$< 7 \times 10^{-3}$	CL=90%	268
$K^+K^-\pi^+\pi^0$ non- ϕ		$(1.5 \begin{smallmatrix} +0.7 \\ -0.6 \end{smallmatrix}) \%$		682
$K^+\bar{K}^0\pi^+\pi^-$		$< 2 \%$	CL=90%	678
$K^0K^-\pi^+\pi^+$		$(1.0 \pm 0.6) \%$		678
$K^*(892)^+\bar{K}^*(892)^0$		$(1.2 \pm 0.5) \%$		273
$\times B^2(K^{*+} \rightarrow K^0\pi^+)$				
$K^0K^-\pi^+\pi^+$ non- $K^*\bar{K}^{*0}$		$< 7.9 \times 10^{-3}$	CL=90%	678
$K^+K^-\pi^+\pi^+\pi^-$		—		600
$\phi\pi^+\pi^+\pi^-$		$< 1 \times 10^{-3}$	CL=90%	565
$\times B(\phi \rightarrow K^+K^-)$				
$K^+K^-\pi^+\pi^+\pi^-$ nonresonant		$< 3 \%$	CL=90%	600

Fractions of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\phi\pi^+$		$(6.1 \pm 0.6) \times 10^{-3}$		647
$\phi\pi^+\pi^0$		$(2.3 \pm 1.0) \%$		619
$\phi\rho^+$		$< 1.4 \%$	CL=90%	268
$\phi\pi^+\pi^+\pi^-$		$< 2 \times 10^{-3}$	CL=90%	565
$K^+\bar{K}^*(892)^0$		$(4.2 \pm 0.5) \times 10^{-3}$		610
$K^*(892)^+\bar{K}^0$		$(3.2 \pm 1.5) \%$		611
$K^*(892)^+\bar{K}^*(892)^0$		$(2.6 \pm 1.1) \%$		273

**Doubly Cabibbo suppressed (*DC*) modes,
 $\Delta C = 1$ weak neutral current (*C1*) modes, or
 Lepton Family number (*LF*) or Lepton number (*L*) violating modes**

$K^+ \pi^+ \pi^-$	<i>DC</i>	$(6.8 \pm 1.5) \times 10^{-4}$			845
$K^+ \rho^0$	<i>DC</i>	$(2.5 \pm 1.2) \times 10^{-4}$			681
$K^*(892)^0 \pi^+$	<i>DC</i>	$(3.6 \pm 1.6) \times 10^{-4}$			712
$K^+ \pi^+ \pi^-$ nonresonant	<i>DC</i>	$(2.4 \pm 1.2) \times 10^{-4}$			845
$K^+ K^+ K^-$	<i>DC</i>	< 1.4	$\times 10^{-4}$	CL=90%	550
ϕK^+	<i>DC</i>	< 1.3	$\times 10^{-4}$	CL=90%	527
$\pi^+ e^+ e^-$	<i>C1</i>	< 6.6	$\times 10^{-5}$	CL=90%	929
$\pi^+ \mu^+ \mu^-$	<i>C1</i>	< 1.8	$\times 10^{-5}$	CL=90%	917
$\rho^+ \mu^+ \mu^-$	<i>C1</i>	< 5.6	$\times 10^{-4}$	CL=90%	759
$K^+ e^+ e^-$		[<i>ss</i>] < 2.0	$\times 10^{-4}$	CL=90%	869
$K^+ \mu^+ \mu^-$		[<i>ss</i>] < 9.7	$\times 10^{-5}$	CL=90%	856
$\pi^+ e^+ \mu^-$	<i>LF</i>	< 1.1	$\times 10^{-4}$	CL=90%	926
$\pi^+ e^- \mu^+$	<i>LF</i>	< 1.3	$\times 10^{-4}$	CL=90%	926
$K^+ e^+ \mu^-$	<i>LF</i>	< 1.3	$\times 10^{-4}$	CL=90%	866
$K^+ e^- \mu^+$	<i>LF</i>	< 1.2	$\times 10^{-4}$	CL=90%	866
$\pi^- e^+ e^+$	<i>L</i>	< 1.1	$\times 10^{-4}$	CL=90%	929
$\pi^- \mu^+ \mu^+$	<i>L</i>	< 8.7	$\times 10^{-5}$	CL=90%	917
$\pi^- e^+ \mu^+$	<i>L</i>	< 1.1	$\times 10^{-4}$	CL=90%	926
$\rho^- \mu^+ \mu^+$	<i>L</i>	< 5.6	$\times 10^{-4}$	CL=90%	759
$K^- e^+ e^+$	<i>L</i>	< 1.2	$\times 10^{-4}$	CL=90%	869
$K^- \mu^+ \mu^+$	<i>L</i>	< 1.2	$\times 10^{-4}$	CL=90%	856
$K^- e^+ \mu^+$	<i>L</i>	< 1.3	$\times 10^{-4}$	CL=90%	866
$K^*(892)^- \mu^+ \mu^+$	<i>L</i>	< 8.5	$\times 10^{-4}$	CL=90%	703

D^0

$$I(J^P) = \frac{1}{2}(0^-)$$

$$\text{Mass } m = 1864.6 \pm 0.5 \text{ MeV} \quad (S = 1.1)$$

$$m_{D^\pm} - m_{D^0} = 4.76 \pm 0.10 \text{ MeV} \quad (S = 1.1)$$

$$\text{Mean life } \tau = (0.415 \pm 0.004) \times 10^{-12} \text{ s}$$

$$c\tau = 124.4 \text{ } \mu\text{m}$$

$$|m_{D_1^0} - m_{D_2^0}| < 24 \times 10^{10} \hbar \text{ s}^{-1}, \text{ CL} = 90\% \text{ [tt]}$$

$$|\Gamma_{D_1^0} - \Gamma_{D_2^0}|/\Gamma_{D^0} < 0.20, \text{ CL} = 90\% \text{ [tt]}$$

$$\Gamma(K^+ \ell^- \bar{\nu}_\ell \text{ (via } \bar{D}^0)) / \Gamma(K^- \ell^+ \nu_\ell) < 0.005, \text{ CL} = 90\%$$

$$\frac{\Gamma(K^+ \pi^- \text{ or } K^+ \pi^- \pi^+ \pi^- \text{ (via } \bar{D}^0))}{\Gamma(K^- \pi^+ \text{ or } K^- \pi^+ \pi^+ \pi^-)} < 0.0085 \text{ (or } < 0.0037), \text{ CL} = 90\% \text{ [uu]}$$

CP-violation decay-rate asymmetries

$$A_{CP}(K^+ K^-) = 0.026 \pm 0.035$$

$$A_{CP}(\pi^+ \pi^-) = -0.05 \pm 0.08$$

$$A_{CP}(K_S^0 \phi) = -0.03 \pm 0.09$$

$$A_{CP}(K_S^0 \pi^0) = -0.018 \pm 0.030$$

\bar{D}^0 modes are charge conjugates of the modes below.

D^0 DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Inclusive modes			
e^+ anything	(6.75 ± 0.29) %		—
μ^+ anything	(6.6 ± 0.8) %		—
K^- anything	(53 ± 4) %	S=1.3	—
\bar{K}^0 anything + K^0 anything	(42 ± 5) %		—
K^+ anything	(3.4 $^{+0.6}_{-0.4}$) %		—
η anything	[nn] < 13 %	CL=90%	—
Semileptonic modes			
$K^- \ell^+ \nu_\ell$	[oo] (3.50 ± 0.17) %	S=1.3	867
$K^- e^+ \nu_e$	(3.66 ± 0.18) %		867
$K^- \mu^+ \nu_\mu$	(3.23 ± 0.17) %		863
$K^- \pi^0 e^+ \nu_e$	(1.6 $^{+1.3}_{-0.5}$) %		861
$\bar{K}^0 \pi^- e^+ \nu_e$	(2.8 $^{+1.7}_{-0.9}$) %		860
$\bar{K}^*(892)^- e^+ \nu_e$	(1.35 ± 0.22) %		719
$\times B(K^{*-} \rightarrow \bar{K}^0 \pi^-)$			
$K^*(892)^- \ell^+ \nu_\ell$	—		—

$\bar{K}^*(892)^0 \pi^- e^+ \nu_e$	—		708
$K^- \pi^+ \pi^- \mu^+ \nu_\mu$	< 1.2	$\times 10^{-3}$	CL=90% 821
$(\bar{K}^*(892)\pi)^- \mu^+ \nu_\mu$	< 1.4	$\times 10^{-3}$	CL=90% 693
$\pi^- e^+ \nu_e$	(3.7 ± 0.6)	$\times 10^{-3}$	927

A fraction of the following resonance mode has already appeared above as a submode of a charged-particle mode.

$K^*(892)^- e^+ \nu_e$	(2.02 ± 0.33) %	719
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Hadronic modes with a \bar{K} or $\bar{K}K\bar{K}$

$K^- \pi^+$	(3.85 ± 0.09) %	861
$\bar{K}^0 \pi^0$	(2.12 ± 0.21) %	S=1.1 860
$\bar{K}^0 \pi^+ \pi^-$	[qq] (5.4 ± 0.4) %	S=1.2 842
$\bar{K}^0 \rho^0$	(1.21 ± 0.17) %	676
$\bar{K}^0 f_0(980)$	(3.0 ± 0.8) $\times 10^{-3}$	549
$\times B(f_0 \rightarrow \pi^+ \pi^-)$		
$\bar{K}^0 f_2(1270)$	(2.4 ± 0.9) $\times 10^{-3}$	263
$\times B(f_2 \rightarrow \pi^+ \pi^-)$		
$\bar{K}^0 f_0(1370)$	(4.3 ± 1.3) $\times 10^{-3}$	—
$\times B(f_0 \rightarrow \pi^+ \pi^-)$		
$K^*(892)^- \pi^+$	(3.4 ± 0.3) %	711
$\times B(K^{*-} \rightarrow \bar{K}^0 \pi^-)$		
$K_0^*(1430)^- \pi^+$	(6.4 ± 1.6) $\times 10^{-3}$	364
$\times B(K_0^*(1430)^- \rightarrow \bar{K}^0 \pi^-)$		
$\bar{K}^0 \pi^+ \pi^-$ nonresonant	(1.47 ± 0.24) %	842
$K^- \pi^+ \pi^0$	[qq] (13.9 ± 0.9) %	S=1.3 844
$K^- \rho^+$	(10.8 ± 1.0) %	678
$K^*(892)^- \pi^+$	(1.7 ± 0.2) %	711
$\times B(K^{*-} \rightarrow K^- \pi^0)$		
$\bar{K}^*(892)^0 \pi^0$	(2.1 ± 0.3) %	709
$\times B(\bar{K}^{*0} \rightarrow K^- \pi^+)$		
$K^- \pi^+ \pi^0$ nonresonant	(6.9 ± 2.5) $\times 10^{-3}$	844
$\bar{K}^0 \pi^0 \pi^0$	—	843
$\bar{K}^*(892)^0 \pi^0$	(1.1 ± 0.2) %	709
$\times B(\bar{K}^{*0} \rightarrow \bar{K}^0 \pi^0)$		
$\bar{K}^0 \pi^0 \pi^0$ nonresonant	(7.9 ± 2.1) $\times 10^{-3}$	843

$K^- \pi^+ \pi^+ \pi^-$	[qq]	(7.6 ± 0.4) %	S=1.1	812
$K^- \pi^+ \rho^0$ total		(6.3 ± 0.4) %		612
$K^- \pi^+ \rho^0$ 3-body		(4.8 ± 2.1) × 10 ⁻³		612
$\bar{K}^*(892)^0 \rho^0$		(9.8 ± 2.2) × 10 ⁻³		418
× B($\bar{K}^{*0} \rightarrow K^- \pi^+$)				
$K^- a_1(1260)^+$		(3.6 ± 0.6) %		327
× B($a_1(1260)^+ \rightarrow \pi^+ \pi^+ \pi^-$)				
$\bar{K}^*(892)^0 \pi^+ \pi^-$ total		(1.5 ± 0.4) %		683
× B($\bar{K}^{*0} \rightarrow K^- \pi^+$)				
$\bar{K}^*(892)^0 \pi^+ \pi^-$ 3-body		(9.5 ± 2.1) × 10 ⁻³		683
× B($\bar{K}^{*0} \rightarrow K^- \pi^+$)				
$K_1(1270)^- \pi^+$	[rr]	(3.6 ± 1.0) × 10 ⁻³		483
× B($K_1(1270)^- \rightarrow K^- \pi^+ \pi^-$)				
$K^- \pi^+ \pi^+ \pi^-$ nonresonant		(1.76 ± 0.25) %		812
$\bar{K}^0 \pi^+ \pi^- \pi^0$	[qq]	(10.0 ± 1.2) %		812
$\bar{K}^0 \eta \times B(\eta \rightarrow \pi^+ \pi^- \pi^0)$		(1.6 ± 0.3) × 10 ⁻³		772
$\bar{K}^0 \omega \times B(\omega \rightarrow \pi^+ \pi^- \pi^0)$		(1.9 ± 0.4) %		670
$K^*(892)^- \rho^+$		(4.1 ± 1.6) %		422
× B($K^{*-} \rightarrow \bar{K}^0 \pi^-$)				
$\bar{K}^*(892)^0 \rho^0$		(4.9 ± 1.1) × 10 ⁻³		418
× B($\bar{K}^{*0} \rightarrow \bar{K}^0 \pi^0$)				
$K_1(1270)^- \pi^+$	[rr]	(5.1 ± 1.4) × 10 ⁻³		483
× B($K_1(1270)^- \rightarrow \bar{K}^0 \pi^- \pi^0$)				
$\bar{K}^*(892)^0 \pi^+ \pi^-$ 3-body		(4.8 ± 1.1) × 10 ⁻³		683
× B($\bar{K}^{*0} \rightarrow \bar{K}^0 \pi^0$)				
$\bar{K}^0 \pi^+ \pi^- \pi^0$ nonresonant		(2.1 ± 2.1) %		812
$K^- \pi^+ \pi^0 \pi^0$		(15 ± 5) %		815
$K^- \pi^+ \pi^+ \pi^- \pi^0$		(4.1 ± 0.4) %		771
$\bar{K}^*(892)^0 \pi^+ \pi^- \pi^0$		(1.2 ± 0.6) %		641
× B($\bar{K}^{*0} \rightarrow K^- \pi^+$)				
$\bar{K}^*(892)^0 \eta$		(2.9 ± 0.8) × 10 ⁻³		580
× B($\bar{K}^{*0} \rightarrow K^- \pi^+$)				
× B($\eta \rightarrow \pi^+ \pi^- \pi^0$)				
$K^- \pi^+ \omega \times B(\omega \rightarrow \pi^+ \pi^- \pi^0)$		(2.7 ± 0.5) %		605
$\bar{K}^*(892)^0 \omega$		(7 ± 3) × 10 ⁻³		406
× B($\bar{K}^{*0} \rightarrow K^- \pi^+$)				
× B($\omega \rightarrow \pi^+ \pi^- \pi^0$)				
$\bar{K}^0 \pi^+ \pi^+ \pi^- \pi^-$		(5.8 ± 1.6) × 10 ⁻³		768
$\bar{K}^0 \pi^+ \pi^- \pi^0 \pi^0 (\pi^0)$		(10.6 $\begin{smallmatrix} +7.3 \\ -3.0 \end{smallmatrix}$) %		771
$\bar{K}^0 K^+ K^-$		(9.4 ± 1.0) × 10 ⁻³		544
$\bar{K}^0 \phi \times B(\phi \rightarrow K^+ K^-)$		(4.3 ± 0.5) × 10 ⁻³		520
$\bar{K}^0 K^+ K^-$ non- ϕ		(5.1 ± 0.8) × 10 ⁻³		544

$K_S^0 K_S^0 K_S^0$	$(8.4 \pm 1.5) \times 10^{-4}$	538
$K^+ K^- K^- \pi^+$	$(2.1 \pm 0.5) \times 10^{-4}$	434
$K^+ K^- \bar{K}^0 \pi^0$	$(7.2 \begin{smallmatrix} +4.8 \\ -3.5 \end{smallmatrix}) \times 10^{-3}$	435

Fractions of many of the following modes with resonances have already appeared above as submodes of particular charged-particle modes. (Modes for which there are only upper limits and $\bar{K}^*(892)\rho$ submodes only appear below.)

$\bar{K}^0 \eta$	$(7.1 \pm 1.0) \times 10^{-3}$		772
$\bar{K}^0 \rho^0$	$(1.21 \pm 0.17) \%$		676
$K^- \rho^+$	$(10.8 \pm 1.0) \%$	S=1.2	678
$\bar{K}^0 \omega$	$(2.1 \pm 0.4) \%$		670
$\bar{K}^0 \eta'(958)$	$(1.72 \pm 0.26) \%$		565
$\bar{K}^0 f_0(980)$	$(5.7 \pm 1.6) \times 10^{-3}$		549
$\bar{K}^0 \phi$	$(8.6 \pm 1.0) \times 10^{-3}$		520
$K^- a_1(1260)^+$	$(7.3 \pm 1.1) \%$		327
$\bar{K}^0 a_1(1260)^0$	$< 1.9 \%$	CL=90%	322
$\bar{K}^0 f_2(1270)$	$(4.2 \pm 1.5) \times 10^{-3}$		263
$K^- a_2(1320)^+$	$< 2 \times 10^{-3}$	CL=90%	197
$\bar{K}^0 f_0(1370)$	$(7.0 \pm 2.1) \times 10^{-3}$		—
$K^*(892)^- \pi^+$	$(5.1 \pm 0.4) \%$	S=1.2	711
$\bar{K}^*(892)^0 \pi^0$	$(3.2 \pm 0.4) \%$		709
$\bar{K}^*(892)^0 \pi^+ \pi^-$ total	$(2.3 \pm 0.5) \%$		683
$\bar{K}^*(892)^0 \pi^+ \pi^-$ 3-body	$(1.43 \pm 0.32) \%$		683
$K^- \pi^+ \rho^0$ total	$(6.3 \pm 0.4) \%$		612
$K^- \pi^+ \rho^0$ 3-body	$(4.8 \pm 2.1) \times 10^{-3}$		612
$\bar{K}^*(892)^0 \rho^0$	$(1.47 \pm 0.33) \%$		418
$\bar{K}^*(892)^0 \rho^0$ transverse	$(1.5 \pm 0.5) \%$		418
$\bar{K}^*(892)^0 \rho^0$ S-wave	$(2.8 \pm 0.6) \%$		418
$\bar{K}^*(892)^0 \rho^0$ S-wave long.	$< 3 \times 10^{-3}$	CL=90%	418
$\bar{K}^*(892)^0 \rho^0$ P-wave	$< 3 \times 10^{-3}$	CL=90%	418
$\bar{K}^*(892)^0 \rho^0$ D-wave	$(1.9 \pm 0.6) \%$		418
$K^*(892)^- \rho^+$	$(6.1 \pm 2.4) \%$		422
$K^*(892)^- \rho^+$ longitudinal	$(2.9 \pm 1.2) \%$		422
$K^*(892)^- \rho^+$ transverse	$(3.2 \pm 1.8) \%$		422
$K^*(892)^- \rho^+$ P-wave	$< 1.5 \%$	CL=90%	422
$K^- \pi^+ f_0(980)$	$< 1.1 \%$	CL=90%	459
$\bar{K}^*(892)^0 f_0(980)$	$< 7 \times 10^{-3}$	CL=90%	—
$K_1(1270)^- \pi^+$	[rr] $(1.06 \pm 0.29) \%$		483
$K_1(1400)^- \pi^+$	$< 1.2 \%$	CL=90%	386
$\bar{K}_1(1400)^0 \pi^0$	$< 3.7 \%$	CL=90%	387

$K^*(1410)^- \pi^+$	< 1.2	%	CL=90%	378
$K_0^*(1430)^- \pi^+$	(1.04 ± 0.26)	%		364
$K_2^*(1430)^- \pi^+$	< 8	$\times 10^{-3}$	CL=90%	367
$\bar{K}_2^*(1430)^0 \pi^0$	< 4	$\times 10^{-3}$	CL=90%	363
$\bar{K}^*(892)^0 \pi^+ \pi^- \pi^0$	(1.8 ± 0.9)	%		641
$\bar{K}^*(892)^0 \eta$	(1.9 ± 0.5)	%		580
$K^- \pi^+ \omega$	(3.0 ± 0.6)	%		605
$\bar{K}^*(892)^0 \omega$	(1.1 ± 0.5)	%		406
$K^- \pi^+ \eta'(958)$	(7.0 ± 1.8)	$\times 10^{-3}$		479
$\bar{K}^*(892)^0 \eta'(958)$	< 1.1	$\times 10^{-3}$	CL=90%	99

Pionic modes

$\pi^+ \pi^-$	(1.53 ± 0.09)	$\times 10^{-3}$		922
$\pi^0 \pi^0$	(8.5 ± 2.2)	$\times 10^{-4}$		922
$\pi^+ \pi^- \pi^0$	(1.6 ± 1.1)	%	S=2.7	907
$\pi^+ \pi^+ \pi^- \pi^-$	(7.4 ± 0.6)	$\times 10^{-3}$		879
$\pi^+ \pi^+ \pi^- \pi^- \pi^0$	(1.9 ± 0.4)	%		844
$\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^-$	(4.0 ± 3.0)	$\times 10^{-4}$		795

Hadronic modes with a $K\bar{K}$ pair

K^+K^-	$(4.27 \pm 0.16) \times 10^{-3}$		791
$K^0\bar{K}^0$	$(6.5 \pm 1.8) \times 10^{-4}$	S=1.2	788
$K^0K^-\pi^+$	$(6.4 \pm 1.0) \times 10^{-3}$	S=1.1	739
$\bar{K}^*(892)^0K^0$ $\times B(\bar{K}^{*0} \rightarrow K^-\pi^+)$	$< 1.1 \times 10^{-3}$	CL=90%	605
$K^*(892)^+K^-$ $\times B(K^{*+} \rightarrow K^0\pi^+)$	$(2.3 \pm 0.5) \times 10^{-3}$		610
$K^0K^-\pi^+$ nonresonant	$(2.3 \pm 2.3) \times 10^{-3}$		739
$\bar{K}^0K^+\pi^-$	$(5.0 \pm 1.0) \times 10^{-3}$		739
$K^*(892)^0\bar{K}^0$ $\times B(K^{*0} \rightarrow K^+\pi^-)$	$< 5 \times 10^{-4}$	CL=90%	605
$K^*(892)^-K^+$ $\times B(K^{*-} \rightarrow \bar{K}^0\pi^-)$	$(1.2 \pm 0.7) \times 10^{-3}$		610
$\bar{K}^0K^+\pi^-$ nonresonant	$(3.9 \pm_{-1.9}^{+2.3}) \times 10^{-3}$		739
$K^+K^-\pi^0$	$(1.3 \pm 0.4) \times 10^{-3}$		742
$K_S^0K_S^0\pi^0$	$< 5.9 \times 10^{-4}$		739
$K^+K^-\pi^+\pi^-$	[vv] $(2.52 \pm 0.24) \times 10^{-3}$		676
$\phi\pi^+\pi^- \times B(\phi \rightarrow K^+K^-)$	$(5.3 \pm 1.4) \times 10^{-4}$		614
$\phi\rho^0 \times B(\phi \rightarrow K^+K^-)$	$(3.0 \pm 1.6) \times 10^{-4}$		260
$K^+K^-\rho^0$ 3-body	$(9.1 \pm 2.3) \times 10^{-4}$		309
$K^*(892)^0K^-\pi^+ + c.c.$	[ww] $< 5 \times 10^{-4}$		528
$\times B(K^{*0} \rightarrow K^+\pi^-)$			
$K^*(892)^0\bar{K}^*(892)^0$ $\times B^2(K^{*0} \rightarrow K^+\pi^-)$	$(6 \pm 2) \times 10^{-4}$		257
$K^+K^-\pi^+\pi^-$ non- ϕ	—		676
$K^+K^-\pi^+\pi^-$ nonresonant	$< 8 \times 10^{-4}$	CL=90%	676
$K^0\bar{K}^0\pi^+\pi^-$	$(6.9 \pm 2.7) \times 10^{-3}$		673
$K^+K^-\pi^+\pi^-\pi^0$	$(3.1 \pm 2.0) \times 10^{-3}$		600

Fractions of most of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\bar{K}^*(892)^0K^0$	$< 1.6 \times 10^{-3}$	CL=90%	605
$K^*(892)^+K^-$	$(3.5 \pm 0.8) \times 10^{-3}$		610
$K^*(892)^0\bar{K}^0$	$< 8 \times 10^{-4}$	CL=90%	605
$K^*(892)^-K^+$	$(1.8 \pm 1.0) \times 10^{-3}$		610
$\phi\pi^0$	$< 1.4 \times 10^{-3}$	CL=90%	644
$\phi\eta$	$< 2.8 \times 10^{-3}$	CL=90%	489
$\phi\omega$	$< 2.1 \times 10^{-3}$	CL=90%	239
$\phi\pi^+\pi^-$	$(1.08 \pm 0.29) \times 10^{-3}$		614
$\phi\rho^0$	$(6 \pm 3) \times 10^{-4}$		260
$\phi\pi^+\pi^-$ 3-body	$(7 \pm 5) \times 10^{-4}$		614
$K^*(892)^0K^-\pi^+ + c.c.$	[ww] $< 8 \times 10^{-4}$	CL=90%	—
$K^*(892)^0\bar{K}^*(892)^0$	$(1.4 \pm 0.5) \times 10^{-3}$		257

**Doubly Cabibbo suppressed (DC) modes,
 $\Delta C = 2$ forbidden via mixing (C2M) modes,
 $\Delta C = 1$ weak neutral current (C1) modes, or
 Lepton Family number (LF) violating modes**

$K^+ \ell^- \bar{\nu}_\ell$ (via \bar{D}^0)	C2M	< 1.7	$\times 10^{-4}$	CL=90%	–
$K^+ \pi^-$ or $K^+ \pi^- \pi^+ \pi^-$ (via \bar{D}^0)	C2M	< 1.0	$\times 10^{-3}$	CL=90%	–
$K^+ \pi^-$	DC	(2.8 \pm 0.9)	$\times 10^{-4}$		861
$K^+ \pi^-$ (via \bar{D}^0)		< 1.9	$\times 10^{-4}$	CL=90%	861
$K^+ \pi^- \pi^+ \pi^-$	DC	(1.9 \pm 2.7)	$\times 10^{-4}$		812
$K^+ \pi^- \pi^+ \pi^-$ (via \bar{D}^0)		< 4	$\times 10^{-4}$	CL=90%	812
μ^- anything (via \bar{D}^0)		< 4	$\times 10^{-4}$	CL=90%	–
$e^+ e^-$	C1	< 1.3	$\times 10^{-5}$	CL=90%	932
$\mu^+ \mu^-$	C1	< 4.1	$\times 10^{-6}$	CL=90%	926
$\pi^0 e^+ e^-$	C1	< 4.5	$\times 10^{-5}$	CL=90%	927
$\pi^0 \mu^+ \mu^-$	C1	< 1.8	$\times 10^{-4}$	CL=90%	915
$\eta e^+ e^-$	C1	< 1.1	$\times 10^{-4}$	CL=90%	852
$\eta \mu^+ \mu^-$	C1	< 5.3	$\times 10^{-4}$	CL=90%	838
$\rho^0 e^+ e^-$	C1	< 1.0	$\times 10^{-4}$	CL=90%	773
$\rho^0 \mu^+ \mu^-$	C1	< 2.3	$\times 10^{-4}$	CL=90%	756
$\omega e^+ e^-$	C1	< 1.8	$\times 10^{-4}$	CL=90%	768
$\omega \mu^+ \mu^-$	C1	< 8.3	$\times 10^{-4}$	CL=90%	751
$\phi e^+ e^-$	C1	< 5.2	$\times 10^{-5}$	CL=90%	654
$\phi \mu^+ \mu^-$	C1	< 4.1	$\times 10^{-4}$	CL=90%	631
$\bar{K}^0 e^+ e^-$	[ss]	< 1.1	$\times 10^{-4}$	CL=90%	866
$\bar{K}^0 \mu^+ \mu^-$	[ss]	< 2.6	$\times 10^{-4}$	CL=90%	852
$\bar{K}^*(892)^0 e^+ e^-$	[ss]	< 1.4	$\times 10^{-4}$	CL=90%	717
$\bar{K}^*(892)^0 \mu^+ \mu^-$	[ss]	< 1.18	$\times 10^{-3}$	CL=90%	698
$\pi^+ \pi^- \pi^0 \mu^+ \mu^-$	C1	< 8.1	$\times 10^{-4}$	CL=90%	863
$\mu^\pm e^\mp$	LF	[gg] < 1.9	$\times 10^{-5}$	CL=90%	929
$\pi^0 e^\pm \mu^\mp$	LF	[gg] < 8.6	$\times 10^{-5}$	CL=90%	924
$\eta e^\pm \mu^\mp$	LF	[gg] < 1.0	$\times 10^{-4}$	CL=90%	848
$\rho^0 e^\pm \mu^\mp$	LF	[gg] < 4.9	$\times 10^{-5}$	CL=90%	769
$\omega e^\pm \mu^\mp$	LF	[gg] < 1.2	$\times 10^{-4}$	CL=90%	764
$\phi e^\pm \mu^\mp$	LF	[gg] < 3.4	$\times 10^{-5}$	CL=90%	648
$\bar{K}^0 e^\pm \mu^\mp$	LF	[gg] < 1.0	$\times 10^{-4}$	CL=90%	862
$\bar{K}^*(892)^0 e^\pm \mu^\mp$	LF	[gg] < 1.0	$\times 10^{-4}$	CL=90%	712

$D^*(2007)^0$

$$I(J^P) = \frac{1}{2}(1^-)$$

I, J, P need confirmation.

$$\text{Mass } m = 2006.7 \pm 0.5 \text{ MeV} \quad (S = 1.1)$$

$$m_{D^{*0}} - m_{D^0} = 142.12 \pm 0.07 \text{ MeV}$$

$$\text{Full width } \Gamma < 2.1 \text{ MeV, CL} = 90\%$$

$\bar{D}^*(2007)^0$ modes are charge conjugates of modes below.

$D^*(2007)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0 \pi^0$	(61.9±2.9) %	43
$D^0 \gamma$	(38.1±2.9) %	137

 $D^*(2010)^\pm$

$$I(J^P) = \frac{1}{2}(1^-)$$

I, J, P need confirmation.

$$\text{Mass } m = 2010.0 \pm 0.5 \text{ MeV} \quad (S = 1.1)$$

$$m_{D^*(2010)^+} - m_{D^+} = 140.64 \pm 0.10 \text{ MeV} \quad (S = 1.1)$$

$$m_{D^*(2010)^+} - m_{D^0} = 145.397 \pm 0.030 \text{ MeV}$$

$$\text{Full width } \Gamma < 0.131 \text{ MeV, CL} = 90\%$$

$D^*(2010)^-$ modes are charge conjugates of the modes below.

$D^*(2010)^\pm$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0 \pi^+$	(68.3±1.4) %	39
$D^+ \pi^0$	(30.6±2.5) %	38
$D^+ \gamma$	(1.1 ^{+2.1} _{-0.7}) %	136

 $D_1(2420)^0$

$$I(J^P) = \frac{1}{2}(1^+)$$

I, J, P need confirmation.

$$\text{Mass } m = 2422.2 \pm 1.8 \text{ MeV} \quad (S = 1.2)$$

$$\text{Full width } \Gamma = 18.9^{+4.6}_{-3.5} \text{ MeV}$$

$\bar{D}_1(2420)^0$ modes are charge conjugates of modes below.

$D_1(2420)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^*(2010)^+ \pi^-$	seen	355
$D^+ \pi^-$	not seen	474

$D_2^*(2460)^0$

$$I(J^P) = \frac{1}{2}(2^+)$$

$J^P = 2^+$ assignment strongly favored (ALBRECHT 89B).

$$\text{Mass } m = 2458.9 \pm 2.0 \text{ MeV} \quad (S = 1.2)$$

$$\text{Full width } \Gamma = 23 \pm 5 \text{ MeV}$$

$\bar{D}_2^*(2460)^0$ modes are charge conjugates of modes below.

$D_2^*(2460)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^+ \pi^-$	seen	503
$D^*(2010)^+ \pi^-$	seen	387

 $D_2^*(2460)^\pm$

$$I(J^P) = \frac{1}{2}(2^+)$$

$J^P = 2^+$ assignment strongly favored (ALBRECHT 89B).

$$\text{Mass } m = 2459 \pm 4 \text{ MeV} \quad (S = 1.7)$$

$$m_{D_2^*(2460)^\pm} - m_{D_2^*(2460)^0} = 0.9 \pm 3.3 \text{ MeV} \quad (S = 1.1)$$

$$\text{Full width } \Gamma = 25^{+8}_{-7} \text{ MeV}$$

$D_2^*(2460)^-$ modes are charge conjugates of modes below.

$D_2^*(2460)^\pm$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0 \pi^+$	seen	508
$D^{*0} \pi^+$	seen	390

CHARMED, STRANGE MESONS

($C = S = \pm 1$)

$$D_s^+ = c\bar{s}, D_s^- = \bar{c}s, \quad \text{similarly for } D_s^{*'}\text{'s}$$

D_s^\pm
was F^\pm

$$I(J^P) = 0(0^-)$$

$$\text{Mass } m = 1968.5 \pm 0.6 \text{ MeV} \quad (S = 1.1)$$

$$m_{D_s^\pm} - m_{D^\pm} = 99.2 \pm 0.5 \text{ MeV} \quad (S = 1.1)$$

$$\text{Mean life } \tau = (0.467 \pm 0.017) \times 10^{-12} \text{ s}$$

$$c\tau = 140 \mu\text{m}$$

D_s^+ form factors

$$r_2 = 1.6 \pm 0.4$$

$$r_V = 1.5 \pm 0.5$$

$$\Gamma_L/\Gamma_T = 0.72 \pm 0.18$$

Branching fractions for modes with a resonance in the final state include all the decay modes of the resonance. D_s^- modes are charge conjugates of the modes below.

D_s^+ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Inclusive modes			
K^- anything	(13 $\begin{smallmatrix} +14 \\ -12 \end{smallmatrix}$) %		—
\bar{K}^0 anything + K^0 anything	(39 ± 28) %		—
K^+ anything	(20 $\begin{smallmatrix} +18 \\ -14 \end{smallmatrix}$) %		—
non- $K\bar{K}$ anything	(64 ± 17) %		—
e^+ anything	(8 $\begin{smallmatrix} + 6 \\ - 5 \end{smallmatrix}$) %		—
ϕ anything	(18 $\begin{smallmatrix} +15 \\ -10 \end{smallmatrix}$) %		—
Leptonic and semileptonic modes			
$\mu^+ \nu_\mu$	(4.0 $\begin{smallmatrix} + 2.2 \\ - 2.0 \end{smallmatrix}$) $\times 10^{-3}$	S=1.4	981
$\tau^+ \nu_\tau$	(7 ± 4) %		182
$\phi \ell^+ \nu_\ell$	[xx] (2.0 ± 0.5) %		—
$\eta \ell^+ \nu_\ell + \eta'(958) \ell^+ \nu_\ell$	[xx] (3.4 ± 1.0) %		—
$\eta \ell^+ \nu_\ell$	(2.5 ± 0.7) %		—
$\eta'(958) \ell^+ \nu_\ell$	(8.8 ± 3.4) $\times 10^{-3}$		—

Hadronic modes with a $K\bar{K}$ pair (including from a ϕ)

$K^+\bar{K}^0$	(3.6 ± 1.1) %		850
$K^+K^-\pi^+$	[qq] (4.4 ± 1.2) %	S=1.1	805
$\phi\pi^+$	[yy] (3.6 ± 0.9) %		712
$K^+\bar{K}^*(892)^0$	[yy] (3.3 ± 0.9) %		682
$f_0(980)\pi^+$	[yy] (1.8 ± 0.8) %	S=1.3	732
$K^+\bar{K}_0^*(1430)^0$	[yy] (7 ± 4) × 10 ⁻³		186
$f_J(1710)\pi^+ \rightarrow K^+K^-\pi^+$	[zz] (1.5 ± 1.9) × 10 ⁻³		204
$K^+K^-\pi^+$ nonresonant	(9 ± 4) × 10 ⁻³		805
$K^0\bar{K}^0\pi^+$	—		802
$K^*(892)^+\bar{K}^0$	[yy] (4.3 ± 1.4) %		683
$K^+K^-\pi^+\pi^0$	—		748
$\phi\pi^+\pi^0$	[yy] (9 ± 5) %		687
$\phi\rho^+$	[yy] (6.7 ± 2.3) %		407
$\phi\pi^+\pi^0$ 3-body	[yy] < 2.6 %	CL=90%	687
$K^+K^-\pi^+\pi^0$ non- ϕ	< 9 %	CL=90%	748
$K^+\bar{K}^0\pi^+\pi^-$	< 2.8 %	CL=90%	744
$K^0K^-\pi^+\pi^+$	(4.3 ± 1.5) %		744
$K^*(892)^+\bar{K}^*(892)^0$	[yy] (5.8 ± 2.5) %		412
$K^0K^-\pi^+\pi^+$ non- $K^*\bar{K}^*$	< 2.9 %	CL=90%	744
$K^+K^-\pi^+\pi^+\pi^-$	(8.3 ± 3.3) × 10 ⁻³		673
$\phi\pi^+\pi^+\pi^-$	[yy] (1.18 ± 0.35) %		640
$K^+K^-\pi^+\pi^+\pi^-$ non- ϕ	(3.0 ^{+3.0} _{-2.0}) × 10 ⁻³		673

Hadronic modes without K 's

$\pi^+\pi^+\pi^-$	(1.0 ± 0.4) %	S=1.2	959
$\rho^0\pi^+$	< 8 × 10 ⁻⁴	CL=90%	827
$f_0(980)\pi^+$	[yy] (1.8 ± 0.8) %	S=1.7	732
$f_2(1270)\pi^+$	[yy] (2.3 ± 1.3) × 10 ⁻³		559
$f_0(1500)\pi^+ \rightarrow \pi^+\pi^-\pi^+$	[aaa] (2.8 ± 1.6) × 10 ⁻³		391
$\pi^+\pi^+\pi^-\pi^0$ nonresonant	< 2.8 × 10 ⁻³	CL=90%	959
$\pi^+\pi^+\pi^-\pi^0$	< 12 %	CL=90%	935
$\eta\pi^+$	[yy] (2.0 ± 0.6) %		902
$\omega\pi^+$	[yy] (3.1 ± 1.4) × 10 ⁻³		822
$\pi^+\pi^+\pi^+\pi^-\pi^-$	(6.9 ± 3.0) × 10 ⁻³		899
$\pi^+\pi^+\pi^-\pi^0\pi^0$	—		902
$\eta\rho^+$	[yy] (10.3 ± 3.2) %		727
$\eta\pi^+\pi^0$ 3-body	[yy] < 3.0 %	CL=90%	886
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0$	(4.9 ± 3.2) %		856
$\eta'(958)\pi^+$	[yy] (4.9 ± 1.8) %		743
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0\pi^0$	—		803
$\eta'(958)\rho^+$	[yy] (12 ± 4) %		470
$\eta'(958)\pi^+\pi^0$ 3-body	[yy] < 3.1 %	CL=90%	720

Modes with one or three K's

$K^0 \pi^+$		< 8	$\times 10^{-3}$	CL=90%	916
$K^+ \pi^+ \pi^-$		(1.0 ± 0.4)	%		900
$K^+ \rho^0$		< 2.9	$\times 10^{-3}$	CL=90%	747
$K^*(892)^0 \pi^+$	[$\gamma\gamma$]	(6.5 ± 2.8)	$\times 10^{-3}$		773
$K^+ K^+ K^-$		< 6	$\times 10^{-4}$	CL=90%	628
ϕK^+	[$\gamma\gamma$]	< 5	$\times 10^{-4}$	CL=90%	607

 **$\Delta C = 1$ weak neutral current (C1) modes, or
Lepton number (L) violating modes**

$\pi^+ \mu^+ \mu^-$		[ss]	< 4.3	$\times 10^{-4}$	CL=90%	968
$K^+ \mu^+ \mu^-$	C1		< 5.9	$\times 10^{-4}$	CL=90%	909
$K^*(892)^+ \mu^+ \mu^-$	C1		< 1.4	$\times 10^{-3}$	CL=90%	765
$\pi^- \mu^+ \mu^+$	L		< 4.3	$\times 10^{-4}$	CL=90%	968
$K^- \mu^+ \mu^+$	L		< 5.9	$\times 10^{-4}$	CL=90%	909
$K^*(892)^- \mu^+ \mu^+$	L		< 1.4	$\times 10^{-3}$	CL=90%	765

$D_s^{*\pm}$

$$I(J^P) = 0(??)$$

J^P is natural, width and decay modes consistent with 1^- .

$$\text{Mass } m = 2112.4 \pm 0.7 \text{ MeV} \quad (S = 1.1)$$

$$m_{D_s^{*\pm}} - m_{D_s^\pm} = 143.8 \pm 0.4 \text{ MeV}$$

$$\text{Full width } \Gamma < 1.9 \text{ MeV, CL} = 90\%$$

D_s^{*-} modes are charge conjugates of the modes below.

D_s^{*+} DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D_s^+ \gamma$	(94.2 ± 2.5) %	139
$D_s^+ \pi^0$	(5.8 ± 2.5) %	48

$D_{s1}(2536)^\pm$

$I(J^P) = 0(1^+)$
 J, P need confirmation.

Mass $m = 2535.35 \pm 0.34 \pm 0.5$ MeV

Full width $\Gamma < 2.3$ MeV, CL = 90%

$D_{s1}(2536)^-$ modes are charge conjugates of the modes below.

$D_{s1}(2536)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^*(2010)^+ K^0$	seen	150
$D^*(2007)^0 K^+$	seen	169
$D^+ K^0$	not seen	382
$D^0 K^+$	not seen	392
$D_s^{*+} \gamma$	possibly seen	389

$D_{sJ}(2573)^\pm$

$I(J^P) = 0(?^?)$

J^P is natural, width and decay modes consistent with 2^+ .

Mass $m = 2573.5 \pm 1.7$ MeV

Full width $\Gamma = 15^{+5}_{-4}$ MeV

$D_{sJ}(2573)^-$ modes are charge conjugates of the modes below.

$D_{sJ}(2573)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0 K^+$	seen	436
$D^*(2007)^0 K^+$	not seen	245

BOTTOM MESONS

$$(B = \pm 1)$$

$$B^+ = u\bar{b}, B^0 = d\bar{b}, \bar{B}^0 = \bar{d}b, B^- = \bar{u}b, \text{ similarly for } B^{*'}\text{'s}$$

***B*-particle organization**

Many measurements of B decays involve admixtures of B hadrons. Previously we arbitrarily included such admixtures in the B^\pm section, but because of their importance we have created two new sections: " B^\pm/B^0 Admixture" for $\gamma(4S)$ results and " $B^\pm/B^0/B_s^0/b$ -baryon Admixture" for results at higher energies. Most inclusive decay branching fractions are found in the Admixture sections. B^0 - \bar{B}^0 mixing data are found in the B^0 section, while B_s^0 - \bar{B}_s^0 mixing data and B - \bar{B} mixing data for a B^0/B_s^0 admixture are found in the B_s^0 section. CP -violation data are found in the B^0 section. b -baryons are found near the end of the Baryon section.

The organization of the B sections is now as follows, where bullets indicate particle sections and brackets indicate reviews.

[Production and Decay of b -flavored Hadrons]

- B^\pm

- mass, mean life
 - branching fractions

- B^0

- mass, mean life
 - branching fractions
 - polarization in B^0 decay
 - B^0 - \bar{B}^0 mixing

- [CP Violation in B Decay]

- CP violation

- B^\pm B^0 Admixtures

- branching fractions

- $B^\pm/B^0/B_s^0/b$ -baryon Admixtures

- mean life
 - production fractions
 - branching fractions

- B^*

- mass

- B_s^0

- mass, mean life
 - branching fractions
 - polarization in B_s^0 decay

- B_s^0 - \bar{B}_s^0 mixing

- B - \bar{B} mixing (admixture of B^0 , B_s^0)

At end of Baryon Listings:

- Λ_b

- mass, mean life
 - branching fractions

- b -baryon Admixture

- mean life
 - branching fractions

B^\pm

$$I(J^P) = \frac{1}{2}(0^-)$$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

$$\text{Mass } m_{B^\pm} = 5278.9 \pm 1.8 \text{ MeV}$$

$$\text{Mean life } \tau_{B^\pm} = (1.65 \pm 0.04) \times 10^{-12} \text{ s}$$

$$c\tau = 495 \text{ } \mu\text{m}$$

B^- modes are charge conjugates of the modes below. Modes which do not identify the charge state of the B are listed in the B^\pm/B^0 ADMIXTURE section.

The branching fractions listed below assume 50% $B^0\bar{B}^0$ and 50% B^+B^- production at the $\Upsilon(4S)$. We have attempted to bring older measurements up to date by rescaling their assumed $\Upsilon(4S)$ production ratio to 50:50 and their assumed D, D_s, D^* , and ψ branching ratios to current values whenever this would affect our averages and best limits significantly.

Indentation is used to indicate a subchannel of a previous reaction. All resonant subchannels have been corrected for resonance branching fractions to the final state so the sum of the subchannel branching fractions can exceed that of the final state.

B^+ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Semileptonic and leptonic modes			
$l^+ \nu_l$ anything	[pp] (10.3 \pm 0.9) %		—
$\bar{D}^0 l^+ \nu_l$	[pp] (1.86 \pm 0.33) %		—
$\bar{D}^*(2007)^0 l^+ \nu_l$	[pp] (5.3 \pm 0.8) %		—
$\pi^0 e^+ \nu_e$	< 2.2	$\times 10^{-3}$ CL=90%	2638
$\omega l^+ \nu_l$	[pp] < 2.1	$\times 10^{-4}$ CL=90%	—
$\rho^0 l^+ \nu_l$	[pp] < 2.1	$\times 10^{-4}$ CL=90%	—
$e^+ \nu_e$	< 1.5	$\times 10^{-5}$ CL=90%	2639
$\mu^+ \nu_\mu$	< 2.1	$\times 10^{-5}$ CL=90%	2638
$\tau^+ \nu_\tau$	< 5.7	$\times 10^{-4}$ CL=90%	2340
$e^+ \nu_e \gamma$	< 2.0	$\times 10^{-4}$ CL=90%	—
$\mu^+ \nu_\mu \gamma$	< 5.2	$\times 10^{-5}$ CL=90%	—

D , D^* , or D_s modes

$\overline{D}^0 \pi^+$	$(5.3 \pm 0.5) \times 10^{-3}$		2308
$\overline{D}^0 \rho^+$	$(1.34 \pm 0.18) \%$		2238
$\overline{D}^0 \pi^+ \pi^+ \pi^-$	$(1.1 \pm 0.4) \%$		2289
$\overline{D}^0 \pi^+ \pi^+ \pi^-$ nonresonant	$(5 \pm 4) \times 10^{-3}$		2289
$\overline{D}^0 \pi^+ \rho^0$	$(4.2 \pm 3.0) \times 10^{-3}$		2209
$\overline{D}^0 a_1(1260)^+$	$(5 \pm 4) \times 10^{-3}$		2123
$D^{*-}(2010)^- \pi^+ \pi^+$	$(2.1 \pm 0.6) \times 10^{-3}$		2247
$D^- \pi^+ \pi^+$	$< 1.4 \times 10^{-3}$	CL=90%	2299
$\overline{D}^{*}(2007)^0 \pi^+$	$(4.6 \pm 0.4) \times 10^{-3}$		2256
$D^{*}(2010)^+ \pi^0$	$< 1.7 \times 10^{-4}$	CL=90%	2254
$\overline{D}^{*}(2007)^0 \rho^+$	$(1.55 \pm 0.31) \%$		2183
$\overline{D}^{*}(2007)^0 \pi^+ \pi^+ \pi^-$	$(9.4 \pm 2.6) \times 10^{-3}$		2236
$\overline{D}^{*}(2007)^0 a_1(1260)^+$	$(1.9 \pm 0.5) \%$		2062
$D^{*}(2010)^- \pi^+ \pi^+ \pi^0$	$(1.5 \pm 0.7) \%$		2235
$D^{*}(2010)^- \pi^+ \pi^+ \pi^+ \pi^-$	$< 1 \%$	CL=90%	2217
$\overline{D}_1^{*}(2420)^0 \pi^+$	$(1.5 \pm 0.6) \times 10^{-3}$	S=1.3	2081
$\overline{D}_1^{*}(2420)^0 \rho^+$	$< 1.4 \times 10^{-3}$	CL=90%	1997
$\overline{D}_2^{*}(2460)^0 \pi^+$	$< 1.3 \times 10^{-3}$	CL=90%	2064
$\overline{D}_2^{*}(2460)^0 \rho^+$	$< 4.7 \times 10^{-3}$	CL=90%	1979
$\overline{D}^0 D_s^+$	$(1.3 \pm 0.4) \%$		1815
$\overline{D}^0 D_s^{*+}$	$(9 \pm 4) \times 10^{-3}$		1734
$\overline{D}^{*}(2007)^0 D_s^+$	$(1.2 \pm 0.5) \%$		1737
$\overline{D}^{*}(2007)^0 D_s^{*+}$	$(2.7 \pm 1.0) \%$		1650
$D_s^+ \pi^0$	$< 2.0 \times 10^{-4}$	CL=90%	2270
$D_s^{*+} \pi^0$	$< 3.3 \times 10^{-4}$	CL=90%	2214
$D_s^+ \eta$	$< 5 \times 10^{-4}$	CL=90%	2235
$D_s^{*+} \eta$	$< 8 \times 10^{-4}$	CL=90%	2177
$D_s^+ \rho^0$	$< 4 \times 10^{-4}$	CL=90%	2198
$D_s^{*+} \rho^0$	$< 5 \times 10^{-4}$	CL=90%	2139
$D_s^+ \omega$	$< 5 \times 10^{-4}$	CL=90%	2195
$D_s^{*+} \omega$	$< 7 \times 10^{-4}$	CL=90%	2136
$D_s^+ a_1(1260)^0$	$< 2.2 \times 10^{-3}$	CL=90%	2079
$D_s^{*+} a_1(1260)^0$	$< 1.6 \times 10^{-3}$	CL=90%	2014
$D_s^+ \phi$	$< 3.2 \times 10^{-4}$	CL=90%	2141
$D_s^{*+} \phi$	$< 4 \times 10^{-4}$	CL=90%	2079
$D_s^+ \overline{K}^0$	$< 1.1 \times 10^{-3}$	CL=90%	2241
$D_s^{*+} \overline{K}^0$	$< 1.1 \times 10^{-3}$	CL=90%	2184
$D_s^+ \overline{K}^*(892)^0$	$< 5 \times 10^{-4}$	CL=90%	2171

$D_s^{*+} \bar{K}^*(892)^0$	< 4	$\times 10^{-4}$	CL=90%	2110
$D_s^- \pi^+ K^+$	< 8	$\times 10^{-4}$	CL=90%	2222
$D_s^{*-} \pi^+ K^+$	< 1.2	$\times 10^{-3}$	CL=90%	2164
$D_s^- \pi^+ K^*(892)^+$	< 6	$\times 10^{-3}$	CL=90%	2137
$D_s^{*-} \pi^+ K^*(892)^+$	< 8	$\times 10^{-3}$	CL=90%	2075

Charmonium modes

$J/\psi(1S) K^+$	(9.9 \pm 1.0)	$\times 10^{-4}$		1683
$J/\psi(1S) K^+ \pi^+ \pi^-$	(1.4 \pm 0.6)	$\times 10^{-3}$		1612
$J/\psi(1S) K^*(892)^+$	(1.47 \pm 0.27)	$\times 10^{-3}$		1571
$J/\psi(1S) \pi^+$	(5.0 \pm 1.5)	$\times 10^{-5}$		1727
$J/\psi(1S) \rho^+$	< 7.7	$\times 10^{-4}$	CL=90%	1613
$J/\psi(1S) a_1(1260)^+$	< 1.2	$\times 10^{-3}$	CL=90%	1414
$\psi(2S) K^+$	(6.9 \pm 3.1)	$\times 10^{-4}$	S=1.3	1284
$\psi(2S) K^*(892)^+$	< 3.0	$\times 10^{-3}$	CL=90%	1115
$\psi(2S) K^+ \pi^+ \pi^-$	(1.9 \pm 1.2)	$\times 10^{-3}$		909
$\chi_{c1}(1P) K^+$	(1.0 \pm 0.4)	$\times 10^{-3}$		1411
$\chi_{c1}(1P) K^*(892)^+$	< 2.1	$\times 10^{-3}$	CL=90%	1265

K or K* modes

$K^0 \pi^+$	(2.3 \pm 1.1)	$\times 10^{-5}$		2614
$K^+ \pi^0$	< 1.6	$\times 10^{-5}$	CL=90%	2615
$\eta' K^+$	(6.5 \pm 1.7)	$\times 10^{-5}$		2528
$\eta' K^*(892)^+$	< 1.3	$\times 10^{-4}$	CL=90%	2472
ηK^+	< 1.4	$\times 10^{-5}$	CL=90%	2587
$\eta K^*(892)^+$	< 3.0	$\times 10^{-5}$	CL=90%	2534
$K^*(892)^0 \pi^+$	< 4.1	$\times 10^{-5}$	CL=90%	2561
$K^*(892)^+ \pi^0$	< 9.9	$\times 10^{-5}$	CL=90%	2562
$K^+ \pi^- \pi^+$ nonresonant	< 2.8	$\times 10^{-5}$	CL=90%	2609
$K^- \pi^+ \pi^+$ nonresonant	< 5.6	$\times 10^{-5}$	CL=90%	—
$K_1(1400)^0 \pi^+$	< 2.6	$\times 10^{-3}$	CL=90%	2451
$K_2^*(1430)^0 \pi^+$	< 6.8	$\times 10^{-4}$	CL=90%	2443
$K^+ \rho^0$	< 1.9	$\times 10^{-5}$	CL=90%	2559
$K^0 \rho^+$	< 4.8	$\times 10^{-5}$	CL=90%	2559
$K^*(892)^+ \pi^+ \pi^-$	< 1.1	$\times 10^{-3}$	CL=90%	2556
$K^*(892)^+ \rho^0$	< 9.0	$\times 10^{-4}$	CL=90%	2505
$K_1(1400)^+ \rho^0$	< 7.8	$\times 10^{-4}$	CL=90%	2389
$K_2^*(1430)^+ \rho^0$	< 1.5	$\times 10^{-3}$	CL=90%	2382

$K^+ \bar{K}^0$	< 2.1	$\times 10^{-5}$	CL=90%	2592
$K^+ K^- \pi^+$ nonresonant	< 7.5	$\times 10^{-5}$	CL=90%	—
$K^+ K^- K^+$	< 2.0	$\times 10^{-4}$	CL=90%	2522
$K^+ \phi$	< 1.2	$\times 10^{-5}$	CL=90%	2516
$K^+ K^- K^+$ nonresonant	< 3.8	$\times 10^{-5}$	CL=90%	2516
$K^*(892)^+ K^+ K^-$	< 1.6	$\times 10^{-3}$	CL=90%	2466
$K^*(892)^+ \phi$	< 7.0	$\times 10^{-5}$	CL=90%	2460
$K_1(1400)^+ \phi$	< 1.1	$\times 10^{-3}$	CL=90%	2339
$K_2^*(1430)^+ \phi$	< 3.4	$\times 10^{-3}$	CL=90%	2332
$K^+ f_0(980)$	< 8	$\times 10^{-5}$	CL=90%	2524
$K^*(892)^+ \gamma$	$(5.7 \pm 3.3) \times 10^{-5}$			2564
$K_1(1270)^+ \gamma$	< 7.3	$\times 10^{-3}$	CL=90%	2486
$K_1(1400)^+ \gamma$	< 2.2	$\times 10^{-3}$	CL=90%	2453
$K_2^*(1430)^+ \gamma$	< 1.4	$\times 10^{-3}$	CL=90%	2447
$K^*(1680)^+ \gamma$	< 1.9	$\times 10^{-3}$	CL=90%	2361
$K_3^*(1780)^+ \gamma$	< 5.5	$\times 10^{-3}$	CL=90%	2343
$K_4^*(2045)^+ \gamma$	< 9.9	$\times 10^{-3}$	CL=90%	2243

Light unflavored meson modes

$\pi^+ \pi^0$	< 2.0	$\times 10^{-5}$	CL=90%	2636
$\pi^+ \pi^+ \pi^-$	< 1.3	$\times 10^{-4}$	CL=90%	2630
$\rho^0 \pi^+$	< 4.3	$\times 10^{-5}$	CL=90%	2582
$\pi^+ f_0(980)$	< 1.4	$\times 10^{-4}$	CL=90%	2547
$\pi^+ f_2(1270)$	< 2.4	$\times 10^{-4}$	CL=90%	2483
$\pi^+ \pi^- \pi^+$ nonresonant	< 4.1	$\times 10^{-5}$	CL=90%	—
$\pi^+ \pi^0 \pi^0$	< 8.9	$\times 10^{-4}$	CL=90%	2631
$\rho^+ \pi^0$	< 7.7	$\times 10^{-5}$	CL=90%	2582
$\pi^+ \pi^- \pi^+ \pi^0$	< 4.0	$\times 10^{-3}$	CL=90%	2621
$\rho^+ \rho^0$	< 1.0	$\times 10^{-3}$	CL=90%	2525
$a_1(1260)^+ \pi^0$	< 1.7	$\times 10^{-3}$	CL=90%	2494
$a_1(1260)^0 \pi^+$	< 9.0	$\times 10^{-4}$	CL=90%	2494
$\omega \pi^+$	< 4.0	$\times 10^{-4}$	CL=90%	2580
$\eta \pi^+$	< 1.5	$\times 10^{-5}$	CL=90%	2609
$\eta' \pi^+$	< 3.1	$\times 10^{-5}$	CL=90%	2550
$\eta' \rho^+$	< 4.7	$\times 10^{-5}$	CL=90%	2493
$\eta \rho^+$	< 3.2	$\times 10^{-5}$	CL=90%	2554
$\pi^+ \pi^+ \pi^+ \pi^- \pi^-$	< 8.6	$\times 10^{-4}$	CL=90%	2608
$\rho^0 a_1(1260)^+$	< 6.2	$\times 10^{-4}$	CL=90%	2434
$\rho^0 a_2(1320)^+$	< 7.2	$\times 10^{-4}$	CL=90%	2411
$\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^0$	< 6.3	$\times 10^{-3}$	CL=90%	2592
$a_1(1260)^+ a_1(1260)^0$	< 1.3	%	CL=90%	2335

Baryon modes

$p\bar{p}\pi^+$		< 1.6	$\times 10^{-4}$	CL=90%	2439
$p\bar{p}\pi^+$ nonresonant		< 5.3	$\times 10^{-5}$	CL=90%	—
$p\bar{p}\pi^+\pi^+\pi^-$		< 5.2	$\times 10^{-4}$	CL=90%	2369
$p\bar{p}K^+$ nonresonant		< 8.9	$\times 10^{-5}$	CL=90%	—
$p\bar{\Lambda}$		< 6	$\times 10^{-5}$	CL=90%	2430
$p\bar{\Lambda}\pi^+\pi^-$		< 2.0	$\times 10^{-4}$	CL=90%	2367
$\bar{\Delta}^0 p$		< 3.8	$\times 10^{-4}$	CL=90%	2402
$\Delta^{++}\bar{p}$		< 1.5	$\times 10^{-4}$	CL=90%	2402
$\Lambda_c^- p\pi^+$		(6.2 \pm 2.7) $\times 10^{-4}$			—
$\Lambda_c^- p\pi^+\pi^0$		< 3.12	$\times 10^{-3}$	CL=90%	—
$\Lambda_c^- p\pi^+\pi^+\pi^-$		< 1.46	$\times 10^{-3}$	CL=90%	—
$\Lambda_c^- p\pi^+\pi^+\pi^-\pi^0$		< 1.34	%	CL=90%	—

**Lepton Family number (LF) or Lepton number (L) violating modes, or
 $\Delta B = 1$ weak neutral current (B1) modes**

$\pi^+ e^+ e^-$	B1	< 3.9	$\times 10^{-3}$	CL=90%	2638
$\pi^+ \mu^+ \mu^-$	B1	< 9.1	$\times 10^{-3}$	CL=90%	2633
$K^+ e^+ e^-$	B1	< 6	$\times 10^{-5}$	CL=90%	2616
$K^+ \mu^+ \mu^-$	B1	< 1.0	$\times 10^{-5}$	CL=90%	2612
$K^*(892)^+ e^+ e^-$	B1	< 6.9	$\times 10^{-4}$	CL=90%	2564
$K^*(892)^+ \mu^+ \mu^-$	B1	< 1.2	$\times 10^{-3}$	CL=90%	2560
$\pi^+ e^+ \mu^-$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2637
$\pi^+ e^- \mu^+$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2637
$K^+ e^+ \mu^-$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2615
$K^+ e^- \mu^+$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2615
$\pi^- e^+ e^+$	L	< 3.9	$\times 10^{-3}$	CL=90%	2638
$\pi^- \mu^+ \mu^+$	L	< 9.1	$\times 10^{-3}$	CL=90%	2633
$\pi^- e^+ \mu^+$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2637
$K^- e^+ e^+$	L	< 3.9	$\times 10^{-3}$	CL=90%	2616
$K^- \mu^+ \mu^+$	L	< 9.1	$\times 10^{-3}$	CL=90%	2612
$K^- e^+ \mu^+$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2615

B^0

$$I(J^P) = \frac{1}{2}(0^-)$$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

$$\text{Mass } m_{B^0} = 5279.2 \pm 1.8 \text{ MeV}$$

$$m_{B^0} - m_{B^\pm} = 0.35 \pm 0.29 \text{ MeV} \quad (S = 1.1)$$

$$\text{Mean life } \tau_{B^0} = (1.56 \pm 0.04) \times 10^{-12} \text{ s}$$

$$c\tau = 468 \text{ } \mu\text{m}$$

$$\tau_{B^+}/\tau_{B^0} = 1.02 \pm 0.04 \quad (\text{average of direct and inferred})$$

$$\tau_{B^+}/\tau_{B^0} = 1.04 \pm 0.04 \quad (\text{direct measurements})$$

$$\tau_{B^+}/\tau_{B^0} = 0.95^{+0.15}_{-0.12} \quad (\text{inferred from branching fractions})$$

B^0 - \bar{B}^0 mixing parameters

$$\chi_d = 0.172 \pm 0.010$$

$$\Delta m_{B^0} = m_{B^0_H} - m_{B^0_L} = (0.464 \pm 0.018) \times 10^{12} \text{ } \hbar \text{ s}^{-1}$$

$$x_d = \Delta m_{B^0}/\Gamma_{B^0} = 0.723 \pm 0.032$$

CP violation parameters

$$|\text{Re}(\epsilon_{B^0})| = 0.002 \pm 0.008$$

\bar{B}^0 modes are charge conjugates of the modes below. Reactions indicate the weak decay vertex and do not include mixing. Modes which do not identify the charge state of the B are listed in the B^\pm/B^0 ADMIXTURE section.

The branching fractions listed below assume 50% $B^0\bar{B}^0$ and 50% B^+B^- production at the $\Upsilon(4S)$. We have attempted to bring older measurements up to date by rescaling their assumed $\Upsilon(4S)$ production ratio to 50:50 and their assumed D, D_S, D^* , and ψ branching ratios to current values whenever this would affect our averages and best limits significantly.

Indentation is used to indicate a subchannel of a previous reaction. All resonant subchannels have been corrected for resonance branching fractions to the final state so the sum of the subchannel branching fractions can exceed that of the final state.

B^0 DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\ell^+ \nu_\ell$ anything	[$\rho\rho$] (10.5 \pm 0.8) %		—
$D^- \ell^+ \nu_\ell$	[$\rho\rho$] (2.00 \pm 0.25) %		—
$D^*(2010)^- \ell^+ \nu_\ell$	[$\rho\rho$] (4.60 \pm 0.27) %		—
$\rho^- \ell^+ \nu_\ell$	[$\rho\rho$] (2.5 \pm 0.8 / \pm 1.0) $\times 10^{-4}$		—
$\pi^- \ell^+ \nu_\ell$	(1.8 \pm 0.6) $\times 10^{-4}$		—
Inclusive modes			
K^+ anything	(78 \pm 80) %		—

D , D^* , or D_s modes

$D^- \pi^+$	$(3.0 \pm 0.4) \times 10^{-3}$		2306
$D^- \rho^+$	$(7.9 \pm 1.4) \times 10^{-3}$		2236
$\overline{D}^0 \pi^+ \pi^-$	$< 1.6 \times 10^{-3}$	CL=90%	2301
$D^*(2010)^- \pi^+$	$(2.76 \pm 0.21) \times 10^{-3}$		2254
$D^- \pi^+ \pi^+ \pi^-$	$(8.0 \pm 2.5) \times 10^{-3}$		2287
$(D^- \pi^+ \pi^+ \pi^-)$ nonresonant	$(3.9 \pm 1.9) \times 10^{-3}$		2287
$D^- \pi^+ \rho^0$	$(1.1 \pm 1.0) \times 10^{-3}$		2207
$D^- a_1(1260)^+$	$(6.0 \pm 3.3) \times 10^{-3}$		2121
$D^*(2010)^- \pi^+ \pi^0$	$(1.5 \pm 0.5) \%$		2247
$D^*(2010)^- \rho^+$	$(6.7 \pm 3.3) \times 10^{-3}$		2181
$D^*(2010)^- \pi^+ \pi^+ \pi^-$	$(7.6 \pm 1.7) \times 10^{-3}$	S=1.3	2235
$(D^*(2010)^- \pi^+ \pi^+ \pi^-)$ non-resonant	$(0.0 \pm 2.5) \times 10^{-3}$		2235
$D^*(2010)^- \pi^+ \rho^0$	$(5.7 \pm 3.1) \times 10^{-3}$		2151
$D^*(2010)^- a_1(1260)^+$	$(1.30 \pm 0.27) \%$		2061
$D^*(2010)^- \pi^+ \pi^+ \pi^- \pi^0$	$(3.4 \pm 1.8) \%$		2218
$\overline{D}_2^*(2460)^- \pi^+$	$< 2.2 \times 10^{-3}$	CL=90%	2064
$\overline{D}_2^*(2460)^- \rho^+$	$< 4.9 \times 10^{-3}$	CL=90%	1979
$D^- D_s^+$	$(8.0 \pm 3.0) \times 10^{-3}$		1812
$D^*(2010)^- D_s^+$	$(9.6 \pm 3.4) \times 10^{-3}$		1735
$D^- D_s^{*+}$	$(1.0 \pm 0.5) \%$		1731
$D^*(2010)^- D_s^{*+}$	$(2.0 \pm 0.7) \%$		1649
$D_s^+ \pi^-$	$< 2.8 \times 10^{-4}$	CL=90%	2270
$D_s^{*+} \pi^-$	$< 5 \times 10^{-4}$	CL=90%	2214
$D_s^+ \rho^-$	$< 7 \times 10^{-4}$	CL=90%	2198
$D_s^{*+} \rho^-$	$< 8 \times 10^{-4}$	CL=90%	2139
$D_s^+ a_1(1260)^-$	$< 2.6 \times 10^{-3}$	CL=90%	2079
$D_s^{*+} a_1(1260)^-$	$< 2.2 \times 10^{-3}$	CL=90%	2014
$D_s^- K^+$	$< 2.4 \times 10^{-4}$	CL=90%	2242
$D_s^{*-} K^+$	$< 1.7 \times 10^{-4}$	CL=90%	2185
$D_s^- K^*(892)^+$	$< 9.9 \times 10^{-4}$	CL=90%	2172
$D_s^{*-} K^*(892)^+$	$< 1.1 \times 10^{-3}$	CL=90%	2112
$D_s^- \pi^+ K^0$	$< 5 \times 10^{-3}$	CL=90%	2221
$D_s^{*-} \pi^+ K^0$	$< 3.1 \times 10^{-3}$	CL=90%	2164
$D_s^- \pi^+ K^*(892)^0$	$< 4 \times 10^{-3}$	CL=90%	2136
$D_s^{*-} \pi^+ K^*(892)^0$	$< 2.0 \times 10^{-3}$	CL=90%	2074
$\overline{D}^0 \pi^0$	$< 1.2 \times 10^{-4}$	CL=90%	2308
$\overline{D}^0 \rho^0$	$< 3.9 \times 10^{-4}$	CL=90%	2238
$\overline{D}^0 \eta$	$< 1.3 \times 10^{-4}$	CL=90%	2274

$\overline{D}^0 \eta'$	< 9.4	$\times 10^{-4}$	CL=90%	2198
$\overline{D}^0 \omega$	< 5.1	$\times 10^{-4}$	CL=90%	2235
$\overline{D}^*(2007)^0 \pi^0$	< 4.4	$\times 10^{-4}$	CL=90%	2256
$\overline{D}^*(2007)^0 \rho^0$	< 5.6	$\times 10^{-4}$	CL=90%	2183
$\overline{D}^*(2007)^0 \eta$	< 2.6	$\times 10^{-4}$	CL=90%	2220
$\overline{D}^*(2007)^0 \eta'$	< 1.4	$\times 10^{-3}$	CL=90%	2141
$\overline{D}^*(2007)^0 \omega$	< 7.4	$\times 10^{-4}$	CL=90%	2180
$D^*(2010)^+ D^*(2010)^-$	< 2.2	$\times 10^{-3}$	CL=90%	1711
$D^*(2010)^+ D^-$	< 1.8	$\times 10^{-3}$	CL=90%	1790
$D^+ D^*(2010)^-$	< 1.2	$\times 10^{-3}$	CL=90%	1790

Charmonium modes

$J/\psi(1S) K^0$	$(8.9 \pm 1.2) \times 10^{-4}$			1683
$J/\psi(1S) K^+ \pi^-$	$(1.1 \pm 0.6) \times 10^{-3}$			1652
$J/\psi(1S) K^*(892)^0$	$(1.35 \pm 0.18) \times 10^{-3}$			1570
$J/\psi(1S) \pi^0$	< 5.8	$\times 10^{-5}$	CL=90%	1728
$J/\psi(1S) \eta$	< 1.2	$\times 10^{-3}$	CL=90%	1672
$J/\psi(1S) \rho^0$	< 2.5	$\times 10^{-4}$	CL=90%	1614
$J/\psi(1S) \omega$	< 2.7	$\times 10^{-4}$	CL=90%	1609
$\psi(2S) K^0$	< 8	$\times 10^{-4}$	CL=90%	1283
$\psi(2S) K^+ \pi^-$	< 1	$\times 10^{-3}$	CL=90%	1238
$\psi(2S) K^*(892)^0$	$(1.4 \pm 0.9) \times 10^{-3}$			1113
$\chi_{c1}(1P) K^0$	< 2.7	$\times 10^{-3}$	CL=90%	1411
$\chi_{c1}(1P) K^*(892)^0$	< 2.1	$\times 10^{-3}$	CL=90%	1263

K or K* modes

$K^+ \pi^-$	$(1.5 \begin{smallmatrix} + \\ - \end{smallmatrix} \begin{smallmatrix} 0.5 \\ 0.4 \end{smallmatrix}) \times 10^{-5}$			2615
$K^0 \pi^0$	< 4.1	$\times 10^{-5}$	CL=90%	2614
$\eta' K^0$	$(4.7 \begin{smallmatrix} + \\ - \end{smallmatrix} \begin{smallmatrix} 2.8 \\ 2.2 \end{smallmatrix}) \times 10^{-5}$			2528
$\eta' K^*(892)^0$	< 3.9	$\times 10^{-5}$	CL=90%	2472
$\eta K^*(892)^0$	< 3.0	$\times 10^{-5}$	CL=90%	2534
ηK^0	< 3.3	$\times 10^{-5}$	CL=90%	2593
$K^+ K^-$	< 4.3	$\times 10^{-6}$	CL=90%	2593
$K^0 \overline{K}^0$	< 1.7	$\times 10^{-5}$	CL=90%	2592
$K^+ \rho^-$	< 3.5	$\times 10^{-5}$	CL=90%	2559
$K^0 \rho^0$	< 3.9	$\times 10^{-5}$	CL=90%	2559
$K^0 f_0(980)$	< 3.6	$\times 10^{-4}$	CL=90%	2523
$K^*(892)^+ \pi^-$	< 7.2	$\times 10^{-5}$	CL=90%	2562
$K^*(892)^0 \pi^0$	< 2.8	$\times 10^{-5}$	CL=90%	2562
$K_2^*(1430)^+ \pi^-$	< 2.6	$\times 10^{-3}$	CL=90%	2445

$K^0 K^+ K^-$		< 1.3	$\times 10^{-3}$	CL=90%	2522
$K^0 \phi$		< 8.8	$\times 10^{-5}$	CL=90%	2516
$K^- \pi^+ \pi^+ \pi^-$	[bbb]	< 2.3	$\times 10^{-4}$	CL=90%	2600
$K^*(892)^0 \pi^+ \pi^-$		< 1.4	$\times 10^{-3}$	CL=90%	2556
$K^*(892)^0 \rho^0$		< 4.6	$\times 10^{-4}$	CL=90%	2504
$K^*(892)^0 f_0(980)$		< 1.7	$\times 10^{-4}$	CL=90%	2467
$K_1(1400)^+ \pi^-$		< 1.1	$\times 10^{-3}$	CL=90%	2451
$K^- a_1(1260)^+$	[bbb]	< 2.3	$\times 10^{-4}$	CL=90%	2471
$K^*(892)^0 K^+ K^-$		< 6.1	$\times 10^{-4}$	CL=90%	2466
$K^*(892)^0 \phi$		< 4.3	$\times 10^{-5}$	CL=90%	2459
$K_1(1400)^0 \rho^0$		< 3.0	$\times 10^{-3}$	CL=90%	2389
$K_1(1400)^0 \phi$		< 5.0	$\times 10^{-3}$	CL=90%	2339
$K_2^*(1430)^0 \rho^0$		< 1.1	$\times 10^{-3}$	CL=90%	2380
$K_2^*(1430)^0 \phi$		< 1.4	$\times 10^{-3}$	CL=90%	2330
$K^*(892)^0 \gamma$		(4.0 ± 1.9)	$\times 10^{-5}$		2564
$K_1(1270)^0 \gamma$		< 7.0	$\times 10^{-3}$	CL=90%	2486
$K_1(1400)^0 \gamma$		< 4.3	$\times 10^{-3}$	CL=90%	2453
$K_2^*(1430)^0 \gamma$		< 4.0	$\times 10^{-4}$	CL=90%	2445
$K^*(1680)^0 \gamma$		< 2.0	$\times 10^{-3}$	CL=90%	2361
$K_3^*(1780)^0 \gamma$		< 1.0	%	CL=90%	2343
$K_4^*(2045)^0 \gamma$		< 4.3	$\times 10^{-3}$	CL=90%	2244
$\phi \phi$		< 3.9	$\times 10^{-5}$	CL=90%	2435

Light unflavored meson modes

$\pi^+ \pi^-$		< 1.5	$\times 10^{-5}$	CL=90%	2636
$\pi^0 \pi^0$		< 9.3	$\times 10^{-6}$	CL=90%	2636
$\eta \pi^0$		< 8	$\times 10^{-6}$	CL=90%	2609
$\eta \eta$		< 1.8	$\times 10^{-5}$	CL=90%	2582
$\eta' \pi^0$		< 1.1	$\times 10^{-5}$	CL=90%	2551
$\eta' \eta'$		< 4.7	$\times 10^{-5}$	CL=90%	2460
$\eta' \eta$		< 2.7	$\times 10^{-5}$	CL=90%	2522
$\eta' \rho^0$		< 2.3	$\times 10^{-5}$	CL=90%	2493
$\eta \rho^0$		< 1.3	$\times 10^{-5}$	CL=90%	2554
$\pi^+ \pi^- \pi^0$		< 7.2	$\times 10^{-4}$	CL=90%	2631
$\rho^0 \pi^0$		< 2.4	$\times 10^{-5}$	CL=90%	2582
$\rho^\mp \pi^\pm$	[gg]	< 8.8	$\times 10^{-5}$	CL=90%	2582
$\pi^+ \pi^- \pi^+ \pi^-$		< 2.3	$\times 10^{-4}$	CL=90%	2621
$\rho^0 \rho^0$		< 2.8	$\times 10^{-4}$	CL=90%	2525
$a_1(1260)^\mp \pi^\pm$	[gg]	< 4.9	$\times 10^{-4}$	CL=90%	2494
$a_2(1320)^\mp \pi^\pm$	[gg]	< 3.0	$\times 10^{-4}$	CL=90%	2473

$\pi^+ \pi^- \pi^0 \pi^0$	< 3.1	$\times 10^{-3}$	CL=90%	2622
$\rho^+ \rho^-$	< 2.2	$\times 10^{-3}$	CL=90%	2525
$a_1(1260)^0 \pi^0$	< 1.1	$\times 10^{-3}$	CL=90%	2494
$\omega \pi^0$	< 4.6	$\times 10^{-4}$	CL=90%	2580
$\pi^+ \pi^+ \pi^- \pi^- \pi^0$	< 9.0	$\times 10^{-3}$	CL=90%	2609
$a_1(1260)^+ \rho^-$	< 3.4	$\times 10^{-3}$	CL=90%	2434
$a_1(1260)^0 \rho^0$	< 2.4	$\times 10^{-3}$	CL=90%	2434
$\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^-$	< 3.0	$\times 10^{-3}$	CL=90%	2592
$a_1(1260)^+ a_1(1260)^-$	< 2.8	$\times 10^{-3}$	CL=90%	2336
$\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^- \pi^0$	< 1.1	%	CL=90%	2572

Baryon modes

$\rho \bar{p}$	< 1.8	$\times 10^{-5}$	CL=90%	2467
$\rho \bar{p} \pi^+ \pi^-$	< 2.5	$\times 10^{-4}$	CL=90%	2406
$\rho \bar{\Lambda} \pi^-$	< 1.8	$\times 10^{-4}$	CL=90%	2401
$\Delta^0 \bar{\Delta}^0$	< 1.5	$\times 10^{-3}$	CL=90%	2334
$\Delta^{++} \Delta^{--}$	< 1.1	$\times 10^{-4}$	CL=90%	2334
$\bar{\Sigma}_c^{--} \Delta^{++}$	< 1.0	$\times 10^{-3}$	CL=90%	1839
$\Lambda_c^- \rho \pi^+ \pi^-$	$(1.3 \pm 0.6) \times 10^{-3}$			—
$\Lambda_c^- \rho$	< 2.1	$\times 10^{-4}$	CL=90%	2021
$\Lambda_c^- \rho \pi^0$	< 5.9	$\times 10^{-4}$	CL=90%	—
$\Lambda_c^- \rho \pi^+ \pi^- \pi^0$	< 5.07	$\times 10^{-3}$	CL=90%	—
$\Lambda_c^- \rho \pi^+ \pi^- \pi^+ \pi^-$	< 2.74	$\times 10^{-3}$	CL=90%	—

Lepton Family number (LF) violating modes, or $\Delta B = 1$ weak neutral current (B1) modes

$\gamma \gamma$	B1	< 3.9	$\times 10^{-5}$	CL=90%	2640
$e^+ e^-$	B1	< 5.9	$\times 10^{-6}$	CL=90%	2640
$\mu^+ \mu^-$	B1	< 6.8	$\times 10^{-7}$	CL=90%	2637
$K^0 e^+ e^-$	B1	< 3.0	$\times 10^{-4}$	CL=90%	2616
$K^0 \mu^+ \mu^-$	B1	< 3.6	$\times 10^{-4}$	CL=90%	2612
$K^*(892)^0 e^+ e^-$	B1	< 2.9	$\times 10^{-4}$	CL=90%	2564
$K^*(892)^0 \mu^+ \mu^-$	B1	< 2.3	$\times 10^{-5}$	CL=90%	2559
$K^*(892)^0 \nu \bar{\nu}$	B1	< 1.0	$\times 10^{-3}$	CL=90%	2244
$e^\pm \mu^\mp$	LF [gg]	< 5.9	$\times 10^{-6}$	CL=90%	2639
$e^\pm \tau^\mp$	LF [gg]	< 5.3	$\times 10^{-4}$	CL=90%	2341
$\mu^\pm \tau^\mp$	LF [gg]	< 8.3	$\times 10^{-4}$	CL=90%	2339

B[±]/B⁰ ADMIXTURE

The branching fraction measurements are for an admixture of B mesons at the $\Upsilon(4S)$. The values quoted assume that $B(\Upsilon(4S) \rightarrow B\bar{B}) = 100\%$.

For inclusive branching fractions, *e.g.*, $B \rightarrow D^\pm$ anything, the treatment of multiple D 's in the final state must be defined. One possibility would be to count the number of events with one-or-more D 's and divide by the total number of B 's. Another possibility would be to count the total number of D 's and divide by the total number of B 's, which is the definition of average multiplicity. The two definitions are identical when only one of the specified particles is allowed in the final state. Even though the "one-or-more" definition seems sensible, for practical reasons inclusive branching fractions are almost always measured using the multiplicity definition. For heavy final state particles, authors call their results inclusive branching fractions while for light particles some authors call their results multiplicities. In the B sections, we list all results as inclusive branching fractions, adopting a multiplicity definition. This means that inclusive branching fractions can exceed 100% and that inclusive partial widths can exceed total widths, just as inclusive cross sections can exceed total cross sections.

\bar{B} modes are charge conjugates of the modes below. Reactions indicate the weak decay vertex and do not include mixing.

B DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Semileptonic and leptonic modes			
$B \rightarrow e^+ \nu_e$ anything	[ccc] (10.41 ± 0.29) %	S=1.2	—
$B \rightarrow \bar{p} e^+ \nu_e$ anything	< 1.6	× 10 ⁻³ CL=90%	—
$B \rightarrow \mu^+ \nu_\mu$ anything	[ccc] (10.3 ± 0.5) %		—
$B \rightarrow \ell^+ \nu_\ell$ anything	[pp,ccc] (10.45 ± 0.21) %		—
$B \rightarrow D^- \ell^+ \nu_\ell$ anything	[pp] (2.7 ± 0.8) %		—
$B \rightarrow \bar{D}^0 \ell^+ \nu_\ell$ anything	[pp] (7.0 ± 1.4) %		—
$B \rightarrow \bar{D}^{*0} \ell^+ \nu_\ell$	[pp,ddd] (2.7 ± 0.7) %		—
$B \rightarrow \bar{D}_1(2420) \ell^+ \nu_\ell$ anything	(7.4 ± 1.6) × 10 ⁻³		—
$B \rightarrow D \pi \ell^+ \nu_\ell$ anything + $D^* \pi \ell^+ \nu_\ell$ anything	(2.3 ± 0.4) %		—
$B \rightarrow \bar{D}_2^*(2460) \ell^+ \nu_\ell$ anything	< 6.5	× 10 ⁻³ CL=95%	—
$B \rightarrow D^{*-} \pi^+ \ell^+ \nu_\ell$ anything	(1.00 ± 0.34) %		—

$B \rightarrow D_s^- \ell^+ \nu_\ell$ anything	[pp] < 9	$\times 10^{-3}$	CL=90%	—
$B \rightarrow D_s^- \ell^+ \nu_\ell K^+$ anything	[pp] < 6	$\times 10^{-3}$	CL=90%	—
$B \rightarrow D_s^- \ell^+ \nu_\ell K^0$ anything	[pp] < 9	$\times 10^{-3}$	CL=90%	—
$B \rightarrow K^+ \ell^+ \nu_\ell$ anything	[pp] (6.0 \pm 0.5)	%		—
$B \rightarrow K^- \ell^+ \nu_\ell$ anything	[pp] (10 \pm 4)	$\times 10^{-3}$		—
$B \rightarrow K^0 / \bar{K}^0 \ell^+ \nu_\ell$ anything	[pp] (4.4 \pm 0.5)	%		—

D, D*, or D_s modes

$B \rightarrow D^\pm$ anything	(24.1 \pm 1.9)	%		—
$B \rightarrow D^0 / \bar{D}^0$ anything	(63.1 \pm 2.9)	%	S=1.1	—
$B \rightarrow D^*(2010)^\pm$ anything	(22.7 \pm 1.6)	%		—
$B \rightarrow D^*(2007)^0$ anything	(26.0 \pm 2.7)	%		—
$B \rightarrow D_s^\pm$ anything	[gg] (10.0 \pm 2.5)	%		—
$b \rightarrow c \bar{c} s$	(22 \pm 4)	%		—
$B \rightarrow D_s D, D_s^* D, D_s D^*,$ or $D_s^* D^*$	[gg] (4.9 \pm 1.3)	%		—
$B \rightarrow D^*(2010) \gamma$	< 1.1	$\times 10^{-3}$	CL=90%	—
$B \rightarrow D_s^+ \pi^-, D_s^{*+} \pi^-,$ $D_s^+ \rho^-, D_s^{*+} \rho^-, D_s^+ \pi^0,$ $D_s^{*+} \pi^0, D_s^+ \eta, D_s^{*+} \eta,$ $D_s^+ \rho^0, D_s^{*+} \rho^0, D_s^+ \omega,$ $D_s^{*+} \omega$	[gg] < 5	$\times 10^{-4}$	CL=90%	—
$B \rightarrow D_{s1}(2536)^+$ anything	< 9.5	$\times 10^{-3}$	CL=90%	—

Charmonium modes

$B \rightarrow J/\psi(1S)$ anything	(1.13 \pm 0.06)	%		—
$B \rightarrow J/\psi(1S)$ (direct) anything	(8.0 \pm 0.8)	$\times 10^{-3}$		—
$B \rightarrow \psi(2S)$ anything	(3.5 \pm 0.5)	$\times 10^{-3}$		—
$B \rightarrow \chi_{c1}(1P)$ anything	(4.2 \pm 0.7)	$\times 10^{-3}$		—
$B \rightarrow \chi_{c1}(1P)$ (direct) anything	(3.7 \pm 0.7)	$\times 10^{-3}$		—
$B \rightarrow \chi_{c2}(1P)$ anything	< 3.8	$\times 10^{-3}$	CL=90%	—
$B \rightarrow \eta_c(1S)$ anything	< 9	$\times 10^{-3}$	CL=90%	—

K or K* modes

$B \rightarrow K^\pm$ anything	[gg] (78.9 \pm 2.5)	%		—
$B \rightarrow K^+$ anything	(66 \pm 5)	%		—
$B \rightarrow K^-$ anything	(13 \pm 4)	%		—
$B \rightarrow K^0 / \bar{K}^0$ anything	[gg] (64 \pm 4)	%		—
$B \rightarrow K^*(892)^\pm$ anything	(18 \pm 6)	%		—
$B \rightarrow K^*(892)^0 / \bar{K}^*(892)^0$ anything	[gg] (14.6 \pm 2.6)	%		—

$B \rightarrow K_1(1400)\gamma$	<	4.1	$\times 10^{-4}$	CL=90%	—
$B \rightarrow K_2^*(1430)\gamma$	<	8.3	$\times 10^{-4}$	CL=90%	—
$B \rightarrow K_2(1770)\gamma$	<	1.2	$\times 10^{-3}$	CL=90%	—
$B \rightarrow K_3^*(1780)\gamma$	<	3.0	$\times 10^{-3}$	CL=90%	—
$B \rightarrow K_4^*(2045)\gamma$	<	1.0	$\times 10^{-3}$	CL=90%	—
$B \rightarrow \bar{b} \rightarrow \bar{s}\gamma$	(	2.3 ± 0.7) $\times 10^{-4}$		—
$B \rightarrow \bar{b} \rightarrow \bar{s}g\text{luon}$	<	6.8	%	CL=90%	—

Light unflavored meson modes

$B \rightarrow \pi^\pm$ anything	[<i>gg,eee</i>]	(359 ± 7)%			—
$B \rightarrow \eta$ anything		(17.6 ± 1.6)%			—
$B \rightarrow \rho^0$ anything		(21 ± 5)%			—
$B \rightarrow \omega$ anything	<	81	%	CL=90%	—
$B \rightarrow \phi$ anything	(	3.5 ± 0.7	)%	S=1.8	—

Baryon modes

$B \rightarrow \Lambda_c^\pm$ anything		(6.4 ± 1.1)%			—
$B \rightarrow \Lambda_c^- e^+$ anything	<	3.2	$\times 10^{-3}$	CL=90%	—
$B \rightarrow \Lambda_c^- p$ anything	(	3.6 ± 0.7)%		—
$B \rightarrow \Lambda_c^- p e^+ \nu_e$	<	1.5	$\times 10^{-3}$	CL=90%	—
$B \rightarrow \bar{\Sigma}_c^-$ anything	(	4.2 ± 2.4) $\times 10^{-3}$		—
$B \rightarrow \bar{\Sigma}_c^-$ anything	<	9.6	$\times 10^{-3}$	CL=90%	—
$B \rightarrow \bar{\Sigma}_c^0$ anything	(	4.6 ± 2.4) $\times 10^{-3}$		—
$B \rightarrow \bar{\Sigma}_c^0 N$ ($N = p$ or n)	<	1.5	$\times 10^{-3}$	CL=90%	—
$B \rightarrow \Xi_c^0$ anything	(	1.4 ± 0.5) $\times 10^{-4}$		—
$\times B(\Xi_c^0 \rightarrow \Xi^- \pi^+)$					
$B \rightarrow \Xi_c^+$ anything	(	$4.5^{+1.3}_{-1.2}$	) $\times 10^{-4}$		—
$\times B(\Xi_c^+ \rightarrow \Xi^- \pi^+ \pi^+)$					
$B \rightarrow p/\bar{p}$ anything	[<i>gg</i>]	(8.0 ± 0.4)%			—
$B \rightarrow p/\bar{p}$ (direct) anything	[<i>gg</i>]	(5.5 ± 0.5)%			—
$B \rightarrow \Lambda/\bar{\Lambda}$ anything	[<i>gg</i>]	(4.0 ± 0.5)%			—
$B \rightarrow \Xi^-/\bar{\Xi}^+$ anything	[<i>gg</i>]	(2.7 ± 0.6) $\times 10^{-3}$			—
$B \rightarrow$ baryons anything		(6.8 ± 0.6)%			—
$B \rightarrow p\bar{p}$ anything		(2.47 ± 0.23)%			—
$B \rightarrow \Lambda\bar{\Lambda}$ anything	[<i>gg</i>]	(2.5 ± 0.4)%			—
$B \rightarrow \Lambda\bar{\Lambda}$ anything	<	5	$\times 10^{-3}$	CL=90%	—

Lepton Family number (*LF*) violating modes or $\Delta B = 1$ weak neutral current (*B1*) modes

$B \rightarrow e^+ e^- s$	<i>B1</i>	<	5.7	$\times 10^{-5}$	CL=90%	—
$B \rightarrow \mu^+ \mu^- s$	<i>B1</i>	<	5.8	$\times 10^{-5}$	CL=90%	—
$B \rightarrow e^\pm \mu^\mp s$	<i>LF</i>	<	2.2	$\times 10^{-5}$	CL=90%	—

$B^\pm/B^0/B_s^0/b$ -baryon ADMIXTURE

These measurements are for an admixture of bottom particles at high energy (LEP, Tevatron, $S\bar{p}\bar{p}S$).

$$\text{Mean life } \tau = (1.564 \pm 0.014) \times 10^{-12} \text{ s}$$

$$\text{Mean life } \tau = (1.72 \pm 0.10) \times 10^{-12} \text{ s} \quad \text{Charged } b\text{-hadron admixture}$$

$$\text{Mean life } \tau = (1.58 \pm 0.14) \times 10^{-12} \text{ s} \quad \text{Neutral } b\text{-hadron admixture}$$

$$\tau_{\text{charged } b\text{-hadron}}/\tau_{\text{neutral } b\text{-hadron}} = 1.09 \pm 0.13$$

The branching fraction measurements are for an admixture of B mesons and baryons at energies above the $\Upsilon(4S)$. Only the highest energy results (LEP, Tevatron, $S\bar{p}\bar{p}S$) are used in the branching fraction averages. The production fractions give our best current estimate of the admixture at LEP.

For inclusive branching fractions, *e.g.*, $B \rightarrow D^\pm$ anything, the treatment of multiple D 's in the final state must be defined. One possibility would be to count the number of events with one-or-more D 's and divide by the total number of B 's. Another possibility would be to count the total number of D 's and divide by the total number of B 's, which is the definition of average multiplicity. The two definitions are identical when only one of the specified particles is allowed in the final state. Even though the "one-or-more" definition seems sensible, for practical reasons inclusive branching fractions are almost always measured using the multiplicity definition. For heavy final state particles, authors call their results inclusive branching fractions while for light particles some authors call their results multiplicities. In the B sections, we list all results as inclusive branching fractions, adopting a multiplicity definition. This means that inclusive branching fractions can exceed 100% and that inclusive partial widths can exceed total widths, just as inclusive cross sections can exceed total cross sections.

The modes below are listed for a \bar{b} initial state. b modes are their charge conjugates. Reactions indicate the weak decay vertex and do not include mixing.

\bar{b} DECAY MODES	Fraction (Γ_i/Γ)	Confidence level ^P (MeV/c)
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PRODUCTION FRACTIONS

The production fractions for weakly decaying b -hadrons at the Z have been calculated from the best values of mean lives, mixing parameters, and branching fractions in this edition by the LEP B Oscillation Working Group as described in the note "Production and Decay of b -Flavored Hadrons" in the B^\pm Particle Listings. Values assume

$$\begin{aligned} B(\bar{b} \rightarrow B^+) &= B(\bar{b} \rightarrow B^0) \\ B(\bar{b} \rightarrow B^+) + B(\bar{b} \rightarrow B^0) + B(\bar{b} \rightarrow B_s^0) + B(b \rightarrow \Lambda_b) &= 100 \%. \end{aligned}$$

The notation for production fractions varies in the literature (f_{B^0} , $f(b \rightarrow \bar{B}^0)$, $\text{Br}(b \rightarrow \bar{B}^0)$). We use our own branching fraction notation here, $B(\bar{b} \rightarrow B^0)$.

B^+	$(39.7 \pm 1.8) \%$	—
B^0	$(39.7 \pm 1.8) \%$	—
B_s^0	$(10.5 \pm 1.8) \%$	—
Λ_b	$(10.1 \pm 3.9) \%$	—

DECAY MODES

Semileptonic and leptonic modes

ν anything		$(23.1 \pm 1.5) \%$	—
$\ell^+ \nu_\ell$ anything	$[pp, ccc]$	$(10.99 \pm 0.23) \%$	—
$e^+ \nu_e$ anything	$[ccc]$	$(10.9 \pm 0.5) \%$	—
$\mu^+ \nu_\mu$ anything	$[ccc]$	$(10.8 \pm 0.5) \%$	—
$D^- \ell^+ \nu_\ell$ anything	$[pp]$	$(2.02 \pm 0.29) \%$	—
$\bar{D}^0 \ell^+ \nu_\ell$ anything	$[pp]$	$(6.5 \pm 0.6) \%$	—
$D^{*-} \ell^+ \nu_\ell$ anything	$[pp]$	$(2.76 \pm 0.29) \%$	—
$\bar{D}_j^0 \ell^+ \nu_\ell$ anything	$[pp, fff]$	seen	—
$D_j^- \ell^+ \nu_\ell$ anything	$[pp, fff]$	seen	—
$\bar{D}_2^*(2460)^0 \ell^+ \nu_\ell$ anything		seen	—
$D_2^*(2460)^- \ell^+ \nu_\ell$ anything		seen	—
$\tau^+ \nu_\tau$ anything		$(2.6 \pm 0.4) \%$	—
$\bar{c} \rightarrow \ell^- \bar{\nu}_\ell$ anything	$[pp]$	$(7.8 \pm 0.6) \%$	—

Charmed meson and baryon modes

\bar{D}^0 anything	(60.1 ± 3.2) %	—
D^- anything	(23.7 ± 2.3) %	—
\bar{D}_s anything	(18 ± 5) %	—
Λ_c anything	(9.7 ± 2.9) %	—
\bar{c}/c anything	[eee] (117 ± 4) %	—

Charmonium modes

$J/\psi(1S)$ anything	(1.16 ± 0.10) %	—
$\psi(2S)$ anything	(4.8 ± 2.4) × 10 ⁻³	—
$\chi_{c1}(1P)$ anything	(1.8 ± 0.5) %	—

K or K* modes

$\bar{s}\gamma$	< 5.4 × 10 ⁻⁴	90%	—
K^\pm anything	(88 ± 19) %	—	
K_S^0 anything	(29.0 ± 2.9) %	—	

Pion modes

π^0 anything	[eee] (278 ± 60) %	—
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Baryon modes

p/\bar{p} anything	(14 ± 6) %	—
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Other modes

charged anything	[eee] (497 ± 7) %	—
hadron ⁺ hadron ⁻	(1.7 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 1.0 \\ 0.7 \end{smallmatrix}$) × 10 ⁻⁵	—
charmless	(7 ± 21) × 10 ⁻³	—

Baryon modes

$\Lambda/\bar{\Lambda}$ anything	(5.9 ± 0.6) %	—
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 $\Delta B = 1$ weak neutral current (B1) modes

$\mu^+\mu^-$ anything	B1 < 3.2 × 10 ⁻⁴	90%	—
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B^*

$$I(J^P) = \frac{1}{2}(1^-)$$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

$$\text{Mass } m_{B^*} = 5324.9 \pm 1.8 \text{ MeV}$$

$$m_{B^*} - m_B = 45.78 \pm 0.35 \text{ MeV}$$

B^* DECAY MODES	Fraction (Γ_i/Γ)	ρ (MeV/c)
$B\gamma$	dominant	46

BOTTOM, STRANGE MESONS

($B = \pm 1, S = \mp 1$)

$$B_s^0 = s\bar{b}, \bar{B}_s^0 = \bar{s}b, \quad \text{similarly for } B_s^{*'}\text{'s}$$

B_s^0

$$I(J^P) = 0(0^-)$$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

$$\text{Mass } m_{B_s^0} = 5369.3 \pm 2.0 \text{ MeV}$$

$$\text{Mean life } \tau = (1.54 \pm 0.07) \times 10^{-12} \text{ s}$$

$$c\tau = 462 \text{ } \mu\text{m}$$

B_s^0 - \bar{B}_s^0 mixing parameters

$$\chi_B \text{ at high energy} = f_d\chi_d + f_s\chi_s = 0.118 \pm 0.006$$

$$\Delta m_{B_s^0} = m_{B_s^0 H} - m_{B_s^0 L} > 9.1 \times 10^{12} \hbar \text{ s}^{-1}, \text{ CL} = 95\%$$

$$\chi_s = \Delta m_{B_s^0} / \Gamma_{B_s^0} > 14.0, \text{ CL} = 95\%$$

$$\chi_s > 0.4975, \text{ CL} = 95\%$$

These branching fractions all scale with $B(\bar{b} \rightarrow B_s^0)$, the LEP B_s^0 production fraction. The first four were evaluated using $B(\bar{b} \rightarrow B_s^0) = (10.5_{-1.7}^{+1.8})\%$ and the rest assume $B(\bar{b} \rightarrow B_s^0) = 12\%$.

The branching fraction $B(B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell \text{ anything})$ is not a pure measurement since the measured product branching fraction $B(\bar{b} \rightarrow B_s^0) \times B(B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell \text{ anything})$ was used to determine $B(\bar{b} \rightarrow B_s^0)$, as described in the note on "Production and Decay of b -Flavored Hadrons."

B_s^0 DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
D_s^- anything	(92 \pm 33) %		—
$D_s^- \ell^+ \nu_\ell$ anything	[<i>ggg</i>] (8.1 \pm 2.5) %		—
$D_s^- \pi^+$	< 13 %		2321
$J/\psi(1S)\phi$	(9.3 \pm 3.3) $\times 10^{-4}$		1590
$J/\psi(1S)\pi^0$	< 1.2 $\times 10^{-3}$	90%	1788
$J/\psi(1S)\eta$	< 3.8 $\times 10^{-3}$	90%	1735
$\psi(2S)\phi$	seen		1122
$\pi^+ \pi^-$	< 1.7 $\times 10^{-4}$	90%	1122
$\pi^0 \pi^0$	< 2.1 $\times 10^{-4}$	90%	2861
$\eta \pi^0$	< 1.0 $\times 10^{-3}$	90%	2655
$\eta \eta$	< 1.5 $\times 10^{-3}$	90%	2628
$\pi^+ K^-$	< 2.1 $\times 10^{-4}$	90%	2660
$K^+ K^-$	< 5.9 $\times 10^{-5}$	90%	2639
$p \bar{p}$	< 5.9 $\times 10^{-5}$	90%	2515
$\gamma \gamma$	< 1.48 $\times 10^{-4}$	90%	2685
$\phi \gamma$	< 7 $\times 10^{-4}$	90%	2588
Lepton Family number (LF) violating modes or $\Delta B = 1$ weak neutral current (B1) modes			
$\mu^+ \mu^-$	B1 < 2.0 $\times 10^{-6}$	90%	2682
$e^+ e^-$	B1 < 5.4 $\times 10^{-5}$	90%	2864
$e^\pm \mu^\mp$	LF [<i>gg</i>] < 4.1 $\times 10^{-5}$	90%	2864
$\phi \nu \bar{\nu}$	B1 < 5.4 $\times 10^{-3}$	90%	—

c \bar{c} MESONS

 $\eta_c(1S)$

$$J^{PC} = 0^+(0^-+)$$

 Mass $m = 2979.8 \pm 2.1$ MeV ($S = 2.1$)

 Full width $\Gamma = 13.2^{+3.8}_{-3.2}$ MeV

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
Decays involving hadronic resonances			
$\eta'(958)\pi\pi$	(4.1 \pm 1.7) %		1319
$\rho\rho$	(2.6 \pm 0.9) %		1275
$K^*(892)^0 K^- \pi^+ + \text{c.c.}$	(2.0 \pm 0.7) %		1273
$K^*(892)\bar{K}^*(892)$	(8.5 \pm 3.1) $\times 10^{-3}$		1193
$\phi\phi$	(7.1 \pm 2.8) $\times 10^{-3}$		1086
$a_0(980)\pi$	< 2 %	90%	1323
$a_2(1320)\pi$	< 2 %	90%	1193
$K^*(892)\bar{K} + \text{c.c.}$	< 1.28 %	90%	1307
$f_2(1270)\eta$	< 1.1 %	90%	1142
$\omega\omega$	< 3.1 $\times 10^{-3}$	90%	1268
Decays into stable hadrons			
$K\bar{K}\pi$	(5.5 \pm 1.7) %		1378
$\eta\pi\pi$	(4.9 \pm 1.8) %		1425
$\pi^+\pi^-K^+K^-$	(2.0 $^{+0.7}_{-0.6}$) %		1342
$2(K^+K^-)$	(2.1 \pm 1.2) %		1053
$2(\pi^+\pi^-)$	(1.2 \pm 0.4) %		1457
$\rho\bar{\rho}$	(1.2 \pm 0.4) $\times 10^{-3}$		1157
$K\bar{K}\eta$	< 3.1 %	90%	1262
$\pi^+\pi^-\rho\bar{\rho}$	< 1.2 %	90%	1023
$\Lambda\bar{\Lambda}$	< 2 $\times 10^{-3}$	90%	987
Radiative decays			
$\gamma\gamma$	(3.0 \pm 1.2) $\times 10^{-4}$		1489

J/ψ(1S)

$$J^G(J^{PC}) = 0^-(1^{--})$$

Mass $m = 3096.88 \pm 0.04$ MeVFull width $\Gamma = 87 \pm 5$ keV $\Gamma_{ee} = 5.26 \pm 0.37$ keV (Assuming $\Gamma_{ee} = \Gamma_{\mu\mu}$)

J/ψ(1S) DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
hadrons	(87.7 ± 0.5) %		—
virtual $\gamma \rightarrow$ hadrons	(17.0 ± 2.0) %		—
$e^+ e^-$	(6.02 ± 0.19) %		1548
$\mu^+ \mu^-$	(6.01 ± 0.19) %		1545

Decays involving hadronic resonances

$\rho\pi$	(1.27 ± 0.09) %		1449
$\rho^0\pi^0$	(4.2 ± 0.5) × 10 ⁻³		1449
$a_2(1320)\rho$	(1.09 ± 0.22) %		1125
$\omega\pi^+\pi^+\pi^-\pi^-$	(8.5 ± 3.4) × 10 ⁻³		1392
$\omega\pi^+\pi^-$	(7.2 ± 1.0) × 10 ⁻³		1435
$\omega f_2(1270)$	(4.3 ± 0.6) × 10 ⁻³		1143
$K^*(892)^0\bar{K}_2^*(1430)^0 + \text{c.c.}$	(6.7 ± 2.6) × 10 ⁻³		1005
$\omega K^*(892)\bar{K} + \text{c.c.}$	(5.3 ± 2.0) × 10 ⁻³		1098
$K^+\bar{K}^*(892)^- + \text{c.c.}$	(5.0 ± 0.4) × 10 ⁻³		1373
$K^0\bar{K}^*(892)^0 + \text{c.c.}$	(4.2 ± 0.4) × 10 ⁻³		1371
$\omega\pi^0\pi^0$	(3.4 ± 0.8) × 10 ⁻³		1436
$b_1(1235)^\pm\pi^\mp$	[gg] (3.0 ± 0.5) × 10 ⁻³		1299
$\omega K^\pm K_S^0\pi^\mp$	[gg] (3.0 ± 0.7) × 10 ⁻³		1210
$b_1(1235)^0\pi^0$	(2.3 ± 0.6) × 10 ⁻³		1299
$\phi K^*(892)\bar{K} + \text{c.c.}$	(2.04 ± 0.28) × 10 ⁻³		969
$\omega K\bar{K}$	(1.9 ± 0.4) × 10 ⁻³		1268
$\omega f_J(1710) \rightarrow \omega K\bar{K}$	(4.8 ± 1.1) × 10 ⁻⁴		878
$\phi 2(\pi^+\pi^-)$	(1.60 ± 0.32) × 10 ⁻³		1318
$\Delta(1232)^{++}\bar{p}\pi^-$	(1.6 ± 0.5) × 10 ⁻³		1030
$\omega\eta$	(1.58 ± 0.16) × 10 ⁻³		1394
$\phi K\bar{K}$	(1.48 ± 0.22) × 10 ⁻³		1179
$\phi f_J(1710) \rightarrow \phi K\bar{K}$	(3.6 ± 0.6) × 10 ⁻⁴		875
$p\bar{p}\omega$	(1.30 ± 0.25) × 10 ⁻³	S=1.3	769
$\Delta(1232)^{++}\bar{\Delta}(1232)^{--}$	(1.10 ± 0.29) × 10 ⁻³		938
$\Sigma(1385)^-\bar{\Sigma}(1385)^+ (\text{or c.c.})$	[gg] (1.03 ± 0.13) × 10 ⁻³		692
$p\bar{p}\eta'(958)$	(9 ± 4) × 10 ⁻⁴	S=1.7	596
$\phi f_2'(1525)$	(8 ± 4) × 10 ⁻⁴	S=2.7	871
$\phi\pi^+\pi^-$	(8.0 ± 1.2) × 10 ⁻⁴		1365

$\phi K^\pm K_S^0 \pi^\mp$	[gg]	$(7.2 \pm 0.9) \times 10^{-4}$		1114
$\omega f_1(1420)$		$(6.8 \pm 2.4) \times 10^{-4}$		1062
$\phi \eta$		$(6.5 \pm 0.7) \times 10^{-4}$		1320
$\Xi(1530)^- \Xi^-$		$(5.9 \pm 1.5) \times 10^{-4}$		597
$\rho K^- \bar{\Sigma}(1385)^0$		$(5.1 \pm 3.2) \times 10^{-4}$		645
$\omega \pi^0$		$(4.2 \pm 0.6) \times 10^{-4}$	S=1.4	1447
$\phi \eta'(958)$		$(3.3 \pm 0.4) \times 10^{-4}$		1192
$\phi f_0(980)$		$(3.2 \pm 0.9) \times 10^{-4}$	S=1.9	1182
$\Xi(1530)^0 \Xi^0$		$(3.2 \pm 1.4) \times 10^{-4}$		608
$\Sigma(1385)^- \bar{\Sigma}^+$ (or c.c.)	[gg]	$(3.1 \pm 0.5) \times 10^{-4}$		857
$\phi f_1(1285)$		$(2.6 \pm 0.5) \times 10^{-4}$	S=1.1	1032
$\rho \eta$		$(1.93 \pm 0.23) \times 10^{-4}$		1398
$\omega \eta'(958)$		$(1.67 \pm 0.25) \times 10^{-4}$		1279
$\omega f_0(980)$		$(1.4 \pm 0.5) \times 10^{-4}$		1271
$\rho \eta'(958)$		$(1.05 \pm 0.18) \times 10^{-4}$		1283
$\rho \bar{p} \phi$		$(4.5 \pm 1.5) \times 10^{-5}$		527
$a_2(1320)^\pm \pi^\mp$	[gg]	$< 4.3 \times 10^{-3}$	CL=90%	1263
$K \bar{K}_2^*(1430)^+ \text{ c.c.}$		$< 4.0 \times 10^{-3}$	CL=90%	1159
$K_2^*(1430)^0 \bar{K}_2^*(1430)^0$		$< 2.9 \times 10^{-3}$	CL=90%	588
$K^*(892)^0 \bar{K}^*(892)^0$		$< 5 \times 10^{-4}$	CL=90%	1263
$\phi f_2(1270)$		$< 3.7 \times 10^{-4}$	CL=90%	1036
$\rho \bar{p} \rho$		$< 3.1 \times 10^{-4}$	CL=90%	779
$\phi \eta(1440) \rightarrow \phi \eta \pi \pi$		$< 2.5 \times 10^{-4}$	CL=90%	946
$\omega f_2'(1525)$		$< 2.2 \times 10^{-4}$	CL=90%	1003
$\Sigma(1385)^0 \bar{\Lambda}$		$< 2 \times 10^{-4}$	CL=90%	911
$\Delta(1232)^+ \bar{p}$		$< 1 \times 10^{-4}$	CL=90%	1100
$\Sigma^0 \bar{\Lambda}$		$< 9 \times 10^{-5}$	CL=90%	1032
$\phi \pi^0$		$< 6.8 \times 10^{-6}$	CL=90%	1377

Decays into stable hadrons

$2(\pi^+ \pi^-) \pi^0$		$(3.37 \pm 0.26) \%$		1496
$3(\pi^+ \pi^-) \pi^0$		$(2.9 \pm 0.6) \%$		1433
$\pi^+ \pi^- \pi^0$		$(1.50 \pm 0.20) \%$		1533
$\pi^+ \pi^- \pi^0 K^+ K^-$		$(1.20 \pm 0.30) \%$		1368
$4(\pi^+ \pi^-) \pi^0$		$(9.0 \pm 3.0) \times 10^{-3}$		1345
$\pi^+ \pi^- K^+ K^-$		$(7.2 \pm 2.3) \times 10^{-3}$		1407
$K \bar{K} \pi$		$(6.1 \pm 1.0) \times 10^{-3}$		1440
$\rho \bar{p} \pi^+ \pi^-$		$(6.0 \pm 0.5) \times 10^{-3}$	S=1.3	1107
$2(\pi^+ \pi^-)$		$(4.0 \pm 1.0) \times 10^{-3}$		1517
$3(\pi^+ \pi^-)$		$(4.0 \pm 2.0) \times 10^{-3}$		1466
$n \bar{n} \pi^+ \pi^-$		$(4 \pm 4) \times 10^{-3}$		1106
$\Sigma^0 \bar{\Sigma}^0$		$(1.27 \pm 0.17) \times 10^{-3}$		992
$2(\pi^+ \pi^-) K^+ K^-$		$(3.1 \pm 1.3) \times 10^{-3}$		1320
$\rho \bar{p} \pi^+ \pi^- \pi^0$	[hhh]	$(2.3 \pm 0.9) \times 10^{-3}$	S=1.9	1033

$p\bar{p}$		$(2.14 \pm 0.10) \times 10^{-3}$		1232
$p\bar{p}\eta$		$(2.09 \pm 0.18) \times 10^{-3}$		948
$p\bar{n}\pi^{-}$		$(2.00 \pm 0.10) \times 10^{-3}$		1174
$n\bar{n}$		$(1.9 \pm 0.5) \times 10^{-3}$		1231
$\Xi\bar{\Xi}$		$(1.8 \pm 0.4) \times 10^{-3}$	S=1.8	818
$\Lambda\bar{\Lambda}$		$(1.35 \pm 0.14) \times 10^{-3}$	S=1.2	1074
$p\bar{p}\pi^0$		$(1.09 \pm 0.09) \times 10^{-3}$		1176
$\Lambda\bar{\Sigma}^{-}\pi^{+}$ (or c.c.)	[gg]	$(1.06 \pm 0.12) \times 10^{-3}$		945
$pK^{-}\bar{\Lambda}$		$(8.9 \pm 1.6) \times 10^{-4}$		876
$2(K^{+}K^{-})$		$(7.0 \pm 3.0) \times 10^{-4}$		1131
$pK^{-}\bar{\Sigma}^0$		$(2.9 \pm 0.8) \times 10^{-4}$		820
$K^{+}K^{-}$		$(2.37 \pm 0.31) \times 10^{-4}$		1468
$\Lambda\bar{\Lambda}\pi^0$		$(2.2 \pm 0.7) \times 10^{-4}$		998
$\pi^{+}\pi^{-}$		$(1.47 \pm 0.23) \times 10^{-4}$		1542
$K_S^0 K_L^0$		$(1.08 \pm 0.14) \times 10^{-4}$		1466
$\Lambda\bar{\Sigma} + \text{c.c.}$		$< 1.5 \times 10^{-4}$	CL=90%	1032
$K_S^0 K_S^0$		$< 5.2 \times 10^{-6}$	CL=90%	1466

Radiative decays

$\gamma\eta_c(1S)$		$(1.3 \pm 0.4) \%$		116
$\gamma\pi^{+}\pi^{-}2\pi^0$		$(8.3 \pm 3.1) \times 10^{-3}$		1518
$\gamma\eta\pi\pi$		$(6.1 \pm 1.0) \times 10^{-3}$		1487
$\gamma\eta(1440) \rightarrow \gamma K\bar{K}\pi$	[ρ]	$(9.1 \pm 1.8) \times 10^{-4}$		1223
$\gamma\eta(1440) \rightarrow \gamma\gamma\rho^0$		$(6.4 \pm 1.4) \times 10^{-5}$		1223
$\gamma\eta(1440) \rightarrow \gamma\eta\pi^{+}\pi^{-}$		$(3.4 \pm 0.7) \times 10^{-4}$		—
$\gamma\rho\rho$		$(4.5 \pm 0.8) \times 10^{-3}$		1343
$\gamma\eta'(958)$		$(4.31 \pm 0.30) \times 10^{-3}$		1400
$\gamma 2\pi^{+}2\pi^{-}$		$(2.8 \pm 0.5) \times 10^{-3}$	S=1.9	1517
$\gamma f_4(2050)$		$(2.7 \pm 0.7) \times 10^{-3}$		874
$\gamma\omega\omega$		$(1.59 \pm 0.33) \times 10^{-3}$		1337
$\gamma\eta(1440) \rightarrow \gamma\rho^0\rho^0$		$(1.7 \pm 0.4) \times 10^{-3}$	S=1.3	1223
$\gamma f_2(1270)$		$(1.38 \pm 0.14) \times 10^{-3}$		1286
$\gamma f_J(1710) \rightarrow \gamma K\bar{K}$		$(8.5 \pm_{-0.9}^{+1.2}) \times 10^{-4}$	S=1.2	1075
$\gamma\eta$		$(8.6 \pm 0.8) \times 10^{-4}$		1500
$\gamma f_1(1420) \rightarrow \gamma K\bar{K}\pi$		$(8.3 \pm 1.5) \times 10^{-4}$		1220
$\gamma f_1(1285)$		$(6.5 \pm 1.0) \times 10^{-4}$		1283
$\gamma f_2'(1525)$		$(4.7 \pm_{-0.5}^{+0.7}) \times 10^{-4}$		1173
$\gamma\phi\phi$		$(4.0 \pm 1.2) \times 10^{-4}$	S=2.1	1166
$\gamma p\bar{p}$		$(3.8 \pm 1.0) \times 10^{-4}$		1232
$\gamma\eta(2225)$		$(2.9 \pm 0.6) \times 10^{-4}$		834

$\gamma\eta(1760) \rightarrow \gamma\rho^0\rho^0$	$(1.3 \pm 0.9) \times 10^{-4}$		1048
$\gamma\pi^0$	$(3.9 \pm 1.3) \times 10^{-5}$		1546
$\gamma p\bar{p}\pi^+\pi^-$	$< 7.9 \times 10^{-4}$	CL=90%	1107
$\gamma\gamma$	$< 5 \times 10^{-4}$	CL=90%	1548
$\gamma\Lambda\bar{\Lambda}$	$< 1.3 \times 10^{-4}$	CL=90%	1074
3γ	$< 5.5 \times 10^{-5}$	CL=90%	1548
$\gamma f_J(2220)$	$> 2.50 \times 10^{-3}$	CL=99.9%	—
$\gamma f_0(1500)$	$(5.7 \pm 0.8) \times 10^{-4}$		1184
γe^+e^-	$(8.8 \pm 1.4) \times 10^{-3}$		—

 $\chi_{c0}(1P)$

$$I^G(J^{PC}) = 0^+(0^{++})$$

 Mass $m = 3417.3 \pm 2.8$ MeV

 Full width $\Gamma = 14 \pm 5$ MeV

$\chi_{c0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	$\frac{p}{\text{MeV}/c}$
Hadronic decays			
$2(\pi^+\pi^-)$	$(3.7 \pm 0.7) \%$		1679
$\pi^+\pi^-K^+K^-$	$(3.0 \pm 0.7) \%$		1580
$\rho^0\pi^+\pi^-$	$(1.6 \pm 0.5) \%$		1608
$3(\pi^+\pi^-)$	$(1.5 \pm 0.5) \%$		1633
$K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}$	$(1.2 \pm 0.4) \%$		1522
$\pi^+\pi^-$	$(7.5 \pm 2.1) \times 10^{-3}$		1702
K^+K^-	$(7.1 \pm 2.4) \times 10^{-3}$		1635
$\pi^+\pi^-p\bar{p}$	$(5.0 \pm 2.0) \times 10^{-3}$		1320
$p\bar{p}$	$< 9.0 \times 10^{-4}$	90%	1427
Radiative decays			
$\gamma J/\psi(1S)$	$(6.6 \pm 1.8) \times 10^{-3}$		303
$\gamma\gamma$	$< 5 \times 10^{-4}$	95%	1708

$\chi_{c1}(1P)$

$$J^{PC} = 0^+(1^{++})$$

 Mass $m = 3510.53 \pm 0.12$ MeV

 Full width $\Gamma = 0.88 \pm 0.14$ MeV

$\chi_{c1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
Hadronic decays		
$3(\pi^+ \pi^-)$	(2.2 ± 0.8) %	1683
$2(\pi^+ \pi^-)$	(1.6 ± 0.5) %	1727
$\pi^+ \pi^- K^+ K^-$	(9 ± 4) $\times 10^{-3}$	1632
$\rho^0 \pi^+ \pi^-$	(3.9 ± 3.5) $\times 10^{-3}$	1659
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	(3.2 ± 2.1) $\times 10^{-3}$	1576
$\pi^+ \pi^- \rho \bar{p}$	(1.4 ± 0.9) $\times 10^{-3}$	1381
$\rho \bar{p}$	(8.6 ± 1.2) $\times 10^{-5}$	1483
$\pi^+ \pi^- + K^+ K^-$	$< 2.1 \times 10^{-3}$	—
Radiative decays		
$\gamma J/\psi(1S)$	(27.3 ± 1.6) %	389

 $\chi_{c2}(1P)$

$$J^{PC} = 0^+(2^{++})$$

 Mass $m = 3556.17 \pm 0.13$ MeV

 Full width $\Gamma = 2.00 \pm 0.18$ MeV

$\chi_{c2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Hadronic decays			
$2(\pi^+ \pi^-)$	(2.2 ± 0.5) %		1751
$\pi^+ \pi^- K^+ K^-$	(1.9 ± 0.5) %		1656
$3(\pi^+ \pi^-)$	(1.2 ± 0.8) %		1707
$\rho^0 \pi^+ \pi^-$	(7 ± 4) $\times 10^{-3}$		1683
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	(4.8 ± 2.8) $\times 10^{-3}$		1601
$\pi^+ \pi^- \rho \bar{p}$	(3.3 ± 1.3) $\times 10^{-3}$		1410
$\pi^+ \pi^-$	(1.9 ± 1.0) $\times 10^{-3}$		1773
$K^+ K^-$	(1.5 ± 1.1) $\times 10^{-3}$		1708
$\rho \bar{p}$	(10.0 ± 1.0) $\times 10^{-5}$		1510
$J/\psi(1S) \pi^+ \pi^- \pi^0$	< 1.5 %	90%	185
Radiative decays			
$\gamma J/\psi(1S)$	(13.5 ± 1.1) %		430
$\gamma\gamma$	(1.6 ± 0.5) $\times 10^{-4}$		1778

$\psi(2S)$

$$J^{PC} = 0^-(1^{--})$$

 Mass $m = 3686.00 \pm 0.09$ MeV

 Full width $\Gamma = 277 \pm 31$ keV ($S = 1.1$)

 $\Gamma_{ee} = 2.14 \pm 0.21$ keV (Assuming $\Gamma_{ee} = \Gamma_{\mu\mu}$)

$\psi(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
hadrons	$(98.10 \pm 0.30) \%$		—
virtual $\gamma \rightarrow$ hadrons	$(2.9 \pm 0.4) \%$		—
$e^+ e^-$	$(8.5 \pm 0.7) \times 10^{-3}$		1843
$\mu^+ \mu^-$	$(7.7 \pm 1.7) \times 10^{-3}$		1840

Decays into $J/\psi(1S)$ and anything

$J/\psi(1S)$ anything	$(54.2 \pm 3.0) \%$		—
$J/\psi(1S)$ neutrals	$(22.8 \pm 1.7) \%$		—
$J/\psi(1S) \pi^+ \pi^-$	$(30.2 \pm 1.9) \%$		477
$J/\psi(1S) \pi^0 \pi^0$	$(17.9 \pm 1.8) \%$		481
$J/\psi(1S) \eta$	$(2.7 \pm 0.4) \%$	$S=1.7$	200
$J/\psi(1S) \pi^0$	$(9.7 \pm 2.1) \times 10^{-4}$		527
$J/\psi(1S) \mu^+ \mu^-$	$(10.0 \pm 3.3) \times 10^{-3}$		—

Hadronic decays

$3(\pi^+ \pi^-) \pi^0$	$(3.5 \pm 1.6) \times 10^{-3}$		1746
$2(\pi^+ \pi^-) \pi^0$	$(3.0 \pm 0.8) \times 10^{-3}$		1799
$\pi^+ \pi^- K^+ K^-$	$(1.6 \pm 0.4) \times 10^{-3}$		1726
$\pi^+ \pi^- \rho \bar{\rho}$	$(8.0 \pm 2.0) \times 10^{-4}$		1491
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(6.7 \pm 2.5) \times 10^{-4}$		1673
$2(\pi^+ \pi^-)$	$(4.5 \pm 1.0) \times 10^{-4}$		1817
$\rho^0 \pi^+ \pi^-$	$(4.2 \pm 1.5) \times 10^{-4}$		1751
$\bar{\rho} \rho$	$(1.9 \pm 0.5) \times 10^{-4}$		1586
$3(\pi^+ \pi^-)$	$(1.5 \pm 1.0) \times 10^{-4}$		1774
$\bar{\rho} \rho \pi^0$	$(1.4 \pm 0.5) \times 10^{-4}$		1543
$K^+ K^-$	$(1.0 \pm 0.7) \times 10^{-4}$		1776
$\pi^+ \pi^- \pi^0$	$(9 \pm 5) \times 10^{-5}$		1830
$\rho \pi$	$< 8.3 \times 10^{-5}$	CL=90%	1760
$\pi^+ \pi^-$	$(8 \pm 5) \times 10^{-5}$		1838
$\Lambda \bar{\Lambda}$	$< 4 \times 10^{-4}$	CL=90%	1467
$\Xi^- \bar{\Xi}^+$	$< 2 \times 10^{-4}$	CL=90%	1285
$K^+ K^- \pi^0$	$< 2.96 \times 10^{-5}$	CL=90%	1754
$K^+ \bar{K}^*(892)^- + \text{c.c.}$	$< 5.4 \times 10^{-5}$	CL=90%	1698

Radiative decays

$\gamma\chi_{c0}(1P)$	(9.3 \pm 0.9) %		261
$\gamma\chi_{c1}(1P)$	(8.7 \pm 0.8) %		171
$\gamma\chi_{c2}(1P)$	(7.8 \pm 0.8) %		127
$\gamma\eta_c(1S)$	(2.8 \pm 0.6) $\times 10^{-3}$		639
$\gamma\eta'(958)$	< 1.1 $\times 10^{-3}$	CL=90%	1719
$\gamma\gamma$	< 1.6 $\times 10^{-4}$	CL=90%	1843
$\gamma\eta(1440) \rightarrow \gamma K\bar{K}\pi$	< 1.2 $\times 10^{-4}$	CL=90%	1569

 $\psi(3770)$

$$J^{PC} = ??(1^{--})$$

 Mass $m = 3769.9 \pm 2.5$ MeV (S = 1.8)

 Full width $\Gamma = 23.6 \pm 2.7$ MeV (S = 1.1)

 $\Gamma_{ee} = 0.26 \pm 0.04$ keV (S = 1.2)

$\psi(3770)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
$D\bar{D}$	dominant		242
e^+e^-	$(1.12 \pm 0.17) \times 10^{-5}$	1.2	1885

 $\psi(4040)$ [iii]

$$J^{PC} = ??(1^{--})$$

 Mass $m = 4040 \pm 10$ MeV

 Full width $\Gamma = 52 \pm 10$ MeV

 $\Gamma_{ee} = 0.75 \pm 0.15$ keV

$\psi(4040)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(1.4 \pm 0.4) \times 10^{-5}$	2020
$D^0\bar{D}^0$	seen	777
$D^*(2007)^0\bar{D}^0 + c.c.$	seen	578
$D^*(2007)^0\bar{D}^*(2007)^0$	seen	232

 $\psi(4160)$ [iii]

$$J^{PC} = ??(1^{--})$$

 Mass $m = 4159 \pm 20$ MeV

 Full width $\Gamma = 78 \pm 20$ MeV

 $\Gamma_{ee} = 0.77 \pm 0.23$ keV

$\psi(4160)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(10 \pm 4) \times 10^{-6}$	2079

$\psi(4415)$ ^[iii]

$$I^G(J^{PC}) = ??(1^{--})$$

Mass $m = 4415 \pm 6$ MeV

Full width $\Gamma = 43 \pm 15$ MeV (S = 1.8)

$\Gamma_{ee} = 0.47 \pm 0.10$ keV

$\psi(4415)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
hadrons	dominant	–
$e^+ e^-$	$(1.1 \pm 0.4) \times 10^{-5}$	2207

$b\bar{b}$ MESONS

$\Upsilon(1S)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass $m = 9460.37 \pm 0.21$ MeV (S = 2.7)

Full width $\Gamma = 52.5 \pm 1.8$ keV

$\Gamma_{ee} = 1.32 \pm 0.05$ keV

$\Upsilon(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\tau^+ \tau^-$	$(2.67^{+0.14}_{-0.16}) \%$		4384
$e^+ e^-$	$(2.52 \pm 0.17) \%$		4730
$\mu^+ \mu^-$	$(2.48 \pm 0.07) \%$	S=1.1	4729
Hadronic decays			
$J/\psi(1S)$ anything	$(1.1 \pm 0.4) \times 10^{-3}$		4223
$\rho\pi$	$< 2 \times 10^{-4}$	CL=90%	4698
$\pi^+ \pi^-$	$< 5 \times 10^{-4}$	CL=90%	4728
$K^+ K^-$	$< 5 \times 10^{-4}$	CL=90%	4704
$p\bar{p}$	$< 5 \times 10^{-4}$	CL=90%	4636

Radiative decays

$\gamma 2h^+ 2h^-$	$(7.0 \pm 1.5) \times 10^{-4}$		4720
$\gamma 3h^+ 3h^-$	$(5.4 \pm 2.0) \times 10^{-4}$		4703
$\gamma 4h^+ 4h^-$	$(7.4 \pm 3.5) \times 10^{-4}$		4679
$\gamma \pi^+ \pi^- K^+ K^-$	$(2.9 \pm 0.9) \times 10^{-4}$		4686
$\gamma 2\pi^+ 2\pi^-$	$(2.5 \pm 0.9) \times 10^{-4}$		4720
$\gamma 3\pi^+ 3\pi^-$	$(2.5 \pm 1.2) \times 10^{-4}$		4703
$\gamma 2\pi^+ 2\pi^- K^+ K^-$	$(2.4 \pm 1.2) \times 10^{-4}$		4658
$\gamma \pi^+ \pi^- p \bar{p}$	$(1.5 \pm 0.6) \times 10^{-4}$		4604
$\gamma 2\pi^+ 2\pi^- p \bar{p}$	$(4 \pm 6) \times 10^{-5}$		4563
$\gamma 2K^+ 2K^-$	$(2.0 \pm 2.0) \times 10^{-5}$		4601
$\gamma \eta'(958)$	< 1.3	$\times 10^{-3}$	CL=90% 4682
$\gamma \eta$	< 3.5	$\times 10^{-4}$	CL=90% 4714
$\gamma f'_2(1525)$	< 1.4	$\times 10^{-4}$	CL=90% 4607
$\gamma f_2(1270)$	< 1.3	$\times 10^{-4}$	CL=90% 4644
$\gamma \eta(1440)$	< 8.2	$\times 10^{-5}$	CL=90% 4624
$\gamma f_J(1710) \rightarrow \gamma K \bar{K}$	< 2.6	$\times 10^{-4}$	CL=90% 4576
$\gamma f_0(2200) \rightarrow \gamma K^+ K^-$	< 2	$\times 10^{-4}$	CL=90% 4475
$\gamma f_J(2220) \rightarrow \gamma K^+ K^-$	< 1.5	$\times 10^{-5}$	CL=90% 4469
$\gamma \eta(2225) \rightarrow \gamma \phi \phi$	< 3	$\times 10^{-3}$	CL=90% 4469
γX	< 3	$\times 10^{-5}$	CL=90% -
X = pseudoscalar with $m < 7.2$ GeV)			
$\gamma X \bar{X}$	< 1	$\times 10^{-3}$	CL=90% -
X \bar{X} = vectors with $m < 3.1$ GeV)			

$\chi_{b0}(1P)$ ^[*ijj*]

$$I^G(J^{PC}) = 0^+(0^{++})$$

J needs confirmation.

Mass $m = 9859.8 \pm 1.3$ MeV

$\chi_{b0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	^p (MeV/c)
$\gamma \Upsilon(1S)$	$< 6\%$	90%	391

$\chi_{b1}(1P)$ ^[*ijj*]

$$I^G(J^{PC}) = 0^+(1^{++})$$

J needs confirmation.

Mass $m = 9891.9 \pm 0.7$ MeV

$\chi_{b1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	<i>p</i> (MeV/c)
$\gamma \Upsilon(1S)$	$(35 \pm 8)\%$	422

$\chi_{b2}(1P)$ *[jj]*

$$I^G(J^{PC}) = 0^+(2^{++})$$

J needs confirmation.

$$\text{Mass } m = 9913.2 \pm 0.6 \text{ MeV}$$

$\chi_{b2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	<i>p</i> (MeV/c)
$\gamma \Upsilon(1S)$	(22±4) %	443

 $\Upsilon(2S)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

$$\text{Mass } m = 10.02330 \pm 0.00031 \text{ GeV}$$

$$\text{Full width } \Gamma = 44 \pm 7 \text{ keV}$$

$$\Gamma_{ee} = 0.520 \pm 0.032 \text{ keV}$$

$\Upsilon(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	<i>p</i> (MeV/c)
$\Upsilon(1S)\pi^+\pi^-$	(18.5 ±0.8) %		475
$\Upsilon(1S)\pi^0\pi^0$	(8.8 ±1.1) %		480
$\tau^+\tau^-$	(1.7 ±1.6) %		4686
$\mu^+\mu^-$	(1.31±0.21) %		5011
e^+e^-	(1.18±0.20) %		5012
$\Upsilon(1S)\pi^0$	< 8	$\times 10^{-3}$ 90%	531
$\Upsilon(1S)\eta$	< 2	$\times 10^{-3}$ 90%	127
$J/\psi(1S)$ anything	< 6	$\times 10^{-3}$ 90%	4533

Radiative decays

$\gamma\chi_{b1}(1P)$	(6.7 ±0.9) %		131
$\gamma\chi_{b2}(1P)$	(6.6 ±0.9) %		110
$\gamma\chi_{b0}(1P)$	(4.3 ±1.0) %		162
$\gamma f_J(1710)$	< 5.9	$\times 10^{-4}$ 90%	4866
$\gamma f'_2(1525)$	< 5.3	$\times 10^{-4}$ 90%	4896
$\gamma f_2(1270)$	< 2.41	$\times 10^{-4}$ 90%	4931

 $\chi_{b0}(2P)$ *[jj]*

$$I^G(J^{PC}) = 0^+(0^{++})$$

J needs confirmation.

$$\text{Mass } m = 10.2321 \pm 0.0006 \text{ GeV}$$

$\chi_{b0}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	<i>p</i> (MeV/c)
$\gamma \Upsilon(2S)$	(4.6±2.1) %	210
$\gamma \Upsilon(1S)$	(9 ±6) $\times 10^{-3}$	746

$\chi_{b1}(2P) [jjj]$

$$J^G(J^{PC}) = 0^+(1^{++})$$

J needs confirmation.

$$\text{Mass } m = 10.2552 \pm 0.0005 \text{ GeV}$$

$$m_{\chi_{b1}(2P)} - m_{\chi_{b0}(2P)} = 23.5 \pm 1.0 \text{ MeV}$$

$\chi_{b1}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
$\gamma \Upsilon(2S)$	(21 \pm 4) %	1.5	229
$\gamma \Upsilon(1S)$	(8.5 \pm 1.3) %	1.3	764

 $\chi_{b2}(2P) [jjj]$

$$J^G(J^{PC}) = 0^+(2^{++})$$

J needs confirmation.

$$\text{Mass } m = 10.2685 \pm 0.0004 \text{ GeV}$$

$$m_{\chi_{b2}(2P)} - m_{\chi_{b1}(2P)} = 13.5 \pm 0.6 \text{ MeV}$$

$\chi_{b2}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma \Upsilon(2S)$	(16.2 \pm 2.4) %	242
$\gamma \Upsilon(1S)$	(7.1 \pm 1.0) %	776

 $\Upsilon(3S)$

$$J^G(J^{PC}) = 0^-(1^{--})$$

$$\text{Mass } m = 10.3553 \pm 0.0005 \text{ GeV}$$

$$\text{Full width } \Gamma = 26.3 \pm 3.5 \text{ keV}$$

$\Upsilon(3S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\Upsilon(2S)$ anything	(10.6 \pm 0.8) %		296
$\Upsilon(2S) \pi^+ \pi^-$	(2.8 \pm 0.6) %	S=2.2	177
$\Upsilon(2S) \pi^0 \pi^0$	(2.00 \pm 0.32) %		190
$\Upsilon(2S) \gamma \gamma$	(5.0 \pm 0.7) %		327
$\Upsilon(1S) \pi^+ \pi^-$	(4.48 \pm 0.21) %		814
$\Upsilon(1S) \pi^0 \pi^0$	(2.06 \pm 0.28) %		816
$\Upsilon(1S) \eta$	< 2.2 $\times 10^{-3}$	CL=90%	–
$\mu^+ \mu^-$	(1.81 \pm 0.17) %		5177
$e^+ e^-$	seen		5177

Radiative decays

$\gamma \chi_{b2}(2P)$	(11.4 \pm 0.8) %	S=1.3	87
$\gamma \chi_{b1}(2P)$	(11.3 \pm 0.6) %		100
$\gamma \chi_{b0}(2P)$	(5.4 \pm 0.6) %	S=1.1	123

$\Upsilon(4S)$
or **$\Upsilon(10580)$**

$$I^G(J^{PC}) = ??(1^{--})$$

Mass $m = 10.5800 \pm 0.0035$ GeV

Full width $\Gamma = 10 \pm 4$ MeV

$\Gamma_{ee} = 0.248 \pm 0.031$ keV ($S = 1.3$)

$\Upsilon(4S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$B\bar{B}$	> 96 %	95%	—
non- $B\bar{B}$	< 4 %	95%	—
e^+e^-	$(2.8 \pm 0.7) \times 10^{-5}$		5290
$J/\psi(3097)$ anything	$(2.2 \pm 0.7) \times 10^{-3}$		—
D^{*+} anything + c.c.	< 7.4 %	90%	5099
ϕ anything	< 2.3 $\times 10^{-3}$	90%	5240
$\Upsilon(1S)$ anything	< 4 $\times 10^{-3}$	90%	1053

$\Upsilon(10860)$

$$I^G(J^{PC}) = ??(1^{--})$$

Mass $m = 10.865 \pm 0.008$ GeV ($S = 1.1$)

Full width $\Gamma = 110 \pm 13$ MeV

$\Gamma_{ee} = 0.31 \pm 0.07$ keV ($S = 1.3$)

$\Upsilon(10860)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(2.8 \pm 0.7) \times 10^{-6}$	5432

$\Upsilon(11020)$

$$I^G(J^{PC}) = ??(1^{--})$$

Mass $m = 11.019 \pm 0.008$ GeV

Full width $\Gamma = 79 \pm 16$ MeV

$\Gamma_{ee} = 0.130 \pm 0.030$ keV

$\Upsilon(11020)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(1.6 \pm 0.5) \times 10^{-6}$	5509

NOTES

- [a] See the “Note on $\pi^\pm \rightarrow \ell^\pm \nu \gamma$ and $K^\pm \rightarrow \ell^\pm \nu \gamma$ Form Factors” in the π^\pm Particle Listings for definitions and details.
- [b] Measurements of $\Gamma(e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$ always include decays with γ 's, and measurements of $\Gamma(e^+ \nu_e \gamma)$ and $\Gamma(\mu^+ \nu_\mu \gamma)$ never include low-energy γ 's. Therefore, since no clean separation is possible, we consider the modes with γ 's to be subreactions of the modes without them, and let $[\Gamma(e^+ \nu_e) + \Gamma(\mu^+ \nu_\mu)]/\Gamma_{\text{total}} = 100\%$.
- [c] See the π^\pm Particle Listings for the energy limits used in this measurement; low-energy γ 's are not included.
- [d] Derived from an analysis of neutrino-oscillation experiments.
- [e] Astrophysical and cosmological arguments give limits of order 10^{-13} ; see the π^0 Particle Listings.
- [f] See the “Note on the Decay Width $\Gamma(\eta \rightarrow \gamma \gamma)$ ” in our 1994 edition, Phys. Rev. **D50**, 1 August 1994, Part I, p. 1451.
- [g] C parity forbids this to occur as a single-photon process.
- [h] See the “Note on scalar mesons” in the $f_0(1370)$ Particle Listings . The interpretation of this entry as a particle is controversial.
- [i] See the “Note on $\rho(770)$ ” in the $\rho(770)$ Particle Listings .
- [j] The $e^+ e^-$ branching fraction is from $e^+ e^- \rightarrow \pi^+ \pi^-$ experiments only. The $\omega \rho$ interference is then due to $\omega \rho$ mixing only, and is expected to be small. If $e \mu$ universality holds, $\Gamma(\rho^0 \rightarrow \mu^+ \mu^-) = \Gamma(\rho^0 \rightarrow e^+ e^-) \times 0.99785$.
- [k] See the “Note on scalar mesons” in the $f_0(1370)$ Particle Listings .
- [l] See the “Note on $a_1(1260)$ ” in the $a_1(1260)$ Particle Listings .
- [m] This is only an educated guess; the error given is larger than the error on the average of the published values. See the Particle Listings for details.
- [n] See the “Note on the $f_1(1420)$ ” in the $\eta(1440)$ Particle Listings.
- [o] See also the $\omega(1600)$ Particle Listings.
- [p] See the “Note on the $\eta(1440)$ ” in the $\eta(1440)$ Particle Listings.
- [q] See the “Note on the $\rho(1450)$ and the $\rho(1700)$ ” in the $\rho(1700)$ Particle Listings.
- [r] See the “Note on non- $q\bar{q}$ mesons” in the Particle Listings (see the index for the page number).
- [s] See also the $\omega(1420)$ Particle Listings.
- [t] See the “Note on $f_J(1710)$ ” in the $f_J(1710)$ Particle Listings .
- [u] See the note in the K^\pm Particle Listings.

[v] The definition of the slope parameter g of the $K \rightarrow 3\pi$ Dalitz plot is as follows (see also “Note on Dalitz Plot Parameters for $K \rightarrow 3\pi$ Decays” in the K^\pm Particle Listings):

$$|M|^2 = 1 + g(s_3 - s_0)/m_{\pi^+}^2 + \dots$$

[w] For more details and definitions of parameters see the Particle Listings.

[x] See the K^\pm Particle Listings for the energy limits used in this measurement.

[y] Most of this radiative mode, the low-momentum γ part, is also included in the parent mode listed without γ 's.

[z] Direct-emission branching fraction.

[aa] Structure-dependent part.

[bb] Derived from measured values of ϕ_{+-} , ϕ_{00} , $|\eta|$, $|m_{K_L^0} - m_{K_S^0}|$, and $\tau_{K_S^0}$, as described in the introduction to “Tests of Conservation Laws.”

[cc] The CP -violation parameters are defined as follows (see also “Note on CP Violation in $K_S \rightarrow 3\pi$ ” and “Note on CP Violation in K_L^0 Decay” in the Particle Listings):

$$\eta_{+-} = |\eta_{+-}|e^{i\phi_{+-}} = \frac{A(K_L^0 \rightarrow \pi^+\pi^-)}{A(K_S^0 \rightarrow \pi^+\pi^-)} = \epsilon + \epsilon'$$

$$\eta_{00} = |\eta_{00}|e^{i\phi_{00}} = \frac{A(K_L^0 \rightarrow \pi^0\pi^0)}{A(K_S^0 \rightarrow \pi^0\pi^0)} = \epsilon - 2\epsilon'$$

$$\delta = \frac{\Gamma(K_L^0 \rightarrow \pi^-\ell^+\nu) - \Gamma(K_L^0 \rightarrow \pi^+\ell^-\nu)}{\Gamma(K_L^0 \rightarrow \pi^-\ell^+\nu) + \Gamma(K_L^0 \rightarrow \pi^+\ell^-\nu)},$$

$$\text{Im}(\eta_{+-0})^2 = \frac{\Gamma(K_S^0 \rightarrow \pi^+\pi^-\pi^0)^{CP \text{ viol.}}}{\Gamma(K_L^0 \rightarrow \pi^+\pi^-\pi^0)},$$

$$\text{Im}(\eta_{000})^2 = \frac{\Gamma(K_S^0 \rightarrow \pi^0\pi^0\pi^0)}{\Gamma(K_L^0 \rightarrow \pi^0\pi^0\pi^0)}.$$

where for the last two relations CPT is assumed valid, *i.e.*, $\text{Re}(\eta_{+-0}) \simeq 0$ and $\text{Re}(\eta_{000}) \simeq 0$.

[dd] See the K_S^0 Particle Listings for the energy limits used in this measurement.

[ee] Calculated from K_L^0 semileptonic rates and the K_S^0 lifetime assuming $\Delta S = \Delta Q$.

[ff] ϵ'/ϵ is derived from $|\eta_{00}/\eta_{+-}|$ measurements using theoretical input on phases.

- [*gg*] The value is for the sum of the charge states of particle/antiparticle states indicated.
- [*hh*] See the K_L^0 Particle Listings for the energy limits used in this measurement.
- [*ii*] Allowed by higher-order electroweak interactions.
- [*jj*] Violates CP in leading order. Test of direct CP violation since the indirect CP -violating and CP -conserving contributions are expected to be suppressed.
- [*kk*] See the “Note on $f_0(1370)$ ” in the $f_0(1370)$ Particle Listings and in the 1994 edition.
- [*ll*] See the note in the $L(1770)$ Particle Listings in Reviews of Modern Physics **56** No. 2 Pt. II (1984), p. S200. See also the “Note on $K_2(1770)$ and the $K_2(1820)$ ” in the $K_2(1770)$ Particle Listings .
- [*mm*] See the “Note on $K_2(1770)$ and the $K_2(1820)$ ” in the $K_2(1770)$ Particle Listings .
- [*nn*] This is a weighted average of D^\pm (44%) and D^0 (56%) branching fractions. See “ D^+ and $D^0 \rightarrow (\eta \text{ anything}) / (\text{total } D^+ \text{ and } D^0)$ ” under “ D^+ Branching Ratios” in the Particle Listings.
- [*oo*] This value averages the e^+ and μ^+ branching fractions, after making a small phase-space adjustment to the μ^+ fraction to be able to use it as an e^+ fraction; hence our ℓ^+ here is really an e^+ .
- [*pp*] An ℓ indicates an e or a μ mode, not a sum over these modes.
- [*qq*] The branching fraction for this mode may differ from the sum of the submodes that contribute to it, due to interference effects. See the relevant papers in the Particle Listings.
- [*rr*] The two experiments measuring this fraction are in serious disagreement. See the Particle Listings.
- [*ss*] This mode is not a useful test for a $\Delta C=1$ weak neutral current because both quarks must change flavor in this decay.
- [*tt*] The D_1^0 - D_2^0 limits are inferred from the D^0 - \bar{D}^0 mixing ratio $\Gamma(K^+ \ell^- \bar{\nu}_\ell \text{ (via } \bar{D}^0)) / \Gamma(K^- \ell^+ \nu_\ell)$.
- [*uu*] The larger limit (from E791) allows interference between the doubly Cabibbo-suppressed and mixing amplitudes; the smaller limit (from E691) doesn't. See the papers for details.
- [*vv*] The experiments on the division of this charge mode amongst its submodes disagree, and the submode branching fractions here add up to considerably more than the charged-mode fraction.
- [*ww*] However, these upper limits are in serious disagreement with values obtained in another experiment.

- [xx] For now, we average together measurements of the $X e^+ \nu_e$ and $X \mu^+ \nu_\mu$ branching fractions. This is the *average*, not the *sum*.
- [yy] This branching fraction includes all the decay modes of the final-state resonance.
- [zz] This value includes only $K^+ K^-$ decays of the $f_J(1710)$, because branching fractions of this resonance are not known.
- [aaa] This value includes only $\pi^+ \pi^-$ decays of the $f_0(1500)$, because branching fractions of this resonance are not known.
- [bbb] B^0 and B_s^0 contributions not separated. Limit is on weighted average of the two decay rates.
- [ccc] These values are model dependent. See 'Note on Semileptonic Decays' in the B^+ Particle Listings.
- [ddd] D^{**} stands for the sum of the $D(1^1P_1)$, $D(1^3P_0)$, $D(1^3P_1)$, $D(1^3P_2)$, $D(2^1S_0)$, and $D(2^1S_1)$ resonances.
- [eee] Inclusive branching fractions have a multiplicity definition and can be greater than 100%.
- [fff] D_j represents an unresolved mixture of pseudoscalar and tensor D^{**} (P -wave) states.
- [ggg] Not a pure measurement. See note at head of B_s^0 Decay Modes.
- [hhh] Includes $p\bar{p}\pi^+\pi^-\gamma$ and excludes $p\bar{p}\eta$, $p\bar{p}\omega$, $p\bar{p}\eta'$.
- [iii] J^{PC} known by production in $e^+ e^-$ via single photon annihilation. I^G is not known; interpretation of this state as a single resonance is unclear because of the expectation of substantial threshold effects in this energy region.
- [jjj] Spectroscopic labeling for these states is theoretical, pending experimental information.

N BARYONS

($S = 0, I = 1/2$)

$$p, N^+ = uud; \quad n, N^0 = udd$$

p

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

$$\text{Mass } m = 938.27231 \pm 0.00028 \text{ MeV [a]}$$

$$= 1.007276470 \pm 0.000000012 \text{ u}$$

$$\left| \frac{q_{\bar{p}}}{m_{\bar{p}}} \right| / \left(\frac{q_p}{m_p} \right) = 1.0000000015 \pm 0.0000000011$$

$$\left| q_p + q_{\bar{p}} \right| / e < 2 \times 10^{-5}$$

$$\left| q_p + q_e \right| / e < 1.0 \times 10^{-21} \text{ [b]}$$

$$\text{Magnetic moment } \mu = 2.79284739 \pm 0.00000006 \mu_N$$

$$\text{Electric dipole moment } d = (-4 \pm 6) \times 10^{-23} \text{ e cm}$$

$$\text{Electric polarizability } \bar{\alpha} = (12.1 \pm 0.9) \times 10^{-4} \text{ fm}^3$$

$$\text{Magnetic polarizability } \bar{\beta} = (2.1 \pm 0.9) \times 10^{-4} \text{ fm}^3$$

$$\text{Mean life } \tau > 1.6 \times 10^{25} \text{ years (independent of mode)}$$

$$> 10^{31} \text{ to } 5 \times 10^{32} \text{ years [c] (mode dependent)}$$

Below, for N decays, p and n distinguish proton and neutron partial lifetimes. See also the "Note on Nucleon Decay" in our 1994 edition (Phys. Rev. **D50**, 1673) for a short review.

The "partial mean life" limits tabulated here are the limits on τ/B_i , where τ is the total mean life and B_i is the branching fraction for the mode in question.

p DECAY MODES	Partial mean life (10^{30} years)	Confidence level	p (MeV/c)
Antilepton + meson			
$N \rightarrow e^+ \pi$	$> 130 (n), > 550 (p)$	90%	459
$N \rightarrow \mu^+ \pi$	$> 100 (n), > 270 (p)$	90%	453
$N \rightarrow \nu \pi$	$> 100 (n), > 25 (p)$	90%	459
$p \rightarrow e^+ \eta$	> 140	90%	309
$p \rightarrow \mu^+ \eta$	> 69	90%	296
$n \rightarrow \nu \eta$	> 54	90%	310
$N \rightarrow e^+ \rho$	$> 58 (n), > 75 (p)$	90%	153
$N \rightarrow \mu^+ \rho$	$> 23 (n), > 110 (p)$	90%	119
$N \rightarrow \nu \rho$	$> 19 (n), > 27 (p)$	90%	153
$p \rightarrow e^+ \omega$	> 45	90%	142

$p \rightarrow \mu^+ \omega$	> 57	90%	104
$n \rightarrow \nu \omega$	> 43	90%	144
$N \rightarrow e^+ K$	> 1.3 (n), > 150 (p)	90%	337
$p \rightarrow e^+ K_S^0$	> 76	90%	337
$p \rightarrow e^+ K_L^0$	> 44	90%	337
$N \rightarrow \mu^+ K$	> 1.1 (n), > 120 (p)	90%	326
$p \rightarrow \mu^+ K_S^0$	> 64	90%	326
$p \rightarrow \mu^+ K_L^0$	> 44	90%	326
$N \rightarrow \nu K$	> 86 (n), > 100 (p)	90%	339
$p \rightarrow e^+ K^*(892)^0$	> 52	90%	45
$N \rightarrow \nu K^*(892)$	> 22 (n), > 20 (p)	90%	45

Antilepton + mesons

$p \rightarrow e^+ \pi^+ \pi^-$	> 21	90%	448
$p \rightarrow e^+ \pi^0 \pi^0$	> 38	90%	449
$n \rightarrow e^+ \pi^- \pi^0$	> 32	90%	449
$p \rightarrow \mu^+ \pi^+ \pi^-$	> 17	90%	425
$p \rightarrow \mu^+ \pi^0 \pi^0$	> 33	90%	427
$n \rightarrow \mu^+ \pi^- \pi^0$	> 33	90%	427
$n \rightarrow e^+ K^0 \pi^-$	> 18	90%	319

Lepton + meson

$n \rightarrow e^- \pi^+$	> 65	90%	459
$n \rightarrow \mu^- \pi^+$	> 49	90%	453
$n \rightarrow e^- \rho^+$	> 62	90%	154
$n \rightarrow \mu^- \rho^+$	> 7	90%	120
$n \rightarrow e^- K^+$	> 32	90%	340
$n \rightarrow \mu^- K^+$	> 57	90%	330

Lepton + mesons

$p \rightarrow e^- \pi^+ \pi^+$	> 30	90%	448
$n \rightarrow e^- \pi^+ \pi^0$	> 29	90%	449
$p \rightarrow \mu^- \pi^+ \pi^+$	> 17	90%	425
$n \rightarrow \mu^- \pi^+ \pi^0$	> 34	90%	427
$p \rightarrow e^- \pi^+ K^+$	> 20	90%	320
$p \rightarrow \mu^- \pi^+ K^+$	> 5	90%	279

Antilepton + photon(s)

$p \rightarrow e^+ \gamma$	> 460	90%	469
$p \rightarrow \mu^+ \gamma$	> 380	90%	463
$n \rightarrow \nu \gamma$	> 24	90%	470
$p \rightarrow e^+ \gamma \gamma$	> 100	90%	469

Three (or more) leptons

$p \rightarrow e^+ e^+ e^-$	> 510	90%	469
$p \rightarrow e^+ \mu^+ \mu^-$	> 81	90%	457
$p \rightarrow e^+ \nu \nu$	> 11	90%	469
$n \rightarrow e^+ e^- \nu$	> 74	90%	470
$n \rightarrow \mu^+ e^- \nu$	> 47	90%	464
$n \rightarrow \mu^+ \mu^- \nu$	> 42	90%	458
$p \rightarrow \mu^+ e^+ e^-$	> 91	90%	464
$p \rightarrow \mu^+ \mu^+ \mu^-$	> 190	90%	439
$p \rightarrow \mu^+ \nu \nu$	> 21	90%	463
$p \rightarrow e^- \mu^+ \mu^+$	> 6	90%	457
$n \rightarrow 3\nu$	> 0.0005	90%	470

Inclusive modes

$N \rightarrow e^+$ anything	> 0.6 (n, p)	90%	—
$N \rightarrow \mu^+$ anything	> 12 (n, p)	90%	—
$N \rightarrow e^+ \pi^0$ anything	> 0.6 (n, p)	90%	—

$\Delta B = 2$ dinucleon modes

The following are lifetime limits per iron nucleus.

$pp \rightarrow \pi^+ \pi^+$	> 0.7	90%	—
$pn \rightarrow \pi^+ \pi^0$	> 2	90%	—
$nn \rightarrow \pi^+ \pi^-$	> 0.7	90%	—
$nn \rightarrow \pi^0 \pi^0$	> 3.4	90%	—
$pp \rightarrow e^+ e^+$	> 5.8	90%	—
$pp \rightarrow e^+ \mu^+$	> 3.6	90%	—
$pp \rightarrow \mu^+ \mu^+$	> 1.7	90%	—
$pn \rightarrow e^+ \bar{\nu}$	> 2.8	90%	—
$pn \rightarrow \mu^+ \bar{\nu}$	> 1.6	90%	—
$nn \rightarrow \nu_e \bar{\nu}_e$	> 0.000012	90%	—
$nn \rightarrow \nu_\mu \bar{\nu}_\mu$	> 0.000006	90%	—

\bar{p} DECAY MODES

\bar{p} DECAY MODES	Partial mean life (years)	Confidence level	p (MeV/c)
$\bar{p} \rightarrow e^- \gamma$	> 1848	95%	469
$\bar{p} \rightarrow e^- \pi^0$	> 554	95%	459
$\bar{p} \rightarrow e^- \eta$	> 171	95%	309
$\bar{p} \rightarrow e^- K_S^0$	> 29	95%	337
$\bar{p} \rightarrow e^- K_L^0$	> 9	95%	337

n

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

$$\text{Mass } m = 939.56563 \pm 0.00028 \text{ MeV [a]}$$

$$= 1.008664904 \pm 0.000000014 \text{ u}$$

$$m_n - m_p = 1.293318 \pm 0.000009 \text{ MeV}$$

$$= 0.001388434 \pm 0.000000009 \text{ u}$$

$$\text{Mean life } \tau = 886.7 \pm 1.9 \text{ s } (S = 1.2)$$

$$c\tau = 2.658 \times 10^8 \text{ km}$$

$$\text{Magnetic moment } \mu = -1.9130428 \pm 0.0000005 \mu_N$$

$$\text{Electric dipole moment } d < 0.97 \times 10^{-25} \text{ e cm, CL} = 90\%$$

$$\text{Electric polarizability } \alpha = (0.98_{-0.23}^{+0.19}) \times 10^{-3} \text{ fm}^3 (S = 1.1)$$

$$\text{Charge } q = (-0.4 \pm 1.1) \times 10^{-21} \text{ e}$$

$$\text{Mean } n\bar{n}\text{-oscillation time } > 1.2 \times 10^8 \text{ s, CL} = 90\% [d] \text{ (bound } n)$$

$$> 0.86 \times 10^8 \text{ s, CL} = 90\% \text{ (free } n)$$

Decay parameters [e]

$$p e^- \bar{\nu}_e \quad g_A/g_V = -1.2670 \pm 0.0035 (S = 1.9)$$

$$" \quad A = -0.1162 \pm 0.0013 (S = 1.8)$$

$$" \quad B = 0.990 \pm 0.008$$

$$" \quad a = -0.102 \pm 0.005$$

$$" \quad \phi_{AV} = (180.07 \pm 0.18)^\circ [f]$$

$$" \quad D = (-0.5 \pm 1.4) \times 10^{-3}$$

<i>n</i> DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	$\frac{p}{\text{MeV}/c}$
$p e^- \bar{\nu}_e$	100 %		1.19
Charge conservation (<i>Q</i>) violating mode			
$p \nu_e \bar{\nu}_e$	$Q < 8 \times 10^{-27}$	68%	1.29

$N(1440) P_{11}$

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

Breit-Wigner mass = 1430 to 1470 (≈ 1440) MeVBreit-Wigner full width = 250 to 450 (≈ 350) MeV

$$p_{\text{beam}} = 0.61 \text{ GeV}/c \quad 4\pi\lambda^2 = 31.0 \text{ mb}$$

Re(pole position) = 1345 to 1385 (≈ 1365) MeV $-2\text{Im}(\text{pole position}) = 160$ to 260 (≈ 210) MeV

$N(1440)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	60–70 %	397
$N\pi\pi$	30–40 %	342
$\Delta\pi$	20–30 %	143
$N\rho$	<8 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	5–10 %	–
$p\gamma$	0.035–0.048 %	414
$p\gamma$, helicity=1/2	0.035–0.048 %	414
$n\gamma$	0.009–0.032 %	413
$n\gamma$, helicity=1/2	0.009–0.032 %	413

 $N(1520) D_{13}$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$$

Breit-Wigner mass = 1515 to 1530 (≈ 1520) MeVBreit-Wigner full width = 110 to 135 (≈ 120) MeV

$$p_{\text{beam}} = 0.74 \text{ GeV}/c \quad 4\pi\lambda^2 = 23.5 \text{ mb}$$

Re(pole position) = 1505 to 1515 (≈ 1510) MeV $-2\text{Im}(\text{pole position}) = 110$ to 120 (≈ 115) MeV

$N(1520)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	50–60 %	456
$N\pi\pi$	40–50 %	410
$\Delta\pi$	15–25 %	228
$N\rho$	15–25 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	<8 %	–
$p\gamma$	0.46–0.56 %	470
$p\gamma$, helicity=1/2	0.001–0.034 %	470
$p\gamma$, helicity=3/2	0.44–0.53 %	470
$n\gamma$	0.30–0.53 %	470
$n\gamma$, helicity=1/2	0.04–0.10 %	470
$n\gamma$, helicity=3/2	0.25–0.45 %	470

$N(1535) S_{11}$

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^-)$$

 Breit-Wigner mass = 1520 to 1555 (≈ 1535) MeV

 Breit-Wigner full width = 100 to 250 (≈ 150) MeV

$$p_{\text{beam}} = 0.76 \text{ GeV}/c \quad 4\pi\lambda^2 = 22.5 \text{ mb}$$

 Re(pole position) = 1495 to 1515 (≈ 1505) MeV

 $-2\text{Im}(\text{pole position}) = 90 \text{ to } 250$ (≈ 170) MeV

$N(1535)$ DECAY MODES	Fraction (Γ_i/Γ)	ρ (MeV/c)
$N\pi$	35–55 %	467
$N\eta$	30–55 %	182
$N\pi\pi$	1–10 %	422
$\Delta\pi$	<1 %	242
$N\rho$	<4 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	<3 %	–
$N(1440)\pi$	<7 %	†
$p\gamma$	0.15–0.35 %	481
$p\gamma$, helicity=1/2	0.15–0.35 %	481
$n\gamma$	0.004–0.29 %	480
$n\gamma$, helicity=1/2	0.004–0.29 %	480

$N(1650) S_{11}$

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^-)$$

 Breit-Wigner mass = 1640 to 1680 (≈ 1650) MeV

 Breit-Wigner full width = 145 to 190 (≈ 150) MeV

$$p_{\text{beam}} = 0.96 \text{ GeV}/c \quad 4\pi\lambda^2 = 16.4 \text{ mb}$$

 Re(pole position) = 1640 to 1680 (≈ 1660) MeV

 $-2\text{Im}(\text{pole position}) = 150 \text{ to } 170 (\approx 160) \text{ MeV}$

$N(1650)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	55–90 %	547
$N\eta$	3–10 %	346
ΛK	3–11 %	161
$N\pi\pi$	10–20 %	511
$\Delta\pi$	1–7 %	344
$N\rho$	4–12 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	<4 %	–
$N(1440)\pi$	<5 %	147
$p\gamma$	0.04–0.18 %	558
$p\gamma$, helicity=1/2	0.04–0.18 %	558
$n\gamma$	0.003–0.17 %	557
$n\gamma$, helicity=1/2	0.003–0.17 %	557

$N(1675) D_{15}$

$$I(J^P) = \frac{1}{2}(\frac{5}{2}^-)$$

 Breit-Wigner mass = 1670 to 1685 (≈ 1675) MeV

 Breit-Wigner full width = 140 to 180 (≈ 150) MeV

$$p_{\text{beam}} = 1.01 \text{ GeV}/c \quad 4\pi\lambda^2 = 15.4 \text{ mb}$$

 Re(pole position) = 1655 to 1665 (≈ 1660) MeV

 $-2\text{Im}(\text{pole position}) = 125 \text{ to } 155$ (≈ 140) MeV

$N(1675)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	40–50 %	563
ΛK	<1 %	209
$N\pi\pi$	50–60 %	529
$\Delta\pi$	50–60 %	364
$N\rho$	< 1–3 %	†
$p\gamma$	0.004–0.023 %	575
$p\gamma$, helicity=1/2	0.0–0.015 %	575
$p\gamma$, helicity=3/2	0.0–0.011 %	575
$n\gamma$	0.02–0.12 %	574
$n\gamma$, helicity=1/2	0.006–0.046 %	574
$n\gamma$, helicity=3/2	0.01–0.08 %	574

$N(1680) F_{15}$

$$I(J^P) = \frac{1}{2}(\frac{5}{2}^+)$$

Breit-Wigner mass = 1675 to 1690 (≈ 1680) MeVBreit-Wigner full width = 120 to 140 (≈ 130) MeV

$$p_{\text{beam}} = 1.01 \text{ GeV}/c \quad 4\pi\lambda^2 = 15.2 \text{ mb}$$

Re(pole position) = 1665 to 1675 (≈ 1670) MeV $-2\text{Im}(\text{pole position}) = 105$ to 135 (≈ 120) MeV

$N(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	60–70 %	567
$N\pi\pi$	30–40 %	532
$\Delta\pi$	5–15 %	369
$N\rho$	3–15 %	†
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	5–20 %	–
$p\gamma$	0.21–0.32 %	578
$p\gamma$, helicity=1/2	0.001–0.011 %	578
$p\gamma$, helicity=3/2	0.20–0.32 %	578
$n\gamma$	0.021–0.046 %	577
$n\gamma$, helicity=1/2	0.004–0.029 %	577
$n\gamma$, helicity=3/2	0.01–0.024 %	577

 $N(1700) D_{13}$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$$

Breit-Wigner mass = 1650 to 1750 (≈ 1700) MeVBreit-Wigner full width = 50 to 150 (≈ 100) MeV

$$p_{\text{beam}} = 1.05 \text{ GeV}/c \quad 4\pi\lambda^2 = 14.5 \text{ mb}$$

Re(pole position) = 1630 to 1730 (≈ 1680) MeV $-2\text{Im}(\text{pole position}) = 50$ to 150 (≈ 100) MeV

$N(1700)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	580
ΛK	<3 %	250
$N\pi\pi$	85–95 %	547
$N\rho$	<35 %	†
$p\gamma$	0.01–0.05 %	591
$p\gamma$, helicity=1/2	0.0–0.024 %	591
$p\gamma$, helicity=3/2	0.002–0.026 %	591
$n\gamma$	0.01–0.13 %	590
$n\gamma$, helicity=1/2	0.0–0.09 %	590
$n\gamma$, helicity=3/2	0.01–0.05 %	590

$N(1710) P_{11}$

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

 Breit-Wigner mass = 1680 to 1740 (≈ 1710) MeV

 Breit-Wigner full width = 50 to 250 (≈ 100) MeV

$$p_{\text{beam}} = 1.07 \text{ GeV}/c \quad 4\pi\chi^2 = 14.2 \text{ mb}$$

 Re(pole position) = 1670 to 1770 (≈ 1720) MeV

 $-2\text{Im}(\text{pole position}) = 80 \text{ to } 380$ (≈ 230) MeV

$N(1710)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	587
ΛK	5–25 %	264
$N\pi\pi$	40–90 %	554
$\Delta\pi$	15–40 %	393
$N\rho$	5–25 %	48
$N(\pi\pi)_{S\text{-wave}}^{I=0}$	10–40 %	–
$p\gamma$	0.002–0.05%	598
$p\gamma$, helicity=1/2	0.002–0.05%	598
$n\gamma$	0.0–0.02%	597
$n\gamma$, helicity=1/2	0.0–0.02%	597

 $N(1720) P_{13}$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^+)$$

 Breit-Wigner mass = 1650 to 1750 (≈ 1720) MeV

 Breit-Wigner full width = 100 to 200 (≈ 150) MeV

$$p_{\text{beam}} = 1.09 \text{ GeV}/c \quad 4\pi\chi^2 = 13.9 \text{ mb}$$

 Re(pole position) = 1650 to 1750 (≈ 1700) MeV

 $-2\text{Im}(\text{pole position}) = 110 \text{ to } 390$ (≈ 250) MeV

$N(1720)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	594
ΛK	1–15 %	278
$N\pi\pi$	>70 %	561
$N\rho$	70–85 %	104
$p\gamma$	0.003–0.10 %	604
$p\gamma$, helicity=1/2	0.003–0.08 %	604
$p\gamma$, helicity=3/2	0.001–0.03 %	604
$n\gamma$	0.002–0.39 %	603
$n\gamma$, helicity=1/2	0.0–0.002 %	603
$n\gamma$, helicity=3/2	0.001–0.39 %	603

$N(2190) G_{17}$

$$I(J^P) = \frac{1}{2}(\frac{7}{2}^-)$$

Breit-Wigner mass = 2100 to 2200 (≈ 2190) MeVBreit-Wigner full width = 350 to 550 (≈ 450) MeV

$$p_{\text{beam}} = 2.07 \text{ GeV}/c \quad 4\pi\lambda^2 = 6.21 \text{ mb}$$

Re(pole position) = 1950 to 2150 (≈ 2050) MeV $-2\text{Im}(\text{pole position}) = 350 \text{ to } 550 (\approx 450) \text{ MeV}$

$N(2190)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	888

 $N(2220) H_{19}$

$$I(J^P) = \frac{1}{2}(\frac{9}{2}^+)$$

Breit-Wigner mass = 2180 to 2310 (≈ 2220) MeVBreit-Wigner full width = 320 to 550 (≈ 400) MeV

$$p_{\text{beam}} = 2.14 \text{ GeV}/c \quad 4\pi\lambda^2 = 5.97 \text{ mb}$$

Re(pole position) = 2100 to 2240 (≈ 2170) MeV $-2\text{Im}(\text{pole position}) = 370 \text{ to } 570 (\approx 470) \text{ MeV}$

$N(2220)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	905

 $N(2250) G_{19}$

$$I(J^P) = \frac{1}{2}(\frac{9}{2}^-)$$

Breit-Wigner mass = 2170 to 2310 (≈ 2250) MeVBreit-Wigner full width = 290 to 470 (≈ 400) MeV

$$p_{\text{beam}} = 2.21 \text{ GeV}/c \quad 4\pi\lambda^2 = 5.74 \text{ mb}$$

Re(pole position) = 2080 to 2200 (≈ 2140) MeV $-2\text{Im}(\text{pole position}) = 280 \text{ to } 680 (\approx 480) \text{ MeV}$

$N(2250)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	923

$N(2600)$ $I_{1,11}$

$$I(J^P) = \frac{1}{2}(\frac{11}{2}^-)$$

Breit-Wigner mass = 2550 to 2750 (≈ 2600) MeV

Breit-Wigner full width = 500 to 800 (≈ 650) MeV

$$p_{\text{beam}} = 3.12 \text{ GeV}/c \quad 4\pi\lambda^2 = 3.86 \text{ mb}$$

$N(2600)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–10 %	1126

Δ BARYONS

($S = 0, I = 3/2$)

$$\Delta^{++} = uuu, \quad \Delta^+ = uud, \quad \Delta^0 = udd, \quad \Delta^- = ddd$$

Δ(1232) P_{33}

$$I(J^P) = \frac{3}{2}(\frac{3}{2}^+)$$

Breit-Wigner mass (mixed charges) = 1230 to 1234 (≈ 1232) MeV

Breit-Wigner full width (mixed charges) = 115 to 125 (≈ 120) MeV

$$p_{\text{beam}} = 0.30 \text{ GeV}/c \quad 4\pi\lambda^2 = 94.8 \text{ mb}$$

Re(pole position) = 1209 to 1211 (≈ 1210) MeV

$-2\text{Im}(\text{pole position}) = 98$ to 102 (≈ 100) MeV

Δ(1232) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	>99 %	227
$N\gamma$	0.52–0.60 %	259
$N\gamma$, helicity=1/2	0.11–0.13 %	259
$N\gamma$, helicity=3/2	0.41–0.47 %	259

Δ(1600) P_{33}

$$I(J^P) = \frac{3}{2}(\frac{3}{2}^+)$$

Breit-Wigner mass = 1550 to 1700 (≈ 1600) MeV

Breit-Wigner full width = 250 to 450 (≈ 350) MeV

$$p_{\text{beam}} = 0.87 \text{ GeV}/c \quad 4\pi\lambda^2 = 18.6 \text{ mb}$$

Re(pole position) = 1500 to 1700 (≈ 1600) MeV

$-2\text{Im}(\text{pole position}) = 200$ to 400 (≈ 300) MeV

Δ(1600) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–25 %	512
$N\pi\pi$	75–90 %	473
$\Delta\pi$	40–70 %	301
$N\rho$	<25 %	†
$N(1440)\pi$	10–35 %	74
$N\gamma$	0.001–0.02 %	525
$N\gamma$, helicity=1/2	0.0–0.02 %	525
$N\gamma$, helicity=3/2	0.001–0.005 %	525

$\Delta(1620) S_{31}$

$$I(J^P) = \frac{3}{2}(\frac{1}{2}^-)$$

 Breit-Wigner mass = 1615 to 1675 (≈ 1620) MeV

 Breit-Wigner full width = 120 to 180 (≈ 150) MeV

$$p_{\text{beam}} = 0.91 \text{ GeV}/c \quad 4\pi\lambda^2 = 17.7 \text{ mb}$$

 Re(pole position) = 1580 to 1620 (≈ 1600) MeV

 $-2\text{Im}(\text{pole position}) = 100$ to 130 (≈ 115) MeV

$\Delta(1620)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	20–30 %	526
$N\pi\pi$	70–80 %	488
$\Delta\pi$	30–60 %	318
$N\rho$	7–25 %	†
$N\gamma$	0.004–0.044 %	538
$N\gamma$, helicity=1/2	0.004–0.044 %	538

 $\Delta(1700) D_{33}$

$$I(J^P) = \frac{3}{2}(\frac{3}{2}^-)$$

 Breit-Wigner mass = 1670 to 1770 (≈ 1700) MeV

 Breit-Wigner full width = 200 to 400 (≈ 300) MeV

$$p_{\text{beam}} = 1.05 \text{ GeV}/c \quad 4\pi\lambda^2 = 14.5 \text{ mb}$$

 Re(pole position) = 1620 to 1700 (≈ 1660) MeV

 $-2\text{Im}(\text{pole position}) = 150$ to 250 (≈ 200) MeV

$\Delta(1700)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	580
$N\pi\pi$	80–90 %	547
$\Delta\pi$	30–60 %	385
$N\rho$	30–55 %	†
$N\gamma$	0.12–0.26 %	591
$N\gamma$, helicity=1/2	0.08–0.16 %	591
$N\gamma$, helicity=3/2	0.025–0.12 %	591

$\Delta(1905) F_{35}$

$$I(J^P) = \frac{3}{2}(\frac{5}{2}^+)$$

Breit-Wigner mass = 1870 to 1920 (≈ 1905) MeVBreit-Wigner full width = 280 to 440 (≈ 350) MeV

$$p_{\text{beam}} = 1.45 \text{ GeV}/c \quad 4\pi\lambda^2 = 9.62 \text{ mb}$$

Re(pole position) = 1800 to 1860 (≈ 1830) MeV $-2\text{Im}(\text{pole position}) = 230$ to 330 (≈ 280) MeV

$\Delta(1905)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	713
$N\pi\pi$	85–95 %	687
$\Delta\pi$	<25 %	542
$N\rho$	>60 %	421
$N\gamma$	0.01–0.03 %	721
$N\gamma$, helicity=1/2	0.0–0.1 %	721
$N\gamma$, helicity=3/2	0.004–0.03 %	721

 $\Delta(1910) P_{31}$

$$I(J^P) = \frac{3}{2}(\frac{1}{2}^+)$$

Breit-Wigner mass = 1870 to 1920 (≈ 1910) MeVBreit-Wigner full width = 190 to 270 (≈ 250) MeV

$$p_{\text{beam}} = 1.46 \text{ GeV}/c \quad 4\pi\lambda^2 = 9.54 \text{ mb}$$

Re(pole position) = 1830 to 1880 (≈ 1855) MeV $-2\text{Im}(\text{pole position}) = 200$ to 500 (≈ 350) MeV

$\Delta(1910)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	15–30 %	716
$N\gamma$	0.0–0.2 %	725
$N\gamma$, helicity=1/2	0.0–0.2 %	725

 $\Delta(1920) P_{33}$

$$I(J^P) = \frac{3}{2}(\frac{3}{2}^+)$$

Breit-Wigner mass = 1900 to 1970 (≈ 1920) MeVBreit-Wigner full width = 150 to 300 (≈ 200) MeV

$$p_{\text{beam}} = 1.48 \text{ GeV}/c \quad 4\pi\lambda^2 = 9.37 \text{ mb}$$

Re(pole position) = 1850 to 1950 (≈ 1900) MeV $-2\text{Im}(\text{pole position}) = 200$ to 400 (≈ 300) MeV

$\Delta(1920)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–20 %	722

$\Delta(1930) D_{35}$

$$I(J^P) = \frac{3}{2}(\frac{5}{2}^-)$$

 Breit-Wigner mass = 1920 to 1970 (≈ 1930) MeV

 Breit-Wigner full width = 250 to 450 (≈ 350) MeV

$$p_{\text{beam}} = 1.50 \text{ GeV}/c \quad 4\pi\lambda^2 = 9.21 \text{ mb}$$

 Re(pole position) = 1840 to 1940 (≈ 1890) MeV

 $-2\text{Im}(\text{pole position}) = 200 \text{ to } 300$ (≈ 250) MeV

$\Delta(1930)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	10–20 %	729
$N\gamma$	0.0–0.02 %	737
$N\gamma$, helicity=1/2	0.0–0.01 %	737
$N\gamma$, helicity=3/2	0.0–0.01 %	737

 $\Delta(1950) F_{37}$

$$I(J^P) = \frac{3}{2}(\frac{7}{2}^+)$$

 Breit-Wigner mass = 1940 to 1960 (≈ 1950) MeV

 Breit-Wigner full width = 290 to 350 (≈ 300) MeV

$$p_{\text{beam}} = 1.54 \text{ GeV}/c \quad 4\pi\lambda^2 = 8.91 \text{ mb}$$

 Re(pole position) = 1880 to 1890 (≈ 1885) MeV

 $-2\text{Im}(\text{pole position}) = 210 \text{ to } 270$ (≈ 240) MeV

$\Delta(1950)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	35–40 %	741
$N\pi\pi$		716
$\Delta\pi$	20–30 %	574
$N\rho$	<10 %	469
$N\gamma$	0.08–0.13 %	749
$N\gamma$, helicity=1/2	0.03–0.055 %	749
$N\gamma$, helicity=3/2	0.05–0.075 %	749

 $\Delta(2420) H_{3,11}$

$$I(J^P) = \frac{3}{2}(\frac{11}{2}^+)$$

 Breit-Wigner mass = 2300 to 2500 (≈ 2420) MeV

 Breit-Wigner full width = 300 to 500 (≈ 400) MeV

$$p_{\text{beam}} = 2.64 \text{ GeV}/c \quad 4\pi\lambda^2 = 4.68 \text{ mb}$$

 Re(pole position) = 2260 to 2400 (≈ 2330) MeV

 $-2\text{Im}(\text{pole position}) = 350 \text{ to } 750$ (≈ 550) MeV

$\Delta(2420)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\pi$	5–15 %	1023

Λ BARYONS

(S = -1, I = 0)

$$\Lambda^0 = uds$$

Λ

$$I(J^P) = 0(\frac{1}{2}^+)$$

 Mass $m = 1115.683 \pm 0.006$ MeV

 Mean life $\tau = (2.632 \pm 0.020) \times 10^{-10}$ s (S = 1.6)

$$c\tau = 7.89$$
 cm

 Magnetic moment $\mu = -0.613 \pm 0.004$ μ_N

 Electric dipole moment $d < 1.5 \times 10^{-16}$ ecm, CL = 95%

Decay parameters

$p\pi^-$	$\alpha_- = 0.642 \pm 0.013$
"	$\phi_- = (-6.5 \pm 3.5)^\circ$
"	$\gamma_- = 0.76$ [g]
"	$\Delta_- = (8 \pm 4)^\circ$ [g]
$n\pi^0$	$\alpha_0 = +0.65 \pm 0.05$
$pe^- \bar{\nu}_e$	$g_A/g_V = -0.718 \pm 0.015$ [e]

Λ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$p\pi^-$	(63.9 ± 0.5) %	101
$n\pi^0$	(35.8 ± 0.5) %	104
$n\gamma$	(1.75 ± 0.15) $\times 10^{-3}$	162
$p\pi^- \gamma$	[h] (8.4 ± 1.4) $\times 10^{-4}$	101
$pe^- \bar{\nu}_e$	(8.32 ± 0.14) $\times 10^{-4}$	163
$p\mu^- \bar{\nu}_\mu$	(1.57 ± 0.35) $\times 10^{-4}$	131

Λ(1405) S₀₁

$$I(J^P) = 0(\frac{1}{2}^-)$$

 Mass $m = 1407 \pm 4$ MeV

 Full width $\Gamma = 50.0 \pm 2.0$ MeV

 Below $\bar{K}N$ threshold

Λ(1405) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Sigma \pi$	100 %	152

$\Lambda(1520) D_{03}$

$$I(J^P) = 0(\frac{3}{2}^-)$$

 Mass $m = 1519.5 \pm 1.0$ MeV [i]

 Full width $\Gamma = 15.6 \pm 1.0$ MeV [i]

$$p_{\text{beam}} = 0.39 \text{ GeV}/c \quad 4\pi\lambda^2 = 82.8 \text{ mb}$$

$\Lambda(1520)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	$45 \pm 1\%$	244
$\Sigma\pi$	$42 \pm 1\%$	267
$\Lambda\pi\pi$	$10 \pm 1\%$	252
$\Sigma\pi\pi$	$0.9 \pm 0.1\%$	152
$\Lambda\gamma$	$0.8 \pm 0.2\%$	351

 $\Lambda(1600) P_{01}$

$$I(J^P) = 0(\frac{1}{2}^+)$$

 Mass $m = 1560$ to 1700 (≈ 1600) MeV

 Full width $\Gamma = 50$ to 250 (≈ 150) MeV

$$p_{\text{beam}} = 0.58 \text{ GeV}/c \quad 4\pi\lambda^2 = 41.6 \text{ mb}$$

$\Lambda(1600)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	15–30 %	343
$\Sigma\pi$	10–60 %	336

 $\Lambda(1670) S_{01}$

$$I(J^P) = 0(\frac{1}{2}^-)$$

 Mass $m = 1660$ to 1680 (≈ 1670) MeV

 Full width $\Gamma = 25$ to 50 (≈ 35) MeV

$$p_{\text{beam}} = 0.74 \text{ GeV}/c \quad 4\pi\lambda^2 = 28.5 \text{ mb}$$

$\Lambda(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	15–25 %	414
$\Sigma\pi$	20–60 %	393
$\Lambda\eta$	15–35 %	64

$\Lambda(1690) D_{03}$

$$I(J^P) = 0(\frac{3}{2}^-)$$

 Mass $m = 1685$ to 1695 (≈ 1690) MeV

 Full width $\Gamma = 50$ to 70 (≈ 60) MeV

$$p_{\text{beam}} = 0.78 \text{ GeV}/c \quad 4\pi\lambda^2 = 26.1 \text{ mb}$$

$\Lambda(1690)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	20–30 %	433
$\Sigma\pi$	20–40 %	409
$\Lambda\pi\pi$	~ 25 %	415
$\Sigma\pi\pi$	~ 20 %	350

 $\Lambda(1800) S_{01}$

$$I(J^P) = 0(\frac{1}{2}^-)$$

 Mass $m = 1720$ to 1850 (≈ 1800) MeV

 Full width $\Gamma = 200$ to 400 (≈ 300) MeV

$$p_{\text{beam}} = 1.01 \text{ GeV}/c \quad 4\pi\lambda^2 = 17.5 \text{ mb}$$

$\Lambda(1800)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	25–40 %	528
$\Sigma\pi$	seen	493
$\Sigma(1385)\pi$	seen	345
$N\bar{K}^*(892)$	seen	†

 $\Lambda(1810) P_{01}$

$$I(J^P) = 0(\frac{1}{2}^+)$$

 Mass $m = 1750$ to 1850 (≈ 1810) MeV

 Full width $\Gamma = 50$ to 250 (≈ 150) MeV

$$p_{\text{beam}} = 1.04 \text{ GeV}/c \quad 4\pi\lambda^2 = 17.0 \text{ mb}$$

$\Lambda(1810)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	20–50 %	537
$\Sigma\pi$	10–40 %	501
$\Sigma(1385)\pi$	seen	356
$N\bar{K}^*(892)$	30–60 %	†

$\Lambda(1820) F_{05}$

$$I(J^P) = 0(\frac{5}{2}^+)$$

Mass $m = 1815$ to 1825 (≈ 1820) MeVFull width $\Gamma = 70$ to 90 (≈ 80) MeV

$$p_{\text{beam}} = 1.06 \text{ GeV}/c \quad 4\pi\lambda^2 = 16.5 \text{ mb}$$

$\Lambda(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	55–65 %	545
$\Sigma\pi$	8–14 %	508
$\Sigma(1385)\pi$	5–10 %	362

 $\Lambda(1830) D_{05}$

$$I(J^P) = 0(\frac{5}{2}^-)$$

Mass $m = 1810$ to 1830 (≈ 1830) MeVFull width $\Gamma = 60$ to 110 (≈ 95) MeV

$$p_{\text{beam}} = 1.08 \text{ GeV}/c \quad 4\pi\lambda^2 = 16.0 \text{ mb}$$

$\Lambda(1830)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	3–10 %	553
$\Sigma\pi$	35–75 %	515
$\Sigma(1385)\pi$	>15 %	371

 $\Lambda(1890) P_{03}$

$$I(J^P) = 0(\frac{3}{2}^+)$$

Mass $m = 1850$ to 1910 (≈ 1890) MeVFull width $\Gamma = 60$ to 200 (≈ 100) MeV

$$p_{\text{beam}} = 1.21 \text{ GeV}/c \quad 4\pi\lambda^2 = 13.6 \text{ mb}$$

$\Lambda(1890)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	20–35 %	599
$\Sigma\pi$	3–10 %	559
$\Sigma(1385)\pi$	seen	420
$N\bar{K}^*(892)$	seen	233

$\Lambda(2100) G_{07}$

$$I(J^P) = 0(\frac{7}{2}^-)$$

Mass $m = 2090$ to 2110 (≈ 2100) MeVFull width $\Gamma = 100$ to 250 (≈ 200) MeV

$$p_{\text{beam}} = 1.68 \text{ GeV}/c \quad 4\pi\lambda^2 = 8.68 \text{ mb}$$

$\Lambda(2100)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	25–35 %	751
$\Sigma\pi$	~ 5 %	704
$\Lambda\eta$	<3 %	617
ΞK	<3 %	483
$\Lambda\omega$	<8 %	443
$N\bar{K}^*(892)$	10–20 %	514

 $\Lambda(2110) F_{05}$

$$I(J^P) = 0(\frac{5}{2}^+)$$

Mass $m = 2090$ to 2140 (≈ 2110) MeVFull width $\Gamma = 150$ to 250 (≈ 200) MeV

$$p_{\text{beam}} = 1.70 \text{ GeV}/c \quad 4\pi\lambda^2 = 8.53 \text{ mb}$$

$\Lambda(2110)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	5–25 %	757
$\Sigma\pi$	10–40 %	711
$\Lambda\omega$	seen	455
$\Sigma(1385)\pi$	seen	589
$N\bar{K}^*(892)$	10–60 %	524

 $\Lambda(2350) H_{09}$

$$I(J^P) = 0(\frac{9}{2}^+)$$

Mass $m = 2340$ to 2370 (≈ 2350) MeVFull width $\Gamma = 100$ to 250 (≈ 150) MeV

$$p_{\text{beam}} = 2.29 \text{ GeV}/c \quad 4\pi\lambda^2 = 5.85 \text{ mb}$$

$\Lambda(2350)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	~ 12 %	915
$\Sigma\pi$	~ 10 %	867

Σ BARYONS

(S = -1, I = 1)

$$\Sigma^+ = uus, \quad \Sigma^0 = uds, \quad \Sigma^- = dds$$

Σ⁺

$$I(J^P) = 1(\frac{1}{2}^+)$$

Mass $m = 1189.37 \pm 0.07$ MeV (S = 2.2)

Mean life $\tau = (0.799 \pm 0.004) \times 10^{-10}$ s

$c\tau = 2.396$ cm

Magnetic moment $\mu = 2.458 \pm 0.010 \mu_N$ (S = 2.1)

$\Gamma(\Sigma^+ \rightarrow n\ell^+\nu)/\Gamma(\Sigma^- \rightarrow n\ell^-\bar{\nu}) < 0.043$

Decay parameters

$p\pi^0$	$\alpha_0 = -0.980^{+0.017}_{-0.015}$
"	$\phi_0 = (36 \pm 34)^\circ$
"	$\gamma_0 = 0.16$ [g]
"	$\Delta_0 = (187 \pm 6)^\circ$ [g]
$n\pi^+$	$\alpha_+ = 0.068 \pm 0.013$
"	$\phi_+ = (167 \pm 20)^\circ$ (S = 1.1)
"	$\gamma_+ = -0.97$ [g]
"	$\Delta_+ = (-73^{+133}_{-10})^\circ$ [g]
$p\gamma$	$\alpha_\gamma = -0.76 \pm 0.08$

Σ ⁺ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$p\pi^0$	(51.57 ± 0.30) %		189
$n\pi^+$	(48.31 ± 0.30) %		185
$p\gamma$	(1.23 ± 0.05) × 10 ⁻³		225
$n\pi^+\gamma$	[h] (4.5 ± 0.5) × 10 ⁻⁴		185
$\Lambda e^+\nu_e$	(2.0 ± 0.5) × 10 ⁻⁵		71

ΔS = ΔQ (SQ) violating modes or ΔS = 1 weak neutral current (S1) modes

$ne^+\nu_e$	SQ	< 5	× 10 ⁻⁶	90%	224
$n\mu^+\nu_\mu$	SQ	< 3.0	× 10 ⁻⁵	90%	202
pe^+e^-	S1	< 7	× 10 ⁻⁶		225

Σ^0

$$I(J^P) = 1(\frac{1}{2}^+)$$

 Mass $m = 1192.642 \pm 0.024$ MeV

 $m_{\Sigma^-} - m_{\Sigma^0} = 4.807 \pm 0.035$ MeV (S = 1.1)

 $m_{\Sigma^0} - m_{\Lambda} = 76.959 \pm 0.023$ MeV

 Mean life $\tau = (7.4 \pm 0.7) \times 10^{-20}$ s

 $c\tau = 2.22 \times 10^{-11}$ m

 Transition magnetic moment $|\mu_{\Sigma\Lambda}| = 1.61 \pm 0.08 \mu_N$

Σ^0 DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Lambda\gamma$	100 %		74
$\Lambda\gamma\gamma$	< 3 %	90%	74
$\Lambda e^+ e^-$	[j] 5×10^{-3}		74

Σ^-

$$I(J^P) = 1(\frac{1}{2}^+)$$

 Mass $m = 1197.449 \pm 0.030$ MeV (S = 1.2)

 $m_{\Sigma^-} - m_{\Sigma^+} = 8.08 \pm 0.08$ MeV (S = 1.9)

 $m_{\Sigma^-} - m_{\Lambda} = 81.766 \pm 0.030$ MeV (S = 1.2)

 Mean life $\tau = (1.479 \pm 0.011) \times 10^{-10}$ s (S = 1.3)

 $c\tau = 4.434$ cm

 Magnetic moment $\mu = -1.160 \pm 0.025 \mu_N$ (S = 1.7)

Decay parameters

 $n\pi^- \quad \alpha_- = -0.068 \pm 0.008$

 " $\phi_- = (10 \pm 15)^\circ$

 " $\gamma_- = 0.98$ [g]

 " $\Delta_- = (249_{-120}^{+12})^\circ$ [g]

 $ne^- \bar{\nu}_e \quad g_A/g_V = 0.340 \pm 0.017$ [e]

 " $f_2(0)/f_1(0) = 0.97 \pm 0.14$

 " $D = 0.11 \pm 0.10$
 $\Lambda e^- \bar{\nu}_e \quad g_V/g_A = 0.01 \pm 0.10$ [e] (S = 1.5)

 " $g_{WM}/g_A = 2.4 \pm 1.7$ [e]

Σ^- DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$n\pi^-$	(99.848 ± 0.005) %	193
$n\pi^- \gamma$	[h] (4.6 ± 0.6) × 10 ⁻⁴	193
$ne^- \bar{\nu}_e$	(1.017 ± 0.034) × 10 ⁻³	230
$n\mu^- \bar{\nu}_\mu$	(4.5 ± 0.4) × 10 ⁻⁴	210
$\Lambda e^- \bar{\nu}_e$	(5.73 ± 0.27) × 10 ⁻⁵	79

$\Sigma(1385) P_{13}$

$$I(J^P) = 1(\frac{3}{2}^+)$$

$$\Sigma(1385)^+ \text{ mass } m = 1382.8 \pm 0.4 \text{ MeV} \quad (S = 2.0)$$

$$\Sigma(1385)^0 \text{ mass } m = 1383.7 \pm 1.0 \text{ MeV} \quad (S = 1.4)$$

$$\Sigma(1385)^- \text{ mass } m = 1387.2 \pm 0.5 \text{ MeV} \quad (S = 2.2)$$

$$\Sigma(1385)^+ \text{ full width } \Gamma = 35.8 \pm 0.8 \text{ MeV}$$

$$\Sigma(1385)^0 \text{ full width } \Gamma = 36 \pm 5 \text{ MeV}$$

$$\Sigma(1385)^- \text{ full width } \Gamma = 39.4 \pm 2.1 \text{ MeV} \quad (S = 1.7)$$

Below $\bar{K}N$ threshold

$\Sigma(1385)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda\pi$	88±2 %	208
$\Sigma\pi$	12±2 %	127

 $\Sigma(1660) P_{11}$

$$I(J^P) = 1(\frac{1}{2}^+)$$

$$\text{Mass } m = 1630 \text{ to } 1690 (\approx 1660) \text{ MeV}$$

$$\text{Full width } \Gamma = 40 \text{ to } 200 (\approx 100) \text{ MeV}$$

$$p_{\text{beam}} = 0.72 \text{ GeV}/c \quad 4\pi\lambda^2 = 29.9 \text{ mb}$$

$\Sigma(1660)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	10–30 %	405
$\Lambda\pi$	seen	439
$\Sigma\pi$	seen	385

 $\Sigma(1670) D_{13}$

$$I(J^P) = 1(\frac{3}{2}^-)$$

$$\text{Mass } m = 1665 \text{ to } 1685 (\approx 1670) \text{ MeV}$$

$$\text{Full width } \Gamma = 40 \text{ to } 80 (\approx 60) \text{ MeV}$$

$$p_{\text{beam}} = 0.74 \text{ GeV}/c \quad 4\pi\lambda^2 = 28.5 \text{ mb}$$

$\Sigma(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	7–13 %	414
$\Lambda\pi$	5–15 %	447
$\Sigma\pi$	30–60 %	393

$\Sigma(1750) S_{11}$

$$I(J^P) = 1(\frac{1}{2}^-)$$

 Mass $m = 1730$ to 1800 (≈ 1750) MeV

 Full width $\Gamma = 60$ to 160 (≈ 90) MeV

$$p_{\text{beam}} = 0.91 \text{ GeV}/c \quad 4\pi\lambda^2 = 20.7 \text{ mb}$$

$\Sigma(1750)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	10–40 %	486
$\Lambda\pi$	seen	507
$\Sigma\pi$	<8 %	455
$\Sigma\eta$	15–55 %	81

 $\Sigma(1775) D_{15}$

$$I(J^P) = 1(\frac{5}{2}^-)$$

 Mass $m = 1770$ to 1780 (≈ 1775) MeV

 Full width $\Gamma = 105$ to 135 (≈ 120) MeV

$$p_{\text{beam}} = 0.96 \text{ GeV}/c \quad 4\pi\lambda^2 = 19.0 \text{ mb}$$

$\Sigma(1775)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	37–43%	508
$\Lambda\pi$	14–20%	525
$\Sigma\pi$	2–5%	474
$\Sigma(1385)\pi$	8–12%	324
$\Lambda(1520)\pi$	17–23%	198

 $\Sigma(1915) F_{15}$

$$I(J^P) = 1(\frac{5}{2}^+)$$

 Mass $m = 1900$ to 1935 (≈ 1915) MeV

 Full width $\Gamma = 80$ to 160 (≈ 120) MeV

$$p_{\text{beam}} = 1.26 \text{ GeV}/c \quad 4\pi\lambda^2 = 12.8 \text{ mb}$$

$\Sigma(1915)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	5–15 %	618
$\Lambda\pi$	seen	622
$\Sigma\pi$	seen	577
$\Sigma(1385)\pi$	<5 %	440

$\Sigma(1940) D_{13}$

$$I(J^P) = 1(\frac{3}{2}^-)$$

 Mass $m = 1900$ to 1950 (≈ 1940) MeV

 Full width $\Gamma = 150$ to 300 (≈ 220) MeV

$$p_{\text{beam}} = 1.32 \text{ GeV}/c \quad 4\pi\lambda^2 = 12.1 \text{ mb}$$

$\Sigma(1940)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	<20 %	637
$\Lambda\pi$	seen	639
$\Sigma\pi$	seen	594
$\Sigma(1385)\pi$	seen	460
$\Lambda(1520)\pi$	seen	354
$\Delta(1232)\bar{K}$	seen	410
$N\bar{K}^*(892)$	seen	320

 $\Sigma(2030) F_{17}$

$$I(J^P) = 1(\frac{7}{2}^+)$$

 Mass $m = 2025$ to 2040 (≈ 2030) MeV

 Full width $\Gamma = 150$ to 200 (≈ 180) MeV

$$p_{\text{beam}} = 1.52 \text{ GeV}/c \quad 4\pi\lambda^2 = 9.93 \text{ mb}$$

$\Sigma(2030)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	17–23 %	702
$\Lambda\pi$	17–23 %	700
$\Sigma\pi$	5–10 %	657
ΞK	<2 %	412
$\Sigma(1385)\pi$	5–15 %	529
$\Lambda(1520)\pi$	10–20 %	430
$\Delta(1232)\bar{K}$	10–20 %	498
$N\bar{K}^*(892)$	<5 %	438

$\Sigma(2250)$

$$I(J^P) = 1(??)$$

Mass $m = 2210$ to 2280 (≈ 2250) MeV

Full width $\Gamma = 60$ to 150 (≈ 100) MeV

$$p_{\text{beam}} = 2.04 \text{ GeV}/c \quad 4\pi\lambda^2 = 6.76 \text{ mb}$$

$\Sigma(2250)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$N\bar{K}$	<10 %	851
$\Lambda\pi$	seen	842
$\Sigma\pi$	seen	803

Ξ BARYONS

($S = -2, I = 1/2$)

$$\Xi^0 = uss, \quad \Xi^- = dss$$

Ξ^0

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

P is not yet measured; + is the quark model prediction.

$$\text{Mass } m = 1314.9 \pm 0.6 \text{ MeV}$$

$$m_{\Xi^-} - m_{\Xi^0} = 6.4 \pm 0.6 \text{ MeV}$$

$$\text{Mean life } \tau = (2.90 \pm 0.09) \times 10^{-10} \text{ s}$$

$$c\tau = 8.71 \text{ cm}$$

$$\text{Magnetic moment } \mu = -1.250 \pm 0.014 \mu_N$$

Decay parameters

$$\Lambda\pi^0 \quad \alpha = -0.411 \pm 0.022 \quad (S = 2.1)$$

$$" \quad \phi = (21 \pm 12)^\circ$$

$$" \quad \gamma = 0.85 \text{ [g]}$$

$$" \quad \Delta = (218_{-19}^{+12})^\circ \text{ [g]}$$

$$\Lambda\gamma \quad \alpha = 0.4 \pm 0.4$$

$$\Sigma^0\gamma \quad \alpha = 0.20 \pm 0.32$$

Ξ^0 DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$\Lambda\pi^0$	$(99.54 \pm 0.05) \%$		135
$\Lambda\gamma$	$(1.06 \pm 0.16) \times 10^{-3}$		184
$\Sigma^0\gamma$	$(3.5 \pm 0.4) \times 10^{-3}$		117
$\Sigma^+ e^- \bar{\nu}_e$	$< 1.1 \times 10^{-3}$	90%	120
$\Sigma^+ \mu^- \bar{\nu}_\mu$	$< 1.1 \times 10^{-3}$	90%	64

$\Delta S = \Delta Q$ (SQ) violating modes or $\Delta S = 2$ forbidden (S2) modes

$\Sigma^- e^+ \nu_e$	SQ	$< 9 \times 10^{-4}$	90%	112
$\Sigma^- \mu^+ \nu_\mu$	SQ	$< 9 \times 10^{-4}$	90%	49
$p\pi^-$	S2	$< 4 \times 10^{-5}$	90%	299
$p e^- \bar{\nu}_e$	S2	$< 1.3 \times 10^{-3}$		323
$p \mu^- \bar{\nu}_\mu$	S2	$< 1.3 \times 10^{-3}$		309



$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

P is not yet measured; + is the quark model prediction.

$$\text{Mass } m = 1321.32 \pm 0.13 \text{ MeV}$$

$$\text{Mean life } \tau = (1.639 \pm 0.015) \times 10^{-10} \text{ s}$$

$$c\tau = 4.91 \text{ cm}$$

$$\text{Magnetic moment } \mu = -0.6507 \pm 0.0025 \mu_N$$

Decay parameters

$$\Lambda\pi^- \quad \alpha = -0.456 \pm 0.014 \quad (S = 1.8)$$

$$" \quad \phi = (4 \pm 4)^\circ$$

$$" \quad \gamma = 0.89 [g]$$

$$" \quad \Delta = (188 \pm 8)^\circ [g]$$

$$\Lambda e^- \bar{\nu}_e \quad g_A/g_V = -0.25 \pm 0.05 [e]$$

Ξ^- DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$\Lambda\pi^-$	(99.887±0.035) %		139
$\Sigma^- \gamma$	(1.27 ±0.23) × 10 ⁻⁴		118
$\Lambda e^- \bar{\nu}_e$	(5.63 ±0.31) × 10 ⁻⁴		190
$\Lambda\mu^- \bar{\nu}_\mu$	(3.5 ^{+3.5} _{-2.2}) × 10 ⁻⁴		163
$\Sigma^0 e^- \bar{\nu}_e$	(8.7 ±1.7) × 10 ⁻⁵		122
$\Sigma^0 \mu^- \bar{\nu}_\mu$	< 8 × 10 ⁻⁴	90%	70
$\Xi^0 e^- \bar{\nu}_e$	< 2.3 × 10 ⁻³	90%	6

$\Delta S = 2$ forbidden (S_2) modes

$n\pi^-$	S_2	< 1.9 × 10 ⁻⁵	90%	303
$ne^- \bar{\nu}_e$	S_2	< 3.2 × 10 ⁻³	90%	327
$n\mu^- \bar{\nu}_\mu$	S_2	< 1.5 %	90%	314
$p\pi^- \pi^-$	S_2	< 4 × 10 ⁻⁴	90%	223
$p\pi^- e^- \bar{\nu}_e$	S_2	< 4 × 10 ⁻⁴	90%	304
$p\pi^- \mu^- \bar{\nu}_\mu$	S_2	< 4 × 10 ⁻⁴	90%	250
$p\mu^- \mu^-$	L	< 4 × 10 ⁻⁴	90%	272

$\Xi(1530) P_{13}$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^+)$$

 $\Xi(1530)^0$ mass $m = 1531.80 \pm 0.32$ MeV (S = 1.3)

 $\Xi(1530)^-$ mass $m = 1535.0 \pm 0.6$ MeV

 $\Xi(1530)^0$ full width $\Gamma = 9.1 \pm 0.5$ MeV

 $\Xi(1530)^-$ full width $\Gamma = 9.9^{+1.7}_{-1.9}$ MeV

$\Xi(1530)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Xi \pi$	100 %		152
$\Xi \gamma$	<4 %	90%	200

 $\Xi(1690)$

$$I(J^P) = \frac{1}{2}(?^?)$$

 Mass $m = 1690 \pm 10$ MeV [i]

 Full width $\Gamma < 50$ MeV

$\Xi(1690)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda \bar{K}$	seen	240
$\Sigma \bar{K}$	seen	51
$\Xi^- \pi^+ \pi^-$	possibly seen	214

 $\Xi(1820) D_{13}$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$$

 Mass $m = 1823 \pm 5$ MeV [i]

 Full width $\Gamma = 24^{+15}_{-10}$ MeV [i]

$\Xi(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda \bar{K}$	large	400
$\Sigma \bar{K}$	small	320
$\Xi \pi$	small	413
$\Xi(1530) \pi$	small	234

$\Xi(1950)$

$$I(J^P) = \frac{1}{2}(??)$$

 Mass $m = 1950 \pm 15$ MeV [i]

 Full width $\Gamma = 60 \pm 20$ MeV [i]

$\Xi(1950)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda \bar{K}$	seen	522
$\Sigma \bar{K}$	possibly seen	460
$\Xi \pi$	seen	518

 $\Xi(2030)$

$$I(J^P) = \frac{1}{2}(\geq \frac{5}{2}?)$$

 Mass $m = 2025 \pm 5$ MeV [i]

 Full width $\Gamma = 20^{+15}_{-5}$ MeV [i]

$\Xi(2030)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda \bar{K}$	$\sim 20\%$	589
$\Sigma \bar{K}$	$\sim 80\%$	533
$\Xi \pi$	small	573
$\Xi(1530) \pi$	small	421
$\Lambda \bar{K} \pi$	small	501
$\Sigma \bar{K} \pi$	small	430

Ω BARYONS

($S = -3, I = 0$)

$$\Omega^- = sss$$

Ω⁻

$$I(J^P) = 0(\frac{3}{2}^+)$$

J^P is not yet measured; $\frac{3}{2}^+$ is the quark model prediction.

Mass $m = 1672.45 \pm 0.29$ MeV

Mean life $\tau = (0.822 \pm 0.012) \times 10^{-10}$ s

$c\tau = 2.46$ cm

Magnetic moment $\mu = -2.02 \pm 0.05 \mu_N$

Decay parameters

$\Lambda K^- \quad \alpha = -0.026 \pm 0.026$

$\Xi^0 \pi^- \quad \alpha = 0.09 \pm 0.14$

$\Xi^- \pi^0 \quad \alpha = 0.05 \pm 0.21$

Ω⁻ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
ΛK^-	$(67.8 \pm 0.7) \%$		211
$\Xi^0 \pi^-$	$(23.6 \pm 0.7) \%$		294
$\Xi^- \pi^0$	$(8.6 \pm 0.4) \%$		290
$\Xi^- \pi^+ \pi^-$	$(4.3^{+3.4}_{-1.3}) \times 10^{-4}$		190
$\Xi(1530)^0 \pi^-$	$(6.4^{+5.1}_{-2.0}) \times 10^{-4}$		17
$\Xi^0 e^- \bar{\nu}_e$	$(5.6 \pm 2.8) \times 10^{-3}$		319
$\Xi^- \gamma$	$< 4.6 \times 10^{-4}$	90%	314
ΔS = 2 forbidden (S2) modes			
$\Lambda \pi^-$	S2 $< 1.9 \times 10^{-4}$	90%	449

Ω(2250)⁻

$$I(J^P) = 0(?^?)$$

Mass $m = 2252 \pm 9$ MeV

Full width $\Gamma = 55 \pm 18$ MeV

Ω(2250)⁻ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi^- \pi^+ K^-$	seen	531
$\Xi(1530)^0 K^-$	seen	437

CHARMED BARYONS

($C = +1$)

$$\Lambda_c^+ = udc, \quad \Sigma_c^{++} = uuc, \quad \Sigma_c^+ = udc, \quad \Sigma_c^0 = ddc,$$

$$\Xi_c^+ = usc, \quad \Xi_c^0 = dsc, \quad \Omega_c^0 = ssc$$

Λ_c^+

$$I(J^P) = 0(\frac{1}{2}^+)$$

J not confirmed; $\frac{1}{2}$ is the quark model prediction.

$$\text{Mass } m = 2284.9 \pm 0.6 \text{ MeV}$$

$$\text{Mean life } \tau = (0.206 \pm 0.012) \times 10^{-12} \text{ s}$$

$$c\tau = 61.8 \text{ } \mu\text{m}$$

Decay asymmetry parameters

$$\Lambda\pi^+ \quad \alpha = -0.98 \pm 0.19$$

$$\Sigma^+\pi^0 \quad \alpha = -0.45 \pm 0.32$$

$$\Lambda\ell^+\nu_\ell \quad \alpha = -0.82^{+0.11}_{-0.07}$$

Nearly all branching fractions of the Λ_c^+ are measured relative to the $pK^-\pi^+$ mode, but there are no model-independent measurements of this branching fraction. We explain how we arrive at our value of $B(\Lambda_c^+ \rightarrow pK^-\pi^+)$ in a Note at the beginning of the branching-ratio measurements, in the Listings. When this branching fraction is eventually well determined, all the other branching fractions will slide up or down proportionally as the true value differs from the value we use here.

Λ_c^+ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Hadronic modes with a p and one \bar{K}			
$p\bar{K}^0$	(2.5 \pm 0.7) %		872
$pK^-\pi^+$	[k] (5.0 \pm 1.3) %		822
$p\bar{K}^*(892)^0$	[l] (1.8 \pm 0.6) %		681
$\Delta(1232)^{++}K^-$	(8 \pm 5) $\times 10^{-3}$		709
$\Lambda(1520)\pi^+$	[l] (4.5 \pm 2.5 \pm 2.1) $\times 10^{-3}$		626
$pK^-\pi^+$ nonresonant	(2.8 \pm 0.9) %		822
$p\bar{K}^0\eta$	(1.3 \pm 0.4) %		567

$\rho \bar{K}^0 \pi^+ \pi^-$	(2.4 ± 1.1) %	753
$\rho K^- \pi^+ \pi^0$	seen	758
$\rho K^*(892)^- \pi^+$	[/] (1.1 ± 0.6) %	579
$\rho (K^- \pi^+)_{\text{nonresonant}} \pi^0$	(3.6 ± 1.2) %	758
$\Delta(1232) \bar{K}^*(892)$	seen	416
$\rho K^- \pi^+ \pi^+ \pi^-$	(1.1 ± 0.8) × 10 ⁻³	670
$\rho K^- \pi^+ \pi^0 \pi^0$	(8 ± 4) × 10 ⁻³	676
$\rho K^- \pi^+ \pi^0 \pi^0 \pi^0$	(5.0 ± 3.4) × 10 ⁻³	573

Hadronic modes with a ρ and zero or two K 's

$\rho \pi^+ \pi^-$	(3.5 ± 2.0) × 10 ⁻³	926
$\rho f_0(980)$	[/] (2.8 ± 1.9) × 10 ⁻³	621
$\rho \pi^+ \pi^+ \pi^- \pi^-$	(1.8 ± 1.2) × 10 ⁻³	851
$\rho K^+ K^-$	(2.3 ± 0.9) × 10 ⁻³	615
$\rho \phi$	[/] (1.2 ± 0.5) × 10 ⁻³	589

Hadronic modes with a hyperon

$\Lambda \pi^+$	(9.0 ± 2.8) × 10 ⁻³	863
$\Lambda \pi^+ \pi^0$	(3.6 ± 1.3) %	843
$\Lambda \rho^+$	< 5 %	CL=95% 638
$\Lambda \pi^+ \pi^+ \pi^-$	(3.3 ± 1.0) %	806
$\Lambda \pi^+ \eta$	(1.7 ± 0.6) %	690
$\Sigma(1385)^+ \eta$	[/] (8.5 ± 3.3) × 10 ⁻³	569
$\Lambda K^+ \bar{K}^0$	(6.0 ± 2.1) × 10 ⁻³	441
$\Sigma^0 \pi^+$	(9.9 ± 3.2) × 10 ⁻³	824
$\Sigma^+ \pi^0$	(1.00 ± 0.34) %	826
$\Sigma^+ \eta$	(5.5 ± 2.3) × 10 ⁻³	712
$\Sigma^+ \pi^+ \pi^-$	(3.4 ± 1.0) %	803
$\Sigma^+ \rho^0$	< 1.4 %	CL=95% 578
$\Sigma^- \pi^+ \pi^+$	(1.8 ± 0.8) %	798
$\Sigma^0 \pi^+ \pi^0$	(1.8 ± 0.8) %	802
$\Sigma^0 \pi^+ \pi^+ \pi^-$	(1.1 ± 0.4) %	762
$\Sigma^+ \pi^+ \pi^- \pi^0$	—	766
$\Sigma^+ \omega$	[/] (2.7 ± 1.0) %	568
$\Sigma^+ \pi^+ \pi^+ \pi^- \pi^-$	(3.0 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 4.1 \\ 2.1 \end{smallmatrix}$) × 10 ⁻³	707
$\Sigma^+ K^+ K^-$	(3.5 ± 1.2) × 10 ⁻³	346
$\Sigma^+ \phi$	[/] (3.5 ± 1.7) × 10 ⁻³	292
$\Sigma^+ K^+ \pi^-$	(7 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 6 \\ 4 \end{smallmatrix}$) × 10 ⁻³	668
$\Xi^0 K^+$	(3.9 ± 1.4) × 10 ⁻³	652
$\Xi^- K^+ \pi^+$	(4.9 ± 1.7) × 10 ⁻³	564
$\Xi(1530)^0 K^+$	[/] (2.6 ± 1.0) × 10 ⁻³	471

Semileptonic modes

$\Lambda \ell^+ \nu_\ell$	[<i>m</i>] (2.0 ± 0.6) %	—
$\Lambda e^+ \nu_e$	(2.1 ± 0.6) %	—
$\Lambda \mu^+ \nu_\mu$	(2.0 ± 0.7) %	—
e^+ anything	(4.5 ± 1.7) %	—
$p e^+$ anything	(1.8 ± 0.9) %	—
Λe^+ anything	—	—
$\Lambda \mu^+$ anything	—	—
$\Lambda \ell^+ \nu_\ell$ anything	—	—

Inclusive modes

p anything	(50 ± 16) %	—
p anything (no Λ)	(12 ± 19) %	—
p hadrons	—	—
n anything	(50 ± 16) %	—
n anything (no Λ)	(29 ± 17) %	—
Λ anything	(35 ± 11) %	S=1.4
Σ^\pm anything	[<i>n</i>] (10 ± 5) %	—

 **$\Delta C = 1$ weak neutral current (*C1*) modes, or
Lepton number (*L*) violating modes**

$p \mu^+ \mu^-$	<i>C1</i>	< 3.4	$\times 10^{-4}$	CL=90%	936
$\Sigma^- \mu^+ \mu^+$	<i>L</i>	< 7.0	$\times 10^{-4}$	CL=90%	811

$\Lambda_c(2593)^+$

$$I(J^P) = 0(\frac{1}{2}^-)$$

The spin-parity follows from the fact that $\Sigma_c(2455)\pi$ decays, with little available phase space, are dominant.

$$\text{Mass } m = 2593.9 \pm 0.8 \text{ MeV}$$

$$m - m_{\Lambda_c^+} = 308.9 \pm 0.6 \text{ MeV} \quad (S = 1.1)$$

$$\text{Full width } \Gamma = 3.6_{-1.3}^{+2.0} \text{ MeV}$$

$\Lambda_c^+ \pi \pi$ and its submode $\Sigma_c(2455)\pi$ — the latter just barely — are the only strong decays allowed to an excited Λ_c^+ having this mass; and the $\Lambda_c^+ \pi^+ \pi^-$ mode seems to be largely via $\Sigma_c^{++} \pi^-$ or $\Sigma_c^0 \pi^+$.

$\Lambda_c(2593)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \pi^+ \pi^-$	[o] $\approx 67\%$	124
$\Sigma_c(2455)^{++} \pi^-$	$24 \pm 7\%$	17
$\Sigma_c(2455)^0 \pi^+$	$24 \pm 7\%$	23
$\Lambda_c^+ \pi^+ \pi^-$ 3-body	$18 \pm 10\%$	124
$\Lambda_c^+ \pi^0$	not seen	261
$\Lambda_c^+ \gamma$	not seen	290

 $\Lambda_c(2625)^+$

$$I(J^P) = 0(?^?)$$

J^P is expected to be $3/2^-$.

$$\text{Mass } m = 2626.6 \pm 0.8 \text{ MeV} \quad (S = 1.2)$$

$$m - m_{\Lambda_c^+} = 341.7 \pm 0.6 \text{ MeV} \quad (S = 1.6)$$

$$\text{Full width } \Gamma < 1.9 \text{ MeV, CL} = 90\%$$

$\Lambda_c^+ \pi \pi$ and its submode $\Sigma(2455)\pi$ are the only strong decays allowed to an excited Λ_c^+ having this mass.

$\Lambda_c(2625)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \pi^+ \pi^-$	seen	184
$\Sigma_c(2455)^{++} \pi^-$	small	100
$\Sigma_c(2455)^0 \pi^+$	small	101
$\Lambda_c^+ \pi^+ \pi^-$ 3-body	large	184
$\Lambda_c^+ \pi^0$	not seen	293
$\Lambda_c^+ \gamma$	not seen	319

$\Sigma_c(2455)$

$$I(J^P) = 1(\frac{1}{2}^+)$$

J^P not confirmed; $\frac{1}{2}^+$ is the quark model prediction.

$$\Sigma_c(2455)^{++} \text{ mass } m = 2452.8 \pm 0.6 \text{ MeV}$$

$$\Sigma_c(2455)^+ \text{ mass } m = 2453.6 \pm 0.9 \text{ MeV}$$

$$\Sigma_c(2455)^0 \text{ mass } m = 2452.2 \pm 0.6 \text{ MeV}$$

$$m_{\Sigma_c^{++}} - m_{\Lambda_c^+} = 167.87 \pm 0.19 \text{ MeV}$$

$$m_{\Sigma_c^+} - m_{\Lambda_c^+} = 168.7 \pm 0.6 \text{ MeV}$$

$$m_{\Sigma_c^0} - m_{\Lambda_c^+} = 167.30 \pm 0.20 \text{ MeV}$$

$$m_{\Sigma_c^{++}} - m_{\Sigma_c^0} = 0.57 \pm 0.23 \text{ MeV}$$

$$m_{\Sigma_c^+} - m_{\Sigma_c^0} = 1.4 \pm 0.6 \text{ MeV}$$

$\Lambda_c^+ \pi$ is the only strong decay allowed to a Σ_c having this mass.

$\Sigma_c(2455)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda_c^+ \pi$	$\approx 100 \%$	90

 $\Sigma_c(2520)$

$$I(J^P) = 1(?^?)$$

$$\Sigma_c(2520)^{++} \text{ mass } m = 2519.4 \pm 1.5 \text{ MeV}$$

$$\Sigma_c(2520)^0 \text{ mass } m = 2517.5 \pm 1.4 \text{ MeV}$$

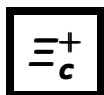
$$m_{\Sigma_c(2520)^{++}} - m_{\Lambda_c^+} = 234.5 \pm 1.4 \text{ MeV}$$

$$m_{\Sigma_c(2520)^0} - m_{\Lambda_c^+} = 232.6 \pm 1.3 \text{ MeV}$$

$$m_{\Sigma_c(2520)^{++}} - m_{\Sigma_c(2520)^0} = 1.9 \pm 1.9 \text{ MeV}$$

$$\Sigma_c(2520)^{++} \text{ full width } \Gamma = 18 \pm 5 \text{ MeV}$$

$$\Sigma_c(2520)^0 \text{ full width } \Gamma = 13 \pm 5 \text{ MeV}$$



$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

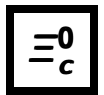
$I(J^P)$ not confirmed; $\frac{1}{2}(\frac{1}{2}^+)$ is the quark model prediction.

$$\text{Mass } m = 2465.6 \pm 1.4 \text{ MeV}$$

$$\text{Mean life } \tau = (0.35_{-0.04}^{+0.07}) \times 10^{-12} \text{ s}$$

$$c\tau = 106 \mu\text{m}$$

Ξ_c^+ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda K^- \pi^+ \pi^+$	seen	784
$\Lambda \bar{K}^*(892)^0 \pi^+$	not seen	601
$\Sigma(1385)^+ K^- \pi^+$	not seen	676
$\Sigma^+ K^- \pi^+$	seen	808
$\Sigma^+ \bar{K}^*(892)^0$	seen	653
$\Sigma^0 K^- \pi^+ \pi^+$	seen	733
$\Xi^0 \pi^+$	seen	875
$\Xi^- \pi^+ \pi^+$	seen	850
$\Xi(1530)^0 \pi^+$	not seen	748
$\Xi^0 \pi^+ \pi^0$	seen	854
$\Xi^0 \pi^+ \pi^+ \pi^-$	seen	817
$\Xi^0 e^+ \nu_e$	seen	882



$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

$I(J^P)$ not confirmed; $\frac{1}{2}(\frac{1}{2}^+)$ is the quark model prediction.

$$\text{Mass } m = 2470.3 \pm 1.8 \text{ MeV} \quad (S = 1.3)$$

$$m_{\Xi_c^0} - m_{\Xi_c^+} = 4.7 \pm 2.1 \text{ MeV} \quad (S = 1.2)$$

$$\text{Mean life } \tau = (0.098_{-0.015}^{+0.023}) \times 10^{-12} \text{ s}$$

$$c\tau = 29 \mu\text{m}$$

Ξ_c^0 DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Lambda \bar{K}^0$	seen	864
$\Xi^- \pi^+$	seen	875
$\Xi^- \pi^+ \pi^+ \pi^-$	seen	816
$p K^- \bar{K}^*(892)^0$	seen	406
$\Omega^- K^+$	seen	522
$\Xi^- e^+ \nu_e$	seen	882
$\Xi^- \ell^+$ anything	seen	—

$\Xi_c(2645)$

$$I(J^P) = ?(??)$$

$$\Xi_c(2645)^+ \text{ mass } m = 2644.6 \pm 2.1 \text{ MeV} \quad (S = 1.2)$$

$$\Xi_c(2645)^0 \text{ mass } m = 2643.8 \pm 1.8 \text{ MeV}$$

$$m_{\Xi_c(2645)^+} - m_{\Xi_c^0} = 174.3 \pm 1.1 \text{ MeV}$$

$$m_{\Xi_c(2645)^0} - m_{\Xi_c^+} = 178.2 \pm 1.1 \text{ MeV}$$

$$\Xi_c(2645)^+ \text{ full width } \Gamma < 3.1 \text{ MeV, CL} = 90\%$$

$$\Xi_c(2645)^0 \text{ full width } \Gamma < 5.5 \text{ MeV, CL} = 90\%$$

$\Xi_c \pi$ is the only strong decay allowed to a Ξ_c resonance having this mass.

$\Xi_c(2645)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Xi_c^0 \pi^+$	seen	101
$\Xi_c^+ \pi^-$	seen	107

 Ω_c^0

$$I(J^P) = 0(\frac{1}{2}^+)$$

$I(J^P)$ not confirmed; $0(\frac{1}{2}^+)$ is the quark model prediction.

$$\text{Mass } m = 2704 \pm 4 \text{ MeV} \quad (S = 1.8)$$

$$\text{Mean life } \tau = (0.064 \pm 0.020) \times 10^{-12} \text{ s}$$

$$c\tau = 19 \mu\text{m}$$

Ω_c^0 DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\Sigma^+ K^- K^- \pi^+$	seen	697
$\Xi^- K^- \pi^+ \pi^+$	seen	838
$\Omega^- \pi^+$	seen	827
$\Omega^- \pi^- \pi^+ \pi^+$	seen	759

BOTTOM BARYONS

($B = -1$)

$$\Lambda_b^0 = udb, \Xi_b^0 = usb, \Xi_b^- = dsb$$

 Λ_b^0

$$I(J^P) = 0(\frac{1}{2}^+)$$

$I(J^P)$ not yet measured; $0(\frac{1}{2}^+)$ is the quark model prediction.

$$\text{Mass } m = 5624 \pm 9 \text{ MeV} \quad (S = 1.8)$$

$$\text{Mean life } \tau = (1.24 \pm 0.08) \times 10^{-12} \text{ s}$$

$$c\tau = 372 \text{ } \mu\text{m}$$

These branching fractions are actually an average over weakly decaying b -baryons weighted by their production rates in Z decay (or high-energy $p\bar{p}$), branching ratios, and detection efficiencies. They scale with the LEP Λ_b production fraction $B(b \rightarrow \Lambda_b)$ and are evaluated for our value $B(b \rightarrow \Lambda_b) = (10.1_{-3.1}^{+3.9})\%$.

The branching fractions $B(b\text{-baryon} \rightarrow \Lambda \ell^- \bar{\nu}_\ell \text{ anything})$ and $B(\Lambda_b^0 \rightarrow \Lambda_c^+ \ell^- \bar{\nu}_\ell \text{ anything})$ are not pure measurements because the underlying measured products of these with $B(b \rightarrow \Lambda_b)$ were used to determine $B(b \rightarrow \Lambda_b)$, as described in the note "Production and Decay of b -Flavored Hadrons."

Λ_b^0 DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$J/\psi(1S)\Lambda$	$(4.7 \pm 2.8) \times 10^{-4}$		1744
$\Lambda_c^+ \pi^-$	seen		2345
$\Lambda_c^+ a_1(1260)^-$	seen		2156
$\Lambda_c^+ \ell^- \bar{\nu}_\ell \text{ anything}$	[p] $(9.0_{-3.8}^{+3.1})\%$		—
$p\pi^-$	$< 5.0 \times 10^{-5}$	90%	2732
pK^-	$< 5.0 \times 10^{-5}$	90%	2711

b-baryon ADMIXTURE ($\Lambda_b, \Xi_b, \Sigma_b, \Omega_b$)

$$\text{Mean life } \tau = (1.20 \pm 0.07) \times 10^{-12} \text{ s}$$

These branching fractions are actually an average over weakly decaying b -baryons weighted by their production rates in Z decay (or high-energy $p\bar{p}$), branching ratios, and detection efficiencies. They scale with the LEP Λ_b production fraction $B(b \rightarrow \Lambda_b)$ and are evaluated for our value $B(b \rightarrow \Lambda_b) = (10.1^{+3.9}_{-3.1})\%$.

The branching fractions $B(b\text{-baryon} \rightarrow \Lambda \ell^- \bar{\nu}_\ell \text{ anything})$ and $B(\Lambda_b^0 \rightarrow \Lambda_c^+ \ell^- \bar{\nu}_\ell \text{ anything})$ are not pure measurements because the underlying measured products of these with $B(b \rightarrow \Lambda_b)$ were used to determine $B(b \rightarrow \Lambda_b)$, as described in the note "Production and Decay of b -Flavored Hadrons."

b-baryon ADMIXTURE ($\Lambda_b, \Xi_b, \Sigma_b, \Omega_b$)	Fraction (Γ_i/Γ)	p (MeV/c)
$p\mu^- \bar{\nu}$ anything	$(4.9 \pm 2.4)\%$	—
$\Lambda \ell^- \bar{\nu}_\ell$ anything	$(3.1^{+1.0}_{-1.2})\%$	—
$\Lambda/\bar{\Lambda}$ anything	$(35^{+12}_{-14})\%$	—
$\Xi^- \ell^- \bar{\nu}_\ell$ anything	$(5.5^{+2.0}_{-2.4}) \times 10^{-3}$	—

NOTES

- [a] The masses of the p and n are most precisely known in u (unified atomic mass units). The conversion factor to MeV, $1 u = 931.49432 \pm 0.00028$ MeV, is less well known than are the masses in u .
- [b] The limit is from neutrality-of-matter experiments; it assumes $q_n = q_p + q_e$. See also the charge of the neutron.
- [c] The first limit is geochemical and independent of decay mode. The second entry, a range of limits, assumes the dominant decay modes are among those investigated. For antiprotons the best limit, inferred from the observation of cosmic ray \bar{p} 's is $\tau_{\bar{p}} > 10^7$ yr, the cosmic-ray storage time, but this limit depends on a number of assumptions. The best direct observation of stored antiprotons gives $\tau_{\bar{p}}/B(\bar{p} \rightarrow e^- \gamma) > 1848$ yr.
- [d] There is some controversy about whether nuclear physics and model dependence complicate the analysis for bound neutrons (from which the best limit comes). The second limit here is from reactor experiments with free neutrons.
- [e] The parameters g_A , g_V , and g_{WM} for semileptonic modes are defined by $\bar{B}_f[\gamma_\lambda(g_V + g_A\gamma_5) + i(g_{WM}/m_{B_i}) \sigma_{\lambda\nu} q^\nu]B_i$, and ϕ_{AV} is defined by $g_A/g_V = |g_A/g_V|e^{i\phi_{AV}}$. See the "Note on Baryon Decay Parameters" in the neutron Particle Listings.
- [f] Time-reversal invariance requires this to be 0° or 180° .
- [g] The decay parameters γ and Δ are calculated from α and ϕ using
- $$\gamma = \sqrt{1-\alpha^2} \cos\phi, \quad \tan\Delta = -\frac{1}{\alpha} \sqrt{1-\alpha^2} \sin\phi.$$
- See the "Note on Baryon Decay Parameters" in the neutron Particle Listings.
- [h] See the Particle Listings for the pion momentum range used in this measurement.
- [i] The error given here is only an educated guess. It is larger than the error on the weighted average of the published values.
- [j] A theoretical value using QED.
- [k] See the "Note on Λ_c^+ Branching Fractions" in the Branching Fractions of the Λ_c^+ Particle Listings.
- [l] This branching fraction includes all the decay modes of the final-state resonance.
- [m] An ℓ indicates an e or a μ mode, not a sum over these modes.
- [n] The value is for the sum of the charge states of particle/antiparticle states indicated.
- [o] Assuming isospin conservation, so that the other third is $\Lambda_c^+ \pi^0 \pi^0$.
- [p] Not a pure measurement. See note at head of Λ_b^0 Decay Modes.

SEARCHES FOR MONOPOLES, SUPERSYMMETRY, COMPOSITENESS, etc.

Magnetic Monopole Searches

Isolated supermassive monopole candidate events have not been confirmed. The most sensitive experiments obtain negative results.

Best cosmic-ray supermassive monopole flux limit:

$$< 1.0 \times 10^{-15} \text{ cm}^{-2}\text{sr}^{-1}\text{s}^{-1} \quad \text{for } 1.1 \times 10^{-4} < \beta < 0.1$$

Supersymmetric Particle Searches

Limits are based on the Minimal Supersymmetric Standard Model.

Assumptions include: 1) $\tilde{\chi}_1^0$ (or $\tilde{\gamma}$) is lightest supersymmetric particle; 2) R -parity is conserved; 3) All scalar quarks (except \tilde{t}_L and \tilde{t}_R) are degenerate in mass, and $m_{\tilde{q}_R} = m_{\tilde{q}_L}$. 4) Limits for selectrons and smuons refer to the $\tilde{\ell}_R$ states.

See the Particle Listings for a Note giving details of supersymmetry.

$\tilde{\chi}_i^0$ — neutralinos (mixtures of $\tilde{\gamma}$, \tilde{Z}^0 , and \tilde{H}_i^0)

$$\text{Mass } m_{\tilde{\chi}_1^0} > 10.9 \text{ GeV, CL} = 95\%$$

$$\text{Mass } m_{\tilde{\chi}_2^0} > 45.3 \text{ GeV, CL} = 95\% \quad [\tan\beta > 1]$$

$$\text{Mass } m_{\tilde{\chi}_3^0} > 75.8 \text{ GeV, CL} = 95\% \quad [\tan\beta > 1]$$

$$\text{Mass } m_{\tilde{\chi}_4^0} > 127 \text{ GeV, CL} = 95\% \quad [\tan\beta > 3]$$

$\tilde{\chi}_i^\pm$ — charginos (mixtures of \tilde{W}^\pm and \tilde{H}_i^\pm)

$$\text{Mass } m_{\tilde{\chi}_1^\pm} > 65.7 \text{ GeV, CL} = 95\% \quad [m_{\tilde{\chi}_1^\pm} - m_{\tilde{\chi}_1^0} \geq 2 \text{ GeV}]$$

$$\text{Mass } m_{\tilde{\chi}_2^\pm} > 99 \text{ GeV, CL} = 95\% \quad [\text{GUT relations assumed}]$$

$\tilde{\nu}$ — scalar neutrino (sneutrino)

$$\text{Mass } m > 37.1 \text{ GeV, CL} = 95\% \quad [\text{one flavor}]$$

$$\text{Mass } m > 43.1 \text{ GeV, CL} = 95\% \quad [\text{three degenerate flavors}]$$

\tilde{e} — scalar electron (selectron)

$$\text{Mass } m > 58 \text{ GeV, CL} = 95\% \quad [m_{\tilde{e}_R} - m_{\tilde{\chi}_1^0} \geq 4 \text{ GeV}]$$

$\tilde{\mu}$ — scalar muon (smuon)

$$\text{Mass } m > 55.6 \text{ GeV, CL} = 95\% \quad [m_{\tilde{\mu}_R} - m_{\tilde{\chi}_1^0} \geq 4 \text{ GeV}]$$

$\tilde{\tau}$ — scalar tau (stau)

$$\text{Mass } m > 45 \text{ GeV, CL} = 95\% \quad [\text{if } m_{\tilde{\chi}_1^0} < 38 \text{ GeV}]$$

\tilde{q} — scalar quark (squark)

These limits include the effects of cascade decays, evaluated assuming a fixed value of the parameters μ and $\tan\beta$. The limits are weakly sensitive to these parameters over much of parameter space. Limits assume GUT relations between gaugino masses and the gauge coupling; in particular that for $|\mu|$ not small, $m_{\tilde{\chi}_1^0} \approx m_{\tilde{g}}/6$.

$$\text{Mass } m > 176 \text{ GeV, CL} = 95\% \quad [\text{any } m_{\tilde{g}} < 300 \text{ GeV,} \\ \mu = -250 \text{ GeV, } \tan\beta = 2]$$

$$\text{Mass } m > 224 \text{ GeV, CL} = 95\% \quad [m_{\tilde{g}} \leq m_{\tilde{q}}, \\ \mu = -400 \text{ GeV, } \tan\beta = 4]$$

\tilde{g} — gluino

There is some controversy on whether gluinos in a low-mass window ($1 \lesssim m_{\tilde{g}} \lesssim 5 \text{ GeV}$) are excluded or not. See the Supersymmetry Listings for details.

The limits summarised here refer to the high-mass region ($m_{\tilde{g}} \gtrsim 5 \text{ GeV}$), and include the effects of cascade decays, evaluated assuming a fixed value of the parameters μ and $\tan\beta$. The limits are weakly sensitive to these parameters over much of parameter space. Limits assume GUT relations between gaugino masses and the gauge coupling; in particular that for $|\mu|$ not small, $m_{\tilde{\chi}_1^0} \approx m_{\tilde{g}}/6$.

$$\text{Mass } m > 173 \text{ GeV, CL} = 95\% \quad [\text{any } m_{\tilde{q}}, \mu = -200 \text{ GeV,} \\ \tan\beta = 2]$$

$$\text{Mass } m > 212 \text{ GeV, CL} = 95\% \quad [m_{\tilde{g}} \geq m_{\tilde{q}}, \mu = -250 \text{ GeV,} \\ \tan\beta = 2]$$

Quark and Lepton Compositeness, Searches for

Scale Limits Λ for Contact Interactions (the lowest dimensional interactions with four fermions)

If the Lagrangian has the form

$$\pm \frac{g^2}{2\Lambda^2} \bar{\psi}_L \gamma_\mu \psi_L \bar{\psi}_L \gamma^\mu \psi_L$$

(with $g^2/4\pi$ set equal to 1), then we define $\Lambda \equiv \Lambda_{LL}^\pm$. For the full definitions and for other forms, see the Note in the Listings on Searches for Quark and Lepton Compositeness in the full *Review* and the original literature.

$\Lambda_{LL}^+(e e e e)$	> 2.4 TeV, CL = 95%
$\Lambda_{LL}^-(e e e e)$	> 3.6 TeV, CL = 95%
$\Lambda_{LL}^+(e e \mu \mu)$	> 2.6 TeV, CL = 95%
$\Lambda_{LL}^-(e e \mu \mu)$	> 2.9 TeV, CL = 95%
$\Lambda_{LL}^+(e e \tau \tau)$	> 1.9 TeV, CL = 95%
$\Lambda_{LL}^-(e e \tau \tau)$	> 3.0 TeV, CL = 95%
$\Lambda_{LL}^+(\ell \ell \ell \ell)$	> 3.5 TeV, CL = 95%
$\Lambda_{LL}^-(\ell \ell \ell \ell)$	> 3.8 TeV, CL = 95%
$\Lambda_{LL}^+(e e q q)$	> 2.5 TeV, CL = 95%
$\Lambda_{LL}^-(e e q q)$	> 3.7 TeV, CL = 95%
$\Lambda_{LL}^+(e e b b)$	> 3.1 TeV, CL = 95%
$\Lambda_{LL}^-(e e b b)$	> 2.9 TeV, CL = 95%
$\Lambda_{LL}^+(\mu \mu q q)$	> 2.9 TeV, CL = 95%
$\Lambda_{LL}^-(\mu \mu q q)$	> 4.2 TeV, CL = 95%
$\Lambda_{LR}^\pm(\nu_\mu \nu_e \mu e)$	> 3.1 TeV, CL = 90%
$\Lambda_{LL}^\pm(q q q q)$	> 1.6 TeV, CL = 95%

Excited Leptons

The limits from $\ell^{*+} \ell^{*-}$ do not depend on λ (where λ is the $\ell\ell^*$ transition coupling). The λ -dependent limits assume chiral coupling, except for the third limit for e^* which is for nonchiral coupling. For chiral coupling, this limit corresponds to $\lambda_\gamma = \sqrt{2}$.

$e^{*\pm}$ — excited electron

Mass $m > 85.0$ GeV, CL = 95% (from $e^{*+} e^{*-}$)

Mass $m > 91$ GeV, CL = 95% (if $\lambda_Z > 1$)

Mass $m > 194$ GeV, CL = 95% (if $\lambda_\gamma = 1$)

$\mu^{*\pm}$ — excited muon

Mass $m > 85.3$ GeV, CL = 95% (from $\mu^{*+} \mu^{*-}$)

Mass $m > 91$ GeV, CL = 95% (if $\lambda_Z > 1$)

$\tau^{*\pm}$ — excited tau

Mass $m > 84.6$ GeV, CL = 95% (from $\tau^{*+} \tau^{*-}$)

Mass $m > 90$ GeV, CL = 95% (if $\lambda_Z > 0.18$)

ν^* — excited neutrino

Mass $m > 84.9$ GeV, CL = 95% (from $\nu^* \bar{\nu}^*$)

Mass $m > 91$ GeV, CL = 95% (if $\lambda_Z > 1$)

Mass $m = \text{none } 40\text{--}96$ GeV, CL = 95% (from $e p \rightarrow \nu^* X$)

q^* — excited quark

Mass $m > 45.6$ GeV, CL = 95% (from $q^* \bar{q}^*$)

Mass $m > 88$ GeV, CL = 95% (if $\lambda_Z > 1$)

Mass $m > 570$ GeV, CL = 95% ($p\bar{p} \rightarrow q^* X$)

Color Sextet and Octet Particles

Color Sextet Quarks (q_6)

Mass $m > 84$ GeV, CL = 95% (Stable q_6)

Color Octet Charged Leptons (ℓ_8)

Mass $m > 86$ GeV, CL = 95% (Stable ℓ_8)

Color Octet Neutrinos (ν_8)

Mass $m > 110$ GeV, CL = 90% ($\nu_8 \rightarrow \nu g$)

TESTS OF CONSERVATION LAWS

Revised by L. Wolfenstein and T.G. Trippe, May 1998.

In keeping with the current interest in tests of conservation laws, we collect together a Table of experimental limits on all weak and electromagnetic decays, mass differences, and moments, and on a few reactions, whose observation would violate conservation laws. The Table is given only in the full *Review of Particle Physics*, not in the Particle Physics Booklet. For the benefit of Booklet readers, we include the best limits from the Table in the following text. Limits in this text are for CL=90% unless otherwise specified. The Table is in two parts: “Discrete Space-Time Symmetries,” *i.e.*, C , P , T , CP , and CPT ; and “Number Conservation Laws,” *i.e.*, lepton, baryon, hadronic flavor, and charge conservation. The references for these data can be found in the the Particle Listings in the *Review*. A discussion of these tests follows.

CPT INVARIANCE

General principles of relativistic field theory require invariance under the combined transformation CPT . The simplest tests of CPT invariance are the equality of the masses and lifetimes of a particle and its antiparticle. The best test comes from the limit on the mass difference between K^0 and \bar{K}^0 . Any such difference contributes to the CP -violating parameter ϵ . Assuming CPT invariance, ϕ_ϵ , the phase of ϵ should be very close to 44° . (See the “Note on CP Violation in K_L^0 Decay” in the Particle Listings.) In contrast, if the entire source of CP violation in K^0 decays were a $K^0 - \bar{K}^0$ mass difference, ϕ_ϵ would be $44^\circ + 90^\circ$.

Assuming that there is no other source of CPT violation than this mass difference, it is possible to deduce that [1]

$$m_{\bar{K}^0} - m_{K^0} \approx \frac{2(m_{K_L^0} - m_{K_S^0}) |\eta| (\frac{2}{3}\phi_{+-} + \frac{1}{3}\phi_{00} - \phi_0)}{\sin \phi_0},$$

where $\phi_0 = 43.5^\circ$ with an uncertainty of less than 0.1° . Using our best values of the CP -violation parameters, we get $|(m_{\bar{K}^0} - m_{K^0})/m_{K^0}| \leq 10^{-18}$. Limits can also be placed on specific CPT -violating decay amplitudes. Given the small value of $(1 - |\eta_{00}/\eta_{+-}|)$, the value of $\phi_{00} - \phi_{+-}$ provides a measure of

CPT violation in $K_L^0 \rightarrow 2\pi$ decay. Results from CERN [1] and Fermilab [2] indicate no CPT -violating effect.

CP AND T INVARIANCE

Given CPT invariance, CP violation and T violation are equivalent. So far the only evidence for CP or T violation comes from the measurements of η_{+-} , η_{00} , and the semileptonic decay charge asymmetry for K_L , *e.g.*, $|\eta_{+-}| = |A(K_L^0 \rightarrow \pi^+\pi^-)/A(K_S^0 \rightarrow \pi^+\pi^-)| = (2.285 \pm 0.019) \times 10^{-3}$ and $[\Gamma(K_L^0 \rightarrow \pi^-e^+\nu) - \Gamma(K_L^0 \rightarrow \pi^+e^-\bar{\nu})]/[\text{sum}] = (0.333 \pm 0.014)\%$. Other searches for CP or T violation divide into (a) those that involve weak interactions or parity violation, and (b) those that involve processes otherwise allowed by the strong or electromagnetic interactions. In class (a) the most sensitive are probably the searches for an electric dipole moment of the neutron, measured to be $< 1.0 \times 10^{-25}$ e cm, and the electron $(-0.18 \pm 0.16) \times 10^{-26}$ e cm. A nonzero value requires both P and T violation. Class (b) includes the search for C violation in η decay, believed to be an electromagnetic process, *e.g.*, as measured by $\Gamma(\eta \rightarrow \mu^+\mu^-\pi^0)/\Gamma(\eta \rightarrow \text{all}) < 5 \times 10^{-6}$, and searches for T violation in a number of nuclear and electromagnetic reactions.

CONSERVATION OF LEPTON NUMBERS

Present experimental evidence and the standard electroweak theory are consistent with the absolute conservation of three separate lepton numbers: electron number L_e , muon number L_μ , and tau number L_τ . Searches for violations are of the following types:

a) $\Delta L = 2$ for one type of lepton. The best limit comes from the search for neutrinoless double beta decay $(Z, A) \rightarrow (Z + 2, A) + e^- + e^-$. The best laboratory limit is $t_{1/2} > 1.1 \times 10^{25}$ yr (CL=90%) for ^{76}Ge .

b) Conversion of one lepton type to another. For purely leptonic processes, the best limits are on $\mu \rightarrow e\gamma$ and $\mu \rightarrow 3e$, measured as $\Gamma(\mu \rightarrow e\gamma)/\Gamma(\mu \rightarrow \text{all}) < 5 \times 10^{-11}$ and $\Gamma(\mu \rightarrow 3e)/\Gamma(\mu \rightarrow \text{all}) < 1.0 \times 10^{-12}$. For semileptonic processes, the best limit comes from the coherent conversion process in a muonic atom, $\mu^- + (Z, A) \rightarrow e^- + (Z, A)$, measured as $\Gamma(\mu^- \text{Ti} \rightarrow e^- \text{Ti})/\Gamma(\mu^- \text{Ti} \rightarrow \text{all}) < 4 \times 10^{-12}$. Of special interest is the case in which the hadronic flavor also changes, as in $K_L \rightarrow e\mu$ and $K^+ \rightarrow \pi^+e^-\mu^+$, measured as $\Gamma(K_L \rightarrow e\mu)/\Gamma(K_L \rightarrow \text{all}) < 3.3 \times 10^{-11}$ and $\Gamma(K^+ \rightarrow \pi^+e^-\mu^+)/\Gamma(K^+ \rightarrow \text{all}) < 2.1 \times 10^{-10}$. Limits on the conversion of τ into e or μ are found in τ decay and are much less stringent than

those for $\mu \rightarrow e$ conversion, *e.g.*, $\Gamma(\tau \rightarrow \mu\gamma)/\Gamma(\tau \rightarrow \text{all}) < 3.0 \times 10^{-6}$ and $\Gamma(\tau \rightarrow e\gamma)/\Gamma(\tau \rightarrow \text{all}) < 2.7 \times 10^{-6}$.

c) Conversion of one type of lepton into another type of antilepton.

The case most studied is $\mu^- + (Z, A) \rightarrow e^+ + (Z - 2, A)$, the strongest limit being $\Gamma(\mu^- \text{Ti} \rightarrow e^+ \text{Ca})/\Gamma(\mu^- \text{Ti} \rightarrow \text{all}) < 9 \times 10^{-11}$.

d) Relation to neutrino mass. If neutrinos have mass, then it is expected even in the standard electroweak theory that the lepton numbers are not separately conserved, as a consequence of lepton mixing analogous to Cabibbo quark mixing. However, in this case lepton-number-violating processes such as $\mu \rightarrow e\gamma$ are expected to have extremely small probability. For small neutrino masses, the lepton-number violation would be observed first in neutrino oscillations, which have been the subject of extensive experimental searches. For example, searches for $\bar{\nu}_e$ disappearance, which we label as $\bar{\nu}_e \not\rightarrow \bar{\nu}_e$, give measured limits $\Delta(m^2) < 9 \times 10^{-4} \text{ eV}^2$ for $\sin^2(2\theta) = 1$, and $\sin^2(2\theta) < 0.02$ for large $\Delta(m^2)$, where θ is the neutrino mixing angle. Possible evidence for mixing has come from two sources. The deficit in the solar neutrino flux compared with solar model calculations could be explained by oscillations with $\Delta(m^2) \leq 10^{-5} \text{ eV}^2$ causing the disappearance of ν_e . In addition underground detectors observing neutrinos produced by cosmic rays in the atmosphere have measured a ν_μ/ν_e ratio much less than expected and also a deficiency of upward going ν_μ compared to downward. This could be explained by oscillations leading to the disappearance of ν_μ with $\Delta(m^2)$ of the order 10^{-2} – 10^{-3} eV^2 .

CONSERVATION OF HADRONIC FLAVORS

In strong and electromagnetic interactions, hadronic flavor is conserved, *i.e.* the conversion of a quark of one flavor (d, u, s, c, b, t) into a quark of another flavor is forbidden. In the Standard Model, the weak interactions violate these conservation laws in a manner described by the Cabibbo-Kobayashi-Maskawa mixing (see the section “Cabibbo-Kobayashi-Maskawa Mixing Matrix”). The way in which these conservation laws are violated is tested as follows:

a) $\Delta S = \Delta Q$ rule. In the semileptonic decay of strange particles, the strangeness change equals the change in charge of the hadrons. Tests come from limits on decay rates such as $\Gamma(\Sigma^+ \rightarrow ne^+\nu)/\Gamma(\Sigma^+ \rightarrow \text{all}) < 5 \times 10^{-6}$, and from a detailed analysis of $K_L \rightarrow \pi e\nu$, which yields the parameter x ,

measured to be $(\text{Re } x, \text{Im } x) = (0.006 \pm 0.018, -0.003 \pm 0.026)$. Corresponding rules are $\Delta C = \Delta Q$ and $\Delta B = \Delta Q$.

b) Change of flavor by two units. In the Standard Model this occurs only in second-order weak interactions. The classic example is $\Delta S = 2$ via $K^0 - \bar{K}^0$ mixing, which is directly measured by $m(K_S) - m(K_L) = (3.489 \pm 0.009) \times 10^{-12}$ MeV. There is now evidence for $B^0 - \bar{B}^0$ mixing ($\Delta B = 2$), with the corresponding mass difference between the eigenstates $(m_{B_H^0} - m_{B_L^0}) = (0.723 \pm 0.032) \Gamma_{B^0} = (3.05 \pm 0.12) \times 10^{-10}$ MeV, and for $B_s^0 - \bar{B}_s^0$ mixing, with $(m_{B_{sH}^0} - m_{B_{sL}^0}) > 14 \Gamma_{B_s^0}$ or $> 6 \times 10^{-9}$ MeV (CL=95%). No evidence exists for $D^0 - \bar{D}^0$ mixing, which is expected to be much smaller in the Standard Model.

c) Flavor-changing neutral currents. In the Standard Model the neutral-current interactions do not change flavor. The low rate $\Gamma(K_L \rightarrow \mu^+ \mu^-) / \Gamma(K_L \rightarrow \text{all}) = (7.2 \pm 0.5) \times 10^{-9}$ puts limits on such interactions; the nonzero value for this rate is attributed to a combination of the weak and electromagnetic interactions. The best test should come from $K^+ \rightarrow \pi^+ \nu \bar{\nu}$, which occurs in the Standard Model only as a second-order weak process with a branching fraction of $(1 \text{ to } 8) \times 10^{-10}$. Observation of one event has been reported [4], yielding $\Gamma(K^+ \rightarrow \pi^+ \nu \bar{\nu}) / \Gamma(K^+ \rightarrow \text{all}) = (4.2_{-3.5}^{+9.7}) \times 10^{-10}$. Limits for charm-changing or bottom-changing neutral currents are much less stringent: $\Gamma(D^0 \rightarrow \mu^+ \mu^-) / \Gamma(D^0 \rightarrow \text{all}) < 4 \times 10^{-6}$ and $\Gamma(B^0 \rightarrow \mu^+ \mu^-) / \Gamma(B^0 \rightarrow \text{all}) < 7 \times 10^{-7}$. One cannot isolate flavor-changing neutral current (FCNC) effects in non leptonic decays. For example, the FCNC transition $s \rightarrow d + (\bar{u} + u)$ is equivalent to the charged-current transition $s \rightarrow u + (\bar{u} + d)$. Tests for FCNC are therefore limited to hadron decays into lepton pairs. Such decays are expected only in second-order in the electroweak coupling in the Standard Model.

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TESTS OF DISCRETE SPACE-TIME SYMMETRIES

CHARGE CONJUGATION (C) INVARIANCE

$\Gamma(\pi^0 \rightarrow 3\gamma)/\Gamma_{\text{total}}$	$<3.1 \times 10^{-8}$, CL = 90%
η C-nonconserving decay parameters	
$\pi^+ \pi^- \pi^0$ left-right asymmetry parameter	$(0.09 \pm 0.17) \times 10^{-2}$
$\pi^+ \pi^- \pi^0$ sextant asymmetry parameter	$(0.18 \pm 0.16) \times 10^{-2}$
$\pi^+ \pi^- \pi^0$ quadrant asymmetry parameter	$(-0.17 \pm 0.17) \times 10^{-2}$
$\pi^+ \pi^- \gamma$ left-right asymmetry parameter	$(0.9 \pm 0.4) \times 10^{-2}$
$\pi^+ \pi^- \gamma$ parameter β (<i>D</i> -wave)	0.05 ± 0.06 ($S = 1.5$)
$\Gamma(\eta \rightarrow 3\gamma)/\Gamma_{\text{total}}$	$<5 \times 10^{-4}$, CL = 95%
$\Gamma(\eta \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	[a] $<4 \times 10^{-5}$, CL = 90%
$\Gamma(\eta \rightarrow \pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	[a] $<5 \times 10^{-6}$, CL = 90%
$\Gamma(\omega(782) \rightarrow \eta \pi^0)/\Gamma_{\text{total}}$	$<1 \times 10^{-3}$, CL = 90%
$\Gamma(\omega(782) \rightarrow 3\pi^0)/\Gamma_{\text{total}}$	$<3 \times 10^{-4}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	[a] $<1.3 \times 10^{-2}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \eta e^+ e^-)/\Gamma_{\text{total}}$	[a] $<1.1 \times 10^{-2}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow 3\gamma)/\Gamma_{\text{total}}$	$<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \mu^+ \mu^- \pi^0)/\Gamma_{\text{total}}$	[a] $<6.0 \times 10^{-5}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \mu^+ \mu^- \eta)/\Gamma_{\text{total}}$	[a] $<1.5 \times 10^{-5}$, CL = 90%

PARITY (P) INVARIANCE

e electric dipole moment	$(0.18 \pm 0.16) \times 10^{-26}$ ecm
μ electric dipole moment	$(3.7 \pm 3.4) \times 10^{-19}$ ecm
τ electric dipole moment (d_τ)	> -3.1 and $< 3.1 \times 10^{-16}$ ecm, CL = 95%
$\Gamma(\eta \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<9 \times 10^{-4}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<2 \times 10^{-2}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<9 \times 10^{-4}$, CL = 90%
p electric dipole moment	$(-4 \pm 6) \times 10^{-23}$ ecm
n electric dipole moment	$<0.97 \times 10^{-25}$ ecm, CL = 90%
Λ electric dipole moment	$<1.5 \times 10^{-16}$ ecm, CL = 95%

TIME REVERSAL (T) INVARIANCE

Limits on e , μ , τ , p , n , and Λ electric dipole moments under Parity Invariance above are also tests of Time Reversal Invariance.

μ decay parameters

transverse e^+ polarization normal to plane of μ spin, e^+ momentum 0.007 ± 0.023

α'/A $(0 \pm 4) \times 10^{-3}$

β'/A $(2 \pm 6) \times 10^{-3}$

τ electric dipole moment (d_τ) > -3.1 and $< 3.1 \times 10^{-16}$ ecm, CL = 95%

$\text{Im}(\xi)$ in $K_{\mu 3}^\pm$ decay (from transverse μ pol.) -0.017 ± 0.025

$\text{Im}(\xi)$ in $K_{\mu 3}^0$ decay (from transverse μ pol.) -0.007 ± 0.026

$n \rightarrow p e^- \nu$ decay parameters

ϕ_{AV} , phase of g_A relative to g_V [b] $(180.07 \pm 0.18)^\circ$

triple correlation coefficient D $(-0.5 \pm 1.4) \times 10^{-3}$

triple correlation coefficient D for $\Sigma^- \rightarrow n e^- \bar{\nu}_e$ 0.11 ± 0.10

CP INVARIANCE

$\text{Re}(d_{\tau}^W)$	$<0.56 \times 10^{-17}$ ecm, CL = 95%
$\text{Im}(d_{\tau}^W)$	$<1.5 \times 10^{-17}$ ecm, CL = 95%
$\Gamma(\eta \rightarrow \pi^+ \pi^-) / \Gamma_{\text{total}}$	$<9 \times 10^{-4}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^+ \pi^-) / \Gamma_{\text{total}}$	$<2 \times 10^{-2}$, CL = 90%
$\Gamma(\eta'(958) \rightarrow \pi^0 \pi^0) / \Gamma_{\text{total}}$	$<9 \times 10^{-4}$, CL = 90%
$K^{\pm} \rightarrow \pi^{\pm} \pi^+ \pi^-$ rate difference/average	$(0.07 \pm 0.12)\%$
$K^{\pm} \rightarrow \pi^{\pm} \pi^0 \pi^0$ rate difference/average	$(0.0 \pm 0.6)\%$
$K^{\pm} \rightarrow \pi^{\pm} \pi^0 \gamma$ rate difference/average	$(0.9 \pm 3.3)\%$
$(g_{\tau^+} - g_{\tau^-}) / (g_{\tau^+} + g_{\tau^-})$ for $K^{\pm} \rightarrow \pi^{\pm} \pi^+ \pi^-$	$(-0.7 \pm 0.5)\%$
CP-violation parameters in K_S^0 decay	
$\text{Im}(\eta_{+-0}) = \text{Im}(A(K_S^0 \rightarrow \pi^+ \pi^- \pi^0, \text{CP-violating}) / A(K_L^0 \rightarrow \pi^+ \pi^- \pi^0))$	-0.002 ± 0.008
$\text{Im}(\eta_{000})^2 = \Gamma(K_S^0 \rightarrow 3\pi^0) / \Gamma(K_L^0 \rightarrow 3\pi^0)$	<0.1 , CL = 90%
charge asymmetry j for $K_L^0 \rightarrow \pi^+ \pi^- \pi^0$	0.0011 ± 0.0008
$|\epsilon'_{+-\gamma}| / \epsilon$ for $K_L^0 \rightarrow \pi^+ \pi^- \gamma$	<0.3 , CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \mu^+ \mu^-) / \Gamma_{\text{total}}$	[c] $<5.1 \times 10^{-9}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 e^+ e^-) / \Gamma_{\text{total}}$	[c] $<4.3 \times 10^{-9}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \nu \bar{\nu}) / \Gamma_{\text{total}}$	[d] $<5.8 \times 10^{-5}$, CL = 90%
$A_{CP}(K^+ K^- \pi^{\pm})$ in $D^{\pm} \rightarrow K^+ K^- \pi^{\pm}$	-0.017 ± 0.027
$A_{CP}(K^{\pm} K^{*0})$ in $D^+ \rightarrow K^+ \bar{K}^{*0}$ and $D^- \rightarrow K^- K^{*0}$	-0.02 ± 0.05
$A_{CP}(\phi \pi^{\pm})$ in $D^{\pm} \rightarrow \phi \pi^{\pm}$	-0.014 ± 0.033
$A_{CP}(\pi^+ \pi^- \pi^{\pm})$ in $D^{\pm} \rightarrow \pi^+ \pi^- \pi^{\pm}$	-0.02 ± 0.04
$A_{CP}(K^+ K^-)$ in $D^0, \bar{D}^0 \rightarrow K^+ K^-$	0.026 ± 0.035
$A_{CP}(\pi^+ \pi^-)$ in $D^0, \bar{D}^0 \rightarrow \pi^+ \pi^-$	-0.05 ± 0.08
$A_{CP}(K_S^0 \phi)$ in $D^0, \bar{D}^0 \rightarrow K_S^0 \phi$	-0.03 ± 0.09
$A_{CP}(K_S^0 \pi^0)$ in $D^0, \bar{D}^0 \rightarrow K_S^0 \pi^0$	-0.018 ± 0.030
$|\text{Re}(\epsilon_{B0})|$	0.002 ± 0.008
$[\alpha_-(\Lambda) + \alpha_+(\bar{\Lambda})] / [\alpha_-(\Lambda) - \alpha_+(\bar{\Lambda})]$	-0.03 ± 0.06

CP VIOLATION OBSERVED

K_L^0 branching ratios

charge asymmetry in $K_{\ell 3}^0$ decays

$$\delta(\mu) = [\Gamma(\pi^- \mu^+ \nu_\mu) - \Gamma(\pi^+ \mu^- \bar{\nu}_\mu)] / \text{sum} \quad (0.304 \pm 0.025)\%$$

$$\delta(e) = [\Gamma(\pi^- e^+ \nu_e) - \Gamma(\pi^+ e^- \bar{\nu}_e)] / \text{sum} \quad (0.333 \pm 0.014)\%$$

parameters for $K_L^0 \rightarrow 2\pi$ decay

$$|\eta_{00}| = |A(K_L^0 \rightarrow 2\pi^0) / A(K_S^0 \rightarrow 2\pi^0)| \quad (2.275 \pm 0.019) \times 10^{-3} \quad (S = 1.1)$$

$$|\eta_{+-}| = |A(K_L^0 \rightarrow \pi^+ \pi^-) / A(K_S^0 \rightarrow \pi^+ \pi^-)| \quad (2.285 \pm 0.019) \times 10^{-3}$$

$$\epsilon'/\epsilon \approx \text{Re}(\epsilon'/\epsilon) = (1 - |\eta_{00}/\eta_{+-}|) / 3 \quad [e] \quad (1.5 \pm 0.8) \times 10^{-3} \quad (S = 1.8)$$

$$\phi_{+-}, \text{ phase of } \eta_{+-} \quad (43.5 \pm 0.6)^\circ$$

$$\phi_{00}, \text{ phase of } \eta_{00} \quad (43.4 \pm 1.0)^\circ$$

parameters for $K_L^0 \rightarrow \pi^+ \pi^- \gamma$ decay

$$|\eta_{+-\gamma}| = |A(K_L^0 \rightarrow \pi^+ \pi^- \gamma, CP \text{ violating}) / A(K_S^0 \rightarrow \pi^+ \pi^- \gamma)| \quad (2.35 \pm 0.07) \times 10^{-3}$$

$$\phi_{+-\gamma} = \text{phase of } \eta_{+-\gamma} \quad (44 \pm 4)^\circ$$

$$\Gamma(K_L^0 \rightarrow \pi^+ \pi^-) / \Gamma_{\text{total}} \quad (2.067 \pm 0.035) \times 10^{-3} \quad (S = 1.1)$$

$$\Gamma(K_L^0 \rightarrow \pi^0 \pi^0) / \Gamma_{\text{total}} \quad (9.36 \pm 0.20) \times 10^{-4}$$

CPT INVARIANCE

$(m_{W^+} - m_{W^-}) / m_{\text{average}}$	-0.002 ± 0.007
$(m_{e^+} - m_{e^-}) / m_{\text{average}}$	$<4 \times 10^{-8}$, CL = 90%
$|q_{e^+} + q_{e^-}|/e$	$<4 \times 10^{-8}$
$(g_{e^+} - g_{e^-}) / g_{\text{average}}$	$(-0.5 \pm 2.1) \times 10^{-12}$
$(\tau_{\mu^+} - \tau_{\mu^-}) / \tau_{\text{average}}$	$(2 \pm 8) \times 10^{-5}$
$(g_{\mu^+} - g_{\mu^-}) / g_{\text{average}}$	$(-2.6 \pm 1.6) \times 10^{-8}$
$(m_{\pi^+} - m_{\pi^-}) / m_{\text{average}}$	$(2 \pm 5) \times 10^{-4}$
$(\tau_{\pi^+} - \tau_{\pi^-}) / \tau_{\text{average}}$	$(6 \pm 7) \times 10^{-4}$
$(m_{K^+} - m_{K^-}) / m_{\text{average}}$	$(-0.6 \pm 1.8) \times 10^{-4}$
$(\tau_{K^+} - \tau_{K^-}) / \tau_{\text{average}}$	$(0.11 \pm 0.09)\%$ (S = 1.2)
$K^\pm \rightarrow \mu^\pm \nu_\mu$ rate difference/average	$(-0.5 \pm 0.4)\%$
$K^\pm \rightarrow \pi^\pm \pi^0$ rate difference/average	[f] $(0.8 \pm 1.2)\%$
$|m_{K^0} - m_{\bar{K}^0}| / m_{\text{average}}$	[g] $<10^{-18}$
phase difference $\phi_{00} - \phi_{+-}$	$(-0.1 \pm 0.8)^\circ$
<i>CPT</i> -violation parameters in K^0 decay	
real part of Δ	0.018 ± 0.020
imaginary part of Δ	0.02 ± 0.04
$(|\frac{q_{\bar{p}}}{m_{\bar{p}}} - \frac{q_p}{m_p}|) / |\frac{q}{m}|_{\text{average}}$	$(1.5 \pm 1.1) \times 10^{-9}$
$|q_p + q_{\bar{p}}|/e$	$<2 \times 10^{-5}$
$(\mu_p + \mu_{\bar{p}}) / |\mu|_{\text{average}}$	$(-2.6 \pm 2.9) \times 10^{-3}$
$(m_n - m_{\bar{n}}) / m_{\text{average}}$	$(9 \pm 5) \times 10^{-5}$
$(m_\Lambda - m_{\bar{\Lambda}}) / m_\Lambda$	$(-1.0 \pm 0.9) \times 10^{-5}$
$(\tau_\Lambda - \tau_{\bar{\Lambda}}) / \tau_{\text{average}}$	0.04 ± 0.09
$(\mu_{\Sigma^+} + \mu_{\bar{\Sigma}^-}) / |\mu|_{\text{average}}$	0.014 ± 0.015
$(m_{\Xi^-} - m_{\bar{\Xi}^+}) / m_{\text{average}}$	$(1.1 \pm 2.7) \times 10^{-4}$
$(\tau_{\Xi^-} - \tau_{\bar{\Xi}^+}) / \tau_{\text{average}}$	0.02 ± 0.18
$(m_{\Omega^-} - m_{\bar{\Omega}^+}) / m_{\text{average}}$	$(0 \pm 5) \times 10^{-4}$

TESTS OF NUMBER CONSERVATION LAWS

LEPTON FAMILY NUMBER

Lepton family number conservation means separate conservation of each of L_e , L_μ , L_τ .

$\Gamma(Z \rightarrow e^\pm \mu^\mp) / \Gamma_{\text{total}}$	[h] $< 1.7 \times 10^{-6}$, CL = 95%
$\Gamma(Z \rightarrow e^\pm \tau^\mp) / \Gamma_{\text{total}}$	[h] $< 9.8 \times 10^{-6}$, CL = 95%
$\Gamma(Z \rightarrow \mu^\pm \tau^\mp) / \Gamma_{\text{total}}$	[h] $< 1.2 \times 10^{-5}$, CL = 95%
limit on $\mu^- \rightarrow e^-$ conversion	
$\sigma(\mu^- {}^{32}\text{S} \rightarrow e^- {}^{32}\text{S}) /$ $\sigma(\mu^- {}^{32}\text{S} \rightarrow \nu_\mu {}^{32}\text{P}^*)$	$< 7 \times 10^{-11}$, CL = 90%
$\sigma(\mu^- \text{Ti} \rightarrow e^- \text{Ti}) /$ $\sigma(\mu^- \text{Ti} \rightarrow \text{capture})$	$< 4.3 \times 10^{-12}$, CL = 90%
$\sigma(\mu^- \text{Pb} \rightarrow e^- \text{Pb}) /$ $\sigma(\mu^- \text{Pb} \rightarrow \text{capture})$	$< 4.6 \times 10^{-11}$, CL = 90%
limit on muonium \rightarrow antimuonium conversion $R_g =$ G_C / G_F	< 0.018 , CL = 90%
$\Gamma(\mu^- \rightarrow e^- \nu_e \bar{\nu}_\mu) / \Gamma_{\text{total}}$	[i] $< 1.2 \times 10^{-2}$, CL = 90%
$\Gamma(\mu^- \rightarrow e^- \gamma) / \Gamma_{\text{total}}$	$< 4.9 \times 10^{-11}$, CL = 90%
$\Gamma(\mu^- \rightarrow e^- e^+ e^-) / \Gamma_{\text{total}}$	$< 1.0 \times 10^{-12}$, CL = 90%
$\Gamma(\mu^- \rightarrow e^- 2\gamma) / \Gamma_{\text{total}}$	$< 7.2 \times 10^{-11}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \gamma) / \Gamma_{\text{total}}$	$< 2.7 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \gamma) / \Gamma_{\text{total}}$	$< 3.0 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^0) / \Gamma_{\text{total}}$	$< 3.7 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^0) / \Gamma_{\text{total}}$	$< 4.0 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- K^0) / \Gamma_{\text{total}}$	$< 1.3 \times 10^{-3}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- K^0) / \Gamma_{\text{total}}$	$< 1.0 \times 10^{-3}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \eta) / \Gamma_{\text{total}}$	$< 8.2 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \eta) / \Gamma_{\text{total}}$	$< 9.6 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \rho^0) / \Gamma_{\text{total}}$	$< 2.0 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \rho^0) / \Gamma_{\text{total}}$	$< 6.3 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- K^*(892)^0) / \Gamma_{\text{total}}$	$< 5.1 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- K^*(892)^0) / \Gamma_{\text{total}}$	$< 7.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \bar{K}^*(892)^0) / \Gamma_{\text{total}}$	$< 7.4 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \bar{K}^*(892)^0) / \Gamma_{\text{total}}$	$< 7.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \phi) / \Gamma_{\text{total}}$	$< 6.9 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \phi) / \Gamma_{\text{total}}$	$< 7.0 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- e^+ e^-) / \Gamma_{\text{total}}$	$< 2.9 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 1.8 \times 10^{-6}$, CL = 90%

$\Gamma(\tau^- \rightarrow e^+ \mu^- \mu^-)/\Gamma_{\text{total}}$	$<1.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- e^+ e^-)/\Gamma_{\text{total}}$	$<1.7 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ e^- e^-)/\Gamma_{\text{total}}$	$<1.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<1.9 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<2.2 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^+ \pi^-)/\Gamma_{\text{total}}$	$<8.2 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^+ K^-)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^- K^+)/\Gamma_{\text{total}}$	$<3.8 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- K^+ K^-)/\Gamma_{\text{total}}$	$<6.0 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^+ K^-)/\Gamma_{\text{total}}$	$<7.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^- K^+)/\Gamma_{\text{total}}$	$<7.4 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- K^+ K^-)/\Gamma_{\text{total}}$	$<1.5 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<6.5 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^0 \pi^0)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \eta \eta)/\Gamma_{\text{total}}$	$<3.5 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \eta \eta)/\Gamma_{\text{total}}$	$<6.0 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \pi^0 \eta)/\Gamma_{\text{total}}$	$<2.4 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^- \pi^0 \eta)/\Gamma_{\text{total}}$	$<2.2 \times 10^{-5}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^- \text{light boson})/\Gamma_{\text{total}}$	$<2.7 \times 10^{-3}$, CL = 95%
$\Gamma(\tau^- \rightarrow \mu^- \text{light boson})/\Gamma_{\text{total}}$	$<5 \times 10^{-3}$, CL = 95%

ν oscillations. (For other lepton mixing effects in particle decays, see the Particle Listings.)

$\bar{\nu}_e \not\leftrightarrow \bar{\nu}_e$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<9 \times 10^{-4} \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	<0.02 , CL = 90%

$\nu_e \rightarrow \nu_\tau$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<9 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	<0.25 , CL = 90%

$\bar{\nu}_e \rightarrow \bar{\nu}_\tau$

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	<0.7 , CL = 90%
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$\nu_\mu \rightarrow \nu_e$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<0.09 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	$<3.0 \times 10^{-3}$, CL = 90%

$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<0.14 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	<0.004 , CL = 95%

$\nu_\mu(\bar{\nu}_\mu) \rightarrow \nu_e(\bar{\nu}_e)$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<0.075 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	$<1.8 \times 10^{-3}$, CL = 90%

$\nu_\mu \rightarrow \nu_\tau$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<0.9 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	<0.004 , CL = 90%

$\bar{\nu}_\mu \rightarrow \bar{\nu}_\tau$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<2.2 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	$<4.4 \times 10^{-2}$, CL = 90%
$\nu_\mu(\bar{\nu}_\mu) \rightarrow \nu_\tau(\bar{\nu}_\tau)$	
$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<1.5 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	$<8 \times 10^{-3}$, CL = 90%
$\nu_e \not\leftrightarrow \nu_e$	
$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<0.17 \text{ eV}^2$, CL = 90%
$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$	$<7 \times 10^{-2}$, CL = 90%
$\nu_\mu \not\leftrightarrow \nu_\mu$	
$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	<0.23 or $>1500 \text{ eV}^2$
$\sin^2(2\theta)$ for $\Delta(m^2) = 100\text{eV}^2$	[j] <0.02 , CL = 90%
$\bar{\nu}_\mu \not\leftrightarrow \bar{\nu}_\mu$	
$\Delta(m^2)$ for $\sin^2(2\theta) = 1$	<7 or $>1200 \text{ eV}^2$
$\sin^2(2\theta)$ for $190 \text{ eV}^2 < \Delta(m^2) < 320 \text{ eV}^2$	[k] <0.02 , CL = 90%
$\Gamma(\pi^+ \rightarrow \mu^+ \nu_e)/\Gamma_{\text{total}}$	[l] $<8.0 \times 10^{-3}$, CL = 90%
$\Gamma(\pi^+ \rightarrow \mu^- e^+ e^+ \nu)/\Gamma_{\text{total}}$	$<1.6 \times 10^{-6}$, CL = 90%
$\Gamma(\pi^0 \rightarrow \mu^+ e^- + e^- \mu^+)/\Gamma_{\text{total}}$	$<1.72 \times 10^{-8}$, CL = 90%
$\Gamma(\eta \rightarrow \mu^+ e^- + \mu^- e^+)/\Gamma_{\text{total}}$	$<6 \times 10^{-6}$, CL = 90%
$\Gamma(K^+ \rightarrow \mu^- \nu e^+ e^+)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-8}$, CL = 90%
$\Gamma(K^+ \rightarrow \mu^+ \nu_e)/\Gamma_{\text{total}}$	[l] $<4 \times 10^{-3}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^+ \mu^+ e^-)/\Gamma_{\text{total}}$	$<2.1 \times 10^{-10}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^+ \mu^- e^+)/\Gamma_{\text{total}}$	$<7 \times 10^{-9}$, CL = 90%
$\Gamma(K_L^0 \rightarrow e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<3.3 \times 10^{-11}$, CL = 90%
$\Gamma(K_L^0 \rightarrow e^\pm e^\pm \mu^\mp \mu^\mp)/\Gamma_{\text{total}}$	[h] $<6.1 \times 10^{-9}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^+ e^+ \mu^-)/\Gamma_{\text{total}}$	$<1.1 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^+ e^- \mu^+)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^+ e^+ \mu^-)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^+ e^- \mu^+)/\Gamma_{\text{total}}$	$<1.2 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \mu^\pm e^\mp)/\Gamma_{\text{total}}$	[h] $<1.9 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<8.6 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \eta e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \rho^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<4.9 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \omega e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<1.2 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \phi e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<3.4 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \bar{K}^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \bar{K}^*(892)^0 e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<1.0 \times 10^{-4}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ e^+ \mu^-)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ e^- \mu^+)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ e^+ \mu^-)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ e^- \mu^+)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^- e^+ \mu^+)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow K^- e^+ \mu^+)/\Gamma_{\text{total}}$	$<6.4 \times 10^{-3}$, CL = 90%

$\Gamma(B^0 \rightarrow e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<5.9 \times 10^{-6}$, CL = 90%
$\Gamma(B^0 \rightarrow e^\pm \tau^\mp)/\Gamma_{\text{total}}$	[h] $<5.3 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$	[h] $<8.3 \times 10^{-4}$, CL = 90%
$\Gamma(B \rightarrow e^\pm \mu^\mp s)/\Gamma_{\text{total}}$	$<2.2 \times 10^{-5}$, CL = 90%
$\Gamma(B_s^0 \rightarrow e^\pm \mu^\mp)/\Gamma_{\text{total}}$	[h] $<4.1 \times 10^{-5}$, CL = 90%

TOTAL LEPTON NUMBER

Violation of total lepton number conservation also implies violation of lepton family number conservation.

limit on $\mu^- \rightarrow e^+$ conversion	
$\sigma(\mu^- {}^{32}\text{S} \rightarrow e^+ {}^{32}\text{Si}^*) /$ $\sigma(\mu^- {}^{32}\text{S} \rightarrow \nu_\mu {}^{32}\text{P}^*)$	$<9 \times 10^{-10}$, CL = 90%
$\sigma(\mu^- {}^{127}\text{I} \rightarrow e^+ {}^{127}\text{Sb}^*) /$ $\sigma(\mu^- {}^{127}\text{I} \rightarrow \text{anything})$	$<3 \times 10^{-10}$, CL = 90%
$\sigma(\mu^- \text{Ti} \rightarrow e^+ \text{Ca}) /$ $\sigma(\mu^- \text{Ti} \rightarrow \text{capture})$	$<8.9 \times 10^{-11}$, CL = 90%
$\Gamma(\tau^- \rightarrow \pi^- \gamma)/\Gamma_{\text{total}}$	$<2.8 \times 10^{-4}$, CL = 90%
$\Gamma(\tau^- \rightarrow \pi^- \pi^0)/\Gamma_{\text{total}}$	$<3.7 \times 10^{-4}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^+ \pi^- \pi^-)/\Gamma_{\text{total}}$	$<1.9 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ \pi^- \pi^-)/\Gamma_{\text{total}}$	$<3.4 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^+ \pi^- K^-)/\Gamma_{\text{total}}$	$<2.1 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow e^+ K^- K^-)/\Gamma_{\text{total}}$	$<3.8 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ \pi^- K^-)/\Gamma_{\text{total}}$	$<7.0 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \mu^+ K^- K^-)/\Gamma_{\text{total}}$	$<6.0 \times 10^{-6}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \gamma)/\Gamma_{\text{total}}$	$<2.9 \times 10^{-4}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \pi^0)/\Gamma_{\text{total}}$	$<6.6 \times 10^{-4}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \eta)/\Gamma_{\text{total}}$	$<1.30 \times 10^{-3}$, CL = 90%
$\nu_e \rightarrow (\bar{\nu}_e)_L$	
$\alpha \Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<0.14 \text{ eV}^2$, CL = 90%
$\alpha^2 \sin^2(2\theta)$ for "Large" $\Delta(m^2)$	<0.032 , CL = 90%
$\nu_\mu \rightarrow (\bar{\nu}_e)_L$	
$\alpha \Delta(m^2)$ for $\sin^2(2\theta) = 1$	$<0.16 \text{ eV}^2$, CL = 90%
$\alpha^2 \sin^2(2\theta)$ for "Large" $\Delta(m^2)$	<0.001 , CL = 90%
$\Gamma(\pi^+ \rightarrow \mu^+ \bar{\nu}_e)/\Gamma_{\text{total}}$	[I] $<1.5 \times 10^{-3}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^- \mu^+ e^+)/\Gamma_{\text{total}}$	$<7 \times 10^{-9}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^- e^+ e^+)/\Gamma_{\text{total}}$	$<1.0 \times 10^{-8}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	[I] $<1.5 \times 10^{-4}$, CL = 90%
$\Gamma(K^+ \rightarrow \mu^+ \bar{\nu}_e)/\Gamma_{\text{total}}$	[I] $<3.3 \times 10^{-3}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^0 e^+ \bar{\nu}_e)/\Gamma_{\text{total}}$	$<3 \times 10^{-3}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^- e^+ e^+)/\Gamma_{\text{total}}$	$<1.1 \times 10^{-4}$, CL = 90%

$\Gamma(D^+ \rightarrow \pi^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<8.7 \times 10^{-5}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^- e^+ \mu^+)/\Gamma_{\text{total}}$	$<1.1 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow \rho^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<5.6 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^- e^+ e^+)/\Gamma_{\text{total}}$	$<1.2 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<1.2 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^- e^+ \mu^+)/\Gamma_{\text{total}}$	$<1.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^+ \rightarrow K^*(892)^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<8.5 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow \pi^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<4.3 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<5.9 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^*(892)^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<1.4 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^- e^+ e^+)/\Gamma_{\text{total}}$	$<3.9 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<9.1 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow K^- e^+ e^+)/\Gamma_{\text{total}}$	$<3.9 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow K^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<9.1 \times 10^{-3}$, CL = 90%
$\Gamma(\Xi^- \rightarrow p \mu^- \mu^-)/\Gamma_{\text{total}}$	$<4 \times 10^{-4}$, CL = 90%
$\Gamma(\Lambda_c^+ \rightarrow \Sigma^- \mu^+ \mu^+)/\Gamma_{\text{total}}$	$<7.0 \times 10^{-4}$, CL = 90%

BARYON NUMBER

$\Gamma(\tau^- \rightarrow \bar{p} \gamma)/\Gamma_{\text{total}}$	$<2.9 \times 10^{-4}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \pi^0)/\Gamma_{\text{total}}$	$<6.6 \times 10^{-4}$, CL = 90%
$\Gamma(\tau^- \rightarrow \bar{p} \eta)/\Gamma_{\text{total}}$	$<1.30 \times 10^{-3}$, CL = 90%
p mean life	$>1.6 \times 10^{25}$ years

A few examples of proton or bound neutron decay follow. For limits on many other nucleon decay channels, see the Baryon Summary Table.

$\tau(N \rightarrow e^+ \pi)$	$> 130 (n), > 550 (p) \times 10^{30}$ years, CL = 90%
$\tau(N \rightarrow \mu^+ \pi)$	$> 100 (n), > 270 (p) \times 10^{30}$ years, CL = 90%
$\tau(N \rightarrow e^+ K)$	$> 1.3 (n), > 150 (p) \times 10^{30}$ years, CL = 90%
$\tau(N \rightarrow \mu^+ K)$	$> 1.1 (n), > 120 (p) \times 10^{30}$ years, CL = 90%
limit on $n\bar{n}$ oscillations (bound n)	$[m] >1.2 \times 10^8$ s, CL = 90%
limit on $n\bar{n}$ oscillations (free n)	$>0.86 \times 10^8$ s, CL = 90%

ELECTRIC CHARGE (Q)

e mean life / branching fraction	$[n] >4.3 \times 10^{23}$ yr, CL = 68%
$\Gamma(n \rightarrow p \nu_e \bar{\nu}_e)/\Gamma_{\text{total}}$	$<8 \times 10^{-27}$, CL = 68%

$\Delta S = \Delta Q$ RULE

Allowed in second-order weak interactions.

$\Gamma(K^+ \rightarrow \pi^+ \pi^+ e^- \bar{\nu}_e)/\Gamma_{\text{total}}$	$< 1.2 \times 10^{-8}$, CL = 90%
$\Gamma(K^+ \rightarrow \pi^+ \pi^+ \mu^- \bar{\nu}_\mu)/\Gamma_{\text{total}}$	$< 3.0 \times 10^{-6}$, CL = 95%
$x = A(\bar{K}^0 \rightarrow \pi^- \ell^+ \nu)/A(K^0 \rightarrow \pi^- \ell^+ \nu) = A(\Delta S = -\Delta Q)/A(\Delta S = \Delta Q)$	
real part of x	0.006 ± 0.018 (S = 1.3)
imaginary part of x	−0.003 ± 0.026 (S = 1.2)
$\Gamma(\Sigma^+ \rightarrow n \ell^+ \nu)/\Gamma(\Sigma^- \rightarrow n \ell^- \bar{\nu})$	< 0.043
$\Gamma(\Sigma^+ \rightarrow n e^+ \nu_e)/\Gamma_{\text{total}}$	$< 5 \times 10^{-6}$, CL = 90%
$\Gamma(\Sigma^+ \rightarrow n \mu^+ \nu_\mu)/\Gamma_{\text{total}}$	$< 3.0 \times 10^{-5}$, CL = 90%
$\Gamma(\Xi^0 \rightarrow \Sigma^- e^+ \nu_e)/\Gamma_{\text{total}}$	$< 9 \times 10^{-4}$, CL = 90%
$\Gamma(\Xi^0 \rightarrow \Sigma^- \mu^+ \nu_\mu)/\Gamma_{\text{total}}$	$< 9 \times 10^{-4}$, CL = 90%

$\Delta S = 2$ FORBIDDEN

Allowed in second-order weak interactions.

$\Gamma(\Xi^0 \rightarrow p \pi^-)/\Gamma_{\text{total}}$	$< 4 \times 10^{-5}$, CL = 90%
$\Gamma(\Xi^0 \rightarrow p e^- \bar{\nu}_e)/\Gamma_{\text{total}}$	$< 1.3 \times 10^{-3}$
$\Gamma(\Xi^0 \rightarrow p \mu^- \bar{\nu}_\mu)/\Gamma_{\text{total}}$	$< 1.3 \times 10^{-3}$
$\Gamma(\Xi^- \rightarrow n \pi^-)/\Gamma_{\text{total}}$	$< 1.9 \times 10^{-5}$, CL = 90%
$\Gamma(\Xi^- \rightarrow n e^- \bar{\nu}_e)/\Gamma_{\text{total}}$	$< 3.2 \times 10^{-3}$, CL = 90%
$\Gamma(\Xi^- \rightarrow n \mu^- \bar{\nu}_\mu)/\Gamma_{\text{total}}$	$< 1.5 \times 10^{-2}$, CL = 90%
$\Gamma(\Xi^- \rightarrow p \pi^- \pi^-)/\Gamma_{\text{total}}$	$< 4 \times 10^{-4}$, CL = 90%
$\Gamma(\Xi^- \rightarrow p \pi^- e^- \bar{\nu}_e)/\Gamma_{\text{total}}$	$< 4 \times 10^{-4}$, CL = 90%
$\Gamma(\Xi^- \rightarrow p \pi^- \mu^- \bar{\nu}_\mu)/\Gamma_{\text{total}}$	$< 4 \times 10^{-4}$, CL = 90%
$\Gamma(\Omega^- \rightarrow \Lambda \pi^-)/\Gamma_{\text{total}}$	$< 1.9 \times 10^{-4}$, CL = 90%

$\Delta S = 2$ VIA MIXING

Allowed in second-order weak interactions, e.g. mixing.

$m_{K_L^0} - m_{K_S^0}$	$(0.5301 \pm 0.0014) \times 10^{10} \hbar \text{ s}^{-1}$
$m_{K_L^0} - m_{K_S^0}$	$(3.489 \pm 0.009) \times 10^{-12} \text{ MeV}$

$\Delta C = 2$ VIA MIXING

Allowed in second-order weak interactions, e.g. mixing.

$|m_{D_1^0} - m_{D_2^0}|$	[o] $< 24 \times 10^{10} \hbar \text{ s}^{-1}$, CL = 90%
$|\Gamma_{D_1^0} - \Gamma_{D_2^0}|/\Gamma_{D^0}$ mean life difference/average	[o] < 0.20 , CL = 90%
$\Gamma(K^+ \ell^- \bar{\nu}_\ell \text{ (via } \bar{D}^0))/\Gamma(K^- \ell^+ \nu_\ell)$	< 0.005 , CL = 90%
$\Gamma(K^+ \pi^- \text{ or } K^+ \pi^- \pi^+ \pi^- \text{ (via } \bar{D}^0))/\Gamma(K^- \pi^+ \text{ or } K^- \pi^+ \pi^+ \pi^-)$	[p] < 0.0085 (or < 0.0037), CL = 90%
$\Gamma(D^0 \rightarrow K^+ \ell^- \bar{\nu}_\ell \text{ (via } \bar{D}^0))/\Gamma_{\text{total}}$	$< 1.7 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow K^+ \pi^- \text{ or } K^+ \pi^- \pi^+ \pi^- \text{ (via } \bar{D}^0))/\Gamma_{\text{total}}$	$< 1.0 \times 10^{-3}$, CL = 90%

$\Delta B = 2$ VIA MIXING

Allowed in second-order weak interactions, e.g. mixing.

χ_d	0.172 ± 0.010
$\Delta m_{B^0} = m_{B_H^0} - m_{B_L^0}$	$(0.464 \pm 0.018) \times 10^{12} \hbar \text{ s}^{-1}$
$x_d = \Delta m_{B^0}/\Gamma_{B^0}$	0.723 ± 0.032
χ_B at high energy	0.118 ± 0.006
$\Delta m_{B_s^0} = m_{B_{sH}^0} - m_{B_{sL}^0}$	$> 9.1 \times 10^{12} \hbar \text{ s}^{-1}$, CL = 95%
$x_s = \Delta m_{B_s^0}/\Gamma_{B_s^0}$	> 14.0 , CL = 95%
χ_s	> 0.4975 , CL = 95%

$\Delta S = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(K^+ \rightarrow \pi^+ e^+ e^-)/\Gamma_{\text{total}}$	$(2.74 \pm 0.23) \times 10^{-7}$
$\Gamma(K^+ \rightarrow \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(5.0 \pm 1.0) \times 10^{-8}$
$\Gamma(K^+ \rightarrow \pi^+ \nu \bar{\nu})/\Gamma_{\text{total}}$	$(4.2_{-3.5}^{+9.7}) \times 10^{-10}$
$\Gamma(K_S^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$< 3.2 \times 10^{-7}$, CL = 90%
$\Gamma(K_S^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$< 1.4 \times 10^{-7}$, CL = 90%
$\Gamma(K_S^0 \rightarrow \pi^0 e^+ e^-)/\Gamma_{\text{total}}$	$< 1.1 \times 10^{-6}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$(7.2 \pm 0.5) \times 10^{-9}$ (S = 1.4)
$\Gamma(K_L^0 \rightarrow \mu^+ \mu^- \gamma)/\Gamma_{\text{total}}$	$(3.25 \pm 0.28) \times 10^{-7}$
$\Gamma(K_L^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$< 4.1 \times 10^{-11}$, CL = 90%
$\Gamma(K_L^0 \rightarrow e^+ e^- \gamma)/\Gamma_{\text{total}}$	$(9.1 \pm 0.5) \times 10^{-6}$

$\Gamma(K_L^0 \rightarrow e^+ e^- \gamma \gamma) / \Gamma_{\text{total}}$	[q] $(6.5 \pm 1.2) \times 10^{-7}$
$\Gamma(K_L^0 \rightarrow \pi^+ \pi^- e^+ e^-) / \Gamma_{\text{total}}$	[q] $< 4.6 \times 10^{-7}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \mu^+ \mu^- e^+ e^-) / \Gamma_{\text{total}}$	$(2.9^{+6.7}_{-2.4}) \times 10^{-9}$
$\Gamma(K_L^0 \rightarrow e^+ e^- e^+ e^-) / \Gamma_{\text{total}}$	$(4.1 \pm 0.8) \times 10^{-8}$ (S = 1.2)
$\Gamma(K_L^0 \rightarrow \pi^0 \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 5.1 \times 10^{-9}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 e^+ e^-) / \Gamma_{\text{total}}$	$< 4.3 \times 10^{-9}$, CL = 90%
$\Gamma(K_L^0 \rightarrow \pi^0 \nu \bar{\nu}) / \Gamma_{\text{total}}$	$< 5.8 \times 10^{-5}$, CL = 90%
$\Gamma(\Sigma^+ \rightarrow p e^+ e^-) / \Gamma_{\text{total}}$	$< 7 \times 10^{-6}$

$\Delta C = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(D^+ \rightarrow \pi^+ e^+ e^-) / \Gamma_{\text{total}}$	$< 6.6 \times 10^{-5}$, CL = 90%
$\Gamma(D^+ \rightarrow \pi^+ \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 1.8 \times 10^{-5}$, CL = 90%
$\Gamma(D^+ \rightarrow \rho^+ \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 5.6 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow e^+ e^-) / \Gamma_{\text{total}}$	$< 1.3 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 4.1 \times 10^{-6}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^0 e^+ e^-) / \Gamma_{\text{total}}$	$< 4.5 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^0 \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 1.8 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \eta e^+ e^-) / \Gamma_{\text{total}}$	$< 1.1 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \eta \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 5.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \rho^0 e^+ e^-) / \Gamma_{\text{total}}$	$< 1.0 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \rho^0 \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 2.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \omega e^+ e^-) / \Gamma_{\text{total}}$	$< 1.8 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \omega \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 8.3 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \phi e^+ e^-) / \Gamma_{\text{total}}$	$< 5.2 \times 10^{-5}$, CL = 90%
$\Gamma(D^0 \rightarrow \phi \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 4.1 \times 10^{-4}$, CL = 90%
$\Gamma(D^0 \rightarrow \pi^+ \pi^- \pi^0 \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 8.1 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^+ \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 5.9 \times 10^{-4}$, CL = 90%
$\Gamma(D_s^+ \rightarrow K^*(892)^+ \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 1.4 \times 10^{-3}$, CL = 90%
$\Gamma(\Lambda_c^+ \rightarrow p \mu^+ \mu^-) / \Gamma_{\text{total}}$	$< 3.4 \times 10^{-4}$, CL = 90%

$\Delta B = 1$ WEAK NEUTRAL CURRENT FORBIDDEN

Allowed by higher-order electroweak interactions.

$\Gamma(B^+ \rightarrow \pi^+ e^+ e^-)/\Gamma_{\text{total}}$	$<3.9 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow \pi^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<9.1 \times 10^{-3}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ e^+ e^-)/\Gamma_{\text{total}}$	$<6 \times 10^{-5}$, CL = 90%
$\Gamma(B^+ \rightarrow K^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<1.0 \times 10^{-5}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^+ e^+ e^-)/\Gamma_{\text{total}}$	$<6.9 \times 10^{-4}$, CL = 90%
$\Gamma(B^+ \rightarrow K^*(892)^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<1.2 \times 10^{-3}$, CL = 90%
$\Gamma(B^0 \rightarrow \gamma\gamma)/\Gamma_{\text{total}}$	$<3.9 \times 10^{-5}$, CL = 90%
$\Gamma(B^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$<5.9 \times 10^{-6}$, CL = 90%
$\Gamma(B^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<6.8 \times 10^{-7}$, CL = 90%
$\Gamma(B^0 \rightarrow K^0 e^+ e^-)/\Gamma_{\text{total}}$	$<3.0 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow K^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<3.6 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow K^*(892)^0 e^+ e^-)/\Gamma_{\text{total}}$	$<2.9 \times 10^{-4}$, CL = 90%
$\Gamma(B^0 \rightarrow K^*(892)^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<2.3 \times 10^{-5}$, CL = 90%
$\Gamma(B^0 \rightarrow K^*(892)^0 \nu\bar{\nu})/\Gamma_{\text{total}}$	$<1.0 \times 10^{-3}$, CL = 90%
$\Gamma(B \rightarrow e^+ e^- s)/\Gamma_{\text{total}}$	$<5.7 \times 10^{-5}$, CL = 90%
$\Gamma(B \rightarrow \mu^+ \mu^- s)/\Gamma_{\text{total}}$	$<5.8 \times 10^{-5}$, CL = 90%
$\Gamma(\bar{b} \rightarrow \mu^+ \mu^- \text{anything})/\Gamma_{\text{total}}$	$<3.2 \times 10^{-4}$, CL = 90%
$\Gamma(B_S^0 \rightarrow \mu^+ \mu^-)/\Gamma_{\text{total}}$	$<2.0 \times 10^{-6}$, CL = 90%
$\Gamma(B_S^0 \rightarrow e^+ e^-)/\Gamma_{\text{total}}$	$<5.4 \times 10^{-5}$, CL = 90%
$\Gamma(B_S^0 \rightarrow \phi \nu\bar{\nu})/\Gamma_{\text{total}}$	$<5.4 \times 10^{-3}$, CL = 90%

NOTES

- [a] C parity forbids this to occur as a single-photon process.
- [b] Time-reversal invariance requires this to be 0° or 180° .
- [c] Allowed by higher-order electroweak interactions.
- [d] Violates *CP* in leading order. Test of direct *CP* violation since the indirect *CP*-violating and *CP*-conserving contributions are expected to be suppressed.
- [e] ϵ'/ϵ is derived from $|\eta_{00}/\eta_{+-}|$ measurements using theoretical input on phases.
- [f] Neglecting photon channels. See, *e.g.*, A. Pais and S.B. Treiman, Phys. Rev. **D12**, 2744 (1975).
- [g] Derived from measured values of ϕ_{+-} , ϕ_{00} , $|\eta|$, $|m_{K_L^0} - m_{K_S^0}|$, and $\tau_{K_S^0}$, as described in the introduction to "Tests of Conservation Laws."
- [h] The value is for the sum of the charge states of particle/antiparticle states indicated.
- [i] A test of additive vs. multiplicative lepton family number conservation.
- [j] $\Delta(m^2) = 100 \text{ eV}^2$.
- [k] $190 \text{ eV}^2 < \Delta(m^2) < 320 \text{ eV}^2$.
- [l] Derived from an analysis of neutrino-oscillation experiments.
- [m] There is some controversy about whether nuclear physics and model dependence complicate the analysis for bound neutrons (from which the best limit comes). The second limit here is from reactor experiments with free neutrons.
- [n] This is the best "electron disappearance" limit. The best limit for the mode $e^- \rightarrow \nu \gamma$ is $> 2.35 \times 10^{25} \text{ yr}$ (CL=68%).
- [o] The D_1^0 - D_2^0 limits are inferred from the D^0 - \bar{D}^0 mixing ratio $\Gamma(K^+ \ell^- \bar{\nu}_\ell \text{ (via } \bar{D}^0)) / \Gamma(K^- \ell^+ \nu_\ell)$.
- [p] The larger limit (from E791) allows interference between the doubly Cabibbo-suppressed and mixing amplitudes; the smaller limit (from E691) doesn't. See the papers for details.
- [q] See the K_L^0 Particle Listings for the energy limits used in this measurement.

TABLE OF THE ISOTOPES

Norman E. Holden

This table presents an evaluated set of values for the experimental quantities which characterize the decay of radioactive nuclides. A list of the major references used in this evaluation is given below. When uncertainties are not listed, they are assumed to be five or less in the last digit quoted. If they exceed five in the last digit, the value is prefaced by an approximate sign. The effective literature cutoff date for data in this edition of the Table is December, 2000.

Table Layout

Column No.	Column Title	Description
1	Isotope or Element	For elements, the atomic number and chemical symbol are listed. For nuclides, the mass number and chemical symbol are listed. Isomers are indicated by the addition of m, m1, or m2.
2	Isotopic Abundance	in atom percent.
3	Atomic Mass or Atomic Weight	Atomic mass relative to $^{12}\text{C} = 12$. Atomic weight is given on the same scale.
4	Half-life	Half-life in decimal notation. μs = microseconds; ms = milliseconds; s = seconds; m = minutes; h = hours; d = days; and y = years.
5	Decay Mode/Energy	Decay modes are α = alpha particle emission; β^- = negative beta emission; β^+ = positron emission; EC = orbital electron capture; IT = isomeric transition from upper to lower isomeric state; n = neutron emission; SF = spontaneous fission. Total disintegration energy in MeV units.
6	Particle Energy/Intensity	End point energies of beta transitions and discrete energies of alpha particles in MeV and their intensities in percent.
7	Spin and Parity	Nuclear spin or angular momentum of the nuclides in units of $h/2\pi$; parity is positive or negative.
8	Magnetic Dipole Moment	Magnetic dipole moments in nuclear magneton units.
9	Electric Quadrupole Moment	Electric quadrupole moments in barn units (10^{-24} cm^2).
10	Gamma Ray Energy/Intensity	Gamma ray energies in MeV and intensities in percent. Ann. rad. refers to the 511.006 keV photons emitted in the annihilation of positrons in matter.

General Nuclear Data References

The following references represent the major sources of the nuclear data presented, along with subsequent published journals and reports:

1. G. Audi, O. Bersillon, J. Blachot, A.H. Wapstra, *The Nubase Evaluation of Nuclear and Decay Properties*, Nuclear Physics **A624**, 1 (1997).
2. International Commission on Atomic Weights, *Atomic Weights of the Elements - 1999*, Pure & Applied Chemistry **73**, to be published (2000).
3. J.R. Parrington, H.D. Knox, S. Breneman, E.M. Baum, F. Feiner, *Chart of the Nuclides, 15th Edition*, Knolls Atomic Power Lab. (1996).
4. N.E. Holden, *Total and Spontaneous Fission Half-lives for Uranium, Plutonium, Americium and Curium Nuclides*, Pure & Applied Chemistry **61**, 1483 (1989).
5. N.E. Holden, *Half-lives of Selected Nuclides*, Pure & Applied Chemistry **62**, 941 (1990).
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7. P. Raghavan, *Table of Nuclear Moments*, Atomic Data Nuclear Data Tables **42**, 189 (1989).
8. E. Brown, R. Firestone, *Radioactivity Handbook*, Wiley Interscience Press (1986).
9. J.K. Tuli, *Nuclear Wallet Cards*, Brookhaven National Laboratory (Jan. 2000).
10. N.E. Holden, D.C. Hoffman, *Spontaneous Fission Half-lives for Ground State Nuclides*, Pure & Applied Chemistry **72**, 1525 (2000).
11. N. Stone, Table of New Nuclear Moments, private communication, www.nndc.bnl.gov/nndc/stone_moments/moments.html (Dec. 2000).

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TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
${}_0^1\text{n}$		1.008664924	614. s	$\beta^-/0.78235$	0.782/100.	1/2+	-1.913043		
${}_1^1\text{H}$		1.00794(7)							
${}_1^1\text{H}$	99.985(1)	1.007825032				1/2+	+2.79285		
${}_1^2\text{H}$	0.015(1)	2.014101778				1+	+0.85744	+2.86 mb	
${}_1^3\text{H}$		3.016049268	12.33 y	$\beta^-/0.01859$	0.01860/100.	1/2+	+2.97896		
${}_1^4\text{H}$		4.0278	1.9×10^{-22} s	n/	/100	2-			
${}_1^5\text{H}$		5.040	$8. \times 10^{-23}$ s	n/	/100				
${}_1^6\text{H}$		6.0449	$3. \times 10^{-22}$ s						
${}_2^2\text{He}$		4.002602(2)							
${}_2^3\text{He}$	1.37×10^{-4}	3.016029309				1/2+	-2.12762		
${}_2^4\text{He}$	$\approx 100.$	4.002603250				0+			
${}_2^5\text{He}$		5.01222	7.6×10^{-22} s	n, α		3/2-			
${}_2^6\text{He}$		6.018888	0.807 s	$\beta^-/3.508, d$	3.510/100.	0+			
${}_2^7\text{He}$		7.02803	$3. \times 10^{-21}$ s	n		(3/2)-			
${}_2^8\text{He}$		8.03392	0.119 s	$\beta^-/10.65, t$	13/88.	0+			0.9807/84. 0.4776/5.
${}_2^9\text{He}$		9.0438	$7. \times 10^{-21}$ s	n	/100	(1/2-)			
${}_2^{10}\text{He}$		10.0524	$3. \times 10^{-21}$ s	2n	/100	0+			
${}_3^3\text{Li}$		6.941(2)							
${}_3^4\text{Li}$		4.0272	$9. \times 10^{-23}$ s	p/	/100	2-			
${}_3^5\text{Li}$		5.01254	$\approx 3. \times 10^{-22}$ s	p/		3/2-			
${}_3^6\text{Li}$	7.5(2)	6.0151223				1+	+0.82205	-0.8 mb	
${}_3^7\text{Li}$	92.5(2)	7.0160041				3/2-	+3.25644	-0.041	
${}_3^8\text{Li}$		8.022486	0.84 s	$\beta^-/16.004$	12.5/100.	2+	+1.6536	+0.032	
${}_3^9\text{Li}$		9.026789	0.178 s	$\beta^-/13.606$	13.5/75.	3/2-	3.439	-0.027	
${}_3^{10}\text{Li}$		10.03590	$4. \times 10^{-22}$ s	$\beta^-/20.84$					
${}_3^{11}\text{Li}$		11.04380	8.4 ms	$\beta^-/20.6$		3/2(-)	3.668	-0.031	3.367/35. (0.22-2.81)
${}_3^{12}\text{Li}$		12.054	<0.01 μ s	n,2n,3n, α	n//106.				
${}_4^6\text{Be}$		9.012182(3)							
${}_4^5\text{Be}$		5.041							
${}_4^6\text{Be}$		6.01973	5.0×10^{-21} s	2p, α		0+			
${}_4^7\text{Be}$		7.0169293	53.28 d	EC/0.8618		3/2-			0.4776/10.4
${}_4^8\text{Be}$		8.00530509	$\approx 7. \times 10^{-17}$ s	$2\alpha/0.046$		0+			
${}_4^9\text{Be}$	100.	9.0121822				3/2-	-1.1776	+0.0529	
${}_4^{10}\text{Be}$		10.0135338	1.52×10^6 y	$\beta^-/0.5559$	0.555/100.	0+			
${}_4^{11}\text{Be}$		11.02166	13.8 s	$\beta^-, \beta^- \alpha/11.51$	11.48/61.	1/2+			2.125/35.5 (0.478-7.97)
${}_4^{12}\text{Be}$		12.02692	24. ms	$\beta^-, (n)/11.71$	n//0.5	0+			(0.95 - 4.4)
${}_4^{13}\text{Be}$		13.0361	$\approx 3. \times 10^{-21}$ s						
${}_4^{14}\text{Be}$		14.0428	4.3 ms	$\beta^-, (n)/16.2$	n//100.	0+			
${}_5^6\text{B}$		10.811(7)							
${}_5^7\text{B}$		7.0299	$4. \times 10^{-22}$ s	p					
${}_5^8\text{B}$		8.024607	0.770 s	$\beta^+, 2\alpha/17.979$	13.7(β^+)/93.	2+	1.0355	0.068	ann.rad.
${}_5^9\text{B}$		9.013329	8×10^{-19} s	$p2\alpha/$		3/2-			
${}_5^{10}\text{B}$	19.9(2)	10.0129371				3+	+1.8006	+0.085	
${}_5^{11}\text{B}$	80.1(2)	11.0093055				3/2-	+2.6886	+0.0406	
${}_5^{12}\text{B}$		12.014352	0.0202 s	$\beta^-/13.369$		1+	+1.0027	0.0132	4.438/1.3 3.215/0.00065
${}_5^{13}\text{B}$		13.017780	0.0174 s	$\beta^- \alpha/1.6/$	13.4	3/2-	+3.17778	0.037	3.68/7.6
				$\beta^- n/0.25/$	2.43(n)/0.09				
					3.55(n)/0.16				

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴ B		14.02540	14. ms	β^- /20.64			1.185	0.0298	6.094/90.
¹⁵ B		15.03110	10.4 ms	β^- , (n)/19.09		(3/2-)	2.66	0.038	
¹⁶ B		16.0398	<1.9x10 ⁻¹⁰ s						
¹⁷ B		17.0469	5.1 ms	β^- , (n)/22.7			2.54		
¹⁸ B		18.056	<0.026 μ s						
¹⁹ B		19.0637	3.3 ms	β^- , (n)/26.5	n//125.				
₆ C		12.0107(8)							
⁸ C		8.03768	2.0x10 ⁻²¹ s	p		0+			
⁹ C		9.031040	127. ms	β^+ , p, 2 α /16.498		(3/2-)	-1.391		ann.rad.
¹⁰ C		10.0168532	19.3 s	β^+ /3.648	1.865	0+			ann.rad. 0.71829/100.
¹¹ C		11.011433	20.3 m	β^+ , EC/1.982	0.9608/99.	3/2-	-0.964	0.0333	ann.rad.
¹² C	98.93(8)	12.00000000 0				0+			
¹³ C	1.07(8)	13.00335483 8				1/2-	+0.70241		
¹⁴ C		14.00324199 1	5715. y	β^- /0.15648	0.1565/100.	0+			
¹⁵ C		15.010599	2.45 s	β^- /9.772	4.51/68. 9.82/32.	1/2+	1.32		5.298/68. (7.30-9.05)
¹⁶ C		16.014701	0.75 s	β^- , n/8.012		0+			
¹⁷ C		17.02258	0.19 s	β^- , n/13.17					1.375 1.849 1.906
¹⁸ C		18.02676	0.09 s	β^- , n/11.81		0+			
¹⁹ C		19.0353	0.05 s	n					
²⁰ C		20.0403	0.01 s			0+			
²¹ C		21.0493	<0.03 μ s						
²² C		22.056	9 ms	β^- , n	n//99.	0+			
₇ N		14.0067(2)							
¹⁰ N		10.0426							
¹¹ N		11.0268	5.x10 ⁻²² s						
¹² N		12.018613	11.00 ms	β^+ , β^+ α /17.338	16.38/95.	1+	+0.457	+10. mb	ann.rad. 4.438/2.
¹³ N		13.0057386	9.97 m	β^+ /2.2204	1.190/100.	1/2-	0.3222		
¹⁴ N	99.632(7)	14.00307400 7				1+	+0.40376	+0.0200	
¹⁵ N	0.368(7)	15.00010897				1/2-	-0.28319		
¹⁶ N		16.006100	7.13 s	β^- /10.419	4.27/68. 10.44/26.	2-			6.129/68.8 7.115/4.7 (0.99-8.87)
¹⁷ N		17.00845	4.17 s	β^- , α β^- , β^- , n/8.68 0.4-1.7n/95.	1.85/0012 3.7/100.	1/2-	0.352		0.871/3. 2.1842/0.3
¹⁸ N		18.01408	0.62 s	β^- α β^- /13.90	8.0, 8.2 9.4/100.	1-	0.328	0.012	0.822/61. 1.65/60.5 1.982/98. (0.535-7.13)
¹⁹ N		19.01703	0.32 s	β^- /12.53					(0.096-3.14)
²⁰ N		20.02337	0.14 s	β^- /17.97					
²¹ N		21.0271	0.08 s						
²² N		22.0344	0.02 s						
²³ N		23.0405	15 ms	β^- , n	n//80.				
²⁴ N		24.050	<0.052 μ s						
₈ O		15.9994(3)							
¹² O		12.03440	\approx 1.x10 ⁻²¹ s	2p					
¹³ O		13.02481	8.9 ms	β^+ , p/17.77	1.56 (p/)	(3/2-)	1.389	0.026	ann.rad.

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴ O		14.0085953	70.60 s	β ⁺ /5.1430	1.81/99.	0+			4.438/0.56 ann.rad. 2.312/99.4
¹⁵ O		15.0030655	122.2 s	β ⁺ /2.754	1.723/100.	1/2-	0.7195		ann.rad.
¹⁶ O	99.757(16)	15.99491462 2				0+			
¹⁷ O	0.038(1)	16.9991315				5/2+	-1.8938	-0.026	
¹⁸ O	0.205(14)	17.999160				0+			
¹⁹ O		19.003579	26.9 s	β ⁻ /4.820	3.25/60. 4.60/40.	5/2+	1.5320	3.7 mb	0.197/95.9 1.3569/50.4 (0.11-4.18)
²⁰ O		20.004076	13.5 s	β ⁻ /3.814		0+			1.057/100.
²¹ O		21.00866	3.4 s	β ⁻ /8.11					(0.28-4.6)
²² O		22.00997	2.2 s	β ⁻ /6.5					(0.64-1.86)
²³ O		23.0157	0.08 s						
²⁴ O		24.0204	≈65 ms	β ⁻ ,n	n//18.				1.83/28 0.52/14. 1.31/12.
²⁵ O		25.029	<0.05 μs						
²⁶ O		26.038	<0.04 μs						
⁹ F		18.9984032(5)							
¹⁴ F		14.036							
¹⁵ F		15.0180	5.x10 ⁻²² s	p		(1/2+)			
¹⁶ F		16.01147	≈1.x10 ⁻²⁰ s	p		0-			
¹⁷ F		17.0020952	64.5 s	β ⁺ /2.761	1.75/	5/2+	+4.721	0.058	ann.rad.
¹⁸ F		18.000938	1.830 h	β ⁺ ,EC/1.656	0.635/97.	1+			ann.rad.
¹⁹ F	100.	18.9984032				1/2+	+2.62887	0.072	
²⁰ F		19.9999813	11.00 s	β ⁻ /7.0245	5.398/100.	2+	+2.0934	0.042	1.634/100. 3.33/0.009
²¹ F		20.999949	4.16 s	β ⁻ /5.684	3.7/8. 5.0/63. 5.4/29.	5/2+	3.9		0.3507/90. 1.395/15. (1.746-4.684)
²² F		22.00300	4.23 s	β ⁻ /10.82	3.48/15. 4.67/7. 5.50/62.	4+			1.2746/100. 2.0826/82. (0.82-4.37)
²³ F		23.00357	2.2 s	β ⁻ /8.5		5/2+			1.701/48. 2.129/34. (0.493-3.83)
²⁴ F		24.0081	0.3 s	β ⁻ /13.5					1.9816/ 1.70/39. (0.57-2.19)
²⁵ F		25.0121	≈50 ms	β ⁻ ,(n)	n//14.				
²⁶ F		26.0196	10 ms	β ⁻ ,(n)	n//11.				2.02/67. 1.67/19.
²⁷ F		27.0269	5. ms	β ⁻ ,(n)	n//90.				
²⁹ F		29.043	3. ms	β ⁻ ,(n)	n//100.				
³¹ F									
¹⁰ Ne		20.1797(6)							
¹⁶ Ne		16.02575	4.x10 ⁻²¹ s	2p		0+			
¹⁷ Ne		17.01770	109. ms	β ⁺ .p/14.53	1.4-10.6/	1/2-			ann.rad./ 0.495
¹⁸ Ne		18.005697	1.67 s	β ⁺ /4.446	3.416/92.	0+			ann.rad./ 1.0413/7.8 (0.658-1.70)
¹⁹ Ne		19.001880	17.22 s	β ⁺ /3.238	2.24/99.	1/2+	-1.885		ann.rad./ (0.11-1.55)
²⁰ Ne	90.48(3)	19.99244017 6				0+			
²¹ Ne	0.27(1)	20.99384674				3/2+	-0.66180	+0.103	

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²² Ne	9.25(3)	21.9913855				0+		-0.19	
²³ Ne		22.9944673	37.2 s	β^- /4.376	3.95/32. 4.39/67.	5/2+	-1.08		0.440/33. (1.64-2.98)
²⁴ Ne		23.99362	3.38 m	β^- /2.47	1.10/8. 1.98/92.	0+			0.4723/100. 0.874/7.9
²⁵ Ne		24.99779	0.61 s	β^- /7.30	6.3/ 7.3/	1/2+			0.0895/96. (0.98-3.69)
²⁶ Ne		26.00046	197 ms	β^- /7.3		0+			0.233/
²⁷ Ne		27.0076	32 ms	β^- , n/12.7		(3/2+)			
²⁸ Ne		28.0121	18. ms	β^- , n/12.3	n//11.	0+			2.06/19. 0.86/3.
²⁹ Ne		29.0194	15. ms	β^- , (n)/15.4	n//27.	(3/2+)			2.92/54. (0.22-1.18)
³⁰ Ne		30.024	7. ms	β^- , (n)	n//9.	0+			
³¹ Ne		31.033	>0.26 μ s						
³² Ne		32.040	>0.20 μ s			0+			
¹¹ Na		22.989770(2)							
¹⁸ Na		18.0272							
¹⁹ Na		19.01388	0.03 s	β^+ , p/11.18					
²⁰ Na		20.00735	0.446 s	β^+ /13.89		2+	+0.3694		ann.rad./ 1.634/79.
²¹ Na		20.997655	22.48 s	α β^+ /3.547	2.15/ 2.50/95.	3/2+	+2.3863	+0.05	ann.rad./ 0.351/5.
²² Na		21.9944366	2.605 y	β^+ /90/2.842 EC/10/	0.545/90.	3+	+1.746		ann.rad./ 1.2745/99.9
²³ Na	100.	22.9897697				3/2+	+2.21752	+0.104	
^{24m} Na			20.2 ms	I.T., β^-		1+			0.4723/100.
²⁴ Na		23.9909633	14.96 h	β^- /5.5158	1.389/>99.	4+	+1.690		1.3686/100. 2.754/100. (0.997-4.238)
²⁵ Na		24.989954	59.3 s	β^- /3.835	2.6/7. 3.15/25. 4.0/65.	5/2+	+3.683	-0.10	0.3897/12.7 0.5850/13. 0.9747/14.9 (0.836-2.80)
²⁶ Na		25.99259	1.07 s	β^- /9.31		3+	+2.851	-0.08	1.809/98.9
²⁷ Na		26.99401	0.290 s	β^- /9.01	7.95/ β^- , n/	5/2+	+3.90	0.24	0.9847/87.4 1.698/11.9
²⁸ Na		27.9989	31. ms	β^- /14.0	12.3/ β^- , n/	1+	+2.43	-0.02	1.473/37. 2.389/18.6
²⁹ Na		29.0028	44. ms	β^- , n/13.3	11.5/	3/2+	+2.45	-1.3	2.560/36. (1.04-3.99)
³⁰ Na		30.0092	50. ms	β^- /17.5		2	+2.08		1.483/46.
³¹ Na		31.0136	17.2 ms	/15.9 β^- , n		(3/2-)	+2.31		1.483/14. (0.05-3.54)
³² Na		32.0197	13.5 ms	β^- /19.1					0.886/60.
³³ Na		33.027	8.1 ms	β^- /20.					0.886/16.
³⁴ Na		34.035	5. ms	β^- /24.					0.886/60.
³⁵ Na		35.044	1.5 ms	β^- /24					
¹² Mg		24.3050(6)							
²⁰ Mg		20.01886	96. ms	β^+ , p/10.73		0+			
²¹ Mg		21.01171	122. ms	β^+ , p/13.10		5/2+			0.332/51.
²² Mg		21.999574	3.86 s	β^+ /4.786	3.05/	0+			0.0729/60. 0.5820/100. (1.28-1.93)
²³ Mg		22.994125	11.32 s	β^+ /4.057	3.09/92.	3/2+	0.536	1.25	0.440/8.2
²⁴ Mg	78.99(4)	23.9850419				0+			
²⁵ Mg	10.00(1)	24.9858370				5/2+	-0.85545	+0.199	
²⁶ Mg	11.01(3)	25.9825930				0+			
²⁷ Mg		26.9843407	9.45 m	β^- /2.6103	1.59/41.	1/2+			0.17068/0.9

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					1.75/58.				0.84376/72.
					2.65/0.3				1.01443/28.
²⁸ Mg		27.983877	20.9 h	β^- /1.832	0.459/95.	0+			0.0306/95.
									0.4006/36.
									0.9418/36.
									1.342/54.
²⁹ Mg		28.98855	1.3 s	β^- /7.55	5.4/	3/2+			0.960/15.
									1.398/16.
									2.224/36.
³⁰ Mg		29.9905	0.32 s	β^- /7.0		0+			0.224/85.
³¹ Mg		30.9966	0.24 s	β^- /11.7		(3/2+)			1.61/26.
³² Mg		31.9992	0.12 s	β^- /10.3		0+			2.765/25.
³³ Mg		33.0056	0.09 s	β^- /13.7					1.848/
³⁴ Mg		34.0091	0.02 s	β^- /11.3		0+			
³⁵ Mg		35.0175	0.07 s			(7/2-)			
³⁶ Mg		36.022	>0.2 μ s			0+			
³⁷ Mg		37.031	>0.26 μ s			(7/2-)			
³⁸ Mg						0+			
¹³ Al		26.981538(2)							
²¹ Al		21.028	<0.035 μ s						
²² Al		22.0195	59. ms	β^+ /18.6		4+			ann.rad./
				$\beta^+, p, 2p, \alpha$					
^{23m} Al			\approx 0.35 s	$\beta^+, p/0.17$					0.554
									0.839
²³ Al		23.00727	0.47 s	β^+ /12.24					ann.rad./
				$\beta^+, p/$					
^{24m} Al			0.129 s	I.T./0.4259					
				β^+	13.3	1+			1.3686/5.3
²⁴ Al		23.999941	2.07 s	β^+ /13.878,p	3.40/48.	4+			1.078(2)/16.
					4.42/41.				1.368(2)/96.
					6.80/3.				2.753(2)/43.
					8.74/8.				4.315(3)/15.
									5.392(3)/20.
									7.0662(2)/41.
²⁵ Al		24.990429	7.17 s	β^+ /4.277	3.27/	5/2+	3.646		ann.rad./
									1.6115(2)/100.
									0.975(2)/5.
^{26m} Al			6.345 s	β^+ /	3.2/	0+			ann.rad./
²⁶ Al		25.9868917	7.1x10 ⁵ y	β^+ /82/4.0042	1.16/	5+	+2.804	+0.17	ann.rad./
				EC/18/					1.8087/99.8
²⁷ Al	100.	26.9815384				5/2+	+3.64151	+0.140	
²⁸ Al		27.9819102	2.25 m	β^- /4.6422	2.865/100.	3+	3.24	0.18	1.7778(6)/100.
²⁹ Al		28.980445	6.5 m	β^- /3.680	1.4/30.	5/2+			1.2732(8)/89.
					2.5/70.				2.0282(8)/4.
									2.4262(8)/7.
³⁰ Al		29.98296	3.68 s	β^- /8.56	5.05/	3+			1.26313(3)/35.
									2.23525(5)/65.
³¹ Al		30.98395	0.64 s	β^- /8.00	6.25/				0.75223(3)/18.
									1.69473(3)/59.
									2.31664(4)/73.
³² Al		31.9881	33. ms	β^- /13.0		1+			
³³ Al		32.9909	41. ms						
³⁴ Al		33.9969	\approx 42. ms	β^- /17.1					
³⁵ Al		34.9999	30 ms						
³⁶ Al		36.0064	0.09 s						
³⁷ Al		37.010	>1 μ s						
³⁸ Al		38.0169	>0.2 μ s						
³⁹ Al		39.022	>0.2 μ s						
⁴⁰ Al									

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁴¹ Al									
¹⁴ Si		28.0855(3)							
²² Si		22.0345	29. ms	β^+ ,p	1.99/20	0+			
²³ Si		23.0255	40.7 ms	β^+ ,p/5.9	1.32,2.40,2.83				
²⁴ Si		24.01155	0.14 s	β^+ ,p/10.81	1.51,4.09,1.73	0+			ann.rad./
					1.13-4.38				
²⁵ Si		25.00411	221 ms	β^+ ,p/12.74		5/2+			ann.rad./
²⁶ Si		25.992330	2.23 s	β^+ /5.066	3.282/	0+			ann.rad./
									0.8294(8)/22.
²⁷ Si		26.9867048	4.14 s	β^+ /4.8118	3.85/100.	5/2+	-0.8554		ann.rad./
									2.211(5)/0.2
²⁸ Si	92.22(2)	27.97692653				0+			
²⁹ Si	4.69(1)	28.97649472				1/2+	-0.5553		
³⁰ Si	3.09(1)	29.97377022				0+			
³¹ Si		30.9753633	2.62 h	β^- /1.4920	1.471/99.9	3/2+			1.2662(5)/0.05
³² Si		31.974148	1.6x10 ² y	β^- /0.224	0.213/100.	0+			
³³ Si		32.97800	6.1 s	β^- /5.85	3.92	(3/2+)	1.21		1.4313(5)/13.
									1.8477/100.
									2.538(2)/10.
³⁴ Si		33.97858	2.8 s	β^- /4.60	3.09/	0+			0.42907(5)/60.
									1.17852(2)/64.
									1.60756(5)/36.
³⁵ Si		34.98458	0.9 s	β^- /10.50					
³⁶ Si		35.9867	0.5 s	β^- /7.9		0+			
³⁷ Si		36.9930	≈0.09 s						
³⁸ Si		37.9960	>1 μs			0+			
³⁹ Si		39.0023	>1 μs						
⁴⁰ Si		40.0058	>0.2 μs			0+			
⁴¹ Si		41.013	>0.2 μs						
⁴² Si		42.016	>0.2 μs			0+			
¹⁵ P		30.973761(2)							
²⁴ P		24.0344							
²⁵ P		25.0203	<0.03 μs						
²⁶ P		26.0118	≈20. ms	β^+ ,p/18.1		3+			
²⁷ P		26.99919	0.3 s	β^+ ,p/11.63		1/2+			
²⁸ P		27.992312	270. ms	β^+ /14.332	3.94/13.	3+			ann.rad./
					5.25/13.				1.779(2)/98.
					6.96/16.				2.839(2)/2.8
					8.8/7.				3.040(2)/3.2
					11.49/52.				4.498(2)/12.
									7.537(2)/9.
²⁹ P		28.981801	4.14 s	β^+ /4.9431	3.945/98.	1/2+	1.2349		ann.rad./
									1.273/1.32
									2.426/0.39
³⁰ P		29.9783138	2.50 m	β^+ /4.2323	3.245/99.9	1+			ann.rad./
									2.230(3)/0.07
³¹ P	100.	30.9737615				1/2+	+1.13160		
³² P		31.9739071	14.28 d	β^- /1.7106	1.710/100.	1+	-0.2524		
³³ P		32.971725	25.3 d	β^- /0.249	0.249/100.	1/2+			
³⁴ P		33.973636	12.4 s	β^- /5.374	3.2/15.	1+			1.78-4.1/
					5.1/85.				2.127(5)/15.
³⁵ P		34.973314	47. s	β^- /3.989	2.34/100.	1/2+			1.572(1)/100.
³⁶ P		35.97826	5.7 s	β^- /10.41					0.902/77.
									3.291/100.
³⁷ P		36.97961	2.3 s	β^- /7.90					0.6462/
									1.5829/
³⁸ P		37.9845	0.6 s	β^- /12.4					1.2923/
									2.224/
³⁹ P		38.9864	≈0.16 s						

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁴⁰ P		39.9911	≈0.26 s						
⁴¹ P		40.9948	0.12 s						
⁴² P		42.0001	0.11 s						
⁴³ P		43.0033	33. ms	β ⁻ ,(n)/					
⁴⁴ P		44.010	>0.2 μs						
⁴⁵ P		45.015	>0.2 μs						
⁴⁶ P		46.024	>0.2 μs						
¹⁶ S		32.065(5)							
²⁶ S		26.0278	≈ 10 ms			0 ⁺			
²⁷ S		27.0188	21. ms	β ⁺ , 2p/18.3					
²⁸ S			0.13 s			0 ⁺			
²⁹ S		28.99661	0.188 s	β ⁺ /13.79		5/2 ⁺			ann.rad./
				β ⁺ , p/					
³⁰ S		29.984903	1.18 s	β ⁺ /6.138	4.42/78.	0 ⁺			ann.rad./
					5.08/20.				0.678/79.
³¹ S		30.979555	2.56 s	β ⁺ /5.396	4.39/99.	1/2 ⁺	0.48793		ann.rad./
									1.2662(5)/1.2
³² S	94.93(31)	31.9720707				0 ⁺			
³³ S	0.76(2)	32.9714585				3/2 ⁺	+0.64382	-0.68	
³⁴ S	4.29(28)	33.9678668				0 ⁺			
³⁵ S		34.9690321	87.2 d	β ⁻ /0.1672	0.1674/100.	3/2 ⁺	+1.00	+0.047	
³⁶ S	0.02(1)	35.9670809				0 ⁺			
³⁷ S		36.9711257	5.05 m	β ⁻ /4.8653	1.64/94.	7/2 ⁻			0.9083(4)/0.06
					4.75/5.6				3.1033(2)/94.2
³⁸ S		37.97116	2.84 h	β ⁻ /2.94	1.00/	0 ⁺			0.1962(4)/0.2
									1.9421(3)/84.
³⁹ S		38.97514	11.5 s	β ⁻ /6.64					1.301/52.
									1.697/44.
⁴⁰ S		39.9755	9. s	β ⁻ /4.7		0 ⁺			
⁴¹ S		40.9800	≈2.6 s						
⁴² S		41.9815	≈0.56 s	β _n ,(n)/		0 ⁺			
⁴³ S		42.987	0.22 s						
⁴⁴ S		43.9883	0.12 s	β ⁻ , n/9.		0 ⁺			
⁴⁵ S		44.9948	0.08 s	β ⁻ , n/					
⁴⁶ S		45.9996	>0.2 μs			0 ⁺			
⁴⁷ S		47.008	>0.2 μs						
⁴⁸ S		48.013	>0.2 μs			0 ⁺			
⁴⁹ S		49.022	<0.2 μs						
¹⁷ Cl		35.453(2)							
²⁸ Cl		28.0285							
²⁹ Cl		29.0141	<0.02 μs						
³⁰ Cl		30.0048	<0.03 μs						
³¹ Cl		30.99242	0.15 s	β ⁺ , p/11.98	1.52	3/2 ⁺			ann.rad./
³² Cl		31.98569	297. ms	β ⁺ /12.69	4.75/25.	1 ⁺	1.11		ann.rad./
					6.18/10.				1.548(2)/3.5
					7.48/14.				2.2305(1)/92.
					9.47/50.				2.4638(1)/4.
					11.6/1.				2.885(1)/1.
									4.770(1)/20.
³³ Cl		32.977452	2.511 s	β ⁺ /5.583	4.51/98.	3/2 ⁺	+0.752		ann.rad./
									0.8409/0.52
									1.966/0.45
									2.866/0.44
^{34m} Cl			32.2 m	β ⁺ /	1.35/24.	3 ⁺			ann.rad./
					2.47/28.				
				I.T./					0.1457(8)/42.
									2.1276(5)/42.
³⁴ Cl		33.9737620	1.528 s	β ⁺ /5.4922	4.50/100.	0 ⁺			ann.rad./
³⁵ Cl	75.78(4)	34.96885271				3/2 ⁺	+0.82187	-0.0825	

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
³⁶ Cl		35.9683069	3.01x10 ⁵ y	β ⁻ /0.7086	0.7093/98.	0+	+1.28547	-0.018	
				β ⁺ , EC/1.1421	0.115/0.002				ann.rad./
³⁷ Cl	24.22(4)	36.96590260				3/2+	+0.68412	-0.0649	
^{38m} Cl			0.715 s	I.T./		5-			0.6714/100
³⁸ Cl		37.9680106	37.2 m	β ⁻ /4.9168	1.11/31.	2-	2.05		1.64216(1)/31.
					2.77/11.				2.16760(2)/42.
					4.91/58.				
³⁹ Cl		38.968008	55.6 m	β ⁻ /3.442	1.91/85.	3/2+			0.25026(1)/47.
					2.18/8.				1.26720(5)/54.
					3.45/7.				0.986-1.517
⁴⁰ Cl		39.97042	1.38 m	β ⁻ /7.48		2-			0.6431(3)/6.
									1.4608(1)/77.
									2.8402(2)/17.
									(0.167-1.359)
⁴¹ Cl		40.9707	34. s	β ⁻ /5.7	3.8/				
⁴² Cl		41.9732	6.8 s	β ⁻ /9.4					
⁴³ Cl		42.9742	3.3 s	β ⁻ /8.0					
⁴⁴ Cl		43.9785	≈0.43 s	β ⁻ , n/12.3					
⁴⁵ Cl		44.980	0.40 s	β ⁻ , n/11.					
⁴⁶ Cl		45.984	0.22 s	β ⁻ , n/14.9					
⁴⁷ Cl		46.988	>0.2 μs	β ⁻ , n/15.					
⁴⁸ Cl		47.995	>0.2 μs						
⁴⁹ Cl		48.9999	>0.17 s						
⁵⁰ Cl		50.008							
⁵¹ Cl		51.014	>0.2 μs						
¹⁸ Ar		39.948(1)							
³⁰ Ar		30.0216	<0.02 μs			0+			
³¹ Ar		31.0121	≈14.1 ms	β ⁺ /18.4	p/2.08/100.	5/2			
				β ⁺ , 2p/<10 ⁻⁴	p/1.42/37				
				β ⁺ , 3p/<10 ⁻³	p/0.45-11.67				
³² Ar		31.99766	98. ms	β ⁺ , p/11.2		0+			ann.rad./
³³ Ar		32.98993	174. ms	β ⁺ /11.62	3.12/	1/2+	-0.72		ann.rad./
				β ⁺ , p/					0.810(2)/48.
³⁴ Ar		33.980270	0.844 s	β ⁺ /6.061	5.0/95.	0+			ann.rad./
									0.6658(1)/2.5
									3.1290(1)/1.3
³⁵ Ar		34.975257	1.77 s	β ⁺ /5.965	4.94/93.	3/2+	+0.633	-0.08	ann.rad./
									1.2185(5)/1.22
									1.763(1)/0.25
									2.964(1)/0.2
³⁶ Ar	0.3365(30)	35.9675463				0+			
³⁷ Ar		36.9667759	35.0 d	EC/813		3/2+	+1.15	+0.076	
³⁸ Ar	0.0632(5)	37.9627322				0+			
³⁹ Ar		38.964313	268. y	β ⁻ /0.565	0.565/100.	7/2-	-1.59	-0.12	
⁴⁰ Ar	99.6003(30)	39.96238312 3				0+			
⁴¹ Ar		40.964501	1.82 h	β ⁻ /2.492	1.198/	7/2-			1.29364(5)/99.
									1.6770(3)/0.05
⁴² Ar		41.96305	33. y	β ⁻ /0.60	0.60/100.	0+			
⁴³ Ar		42.9657	5.4 m	β ⁻ /4.6					0.4791(2)/10.
									0.7380(1)/43.
									0.9752(1)/100.
									1.4400(3)/39.
⁴⁴ Ar		43.96537	11.87 m	β ⁻ /3.55		0+			0.182-1.866
⁴⁵ Ar		44.96809	21.5 s	β ⁻ /6.9		7/2-			0.0610/25.
									1.020/35.
									3.707/34.
⁴⁶ Ar		45.96809	8.4 s	β ⁻ /5.70		0+			1.944/
⁴⁷ Ar		46.9722	≈0.7 s	β ⁻					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁴⁸ Ar		47.9751							
⁴⁹ Ar		48.9822	>0.17 μs	β ⁻					
⁵⁰ Ar		49.986	>0.17 μs	β ⁻					
⁵¹ Ar		50.993	>0.2 μs	β ⁻					
⁵² Ar		51.998	10 ms	β ⁻					
⁵³ Ar		52.994		β ⁻					
¹⁹ K		39.0983(1)							
³² K		32.0219							
³³ K		33.0073	<0.025 μs						
³⁴ K		33.9984	<0.04 μs						
³⁵ K		34.98801	0.19 s	β ⁺ /11.88 β ⁺ ,p/		3/2+			ann.rad./ 1.751/14. 2.5698/26. 2.9827/51.
³⁶ K		35.98129	0.342 s	β ⁺ /12.81	5.3/42. 9.9/44.	2+	+0.548		ann.rad./ 1.97044(5)/82. 2.20783(5)/30. 2.43343(2)/32.
³⁷ K		36.9733769	1.23 s	β ⁺ /6.149	5.13/	3/2+	+0.2032		ann.rad./ 2.7944(8)/2. 3.602(2)/0.05
^{38m} K			0.924 s	β ⁺ /6.742	5.02/100.	0+			ann.rad./
³⁸ K		37.969080	7.63 m	β ⁺ /5.913	2.60/99.8	3+	+1.37		ann.rad./ 2.1675(3)/99.8 3.9356(5)/0.2
³⁹ K	93.2581(44)	38.9637069				3/2+	+0.39146	+0.049	
⁴⁰ K	0.0117(1)	39.9639987	1.26x10 ⁹ y	β ⁻ /1.3111 β ⁺ ,EC/1.505	1.312/89. 1.50/10.7	4-	-1.29810	-0.061	ann.rad./ 1.4608/10.5
⁴¹ K	6.7302(44)	40.9618260				3/2+	+0.21487	+0.060	
⁴² K		41.9624031	12.36 h	β ⁻ /3.525	1.97/19. 3.523/81.	2-	-1.1425		0.31260(2)/0.3 1.5246(3)/18.
⁴³ K		42.96072	22.3 h	β ⁻ /1.82	0.465/8. 0.825/87. 1.24/3.5 1.814/1.3	3/2+	+0.163		0.2211(2)/4. 0.3729(2)/88. 0.3971(2)/11. 0.6178(2)/81.
⁴⁴ K		43.96156	22.1 m	β ⁻ /5.66	5.66/34.	2-	-0.856		0.36821/2.2 1.15700(1)/58. 2.15079(2)/22.
⁴⁵ K		44.96070	17.8 m	β ⁻ /4.20	1.1/23. 2.1/69. 4.0/8.	3/2+	+0.173		0.1743(5)/80. 1.2607(8)/7. 1.7056(6)/69. 2.3542(5)/14.
⁴⁶ K		45.96198	1.8 m	β ⁻ /7.72	6.3/	2-	-1.05		1.347(1)/91. 3.700(5)/28.
⁴⁷ K		46.96168	17.5 s	β ⁻ /6.64	4.1/99. 6.0/1.	1/2+	+1.93		0.56474(3)/15. 0.58575(3)/85. 2.0131/100
⁴⁸ K		47.96551	6.8 s	β ⁻ /12.09	5.0/	(2-)			0.67122(1)/4. 0.6723(5)/20. 0.78016(1)/32. 3.83153(7)/80.
⁴⁹ K		48.9675	1.26 s	β ⁻ /11.0					2.025/ 2.252/
⁵⁰ K		49.9728	0.472 s	β ⁻ /14.2					
⁵¹ K		50.9764	0.365 s	β ⁻ /					
⁵² K		51.983	0.105 s	β ⁻					
⁵³ K		52.987	30. ms	β ⁻		3/2+			
⁵⁴ K		53.994	10. ms	β ⁻					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁰ Ca		40.078(4)							
³⁴ Ca		34.0141	<0.035 μs						
³⁵ Ca		35.0048	25.7 ms	β ⁺ ,p/15.6	p/1.43/49 1.9-8.8				
³⁶ Ca		35.99309	0.10 s	β ⁺ ,(p)/10.99	2.52				ann.rad./
³⁷ Ca		36.98587	0.18 s	β ⁺ ,n/ β ⁺ /11.64	3.103	3/2+			ann.rad./ 1.369
³⁸ Ca		37.976319	0.44 s	β ⁺ ,n/ β ⁺ /6.74		0+			ann.rad./ 1.5677(5)/25. 3.210(2)/1.
³⁹ Ca		38.970718	0.861 s	β ⁺ /6.531	5.49/100.	3/2+	1.02168		ann.rad./
⁴⁰ Ca	96.941(156)	39.9625912				0+			
⁴¹ Ca		40.9622783	1.02x10 ⁵ y	EC/0.4214		7/2-	-1.5948	-0.08	
⁴² Ca	0.647(23)	41.9586183				0+			
⁴³ Ca	0.135(10)	42.9587668				7/2-	-1.3173	-0.05	
⁴⁴ Ca	2.086(110)	43.955481				0+			
⁴⁶ Ca		44.956186	162.7 d	β ⁻ /0.257	0.257/100.	7/2-	-1.327	+0.05	
⁴⁶ Ca	0.004(3)	45.953693	>0.4x10 ¹⁶ y	β-β ⁻		0+			
⁴⁷ Ca		46.954546	4.536 d	β ⁻ /1.992	0.684/84. 1.98/16.	7/2-	-1.38	+0.02	1.297/75 (0.041-1.88)
⁴⁸ Ca	0.187(21)	47.952533	4.3x10 ¹⁹ y	β-β ⁻		0+			
⁴⁹ Ca		48.955673	8.72 m	β ⁻ /5.262	0.89/7. 1.95/92.	3/2-			3.0844(1)/92. 4.0719(1)/7. 0.2569/98. (0.0715 -1.59)
⁵⁰ Ca		49.95752	14. s	β ⁻ /4.97	3.12/	0+			
⁵¹ Ca		50.9615	10. s	β ⁻ /7.3		(3/2-)			
⁵² Ca		51.9651	4.6 s	β ⁻ /8.0					
⁵³ Ca		52.9701	0.09 s	β ⁻ /10.9					
⁵⁴ Ca		53.975							
⁵⁵ Ca		54.981							
⁵⁶ Ca		55.986							
²¹ Sc		44.955910(8)							
³⁶ Sc		36.0149							
³⁷ Sc		37.0030							
³⁸ Sc		37.9947	<0.3 μs						
³⁹ Sc		38.98479	<0.3 μs	p					
⁴⁰ Sc		39.977964	0.182 s	β ⁺ /14.320	5.73/50. 7.53/15. 8.76/15. 9.58/20.	4-			ann.rad./ 0.752/41. 3.732/99.5 (1.12-3.92)
⁴¹ Sc		40.9692513	0.596 s	β ⁺ /6.4953	5.61/100.	7/2-	+5.431	-0.156	ann.rad./
^{42m} Sc			61.6 s	β ⁺ /	2.82/	7+			ann.rad./ 0.4375(5)/100. 1.2270(5)/100. 1.5245(5)/100.
⁴² Sc		41.9655168	0.682 s	β ⁺ /6.4259	5.32/100.	0+			ann.rad./
⁴³ Sc		42.961151	3.89 h	β ⁺ ,EC/2.221	0.82/22. 1.22/78.	7/2-	+4.62	-0.26	ann.rad./ 0.3729(1)/22.
^{44m} Sc			58.2 h	I.T./0.27 EC/3.926		6+	+3.88		0.27124(1)/87. (1.00-1.16)
⁴⁴ Sc		43.959403	3.93 h	β ⁺ , EC/3.653	1.47/	2+	+2.56	+0.10	ann.rad./ 1.157/100
⁴⁵ Sc	100.	44.955910				7/2-	+4.75649	-0.220	
^{46m} Sc			18.7 s	I.T./0.14253		1-			0.14253(2)/62.
⁴⁶ Sc		45.955170	83.81 d	β ⁻ /2.367	0.357/100.	4+	+3.03	+0.12	0.8893/100 1.121/100

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy (/Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁴⁷ Sc		46.952408	3.349 d	β^- /0.600	0.439/69. 0.601/31.	7/2-	+5.34	-0.22	0.15938(1)/68.
⁴⁸ Sc		47.95224	43.7 h	β^- /3.99	0.655/	6+			0.9835/100 1.03750(1)/97. 1.3121/100
⁴⁹ Sc		48.950024	57.3 m	β^- /2.006	2.00/99.9.	7/2-			1.7619(3)/0.05
⁵⁰ Sc		49.95219	1.71 m	β^- /6.89	3.05/76. 3.60/24.	(5+)			0.5235(1)/88. 1.1210(1)/100. 1.5537(2)/100.
⁵¹ Sc		50.95360	12.4 s	β^- /6.51	4.4/ 5.0/	7/2-			1.4373(4)/52. 0.718-2.144
⁵² Sc		51.9566	8.2 s	β^- /9.0		(3+)			
⁵³ Sc		52.9592	> 3. ms	β^- /8.1					
^{54m} Sc			$\approx 7 \mu\text{s}$			(5+)			0.110/IT
⁵⁴ Sc		53.9630	0.23 s	β^- /11.6					0.100/50 1.70/40 0.50/40
⁵⁵ Sc		54.967	0.12 s	β^- /13					
⁵⁶ Sc		55.973							
⁵⁷ Sc		56.977							
⁵⁸ Sc		57.983							
²² Ti		47.867(1)							
³⁸ Ti		38.0098	<0.12 μs						
³⁹ Ti		39.0013	28. ms	β^+ /15.4					
⁴⁰ Ti		39.9905	52. ms	β^+ /11.7	p/2.17/28 β^+ .p 3.73/23 1.7/22				
					0.242-5.74				
⁴¹ Ti		40.98313	80. ms	β^+ .p/12.93	p/4.73/107 3.10/67 3.75/39 0.744-6.73	3/2+			ann.rad./
⁴² Ti		41.97303	0.20 s	β^+ /7.000	6.0/				ann.rad./ 0.6107(5)/56.
⁴³ Ti		42.96852	0.50 s	β^+ /6.87	5.80/	7/2-	0.85		ann.rad./
⁴⁴ Ti		43.959690	60. y	EC/0.268		0+			0.06787/91 0.07832/97
⁴⁵ Ti		44.958124	3.078 h	β^+ /86/2.062	1.04	7/2-	0.095	0.015	ann.rad./ (0.36-1.66)
⁴⁶ Ti	8.25(3)	45.952630				0+			
⁴⁷ Ti	7.44(2)	46.951764				5/2-	-0.78848	+0.30	
⁴⁸ Ti	73.72(3)	47.947947				0+			
⁴⁹ Ti	5.41(2)	48.947871				7/2-	-1.10417	+0.24	
⁵⁰ Ti	5.18(2)	49.944792				0+			
⁵¹ Ti		50.946616	5.76 m	β^- /2.471	1.50/92. 2.13/	3/2-			0.3197(2)/93. 0.6094-0.9291
⁵² Ti		51.94690	1.7 m	β^- /1.97	1.8/100.	0+			0.0170(5)/100. 0.1245/100
⁵³ Ti		52.9497	33. s	β^- /5.0	(2.2-3)/	3/2-			0.1008(1)/20. 0.1276(1)/45. 0.2284(1)/39. 1.6755(5)/45. (1.72-2.8)/
⁵⁴ Ti		53.9509	1.5 s	β^- /4.3					
⁵⁵ Ti		54.9551	0.32 s	β^- /7.4					
⁵⁶ Ti		55.9580	0.19 s	β^- /7.0					
⁵⁷ Ti		56.963	0.06 s	β^- /11.					
⁵⁸ Ti		57.966	≈ 47 ms						
⁵⁹ Ti		58.972	0.06 s						

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁶⁰ Ti		59.976	>0.15 μs						
⁶¹ Ti		60.982	>0.15 μs						
²³ V		50.9415(1)							
⁴⁰ V		40.0111							
⁴¹ V		40.9997							
⁴² V		41.9912	<0.055 μs						
⁴³ V		42.9807	>0.8 s	β ⁺ /11.3					
⁴⁴ V		43.9744	0.09 s	β ⁺ ,α/13.7					ann.rad./
⁴⁵ V		44.96578	0.54 s	β ⁺ /7.13		7/2-			
⁴⁶ V		45.960200	0.4223 s	β ⁺ /7.051	6.03/100.	0+			ann.rad./
⁴⁷ V		46.954907	32.6 m	β ⁺ ,EC/2.928	1.90/99.+	3/2-			ann.rad./
									1.7949(8)/0.19
									(0.2-2.16)
⁴⁸ V		47.952254	15.98 d	β ⁺ /4.012	0.698/50.	4+	2.01		ann.rad./
									0.9835/100
									(1.3-2.4)
⁴⁹ V		48.948517	337. d	EC/0.602		7/2-	4.47		
⁵⁰ V	0.250(4)	49.947163	>1.4x10 ¹⁷ y	EC, β ⁻		6+	+3.34569	+0.21	
⁵¹ V	99.750(4)	50.943964				7/2-	+5.14870 6	-0.04	
⁵² V		51.944780	3.76 m	β ⁻ /3.976	2.47/	3+			1.4341(1)/100.
⁵³ V		52.944342	1.56 m	β ⁻ /3.436	2.52/	7/2-			1.0060(5)/90.
									1.2891(3)/10.
^{54m} V			0.9 μs			(5+)			0.108/IT
⁵⁴ V		53.94644	49.8 s	β ⁻ /7.04	1.00/5.	3+			0.8348/97.
					2.00/12.				0.9887/80.
					2.95/45.				2.259/46.
					5.20/11.				(0.56-3.38)
⁵⁵ V		54.9472	6.5 s	β ⁻ /6.0	6.0/	(7/2-)			0.5177/73.
									(0.224-1.21)
⁵⁶ V		55.9504	0.23 s	β ⁻ /9.1					0.70/50.
									0.34/40.
									1.00/30.
⁵⁷ V		56.9524	0.33 s	β ⁻ /8.1					0.30/60.
									0.60/30.
									0.80/30.
⁵⁸ V		57.9567	0.20 s	β ⁻ /11.6					
⁵⁹ V		58.9593	0.13 s	β ⁻ /9.9					0.90/80.
⁶⁰ V		59.965	0.20 s	β ⁻ /14.					0.102-0.208
⁶¹ V		60.967	0.04 s						0.646
⁶² V		61.973	≈ 65 ms						
⁶³ V		62.977	>0.15 μs						
⁶⁴ V			>0.15 μs						
²⁴ Cr		51.9961(6)							
⁴² Cr		42.0064	>0.35 μs						
⁴³ Cr		42.9977	21. ms						
⁴⁴ Cr		43.9855	53. ms	β ⁺ ,(p)/10.3	p/0.95-3.1				
⁴⁵ Cr		44.9792	0.05 s	β ⁺ ,p/12.5		7/2-			ann.rad./
⁴⁶ Cr		45.96836	0.3 s	β ⁺ /7.60					ann.rad./
⁴⁷ Cr		46.96291	0.51 s	β ⁺ /7.45		3/2-			ann.rad./
⁴⁸ Cr		47.95404	21.6 h	EC/1.66					ann.rad./
									0.116(2)/95.
									0.305(10)/100.
⁴⁹ Cr		48.951341	42.3 m	β ⁺ ,EC/2.631	1.39/	5/2-	0.476		ann.rad./
					1.45/				0.09064(1)/51.
					1.54/				0.15293(1)/27.
									(0.062-1.6)
⁵⁰ Cr	4.345(13)	49.946050				0+			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁵¹ Cr		50.944772	27.70 d	EC/0.7527		7/2-	-0.934		0.3201/10.2
⁵² Cr	83.789(18)	51.940512				0+			
⁵³ Cr	9.501(17)	52.940653				3/2-	-0.47454	-0.15	
⁵⁴ Cr	2.365(7)	53.938885				0+			
⁵⁵ Cr		54.940844	3.497 m	β^- /2.603	2.5/	3/2-			1.5282(2)/0.04 (0.13-2.37)
⁵⁶ Cr		55.94065	5.9 m	β^- /1.62	1.50/100.	0+			0.026(2)/100. 0.083(3)/100.
⁵⁷ Cr		56.9438	21. s	β^- /5.1	3.3/ 3.5/	3/2-	0.0834		0.850/8. (0.083-2.62)
⁵⁸ Cr		57.9443	7.0 s	β^- /4.0					(0.131-0.683)
^{59m} Cr			0.10 ms			(9/2+)			0.208/IT 0.193 0.102
⁵⁹ Cr		58.9487	1.0 s	β^- /7.7					1.236
⁶⁰ Cr		59.9497	0.6 s	β^- /6.0					
⁶¹ Cr		60.9541	0.26 s	β^- /8.8					0.354-1.860
⁶² Cr		61.9558	0.19 s	β^- /7.3					0.285
⁶³ Cr		62.962	0.11 s						
⁶⁴ Cr		63.964	0.04 s						
⁶⁵ Cr		64.970	>0.15 μ s						
⁶⁶ Cr			>0.15 μ s						
⁶⁷ Cr									
²⁵ Mn		54.938049(9)							
⁴⁴ Mn		44.0069	<0.105 μ s						
⁴⁵ Mn		44.9945	<0.07 μ s						
⁴⁶ Mn		45.9867	\approx 41. ms	β^+ /17.1					
⁴⁷ Mn		46.9761	\approx 0.1 s	β^+ /12.3					
⁴⁸ Mn		47.9689	0.15 s	β^+ /13.5	5.79/58. 4.43/10.	4+			
⁴⁹ Mn		48.95962	0.38 s	β^+ /7.72	6.69/	5/2-			ann.rad./
^{50m} Mn			1.74 m	β^+ /7.887	3.54/	5+			ann.rad./ 1.0980/94. 0.783/91. (0.66-3.11)
⁵⁰ Mn		49.954244	0.283 s	β^+ /7.6330	6.61/	0+			ann.rad./
⁵¹ Mn		50.948215	46.2 m	β^+ , EC/3.208	2.2/	5/2-	3.568	0.4	ann.rad./ 0.7491(1)/0.26 (1.148-1.164)
^{52m} Mn			21.1 m	β^+ /98/5.09 I.T./2/0.378	2.631/	2+	0.0076		ann.rad./ 0.3778 (I.T.) 1.43406(1)/98. (0.7-4.8)
⁵² Mn		51.945570	5.591 d	β^+ /4.712 EC/	0.575/	6+	+3.063	+0.5	ann.rad./ 0.74421(1)/90. 1.4341/100
⁵³ Mn		52.941294	3.7x10 ⁶ y	EC/0.5970		7/2-	5.024		
⁵⁴ Mn		53.940363	312.1 d	EC/1.377		3+	+3.282	+0.33	0.8340/100
⁵⁵ Mn	100.	54.938049				5/2-	+3.4687	+0.32	
⁵⁶ Mn		55.938909	2.579 h	β^- /3.6954	0.718/18. 1.028/34.	3+	+3.2266		0.84675/99 1.81072(4)/27. 2.113/14.5
⁵⁷ Mn		56.938287	1.45 m	β^- /2.691		5/2-			
⁵⁸ Mn		57.93999	65 s	β^- /6.25	3.8/ 5.1/	3+			0.45916(2)/20. 0.81076(1)/82. 1.32309(5)/53.
⁵⁹ Mn		58.94045	4.6 s	β^- /5.19	4.5/				0.471/ 0.531-0.726
^{60m} Mn			1.77 s	β^- /IT	5.7/	3+			0.824/

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁶⁰ Mn		59.9433	50. s	β^- /8.6		0+			1.969/
⁶¹ Mn		60.9446	0.67 s	β^- /7.4		(5/2)-			
⁶² Mn		61.9480	0.67 s	β^- /10.4		(3+)			0.877/
									0.942-1.299
⁶³ Mn		62.9498	0.28 s	β^- /8.8					0.356,0.450
^{64m} Mn			> 0.1 ms						0.135/IT
⁶⁴ Mn		63.9537	87 ms	β^- /11.8					0.746
⁶⁵ Mn		64.9561	0.09 s	β^- /10.					0.366
⁶⁶ Mn		65.961	66 ms						0.471
⁶⁷ Mn		66.964	42 ms						
⁶⁸ Mn			28 ms						
⁶⁹ Mn			14 ms						
²⁶ Fe		55.845(2)							
⁴⁵ Fe		45.0146	>0.35 μ s						
⁴⁶ Fe		46.0008	\approx 0.02 s	β^+ /13.1					
⁴⁷ Fe		46.9929	\approx 0.03 s	β^+ /15.6					
⁴⁸ Fe		47.9806	\approx 44. ms	β^+ /11.2					
⁴⁹ Fe		48.9763	70. ms	β^+ /13.0		(7/2-)			ann.rad./
⁵⁰ Fe		49.9630	0.15 s	β^+ /8.2					0.651
⁵¹ Fe		50.95683	0.31 s	β^+ /8.02		(5/2-)			ann.rad./
^{52m} Fe			46. s	β^+ /4.4		(12+)			ann.rad./
									(0.622-2.286)/
⁵² Fe		51.94812	8.28 h	β^+ /57/2.37 EC/43/ I.T./	0.804/	0+			ann.rad./
									0.16868(1)/99.
									0.377 (I.T.)/
^{53m} Fe			2.6 m	I.T./3.0407		19/2-			0.7011(1)/99.
									1.0115(1)/87.
									1.3281(1)/87.
									2.3396(1)/13.
⁵³ Fe		52.945312	8.51 m	β^+ /3.743	2.40/42. 2.80/57.	7/2-			ann.rad./
									0.3779(1)/42.
									(1.2 - 3.2)
⁵⁴ Fe	5.845(35)	53.939615				0+			
⁵⁵ Fe		54.938298	2.73 y	EC/0.2314		3/2-			
⁵⁶ Fe	91.754(36)	55.934942				0+			
⁵⁷ Fe	2.119(10)	56.935398				1/2-	+0.0906	0.16	
⁵⁸ Fe	0.282(4)	57.933280				0+			
⁵⁹ Fe		58.934880	44.51 d	β^- /1.565	0.273/48. 0.475/51.	3/2-	- 0.336		1.099/57 1.292/43.
									(0.14-1.48)
⁶⁰ Fe		59.934077	1.5x10 ⁶ y	β^- /0.237	0.184/100.	0+			0.0586/100
^{61m} Fe			0.25 μ s			(9/2+)			0.654/IT
									0.207
⁶¹ Fe		60.93675	6.0 m	β^- /3.98	2.5/13. 2.63/54. 2.80/31.				1.205/44. 1.028/43. (0.12-3.37)
⁶² Fe		61.93677	68. s	β^- /2.53	2.5/100.	0+			0.5061(1)/100.
⁶³ Fe		62.9404	6. s	β^- /6.3		5/2-			0.995/ (1.365-1.427)
⁶⁴ Fe		63.9411	2.0 s	β^- /4.9					
^{65m} Fe			0.4 μ s			(5/2-)			0.364/IT
⁶⁵ Fe		64.9449	1.3 s	β^- /7.9					
⁶⁶ Fe		65.9460	0.44 s	β^- /5.7					0.471-1.425
^{67m} Fe			\approx 0.04 ms			(5/2-)			0.367/IT
⁶⁷ Fe		66.9500	0.48 s	β^- /8.8					0.189
⁶⁸ Fe		67.953	0.15 s	β^- /7.6					
⁶⁹ Fe		68.958	0.17 s						
⁷⁰ Fe			>0.15 μ s						
⁷¹ Fe			>0.15 μ s						

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁷² Fe			>0.15 μs						
²⁷ Co		58.933200(9)							
⁴⁸ Co		48.0018							
⁴⁹ Co		48.990	<0.035 μs						
⁵⁰ Co		49.9812	44. ms	β ⁺ /17.0	2.03-2.79				
⁵¹ Co		50.9705	>0.2 μs	β ⁺ /12.8					
⁵² Co		51.9632	0.12 s	β ⁺ /14.0					0.849-1.942
^{53m} Co			0.25 s	β ⁺ , p/		19/2-			ann.rad./
⁵³ Co		52.95423	0.26 s	β ⁺ /8.30		7/2-			ann.rad./
^{54m} Co			1.46 m	β ⁺ /8.44	4.25/100.	7+			ann.rad./
									0.411(1)/99.
									1.130(1)/100.
									1.408(1)/100.
⁵⁴ Co		53.948464	0.1932 s	β ⁺ /8.2430	7.34/100.	0+			ann.rad./
⁵⁵ Co		54.942003	17.53 h	β ⁺ /3.4513	0.53/	7/2-	+4.822		ann.rad./
				EC/	1.03/				0.9312/75.
					1.50/				0.4772/20.
									(0.092-3.11)
⁵⁶ Co		55.939844	77.3 d	β ⁺ /4.566	1.459/18.	4+	3.85	+0.25	ann.rad./
				EC/					0.8468/99.9
									1.2383/68.
									(0.26-3.61)
⁵⁷ Co		56.936296	271.8 d	EC/0.8361		7/2-	+4.72	+0.5	0.12206/86
									(0.014-0.706)
^{58m} Co			9.1 h	I.T./		5+			0.02489/0.035
⁵⁸ Co		57.935757	70.88 d	β ⁺ /2.307		2+	+4.04	+0.22	ann.rad./
				EC/					0.81076/99
⁵⁹ Co	100.	58.933200				7/2-	+4.63	+0.41	
^{60m} Co			10.47 m	I.T./99.8/0.059		2+	+4.40	+0.3	0.0586/2.0
				β ⁻ /0.2/1.56					
⁶⁰ Co		59.933822	5.271 y	β ⁻ /2.824	0.315/99.7	5+	+3.799	+0.44	1.1732/100
									1.3325/100
⁶¹ Co		60.932479	1.650 h	β ⁻ /1.322	1.22/95.	7/2-			0.0674/86.
									0.842-0.909
^{62m} Co			13.9 m	β ⁻ /	0.88/25.	5+			1.1635(3)/70.
					2.88/75.				1.1730(3)/98.
									2.0039(3)/19.
⁶² Co		61.93405	1.50 m	β ⁻ /5.32	1.03/10.	2+			1.1292(3)/13.
					1.76/5.				1.1730(3)/83.
					2.9/20.				1.9851(1)/3.
					4.05/60.				2.3020(1)/19.
⁶³ Co		62.93362	27.5 s	β ⁻ /3.67	3.6/	7/2-			0.08713(1)/49.
									0.9817(3)/2.6
									0.156-2.17
⁶⁴ Co		63.93581	0.30 s	β ⁻ /7.31	7.0/	1+			
⁶⁵ Co		64.93648	1.14 s	β ⁻ /5.96		(7/2)-			
^{66m2} Co			>0.1 ms			(8-)			0.252/IT
									0.214
									0.175
^{66m1} Co			1.2 μs			(5+)			0.175/IT
⁶⁶ Co		65.9398	0.25 s	β ⁻ /10.0					(1.245-1.425)
⁶⁷ Co		66.9406	0.43 s	β ⁻ /8.4					0.694
⁶⁸ Co		67.9444	0.19 s	β ⁻ /11.7					
⁶⁹ Co		68.9452	0.20 s	β ⁻ /9.3					
⁷⁰ Co		69.950	0.09 s	β ⁻ 13.					
⁷¹ Co		70.952	0.21 s	β					
⁷² Co		71.956	0.09 s	β					
⁷³ Co			>0.15 μs						
⁷⁴ Co			>0.15 μs						

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁷⁵ Co			>0.15 μs						
²⁸ Ni		58.6934(2)							
⁴⁹ Ni			>0.35 μs						
⁵⁰ Ni		49.9959	>0.3 μs						
⁵¹ Ni		50.9877	>0.2 μs	β ⁺ /16.0					
⁵² Ni		51.9757	38. ms	β ⁺ /11.7					
⁵³ Ni		52.9685	0.05 s	β ⁺ ,p/13.3		7/2-			ann.rad./
⁵⁴ Ni		53.95791	0.14 s	β ⁺ /8.80					0.937
⁵⁵ Ni		54.95134	0.20 s	β ⁺ /8.70	7.66/	7/2-			ann.rad./
⁵⁶ Ni		55.94214	6.08 d	EC/2.14		0+			0.15838/99
				β ⁺ < 10 ⁻⁶					0.81185(3)/87.
									0.2695-0.7500
⁵⁷ Ni		56.939800	35.6 h	β ⁺ /3.264	0.712/10.	3/2-	- 0.798		ann.rad./
				EC/	0.849/76.				1.3776/78.
									(0.127-3.177)
⁵⁸ Ni	68.0769(89)		57.93534 8			0+			
⁵⁹ Ni		58.934351	≈7.6x10 ⁴ y	EC/		3/2-			
⁶⁰ Ni	26.2231(77)		59.93079 0			0+			
⁶¹ Ni	1.1399(6)	60.931060				3/2-	-0.75002	+0.16	
⁶² Ni	3.6345(17)	61.928348				0+			
⁶³ Ni		62.929673	100. y	β ⁻ /0.066945	0.065/	1/2-			
⁶⁴ Ni	0.9256(9)	63.927969				0+			
⁶⁵ Ni		64.930088	2.517 h	β ⁻ /2.137	0.65/30.	5/2-	0.69		0.36627(3)/5.
					1.020/11.				1.11553(4)/16.
					2.140/58.				1.48184(5)/23.
⁶⁶ Ni		65.92912	54.6 h	β ⁻ /0.23		0+			
^{67m} Ni			13.3 μs			9/2+			0.313/IT
									0.694
⁶⁷ Ni		66.93157	21. s	β ⁻ /3.56	3.8/	1/2-	+0.601		1.0722/100.
									1.6539/100.
									(0.10-1.98)
^{68m2} Ni			0.34 μs			0+			0.511
^{68m1} Ni			0.86 ms			(5-)			0.814/IT
									2.033
⁶⁸ Ni		67.93185	29. s	β ⁻ /2.06					
^{69m2} Ni			0.44 μs			(17/2)			0.148/IT
									0.593
									1.959
^{69m1} Ni			3.5 s						
⁶⁹ Ni		68.9352	11. s	β ⁻ /5.4					0.6807(3)/100.
									(0.207-1.213)
^{70m} Ni			0.21 μs			(8+)			0.183/IT
									0.448
									0.970
									1.259
⁷⁰ Ni		69.9361	6.0 s	β ⁻ /3.5					
⁷¹ Ni		70.9400	2.56 s	β ⁻ /6.9					
⁷² Ni		71.9413	1.6 s	β ⁻ /5.2					
⁷³ Ni		72.946	0.84 s	β ⁻ /9.					
⁷⁴ Ni		73.948	1.1 s	β ⁻ /7.					
⁷⁵ Ni		74.953	≈ 0.47 s						
⁷⁶ Ni		75.955	≈ 0.24 s						
⁷⁷ Ni		76.961	>0.15 μs						
⁷⁸ Ni		77.964	>0.15 μs						
²³ Cu		63.546(3)							
⁵² Cu		51.9972							

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁵³ Cu		52.9856	<0.3 μs						
⁵⁴ Cu		53.9767	<0.075 μs						
⁵⁵ Cu		54.9655	>0.2 μs	β ⁺ /13.2					
⁵⁶ Cu		55.9586	0.08 s	β ⁺ /15.3					0.511/233 2.700/100 1.23-2.78
⁵⁷ Cu		56.94922	196. ms	β ⁺ /8.77		3/2-			0.77-3.01
⁵⁸ Cu		57.944541	3.21 s	β ⁺ /8.563 EC/	4.5/15. 7.439/83.	1+			ann.rad./ 0.0403(4)/5. 1.4483(2)/11. 1.4546(2)/16.
⁵⁹ Cu		58.939504	1.36 m	β ⁺ /4.800	1.9/ 3.75/	3/2-			ann.rad./ 0.3393(1)/8. 0.8780(1)/12. 1.3015(1)/15. (0.4 - 2.6)
⁶⁰ Cu		59.937368	23.7 m	β ⁺ /6.127 EC/	2.00/69. 3.00/18. 3.92/6.	2+	+1.219		ann.rad./ 1.3325/88. 1.7915/45. (0.12-5.048)
⁶¹ Cu		60.933462	3.35 h	β ⁺ /2.237	0.56/3. 0.94/5. 1.15/2. 1.220/51.	3/2-	+2.14		ann.rad./ 0.2830/13. 0.6560/11. (0.067-2.123)
⁶² Cu		61.932587	9.67 m	β ⁺ /98/3.948 EC/	2.93/98.	1+	-0.380		ann.rad./ 1.17302(1)/0.6 (0.87-3.37)
⁶³ Cu	69.17(3)	62.929601				3/2-	+2.2233	-0.211	
⁶⁴ Cu		63.929768	12.701 h	β ⁻ /39/0.579 β ⁻ /19/1.6751 EC/41/	0.578/ 0.65/	1+	-0.217		ann.rad./ 1.3459(3)/0.6
⁶⁵ Cu	30.83(3)	64.927794				3/2-	+2.3817	-0.195	
⁶⁶ Cu		65.928873	5.09 m	β ⁻ /2.642	1.65/6. 2.7/94.	1+	-0.282		0.8330(1)/0.22 1.0392(2)/9.2
⁶⁷ Cu		66.92775	2.580 d	β ⁻ /0.58	0.395/56. 0.484/23. 0.577/20.	3/2-			0.09125(1)/7. 0.09325(1)/17. 0.18453(1)/47.
^{68m} Cu			3.79 m	I.T./86/ β ⁻ /14/1.8		6-			0.0843(5)/70. 0.1112(5)/18. 0.5259(5)/74. (0.64-1.34)
⁶⁸ Cu		67.92964	31. s	β ⁻ /4.46	3.5/40. 4.6/31.	1+			1.0774(5)/58. 1.2613(5)/17. (0.15-2.34)
^{69m} Cu			0.36 μs			(13/ 2+)			0.075/IT 0.190/IT 0.680 1.871
⁶⁹ Cu		68.92943	2.8 m	β ⁻ /2.68	2.48/80.	3/2-	+2.84		0.5307(3)/3. 0.8340(5)/6. 1.0065(8)/10.
^{70m} Cu			47. s	β ⁻ /	2.52/10.	5-			0.8848(2)/100. 0.9017(2)/90. 1.2517(5)/60. (0.39-3.06)
⁷⁰ Cu		69.93241	5. s	β ⁻ /6.60	5.42/54. 6.09/46.	1+			0.8848(2)/54.

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/IT)
^{71m} Cu			0.28 μs			(19/2)			0.133/IT
									0.494
									0.939
									1.189
⁷¹ Cu		70.93262	20. s	β ⁻ /4.56		3/2-			0.490/
^{72m} Cu			1.76 μs			(4-)			0.051/IT
									0.082
									0.138
⁷² Cu		71.9357	6.6 s	β ⁻ /8.2		(1+)			0.652/
⁷³ Cu		72.9365	4.2 s	β ⁻ /6.3	5.8/43				0.450/100
					6.25/42				0.307-1.559
⁷⁴ Cu		73.9401	1.6 s	β ⁻ /9.9					
⁷⁵ Cu		74.9414	1.2 s	β ⁻ /7.9					
⁷⁶ Cu		75.9455	0.64 s	β ⁻ /11.					
⁷⁷ Cu		76.947	0.47 s	β ⁻ /≈10.					
⁷⁸ Cu		77.952	0.34 s	β ⁻ /12.					
⁷⁹ Cu		78.954	0.19 s	β ⁻ /11.					
⁸⁰ Cu		79.962	>0.15 μs						
³⁰ Zn		65.39(2)							
⁵⁴ Zn		53.9929							
⁵⁵ Zn		54.9840							
⁵⁶ Zn		55.9724	0.04 s						
⁵⁷ Zn		56.9649	0.04 s	β ⁺ ,p/14.6		(7/2-)			ann.rad./
⁵⁸ Zn		57.9546	0.09 s	β ⁺					
⁵⁹ Zn		58.94927	183. ms	β ⁺ ,p/9.09	8.1/	3/2-			ann.rad./
									(0.491-0.914)
⁶⁰ Zn		59.94183	2.40 m	β ⁺ /97/4.16		0+			ann.rad./
				EC/3/					0.669/47.
									(0.062-0.947)
⁶¹ Zn		60.93951	1.485 m	β ⁺ /5.64	4.38/68.	3/2-			ann.rad./
									0.4748/17.
									(0.15-3.52)
⁶² Zn		61.93433	9.22 h	β ⁺ /3/1.63	0.66/7.	0+			ann.rad./
				EC/93/					0.0408/25
									0.5967/26.
									(0.20-1.526)/
⁶³ Zn		62.933215	38.5 m	β ⁺ /93/3.367	1.02/	3/2-	-0.28164	+0.29	ann.rad./
				EC/7/	1.40/				0.66962(5)/8.4
					1.71/				0.96206(5)/6.6
					2.36/84.				(0.24-3.1)
⁶⁴ Zn	48.63(60)	63.929146				0+			
⁶⁵ Zn		64.929245	243.8 d	β ⁺ /98/1.3514	0.325/	5/2-	+0.7690	-0.023	ann.rad./
				EC/1.5/					1.116/50.8
⁶⁶ Zn	27.90(27)	65.926036				0+			
⁶⁷ Zn	4.10(13)	66.927131				5/2-	+0.8755	+0.15	
⁶⁸ Zn	18.75(51)	67.924847				0+			
^{69m} Zn			13.76 h	I.T./99+/0.439		9/2+			0.4390(2)/95.
⁶⁹ Zn		68.926553	56. m	β ⁻ /0.906	0.905/99.9	1/2-			0.318/
⁷⁰ Zn	0.62(3)	69.925325				0+			
^{71m} Zn			3.97 h	β ⁻ /	1.45/	9/2+			0.3864/93.
									0.4874/62.
									0.6203/57.
									(0.099-2.489)
⁷¹ Zn		70.92773	2.4 m	β ⁻ /2.81		1/2-			0.5116(1)/30.
									0.9103(1)/7.5
									(0.12-2.29)
⁷² Zn		71.92686	46.5 h	β ⁻ /0.46	0.25/14.	0+			0.0164(3)/8.
					0.30/86.				0.1447(1)/83.
									0.1915(2)/9.4

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p) (7/2+)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{73m} Zn		72.92978	6. s	β^- 74.29	4.7/	(1/2-)			0.042
⁷³ Zn		72.92978	24. s	β^- 74.29	4.7/	(1/2-)			0.216(1)/100. 0.496-0.911
⁷⁴ Zn		73.92946	1.60 m	β^- 72.3	2.1/				0.0565/ 0.1401/ (0.05-0.35)
⁷⁵ Zn		74.9329	10.2 s	β^- 76.0					0.229/
⁷⁶ Zn		75.9334	5.7 s	β^- 74.2	3.6/				0.119/
^{77m} Zn			1.0 s	β^- /		(1/2-)			0.772
⁷⁷ Zn		76.9371	2.1 s	β^- 77.3	4.8/				0.189/
^{78m} Zn			>0.03 ms						1.070
⁷⁸ Zn		77.9386	1.5 s	β^- 76.4					0.225/
⁷⁹ Zn		78.9421	1.0 s	β^- 78.6					0.702/
⁸⁰ Zn		79.9444	0.54 s	β^- 77.3					0.713/ 0.2248/
⁸¹ Zn		80.9505	0.29 s	β^- 71.9					
⁸² Zn		81.9548	>0.15 μ s						
⁸³ Zn			>0.15 μ s						
³¹ Ga		69.723(1)							
⁵⁶ Ga		55.9949							
⁵⁷ Ga		56.9829							
⁵⁸ Ga		57.9742							
⁵⁹ Ga		58.9634							
⁶⁰ Ga		59.9571							
⁶¹ Ga		60.9492	0.15 s	β^+ 9.0		3/2-			
⁶² Ga		61.94418	0.116 s	β^+ 9.17	8.3/	0+			ann.rad./
⁶³ Ga		62.9391	32. s	EC/ β^+ 5.5	4.5/				ann.rad./
^{64m} Ga			0.022 ms						0.6271(2)/10. 0.6370(2)/11. 1.0652(4)/45.
⁶⁴ Ga		63.936838	2.63 m	β^+ 7.165	2.79/ 6.05/	0+			0.0429 ann.rad./ 0.80785(1)/14. 0.99152(1)/43. 1.38727(1)/12. 3.3659(1)/13.
⁶⁵ Ga		64.9394	15.2 m	β^+ 86/3.255	0.82/10. 1.39/19. 2.113/56. 2.237/15.	3/2-			ann.rad./ 0.1151(2)/55. 0.1530(2)/96. 0.2069(2)/39. (0.06-2.4)
⁶⁶ Ga		65.931592	9.5 h	β^+ 56/5.175	0.74/1. 1.84/54. 4.153/51.	0+			ann.rad./ 1.03935(8)/38. 2.7523(1)/23. (0.28-5.01)
⁶⁷ Ga		66.928205	3.260 d	EC/1.001		3/2-	+1.8507	0.20	0.09332/37. 0.18459/20. 0.30024/17. (0.091-0.89)
⁶⁸ Ga		67.927983	1.130 h	β^+ 90/2.921	1.83/ EC/10/	1+	0.01175	0.028	ann.rad./ 1.0774(1)/3. (0.57-2.33)/
⁶⁹ Ga	60.108(9)	68.925581				3/2-	+2.01659	+0.17	
⁷⁰ Ga		69.926027	21.1 m	EC/0.2/0.655		1+			0.1755(5)/0.15 1.042(5)/0.48
⁷¹ Ga	39.892(9)	70.924707		β^- 99.8/1.656	1.65/99.	3/2-	+2.56227	+0.11	
⁷² Ga		71.926372	14.10 h	β^- 74.001	0.64/40.	3-	-0.13224	+0.5	0.62986(5)/24.

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					1.51/9.				2.2016(2)/26.
					2.52/8.				2.5077(2)/12.8
					3.15/11.				(0.11-3.3)
⁷³ Ga		72.92517	74.87 h	β ⁻ /1.59		3/2-			0.05344(5)/10.
									0.29732(5)/47.
									(0.01-1.00)
^{74m} Ga			10. s	I.T./		1+			0.0565(1)/75.
⁷⁴ Ga		73.92694	8.1 m	β ⁻ /5.4	2.6/	3-			0.5959/92.
									2.354/45.
									(0.23-3.99)
⁷⁵ Ga		74.92650	2.10 m	β ⁻ /3.39	3.3/	3/2-			0.2529/
									0.5746/
									(0.12-2.10)
⁷⁶ Ga		75.9289	29. s	β ⁻ /7.0		3-			0.5629/66.
									0.5455/26.
									(0.34-4.25)
⁷⁷ Ga		76.9293	13.0 s	β ⁻ /5.3	5.2/				0.469/
									0.459/
⁷⁸ Ga		77.9317	5.09 s	β ⁻ /8.2		3+			0.619/77.
									1.187/20.
⁷⁹ Ga		78.9329	2.85 s	β ⁻ /7.0	4.6/				0.465/
⁸⁰ Ga		79.9366	1.68 s	β ⁻ /10.4	10./				0.659/
⁸¹ Ga		80.9377	1.22 s	β ⁻ /8.3	5.1/				0.217/
⁸² Ga		81.9432	0.599 s	β ⁻ /12.6					1.348/
⁸³ Ga		82.9469	0.308 s	β ⁻ /11.5					
⁸⁴ Ga		83.952	≈0.085 s	β ⁻ /14					
⁸⁵ Ga			>0.15 μs						
⁸⁶ Ga			>0.15 μs						
³² Ge		72.64(1)							
⁵⁸ Ge		57.9910							
⁵⁹ Ge		58.9817							
⁶⁰ Ge		59.9702							
⁶¹ Ge		60.9638	0.04 s	β ⁺ /13.6					
⁶³ Ge		62.9496	0.10 s	β ⁺ /9.8					
⁶⁴ Ge		63.9416	1.06 m	β ⁺ /4.4	3.0/	0+			ann.rad./
				EC/					0.1282(2)/11.
				β ⁺ .p					0.4270(3)/37.
									0.6671(3)/17.
⁶⁵ Ge		64.9394	31. s	β ⁺ /6.2	0.82/10.				ann.rad./
				EC/	1.39/19.				0.0620/27.
				EC.p	2.113/56.				0.6497/33.
					2.237/15.				0.8091/21.
									(0.19-3.28)
⁶⁶ Ge		65.93385	2.26 h	β ⁺ /27/2.10		0+			ann.rad./
				EC/73/					0.0438/29.
									0.3819/28.
									(0.022-1.77)
⁶⁷ Ge		66.932738	19.0 m	β ⁺ /96/4.225	1.6/	1/2-			ann.rad./
				EC/4/	2.3/				0.1670/84.
					3.15/				(0.25-3.73)
⁶⁸ Ge		67.92810	270.8 d	EC/0.11		0+			Ga k x-ray/39.
⁶⁹ Ge		68.927973	1.63 d	β ⁺ /36/2.2273	0.70/	5/2-	0.735	0.02	ann.rad./
				EC/64/	1.2/				0.574/13.
									1.1068/36.
									(0.2-2.04)
⁷⁰ Ge	20.84(87)	69.924250				0+			
^{71m} Ge			20.4 ms		I.T./0.0234	9/2+			0.1749
⁷¹ Ge		70.924954	11.2 d	EC/0.229		1/2-	+0.547		
⁷² Ge	27.54(34)	71.922076				0+			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁷³ Ge	7.73(5)	72.923460				9/2+	-0.879467	-0.17	
⁷⁴ Ge	36.28(73)	73.921178				0+			
^{75m} Ge			48. s	I.T./		7/2+			0.13968(3)/39.
⁷⁶ Ge		74.922860	1.380 h	β ⁻ /1.177	1.19/	1/2-	+0.510		0.26461(5)/11. 0.41931(5)/0.2
⁷⁶ Ge	7.61(38)	75.921403	≈1×10 ²¹ y	β-β ⁻		0+			
^{77m} Ge			53. s	I.T./20/		1/2-			1.605/0.22 1.676/0.16 0.195-1.482
				β ⁻ /80/2.861	2.9/				
⁷⁷ Ge		76.923549	11.25 h	β ⁻ /2.702	0.71/23. 1.38/35. 2.19/42.	7/2+			0.2110/29. 0.2155/27. 0.2644/51. (0.15-2.35)
⁷⁸ Ge		77.922853	1.45 h	β ⁻ /0.95	0.70/	0+			0.2773(5)/96. 0.2939(5)/4.
^{79m} Ge			39. s	β ⁻ /IT		7/2+			
⁷⁹ Ge		78.9254	19.1 s	β ⁻ /4.2	4.0/20. 4.3/80.	1/2-			0.1096/21. (0.10-2.59) 0.5427(4)/15.
⁸⁰ Ge		79.92545	29.5 s	β ⁻ /2.67	2.4/	0+			0.1104(4)/6. 0.2656(4)/25.
^{81m} Ge			≈7.6 s	β ⁻ /	3.75/	1/2+			0.3362(4)/ 0.7935(4)/
⁸¹ Ge		80.9288	≈7.6 s	β ⁻ /6.2	3.44/	9/2+			0.1976(4)/21. 0.3362(4)/100.
⁸² Ge		81.9296	4.6 s	β ⁻ /4.7		0+			1.093/
⁸³ Ge		82.9345	1.9 s	β ⁻ /8.9					
⁸⁴ Ge		83.9373	0.98 s	β ⁻ /7.7					
⁸⁵ Ge		84.943	0.54 s	β ⁻ /10.					
⁸⁶ Ge		85.946	>0.15 μs						
⁸⁷ Ge			>0.15 μs						
⁸⁸ Ge			>0.15 μs						
⁸⁹ Ge			>0.15 μs						
³³ As		74.92160(2)							
⁶⁰ As		59.993							
⁶¹ As		60.981							
⁶² As		61.9732							
⁶³ As		62.9637							
⁶⁴ As		63.9576	>1.2 μs						
⁶⁵ As		64.9495	0.19 s	β ⁺ /9.4					
^{66m2} As			1.9 μs						
^{66m1} As			0.018 ms						
⁶⁶ As		65.94410	95.8 ms	β ⁺ /9.55					
⁶⁷ As		66.9392	42. s	β ⁺ /6.0	5.0/	5/2-			0.121/ 0.123/ 0.244/
				EC/					
⁶⁸ As		67.9368	2.53 m	β ⁺ /8.1		3+			ann.rad./ 0.652/32. 0.762/33. 1.016/77. (0.61-3.55)
⁶⁹ As		68.93228	15.2 m	β ⁺ /98/4.01	2.95/	5/2-	1.6		ann.rad./ 0.0868(5)/1.5 0.1458(3)/2.4
				EC/2/					
⁷⁰ As		69.93093	52.6 m	β ⁺ /84/6.22	1.44/	4+	+2.1061	+0.09	ann.rad./ 1.0395(7)/82. (0.17-4.4)/
				EC/16/2.14					
				/2.89					
⁷¹ As		70.927114	2.72 d	β ⁺ /32/2.013		5/2-	+1.6735	-0.02	ann.rad./ 0.1749(2)/84.
				EC/68/					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁷² As		71.926753	26.0 h	β^+ /77/4.356	0.669/5. 1.884/12. 2.498/62. 3.339/19.	2-	-2.1566	-0.08	1.0957(2)/4.2 ann.rad./ 0.83395(5)/80. 1.0507(1)/9.6 (0.1-4.0)
⁷³ As		72.923825	80.3 d	EC/0.341		3/2-			0.0133/0.1 0.0534/10.5 Se k x-ray/90.
⁷⁴ As		73.923829	17.78 d	β^+ /31/2.562 EC/37/ β^- /1.353	0.94/26. 1.53/3. 0.71/16. 1.35/16.	2-	-1.597		ann.rad./ 0.59588(1)/60. 0.6084(1)/0.6 0.6348(1)/15.
^{75m} As			0.017 s						
⁷⁵ As	100.	74.921597				3/2-	+1.43947	+0.31	
⁷⁶ As		75.922394	26.3 h	β^- /2.962	0.54/3. 1.785/8. 2.410/36. 2.97/51.	2-	-0.903		0.5591(1)/45. 0.65703(5)/6.2 1.21602(1)/3.4 (0.3-2.67)
⁷⁷ As		76.920648	38.8 h	β^- /0.683	0.70/98.	3/2-	+1.295		0.2391(2)/1.6 0.2500(3)/0.4 0.5208/0.43
⁷⁸ As		77.92183	1.512 h	β^- /4.21	3.00/12. 3.70/17. 4.42/37.	2-			0.6136(3)/54. 0.6954(3)/18. 1.3088(3)/10.
^{79m} As			1.21 μ s			9/2+			0.542/IT 0.231
⁷⁹ As		78.92095	9.0 m	β^- /2.28	1.80/95.	3/2-			0.0955(5)/16. 0.3645(5)/1.9
⁸⁰ As		79.92258	16. s	β^- /5.64	3.38/	1+			0.6662(2)/42. (2.5-3.0)
⁸¹ As		80.92213	33. s	β^- /3.856		3/2-			0.4676(2)/20. 0.4911(2)/8.
^{82m} As			13.7 s	β^- /	3.6/	5-			0.6544(1)/72. 0.8186(4)/27. 1.7313(2)/27. 1.8954(2)/38.
⁸² As		81.9246	19. s	β^- /7.4	7.2/80.	1+			0.6544(1)/15.
⁸³ As		82.9250	13.4 s	β^- /5.5					0.7345/100. 1.1131/34. 2.0767/28.
^{84m} As			0.6 s	β^-					
⁸⁴ As		83.9291	4. s	β^- , n/7.2		1-			0.6671(2)/21. 1.4439(5)/49. (0.325-5.150)
⁸⁵ As		84.9318	2.03 s	β^- , n/8.9		3/2-			0.667(1)/42. 1.4551(2)/100.
⁸⁶ As		85.9362	0.95 s	β^- , n/11.4					0.704/
⁸⁷ As		86.9396	0.49 s	β^- , n/10.					0.704/
⁸⁸ As		87.945	>0.15 μ s						
⁸⁹ As		88.949	>0.15 μ s						
⁹⁰ As			>0.15 μ s						
⁹¹ As			>0.15 μ s						
⁹² As			>0.15 μ s						
³⁴ Se		78.96(3)							
⁶⁵ Se		64.965	0.011 s	β^+ /60/14. β^+ , p	3.55/				
⁶⁶ Se		65.9552							
⁶⁷ Se		66.9501	0.06 s	β^+ /10.2 β^+ ,(p/)					ann.rad./ 0.352

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁶⁸ Se		67.9419	36. s	β^- /4.7					ann.rad./ (0.050-0.426)
⁶⁸ Se		68.93956	27.4 s	β^- /6.78 EC/	5.006/				ann.rad./ 0.0664(4)/27. 0.0982(4)/63.
⁷⁰ Se		69.9335	41.1 m	β^- /2.4		0+			ann.rad 0.04951(5)/35. 0.4262(2)/29.
⁷¹ Se		70.9319	4.7 m	β^- /4.4 EC/	3.4/36.	5/2-			ann.rad 0.1472(3)/47. 0.8309(3)/13. 1.0960(3)/10.
⁷² Se		71.92711	8.5 d	EC/0.34		0+			0.0460(2)/57.
^{73m} Se			40. m	I.T./73/0.0257 β^- /27/2.77	0.85 1.45/	3/2-			ann.rad. 0.0257(2)/27. 0.2538(1)/2.5
⁷³ Se		72.92678	7.1 h	β^- /65/2.74 EC/35/	0.80/ 1.32/95. 1.68/1.	9/2+	0.86		ann.rad 0.0670(1)/72. 0.3609(1)/97. (0.6-1.5)
⁷⁴ Se	0.89(4)	73.922477				0+			
⁷⁶ Se		74.922524	119.78 d	EC/0.864		5/2+	0.67	1.0	0.13600/55 0.26465/58 (0.024-0.821)
⁷⁶ Se	9.37(29)	75.919214				0+			
^{77m} Se			17.4 s	I.T./		7/2+			0.1619(2)/52.
⁷⁷ Se	7.63(16)	76.919915				1/2-	+0.53506		
⁷⁸ Se	23.77(28)	77.917310				0+			
^{79m} Se			3.92 m	I.T./					0.09573(3)/9.5
⁷⁸ Se		78.918500	1.1x10 ⁶ y	β^- /0.151		7/2+	-1.018	+0.8	
⁸⁰ Se	49.61(41)	79.916522				0+			
^{81m} Se			57.3 m	I.T./99/0.1031		7/2+			0.1031(3)/9.7 0.2602(2)/0.06 0.2760/0.06
⁸¹ Se		80.917993	18.5 m	β^- /1.585	1.6/98.	1/2-			0.2759/0.85 0.2901/0.75 0.8283/0.32
⁸² Se	8.73(22)	81.916700	$\approx 1 \times 10^{20}$ y	$\beta^- \beta^-$		0+			
^{83m} Se			1.17 m	β^- /3.96	2.88/ 3.92/	1/2-			0.35666(6)/17. 0.9879(1)/15. 1.0305(1)/21. 2.0514(2)/11. (0.19-3.1)
⁸³ Se		82.919119	22.3 m	β^- /3.668	0.93/ 1.51/	9/2+			0.22516(6)/33. 0.35666(6)/69. 0.51004(8)/45. (0.21-2.42)
⁸⁴ Se		83.91847	3.3 m	β^- /1.83	1.41/100.	0+			0.4088(5)/100.
⁸⁵ Se		84.92225	32. s	β^- /6.18	5.9/	5/2+			0.3450(1)/22. 0.6094(1)/41.
⁸⁶ Se		85.92428	15. s	β^- /5.10		5/2+			2.0124(1)/24. 2.4433(8)/100. 2.6619(1)/49.
⁸⁷ Se		86.92853	5.4 s	β^- /7.28 n/					0.468(1)/100. 1.4979(1)/23.
⁸⁸ Se		87.93143	1.5 s	β^- ,n/6.85					0.5346/
⁸⁸ Se		88.9360	0.41s	β^- ,n/9.0					
⁹⁰ Se		89.9394	>0.15 μ s						
⁹¹ Se		90.945	0.27 s	β^- ,n/8.					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁹² Se		91.949	>0.15 μs						
⁹³ Se			>0.15 μs						
⁹⁴ Se			>0.15 μs						
³⁵ Br		79.904(1)							
⁶⁷ Br		66.9648							
⁶⁸ Br		67.958	<1.2 μs						
⁶⁹ Br		68.9502	<0.024 μs	β ⁻ /9.6					
⁷⁰ Br		69.9446	79. ms	β ⁻ /10.0	/0.75				
⁷¹ Br		70.9392	21. s	β ⁻ /6.9					
⁷² Br		71.9365	1.31 m	β ⁻ /8.7		3	≈0.55		0.4547-1.3167
⁷³ Br		72.9318	3.4 m	β ⁻ /4.7	3.7/	3/2-			ann.rad
									0.065-0.700
^{74m} Br			46. m	β ⁻ /	4.5/	4-	1.82		ann.rad
									0.6348
									0.7285
									(0.2 - 4.38)
⁷⁴ Br		73.92989	25.4 m	β ⁻ /6.91					ann.rad
									0.6341
									0.6348
									(0.2-4.7)
⁷⁵ Br		74.92578	1.62 h	β ⁻ /76/3.03		3/2-	+0.75		ann.rad
									0.28650
									(0.1-1.56)
^{76m} Br			1.4 s	I.T./5.05		4+			0.104548
									0.05711
⁷⁶ Br		75.92454	16.0 h	β ⁻ /57/4.96	1.9/ 3.68/	1-	0.54821	0.270	ann.rad
									0.55911
									1.85368
									(0.4-4.6)
^{77m} Br			4.3 m	I.T./0.1059		9/2+			0.1059
⁷⁷ Br		76.921380	2.376 d	EC/99/1.365		3/2-	0.973	+0.53	ann.rad.
									0.23898
									0.52069
									(0.08-1.2)
⁷⁸ Br		77.921146	6.45 m	β ⁻ /92/3.574	1.2/ EC/8/ 2.5/	1+	0.13		ann.rad.
									0.61363
									(0.7-3.0)
^{79m} Br			4.86 s	I.T./0.207		9/2+			0.2072
⁷⁹ Br	50.69(7)	78.918338				3/2-	+2.10640 0	+0.331	
^{80m} Br			4.42 h	I.T./0.04885		5-	+1.3177	+0.75	Br k x-ray
									0.03705/39.1
									0.04885/0.3
⁸⁰ Br		79.918530	17.66 m	β ⁻ /92/2.004	1.38 β ⁻ /7.6	1+	0.5140	0.196	ann.rad.
				EC/5.7/1.8706	1.99 β ⁻ /82				0.6169/6.7
				β ⁻ /2.6/	0.85 β ⁻ /2.8				(0.64-1.45)
⁸¹ Br	49.31(7)	80.916291				3/2-	+2.27056 2	+0.276	
^{82m} Br			6.1 m	I.T./98/0.046		2-			0.046/0.24
				β ⁻ /2/3.139					(0.62-2.66)
⁸² Br		81.916805	1.471 d	β ⁻ /3.093	0.444/	5-	+1.6270	0.751	0.5544/71
									0.61905/43
									0.77649/84
									(0.013-1.96)
⁸³ Br		82.915181	2.40 h	β ⁻ /0.972	0.395/1	3/2-			0.52964
					0.925/99				(0.12-0.68)
^{84m} Br			6.0 m	β ⁻ /4.97	2.2/100	(6-)			0.4240/100

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.8817/98
									1.4637/101
⁸⁴ Br		83.91651	31.8 m	β^- /4.65	2.70/11	2-	2.		0.8816/41
					3.81/20				1.8976/13
					4.63/34				(0.23-4.12)
⁸⁵ Br		84.91561	2.87 m	β^- /2.87	2.57	3/2-			0.80241/2.56
									0.92463/1.6
									(0.09-2.4)
⁸⁶ Br		85.91880	55.5 s	β^- /7.63	3.3	(2-)			1.56460/64
					7.4				2.75106/21
									(0.5-6.8)
⁸⁷ Br		86.92072	55.6 s	β^- /6.85	6.1/	3/2-			1.41983
				n/					1.4762
									(0.2-6.1)
^{88m} Br			5.1 μ s						
⁸⁸ Br		87.92407	16.3 s	β^- /8.96		1-			0.7649
				n/					0.7753
									0.8021
									(0.1-6.99)
⁸⁹ Br		88.92640	4.35 s	β^- /8.16		3/2-			0.7753
				n/					1.0978
⁹⁰ Br		89.9306	1.91 s	β^- /10.4	8.3/	2-			0.6555
				n/	9.8/				0.7071
									1.3626
⁹¹ Br		90.9339	0.54 s	β^- /90/9.80					0.263
				β^- n/10/					0.803
⁹² Br		91.9392	0.31 s	β^- /12.20					0.740
				β^- n/					
⁹³ Br		92.9431	0.10 s	β^- n/11.1					
⁹⁴ Br		93.9487	0.07 s	β^- n/					
⁹⁵ Br			>0.15 μ s						
⁹⁶ Br			>0.15 μ s						
⁹⁷ Br			>0.15 μ s						
³⁶ Kr		83.80(1)							
⁶⁹ Kr		68.9653	0.03 s	β^+ , (p)	4.07/				
⁷⁰ Kr		69.9560	>1.2 μ s						
⁷¹ Kr		70.9505	100. ms	β^+ , EC/10.1					(0.198-0.207)
⁷² Kr		71.9419	17. s	β^+ /5.0		0+			ann.rad
				EC/					0.3100/29
									0.4150/36
									(0.12-0.58)
⁷³ Kr		72.9389	28. s	β^+ /6.7		5/2-			ann.rad.
				EC/					0.1781/66
				β^+ , p/	/0.25				(0.06-0.86)
⁷⁴ Kr		73.9333	11.5 m	β^+ /3.1		0+			ann.rad.
				EC/					0.08970/31
									0.2030/20
									(0.010-1.06)
⁷⁵ Kr		74.93104	4.3 m	β^+ /4.90	3.2/	5/2+	- 0.531	+ 1.1	ann.rad.
				EC/					0.1325/68
									0.1547/21
									(0.02-1.7)
⁷⁶ Kr		75.92595	14.8 h	EC/1.31		0+			Br k x-ray
									0.270/21
									0.3158/39
									(0.03-1.07)
⁷⁷ Kr		76.92467	1.24 h	β^+ /80/3.06		5/2+	- 0.583	+ 0.9	ann.rad.
				EC/20/	1.55/				0.1297/80
					1.70/				0.1465/38

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%) (0.02-2.3)
⁷⁸ Kr	0.35(1)	77.92039	>0.9×10 ²⁰ y	β-β-	1.87/	0+			
^{79m} Kr			53. s	I.T./0.1299		7/2+	- 0.786	+ 0.40	Kr x-ray
⁷⁹ Kr		78.920083	1.455 d	β ⁺ /7/1.626 EC/93/		1/2-	+ 0.536		ann.rad. 0.2613/13 0.39756/19 0.6061/8 (0.04-1.3)
⁸⁰ Kr	2.28(6)	79.916379				0+			
^{81m} Kr			13.1 s	I.T./0.1904		1/2-	+ 0.586		0.1904
⁸¹ Kr		80.916593	2.1×10 ⁵ y	EC/0.2807		7/2+	- 0.908	+ 0.63	Br k x-ray 0.2760
⁸² Kr	11.58(14)	81.913485				0+			
^{83m} Kr			1.86 h	I.T./0.0416		1/2-	+ 0.591		Kr k x-ray 0.00940 0.03216
⁸³ Kr	11.49(6)	82.914137				9/2+	-0.970699	+0.253	
⁸⁴ Kr	57.00(4)	83.911508				0+			
^{85m} Kr			4.48 h	β ⁻ /79/ I.T./21/0.305	0.83/79	1/2-	+ 0.633		0.30487 0.15118
⁸⁵ Kr		84.912530	10.73 y	β ⁻ /0.687	0.15/0.4	9/2+	1.005	+0.43	0.51399
⁸⁶ Kr	17.30(22)	85.910615				0+			
⁸⁷ Kr		86.913359	1.27 h	β ⁻ /3.887	1.33/8 3.49/43 3.89/30	5/2+	-1.023	- 0.30	0.40258/49.6 2.5548/9.2 (0.13-3.31)
⁸⁸ Kr		87.91445	2.84 h	β ⁻ /2.91		0+			0.19632/26. 2.392/34.6 (0.03-2.8)
⁸⁹ Kr		88.91764	3.15 m	β ⁻ /4.99	3.8/ 4.6/ 4.9/	5/2+	- 0.330	+ 0.16	0.19746 0.2209/19.9 0.5858/16.4 1.4728/6.8 (0.2-4.7)
⁹⁰ Kr		89.91953	32.3 s	β ⁻ /4.39	2.6/77 2.8/6	0+			0.12182/32.9 0.5395/28.6 1.1187/36.2 (0.1 - 4.2)
⁹¹ Kr		90.9234	8.6 s	β ⁻ /6.4	4.33/ 4.59/	5/2+	- 0.583	+ 0.30	0.10878/43.5 0.50658/19. (0.2-4.4)
⁹² Kr		91.92611	1.84 s	β ⁻ /5.99 n/					0.1424/66. (0.14 - 3.7)
⁹³ Kr		92.9312	1.29 s	β ⁻ /8.6 n/	7.1/	1/2+	- 0.413		0.1820 0.2534/42. 0.32309/24.6 (0.057-4.03)
⁹⁴ Kr		93.9343	0.21 s	β ⁻ /7.3					0.2196/67 0.6293/100. - 0.410 (0.098-0.985)
⁹⁵ Kr		94.9397	0.78 s	β ⁻ /9.7					
⁹⁶ Kr		95.9431	> 50 ms						
⁹⁷ Kr		96.9486	< 0.1 s	β ⁻					
⁹⁸ Kr			>0.15 μs						
⁹⁹ Kr			>0.15 μs						
¹⁰⁰ Kr			>0.15 μs						
³⁷ Rb		85.4678(3)							
⁷¹ Rb		70.9653							
⁷² Rb		71.9591	<1.2 μs						

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁷³ Rb		72.9504	<0.03 μs						
⁷⁴ Rb		73.9445	65. ms	β ⁺ /10.4					
⁷⁵ Rb		74.93857	19. s	β ⁺ /7.02	2.31/				ann. rad. 0.179
⁷⁶ Rb		75.93508	39. s	β ⁺ /8.50	4.7/	1-	-0.372623	+0.4	ann.rad. 0.4240/92. (0.064-1.68)
⁷⁷ Rb		76.93041	3.8 m	β ⁺ /5.34	3.86/	3/2-	+0.65446 8	+0.70	ann.rad. 0.0665/59 (0.04 - 2.82)
^{78m} Rb			5.7 m	I.T./0.1034 β ⁺ / EC/	3.4	4-	+2.549	+0.81	ann.rad. 0.4553/81. (0.103-4.01)
⁷⁸ Rb		77.92814	17.7 m	β ⁺ /7.22 EC/		0+			ann.rad. 0.4553/63. (0.42-5.57)
⁷⁹ Rb		78.92400	23. m	β ⁺ /84/3.65 EC/16/		5/2+	+0.3358	-0.10	ann.rad. 0.68812/23. (0.017-3.02)
⁸⁰ Rb		79.92252	34. s	β ⁺ /5.72	4.1/22 4.7/74	1+	-0.0836	+0.35	ann.rad. 0.6167/25.
^{81m} Rb			30.5 m	I.T./0.85 β ⁺ ,EC/	1.4	9/2+	+5.598	-0.74	ann.rad. (0.085-1.9)
⁸¹ Rb		80.91900	4.57 h	β ⁺ /27/2.24 EC/73	1.05/	3/2-	+2.060	+0.40	ann.rad./ 0.19030/64. (0.05 - 1.9)
^{82m} Rb			6.47 h	β ⁺ /26/ EC/74/	0.80/	5-	+1.5100	+1.0	ann.rad./ 0.5544/63. 0.7765/85. (0.092 - 2.3)
⁸² Rb		81.91821	1.258 m	β ⁺ /96/4.40 EC/4/	3.3/	1+	+0.55450 8	+0.19	ann.rad./ 0.7665/13. (0.47 - 3.96)
⁸³ Rb		82.91511	86.2 d	EC/0.91		5/2-	+1.425	+0.20	Kr x-ray 0.5205/46. (0.03-0.80)
^{84m} Rb			20.3 m	I.T./0.216		6-	+0.2129	+0.6	0.2163/34. 0.2482/63. 0.4645/32.
⁸⁴ Rb		83.914387	32.9 d	β ⁺ /22/2.681 EC/75/ β ⁻ /3/0.894	0.780/11 1.658/11 0.893/	2-	-1.32412	-0.015	ann.rad./ 0.8817/68. (1.02-1.9)
⁸⁵ Rb	72.17(2)	84.911792				5/2-	+1.353	+0.23	
^{86m} Rb			1.018 m	I.T./0.5560		6-	+1.815	+0.37	0.556/98.
⁸⁶ Rb		85.911170	18.65 d	β ⁻ /1.775	1.774/8.8	2-	-1.6920	+0.19	1.0768/8.8
⁸⁷ Rb	27.83(2)	86.909186	4.88x10 ¹⁰ y	β ⁻ /0.283	0.273/100	3/2-	+2.7512	+0.13	
⁸⁸ Rb		87.911323	17.7 m	β ⁻ /5.316	5.31	2-	0.508		0.8980/14. 1.8360/21. (0.34-4.85)
⁸⁹ Rb		88.91229	15.4 m	β ⁻ /4.50	1.26/38 1.9/5 2.2/34 4.49/18	3/2-	+2.304	+0.14	1.032/58. 1.248/42. 2.1960/13 (0.12-4.09)
^{90m} Rb			4.3 m	β ⁻ /4.50	1.7/ 6.5/	4-	+1.616	+0.20	0.1069(IT) 0.8317/94 (0.20-5.00)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁹⁰ Rb		89.91481	2.6 m	β^- /6.59	6.6	1-			0.8317/28. (0.31-5.60)
⁹¹ Rb		90.91649	58.0 s	β^- /5.861	5.9	3/2-	+2.182	+0.15	0.0936/34. (0.35-4.70)
⁹² Rb		91.91968	4.48 s	β^- /8.11	8.1/94	1-			0.8148/8. (0.1-6.1)
⁹³ Rb		92.92195	5.85 s	β^- /7.46 n/1	7.4/	5/2	+1.410	+0.18	0.2134/4.8 0.4326/12.5 0.9861/4.9 (0.16-5.41)
⁹⁴ Rb		93.92643	2.71 s	β^- /10.31 n/10	9.5/	3	+1.498	+0.16	0.8369/87. 1.5775/32. (0.12-6.35)
⁹⁵ Rb		94.92929	0.377 s	β^- /9.30 n/8	8.6/	5/2	+1.334	+0.21	0.352/65. 0.680/22. (0.20-2.27)
^{96m} Rb			1.7 μ s						0.2999 0.4612 0.2400 0.093-0.369
⁹⁶ Rb		95.93427	0.199 s	β^- /11.76 n/13/	10.8/	2+	+1.466	+0.25	0.815/76. (0.20-5.42)
⁹⁷ Rb		96.93733	0.169 s	β^- /10.42 n/27/	10.0	3/2	+1.841	+0.58	0.167/100. 0.585/79. 0.599/56. 1.258/52. (0.14-2.08)
⁹⁸ Rb		97.94174	0.107 s	β^- /12.34 n/13	0.144/				(0.07-3.68)
⁹⁹ Rb		98.9453	59. ms	β^- /11.3					
¹⁰⁰ Rb		99.9499	53. ms	β^- /13.5					
¹⁰¹ Rb		100.9532	0.03 s	β^- /11.8					
¹⁰² Rb		101.9592	0.09 s	β^-					
³⁶ Sr		87.62(1)							
⁷³ Sr		72.966	> 25 ms						
⁷⁴ Sr		73.9563	>1.2 μ s						
⁷⁵ Sr		74.9499	\approx 0.07 s						
⁷⁶ Sr		75.9416	8.9 s	β^+ /6.1					
⁷⁷ Sr		76.9378	9.0 s	β^+ /6.9	5.6		-0.35	+1.4	0.147
⁷⁸ Sr		77.93218	2.7 m	β^+ /3.76					(0.047-0.793)
⁷⁹ Sr		78.92971	2.1 m	β^+ /5.32	4.1	3/2-	-0.474	+0.74	ann.rad./ 0.039/28. 0.105/22. (0.135-0.612)
⁸⁰ Sr		79.92453	1.77 h	β^+ /1.87		0+			ann.rad./ 0.174/10. 0.589/39. (0.24-0.55)
⁸¹ Sr		80.92322	22.3 m	β^+ /87/3.93 EC/13/	2.43/ 2.68/	1/2-	+0.544		ann.rad./ 0.148/31. 0.1534/35 (0.06-1.7)
⁸² Sr		81.91840	25.36 d	EC/0.18					Rb x-ray
^{83m} Sr			5.0 s	I.T./0.2591		1/2-	+0.582		0.2591/87.5
⁸³ Sr		82.91756	1.350 d	β^+ /24/2.28 EC/76/	0.465/ 0.803/ 1.227/	7/2+	-0.898	+0.79	ann.rad./ 0.3816/12. 0.3816 0.7627/30. (0.094-2.15)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁸⁴ Sr	0.56(1)	83.913426				0+			
^{85m} Sr			1.127 h	I.T./87/0.2387		1/2-	+0.601		0.2318/84. (0.15-0.24)
				EC/13					
⁸⁵ Sr		84.912936	64.85 d	EC/1.065		9/2+	-1.001	+0.30	0.51399/99.3
⁸⁶ Sr	9.86(1)	85.909265				0+			
^{87m} Sr			2.81 h	I.T./0.3884		1/2-	+0.63		0.3884(IT)
⁸⁷ Sr	7.00(1)	86.908882				9/2+	-1.09360	+0.34	
⁸⁸ Sr	82.58(1)	87.905617				0+			
⁸⁹ Sr		88.907455	50.52 d	β^- /1.497	1.492/100	5/2+	-1.149	-0.3	0.9092
⁹⁰ Sr		89.907738	29.1 y	β^- /0.546	0.546/100	0+			
⁹¹ Sr		90.91020	9.5 h	β^- /2.70	0.61/7	5/2+	-0.887	+0.044	0.5556/61. 0.7498/24. 1.0243/33. (0.12-2.4)
					1.09/33				
					1.36/29				
					2.66/26				
⁹² Sr		91.91098	2.71 h	β^- /1.91	0.55/96	0+			1.3831/90. (0.24-1.1)
					1.5/3				
⁹³ Sr		92.91394	7.4 m	β^- /4.08	2.2/10	5/2+	-0.794	+0.26	0.5903/ 0.7104 0.87573 0.8883/ (0.17-3.97)
					2.6/25				
					3.2/65				
⁹⁴ Sr		93.91537	1.25 m	β^- /3.511	2.1/	0+			0.6219 0.7043 0.7241 0.8064 1.4283
					3.3/				
⁹⁵ Sr		94.91931	25.1 s	β^- /6.08	6.1/50	1/2+	-0.5379		0.6859 0.8269 2.7173 2.9332
⁹⁶ Sr		95.92165	1.06 s	β^- /5.37	4.2/	0+			0.1222 0.5305 0.8094 0.9318
⁹⁷ Sr		96.92615	0.42 s	β^- /7.47	5.3	(1/2+)	-0.500		0.2164 0.3071 0.6522 0.9538 1.2580 1.9050
⁹⁸ Sr		97.92845	0.65 s	β^- /5.83	5.1				0.0365 0.1190 0.4286 0.4447 0.5636
⁹⁹ Sr		98.9333	0.27 s	β^- /8.0			-0.26	0.8	
¹⁰⁰ Sr		99.9354	0.201 s	β^- /7.1					
¹⁰¹ Sr		100.9405	0.115 s	β^- /9.5					
¹⁰² Sr		101.9430	68. ms	β^- /8.8					
¹⁰³ Sr		102.9490	>0.15 μ s						
¹⁰⁴ Sr		103.952	>0.15 μ s						
¹⁰⁵ Sr			>0.15 μ s						
³⁹ Y		88.90585(2)							
⁷⁷ Y		76.9496	> 0.5 μ s						
^{78m} Y			0.06 s						
⁷⁸ Y		77.9435	5.8 s	β^+ /10.5		(5+)			0.279/100 0.504/90 0.713/40
⁷⁶ Y		78.9374	15. s	β^+ /7.1					(0.152-1.106)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{80m} Y			4.7 s						0.2285
⁸⁰ Y		79.9320	30. s	$\beta^-/7.0$	5.5	(4)			ann.rad./
					5.0/				0.3858/100
									0.5951/42
									0.756-1.396
⁸¹ Y		80.9291	1.21 m	$\beta^-/5.5$	3.7/				ann.rad./
					4.2/				0.428
									0.469
⁸² Y		81.9268	9.5 s	$\beta^-/7.8$	6.3/	1+			ann.rad./
									0.5736
									0.6017
									0.7375
^{83m} Y			2.85 m	$\beta^-/95/4.6$	2.9	1/2-			ann.rad./
				EC/5/					0.2591
									0.4218
									0.4945
⁸³ Y		82.92235	7.1 m	$\beta^-/4.47$	3.3	9/2+			ann.rad./
				EC/					0.0355
									0.4899
									0.8821
									(0.03 - 3.4)
^{84m} Y			4.6 s	$\beta^-/$		1+			ann.rad./
				EC/					0.7930
⁸⁴ Y		83.9203	40. m	$\beta^-/6.4$	1.64/47	5-			ann.rad./
				EC/	2.24/25				0.4628
					2.64/21				0.6606
					3.15/7				0.7931
									0.9744
									1.0398
									(0.2 - 3.3)
^{85m} Y			4.9 h	$\beta^-/70/$		9/2+	6.2		ann.rad./
				EC/30/					0.2317
									0.5356
									0.7673
									2.1238
									(0.1 - 3.1)
⁸⁵ Y		84.91643	2.6 h	$\beta^-/55/3.26$	1.54/	1/2-			ann.rad./
				EC/45/					0.2317
									0.5045
									0.9140
									(0.07 - 1.4)
^{86m} Y			48. m	I.T./99/		8+	4.8		ann.rad./
				$\beta^-/$					0.0102(IT)
				EC/					0.2080
									(0.09 - 1.1)
⁸⁶ Y		85.91489	14.74 h	$\beta^-/5.24$		4-	<0.6		ann.rad./
				EC/					0.3070
									0.6277
									1.0766
									1.1531
									1.9207
									(0.1 - 3.8)
^{87m} Y			13. h	I.T./98/		9/2+	6.1		0.3807
				$\beta^-/0.7/$	1.15/0.7				
				EC/					
⁸⁷ Y		86.910880	3.35 d	EC/99+/1.862	0.78/	1/2-			0.3880
									0.4870
⁸⁸ Y		87.909506	106.6 d	EC/99+/3.623	0.76/	4-			ann.rad./
				$\beta^-/0.2/$					0.89802

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									1.83601
									2.73404
									3.2190
^{89m} Y			15.7 s	I.T./0.909		9/2+			0.9092(IT)
⁸⁹ Y	100.	88.905849				1/2-	-0.13742		
^{90m} Y			3.24 h	I.T./99+0.68204 β ⁻ /0.002/		7+	5.1		0.2025 0.4794 0.6820
⁹⁰ Y		89.907152	2.67 d	β ⁻ /2.282	2.28/	2-	-1.630	-0.155	
^{91m} Y			49.7 m	I.T./0.555		9/2+	5.96		0.5556(IT)
⁹¹ Y		90.907301	58.5 d	β ⁻ /1.544	1.545/	1/2-	0.1641		1.208
⁹² Y		91.90893	3.54 h	β ⁻ /3.63	3.64/	2-			0.4485 0.5611 0.9345 1.4054 (0.4 - 3.3)
^{93m} Y			0.82 s	I.T./0.759		9/2+			0.1686(IT)
⁹³ Y		92.90956	10.2 h	β ⁻ /2.87	2.88/90	1/2-			0.5902 0.2669 0.9471 1.9178
^{94m} Y			1.4 μs						0.4322 0.7699 1.2024
⁹⁴ Y		93.91160	18.7 m	β ⁻ /4.919	4.92/	2-			0.3816 0.9188 1.1389 (0.3 - 4.1)
⁹⁵ Y		94.91279	10.3 m	β ⁻ /4.42		1/2-			0.4324 0.9542 2.1760 3.5770
^{96m} Y			9.6 s	β ⁻ /		(3+)			0.1467 0.6174 0.9150 1.1071 1.7507
⁹⁶ Y		95.91588	6.2 s	β ⁻ /7.09	7.12/	0-			1.594
^{97m} Y			1.21 s	β ⁻ /7.4	4.8/ 6.0/	9/2+			0.1614 0.9700 1.1030
⁹⁷ Y		96.91813	3.76 s	β ⁻ /6.69	6.7	1/2-			0.2969 1.9960 3.2876 3.4013
^{98m} Y			2.1 s	β ⁻ /9.8	5.5/	(4-)			0.2415 0.6205 0.6473 1.2228 1.8016
⁹⁸ Y		97.92224	0.59 s	β ⁻ /8.83	8.7/	1+			0.2131 1.2228 1.5907 2.9413 4.4501
^{99m} Y			0.011 ms						
⁹⁹ Y		98.92463	1.47 s	β ⁻ /7.57 n	/2.5/	1/2-			0.1218/43.8 0.5362 0.7242

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{100m} Y			0.94 s	β^- ,n/		3+			1.0130
¹⁰⁰ Y		99.9278	0.73 s	β^- ,n/9.3	n/1.8/	1+			
¹⁰¹ Y		100.9303	0.43 s	β^- ,n/8.6	n/1.5/	(5/2)			
¹⁰² Y		101.9336	0.36 s	β^- ,n/9.9	n/4.0/				
¹⁰³ Y		102.9369	0.23 s	β^- ,n	n/8.3/				
¹⁰⁴ Y		103.9414	0.18 s						
¹⁰⁵ Y		104.9451	>0.15 μ s						
¹⁰⁶ Y		105.950	>0.15 μ s						
¹⁰⁷ Y			>0.15 μ s						
¹⁰⁸ Y			>0.15 μ s						
⁴⁰ Zr		91.224(2)							
⁷⁹ Zr		78.949	0.06 s						
⁸⁰ Zr		79.9406	4. s	β^+ /8.0					0.290 0.538
⁸¹ Zr		80.9368	5. s	β^+ /7.2	6.1	(3/2-)			
⁸² Zr		81.9311	32. s	β^+ /4.0	3.				ann.rad./
^{83m} Zr			7. s	β^+ /7.0		(7/2+)			ann.rad./
⁸³ Zr		82.9287	44. s	β^+ /5.9 EC	4.8	(1/2-)			ann.rad./ 0.0556 0.1050 0.2560 0.474 1.525
⁸⁴ Zr		83.9233	26. m	β^+ /2.7 EC/		0+			ann.rad./ 0.0449 0.1125 0.3729 0.667
^{85m} Zr			10.9 s	I.T./0.2922 β^+ ,EC/		1/2-			ann.rad./ 0.2922(IT) 0.4165
⁸⁵ Zr		84.9215	7.9 m	β^+ /4.7 EC/	3.1	7/2+			ann.rad./ 0.2663 0.4163 0.4543
⁸⁶ Zr		85.91647	16.5 h	EC/1.47		0+			0.0280 0.243 0.612
^{87m} Zr			14.0 s	I.T./0.3362		1/2-			0.1352(IT) 0.2010
⁸⁷ Zr		86.91482	1.73 h	β^+ /3.67 EC/	2.26	9/2+			ann.rad./ 0.3811 1.228
⁸⁸ Zr		87.91023	83.4 d	EC/0.67		0+			0.3929
^{89m} Zr			4.18 m	I.T./94/0.5877 β^+ /1.5/ EC/4.7/		1/2-			ann.rad./ 0.5877(IT) 1.507
⁸⁹ Zr		88.908889	3.27 d	β^+ /23/2.832 EC/77/	0.9/	9/2+	-1.07		ann.rad./ 0.9092
^{90m} Zr			0.809 s	I.T./		5-	6.3		0.1326 2.1862 2.3189(IT)
⁹⁰ Zr	51.45(40)	89.904702				0+			
⁹¹ Zr	11.22(5)	90.905643				5/2+	-1.30362	-0.21	
⁹² Zr	17.15(8)	91.905039				0+			
⁹³ Zr		92.906474	1.5x10 ⁶ y	β^- /0.091		5/2+			0.0304
⁹⁴ Zr	17.38(28)	93.906314	> 10 ¹⁷ y	β^- β^-		0+			
⁹⁵ Zr		94.908041	64.02 d	β^- /1.125	0.366/55	5/2+	1.13	+0.29	0.7242

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁹⁶ Zr	2.80(9)	95.908275	>2×10 ¹⁹ y	β-β-	0.400/44	0+			0.7567
⁹⁷ Zr		96.910950	16.8 h	β ⁻ /2.658	1.91/	1/2-			0.7434
⁹⁸ Zr		97.91276	30.7 s	β ⁻ /2.26	2.2/100	0+			
⁹⁹ Zr		98.91651	2.2 s	β ⁻ /4.56	3.9/	1/2+			0.4692/55.2
					3.5/				0.5459/48
									0.028-1.321
¹⁰⁰ Zr		99.91776	7.1 s	β ⁻ /3.34		0+			0.4006
									0.5043
¹⁰¹ Zr		100.92114	2.1 s	β ⁻ /5.49	6.2/	3/2-			0.1194
									0.2057
									0.2089
¹⁰² Zr		101.92298	2.9 s	β ⁻ /4.61					
¹⁰³ Zr		102.9266	1.3 s	β ⁻ /7.0					
¹⁰⁴ Zr		103.9288	1.2 s	β ⁻ /5.9					
¹⁰⁵ Zr		104.9331	≈1. s	β ⁻ /8.5					
¹⁰⁶ Zr		105.9359	>0.24 μs						
¹⁰⁷ Zr		106.941	>0.24 μs						
¹⁰⁸ Zr		107.944	>0.15 μs						
¹⁰⁹ Zr			>0.15 μs						
¹¹⁰ Zr			>0.15 μs						
⁴¹ Nb		92.90638(2)							
⁸¹ Nb		80.949	< 0.08 μs						
⁸² Nb		81.9431	50 ms	β ⁺ /11.					
⁸³ Nb		82.9367		β ⁺ /7.5					
⁸⁴ Nb		83.9336	12. s	β ⁺ ,EC/9.6		(3+)			
⁸⁵ Nb		84.9279	2.3 m	β ⁺ /6.0					
^{86m} Nb			56. s	β ⁺					
⁸⁶ Nb		85.9250	1.46 m	β ⁺ /8.0					ann.rad./
									0.751
									1.003
^{87m} Nb			3.7 m	β ⁺ /		1/2-			ann.rad./
				EC/					0.1352
									0.2010
⁸⁷ Nb		86.92036	2.6 m	β ⁺ 5.2/		(9/2+)			ann.rad./
				EC/					0.2010
									0.4706
									0.6165
									1.0665
									1.8842
^{88m} Nb			7.7 m	β ⁺ /		4-			ann.rad./
				EC/					0.2625
									0.3996
									1.0569
									1.0825
⁸⁸ Nb		87.9183	14.3 m	β ⁺ /7.6	3.2/	8+			ann.rad./
				EC/					1.0570
									1.0828
									(0.07 - 2.5)
^{89m} Nb			2.0 h	β ⁺ /	3.3/	9/2+			0.5880/10(D)
				EC/					(0.17 - 4.0)
⁸⁹ Nb		88.91349	1.10 h	β ⁺ /74/4.29	2.8/	1/2-	+6.216		ann.rad./
				EC/26/					0.5074
									0.5880
									0.7696
									1.2775
^{90m} Nb			18.8 s	I.T./0.1246		4-			0.002
									0.1225
⁹⁰ Nb		89.911263	14.6 h	β53/6.111	0.86/5	8+	4.961		ann.rad./

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
				EC/47/	1.5/92				0.1412
									1.1292
									2.1862
									2.3189
									(0.1 - 3.3)
^{91m} Nb			62. d	I.T./97/		1/2-			0.1045(IT)
				EC/3/					1.2050
⁹¹ Nb		90.906989	7x10 ² y	EC/1.253		9/2+			Mo k x-ray
^{92m} Nb			10.13 d	EC/99+/		2+	6.114		0.9126
									0.9345
									1.8475
⁹² Nb		91.907192	3.7x10 ⁷ y	EC/2.006		7+			0.5611
									0.9345
^{93m} Nb			16.1 y	I.T./0.0304		1/2-			Nb x-ray
									0.0304
⁹³ Nb	100.	92.906376				9/2+	+6.1705	-0.32	
^{94m} Nb			6.26 m	I.T./99+/2.086		3+			Nb k x-ray
				β ⁻ /0.5/					0.0409
									0.87109
⁹⁴ Nb		93.907282	2.4x10 ⁴ y	β ⁻ /2.045	0.47/	6+			0.70263
									0.87109
^{95m} Nb			3.61 d	I.T./97.5/	0.2357	1/2-			0.2040
				β ⁻ /2.5/					0.2356
⁹⁵ Nb		94.906834	34.97 d	β ⁻ /0.926	0.160/	9/2+	6.141		0.76578
⁹⁶ Nb		95.908099	23.4 h	β ⁻ /3.187	0.5/10	6+	4.976		0.7782
					0.75/90				0.2191-1.498
^{97m} Nb			58.1 s	I.T./0.7434	0.734/98	1/2-			0.7434
⁹⁷ Nb		96.908096	1.23 h	β ⁻ /1.934	1.27/98	9/2+	6.15		0.4809
									0.6579
^{98m} Nb			51. m	β ⁻ /4.67		5+			0.7874
									0.1726-1.89
⁹⁸ Nb		97.91033	2.9 s	β ⁻ /4.59	4.6/	1+			0.6451
									0.7874
									1.0243
^{99m} Nb			2.6 m	β ⁻ /	3.2/	1/2-			0.0978/100
									(0.138-3.010)
⁹⁹ Nb		98.91162	15.0 s	β ⁻ /3.64	3.5/100	9/2+			0.0977
									0.1378/3.1
^{100m2} Nb			0.013 ms						
^{100m1} Nb			3.0 s	β ⁻ /6.74	5.8				Nb k x-ray
									0.159
									0.6364
									1.0637
¹⁰⁰ Nb		99.91418	1.5 s	β ⁻ /6.25	6.2/				0.5354
					5.3/				0.6001-1.566
¹⁰¹ Nb		100.91525	7.1 s	β ⁻ /4.57	4.3/				0.1105-0.810
^{102m} Nb			4.3 s	β ⁻ /					
¹⁰² Nb		101.91804	1.3 s	β ⁻ /7.21	7.2/				0.2960-2.184
¹⁰³ Nb		102.91914	1.5 s	β ⁻ /5.53	5.3/	5/2+			
^{104m} Nb			0.9 s	β ⁻ ,n/	n/0.06				
¹⁰⁴ Nb		103.9225	4.8 s	β ⁻ ,n/8.1	n/0.05				
¹⁰⁵ Nb		104.9239	3.0 s	β ⁻ ,n/6.5	n/1.7				
¹⁰⁶ Nb		105.9282	1.0 s	β ⁻ ,n/9.3	n/4.5				
¹⁰⁷ Nb		106.9303	0.30 s	β ⁻ ,n/7.9	n/6.0				
¹⁰⁸ Nb		107.9350	0.19 s	β ⁻ ,n/	n/6.2				(0.193-0.590)
¹⁰⁹ Nb		108.9376	0.19 s	β ⁻ ,n/	n/31				
¹¹⁰ Nb		109.943	0.17 s	β ⁻ ,n/	n/40				
¹¹¹ Nb			>0.15 μs						
¹¹² Nb			>0.15 μs						

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹¹³ Nb			>0.15 μs						
⁴² Mo		95.94(1)							
⁸³ Mo		82.949							
⁸⁴ Mo		83.9401	>0.15 μs	β ⁺ /6.		(1/2-)			
⁸⁵ Mo		84.9366	3.2 s	β ⁺ /8.1					
⁸⁶ Mo		85.9302	20. s	β ⁺ /4.8					
⁸⁷ Mo		86.9273	14. s	EC, β ⁺ /6.5					(0.752-1.004)
⁸⁸ Mo		87.92195	8.0 m	β ⁺ /3.4		0+	+0.5		ann.rad./
				EC					0.0800
									0.1399
									0.1707
^{89m} Mo			0.19 s	I.T./0.118		1/2-			0.118(IT)
									0.268
⁸⁹ Mo		88.91948	2.2 m	β ⁺ /5.58		9/2+			ann.rad./
				EC/					0.659
									0.803
									1.155
									1.272
⁹⁰ Mo		89.91394	5.7 h	β ⁺ /25/2.489 1.085/		0+			ann.rad./
				EC/75/					0.04274
									0.12237
									0.25734
^{91m} Mo			1.08 m	I.T./50/0.653		1/2-			ann.rad./
				β ⁺ ,EC/50/	2.5/				0.6529
					2.8/				1.2081
					4.0/				1.5080
									2.2407
⁹¹ Mo		90.91175	15.5 m	β ⁺ /94/4.43	3.44/94	9/2-			ann.rad./
				EC/6/					1.6373
									2.6321
									3.0286
									(0.1 - 4.2)
⁹² Mo	14.84(35)	91.906810				0+			
^{93m} Mo			6.9 h	I.T./99+/2.425		21/2+	+9.21		0.26306(IT)
									0.68461
									1.47711
⁹³ Mo		92.906811	3.5x10 ³ y	EC/0.405		5/2+			0.0304
⁹⁴ Mo	9.25(12)	93.905087				0+			
⁹⁵ Mo	15.92(13)	94.905841				5/2+	-0.9142	-0.02	
⁹⁶ Mo	16.68(2)	95.904678				0+			
⁹⁷ Mo	9.55(8)	96.906020				5/2+	-0.9335	+0.26	
⁹⁸ Mo	24.13(31)	97.905407				0+			
⁹⁹ Mo		98.907711	2.7476 d	β ⁻ /1.357	0.45/14	1/2+	0.375		0.144048
					0.84/2				0.18109
					1.21/84				0.36644
									0.73947
¹⁰⁰ Mo	9.63(23)	99.90748	≈ 1x10 ¹⁹ y	β-β ⁻		0+			
¹⁰¹ Mo		100.91035	14.6 m	β ⁻ /2.82	2.23/	1/2+			0.0063
					0.7/				0.19193
									0.5909
									(0.0809-2.405)
¹⁰² Mo		101.91030	11.3 m	β ⁻ /1.01	1.2/	0+			0.1493/89.
									0.2116/100.
									0.2243/32.
¹⁰³ Mo		102.91320	1.13 m	β ⁻ /3.8		3/2+			0.1028(2)/
									0.1440(2)
									0.2511(2)
¹⁰⁴ Mo		103.91376	1.00 m	β ⁻ /2.16		0+			0.0686(1)/100.

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁰⁵ Mo		104.9170	36. s	β^- /4.95		3/2+			0.4239(4)/21. 0.0642/ 0.0856/ 0.2495/
¹⁰⁶ Mo		105.91814	8.4 s	β^- /3.52		0+			0.1894(2)/22. 0.3644(2)/6. 0.3723(2)/12.
¹⁰⁷ Mo		106.9217	3.5 s	β^- /6.2					
¹⁰⁸ Mo		107.9236	1.1 s	β^- /5.1					(0.028-0.636)
¹⁰⁹ Mo		108.9278	0.5 s	β^- /7.2					
¹¹⁰ Mo		109.9297	0.30 s	β^- /5.7					Tc k x-ray 0.142 (0.039-0.599)
¹¹¹ Mo		110.9345	>0.15 μ s						
¹¹² Mo		111.937	>0.15 μ s						
¹¹³ Mo		112.942	>0.15 μ s						
¹¹⁴ Mo			>0.15 μ s						
¹¹⁵ Mo			>0.15 μ s						
¹¹⁶ Mo			>0.15 μ s						
¹¹⁷ Mo			>0.15 μ s						
⁴³ Tc									
⁸⁵ Tc		84.949	< 0.1 ms						
⁸⁶ Tc		85.9430	0.05 s	β^+ /11.9					
⁸⁷ Tc		86.9365	>0.15 μ s	β^+ /8.6					
⁸⁸ Tc		87.9328	5.8 s	β^+ /10.1					
^{89m} Tc			13. s						
⁸⁹ Tc		88.9275	13. s	β^+ /7.5					
^{90m} Tc			49.2 s	β^+	5.3/	6+			ann.rad./ 0.9479/ 1.0542/
⁹⁰ Tc		89.9235	8.3 s	β^+ /8.9	7.0/15 7.9/95.	1+			ann.rad./ 0.9479/
^{91m} Tc			3.3 m	β^+ EC		1/2+			ann.rad./170. 0.8110(5)/5. 1.6052(1)/7.8 1.6339(1)/9.1 1.9023(1)/6. 2.4509(1)/13.5
⁹¹ Tc		90.9184	3.14 m	β^+ /6.2	5.2	9/2+			ann.rad./200.
⁹² Tc		91.91526	4.4 m	β^+ /7.87	4.1	8+			ann.rad./200. 0.0850/ 0.1475 0.3293 0.7731 1.5096
^{93m} Tc			43. m	I.T./13 EC/20		1/2-			0.3924(IT) 0.9437 2.6445
⁹³ Tc		92.910248	2.73 h	β^+ /13/3.201 EC/87/	0.81	9/2+	6.26		ann.rad./ 1.3629 1.4771 1.5203 (0.1 - 3.0)
^{94m} Tc			52. m	β^+ /72/4.33 EC/28/		2+			ann.rad./ 0.8710 1.8686
⁹⁴ Tc		93.909655	4.88 h	β^+ /11/4.256 EC/89/		7+	5.08		ann.rad./ 0.4491 0.7026

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.8496
									0.8710
^{95m} Tc			61. d	I.T./4/		1/2-			ann.rad./
				β ⁺ /0.3	0.5/				0.0389(IT)
				EC/96	0.7/				0.2041
									0.5821
									0.5821
									0.8351
⁹⁵ Tc		94.90766	20.0 h	EC/100/1.691		9/2+	5.89		0.7657
									1.0738
^{96m} Tc			52. m	I.T./90/		4+			0.0342(IT)
				β ⁺ ,EC/2/					0.7782
									1.2002
⁹⁶ Tc		95.90787	4.3 d	EC/2.973		7+	+5.04		Mo k x-ray
									0.7782
									0.8125
									0.8498
									1.12168
^{97m} Tc			91. d	I.T./0.0965		1/2-			Tc k x-ray
				EC	/3.9				0.0965
⁹⁷ Tc		96.906364	4.2x10 ⁶ y	EC/100/0.320		9/2+			Mo k x-ray
⁹⁸ Tc		97.907215	≈6.6x10 ⁶ y	β ⁻ /1.80	0.40/100	6+			0.65241
									0.74535
^{99m} Tc			6.01 h	I.T./100/0.142		1/2-			Tc k x-ray
									0.14049
									0.14261
⁹⁹ Tc		98.906254	2.13x10 ⁵ y	β ⁻ /0.294	0.293/100	9/2+	+5.6847	-0.129	
¹⁰⁰ Tc		99.907657	15.8 s	β ⁻ /3.202	2.2/	1+			0.5396
				EC/1.8(10) ⁻³ /0.17	2.9/				0.5908
					3.3				1.5122
									(0.3 - 2.6)
¹⁰¹ Tc		100.90731	14.2 m	β ⁻ /1.61	1.32/	9/2+			0.1272
									0.1841
									0.3068
									0.5451
									(0.073-0.969)
^{102m} Tc			4.4 m	I.T./2/4.8	1.8/				0.4184
				β ⁻ /98/					0.4752
									0.6281
									0.6302
									1.0464
									1.1033
									1.6163
									2.2447
¹⁰² Tc		101.90921	5.3 s	β ⁻ /4.53	3.4/	1+			0.4686
					4.2				0.4751
					2.2/				1.1055
¹⁰³ Tc		102.90918	54. s	β ⁻ /2.66	2.0/	5/2+			0.1361
					2.2/				0.1743
									0.2104
									0.3464
									0.5629
									(0.13 - 1.0)
^{104m} Tc			0.005 ms						
¹⁰⁴ Tc		103.91144	18.2 m	β ⁻ /5.60	5.3/	(3+)			0.3483
									0.3580
									0.5305

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Decay Mode/Energy (/MeV)	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.5351
									0.8844
									0.8931
									1.6768
									(0.3 - 3.7)
¹⁰⁵ Tc		104.91166	7.6 m	β ⁻ /3.6	3.4/	5/2+			0.1079
									0.1432
									0.3215
¹⁰⁶ Tc		105.91436	36. s	β ⁻ /6.55		2+			0.2703
									0.5222
									1.9694
									2.2393
									2.7893
¹⁰⁷ Tc		106.9151	21.2 s	β ⁻ /4.8					0.1027
									0.1063
									0.1770
¹⁰⁸ Tc		107.9185	5.1 s	β ⁻ /7.72		(3)			0.4587
									0.2422
									0.4656
									0.7078
									0.7326
									1.5835
¹⁰⁹ Tc		108.9200	1.4 s	β ⁻ /6.3	p/0.08				
¹¹⁰ Tc		109.9234	0.83 s	β ⁻ /8.8	p/0.04				0.2407
¹¹¹ Tc		110.9250	0.30 s	β ⁻ ,n/7.0	n/0.85				0.150/92.7
									0.063-1.435
¹¹² Tc		111.9292	0.26 s	β,n	n/2.6				
¹¹³ Tc		112.931	0.15 s	β ⁻ ,n/8.	/2.1				0.0985/100
									0.0658-1.520
¹¹⁴ Tc		113.936	0.15 s	β ⁻ ,n	/1.3				
¹¹⁵ Tc		114.938	>0.15 μs						
¹¹⁶ Tc			>0.15 μs						
¹¹⁷ Tc			>0.15 μs						
¹¹⁸ Tc			>0.15 μs						
⁴⁴ Ru		101.07(2)							
⁸⁷ Ru		86.949	>1.5 μs						
⁸⁸ Ru		87.9404	>0.15 μs			0 ⁺			
⁸⁹ Ru		88.936	1.2 s	β ⁺ ,p/8.					
⁹⁰ Ru		89.9298	11. s	β ⁺ /5.9		0 ⁺			ann.rad./
									0.155 - 1.551
⁹¹ Ru		90.9264	9. s	β ⁺ ,EC/7.4		9/2+			ann.rad./
⁹² Ru		91.9201	3.7 m	β ⁺ /53/4.5		0 ⁺			ann.rad./
				EC/47/					0.1346
									0.2138
									0.2593
^{93m} Ru			10.8 s	l.T./21/		1/2-			ann.rad./
				β ⁺ ,EC/79/	5.3/				0.7344
									1.1112
									1.3962
									2.0931
⁹³ Ru		92.9171	1.0 m	β ⁺ /6.3		9/2+			ann.rad./
				EC/					0.6807
									1.4349
									(0.5- 4.2)weak
⁹⁴ Ru		93.91137	52. m	EC/100/1.59		0 ⁺			0.3672
									0.5247
									0.8922
⁹⁵ Ru		94.91042	1.64 h	EC/85/2.57	1.20/	5/2+	0.86		ann.rad./
				β ⁺ /15/	0.91/				0.2904

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.3364
									0.6268
⁹⁶ Ru	5.52(20)	95.90760				0+			
⁹⁷ Ru		96.90756	2.89 d	EC/1.12		5/2+	-0.78		Tc k x-ray
									0.2157
									0.3245
									0.4606
⁹⁸ Ru	1.88(9)	97.90529				0+			
⁹⁹ Ru	12.74(26)	98.905939				5/2+	-0.6413	+0.079	
¹⁰⁰ Ru	12.60(19)	99.904219				0+			
¹⁰¹ Ru	17.05(7)	100.905582				5/2+	-0.7188	+0.46	
¹⁰² Ru	31.57(31)	101.904349				0+			
¹⁰³ Ru		102.906323	39.27 d	β^- /0.763	0.223	3/2+	0.206	+0.62	0.05329
									0.29498
									0.4438
									0.49708
									0.55704
									0.61033
									(0.04 - 1.6)
¹⁰⁴ Ru	18.66(44)	103.905430				0+			
¹⁰⁵ Ru		104.907750	4.44 h	β^- /1.917	1.11/22	3/2+	-0.3		0.12968
					1.134/13				0.1491
					1.187/49				0.2629
									0.31664
									0.46943
									0.67634
									0.72420
									(0.1 - 1.8)
¹⁰⁶ Ru		105.90733	1.020 y	β^- /0.0394	0.0394/100	0+			
¹⁰⁷ Ru		106.9099	3.8 m	β^- /2.9	2.1/				0.1939
					3.2/				0.3741
									0.4625
									0.8488
¹⁰⁸ Ru		107.9102	4.5 m	β^- /1.4	1.2/	0+			0.0923
									0.1651
									0.4339
									0.4975
									0.6189
¹⁰⁹ Ru		108.91320	34.5 s	β^- /4.2					0.1164
									0.3584
¹¹⁰ Ru		109.9140	15. s	β^- /2.81					0.1121
									0.3737
									0.4397
									0.7967
¹¹¹ Ru		110.9176	1.5 s	β^- /5.5					
¹¹² Ru		111.9188	4.5 s	β^- /4.5					
¹¹³ Ru		112.9225	2.7 s	β^- /7.					
¹¹⁴ Ru		113.9239	0.57 s	β^- /6.1					0.127/24
									(0.053-0.180)
¹¹⁵ Ru		114.928	≈0.74 s		β^- /8.				
¹¹⁶ Ru		115.930	>0.15 μs						
¹¹⁷ Ru		116.935	>0.15 μs						
¹¹⁸ Ru		117.937	>0.15 μs						
¹¹⁹ Ru			>0.15 μs						
¹²⁰ Ru			>0.15 μs						
⁴⁵ Rh		102.90550(2)							
⁸⁹ Rh		88.9494	>0.15 μs						
⁹⁰ Rh		89.9429	>0.15 μs						
⁹¹ Rh		90.9366	>0.15 μs						

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁹² Rh		91.9320	>0.15 μs	β ⁻ /11.1					
⁹³ Rh		92.9257	>0.15 μs	β ⁻ /8.1					(0.138-1.493)
^{94m} Rh			25.8 s	β ⁻ /		8+			ann.rad./
									0.1264
									0.3117
									0.7562
									1.0752
									1.4307
⁹⁴ Rh		93.9217	1.18 m	β ⁻ /9.6	6.4/	3+			ann.rad./
									0.1461
									0.3117
									0.7562
									1.4307
^{95m} Rh			1.96 m	I.T./88/ β ⁺ ,EC/12/		1/2+			ann.rad./
									0.5433(IT)
									0.7837
⁹⁵ Rh		94.9159	5.0 m	β ⁻ /5.1	3.2	9/2+			ann.rad./
									0.2293
									0.4103
									0.6610
									0.9416
									1.3520
									(0.2 - 3.8)
^{96m} Rh			1.51 m	I.T./60/0.052 β ⁺ ,EC/40/	4.70/	2+			ann.rad./
									Tc,Ru x-rays
									0.8326
									1.0985
									1.6921
									(0.4 - 3.3)
⁹⁶ Rh		95.91452	9.6 m	β ⁻ /6.45 EC/	3.3/	5+			ann.rad./
									0.4299
									0.6315
									0.6853
									0.7418
									0.8326
									(0.2 - 3.4)
^{97m} Rh			46.m	I.T./5/ β ⁺ ,EC/95/	2.6/	1/2-			ann.rad./
									0.1886
									0.4215
									2.2452
⁹⁷ Rh		96.91134	31.0m	β ⁻ /3.52	2.1/	9/2+			ann.rad./
									0.1886
									0.3892
									0.4515
									0.8398
									0.8788
									(0.2 - 3.5)
^{98m} Rh			3.5 m	β ⁺ /		5+			ann.rad./
									0.6154
									0.6524
									0.7452
⁹⁸ Rh		97.91072	8.7 m	β ⁻ /90/5.06	3.4/	2+			ann.rad./
									0.6524
									0.7623
^{99m} Rh			4.7 h	β ⁻ /8/ EC/92/	.74/	9/2+	5.67		ann.rad./
									0.2766/
									0.3408
									0.6178
									1.2612

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁹⁹ Rh		98.90820	16. d	$\beta^+ / 4.2.10$ EC/97/	0.54/ 0.68/	1/2-			ann.rad./ 0.0894/ 0.3530 0.5277 (0.1 - 2.0)
^{100m} Rh			4.7 m	I.T./99/ $\beta^+ / 0.4/$		5+			ann.rad./ 0.0748/ 0.2647(IT)
¹⁰⁰ Rh		99.90812	20.8 h	$\beta^+ / 3.63$ EC/	2.62/ 2.07/	1-			0.4462 0.5396 0.5882 0.8225 1.5534 2.3761
^{101m} Rh			4.35 d	EC/92/ I.T./8/0.1573		9/2+	+5.51		Rh k x-ray 0.1272/ 0.3069 0.5451
¹⁰¹ Rh		100.90616	3.3 y	EC/0.54		1/2-			Ru k x-ray 0.1272 0.1980 0.3252
^{102m} Rh			3.74 y	EC/2.323 IT/0.0419		6*	4.04		0.4751 0.6313 0.6975 0.7668 1.0466 1.1032
¹⁰² Rh		101.906842	207. d	EC/62 $\beta^- / 19/$ $\beta^+ / 14/$			0.5		ann.rad./ 0.4686 0.4751 0.5566 0.6280 1.1032 (0.4 - 1.6)
^{103m} Rh			56.12 m	IT		7/2+	4.54		
¹⁰³ Rh	100.	102.905504				1/2-	-0.0884		
^{104m} Rh			4.36 m	I.T./99+/ β^-	1.3/	5+			Rh k x-ray 0.0514 0.0971 0.5558
¹⁰⁴ Rh		103.906655	42.3 s	$\beta^- / 99+2.441$ EC/0.4/1.141	1.88/2 2.44/98	1+			0.3581 0.5558 1.2370 (0.35 - 1.8)
^{105m} Rh			43. s	I.T./1.296		1/2-			Rh k x-ray 0.1296
¹⁰⁵ Rh		104.905692	35.4 h	$\beta^- / 0.567$	0.247/30 0.567/70	7/2+	+4.45		0.2801 0.3061 0.3189
^{106m} Rh			2.18 h	$\beta^- /$	0.92/	6+			0.2217 0.4510 0.5119 0.6162 0.7173 0.7484 1.0458 1.5277
¹⁰⁶ Rh		105.90729	29.9 s	$\beta^- / 3.54$	2.4/2	1+	+2.58		0.51186/

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					3.0/12			0.61612	
					3.54/79			0.62187	
								(0.05 - 3.04)	
¹⁰⁷ Rh		106.90675	21.7 m	β^- /1.51	1.20/65	7/2+		0.2776	
					1.5/17			0.3028	
								0.3925	
^{108m} Rh			6.0 m	β^- /	1.57/			0.4339	
								0.4973	
								0.6189	
¹⁰⁸ Rh		107.9087	17. s	β^- /4.5		1+		0.4046	
								0.4339	
								0.4973	
								0.5811	
								0.6146	
								0.9014	
								0.9471	
¹⁰⁹ Rh		108.90874	1.34 m	β^- /2.59	2.25/	7/2+		0.1134	
								0.1780	
								0.2914	
								0.3254	
								0.3268	
								0.4261	
								(0.1 - 1.6)	
^{110m} Rh			29. s	β^- /	0.6/			0.3737	
								0.4397	
								0.7967	
¹¹⁰ Rh		109.9110	3.1 s	β^- /5.4	5.5/	1+		0.3737	
								0.4400	
								0.5463	
								0.6877	
								0.8381	
								0.9045	
¹¹¹ Rh		110.9117	11. s	β^- /3.7				0.275	
^{112m} Rh			6.8 s	β^- /					
¹¹² Rh		111.9140	3.5 s	β^- /6.2		1+		0.3489	
¹¹³ Rh		112.9154	0.9 s	β^- /4.9				0.1285	
^{114m} Rh			1.8 s	β^- /					
¹¹⁴ Rh		113.9173	1.8 s	β^- /6.5		1+			
¹¹⁵ Rh		114.9201	0.99 s	β^- /6.0					
^{116m} Rh			0.9 s	β^- /				0.3405	
¹¹⁶ Rh		115.9228	0.7 s	β^- /8.0		1+			
¹¹⁷ Rh		116.925	0.44 s	β^- /7.				0.0346	
								0.1317	
¹¹⁸ Rh		117.929	>0.15 μ s						
¹¹⁹ Rh		118.931	>0.15 μ s						
¹²⁰ Rh		119.936	>0.15 μ s						
¹²¹ Rh		120.938	>0.15 μ s						
¹²² Rh									
⁴⁶ Pd		106.42(1)							
⁹¹ Pd		90.949	>1.5 μ s						
⁹² Pd		91.9404	>0.15 μ s						
⁹³ Pd		92.9359	0.9 s	β^+ ,p				0.240/81	
								0.382-0.864	
⁹⁴ Pd		93.9288	9. s	EC, β^+ / \approx 6.6				0.5582	
								(0.0546-0.798)	
^{95m} Pd		94.92684	13.4 s	EC, β^+ /10.2		21/2+			
⁹⁵ Pd									
⁹⁶ Pd		95.9182	2.03 m	EC, β^+ /3.5	1.15/			0.1248	
								0.4995	

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
⁹⁷ Pd		96.9165	3.1 m	β^+ /EC/4.8	3.5/	5/2+			ann.rad./ 0.2653 0.4752 0.7927 (0.2 - 3.4)
⁹⁸ Pd		97.91273	17.7 m	β^+ /1.87 EC/		0+			ann.rad./ 0.0677 0.1125 0.6630 0.8379
⁹⁹ Pd		98.91181	21.4 m	β^+ /49/3.37 EC/51/	2.18/	5/2+			ann.rad./ 0.1360 0.2636 0.6734 (0.2 - 2.85)
¹⁰⁰ Pd		99.90851	3.7 d	EC/0.36		0+			0.03271 0.0748 0.0840
¹⁰¹ Pd		100.90829	8.4 h	β^+ /5/1.980 EC/95/	0.776/	5/2+	-0.66		ann.rad./ 0.0244 0.2963 0.5904
¹⁰² Pd	1.02(1)	101.905607				0+			
¹⁰³ Pd		102.906087	16.99 d	EC/0.543		5/2+			Rh k x-ray 0.03975 0.3575 0.4971
¹⁰⁴ Pd	11.14(8)	103.904034				0+			
¹⁰⁵ Pd	22.33(8)	104.905083				5/2+	-0.642	+0.66	
¹⁰⁶ Pd	27.33(3)	105.903484				0+			
^{107m} Pd			20.9 s	I.T./0.2149		11/2-			Pd k x-ray 0.2149(IT)
¹⁰⁷ Pd		106.90513	6.5x10 ⁶ y	β^- /0.033	0.03/	5/2+			
¹⁰⁸ Pd	26.46(9)	107.903895				0+			
^{109m} Pd			4.75 m	I.T./0.1889		11/2-			Pd x-ray 0.1889(IT)
¹⁰⁹ Pd		108.905954	13.5 h	β^- /1.116	1.028	5/2+			0.0880 (0.08 - 1.0)
¹¹⁰ Pd	11.72(9)	109.905153				0+			
^{111m} Pd			5.5 h	I.T./73/0.172 β^- /27/	0.35 0.77	11/2-			0.0704 0.1722 0.3912 (0.1 - 1.97)
¹¹¹ Pd		110.90764	23.4 m	β^- /2.19	2.2/95	5/2+			0.0598 0.2454 0.5800 0.6504 1.3885 1.4590
¹¹² Pd		111.90731	21.04 h	β^- /0.29	0.28/	0+			0.018
^{113m} Pd			1.48 m	β^- /		5/2+			0.0959
¹¹³ Pd		112.91015	1.64 m	β^- /3.34					0.0958 0.4824 0.6436 0.7394
¹¹⁴ Pd		113.91037	2.48 m	β^- /1.45		0+			0.1266 0.2320 0.5582 0.5760

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹¹⁵ Pd		114.9137	47. s	β^- /4.58					0.1255
									0.2554
									0.3428
¹¹⁶ Pd		115.9142	12.7 s	β^- /2.61					0.1015
									0.1147
									0.1778
¹¹⁷ Pd		116.9178	4.4 s	β^- /5.7					0.2473
									0.077-0.403
¹¹⁸ Pd		117.9189	2.4 s	β^- /4.1					0.1254
									0.028-0.596
¹¹⁹ Pd		118.9227	0.9 s	β^- /6.5					0.2566
									0.070-0.326
¹²⁰ Pd		119.9240	0.5 s	β^- /5.0					0.1581
									0.053-0.595
¹²¹ Pd		120.9282	>0.24 μ s						
¹²² Pd		121.9298	>0.24 μ s						
¹²³ Pd		122.934	>0.15 μ s						
¹²⁴ Pd									
⁴⁷ Ag		107.8682(2)							
⁹³ Ag									
⁹⁴ Ag		93.9428	0.42 s	β^+ , p/					
⁹⁵ Ag		94.9355	2.0 s	β^+ , p/					(0.539-2.025)
⁹⁶ Ag		95.9307	5.1 s	β^+ /11.6					ann.rad./
				EC/					0.1248
									0.4995
									(0.1066-1.416)
⁹⁷ Ag		96.9240	19. s	β^+ /7.0					ann.rad./
				EC/					0.6862
									1.2941
									(0.352-3.294)
⁹⁸ Ag		97.9218	47. s	β^+ /8.4		5+			ann.rad./
				EC/					0.5711
									0.6786
									0.8631
									(0.153-1.185)
^{99m} Ag			11. s	I.T./100/		1/2-			Ag k x-ray
									0.1636(IT)
									0.3426
⁹⁹ Ag		98.9176	2.07 m	β^+ /87/5.4		9/2+			ann.rad./
				EC/13/					0.2199
									0.2645
									0.8056
									0.8323
									(0.2 - 3.5)
^{100m} Ag			2.3 m	β^+ /		2+			ann.rad./
				EC/					0.6657
									1.6941
¹⁰⁰ Ag		99.9161	2.0m	β^+ /7.1	4.7/	5+			ann.rad./
				EC/					0.2807
									0.4503
									0.6657
									0.7508
									0.7732
^{101m} Ag			3.1 s	I.T./0.23		1/2-			Ag k x-ray
									0.0981
									0.176(IT)
¹⁰¹ Ag		100.9128	11.1 m	β^+ /69/4.2	2.7/	9/2+	5.7		ann.rad./
				EC/31/					0.2610
					2.18/				0.2747

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.3269
									0.4392
									0.6673
									1.1739
									(0.2 - 3.1)
^{102m} Ag			7.8 m	β ⁺ /38/ EC/13/ I.T./49/	3.4	2+	+4.14		ann.rad./ 0.5567 0.9777 1.8347 2.0545 2.1594 3.2386
¹⁰² Ag		101.91197	13.0 m	β ⁻ /78/5.92 EC/22/	2.26/	5+	4.6		ann.rad./ 0.5567 0.7194 0.8354 1.2571 1.5816 1.7446
^{103m} Ag			5.7 s	I.T./0.134		1/2-			Ag k x-ray 0.1344
¹⁰³ Ag		102.90897	1.10 h	β ⁺ /28/2.69 EC/72/	1.7 1.3	7/2+	+4.47		ann.rad./ 0.1187 0.1482
^{104m} Ag			33. m	β ⁺ /64/ EC/36/ I.T./0.07/	2.71/	2+	+3.7		ann.rad./ 0.5558 0.7657 (0.5 - 3.4)
¹⁰⁴ Ag		103.90863	69. m	β ⁺ /16/4.28 EC/84/	0.99/	5+	3.92		ann.rad./ 0.5558 0.9259 0.9416 (0.18 - 2.27)
^{105m} Ag			7.2 m	I.T./98/0.0255 EC/2/		7/2+	+4.41		Ag x-ray 0.3063 0.3192 (0.1 - 1.0)
¹⁰⁵ Ag		104.90653	41.3 d	EC/1.35		1/2-	0.1014		0.0640 0.2804 0.3445 0.4434
^{106m} Ag			8.4 d	EC/		6+	3.71	+1.1	Pd k x-ray 0.4510 0.5118 0.7173 1.0458
¹⁰⁶ Ag		105.90667	24.0 m	β ⁺ /59/2.965 EC/41/	/1.96	1+	+2.85		ann.rad./ 0.5119
^{107m} Ag			44.2 s	I.T./0.093		7/2+	+4.40	1.0	Ag x-ray 0.0931
¹⁰⁷ Ag	51.839(8)	106.905093				1/2-	-0.11357		
^{108m} Ag			418.y	EC/92/ I.T./8/0.079		6+	3.580	+1.3	Ag k x-ray Pd k x-ray 0.43392 0.61427 0.72290
¹⁰⁸ Ag		107.905954	2.39 m	β ⁻ /97/1.65 EC/2/ β ⁻ /1/1.92	1.02/1.7 1.65/96 0.88/0.3	1+	+2.6884		ann.rad./ 0.43392 0.61885

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{109m} Ag			39.8 s	I.T./0.088		7/2+	+4.40	+1.0	0.63298 Ag k x-ray 0.0880
¹⁰⁹ Ag	48.161(8)	108.904756				1/2-	-0.13069		
^{110m} Ag			249.8 d	β^- /99/ I.T./1/0.1164	0.087 0.530	6+	+3.60	+1.4	0.65774 0.76393 0.88467 0.93748 1.38427 (0.447-1.56)
¹¹⁰ Ag		109.906111	24.6 s	β^- /2.892	2.22/5 2.89/95	1+	+2.7271	0.2	0.65774 0.8154 1.1257
^{111m} Ag			1.08 m	IT/99/0.0598 β^- /1/	7/2+				Ag k x-ray 0.0598 0.2454
¹¹¹ Ag		110.905295	7.47 d	β^- /1.037	1.035/	1/2-	-0.146		0.2454 0.3421
¹¹² Ag		111.90701	3.13 h	β^- /3.96	3.94/ 3.4	2-	0.0547		0.6067 0.6174 1.3877 (0.4 - 2.9)
^{113m} Ag			1.14 m	I.T./80/0.043 β^- /20/	7/2+ 1.5				0.1422 0.2983 0.3161 0.3923
¹¹³ Ag		112.90657	5.3 h	β^- /2.02	2.01/	1/2-	0.159		0.2588 0.2986
¹¹⁴ Ag		113.90881	4.6 s	β^- /5.08	4.9/	1+			0.5582 0.5760 1.9946
^{115m} Ag			18.7 s	β^- /		7/2+			0.1134 0.1315 0.2288 0.3887
¹¹⁵ Ag		114.90876	20. m	β^- /3.10		1/2-			0.1316 0.2128 0.2291 0.4727 (0.13 - 2.49)
^{116m} Ag			10.5 s	I.T./2/ β^- /98/	3.2/ 2.9	5+			0.1027 0.2549 0.5134 0.7055 1.0289
¹¹⁶ Ag		115.91137	2.68 m	β^- /6.16	5.3	2-			0.5134 0.6993 2.4779
^{117m} Ag			5.3 s	β^- /	3.2/	7/2+			0.1354 0.2981 0.3868
¹¹⁷ Ag		116.91171	1.22 m	β^- /4.18	2.3	1/2-			0.1354 0.1571 0.3377
^{118m} Ag			2.8 s	β^- /59/ I.T./41/0.1277					0.1277 0.4878 0.6771 0.7709 1.0586

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹¹⁸ Ag		117.9145	4.0 s	β^- /7.1					0.4878 0.6771 3.2259
¹¹⁹ Ag		118.9157	2.1 s	β^- /5.35		7/2+			0.0674 0.3662 0.3991 0.6264
^{120m} Ag			0.32 s	β^- / I.T./					0.2030 0.5059 0.6978 0.8300 0.9258
¹²⁰ Ag		119.9188	1.23 s	β^- /8.2					0.5059 0.6978 0.8171 1.3231
¹²¹ Ag		120.9198	0.78 s	β^- /6.4					0.1150 0.3148 0.3537 0.3696 0.5007 1.5105 (0.11 - 2.5)
^{122m} Ag			1. s	β^- / I.T./					
¹²² Ag		121.9233	0.44 s	β^- /9.2					
¹²³ Ag		122.9249	0.31 s	β^- /7.4					
¹²⁴ Ag		123.9285	0.22 s	β^- /10.1					
¹²⁵ Ag		124.9305	0.17 s	β^-					
¹²⁶ Ag		125.9345	0.11 s	β^-					
¹²⁷ Ag		126.9369	0.11 s	β^-					
¹²⁸ Ag			58 ms	β^-					
¹²⁹ Ag			0.05 s	β^- ,n					
₄₈ Cd		112.411(8)							
⁹⁶ Cd		95.9398							
⁹⁷ Cd		96.9349	3. s	β^+ ,(p)					
⁹⁸ Cd		97.9276	9.2 s	β^+ /5.4 (p)	/0.025				
⁹⁹ Cd		98.9250	16. s	β^+ ,EC/6.9					ann.rad./
¹⁰⁰ Cd		99.9203	1.1 m	β^+ ,EC/3.9					ann.rad./ (0.090-1.043)
¹⁰¹ Cd		100.9187	1.2 m	β^+ /83/5.5 EC/17/	4.5	5/2+			ln k x-ray 0.0985 1.7225 0.31 - 2.84)
¹⁰² Cd		101.91474	5.8 m	β^+ /27/2.59 EC/73		0+			ann.rad./ 0.0974 0.4810 1.0366 1.3598
¹⁰³ Cd		102.91342	7.5 m	β^+ /33/4.14 EC/67/		5/2+	-0.81	-0.8	ann.rad./ Ag k x-ray 1.0799 1.4487 1.4618 (0.1 - 2.8)
¹⁰⁴ Cd		103.90985	58. m	EC/1.14		0+			Ag k x-ray 0.0835 0.7093
¹⁰⁵ Cd		104.90947	55.5 m	β^+ /26/2.739	1.69/	5/2+	-0.7393	+0.43	Ag k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV) EC/74/	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.3469
									0.6072
									0.9618
									1.3025
									(0.25 - 2.4)
¹⁰⁶ Cd	1.25(6)	105.90646	>2.6x10 ¹⁷ y	β ⁺ ,EC		0+			
¹⁰⁷ Cd		106.90661	6.52 h	EC/99+/1.417 β ⁺ /		5/2+	-0.615055	+0.68	Ag k x-ray 0.0931 0.8289
¹⁰⁸ Cd	0.89(3)	107.90418				0+			
¹⁰⁹ Cd		108.904985	462.0 d	EC/0.214		5/2+	-0.827846	+0.69	Ag k x-ray 0.08804
¹¹⁰ Cd	12.49(18)	109.903006				0+			
^{111m} Cd			48.5 m	I.T./		11/2-			Cd k x-ray 0.1508(IT) 0.2454
¹¹¹ Cd	12.80(12)	110.904182				1/2+	-0.594886		
¹¹² Cd	24.13(21)	111.902758				0+			
^{113m} Cd			14.1 y	β ⁻ /99.9/0.59	0.59/99.9	11/2-	-1.087	-0.71	0.2637
¹¹³ Cd	12.22(12)	112.904401	7.7x10 ¹⁵ y	β ⁻		1/2+	-0.622301		
¹¹⁴ Cd	28.73(42)	113.903359				0+			
^{115m} Cd			44.6 d	β ⁻ /1.629	0.68/1.6 1.62/97	11/2-	-1.042	-0.54	0.48450 0.93381 1.29064
¹¹⁵ Cd		114.905431	2.228 d	β ⁻ /1.446	0.593/42 1.11/58	1/2+	-0.648426		0.23141 0.26085 0.33624 0.49227 0.52780
¹¹⁶ Cd	7.49(18)	115.904756	2.3x10 ¹⁹ y	β ⁻ β ⁻		0+			
^{117m} Cd			3.4 h	β ⁻ /2.66	0.72/	11/2-			0.1586 0.5529 0.37 - 2.42
¹¹⁷ Cd		116.907219	2.49 h	β ⁻ /2.52	0.67/51 2.2/10	1/2+			0.2209 0.2733 0.3445 1.3033
¹¹⁸ Cd		117.90692	50.3 m	β ⁻ /0.52		0+			
^{119m} Cd			2.20 m	β ⁻ /		11/2-			0.1056 0.7208 1.0250 2.0213
¹¹⁹ Cd		118.90992	2.69 m	β ⁻ /3.8	= 3.5/	1/2+			0.1340 0.2929 0.3429
¹²⁰ Cd		119.90985	50.8 s	β ⁻ /1.76	1.5/	0+			
^{121m} Cd			8. s	β ⁻ /		11/2-			0.1008 0.9878 1.0209 1.1815 2.0594
¹²¹ Cd		120.9131	13.5 s	β ⁻ /4.9		(3/2+)			0.2102 0.3242 0.3492 1.0403
¹²² Cd		121.9135	5.3 s	β ⁻ /3.0		0+			
^{123m} Cd			1.9 s	β ⁻ /					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹²³ Cd		122.91770	2.09 s	β^- /6.12		3+			
¹²⁴ Cd		123.9177	1.24 s	β^- /4.17		0+			0.0365 0.0628 0.1799
^{125m} Cd			0.66 s	β^- /					
¹²⁵ Cd		124.92129	0.68 s	β^- /7.16		3/+			
¹²⁶ Cd		125.9224	0.52 s	β^- /5.49		0+			0.2601
¹²⁷ Cd		126.9264	0.4 s	β^- /8.5		3/+			
¹²⁸ Cd		127.9278	0.28 s	β^- /7.1		0+			0.247
¹²⁹ Cd		128.9323	0.27 s	β^- /5.9					0.281
¹³⁰ Cd		129.9340	0.20 s	β^- /		0+			
¹³¹ Cd			68 ms	p/	/3.5				
¹³² Cd			0.10 ms	p/	/60				
⁴⁹ In		114.818(3)							
⁹⁸ In		97.9422	>1.5 μ s						
⁹⁹ In		98.9346	>0.15 μ s	β^- /8.9					
¹⁰⁰ In		99.9316	6. s	β^- , (p)/10.5					
¹⁰¹ In		100.9266	15. s	β^- /7.3					
¹⁰² In		101.9243	22. s	EC/8.9		(5)			0.1566 0.7767 (0.397-0.923)
^{103m} In			34. s						
¹⁰³ In		102.91991	1.1 m	β^- , EC/6.05 EC	4.2 /45	9/2+			ann.rad./ 0.1879 (0.157-3.98)
^{104m} In			16. s	IT/0.0935					
¹⁰⁴ In		103.9183	1.84 m	β^- , EC/7.9	4.8	5+	+4.44	+0.7	ann.rad./ 0.6580 0.8341 0.8781
^{105m} In			43. s	I.T.		1/2-			In k x-ray 0.6740
¹⁰⁵ In		104.91467	5.1 m	β^- , EC/4.85	3.7	9/2+	+5.675	+0.83	0.1310 0.2600 0.6038
^{106m} In			5.3 m	β^- /85/ EC/15/	4.90	3+			ann.rad./ 0.6326 0.8611 1.7164
¹⁰⁶ In		105.91346	6.2 m	β^- /65/6.52 EC/35/	2.6	7+	+4.92	+0.97	ann.rad./ 0.2259 0.6327 0.8611 0.9978 1.0091
^{107m} In			51. s	I.T./0.6786		1/2-			In k x-ray 0.6785
¹⁰⁷ In		106.91029	32.4 m	β^- /35/3.43 E.C/65/	2.20/	9/2+	+5.59	+0.81	ann.rad./ Cd k x-ray 0.2050 0.3209 0.5055 (0.2 - 2.99)
^{108m} In			57. m	β^- /53/ EC/47/	1.3	6+	+4.94	+0.47	ann.rad./ Cd k x-ray 0.6329 1.9863 3.4522
¹⁰⁸ In		107.90971	40. m	β^- /33/5.15	3.49/	3+	+4.56	+1.01	ann.rad./

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV) EC/67/	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									Cd k x-ray
									0.2429
									0.6331
									0.8756
^{109m} In			1.3 m	I.T./0.650		1/2-			In k x-ray
									0.6498
¹⁰⁹ In		108.90715	4.2 h	β ⁺ /8/2.02 EC/92/	0.79/	9/2+	+5.54	+0.84	ann.rad./
									Cd k x-ray
									0.2035
									0.6235
^{110m} In			4.9 h	EC/		7+	+4.72	+1.00	Cd k x-ray
									0.6577
									0.8847
									0.9375
									(0.1 - 1.98)
¹¹⁰ In		109.90717	1.15 h	β ⁺ /62/3.88 EC/38/	2.22/	2+	+4.37	+0.35	ann.rad./
									Cd k x-ray
									0.6577
									(0.6 - 3.6)
^{111m} In			7.7 m	I.T./0.537		1/2-	+5.53		In k x-ray
									0.537
¹¹¹ In		110.90511	2.8049 d	EC/0.866		9/2+	+5.50	+0.80	Cd k x-ray
									0.1712
									0.2453
^{112m} In			20.8 m	I.T./0.155		4+			In k x-ray
									0.1555
¹¹² In		111.90553	14.4 m	β ⁺ /22/2.586 EC/34/ β ⁻ /0.663		1+	+2.82	+0.09	ann.rad./
									Cd k x-ray
									0.6171
^{113m} In			1.658 h	I.T./0.3917		1/2-	-0.210		In k x-ray
									0.3917
¹¹³ In	4.29(5)	112.904062				9/2+	+5.529	+0.80	
^{114m} In			49.51 d	I.T./97/0.190 EC/3/		5+	+4.65	+0.74	In k x-ray
									0.19027
¹¹⁴ In		113.904918	1.198 m	β ⁻ /97/1.989 EC/3/1.453	1.984/	1+	+2.82		Cd k x-ray
									0.5584
									0.5727
									1.2998
^{115m} In			4.486 h	I.T./95/0.336 β ⁻ /5/0.83		1/2-	-0.255		In k x-ray
									0.3362
									0.4974
¹¹⁵ In	95.71(5)	114.903879	4.4x10 ¹⁴ y	β ⁻ /0.495		9/2+	+5.541	+0.81	
^{116m2} In			2.16 s	I.T./0.162 EC	/0.023	8-	+3.22	+0.31	In k x-ray
									0.1624
^{116m1} In			54.1 m	β ⁻ /	1.0	5+	+4.43	+0.80	0.13792
									0.41688/27
									1.09723/58.5
									1.29349/85
¹¹⁶ In		115.905261	14.1 s	β ⁻ /3.274	3.3/99	1+	2.788	0.11	0.46313
									1.2526
									1.29349
^{117m} In			1.94 h	β ⁻ /53/1.769 I.T./47/	1.77/	1/2-	-0.2517		In k x-ray
									0.15855
									0.31531
									0.55294
¹¹⁷ In		116.90452	44. m	β ⁻ /1.455	0.74/	9/2+	+5.52	+0.83	0.15855
									0.3966
									0.55294
^{118m2} In			8.5 s	I.T./98/		(8-)	+3.32	+0.44	In k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{118m1} In			4.40 m	β^- /2/	1.3	5+	+4.23	+0.80	0.1382
				β^- /7	2.0				0.2086
									0.6833
									1.2295
¹¹⁸ In	117.90636		5.0 s	β^- /4.42	4.2/	1+			0.5282
									1.1734
									1.2295
									2.0432
^{119m} In			17.9 m	β^- /97/	2.7/	1/2-	-0.32		0.3114
				I.T./3/0.311					0.7631
¹¹⁹ In	118.90585		2.3 m	β^- /2.36	1.6/	9/2+	+5.52	+0.85	0.0239
									0.6495
									0.7631
									1.2149
^{120m2} In			47 s	β^- /6.1		8-	+3.692	+0.53	1.171
									1.023
^{120m1} In			46. s	β^- /5.8	2.2/	5+	+4.30	+0.81	1.171
									1.023
¹²⁰ In	119.90796		3.1 s	β^- /5.37	5.6/	(1+)			0.4146
					3.1/				0.5924
									0.8637
									1.0232
									1.1714
									(0.4 - 2.7)
^{121m} In			3.8 m	β^- /99/	3.7/	1/2-	-0.36		0.0601
				I.T./1/0.313					0.3136
									0.9256
									1.0412
									1.1022
									1.1204
¹²¹ In	120.90785		23. s	β^- /3.36	2.5	9/2+	+5.50	+0.81	0.2620
									0.6573
									0.9256
^{122m} In			10. s	β^- /7	4.4/	8-	+3.78	+0.59	1.0014
									1.1403
¹²² In	121.91028		1.5 s	β^- /6.37	5.3/	(1+)			0.2391
									1.0014
									1.1403
									1.164
									1.1903
^{123m} In			47. s	β^- /7	4.6/	(1/2-)	-0.40		0.1258
									1.170
									3.234
¹²³ In	122.91044		6.0 s	β^- /4.39	3.3/	(9/2+)	+5.49	+0.76	0.6188
									1.0197
									1.1305
^{124m} In			3.4 s	β^-		8-	+3.89	+0.66	0.1029
									0.9699
									1.0729
									1.1316
¹²⁴ In	123.91318		3.18 s	β^- /7.36	5/	3+	+4.04	+0.61	0.7070
									0.9978
									1.1316
									3.2142
									(0.3 - 4.6)
^{125m} In			12.2 s	β^- /7	5.5/	1/2-	-0.43		0.1876
¹²⁵ In	124.91360		2.33 s	β^- /5.42	4.1/	9/2+	+5.50	+0.71	0.4260
									1.0318
									1.3350

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{126m} In			1.53 s		4.9/	3+	+4.03	+0.49	0.9086
									0.9696
									1.1411
¹²⁶ In		125.91646	1.63 s	β^- /8.21	4.2/	8-	+4.06		0.1118
									0.9086
									1.1411
^{127m} In			3.73 s	β^- /	6.4/	(1/2-)			0.2523
									3.074
¹²⁷ In		126.91734	1.14 s	β^- /6.51	4.9/	(9/2+)	+5.52	+0.59	0.4680
									0.6461
									0.8051
									1.5977
^{128m} In			0.7 s	β^- /	5.4/	(8-)			1.8670
									1.9739
									(0.1205-2.12)
¹²⁸ In		127.92017	0.80 s	β^- /8.98	5.0/	3+			0.9352
									1.1688
									3.5198
									4.2970
^{129m} In			1.23 s	β^- /98/ n/2/	= 7.5/	1/2-			0.3153
									0.9067
									1.2220
¹²⁹ In		128.9217	0.63 s	β^- /7.66	5.5/	9/2+			0.2853
									0.7693
									1.8650
									2.1180
^{130m2} In			0.53 s	β^- /	8.8/	5+			0.0892
									0.7744
									1.2212
^{130m1} In			0.51 s	β^- /	6.1/	10-			0.0892
									0.1298
									0.7744
									1.2212
									1.9052
¹³⁰ In		129.92486	0.29 s	β^- /10.25	10.0/	1-			
^{131m2} In			0.3 s	β^- /		(21/ 2+)			
^{131m1} In			0.35 s	β^- /		(1/2-)			
¹³¹ In		130.9268	0.28 s	β^- /9.18	6.4/	(9/2+)			0.3328
									2.433
¹³² In		131.9323	0.20 s	β^- /13.6	6.0/	(7-)			0.1320
					8.8/				0.2992
									0.3747
									4.0406
¹³³ In		132.9383	0.18 s	β^- , (n)					
¹³⁴ In		133.9447	0.14 s						(0.354-2.005)
¹³⁵ In									
⁵⁰ Sn		118.710(7)							
¹⁰⁰ Sn		99.9394	≈ 0.9 s	β^+ /7.3	3.4/				
¹⁰¹ Sn		100.9361	3. s	β^+ /9.					
¹⁰² Sn		101.9243	≈ 5 s	β^+ /5.8					
¹⁰³ Sn		102.9281	7. s	β^+ /7.7					
¹⁰⁴ Sn		103.9232	21. s	β^+ , EC/4.5					
¹⁰⁵ Sn		104.9214	28. s	β^+ /6.3					In-x-ray
									(0.2879-3.819)
¹⁰⁶ Sn		105.91688	2.0 m	β^+ /20/3.18					ann.rad./
				EC/80/					In k x-ray
									0.3865
									0.4772

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy (/Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁰⁷ Sn		106.9157	2.92 m	EC/5.0	1.2/				0.4218
				β ⁺ /					0.6105
									0.6785
									1.0013
									1.1290
									1.542
¹⁰⁸ Sn		107.91196	10.3 m	β ⁺ /1.2.09	0.36/	0+			ln k x-ray
				EC/99/					0.2724
									0.3965
									(0.105-1.68)
¹⁰⁹ Sn		108.91129	18.0 m	β ⁺ /9/3.85	1.52/	7/2+	-1.08	+0.3	ann.rad./
				EC/91/					ln k x-ray
									0.6498
									1.0992
¹¹⁰ Sn		109.90785	4.1 h	EC/0.64		0+			ln k x-ray
									0.283
¹¹¹ Sn		110.90774	35. m	β ⁺ /31/2.45	1.5/	7/2+	+0.61	+0.2	ln k x-ray
				EC/69/					0.7620
									1.1530
									1.9147
¹¹² Sn	0.97(1)	111.904822				0+			
^{113m} Sn			21.4 m	I.T./92/0.077		7/2+			Sn k x-ray
				EC/8/					ln x-ray
									0.0774
¹¹³ Sn		112.905174	115.1 d	EC/1.036		1/2+	-0.879		ln k x-ray
									0.25511
									0.39169
¹¹⁴ Sn	0.65(1)	113.902783				0+			
¹¹⁵ Sn	0.34(1)	114.903347				1/2+	-0.9188		
¹¹⁶ Sn	14.54(9)	115.901745				0+			
^{117m} Sn			13.60 d	I.T./0.3146		11/2-	-1.396	-0.4	Sn k x-ray
									0.15856
¹¹⁷ Sn	7.68(7)	116.902955				1/2+	-1.0010		
¹¹⁸ Sn	24.22(9)	117.901608				0+			
^{119m} Sn			293. d	I.T./0.0896		11/2-	-1.4	0.21	Sn k x-ray
									0.02387
¹¹⁹ Sn	8.59(4)	118.903311				1/2+	-1.0473		
¹²⁰ Sn	32.59(9)	119.902199				0+			
^{121m} Sn			≈ 55. y	I.T./78/0.006		11/2-	-1.388	-0.14	Sn k x-ray
				β ⁻ /22/	0.354/				0.03715
¹²¹ Sn		120.904239	1.128 d	β ⁻ /0.388	0.383/100	3/2+	0.698	-0.02	
¹²² Sn	4.63(3)	121.903441				0+			
^{123m} Sn			40.1 m	β ⁻ /1.428	1.26/99	3/2+			0.1603
									0.3814
¹²³ Sn		122.905723	129.2 d	β ⁻ /1.404	1.42/99.4	11/2-	-1.370	+0.03	0.1603
									1.0302
									1.0886
¹²⁴ Sn	5.79(5)	123.905275				0+			
^{125m} Sn			9.51 m	β ⁻ /2.387	2.03/98	3/2+			0.3321
									1.4040
¹²⁵ Sn		124.907785	9.63 d	β ⁻ /2.364	2.35/82	11/2-	-1.35	+0.1	1.0671
									(0.2-2.3)
¹²⁶ Sn		125.90765	2.34x10 ⁶ y	β ⁻ /0.38	0.25/100	0+			0.0643
									0.0876
									0.4148
									0.6663
									0.6950
^{127m} Sn			4.15 m	β ⁻ /3.21	2.72/	3/2+			0.4909
									1.3480

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹²⁷ Sn		126.91035	2.12 h	β^- /3.20	2.42/ 3.2/	11/2-			1.5640 0.8231 1.0956 (0.120-2.84)
^{128m} Sn			6.5 s	IT/0.091		(7-)			
¹²⁸ Sn		127.91054	59.1 m	β^- /1.27	0.48/ 0.63/	0+			0.4823 0.5573 0.6805
^{129m} Sn			6.9 m	β^- /		11/2-			1.1611
¹²⁹ Sn		128.9134	2.4 m	β^- /4.0		3/2+			0.6456
^{130m} Sn			1.7 m	β^- /		(7-)			0.1449 0.8992
¹³⁰ Sn		129.91386	3.7 m	β^- /2.15	1.10/	0+			0.0700 0.1925 0.7798
^{131m} Sn			1.02m	β^- /	3.4/	11/2-			0.3043 0.4500 0.7985 1.2260 (0.08 - 3.21)
¹³¹ Sn		130.9169	39. s	β^- /4.69	3.8/	3/2+			see ^{131m} Sn
¹³² Sn		131.91775	40. s	β^- /3.12	1.8/				0.0855 0.2467 0.3402 0.8985
¹³³ Sn		132.9236	1.44 s	β^- /7.8	7.5/	7/2-			
¹³⁴ Sn		133.9278	1.04 s	β^- /6.8					
¹³⁵ Sn		134.9347	>0.15 μ s						
¹³⁶ Sn		135.9393	>0.15 μ s						
¹³⁷ Sn		136.946	>0.15 μ s						
⁵¹ Sb		121.760(1)							
¹⁰³ Sb		102.9401	>1.5 μ s						
¹⁰⁴ Sb		103.9363	0.5 s						
¹⁰⁵ Sb		104.9315	1.1 s						
¹⁰⁶ Sb		105.9288	0.6 s	β^+ /10.5					
¹⁰⁷ Sb		106.9242	\approx 4.6 s	β^+ /7.9					(0.253-2.154)
¹⁰⁸ Sb		107.9222	7.0 s	β^+ /9.5					(0.151-1.280)
¹⁰⁹ Sb		108.91814	17. s	β^+ /6.38	4.42/ EC/ 4.67/ 4.33/	5/2+			0.6645/63 0.9254/100 1.0617/75 0.247-1.495
¹¹⁰ Sb		109.9175	24. s	β^+ /9.0	6.8/	3+			ann.rad./ 0.6365 0.9847 1.2117 1.2433
¹¹¹ Sb		110.91254	1.25 m	β^+ /87/4.47	3.3/	5/2+			ann.rad./ 0.1002 0.1545 0.4891 1.0326
¹¹² Sb		111.91240	51.4 s	β^+ /90/7.06	4.75/	3+			ann.rad./ 0.6700 0.9909 1.2571 (0.3 - 3.6)
¹¹³ Sb		112.90937	6.7 m	β^+ /65/3.91	2.42/	5/2+			ann.rad./ EC/35/ Sn k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.3324
									0.4980
¹¹⁴ Sb		113.9091	3.49 m	β^+ /78/5.9 EC/22/	3.4/	3+	1.7		ann.rad./ Sn k x-ray 0.8876
									1.2999
¹¹⁵ Sb		114.90660	32.1 m	β^+ /67/3.03 EC/33/	1.51/	5/2+	+3.46	-0.4	ann.rad./ Sn k x-ray 0.4973
^{116m} Sb			1.00 h	β^+ /78/ EC/22/	1.16/	8-	2.6		ann.rad./ Sn k x-ray 0.4073 0.5429 0.9725 1.2935
									(0.0998-1.501)
¹¹⁶ Sb		115.90680	16. m	β^+ /50/4.707 EC/50/	1.3/ 2.3/	3+	2.72		ann.rad./ Sn k x-ray 0.93180 1.29354
									(0.138-3.903)
¹¹⁷ Sb		116.90484	2.80 h	β^+ /2/1.76 EC/98/	0.57/	5/2+	+3.4		Sn k x-ray 0.1586
^{118m} Sb			5.00 h	EC/99/		8-	2.3		Sn k x-ray 0.25368 1.05069 1.22964
¹¹⁸ Sb		117.905533	3.6 m	β^+ /74/3.657 EC/26/	2.65/	1+	2.5		ann.rad./ Sn k x-ray 1.22964
¹¹⁹ Sb		118.90395	38.1 h	EC/0.59		5/2+	+3.45	-0.4	Sn k x-ray 0.0239
^{120m} Sb			5.76 d	EC/		8-	2.34		Sn k x-ray 0.0898 0.19730 1.02301 1.17121
¹²⁰ Sb		119.90508	15.89 m	β^+ /41/2.68 EC/59/	1.72/	1+	+2.3		ann.rad./ Sn k x-ray 0.7038 1.17121
¹²¹ Sb	57.21(5)	120.903822				5/2+	+3.363	-0.4	
^{122m} Sb			4.19 m	I.T./0.162		8-			Sb x-ray 0.0614 0.0761
¹²² Sb		121.90518	2.72 d	β^- /98/1.979 β^+ /2/1.620	1.414/65 1.980/26	2-	-1.90	+0.9	0.56409 0.69277 1.14050 1.2569
¹²³ Sb	42.79(5)	122.904216				7/2+	+2.550	-0.5	
^{124m2} Sb			20.3 m	I.T./0.035		8-			
^{124m1} Sb			1.6 m	I.T./80/ β^- /20/	1.2/ 1.7/	5+			0.4984 0.6027 0.6458 1.1010
¹²⁴ Sb		123.905938	60.20 d	β^- /2.905	0.61/52 2.301/23	3-	1.2	+1.9	0.60271/97.8 0.64583/7.4 0.72277/10.5 1.69094/48.2

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%) (0.0274-2.808)
¹²⁵ Sb		124.905247	2.758 y	β^- /0.767	0.13/30	7/2+	+2.63		0.0355
					0.302/45				0.17632
					0.62/13				0.38044
									0.42786
									0.46336
^{126m2} Sb			11. s	I.T./		3-			0.60060
									0.63595
									L x-ray
^{126m1} Sb			19.0 m	β^- /86/ I.T./14/	1.9	5+			0.0227
									0.4148
									0.6663
¹²⁶ Sb		125.90725	12.4 d	β^- /3.67	1.9	8-	1.3		0.6950
									0.2786
									0.4148/83.3
									0.6663/99.7
									0.6950/99
¹²⁷ Sb		126.906914	3.84 d	β^- /1.581	0.89/	7/2+	2.70		0.7205
					1.10/				0.2524
					1.50/				0.2908
									0.4121
									0.4370
^{128m} Sb			10.1 m	β^- /96/ I.T./4/	2.6/	5+			0.6857
									0.7837
									0.3140
									0.5941
									0.7432
¹²⁸ Sb		127.90917	9.1 h	β^- /4.38	2.3/	8-	1.3		0.7539
									0.2148
									0.3141
									0.5265
									0.7433
^{129m} Sb			17.7 m	β^- /					0.7540
									0.4338
									0.6578
									0.7598
									0.7598
¹²⁹ Sb		128.90915	4.40 h	β^- /2.38	0.65/	7/2-	2.82		0.0278
									0.1808
									0.3594
									0.4596
									0.5447
									0.8128
									0.9146
									1.0301
									0.1023
									0.7934
0.8394									
^{130m} Sb			6.5 m	β^- /2.6	2.12/				0.1823
									0.3309
									0.4680
									0.7394
									0.8394
¹³⁰ Sb		129.91155	38.4 m	β^- /4.96	2.9/	8-			0.1823
									0.3309
									0.4680
									0.7394
									0.8394
¹³¹ Sb		130.9120	23.0 m	β^- /3.20	1.31/	7/2+			0.6423
					3.0/				0.6579
									0.9331
									0.9434
									0.9434
^{132m} Sb			2.8 m	β^- /	3.9/	4+			0.1034
									0.3538
									0.6968

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.9739
									0.9896
¹³² Sb		131.91420	4.2 m	β^- /5.49		8-			0.1034
									0.1506
									0.6968
									0.9739
¹³³ Sb		132.9152	2.5 m	β^- /4.00	1.20/	7/2+	3.00		0.4235
									0.6318
									0.8165
									1.0764
^{134m} Sb			10.4 s	β^- /	6.1	7-			
¹³⁴ Sb		133.9206	0.8 s	β^- /8.4	8.4	0-			0.1152
									0.2970
									0.7063
									1.2791
¹³⁵ Sb		134.9252	1.71 s	β^- /8.12		7/2+			1.127
									1.279
¹³⁶ Sb		135.9301	0.82 s	β^- /9.3					
¹³⁷ Sb		136.9353	>0.15 μ s						
¹³⁸ Sb		137.9410	>0.15 μ s						
¹³⁹ Sb		138.946	>0.15 μ s						
⁵² Te		127.60(3)							
¹⁰⁶ Te		105.9377	0.06 ms	α /4.32					
¹⁰⁷ Te		106.9350	3.1 ms	α /70/	3.86(1)/				
				β^+ ,EC/10.1					
¹⁰⁸ Te		107.9295	2.1 s	α /68/	3.314(4)/	0+			
				β^+ ,EC/32/6.8					
¹⁰⁹ Te		108.9275	4.6 s	β^+ EC/96/8.7					
				α /4/	3.107(4)/				
¹¹⁰ Te		109.9224	19. s	β^+ ,EC/4.5		0+			ann.rad./
									0.2191
									0.6059
¹¹¹ Te		110.9211	19.3 s	β^+ ,EC/8.0		(7/2+)			ann.rad./
									0.267
									0.322
									0.341
¹¹² Te		111.9171	2.0 m	β^+ ,EC/4.3		0+			ann.rad./
									0.2962
									0.3727
									0.4187
¹¹³ Te		112.9154	1.7 s	β^+ /85/5.7	4.5/	(7/2+)			ann.rad./
				EC/15/					Sb k x-ray
									0.8144
									1.0181
									1.1812
¹¹⁴ Te		113.9125	15. m	β^+ /40/3.2		0+			ann.rad./
				EC/60/					Sb k x-ray
									0.0838
									0.0903
^{115m} Te			6.7 m	β^+ /45/		(1/2+)			ann.rad./
				EC/55/					Sb k x-ray
									0.7236
									0.7704
¹¹⁵ Te		114.9116	5.8 m	β^+ /45/4.6	2.7/	7/2+			ann.rad./
				EC/55/					Sb k x-ray
									0.7236
									1.3268
									1.3806
									(0.22 - 2.7)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹¹⁶ Te		115.9084	2.49 h	EC/1.5		0+			Sb k x-ray 0.0937
¹¹⁷ Te		116.90864	1.03 h	EC/75/3.54 $\beta^+/25/$	1.78/	1/2+			ann.rad./ Sb k x-ray 0.9197 1.7164 2.3000
¹¹⁸ Te		117.90583	6.00 d	EC/0.28		0+			Sb k x-ray
^{119m} Te			4.69 d	EC/		11/2-	0.89		Sb k x-ray 0.15360 0.2705 1.21271
¹¹⁹ Te		118.90641	16.0 h	$\beta^+/2/2.293$ EC/98/	0.627/	1/2+	0.25		ann.rad. Sb k x-ray 0.6440 0.6998
¹²⁰ Te	0.09(1)	119.90403				0+			
^{121m} Te			$\approx 154. d$	I.T.(89%) EC(11%)		11/2-	0.90		Te k x-ray 0.2122
¹²¹ Te		120.90494	16.8 d	EC/1.04		1/2+			Sb k x-ray 0.5076 0.5731
¹²² Te	2.55(12)	121.903056				0+			
^{123m} Te			119.7 d	I.T./0.247		11/2-	-0.93		Te k x-ray 0.1590/84.1
¹²³ Te	0.89(3)	122.904271	2.4x10 ¹⁹ y	EC/0.051		1/2+	-0.73695		
¹²⁴ Te	4.74(14)	123.902819				0+			
^{125m} Te			58. d	I.T./0.145		11/2-	-0.99	-0.06	Te k x-ray 0.0355
¹²⁵ Te	7.07(15)	124.904424				1/2+	-0.8885		
¹²⁶ Te	18.84(25)	125.903305				0+			
^{127m} Te			109. d	I.T./98/0.088 $\beta^-/2/0.77$		11/2-	-1.04		Te k x-ray 0.0883
¹²⁷ Te		126.905217	9.4 h	$\beta^-/0.698$	0.696/	3/2+	0.64		0.3603
¹²⁸ Te	31.74(8)	127.904462	>0.6x10 ²³ y	$\beta^-\beta^-$		0+			
^{129m} Te			33.6 d	I.T./63/0.105 $\beta^-/37/$	1.60/	11/2-	-1.09		Te k x-ray 0.45984 0.6959
¹²⁹ Te		128.906596	1.16 h	$\beta^-/1.498$	0.99/9 1.45/89	3/2+	0.70	0.06	0.0278 0.45984 0.48728
¹³⁰ Te	34.08(62)	129.906223	$\approx 2 \times 10^{21}$ y	$\beta^-\beta^-$		0+			
^{131m} Te			1.35 d	$\beta^-/78/2.4$ I.T./22/0.18	0.42/	11/2-	-1.04		0.0811 0.1021 0.14973 0.77369 0.79375 0.85225
¹³¹ Te		130.908522	25.0 m	$\beta^-/2.233$	1.35/12 1.69/22 2.14/60	3/2+	0.70		0.14973 0.45327 0.49269
¹³² Te		131.90852	3.26 d	$\beta^-/0.51$	0.215	0+			0.049725 0.11198 0.22830
^{133m} Te			55.4 m	$\beta^-/82/$ I.T./18/0.334	2.4/30	11/2-			Te k x-ray 0.0949 0.1689 0.3121

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹³³ Te		132.9109	12.4 m	β^- /2.94	2.25/25 2.65	3/2+			0.3341 0.3121 0.4079 1.3334
¹³⁴ Te		133.9116	42. m	β^- /1.51	0.6/ 0.7/	0+			0.7672/29 0.0794-0.9255
¹³⁵ Te		134.9165	19.0 s	β^- /6.0	5.4/ 6.0				0.267 0.603 0.870
¹³⁶ Te		135.92010	17.5 s	β^- /5.1	2.5/	0+			2.0779/25 0.0873-3.235
¹³⁷ Te		136.9253	2.5 s	β^- /98/6.9 n/2/	6.8	7/2-			0.2436
¹³⁸ Te		137.9292	1.4 s	β^- /6.4					
¹³⁹ Te		138.9347	>0.15 μ s						
¹⁴⁰ Te		139.9387	>0.15 μ s						
¹⁴¹ Te		140.9444	>0.15 μ s						
¹⁴² Te		141.949	>0.15 μ s						
⁵³ I		126.90447(3)							
¹⁰⁸ I		107.9436	0.04 s	α /91/4.	3.95				
¹⁰⁹ I		108.9382	0.11 ms	p					0.593/100 0.717/63 0.496-1.057
¹¹⁰ I		109.9346	0.65 s	β^+ ,EC/83/11.4 α /17/≈3.6 p/11/	3.457(10)/				ann.rad./
¹¹¹ I		110.9303	2.5 s	β^+ ,E./8.5					ann.rad./ 0.2665 0.3215 0.3412
¹¹² I		111.9280	3.4 s	β^+ ,EC/10.2					ann.rad./ 0.6889 0.7869
¹¹³ I		112.9237	5.9 s	β^+ ,EC/7.6					ann.rad./ 0.4625/100 0.6224/74 0.0550-1.422
¹¹⁴ I		113.9219	2.1 s	β^+ ,EC/8.7					ann.rad./ 0.6826 0.7088
¹¹⁵ I		114.9188	1.3 m	β^+ ,EC/6.7		5/2+			ann.rad./ 0.275 0.284 0.460 0.709
¹¹⁶ I		115.9167	2.9 s	β^+ /97/7.8 EC/3/	6.7/	1+			ann.rad./ 0.5402 0.6789
¹¹⁷ I		116.9136	2.22 m	β^+ ,EC/4.7	3.2/	(5/2+)	3.1		ann.rad./ 0.2744 0.3259
^{118m} I			8.5 m	β^+ ,EC/ I.T.	4.9/	7-	4.2		ann.rad./ 0.104 0.5998 0.6052 0.6138
¹¹⁸ I		117.9134	14. m	β^+ ,EC/7.0		2-	2.0		ann.rad./ 0.5448 0.6052

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹¹⁹ I		118.9102	19. m	β^+ /54/3.5 EC/46/	2.4/ 4.60	(5/2+)	+2.9		1.3384 ann.rad./ Te k x-ray 0.2575
^{120m} I			53. m	β^+ /80/ EC/20/	3.8		4.2		ann.rad. Te k x-ray 0.4257 0.5604 0.6147 1.3459
¹²⁰ I		119.91005	1.35 h	β^+ /56/5.62 EC/	4.03 4.60	2-	1.23		ann.rad./ Te k x-ray 0.5604 0.6411 1.5230 (0.43 - 3.1)
¹²¹ I		120.90737	2.12 h	β^+ /13/2.27 EC/87/	1.2/	5/2+	2.3		ann.rad./ Te k x-ray 0.2122 (0.14 - 1.1)
¹²² I		121.90760	3.6 m	β^+ /4.234 EC/	3.1/	1+	+0.94		ann.rad./ Te k x-ray 0.5641
¹²³ I		122.905605	13.2 h	EC/1.242		5/2+	2.82		Te k x-ray 0.1590
¹²⁴ I		123.906211	4.18 d	β^+ /23/3.160 EC/77/	1.54/ 2.14/ 0.75/	2-	1.44		ann.rad./ Te k x-ray 0.6027/62.9 0.7228/10.3 1.6910/11.2 (0.31-1.73)
¹²⁵ I		124.904624	59.4 d	EC/0.1861		5/2+	2.82	-0.89	Te k x-ray 0.0355
¹²⁶ I		125.905619	13.0 d	EC/ β^+ /2.155 β^- /1.258/47	1.13/ 0.87/ 1.25/	2-	1.44		ann.rad./ Te k x-ray 0.3887 0.6622
¹²⁷ I	100.	126.904468				5/2+	+2.8133	-0.79	
¹²⁸ I		127.905805	25.00 m	β^- /2.118 EC/1.251	2.13/	1+			Te k x-ray 0.44287 0.52658
¹²⁹ I		128.904988	1.7x10 ⁷ y	β^- /0.194	0.15/	7/2+	+2.621	-0.55	Xe k x-ray 0.0396
^{130m} I			9.0 m	I.T./83/0.048 β^- /17/		2+			I k x-ray 0.5361
¹³⁰ I		129.906674	12.36 h	β^- /2.949	1.04/ 0.62	5+	3.35		0.4180 0.5361 0.6685 0.7395
¹³¹ I		130.906125	8.040 d	β^- /0.971	0.606/	7/2+	+2.742	-0.40	0.08017 0.28431 0.36446 0.63699
^{132m} I			1.39 h	IT		8-			
¹³² I		131.90800	2.28 h	β^- /14/3.58 I.T./86/	0.80/ 1.03/ 1.2/ 1.6/ 2.16/	4+	3.09	0.09	I k x-ray 0.0980 0.5059 0.52264 0.63019

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.6506
									0.66768
									0.77260
									0.95457
^{133m} I			9. s	I.T./1.63		19/2-			1 k x-ray
									0.0730
									0.6474
									0.9126
¹³³ I		132.90781	20.8 h	β ⁻ /1.77	1.24/85	7/2+	+2.86	-0.27	0.51056
									0.52989
									0.87537
^{134m} I			3.7 m	I.T./98/0.316		8-			1 k x-ray
				β ⁻ /2/					0.0444
									0.2719
¹³⁴ I		133.9099	52.6 m	β ⁻ /4.05	1.2/	4+			0.1354
									0.84702
									0.88409
¹³⁵ I		134.91005	6.57 h	β ⁻ /2.63	0.9/	7/2+	2.94		0.2884
					1.3/				0.41768
									0.52658
									1.13156
									1.26046
^{136m} I			47. s	β ⁻ /	4.7/	6-			0.1973
					5.2/				0.3468
									0.3701
									0.3814
									1.3130
									(0.16 - 2.36)
¹³⁶ I		135.91466	1.39 m	β ⁻ /6.93	4.3/	2-			0.3447
					5.6/				1.3130
									1.3211
									2.2896
									(0.3 - 6.1)
¹³⁷ I		136.91787	24.5 s	β ⁻ /5.88	5.0/	(7/2+)			0.6010
									1.2180
									1.2201
									1.3026
									1.5343
									(0.25 - 4.4)
¹³⁸ I		137.9224	6.5 s	β ⁻ /7.8	6.9/	2-			0.4836
					7.4/				0.5888
									0.8752
									(0.4 - 5.3)
¹³⁹ I		138.92609	2.30 s	β ⁻ /6.81					0.192
				n/					0.198
									0.273
									0.382
									0.386
									0.468
									0.683
									1.313
¹⁴⁰ I		139.9310	0.86 s	β ⁻ /8.8		(3)			0.372
				n/					0.377
									0.457
¹⁴¹ I		140.9351	0.45 s	β ⁻ /7.8					
¹⁴² I		141.9402	≈ 0.2 s	β ⁻					
¹⁴³ I		142.9441	>0.15 μs						
¹⁴⁴ I		143.9496	>0.15 μs						
⁵⁴ Xe		131.293(6)							

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹¹⁰ Xe		109.9445	0.2 s	$\beta^-/9.2$					
^{111m} Xe			0.9 s	EC, β^+					
¹¹¹ Xe		110.9416	0.7 s	EC, $\beta^-/10.6$					
				$\alpha/$	3.58(1)/				
¹¹² Xe		111.9357	3. s	EC, $\beta^-/7.2$ $\alpha/0.8/$					
¹¹³ Xe		112.9334	2.8 s	EC, $\beta^-/9.1$					
¹¹⁴ Xe		113.9281	10.0 s	β^- ,EC/5.9		0+			ann.rad./ 0.1031 0.1616 0.3085 0.6826 0.7088
¹¹⁵ Xe		114.9270	18. s	β^- ,EC/7.6		(5/2+)			ann.rad./
¹¹⁶ Xe		115.9214	56. s	β^- ,EC/4.3	3.3/	0+			ann.rad./ 0.1042 0.1916 0.2477 0.3107 0.4127
¹¹⁷ Xe		116.9206	1.02 m	β^- ,EC/6.5		(5/2+)	-0.594	+1.16	ann.rad./ 0.2214 0.5190 0.6389 0.6613
¹¹⁸ Xe		117.917	\approx 4. m	β^- ,EC/3.	2.7/	0+			ann.rad./ 0.0535 0.0600 0.1199
¹¹⁹ Xe		118.9156	5.8 m	β^- ,EC/5.0	3.5/	7/2+	-0.654	+1.31	0.0873 0.1000 0.2318 0.4615
¹²⁰ Xe		119.91216	40. m	β^- ,EC/97/1.96 $\beta^-/3/$		0+			l k x-ray 0.0251 0.0726 0.1781 (0.1 - 1.03)
¹²¹ Xe		120.91138	39. m	$\beta^-/44/3.73$ EC/56/	2.8/	5/2+	-0.701	+1.33	ann.rad./ l k x-ray 0.1328 0.2527 0.4452 (0.1 - 3.1)
¹²² Xe		121.9086	20.1 h	EC/0.9		0+			l k x-ray 0.3501
¹²³ Xe		122.90848	2.00 h	$\beta^-/23/2.68$ EC/77/	1.51/	1/2+	-0.150		ann.rad./ l k x-ray 0.1489 0.1781 (0.1 - 2.1)
¹²⁴ Xe	0.09(1)	123.905895	$> 10^{17}$ y	β^-					
^{125m} Xe			57. s	I.T./0.252		(9/2-)	-0.745	+0.42	Xe k x-ray 0.1111 0.141
¹²⁵ Xe		124.906398	17.1 h	EC/1.653	0.47/	1/2+	-0.269		l k x-ray 0.1884 0.2434
¹²⁶ Xe	0.09(1)	125.90427				0+			
^{127m} Xe			1.15 m	I.T./0.297		(9/2-)	-0.884	+0.69	Xe k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.1246
									0.1725
¹²⁷ Xe		126.905179	36.4 d	EC/0.662		1/2+	-0.504		l k x-ray
									0.1721
									0.2029
									0.3750
¹²⁸ Xe	1.92(3)	127.903531				0+			
^{129m} Xe			8.89 d	I.T./0.236		11/2-	-0.891	+0.64	Xe k x-ray
									0.0396
									0.1966
¹²⁹ Xe	26.44(24)	128.904780				1/2+	-0.7780		
¹³⁰ Xe	4.08(2)	129.903509				0+			
^{131m} Xe			11.9 d	I.T./0.164		11/2-	-0.9940	+0.73	Xe k x-ray
									0.16398
¹³¹ Xe	21.18(3)	130.905083				3/2+	+0.69186	-0.12	
¹³² Xe	26.89(6)	131.904155				0+			
^{133m} Xe			2.19 d	I.T./0.233		11/2-	-1.082	+0.77	Xe k x-ray
									0.23325
¹³³ Xe		132.905906	5.243 d	β ⁻ /0.427	0.346/99	3/2+	+0.813	+0.14	Cs k x-ray
									0.080998
									0.1606
¹³⁴ Xe	10.44(10)	133.905395				0+			
^{135m} Xe			15.3 m	I.T./		11/2-	1.103	+0.62	Xe k x-ray
									0.52658
¹³⁵ Xe		134.90721	9.10 h	β ⁻ /1.15	0.91/	3/2+	0.903	+0.21	0.24975
									0.60807
¹³⁶ Xe	8.87(16)	135.90722	>0.8×10 ²¹ y	β ⁻ β ⁻		0+			
¹³⁷ Xe		136.91156	3.82 m	β ⁻ /4.17	4.1/ 3.6/	7/2-	-0.970	-0.49	0.45549
									0.8489
									0.9822
									1.2732
									1.7834
									2.8498
¹³⁸ Xe		137.91399	14.1 m	β ⁻ /2.77	0.8/ 2.4/	0+			0.1538
									0.2426
									0.2583
									0.4345
									1.76826
									2.0158
¹³⁹ Xe		138.91879	39.7 s	β ⁻ /5.06	4.5/ 5.0/		-0.304	+0.40	0.1750
									0.2186
									0.2965
									(0.1 - 3.37)
¹⁴⁰ Xe		139.9216	13.6 s	β ⁻ /4.1	2.6	0+			0.0801
									0.6220
									0.8055
									1.4137
									(0.04 - 2.3)
¹⁴¹ Xe		140.9267	1.72 s	β ⁻ /6.2	6.2/	5/2+	+0.010	-0.58	0.1187
									0.9095
									(0.05 - 2.55)
¹⁴² Xe		141.9297	1.22 s	β ⁻ /5.0	3.7/ 4.2/	0+			0.0338
									0.0729
									0.2038
									0.3091
									0.4145
									0.5382
									0.5718

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.6181
									0.6448
^{143m} Xe			0.96 s	β^-					
¹⁴³ Xe		142.9352	0.30 s	β^- /7.3			-0.460	+0.93	
¹⁴⁴ Xe		143.9385	1.2 s	β^- /6.1					
¹⁴⁵ Xe		144.9437	0.9 s	β^- , (n)					
¹⁴⁶ Xe		145.9473	>0.15 μ s						
¹⁴⁷ Xe		146.9530	>0.15 μ s						
⁵⁵ Cs		132.90545(2)							
¹¹² Cs		111.9503	0.5 ms	p	0.81				
¹¹³ Cs		112.9445	17. μ s	p	0.96				
¹¹⁴ Cs		113.9408	0.58 s	β^+ ,EC/11.8		1+			ann.rad./ 0.6826 0.7088
¹¹⁵ Cs		114.9359	\approx 1.4 s	β^+ ,EC/8.4					ann.rad./
^{116m} Cs			0.7 s	β^- ,EC/					ann.rad./ 0.3935
¹¹⁶ Cs		115.9330	3.8 s	β^+ ,EC/10.8					ann.rad./ 0.3935 0.5243 0.6151 0.6223
^{117m} Cs			6.5 s	β^+ ,EC/					
¹¹⁷ Cs		116.9286	\approx 8.4 s	β^+ ,EC/7.5					ann.rad./
^{118m} Cs			17. s	β^+ ,EC/			5.		
¹¹⁸ Cs		117.92654	14. s	β^+ ,EC/9.		2	+3.88	+1.4	ann.rad./ 0.3372 0.4727 0.5865 0.5906
^{119m} Cs			28. s			3/2	+0.84	+0.9	
¹¹⁹ Cs		118.92234	38. s	β^+ ,EC/6.3		9/2+	+5.5	+2.8	ann.rad./ 0.169 0.176 0.224 0.257
^{120m} Cs			60. s	β^+ ,EC/					
¹²⁰ Cs		119.92066	64. s	β^+ ,EC/7.92		2+	+3.87	+1.45	ann.rad./ 0.3224 0.4735 0.5534 (0.3 - 3.28)
^{121m} Cs			2.0 m	I.T./60/ β^+ /40/	4.4	(9/2+)	+5.41	+2.7	ann.rad./ 0.1794 0.1961
¹²¹ Cs		120.91718	2.3 m	β^+ ,EC/5.40	4.38/	3/2+	+0.77	+0.84	ann.rad./ 0.1537 (0.08 - 0.56)
^{122m2} Cs			4.4 m	β^+ ,EC		8-	+4.77	+3.3	ann.rad./
^{122m1} Cs			0.36 s	IT					0.3311 0.4971 0.6385 (0.27 - 2.22)
¹²² Cs		121.91614	21. s	β^+ ,EC/7.1	5.8/	(1+)	-0.133	-0.19	ann.rad./ 0.3311 0.5120 0.8179
^{123m} Cs			1.6 s	I.T./		11/2-			Cs k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹²³ Cs		122.91299	5.87 m	β^- /75/4.20 EC/25/	3.0/	1/2+	+1.38		0.0946 ann.rad./ Xe k x-ray 0.0974 0.5964
^{124m} Cs			6.3 s	IT		7+			
¹²⁴ Cs		123.91225	30. s	β^- /92/5.92 EC/8/	\approx 5.	1+	+0.673	-0.74	ann.rad./ Xe k x-ray 0.3539 0.4925 0.9418
¹²⁵ Cs		124.90972	45. m	β^- /40/3.09 EC/60/	2.06/	1/2+	+1.41		ann.rad./ Xe k x-ray 0.112 0.526
¹²⁶ Cs		125.90945	1.64 m.	β^- /81/4.83 EC/19/	3.4 3.7/	1+	+0.78	-0.68	ann.rad./ Xe k x-ray 0.3886 0.4912 0.9252
¹²⁷ Cs		126.90741	6.2 h	β^- /96/2.08 EC/4/	0.65/ 1.06	1/2+	+1.46		Xe k x-ray 0.1247 0.4119
¹²⁸ Cs		127.90775	3.62 m	β^- /68/3.930 EC/32/	2.44/ 2.88/	1+	+0.97	-0.57	ann.rad./ Xe k x-ray 0.4429
¹²⁹ Cs		128.90606	1.336 d	EC/1.195		1/2+	+1.49		Xe k x-ray 0.3719 0.4115
^{130m} Cs			3.5 m	IT, β^+ ,EC		5-	+0.629		+1.45
¹³⁰ Cs		129.90671	29.21 m	β^- /55/2.98 EC/43/ β^- /1.6/0.37	1.98/ 0.44/1.6	1+	+1.46	-0.06	ann.rad./ Xe k x-ray 0.5361
¹³¹ Cs		130.90546	9.69 d	EC/0.352		5/2+	+3.54	-0.58	Xe k x-ray
¹³² Cs		131.906430	6.48 d	EC/98/ β^- /0.3/2.120 β^- /1.280		2-	+2.22	+0.51	Xe k x-ray 0.4646 0.6302 0.66769
¹³³ Cs	100.	132.905447				7/2+	+2.582	-0.0037	
^{134m} Cs			2.91 h	I.T./0.139		8-	+1.098	+1.0	Cs k x-ray 0.12749
¹³⁴ Cs		133.906714	2.065 y	β^- /2.059 EC/1.22	0.089/27 0.658/70	4+	+2.994	+0.39	0.56327 0.56935 0.60473 0.79584
^{135m} Cs			53. m	I.T./1.627		19/2-	+2.18	+0.9	0.7869 0.8402
¹³⁵ Cs		134.905972	2.3x10 ⁶ y	β^- /0.269	0.205/100	7/2+	+2.732	+0.05	
^{136m} Cs			19. s	I.T./		8	+1.32	+0.7	
¹³⁶ Cs		135.907307	13.16 d	β^- /2.548	0.341/	5+	+3.71	+0.2	0.06691 0.34057 0.81850 1.04807
¹³⁷ Cs		136.907085	30.2 y	β^- /1.176	0.514/95	7/2+	+2.84	+0.05	Ba k x-ray 0.66164
^{138m} Cs			2.9 m	I.T./75/0.080 β^- /25/	3.3	6-	+1.71	-0.40	Cs k x-ray 0.0799 0.1917 0.4628

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹³⁸ Cs		137.91101	32.2 m	β^- /5.37	2.9/	3-	+0.700	+0.12	1.43579 0.1381 0.46269 1.00969 1.43579 2.21788
¹³⁹ Cs		138.913359	9.3 m	β^- /4.213	4.21	7/2+	+2.70	-0.07	0.6272 1.2832 (0.4 - 3.66)
¹⁴⁰ Cs		139.91727	1.06 m	β^- /6.22	5.7/ 6.21/	1-	+0.13390	-0.11	0.5283 0.6023 0.9084 (0.41 - 3.94)
¹⁴¹ Cs		140.92005	24.9 s	β^- /5.26	5.20/	7/2+	+2.44	-0.4	Ba k x-ray 0.0485 0.5616 0.5887 1.1940 (0.05 - 3.33)
¹⁴² Cs		141.92430	1.8 s	β^- /7.31	6.9/ 7.28				0.3596 0.9668 1.1759 1.3265
¹⁴³ Cs		142.92732	1.78 s	β^- /6.24	6.1	(3/2+)	+0.87	+0.47	0.1955 0.2324 0.3064 (0.17 - 1.98)
¹⁴⁴ Cs		143.93203	1.01 s	β^- /8.47	8.46/ 7.9/	1	-0.546	+0.30	0.1993 0.5598 0.6392 0.7587
¹⁴⁵ Cs		144.93541	0.59 s	β^- /7.89	7.4/ 7.9/	3/2+	+0.784	+0.6	0.1126 0.1755 0.1990
¹⁴⁶ Cs		145.94024	0.322 s	$\beta^-, (n)$ /9.38	\approx 9.0	2-	-0.515	+0.22	
¹⁴⁷ Cs		146.9439	0.227 s	$\beta^-, (n)$ /9.3					
¹⁴⁸ Cs		147.9490	0.15 s	$\beta^-, (n)$ /10.5					
¹⁴⁹ Cs		148.9527	> 50 ms						
¹⁵⁰ Cs		149.9580	> 50 ms						
¹⁵¹ Cs		150.9620	> 50 ms						
⁵⁶ Ba		137.327(7)							
¹¹⁴ Ba		113.9509	0.43 s	$\beta^+, (p)$	p/20				
¹¹⁵ Ba		114.948	0.45 s	$\beta^+, (p)$	p/<15				
¹¹⁶ Ba		115.9417	1.3 s	$\beta^+, (p)$	p/3				
¹¹⁷ Ba		116.9377	1.8 s	$\beta^+, (p), EC$ /8.4	p/13	(3/2-)			(0.0457-0.364)
¹¹⁸ Ba		117.9466	5.2 s	β^+ ,					(0.040-0.156)
¹¹⁹ Ba		118.931	5.4 s	β^+, EC /8.					
¹²⁰ Ba		119.9260	24. s	β^+, EC /5.0		0+			ann.rad./ 0.140 (0.075-0.146)
¹²¹ Ba		120.9245	30. s	β^+, EC /6.8		5/2	+0.660	+1.8	ann.rad./
¹²² Ba		121.9203	2.0 m	β^+, EC /3.8		0+			ann.rad./
¹²³ Ba		122.9189	2.7 m	β^+, EC /5.5			-0.68	+1.5	ann.rad./ 0.0306 0.0927 0.1161 0.1235
¹²⁴ Ba		123.91509	12. m	β^+, EC /2.65					ann.rad./ 0.1695

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.1888
									1.2160
^{125m} Ba			8. m	β ⁺ ,EC/	4.5		0.174		
¹²⁵ Ba		124.9146	3.5 m	β ⁺ ,EC/4.6	3.4	1/2+	+0.18		ann.rad./
									0.0550
									0.0776
									0.0854
									0.1409
¹²⁶ Ba		125.91124	1.65 h	β ⁺ /2/1.67 EC/98/		0+			Cs k x-ray
									0.2179
									0.2336
									0.2576
^{127m} Ba			1.9 s	IT		7/2-	-0.723	1.6	
¹²⁷ Ba		126.9111	12.9 m	β ⁺ /54/3.5 EC/46/		1/2+	+0.083		ann.rad./
									Cs k x-ray
									0.1148
									0.1808
									(0.07 - 2.5)
¹²⁸ Ba		127.90831	2.43 d	EC/0.52		0+			Cs k x-ray
									0.27344
^{129m} Ba			2.17 h	EC/98/ β ⁺ /2/		7/2+	+0.93	+1.6	Cs k x-ray
									0.1769
									0.1823
									0.2023
									1.4593
¹²⁹ Ba		128.90868	2.2 h	β ⁺ /20/2.43 EC/80/	1.42/	1/2+	-0.40		ann.rad./
									Cs k x-ray
									0.1291
									0.2143
									0.2208
¹³⁰ Ba	0.106(1)	129.90631	>0.5×10 ¹⁵ y	β ⁻ β ⁻		0+			
^{131m} Ba			14.6 m	I.T./0.187		9/2-	-0.87	+1.5	Ba k x-ray
									0.1085
¹³¹ Ba		130.90693	11.7 d	EC/1.37		1/2+	0.7081		Cs k x-ray
									0.12381/28.4
									0.21608/21.3
									0.49636/42.9
									(0.0549-1.171)
¹³² Ba	0.101(1)	131.905056				0+			
^{133m} Ba			1.621 d	I.T./0.288		11/2-	-0.91	+0.9	Ba k x-ray
									0.2761
¹³³ Ba		132.906003	10.53 y	EC/0.517		1/2+	0.7717		Cs k x-ray
									0.08099
									0.35600
¹³⁴ Ba	2.417(18)	133.904504				0+			
^{135m} Ba			1.20 d	I.T./0.2682		11/2-	-1.00	+1.0	Ba k x-ray
									0.2682
¹³⁵ Ba	6.592(12)	134.905684				3/2+	+0.838	+0.16	
^{136m} Ba			0.308 s	I.T./2.0305		7-			Ba k x-ray
									0.8185
									1.0481
¹³⁶ Ba	7.854(24)	135.904571				0+			
^{137m} Ba			2.552 m	I.T./0.6617		11/2-	-0.99	+0.8	Ba k x-ray
									0.66164
¹³⁷ Ba	11.232(24)	136.905822				3/2+	+0.9374	+0.245	
¹³⁸ Ba	71.698(42)	137.905242				0+			
¹³⁹ Ba		138.908836	1.396 h	β ⁻ /2.317	2.14/27	7/2-	-0.97	-0.57	0.16585
					2.27/72				1.2544

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴⁰ Ba		139.91060	12.75 d	β^- /1.05	0.48	0+			1.42033
					1.0/				0.16268
					1.02/				0.30485
									0.53727
¹⁴¹ Ba		140.91441	18.3 m	β^- /3.22	2.59/	3/2-	-0.34	+0.45	0.1903
					2.73/				0.2770
									0.3042
									(0.1 - 2.5)
¹⁴² Ba		141.91645	10.7 m	β^- /2.212	1.0/	0+			0.23152
					1.10/				0.25512
									0.3090
									1.2040
¹⁴³ Ba		142.92061	14.3 s	β^- /4.24	4.2/	5/2+	+0.44	-0.88	0.1786
									0.21148
									0.7988
									(0.17 - 2.4)
¹⁴⁴ Ba		143.92294	11.4 s	β^- /3.1	2.4/	0+			La k x-ray
					2.9/				0.10386
									0.1566
									0.1728
									0.3882
									0.43048
¹⁴⁵ Ba		144.9269	4.0 s	β^- /4.9	4.9/	(5/2-)	-0.28	+1.22	La k x-ray
									0.0918
									0.09709
¹⁴⁶ Ba		145.9302	2.20 s	β^- /4.12	3.9/	0+			0.0644
									0.2513
									0.3270
									0.3329
									0.3622
¹⁴⁷ Ba		146.9340	0.892 s	β^- /5.75	5.5/				
¹⁴⁸ Ba		147.9377	0.64 s	β^- ,n/5.11					
¹⁴⁹ Ba		148.9421	0.36 s	β^- ,(n)/7.3					
¹⁵⁰ Ba		149.9456	0.3 s						
¹⁵¹ Ba		150.9507	>0.15 μ s						
¹⁵² Ba		151.9542							
¹⁵³ Ba		151.9596							
⁵⁷ La		138.9055(2)							
¹¹⁷ La		116.950							
¹¹⁸ La		117.946							
¹¹⁹ La		118.941							
¹²⁰ La		119.938	2.8 s	EC, β^+ /11.					
¹²¹ La		120.9330	5.3 s						
¹²² La		121.9307	9. s	EC, β^+ /= 9.7					
¹²³ La		122.9262	17. s	EC/7.					
¹²⁴ La		123.9245	30. s	EC/= 8.8		(7+)			
^{125m} La			0.39 s						
¹²⁵ La		124.9207	1.2 m	β^+ ,EC/5.6		11/2-			ann.rad./
									0.0436
									0.0676
¹²⁶ La		125.9194	1.0 m	β^+ ,EC/7.6					ann.rad./
									0.2561
									0.340
									0.4555
									0.6214
¹²⁷ La		126.9162	3.8 m	β^+ ,EC/4.7		3/2+			ann.rad./
									0.025
									0.0562
¹²⁸ La		127.9155	5.0 m	β^+ /80/6.7		(5-)			ann.rad./

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV) EC/20/	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									Ba k x-ray
									0.2841/87
									0.4793/54
									(0.315-2.212)
^{129m} La			0.56 s	IT		(11/2-)			
¹²⁹ La		128.91267	11.6 m	β^+ /58/3.72	2.42/	3/2+			ann.rad./
				EC/42/					Ba k x-ray
									0.1105
									0.2786
									(0.1 - 1.8)
¹³⁰ La		129.9123	8.7 m	β^+ /78/5.6		3+			ann.rad./
				EC/22/					Ba k x-ray
									0.3573/81
									0.5506/27
									(0.1965-1.989)
¹³¹ La		130.9101	59. m	β^+ /76/3.0	1.42/	3/2+			ann.rad./
				EC/24/	1.94/				Ba k x-ray
									0.1085
									0.3658
									0.5263
^{132m} La			24. m	I.T./76/		6-			La k x-ray
				β^+ ,EC/24/					0.1352
									0.4645
¹³² La		131.91011	4.8 h	β^+ /40/4.71	2.6/	2-			ann.rad./
				EC/60/	3.2				Ba k x-ray
					3.7/				0.4645
									0.5671
¹³³ La		132.9084	3.91 h	β^+ /4/2.2	1.2/	5/2+			Ba k x-ray
				EC/96/					0.2788
									0.2901
									0.3024
¹³⁴ La		133.90849	6.5 m	β^+ /63/3.71	2.67/	1+			ann.rad./
				EC/37/					Ba k x-ray
									0.6047
									(0.5 - 1.9)
¹³⁵ La		134.90697	19.5 h	EC/1.20		5/2+			Ba k x-ray
									0.4805
¹³⁶ La		135.9077	9.87 m	β^+ /36/2.9	1.8/	1+			ann.rad./
				EC/64/					Ba k x-ray
									0.8185
¹³⁷ La		136.90647	6x10 ⁴ y	EC/0.60		7/2+	+2.70	+0.2	0.2836
¹³⁸ La	0.090(1)	137.907107	1.06x10 ¹¹ y			5+	+3.7136	+0.4	1.4358/65
									0.7887/35
¹³⁹ La	99.910(1)	138.906349				7/2+	+2.7830	+0.20	
¹⁴⁰ La		139.909473	1.678 d	β^- /3.762	1.35	3-	+0.73	+0.09	
					1.24/				
					1.67/				
¹⁴¹ La		140.910958	3.90 h	β^- /2.502	2.43/	7/2+			
¹⁴² La		141.91408	1.54 h	β^- /4.505	2.11/	2-			
					2.98/				
					4.52/				
¹⁴³ La		142.91606	14.1 m	β^- /3.43	3.3/	7/2-			
¹⁴⁴ La		143.9196	40.7 s	β^- /5.5	4.1/				
¹⁴⁵ La		144.9217	24. s	β^- /4.1	4.1/	3/2+			
^{146m} La			10.0 s	β^- /6.7	5.5/	(6)			
¹⁴⁶ La		145.9258	6.3 s	β^- /6.6	6.2/	(2-)			
¹⁴⁷ La		146.9278	4.02 s	β^- /5.0	4.6/				
¹⁴⁸ La		147.9322	1.1 s	β^- /7.26		2-			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴⁹ La		148.9342	1.10 s	β^- /5.5					
¹⁵⁰ La		149.9386	0.51 s						x-ray (0.097-0.209)
¹⁵¹ La		150.9416	>0.15 μ s						
¹⁵² La		151.946	>0.15 μ s						
¹⁵³ La		152.949	>0.15 μ s						
¹⁵⁴ La		153.954							
¹⁵⁵ La		154.958							
⁵⁸ Ce		140.116(1)							
¹¹⁹ Ce		118.953							
¹²⁰ Ce		119.947							
¹²¹ Ce		120.944	1.1 s	β^+ ,p					
¹²² Ce		121.938							
¹²³ Ce		122.936	3.8 s	β^+ ,EC/8.6					ann.rad./
¹²⁴ Ce		123.931	6. s	EC/5.6					
¹²⁵ Ce		124.929	9.6 s	β^+ ,EC/7.		(5/2+)			ann.rad./
¹²⁶ Ce		125.9241	50. s	EC/4.					
¹²⁷ Ce		126.9228	32. s	β^+ ,EC/6.1					ann.rad./ (0.058-1.148)
¹²⁸ Ce		127.9189	4.1 m	β^+ ,EC/3.2					ann.rad./ (0.023-0.880)
¹²⁹ Ce		128.9187	3.5 m	β^+ ,EC/5.6					ann.rad./ (0.0675-1.015)
¹³⁰ Ce		129.9147	26. m	β^+ ,EC/2.2		0+			ann.rad./ La k x-ray (0.047-1.431)
^{131m} Ce			5. m	β^+ ,EC/					ann.rad./ 0.2304 0.3955 0.4213
¹³¹ Ce		130.9144	10. m	β^+ ,EC/4.0	2.8/				ann.rad./ 0.119 0.169 0.414
¹³² Ce		131.9115	3.5 h	EC/1.3		0+			La k x-ray 0.1554 0.1821
^{133m} Ce			1.6 h	β^+ ,EC/		1/2+			ann.rad./ 0.0769 0.0973 0.5577
¹³³ Ce		132.9116	5.4 h	β^+ /8/2.9 EC/92/	1.3/	9/2-			ann.rad./ La k x-ray 0.0584 0.1308 0.4722 0.5104
¹³⁴ Ce		133.9090	3.16 d	EC/0.5		0+			La k x-ray 0.1304 0.1623 0.6047
^{135m} Ce			20. s	I.T./0.446		11/2-			Ce k x-ray 0.0826 0.1497 0.2134
¹³⁵ Ce		134.90915	17.7 h	β^+ /1/2.026 EC/99/	0.8/	1/2+			La k x-ray 0.0345 0.2656 0.3001

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹³⁶ Ce	0.19(1)	135.90714				0+			0.6068
^{137m} Ce			1.43 d	I.T./99/0.254 EC/0.8/		11/2-	1.0		Ce k x-ray 0.1693 0.2543
¹³⁷ Ce		136.90778	9.0 h	β ⁺ /1.222		3/2+	0.96		La k x-ray 0.4472
¹³⁸ Ce	0.25(1)	137.90599				0+			
^{139m} Ce			56.4 s	I.T./0.7542		11/2-			Ce k x-ray 0.7542
¹³⁹ Ce		138.90665	137.6 d	EC/0.28		3/2+	1.06		La k x-ray 0.16585
¹⁴⁰ Ce	88.48(10)	139.905435				0+			
¹⁴¹ Ce		140.908272	32.50 d	β ⁻ /0.581	0.436/69 0.581/31	7/2-	1.1		Pr k x-ray 0.14544/48.0
¹⁴² Ce	11.08(10)	141.909241				0+			
¹⁴³ Ce		142.912382	1.38 d	β ⁻ /1.462	1.404/ 1.110/47	3/2-	≈ 1.		Pr k x-ray 0.0574 0.2933
¹⁴⁴ Ce		143.913643	284.6 d	β ⁻ /0.319	0.185/20 0.318/	0+			Pr k x-ray 0.0801 0.1335
¹⁴⁵ Ce		144.91723	3.00 m	β ⁻ /2.54	1.7/24 1.3	3/2-			Pr k x-ray 0.0627 0.7245
¹⁴⁶ Ce		145.9187	13.5 m	β ⁻ /1.04	0.7/90	0+			Pr k x-ray 0.0986 0.2182 0.3167
¹⁴⁷ Ce		146.9225	56. s	β ⁻ /3.29	3.3/				0.0930 0.2687
¹⁴⁸ Ce		147.9244	56. s	β ⁻ /2.1	1.66/	0+			0.0904 0.0985 0.1212 0.2918
¹⁴⁹ Ce		148.9283	5.2 s	β ⁻ /4.2					0.0577 0.0864 0.3800
¹⁵⁰ Ce		149.9302	4.4 s	β ⁻ /3.0					0.1099
¹⁵¹ Ce		150.9340	1.0 s	β ⁻ /5.3					0.0526
¹⁵² Ce		151.9366	1.4 s	β ⁻ /4.4					Pr k x-ray 0.098 0.115
¹⁵³ Ce		152.9406	>0.15 μs						
¹⁵⁴ Ce		153.943	>0.15 μs						
¹⁵⁵ Ce		154.947	>0.15 μs						
¹⁵⁶ Ce		155.951							
¹⁵⁷ Ce		156.956							
⁵⁹ Pr		140.90765(2)							
¹²¹ Pr		120.955	0.6 s						
¹²² Pr		121.952							
¹²³ Pr		122.946							
¹²⁴ Pr		123.943	1.2 s	β ⁺ ,EC/12.					ann.rad./
¹²⁵ Pr		124.9378	≈ 3.3 s	β ⁺					ann.rad./ 0.1358
¹²⁶ Pr		125.9353	3.1 s	β ⁺ ,EC/≈10.4					ann.rad./ (0.170-0.985)
¹²⁷ Pr		126.9308	4.2 s	β ⁺ /≈7.5					ann.rad./ (0.028-0.8949)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹²⁸ Pr		127.9288	3.0 s	β ⁺ ,EC/9.3					ann.rad./ 0.207/100 0.400-1.373
¹²⁹ Pr		128.9249	32 s	β ⁺ ,EC/5.8					ann.rad./ (0.0395-1.865)
¹³⁰ Pr		129.9234	40. s	β ⁺ ,EC/8.1					ann.rad./
^{131m} Pr			5.7 s						(0.06 - 0.16)
¹³¹ Pr		130.9201	1.7 m	β ⁺ ,EC/5.3				≈5.5	ann.rad./ (0.059-0.980)
¹³² Pr		131.9191	1.6 m	β ⁺ ,EC/7.1					ann.rad./ 0.325 0.496 0.533
¹³³ Pr		132.9162	6.5 m	β ⁺ ,EC/4.3		5/2+			ann.rad./ 0.074 0.1343 0.2419 0.3156 0.3308 0.4650
^{134m} Pr			≈ 11. m	β ⁺ ,EC/					ann.rad./ 0.294 0.460 0.495 0.632
¹³⁴ Pr		133.9157	17. m	β ⁺ ,EC/6.2		2+			ann.rad./ 0.294 0.495
¹³⁵ Pr		134.9131	24. m	β ⁺ ,EC/3.7	2.5/	3/2+			ann.rad./ 0.0826 0.2135 0.2961 0.5832
¹³⁶ Pr		135.91265	13.1 m	β ⁺ /57/5.13 EC/43	2.98/	2+			ann.rad./ Ce k x-ray 0.5398 0.5522
¹³⁷ Pr		136.91068	1.28 h	β ⁺ /26/2.70 EC/74/	1.68/	5/2+			ann.rad./ Ce k x-ray 0.4339 0.5140 0.8367 (0.16 - 1.8)
^{138m} Pr			2.1 h	β ⁺ /24/ EC/76/	1.65/	7-			ann.rad./ Ce k x-ray 0.3027 0.7887 1.0378 (0.07 - 2.0)
¹³⁸ Pr		137.91075	1.45 m	β ⁺ /75/4.44 EC/25/	3.42/	1+			ann.rad./ Ce k x-ray 0.7887
¹³⁹ Pr		138.90893	4.41 h	β ⁺ /8/2.129 EC/92/	1.09/	5/2+			ann.rad./ Ce k x-ray 0.2551 1.3473 1.6307
¹⁴⁰ Pr		139.90907	3.39 m	β ⁺ /51/3.39 EC/49/	2.37/	1+			ann.rad./ Ce k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.3069 1.5965
¹⁴¹ Pr	100.	140.907648				5/2+	+4.275	-0.08	
^{142m} Pr			14.6 m	I.T./0.004	c.e./	5-	2.2		
¹⁴² Pr		141.910041	19.12 h	β^- /2.162	0.58/4	2-	+0.234	+0.030	0.5088
				EC/0.744	2.16/96				1.57580
¹⁴³ Pr		142.910813	13.57 d	β^- /0.934	0.933/	7/2+	+2.70	+0.8	0.7420
^{144m} Pr			7.2 m	IT/99+/0.059		3-			Pr k x-ray
				β^- /					0.0590 0.6965 0.8142
¹⁴⁴ Pr		143.913301	17.28 m	β^- /2.998	0.807/1	0-			0.69649
					2.30/				1.48912
					2.996/98				2.18562
¹⁴⁵ Pr		144.91451	5.98 h	β^- /1.81	1.80/97	7/2+			0.0725
									0.6758 0.7483
¹⁴⁶ Pr		145.9176	24.2 m	β^- /4.2	2.2/30	2-			0.4539/48
					3.7/10				1.5247
					4.2/40				
¹⁴⁷ Pr		146.91898	13.4 m	β^- /2.69	1.5/	3/2+			0.3146/24.
					2.1/				0.5779/16 0.6413/19.
^{148m} Pr			2.0 m	β^- /	4.0/	(4)			0.3016
					3.8/				0.4506 0.6975
¹⁴⁸ Pr		147.9222	2.27 m	β^- /4.9	4.8/	1 ⁻			0.3017
					4.5/				
¹⁴⁹ Pr		148.92379	2.3 m	β^- /3.40	3.0	(5/2 ⁺)			0.1085
									0.1385 0.1651
¹⁵⁰ Pr		149.9270	6.2 s	β^- /5.7		1 ⁻			0.1302
					\approx 5.5				0.8044 0.8527
¹⁵¹ Pr		150.9283	22.4 s	β^- /4.2					
¹⁵² Pr		151.9319	3.2 s	β^- /6.7		4 ⁺			0.0726
									0.164 0.285
¹⁵³ Pr		152.9339	4.3 s	β^- /5.5					
¹⁵⁴ Pr		153.9381	2.3 s	β^- /7.9					
¹⁵⁵ Pr		154.9400							
¹⁵⁶ Pr		155.944							
¹⁵⁷ Pr		156.947							
¹⁵⁸ Pr		157.952							
¹⁵⁹ Pr		158.955							
⁶⁰ Nd		144.24(3)							
¹²⁵ Nd			0.6 s	β^+ ,p					
¹²⁶ Nd		125.943							
¹²⁷ Nd		126.941	1.8 s	β^+ ,EC/9.		(5/2)			ann.rad./
¹²⁸ Nd		127.935	4. s	β^+ ,EC/6.					ann.rad./
¹²⁹ Nd		128.933	4.9 s	β^+ ,EC/8.		5/2(-)			ann.rad./
									(0.091-0.875)
¹³⁰ Nd		129.929	28. s	β^+ ,EC/5.					ann.rad./
¹³¹ Nd		130.9271	0.5 m	β^+ ,EC/6.6					ann.rad./
									(0.09-0.36)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹³² Nd		131.9231	1.5 m	β ⁺ ,EC/3.7					ann.rad./ (0.099-0.567)
¹³³ Nd		132.9222	1.2 m	β ⁺ ,EC/5.6					ann.rad./ (0.06-0.37)
¹³⁴ Nd		133.9187	≈ 8.5 m	β ⁺ /17/2.8		0+			ann.rad./ Pr k x-ray 0.1631/58 (0.09-1.00)
				EC/83/					
^{135m} Nd			5.5 m	β ⁺ /					
¹³⁵ Nd		134.9182	12. m	β ⁺ /65/4.8		9/2-	-0.78	+2.0	ann.rad./ Pr k x-ray 0.0415/23. 0.204/51. (0.11-1.8)
				EC/35/					
¹³⁶ Nd		135.9150	50.6 m	EC/94/2.21	1.04/	0+			Pr kx-ray 0.0401/21. 0.1091/35. (0.10-0.97)
				β ⁺ /6/					
^{137m} Nd			1.6 s	I.T./0.5196		11/2-			Nd k x-ray 0.1084 0.1775 0.2337
¹³⁷ Nd		136.9146	38. m	β ⁺ /40/3.69	1.7/20	1/2+	-0.63		ann.rad./ Pr k x-ray 0.0755 0.5806
				EC/60/	2.40/20				
¹³⁸ Nd		137.9119	5.1 h	EC/1.1		0+			Pr k x-ray 0.1995 0.3258
^{139m} Nd			5.5 h	I.T./12/0.231	1.17/	11/2-			Nd k x-ray Pr k x-ray 0.1139/34. 0.7382/30.
				β ⁺ /88/					
¹³⁹ Nd		138.91192	30. m	β ⁺ /25/2.79	1.77/	3/2+	0.91	+0.3	ann.rad./ Pr k x-ray 0.4050
				EC/75/					
¹⁴⁰ Nd		139.90931	3.37 d	EC/0.22		0+			Pr k x-ray
^{141m} Nd			1.04 m	IT/99+/0.756		11/2-			Nd k x-ray 0.7565
¹⁴¹ Nd		140.909605	2.49 h	EC/98/1.823	0.802/	3/2+	1.01	+0.3	Pr k x-ray (0.15-1.7)
				β ⁺ /2/					
¹⁴² Nd	27.13(12)	141.907719				0+			
¹⁴³ Nd	12.18(6)	142.909810				7/2-	-1.07	-0.60	
¹⁴⁴ Nd	23.80(12)	143.910083	2.1×10 ¹⁵ y			0+			
¹⁴⁵ Nd	8.30(6)	144.912569				7/2-	-0.66	-0.31	
¹⁴⁶ Nd	17.19(9)	145.913113				0+			
¹⁴⁷ Nd		146.916096	10.98 d	β ⁻ /0.896	0.805/	5/2-	0.58	0.9	Pr k x-ray 0.53102 0.09111-0.686
¹⁴⁸ Nd	5.76(3)	147.916889				0+			
¹⁴⁹ Nd		148.920145	1.73 h	β ⁻ /1.691	1.03/25	5/2-	0.35	1.3	Pr k x-ray 0.1143/19. 0.2113/27. (0.06 - 1.6)
					1.13/26				
					1.42/				
¹⁵⁰ Nd	5.64(3)	149.920887	≈1×10 ¹⁹ y	β-β ⁻		0+			
¹⁵¹ Nd		150.923825	12.4 m	β ⁻ /2.442	1.2/	(3/2+)			Pm k x-ray 0.1168 0.2557 1.1806

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵² Nd		151.92468	11.4 m	β^- /1.1		0+			(0.10 - 1.9)m 0.2785/29. 0.2501/18. (0.016 - 0.66)
¹⁵³ Nd		152.9280	28.9 s	β^- /3.6					0.418
¹⁵⁴ Nd		153.9296	25.9 s	β^- /2.8					0.1519 0.7998
¹⁵⁵ Nd		154.9334	8.9 s	β^- /5.0					0.1807
¹⁵⁶ Nd		155.9355	5.5 s	β^- /4.1					0.0848
¹⁵⁷ Nd		156.9393							
¹⁵⁸ Nd		157.942							
¹⁵⁹ Nd		158.946							
¹⁶⁰ Nd		159.949							
¹⁶¹ Nd		160.954							
⁶¹ Pm									
¹²⁸ Pm		127.948	1.0 s	β^+ ,p					Ann.rad.
¹²⁹ Pm		128.943							
¹³⁰ Pm		129.940	2.5 s	β^+ ,EC/11.					0.1589 0.326-1.062
¹³¹ Pm		130.936	= 6.3 s	β^+					0.185 0.220 0.146
¹³² Pm		131.934	6. s	β^+ ,EC/10.					ann.rad./
¹³³ Pm		132.930	12. s	β^+ ,EC/ \approx 7.0					ann.rad./
¹³⁴ Pm		133.9282	24. s	β^+ ,EC/ \approx 8.9		(5+)			ann.rad./ 0.294 0.495
¹³⁵ Pm		134.9247	0.8 m	β^+ ,EC/6.0		11/2-			(0.13-0.47)
¹³⁶ Pm		135.9235	1.8 m	β^+ /89/7.9 EC/11/		(3+)			ann.rad./ Nd k x-ray 0.3735 0.6027
¹³⁷ Pm		136.9206	2.4 m	β^+ ,EC/5.6		(11/2-)			ann.rad./ 0.1086 0.1775
^{138m} Pm			3.2 m	β^+ /50/ \approx 7.0 EC/50/	3.9/	3+	3.		ann.rad./ Nd k x-ray 0.5209 0.7290
¹³⁸ Pm		137.9193	10. s	β^+ /6.9	6.1/	1+			ann.rad./
^{139m} Pm			0.18 s	IT/		(11/2-)			0.1887
¹³⁹ Pm		138.91678	4.14 m	β^+ /68/4.52 EC/32/	3.52/	(5/2+)			ann.rad./ Nd k x-ray 0.4028 (0.27 - 2.4)
^{140m} Pm			5.87 m	β^+ /70/ EC/30/	3.2	7/2-			ann.rad./ Nd k x-ray 0.4199 0.7738 1.0283
¹⁴⁰ Pm		139.91585	9.2 s	β^+ /89/6.09 EC/11/	5.07/74	1+			ann.rad./ Nd k x-ray 0.7738 1.4898
¹⁴¹ Pm		140.91359	20.9 m	β^+ /52/3.72 EC/48/	2.71	5/2+			ann.rad./ Nd k x-ray 0.8862 1.2233
¹⁴² Pm		141.91295	40.5 s	β^+ /86/4.87	3.8/	1+			ann.rad./

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV) EC/20/	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									Nd k x-ray
									0.6414
									1.5758
¹⁴³ Pm		142.910928	265. d	EC/1.041		5/2+	3.8		Nd k x-ray
				$\beta^+ / <6 \times 10^{-6}$ /					0.7420
¹⁴⁴ Pm		143.912586	360. d	EC/2.332		5-	1.7		Nd k x-ray
				$\beta^+ / 7 \times 10^{-6}$ /					0.6180
									0.6965
¹⁴⁵ Pm		144.912745	17.7 y	EC/0.163		5/2+	+3.8	+0.2	Nd k x-ray
									0.0723
¹⁴⁶ Pm		145.914693	5.53 y	EC/63/1.472		3-			Nd k x-ray
				$\beta^- / 37 / 1.542$	0.795/				0.4538
									0.7362
									0.7474
¹⁴⁷ Pm		146.915134	2.623 y	$\beta^- / 0.224$	0.224/	7/2+	+2.6	+0.7	0.1213
									0.1974
^{148m} Pm			41.3 d	$\beta^- / 95 / 2.6$	0.4/60	6-	1.8		0.5503/94.
				I.T./5/0.137	0.5/17				0.6300/89.
					0.7/21				0.7257/33
¹⁴⁸ Pm		147.91747	5.37 d	$\beta^- / 2.47$	1.02/	1-	+2.0	+0.2	0.5503
					2.47/				0.9149
									1.4651
¹⁴⁹ Pm		148.918330	2.212 d	$\beta^- / 1.071$	0.78/9	7/2+	3.3		0.2859
					1.072/90				0.5909
									0.8594
¹⁵⁰ Pm		149.92098	2.68 h	$\beta^- / 3.45$	1.6/	(1-)			0.3339/69.
					2.3/				1.1658/16.
					1.8/				1.3245/17.
									(0.25 - 2.9)
¹⁵¹ Pm		150.92120	1.183 d	$\beta^- / 1.187$	0.84/	5/2+	+1.8	1.9	0.1677/8
									0.2751/7
									0.3401/22
^{152m2} Pm			15. m	β^- , I.T./		(>6)			(0.14-1.4)
^{152m1} Pm			7.5 m	$\beta^- /$		(4-)			0.1218
									0.2447
									0.3404
									1.0971
									1.4375
¹⁵² Pm		151.9235	4.1 m	$\beta^- / 3.5$	3.5/20	1+			0.1218
					3.50/60				(0.12 - 2.1)
¹⁵³ Pm		152.92414	5.4 m	$\beta^- / 1.90$	1.7/	(5/2-)			0.0910
									0.1198
									0.1273
^{154m} Pm			2.7 m	$\beta^- /$	2.0/				0.0820
									0.1848
									1.4403
¹⁵⁴ Pm		153.9266	1.7 m	$\beta^- / 4.1$	1.9/				0.0820
									0.8396
									1.3940
									2.0589
									(0.08 - 2.8)
¹⁵⁵ Pm		154.9280	48. s	$\beta^- / 3.2$		(5/2-)			(0.05-0.78)
¹⁵⁶ Pm		155.93106	26.7 s	$\beta^- / 5.16$					
¹⁵⁷ Pm		156.9332	10.9 s	$\beta^- / 4.6$					
¹⁵⁸ Pm		157.9367	5. s	$\beta^- / 6.3$					
¹⁵⁹ Pm		158.939	2 s						
¹⁶⁰ Pm		159.943							
¹⁶¹ Pm		160.946							
¹⁶² Pm		161.950							

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁶³ Pm		162.954							
⁶² Sm		150.36(3)							
¹²⁹ Sm			≈ 0.55 s	β ⁺ ,p					
¹³⁰ Sm		129.949							
¹³¹ Sm		130.946	1.2 s	β ⁺ ,EC/					ann.rad./
¹³² Sm		131.941	4.0 s	β ⁺					
¹³³ Sm		132.939	2.9 s	β ⁺ ,EC/≈8.4		5/2+			ann.rad./
¹³⁴ Sm		133.934	11. s	β ⁺ ,EC/5.		0+			ann.rad./
¹³⁵ Sm		134.932	10. s	β ⁺ ,EC/7.		7/2+			ann.rad./
¹³⁶ Sm		135.9283	42. s	β ⁺ ,EC/4.5		0+			ann.rad./
¹³⁷ Sm		136.9271	45. s	β ⁺ ,EC/6.1					ann.rad./
¹³⁸ Sm		137.9235	3.0 m	β ⁺ ,EC/3.9		0+			ann.rad./
									0.0536
									0.0747
^{139m} Sm			10. s	I.T./94/0.457		(11/2-)	1.1		Sm k x-ray
				β ⁺ /6/	4.7				0.1118
									0.1553
									0.1901
									0.2673
¹³⁹ Sm		138.9226	2.6 m	β ⁺ /75/5.5	4.1/	1/2+	-0.53		Pm k x-ray
				EC/25/					0.3678
									0.4028
									(0.27 - 2.4)
¹⁴⁰ Sm		139.9195	14.8 m	β ⁺ ,EC/3.4	1.9/	0+			ann.rad./
									Pm k x-ray
									0.1396
									0.2255
									(0.07 - 1.7)
^{141m} Sm			22.6 m	β ⁺ /32/	1.6/	11/2-	-0.83	+1.6	ann.rad./
				EC/68/	2.19/				Pm k x-ray
				I.T./0.3/0.1758					0.1966
									0.4318
									0.7774
¹⁴¹ Sm		140.91847	10.2 m	β ⁺ /52/4.54	3.2/	1/2+	-0.74		ann.rad./
				EC/48/					Pm k x-ray
									0.4382
¹⁴² Sm		141.91520	1.208 h	β ⁺ /6/2.10	1.0/	0+			ann.rad./
				EC/94/					Pm k x-ray
^{143m} Sm			1.10 m	IT/99/0.7540		11/2-			Sm k x-ray
									0.7540
¹⁴³ Sm		142.914624	8.83 m	β ⁺ /46/3.443	2.47/	3/2+	+1.01	+0.4	ann.rad./
				EC/54/					Pm k x-ray
									1.0565
¹⁴⁴ Sm	3.1(1)	143.911996				0+			
¹⁴⁵ Sm		144.913407	340. d	EC/0.617		7/2-	-1.12	-0.60	Pm k x-ray
									0.0613
									0.4924
¹⁴⁶ Sm		145.913038	1.03x10 ⁸ y	α/	2.50/	0+			
¹⁴⁷ Sm	15.0(2)	146.914894	1.06x10 ¹¹ y	α/	2.23/	7/2-	-0.815	-0.26	
¹⁴⁸ Sm	11.3(1)	147.914818	7x10 ¹⁵ y	α/	1.96/	0+			
¹⁴⁹ Sm	13.8(1)	148.917180	10 ¹⁶ y	α/		7/2-	-0.672	+0.075	
¹⁵⁰ Sm	7.4(1)	149.917272				0+			
¹⁵¹ Sm		150.919929	90. y	β ⁻ /0.0768	0.076/	5/2-	-0.363	+0.7	0.02154
¹⁵² Sm	26.7(2)	151.919729				0+			
¹⁵³ Sm		152.922094	1.929 d	β ⁻ /0.808	0.64/	3/2+	-0.0216	+1.3	Eu k x-ray
					0.69/				0.0697/4.7
									0.10318/29

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵⁴ Sm	22.7(2)	153.922206				0+			0.075-0.714
¹⁵⁵ Sm		154.924636	22.2 m	β^- /1.627	1.52	3/2-		1.1	Eu k x-ray 0.1043/75.
¹⁵⁶ Sm		155.92553	9.4 h	β^- /0.72	0.43/ 0.71/	0+			0.0872 0.1657 0.2038
¹⁵⁷ Sm		156.9283	8.0 m	β^- /2.7	2.4/	3/2-			Eu k x-ray 0.1964 0.1978 0.3942
¹⁵⁸ Sm		157.9299	5.5 m	β^- /2.0		0+			0.1894/100. 0.3636/82.
¹⁵⁹ Sm		158.9332	11.3 s	β^- /3.8					0.1898
¹⁶⁰ Sm		159.9353	9.6 s	β^- /3.6		0+			0.110
¹⁶¹ Sm		160.9388	\approx 4.8 s						0.264
¹⁶² Sm		161.941							
¹⁶³ Sm		162.945							
¹⁶⁴ Sm		163.948							
¹⁶⁵ Sm		164.953							
⁶³ Eu		151.964(1)							
¹³¹ Eu			\approx 26. ms	β^+ ,p	p/0.95				
¹³² Eu		131.954							
¹³³ Eu		132.949							
¹³⁴ Eu		133.946	0.5 s	EC, β^+					ann.rad./
¹³⁵ Eu		134.942	1.5 s	EC, β^+ / \approx 8.7					ann.rad./
^{136m} Eu			\approx 3.2 s			7+			0.255
¹³⁶ Eu		135.940	\approx 3.9 s	EC, β^+ /10.		1+			ann.rad./
¹³⁷ Eu		136.935	11. s	EC/ \approx 7.5		11/2-			ann.rad./
¹³⁸ Eu		137.9335	12. s	EC, β^+ / \approx 9.2		7+	5		ann.rad./
¹³⁹ Eu		138.9298	18. s	EC, β^+ /6.7			6		ann.rad./
^{140m} Eu			0.125 s	EC, β^+					ann.rad./
¹⁴⁰ Eu		139.9285	1.51 s	EC, β^+ /8.4		1-			ann.rad./
^{141m} Eu			3.0 s	β^+ /58/ EC/9/ I.T./33/0.0964		11/2-			ann.rad./ Eu k x-ray (0.09 - 1.6)
¹⁴¹ Eu		140.9244	40. s	β^+ /81/5.6 EC/15/		5/2+	+3.49	+0.85	ann.rad./ Sm k x-ray 0.3845 0.3940
^{142m} Eu			1.22 m	β^+ /83/ EC/17/	4.8/	8-	+2.98	+1.4	ann.rad./ Sm k x-ray 0.5566 0.7680 1.0233
¹⁴² Eu		141.9231	2.4 s	β^- /94/7.4 EC/6/	7.0/	1+	+1.54	+0.12	ann.rad./ 0.7680
¹⁴³ Eu		142.92017	2.62 m	β^+ /72/5.17 EC/28/	4.1/ 5.1/	5/2+	+3.67	+0.51	ann.rad./ Sm k x-ray 0.1107/7 1.5368/3. 1.9127/2.
¹⁴⁴ Eu		143.91879	10.2 s	β^+ /86/6.33 EC/13/	5.31/	1+	+1.89	+0.10	ann.rad./ Sm k x-ray 1.6601
¹⁴⁵ Eu		144.916263	5.93 d	β^+ /2/2.660 EC/98/1.71	0.79/	5/2+	+4.00	+0.29	ann.rad./ Sm k x-ray 0.6535 0.8937

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴⁶ Eu		145.91720	4.57 d	β^- /5/3.88 EC/95/	1.47/	4-	+1.42	-0.18	1.6587 ann.rad./ Sm k x-ray 0.6336 0.6341 0.7470 (0.27 - 2.64)
¹⁴⁷ Eu		146.916742	24.4 d	EC/99./1.722 β^+ /0.4/		5/2+	+3.72	+0.53	Sm k x-ray 0.12113 0.19725 0.6776
¹⁴⁸ Eu		147.91815	54.5 d	EC/3.11	0.92	5-	+2.34	+0.35	Sm k x-ray 0.5503/99. 0.6299/71. (0.067-2.17)
¹⁴⁹ Eu		148.91792	93.1 d	EC/0.692		5/2+	+3.57	+0.75	Sm k x-ray 0.2770 0.3275
¹⁵⁰ Eu		149.91970	36. y	EC/2.26		5-	+2.71	+1.13	Sm k x-ray 0.3340 0.4394 0.5843 (0.25 - 1.8)
^{150m} Eu			12.8 h	β^- /92/ β^+ /0.4/ EC/8/	1.013/ 1.24/	0-			Sm k x-ray 0.3339 0.4065
¹⁵¹ Eu	47.8(15)	150.919846				5/2+	+3.472	+0.90	
^{152m2} Eu			1.60 h	I.T./0.1478		8-			Eu k x-ray 0.0898
^{152m1} Eu			9.30 h	β^- /72/ EC/28/	1.85/ 0.89/	0-			Sm k x-ray 0.12178 0.84153 0.96334
¹⁵² Eu		151.921741	13.5 y	EC/72/1.874 β^- /28/1.818	0.69/ 1.47/	3-	-1.941	+2.71	Sm k x-ray Gd k x-ray 0.12178 0.34427 1.40802 (0.252-1.528)
¹⁵³ Eu	52.2(15)	152.921227				5/2+	+1.533	+2.41	
^{154m} Eu			46.1 m	I.T./ \approx 0.16		8-			Eu k x-ray 0.0682 0.1009
¹⁵⁴ Eu		153.922976	8.59 y	β^- /99.9/1.969 EC/0.02/0.717	0.27/29 0.58/38 0.84/17 0.98/4 1.87/11	3-	-2.01	+2.8	Gd k x-ray 0.12299/40. 0.72331/20. 1.2745/36 (0.059-1.90)
¹⁵⁵ Eu		154.922890	4.76 y	β^- /0.252	0.15/	5/2+	+1.52	+2.4	Gd k x-ray 0.0865/30 0.1053/20
¹⁵⁶ Eu		155.92475	15.2 d	β^- /2.451	0.30/11 0.49/30 1.2/12 2.45/31	1+	\approx 1.1		0.08899/9. 0.64623/7. 0.72344/16. 0.8118/10.
¹⁵⁷ Eu		156.92542	15.13 h	β^- /1.36	0.98/ 1.30/41	(5/2+)	+1.50	+2.6	Gd k x-ray 0.0639/100. 0.3705/48. 0.4107/76.

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵⁸ Eu		157.9278	45.9 m	β^- /3.5	2.5/	(1-)	+1.44	+0.7	0.0795 0.8976 0.9442 0.9771
¹⁵⁹ Eu		158.92909	18.1 m	β^- /2.51	2.4/ 2.57/	(5/2+)	+1.38	+2.7	0.0678 0.0786 0.0957
¹⁶⁰ Eu		159.9315	38. s	β^- /4.1	2.7/ 4.1/	(0-)			0.0753 0.1735 0.4131 0.5155 0.8217 0.9110 0.9246
¹⁶¹ Eu		160.9337	27. s	β^- /3.7					0.0719
¹⁶² Eu		161.9370	11. s	β^- /5.6					
¹⁶³ Eu		162.9392							
¹⁶⁴ Eu		163.943							
¹⁶⁵ Eu		164.946							
¹⁶⁶ Eu		165.950							
¹⁶⁷ Eu		166.953							
₆₄ Gd		157.25(3)							
¹³⁵ Gd			1.1 s	β^+					(0.163-0.360)
¹³⁶ Gd		135.947							
¹³⁷ Gd		136.945	7. s	EC, β^+ /=8.8					ann.rad./
¹³⁸ Gd		137.9400	\approx 4.7 s	EC, β^+					0.0647
^{139m} Gd			\approx 4.8 s						0.1216
¹³⁹ Gd		138.9381	5. s	EC, β^+ /=7.7					0.104-0.323
¹⁴⁰ Gd		139.934	16. s	EC/4.8		0+			0.1748
^{141m} Gd			25. s	EC, β^+ /		11/2-			ann.rad./
¹⁴¹ Gd		140.9322	21. s	β^+ /7.3		0+			ann.rad./
¹⁴² Gd		141.9276	1.17 m	EC, β^+ /4.2		1/2+			ann.rad./
^{143m} Gd			1.84 m	β^+ /67/ EC/33/ I.T./		11/2-			ann.rad./ Eu k x-ray 0.1176 0.2719 0.5880 0.6681 0.7999
¹⁴³ Gd		142.9266	39. s	β^+ /82/6.0 EC/18/		1/2+			ann.rad./ Eu k x-ray 0.2048 0.2588
¹⁴⁴ Gd		143.9234	4.5 m	β^+ /45/4.3 EC/55/	3.3/	0+			ann.rad./ Eu k x-ray 0.3332
^{145m} Gd			1.44 m	I.T./95/0.749 β^+ /4/5.7		11/2-			0.0273 0.3295 0.3866 0.7214
¹⁴⁵ Gd		144.92169	23.4 m	β^+ /33/5.05 EC/67/	2.5/	1/2+			ann.rad./ Eu k x-ray 1.7579 1.8806
¹⁴⁶ Gd		145.91831	48.3 d	EC/99.9/1.03 β^+ /0.2	0.35/	0+			(0.32 - 3.69) Eu k x-ray 0.1147 0.1155 0.1546

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴⁷ Gd		146.919090	1.588 d	EC/0.2/	0.93/	7/2-	1.0		Eu k x-ray 0.2293 0.3699 0.3960 0.9289 (0.1 - 1.8)
¹⁴⁸ Gd		147.918111	75. y	α /3.27	3.1828/	0+			
¹⁴⁹ Gd		148.919339	9.3 d	EC/1.32		7/2-	0.9		Eu k x-ray 0.1496 0.2985 0.3465
¹⁵⁰ Gd		149.91866	1.8x10 ⁶ y	α /2.80	2.73/	0+			
¹⁵¹ Gd		150.920345	124. d	EC/0.464		7/2-	0.8		Eu k x-ray 0.1536 0.2432
¹⁵² Gd	0.20(1)	151.919789				0+			
¹⁵³ Gd		152.921747	241.6 d	EC/0.485		3/2-	0.4		Eu k x-ray 0.09743 0.10318
¹⁵⁴ Gd	2.18(3)	153.920862				0+			
¹⁵⁵ Gd	14.80(5)	154.922619				3/2-	-2.59	+1.30	
¹⁵⁶ Gd	20.47(4)	155.922120				0+			
¹⁵⁷ Gd	15.65(3)	156.923957				3/2-	-3.40	+1.36	
¹⁵⁸ Gd	24.84(12)	157.924101				0+			
¹⁵⁹ Gd		158.926385	18.6 h	β^- 0.971	0.60/11 0.89/26 0.96/63	3/2-	-0.44		Tb k x-ray 0.36351 0.058-0.855
¹⁶⁰ Gd	21.86(4)	159.927051				0+			
¹⁶¹ Gd		160.929666	3.66 m	β^- 1.956	1.56/85	5/2-			Tb k x-ray 0.1023 0.3149 0.3609
¹⁶² Gd		161.930981	8.4 m	β^- 1.39	1.0/	0+			0.4030 0.4421
¹⁶³ Gd		162.9340	1.13 m	β^- 3.1					0.2868 0.214 1.685
¹⁶⁴ Gd		163.9359	45. s	β^- 2.3					
¹⁶⁵ Gd		164.9394	10 s	β^-					
¹⁶⁶ Gd		165.942							
¹⁶⁷ Gd		166.946							
¹⁶⁸ Gd		167.948							
¹⁶⁹ Gd		168.953							
⁶⁵ Tb		158.92534(2)							
¹³⁸ Tb									
¹³⁹ Tb		138.948	1.6 s						0.109 0.120
¹⁴⁰ Tb		139.946	2.4 s	β^+ ,EC/11					0.329 0.355-0.740
¹⁴¹ Tb		140.941	3.5 s	β^+ ,EC/ \approx 8.3					
^{142m} Tb			0.30 s	β^+ ,EC/		4-			
¹⁴² Tb		141.939	0.60 s	β^+ ,EC/10.		0+			
¹⁴³ Tb		142.9346	12. s	β^+ ,EC/7.4		11/2-			
^{144m} Tb			4.1 s	IT		5-			
¹⁴⁴ Tb		143.9324	< 1.5 s	β^+ ,EC/8.4		1+			
^{145m} Tb			30. s	β^+ ,EC/ \approx 6.6		11/2-			ann.rad./ 0.2577 0.5370 0.9876

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴⁵ Tb		144.9287		β^+ ,EC/6.5		1/2+			
^{146m} Tb			23. s	β^+ /76/ EC/24/		(5-)			ann.rad./ Gd k x-ray 1.0789 1.5795
¹⁴⁶ Tb		145.9270	\approx 8. s	β^+ /8.1		1+			
^{147m} Tb			1.8 m	β^+ /35/ EC/65/		11/2-			ann.rad./ Gd k x-ray 1.3977 1.7978
¹⁴⁷ Tb		146.92404	1.6 h	β^+ /42/4.61 EC/58/		5/2+	+1.70		ann.rad./ Gd k x-ray 0.6944 1.1522 (0.120-3.318)
^{148m} Tb			2.3 m	β^+ /25/ EC/75/		9+			ann.rad./ Gd k x-ray 0.3945 0.6319 0.7845 0.8824
¹⁴⁸ Tb		147.92422	1.00 h	β^+ ,EC/5.69		2-	-1.75	-0.3	ann.rad./ Gd k x-ray 0.4888 0.7845 (0.14 - 3.8)
^{149m} Tb			4.16 m	EC/88/ β^+ /12/		11/2-			ann.rad./ Gd k x-ray 0.1650 0.7960
¹⁴⁹ Tb		148.923243	4.13 h	β^+ /4/3.636 α /16/	1.8/ 3.97/	1/2+	+1.35		Gd k x-ray 0.1650 0.3522 0.3886 (0.1 - 3.2)
^{150m} Tb			6.0 m	β^+ /17/ EC/83/					ann.rad./ Gd k x-ray 0.4384 0.6380 0.6504 0.8275
¹⁵⁰ Tb		149.92366	3.3 h	β^+ ,EC/4.66		2-	-0.90		ann.rad./ 0.4963 0.6380 (0.3 - 4.29)
^{151m} Tb			25. s	I.T./95/ β^+ ,EC/7/		11/2-			0.0229 0.0495 0.3797 0.8305
¹⁵¹ Tb		150.923099	17.61 h	β^+ /1/2.565 EC/99/	0.70/	1/2+	+0.92		Gd k x-ray 0.1083 0.2517 0.2870 (0.1 - 1.8)
^{152m} Tb			4.3 m	I.T./79/0.5018 EC/21/4.35		(8+)			Tb k x-ray Gd k x-ray 0.2833 0.3443 0.4111

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵² Tb		151.92407	17.5 h	β^+ /20/3.99 EC/80/	2.5/ 2.8/	2-	-0.58	+0.3	ann.rad./ Gd k x-ray 0.3443 (0.2 - 2.88)
¹⁵³ Tb		152.923433	2.34 d	EC/1.570		5/2+	+3.44	+1.1	Gd k x-ray 0.2119 (0.05 - 1.1)
^{154m2} Tb			23.1 h	EC/98/ I.T./2/		(7-)	0.9		Gd k x-ray 0.1231 0.2479 0.3467 1.4199
^{154m1} Tb			9. h	β^+ /78/ I.T./22/		(3-)	1.7	+3.	Gd k x-ray 0.1231 0.2479 0.5401 (0.12 - 2.57)
¹⁵⁴ Tb		153.92469	21.5 h	EC/99/3.56 β^+ /1/	1.86/ 2.45	0-			Gd k x-ray 0.1231 1.2744 2.1872 (0.12 - 3.14)
¹⁵⁵ Tb		154.92350	5.3 d	EC/0.82		3/2+	+2.01	+1.41	Gd k x-ray 0.08654 0.10530
^{156m2} Tb			1.02 d	I.T./		(7-)			Tb k x-ray 0.0496
^{156m1} Tb			5.3 h	I.T./0.0884		(0+)			Tb k x-ray 0.0884
¹⁵⁶ Tb		155.924744	5.3 d	EC/2.444		3-	\approx 1.7	+2.	Gd k x-ray 0.08896 0.19921 0.53435 1.22245
¹⁵⁷ Tb		156.924021	1.1x10 ² y	EC/0.0601		3/2+	+2.01	+1.4	Gd k x-ray 0.0545
^{158m} Tb			10.5 s	I.T./0.11		0-			Gd k x-ray 0.0110
¹⁵⁸ Tb		157.925410	1.8x10 ² y	EC/80/1.220 β^- /20/0.937		3-	+1.76	+2.7	Gd k x-ray 0.0795 0.9442 0.9621
¹⁵⁹ Tb	100.	158.925343				3/2+	+2.014	+1.43	
¹⁶⁰ Tb		159.927164	72.3 d	β^- /1.835	0.57/47 0.86/27	3-	+1.79	3.8	Dy k x-ray 0.08678 0.29857 0.87936 0.96615
¹⁶¹ Tb		160.927566	6.91 d	β^- /0.593	0.46/23 0.52/66 0.6/10	3/2+	2.2	+1.2	Dy k x-ray 0.02565 0.04892 0.07458
¹⁶² Tb		161.92948	7.6 m	β^- /2.51	1.4	(1/2-)			Dy k x-ray 0.2600 0.8075 0.8882
¹⁶³ Tb		162.930644	19.5 m	β^- /1.785	0.80/	3/2+			Dy k x-ray 0.3511 0.3897

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.4945
¹⁶⁴ Tb		163.9334	3.0 m	β ⁻ /3.9	1.7/	(5+)			Dy k x-ray 0.1689 0.2157 0.6110 0.6885 0.7548
¹⁶⁵ Tb		164.9349	2.1 m	β ⁻ /3.0		3/2+			0.5389 1.1785 1.2920 1.6648
¹⁶⁶ Tb		165.9380	≈ 21 s	β ⁻ /					
¹⁶⁷ Tb		166.9401	19 s						0.057 0.070
¹⁶⁸ Tb		167.9436	8 s						0.075-0.227
¹⁶⁹ Tb		168.946							
¹⁷⁰ Tb		169.950							
¹⁷¹ Tb		170.953							
⁶⁶ Dy		162.50(3)							
¹³⁹ Dy			0.6 s	β ⁺ ,p					
¹⁴⁰ Dy		139.954							
¹⁴¹ Dy		140.951	0.9 s	EC,β ⁺ /9.					
¹⁴² Dy		141.946	2.3 s	EC,β ⁺ /7.1					
¹⁴³ Dy		142.9440	3.9 s	EC,β ⁺ /≈ 8.8					
¹⁴⁴ Dy		143.9391	9.1 s	EC,β ⁺ /≈ 6.2					
^{145m} Dy		144.9365	14. s	EC,β ⁺		11/2-			
^{146m} Dy			0.15 s	I.T.		10+			
¹⁴⁶ Dy		145.9325	30. s	EC,β ⁺ /5.2					
^{147m} Dy			56. s	I.T./40/ β ⁺ ,EC/60/		(11/2-)	-0.66	+0.7	Dy k x-ray 0.072 0.6787
¹⁴⁷ Dy		146.9309	75. s	EC,β ⁺ /6.37		1/2+	-0.92		ann.rad./ 0.1007 0.2534 0.3653
¹⁴⁸ Dy		147.92710	3.1 m	β ⁺ /4/2.68 EC/96/	1.2/	0+			ann.rad./ Tb k x-ray 0.6202
¹⁴⁹ Dy		148.92734	4.2 m	β ⁺ ,EC/3.81		(7/2-)	-0.12	-0.62	ann.rad./ 0.1008 0.1063 0.2534 0.6536 0.7894 1.7765 1.8062
¹⁵⁰ Dy		149.92558	7.18 m	β ⁺ ,EC/67/1.79 α/33/	4.233/	0+			Tb k x-ray 0.3967
¹⁵¹ Dy		150.926181	17. m	β ⁺ /5/2.871 EC/89/ α/6/	4.067/	7/2-	-0.95	-0.30	Tb k x-ray 0.1764 0.3030 0.3861 0.5463 (0.16 - 2.09)
¹⁵² Dy		151.92472	2.37 h	EC/0.60 α/	3.63/	0+			Tb k x-ray 0.2569
¹⁵³ Dy		152.925763	6.3 h	β ⁺ /1/2.171 EC/99/ α/0.01/	0.89/	(7/2-)	-0.78	≈-0.15	Tb k x-ray 0.0807 0.0997

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.2137 (0.08 - 1.66)
¹⁵⁴ Dy		153.92442	3.x10 ⁶ y	α /2.95	2.87/	0+			
¹⁵⁵ Dy		154.92575	9.9 h	β^- /2/0.095 EC/98/	0.845/	3/2-	-0.385	+1.04	Tb k x-ray 0.0655 0.2269
¹⁵⁶ Dy	0.06(1)	155.92428				0+			
¹⁵⁷ Dy		156.92546	8.1 h	EC/1.34		3/2-	-0.301	+1.30	Tb k x-ray (0.0609-1.319)
¹⁵⁸ Dy	0.10(1)	157.924405				0+			
¹⁵⁹ Dy		158.925736	144. d	EC/0.366		3/2-	-0.354	+1.37	Tb k x-ray 0.3262
¹⁶⁰ Dy	2.34(6)	159.925194				0+			
¹⁶¹ Dy	18.9(2)	160.926930				5/2+	-0.480	+2.51	
¹⁶² Dy	25.5(2)	161.926795				0+			
¹⁶³ Dy	24.9(2)	162.928728				5/2-	+0.673	+2.65	
¹⁶⁴ Dy	28.2(2)	163.929171				0+			
^{165m} Dy			1.26 m	I.T./98/0.108 β^- /2/		1/2-			Dy k x-ray 0.1082 0.5155
¹⁶⁵ Dy		164.931700	2.33 h	β^- /1.286	1.29/	7/2+	-0.52	-3.5	Ho k x-ray 0.09468
¹⁶⁶ Dy		165.932803	3.400 d	β^- /0.486	0.40/	0+			Ho k x-ray 0.0282 0.0825
¹⁶⁷ Dy		166.9357	6.2 m	β^- / \approx 2.35	1.78	(1/2-)			Ho k x-ray 0.2593 0.3103 0.5697 (0.06 - 1.4)
¹⁶⁸ Dy		167.9372	8.5 m	β^- /1.6		0+			Ho k x-ray 0.1925 0.4867
¹⁶⁹ Dy		168.9403	\approx 39. s	β^- /3.2					
¹⁷⁰ Dy		169.9427							
¹⁷¹ Dy		170.9465							
¹⁷² Dy		171.949							
¹⁷³ Dy		172.953							
⁶⁷ Ho		164.93032(2)							
¹⁴⁰ Ho			6 ms	p/	p/1.09				
^{141m} Ho			8 μ s	p/	p/1.23				
¹⁴¹ Ho			4.2 ms	β^+ ,p	p/1.71				
¹⁴² Ho		141.960							
¹⁴³ Ho		142.955							
¹⁴⁴ Ho		143.952	0.7 s	β^+ ,EC/12					
¹⁴⁵ Ho		144.947	2.4 s	β^+					
¹⁴⁶ Ho		145.9440	3.3 s	β^+ ,EC/10.7		(10+)			ann.rad./
¹⁴⁷ Ho		146.9396	5.8 s	β^+ ,EC/8.2		11/2-			ann.rad./
^{148m} Ho			9. s	β^+ ,EC/		4-			ann.rad./
¹⁴⁸ Ho		147.9372	2. s	β^+ ,EC/9.4		1+			ann.rad./ 0.6615 1.6883
^{149m} Ho			21. s	β^+ ,EC/		11/2-			ann.rad./ 1.0733 1.0911
¹⁴⁹ Ho		148.93379	> 30. s	β^+ ,EC/6.01		1/2+			
^{150m} Ho			25. s	β^+ ,EC/		(9+)			ann.rad./ 0.3939 0.5511

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.6534
									0.8034
¹⁵⁰ Ho		149.9326	1.3 m	β ⁺ ,EC/6.6					ann.rad./
									0.5913
									0.6534
									0.8034
^{151m} Ho			47. s	β ⁺ ,EC/87/ α/13	4.605/				ann.rad./
									0.2102
									0.4889
									0.6948
									0.7762
¹⁵¹ Ho		150.93169	35.2 s	β ⁺ ,EC/80/5.13 α/20/	4.519/				ann.rad./
									0.3522
									0.5274
									0.9676
									1.0471
^{152m} Ho			50. s	β ⁺ ,EC/90/ α/10/	4.453/	(9+)	+5.9	-1.	ann.rad./
									0.4929
									0.6138
									0.6474
									0.6835
¹⁵² Ho		151.93166	2.4 m	β ⁺ ,EC/88/6.47 α/12/	4.387/	(3+)	-1.02	+0.1	ann.rad./
									0.6140
									0.6476
^{153m} Ho			9.3 m	β ⁺ ,EC/99+/4.12 α/	4.01/	5/2	+1.19		ann.rad./
									0.0905
									0.1089
									0.1618
									0.2302
									0.2707
									0.3659
									0.4565
¹⁵³ Ho		152.93020	2.0 m	β ⁺ ,EC/99+/4.13 α/	3.91/	11/2-	+6.8	-1.1	ann.rad./
									0.2958
									0.3346
									0.4381
									0.6383
^{154m} Ho			3.3 m	β ⁺ ,EC/		(8+)	5.7	-1.0	ann.rad./
									0.3346
									0.4124
									0.4771
¹⁵⁴ Ho		153.93060	12. m	β ⁺ ,EC/5.75		1-	-0.64	+0.2	ann.rad./
									Dy k x-ray
									0.3346
									0.5700
									0.8734
¹⁵⁵ Ho		154.92908	48. m	β ⁺ /6/3.10 EC/94/		(5/2+)	+3.51	+1.5	ann.rad./
									Dy k x-ray
									0.0474
									0.1363
									0.3254
									(0.06 - 2.24)
^{156m} Ho			5.8 m	I.T./0.0352 β ⁺ /25/ EC/75/	1.8/ 2.9/		+2.99	+2.3	ann.rad./
									Dy k x-ray
									0.1378
									0.2666
									(0.28 - 2.9)
¹⁵⁶ Ho		155.9290	56. m	β ⁺ ,EC/4.4		(5+)			ann.rad./
									0.1378

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵⁷ Ho		156.92819	12.6 m	$\beta^+7/2.54$ EC/95/	1.18/	7/2-	+4.35	+3.0	0.2665 ann.rad./ Dy k x-ray 0.2800 0.3411
^{158m2} Ho			28. m	I.T./44/ EC/56/		2-	+2.44	+1.6	ann.rad./ Dy k x-ray 0.0989 0.2182
^{158m1} Ho			21. m	$\beta^+,EC/$		(9+)			ann.rad./ 0.0981 0.1664 0.2182 0.3205 0.4062 0.9774 1.0532 0.4846
¹⁵⁸ Ho		157.92895	11.3 m	$\beta^+8/4.24$ EC/92/	1.30/	5+	+3.77	+4.1	ann.rad./ Dy k x-ray 0.0989 0.2182 0.9488
^{159m} Ho			8.3 s	IT/0.206		1/2+			Ho k x-ray 0.1660 0.2059
¹⁵⁹ Ho		158.927708	33.0 m	EC/1.838		7/2-	+4.28	+3.2	Dy k x-ray 0.1210 0.1320 0.2529 0.3096 (0.06 - 1.2)
^{160m2} Ho			3. s			1+			
^{160m} Ho			5.0 h	IT/67/0.060 EC/33/3.35		2-	+2.52	+1.8	0.0868 0.1970 0.6464 0.7281 0.8791 0.9619 0.9658
¹⁶⁰ Ho		159.92873	25.6 m	$\beta^+,EC/3.29$	0.57/	5+	+3.71	+4.0	See Ho[166m] 0.7282 0.8794
^{161m} Ho			6.8 s	IT/0.211					Ho k x-ray 0.2112
¹⁶¹ Ho		160.927852	2.48 h	EC/0.859		7/2-	+4.25	+3.2	Dy k x-ray 0.0256 0.0592 0.0774 0.1031
^{162m} Ho			1.12 h	IT/61/ EC/39/		6-	+3.60	+4.	Dy k x-ray Ho k x-ray 0.0807 0.1850 0.2828 0.9372 1.2200
¹⁶² Ho		161.929092	15. m	EC/96/0.295 $\beta^+4/$		1+			Dy k x-ray 0.0807

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									1.3196
									1.3728
^{163m} Ho			1.09 s	I.T./0.298		(1/2+)			Ho k x-ray 0.2798
¹⁶³ Ho		162.928730	4.57x10 ⁵ y	EC/0.00258		7/2-	+4.23	+3.6	Dy M x-rays
^{164m} Ho			38. m	I.T./0.140		(6-)			Ho k x-ray 0.0373 0.0566 0.0940
¹⁶⁴ Ho		163.930231	29. m	EC/58/0.987 β ⁻ /42/0.963		1+			Dy k x-ray 0.0734 0.0914
¹⁶⁵ Ho	100.	164.930319				7/2-	+4.17	+3.49	
^{166m} Ho			1.2x10 ³ y	β ⁻ /		7-	3.6	-3.	Er k x-ray 0.18407 0.71169 0.81031
¹⁶⁶ Ho		165.932281	1.117 d	β ⁻ /1.855	1.776/48 1.855/51	0-			Er k x-ray 0.08057 1.37943
¹⁶⁷ Ho		166.933127	3.1 h	β ⁻ /1.007	0.31/43 0.61/21 0.96/15 0.97/15	(7/2-)			Er k x-ray 0.0793 0.0835 0.2379 0.3213 0.3465
^{168m} Ho			2.2 m	I.T./					
¹⁶⁸ Ho		167.93550	3.0 m	β ⁻ /2.91	2.0/	3+			Er k x-ray 0.7413 0.8159 0.8211 (0.08 - 2.34)
¹⁶⁹ Ho		168.93687	4.7 m	β ⁻ /2.12	1.2/ 2.0/	(7/2-)			0.1496 0.7610 0.7784 0.7884 0.8529
^{170m} Ho			43. s	β ⁻ /		1+			0.0787 0.8123 1.8940 1.9726
¹⁷⁰ Ho		169.93962	2.8 m	β ⁻ /3.87		6+			Er k x-ray 0.1816 0.2582 0.8902 0.9321 0.9414 1.1387
¹⁷¹ Ho		170.941	53 s	β ⁻ /					
¹⁷² Ho		171.9448	25. s	β ⁻ /					Er k x-ray (0.077-1.186)
¹⁷³ Ho		172.947							
¹⁷⁴ Ho		173.951							
¹⁷⁵ Ho		174.954							
⁶⁸ Er		167.259(3)							
¹⁴⁴ Er		143.961							
¹⁴⁵ Er		144.957	0.9 s	β ⁺					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁴⁶ Er		145.952	≈ 1.7 s	β ⁺					
¹⁴⁷ Er		146.9494	2.5 s	E.C,β ⁺ /≈ 9.1					
¹⁴⁸ Er		147.9444	4.5 s	β ⁺ ,EC/6.8					
^{149m} Er			10. s	IT		11/2-			
¹⁴⁹ Er		148.9425	10.7 s	ECβ ⁺ /8.1		1/2+			
¹⁵⁰ Er		149.9370	18. s	β ⁺ /36/4.11		0+			ann.rad./
				EC/64/					Ho k x-ray
									0.4758
¹⁵¹ Er		150.9373	23. s	β ⁺ ,EC/5.2		7/2-			ann.rad./
¹⁵² Er		151.93500	10.2 s	β ⁺ ,EC/10/3.11		0+			ann.rad./
				α/90/	4.804/				
¹⁵³ Er		152.93509	37.1 s	α/	4.674		-0.934	-0.42	0.351
				β ⁺ ,EC/47/4.56	4.35/				(0.0945-1.700)
¹⁵⁴ Er		153.93278	3.7 m	β ⁺ ,EC/99+/2.03		0+			ann.rad./
				α/0.5/	4.166/				
¹⁵⁵ Er		154.93321	5.3 m	β ⁺ ,EC/47/3.84		(7/2-)	-0.669	-0.27	ann.rad./
				EC/53/					Ho k x-ray
									0.1101
									0.2415
¹⁵⁶ Er		155.9308	20. m	β ⁺ ,EC/1.7		0+			ann.rad./
									0.0298
									0.0352
									0.0522
									0.1336
¹⁵⁷ Er		156.9319	25. m	β ⁺ ,EC/3.5		3/2-	-0.412	+0.92	ann.rad./
									0.117
									0.385
									1.320
									1.660
									1.820
									2.000
¹⁵⁸ Er		157.93087	2.2 h	EC/99.5/1.78	0.74/	0+			Ho k x-ray
				β ⁺ /0.5/					0.0719
									0.2486
									0.3868
¹⁵⁹ Er		158.930681	36. m	β ⁺ /7/2.769		3/2-	-0.304	+1.17	ann.rad./
				EC/93/					Ho k x-ray
									0.6245
									0.6493
									(0.07 - 2.5)
¹⁶⁰ Er		159.92908	1.191 d	EC/0.33		0+			Ho k x-ray
									(0.05 - 0.96)
¹⁶¹ Er		160.93000	3.21 h	EC/2.00		3/2-	-0.37	+1.36	Ho k x-ray
									0.8265
									(0.07 - 1.74)
¹⁶² Er	0.14(1)	161.928775				0+			
¹⁶³ Er		162.93003	1.25 h	EC/1.210		5/2-	+0.557	+2.55	Ho k x-ray
									0.4361
									0.4399
									1.1135
¹⁶⁴ Er	1.61(2)	163.929197				0+			
¹⁶⁵ Er		164.930723	10.36 h	EC/0.376		5/2-	+0.643	+2.71	Ho k x-ray
¹⁶⁶ Er	33.6(2)	165.930290				0+			
^{167m} Er			2.27 s	I.T./0.208		1/2-			Er k x-ray
									0.2078
¹⁶⁷ Er	22.95(15)	166.932046				7/2+	-0.5639	+3.57	
¹⁶⁸ Er	26.8(2)	167.932368				0+			
¹⁶⁹ Er		168.934588	9.40 d	β ⁻ /0.351	0.35/≈ 100	1/2-	+0.485		Tm k x-ray
									0.1098

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁷⁰ Er	14.9(2)	169.935461				0+			0.1182
¹⁷¹ Er		170.938026	7.52 h	β^- /1.491		5/2-	0.66	2.9	Tm k x-ray
									0.11160
									0.29591
									0.30832
									(0.08 - 1.4)
¹⁷² Er		171.939352	2.05 d	β^- /0.891	0.28/48				Tm k x-ray
					0.36/46				0.0597
									0.4073
									0.6101
¹⁷³ Er		172.9424	1.4 m	β^- /2.6		(7/2-)			Tm k x-ray
									0.1928
									0.1992
									0.8952
¹⁷⁴ Er		173.9441	3.1 m	β^- /1.8					Tm k x-ray
									(0.100-0.152)
¹⁷⁵ Er		174.9479	1.2 m	β^-					(0.0765-1.168)
¹⁷⁶ Er		175.9503							
¹⁷⁷ Er		176.954							
⁶⁹ Tm		168.93421(2)							
¹⁴⁵ Tm			\approx 3.5 μ s						
^{146m} Tm			0.21 s	β^+ ,p	p/1.118				
¹⁴⁶ Tm		145.967	0.06 s	β^+ /14.					
				p	1.119/				
					1.189/				
^{147m} Tm			0.4 ms	β^+ ,p	p/1.115				
¹⁴⁷ Tm		146.961	0.56 s	EC, β^+ /85 \approx 10.7					
				p/15/	1.052/				
^{148m} Tm		147.9573	0.7 s	β^+ ,EC/12.					ann.rad./
¹⁴⁸ Tm									
¹⁴⁹ Tm		148.9524	0.9 s	β^+ ,EC/ \approx 9.2		11/2-			
¹⁵⁰ Tm		149.9494	2.3 s	β^+ ,EC/ \approx 11.5		6-			(0.1007-2.177)
¹⁵¹ Tm		150.9454	4. s	β^+ ,EC/7.5					ann.rad./
^{152m} Tm			8. s	β^+ ,EC/		9+			
¹⁵² Tm		151.9443	5. s	β^+ ,EC/8.8					ann.rad./
¹⁵³ Tm		152.94203	1.6 s	β^+ ,EC/10/6.46					ann.rad./
				α /90/	5.109/				
^{154m} Tm			3.3 s	β^+ ,EC/15/	α /5.031/100				ann.rad./
				α /	4.84/0.24				0.4605-0.7960
¹⁵⁴ Tm		153.9407	8.1 s	β^+ ,EC/56/7.4	α /4.956/100				ann.rad./
				α /44/	4.83/0.45				
¹⁵⁵ Tm		154.93919	30. s	β^+ ,EC/5.58					0.0315
				α /	4.46/				0.0638
									0.0881
									0.2268
									0.5320
									0.6067
^{156m} Tm			19. s	α /	4.46/				
¹⁵⁶ Tm		155.9389	1.40 m	β^+ ,EC/7.6		2-	+0.40	-0.5	ann.rad./
				α /	4.23/				0.3446
									0.4529
									0.5860
¹⁵⁷ Tm		156.9367	3.6 m	β^+ ,EC/4.5	2.6	1/2	+0.48		ann.rad./
				α /	3.97/				0.1104
									0.3484
									0.3855
									0.4550
									(0.1 - 1.58)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵⁸ Tm		157.9379	4.0 m	β^+ ,EC/74/6.5		(2-)	+0.04	+0.7	ann.rad./
				EC/26/					Er k x-ray
									0.1921
									0.3351
									0.6280
									1.1498
									(0.18 - 2.81)
¹⁵⁹ Tm		158.9348	9.1 m	β^+ /23/3.9		5/2+	+3.42	+1.9	ann.rad./
				EC/77/					Er k x-ray
									0.0591
									0.0848
									0.2713
									(0.05 - 1.27)
^{160m} Tm			1.24 m	IT		(5)			
¹⁶⁰ Tm		159.9354	9.4 m	β^+ /15/5.9		1-	+0.16	+0.58	ann.rad./
				EC/85/					Er k x-ray
									0.1264
									0.2642
									0.7285
									0.8544
									0.8614
									1.3685
¹⁶¹ Tm		160.9334	31. m	β^+ ,EC/3.2		7/2+	+2.40	+2.9	ann.rad./
									Er k x-ray
									0.0595
									0.0844
									1.6481
									(0.04 - 2.15)
^{162m} Tm			24. s	I.T./90/		5+			Tm k x-ray
				β^+ ,EC/10/					Er k x-ray
									0.0669
									0.8115
									0.9003
¹⁶² Tm		161.93394	21.7 m	β^+ /8/4.81		1-	+0.07	+0.69	ann.rad./
				EC/92/					Er k x-ray
									0.1020
									0.7987
									(0.1 - 3.75)m
¹⁶³ Tm		162.93265	1.81 h	EC/98/2.439		1/2+	-0.082		Er k x-ray
				β^+ /1/					0.0692
									0.1043
									0.2414
^{164m} Tm			5.1 m	I.T./80/		6-			0.0914
				β^+ ,EC/20/					0.1394
									0.2081
									0.2405
									0.3149
¹⁶⁴ Tm		163.93345	2.0 m	β^+ /36/3.96	2.94/	1+	+2.38	+0.71	ann.rad./
				EC/64/					Er k x-ray
									0.0914
¹⁶⁵ Tm		164.932433	1.253 d	EC/1.593		1/2+	-0.139		Er k x-ray
									0.0472
									0.0544
									0.29728
									0.80636
¹⁶⁶ Tm		165.93355	7.70 h	EC/98/3.04		2+	+0.092	+2.14	Er k x-ray
				β^+ /2/					0.0806
									0.1844
									0.7789

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									1.2734
									2.0524
¹⁶⁷ Tm		166.932849	9.24 d	EC/0.748		1/2+	-0.197		Er k x-ray
									0.0571
									0.20778
¹⁶⁸ Tm		167.934171	93.1 d	EC/1.679		3+	+0.23	+3.2	Er k x-ray
									0.19825
									0.4475
									0.81595
¹⁶⁹ Tm	100	168.934211				1/2+	-0.232	-1.2	
¹⁷⁰ Tm		169.935798	128.6 d	β^- /99.8/0.968	0.883/24	1-	+0.247	+0.74	Yb k x-ray
				EC/0.2/0.314	0.968/76				0.08425
¹⁷¹ Tm		170.936426	1.92 y	β^- /0.096	0.03/2	1/2+	-0.230		0.06674
					0.096/98				
¹⁷² Tm		171.93840	2.65 d	β^- /1.88	1.79/36	2-			Yb k x-ray
					1.88/29				0.07879
									1.38722
									1.46601
									1.52982
									1.60861
¹⁷³ Tm		172.93960	8.2 h	β^- /1.298	0.80/21	1/2+			Yb k x-ray
					0.86/71				0.3988
									0.4613
¹⁷⁴ Tm		173.94216	5.4 m	β^- /3.08	0.70/14	(4-)			Yb k x-ray
					1.20/83				0.07664
									0.17669
									0.27332
									0.3666
									0.99205
									(0.08 - 1.6)
¹⁷⁵ Tm		174.94383	15.2 m	β^- /2.39	0.9/36	(1/2+)			Yb k x-ray
					1.9/23				0.36396
									0.51487
									0.94125
									0.98247
¹⁷⁶ Tm		175.9471	1.9 m	β^- /4.2	2.0/	(4+)			Yb k x-ray
					1.2/				0.1898
									0.3819
									1.0691
¹⁷⁷ Tm		176.9490	1.4 m	β^-					
¹⁷⁸ Tm		177.9526							
¹⁷⁹ Tm		178.9553							
⁷⁰ Yb		173.04(3)							
¹⁴⁸ Yb		147.967							
¹⁴⁹ Yb		148.963							
¹⁵⁰ Yb		149.958							
¹⁵¹ Yb		150.9545	1.6 s	β^+ /8.5					
¹⁵² Yb		151.9502	3.2 s	β^+ EC/5.5					
¹⁵³ Yb		152.9492	4. s	β^+ EC/6.7					
¹⁵⁴ Yb		153.9455	0.40 s	β^+ EC/7/4.49					ann.rad./
				α /93/	5.32/				
¹⁵⁵ Yb		154.9456	1.7 s	β^+ ,EC/16/6.0			-0.8	-1.	ann.rad./
				α /84/	5.19/				
¹⁵⁶ Yb		155.94277	26. s	β^+ ,EC/21/3.57		0+			ann.rad./
				α /79/	4.69/				
¹⁵⁷ Yb		156.9427	39. s	β^+ ,EC/99+/5.5			-0.64		ann.rad./
				α /0.5/	4.69/				0.231
									(0.035-0.670)
¹⁵⁸ Yb		157.93986	1.5 m	β^+ ,EC/1.9		0+			ann.rad./

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.0741
									0.2526
¹⁵⁹ Yb		158.9402	1.4 m	EC,β ⁺ /5.1			-0.37	-0.22	Tm k x-ray
									0.1661
									0.1772
									0.3297
									0.3903
¹⁶⁰ Yb		159.9376	4.8 m	β ⁺ ,EC/2.0		0+			ann.rad./
									0.1404
									0.1737
									0.2158
¹⁶¹ Yb		160.9375	4.2 m	β ⁺ ,EC/3.9		3/2-	-0.33	+1.03	ann.rad./
									Tm k x-ray
									0.0782
									0.5999
									0.6315
¹⁶² Yb		161.9358	18.9 m	β ⁺ ,EC/1.7		0+			ann.rad./
									Tm k x-ray
									0.1188
									0.1635
¹⁶³ Yb		162.9363	11.1 m	β ⁺ /26/3.4	1.4/	3/2-	-0.37	+1.24	ann.rad./
									Tm k x-ray
									0.0636
									0.8603
									(0.06 - 1.9)
¹⁶⁴ Yb		163.9345	1.26 h	EC/1.0		0+			Tm k x-ray
									0.0914
									0.6752
¹⁶⁵ Yb		164.93540	9.9 m	β ⁺ /10/2.76	1.58/	(5/2-)	+0.48	+2.48	ann.rad./
				EC/90/					Tm k x-ray
									0.0801
									1.0903
¹⁶⁶ Yb		165.93388	2.363 d	EC/0.30		0+			Tm k x-ray
									0.0828
									0.1844
									0.7789
									1.2734
									2.0524
¹⁶⁷ Yb		166.934947	17.5 m	β ⁺ /0.5/1.954	0.639/	5/2-	+0.62	+2.70	Tm k x-ray
				EC/99.5/					0.06296
									0.10616
									0.11337
									0.17633
¹⁶⁸ Yb	0.13(1)	167.933895				0+			
^{169m} Yb			46. s	I.T./0.0242		1/2-			Yb L x-ray
									0.0242
¹⁶⁹ Yb		168.935187	32.03 d	EC/0.909		7/2+	-0.63	+3.5	Tm k x-ray
									0.1979/35.9
									0.0498-0.3078
¹⁷⁰ Yb	3.05(6)	169.934759				0+			
¹⁷¹ Yb	14.3(2)	170.936323				1/2-	+0.49367		
¹⁷² Yb	21.9(3)	171.936378				0+			
¹⁷³ Yb	16.12(21)	172.938207				5/2-	-0.67989	+2.80	
¹⁷⁴ Yb	31.8(4)	173.938858				0+			
¹⁷⁵ Yb		174.941273	4.19 d	β ⁻ /0.470	0.466/73	7/2-	0.77		Lu k x-ray
					0.071/21				0.3963/13
					0.353/6.2				(0.114 - 0.28)
^{176m} Yb			11.4 s	I.T./1.051		(8-)			Yb k x-ray
									0.0961

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
								0.1901	
								0.2929	
								0.3897	
¹⁷⁶ Yb	12.7(2)	175.942569	10 ²⁶ y	β ⁻		0+			
^{177m} Yb			6.41 s	I.T./0.3315		1/2-		Yb k x-ray	
								0.1131	
								0.2084	
¹⁷⁷ Yb		176.945257	1.9 h	β ⁻ /1.399	1.40	9/2+		Lu k x-ray	
								0.1504	
¹⁷⁸ Yb		177.94664	1.23 h	β ⁻ /0.65	0.25/	0+		0.1415	
								0.3246	
								0.3516	
								0.3815	
								0.6125	
¹⁷⁹ Yb		178.9499	8. m	β ⁻ /2.4					
¹⁸⁰ Yb		179.9523	2. m	β ⁻				0.1028-0.4423	
¹⁸¹ Yb		180.9561							
⁷⁰ Lu		174.967(1)							
^{150m} Lu			≈0.03 ms	p/1.295					
¹⁵⁰ Lu		149.973	49. ms	p					
^{151m} Lu			16 μs	p/1.31					
¹⁵¹ Lu		150.967	0.08 s	p/1.231					
¹⁵² Lu		151.963	0.7 s						
¹⁵³ Lu		152.959							
¹⁵⁴ Lu		153.9571	1.0 s	β ⁺ ,EC/10.8					
^{155m} Lu			2.6 ms	α/7.41					
¹⁵⁵ Lu		154.9542	0.07 s	EC/8.0					
				α/	5.66/90				
^{156m} Lu			0.20 s	α/	5.57/				
¹⁵⁶ Lu		155.9529	≈ 0.5 s	β ⁺ ,EC/9.5				ann.rad./	
				α/	5.45/				
^{157m} Lu			≈9.6 s	α	4.925/				
¹⁵⁷ Lu		156.95010	4.8 s	β ⁺ ,EC/94/6.93				ann.rad./	
				α/	5.00/				
¹⁵⁸ Lu		157.94984	10.4 s	β ⁺ ,EC/99/8.0				ann.rad./	
				α/	4.67/			0.3682	
								0.4770	
¹⁵⁹ Lu		158.9467	12.3 s	β ⁺ ,EC/6.0				ann.rad./	
								0.1505	
								0.1875	
								0.3693	
¹⁶⁰ Lu		159.94654	36.1 s	β ⁺ ,EC/7.3				ann.rad./	
								0.2434	
								0.3957	
								0.5773	
¹⁶¹ Lu		160.9432	1.2 m	β ⁺ ,EC/5.3				ann.rad./	
								0.0437	
								0.0671	
								0.1003	
								0.1108	
								0.1562	
								0.2562	
^{162m} Lu			≈ 1.5 m	EC/		4-			
¹⁶² Lu		161.9432	1.37 m	β ⁺ ,EC/6.9		1-		ann.rad./	
								0.1666	
								0.6314	
¹⁶³ Lu		162.9412	4.1 m	β ⁺ ,EC/4.6				ann.rad./	
								0.0539	
								0.0581	

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
								0.1504	
								0.1631	
								0.3717	
¹⁶⁴ Lu		163.9412	3.14 m	β ⁺ ,EC/6.3	1.6/ 3.8/			0.1238	
								0.2621	
								0.7404	
								0.8639	
								0.8804	
¹⁶⁵ Lu		164.9396	10.7 m	β ⁺ ,EC/3.9	2.06/	1/2+		ann.rad./	
								0.1206	
								0.1324	
								0.1742	
								0.2036	
								(0.04 - 2.0)	
^{166m2} Lu			2.1 m	β ⁺ /35/ EC/65/		(0-)		ann.rad./	
								Yb k x-ray	
								1.0673	
								1.2566	
								2.0986	
^{166m1} Lu			1.4 m	β ⁺ ,EC/58/ I.T./42/0.0344		(3-)		ann.rad./	
								0.1024	
								0.2281	
								0.2861	
								0.8119	
								0.8301	
¹⁶⁶ Lu		165.9398	2.8 m	β ⁺ /25/5.5 EC/75/		(6-)		ann.rad./	
								Yb k x-ray	
								0.1024	
								0.2281	
								0.3375	
								0.3679	
¹⁶⁷ Lu		166.9383	52. m	β ⁺ /2/3.1 EC/98/	2.1/	7/2+		Yb k x-ray	
								0.0297	
								0.2392	
								(0.03 - 2.0)	
^{168m} Lu			6.7 m	β ⁺ /12/ EC/88/ IT/<0.8		3+		ann.rad./	
								Yb k x-ray	
								0.1988/190	
								0.8960/100	
								0.9792/128	
								0.018-2.65	
¹⁶⁸ Lu		167.9387	5.5 m	β ⁺ /6/4.5 EC/94/	1.2/	(6-)		ann.rad./	
								Yb k x-ray	
								0.1114	
								0.1124	
								0.2286	
								0.3483	
								1.4836	
^{169m} Lu			2.7 m	I.T./0.0290		1/2-		Lu L x-ray	
								0.0290	
¹⁶⁹ Lu		168.93765	1.419 d	EC/2.293	1.271/	7/2+	2.30	3.5	
								Yb k x-ray	
								0.19121	
								0.9606	
								(0.08 - 2.1)	
^{170m} Lu			0.7 s	I.T./0.0929		4-		Lu L x-ray	
								0.04449	
								0.0484	
¹⁷⁰ Lu		169.93847	2.01 d	EC/3.46	2.44/	0+		Yb k x-ray	
								0.58711	

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
								0.5908	
								1.28029	
								(0.1 - 3.38)	
^{171m} Lu			1.31 m	I.T./0.0711		1/2-		Lu k x-ray	
								0.07119	
¹⁷¹ Lu		170.937910	8.24 d	EC/1.479	0.362/	7/2+	2.30	3.42	
								Yb k x-ray	
								0.01939	
								0.66744	
								(0.02 - 1.3)	
^{172m} Lu			3.7 m	I.T./0.0419		1-		Lu L x-rays	
								0.04186	
¹⁷² Lu		171.939082	6.70 d	EC/2.519		4-	2.90	3.80	
								Yb k x-ray	
								0.18156	
								1.09367	
								(0.07 - 2.2)	
¹⁷³ Lu		172.938927	1.37 y	EC/0.671		7/2+	2.28	3.63	
								Yb k x-ray	
								0.07860	
								0.27198	
^{174m} Lu			142. d	IT/99.3/ EC/0.7/	0.17086	6-	1.50		
								Lu k x-ray	
								0.067055	
¹⁷⁴ Lu		173.940334	3.3 y	EC/1.374		1-	1.9		
								Yb k x-ray	
								0.07664	
								1.2419	
¹⁷⁵ Lu	97.41(2)	174.940768				7/2+	+2.2327	+3.49	
^{176m} Lu			3.66 h	β^- /1.315	1.229/ 1.317/	1-	+0.318	-1.47	
								Hf k x-ray	
								0.088372	
¹⁷⁶ Lu	2.59(2)	175.942683	3.8x10 ¹⁰ y	β^- /1.192		7-	+3.169	+4.92	
								Hf k x-ray	
								0.20187	
								0.30691	
^{177m} Lu			160.7 d	IT/22/0.9702 β^- /78		23/2-	2.33	5.4	
								Lu k x-ray	
								Hf k x-ray	
								0.11295	
								0.20836	
								0.37850	
								0.41853	
¹⁷⁷ Lu		176.943755	6.75 d	β^- /0.498	0.497/	7/2+	+2.239	+3.39	
								0.11295	
								0.20836	
^{178m} Lu			23.1 m	β^- /		(9-)			
								0.2166	
								0.3317	
¹⁷⁸ Lu		177.945952	28.5 m	β^- /2.099	2.03/	1+			
								Hf k x-ray	
								0.0932	
								1.3099	
								1.3408	
								(0.09 - 1.7)	
¹⁷⁹ Lu		178.94732	4.6 h	β^- /1.405	1.35/	7/2+			
								0.2143	
								0.3377	
¹⁸⁰ Lu		179.9499	5.7 m	β^- /3.1	1.49/				
								0.40795/50.	
								(0.07-1.9)	
¹⁸¹ Lu		180.9518	3.5 m	β^- /2.5		(7/2+)			
								0.0458	
								0.2059	
								0.5749	
¹⁸² Lu		181.9552	2.0 m	β^- /≈ 4.1					
								0.0978	
								0.7208	
								0.8182	
¹⁸³ Lu		182.9576	58. s	β^- /		7/2+			
¹⁸⁴ Lu		183.9612	20 s	β^-					
⁷² Hf		178.49(2)							
¹⁵⁴ Hf		153.964	2. s	EC, β^+ /≈ 6.7					
¹⁵⁵ Hf		154.963	0.9 s	EC, β^+ /8.					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵⁶ Hf		155.9593	25. ms	α					
¹⁵⁷ Hf		156.9581	0.11 s	α					
¹⁵⁸ Hf		157.9539	2.9 s	EC/54/5.1		0+			
				α /46/	5.27/				
¹⁵⁹ Hf		158.9538	5.6 s	β^+ ,EC/88/6.9					ann.rad./
				α /12/	5.09/				
¹⁶⁰ Hf		159.95063	\approx 12. s	β^+ ,EC/97/4.9		0+			ann.rad./
				α /4.78					
¹⁶¹ Hf		160.9503	17. s	α	4.60/				
¹⁶² Hf		161.94720	38. s	β^+ ,EC/3.7		0+			ann.rad./
									0.1739
									0.1963
									0.4101
¹⁶³ Hf		162.9471	40. s	β^+ ,EC/5.5					ann.rad./
									0.0454
									0.0621
									0.0710
									0.6882
¹⁶⁴ Hf		163.9536	2.8 m	EC, β^+ /3.0					
¹⁶⁵ Hf		164.9445	1.32 m	EC/4.6		11/2-			
¹⁶⁶ Hf		165.9423	6.8 m	EC/93/2.3					ann.rad./
				β^+ /7/					Lu k x-ray
									0.0788
¹⁶⁷ Hf		166.9426	2.0 m	β^+ /40/4.0		(5/2-)			ann.rad./
				EC/60/					Lu k x-ray
									0.1754
									0.3152
¹⁶⁸ Hf		167.9406	25.9 m	β^+ ,EC/1.8		0+			ann.rad./
									(0.0144-1.311)
¹⁶⁹ Hf		168.9412	3.25 m	EC/85/3.3		(5/2-)			ann.rad./
				β^+ /15/					Lu k x-ray
									0.3695
									0.4929
¹⁷⁰ Hf		169.9397	16.0 h	EC/1.1		0+			Lu k x-ray
									0.0985
									0.1202
									0.1647
									0.5729
									0.6207
^{171m} Hf			30. s			(1/2-)	+0.53		
¹⁷¹ Hf		170.9405	12.2 h	EC, β^+ /2.4		7/2+	-0.67	+3.46	ann.rad./
									Lu k x-ray
									0.1221
									0.6620
									1.0714
¹⁷² Hf		171.93946	1.87 y	EC/0.35		0+			Lu k x-ray
									0.02399
									0.12582
									(0.0818-0.123)
¹⁷³ Hf		172.9407	23.6 h	EC/1.6		1/2-			Lu k x-ray
									0.12367
									0.13963
									0.29697
									0.31124
									(0.1 - 2.1)
¹⁷⁴ Hf	0.162(3)	173.940042	2.0x10 ¹⁵ y			0+			
¹⁷⁵ Hf		174.941504	70. d	EC/0.686		5/2-	-0.60	+2.7	Lu k x-ray
									0.08936
									0.34340

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁷⁶ Hf	5.206(5)	175.941403				0+			
^{177m2} Hf			51.4 m	I.T./2.740		37/2-			Hf k x-ray 0.2140 0.2951 0.3115 0.3267
^{177m1} Hf			1.1 s	I.T./		23/2+			Hf k x-ray 0.20836 0.22847 0.37851
¹⁷⁷ Hf	18.606(4)	176.943220				7/2-	+0.7935	+0.337	
^{178m2} Hf			31. y	I.T./		16+	+8.2	+6.0	Hf k x-ray 0.32555 0.42635 (0.0889-0.5742)
^{178m1} Hf			4.0 s	I.T./		8-			Hf k x-ray 0.21342 0.32555 0.42635
¹⁷⁸ Hf	27.297(4)	177.943698				0+			
^{179m2} Hf			25.1 d	I.T./1.1057		25/2-	7.4		Hf k x-ray 0.1227 0.1461 0.3626 0.4537
^{179m1} Hf			18.7 s	I.T./0.375		1/2-			Hf k x-ray 0.1607 0.2141
¹⁷⁹ Hf	13.629(6)	178.945815				9/2+	-0.641	+3.79	
^{180m} Hf			5.52 h	I.T./1.1416		8-	+9.	+4.6	Hf k x-ray 0.2152 0.3323 0.4432
¹⁸⁰ Hf	35.100(7)	179.946549				0+			
¹⁸¹ Hf		180.949099	42.4 d	β^- /1.027	0.408/	1/2-			Ta k x-ray 0.13294 0.48200
^{182m} Hf			62. m	β^- /54/1.60 IT/46/1.173	0.49/43 0.95/10	8-			Hf k x-ray 0.0509 0.2244 0.3441 0.4558 0.5066 0.9428
¹⁸² Hf		181.95055	9.x10 ⁶ y	β^- /0.37		0+			Ta k x-ray 0.2704
¹⁸³ Hf		182.95353	1.07 h	β^- /2.01	1.18/68 1.54/25	3/2-			Ta k x-ray 0.0732 0.4591 0.7837
¹⁸⁴ Hf		183.95545	4.1 h	β^- /1.34	0.74/38 0.85/16 1.10/46	0+			Ta k x-ray 0.0414 0.1391 0.3449
¹⁸⁵ Hf		184.9588	≈3.5m	β^- /					0.165
¹⁸⁶ Hf		185.9609	≈2.1 m						0.738
⁷³ Ta		180.9479(1)							
¹⁵⁵ Ta			12 μs	p/1.77					
¹⁵⁶ Ta		155.972	0.11 s	β^- /≈11.6					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁵⁷ Ta		156.968	10 ms	p/ α/	1.02/≈100 6.117				
¹⁵⁸ Ta		157.9664	37. ms	p/ α/	0.927/3.4 6.05/100 5.97/100				
¹⁵⁹ Ta		158.9629	0.6 s	β ⁺ ,EC/20/8.5 α/80/	α/5.52/34 5.60/55				ann.rad./
¹⁶⁰ Ta		159.9615	1.4 s	β ⁺ ,EC/10.1 α	5.41/				ann.rad./
¹⁶¹ Ta		160.9584	2.9 s	β ⁺ ,EC/7.5 α/	5.15				ann.rad./
¹⁶² Ta		161.9564	4. s	EC/8.6					
¹⁶³ Ta		162.9544	10.6 s	EC/6.8					
¹⁶⁴ Ta		163.9536	14.2 s	β ⁺ /8.5 α/	4.62/	3+			ann.rad./ 0.2110 0.3768
¹⁶⁵ Ta		164.9508	31. s	ECβ ⁺ /5.9					
¹⁶⁶ Ta		165.9505	34. s	β ⁺ /82/7.7 EC/18/					ann.rad./ Hf k x-ray 0.1587 0.3117 0.8101
¹⁶⁷ Ta		166.9486	1.4 m	β ⁺ ,EC/5.6					ann.rad./
¹⁶⁸ Ta		167.9478	2.4 m	β ⁺ /77/6.7 EC/23/		3+			ann.rad./ Hf k x-ray 0.1239 0.2615 0.7502
¹⁶⁹ Ta		168.9459	4.9 m	β ⁺ ,EC/4.4					ann.rad./ 0.0288 0.1535 0.1924
¹⁷⁰ Ta		169.9461	6.8 m	β ⁺ /70/6.0 EC/35/		(3+)			ann.rad./ Hf k x-ray 0.1008 0.2212
¹⁷¹ Ta		170.9445	23.3 m	β ⁺ ,EC/3.7		(5/2-)			0.0496 0.5018 0.5064 (0.05 - 1.02)
¹⁷² Ta		171.9447	36.8 m	β ⁺ /25/4.9 EC/75/		(3-)			ann.rad./ Hf k x-ray 0.21396 1.10923 (0.09 - 3.8)
¹⁷³ Ta		172.9446	3.6 h	β ⁺ /24/3.7 EC/76/		(5/2-)	1.70	-1.9	ann.rad./ Hf k x-ray 0.06972 0.17219 (0.06 - 2.7)
¹⁷⁴ Ta		173.9442	1.12 h	β ⁺ /27/3.8 EC/73/		(3+)			ann.rad./ Hf k x-ray 0.09089 0.20638 (0.09 - 3.64)
¹⁷⁵ Ta		174.9437	10.5 h	EC/2.0		7/2+	2.27	+3.7	Hf k x-ray 0.2077 0.2671 0.3487

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁷⁶ Ta		175.9447	8.1 h	EC/3.1		1-			Hf k x-ray 0.08837 1.15735
¹⁷⁷ Ta		176.944472	2.356 d	EC/1.166		7/2+	2.25		Hf k x-ray 0.11295 (0.07 - 1.06)
^{178m} Ta			2.4 h	EC/		(7-)			Hf k x-ray 0.08886 0.21342 0.32555 0.42635
¹⁷⁸ Ta		177.9458	9.29 m	EC/99/1.9 β ⁺ /1/		1+	+2.74	+0.65	ann.rad./ Hf k x-ray 0.09316
¹⁷⁹ Ta		178.94593	1.8 y	EC/0.110		7/2+	2.29	3.37	Hf k x-ray
^{180m} Ta	0.012(2)		>1.2x10 ¹⁵ y			(9-)	4.82		
¹⁸⁰ Ta		179.947466	8.15 h	EC/87/0.854 β ⁻ /13/0.708	0.61/3 0.71/10	1+			Hf k x-ray W k x-ray 0.09333 0.10340
¹⁸¹ Ta	99.988(2)	180.947996				7/2+	+2.370	+3.3	
^{182m} Ta			15.8 m	I.T./0.5198		10-			Ta k x-ray 0.14678 0.17157
¹⁸² Ta		181.950152	114.43 d	β ⁻ /1.814	0.25/30 0.44/20 0.52/40	3-	+3.02	+2.6	W k x-ray 1.12127/100 1.22138/79 0.085-1.289
¹⁸³ Ta		182.951373	5.1 d	β ⁻ /1.070	0.45/5 0.62/91	7/2+	+2.36		W k x-ray 0.0847 0.0991 0.1079 0.2461 0.3540
¹⁸⁴ Ta		183.95401	8.7 h	β ⁻ /2.87	1.11/15 1.17/81	(5-)			W k x-ray 0.2528/44. 0.4140/74. (0.09-1.4)
¹⁸⁵ Ta		184.95556	49. m	β ⁻ /1.99	1.21/5 1.77/81	(7/2+)			W k x-ray 0.0697 0.1739 0.1776
¹⁸⁶ Ta		185.9586	10.5 m	β ⁻ /3.9	2.2/	(3-)			W k x-ray 0.1979 0.2149 0.5106 (0.09 - 1.5)
¹⁸⁷ Ta		186.9604							
¹⁸⁸ Ta		187.9637							
⁷⁴ W		183.84(1)							
^{158m} W			0.14 ms	α	8.28(3)/				
¹⁵⁸ W		157.974	1.3 ms	α/	6.433/96				
¹⁵⁹ W		158.972	7. ms	α/					
¹⁶⁰ W		159.9684	0.08 s	α/	5.92/	0+			
¹⁶¹ W		160.9671	0.41 s	β ⁺ ,EC/18/8.1 α/82/	5.78/				
¹⁶² W		161.9626	1.39 s	β ⁺ ,EC/54/5.8 α/46/	5.54/	0+			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁶³ W		162.9624	2.8 s	β^+ ,EC/59/7.5					
				α /41/	5.38/				
¹⁶⁴ W		163.95890	6. s	β^+ ,EC/97/5.0		0+			ann.rad./
				α /3/	5.15/				
¹⁶⁵ W		164.9583	5.1 s	β^+ ,EC/99/7.0					ann.rad./
				α /1/	4.91/				
¹⁶⁶ W		165.95502	16. s	β^+ ,EC/99/4.2		0+			ann.rad./
				α /1/	4.74/				
¹⁶⁷ W		166.9547	20. s	EC/5.6					
¹⁶⁸ W		167.9519	53. s	EC/3.8					ann.rad./
				α /10 ⁻⁵ /	4.40(1)				Ta k x-ray 0.1755 (0.037-0.573)
¹⁶⁹ W		168.9518	1.3 m	EC/5.4					ann.rad./
									Ta k x-ray 0.123 (0.097-0.699)
¹⁷⁰ W		169.9485	2.4 m	EC/2.2					ann.rad./
									Ta k x-ray 0.3162 (0.060-0.144)
¹⁷¹ W		170.9494	2.4 m	EC/4.6					ann.rad./
									Ta k x-ray 0.1842 (0.052-0.479)
¹⁷² W		171.9474	6.6 m	β^+ ,EC/2.5					ann.rad./
									Ta k x-ray 0.0389 (0.034-0.674)
¹⁷³ W		172.9489	6.3 m	EC/4.0					ann.rad./
									Ta k x-ray 0.4576 (0.035-0.623)
¹⁷⁴ W		173.9462	35. m	EC/1.9		0+			ann.rad./
									Ta k x-ray 0.3287 0.4288 (0.056-0.429)
¹⁷⁵ W		174.9468	35. m	EC/2.9		1/2-			(0.015-0.27)
¹⁷⁶ W		175.9456	2.5 h	β^+ ,EC/0.8		0+			0.03358 0.06129 0.09487 0.10020
¹⁷⁷ W		176.9466	2.21 h	EC/2.0		(1/2-)			Ta k x-ray 0.15505 0.18569 0.42694
¹⁷⁸ W		177.9459	21.6 d	EC/0.091		0+			Ta k x-ray
^{179m} W			6.4 m	IT/99.7/0.222		(1/2-)			W k x-ray 0.2220
				EC/0.3/					
¹⁷⁹ W		178.94707	38. m	EC/1.06		(7/2-)			Ta k x-ray 0.0307
¹⁸⁰ W	0.120(1)	179.946706	7.4x10 ¹⁶ y	α /		0+			
¹⁸¹ W		180.94820	121.2 d	EC/0.188		9/2+			Ta k x-ray 0.13617 0.15221
¹⁸² W	26.498(29)	181.948205	8.3x10 ¹⁸ y	α /		0+			
^{183m} W			5.15 s	I.T./		(11/2+)			W k x-ray 0.0465

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.0526
									0.0991
									0.1605
¹⁸³ W	14.314(4)	182.950224	1.9x10 ¹⁸ y	α /		1/2-	+0.117784 8		
¹⁸⁴ W	30.642(8)	183.950932	4.0x10 ¹⁸ y	α /		0+			
^{185m} W			1.6 m	I.T./0.1974		11/2+			W k x-ray
									0.0659
									0.1315
									0.1737
¹⁸⁵ W		184.953420	74.8 d	β^- /0.433	0.433/99.9	3/2-			0.12536
¹⁸⁶ W	28.426(37)	185.954362	6.5x10 ¹⁸ y	α /		0+			
¹⁸⁷ W		186.957158	23.9 h	β^- /1.311	0.624/66 1.315/16 0.081-1.18	3/2-	0.62		Re k x-ray 0.68572/33 0.134-0.773
¹⁸⁸ W		187.958487	69.4 d	β^- /0.349	0.349/99	0+			0.0636 0.2271 0.2907
¹⁸⁹ W		188.9619	11.5 m	β^- /2.5	1.4/ 2.5/	(3/2-)			(0.1262-1.466)
^{190m} W			0.3 ms						
¹⁹⁰ W		189.9632	30. m	β^- /1.3	0.95/	0+			Re k x-ray 0.1576 0.1621
⁷⁵ Re		186.207(1)							
¹⁶⁰ Re		159.981	0.7 ms	p/	1.261(6)/91 6.54/				
¹⁶¹ Re		160.978	14 ms	α /	6.24 1.35				
¹⁶² Re		161.9757	0.10 s	α /	6.12/94 6.09/94				
¹⁶³ Re		162.9721	0.26 s	β^+ ,EC/9.0	α /5.87/32 α /5.92/66				
¹⁶⁴ Re		163.9704	0.9 s	β^+ ,EC/10.7	α /5.78/				
¹⁶⁵ Re		164.9671	2. s	β^+ ,EC/87/8.1	α /5.51/				
¹⁶⁶ Re		165.9651	2.5 s	β^+ ,EC/9.4	α /5.50/				
^{167m} Re			6.2 s	α , EC/					
¹⁶⁷ Re		166.9626	3.4 s	β^+ ,EC/7.4	α /5.015/				
¹⁶⁸ Re		167.9616	4.4 s	β^+ ,EC/9.1	α /4.833/				0.1117
^{169m} Re			8.1 s	α	4.70/ 4.87/				
¹⁶⁹ Re		168.9588	16. s						
¹⁷⁰ Re		169.9582	9.2 s	β^+ , EC/9.0					0.1560 0.3055 0.4125
¹⁷¹ Re		170.9555	15.2 s	EC/= 5.7					
^{172m} Re			55. s	β^+ ,EC/		(2)			ann.rad./ 0.1234 0.2537 0.3504
¹⁷² Re		171.9553	15. s	β^+ ,EC/7.3					ann.rad./ 0.1234 0.2537
¹⁷³ Re		172.9531	2.0 m	EC/=3.9					ann.rad./

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁷⁴ Re		173.9521	2.4 m	β ⁺ ,EC/5.6					ann.rad./ 0.1119 0.2430
¹⁷⁵ Re		174.9514	5.8 m	β ⁺ ,EC/4.3					ann.rad./
¹⁷⁶ Re		175.9516	5.3 m	β ⁺ ,EC/5.6		(3+)			ann.rad./ 0.1089 0.2406
¹⁷⁷ Re		176.9503	14. m	EC/78/3.4 β ⁺ /22/		(5/2-)			ann.rad./ W k x-ray 0.0797 0.0843 0.1968
¹⁷⁸ Re		177.9509	13.2 m	β ⁺ /11/4.7 EC/89/	3.3/ 3.3/	(3)			ann.rad./ W k x-ray 0.1059 0.2373 0.9391
¹⁷⁹ Re		178.9500	19.7 m	EC/99/2.71 β ⁺ /1/	0.95/	(5/2+)	2.8		W k x-ray 0.1199 0.2900 0.4154 0.4302 1.6803
¹⁸⁰ Re		179.95079	2.45 m	EC/92/3.80 β ⁺ /8/	1.76/	1-	1.6		ann.rad./ W k x-ray 0.1036 0.9028 (0.07 - 2.2)
¹⁸¹ Re		180.95006	20. h	EC/1.74		5/2+	3.19		W k x-ray 0.3607 0.3655 0.6390
^{182m} Re			12.7 h	EC/	0.55/ 1.74/	2+	3.3	+1.8	W k x-ray 0.0677 1.1214 1.2215 (0.06 - 2.2)
¹⁸² Re		181.9512	2.67 d	EC/2.8		(7+)	2.8	+4.1	W k x-ray 0.0678 0.2293 1.1213 1.2214
¹⁸³ Re		182.95082	70. d	EC/0.56		(5/2+)	+3.17	+2.3	W k x-ray 0.16232
^{184m} Re			165. d	I.T./75/0.188 EC/25/		8+	+2.9		Re k x-ray 0.1047 0.2165 0.92093 (0.10 - 1.1)
¹⁸⁴ Re		183.95252	38. d	EC/1.48		3-	+2.53	+2.8	W k x-ray 0.79207 0.90328 (0.1 - 1.4)
¹⁸⁵ Re	37.40(2)	184.952955				5/2+	+3.1871	+2.18	
^{186m} Re			2.0x10 ⁵ y	I.T./0.150		8+			Re k x-ray 0.0590
¹⁸⁶ Re		185.954986	3.718 d	β ⁻ /92/1.070 EC/8/0.582	0.973/21 1.07/71	1-	+1.739	+0.62	W k x-ray 0.1227/0.6 0.1372/9.5

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%) (0.63-0.77)
¹⁸⁷ Re	62.60(2)	186.955751	4.4x10 ¹⁰ y	β ⁻ /0.00266	0.0025/	5/2+	+3.2197		+2.07
^{188m} Re			18.6 m	I.T./0.172		(6-)			Re k x-ray 0.0925 0.1059
¹⁸⁸ Re		187.958112	16.94 h	β ⁻ /2.120	1.962/20 2.118/79	1-	+1.788	+0.57	Os k x-ray 0.15502 0.309-2.022
¹⁸⁹ Re		188.959228	24. h	β ⁻ /1.01	1.01/	(5/2+)			0.1471 0.2167 0.2194 0.2451
^{190m} Re			3.0 h	β ⁻ /51/ I.T./49/		(6-)			Re k x-ray 0.1191 0.2238 0.6731 (0.1 - 1.79)
¹⁹⁰ Re		189.9618	3.0 m	β ⁻ /3.2	1.8/	(2-)			Os k x-ray 0.1867 0.5580 0.6051
¹⁹¹ Re		190.96312	9.7 m	β ⁻ /2.05	1.8/				
¹⁹² Re		191.9660	16. s	β ⁻ /4.2	≈ 2.5/				(0.2-0.75)
⁷⁶ Os		190.23(3)							
¹⁶² Os		161.984	1.8 ms	α/	6.60				
¹⁶³ Os		162.982	5.5 ms	α/	6.51				
¹⁶⁴ Os		163.9779	0.04 s	α					
¹⁶⁵ Os		164.9765	0.07 s	α					
¹⁶⁶ Os		165.9718	0.18 s	β ⁺ ,EC/28/6.3 α/72/	6.27/ 5.98/	0+			ann. rad./
¹⁶⁷ Os		166.9714	0.7 s	β ⁺ ,EC/76/8.2 α/24/	5.84/				ann. rad./
¹⁶⁸ Os		167.96775	2.2 s	β ⁺ ,EC/51/5.7 α/49/		0+			ann. rad./
¹⁶⁹ Os		168.9671	3.3 s	β ⁺ ,EC/89/7.7 α/13/	5.57/80 5.51/12 5.54/8				ann. rad./
¹⁷⁰ Os		169.96357	7.1 s	β ⁺ ,EC/5.0 α/	5.40/	0+			ann. rad./ (0.162-0.216)
¹⁷¹ Os		170.9630	8.4 s	β ⁺ ,EC/98/7.1 α/19/	α/5.24/93.5 5.17/6.5				ann. rad./ 0.190-0.705
¹⁷² Os		171.9601	19. s	β ⁺ ,EC/99/4.5 α/1.1/	5.10/	0+			ann. rad./ (0.063-1.120)
¹⁷³ Os		172.9598	16. s	β ⁺ ,EC/6.3 α/0.4/	4.94/				ann. rad./ 0.142-0.299
¹⁷⁴ Os		173.9563	44. s	β ⁺ ,EC/3.9 α/0.02/	4.76/	0+			0.118 0.138/ 0.001 0.158 0.325
¹⁷⁵ Os		174.9570	1.4 m	β ⁺ ,EC/5.3					0.125 0.181 0.248
¹⁷⁶ Os		175.9550	3.6 m	β ⁺ ,EC/3.2		0+			0.8155 0.7758 0.8573 1.2093 1.2909
¹⁷⁷ Os		176.9551	2.8 m	β ⁺ ,EC/4.5		(1/2-)			0.0848 0.1958

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.3002
									1.2686
¹⁷⁸ Os		177.9534	5.0 m	β ⁺ ,EC/2.3		0+			ann.rad./
									0.5946
									0.6850
									0.9687
									1.3311
¹⁷⁹ Os		178.9539	7. m	β ⁺ ,EC/3.7					ann.rad./
									0.0654
									0.2186
									0.5938
¹⁸⁰ Os		179.9524	21.5 m	β ⁺ ,EC/1.5		0+			Re k x-ray
									0.0202-0.7174
^{181m} Os			1.75 h	EC/		(1/2-)			ann.rad./
									0.0489
¹⁸¹ Os		180.9532	2.7 m	EC/2.9		(7/2-)			ann.rad./
									0.11794
									0.23868
									0.8267
									(0.07 - 2.64)
¹⁸² Os		181.95219	21.5 h	EC/0.9		0+			Re k x-ray
									0.1802
									0.5100
^{183m} Os			9.9 h	EC/84/ I.T./16/		1/2-			Os k x-ray
									Re k x-ray
									1.1020
									1.1080
¹⁸³ Os		182.9531	13. h	EC/2.1		9/2+	-0.79	+3.1	Re k x-ray
									0.1144
									0.3818
¹⁸⁴ Os	0.020(3)	183.952491				0+			
¹⁸⁵ Os		184.954043	93.6 d	EC/1.013		1/2-			Re k x-ray
									0.6461
									0.8748
									0.8805
¹⁸⁶ Os	1.58(10)	185.953838	2.x10 ¹⁵ y	α/	≈ 2.75/	0+			
¹⁸⁷ Os	1.6(1)	186.955748				1/2-	+0.06465 19		
¹⁸⁸ Os	13.3(2)	187.955836				0+			
^{189m} Os			5.8 h	I.T./0.0308		9/2-			Os L x-ray
									0.0308
¹⁸⁹ Os	16.1(3)	188.958145				3/2+	+0.65993	+0.86	
^{190m} Os			9.9 m	I.T./1.705		10-	-0.6		Os k x-ray
									0.1867
									0.3611
									0.5026
									0.6161
¹⁹⁰ Os	26.4(4)	189.958445				0+			
^{191m} Os			13.1 h	I.T./0.0744		3/2-			Os k x-ray
									0.0744
¹⁹¹ Os		190.960928	15.4 d	β ⁻ /0.314	0.140/100	9/2-		+2.5	Ir k x-ray
									0.1294
^{192m} Os			6.0 s	I.T./2.0154		(10-)			Os k x-ray
									0.2058/65.9
									0.5692/70
									(0.201-1.000)
¹⁹² Os	41.0(3)	191.961479				0+			
¹⁹³ Os		192.964148	30.5 h	β ⁻ /1.141	1.04/20	3/2-	+0.730	+0.47	Ir k x-ray
									0.1389

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁹⁴ Os		193.965179	6.0 y	β^- /0.097	0.054/33 0.096/67	0+			0.4605 Ir L x-ray 0.0429
¹⁹⁵ Os		194.9681	6.5 m	β^- /2.0	2.0/				
¹⁹⁶ Os		195.96962	34.9 m	β^- /1.16	0.84/	0+			0.1262/5 0.4079/5.9
⁷⁷ Ir		192.217(3)							
¹⁶⁴ Ir									
¹⁶⁵ Ir		164.9876	0.3 ms	β^- /87	1.71				
				α /13	6.72				
^{166m} Ir			15 ms	α /98.2	6.56				
				β^- /1.8	1.32				
¹⁶⁶ Ir		165.9855	≈ 11 ms	α /93	6.56				
				β^- /6.9	1.15				
^{167m} Ir			30 ms	α /48, β^+	6.41/80				
				β^- /32	1.24/0.4				
¹⁶⁷ Ir		166.9817	35. ms	α /80, β^+	6.35/48				
				β^- /0.4	1.04/32				
¹⁶⁸ Ir		167.9799	0.16 s	α /82					
^{169m} Ir			0.3 s	α /	6.11/84				
¹⁶⁹ Ir		168.9764	0.6 s	α /	6.00/50				
¹⁷⁰ Ir		169.9743	1.0 s	α /	6.03/				
¹⁷¹ Ir		170.9718	1.5 s	α /	5.91/				
¹⁷² Ir		171.9706	2.1 s	α /	5.811/				0.228 (0.379-0.475)
¹⁷³ Ir		172.9677	3.0 s	α /	5.665/				0.0493 (0.092-0.296)
¹⁷⁴ Ir		173.9668	4. s	α /	5.478/				0.1587 (0.276-1.33)
¹⁷⁵ Ir		174.9641	≈ 4.5 s	α /	5.393/				0.1056
¹⁷⁶ Ir		175.9635	8. s	EC, β^+ /80					0.260
				α /3.2/	5.118/				(0.135-0.415)
¹⁷⁷ Ir		176.9612	30. s	EC, β^+ /5.7					0.184
				α /0.06/	5.011/				(0.062-0.194)
¹⁷⁸ Ir		177.9601	12. s	β^+ , EC/6.3					0.1320 0.2667 0.3633
¹⁷⁹ Ir		178.9592	4. m	EC/4.9					0.0975 (0.045-0.220)
¹⁸⁰ Ir		179.9593	1.5 m	EC/6.4					0.2765 (0.132-1.106)
¹⁸¹ Ir		180.9576	4.9 m	β^+ , EC/4.1		(7/2+)			ann.rad./ 0.1076 (0.0196-1.715)
¹⁸² Ir		181.9582	15. m	β^+ /44/5.6					ann.rad./ Os k x-ray 0.1273 0.2370
				EC/56/					
¹⁸³ Ir		182.9568	57. m	β^+ , EC/3.5					ann.rad./ 0.0877 0.2285 0.2824
¹⁸⁴ Ir		183.9574	3.0 h	β^+ /12/4.6	2.3/	5-	0.70	+2.41	ann.rad./ Os k x-ray 0.11968 0.2640 0.3904
				EC/88/	2.9/				
¹⁸⁵ Ir		184.9566	14. h	β^+ /3/2.4		(5/2-)	2.60	-2.1	ann.rad./

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV) EC/97/	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									Os k x-ray
									0.2543
									1.8288
^{186m} Ir			1.7 h	EC/		(2-)	0.64	+1.46	Os k x-ray
									0.1371
									0.7675
¹⁸⁶ Ir		185.95795	15.7 h	EC/98/3.83 β ⁺ /2/		(5+)	3.9	-2.55	Os k x-ray
									0.1372
									0.2968
									0.4348
									(0.13 - 3.0)
¹⁸⁷ Ir		186.95736	10.5 h	EC/1.50		3/2+		+0.94	Os k x-ray
									0.0743
									0.4009
									0.4271
									0.6109
									0.9128
¹⁸⁸ Ir		187.95885	1.72 d	β ⁺ /2.81 EC/99+/ 1.64/	1.13/ 1.64/	(2-)	0.30	+0.48	Os k x-ray
									0.1550
									0.4780
									0.6330
									2.2146
¹⁸⁹ Ir		188.95872	13.2 d	EC/0.53		3/2+	0.13	+0.88	Os k x-ray
									0.2449
^{190m2} Ir			3.09 h	β ⁺ ,EC/95/ I.T./5/		(11-)			0.376
^{190m1} Ir			1.12 h	I.T./0.0263		7+			Ir L x-ray
¹⁹⁰ Ir		189.9606	11.8 d	EC/2.0		(4+)	0.04	+2.8	Os k x-ray
									0.1867
									0.4072
									0.5186
									0.5580
									0.6051
									(0.2 - 1.4)
^{191m} Ir			4.93 s	I.T./0.1714		11/2-	+0.603		Ir k x-ray
									0.1294
¹⁹¹ Ir	37.3(5)	190.960591				3/2+	+0.151	+0.82	
^{192m2} Ir			241. y	I.T./0.161		(9+)			Ir k x-ray
^{192m1} Ir			1.44 m	I.T./0.0580		(1+)			Ir L x-ray
									0.0580
									0.3165
¹⁹² Ir		191.962602	73.83 d	β ⁻ /1.460		(4-)	+1.92	+2.15	Pt k x-ray
									0.31649/83.
									0.46806/48.
^{193m} Ir			10.53 d	I.T./0.0802		11/2-			Ir L x-ray
									0.0803
¹⁹³ Ir	62.7(5)	192.962923				3/2+	+0.164	+0.75	
^{194m} Ir			170. d	β ⁻ /		11			Pt k x-ray
									0.3284
									0.4829
									0.5624
¹⁹⁴ Ir		193.965075	19.3 h	β ⁻ /2.247	1.92/9 2.25/86	1-	+0.39	+0.34	0.2935
									0.3284
									0.6451
									(0.1 - 2.2)
^{195m} Ir			3.9 h	β ⁻ /	0.41/ 0.97/	(11/2-)			Pt k x-ray
									0.3199/9.6
									0.3649/9.5
									0.4329/9.6

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁹⁵ Ir		194.965976	2.8 h	β^- /1.120	1.0/80 1.11/13	(3/2+)			0.6849/9.6 Pt k x-ray 0.0989/9.7
^{196m} Ir			1.40 h	β^- /	1.16/				Pt k x-ray 0.3557 0.3935 0.4471 0.5214 0.6473
¹⁹⁶ Ir		195.96838	52. s	β^- /3.21	2.1/15 3.2/80	0-			0.3329 0.3557 0.7796
^{197m} Ir			8.9 m	β^- / I.T./		(11/2-)			0.3465 See Ir[197]
¹⁹⁷ Ir		196.96964	5.8 m	β^- /2.16	1.5/ 2.0/	(3/2+)			0.0531 0.1351 0.4306 0.4697
¹⁹⁸ Ir		197.9723	8. s	β^- /4.1					0.4074 0.5070
¹⁹⁹ Ir		198.97378							
⁷⁸ Pt		195.078(2)							
¹⁶⁶ Pt			0.3 ms	α /	7.11/				
¹⁶⁷ Pt			0.7 ms	α /	6.99/				
¹⁶⁸ Pt		167.9880	2.0 ms	α	6.83				0.582/69 0.594/69 0.725/62
¹⁶⁹ Pt		168.9864	3. ms	α					
¹⁷⁰ Pt		169.9816	14 ms	α	6.55				0.509/100 0.662/86 0.214-0.726
¹⁷¹ Pt		170.9811	0.03 s	α					
¹⁷² Pt		171.97730	0.10 s	α /	6.31/94	0+			
¹⁷³ Pt		172.9765	0.34 s	β^+ ,EC/8.2 α /	6.20/				
¹⁷⁴ Pt		173.97281	0.89 s	β^+ ,EC/17/5.6 α /83/	6.040/	0+			
¹⁷⁵ Pt		174.9723	2.5 s	β^+ ,EC/65/7.6 α /35/	5.831/5 5.96/54 6.038/				0.0774 0.1354 0.2128
¹⁷⁶ Pt		175.9690	6.3 s	β^+ ,EC/60/5.1 α /40/	5.528/0.6 5.750/41	0+			ann.rad./ 0.2277
¹⁷⁷ Pt		176.9685	11. s	EC/91/6.8 α /9/	5.53/ 5.485/3 5.525/6				0.0908
¹⁷⁸ Pt		177.9649	21. s	EC/93/4.5 α /7/	5.286/0.2 5.442/7	0+			
¹⁷⁹ Pt		178.9653	33. s	β^+ ,EC/5.7 α /	5.16/				
¹⁸⁰ Pt		179.9632	52. s	β^+ ,EC/99.7/3.7 α /0.3/	5.140/	0+			
¹⁸¹ Pt		180.9632	51. s	β^+ ,EC/5.2					
¹⁸² Pt		181.9613	2.7 m	β^+ ,EC/2.9		0+			ann.rad./ 0.1360 0.1460 0.2100

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{183m} Pt			43. s			(7/2-)	1.0		ann.rad./ 0.3132/26 0.3164/59 0.6296/100 0.058-1.75
				I.T./					
¹⁸³ Pt		182.9617	7. m	β ⁺ ,EC/4.6			+0.51		ann.rad./ 0.119/100 0.307/93 0.260/90 0.058-1.377
¹⁸⁴ Pt		183.9599	17.3 m	β ⁺ ,EC/2.3					ann.rad./ 0.1549 0.1919 0.5484
^{185m} Pt			33. m	β ⁺ ,EC/		1/2-	+0.54		
¹⁸⁵ Pt		184.9607	1.18 h	β ⁺ ,EC/3.8		(9/2+)	-0.80	+4.5	ann.rad./ 0.1353 0.1974 0.2296 0.2551
¹⁸⁶ Pt		185.95943	2.0 h	β ⁺ ,EC/1.38		0+			ann.rad./ 0.6115 0.6892
¹⁸⁷ Pt		186.9607	2.35 h	β ⁺ ,EC/3.1		3/2	-0.41	-1.2	ann.rad./ Ir k x-ray 0.1064 0.1100 0.2015 0.2849 0.7092
¹⁸⁸ Pt		187.95940	10.2 d	EC/0.51		0+			Ir k x-ray 0.1876 0.1951
¹⁸⁹ Pt		188.96083	10.9 h	β ⁺ ,EC/1.97		3/2-	0.43	-1.1	Ir k x-ray 0.0943 0.6076 0.7214 (0.09 - 1.47)
¹⁹⁰ Pt	0.01(1)	189.95993	4.5x10 ¹¹ y			0+			
¹⁹¹ Pt		190.961684	2.96 d	EC/1.02		(3/2-)	0.50	-0.9	Ir k x-ray 0.3599 0.4094 0.5389
¹⁹² Pt	0.79(6)	191.961035				0+			
^{193m} Pt			4.33 d	I.T./0.1498		13/2+	-0.75		Pt k x-ray 0.1355
¹⁹³ Pt		192.962984	60. y	EC/0.0566		(1/2-)	+0.60		Ir k x-rays
¹⁹⁴ Pt	32.9(6)	193.962663				0+			
^{195m} Pt			4.02 d	I.T./0.2952		13/2+	-0.61	+1.4	Pt k x-ray 0.0989
¹⁹⁵ Pt	33.8(6)	194.964774				1/2-	+0.6095		
¹⁹⁶ Pt	25.3(6)	195.964934				0+			
^{197m} Pt			1.590 h	I.T./97/ β ⁻ /3/		13/2+			Pt k x-ray 0.0530 0.3465
¹⁹⁷ Pt		196.967323	18.3 h	β ⁻ /0.719		1/2-	0.51		Au k x-ray 0.1914 0.2688
¹⁹⁸ Pt	7.2(2)	197.967875				0+			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{199m} Pt			13.6 s	I.T./0.424		13/2+			Pt k x-ray 0.3919
¹⁹⁹ Pt		198.970576	30.8 m	β^- /1.70	0.90/18 1.14/14	(5/2-)			0.3170/4.9 0.49375/5.7 0.5430/14.8 (0.055-1.293)
²⁰⁰ Pt		199.97142	12.5 h	β^- /=0.66		0+			Au k x-ray 0.13590 0.22747 0.24371
²⁰¹ Pt		200.9745	2.5 m	β^- /2.66		(5/2-)			0.070 0.152 0.222 1.760
²⁰² Pt		201.9757	1.8 d						0.440
⁷⁹ Au		196.96655(2)							
¹⁷¹ Au		170.9918	1.0 ms	α /46 α /54	1.44/100 7.00				
¹⁷² Au		171.9901	4 ms	α /7.02	6.86				
^{173m} Au			12 ms	α /92	6.732				
¹⁷³ Au		172.9864	0.020 s	α /94	6.672				
¹⁷⁴ Au		173.9842	0.12 s	α					
¹⁷⁵ Au		174.9817	0.20 s	α					
¹⁷⁶ Au		175.9803	1.2 s	β^+ ,EC/10.5 α	6.260/80 6.290/20				
¹⁷⁷ Au		176.9772	1.2 s	α	6.115/ 6.150/				
¹⁷⁸ Au		177.9760	2.6 s	α	5.920/				
¹⁷⁹ Au		178.9732	7.5 s	α	5.85/				
¹⁸⁰ Au		179.9724	8.1 s	EC/8.6 α	5.65 5.61 5.50				0.1522 0.2564 0.5242 0.6765 0.8084 0.8597
¹⁸¹ Au		180.9700	11.4 s	EC/97.5/6.3 α /2.7/	5.482/				
¹⁸² Au		181.9686	21. s	β^+ ,EC/6.9 α /0.13/					ann.rad./ 0.1549 0.2649 (0.13 - 1.4)
¹⁸³ Au		182.9676	42. s	EC/5.5 α /0.8/			+1.97		0.1630 0.2730 0.3625
^{184m} Au			48 s			(2+)	+1.44	+1.9	0.069(IT)
¹⁸⁴ Au		183.9675	21. s	EC, β^+ /7.1 α /0.013/		(5+)	+2.07	+4.7	
^{185m} Au			6.8 m	β^+ ,EC/ I.T./0.145					
¹⁸⁵ Au		184.9657	4.3 m	β^+ ,EC/4.71 α /0.26/		(5/2-)	+2.17	-1.1	ann.rad./
^{186m} Au			< 2. m	β^+ ,EC/					0.1915
¹⁸⁶ Au		185.9659	10.7 m	β^+ ,EC/6.0 α /8(10) ⁻⁴ /		3-	-1.26	+3.1	ann.rad./ 0.1915 0.2988
^{187m} Au			2.3 s	IT		9/2-			
¹⁸⁷ Au		186.9646	8.3 m	β^+ ,EC/3.60		1/2+	+0.54		ann.rad./ 0.9152

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									1.2668
									1.3321
									1.4081
¹⁸⁸ Au		187.9651	8.8 m	β ⁺ ,EC/5.3		(1-)	-0.07		ann.rad./
									0.2660
									0.3404
									0.6061
^{189m} Au			4.6 m	β ⁺ ,EC/		11/2-	+6.19		0.1667
¹⁸⁹ Au		188.9642	28.7 m	EC/96/3.2		1/2+	+0.49		ann.rad./
				β ⁺ /4/					Pt k x-ray
									0.4478
									0.7133
									0.8128
¹⁹⁰ Au		189.96470	43. m	β ⁺ /2/4.44		1-	-0.07		ann.rad./
				EC/98/					Pt k x-ray
									0.2958
									0.3018
									0.5977
^{191m} Au			0.9 s	I.T./0.2663		11/2-	6.6		Au k x-ray
									0.2414
									0.2526
¹⁹¹ Au		190.96365	3.2 h	EC/1.83		3/2+	+0.137	+0.72	Pt k x-ray
									0.5864/16
									(0.088-1.30)
¹⁹² Au		191.96481	4.9 h	β ⁺ /5/3.52	2.19/	1-	-0.011	-0.23	ann.rad./
				EC/95/	2.49/				Pt k x-ray
									0.2959
									0.3165
^{193m} Au			3.9 s	I.T./0.2901		11/2-	6.2	+1.98	Au k x-ray
									0.2580
¹⁹³ Au		192.96413	17.6 h	EC/1.07		3/2+	+0.140	+0.66	Pt k x-ray
									0.1862
									0.2556
¹⁹⁴ Au		193.96534	1.64 d	β ⁺ /3/2.49	1.49/	1-	+0.076	-0.24	ann.rad./
				EC/97/					Pt k x-ray
									0.2935
									0.3284/61
^{195m} Au			30.5 s	I.T./0.3186		11/2-	6.2	+1.9	Au k x-ray
									0.2617
¹⁹⁵ Au		194.965017	186.12 d	EC/0.227		3/2+	+0.149	+0.61	Pt k x-ray
^{196m2} Au			9.7 h	I.T./0.5954		12-	5.7		Au k x-ray
									0.1478
									0.1883
^{196m1} Au			8.1 s	I.T./0.0846		8+			0.0847
¹⁹⁶ Au		195.966551	6.18 d	EC/92/1.506		2-	+0.591	0.81	Pt k x-ray
^{197m} Au			7.8 s	I.T./0.4094		11/2-	+6.0	+1.7	Au k x-ray
				β ⁻ /8/0.686					0.1302
									0.2790
¹⁹⁷ Au	100.	196.966551				3/2+	+0.14575	+0.55	
^{198m} Au			2.30 d	I.T./0.812		(12-)			Au k x-ray
									0.0972
									0.1803
									0.2419
¹⁹⁸ Au		197.968225	2.694 d	β ⁻ /1.372	0.290/1	2-	+0.5934	+0.64	Hg k x-ray
					0.961/99				0.411794
¹⁹⁹ Au		198.968748	3.14 d	β ⁻ /0.453	0.25/22	3/2+	+0.2715	+0.51	Hg k x-ray
					0.292/72				0.15837
					0.462/6				0.20820
^{200m} Au			18.7 h	β ⁻ /84/1.0	0.56/	12-	5.9		Au k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
				I.T./16/					0.2559/71
									0.3680/77
									0.4978/73
									0.5793/72
									0.084-0.904)
²⁰⁰ Au		199.97072	48.4 m	β^- /2.24	0.7/15	1-			0.3679/19
					2.2/77				1.2254/10.6
									(0.077-1.570)
²⁰¹ Au		200.97165	26. m	β^- /1.28	1.27/82	3/2+			(0.027-0.732)
²⁰² Au		201.9738	29. s	β^- /3.0		(1-)			0.4396
²⁰³ Au		202.97515	1.0 m	β^- /2.14	\approx 1.9/	3/2+			(0.04-0.37)
²⁰⁴ Au		203.9783	40. s	β^- /4.5		(2-)			0.4366
									1.5113
²⁰⁵ Au		204.9796	31. s	β^- /					(0.38 - 1.33)
⁸⁰ Hg		200.59(2)							
¹⁷² Hg			\approx 0.25 ms	α	7.35				
¹⁷³ Hg			0.9 ms	α	7.21				
¹⁷⁴ Hg			1.9 ms	α	7.07				
¹⁷⁵ Hg		174.9912	0.02 s	α					
¹⁷⁶ Hg		175.98733	21 ms	α	6.74/94				
¹⁷⁷ Hg		176.9863	0.13 s	α					
¹⁷⁸ Hg		177.98248	0.26 s	EC/50/6.1		0+			
				α /50/	6.43/				
¹⁷⁹ Hg		178.9818	1.09 s	EC/8.0					
				α /	6.29/				
¹⁸⁰ Hg		179.9783	2.6 s	EC/5.5		0+			0.1250
				α /	6.12/33				0.3005
					5.69/.03				0.3812
¹⁸¹ Hg		180.9778	3.6 s	β^+ EC/74/ \approx 7.3		(1/2-)	+0.507		0.0663
				α /26/					0.0811
									0.0924
									0.1474
									0.1587
									0.2142
									0.2398
¹⁸² Hg		181.9739	10.8 s	β^+ ,EC/85/5.0		0+			0.1289
				α /15/	5.87/8.6				0.2168
					5.45/0.03				0.4126
¹⁸³ Hg		182.9744	9. s	β^+ ,EC/77/6.3		1/2-	+0.524		0.0714
				α /	5.83/				0.0874
					5.91/				0.1538
¹⁸⁴ Hg		183.9719	30.9 s	β^+ ,EC/99/4.1		0+			0.0915
				α /1/	5.54/1.3				0.1265
					5.07/2 x 10 ⁻³				0.1560
									0.2362
^{185m} Hg			21. s	β^+ ,EC,IT, α /	5.37/	13/2+	-1.02	+0.2	0.211
									0.292
¹⁸⁵ Hg		184.9720	51. s	β^+ ,EC/95/5.8		1/2-	+0.509		(0.02 - 0.55)
¹⁸⁶ Hg		185.9695	1.4 m	β^+ ,EC/3.3		0+			0.1119
				α	5.09/0.02				0.2518
^{187m} Hg			1.7 m	β^+ ,EC/		13/2+	-1.04	+0.5	See Hg[187]
¹⁸⁷ Hg		186.9698	2.4 m	β^+ ,EC/4.9		3/2-	-0.594	-0.8	0.1034/32.
									0.2334/100.
									0.2403/33.
									0.27151/31.
									0.3763/38.
									0.5254/30.
									(0.10-2.18)
¹⁸⁸ Hg		187.9676	3.2 m	β^+ ,EC/2.3		0+			0.0988

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
				α	4.61				0.1148
									0.1424
									0.1900
^{189m} Hg			8.6 m	EC/		13/2+	-1.06	+0.7	0.0780
									0.3210
									0.4345
									0.5655
									(0.08 - 2.170)
¹⁸⁹ Hg		188.9687	7.6 m	EC/4.2		3/2-	-0.6086	-0.8	0.2005
									0.2038
									0.2386
									0.2485
¹⁹⁰ Hg		189.9663	20.0 m	EC/1.5		0+			0.1296
									0.1426
^{191m} Hg			51. m	β^+ /6/ EC/94/		13/2+	-1.07	+0.6	ann.rad./ Au k x-ray
									0.2741
									0.4203
									0.5787
									(0.07 - 1.9)
¹⁹¹ Hg		190.9671	50. m	β^+ ,EC/3.2		(3/2-)	-0.62	-0.8	0.1963
									0.2247
									0.2524
¹⁹² Hg		191.9653	5.0 h	EC/ \approx 0.5		0+			Au k x-ray
									0.1572
									0.2748
									0.3065
^{193m} Hg			11.8 h	β^+ ,EC/91/ I.T./9/0.2901		13/2+	-1.05843	+0.92	Hg k x-ray
									0.1866
									0.2580
									0.4076
									0.5733
									0.9324
									(0.1 - 1.96)
¹⁹³ Hg		192.96664	3.8 h	EC,B ⁺ /2.34		3/2-	-0.6276	-0.7	0.1866
									0.2580
									0.8611
¹⁹⁴ Hg		193.96538	520. y	EC/0.04		0+			Au L x-rays
^{195m} Hg			1.67 d	I.T./((54)/0.3186 EC/(46)/		13/2+	-1.04465	+1.1	Hg k x-ray
									Au k x-ray
									0.2617
									0.5603
									0.7798
¹⁹⁵ Hg		194.96664	9.5 h	EC/1.51		1/2-	+0.54147 5		Au k x-ray
									0.0614
									0.7798
¹⁹⁶ Hg	0.15(1)	195.965814				0+			
^{197m} Hg			23.8 h	I.T./((93)/0.2989		13/2+	-1.02768	+1.2	Hg k x-ray
									Au k x-ray
									0.13398
¹⁹⁷ Hg		196.967195	2.672 d	EC/0.600		1/2-	+0.52737 4		Au k x-ray
									0.07735
¹⁹⁸ Hg	9.97(8)	197.966752				0+			
^{199m} Hg			42.6 m	I.T./0.532		13/2+	-1.014703	+1.2	Hg k x-ray
									0.15841
¹⁹⁹ Hg	16.87(10)	198.968262				1/2-	+0.50588 5		

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁰⁰ Hg	23.10(16)	199.968309				0+			
²⁰¹ Hg	13.18(8)	200.970285				3/2-	-0.560226	+0.39	
²⁰² Hg	29.86(20)	201.970625				0+			
²⁰³ Hg		202.972857	46.61 d	β^- /0.492	0.213/100	5/2-	+0.8489	+0.34	Tl k x-ray 0.279188
²⁰⁴ Hg	6.87(4)	203.973475				0+			
²⁰⁵ Hg		204.976056	5.2 m	β^- /1.531	1.33/4	1/2-	+0.6010		0.20378 (0.2 - 1.4)
²⁰⁶ Hg		205.97750	8.2 m	β^- /1.31	0.935/34 1.3/63	0+			Tl k x-ray 0.3052 0.6502
²⁰⁷ Hg		206.9825	2.9 m	β^- /4.8		(9/2+)			
²⁰⁸ Hg		207.9859	0.7 h	β^-					0.474
⁸¹ Tl		204.3833(2)							
^{177m} Tl			0.23 ms	α /51 α /49					
¹⁷⁷ Tl		176.9969	0.017 s	α /73 P/27					
¹⁷⁸ Tl		177.9952	\approx 0.2 s						
^{179m} Tl			1.7 ms	α	7.21/80 7.10/20				
¹⁷⁹ Tl		178.9917	0.2 s	α					
¹⁸⁰ Tl		179.9912	1.5 s	α	6.28/30 6.36/30 6.21/18 6.56/15 6.47/7				
^{181m} Tl			1.4 ms	α	6.58/100				
¹⁸¹ Tl		180.9869	3.2 ms	α	6.19/100				
¹⁸² Tl		181.9856	3. s	β^+ , EC/10.9					0.351 (0.26 - 0.41)
^{183m} Tl			0.06 s	α		9/2-			
¹⁸³ Tl		182.9826	5. s	β^+ , EC/7.7		1/2+			0.208
¹⁸⁴ Tl		183.9818	11. s	β^+ , EC/(98)/9.2 α (2)/	6.16/				0.2868 0.3399 0.3667
^{185m} Tl			1.8 s	I.T./0.453 α /5.97	6.01	(9/2-)			0.1688 0.2840
¹⁸⁵ Tl		184.9791	20. s	EC/ β^+ /6.6					
^{186m} Tl			4. s	I.T./0.374					0.3738
¹⁸⁶ Tl		185.9776	28. s	β^+ , EC/7.5					0.3567 0.4026 0.4053
^{187m} Tl			15.6 s	I.T./ \approx 0.33		(9/2+)	+3.8	-2.4	0.2995
¹⁸⁷ Tl		186.9762	50. s	β^+ , EC/6.0		1/2+	1.6		
^{188m} Tl			1.18 m	β^+ , EC/		(7+)			Hg k x-ray 0.4129 0.5043 0.5921
¹⁸⁸ Tl		187.9759	1.2 m	β^+ , EC/7.8		(2-)	+0.48	+0.13	See Tl[188m] 0.4129
^{189m} Tl			1.4 m	β^+ , EC/		(9/2-)	+3.878	-2.29	0.2156 0.2284 0.3175 0.4452
¹⁸⁹ Tl		188.9743	2.3 m	β^+ , EC/5.2		(1/2+)			0.3337 0.4510 0.5223 0.9422

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{190m} Tl			3.7 m	β^+ ,EC/	4.2/	(7+)	+0.495	+0.29	0.1968 0.4164 0.7311
¹⁹⁰ Tl		189.9738	2.6 m	β^+ ,EC/7.0	5.7/	(2-)	+0.25	-0.33	0.4164 0.6254 0.6838 1.0999
^{191m} Tl			5.2 m	β^+ ,EC/(98)/		(9/2+)	+3.903	-2.3	0.2157 0.2647 0.3256 0.3359
¹⁹¹ Tl		190.9723				(1/2)	1.59		
^{192m} Tl			10.8 m	β^+ ,EC/		(7+)	+0.518	0.46	0.1740 0.4228 0.6348 0.7863 0.7455
¹⁹² Tl		191.972	9.6 m	β^+ ,EC/6.4		(2-)	+0.20	-0.33	0.3975 0.4228 0.6908
^{193m} Tl			2.1 m	I.T./ (75)/		(9/2-)	+3.948	-2.2	0.3650
¹⁹³ Tl		192.9706	22. m	β^+ ,EC/3.6		(1/2+)	+1.591		0.2077 0.3244 0.3440 0.6761 1.0447 1.5793
^{194m} Tl			32.8 m	β^+ /(20)/=0.30 EC/(80)/		(7+)	+0.540	+0.61	ann.rad./ Hg k x-ray 0.4282 0.6363 0.7490
¹⁹⁴ Tl		193.9711	34. m	β^+ ,EC/5.3		2-	0.140	-0.28	0.3955 0.4282 0.6363
^{195m} Tl			3.6 s	I.T./0.483		9/2-			Tl k x-ray 0.0990 0.3836
¹⁹⁵ Tl		194.9697	1.16 h	EC/97/2.8 β^+ /(3)/		1/2+	+1.58		ann.rad./ Hg k x-ray 0.2422 0.5635 0.8845 1.3639 (0.13 - 2.5)
^{196m} Tl			1.41 h	β^+ ,EC/95/4.9		(7+)	0.55	+0.76	0.0840 0.4261 0.6353 0.6954 (0.08 - 1.0)
¹⁹⁶ Tl		195.9705	1.84 h	β^+ /(15)/4.4 EC/(85)/		2-	+0.072	-0.18	ann.rad./ Hg k x-ray 0.4257 0.6105 (0.03 - 2.4)
^{197m} Tl			0.54 s	IT/53/0.608 β^+ ,EC/47/		9/2-			Tl k x-ray 0.2262 0.4118 0.5872

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁹⁷ Tl		196.96954	2.83 h	$\beta^+/(1)/2.18$ EC/(99/)		1/2+	+1.58		0.6367 Hg k x-ray 0.1522/8.2 0.4258
^{198m} Tl			1.87 h	$\beta^+,EC/(53/)$ IT/47/0.5347		7+	+0.64		Hg k x-ray Tl k x-ray 0.4118 0.5872 0.6367
¹⁹⁸ Tl		197.9405	5.3 h	EC, $\beta^+/(1)/3.5$	1.4/ 2.1/ 2.4/	2-			Hg k x-ray 0.4118 0.6367 0.6759 (0.23 - 2.8)
¹⁹⁹ Tl		198.9698	7.4 h	EC/1.4		1/2-	+1.60		Hg k x-ray 0.2082 0.2473 0.4555
²⁰⁰ Tl		199.97095	1.087 d	EC/2.46	1.07/ 1.44/	2-	0.04		Hg k x-ray 0.36799 1.2057 (0.11 - 2.3)
²⁰¹ Tl		200.97080	3.040 d	EC/0.48		1/2+	+1.605		Hg k x-ray 0.13528 0.16740/10.0
²⁰² Tl		201.97209	12.23 d	EC/1.36		2-	0.06		Hg k x-ray 0.43957
²⁰³ Tl	29.524(14)	202.972329				1/2+	+1.62225 8		
²⁰⁴ Tl		203.973848	3.78 y	$\beta^-/97/0.7637$ EC(3)/0.347	0.763/97	2-	0.09		Hg k x-ray
²⁰⁵ Tl	70.476(14)	204.974412				1/2+	+1.63821 5		
^{206m} Tl			3.76 m	I.T./2.644		12-			Tl k x-ray 0.2166 0.2661 0.4534 0.6866 1.0219
²⁰⁶ Tl		205.976095	4.20 m	$\beta^-/1.533$	1.53/99.9	0-			Pb k x-ray 0.80313
^{207m} Tl			1.3 s	I.T./1.350		11/2-			Tl k x-ray 0.3501 1.0000
²⁰⁷ Tl		206.97741	4.77 m	$\beta^-/1.423$	1.43/99.8	1/2+	+1.88		0.89723
²⁰⁸ Tl		207.982004	3.053 m	$\beta^-/5.001$	1.28/23 1.52/22 1.796/51	(5+)	+0.29		Pb k x-ray 0.27728 0.51061 0.58302 2.61448
²⁰⁹ Tl		208.98535	2.16 m	$\beta^-/3.98$	1.8 /100	(1/2+)			Pb k x-ray 1.5670/100 0.4651/95 (0.12 - 1.33)
²¹⁰ Tl		209.99006	1.30 m	$\beta^-/5.48$	1.3/25 1.9/56	(5+)			Pb k x-ray 0.081 0.2981 0.79788
⁸² Pb		207.2(1)							

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
¹⁷⁸ Pb			≈0.2 ms						
¹⁸⁰ Pb			5 ms	α/	7.25				
¹⁸¹ Pb		180.9967	0.05 s	α/	7.07				
¹⁸² Pb		181.99268	55 ms	α	6.90				
¹⁸³ Pb		182.9919	0.3 s	α/		1/2+			
¹⁸⁴ Pb		183.9882	0.48 s	α/	6.63/	0+			
¹⁸⁵ Pb		184.9876	4.1 s	α/	6.34/				
					6.40/				
					6.48/				
¹⁸⁶ Pb		185.9835	5. s	β ⁺ ,EC/95/5.5		0+			
				α/(5)/	6.32/				
					6.34/<100				
					6.01/<0.2				
^{187m} Pb			15.2 s	β ⁺ ,EC/	5.99/	(1/2-)			0.0674
				α/12	6.19/				0.2080
									0.2755
									0.2995
									0.4487
									0.7477
¹⁸⁷ Pb		186.9839	18.3 s	EC/7.2		13/2+			0.1930
				α/7	6.08/				0.3314
									0.3435
									0.3934
¹⁸⁸ Pb		187.9811	23. s	EC/(78)/4.8		0+			0.1850
				α/(22)/	5.98/<10				0.7582
					5.61/<0.1				
¹⁸⁹ Pb		188.9809	51. s	EC/6.1					
				α/	5.58/				
¹⁹⁰ Pb		189.9782	1.2 m	β ⁺ (13)/4.1		0+			ann.rad./
				EC/(86)/					Tl k x-ray
				α/(0.9)/	5.58/				0.1415
									0.1512
									0.9422
^{191m} Pb			2.2 m	β ⁺ ,EC/		13/2+	-1.17	+0.085	ann.rad./
									0.3871
									0.6135
									0.7122
¹⁹¹ Pb		190.9782	1.3 m	β ⁺ ,EC/5.5					ann.rad./
									0.9368
¹⁹² Pb		191.9758	3.5 m	β ⁺ ,EC/≈3.4		0+			ann.rad./
				α/.006/	5.11				0.1675
									0.6082
									1.1954
^{193m} Pb			5.8 m	β ⁺ ,EC/		13/2+	-1.15	+0.19	ann.rad./
									0.3650
									0.3922
¹⁹³ Pb		192.9761	≈ 2. m	EC/5.2		3/2			
¹⁹⁴ Pb		193.9740	11. m	β ⁺ ,EC/2.7		0+			ann.rad./
				α	4.64				0.2036
^{195m} Pb			15. m	β ⁺ /(8)/		13/2+	-1.132	+0.30	ann.rad./
				EC/(92)/					Tl k x-ray
									0.3836
									0.3942
									0.8784
¹⁹⁵ Pb		194.976	≈ 15. m	β ⁺ ,EC/5.8					ann.rad./
									0.3836
									0.3937
									0.7776
¹⁹⁶ Pb		195.9727	37. m	β ⁺ ,EC/2.1		0+			Tl k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.2531
									0.5021
^{197m} Pb			43. m	EC/79/ β ⁺ /2/ IT/19/0.3193		13/2+	-1.104	+0.38	Tl k x-ray
									0.3079
									0.3877
									0.7743
									(0.2 - 2.2)
¹⁹⁷ Pb		196.9734	≈ 8. m	EC/97/3.6 β ⁺ /3/		(3/2-)	-1.075	-0.08	Tl k x-ray
									0.3755
									0.3858
									0.7611
¹⁹⁸ Pb		197.9720	2.4 h	EC/1.4		0+			Tl k x-ray
									0.1734
									0.2903
									0.3654
^{199m} Pb			12.2 m	IT/93/0.4248 β ⁺ ,EC/(7/)		13/2+			Pb k x-ray
									0.4255
¹⁹⁹ Pb		198.9729	1.5 h	EC/(99)/2.9 β ⁺ /(1/)		5/2-	-1.074	+0.08	Tl k x-ray
									0.3534
									0.7202
									1.1350
									(0.22 - 2.4)
²⁰⁰ Pb		199.97182	21.5 h	EC/0.81		0+			Tl k x-ray
									0.14763
^{201m} Pb			1.02 m	I.T./0.6291		13/2+			Pb k x-ray
									0.6288
²⁰¹ Pb		200.97285	9.33 h	EC/1.90		5/2-	+0.675	-0.009	Tl k x-ray
									0.33120
									0.36131
									(0.11 - 1.8)
^{202m} Pb			3.53 h	IT/90/2.170 β ⁺ /10/		9-	-0.228	+0.58	Pb k x-ray
									Tl k x-ray
									0.42219
									0.78700
									0.96271
²⁰² Pb		201.97214	5.3x10 ⁴ y	EC/0.05		0+			Tl L x-ray
^{203m} Pb			6.2 s	I.T./0.8252		13/2+			Pb k x-ray
									0.8203
									0.8252
²⁰³ Pb		202.97338	2.1615 d	EC/0.98		5/2-	+0.686	+0.10	Tl k x-ray
									0.279188
^{204m} Pb			1.12 h	I.T./2.185		9-			Pb k x-ray
									0.37481
									0.89922
									0.91175
²⁰⁴ Pb	1.4(1)	203.973028				0+			
²⁰⁵ Pb		204.974467	1.51x10 ⁷ y	EC/0.0512		5/2-	+0.712	+0.23	Tl L x-ray
²⁰⁶ Pb	24.1(1)	205.974449				0+			
^{207m} Pb			0.80 s	I.T./1.632		13/2+			Pb k x-ray
									0.56915
									1.06310
²⁰⁷ Pb	22.1(1)	206.975880				1/2-	+0.59258		
²⁰⁸ Pb	52.4(1)	207.976636	>2x10 ¹⁹ y	SF		0+			
²⁰⁹ Pb		208.981075	3.25 h	β ⁻ /0.644	0.645/100	9/2+	-1.474	-0.3	
²¹⁰ Pb		209.984174	22.6 y	β ⁻ /0.0635	0.017/81	0+			
					0.061/19				
				α	3.72				
²¹¹ Pb		210.988732	36.1 m	β ⁻ /1.37	0.57/5	(9/2+)	-1.404	+0.09	0.40486

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					1.36/92				0.42700
									0.83186
									(0.09 - 1.27)
²¹² Pb		211.991887	10.64 h	β ⁻ /0.574	0.28/83	0+			Bi k x-ray
					0.57/12				0.23858
²¹³ Pb		212.9966	10.2 m	β ⁻ /2.1					
²¹⁴ Pb		213.999797	26.9 m	β ⁻ /1.0	0.67/48	0+			Bi k x-ray
					0.73/42				0.24192
									0.29509
									0.35187
²¹⁵ Pb			36 s						
₈₃ Bi		208.98038(2)							
¹⁸⁵ Bi		184.9977	0.04 ms	p/86	1.59				
				α/14					
¹⁸⁶ Bi		185.9965	10 ms	α	7.16				
					7.26				
^{187m} Bi			≈ 8. ms	α/12					
¹⁸⁷ Bi		186.9935	32. ms	α/7	7.00/88.3				
					7.61/8.0				
					7.37/3.7				
¹⁸⁸ Bi		187.9922		α					
^{189m} Bi			7.0 ms	α	7.30				
¹⁸⁹ Bi		188.9895	0.68 s	α					
¹⁹⁰ Bi		189.9875	5. s	β ⁺ ,EC/(10)/8.7					
				α(90)/	6.45/				
^{191m} Bi			0.12 ms	α	6.87				
¹⁹¹ Bi		190.9861	12. s	β ⁺ ,EC/(60)/7.3					
				α(40)/	6.32/				
¹⁹² Bi		191.9854	40. s	β ⁺ ,EC/(80)/9.0					
				α(20)/	6.06/				
^{193m} Bi			3.2 s	β ⁺ ,EC/		1/2+			
				α/	6.48/				
¹⁹³ Bi		192.9837	1.11 m	β ⁺ ,EC/40/7.1		9/2+			
				α(60)/	5.91/				
¹⁹⁴ Bi		193.9828	1.8 m	β ⁺ ,EC/99.9/8.2		(10-)			0.1661
				α/0.1/					0.1740
									0.2802
									0.421
									0.5754
									0.9650
^{195m} Bi			1.45 m	β ⁺ ,EC/(94)/					
				α(6)/	6.11/				
¹⁹⁵ Bi		194.9811	2.9 m	β ⁺ ,EC/99.8/5.8		3/2-			
				α(0.2)	5.45/				
¹⁹⁶ Bi		195.9806	5. m	EC/=7.4					0.1376
									0.3720
									0.6880
									1.0486
¹⁹⁷ Bi		196.9789	5. m	β ⁺ ,EC/5.2		1/2+			
^{198m} Bi			7.7 s	I.T./0.2485		(10-)			0.2485
¹⁹⁸ Bi		197.9790	11.8 m	β ⁺ ,EC/6.6		(7+)			0.0900
									0.1976
									0.5624
									1.0635
^{199m} Bi			24.7 m	β ⁺ ,EC/					ann.rad./
¹⁹⁹ Bi		198.9776	27. m	β ⁺ ,EC/4.3		9/2-	4.6		0.7203
									0.8374
									0.8417
									0.9460

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									1.0528
									1.3056
									(0.12 - 3.2)
^{200m} Bi			31. m	β ⁺ ,EC/		(2+)			0.2453
									0.4198
									0.4624
									1.0265
²⁰⁰ Bi		199.9781	36. m	EC/(90)/5.9		7+			ann.rad./
				β ⁺ /(10)/					Pb k x-ray
									0.4198
									0.4623
									1.0265
^{201m} Bi			59.1 m	I.T./0.846		(1/2+)			Bi k x-ray
				β ⁺ ,EC/					0.8464
²⁰¹ Bi		200.97697	1.8 h	EC/3.84		9/2-	4.8		Pb k x-ray
									0.6288
									0.9357
									1.0138
									(0.13 - 2.4)
²⁰² Bi		201.97768	1.72 h	β ⁺ /(3)/5.16		5+	+4.26	-0.72	ann.rad./
				EC/(97)/					Pb k x-ray
									0.57860
									0.92734
									(0.08 - 3.5)
²⁰³ Bi		202.97687	11.8 h	EC/99.8/3.25		9/2-	+4.02	-0.69	Pb k x-ray
				β ⁺ /(0.2)/	1.35/				0.1865
									0.8203
									0.8969
									1.8475
									(0.1 - 2.9)
²⁰⁴ Bi		203.97779	11.2 h	EC/4.44		6+	+4.32	-0.43	Pb k x-ray
									0.37481
									0.89922
									0.98409
²⁰⁵ Bi		204.97737	15.31 d	EC/2.71		9/2-	+4.07	-0.59	Pb k x-ray
									0.70347
									1.76435
²⁰⁶ Bi		205.97848	6.243 d	EC/3.76		6+	+4.36	-0.39	Pb k x-ray
									0.51619
									0.80313
									0.88100
²⁰⁷ Bi		206.978456	35. y	EC/2.399		9/2-	4.08	-0.6	Pb k x-ray
									0.56915
									1.06310
²⁰⁸ Bi		207.979727	3.68x10 ⁵ y	EC/2.880		5+	4.63	-0.64	Pb k x-ray
									2.61435
²⁰⁹ Bi	100.	208.980384				9/2-	+4.111	-0.37	
^{210m} Bi			3.0x10 ⁶ y	α/	4.420(3)/0.29	9-	+2.73	-0.47	Tl k x-ray
					4.569(3)/3.9				0.2661
					4.584(3)/1.4				0.3052
					4.908(4)/39				0.6502
					4.946(3)/55				
²¹⁰ Bi		209.984105	5.01 d	β ⁻ /1.163	1.16/99	1-	-0.0445	+0.136	0.2661
									0.3.52
²¹¹ Bi		210.98726	2.14 m	α/(99.7)/	6.279/16	9/2-			Tl k x-ray
				β ⁻ /(0.3)/0.58	6.623/84				0.3501
^{212m2} Bi			7. m	β ⁻ /		(15-)			
^{212m1} Bi			25.0 m	α/(93)/	6.300/40	(9-)			0.120

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
				β^- /(7)/	6.340/53				0.233
									0.275
									0.404
									0.727
²¹² Bi		211.991271	1.009 h	β^- /(64)/2.254		(1-)	+0.32	+0.1	Tl k x-ray
				α /(36)/	6.051/25				Po k x-ray
					6.090/9.6				0.2881
									0.72725
									0.78551
									1.62066
²¹³ Bi		212.99437	45.6 m	β^- /(98)/1.43	1.02/31	9/2-	+3.72	-0.60	Po k x-ray
				α /(2)/	1.42/66				0.4404
					5.549/0.16				(0.15 - 1.328)
					5.869/2.0				
									1.10006
²¹⁴ Bi		213.99870	19.7 m	β^- /3.27					0.60931
									1.12027
									1.76449
									(0.19 - 3.2)
²¹⁵ Bi		215.0018	7.7 m	β^- /2.3					0.2937
									(0.27 - 0.835)
²¹⁶ Bi		216.0062	2.3 m	β^- /4.0					0.5498
									0.4192
²¹⁷ Bi			97 s	β /					
⁸⁴ Po									
¹⁸⁸ Po			0.4 ms	α	7.92				7.35
¹⁸⁹ Po			5 ms	α	7.54				7.25
					7.32				
¹⁹⁰ Po		189.9951	2.4 ms	α /	7.53				
^{191m} Po			0.10 s	α	7.38				
¹⁹¹ Po		190.9947	22 ms	α /	7.33				
¹⁹² Po		191.9915	34. ms	α /8.5	7.17				
^{193m} Po			0.24 s	α /	7.00				
¹⁹³ Po		192.9911	0.45 s	α /	6.95				
¹⁹⁴ Po		193.9883	0.39 s	α /	6.84/93	0+			
					6.19/0.22				
^{195m} Po			1.9 s	α /	6.70/				
¹⁹⁵ Po		194.9881	4.6 s	α /	6.61/				
¹⁹⁶ Po		195.9855	5.8 s	α /(95)/	6.52/94	0+			
				β^+ ,EC(5)/=4.6	5.77/0.02				
^{197m} Po			25.8 s	α /(84)/	6.385(3)/55	13/2+			
				β^+ ,EC/(16)/					
¹⁹⁷ Po		196.9856	53. s	α /(44)/	6.282(4)/76	(3/2-)			
				β^+ ,EC(56)/6.2					
¹⁹⁸ Po		197.9834	1.76 m	α /(70)/	6.18/57	0+			
				β^+ ,EC(30)/4.0	5.27/7.6x10 ⁻⁴				
^{199m} Po			4.2 m	β^+ ,EC(51)/		13/2+	0.99		ann.rad./
				α /(39)/	6.059/24				0.2745
									0.4998
									1.0020
¹⁹⁹ Po		198.985	5.2 m	β^+ ,EC(88)/7.		(3/2-)			Bi k x-ray
				α /(12)/	5.952/7.5				0.1877
									0.3616
									1.0214
									1.0344
²⁰⁰ Po		199.9817	11.5 m	β^+ ,EC/85/3.4		0+			0.14748
				α /(15)/	5.863/11.1				0.32792

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.6176
									0.6709
^{201m} Po			8.9 m	β^+ ,EC/(57)/ IT/40/0.418		13/2+	1.00		Bi k x-ray Po k x-ray
				α /(3)	5.786/~3.				0.2726
									0.4123
									0.4179
									0.9670
²⁰¹ Po		200.9822	15.3 m	β^+ ,EC/98/4.9		3/2-	0.94		Bi k x-ray
				α /(2)	5.683(3)/1.1				0.2056
									0.2250
									0.8483
									0.9048
²⁰² Po		201.9807	45. m	β^+ ,EC/98/2.8		0+			0.0410
				α /(2)	5.588/1.9				0.1656
									0.3158
									0.6884
^{203m} Po			1.2 m	IT/96/0.6414		13/2+			Bi k x-ray
				β^- EC/(4)/					Po k x-ray
									0.6414
²⁰³ Po		202.9814	35. m	β^+ ,EC/4.2		5/2-	+0.74		0.17516
									0.21477
									0.89350
									0.90863
									1.09095
²⁰⁴ Po		203.98031	3.53 h	EC/2.34		0+			Bi k x-ray
				α	5.377/0.66				0.2702
									0.8844
									1.0162
									(0.11 - 1.9)
²⁰⁵ Po		204.98117	1.7 h	β^+ ,EC/3.53		5/2-	+0.76	+0.17	Bi k x-ray
									0.83681
									0.84983
									0.87241
									1.00124
									(0.12 - 2.7)
²⁰⁶ Po		205.98047	8.8 d	EC/(95)/1.85		0+			Bi k x-ray
				α /(5)	5.223/5.5				0.28644
									0.31156
									0.51134
									0.80737
									1.03228
									(0.11 - 1.5)
^{207m} Po			2.8 s	I.T./1.383		19/2-			Po k x-ray
									0.2682
									0.30074
									0.81448
²⁰⁷ Po		206.98158	5.80 h	EC, β^+ /2.91		5/2-	+0.79	+0.28	Bi k x-ray
									0.74263
									0.91176
									0.99225
²⁰⁸ Po		207.981231	2.898 y	α /5.213	4.233/0.0002	0+			
					5.1158/100				
²⁰⁹ Po		208.982415	102. y	α /4.976	4.624/0.56	1/2-	~+0.77		0.26049
					4.879/99.2				0.8964
²¹⁰ Po		209.982857	138.4 d	α /5.407	4.516/0.001	0+			0.80313
					5.304/100				
^{211m} Po			25.2 s	α	7.273/91	25/2+			Pb k x-ray
					7.994/1.7				0.32808

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					8.316/0.25				0.56915
					8.875/7.0				0.89723
									1.06310
²¹¹ Po		210.986637	0.516 s	α /7.594	6.570/0.54	9/2+			0.56915
					6.892/0.55				0.89723
					7.450/98.9				
^{212m} Po			45. s	α /	8.514/2.0	16+			
					9.086/1.0				
					11.650/97				
²¹² Po		211.988852	0.298 μ s	α /8.953	8.784/100	0+			
²¹³ Po		212.992843	3.7 μ s	α /8.537	7.614/0.003	9/2+			
					8.375/100				
²¹⁴ Po		213.995186	163.7 μ s	α /7.833	6.904/0.01	0+			0.7995
					7.686/99.99				0.298
²¹⁵ Po		214.999415	1.780 ms	α /7.526	6.950/0.02	(9/2+)			
					6.957/0.03				
					7.386/100				
²¹⁶ Po		216.001905	0.145 s	α /6.906	5.895/0.002	0+			
					6.778/99.99				
²¹⁷ Po		217.0064	< 10. s	α /6.662	6.539/				
²¹⁸ Po		218.008965	3.04 m	α /6.114	5.181/1.00	0+			
⁸⁵ At									
¹⁹³ At		192.9998	40 ms	α /					
¹⁹⁴ At		193.9990	40 ms	α /					
^{195m} At			0.39 s	α	6.96				
¹⁹⁵ At		194.9965	140 ms	α /	7.11				
^{196m} At			8 μ s						0.158
¹⁹⁶ At		195.9957	0.39 s	α /	7.05/				
^{197m} At			4. s	α		(1/2+)			
¹⁹⁷ At		196.9939	0.35 s	β^+ ,EC/7.8		(9/2-)			
				α /	6.96/				
^{198m} At			1.5 s	β^+ ,EC/(75)/					
				α /(25)/	6.85/86				
¹⁹⁸ At		197.9928	5. s	α /	6.75/94				
¹⁹⁹ At		198.9910	7.1 s	β^+ ,EC/8/5.6		9/2-			
				α /(92)/	6.64/				
^{200m} At			4.3 s	β^+ ,EC/(80)		10-			
				α /(20)/	6.536/12				
²⁰⁰ At		199.990	43. s	β^+ ,EC/65/=8.0		5+			
				α /(35)/	6.412/44				
					6.465/57				
²⁰¹ At		200.9885	1.48 s	β^+ ,EC/29/5.9		9/2-			
				α /(71)/6.474	6.344/				
^{202m} At			0 1.5 s	I.T./0.391					
²⁰² At		201.9885	3.02 m	β^+ ,EC/88/7.2		5+			ann.rad./
				α /(12)/	6.135/7.7				0.4413
					6.225/4.3				0.5697
									0.6753
²⁰³ At		202.9868	7.4 m	β^+ ,EC/69/5.1		9/2-			0.1458
				α /(31)/6.210	6.088/				0.2459
									0.6414
									1.0020
									1.0340
²⁰⁴ At		203.9873	9.1 m	β^+ ,EC/95/6.5		(5+)			Po k x-ray
				α /(5)/	5.951/				0.3271
									0.4254
									0.5156
									0.6837
²⁰⁵ At		204.98604	26. m	β^+ ,EC/90/4.54		(9/2-)			Po k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
				α (10)/6.020	5.902/				0.1543
									0.6696
									0.7194
²⁰⁶ At		205.98660	29.4 m	β^+ ,EC/99/5.72		5+			Po k x-ray
				α (1)/5.881	5.703/				0.20186
									0.39561
									0.47716
									0.70071
²⁰⁷ At		206.98578	1.81 h	β^+ ,EC/90/3.91		9/2-			Po k x-ray
				α (10)/5.873	5.758/				0.16801
									0.58842
									0.81448
²⁰⁸ At		207.98657	1.63 h	β^+ ,EC/99/4.97		(6+)			Po k x-ray
				α (1)/5.752	5.626/0.01				0.1770
					5.641/0.53				0.2060
									0.6601
									0.6852
									0.8450
									1.0281
²⁰⁹ At		208.98616	5.4 h	β^+ ,EC/96/3.49		(6+)			Po k x-ray
				α (4)/5.757	5.647/4.1				0.10422
									0.54503
									0.78189
									0.79020
									(0.1 - 2.6)
²¹⁰ At		209.98713	8.1 h	EC/99.8/3.98		5+			Po k x-ray
				α (0.2)/5.632	5.361/0.05				0.24535
					5.442/0.05				0.52758
									1.18143
									1.43678
									1.48335
									(0.04 - 2.4)
²¹¹ At		210.987481	7.21 h	EC/(58)/0.787		9/2-			Po k x-ray
				α (42)/5.980	5.211/0.004				0.66956
					5.868/42				0.6870
									0.74263
^{212m} At			0.119 s	α	7.837/65	(9-)			
					7.897/33				
²¹² At		211.990735	0.314 s	α /7.828	7.058/0.4	(1-)			
					7.088/0.6				
					7.618/15				
					7.681/84				
²¹³ At		212.992922	0.11 μ s	α /9.254	9.080/	9/2-			
^{214m} At			0.76 μ s	α /8.762		(9-)			
²¹⁴ At		213.996357	0.56 μ s	α /8.987	8.819/100	(1-)			
²¹⁵ At		214.99864	0.10 ms	α /8.178	7.626/0.045	(9/2-)			0.40486
					8.023/99.9				
²¹⁶ At		216.002408	0.30 ms	α /7.947	7.595/0.2	(1-)			
					7.697/2.1				
					7.800/97				
²¹⁷ At		217.00471	32. ms	α /7.202	6.812/0.06	(9/2-)			0.2595
					7.067/99.9				0.3345
									0.5940
²¹⁸ At		218.00868	1.6 s	α /6.883	6.654/6				
					6.695/90				
					6.748/4				
²¹⁹ At		219.0113	50. s	α /6.390	6.275/				
²²⁰ At		220.0153	3.71 m	β^- /3.7					(0.24-0.70)
²²¹ At		221.0181	2.3 m	β					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²²² At		222.0223	0.9 m	β					
²²³ At		223.0253	50. s	β					
⁸⁶ Rn									
¹⁹⁶ Rn		195.9977	≈ 3 ms	α/	7.49				
^{197m} Rn			0.02 s	α	7.36				
¹⁹⁷ Rn		196.9983	0.07 s	α/	7.26				
¹⁹⁸ Rn		197.9988	0.05 s	α					
^{199m} Rn			0.3 s	α		(13/ 2+)			
¹⁹⁹ Rn		198.9983	0.62 s	α/		3/2-			
²⁰⁰ Rn		199.9957	1.06 s	α/(98)/ EC/(2)/5.	6.901/	0+			0.4329 0.5043
^{201m} Rn			3.8 s	EC/(10)/ α/(90)/	6.773/	13/2+			
²⁰¹ Rn		200.9955	7.0 s	α/(80)/ EC/(20)/	6.725/ α/6.778	(3/2-)			
²⁰² Rn		201.9932	9.9 s	α/(12)/ EC/(88)/	6.641/	0+			0.5695 0.2876-0.6255
^{203m} Rn			28. s	α/	6.551	13/2+	-0.96	+1.3	
²⁰³ Rn		202.9948	45. s	α/(66)/6.629 EC/(34)/=7.4	6.499/	0			
²⁰⁴ Rn		203.9914	1.24 m	α/(68)/ EC/(32)/3.8	6.420/	0+			
²⁰⁵ Rn		204.9917	2.8 m	α/(23)/6.390 EC/(77)/5.2	6.123(3)/0.02 6.262(3)/23	(5/2-)	+0.80	+0.06	0.2652 0.3553 0.4648 0.6205 0.6753 0.7300
²⁰⁶ Rn		205.9902	5.7 m	α/(68)/6.384 EC/(32)/3.3	6.258(3)/	0+			0.06170 0.0968 0.3245 0.3862 0.4822 0.4973 0.7728
²⁰⁷ Rn		206.9907	9.3 m	β+,EC/77/4.6 α/(23)/6.252	5.995(4)/0.02 6.068(3)/0.15 6.126(3)/22.8	5/2-	+0.82	+0.22	At k x-ray 0.32947 0.34455 0.36767 0.40267 0.74723 (0.18 - 1.4)
²⁰⁸ Rn		207.98963	24.3 m	α/(60)/6.260 EC/(40)/2.85	5.469(2)/ 0.003 6.140(2)/60	0+			
²⁰⁹ Rn		208.99038	29. m	β+(83)/3.93 α/(17)/	2.16/2.3 5.887(3)/0.04 5.898(3)/0.02 6.039(2)/16.9	5/2-	+0.8388	+0.31	At k x-ray 0.27933 0.33753 0.40841 0.68942 0.74594 (0.18 - 3.2)
²¹⁰ Rn		209.98968	2.4 h	α/(96)/6.157 EC/(4)/2.37	5.351(2)/ 0.005 6.039(2)/96	0+			At k x-ray 0.19625 0.45824 0.57104 0.64868

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²¹¹ Rn		210.99059	14.6 h	β^+ , EC/74/2.89	α (26)/5.964	1/2-	+0.60		(0.14 - 1.7)
									At k x-ray
									0.16877
									0.25022
									0.37049
									0.67412
²¹² Rn		211.990689	24. m	α /6.385	5.587(4)/0.05	0+			0.67839
									1.36298
									(0.11 - 2.7)
									6.260(4)/
									99.95
									0.540
²¹³ Rn		212.99387	20 ms	α /8.243	7.552(8)/2	9/2+			8.087(8)/98
									0.540
²¹⁴ Rn		213.99535	0.27 μ s	α /9.209	9.037(9)/	0+			
²¹⁵ Rn		214.99873	2.3 μ s	α /8.840	8.674(8)/	(9/2+)			
²¹⁶ Rn		216.00026	45. μ s	α					
²¹⁷ Rn		217.003915	0.6 ms	α /7.885	7.500/0.1	9/2+			7.742(4)/100
									0.6093
²¹⁸ Rn		218.005586	35. ms	α /7.267	6.534(1)/0.16	0+			0.6653
									7.133(1)/99.8
²¹⁹ Rn		219.009475	3.96 s	α /6.946(1)	6.3130(5)/	(5/2+)	-0.44	+0.93	Po k x-ray
									0.05
									0.13057
									0.27113
²²⁰ Rn		220.011384	55.6 s	α /6.404	5.7486(5)/	0+			0.40170
									0.07
									6.2883(1)/
									99.9
²²¹ Rn		221.0156	25. m	α (22)/6.148	5.778(3)/1.8	7/2+	-0.020	-0.38	Fr L x-ray
									β^- (78)/1.2
									5.788(3)/2.2
²²² Rn		222.017570	3.823 d	α /5.590	4.987(1)/0.08	0+			0.07384
									6.037(3)/18
									0.08323
²²³ Rn		223.0218	23. m	β^- /			-0.78	+0.80	0.0610
									0.18639
									0.510
²²⁴ Rn		224.0241	1.8 h	β^- /		0+			0.2601
									0.2655
²²⁵ Rn		225.0284	4.5 m	β^- /		7/2	-0.70	+0.84	
²²⁶ Rn		226.0309	7.4 m	β^- /					
²²⁷ Rn		227.0354	2. s	β^- /					
²²⁸ Rn		228.0381	65. s	β^- /					
⁸⁷ Fr									
¹⁹⁹ Fr			12 s	α	7.66				
²⁰⁰ Fr		200.0065	\approx 20 ms	α	7.47				
²⁰¹ Fr		201.0046	0.05 s	α /	7.36/	(9/2-)			
²⁰² Fr		202.0033	0.34 s	α /7.590	7.237(8)/100				
²⁰³ Fr		203.0014	0.55 s	α /7.280	7.132(5)/	(9/2-)			
²⁰⁴ Fr		204.001	2.1 s	α /	7.03/96				6.97/90
									7.01/74
									6.914(5)/
²⁰⁵ Fr		204.9987	3.9 s	α /7.050	6.914(5)/	(9/2-)			
^{206m} Fr			0.7 s	α /	6.93				0.531(IT)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁰⁶ Fr		205.9985	16.0 s	α /7.416	6.792(5)/84				
²⁰⁷ Fr		206.9969	14.8 s	α /6.900	6.766(5)/	9/2-	+3.9	-0.16	
²⁰⁸ Fr		207.99713	59.1 s	α /(77)/6.770	6.636(5)/	7+	-4.8	+0.004	
				EC/(23)/6.99					
²⁰⁹ Fr		208.99592	50.0 s	α /(89)/5.1	6.646(3)/	9/2-	+3.9	-0.24	0.7978
				EC/(11)/5.16					(0.1103-1.384)
²¹⁰ Fr		209.99640	3.2 m	α /6.670	6.543(5)/	6+	+4.4	+0.19	0.2030
				EC/6.26					0.6438
									0.8175
									0.9008
²¹¹ Fr		210.99553	3.10 m	α /6.660	6.534(5)/	9/2-	+4.0	-0.19	0.220
				EC/4.61					0.2799
									0.5389
									0.9169
²¹² Fr		211.99618	20. m	EC/(57)/5.12	6.261(1)/16	(5+)	+4.6	-0.10	Rn x-ray
				α /(43)/6.529	6.335(1)/4				0.08107
					6.335(1)/4				0.08378
					6.343(1)/1.3				0.2277
					6.383(1)/10				1.1856
					6.406(1)/9.5				1.2748
					6.08-6.18				0.014-1.178
²¹³ Fr		212.99617	34.6 s	α /6.905	8.476(4)/51	9/2-	+4.0	-0.14	
^{214m} Fr			3.4 ms	α /	8.547(4)/46	9-			
					6.775-8.046				
²¹⁴ Fr		213.99895	5.1 ms	α /8.587	7.409(3)/0.3	(1-)			
					7.605(8)/1.0				
					7.940(3)/1.0				
					8.355(3)/4.7				
					8.427(3)/93				
²¹⁵ Fr		215.00033	0.12 μ s	α /9.537	9.360(8)/	(9/2-)			
²¹⁶ Fr		216.00319	0.70 μ s	α /9.175	9.005(10)/95				(0.045-0.160)
²¹⁷ Fr		217.00462	0.016 ms	α /8.471	8.315(8)/	(9/2-)			
^{218m} Fr			22. ms	α					
²¹⁸ Fr		218.00756	1. ms	α /8.014	7.384(10)/0.5	(1-)			
					7.542(15)/1.0				
					7.572(10)/5				
					7.732(10)/0.5				
					7.867(2)/93				
²¹⁹ Fr		219.00924	21. ms	α /8.132	6.802(2)/0.25	(9/2-)			
					6.967(2)/0.6				
					7.146(2)/0.25				
					7.313(2)/99				
²²⁰ Fr		220.012313	27.4 s	α /6.800	6.582(1)/10	1+	-0.67	+0.47	0.0450
					6.630(2)/6				0.061
					6.641(1)/12				0.1060
					6.686(1)/61				0.1539
					6.39-6.58				0.1617
²²¹ Fr		221.01425	4.8 m	α /6.457	5.9393(7)/	(5/2-)	+1.58	-1.0	At k x-ray
					0.17				
					5.9797(7)/				0.0995
					0.49				
					6.0751(7)/				0.21798
					0.15				
					6.1270(7)/				0.4091
					6.2433(3)/1.3				
					6.3410(7)/				
					83.4				
²²² Fr		222.01754	14.3 m	β^- /2.03	1.78/	2-	+0.63	+0.51	
				α /5.850					
²²³ Fr		223.019731	22.0 m	β^- /1.149	1.17/65	(3/2+)	+1.17	+1.17	0.05014

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.07972 (0.13 - 0.9)
²²⁴ Fr		224.02323	3.0 m	β^- /2.82		1-	+0.40	+0.517	0.13150 0.21575 0.8367 (0.1 - 2.21)
²²⁵ Fr		225.02561	3.9 m	β^- /1.87		3/2	+1.07	+1.3	
²²⁶ Fr		226.0293	49. s	β^- /3.6		1	+0.071	-1.35	0.18606 0.25373
²²⁷ Fr		227.0318	2.48 m	β^- /2.5		1/2	+1.50		
²²⁸ Fr		228.0357	39. s	β^- /≈3.5		2-	-0.76	+2.4	
²²⁹ Fr		229.0384	50. s	β^- /					
²³⁰ Fr		230.0425	19. s	β^- /		(3)			
²³¹ Fr		231.0454	17. s	β^- /					
²³² Fr		232.0500	5. s	β^- /					
⁸⁸ Ra									
²⁰² Ra			≈ 3 ms	α	7.86				
^{203m} Ra			0.03 s	α	7.62				
²⁰³ Ra		203.0092	≈ 4 ms	α	7.58				
²⁰⁴ Ra		204.0065	0.06 s	α	7.48				
^{205m} Ra			≈ 0.17 s						
²⁰⁵ Ra		205.0062	0.22 s	α	7.34				
²⁰⁶ Ra		206.0038	0.4 s	α /7.416	7.272(5)/	0+			
²⁰⁷ Ra		207.0037	1.3 s	α /7.270	7.133(5)/				
²⁰⁸ Ra		208.0018	1.4 s	α /7.273	7.133(5)/	0+			
²⁰⁹ Ra		209.0019	4.6 s	α /7.150	7.008(5)/	5/2	+0.87	+0.40	
²¹⁰ Ra		210.0005	3.7 s	α /7.610	7.020(5)/	0+			
²¹¹ Ra		211.0009	13. s	α /7.046	6.912(5)/	(5/2-)	+0.878	+0.48	
				EC/5.0					
²¹² Ra		211.99978	13.0 s	α /7.033	6.901(2)/	0+			
^{213m} Ra			2.1 ms	IT					
²¹³ Ra		213.00034	2.7 m	EC/(20)/3.88		(1/2-)	+0.613		0.1024
				α /(80)/6.860	6.521(3)/4.8				0.11010
					6.622(3)/39				0.2125
					6.730(3)/36				
²¹⁴ Ra		214.00009	2.46 s	α /7.272	7.14/99.8/	0+			0.642
					6.51/0.2				
²¹⁵ Ra		215.00270	1.7 ms	α /8.864	7.883(6)/2.8	(9/2+)			0.773/100
					8.171(3)/1.4				0.852/74
					8.700(3)/95.9				0.055-1.048
²¹⁶ Ra		216.00352	0.18 μ s	α /9.526	9.349(8)/	0+			
²¹⁷ Ra		217.00631	1.6 μ s	α /9.161	8.992(8)/	9/2-			
²¹⁸ Ra		218.00712	26. μ s	α /8.547	8.390(8)/	0+			
²¹⁹ Ra		219.01006	0.010 s	α /8.132	7.680(10)/65				
					7.982(9)/35				
²²⁰ Ra		220.01101	18. ms	α /7.593	7.39/5	0+			0.465
					7.45/95				
²²¹ Ra		221.01391	29. s	α /6.879	6.254(10)/0.7	5/2	-0.180	+1.9	
					6.578(5)/3				
					6.585(3)/8				
					6.608(3)/35				
					6.669(3)/21				
					6.758(3)/31				
²²² Ra		222.015361	36.2 s	α /5.590	6.237(2)/3.0	0+			0.324
					6.556(2)/97				0.1448-0.8402
²²³ Ra		223.018497	11.43 d	α /5.979	5.287(1)/0.15	(3/2+)	+0.271	+1.25	Rn k x-ray
					5.338(1)/0.13				0.12231
					5.365(1)/0.13				0.14418
					5.433(5)/2.3				0.15418

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					5.502(1)/1.0				0.15859
					5.540(1)/9.2				0.26939
					5.607(3)/24				0.32388
					5.716(3)/52				0.33328
					5.747(1)/9				0.44494
					5.857(1)/0.32				(0.10 - 0.7)
					5.872(1)/0.85				
²²⁴ Ra		224.020202	3.66 d	α /5.789	5.034(10)/ 0.003	0+			Rn k x-ray
					5.047(1)/ 0.007				0.2407
					5.164(5)/ 0.007				0.4093
					5.449(2)/4.9				0.6501
					5.685(2)/95				
²²⁵ Ra		225.023603	14.9 d	β^- /0.36 α	0.32/100 5.01/2 \times 10 ⁻⁵ 4.98 \times 10 ⁻⁶	(3/2+)	-0.734		Ac k x-ray 0.0434
²²⁶ Ra		226.025402	1599. y >4 \times 10 ¹⁸ y	α /4.870 Sf/4 \times 10 ⁻¹⁴	4.194(1)/ 0.001 4.343(1)/ 0.006	0+			Rn k x-ray 0.1861
					4.601(1)/5.5 4.784(1)/94				0.2624
²²⁷ Ra		227.029170	42. m	β^- /1.325	1.03/ 1.30/	(3/2+)	-0.404	+1.5	Ac L x-ray Ac k x-ray 0.02739
²²⁸ Ra		228.031063	5.76 y	β^- /0.046	0.039/50 0.014/30 0.026/20	0+			0.0135 (0.006-0.0306)
²²⁹ Ra		229.0348	4.0 m	β^- /1.76	1.76/	(3/2+)	+0.503	+3.1	0.0145-0.1715
²³⁰ Ra		230.03708	1.5 h	β^- /1.0	0.7/	0+			0.0631 0.0720 0.2028 0.4698 0.4787
²³¹ Ra		231.0412	1.7 m	β^-					
²³² Ra		232.0437	4. m	β^-					
²³³ Ra		233.0480	30. s	β^-					
²³⁴ Ra		234.051	\approx 30. s	β^- /					
⁸⁸ Ac									
^{206m} Ac			0.04 s	α	7.79				
²⁰⁶ Ac			\approx 26 ms	α	7.75				
²⁰⁷ Ac		207.0121	27 ms	α /	7.69				
^{208m} Ac			\approx 25. ms	α /	7.72				
²⁰⁸ Ac		208.0115	\approx 0.1 s	α /	7.62				
²⁰⁹ Ac		209.0096	\approx 0.10 s	α /	7.58				
²¹⁰ Ac		210.0093	0.34 s	α /7.610	7.462(8)/				
²¹¹ Ac		211.0076	0.20 s	α /7.620	7.480(8)/				
²¹² Ac		212.0078	0.9 s	α /7.520	7.379(8)/				
²¹³ Ac		213.0066	0.73 s	α /7.500	7.364(8)/	(9/2-)			
²¹⁴ Ac		214.0069	8.2 s	α /(86)/7.350 EC/(14)/6.34	7.007(8)/3 7.082(5)/38 7.214(5)/45	(5+)			
²¹⁵ Ac		215.0065	0.17 s	α /7.750	7.60/99.2 7.21/0.46 7.03/0.20 6.96/0.14	(9/2-)			0.399 0.582 0.654
^{216m} Ac			0.44 ms	α /	8.198(8)/1.7 8.283(8)/2.5	(9-)			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					9.028(5)/49				
					9.106(5)/46				
²¹⁶ Ac		216.00871	≈ 0.3 ms	α/9.241	8.990(2)/10	(1)			
					9.070(8)/90				
^{217m} Ac			0.7 μs	α/	10.540/100				
²¹⁷ Ac		217.00933	0.07 μs	α/9.832	9.650(10)/100	9/2-			
²¹⁸ Ac		218.01162	1.1 μs	α/9.380	9.205(15)/				
²¹⁹ Ac		219.01241	0.012 ms	α/8.830	8.664(10)/	(9/2-)			
²²⁰ Ac		220.0148	26. ms	α/8.350	7.610(20)/23				
					4.680(20)/21				
					7.790(10)/13				
					7.850(10)/24				
					7.985(10)/4				
					8.005(10)/5				
					8.060(10)/6				
					8.195(10)/3				
²²¹ Ac		221.01558	52. ms	α/7.790	7.170(10)/2				
					7.375(10)/10				
					7.440(15)/20				
					7.645(10)/70				
^{222m} Ac			63. s	α(>89)/	6.710(20)/7				
				EC/(1)/	6.750(20)/13				
				I.T./(<10)/	6.810(20)/24				
					6.840(20)/9				
					6.890(20)/13				
					6.970(20)/7				
					7.000(20)/13				
²²² Ac		222.01782	5. s	α/7.141	6.967(10)/6	1-			
					7.013(2)/94				
²²³ Ac		223.01913	2.1 m	α(99)/6.783	6.131(2)/0.12	(5/2-)			0.0725
				EC/(1)/0.59	6.177(2)/0.94				0.0839
					6.293(1)/0.47				0.0927
					6.326(1)/0.3				0.0990
					6.332(2)/0.14				0.1917
					6.360(1)/0.22				0.2158
					6.397(1)/0.13				0.3588
					6.448(1)/0.2				0.4768
					6.473(1)/3.1				
					6.523(2)/0.6				
					6.528(1)/3.1				
					6.563(1)/13.6				
					6.582(3)/0.3				
					6.646(1)/44				
					6.661(1)/31				
²²⁴ Ac		224.021708	2.7 h	EC(90)/1.403	5.841(1)/0.5	0-			Ra L kx-ray
				α(10)/6.323	5.860(1)/0.75				Ra k x-ray
					5.875(1)/1.7				0.08426
					5.941(1)/4.4				0.13150
					6.000(1)/6.7				0.1571
					6.013(1)/1.4				0.21575
					6.056(1)/22				0.2619
					6.138(1)/26				(0.03 - 0.3)
					6.154(1)/1.0				
					6.204(1)/12				
					6.210(1)/20				
²²⁵ Ac		225.02322	10.0 d	α/5.935	5.286(1)/0.2	3/2			Fr k x-ray
					5.444(3)/0.1				0.9958
					5.554(1)/0.1				0.9982
					5.608(1)/1.1				0.1084

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					5.636(1)/4.5				0.1116
					5.681(1)/1.4				0.1451
					5.722(1)/2.9				0.1539
					5.731(1)/10				0.15724
					5.791(1)/9				0.18799
					5.793(1)/18				0.19575
									0.2162
									0.21686
									(0.025 - 0.52)
²²⁶ Ac		226.026089	1.224 d	EC/(17)/0.640		(1-)			Ra k x-ray
				β ⁻ /(83)/1.116					Th k x-ray
				α/(0.006)/5.51	5.399(5)/ 0.006				0.07218
									0.15816
									0.23034
²²⁷ Ac		227.027747	21.77 y	β ⁻ /98.6/0.045	0.045/54	(3/2-)	+1.1	+1.7	0.0838/23.
				α/(1.4)/5.043	4.869(1)/0.09				0.0811/14.
					4.938(1)/0.52				0.2696/13.
					4.951(1)/0.65				(0.044 - 1.27)
²²⁸ Ac		228.031014	6.15 h	β ⁻ /2.127	1.11/32	(3+)			Th L x-ray
					1.85/12				Th k x-ray
					2.18/11				0.12903
									0.33842
									0.91116
									0.96897
									(0.2 - 1.96)
²²⁹ Ac		229.03293	1.04 h	β ⁻ /1.10	1.1/	(3/2+)			0.07450
									0.16451
									0.26188
									0.5085
									0.56916
²³⁰ Ac		230.0360	2.03 m	β ⁻ /2.7	1.4/	1+			Th k x-ray
									0.45497
									0.50820
									(0.12 - 2.5)
²³¹ Ac		231.0386	7.5 m	β ⁻ /2.1	2.1/100	(1/2+)			0.14379
									0.18574
									0.22140
									0.28250
									0.3070
²³² Ac		232.0420	2.0 m	β ⁻ /3.7		(2-)			
²³³ Ac		233.0446	2.4 m	β ⁻ /		(1/2+)			
²³⁴ Ac		234.0484	40. s	β ⁻ /		(1+)			
⁹⁰ Th		232.0381(1)							
²⁰⁹ Th			≈ 0.01 s	α	8.08				
²¹⁰ Th		210.0150	≈ 12 ms	α	7.90				
²¹¹ Th		211.0149	0.04 s	α	7.79				
²¹² Th		212.0129	≈ 30. ms	α/	7.80/	0+			
²¹³ Th		213.0130	0.14 s	α/7.840	7.692(10)/				
²¹⁴ Th		214.0115	0.09 s	α/7.825	7.677(10)/	0+			
²¹⁵ Th		215.0117	1.2 s	α/7.660	7.33(10)/8	(1/2-)			0.134
					7.395(8)/52				0.192
					7.524(8)/40				
^{216m} Th			0.14 ms	α	9.93				
²¹⁶ Th		216.01105	28. ms	α/8.071	7.92/99.46	0+			0.628
					7.30/0.54				
²¹⁷ Th		217.01306	0.25 ms	α/9.424	9.27/94.6				
					8.46/3.8				
					8.73/1.6				

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²¹⁸ Th		218.01327	0.11 μs	α/9.847	9.665(10)/	0+			
²¹⁹ Th		219.01552	1.05 μs	α/9.510	9.340(20)/				
²²⁰ Th		220.01573	10. μs	α/8.953	8.790(20)/	0+			
²²¹ Th		221.01817	1.7 ms	α/8.628	7.743(8)/6				
					8.146(5)/56				
					8.4272(5)/39				
²²² Th		222.01845	2.8 ms	α/8.129	7.982(8)/9.7	0+			
					7.600(15)/3				
²²³ Th		223.02079	0.65 s	α/7.454	7.29(1)/41(5)				
					7.32(1)/29(5)				
					7.350(15)/				
					20(5)				
					7.390(15)/				
					10(4)				
²²⁴ Th		224.02146	1.05 s	α/7.305	6.768(5)/1.2				
					6.997(5)/19				
					7.170(5)/79				
²²⁵ Th		225.02394	8.72 m	EC/(10)/0.68		(3/2+)			
				α/(90)/6.920	6.441(2)/15				
					6.479(2)/43				
					6.501(3)/14				
					6.627(3)/3				
					6.650(5)/3				
					6.700(5)/2				
					6.743(3)/7				
					6.796(2)/9				
²²⁶ Th		226.024891	30.83 m	α/6.454	6.026(1)/0.2	0+			Ra k x-ray
					6.041(1)/0.19				0.1112
					6.098(1)/1.3				0.2421
					6.2283(4)/23				0.1310
					6.3375(4)/75				0.1733-0.9295
²²⁷ Th		227.027699	18.72 d	α/6.146		(3/2+)			Ra L x-ray
									Ra k x-ray
									0.05014
									0.23597
									0.25624
									(0.02 - 1.0)
²²⁸ Th		228.028731	1.913 y	α/5.520	5.1770(2)/	0+			
					0.18				
					5.2114(1)/0.4				
					5.3405(1)/				
					26.7				
					5.4233(1)/73				
²²⁹ Th		229.031754	7.9x10 ³ y	α/5.168	4.814/9.3	5/2+	+0.46	+4.	
					4.845(5)/56				
					4.9008(5)/				
					10.2				
					4.689-5.077				
²³⁰ Th		230.033126	7.54x10 ⁴ y	α/4.771	4.4383(6)/	0+			0.0677/0.46
					0.03				
					4.4798(6)/				0.1439/0.078
					0.12				
			>2.x10 ¹⁸ y	SF/<4x10 ⁻¹²	4.6211(6)/				
					23.4				
					4.6876(6)/				
					76.3				
²³¹ Th		231.036296	1.063 d	β ⁻ /0.390	0.138/22	5/2+			Pa L x-ray
					0.218/20				Pa k x-ray
					0.305/52				0.02564
									0.084203/
									(0.02 - 0.3)

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²³² Th	100.	232.038050	1.40x10 ¹⁰ y	α /4.081	3.830(10)/0.2	0+			0.0590
			1.2x10 ²¹ y	SF/1.1x10 ⁻⁹	3.952(5)/23				0.124
					4.010(5)/77				
²³³ Th		233.041576	22.3 m	β^- /1.245	1.245/	1/2+			Pa L x-ray
									Pa k x-ray
									0.02938
									0.08653
									0.45930
									(0.02 - 1.2)
²³⁴ Th		234.043596	24.10 d	β^- /0.273	0.102/20	0+			Pa L x-ray
					0.198/72				0.06329/4.1
									0.09235/2.4
									0.09278/2.4
²³⁵ Th		235.04751	7.2 m	β^- /1.9					0.4162
									0.6594
									0.7272
									0.747
									0.9318
²³⁶ Th		236.0497	37.5 m	β^- /≈ 1.0					Pa k x-ray
									0.1107
²³⁷ Th		237.0539	5.0 m	β^-					
⁹¹ Pa		231.03588(2)							
²¹² Pa			≈ 5 ms	α	8.27				
²¹³ Pa		213.0212	7 ms	α	8.24				
²¹⁴ Pa		214.0207	17 ms	α	8.12				
²¹⁵ Pa		215.0190	15. ms	α	8.08/100				
²¹⁶ Pa		216.0190	0.19 s	α /	7.95/51				0.134
					7.82/45				
					7.79/4				
^{217m} Pa			1.5 ms	α /	10.16/80				
					9.55/17				
					9.69/3				
²¹⁷ Pa		217.0183	3.4 ms	α /8.490	8.340(10)/100				
²¹⁸ Pa		218.0200	0.12 ms	α /	9.54/31				0.092
					9.61/69				
²¹⁹ Pa		219.0199	0.05 μ s	α					
²²⁰ Pa		220.0219	0.8 μ s	α					
²²¹ Pa		221.0219	6. μ s	α	9.08(3)				
²²² Pa		222.0237	≈ 4.3 ms	α /8.700	8.180/50				
					8.330/20				
					8.540/30				
²²³ Pa		223.0240	≈ 6.5 ms	α /8.340	8.006(10)/55				
					8.196(10)/45				
²²⁴ Pa		224.0256	0.84 s	α /7.630	7.555(10)/				0.1945
					75(3)				
					7.46(1)/25(3)				(0.028-0.412)
²²⁵ Pa		225.0261	1.8 s	α /7.380	7.195(10)/30				
					7.245(10)/70				
²²⁶ Pa		226.02792	1.8 m	α /(74)/6.987	6.728(10)/0.7				
				EC/(26)/2.83	6.823(10)/35				
					6.863(10)/39				
²²⁷ Pa		227.02879	38.3 m	α /(85)/6.582	6.357(4)/7	(5/2-)			0.0649
				EC/(15)/1.02	6.376(10)/2.2				0.0669
					6.401(4)/8				0.1100
					6.416(4)/13				
					6.423(10)/10				
					6.465(4)/43				
²²⁸ Pa		228.03100	22. h	EC/(98)/2.111		(3+)	+3.5		Th k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
				α (2)	5.779/0.23				0.409/100
					5.805/0.15				0.4631/222
					6.078/0.4				0.91116/242
					6.105/0.25				0.96464/120
					6.118/0.22				0.96897/149
²²⁹ Pa		229.03209	1.5 d	EC/(99.8)/0.32		(5/2)			0.058-1.96
				α (0.2)/5.836	5.536(2)/0.02				(0.024 - 0.18)
					5.579(2)/0.09				
					5.668(2)/0.05				
²³⁰ Pa		230.034532	17.4 d	EC(90)/1.310	0.51/	(2-)	2.0		Th L x-ray
				β^- /(10)/0.563					Th k x-ray
									0.4437
									0.45477
									0.89876
									0.91856
									0.95199
									(0.053-1.07)
²³¹ Pa		231.035878	3.25x10 ⁴ y	α /5.148	4.6781(5)/1.5	3/2-	2.01	-1.7	Ac L x-ray
					4.7102(5)/1.0				Ac k x-ray
			>2x10 ¹⁷ y	SF/<1.6x10 ⁻¹⁵	4.7343(5)/8.4				0.01899
					4.8513(5)/1.4				0.027396
					4.9339(5)/3				0.03823
					4.9505(5)/ 22.8				0.04639
					4.9858(5)/1.4				0.25586
					5.0131(5)/ 25.4				0.26029
					5.0292(5)/20				0.28367
					5.0318(5)/2.5				0.30007
					5.0587(5)/11				0.30264
									0.33007
									(0.02 - 0.61)
²³² Pa		232.03858	1.31 d	β^- /1.34		(2-)			U k x-ray
									0.10900
									0.15009
									0.89439
									0.96934
									(0.10 - 1.17)
²³³ Pa		233.040239	27.0 d	β^- /0.571	0.15/40	3/2-	+4.0	-3.0	U L x-ray
					0.256/60				U k x-ray
									0.30017
									0.31201
									0.34059
^{234m} Pa			1.17 m	β^- /99.9/2.29		(0-)			U k x-ray
				IT/0.13/					0.25818/0.07
									0.76641/0.32
									1.0009/0.85
									(0.06 - 1.96)
²³⁴ Pa		234.043303	6.69 h	β^- /2.197	0.51/	(4+)			U L x-ray
									U k x-ray
									0.1312/0.03
									0.5695/0.02
									0.9256/0.02
									(0.02 - 1.99)
²³⁵ Pa		235.04544	24.4 m	β^- /1.41	1.4/97	(3/2-)			0.0308-0.65893
²³⁶ Pa		236.0487	9.1 m	β^- /2.9	1.1/40	(1-)			U k x-ray
					2.0/50				0.64235

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					3.1/10				0.68759
									1.7630
									(0.04 - 2.18)
²³⁷ Pa		237.0511	8.7 m	β ⁻ /2.3	1.1/60	(1/2 ⁺)			0.4986
					1.6/30				0.5293
					2.3/10				0.5407
									0.8536
									0.8650
									(0.04 - 1.4)
²³⁸ Pa		238.0545	2.3 m	β ⁻ /3.5	1.2/	(3 ⁻)			0.10350
					1.7/				0.1785
									0.4484
									0.6350
									0.6800
									1.01446
									(0.04 - 2.5)
²³⁹ Pa		239.0571	1.8 h						
⁹² U		238.02891(3)							
²¹⁷ U			≈16 ms	α	8.005				
²¹⁸ U		218.0235	≈0.002 s	α	8.63(3)/				
²¹⁹ U		219.0249	0.04 ms	α	9.68(4)/				
²²² U		222.0261	≈ 1.μs	α					
²²³ U		223.0277	0.02 s	α/	8.78(4)/				
²²⁴ U		224.02759	≈ 1. ms	α/	8.46/100				
²²⁵ U		225.02938	0.09 s	α/	7.89/58				
					7.83/37				
					7.62/5				
²²⁶ U		226.02933	0.5 s	α/7.560	7.55/82	0 ⁺			
					7.37/15				
					7.32/3				
²²⁷ U		227.03113	1.1 m	α/7.200	6.870/				
²²⁸ U		228.03137	9.1 m	α/6.803	6.404(6)/0.6	0 ⁺			0.095
					6.440(5)/0.7				0.152
					6.589(5)/29				0.187
					6.681(6)/70				0.246
²²⁹ U		229.03350	58. m	EC/(80)/1.31	6.223/3	(3/2 ⁺)			
				α/(20)/6.473	6.297(3)/11				
					6.332(3)/20				
					6.360(3)/64				
²³⁰ U		230.033927	20.8 d	α/5.992	5.5866(3)/	0 ⁺			Th L x-ray
			>4x10 ¹⁰ y	SF/<10 ⁻¹⁰	0.01				
					5.6624(3)/				0.07218
					0.26				
					5.6663(3)/				0.15421
					0.38				
					5.8178(3)/32				0.23034
					5.8887(3)/67				(0.081-0.8565)
²³¹ U		231.03626	4.2 d	EC/0.36		(5/2 ⁻)			Pa L x-ray
				α(10 ⁻³)	5.46/1.6 x				Pa k x-ray
					10 ⁻³				
					5.47/1.4 x				0.02564
					10 ⁻³				
					5.40/1. x 10 ⁻³				0.08420
²³² U		232.037146	70. y	α/5.414	4.9979(1)/	0 ⁺			
					0.003				
			2.6x10 ¹⁵ y	SF/2.7x10 ⁻¹²	5.1367(1)/0.3				
					5.2635(1)/31				
					5.3203(1)/69				
²³³ U		233.039627	1.592x10 ⁵ y	α/4.909	4.7830(8)/	5/2 ⁺	+0.59	3.66	Th L x-ray
					13.2				

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Decay Mode/Energy (/MeV)	Particle Energy (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)	
			Half-Life >2.7x10 ¹⁷ y	SF/6x10 ⁻¹¹	4.8247(8)/ 84.4			0.04244	
					4.510-4.804			0.09714 (0.0252-1.119)	
²³⁴ U	0.0055(5)	234.040945	2.455x10 ⁵ y	α/4.856	4.604(1)/0.24	0+		0.05323/0.156	
			1.5x10 ¹⁶ y	SF/1.6x10 ⁻⁹	4.7231(1)/ 27.5			0.12091	
					4.776(1)/72.5				
^{235m} U			26. m	IT/0.0007		1/2+			
²³⁵ U	0.720(1)	235.043922	7.04x10 ⁸ y	α/4.6793	4.1525(9)/0.9	7/2-	-0.38	4.9	Th L x-ray
			1.0x10 ¹⁹ y	SF/7x10 ⁻⁹	4.2157(9)/5.7				Th k x-ray
					4.3237(9)/4.6				0.10917
					4.3641(9)/11				0.14378
					4.370(4)/6				0.16338
					4.3952(9)/55				0.18574
					4.4144(9)/2.1				0.20213
					4.5025(9)/1.7				0.20533
					4.5558(9)/4.2				0.22140
					4.5970(9)/5.0				(0.03 - 0.79)
²³⁶ U		236.045561	2.342x10 ⁷ y	α/4.569	4.332(8)/0.26	0+			Th L x-ray
			2.5x10 ¹⁶ y	SF/9x10 ⁻⁸	4.445(5)/26				0.04937
					4.494(3)/74				0.11275
²³⁷ U		237.048723	6.75 d	β ⁻ /0.519	0.24/ 0.25/	1/2+			Np L x-ray
									Np k x-ray
									0.05953
									0.20801
²³⁸ U	99.2745(15)	238.050784	4.47x10 ⁹ y	α	4.0395/0.23	0+			Th L x-ray
			8.2x10 ¹⁵ y	SF/5x10 ⁻⁵	4.147(5)/23				0.04955/06
					4.196(5)/77				0.1135/01
²³⁹ U		239.054289	23.5 m	β ⁻ /1.265	1.2/ 1.3/	5/2+			(0.522-0.681)
²⁴⁰ U		240.056585	14.1 h	β ⁻ /0.39	0.36/	0+			Np L x-ray
									0.04410
									0.05558
									0.06760
²⁴² U		242.0629	16.8 m	β ⁻ /≈ 1.2					
⁹³ Np									
²²⁵ Np		225.0339	> 2 μs						
²²⁶ Np		226.0351	0.03 s	α/	8.04(2)/				
²²⁷ Np		227.0350	0.51 s	α/	7.65(2)/				
					7.68(1)/				
²²⁸ Np		228.0362	61. s	EC/60(7)/ α/40(7)/,SF					
²²⁹ Np		229.0363	4.0 m	α/7.010	6.890(20)				
²³⁰ Np		230.0378	4.6 m	EC/97/3.6 α/3	6.660(20)				
²³¹ Np		231.03823	48.8 m	EC/98 /1.8 α/2 /6.368	6.280/2	5/2			0.2629 0.3475 0.3703
²³² Np		232.0400	14.7 m	EC/99/2.7		(4-)			U L x-ray U k x-ray 0.3268 0.81925 0.86683
²³³ Np		233.0410	36.2 m	EC/1.2		(5/2+)			U L x-ray U k x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									0.29887
									0.31201
²³⁴ Np		234.04289	4.4 d	β ⁺ /EC/1.81	0.79/	(0+)			U L x-ray
									U k x-ray
									1.5272
									1.5587
									1.6022
²³⁵ Np		235.044055	1.085 y	EC/99.9/0.124		5/2+			U k x-ray
				α/0.001/5.191					
^{236m} Np			22.5 h	EC/52/		(1-)			U L x-ray
				β ⁻ /48/					Pu L x-ray
									U k x-ray
									0.64235
									0.68759
²³⁶ Np		236.04657	1.55x10 ⁵ y	EC/91/0.94		(6-)			U L x-ray
				β ⁻ /9/0.49					U k x-ray
									0.10423
									0.16031
²³⁷ Np		237.048166	2.14x10 ⁶ y	α/4.957	4.6395(5)/6.5	5/2+	+3.14	+3.89	Pa L x-ray
			1x10 ¹⁸ y	SF/2.1x10 ⁻¹⁰	4.766(5)/9.7				Pa k x-ray
					4.7715(5)/ 22.7				0.029378/15
					4.7884(5)/ 47.8				0.08653/12
					4.558-4.873				(0.03-0.28)
²³⁸ Np		238.050940	2.117 d	β ⁻ /1.292	1.2/	2+			Pu L x-ray
									Pu k x-ray
									0.98447/25.2
									1.02855/18.3
									(.044-1.026)
²³⁹ Np		239.052931	2.355 d	β ⁻ /0.722	0.341/30	5/2+			Pu L x-ray
					0.438/48				Pu k x-ray
									0.10613
									0.228186/11
									0.27760/15
									(0.04-0.50)
^{240m} Np			7.22 m	β ⁻ /99.9/	2.18/	(1+)			0.25143
				IT/0.1/					0.26333
									0.55454
									0.59735
²⁴⁰ Np		240.05617	1.032 h	β ⁻ /2.20	0.89/	5+			0.1471/
									0.5664
									0.6008
²⁴¹ Np		241.0583	13.9 m	β ⁻ /1.3	1.3/	5/2+			0.1330/
									0.1740
									0.280
^{242m} Np			2.2 m	β ⁻ /		(1+)			0.15910
									0.2651/
									0.78570
									0.9448/
²⁴² Np		242.0616	5.5 m	β ⁻ /2.7	2.7/	6+			0.6209
									0.73620
									0.78074
									1.47340
									(0.04-2.37)
²⁴³ Np		243.0643	1.9 m						
²⁴⁴ Np		244.0678	2.3 m						
⁹⁴ Pu									

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²²⁸ Pu		228.0387		α	7.81(2)/				
²²⁹ Pu		229.0362	4.0 m	α	7.46(3)/				
²³⁰ Pu		230.03964	4.6 m	α	7.05/				
²³¹ Pu		231.04126	8.6 m	EC/90					
				α /10	6.72				
²³² Pu		232.04118	34. m	EC/>80/1.1		0+			
				α / $<$ 20/6.716	6.542(10)/38				
					6.600(10)/62				
²³³ Pu		233.04299	20.9 m	EC(99.9)/1.9					0.1503
				α /0.1/6.416	6.300(20)/0.1				0.1804
									0.2353
									0.5002
									0.5346/
									1.0352/
²³⁴ Pu		234.04331	8.8 h	EC/94/0.39		0+			
				α /6/6.310	6.035(3)/ 0.024				
					6.149(3)/1.9				
					6.200(3)/4.0				
²³⁵ Pu		235.0453	25.3 m	EC/99+/1.2		(5/2+)			
				α /0.003/5.957	5.850(20)/ 0.003				
²³⁶ Pu		236.046048	2.87 y	α /5.867	5.611/0.21	0+			0.0476/0.07
			1.5x10 ⁹ y	SF/1.9x10 ⁻⁷	5.7210/30.5				0.109/0.02
					5.7677(1)/ 69.3				(0.17 - 0.97)
²³⁷ Pu		237.048403	45.7 d	EC/99.9/0.220		7/2-			Np L x-ray
				α /0.003/5.747	5.334(4)/ 0.0015				Np k x-ray
					5.356(4)/ 0.0006				0.026344
					5.650(4)/ 0.0007				0.03319
									0.05954
									(0.03-0.5)
²³⁸ Pu		238.049553	87.7 y	α /5.593	5.3583(1)/ 0.10	0+			U k x-ray
			4.75x10 ¹⁰ y	SF/1.8x10 ⁻⁷	5.465(1)/28.3				0.04347
					5.4992(1)/ 71.6				(0.04-1.1)
²³⁹ Pu		239.052156	2.410x10 ⁴ y	α /5.244	5.055/0.047	1/2+	+0.203		U k x-ray
			8.x10 ¹⁵ y	SF/3x10 ⁻¹⁰	5.076/0.078				0.05162
					5.106/11.9				0.05682
					5.144/17.1				0.12928
					5.157/70.8				0.37502
					(4.74 -5.03)				0.41369
²⁴⁰ Pu		240.053807	6.56x10 ³ y	α /5.255	5.0212(1)/ 0.07	0+			U L x-ray
			1.14x10 ¹¹ y	SF/5.7x10 ⁻⁶	5.1237(1)/ 26.4				0.04524
					5.1681(1)/ 73.5				0.10423
									(0.04-0.97)
²⁴¹ Pu		241.056844	14.4 y	β^- /99+/0.0208	4.853(7)/ 3x10 ⁻⁴	5/2+	-0.683	+6.	0.14854
				α /0.002/5.139	4.8966(7)/ 0.002				0.1600
			$<$ 6.x10 ¹⁶ y	SF/>2.4x10 ⁻¹⁴					
²⁴² Pu		242.058736	3.75x10 ⁵ y	α /4.983	4.7546(7)/ 0.098	0+			U L x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
			6.77x10 ¹⁰ y	SF/5.5x10 ⁻⁴	4.8564(7)/ 22.4				0.04491
					4.9006(7)/78				0.10350
²⁴³ Pu		243.061996	4.956 h	β ⁻ /0.582	0.49/21	7/2+			Am L x-ray
					0.58/60				0.0417
									0.0839
²⁴⁴ Pu		244.064197	8.00x10 ⁷ y	α/99.9/4.665	4.546(1)/19.4	0+			U L x-ray
			6.6x10 ¹⁰ y	SF/0.12	4.589(1)/80.5				0.0439
²⁴⁵ Pu		245.06774	10.5 h	β ⁻ /1.21	0.93/57	(9/2-)			Am L x-ray
					1.21/11				Am k x-ray
									0.2804/
									0.30832
									0.32752
									0.56014
									(0.03-1.2)
²⁴⁶ Pu		246.07020	10.85 d	β ⁻ /0.40	0.150/85	0+			Am L x-ray
					0.35/10				Am k x-ray
									0.04379
									0.22371
²⁴⁷ Pu		247.0741	2.3 d						
⁹⁵ Am									
²³² Am		232.0466	0.9 m	EC/≈ 5.0					
²³⁴ Am		234.0478	2.3 m	EC/4.2					
²³⁵ Am		235.0480	≈ 15 m	EC					Pu K x-ray
²³⁶ Am		236.0456	≈4.4 m						
²³⁷ Am		237.0503	1.22 h	EC/99.98/1.7		(5/2-)			Pu k x-ray
				α/0.02/6.20	6.042(5)/0.02				0.14559
									0.28026
									0.43845
²³⁸ Am		238.05198	1.63 h	EC/2.26		1+			Pu L x-ray
				α/0.0001/6.04	5.940/0.0001				Pu k x-ray
									0.91870
									0.96278
²³⁹ Am		239.053018	11.9 h	EC/99.99/0.803		5/2-			Pu L x-ray
				α/0.01/5.924	5.734(2)/ 0.001				Pu k x-ray
					5.776(2)/ 0.008				0.18172
									0.22818
									0.27760
²⁴⁰ Am		240.05529	2.12 d	EC/1.38		(3-)			Pu L x-ray
				α/5.592	5.378(1)/ 16x10 ⁻⁴				Pu k x-ray
									0.88878
									0.98764
									(0.1-1.3)
²⁴¹ Am		241.056822	432.7 y	α/5.637	5.2443(1)/ 0.002	5/2-	+1.58	+3.1	Np L x-ray
			1.2x10 ¹⁴ y	SF/3.6x10 ⁻¹⁰	5.3221(1)/ 0.015				0.02634
					5.3884(1)/1.4				0.033192
					5.4431(1)/ 12.8				0.059536
					5.4857(1)/ 85.2				(0.03-1.128)
					5.5116(1)/ 0.20				
					5.5442(1)/ 0.34				
^{242m} Am			141. y	IT/99.5/0.048		5-	+1.0	+6.5	Am L x-ray

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Decay Mode/Energy (/MeV)	Particle Energy (/Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
			$\alpha/0.5/5.62$	$5.141(4)/0.026$				0.04863
			$>3.x10^{12}$ y	$SF/<4.7x10^{-9}$				0.08648
								0.10944
								0.16304
²⁴² Am		242.059542	16.02 h	$\beta^-/83/0.665$		+0.388	-2.4	Pu L x-ray
				$EC/17/0.750$				Cm L x-ray
								Pu k x-ray
								0.0422
								0.04453
²⁴³ Am		243.061372	$7.37x10^3$ y	$\alpha/5.438$		+1.5	+2.9	0.04354
			$2.x10^{14}$ y	$SF/3.7x10^{-9}$				0.07467
								0.08657
								0.11770
								0.14197
^{244m} Am			≈ 26 . m	$\beta^-/1.498$	(1-)			0.0429
²⁴⁴ Am		244.064279	10.1 h	$\beta^-/1.428$				Am L x-ray
								Cm k x-ray
								0.7460
								0.9000
²⁴⁵ Am		245.066444	2.05 h	$\beta^-/0.894$	(5/2+)			Cm L x-ray
								Cm k x-ray
								0.25299
^{246m} Am			25.0 m	$\beta^-/$	2-			Cm L x-ray
								Cm k x-ray
								0.27002
								0.79881
								1.06201
								1.07885
								(0.04-2.29)
²⁴⁶ Am		246.06977	39. m	$\beta^-/2.38$	(7-)			Cm L x-ray
								Cm k x-ray
								0.1529
								0.2046
								0.6786
²⁴⁷ Am		247.0722	22. m	$\beta^-/1.7$				Cm L x-ray
								Cm k x-ray
								0.2267/
								0.2853/
⁹⁶ Cm								
²³⁵ Cm		235.0516						
²³⁶ Cm		236.0514		$EC/1.7$				
²³⁷ Cm		237.0529		$EC/2.5$				
²³⁸ Cm		238.05302	2.4 h	$EC/>90/0.97$	0+			
				$\alpha/<10/6.632$				6.520(50)/<10
²³⁹ Cm		239.0548	≈ 3 . h	$EC/1.7$				0.0407
								0.1466
								0.1874
²⁴⁰ Cm		240.055519	27. d	$\alpha/6.397$	0+			
								6.147/0.05
			$1.9x10^6$ y	$SF/3.9x10^{-6}$				6.2478(6)/ 28.8
								6.2906(6)/ 70.6
²⁴¹ Cm		241.057646	32.8 d	$EC/99/0.768$	1/2+			Am k x-ray
				$\alpha/1/6.184$				0.13241
								5.8842(4)/ 0.12

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
					5.9291(4)/ 0.18				0.16505
					5.9389(4)/ 0.69				0.18028
									0.43063
									0.47181
²⁴² Cm		242.058828	162.8 d	α /6.216	5.9694(1)/ 0.035	0+			Pu L x-ray
					6.069(1)/25				0.04408
			7.0x10 ⁶ y	SF/6.4x10 ⁻⁶	6.1129(1)/74				0.10189
									(0.04-1.2)
²⁴³ Cm		243.061381	29.1 y	α /6.167	5.6815(5)/0.2	5/2+	0.41		Pu L x-ray
					5.6856(5)/1.6				Pu k x-ray
			5.5x10 ¹¹ y	SF/5.3x10 ⁻⁹	5.7420(5)/ 10.6				0.10612
					5.7859(5)/ 73.3				0.20975
					5.9922(5)/6.5				0.22819
					6.0103(5)/1.0				0.27760
					6.0589(5)/5				0.28546
					6.0666(5)/1.5				0.33431
									(0.04-0.7)
²⁴⁴ Cm		244.062745	18.1 y	α /5.902	5.6656/0.02	0+			Pu L x-ray
					5.7528/23				0.04282
			1.32x10 ⁷ y	SF/1.4x10 ⁻⁴	5.8050/77				0.09885
					5.515/0.004				0.15262
²⁴⁵ Cm		245.065485	8.48x10 ³ y	α /5.623	5.235(10)/0.3	7/2+	0.5		Pu L x-ray
					5.3038(10)/ 5.0				Pu k x-ray
			1.4x10 ¹² y	SF/6.1x10 ⁻⁷	5.3620(7)/93				0.04195
					5.4927(11)/ 0.8				0.13299
					5.5331(11)/ 0.6				0.13606
									0.17494
²⁴⁶ Cm		246.067217	4.76x10 ³ y	α /5.476	5.343(3)/21	0+			Pu L x-ray
			1.8x10 ⁷ y	SF/0.026	5.386(3)/79				0.04453
²⁴⁷ Cm		247.070346	1.56x10 ⁷ y	α /5.352	4.818(4)/4.7	9/2-	0.37		Pu k x-ray
					4.8690(20)/71	9/2-			0.2792
					4.941(4)/1.6				0.2886
					4.9820(20)/ 2.0				0.3471
					5.1436(20)/ 1.2				0.4035
					5.2104(20)/ 5.7				
					5.2659(20)/ 13.8				
²⁴⁸ Cm		248.072341	3.48x10 ⁵ y	α /99.92/5.162	4.931(5)/0.07	0+			
					5.0349(2)/ 16.5				
			4.15x10 ⁶ y	SF/8.38	5.0784(2)/ (75)/1				
²⁴⁹ Cm		249.075946	64.15 m	β^- /0.900	0.9/	1/2+			Bk k x-ray
									0.56039
									0.63431
²⁵⁰ Cm		250.07835	\approx 9.7x10 ³ y		SF/85.8	0+			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁵¹ Cm		251.08228	16.8 m	β^- /1.42	0.90/16	(1/2 ⁺)			0.3896/ 0.5299 0.5425
²⁵² Cm		252.0849	< 2 d						
⁹⁷ Bk									
²³⁸ Bk		238.0583	2.4 m	EC/5.0					
²³⁹ Bk		239.0584							
²⁴⁰ Bk		240.0598	≈ 4.8 m						
²⁴² Bk		242.0621	7.0 m	EC/3.0					
²⁴³ Bk		243.063001	4.5 h	EC/99.8/1.508	6.542(4)/0.03	(3/2 ⁻)			0.1466
				α /0.15/6.871	6.5738(2)/ 0.04				0.1874
					6.7180(22)/ 0.02				0.755
					6.7581(20)/ 0.02				0.840
									0.946
²⁴⁴ Bk		244.0652	4.4 h	EC/99.99/2.26		(4 ⁻)			0.1445
				α /0.01/6.778	6.625(4)/ 0.003				0.1876
					6.667(4)/ 0.003				0.2176
									0.9815
									0.9215/
²⁴⁵ Bk		245.066355	4.94 d	EC/99.9/0.810		3/2 ⁻			Cm L x-ray
				α /0.1/6.453	5.8851(5)/ 0.03				Cm k x-ray
					6.1176(9)/ 0.01				0.25299
					6.1467(5)/ 0.02				0.3809
					6.3087(5)/ 0.014				0.3851
					6.3492(5)/ 0.018				
²⁴⁶ Bk		246.0687	1.80 d	EC/1.35		(2 ⁻)			Cm L x-ray
									Cm k x-ray
									0.79881
									1.08142
²⁴⁷ Bk		247.07030	1.4x10 ³ y	α /5.889	5.465(5)/1.5	(3/2 ⁻)			0.04175
					5.501(5)/7				0.0839
					5.532(5)/45				0.268
					5.6535(20)/ 5.5				
					5.678(2)/13				
					5.712(2)/17				
					5.753(2)/4.3				
					5.794(2)/5.5				
²⁴⁸ Bk		248.07311	23.7 h	β^- /70/0.87	0.86/	(1 ⁻)			Cm L x-ray
				EC/30/0.72					Cf L x-ray
									Cm k x-ray
									Cf k x-ray
									0.5507
²⁴⁹ Bk		249.074980	320. d	β^- /0.125	0.125/100	7/2 ⁺	2.0		0.327/10 ⁻⁵
				α /0.001/5.525	5.390(1)/ 0.0002				0.308/10 ⁻⁶
			1.8x10 ⁹ y	SF/4.9x10 ⁻⁸	5.4174(6)/ 0.001				
²⁵⁰ Bk		250.078309	3.217 h	β^- /1.780	0.74/	2 ⁻			Cf L x-ray
									Cf k x-ray
									0.98912

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
									1.03184 (0.04-1.6)
²⁵¹ Bk		251.08075	56. m	$\beta^-/1.09$		(3/2-)			0.02481 0.1528 0.1776
²⁵² Bk		252.0843	1.8 m						
⁹⁸ Cf									
²³⁷ Cf		237.0621	2.1 s	α ,SF/10					
²³⁸ Cf		238.0614	21 ms	SF/					
²³⁹ Cf		239.0626	≈ 0.7 m	α					
²⁴⁰ Cf		240.0623	1.1 m	$\alpha/7.719$	7.590(10)/	0+			
				SF/ =2.1					
²⁴¹ Cf		241.0637	4. m	EC/3.3					
				$\alpha/7.60$	7.335(5)/				
²⁴² Cf		242.06369	3.5 m	$\alpha/7.509$	7.351(6)/20	0+			
				SF/ α 0.014	7.385(4)/80				
²⁴³ Cf		243.0654	11. m	EC/86/2.2	7.060(6)/20	(1/2+)			
				$\alpha/14/7.40$	7.170/4				
²⁴⁴ Cf		244.065990	20. m	$\alpha/7.328$	7.168(5)/25	0+			
					7.210(5)/75				
²⁴⁵ Cf		245.068038	44. m	$\alpha/36/7.255$	7.15/91.7				Cm K x-ray
				EC/64/1.569	6.983/0.31				0.5709
					7.09/7				0.6014
					7.065/0.68				0.6163
²⁴⁶ Cf		246.068798	1.49 d	$\alpha/6.869$	6.6156(10)/	0+			Cm L x-ray
					0.18				
					6.7086(7)/				0.04221
					21.8				
			1.8x10 ³ y	SF/2.3x10 ⁻⁴	6.7501(7)/				0.0945
					78.0				
									0.147
²⁴⁷ Cf		247.07099	3.11 h	EC/99.96/0.65		7/2+			Bk k x-ray
				$\alpha/0.04/6.55$	6.301(5)/				0.2941
									0.4778
²⁴⁸ Cf		248.07218	334. d	$\alpha/6.369$	6.220(5)/17	0+			
			3.2x10 ⁴ y	SF/0.0029	6.262(5)/83				
²⁴⁹ Cf		249.074846	351. y	$\alpha/6.295$	5.7582(2)/3.7	9/2-			Cm L x-ray
					5.8119(2)/84				Cm k x-ray
			8.x10 ¹⁰ y	SF/4.4x10 ⁻⁷	5.8488(2)/1.0				0.25299
					5.9029(2)/2.8				0.33351
					5.9451(2)/4.0				0.38832
					6.1401(2)/1.1				(0.0376-1.103)
					6.1940(2)/2.2				
²⁵⁰ Cf		250.076399	13.1 y	$\alpha/6.129$	5.8913(4)/0.3	0+			Cm L x-ray
			1.7x10 ⁴ y	SF/0.077	5.9889(4)/15				0.04285
					6.0310(4)/				
					84.5				
²⁵¹ Cf		251.079579	9.0x10 ² y	$\alpha/6.172$	5.56448(7)/	1/2+			
					1.5				
					5.632(1)/4.5				
					5.648(1)/3.5				
					5.6773(6)/35				
					5.762(3)/3.8				
					5.7937(7)/2.0				
					5.8124(8)/4.2				
					5.8514(6)/27				
					6.0140(7)/				
					11.6				
					6.0744(7)/2.7				

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁵² Cf		252.081619	2.65 y	α /96.9/6.217	5.7977(1)/ 0.23	0+			Cm L x-ray
			86. Y	SF/3.1/	6.0756(4)/ 15.2			0.04339	
					6.1184(4)/ 81.6		0.1002		
²⁵³ Cf		253.08512	17.8 d	β^- /99.7/0.29	0.27/100	(7/2+)			
				α /0.3/6.126	5.921(5)/0.02				
²⁵⁴ Cf		254.08732	60.5 d	SF/99.7/		0+			
				α /0.3/5.930	5.792(5)/0.05				
					5.834(5)/0.26				
²⁵⁵ Cf		255.0910	1.4 h	β^- /0.7					
²⁵⁶ Cf		256.0934	12. m	SF					
⁹⁹ Es									
²⁴¹ Es		241.0687	≈ 8 s	α	8.11				
²⁴² Es		242.0697	16 s	α	7.92				
²⁴³ Es		243.0696	21. s	α />30/	7.89/>30				
				EC/<70/4.0					
²⁴⁴ Es		244.0709	37. s	EC/76/4.6					
				α /4/	7.57/4				
²⁴⁵ Es		245.0713	1.3 m	α /40/7.858	7.74				
				EC/60/3.1					
²⁴⁶ Es		246.0730	7.7 m	EC/90/3.9					
				α /10/	7.35				
²⁴⁷ Es		247.07365	4.8 m	EC/93/2.48					
				α /7/	7.32				
²⁴⁸ Es		248.0755	26. m	EC/99.7/3.1					
				α /0.3/	6.87				
²⁴⁹ Es		249.07640	1.70 h	EC/99.4/1.45		(7/2+)			0.3795
				α /0.6/	6.77			0.8132	
^{250m} Es			2.2 h	EC/		(1-)			Cf L x-ray
				β^*				Cf k x-ray	
								0.9891	
								1.0319	
²⁵⁰ Es		250.0787	8.6 h	EC/2.1		(6+)			Cf L x-ray
								Cf k x-ray	
								0.30339	
								0.34948	
								0.82883	
²⁵¹ Es		251.07998	1.38 d	EC/99.5/0.38		(3/2-)			
				α /0.5/	6.462/0.05				
					6.492/0.4				
²⁵² Es		252.08297	1.29 y	α /76/	6.632/61.0	(5-)			
				EC/24/1.26	6.562/10.3				
²⁵³ Es		253.084818	20.47 d	α	6.633/89.8	7/2+	+4.10	7.	0.04180
			6.3x10 ⁵ y	SF/8.9x10 ⁻⁶	6.5916/6.6			0.3892	
^{254m} Es			1.64 d	β^- /99.6/	0.475	2+	2.9	3.7	Fm L x-ray
				α /0.3/6.67	6.382	2+		Fm k x-ray	
			>10. Y	SF/0.045			0.6488		
								0.6938	
²⁵⁴ Es		254.088017	276. d	α	6.429	(7+)			0.064
			>2.5x10 ⁷ y	SF/<3x10 ⁻⁶					
²⁵⁵ Es		255.09027	40. d	β^- /92/0.29		(7/2+)			
				α /8/	6.26				
			2.6x10 ³ y	SF/0.0042	6.300				
^{256m} Es			7.6 h	β^- /		(8+)			0.218
								0.232	
								0.862	
²⁵⁶ Es		256.0936	25. m	β^- /1.7		(1+)			

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁵⁷ Es		257.0960	7.7 d	β ⁻					
¹⁰⁰ Fm									
²⁴² Fm		242.0734	0.8 ms	SF/>96					
²⁴³ Fm		243.0745	0.2 s	α/ <SF/0.4	8.55				
²⁴⁴ Fm		244.0741	3.3 ms	SF/>97		0+			
²⁴⁵ Fm		245.0754	4. s	α/ SF/<0.1	8.15/				
²⁴⁶ Fm		246.07528	1.2 s	α/85/ SF/15/	8.24/	0+			
^{247m} Fm			9. s	α/	8.18/				
²⁴⁷ Fm		247.0768	35. s	α/8.20 EC/2.9	7.87/70 7.93/30				
²⁴⁸ Fm		248.07718	36. s	α/99.9/8.001 SF/0.1/	7.83/20 7.87/80	0+			
²⁴⁹ Fm		249.0790	3. m	EC/2.4 α/		(7/2+)			
^{250m} Fm			1.8 s	IT/ SF/<8x10 ⁻⁵					
²⁵⁰ Fm		250.07951	30. m	α/ EC/0.8 SF/0.007	7.43/	0+			
²⁵¹ Fm		251.08157	5.3 h	EC/98/1.47 α/2/		(9/2-)			
²⁵² Fm		252.08246	1.058 d	α/7.154 SF/0.0023	6.833 6.998/15 7.039/85	0+			
²⁵³ Fm		253.085175	3.0 d	EC(88%)/0.333 α/12/	6.676/ 6.943/	1/2+		Es k x-ray 0.2719	
²⁵⁴ Fm		254.086847	3.240 h	α/ SF/0.059	7.150 7.192	0+			
²⁵⁵ Fm		255.089955	20.1 h 1.0x10 ⁴ y	α/ SF/2.3x10 ⁻⁵	6.9635(5)/5.0 7.0225(5)/ 93.4	7/2+			
²⁵⁶ Fm		256.09177	2.63 h	SF/91 α/19		0+			
²⁵⁷ Fm		257.09510	100.5 d	α/99.79 SF/0.21	6.519	(9/2+)		0.1794 0.2410	
²⁵⁸ Fm		258.0971	0.37 ms	SF/					
²⁵⁹ Fm		259.1006	1.5 s	SF/					
²⁶⁰ Fm			≈4 ms	SF/					
¹⁰¹ Md									
^{245m} Md			≈ 0.4 s	α	8.64,8.68				
²⁴⁵ Md		245.0810	0.9 ms	SF					
²⁴⁶ Md		246.0819	1.0 s	α	8.74 8.50-8.56				
^{247m} Md			≈0.2 s	SF/					
²⁴⁷ Md		247.0818	3. s	α	8.43				
²⁴⁸ Md		248.0828	7. s	EC/80/5.3 α/20/	8.32/15 8.36/5				
²⁴⁹ Md		249.0830	24. s	SF/<0.05 EC>/<80/3.7 α/>20/8.46	8.030(20)/				
²⁵⁰ Md		250.0845	50. s	EC/94/4.6 α/6/8.25	7.75/4 7.83/2				
²⁵¹ Md		251.0849	4.0 m	EC/>94/3.1 α/<6/	7.55/				
²⁵² Md		252.0866	2. m	EC/>50/3.9 α/<50/	7.73/				
²⁵³ Md		253.0873	≈6 m	EC/2.0					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
^{254m} Md			30. m	EC/					
²⁵⁴ Md		254.0897	10. m	EC/2.7					
²⁵⁵ Md		255.09108	27. m	EC/92/1.04	α /7.33/93	(7/2-)			0.121/100
				α /8/	7.27/5				0.115/65
				SF/80.15	7.75/1				0.136/35
					7.71/1				0.141-0.453
²⁵⁶ Md		256.0941	1.30 h	EC/89/2.13	7.21/71				Fm k x-ray
				α /11/	7.14/22				0.121/409
				SF/<2.6	7.68/2.5				0.115/266
					7.25/2.5				0.136/143
					7.64/2.1				0.634/119
									0.141-1.374
²⁵⁷ Md		257.095535	5.5 h	EC/85/0.41	7.074	(7/2-)			Fm k x-ray
				α /15,SF/81	7.014				(0.181-0.389)
^{258m} Md			57. m	EC/		(1-)			Fm k x-ray
				SF/830					
²⁵⁸ Md		258.098427	51.5 d	α /7.40	6.718(2)/	(8-)			0.3678
				SF/ α 0.003	6.763(4)/				0.057 - 0.448
²⁵⁹ Md		259.1005	1.64 h	SF/>98.7		7/2+			
				α /<1.3					
²⁶⁰ Md		260.104	\approx 27.8 d	SF/73-100					
¹⁰² No									
²⁵⁰ No		250.0875	0.25 ms	SF/		0+			
²⁵¹ No		251.0889	0.76 s	α /	8.62/96				
				SF/0.26	8.58/4				
²⁵² No		252.08897	2.3 s	α /74/8.551	8.42	0+			
				SF/26/	8.37				
²⁵³ No		253.0907	1.7 m	α /	8.010(20)	(9/2-)			
				EC/3.2					
^{254m} No			0.28 s	I.T./					
				SF/8.2					
²⁵⁴ No		254.09095	49. s	α /	8.09	0+			
				EC/1.1					
				SF/0.17					
²⁵⁵ No		255.09323	3.1 m	α /62/	8.12/	1/2+			0.187
				EC/38/2.01	7.93				
					8.08				
²⁵⁶ No		256.09428	2.9 s	α /	8.43	0+			
				SF/0.5					
²⁵⁷ No		257.09685	25. s	α /	8.22	(7/2+)			
				SF/<1.5	8.27				
					8.32				
²⁵⁸ No		258.0983	\approx 1.2 ms	SF/		0+			
²⁵⁹ No		259.1011	58. m	α /78/7.794	7.52	(9/2+)			
				EC/22/0.5	7.55				
				SF/<9.7					
²⁶⁰ No		260.103	0.11 s	SF/					
²⁶² No		262.108	\approx 8. ms	SF/					
¹⁰³ Lr									
²⁵¹ Lr		251.0944	39 m	SF					
²⁵² Lr		252.0953	\approx 0.36 s	α	9.02/73				
				SF/<1	8.97/27				
^{253m} Lr			\approx 0.57 s	α	8.79				
				SF/1					
²⁵³ Lr		253.0953	1.5 s	α /	8.72				
				SF/=5					
²⁵⁴ Lr		254.0965	13. s	α /	8.45				
				EC/5.2					
				SF/<0.1					

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁵⁵ Lr		255.0967	22. s	α	8.37/60				
				EC/3.2	8.43/40				
				SF/<0.1					
²⁵⁶ Lr		256.0988	28. s	α /99.7/8.554	8.43/				
				EC/4.2	8.39				
				SF/<0.03					
²⁵⁷ Lr		257.0996	0.65 s	α	8.80	7/2+			
				EC/2.5	8.80				
				SF/<0.03					
²⁵⁸ Lr		258.1019	3.9 s	α	8.60/46				
				EC/3.4	8.62/25				
				SF/<5	8.56/20				
					8.65/9				
²⁵⁹ Lr		259.1030	6.1 s	α /80	8.44(1)				
				SF/20					
²⁶⁰ Lr		260.1056	3. m	α	8.03				
²⁶¹ Lr		261.1069	40. m	SF					
²⁶² Lr		262.1097	3.6 h	EC/2.					
				SF/<10					
¹⁰⁴ Rf									
²⁵³ Rf		253.1007	≈ 48. μ s	SF					
				α /<10					
²⁵⁴ Rf		254.1002	23. μ s	SF/>98.5					
				α /<1.5					
²⁵⁵ Rf		255.1015	1.6 s	α	8.72/55				
				SF/45	8.77/25				
					8.80/7				
					8.69/3.5				
					8.83/3.5				
					8.89/2.5				
					8.92/2.5				
²⁵⁶ Rf		256.10118	6.2 ms	SF/99.68					
				α /0.32	8.81				
²⁵⁷ Rf		257.1031	4.7 s	α /9.22	8.77				0.117
				EC/11	9.01				
				SF/<1.4	8.95				
					8.62				
²⁵⁸ Rf		258.1036	12. ms	SF/87					
				α /13					
²⁵⁹ Rf		259.1056	3.4 s.	α /9.09/93	8.77(2)/				
				SF/7	8.86/				
²⁶⁰ Rf		260.1064	20. ms	SF/					
²⁶¹ Rf		261.1088	1.1 m	α /8.78,SF/<10	8.28/				
²⁶² Rf		262.1099	2.1 s	SF/>99.2					
²⁶³ Rf		263.1125	10. m	SF, α					
¹⁰⁵ Db									
²⁵⁵ Db		255.1074	≈ 1.5 s	α ,					
				SF/=20					
²⁵⁶ Db		256.1081	1.9 s	α /64	9.02/=64				
				EC/35	8.89/=12				
				SF/0.05	9.08/=12				
					9.12/=12				
²⁵⁷ Db		257.1079	1.5 s	α	8.97/33				
				SF/<6	9.07/38				
					9.12/5.5				
					8.94/9				
					9.02/9				
					8.89/5.5				
²⁵⁸ Db		258.1094	4.2 s	α	9.20/				

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
				E.C/5.3	9.16/				
				SF/<33					
²⁵⁹ Db		259.1097	≈ 1.2 s	SF/					
²⁶⁰ Db		260.1114	1.5 s	α/	9.05/				
				SF/<9.6	9.08/				
					9.13/				
²⁶¹ Db		261.1121	1.8 s	α/	8.93/				
				SF/<18					
²⁶² Db		262.1141	34. s	SF/<33					
				α/	8.45/				
					8.53/				
					8.67/				
²⁶³ Db		263.1151	≈0.45 m	SF/57/, α/43/	8.35/43				
¹⁰⁶ Sg									
²⁵⁸ Sg		258.1132	≈ 2.9 ms	SF					
				α/<20					
²⁵⁹ Sg		259.1147	0.5 s	α/	9.62				
				SF/<20	9.35				
					9.03				
²⁶⁰ Sg		260.11444	4. ms	α/50	9.76				
				SF/50	9.72				
					9.81				
²⁶¹ Sg		261.1162	0.3 s	α,SF/<10	9.56				
²⁶³ Sg		263.1183	0.8 s	α	9.06				
				SF/<30	9.25				
²⁶⁵ Sg		265.1211	≈7.4 s	α/>65	8.84/46				
				SF/<35	8.76/23				
					8.94/23				
					8.69/8				
²⁶⁶ Sg		266.1219	≈21. s	α/	8.77/66				
				SF/<82	8.52/33				
²⁶⁹ Sg									
¹⁰⁷ Bh									
²⁶⁰ Bh		260.122		α					
²⁶¹ Bh		261.1218	12. ms	α,SF/<10	10.40				
					10.10				
					10.03				
^{262m} Bh			8. ms	α/	10.37				
				SF/<12	10.24				
²⁶² Bh		262.1230	0.10 s	α/	10.06				
				SF/<12	9.91				
					9.74				
²⁶⁴ Bh		264.1247	0.44 s	α/	9.48				
				SF/	9.62				
²⁶⁶ Bh		266.1270	≈1 s	9.29					
²⁶⁷ Bh		267.1277	≈17 s	8.83					
¹⁰⁸ Hs									
²⁶³ Hs		263.1287		α/					
²⁶⁴ Hs		264.1284	≈ 0.08 ms	α,SF/≈50	11.0				
^{265m} Hs			≈0.75 ms	α	10.57/63				
					10.73				
					10.52				
					10.34				
²⁶⁵ Hs		265.1300	2.0 ms	α/	10.30/90				
				SF/<1	10.43				
					10.37				
					10.25				
²⁶⁷ Hs		267.1371	33 ms	α/>88	9.88				
					9.83				

TABLE OF ISOTOPES (CONTINUED)

Elem. or Isot.	Natural Abundance (%)	Atomic Mass or Weight	Half-Life	Decay Mode/Energy (/MeV)	Particle Energy /Intensity (MeV/%)	Spin (h/2p)	Nuclear Magnetic Mom. (nm)	Elect. Quadr. Mom. (b)	g-ray/Energy Intensity (MeV/%)
²⁶⁹ Hs		269.1341	9.3 s	α	9.75 9.23				
²⁷³ Hs			≈ 1.2 s	α	9.78 9.47				
²⁷⁷ Hs			≈ 11 m	SF					
¹⁰⁹ Mt									
^{266m} Mt			≈ 1.2 ms	α	10.46-10.81				
²⁶⁶ Mt		266.1379	≈ 0.7 ms	α	10.48-11.31				
²⁶⁷ Mt		267.138	19 ms	α					
²⁶⁸ Mt		268.1388	0.07 s	$\alpha > 68$	10.10, 10.24				
¹¹⁰ 110									
²⁶⁷ 110		267.1440	≈ 3 μ s	$\alpha > 32$	11.6				
²⁶⁹ 110		269.1451	0.17 ms	$\alpha > 75$	11.11				
^{271m} 110			≈ 1.1 ms	α	10.68 10.74				
²⁷¹ 110		271.1461	≈ 56 ms	α	10.71				
^{273m} 110			0.076 ms	α	11.8				
²⁷³ 110		273.1492	118 ms	α	9.73				
²⁷⁷ 110			≈ 3.0 ms	α	10.2				
²⁸⁰ 110			≈ 7.5 s		SF/				
²⁸¹ 110			≈ 1 m	α	8.83				
¹¹¹ 111									
²⁷² 111		272.1535	≈ 1.5 ms	$\alpha > 68$	10.82				
¹¹² 112									
²⁷⁷ 112			≈ 0.24 ms	α	11.45 11.65				
²⁸¹ 112			≈ 0.89 ms	α	10.7				
²⁸³ 112			$\approx 1.$ m		sf/ > 0.7				
				$\alpha < 0.3$					
²⁸⁴ 112			≈ 9.8 s	α	9.17				
²⁸⁵ 112			$\approx 11.$ m	α	8.67				
¹¹⁴ 114									
²⁸⁵ 114			≈ 0.58 ms	α	11.3				
²⁸⁷ 114			≈ 5.5 s	α	10.3				
²⁸⁸ 114			≈ 1.9 s	α	9.84				
²⁸⁹ 114			$\approx 20.$ s	α	9.71				
¹¹⁶ 116									
²⁸⁹ 116			≈ 0.60 ms	α	11.6				
¹¹⁸ 118									
²⁹³ 118			≈ 0.12 ms	α	12.4				

NEUTRON SCATTERING AND ABSORPTION PROPERTIES

(Revised 2003)

Norman E. Holden

This table presents an evaluated set of values for experimental quantities that characterize the properties for scattering and absorption of neutrons. The neutron cross section is given for room temperature neutrons, 20.43°C, corresponding to a thermal neutron energy of 0.0253 electron volts (eV) or a neutron velocity of 2200 meters/second. The neutron resonance integral is defined over the energy range from 0.5 eV to 0.1×10^6 eV, or 0.1 MeV. Bound neutron scattering lengths and neutron cross sections averaged over a Maxwellian spectrum at 30 keV for astrophysical applications are also presented. A list of the major references used is given below. The literature cutoff date is January 2003. Uncertainties are given in parentheses. Parentheses with two or more numbers indicate values to the excited state(s) and to the ground state of the product nucleus.

Table Layout

Column Number	Column Title	Description
1	Isotope/Element	For elements, atomic number and chemical symbol are listed. For nuclides, mass number and chemical symbol are listed. Isomers are indicated by the addition of m, m1, or m2.
2	Isotopic Abundance	in atom percent
3	Half-life	Half-life in decimal notation. μ s = microsecond; ms = millisecond; s = second; m = minute; h = hour; d = day; y = year.
4	Thermal Neutron Cross Sections	Cross sections for neutron capture reactions in units of barns (10^{-24} cm ²) or millibarns (mb). Proton, alpha production and fission reactions are designated by σ_p , σ_α , σ_f , respectively. Separate values are listed for isomeric production.
5	Neutron Resonance Integrals	Resonance integrals for neutron capture reactions in barns (10^{-24} cm ²) or millibarns (mb). Proton, alpha production and fission reactions are designated by R.I. _p , R.I. _{α} , R.I. _f , respectively. Separate values are listed for isomeric production.
6	Neutron Scattering Lengths	Bound coherent scattering lengths for neutron scattering reactions in units of femtometers (fm), which is equal to fermis (10^{-13} cm).
7	Maxwellian Averaged Cross Section	Astrophysical Cross Sections, averaged over a stellar neutron maxwellian spectrum characterized by a thermal energy of 30 keV, expressed in barns (10^{-24} cm ²), millibarns (mb) or microbarns (μ b).

General Nuclear Data References

The following references represent the major sources of the nuclear data presented:

- Mughabghab, S.F., Divadeenam, M., Holden, N.E.; *Neutron Cross Sections, Vol. 1 Neutron Resonance Parameters and Thermal Cross Sections*, Part A, Z = 1-60. Academic Press Inc., New York, New York (1981); Mughabghab, S.F.; Part B, Z = 61-100. Academic Press Inc., Orlando, Florida (1984).
- Holden, N.E.; *Fifty Years with Nuclear Fission* Conference, Wash., D.C., Gaithersburg, Md. April 26-29, 1989, p. 946. American Nuclear Society, LaGrange Park, Illinois (1989).
- Tuli, J.K.; *Nuclear Wallet Cards*, Brookhaven National Laboratory (Jan. 2000).
- Holden, N.E.; *Half-lives of Selected Nuclides*, *Pure & Applied Chemistry* 62, 941 (1990).
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- Koester, L., Rauch, H., Seymann, E.; *Neutron Scattering Lengths: A Survey of Experimental Data and Methods*, *Atomic Data Nuclear Data Tables* 49, 65 (1991).
- Sears, V.F.; *Neutron Scattering Lengths and Cross Sections*, *Neutron News* 3, (3), 26 (1992).
- Bao, Z.Y., Beer, H., Käppeler, F., Voss, F., Wisshak, K., Raucher, T.; *Neutron Cross Sections for Nucleo-synthesis Studies*, *Atomic Data Nuclear Data Tables* 76, 70 (2000).

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
^1_1H			0.332(2)	0.149(1)	-3.739(1)	
^1_1H	99.9885(70)	$>2.8 \times 10^{23}$ y	0.332(2)	0.149(1)	-3.741(1)	0.25(2) mb*
^2_1H	0.0115(70)		0.51(1)mb	0.23(2) mb	6.671(4)	2.1(4) μb
^3_1H		12.33 y	$< 6. \mu\text{b}$		4.79(3)	
^2_2He			< 0.05		3.26(3)	
^3_2He	0.000134(3)		$\sigma_p = 5.33(1) \times 10^3$ 0.05(1) mb	$RI_p = 2.39(1) \times 10^3$	5.74(7)	8.(1) μb^*
^4_2He	99.999867(3)				3.26(3)	
^3_3Li			71.(2)	32.(1)	-1.90(2)	
^6_3Li	7.59(4)		$\sigma_t = 9.4(1) \times 10^2$ 39.(5) mb	$RI_t = 422.(4)$ 17.(2) mb	2.0(1)	$\sigma_t \approx 1.$ 0.06(1) mb*
^7_3Li	92.41(4)		45.(5) mb	20.(2) mb	-2.22(2)	42.(3) μb
^6_3Li		0.84 s				$< \approx 5.5 \mu\text{b}$
^4_4Be			8.8(4) mb	3.9(2) mb	7.79(1)	
^7_4Be		53.28 d	$\sigma_p = 3.9(1) \times 10^4$ $\sigma_\alpha \approx 0.1$	$RI_p = 1.75(5) \times 10^4$		$\sigma_p = 16(4)^*$
^9_4Be	100.		8.8(4) mb	3.9(2) mb	7.79(1)	
$^{10}_4\text{Be}$		1.52×10^6 y	$< 1. \text{mb}$			
^5_5B			$7.6(1) \times 10^2$	$3.4(1) \times 10^2$	5.30(4)	
$^{10}_5\text{B}$	19.9(7)		$\sigma_\alpha = 38.4(1) \times 10^2$ 0.3(1)	$RI_\alpha = 17.3(1) \times 10^2$ 0.13(4)	-0.1(3)	
			$\sigma_p = 7.(1) \text{mb}$ $\sigma_t = 8.(2) \text{mb}$			
$^{11}_5\text{B}$	80.1(7)		5.(3) mb	2.(1) mb	6.65(4)	
^6_6C			3.5(1) mb	1.6(1) mb	6.646(1)	
$^{12}_6\text{C}$	98.93(8)		3.5(1) mb	1.6(1) mb	6.651(2)	16.(1) μb^*
$^{13}_6\text{C}$	1.07(8)		1.4(1) mb	1.7(2) mb	6.19(9)	0.021(4) mb
$^{14}_6\text{C}$		5715. y	$< 1.4 \mu\text{b}$			3.(1) μb^*
^7_7N			2.00(6)	0.90(3)	9.36(2)	
$^{14}_7\text{N}$	99.636(20)		$\sigma_p = 1.93(5)$ 0.080(1)	$RI_p = 0.87(3)$ 0.034(1)	9.37(2)	$\sigma_p = 1.8(2) \text{mb}^*$ 0.04(1) mb
$^{15}_7\text{N}$	0.364(20)		0.04(1) mb	0.11(3) mb	6.44(3)	6.(1) μb^*
^8_8O			0.29(1) mb	0.40(4) mb	5.805(4)	
$^{16}_8\text{O}$	99.757(16)		0.19(1) mb	0.36(4) mb	5.805(5)	34.(4) μb
$^{17}_8\text{O}$	0.038(1)		$\sigma_\alpha = 0.257(10)$ 0.54(7) mb	0.11(1) 0.39(5) mb	5.8(2)	$\sigma_\alpha = 3.9(5) \text{mb}^*$
$^{18}_8\text{O}$	0.205(14)		0.16(1) mb	0.81(4) mb	5.84(7)	9.(1) μb^*
^9_9F			9.5(1) mb	21.(3) mb	5.65(1)	6.(1) mb
$^{19}_9\text{F}$	100.		9.5(1) mb	21.(3) mb	5.65(1)	6.(1) mb
$^{10}_{10}\text{Ne}$			42.(5) mb	19.(3) mb	4.566(6)	
$^{20}_{10}\text{Ne}$	90.48(3)		39.(5) mb	18.(3) mb	4.631(6)	0.12(1) mb

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
²¹ Ne	0.27(1)		0.7(1) $\sigma_{\alpha} = 0.18(9)$ mb	0.31(5)	6.7(2)	≈ 1.5 mb
²² Ne	9.25(3)		51.(5) mb	23.(3) mb	3.87(1)	58.(4) μ b*
¹¹ Na			0.53(2)	0.32(2)	3.63(2)	2.1(2) mb
²² Na		2.605 y	$\sigma_p = 2.8(3) \times 10^4$ $\sigma_{\alpha} = 2.6(4) \times 10^2$	$RI_p < 2 \times 10^5$ $RI_{\alpha} = 1.2(2) \times 10^2$		
²³ Na	100.		$\sigma_m = 0.43(3)$	$RI_m = 0.30(6)$	3.63(2)	2.1(2) mb
¹² Mg			66.(6) mb	38.(5) mb	5.375(4)	
²⁴ Mg	78.99(4)		0.053(6)	32.(4) mb	5.7(2)	3.3(4) mb
²⁵ Mg	10.00(1)		0.20(1)	98.(15) mb	3.6(2)	6.4(4) mb
²⁶ Mg	11.01(3)		0.038(1)	25.(2) mb	4.9(2)	0.13(1) mb*
²⁷ Mg		9.45 m	0.07(2)	0.03(1)		
¹³ Al			0.230(2)	0.17(1)	3.45(1)	
²⁶ Al		7.1x10 ⁵ y	$\sigma_p = 1.97(10)$ $\sigma_{\alpha} = 0.34(1)$			0.14(2)
²⁷ Al	100.		0.230(2)	0.17(1)	3.45(1)	2.9(3) mb
¹⁴ Si			0.166(9)	0.12(2)	4.15(1)	
²⁸ Si	92.223(19)		0.17(1)	0.11(2)	4.11(1)	2.9(3) mb
²⁹ Si	4.685(8)		0.12(1)	0.08(2)	4.7(1)	7.9(9) mb
³⁰ Si	3.092(11)		0.107(3)	0.62(6)	4.61(1)	3.2(3) mb*
³¹ Si		2.62 h	73.(6) mb	33.(3) mb		
³² Si		1.6x10 ² y	< 0.5			
¹⁵ P			0.17(1)	0.08(1)	5.13(1)	
³¹ P	100.		0.17(1)	0.08(1)	5.13(1)	1.7(1) mb
¹⁶ S			0.54(2)	0.24(2)	2.847(1)	
³² S	94.93(31)		0.55(5) $\sigma_{\alpha} < 0.5$ mb	0.25(2)	2.804(2)	4.1(2) mb
³³ S	0.76(2)		0.46(3) $\sigma_{\alpha} = 0.12(1)$ $\sigma_p = 2.$ mb	0.21(2) $RI_{\alpha} = 0.05(1)$	4.7(2)	7.4(15) mb $\sigma_{\alpha} = 0.18(1)$
³⁴ S	4.29(28)		0.25(1)	0.13	3.48(3)	0.23(1) mb
³⁶ S	0.02(1)		0.24(2)	0.26(3)		0.17(1) mb*
¹⁷ Cl			33.6(3)	15.(2)	9.58(1)	
³⁵ Cl	75.78(4)		43.7(4) $\sigma_p = 0.44(1)$ $\sigma_{\alpha} \approx 0.08$ mb	20.(2) $RI_p = 0.2$	11.7(1)	9.4(3) mb $\sigma_p = 1.7(2)$ mb*
³⁶ Cl		3.01x10 ⁵ y	$\sigma_p = 46.(2)$ mb <10. $\sigma_{\alpha} = 0.59(7)$ mb	$RI_p = 0.02$		$\sigma_p = 91.(8)$ mb $\sigma_{\alpha} = 0.9(2)$ mb
³⁷ Cl	24.22(4)		(0.05 + 0.38)	(0.04+0.26)	3.1(1)	2.0(2) mb
¹⁸ Ar			0.66(3)	0.42(5)	1.91(1)	
³⁶ Ar	0.3365(30)		5.(1) $\sigma_{\alpha} = 5.4(3)$ mb $\sigma_p < 1.5$ mb	2.(1)	24.9(1)	

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
³⁷ Ar		35.0 d	$\sigma_{\alpha} = 1.08(8) \times 10^3$ $\sigma_{\beta} = 37.(4)$	$RI_{\alpha} = 900.$ $RI_{\beta} = 31.$		$\sigma_{\alpha} \approx 1.3$ $\sigma_{\beta} \approx 0.04$
³⁸ Ar	0.0632(5)		0.8(2)	0.4(1)	3.5(35)	
³⁹ Ar		268. y	$6.(2) \times 10^2$ $\sigma_{\alpha} < 0.29$			
⁴⁰ Ar	99.6003(30)		0.64(3)	0.41(5)	1.83(1)	2.5(3) mb
⁴¹ Ar		1.82 h	0.5(1)	0.2(1)		
¹⁹ K			2.1(1)	1.0(1)	3.67(2)	
³⁹ K	93.2581(44)		2.1(2) $\sigma_{\alpha} = 4.3(5)$ mb $\sigma_{\beta} < 0.05$ mb	0.9(1)	3.74(2)	11.8(4) mb
⁴⁰ K	0.0117(1)	1.26×10^9 y	30.(8) $\sigma_{\beta} = 4.4(4)$ $\sigma_{\alpha} = 0.42(8)$	13.(4) 2.0(2)		$\sigma_{\beta} = 7.(1)$ mb $\sigma_{\alpha} = 40.(6)$ mb
⁴¹ K	6.7302(44)		1.46(3)	1.4(2)	2.69(8)	22.(1) mb
²⁰ Ca			0.43(2)	0.23(2)	4.70(2)	
⁴⁰ Ca	96.941(156)		0.41(3) $\sigma_{\alpha} = 0.13(4)$ mb	0.22(4)	4.80(2)	6.7(7) mb
⁴¹ Ca		1.02×10^5 y	$\approx 4.$ $\sigma_{\alpha} = 0.18(3)$ $\sigma_{\beta} = 7.(2)$ mb			
⁴² Ca	0.647(23)		0.65(10)	0.39(4)	3.4(1)	16.(2) mb
⁴³ Ca	0.135(10)		6.(1)	3.9(2)	- 1.56(9)	51.(6) mb
⁴⁴ Ca	2.086(110)		0.8(2)	0.56(1)	1.42(6)	9.(1) mb
⁴⁵ Ca		162.7 d	$\approx 15.$			
⁴⁶ Ca	0.004(3)	$> 4 \times 10^{15}$ y	0.70(3)	0.9(1)	3.6(2)	5.3(5) mb*
⁴⁸ Ca	0.187(21)	4.3×10^{19} y	1.0(1)	0.5(1)	0.39(9)	0.8(1) mb*
²¹ Sc			27.2(2)	12.(1)	12.3(1)	
⁴⁵ Sc	100.		(10.+17.)	(5.6+6.4)	12.3(1)	69.(5) mb
⁴⁶ Sc		83.81 d	8.(1)	3.6(5)		
²² Ti			6.1(1)	2.8(2)	- 3.438(2)	
⁴⁴ Ti		60 y	1.1(2) $\sigma_{\beta} < 0.2$			
⁴⁶ Ti	8.25(3)		0.6(2)	0.4(1)	4.93(6)	27.(3) mb
⁴⁷ Ti	7.44(2)		1.6(2)	1.6(2)	3.63(1)	64.(8) mb
⁴⁸ Ti	73.72(3)		7.9(9)	3.6(2)	- 6.09(2)	32.(5) mb
⁴⁹ Ti	5.41(2)		1.9(5)	1.2(2)	1.04(5)	22.(2) mb
⁵⁰ Ti	5.18(2)		0.179(3)	0.12(2)	6.18(8)	3.6(4) mb
²³ V			5.0(2)	2.8(1)	- 0.382(1)	
⁵⁰ V	0.250(4)	1.4×10^{17} y	21.(4) $\sigma_{\beta} = 0.7(4)$ mb	50.(20)	7.6(6)	
⁵¹ V	99.750(4)		4.9(1)	2.7(2)	- 0.402(2)	38.(4) mb
²⁴ Cr			3.0(2)	1.7(1)	3.635(7)	
⁵⁰ Cr	4.345(13)	$> 1.8 \times 10^{17}$ y	15.(1)	8.(1)	- 4.5(1)	0.05(1)
⁵¹ Cr		27.70 d	$< 10.$			
⁵² Cr	83.789(18)		0.8(1)	0.6(2)	4.91(2)	8.8(4) mb
⁵³ Cr	9.501(17)		18.(2)	9.(1)	- 4.2(1)	0.06(1)
⁵⁴ Cr	2.365(7)		0.36(4)	0.25(5)	4.6(1)	7.(2) mb

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
²⁵ Mn			13.3(1)	14.0(3)	- 3.75(2)	
⁵³ Mn		3.7x10 ⁶ y	70.(10)	32.(5)		
⁵⁴ Mn		312.1 d	< 10.			
⁵⁵ Mn	100.		13.3(1)	14.0(3)	- 3.75(2)	40.(3) mb
²⁶ Fe			2.7(1)	1.4(2)	9.45(2)	
⁵⁴ Fe	5.845(35)		2.3(2)	1.3(2)	4.2(1)	29.(2) mb
⁵⁵ Fe		2.73 y	13.(2)	6.(1)		
⁵⁶ Fe	91.754(36)		$\sigma_{\alpha} = 10. \mu\text{b}$ 2.8(3)	$Rl_{\alpha} = 1.1(1) \text{ mb}$ 1.4(2)	9.93(3)	11.7(5) mb
⁵⁷ Fe	2.119(10)		1.4(2)	0.8(4)	2.3(1)	40.(4) mb
⁵⁸ Fe	0.282(4)		1.3(1)	1.3(2)	15.(7)	12.(1) mb
⁵⁹ Fe		44.51 d	13.(3)	6.(1)		
²⁷ Co			37.19(8)	74.(2)	2.49(2)	
^{58m} Co		9.1 h	1.4(1)x10 ⁵	2.5(10)x10 ⁵		
⁵⁸ Co		70.88 d	1.9(2)x10 ³	7.(1)x10 ³		
⁵⁹ Co	100.		(20.7+16.5)	(39.+35.)	2.49(2)	38.(4) mb
^{60m} Co		10.47 m	58.(3)	230.(50)		
⁶⁰ Co		5.271 y	2.0(2)	4.3(10)		
²⁸ Ni			4.5(2)	2.3(2)	10.3(1)	
⁵⁸ Ni	68.0769(89)	>4x10 ¹⁹ y	4.6(4)	2.3(2)	14.4(1)	41.(2) mb
⁵⁹ Ni		$\approx 7.6 \times 10^4$ y	$\sigma_{\alpha} < 0.03 \text{ mb}$ $\sigma_{\text{abs}} = 92.(4)$ $\sigma_{\alpha} = 14.(2)$ $\sigma_p = 2.(1)$	$Rl_{\text{abs}} = 1.4(1) \times 10^2$		
⁶⁰ Ni	26.2231(77)		2.9(3)	1.5(2)	2.8(1)	25.(1) mb
⁶¹ Ni	1.1399(6)		2.5(5)	1.5(4)	7.60(6)	82.(8) mb
⁶² Ni	3.6345(17)		15.(1)	6.8(3)	- 8.7(2)	13.(4) mb
⁶³ Ni		100. y	20.(5)	9.(2)		
⁶⁴ Ni	0.9256(9)		1.6(1)	1.2(2)	- 0.37(7)	9.(1) mb
⁶⁵ Ni		2.517 h	22.(2)	10.(1)		
²⁹ Cu			3.8(1)	4.1(4)	7.718(4)	
⁶³ Cu	69.15(15)		4.5(2)	5.(1)	6.43(15)	0.09(1)
⁶⁴ Cu		12.701 h	$\approx 270.$			
⁶⁵ Cu	30.85(15)		2.17(3)	2.2(1)	10.61(19)	41.(5) mb
⁶⁶ Cu		5.09 m	1.4(1)x10 ²	60.(20)		
³⁰ Zn			1.1(2)	2.8(4)	5.680(5)	
⁶⁴ Zn	48.27(32)	>2.3x10 ¹⁸ y	0.74(5)	1.4(3)	5.23(4)	59.(5) mb
⁶⁵ Zn		243.8 d	$\sigma_p < 12. \mu\text{b}$ $\sigma_{\alpha} = 11.(3) \mu\text{b}$ 66.(8)	30.(4)		
⁶⁶ Zn	27.977(77)		$\sigma_{\alpha} = 2.0(2)$ 0.9(3)	1.8(2)	5.98(5)	35.(3) mb
⁶⁷ Zn	4.102(21)		$\sigma_{\alpha} < 0.02 \text{ mb}$ 6.9(1.4)	25.(5)	7.58(8)	0.15(2)
			$\sigma_{\alpha} = 0.4 \text{ mb}$			

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
⁶⁶ Zn	19.02(12)		(0.072 + 0.8)	(0.2 + 2.9)	6.04(3)	19.(2) mb
			$\sigma_{\alpha} < 0.02$ mb			$\sigma_m = 3.(1)$ mb
⁷⁰ Zn	0.631(9)		(8.1+83.) mb	0.9(2)		0.02(1)
³¹ Ga			2.9(1)	22.(3)	7.288(2)	
⁶⁹ Ga	60.108(9)		1.68(7)	16.(2)	7.88(4)	0.14(1)
⁷¹ Ga	39.892(9)	>2.4x10 ²⁶ y	4.7(2)	31.(3)	6.40(3)	0.12(1)
			$\sigma_m = 0.15(5)$			
³² Ge			2.2(1)	6.(2)	8.19(2)	
⁶⁸ Ge		270.8 d	1.0(5)			
⁷⁰ Ge	20.370(89)		(0.3 + 2.7)	2.3(1)	10.0(1)	88.(5) mb
⁷² Ge	27.380(60)		0.9(2)	0.8(3)	8.5(1)	0.07(2)
⁷³ Ge	7.759(78)	>1.8x10 ²³ y	15.(1)	66.(20)	5.02(4)	0.3(1)
⁷⁴ Ge	36.656(80)		(0.14 + 0.28)	(0.4+0.5)	7.6(1)	53.(7) mb
⁷⁶ Ge	7.835(81)	1.6x10 ²¹ y	(0.09 + 0.06)	(1.3+0.6)	8.2(15)	0.03(2)
³³ As			4.0(4)	61.(5)	6.58(1)	
⁷⁵ As	100.		4.0(4)	61.(5)	6.58(1)	0.57(4)
³⁴ Se			12.(1)	14.(3)	7.970(9)	
⁷⁴ Se	0.89(4)		50.(2)	520(50)	0.8(3)	0.2(1)
⁷⁵ Se		119.78 d	3.3(10)x10 ²			
⁷⁶ Se	9.37(29)		(22. + 63.)	(9.+31.)	12.2(1)	0.16(1)
⁷⁷ Se	7.63(16)		42.(4)	30.(5)	8.25(8)	0.3(1)
			$\sigma_{\alpha} = 0.97(3)$ μ b			
⁷⁸ Se	23.77(28)		$\sigma_m = 0.38(2)$	R _m = 4.3(4)	8.24(9)	0.1
⁸⁰ Se	49.61(41)		(0.05+0.54)	(0.15+0.85)	7.48(3)	42.(3) mb
⁸² Se	8.73(22)	$\approx 1 \times 10^{20}$ y	(39.+ 5.2) mb	39.(4) mb	6.34(8)	0.04(2)
³⁵ Br			6.8(2)	92.(8)	6.79(2)	
⁷⁶ Br		16.0 h	224.(42)			
⁷⁹ Br	50.69(7)		(2.5+8.3)	(36.+96.)	6.79(7)	0.63(4)
						$\sigma_m = 0.08(1)$
⁸¹ Br	49.31(7)		(2.4+0.24)	51.(5)	6.78(7)	0.31(2)
³⁶ Kr			24.(1)	39.(6)	7.81(2)	
⁷⁸ Kr	0.353(3)	>2.3x10 ²⁰ y	(0.17+6.)	20.(1)		(0.11+0.19)
⁸⁰ Kr	2.286(10)		(4.6+7.)	57.(6)		(0.09+0.18)
⁸² Kr	11.593(3)		(14.+7.)	130.(13)		90.(6) mb
⁸³ Kr	11.500(19)		183.(30)	183.(20)		0.24(2)
⁸⁴ Kr	56.987(15)		($\sigma_m + \sigma_p$) = 0.11	2.4(3)		(16.+33.) mb
			$\sigma_m = 0.09$			
⁸⁵ Kr		10.73 y	1.7(2)	1.8(10)		0.07(2)
⁸⁶ Kr	17.279(41)		3.(2) mb	$\approx 1.$ mb	8.1(3)	3.2(4) mb
³⁷ Rb			0.39(4)	6.(3)	7.08(2)	
⁸⁴ Rb		32.9 d	$\sigma_0 = 12.(2)$			
⁸⁵ Rb	72.17(2)		(0.06+0.38)	(0.7+7.)	7.0(1)	0.24(1)
⁸⁶ Rb		18.65 d	<20.			
⁸⁷ Rb	27.83(2)	4.88x10 ¹⁰ y	0.10(1)	2.3(4)	7.3(1)	16.(1) mb
⁸⁸ Rb		17.7 m	1.2(3)	0.5(1)		

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
³⁸ Sr			1.2(1)	10.(1)	7.02(2)	
⁸⁴ Sr	0.56(1)		(0.6+0.2)	(9.+1.)		0.4(1)
⁸⁶ Sr	9.86(1)		$\sigma_m = 0.81(4)$	$Rl_m = 4.(1)$	5.68(5)	(48.+22.) mb
⁸⁷ Sr	7.00(1)		16.(3)	118.(30)	7.41(7)	97.(5) mb
⁸⁸ Sr	82.58(1)		5.8(4) mb	0.07(3)	7.16(6)	6.0(2) mb
⁸⁹ Sr		50.52 d	0.42(4)	0.2		
⁹⁰ Sr		29.1 y	10.(1) mb	0.10(2)		
³⁹ Y			1.25(5)	1.0(1)	7.75(2)	
⁸⁹ Y	100.		(0.001+1.25)	(0.006+1.0)	7.75(2)	19.(1) mb
⁹⁰ Y		2.67 d	<6.5			
⁹¹ Y		58.5 d	1.4(3)	0.6(1)		
⁴⁰ Zr			0.19(1)	0.95(9)	7.16(3)	
			$\sigma_\alpha < 0.1$ mb			
⁹⁰ Zr	51.45(40)		≈ 0.014	0.2(1)	6.4(1)	21.(2) mb
⁹¹ Zr	11.22(5)		1.2(3)	5.(2)	8.8(1)	60.(8) mb
⁹² Zr	17.15(8)		0.2(1)	0.6(2)	7.5(2)	33.(4) mb
⁹³ Zr		1.5x10 ⁶ y	<4.	16.(5)		0.10(1)
⁹⁴ Zr	17.38(28)	>10 ¹⁷ y	0.049(6)	0.25(3)	8.3(2)	26.(1) mb
⁹⁶ Zr	2.80(9)	>1.7x10 ¹⁸ y	0.020(3)	5.0(5)	5.5(1)	11.(1) mb
⁴¹ Nb			1.11(1)	8.5(6)	7.14(3)	
			$\sigma_\alpha < 0.1$ mb			
⁹³ Nb	100.		1.1	(6.3+2.2)	7.14(3)	266.(5) mb
			$\sigma_m = 0.86$			
⁹⁴ Nb		2.4x10 ⁴ y	($\sigma_m + \sigma_p$) = 15.(1)	126.(13)		
			$\sigma_m = 0.6(1)$			
⁹⁵ Nb		34.97 d	<7.	<200.		
⁴² Mo			2.5(1)	26.(5)	6.72(2)	
			$\sigma_\alpha < 0.1$ mb			
⁹² Mo	14.77(31)	>3x10 ¹⁷ y	0.06	≈ 0.8	6.93(8)	0.07(1)
			$\sigma_m = 0.2 \mu\text{b}$			
⁹⁴ Mo	9.226(99)		0.02	≈ 0.8	6.82(7)	0.10(2)
⁹⁵ Mo	15.900(85)		13.4(3)	109.(5)	6.93(6)	0.29(1)
			$\sigma_\alpha = 30.(4) \mu\text{b}$			
⁹⁶ Mo	16.674(12)		0.5	17.(3)	6.22(6)	0.11(1)
⁹⁷ Mo	9.560(50)		2.5(2)	14.(3)	7.26(8)	0.34(1)
			$\sigma_\alpha = 0.4(2) \mu\text{b}$			
⁹⁸ Mo	24.20(25)		0.14(1)	7.2(7)	6.60(7)	0.10(1)
¹⁰⁰ Mo	9.67(20)	$\approx 1 \times 10^{19}$ y	0.19(1)	3.6(3)	6.75(7)	0.11(1)
⁴³ Tc						
⁹⁸ Tc		$\approx 6.6 \times 10^6$ y	$\sigma_m = 0.9(2)$			
⁹⁹ Tc		2.13x10 ⁵ y	23.(2)	4.0(4)x10 ²	6.8(3)	0.93(5)
⁴⁴ Ru			2.6 (1)	48.(5)	7.03(3)	
⁹⁶ Ru	5.54(14)	>3.1x10 ¹⁶ y	0.23(4)	7.(2)		0.21(1)
⁹⁸ Ru	1.87(3)		< 8.			0.3(1)
⁹⁹ Ru	12.76(14)		4.(1)	195.(20)		1.2(3)
¹⁰⁰ Ru	12.60(7)		5.8(6)	11.(2)		0.21(1)

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
¹⁰¹ Ru	17.06(2)		5.(1)	1.1(3)x10 ²		1.00(4)
			$\sigma_{\alpha} < 0.15 \mu\text{b}$			
¹⁰² Ru	31.55(14)		1.2(1)	4.3(5)		0.15(1)
¹⁰³ Ru		39.27 d	<20.	$\approx 30.$		
¹⁰⁴ Ru	18.62(27)		0.49(2)	6.(2)		0.15(1)
¹⁰⁵ Ru		4.44 h	0.29(3)	0.13(1)		
¹⁰⁶ Ru		1.020 y	0.15(4)	2.0(6)		
₄₅ Rh			145.(2)	1.2(1)x10 ³	5.88(4)	
¹⁰³ Rh	100.		(11.+134.)	(0.08+1.1)x10 ³	5.88(4)	0.81(1)
^{104m} Rh		4.36 m	800.(100)			
¹⁰⁴ Rh		42.3 s	40.(30)			
¹⁰⁵ Rh		35.4 h	1.1(3)x10 ⁴	1.7(4)x10 ⁴		
₄₆ Pd			7.(1)	82.(8)	5.91(6)	
¹⁰² Pd	1.02(1)		3.2(10)	10.(2)		0.3(1)
¹⁰⁴ Pd	11.14(8)			16.(2)		0.29(3)
¹⁰⁵ Pd	22.33(8)		22.(2)	60.(20)	5.5(3)	1.20(6)
			$\sigma_{\alpha} = 0.5(2) \mu\text{b}$			
¹⁰⁶ Pd	27.33(3)		(0.013+0.28)	(0.2+5.5)	6.4(4)	0.25(3)
¹⁰⁷ Pd		6.5x10 ⁶ y	1.8(2)	108.(4)		1.34(6)
¹⁰⁸ Pd	26.46(9)		(0.19+8.5)	(2.+240.)	4.1(3)	0.20(2)
¹¹⁰ Pd	11.72(9)		(0.033+0.7)	(0.7+8.)		0.15(2)
₄₇ Ag			62.(1)	767.(60)	5.922(7)	
¹⁰⁷ Ag	51.839(8)		(1.+35.)	(3.+105.)	7.56(1)	0.80(3)
¹⁰⁹ Ag	48.161(8)		(4.1 + 87.)	(0.7+14.1)x10 ²	4.17(1)	0.79(3)
^{110m} Ag		249.8 d	82.(11)	20.(4)		
¹¹¹ Ag		7.47 d	3.(2)	105.(20)		
₄₈ Cd			2.52(5)x10 ³	73.(8)	4.87(5)	
¹⁰⁶ Cd	1.25(6)	>2.6x10 ¹⁷ y	0.20(3)	4.(1)		0.30(2)
¹⁰⁸ Cd	0.89(3)	>4.1x10 ¹⁷ y	1.	14.(3)	5.4(1)	0.20(1)
¹⁰⁹ Cd		462.0 d	$\approx 180.$	6.7(12)x10 ³		
			$\sigma_{\alpha} < 0.05$			
¹¹⁰ Cd	12.49(18)		(0.06+11.)	(6.+34.)	5.9(1)	(0.01+0.22)
¹¹¹ Cd	12.80(12)		3.5(20)	51.(6)	6.5(1)	0.75(1)
¹¹² Cd	24.13(21)		(0.012+2.2)	15.	6.4(1)	0.19(1)
¹¹³ Cd	12.22(12)	7.7x10 ¹⁵ y	2.06(4)x10 ⁴	390.(40)	- 8.0(2)	0.67(1)
			$\sigma_{\alpha} < 1. \mu\text{b}$			
¹¹⁴ Cd	28.73(42)		(0.04+0.29)	16.(7)	7.5(1)	(0.01+0.12)
¹¹⁶ Cd	7.49(18)	3.8x10 ¹⁹ y	(26.+52.) mb	1.2	6.3(1)	(12.+47.) mb
₄₉ In			197.(4)	3.3(2)x10 ³	4.07(2)	
¹¹³ In	4.29(5)		(3.1+5.0+3.9)	(220.+90.)	5.39(6)	(0.48+0.31)
¹¹⁵ In	95.71(5)	4.4x10 ¹⁴ y	(88.+73.+44.)	(1.5+1.2+0.7)x10 ³	4.01(2)	(0.69+0.02)
₅₀ Sn			0.61(3)	8.(2)	6.225(2)	
¹¹² Sn	0.97(1)		(0.15+0.40)	(8.+19.)		0.21(1)
¹¹³ Sn		115.1 d	$\approx 9.$	210.(50)		
¹¹⁴ Sn	0.66(1)		≈ 0.12	5.(1)	6.2(3)	134.(3) mb
¹¹⁵ Sn	0.34(1)		$\sigma_{\alpha} = 0.06 \text{ mb}$	29.(6)		0.34(1)
¹¹⁶ Sn	14.54(9)		(0.006+0.14)	(0.5+11.)	5.93(5)	91.(2) mb
¹¹⁷ Sn	7.68(7)		1.1(1)	16.(5)	6.48(5)	319.(7) mb

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
¹¹⁸ Sn	24.22(9)		$\sigma_m = 4. \text{ mb}$	4.7(5)	6.07(5)	62.(1) mb
¹¹⁹ Sn	8.59(4)		2.(1)	2.9(5)	6.12(5)	0.18(1)
¹²⁰ Sn	32.58(9)		(0.001+0.13)	1.2(3)	6.49(5)	(0.5+36.) mb
¹²² Sn	4.63(3)		(0.15+0.001)	0.81(4)	5.74(5)	(18.+4.) mb
¹²⁴ Sn	5.79(5)	>2.2x10 ¹⁸ y	(0.13+0.004)	(8.0+0.08)	5.97(5)	12.(2) mb
⁵¹ Sb			5.2(2)	169.(20)	5.57(3)	
¹²¹ Sb	57.21(5)		(0.4+5.8)	(13.+192.)	5.71(6)	0.53(2)
¹²³ Sb	42.79(5)		(0.02+0.04+4.0)	(1.+119.)	5.38(7)	0.30(1)
¹²⁴ Sb		60.20 d	17.(3)	≈ 8.		
⁵² Te			4.2(1)	47.(3)	5.80(3)	
¹²⁰ Te	0.09(1)		(1.+5.)	≈ 1.	5.3(5)	0.4(1)
¹²² Te	2.55(12)		(0.4+3.)	(5.+75.)	3.8(2)	295.(3) mb
¹²³ Te	0.89(3)	>5.3x10 ¹⁶ y	370.(40)	4.5(3)x10 ³	- 0.05	0.83(1)
			$\sigma_\alpha = 0.05 \text{ mb}$			
¹²⁴ Te	4.74(14)		(1.+6.)	(1.4+4.)	8.0(1)	155.(2) mb
¹²⁵ Te	7.07(15)		1.1(2)	21.(4)	5.02(8)	431.(4) mb
¹²⁶ Te	18.84(25)		(0.12+0.8)	(0.6+7.4)	5.56(7)	(28.+53.) mb
¹²⁸ Te	31.74(8)	2.2x10 ²⁴ y	(0.03+0.2)	(0.2+1.6)	5.89(7)	(3.+41.) mb
¹³⁰ Te	34.08(62)	8.x10 ²⁰ y	(0.01+0.19)	(0.03+0.3)	6.02(7)	(4.+11.) mb
⁵³ I			6.2(1)	1.5(1)x10 ²	5.28(2)	
¹²⁵ I		59.4 d	900.(100)	1.4(2)x10 ⁴		
¹²⁷ I	100.		6.2(1)	1.5(1)x10 ²	5.28(2)	0.64(3)
¹²⁸ I		25.00 m	22.(4)	≈ 10.		
¹²⁹ I		1.7x10 ⁷ y	(20.7+10.3)	36.(4)		0.44(2)
¹³⁰ I		12.36 h	18.(3)	≈ 8.		
¹³¹ I		8.021 d	≈ 0.7	8.(4)		
⁵⁴ Xe			25.(1)	263.(50)	4.92(3)	
¹²⁴ Xe	0.0953(27)	>10 ¹⁷ y	(28.+137.)	(0.6+3.0)x10 ³		(0.13+0.51)
¹²⁵ Xe		17.1 h	$\sigma_\alpha < 0.03$			
¹²⁶ Xe	0.0890(14)		(0.45+3.)	(8.+52.)		(0.04+0.32)
¹²⁷ Xe		36.34 d	$\sigma_\alpha \leq 0.01$			
¹²⁸ Xe	1.910(22)		$\sigma_m = 0.48$	R _m = 38.(10)		0.26(1)
¹²⁹ Xe	26.40(18)		22.(5)	250.(50)		0.62(2)
¹³⁰ Xe	4.071(53)		$\sigma_m = 0.45$	R _m = 16.(4)		0.132(3)
¹³¹ Xe	21.233(62)		90.(10)	9.(1)x10 ²		0.45(8)
¹³² Xe	26.9087(680)		(0.05+0.4)	(0.9+3.7)		(5.+60.) mb
¹³³ Xe		5.243 d	190.(90)			
¹³⁴ Xe	10.436(29)	>1.1x10 ¹⁶ y	(0.003 + 0.26)	0.40(4)		20.(2) mb
¹³⁵ Xe		9.10 h	2.65(11)x10 ⁵	7.6(5)x10 ³		
¹³⁶ Xe	8.858(33)	>8x10 ²⁰ y	0.26(2)	0.7(2)		0.9(1) mb
⁵⁵ Cs			30.4(8)	422.(50)	5.42(2)	
¹³² Cs		6.48 d	$\sigma_\alpha < 0.15$			
¹³³ Cs	100.		(2.7+27.3)	(32.+360.)	5.42(2)	(0.04+0.47)
¹³⁴ Cs		2.065 y	140.(10)	54.(9)		
¹³⁵ Cs		2.3x10 ⁶ y	8.3(3)	38.(3)		
¹³⁷ Cs		30.2 y	(0.20+0.07)	0.36(7)		
⁵⁶ Ba			1.3(2)	10.(2)	5.07(3)	
¹³⁰ Ba	0.106(1)	2.2x10 ²¹ y	(1.+8.)	(25.+200.)	- 3.6(6)	0.76(11)

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
¹³² Ba	0.101(1)	1.3x10 ²¹ y	(0.84+9.7)	(4.7+24.)	7.8(3)	0.6(1)
¹³³ Ba		10.53 y	4.(1)	85.(30)		
¹³⁴ Ba	2.417(18)		(0.1+1.3)	(5.6+18.)	5.7(1)	0.18(1)
¹³⁵ Ba	6.592(12)		(0.014+5.8)	(0.47+131.)	4.7(1)	0.46(2)
¹³⁶ Ba	7.854(24)		(0.010+0.44)	(0.1+1.5)	4.91(8)	61.(2) mb
¹³⁷ Ba	11.232(24)		5.(1)	4.(1)	6.8(1)	76.(3) mb
¹³⁸ Ba	71.698(42)		0.41(2)	0.4(1)	4.84(8)	4.0(2) mb
¹³⁹ Ba		1.396 h	5.(1)	2.2(5)		
¹⁴⁰ Ba		12.75 d	1.6(3)	14.(1)		
⁵⁷ La			9.2(2)	12.(1)	8.24(4)	
¹³⁸ La	0.090(1)	1.06x10 ¹¹ y	57.(6)	4.1(9)x10 ²		
¹³⁹ La	99.910(1)		9.2(2)	12.(1)	8.24(4)	38.(3) mb
¹⁴⁰ La		1.678 d	2.7(3)	69.(4)		
⁵⁸ Ce			0.64(4)	0.71(6)	4.84(2)	
¹³⁶ Ce	0.185(2)		(1.0+6.5)	58.(12)	5.80(9)	(0.028+0.3)
¹³⁸ Ce	0.251(2)		(0.025+1.0)	(1.5+5.2)	6.70(9)	179.(5) mb
¹⁴⁰ Ce	88.450(51)		0.58(4)	0.50(5)	4.84(9)	11.0(4) mb
¹⁴¹ Ce		32.50 d	29.(3)	13.(2)		
¹⁴² Ce	11.114(51)	>1.6x10 ¹⁷ y	0.97(3)	1.3(3)	4.75(9)	28.(1) mb
¹⁴³ Ce		1.38 d	6.1(7)	2.7(3)		
¹⁴⁴ Ce		284.6 d	1.0(1)	2.6(3)		
⁵⁹ Pr			11.5(4)	14.(3)	4.58(5)	
¹⁴¹ Pr	100.		(4.+7.5)	14.(3)	4.58(5)	111.(2) mb
¹⁴² Pr		19.12 h	20.(3)	9.(1)		
¹⁴³ Pr		13.57 d	90.(10)	190.(25)		
⁶⁰ Nd			51.(2)	49.(5)	7.69(5)	
¹⁴² Nd	27.2(5)		19.(1)	34.(11)	7.7(3)	35.(1) mb
¹⁴³ Nd	12.2(2)		330.(10)	128.(30)		0.24(1)
			$\sigma_{\alpha} = 17. \text{ mb}$			
¹⁴⁴ Nd	23.8(3)	2.1x10 ¹⁵ y	3.6(3)	3.9(5)	2.8(3)	81.(2) mb
¹⁴⁵ Nd	8.3(1)		47.(6)	260.(40)		0.42(1)
			$\sigma_{\alpha} = 12. \mu\text{b}$			
¹⁴⁶ Nd	17.2(3)		1.5(2)	3.0(4)	8.7(2)	91.(1) mb
¹⁴⁷ Nd		10.98 d	440.(150)	200.		
¹⁴⁸ Nd	5.7(1)		2.4(1)	13.(2)	5.7(3)	147.(2) mb
¹⁵⁰ Nd	5.6(2)	$\approx 1 \times 10^{19}$ y	1.0(1)	14.(2)	5.3(2)	0.16(1)
⁶¹ Pm						
¹⁴⁶ Pm		5.53 y	8.4(1.7)x10 ³			
¹⁴⁷ Pm		2.623 y	(84+96.)	(1000.+1280.)	12.6(4)	2.(1)
^{148m} Pm		41.3 d	10600.(800)			
¹⁴⁸ Pm		5.37 d	$\approx 10^3$	2.6(2.4)x10 ³		
¹⁴⁹ Pm		2.212 d	1400.(200)			
¹⁵¹ Pm		1.183 d	$\approx 150.$			
⁶² Sm			5.6(1)x10 ³	1.4(2)x10 ³		
¹⁴⁴ Sm	3.07(7)		1.6(1)	2.4(3)		92.(6) mb
¹⁴⁵ Sm		340. d	280.(20)	600.(90)		
¹⁴⁷ Sm	14.99(18)	1.06x10 ¹¹ y	56.(4), $\sigma_{\alpha} = 0.6 \text{ mb}$	710.(50)	14.(3)	0.97(1)
¹⁴⁸ Sm	11.24(10)	7x10 ¹⁵ y	2.4(6)	27.(14)		241.(2) mb

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
¹⁴⁹ Sm	13.82(7)	10 ¹⁶ y	4.01(6)x10 ⁴ , σ_{α} = 31. mb	3.1(5)x10 ³		1.82(2)
¹⁵⁰ Sm	7.38(1)		102.(5)	290.(30)	14.(3)	422.(4) mb
¹⁵¹ Sm		90. y	1.52(3)x10 ⁴	3520.(60)		2.(1)
¹⁵² Sm	26.75(16)		206.(15)	3.0(3)x10 ³	- 5.0(6)	473.(4) mb
¹⁵³ Sm		1.929 d	420.(180)			
¹⁵⁴ Sm	22.75(29)		7.5(3)	32.(6)	9.(1)	0.21(1)
⁶³ Eu			4570.(100)	3.8(5)x10 ³	5.3(3)	
¹⁵¹ Eu	47.81(6)		(4.+3150.+6000.) σ_{α} = 8.7(3) μ b	(2.+4.)x10 ³		(1.6+2.2)
^{152m1} Eu		9.30 h	6.8(15)x10 ⁴	< 10 ⁵		
¹⁵² Eu		13.5 y	1.1(2)x10 ⁴	1.6(2)x10 ³		5.(2)
¹⁵³ Eu	52.19(6)		300.(20), σ_{α} <1. μ b	1.8(4)x10 ³	8.2(1)	2.8(1)
¹⁵⁴ Eu		8.59 y	1.5(3)x10 ³	1.6(2)x10 ³		4.4(7)
¹⁵⁵ Eu		4.76 y	3.9(2)x10 ³	1.6(2)x10 ⁴		1.3(1)
⁶⁴ Gd			48.8(6)x10 ³	400.(10)	9.5(2)	
¹⁴⁸ Gd		75. y	1.40(14)x10 ⁴			
¹⁵² Gd	0.20(1)	1.1x10 ¹⁴ y	700.(200), σ_{α} <7. mb	700.(200)		1.05(2)
¹⁵³ Gd		240. d	2.(1)x10 ⁴ , σ_{α} = 0.03			
¹⁵⁴ Gd	2.18(3)		(0.035+60.)	230.(50)		1.03(1)
¹⁵⁵ Gd	14.80(12)		61.(1)x10 ³ , σ_{α} = .08 mb	1540.(100)		2.65(3)
¹⁵⁶ Gd	20.47(9)		\approx 2.0	104.(15)	6.3(4)	615.(5) mb
¹⁵⁷ Gd	15.65(2)		2.54(3)x10 ³ , σ_{α} <0.05	800.(100)		1.37(2)
¹⁵⁸ Gd	24.84(7)		2.3(3)	73.(7)	9.(2)	324.(3) mb
¹⁶⁰ Gd	21.86(19)	>1.9x10 ¹⁹ y	1.5(7)	6.(1)	9.15(5)	0.15(2)
¹⁶¹ Gd		3.66 m	2.0(6)x10 ⁴			
⁶⁵ Tb			23.2(5)	420.(50)	7.34(2)	
¹⁵⁹ Tb	100.		23.2(5)	420.(50)	7.34(2)	1.6(2)
¹⁶⁰ Tb		72.3 d	570.(110)			
⁶⁶ Dy			9.5(2)x10 ²	1.5(2)x10 ³	16.9(3)	
¹⁵⁶ Dy	0.056(3)		33.(3), σ_{α} < 9. mb	1000.(100)		1.6(2)
¹⁵⁸ Dy	0.095(3)		43.(6), σ_{α} < 6. mb	120.(10)	6.1(5)	0.8(2)
¹⁵⁹ Dy		144. d	8.(2)x10 ³			
¹⁶⁰ Dy	2.39(18)		60.(10), σ_{α} < 0.3 mb	1100.(200)	6.7(4)	0.89(1)
¹⁶¹ Dy	18.889(42)		600.(50), σ_{α} < 1. μ b	1100.(100)	10.3(4)	1.96(2)
¹⁶² Dy	25.475(36)		170.(20)	2755.(300)	- 1.4(5)	446.(4) mb
¹⁶³ Dy	24.896(42)		120.(10), σ_{α} < 20. μ b	1600.(400)	5.0(4)	1.11(1)
¹⁶⁴ Dy	28.260(54)		(1.7+1.0)x10 ³	(4.+2.)x10 ²	49.4(2)	212.(3) mb
^{165m} Dy		1.26 m	2.0(6)x10 ³			
¹⁶⁵ Dy		2.33 h	3.5(3)x10 ³	2.2(3)x10 ⁴		
⁶⁷ Ho			61.(2)	670.(40)	8.01(8)	
¹⁶³ Ho		4.57x10 ³ y				(0.4+1.7)
¹⁶⁵ Ho	100.		(3.1+58.), σ_{α} < 20. μ b	(?+670.)	8.01(8)	(0.8+0.5)
^{166m} Ho		1.2x10 ³ y	3.1(8)x10 ³	10.(3)x10 ³		
⁶⁸ Er			1.5(2)x10 ²	730.(10)	7.79(2)	
¹⁶² Er	0.139(5)		19.(3), σ_{α} < 11. mb	480.(50)	8.8(2)	1.6(1)
¹⁶⁴ Er	1.601(3)		13.(3), σ_{α} < 1.2 mb	105.(10)	8.2(2)	1.08(5)
¹⁶⁶ Er	33.503(36)		(3.+14.), σ_{α} < 70. μ b	96.(12)	10.6(2)	0.56(6)
¹⁶⁷ Er	22.869(9)		6.5(8)x10 ² , σ_{α} = 3. μ b	2970.(70)	3.0(3)	1.4(2)

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
¹⁶⁸ Er	26.978(18)		2.3(3), $\sigma_{\alpha} = 0.09$ mb	37.(5)	7.4(4)	0.34(4)
¹⁷⁰ Er	14.910(36)		8.(2)	26.(4)	9.6(5)	0.17(1)
¹⁷¹ Er		7.52 h	370.(40)	170.(20)		
⁶⁹ Tm			108.(4)	1.5(2)x10 ³	7.07(3)	
¹⁶⁹ Tm	100		(8.+100.)	1.5(2)x10 ³	7.07(3)	1.13(6)
¹⁷⁰ Tm		128.6 d	100.(20)	460.(50)		
¹⁷¹ Tm		1.92 y	≈ 160.	118.(6)		
⁷⁰ Yb			52.(10)	1.7(2)x10 ²	12.43(3)	
¹⁶⁸ Yb	0.13(1)		2.4(2)x10 ³ , $\sigma_{\alpha} < 0.1$ mb	2.0(5)x10 ⁴	-4.07(2)	0.7(4)
¹⁶⁹ Yb		32.02 d	3.6(3)x10 ³	5200.(500)		
¹⁷⁰ Yb	3.04(15)		12.(2), $\sigma_{\alpha} < 10$. μ b	320.(30)	6.8(1)	0.77(1)
¹⁷¹ Yb	14.28(57)		53.(5), $\sigma_{\alpha} < 1.5$ μ b	315.(30)	9.7(1)	1.21(1)
¹⁷² Yb	21.83(67)		≈ 1.3, $\sigma_{\alpha} < 1$. μ b	25.(3)	9.4(1)	0.34(1)
¹⁷³ Yb	16.13(27)		16.(2), $\sigma_{\alpha} < 1$. μ b	380.(30)	9.56(7)	0.75(1)
¹⁷⁴ Yb	31.83(92)		(46.+17.), $\sigma_{\alpha} < 0.02$ mb	(13.+16.)	19.3(1)	151.(2) mb
¹⁷⁶ Yb	12.76(41)		3.1(2), $\sigma_{\alpha} < 1$. μ b	8.(2)	8.7(1)	116.(2) mb
⁷¹ Lu			78.(7)	8.3(7)x10 ²	7.21(3)	
¹⁷⁵ Lu	97.41(2)		(16.+8.)	(550.+270.)	7.24(3)	(1.04+0.11)
¹⁷⁶ Lu	2.59(2)	3.73x10 ¹⁰ y	(2.+2100.)	(3.+930.)	6.1(2)	1.53(7)
^{177m} Lu		160.7 d	3.2(3)	1.4(2)		
¹⁷⁷ Lu		6.65 d	1000.(300)			
⁷² Hf			106.(3)	19.7(5)x10 ²	7.8(1)	
¹⁷⁴ Hf	0.16(1)	2.0x10 ¹⁵ y	600.(50)	400.(50)	11.(1)	0.8(2)
¹⁷⁶ Hf	5.26(7)		23.(4)	700.(100)	6.6(2)	0.46(2)
¹⁷⁷ Hf	18.60(9)		(1.+375.), $\sigma_{\alpha} < 20$. μ b	7170.(200)		1.5(1)
^{178m2} Hf		31. y	$\sigma_{m2} = 45$.(5)	$R_{m2} = 8$ (1)x10 ²		
¹⁷⁸ Hf	27.28(7)		(54.+32.)	(0.9+1.0)x10 ³	5.9(2)	0.31(1)
¹⁷⁹ Hf	13.62(2)		(0.43+46.)	(6.8+620.)	7.5(2)	(0.01+0.95)
¹⁸⁰ Hf	35.08(16)		13.0(5), $\sigma_{\alpha} < 13$. μ b	32.(1)	13.2(3)	179.(5) mb
¹⁸¹ Hf		42.4 d	30.(25)			
⁷³ Ta			20.(1)	650(20.)	6.91(7)	
¹⁷⁹ Ta		1.8 y	9.3(6)x10 ²	1.22(7)x10 ³		
^{180m} Ta	0.012(2)	> 1.2x10 ¹⁵ y	≈ 560.	1350.(100)		
¹⁸¹ Ta	99.988(2)		(0.012 + 20.), $\sigma_{\alpha} < 1$. μ b	(0.4+650.)	6.91(7)	0.77(2)
¹⁸² Ta		114.43 d	8200.(600)	900.(90)		
⁷⁴ W			18.(1)	3.6(3)x10 ²	4.86(2)	
¹⁸⁰ W	0.12(1)	7.4x10 ¹⁶ y	≈ 4.	210.(30)		0.54(6)
¹⁸² W	26.50(16)	8.3x10 ¹⁸ y	20.(1)	600.(90)	6.97(4)	274.(8) mb
¹⁸³ W	14.31(4)	1.9x10 ¹⁸ y	10.5(3)	340.(50)	6.53(4)	0.52(2)
¹⁸⁴ W	30.64(2)	4.0x10 ¹⁸ y	(0.002 + 2.0)	15.(2)	7.48(6)	0.22(1)
¹⁸⁵ W		74.8 d	≈ 3.3	300.(50)		
¹⁸⁶ W	28.43(19)	6.5x10 ¹⁸ y	37.(2)	510.(50)	- 0.72(4)	176.(5) mb
¹⁸⁷ W		23.9 h	70.(10)	2760.(550)		
¹⁸⁸ W		69.78 h	12.(1)			
⁷⁵ Re			90.(4)	8.4(2)x10 ²	9.2(3)	
¹⁸⁵ Re	37.40(2)		(0.33+110.)	1700.(50)	9.0(3)	1.54(6)

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
¹⁸⁷ Re	62.60(2)	4.2x10 ¹⁰ y	(2.+72.)	(9.+310.)	9.3(3)	1.16(6)
⁷⁶ Os			17.(1)	1.5(1)x10 ²	10.7(2)	
¹⁸⁴ Os	0.02(1)	>5.6x10 ¹³ y	3.3(3)x10 ³ , σ_{α} < 10. mb	1.4(1)x10 ³		0.4(2)
¹⁸⁶ Os	1.59(3)	2.x10 ¹⁵ y	\approx 80., σ_{α} < 0.1 mb	3.8(9)x10 ²	12(2)	0.42(2)
¹⁸⁷ Os	1.96(2)		2.(1)x10 ² , σ_{α} < 0.1 mb	5.0(7)x10 ²		0.90(3)
¹⁸⁸ Os	13.24(8)		\approx 5., σ_{α} < 30. μ b	1.5(2)x10 ²	7.6(3)	0.40(2)
¹⁸⁹ Os	16.15(5)		(0.00026+40.), σ_{α} < 10. μ b	(0.013+670.)	10.7(3)	1.17(5)
¹⁹⁰ Os	26.26(2)		(9.+4.), σ_{α} < 20. μ b	(22.+8.)	11.0(3)	0.30(5)
¹⁹¹ Os		15.4 d	3.8(6)x10 ²	1.7(3)x10 ²		
¹⁹² Os	40.78(19)		3.(1), σ_{α} < 10. μ b	7.(1)	11.5(4)	0.31(5)
¹⁹³ Os		30.5 h	2.5(5)x10 ²	1.1(2)x10 ²		
⁷⁷ Ir			4.2(1)x10 ²	2.8(4)x10 ³	10.6(3)	
¹⁹¹ Ir	37.3(2)		(0.14+660.+260.)	(1.0+4.2)x10 ³		1.35(4)
¹⁹² Ir		73.83 d	1.4(3)x10 ³	4.8(7)x10 ³		
¹⁹³ Ir	62.7(2)		(0.04+6.+109.)	1.4(2)x10 ³		0.99(7)
¹⁹⁴ Ir		19.3 h	1.6(3)x10 ³	7.(2)x10 ²		
⁷⁸ Pt			10.(1)	1.3(1)x10 ²	9.60(1)	
¹⁹⁰ Pt	0.014(1)	4.5x10 ¹¹ y	1.5(1)x10 ² , σ_{α} < 8. mb	70.(10)	9.(1)	0.7(2)
¹⁹² Pt	0.782(7)		(2.0+6.), σ_{α} < 0.2 mb	115.(20)	9.9(5)	0.6(1)
¹⁹⁴ Pt	32.967(99)		(0.1+1.1), σ_{α} < 5. μ b	(4.+?)	10.55(8)	(0.03+0.34)
¹⁹⁵ Pt	33.832(10)		28.(1), σ_{α} < 5. μ b	365.(50)	8.8(1)	0.9(2)
¹⁹⁶ Pt	25.242(41)		(0.045+0.55)	7.(2)	9.89(8)	(0.01+0.19)
¹⁹⁸ Pt	7.163(55)		(0.3+3.1)	(5.+53.)	7.8(1)	(3.+79.) mb
¹⁹⁹ Pt		30.8 m	\approx 15.	\approx 7.		
⁷⁹ Au			98.7(1)	1.55(3)x10 ³	7.63(6)	
¹⁹⁷ Au	100.		σ_{m+g} = 98.7(1) σ_m = 8.(2) mb	R_{m+g} = 1.55(3)x10 ³ R_m = 0.06(2)	7.63(6)	582.(9) mb
¹⁹⁸ Au		2.695 d	26.5(15)x10 ³	\approx 4.x10 ⁴		
¹⁹⁹ Au		3.14 d	\approx 30.			
⁸⁰ Hg			3.7(1)x10 ²	87.(5)	12.69(2)	
¹⁹⁶ Hg	0.15(1)	>2.5x10 ¹⁸ y	(105.+3000.)	(53.+410.)	30.(1)	0.4(2)
¹⁹⁸ Hg	9.97(8)		(0.017+2.)	(1.7+70.)		0.17(2)
¹⁹⁹ Hg	16.87(10)		2.1(2)x10 ³	435(20)	16.9(4)	0.37(2)
²⁰⁰ Hg	23.10(16)		\approx 1.	2.1(5)		0.12(1)
²⁰¹ Hg	13.18(8)		\approx 8.	30.(3)		0.26(1)
²⁰² Hg	29.86(20)		4.9(5)	4.5(2)	11.(1)	74.(6) mb
²⁰⁴ Hg	6.87(4)		0.4(1)	0.8(2)		42.(4) mb
⁸¹ Tl			3.3(1)	12.5(8)	8.776(5)	
²⁰³ Tl	29.524(14)		11.(1), σ_{α} < 0.3 mb	41.(2)	7.0(2)	124.(8) mb
²⁰⁴ Tl		3.78 y	22.(2)	90.(20)		0.14(5)
²⁰⁵ Tl	70.476(14)		0.11(2)	0.6(2)	9.52(7)	54.(4) mb
⁸² Pb			0.172(2)	0.14(4)	9.402(2)	
²⁰⁴ Pb	1.4(1)		0.68(7)	2.0(2)	10.9(1)	90.(6) mb
²⁰⁵ Pb		1.51x10 ⁷ y	\approx 5.	\approx 2.		0.06(1)
²⁰⁶ Pb	24.1(1)		0.027(1)	0.10(1)	9.23(5)	16.(1) mb
²⁰⁷ Pb	22.1(1)		0.61(3)	0.38(1)	9.28(2)	10.(1) mb

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
²⁰⁸ Pb	52.4(1)	>2x10 ¹⁹ y	0.23(1) mb, σ_{α} < 8. μ b	2.0(2) mb	9.50(3)	0.36(4) mb
²¹⁰ Pb		22.6 y	< 0.5			
⁸³ Bi			0.034(1)	0.19(2)	8.532(2)	
²⁰⁹ Bi	100.		(11.+23.) mb, σ_{α} < 0.3 μ b	0.19(2)	8.532(2)	2.7(5) mb
^{210m} Bi		3.0x10 ⁶ y	54.(4) mb	0.20(3)		
⁸⁴ Po						
²¹⁰ Po		138.4 d	σ_m < 0.5 mb, σ_{α} < 2. mb σ_g < 30. mb, σ_f < 0.1			
⁸⁵ At						
⁸⁶ Rn						
²²⁰ Rn		55.6 s	< 0.2			
²²² Rn		3.823 d	0.74(5)			
⁸⁸ Ra						
²²³ Ra		11.43 d	1.3(2)x10 ² , σ_f < 0.7			
²²⁴ Ra		3.66 d	12.0(5)			
²²⁶ Ra		1599. y	\approx 13., σ_f < 7. μ b	280.(50)	10.(1)	
²²⁸ Ra		5.76 y	36.(5), σ_f < 2.			
⁸⁹ Ac						
²²⁷ Ac		21.77 y	8.8(7)x10 ² , σ_f < 0.35 mb	1.5(4)x10 ³		
⁹⁰ Th			7.4	85.(3)	10.31(3)	
²²⁷ Th		18.72 d	$\sigma_f = 2.0(2)$ x10 ²			
²²⁸ Th		1.913 y	1.2(2)x10 ² , σ_f < 0.3	1014.(400)		
²²⁹ Th		7.9x10 ³ y	\approx 60. $\sigma_f = 30.$ (3)	1.0(2)x10 ³ R _I = 466.(75)		
²³⁰ Th		7.54x10 ⁴ y	23.4(5) σ_f < 0.5 mb	1.0(1)x10 ³		
²³² Th	100.	1.40x10 ¹⁰ y	7.37(4) $\sigma_f = 3.$ (1) μ b σ_{α} < 1. μ b	85.(3)	10.31(3)	
²³³ Th		22.3 m	1.5(1)x10 ³ $\sigma_f = 15.$ (2)	4.(1)x10 ²		
²³⁴ Th		24.10 d	1.8(5) σ_f < 0.01			
⁹¹ Pa						
²³⁰ Pa		17.4 d	1.5(3)x10 ³			
²³¹ Pa		3.25x10 ⁴ y	2.0(1)x10 ² $\sigma_f = 20.$ (1) mb	750.(80) R _I = 0.05(1)	9.1(3)	
²³² Pa		1.31 d	4.6(10)x10 ² $\sigma_f = 1.5$ (5)x10 ³	300.(70) R _I = 1.0(1)x10 ³		
²³³ Pa		27.0 d	39.(2) $\sigma_m = 20.$ (4) $\sigma_g = 19.$ (3) σ_f < 0.1	(460.+440.)		
⁹² U			3.4(3); $\sigma_f = 4.2$ (1)	280.(20), R _I = 2.0	8.417(5)	

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
²³⁰ U		20.8 d	$\sigma_t \approx 25$.			
²³¹ U		4.2 d	$\sigma_t \approx 250$.			
²³² U		70. y	73.(2)	280.(15)		
²³³ U		1.592x10 ⁵ y	$\sigma_t = 74$.(8) 47.(2) $\sigma_a = 5.3(1) \times 10^2$ $\sigma_\alpha < 0.2$ mb	$R_I = 350$.(30) 137.(6) $R_I = 760$.(17)	10.1(2)	
²³⁴ U	0.0054(5)	2.455x10 ⁵ y	96.(2) $\sigma_a = 0.07$ (2)	660.(70) $R_I = 6.5$	12.(4)	
²³⁵ U	0.7204(6)	7.04x10 ⁸ y	95.(5) $\sigma_t = 586$.(2) $\sigma_\alpha < 0.1$ mb	144.(6) $R_I = 275$ (5)	10.47(4)	
²³⁶ U		2.342x10 ⁷ y	5.1(3) $\sigma_t < 1.3$ mb	360.(15) $R_I = 4.38$ (50)		
²³⁷ U		6.75 d	$\approx 10^2$ $\sigma_t < 0.35$	1200.(200)		
²³⁸ U	99.2742(10)	4.47x10 ⁹ y	2.7(1) $\sigma_t \approx 3$. μ b $\sigma_\alpha = 1.4$ (5) μ b	277.(3) 1.54(15) mb	8.402(5)	
²³⁹ U		23.5 m	22.(2) $\sigma_t = 15$.(3)			
⁹³Np						
²³⁴ Np		4.4 d	$\sigma_t = 9$.(3)x10 ²			
²³⁵ Np		1.085 y	1.6(1)x10 ²			
^{236m} Np		22.5 h	$\sigma_t = 2.7$ (2)x10 ³	7.(4)x10 ²		
²³⁶ Np		1.55x10 ⁵ y	$\sigma_t = 3.0$ (2)x10 ³	1.35(30)x10 ³		
²³⁷ Np		2.14x10 ⁶ y	1.7(1)x10 ² $\sigma_t = 20$.(1) mb	6.5(3)x10 ² $R_I = 4.7$	10.6(1)	
²³⁸ Np		2.117 d	$\sigma_t = 2.6$ (3)x10 ³	1.4(3)x10 ³		
²³⁹ Np		2.355 d	(32.+19.) $\sigma_t < 1$.			
⁹⁴Pu						
²³⁶ Pu		2.87 y	$\sigma_t = 1.6$ (3)x10 ²	1000.(60)		
²³⁷ Pu		45.7 d	$\sigma_t = 2.3$ (3)x10 ³			
²³⁸ Pu		87.7 y	5.1(2)x10 ² $\sigma_t = 17$.(1)	1.6(2)x10 ² $R_I = 26$.(2)	14.1(5)	
²³⁹ Pu		2.410 x 10 ⁴ y	2.7(1)x10 ² $\sigma_t = 752$.(3) $\sigma_\alpha \leq 0.3$ mb	2.0(2)x10 ² 3.0(1)x10 ²	7.7(1)	
²⁴⁰ Pu		6.56x10 ³ y	2.9(1)x10 ² $\sigma_t \approx 59$. mb	8.4(3)x10 ³ $R_I = 3.2$	3.5(1)	
²⁴¹ Pu		14.4 y	3.7(1)x10 ² , $\sigma_\alpha < 0.2$ mb $\sigma_t = 1.01$ (1)x10 ³	1.6(1)x10 ² 5.7(4)x10 ²		
²⁴² Pu		3.75 x 10 ⁵ y	19.(1) $\sigma_t < 0.2$	1.1(1)x10 ³ $R_I = 0.23$	8.1(1)	
²⁴³ Pu		4.956 h	<100. $\sigma_t = 2.0$ (2)x10 ²			
²⁴⁴ Pu		8.00x10 ⁷ y	1.7(1)	41.(3)		
²⁴⁵ Pu		10.5 h	1.5(3)x10 ²	220.(40)		
⁹⁵Am						
²⁴¹ Am		432.7 y	(0.6+6.4)x10 ² $\sigma_t = 3.15$ (10)	(1.+14.)x10 ² 14.(1)		
^{242m} Am		141. y	1.7(4)x10 ³ $\sigma_t = 5.9$ (3)x10 ³	≈ 200 . $R_I = 1.8$ (1)x10 ³		

* Extrapolated value.

NEUTRON SCATTERING AND ABSORPTION PROPERTIES (continued)

Elem. or Isot.	Natural Abundance (%)	Half-Life	Thermal Neut. Cross-Section (barns)	Resonance Integral (barns)	Coh. Scat. Length (fm)	σ (30 keV) Maxw. Avg. (barns)
²⁴² Am		16.02 h	$\sigma_t = 2.1(2) \times 10^3$ 3.3(5) $\times 10^2$	$R_I = < 300.$ $\approx 1.5 \times 10^2$		
²⁴³ Am		7.37 $\times 10^3$ y	(75.+5.) $\sigma_t = 79.(2)$ mb	(17.1+1.0) $\times 10^2$ $R_I = 0.056$	8.3(2)	
^{244m} Am		$\approx 26.$ m	$\sigma_t = 1.6(3) \times 10^3$			
²⁴⁴ Am		10.1 h	$\sigma_t = 2.2(3) \times 10^3$			
⁹⁶ Cm						
²⁴² Cm		162.8 d	$\approx 20.$ $\sigma_t \approx 5.$	120.(50)		
²⁴³ Cm		29.1 y	1.3(1) $\times 10^2$ $\sigma_t = 6.2(2) \times 10^2$	214.(20) $R_I = 1.6(1) \times 10^3$		
²⁴⁴ Cm		18.1 y	15.(1) $\sigma_t = 1.1(2)$	640.(50) $R_I = 10.8(8)$	9.5(3)	
²⁴⁵ Cm		8.48 $\times 10^3$ y	3.5(2) $\times 10^2$ $\sigma_t = 2.1(1) \times 10^3$	110.(10) $R_I = 8.(1) \times 10^2$		
²⁴⁶ Cm		4.76 $\times 10^3$ y	1.2(2) $\sigma_t = 0.16(7)$	120.(10) 13.(2)	9.3(2)	
²⁴⁷ Cm		1.56 $\times 10^7$ y	60.(30) $\sigma_t = 82.(5)$	5.(1) $\times 10^2$ 7.3(7) $\times 10^2$		
²⁴⁸ Cm		3.48 $\times 10^5$ y	2.6(3) $\sigma_t = 0.36(7)$	270.(30) 13.(2)	7.7(2)	
²⁴⁹ Cm		64.15 m	≈ 1.6			
²⁵⁰ Cm		$\approx 9.7 \times 10^3$ y	$\approx 80.$			
⁹⁷ Bk						
²⁴⁹ Bk		320. d	7.(1) $\times 10^2$ $\sigma_t \approx 0.1$	9.(1) $\times 10^2$		
²⁵⁰ Bk		3.217 h	$\sigma_t = 1.0(2) \times 10^3$			
⁹⁸ Cf						
²⁴⁹ Cf		351. y	5.0(3) $\times 10^2$ $\sigma_t = 1.7(1) \times 10^3$	7.7(4) $\times 10^2$ $R_I = 2.1(3) \times 10^3$		
²⁵⁰ Cf		13.1 y	2.0(2) $\times 10^3$ $\sigma_t = 110.(90)$	12.(2) $\times 10^3$ $R_I = 160.(40)$		
²⁵¹ Cf		9.0 $\times 10^2$ y	2.9(2) $\times 10^3$ $\sigma_t = 4.5(5) \times 10^3$	1.6(1) $\times 10^3$ $R_I = 5.5(3) \times 10^3$		
²⁵² Cf		2.65 y	20.(2) $\sigma_t = 32.(4)$	43.(3) $R_I = 1.1(3) \times 10^2$		
²⁵³ Cf		17.8 d	18.(2) $\sigma_t = 1.3(2) \times 10^3$	8.(1)		
²⁵⁴ Cf		60.5 d	4.5(10)	2.		
⁹⁹ Es						
²⁵³ Es		20.47 d	(180.+5.8)	(37.5+1.1) $\times 10^2$		
^{254m} Es		1.64 d	$\sigma_t = 1.8(1) \times 10^3$			
²⁵⁴ Es		276. d	28.(3) $\sigma_t = 1.8(2) \times 10^3$	18.(2) $R_I = 1.2(3) \times 10^3$		
²⁵⁵ Es		40. d	$\approx 55.$			
¹⁰⁰ Fm						
²⁵⁵ Fm		20.1 h	26.(3) $\sigma_t = 3.3(2) \times 10^3$	14.(2)		
²⁵⁷ Fm		100.5 d	$\sigma_t = 3.0(2) \times 10^3$			

* Extrapolated value.

COSMIC RADIATION

A.G. Gregory and R.W. Clay

The Nature of Cosmic Rays

Primary cosmic radiation, in the form of high energy nuclear particles, electrons and photons from outside the solar system and from the Sun, continually bombards our atmosphere. Secondary radiation, resulting from the interaction of the primary cosmic rays with atmospheric gas, is present at sea-level and throughout the atmosphere.

The secondary radiation is collimated by absorption and scattering in the atmosphere and consists of a number of components associated with different particle species. High energy primary particles can produce large numbers of secondary particles forming an extensive air shower. Thus, a number of particles may then be detected simultaneously at sea-level.

Primary particle energies accessible in the vicinity of the earth range from $\sim 10^8$ eV to $\sim 10^{20}$ eV. At the lower energies, the limit is determined by the inability of charged particles to traverse the heliosphere to us through the outward-moving solar wind. The upper energy limit is set by the practicality of building detectors to record particles with the extremely low fluxes found at those energies (J.G. Wilson, 1976; O.C. Allkofer, 1975a).

Primary Cosmic Rays

Primary Particle Energy Spectrum

Figure 1 shows the spectrum of primary particle energies. This includes all particle species. In differential form it is roughly a power law of intensity versus energy with an index of ~ -3 . There appears to be a knee (a steepening) at a little above 10^{15} eV and an ankle (a flattening) above $\sim 10^{18}$ eV. Figure 2 emphasizes the features in the spectrum at the highest energies through multiplying the flux with a strongly rising power law of energy. This figure should be used with caution as errors for the two axes are not now independent.

Data on the high energy cosmic ray spectrum are uncertain largely because of limited event statistics due to the very low flux which might best be measured in particles per square kilometer per century. The highest energy event recorded to 1995 had an energy of 3×10^{20} eV (D.J. Bird et al., 1993).

It is expected that the highest energy cosmic rays will interact with the 2.7 K cosmic microwave background through photoproduction or photodisintegration. These interactions will appreciably reduce the observed flux of cosmic rays with energies above 5×10^{19} eV if they travel further than ~ 150 million light years. This process is known as the Greisen-Zatsepin-Kuz'min (GZK) cut off (P. Sokolsky, 1989).

At energies below $\sim 10^{13}$ eV, solar system magnetic fields and plasma can modulate the primary component and Figure 3 shows the extent of this modulation between solar maximum and minimum (E. Juliusson, 1975; J. Linsley, 1981).

Primary Particle Energy Density

If the above spectrum is corrected for solar effects, the energy density above a particle energy of 10^9 eV outside the solar system is found to be $\sim 5 \times 10^5$ eV m^{-3} . As the threshold energy is increased, the energy density decreases rapidly, being 2×10^4 eV m^{-3} above 10^{12} eV and 10^2 eV m^{-3} above 10^{15} eV. The energy density at lower energies outside the heliosphere is unknown but may be substantially greater if the particle rest mass energy is included together with the kinetic energy (A. W. Wolfendale, 1979).

Primary Particle Isotropy

This is measured as an anisotropy $(I_{\max} - I_{\min}) / (I_{\max} + I_{\min}) \times 100\%$, where I , the intensity ($m^{-2}s^{-1}sr^{-1}$), is usually measured with an angular resolution of a few degrees.

The measured anisotropy is small and energy dependent. It is roughly constant in amplitude at between 0.05 and 0.1% (with a phase of 0 to 6 hours in right ascension) for energies between 10^{11} eV and 10^{14} eV and appears to increase at higher energies roughly as $0.4 \times (\text{Energy(eV)} / 10^{16})^{0.5}\%$ up to $\sim 10^{18}$ eV. The latter rise may well be an artifact of the progressively more limited statistics as the flux drops rapidly with energy. It appears possible that a real anisotropy has been observed at the highest energies (above a few times 10^{19} eV) with a directional preference for the supergalactic plane (this plane reflects the directions of galaxies within about 100 million light years) (A.W. Wolfendale, 1979; R.W. Clay, 1987; T. Stanev et al., 1995).

Primary Particle Composition

The composition of low energy cosmic rays is close to universal nuclear abundances except where propagation effects are present. For example, Li, Be, and B which are spallation products, are over-abundant by about six orders of magnitude.

Composition at 10^{11} eV per nucleus

Charge	1	2	(3-5)	(6-8)	(10-14)	(16-24)	(26-28)	≥ 30
% Composition	50	25	1	12	7	4	4	0.1
(10% uncertainty)								

Measurements at higher energies indicate that there is an increase in the relative abundances of nuclei with charge greater than 6 at energies above 50 TeV/nucleus (K. Asakimori et al., 1993) ($1 \text{ TeV} = 10^{12}$ eV).

Cosmic ray composition at low energies is often quoted at a fixed energy per nucleon. When presented in this way, protons constitute roughly 90% of the flux, helium nuclei about 10% and the remainder sum to a total of about 1%.

Certain radioactive isotopic ratios show lifetime effects. The ratio of $\text{Be}^{10}/\text{B}^9$ abundances is used to measure an "age" of cosmic rays since Be^{10} is unstable with a half life of about 1.6×10^6 years. A ratio of 0.6 is expected in the absence of Be^{10} decay and a ratio of about 0.2 is found experimentally (E. Juliusson, 1975; P. Meyer, 1981).

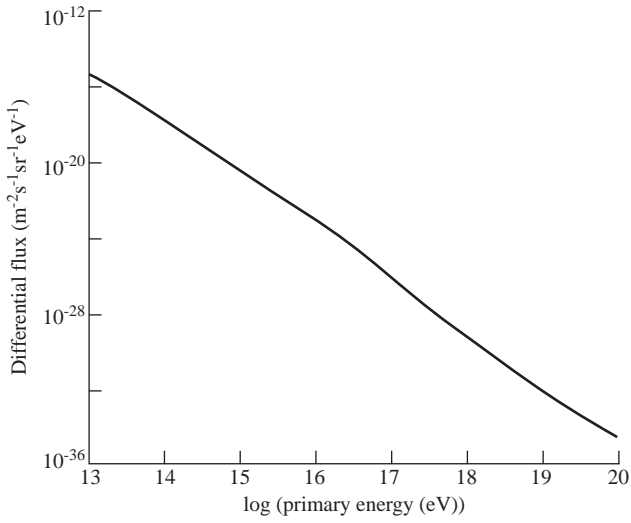


FIGURE 1. The energy spectrum of cosmic ray particles. This spectrum is of a differential form and can be converted to an integral spectrum by integration over all energies above a required threshold (E). Insofar as the spectrum approximates a power law of index -3 , a simple conversion to the integral at an energy $E/1.8$ is obtained by multiplying the differential flux by the energy and dividing by 0.62 .

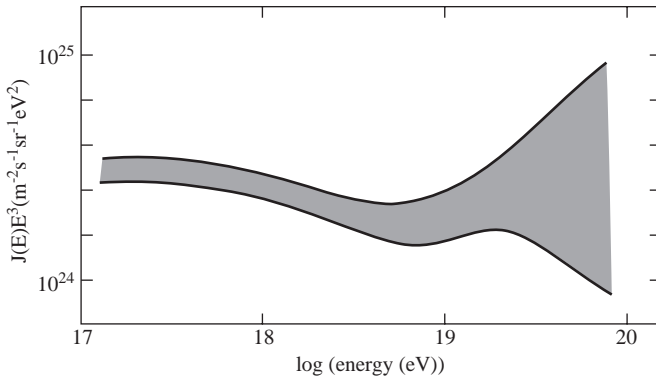


FIGURE 2. Energy spectrum at the highest energies. This spectrum (after Yoshida et al., 1995) has the differential spectrum multiplied by energy cubed. It is from a compilation of a number of measurements and indicates the good general agreement at the lower energies and a spread due to inadequate statistics at the highest energies.

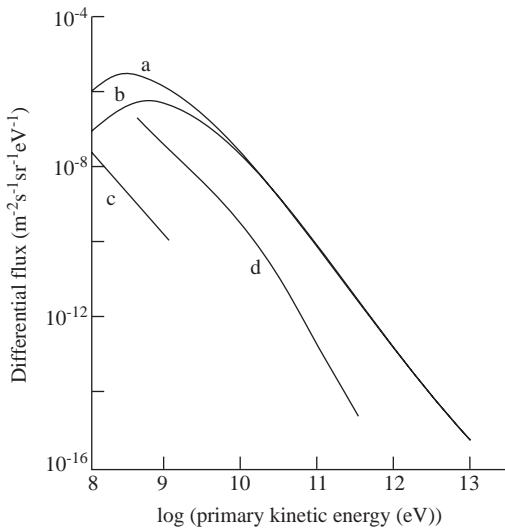


FIGURE 3. Energy spectrum of particles at lower energies. (a) Solar minimum proton energy spectrum. (b) Solar maximum proton energy spectrum. (c) Gamma-ray energy spectrum. (d) Local interstellar electron spectrum.

At higher energies, composition determinations are indirect and are rather contradictory and controversial. Experiments aim to differentiate between broad composition models. The measurement technique is based on studies of cosmic ray shower development. A rather direct technique for such studies is to use fluorescence observations of the shower development to determine the atmospheric depth of maximum development of the shower. Such observations suggest a heavy composition (large atomic number) at energies $\sim 10^{17}$ eV which changes with increasing energy to a light composition (perhaps protonic) above $\sim 10^{19}$ eV (T. K. Gaisser et al., 1993).

Primary Electrons

Primary electrons constitute about 1% of the cosmic ray beam. The positron to negative electron ratio is about 10% (J. M. Clem et al., 1995).

Antimatter in the Primary beam

The ratio of antiprotons to protons in the primary cosmic ray beam (at about 400 MeV) is about 10^{-5} . At about 10 GeV the ratio is about 10^{-3} . At the highest measured energies (10 TeV), the upper limit to the ratio is about 20% (S. Orito et al., 1995; M. Amenomori et al., 1995).

Primary Gamma-Rays

The flux of primary gamma-rays is low at high energies. At 1 GeV the ratio of gamma-rays to protons is about 10^{-6} . The arrival directions of these gamma-rays are strongly concentrated in the plane of the Milky Way although there is a diffuse, near isotropic background flux and some point sources have been detected.

Since the absorption cross section for gamma-rays above 100 MeV is approximately 20 mbarn/electron, less than 10% of gamma-rays reach mountain altitudes (A. W. Wolfendale, 1979; P. F. Michelson, 1994).

Sea Level Cosmic Radiation

The sea level cosmic ray dose is 300 millirad-yr⁻¹ and the sea level ionization is 2.2×10^6 ion pairs m⁻³s⁻¹. The sea level flux has a soft component, which can be absorbed in about 100 mm of lead (about 100 g-cm⁻² of absorber) and a more penetrating (largely muon) hard component. The sea level radiation is largely produced in the atmosphere and is a secondary component from interactions of the primary particles. The steep primary energy spectrum means that most secondaries at sea level are from rather low energy primaries. Thus the secondary flux is dependent on the solar cycle and the geomagnetic latitude of the observer.

Absolute Flux of the Hard Component

Vertical Integral Intensity $I(0) \sim 100$ m⁻²s⁻¹sr⁻¹

Angular dependence $I(\theta) \sim I(0) \cos^2(\theta)$

Integrated Intensity ~ 200 m⁻²s⁻¹

(O.C. Allkofer, 1975b).

Flux of the Soft Component

In free air, the soft component comprises about one third of the total cosmic ray flux.

Latitude Effect

The geomagnetic field influences the trajectories of lower energy cosmic rays approaching the Earth. As a result, the background flux is reduced by about 7% at the geomagnetic equator. The effect decreases towards the poles and is negligible at latitudes above about 40°.

Flux of Protons

The proton component is strongly attenuated by the atmosphere with an attenuation length (reduction by a factor of e) of about 120 g-cm⁻². It constitutes about 1% of the total vertical sea level flux.

Absorption

The soft component is absorbed in about 100 g-cm⁻² of matter. The hard component is absorbed much more slowly:

Absorption in lead, 6% per 100 g-cm⁻²

Absorption in rock, 8.5% per 100 g-cm⁻²

Absorption in water, 10% per 100 g-cm⁻²

(Absorption for depths less than 100 g-pd cm⁻² is given by K. Greisen, 1943.)

Altitude Dependence

The cosmic ray background in the atmosphere has a maximum intensity of about 15 times that at sea level at a depth of about 150 g-cm⁻² (15 km altitude). At maximum intensity, the soft and hard components contribute roughly equally but the hard component is then attenuated more slowly (S. Hayakawa, 1969).

Cosmic Ray Showers

High energy cosmic rays produce particle cascades in the atmosphere which can be detected at sea level provided that their energy exceeds about 100 GeV (such low energy cascades may be detected by using the most sensitive atmospheric Cerenkov detectors). The primary particle progressively loses energy which is transferred through the production of successive generations of secondary particles to a cascade of hadrons, an electromagnetic shower component (both positively and negatively charged electrons and gamma-rays) and muons. The secondary particles are relativistic and all travel effectively at the speed of light. As a result, they reach sea level at approximately the same time but, due to Coulomb scattering (for the electrons) and

production angles (for the pions producing the muons), are spread laterally into a disk-like shower front with a characteristic lateral width of several tens of meters and thickness (near the central shower core) of 2 to 3 m. The number of particles at sea level is roughly proportional to the primary particle energy:

Number of particles at sea level $\sim 10^{-10} \times \text{energy (eV)}$.

At altitudes below a few kilometers, the number of particles in a shower attenuates with an *attenuation length* of about 200 g·cm⁻².

i.e., particle number = original number $\times \exp(-(\text{depth increase})/200)$

The above applies to an individual shower. The rate of observation of showers of a given size (particle number at the detector) at different depths of absorber attenuates with an *absorption length* of about 100 g·cm⁻² (J.G. Wilson, 1976).

Atmospheric Background Light from Cosmic Rays

Cosmic ray particles produce Cerenkov light in the atmosphere and produce fluorescent light through the excitation of atmospheric molecules.

Cerenkov Light

High energy charged particles will cause the emission of Cerenkov light in air if their energies are above about 30 MeV (electrons). This threshold is pressure (and hence altitude) dependent. A typical Cerenkov light pulse (at sea level, 100 m from the central shower core) has a time spread of a few nanoseconds. Over this time, the photon flux between 430 and 530 nm would be $\sim 10^{14} \text{ m}^{-2}\text{s}^{-1}$ for a primary particle energy of 10^{16} eV. For comparison, the night sky background flux is $\sim 6 \times 10^{11} \text{ photons m}^{-2}\text{s}^{-1}\text{sr}^{-1}$ in the same wavelength band (J.V. Jelley, 1967).

Fluorescence Light

Cosmic ray particles in the atmosphere excite atmospheric molecules which then emit fluorescence light. This is weak compared to the highly collimated Cerenkov component when viewed in the direction of the incident cosmic ray particle but is emitted isotropically. Typical pulse widths are longer than 50 ns and may be up to several microseconds for the total pulse from distant large showers (R.M. Baltrusaitis et al., 1985).

Effects of Cosmic Rays

Cerenkov Effects in Transparent Media

Background cosmic ray particles will produce Cerenkov light in transparent material with a photon yield between wavelengths λ_1 and λ_2

$$\sim (2\pi/137)\sin^2(\theta_c) \int_{\lambda_1}^{\lambda_2} d\lambda / \lambda^2 \text{ photons (unit length)}^{-1}$$

where θ_c (the Cerenkov angle) = $\cos^{-1}(1/\text{refractive index})$.

This background light is known to affect light detectors, e.g., photomultipliers, and can be a major source of background noise (R.W. Clay and A.G. Gregory, 1977).

Effects on Electronic Components

If background cosmic ray particles pass through electronic components, they may deposit sufficient energy to affect the state of, e.g., a transistor flip-flop. This effect may be significant where reliability is of great importance or the background flux is high. For instance, it has been estimated that, in communication satellite operation, an error rate of about 2×10^{-3} per transistor per year may be found. Permanent damage may also result. A significant error rate may be found even at sea level in large electronic memories. This error rate is dependent on the sensitivity of the component devices to the deposition of electrons in their sensitive volumes (J.F. Ziegler, 1981).

Biophysical Significance

When cosmic rays interact with living tissue, they produce radiation damage. The amount of the damage depends on the total dose of radiation. At sea level, this dose is small compared with doses from other sources but both the quantity and quality of the radiation change rapidly with altitude. Approximate dose rates under various conditions are:

Dose rates (mrem·yr⁻¹)
 Sea level cosmic rays, 30
 Cosmic rays at 10 km (subsonic jets), 2000
 Cosmic rays at 18 km (supersonic transports), 10,000
 (c.f., mean total sea level dose, 300)

Astronauts would be subject to radiation from galactic (0.05 rads per day) and solar (a few hundred rads per solar flare) cosmic rays as well as large fluxes of low energy radiation when passing through the Van Allen belts (about 0.3 rads per traverse). Both astronauts and SST travellers would be subject to a small flux of low energy heavy nuclei stopping in the body. Such particles are capable of destroying cell nuclei and could be particularly harmful in the early stages of the development of an embryo. The rates of heavy nuclei stopping in tissue in supersonic transports and spacecraft are approximately as follows:

Stopping nuclei ($(\text{cm}^3 \text{ tissue})^{-1} \text{ hr}^{-1}$)
Supersonic transport (16 km), 0.0005
Supersonic transport (20 km), 0.005
Spacecraft, 0.15
(O. C. Allkofer, 1975a; O. C. Allkofer et al., 1974).

Carbon Dating

Radiocarbon is produced in the atmosphere due to the action of cosmic ray slow neutrons. Solar cycle modulation of the very low energy cosmic rays causes an anticorrelation of the atmospheric ^{14}C activity with sunspot number with a mean amplitude of about 0.5%. In the long term, modulation of cosmic rays by a varying magnetic field may be important (A.A. Burchuladze et al., 1979).

Practical Uses of Cosmic Rays

There are few direct practical uses of cosmic rays. Their attenuation in water and snow have, however, enabled automatic monitors of water and snow depth to be constructed. A search for hidden cavities in pyramids has been carried out using a muon "telescope".

Other Effects

Stellar X-rays have been observed to affect the transmission times of radio signals between distant stations by altering the depth of the ionospheric reflecting layer. It has also been suggested that variations in ionization of the atmosphere due to solar modulation may have observable effects on climatic conditions.

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TECHNIQUES FOR MATERIALS CHARACTERIZATION
EXPERIMENTAL TECHNIQUES USED TO DETERMINE THE COMPOSITION, STRUCTURE, AND ENERGY STATES OF SOLIDS AND LIQUIDS
H.P.R.Frederikse

The many experimental methods, originally designed to study the chemical and physical behavior of solids and liquids, have grown into a new field known as Materials Characterization (or Materials Analysis). During the past 30 years a host of techniques aimed at the study of surfaces and thin films has been added to the many tools for the analysis of bulk samples. The field has benefitted particularly from the development of computers and microprocessors, which have vastly increased the speed and accuracy of the measuring devices and the recording of their output. Materials characterization was and is a very important tool in the search for new physical and chemical phenomena. It plays an essential role in new applications of solids and liquids in industry, communications, and medicine. Many of its techniques are used in quality control, in safety regulations, and in the fight against pollution.

In most Materials Characterization experiments the sample is subjected to some kind of radiation: electromagnetic, acoustic, thermal, or particles (electrons, ions, neutrons, etc.). The surface analysis techniques usually require a high vacuum. As a result of interactions between the solid (or liquid) and the incoming radiation a beam of a similar (or a different) nature will emerge from the sample. Measurement of the physical and/or chemical attributes of this emerging radiation will yield qualitative, and often quantitative, information about the composition and the properties of the material being probed.

The modern tendency of describing practically everything in this world by a combination of a few letters (acronyms) has also penetrated the field of Materials Characterization. The table below gives the meaning of the acronym for every technique listed, the form and size of the required sample (bulk, surface, film, liquid, powder, etc.), the nature of the incoming and of the emerging radiation, the depth and the lateral spatial resolution that can be probed, and the information obtained from the experiment. The last column lists one or two major references to the technique described.

Technique	Sample	In	Out	Depth	Lateral resolution	Information obtained	Ref.
OPTICAL AND MASS SPECTROSCOPIES FOR CHEMICAL ANALYSIS							
1. AAS Atomic Absorption Spectroscopy	Atomize (flame, electro, thermal, etc.)	Light e.g., glow discharge	Absorption spectrum	—	—	Concentration of atomic species (quantitative, using standards)	1,2
2. ICP-AES Induct. Coupled Plasma — Atomic Emission Spectroscopy	Atomize (flame, electro, thermal, ICP, etc.)	—	Emission spectrum	—	—	Concentration of atomic species (quantitative, using standards)	3
3. Dynamic SIMS Dynamic Secondary Ion Mass Spectroscopy	Surface	Ion beam (1–20 keV)	Secondary ions; analysis with mass spectrometer	2 nm–1 μm (or deeper: ion milling)	0.50 nm	Elemental and isotopic analysis; depth profile (all elements); detection limits: ppb-ppm	4
4. Static SIMS Static Secondary Ion Mass Spectroscopy	Surface	Ion beam (0.5–20 keV)	Secondary ions, analysis with mass spectrometer	0.1–0.5 nm	10 μm	Elemental analysis of surface layers; molecular analysis; detection limits: ppb-ppm	4
5. SNMS Sputtered Neutral Mass Spectroscopy	Surface, bulk	Plasma discharge; noble gases: 0.5–20 keV	Sputtered atoms ionized by atoms or electrons; then mass analyzed	0.1–0.5 nm (or deeper: ion milling)	1 cm	Elemental analysis $Z \geq 3$; depth profile; detection limit: ppm	4,6
6. SALI Surface Analysis by Laser Ionization	Surface	e-beam, ion-beam, or laser for sputtering	Sputtered atoms ionized by laser; then mass analyzed	0.1–0.5 nm up to 3 μm in milling mode	60 nm	Surface analysis; depth profiling	7
7. LIMS Laser Ionization Mass Spectroscopy	Surface, bulk	u.v. laser (ns pulses)	Ionized species; analyzed with mass spectrometer	50–150 nm	5 μm–1 mm	Elemental (micro)analysis; detection limits: 1–100 ppm	8
8. SSMS Spark Source Mass Spectroscopy	Sample in the form of two electrodes	High voltage R.F. spark produces ions	Ions — analyzed in mass spectrometer	1–5 μm	—	Survey of trace elements; detection limit: 0.01–0.05 ppm	9
9. GDMS Glow Discharge Mass Spectroscopy	Sample forms the cathode for a D.C. glow discharge	Sputtered atoms ionized in plasma	Ions — analyzed in mass spectrometer	0.1–100 μm	3–4 mm	(Bulk) trace element analysis; detection limit: sub-ppb	9,10
10. ICPMS Induct. Coupled Plasma Mass Spectroscopy	Liquid-dissolved sample carried by gas stream into R.F. induction coil	Ions produced in argon plasma	Ions — analyzed in quadrupole mass spectrometer	—	—	High sensitivity analysis of trace elements	11

TECHNIQUES FOR MATERIALS CHARACTERIZATION (continued)

Technique	Sample	In	Out	Depth	Lateral resolution	Information obtained	Ref.
PHOTONS — ABSORPTION, REFLECTION AND ELECTRON EMISSION							
11. IRS Infrared Spectroscopy	Thin crystal, glass, liquid	I.R. light (W-filament, globar, Hg-arc)	I.R. spectrum	—	—	Electronic transitions (mainly in semiconductors and superconductors); vibrational modes (in crystals and molecules)	12,13, 14
12. FTIR Fourier Transform I.R. Spectroscopy	Solid, liquid; transmission or reflection	White light (all frequencies)	Fourier Transform of spectrum (interferometer)	—	—	Spectra obtained at higher speed and resolution	15
13. ATR Attenuated Total Reflection	Surface or thin crystal	—	—	μm's	—	Atomic or molecular spectra of surfaces and films	16
14. (μ)-RS (Micro-) Raman Spectroscopy	Solid, liquid (1 μm–1 cm)	Laser beam, e.g., Ar-line, YAG-line	Raman spectra	0.5 μm	0.5 μm	Molecular and crystal vibrations	12,14, 17
15. CARS Coherent Anti-Stokes Raman Spectroscopy	Solid, liquid (50 μm–3 cm)	Pump beam (ω_p)+ probe beam (ω_s)	Anti-Stokes spectrum	—	—	High resolution Raman spectra	14
16. Ellipsometry	Transparent films, crystals, adsorbed layers	Polarized light	Change in polarization	0.05 nm–5 μm	25 μm (or sample thickness)	Refractive index <i>and</i> absorption	18,19
17. UPS Ultraviolet Photo-electron Spectroscopy	Surfaces, adsorbed layers	u.v. light, 10–100 eV; 200 eV (synchrotron)	Electrons	0.2–10 nm	0.1–10 nm	Energies of electronic states of surfaces and free molecules	20,21
18. PSD Photon Stimulated Desorption	Surfaces with adsorbed species	Far u.v. light E > 10 eV	Ions — analyzed with mass spectrometer	0.1–2 nm	—	Structure and desorption kinetics of adsorbed atoms and molecules	22
X-RAYS							
19. XRD X-Ray Diffraction	Single crystals, powders films	X-rays: $\lambda = 0.05\text{--}0.2$ nm (6–17 keV)	Diffraction X-ray beam	1–1000 μm	0.1–10 mm	Identification of crystallographic structures; all elements (low Z difficult)	23,24
20. XRF/EDS X-Ray Fluorescence/Energy Dispersive Spectroscopy	Thin films, single layer	Prim. X-ray beam $\lambda = 0.02\text{--}0.1$ nm 12–80 keV	Fluorescent X-rays	1–100 μm	10 mm	Elemental analysis; all elements except H, He, Li — (EDS also used in XRD, SEM, TEM and EPMA)	25,26
21. EXAFS Extended X-Ray Absorption Fine Structure	Films, foils	High intensity X-rays (synchrotron)	Spectrum near absorption edge	nm–μm	—	Local atomic structure: order/disorder in vicinity of absorbing atom	27
22. XPS/ESCA X-Ray Photo-electron Spectroscopy/Electron Spect. for Chemical Analysis	Surfaces, thin films (≈20 atomic layers)	Soft X-rays (1–20 keV)	Core electrons; valence electrons	0.5–10 nm	5 nm–50 μm	(Quantitative) identification of all elements in surface layer or film	28,29
ELECTRONS							
23. CL Cathode Luminescence	Insulators, semiconductors	Electrons 5–50 keV	Photons 0.1–5 eV	1 nm–2 μm	1 or 2 μm	Energy levels of impurities and point defects	30
24. APS Appearance Potential Spectroscopy	Surface (≈20 atomic layers)	Electrons (energy scan) 50–2000 eV	X-rays to pinpoint electron energy threshold	—	—	Identification of surface species	21, see also C

TECHNIQUES FOR MATERIALS CHARACTERIZATION (continued)

Technique	Sample	In	Out	Depth	Lateral resolution	Information obtained	Ref.
25. AES Auger Electron Spectroscopy	Thin films, surfaces	Electrons 3–10 keV	Auger electrons 20–2000 eV	0.3–3 nm	≈30 nm	Elemental composition of surface (except H, He); detection limit 0.1–1%	28,29
26. EELS Electron Energy Loss Spectroscopy	Very thin samples (<200 nm)	Electrons (100–400 keV)	(Retarded) electrons; minus 1–1000 eV	<200 nm	1–100 nm	Local elemental concentration; electronic structure, chem. bonding; interatomic distances	31
27. EXELFS Extended Electron Energy Loss Fine Structure	Thin films	Electrons (100–400 keV)	Electrons energies 0–30 eV above edge	<200 nm	1–100 nm	Density of states of valence electrons (above Fermi level)	27,32
28. ESD Electron Stimulated Desorption	Adsorbed species	Electrons E > 10 eV	Ions — analyzed with mass spectrometer	—	—	Structure and desorption properties of adsorbed atoms and molecules	22
29. ESDIAD ESD-Ion Angular Distribution	(See ESD)	(See ESD)	Directional dependence of emitted ions	—	—	Geometries of adsorbed species (atoms or molecules)	22
30. EPMA Electron Probe (X-Ray) Micro Analysis	Solid conductors and insulators <1 cm thick	Electrons 5–30 keV	Characteristic X-ray 0.1–15 keV	100 nm–5 μm	1 μm	Elemental analysis, Z ≤ 4, major, minor and trace amounts	33,34
31. LEED Low Energy Electron Diffraction	Surface	Mono-energetic electron beam 10–1000 eV	Diffraction electrons	0.4–2 nm	<5 μm	Crystallographic structure of surface; resolution: 0.01 nm	35
32. RHEED Reflection High Energy Electron Diffraction	Surface	Electron beam at grazing angle 5–50 keV	Reflected electrons	0.2–10 nm	<5 μm	Surface symmetry	36,37
33. SEM Scanning Electron Microscopy	Bulk, films (conducting)	High energy electrons usually ~30 keV	Secondary and backscattered electrons	1 nm–5 μm	1–20 nm	Surface image, defect structure; resolution 5–15 nm; magnification 300,000×	33,34
34. (S)TEM (Scanning) Transmission Electron Microscopy	Thin specimen — <200 nm	High energy electrons typically 300 keV	Transmitted and diffracted electrons	(Sample thickness)	2–20 nm	(Defect) structure of cryst. solids; microchemistry; high resol.: 0.2 nm	33
35. FEM Field Emission Microscopy	Metals, alloys (sharp point)	—	Electron emission (with appl. electric field — 50 kV)	≈0.5 nm	10–100 nm	Surface image, crystallographic structure	34
36. STM Scanning Tunneling Microscopy	Polished or cleaved surface (conducting)	Tunneling current controls distance between sample and very sharp tip		1–5 nm	2–10 nm	Atomic-scale relief map of surface; resolution: vert. 0.002 nm, hor. 0.2 nm	39
37. SPM Scanned Probe Microscopy	Very flat surface	Any field: e.g. mechan. vibration recorded with laser probe; same with magnetic, electric or thermal field		1–100 nm	1–100 nm	Surface-magnetic field, surface- thermal conductivity, etc.	39a
38. AFM Atomic Force Microscopy	Very flat surface	Similar to STM; force measured with cantilever spring		0.5–5 nm	0.2–130 nm	Surface topography with atomic resolution; interatomic force	40
IONS AND NEUTRONS							
39. ISS (or LEIS) Ion Scattering Spectroscopy (Low Energy Ion Scattering)	Surface	Ion beam He ⁺ or Ne ⁺ <3 keV	Sputtered ions (energy analysis)	0.1–0.5 nm	1–100 μm	Elemental analysis (better for low Z) detection limits: 0.01–1%	41
40. FIM Field Ion Microscopy	Surface: metals, alloys; very sharp tip	(He gas above sample)	He ions + high electric field produce image	≈0.1 nm	0.1–2 nm	Atomic structure of surface	34,42
41. RBS Rutherford Back Scattering	Solids, thin films	Mono-energetic ions (H ⁺ or He ⁺⁺) 0.5–3 MeV	Backscattered ions	10 nm–1 μm	1 mm	Element identification (Li to U) detection limit: 0.01–1%	46

TECHNIQUES FOR MATERIALS CHARACTERIZATION (continued)

Technique	Sample	In	Out	Depth	Lateral resolution	Information obtained	Ref.
42. NRA Nuclear Reaction Analysis	Solids, thin films	Mono-energetic ions (Li, Be, B, etc.) 200 keV–6 MeV	Protons, deuterons ³ He, α -particles, γ -rays	0.1–5 μ m	10 μ m– 10 mm	Element identification (all) detection limit: 10^{-12} – 10^{-2}	47
43. PIXE Particle Induced X-ray Emission	Thin films, surface layers	High energy ions (H ⁺ or He ²⁺)	Characteristic X-rays	<10 μ m	1 μ m–2 mm	Trace impurities: Z > 3 detection limit: 0.1–100 ppm (depending on sample thickness)	48
44. INS Ion Neutralization Spectroscopy	Surface	He-ions (=5 eV)	Electrons	—	—	Energies of valence electrons	49
45. NAA Neutron Activation Analysis	Bulk, >0.5 g	Thermal neutrons	Characteristic γ -rays, (=1 MeV)	Bulk	—	Trace concentrations (of isotopes) of elements: trans. metals, Pt-group; detection limit: 10^8 – 10^{14} atoms/cm ³	43
46. N(P)D Neutron (Powder) Diffraction	Crystalline solids	Thermal neutrons E = 0.0025 eV	Diffraction neutrons	Bulk	—	Crystallographic structure; porosity, particle size	44
47. SANS Small Angle Neutron Scattering	Inhomogeneous solids; powders; porous samples	Thermal neutrons $2\theta = 10^{-2}$ – 10^{-4}	Scattered neutrons	1–25 mm	—	Average size of inhomogeneities; range: 1 nm–1 μ m	45
ACOUSTIC							
48. SLAM Scanning Laser Acoustic Microscopy	Bulk, film	Acoustic wave produced by laser 1 MHz–1 GHz	Reflected acoustic wave	μ m–cm	0.1–20 mm	Defect structure; thickness measurement	50
THERMAL							
49. DTA Differential Thermal Analysis	Specimen and reference sample	Uniform heating	Temperature difference	Bulk	—	Phase transitions, crystallization	51
50. DSC Differential Scanning Calorimetry	Specimen and ref. sample	Controlled heating	Measure heat required for equal temperature	Bulk	—	Phase transitions, crystallization; activation energies	51
51. TGA Thermo Gravimetric Analysis	Bulk, 1–100 g	Controlled heating	Weight as function of temperature (and time)	Bulk	—	Decomposition, non-stoichiometry, kinetics of reaction	52
RESONANCE							
52. EPR (ESR) Electron Paramagnetic (Spin) Resonance	Paramagnetic solids or liquids	Microwave radiation in magnetic field 3–300 GHz; 1–100 kG	Microwave absorption (at resonance)	Bulk	—	Local environment of paramagnetic ion; concentration of paramagnetic, species; detection limit: 10^{11} spins/cm ³	53,54
53. ECR Electron Cyclotron Resonance	Semiconductors, metals; free electrons (low temperature)	Microwave radiation in magnetic field 10–30 GHz; 5–10 kG	Microwave absorption (at resonance)	Bulk	—	Electronic energy bands, effective masses	55
54. Mössbauer Effect	Source and absorber	Mono-energetic γ -rays: 5–100 keV	Mössbauer spectrum (Doppler shifted lines)	50 m	1 cm	Interaction between nucleus and its environment (local electric, magnetic fields; bonds; valency; diffusion, etc.)	56
55. NMR (MRI) Nuclear Magnetic Resonance (Magnetic Resonance Imaging)	Solids, liquids	R.F. radiation + magnetic field; e.g. for protons: 60 MHz, 14 kG	R.F. absorption	<1 cm	1 cm	Quant. analysis; local magnetic environment; diffusion; imaging	58
56. ENDOR Electron Nuclear Double Resonance	Solids, liquids	R.F. + microwave radiation in magn. field.	Microwave absorption	—	—	Hyperfine interaction → local atomic structure	54

TECHNIQUES FOR MATERIALS CHARACTERIZATION (continued)

Technique	Sample	In	Out	Depth	Lateral resolution	Information obtained	Ref.
57. NQR Nuclear Quadrupole Resonance	Solids	R.F. radiation 0.5–1000 MHz	R.F. absorption	—	—	Asymmetry of the charge distribution at the nucleus	55,59
OTHER							
58. BET Brunauer-Emmett-Teller	(Large) surface area 1–20 m ² /g	Adsorbed gas (e.g., N ₂ at low temp.) as function of pressure (monolayer coverage)		—	—	Surface area measurement	60

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SYMMETRY OF CRYSTALS

L. I. Berger

The ability of a body to coincide with itself in its different positions regarding a coordinate system is called its symmetry. This property reveals itself in iteration of the parts of the body in space. The iteration may be done by reflection in mirror planes, rotation about certain axes, inversions and translations. These actions are called the symmetry operations. The planes, axes, points, etc., are known as symmetry elements. Essentially, mirror reflection is the only truly primitive symmetry operation. All other operations may be done by a sequence of reflections in certain mirror planes. Hence, the mirror plane is the only true basic symmetry element. But for clarity, it is convenient to use the other symmetry operations, and accordingly, the other aforementioned symmetry elements. The symmetry elements and operations are presented in Table 1.

The entire set of symmetry elements of a body is called its symmetry class. There are thirty-two symmetry classes that describe all crystals which have ever been noted in mineralogy or been synthesized (more than 150,000). The denominations and symbols of the symmetry classes are presented in Table 2.

There are several known approaches to classification of individual crystals in accordance with their symmetry and crystallochemistry. The particles which form a crystal are distributed in certain points in space. These points are separated by certain distances (translations) equal to each other in any chosen direction in the crystal. Crystal lattice is a diagram that describes the location of particles (individual or groups) in a crystal. The lattice parameters are three non-coplanar translations that form the crystal lattice. Three basic translations form the unit cell of a crystal. August Bravais (1848) has shown that all possible crystal lattice structures belong to one or another of fourteen lattice types (Bravais lattices). The Bravais lattices, both primitive and non-primitive, are the contents of Table 3.

Among the three-dimensional figures, there is a group of polyhedrons that are called regular, which have all faces of the same shape and all edges of the same size (regular polygons). It has been shown that there are only five regular polyhedrons. Because of their importance in crystallography and solid state physics, a brief description of these polyhedrons is included in Table 4.

The systematic description of crystal structures is presented primarily in the well known *Strukturbericht*. The classification of crystals by the *Strukturbericht* does not reflect their crystal class, the Bravais lattice, but is based on the crystallochemical type. This makes it inconvenient to use the *Strukturbericht* categories for comparison of some individual crystals. Thus, there have been several attempts to provide a more convenient classification of crystals. Table 5 presents a compilation of different classifications which allows the reader to correlate the *Strukturbericht* type with the international and Schoenflies point and space groups and with Pearson's symbols, based on the Bravais lattice and chemical composition of the class prototype. The information included in Table 5 has been chosen as an introduction to a more detailed crystallophysical and crystallochemical description of solids.

TABLE 1
Symmetry Operations and Elements

Symmetry operation	Name	Symmetry element		Presentation on the stereographic projection	
		Symbol		Parallel	Perpendicular
		International (Hermann-Mauguin)	Schoenflies		
Reflection in a plane	Plane	m	C _s		
Rotation by angle $\alpha = 360^\circ/n$ about an axis	Axis	n = 1, 2, 3, 4 or 6	C _n		
		n = 2	C ₂		
		n = 3	C ₃		
		n = 4	C ₄		
		n = 6	C ₆		
Rotation about an axis and inversion in a symmetry center lying on the axis	Inversion (improper) axis	$\bar{n} = \bar{3}, \bar{4}, \bar{6}$	C _{ni}		
		$\bar{n} = \bar{3}$	C _{3i}		
		$\bar{n} = \bar{4}$	C _{4i}		

SYMMETRY OF CRYSTALS (continued)

TABLE 1
Symmetry Operations and Elements (continued)



Symmetry operation	Name	Symmetry element		Presentation on the stereographic projection	
		International (Hermann-Mauguin)	Schoenflies	Parallel	Perpendicular
		$\bar{n} = \bar{6}$	C_{6i}		
Inversion in a point	Center	$\bar{1}$	C_i		
Parallel translation	Translation vector a, b, c				
Reflection in a plane and translation parallel to the plane	Glide-plane	a, b, c, n, d			
Rotation about an axis and translation parallel to the axis	Screw axis	n_m (m = 1, 2, ..., n - 1)			
Rotation about an axis and reflection in a plane perpendicular to the axis	Rotatory-reflection axis	\bar{n} $\bar{n} = \bar{1}, \bar{2}, \bar{3}, \bar{4}, \bar{6}$	S_n		

TABLE 2
The Thirty-Two Symmetry Classes

Crystal symbol	Class name ^a													
	Primitive		Central		Planal		Axial		Plane-axial		Inversion primitive		Inversion-planal	
	Int	Sch	Int	Sch	Int	Sch	Int	Sch	Int	Sch	Int	Sch	Int	Sch
Triclinic	1	C_1	$\bar{1}$	C_i										
Monoclinic					m	C_s	2	C_2	2/m	C_{2h}				
Orthorhombic					mm2	C_{2v}	222	D_2	mmm	D_{2h}				
Trigonal	3	C_3	$\bar{3}$	C_{3i}	3m	C_{3v}	32	D_3	$\bar{3}m$	C_{3d}				
Tetragonal	4	C_4	4/m	C_{4h}	4mm	C_{4v}	422	D_4	4/mmm	D_{4h}	$\bar{4}$	S_4	$\bar{4}2m$	D_{2d}
Hexagonal	6	C_6	6/m	C_{6h}	6mm	C_{6v}	622	D_6	6/mmm	D_{6h}	$\bar{6}$	C_{3h}	$\bar{6}m2$	D_{3h}
Cubic	23	T	m3	T_h	$\bar{4}3m$	T_d	432	O	m3m	O_h				

^a Per Fedorov Institute of Crystallography, USSR Academy of Sciences, nomenclature.

SYMMETRY OF CRYSTALS (continued)

TABLE 3
The Fourteen Possible Space Lattices (Bravais Lattices)

Crystal system	Metric category of the system	No. of different lattices in the system	Lattice type ^a (marked by +)					No. of identi-points per unit cell	Characteristic parameters (marked by +)						Description of characteristic parameters $a < X, b < Y, c < Z$ $\alpha \equiv (b,c), \beta \equiv (a,c), \gamma \equiv (a,b)$	Symmetry of the lattice	
			P	C	I	F	R		a	b	c	α	β	γ		Int	Sch
			Triclinic	Trimetric	1	+						1	+	+		+	+
Monoclinic	Trimetric	2	+	+				1 or 2	+	+	+		+		$a \neq b \neq c, \alpha = \gamma = 90^\circ \neq \beta$	2/m	C _{2h}
Orthorhombic	Trimetric	4	+	+	+	+		1, 2 or 4	+	+	+				$a \neq b \neq c, \alpha = \beta = \gamma = 90^\circ$	mmm	D _{2h}
Trigonal (rhombohedral)	Dimetric	1					+	1	+			+			$a = b = c, 120^\circ > \alpha = \beta = \gamma \neq 90^\circ$	3m	D _{3d}
Tetragonal	Dimetric	2	+		+			1 or 2	+		+				$a = b \neq c, \alpha = \beta = \gamma = 90^\circ$	4/mmm	D _{4h}
Hexagonal	Dimetric	1	+					1	+		+				$a = b \neq c, \alpha = \beta = 90^\circ, \gamma = 120^\circ$	6/mmm	D _{6h}
Isometric (cubic)	Monometric	3	+		+	+		1, 2 or 4	+						$a = b = c, \alpha = \beta = \gamma = 90^\circ$	m3m	O _h

^a Designations of the space-lattice types: P — primitive, C — side-centered (base-centered), I — body-centered, F — face-centered, R — rhombohedral.

SYMMETRY OF CRYSTALS (continued)

TABLE 4
The Five Possible Regular Polyhedrons

Polyhedron	Symmetry (Schoenflies)		Form of faces	Number of ^a		
	Class	Elements		Faces (F)	Edges (E)	Vertices (V)
Tetrahedron	T	4C ₃ 3C ₂	Equilateral triangle	4	6	4
Cube (hexahedron)	O	3C ₄ 4C ₃ 6C ₂	Square	6	12	8
Octahedron	O	3C ₄ 4C ₃ 6C ₂	Equilateral triangle	8	12	6
Pentagonal dodecahedron	J	6C ₅ 10C ₃ 15C ₂	Regular pentagon	12	30	20
Icosahedron	J	6C ₅ 10C ₃ 15C ₂	Equilateral triangle	20	30	12

^a Per formula by Leonhard Euler: F + V - E = 2

TABLE 5
Classification of Crystals

Strukturbericht symbol	Structure name	Symmetry group		Pearson symbol ^a	Standard ASTM E157-82a symbol ^b
		International	Schoenflies		
1	2	3	4	5	6
A1	Cu	Fm3m	O _h ⁴	cF4	F
A2	W	Im3m	O _h ⁹	cI2	B
A3	Mg	P6 ₃ /mmc	D _{6h} ⁴	hP2	H
A4	C	Fd3m	O _h ⁷	cF8	F
A5	Sn	If ₁ /amd	D _{4h} ¹⁹	tI4	U
A6	In	I4/mmm	D _{4h} ¹⁷	tI2	U
A7	As	R3m	D _{3d} ⁵	hR2	R
A8	Se	P3 ₁ 21 or P3 ₂ 21	D ₃ ⁴ (D ₃ ⁶)	hP3	H
A10	Hg	R3m	D _{3d} ⁵	hR1	R
A11	Ga	Cmca	D _{2h} ¹⁸	oC8	Q
A12	α-Mn	I43m	T _d ³	cI58	B
A13	β-Mn	P4 ₁ 32	O ₇	cP20	C
A15	OW ₃	Pm3n	O _h ³	cP8	C
A20	α-U	Cmcm	D _{2h} ¹⁷	oC4	Q
B1	ClNa	Fm3m	O _h ⁵	cF8	F
B2	ClCs	Pm3m	O _h ¹	cP2	C
B3	SZn	F43m	T _d ²	cF8	F
B4	SZn	P6 ₃ mc	C _{6v} ⁴	hP4	H
B8 ₁	AsNi	P6 ₃ /mmc	D _{6h} ⁴	hP4	H
B8 ₂	InNi ₂	P6 ₃ /mmc	D _{6h} ⁴	hP6	H
B9	HgS	P3 ₁ 21 or P3 ₂ 21	D ₃ ⁴ or D ₃ ⁶	hP6	H
B10	OPb	P4/nmm	D _{4h} ⁷	tP4	T
B11	γ-CuTi	P4/nmm	D _{4h} ⁷	tP4	T
B13	NiS	R3m	D _{3d} ⁵	hR6	R
B16	GeS	Pnma	D _{2h} ¹⁶	oP8	O
B17	PtS	P4 ₂ /mmc	D _{4h} ⁹	tP4	T
B18	CuS	P6 ₃ /mmc	D _{6h} ⁴	hP12	H
B19	AuCd	Pmma	D _{2h} ⁵	oP4	O
B20	FeSi	P2 ₁ 3	T _d ⁴	cP8	C
B27	BFe	Pnma	D _{2h} ¹⁶	oP8	O
B31	MnP	Pnma	D _{2h} ¹⁶	oP8	O
B32	NaTl	Fd3m	O _h ⁷	cF16	F
B34	Pds	P4 ₂ /m	C _{2h} ²	tP16	T

SYMMETRY OF CRYSTALS (continued)

TABLE 5
Classification of Crystals (continued)

Strukturbericht symbol	Structure name	Symmetry group		Pearson symbol ^a	Standard ASTM E157-82a symbol ^b
		International	Schoenflies		
1	2	3	4	5	6
B35	CoSn	P6/mmm	D ¹ _{6h}	hP6	H
B37	SeTl	I4/mcm	D ¹⁸ _{4h}	tI16	U
B _e	CdSb	Pbca	D ¹⁵ _{2h}	oP16	O
B _r (B33)	ξ-BCr	Cmcm	D ¹⁷ _{2h}	oC8	Q
B _g	BMo	I4 ₁ /amd	D ¹⁹ _{4h}	tI4	U
B _h	CW	P6m2	D ¹ _{3h}	hP2	H
B _i	γ-CMo (AsTi)	P6 ₃ /mmc	D ⁴ _{6h}	hP8	H
C1	CaF ₂	Fm3m	O ⁵ _h	cF12	F
C1 _b	AgAsMg	F43m	T ² _d	cF12	F
C2	FeS ₂	Pa3	T ⁶ _h	cP12	C
C3	Cu ₂ O	Pn3m	O ⁴ _h	cP6	C
C4	O ₂ Ti	P4 ₂ /mnm	D ¹⁴ _{4h}	tP6	T
C6	CdI ₂	P3m1	D ³ _{3d}	hP3	H
C7	MoS ₂	P6 ₃ /mmc	D ⁴ _{6h}	hP6	H
C11 _a	C ₂ Ca	I4/mmm	D ¹⁷ _{4h}	tI6	U
C11 _b	MoSi ₂	I4/mmm	D ¹⁷ _{4h}	tI6	U
C12	CaSi ₂	R3m	D ⁵ _{3d}	hR6	R
C14	MgZn ₂	P6 ₃ /mmc	D ⁴ _{6h}	hP12	H
C15	Cu ₂ Mg	Fd3m	O ⁷ _h	cF24	F
C15 _b	AuBe ₅	F43m or F23	T ² _d or T ²	cF24	F
C16	Al ₂ Cu	I4/mcm	D ¹⁸ _{4h}	tI12	U
C18	FeS ₂	Pnmm	D ¹² _{2h}	oP6	O
C19	CdCl ₂	R3m	D ⁵ _{3d}	hR3	R
C22	Fe ₂ P	P26m	D ¹ _{3h}	hP9	H
C23	Cl ₂ Pb	Pnma	D ¹⁶ _{2h}	oP12	O
C32	AlB ₂	P6/mmm	D ¹ _{6h}	hP3	H
C33	Bi ₂ STe ₂	R3m	D ⁵ _{3d}	hR5	R
C34	AuTe ₂	C2/m (P2/m)	C ³ _{2h} (C ¹ _{2h})	mC6	N
C36	MgNi ₂	P6 ₃ /mmc	D ⁴ _{6h}	hP24	H
C38	Cu ₂ Sb	P4/nmm	D ⁷ _{4h}	tP6	T
C40	CrSi ₂	P6 ₂ 22	D ⁴ ₆	hP9	H
C42	SiS ₂	Ibam	D ²⁶ _{2h}	oI12	P
C44	GeS ₂	Fdd2	C ¹⁹ _{2v}	oF72	S
C46	AuTe ₂	Pma2	C ⁴ _{2v}	oP24	O
C49	Si ₂ Zr	Cmcm	D ¹⁷ _{2h}	oC12	Q
C54	Si ₂ Ti	Fddd	D ²⁴ _{2h}	oF24	S
C _c	Si ₂ Th	I4 ₁ /amd	D ¹⁹ _{4h}	tI12	U
C _e	CoGe ₂	Aba2	C ¹⁷ _{2v}	oC23	Q
DO ₂	As ₃ Co	Im3	T ⁵ _h	cI32	B
DO ₃	BiF ₃	Fm3m	O ⁵ _h	cF16	F
DO ₉	O ₃ Re	Pm3m	O ¹ _h	cP4	C
DO ₁₁	CFe ₃	Pnma	D ¹⁶ _{2h}	oP16	O
DO ₁₈	AsNa ₃	P6 ₃ /mmc	D ⁴ _{6h}	hP8	H
DO ₁₉	Ni ₃ Sn	P6 ₃ /mmc	D ⁴ _{6h}	hP8	H
DO ₂₀	Al ₃ Ni	Pnma	D ¹⁶ _{2h}	oP16	O
DO ₂₁	Cu ₃ P	P3c1	D ⁴ _{3d}	hP24	H
DO ₂₂	Cu ₃ P	I4/mmm	D ¹⁷ _{4h}	tI8	U
DO ₂₃	Al ₃ Zr	I4/mmm	D ¹⁷ _{4h}	tI16	U
DO ₂₄	Ni ₃ Ti	P6 ₃ /mmc	D ⁴ _{6h}	hP16	H
DO _c	SiU ₃	I4/mcm	D ¹⁸ _{4h}	tI16	U
DO _e	Ni ₃ P	I4	S ² ₄	tI32	U
D1 ₃	Al ₄ Ba	I4/mmm	D ¹⁷ _{4h}	tI10	U
D1 _a	MoNi ₄	I4/m	C ⁵ _{4h}	tI10	U

SYMMETRY OF CRYSTALS (continued)

TABLE 5
Classification of Crystals (continued)

Strukturbericht symbol	Structure name	Symmetry group		Pearson symbol ^a	Standard ASTM E157-82a symbol ^b
		International	Schoenflies		
1	2	3	4	5	6
D1 _b	Al ₄ U	Imma	D ²⁸ _{2h}	oI20	P
D1 _c	PtSn ₄	Aba2	C ¹⁷ _{2v}	oC20	Q
D1 _e	B ₄ Th	P4/mbm	D ⁵ _{4h}	tP20	T
D1 _f	BMn ₄	Fddd	D ²⁴ _{2h}	oF40	S
D2 ₁	B ₆ Ca	Pm3m	O ¹ _h	cP7	C
D2 ₃	NaZn ₁₃	Fm3m	O ⁵ _h	cF112	F
D2 _b	Mn ₁₂ Th	I4/mmm	D ¹⁷ _{4h}	tI26	U
D2 _c	MnU ₆	I4/mcm	D ¹⁸ _{4h}	tI28	U
D2 _d	CaCu ₅	P6/mmm	D ¹ _{6h}	hP6	H
D2 _f	B ₁₂ U	Fm3m	O ⁵ _h	cF52	F
D2 _h	Al ₆ Mn	Cmcm	D ¹⁷ _{2h}	oC28	Q
D5 ₁	α-Al ₂ O ₃	R3c	D ⁶ _{3d}	hR10	R
D5 ₂	La ₂ O ₃	P3m1	D ³ _{3d}	hP5	H
D5 ₃	Mn ₂ O ₃	Ia3	T ⁷ _h	cI80	B
D5 ₈	S ₃ Sb ₂	Pnma	D ¹⁶ _{2h}	oP20	O
D5 ₉	P ₂ Zn ₃	P4 ₂ /mmc	D ⁹ _{4h}	tP40	T
D5 ₁₀	C ₂ C ₃	Pnma	D ¹⁶ _{2h}	oP20	O
D5 ₁₃	Al ₃ Ni ₂	P3m1	D ³ _{3d}	hP5	H
D5 _a	Si ₂ U ₃	P4/mbm	D ⁵ _{4h}	tP10	T
D5 _c	C ₃ Pu ₂	I43d	T ⁶ _d	cI40	B
D7 ₁	Al ₄ C ₃	R3m	D ⁵ _{3d}	hR7	R
D7 ₃	P ₄ Th ₃	I43d	T ⁶ _d	cI28	B
D7 _b	B ₄ Ta ₃	Immm	D ²⁵ _{2h}	oI14	P
D8 ₁	Fe ₃ Zn ₁₀	Im3m	O ⁹ _h	cI52	B
D8 ₂	Cu ₅ Zn ₈	I43m	T ³ _d	cI52	B
D8 ₃	Al ₄ Cu ₉	P43m	T ¹ _d	cP52	C
D8 ₄	C ₆ Cr ₂₃	Fm3m	O ⁵ _h	cF116	F
D8 ₅	Fe ₇ W ₆	R3m	D ⁵ _{3d}	hR13	R
D8 ₆	Cu ₁₅ Si ₄	I43m	T ³ _d	cI76	B
D8 ₈	Mn ₅ Si ₃	P6 ₃ /mcm	D ³ _{6h}	hP16	H
D8 ₉	Co ₉ S ₈	Fm3m	O ⁵ _h	cF68	F
D8 ₁₀	Al ₈ Cr ₅	R3m	C ⁵ _{3v}	hR26	R
D8 ₁₁	Al ₅ Co ₂	P6 ₃ /mcm	D ³ _{6h}	hP28	H
D8 _a	Mn ₂₃ Th ₆	Fm3m	O ⁵ _h	cF116	F
D8 _b	σ-phase of Cr-Fe	p4 ₂ /mnm	D ¹⁴ _{4h}	tP30	T
D8 _e	(Al,Zn) ₄₉ Mg ₃₂	Im3	T ⁵ _h	cI162	B
D8 _f	Ge ₇ Ir ₃	Im3m	O ⁹ _h	cI40	B
D8 _h	B ₅ W ₂	P6 ₃ /mmc	D ⁴ _{6h}	hP14	H
D8 _i	B ₃ Mo ₂	R3m	D ⁵ _{3d}	hR7	R
D8 _l	B ₃ Cr ₅	I4/mcm	D ¹⁸ _{4h}	tI32	U
D8 _m	Si ₃ W ₅	I4/mcm	D ¹⁸ _{4h}	tI32	U
D10 ₁	C ₃ Cr ₇	P31c	C ⁴ _{3v}	hP80	H
D10 ₂	Fe ₃ Th ₇	P6 ₃ mc	C ⁴ _{6v}	hP20	H
E0 ₁	ClFPb	P4/nmm	D ⁷ _{4h}	tP6	T
E1 ₁	CuFeS ₂	I42d	D ¹² _{2d}	tI16	U
E2 ₁	CaO ₃ Ti	Pm3m	O ¹ _h	cP5	C
E2 ₄	S ₃ Sn ₂	Pnma	D ¹⁶ _{2h}	oP20	O
E3	Al ₂ CdS ₄	I4	S ² ₄	tI14	U
E9 ₃	SiFe ₃ W ₃	Fd3m	O ⁷ _h	cF112	F
E9 _a	Al ₇ Cu ₂ Fe	P4/mnc	D ⁶ _{4h}	tP40	T
E9 _b	AlLi ₃ N ₂	Ia3	T ⁷ _h	cI96	B
F0 ₁	NiSSb	P2 ₁ 3	T ⁴	cP12	C
F5 ₁	CrNaS ₂	R3m or R32	D ⁵ _{3d} or D ⁷ ₃	hR4	R
F5 ₆	CuS ₂ Sb	Pnma	D ¹⁶ _{2h}	oP16	O

SYMMETRY OF CRYSTALS (continued)

TABLE 5
Classification of Crystals (continued)

Strukturbericht symbol	Structure name	Symmetry group		Pearson symbol ^a	Standard ASTM E157-82a symbol ^b
		International	Schoenflies		
1	2	3	4	5	6
H1 ₁	Al ₂ MgO ₄	Fd3m	O ⁷ _h	cF56	F
H2 ₄	Cu ₃ S ₄ V	P43m	T ¹ _d	cP8	C
H2 ₅	AsCu ₃ S ₄	Pmn2 ₁	C ⁷ _{2v}	oP16	O
L1 ₀	AuCu	P4/mmm	D ¹ _{4h}	tP4	T
L1 ₂	AlCu ₃	Pm3m	O ¹ _h	cP4	C
L2 ₁	AlCu ₂ Mn	Fm3m	O ⁵ _h	cF16	F
L2 ₂	Sb ₂ Tl ₇	Im3m	O ⁹ _h	cI54	B
L'2 _b	H ₂ Th	I4/mmm	D ¹⁷ _{4h}	tI6	U
L'3	Fe ₂ N	P6 ₃ /mmc	D ⁴ _{6h}	hP3	H
L6 ₀	CuTi ₃	P4/mmm	D ¹ _{4h}	tP4	T

^a The first letter denotes the crystal system: triclinic (a), monoclinic (m), orthorhombic (o), tetragonal (t), hexagonal (h) and cubic (c). Trigonal (rhombohedral) system is presented by combination hR. The second letter of Pearson's symbol denotes lattice type: primitive (P), edge-(base)-centered (C), body-centered (I) or face-centered (F). The following number denotes amount of atoms in the crystal unit cell.

^b Standard ASTM E157-82a has the Bravais lattices designations as following: C — primitive cubic; B — body-centered cubic; F — face-centered cubic; T — primitive tetragonal; U — body-centered tetragonal; R — rhombohedral; H — hexagonal; O — primitive orthorhombic; P — body-centered orthorhombic; Q — base-centered orthorhombic; S — face-centered orthorhombic; M — primitive monoclinic; N — centered monoclinic; A — triclinic.

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IONIC RADII IN CRYSTALS

Ionic radii are a useful tool for predicting and visualizing crystal structures. This table lists a set of ionic radii R_i in Å units for the most common coordination numbers CN of positive and negative ions. The values are based on experimental crystal structure determinations, supplemented by empirical relationships, and theoretical calculations. The notation sq after the coordination number indicates a square configuration, while py indicates pyramidal.

The advice of Howard T. Evans and Marvin J. Weber in preparing this table is appreciated.

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Ion	CN	$R_i/\text{Å}$	Ion	CN	$R_i/\text{Å}$	Ion	CN	$R_i/\text{Å}$
Anions			C ⁺⁴	4	0.15	Er ⁺³	6	0.89
F ⁻¹	6	1.33		6	0.16		8	1.00
Cl ⁻¹	6	1.81	Ca ⁺²	6	1.00	Eu ⁺²	6	1.17
Br ⁻¹	6	1.96		8	1.12		8	1.25
I ⁻¹	6	2.20		10	1.23		10	1.35
OH ⁻¹	4	1.35		12	1.34	Eu ⁺³	6	0.95
	6	1.37	Cd ⁺²	4	0.78		8	1.07
O ⁻²	2	1.21		6	0.95	F ⁺⁷	6	0.08
	6	1.40		8	1.10	Fe ⁺²	4	0.63
	8	1.42		12	1.31		6	0.61
S ⁻²	6	1.84	Ce ⁺³	6	1.01		8	0.92
Se ⁻²	6	1.98		8	1.14	Fe ⁺³	4	0.49
Te ⁻²	6	2.21		10	1.25		6	0.55
				12	1.34		8	0.78
Cations			Ce ⁺⁴	6	0.87	Fr ⁺¹	6	1.80
Ac ⁺³	6	1.12		8	0.97	Ga ⁺³	4	0.47
Ag ⁺¹	4	1.00		10	1.07		6	0.62
	6	1.15		12	1.14	Gd ⁺³	6	0.94
	8	1.28	Cf ⁺³	6	0.95		8	1.05
Ag ⁺²	4sq	0.79	Cf ⁺⁴	6	0.82	Ge ⁺²	6	0.73
	6	0.94		8	0.92	Ge ⁺⁴	4	0.39
Al ⁺³	4	0.39	Cl ⁺⁵	3py	0.12		6	0.53
	5	0.48	Cl ⁺⁷	4	0.08	Hf ⁺⁴	4	0.58
	6	0.54	Cm ⁺³	6	0.97		6	0.71
Am ⁺³	6	0.98	Cm ⁺⁴	6	0.85		8	0.83
	8	1.09		8	0.95	Hg ⁺¹	6	1.19
Am ⁺⁴	6	0.85	Co ⁺²	4	0.56	Hg ⁺²	2	0.69
	8	0.95		6	0.65		4	0.96
As ⁺³	6	0.58		8	0.90		6	1.02
As ⁺⁵	4	0.34	Co ⁺³	6	0.55		8	1.14
	6	0.46	Cr ⁺²	6	0.73	I ⁺⁵	3py	0.44
Au ⁺¹	6	1.37	Cr ⁺³	6	0.62		6	0.95
Au ⁺³	4sq	0.64	Cr ⁺⁴	4	0.41	I ⁺⁷	4	0.42
	6	0.85		6	0.55		6	0.53
Ba ⁺²	6	1.35	Cr ⁺⁶	4	0.26	In ⁺³	4	0.62
	8	1.42		6	0.44		6	0.80
	12	1.61	Cs ⁺¹	6	1.67	Ir ⁺³	6	0.68
Be ⁺²	4	0.27		8	1.74	Ir ⁺⁴	6	0.63
	6	0.45		10	1.81	Ir ⁺⁵	6	0.57
Bi ⁺³	5	0.96		12	1.88	K ⁺¹	4	1.37
	6	1.03	Cu ⁺¹	2	0.46		6	1.38
	8	1.17		4	0.60		8	1.51
Bi ⁺⁵	6	0.76		6	0.77		12	1.64
Bk ⁺³	6	0.96	Cu ⁺²	4sq	0.57	La ⁺³	6	1.03
Bk ⁺⁴	6	0.83		6	0.73		8	1.16
	8	0.93	Dy ⁺²	6	1.07		10	1.27
Br ⁺⁵	3py	0.31		8	1.19		12	1.36
Br ⁺⁷	4	0.25	Dy ⁺³	6	0.91	Li ⁺¹	4	0.59
	6	0.39		8	1.03		6	0.76

IONIC RADII IN CRYSTALS (continued)

Ion	CN	$R_f/\text{\AA}$	Ion	CN	$R_f/\text{\AA}$	Ion	CN	$R_f/\text{\AA}$
Lu ⁺³	8	0.92		6	0.78	Sr ⁺²	6	1.18
	6	0.86		8	0.94		8	1.26
	8	0.97	Pd ⁺²	4sq	0.64		10	1.36
Mg ⁺²	4	0.57		6	0.86		12	1.44
	6	0.72	Pd ⁺³	6	0.76	Ta ⁺³	6	0.72
	8	0.89	Pd ⁺⁴	6	0.62	Ta ⁺⁴	6	0.68
Mn ⁺²	4	0.66	Pm ⁺³	6	0.97	Ta ⁺⁵	6	0.64
	6	0.83		8	1.09	Tb ⁺³	6	0.92
	8	0.96	Po ⁺⁴	6	0.97		8	1.04
Mn ⁺³	6	0.58	Pr ⁺³	6	0.99	Tb ⁺⁴	6	0.76
Mn ⁺⁴	4	0.39		8	1.13		8	0.88
	6	0.53	Pr ⁺⁴	6	0.85	Tc ⁺⁴	6	0.65
Mn ⁺⁵	4	0.33		8	0.96	Te ⁺⁴	4	0.66
Mn ⁺⁶	4	0.26	Pt ⁺²	4sq	0.60		6	0.97
Mn ⁺⁷	4	0.25		6	0.80	Te ⁺⁶	4	0.43
Mo ⁺³	6	0.69	Pt ⁺⁴	6	0.63		6	0.56
Mo ⁺⁴	6	0.65	Pu ⁺³	6	1.00	Th ⁺⁴	6	0.94
Mo ⁺⁵	4	0.46	Pu ⁺⁴	6	0.86		8	1.05
	6	0.61	Pu ⁺⁵	6	0.74		10	1.13
Mo ⁺⁶	4	0.41	Pu ⁺⁶	6	0.71		12	1.21
	6	0.59	Ra ⁺²	8	1.48	Ti ⁺²	6	0.86
	7	0.73		12	1.70	Ti ⁺³	6	0.67
N ⁺³	6	0.16	Rb ⁺¹	6	1.52	Ti ⁺⁴	4	0.42
N ⁺⁵	6	0.13		8	1.61		6	0.61
Na ⁺¹	4	0.99		10	1.66		8	0.74
	6	1.02		12	1.72	Tl ⁺¹	6	1.50
	8	1.18	Re ⁺⁴	6	0.63		8	1.59
	9	1.24	Re ⁺⁵	6	0.58		12	1.70
	12	1.39	Re ⁺⁶	6	0.55	Tl ⁺³	4	0.75
Nb ⁺³	6	0.72	Re ⁺⁷	4	0.38		6	0.89
	8	0.79		6	0.53		8	0.98
Nb ⁺⁴	6	0.68	Rh ⁺³	6	0.67	Tm ⁺²	6	1.01
Nb ⁺⁵	4	0.48	Rh ⁺⁴	6	0.60		7	1.09
	6	0.64	Rh ⁺⁵	6	0.55	Tm ⁺³	6	0.88
	8	0.74	Ru ⁺³	6	0.68		8	0.99
Nd ⁺³	6	0.98	Ru ⁺⁴	6	0.62	U ⁺³	6	1.03
	8	1.12	Ru ⁺⁵	6	0.57	U ⁺⁴	6	0.89
	9	1.16	Ru ⁺⁷	4	0.38		8	1.00
	12	1.27	Ru ⁺⁸	4	0.36		12	1.17
Ni ⁺²	4sq	0.49	S ⁺⁴	6	0.37	U ⁺⁵	6	0.76
	6	0.69	S ⁺⁶	4	0.12	U ⁺⁶	2	0.45
Ni ⁺³	6	0.56		6	0.29		4	0.52
Np ⁺³	6	1.01	Sb ⁺³	4py	0.76		6	0.73
Np ⁺⁴	6	0.87		6	0.76		8	0.86
Np ⁺⁵	6	0.75	Sb ⁺⁵	6	0.60	V ⁺²	6	0.79
Np ⁺⁶	6	0.72	Sc ⁺³	6	0.75	V ⁺³	6	0.64
Os ⁺⁴	6	0.63		8	0.87	V ⁺⁴	5	0.53
Os ⁺⁵	6	0.58	Se ⁺⁴	6	0.50		6	0.58
Os ⁺⁶	6	0.55	Se ⁺⁶	4	0.28		8	0.72
Os ⁺⁸	4	0.39		6	0.42	V ⁺⁵	4	0.36
P ⁺⁵	4	0.17	Si ⁺⁴	4	0.26		5	0.46
	6	0.38		6	0.40		6	0.54
Pa ⁺³	6	1.04	Sm ⁺²	6	1.19	W ⁺⁴	6	0.66
Pa ⁺⁴	6	0.90		8	1.27	W ⁺⁵	6	0.62
Pa ⁺⁵	6	0.78	Sm ⁺³	6	0.96	W ⁺⁶	4	0.42
Pb ⁺²	6	1.19		8	1.08		5	0.51
	8	1.29		12	1.24		6	0.60
	10	1.40	Sn ⁺⁴	4	0.55	Y ⁺³	6	0.90
	12	1.49		6	0.69		8	1.02
Pb ⁺⁴	4	0.65		8	0.81		9	1.08

IONIC RADII IN CRYSTALS (continued)

Ion	CN	$R_i/\text{\AA}$	Ion	CN	$R_i/\text{\AA}$	Ion	CN	$R_i/\text{\AA}$
Yb ⁺²	6	1.02	Zn ⁺²	4	0.60		6	0.72
	8	1.14		6	0.74		8	0.84
Yb ⁺³	8	0.99		8	0.90		9	0.89
	9	1.04	Zr ⁺⁴	4	0.59			

POLARIZABILITIES OF ATOMS AND IONS IN SOLIDS

H. P. R. Frederikse

The polarization of a solid dielectric medium, \mathbf{P} , is defined as the dipole moment per unit volume averaged over the volume of a crystal cell. A component of \mathbf{P} can be expanded as a function of the electric field \mathbf{E} :

$$P_i = \sum_j a_j E_j + \sum_{jk} b_{jk} E_j E_k$$

For relatively small electric fields in isotropic substances $\mathbf{P} = \chi_e \mathbf{E}$, where χ_e is the electric susceptibility. If the medium is made up of N atoms (or ions) per unit volume, the polarization is $\mathbf{P} = N \mathbf{p}_m$ where \mathbf{p}_m is the average dipole moment per atom. The polarizability α can be defined as $\mathbf{p}_m = \alpha \mathbf{E}_0$, where \mathbf{E}_0 is the local field at the position of the atom. Using the Lorentz method to calculate the local field one finds:

$$\mathbf{P} = N\alpha(\mathbf{E} + 4\pi\mathbf{P}) = \chi_e \mathbf{E}$$

Together with the definition of the dielectric constant (relative permittivity), $\epsilon = 1 + 4\pi\chi_e$, this leads to:

$$\alpha = \frac{3}{4\pi N} \left(\frac{\epsilon - 1}{\epsilon + 2} \right)$$

This expression is known as the Clausius-Mossotti equation.

The total polarization associated with atoms, ions, or molecules is due to three different sources:

1. Electronic polarization arises because the center of the local electronic charge cloud around the nucleus is displaced under the action of the field: $P_e = N\alpha_e E_0$ where α_e is the *electronic polarizability*.
2. Ionic polarization occurs in ionic materials because the electric field displaces cations and anions in opposite directions: $P_i = N\alpha_i E_0$, where α_i is the *ionic polarizability*.
3. Orientational polarization can occur in substances composed of molecules that have permanent electric dipoles. The alignment of these dipoles depends on temperature and leads to an *orientational polarizability* per molecule: $\alpha_{or} = p^2/3kT$, where p is the permanent dipole moment per molecule, k is the Boltzmann constant, and T is the temperature.

Because of the different nature of these three polarization processes the response of a dielectric solid to an applied electric field will strongly depend on the frequency of the field. The resonance of the electronic excitation in insulators (dielectrics) takes place in the ultraviolet part of the spectrum; the characteristic frequency of the lattice vibrations is located in the infrared, while the orientation of dipoles requires fields of much lower frequencies (below 10^{10} Hz). This response to electric fields of different frequencies is shown in Figure 1. Values of the electronic polarizabilities for selected atoms and ions are given in Table 1.

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POLARIZABILITIES OF ATOMS AND IONS IN SOLIDS (continued)

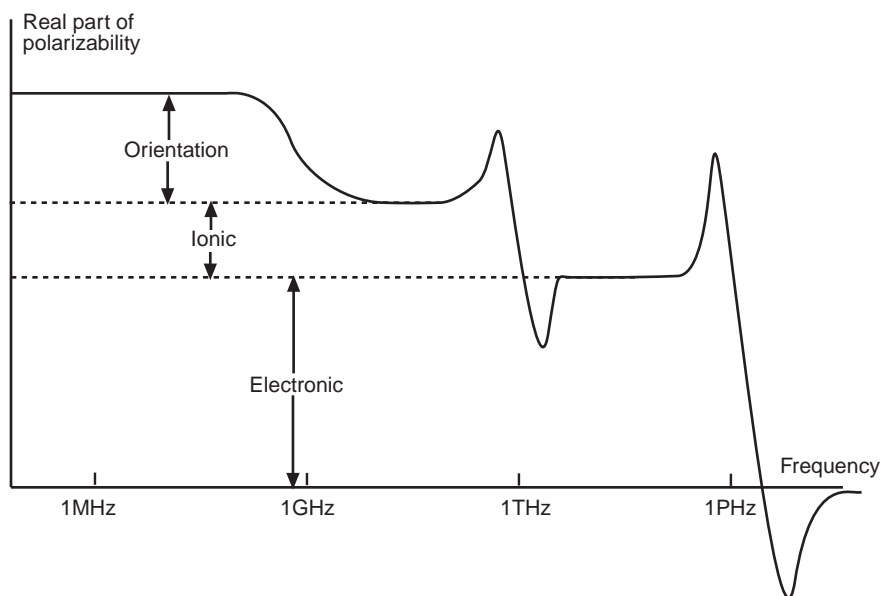


Figure 1. Schematic graph of the frequency dependence of the different contributions to polarizability.

TABLE 1
Electronic Polarizabilities in Units of 10^{-24} cm^3

						He 0.201
Li⁺ 0.029	Be²⁺ 0.008	B³⁺ 0.003	C⁴⁺ 0.0013	O²⁻ 3.88	F⁻ 1.04	Ne 0.39
Na⁺ 0.179	Mg²⁺ 0.094	Al³⁺ 0.052	Si⁴⁺ 0.0165	S²⁻ 10.2	Cl⁻ 3.66	Ar 1.62
K⁺ 0.83	Ca²⁺ 0.47	Sc³⁺ 0.286	Ti⁴⁺ 0.185	Se²⁻ 10.5	Br⁻ 4.77	Kr 2.46
Rb⁺ 1.40	Sr²⁺ 0.86	Y³⁺ 0.55	Zr⁴⁺ 0.37	Te²⁻ 14.0	I⁻ 7.1	Xe 3.99
Cs⁺ 2.42	Ba²⁺ 1.55	La³⁺ 1.04	Ce⁴⁺ 0.73			

Data from Pauling, L., *Proc. R. Soc. London*, A114, 181, 1927. See also Jaswal, S.S. and Sharma, T.P., *J. Phys. Chem. Solids*, 34, 509, 1973.

Values are appropriate for cgs units. To convert to SI, use the relation
 $\alpha(\text{SI})/\text{C m}^2\text{V}^{-1} = 1.11265 \cdot 10^{-16} \alpha(\text{cgs})/\text{cm}^3$

CRYSTAL STRUCTURES AND LATTICE PARAMETERS OF ALLOTROPES OF THE ELEMENTS

H. W. King

The crystal structures of the allotropic forms of the elements are presented in terms of the Pearson symbol, the Strukturbericht designation, and the prototype of the structure. The temperatures of the phase transformations are listed in degrees Celsius and the pressures are in GPa. A consistent nomenclature is used, whereby all allotropes are labeled by Greek letters. The lattice parameters of the unit cells are given in nanometers (nm) and are considered to be accurate to ± 2 in the last reported digit.

This compilation is restricted to changes in crystal structure that occur as a result of a change in temperature or pressure. Low-temperature structures are included for the diatomic and rare gases, which show many similarities with respect to the metallic elements. The elements identified with an asterisk (*) have polymorphic structures based on different molecular configurations. The crystal data given for these elements refer to the most stable structure at room temperature.

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Element	Temperature, °C	Pressure, GPa	Pearson symbol	Space group	Strukturbericht designation	Prototype	Lattice parameters, nm			Comment, c/a or α or β
							a	b	c	
Ac	25	atm	cF4	Fm3m	A1	Cu	0.5311	...	...	...
Ag	25	atm	cF4	Fm3m	A1	Cu	0.40857	...	...	...
α Al	25	atm	cF4	Fm3m	A1	Cu	0.40496	...	...	...
β Al	25	>20.5	hP2	P6 ₃ /mmc	A3	Mg	0.2693	...	0.4398	1.6331
α' Am	25	atm	hP4	P6 ₃ /mmc	A3'	α La	0.34681	...	1.1241	2*1.621
α Am	>769	atm	cF4	Fm3m	A1	Cu	0.4894	...	...	...
β Am	>1074	atm	cI2	Im3m	A2	W	?	...	...	...
γ Am	25	>15	oC4	Cmcm	A20	α U	0.3063	0.5968	0.5169	...
α Ar	<-189.35	atm	cF4	Fm3m	A1	Cu	0.5316	...	...	...
(β Ar)	<-189.40	atm	hP2	P6 ₃ /mmc	A3	Mg	0.3760	...	0.6141	1.633
α As	25	atm	hR2	R3m	A7	α As	0.41319	...	...	$\alpha = 54.12^\circ$
ϵ As	>448	atm	oC8	Cmca	...	P (black)	0.362	1.085	0.448	...
Au	25	atm	cF4	Fm3m	A1	Cu	0.40782	...	...	...
β B	25	atm	hR105	R3m	...	β B	1.017	...	...	$\alpha = 65.12^\circ$
α Ba	25	atm	cI2	Im3m	A2	W	0.50227	...	...	...
β Ba	25	>5.33	hP2	P6 ₃ /mmc	A3	Mg	0.3901	...	0.6154	1.5775
γ Ba	25	>23	?	?	...	...	...	...	...	...
α Be	25	atm	hP2	P6 ₃ /mmc	A3	Mg	0.22859	...	0.35845	1.5681
β Be	>1270	atm	cI2	Im3m	A2	W	0.25515	...	...	...
γ Be	25	>9.3	?	...	...	...	...	...	...	...
α Bi	25	atm	hR2	R3m	A7	α As	0.47460	...	...	$\alpha = 57.23^\circ$
β Bi	25	>2.6	mC4	C2/m	...	β Bi	0.6674	0.6117	0.3304	$\beta = 110.33^\circ$
γ Bi	25	>3.0	mP3	?	...	...	0.605	0.42	0.465	$\beta = 85.33^\circ$
σ Bi	25	>4.3	?	?	...	...	...	...	...	...
ϵ Bi	25	>6.5	?	?	...	...	...	...	...	...
ζ Bi	25	>9.0	cI2	Im3m	A2	W	0.3800	...	...	...
α Bk	25	atm	hP4	P6 ₃ /mmc	A3'	α La	0.3416	...	1.1069	2*1.620
β Bk	>977	atm	cF4	Fm3m	A1	Cu	0.4997	...	...	...
Br	<7.25	atm	oC8	Cmca	...	Cl	0.668	0.449	0.874	...
C (graphite)	25	atm	hP4	P6 ₃ /mmc	A9	C (graphite)	0.24612	...	0.6709	2.7258
C (diamond)	25	>60	cF8	Fd3m	A4	C (diamond)	0.35669	...	...	...
C (hd)	25	HP	hP4	P6 ₃ /mmc	...	C (hd)	0.2522	...	0.4119	1.633
α Ca	25	atm	cF4	Fm3m	A1	Cu	0.55884	...	...	...
β Ca	>443	atm	cI2	Im3m	A2	W	0.4480	...	...	...
γ Ca	25	>1.5	?	...	...	...	...	...	...	...
Cd	25	atm	hP2	P6 ₃ /mmc	A3	Mg	0.29793	...	0.56196	1.8862
α Ce	<-177	atm	cF4	Fm3m	A1	Cu	0.485	...	...	...
β Ce	25	atm	hP4	P6 ₃ /mmc	A3'	α La	0.36810	...	1.1857	2*1.611
γ Ce	25	atm	cF4	Fm3m	A1	Cu	0.51610	...	...	...
δ -Ce	>726	atm	cI2	Im3m	A2	W	0.412	...	...	...
α' Ce	25	>5.4	oC4	Cmcm	A20	α U	0.3049	0.5998	0.5215	...
α Cf	25	atm	hP4	P6 ₃ /mmc	A3'	α La	0.339	...	1.1015	2*1.625
β Cf	>590	atm	cF4	Fm3m	A1	Cu	?	...	...	...
Cl	25	atm	oC8	Cmca	...	Cl	0.624	0.448	0.826	...
α Cm	25	atm	hP4	P6 ₃ /mmc	A3'	α La	0.3496	...	1.1331	2*1.621
β Cm	>1277	atm	cF4	Fm3m	A1	Cu	0.4382	...	...	...
ϵ Co	25	atm	hP2	P6 ₃ /mmc	A3	Mg	0.25071	...	0.40686	1.6228
α Co	>422	atm	cF4	Fm3m	A1	Cu	0.35447	...	...	...
α Cr	25	atm	cI2	Im3m	A2	W	0.28848	...	...	...
α' Cr	25	HP	hI2	I4/mnm	...	α' Cr	0.2882	...	0.2887	1.002
α Cs	25	atm	cI2	Im3m	A2	W	0.6141	...	...	...
β Cs	25	>2.37	cF4	Fm3m	A1	Cu	0.6465	...	...	...
β' Cs	25	>4.22	cF4	Fm3m	A1	Cu	0.5800	...	...	...
γ Cs	25	>4.27	?	...	...	...	...	...	...	...
Cu	25	atm	cF4	Fm3m	A1	Cu	0.36146	...	...	...
α' Dy	<-187	atm	oC4	Cmcm	...	α' Dy	0.3595	0.6184	0.5678	...
α Dy	25	atm	hP2	P6 ₃ /mmc	A3	Mg	0.35915	...	0.56501	1.5732

LATTICE ENERGIES

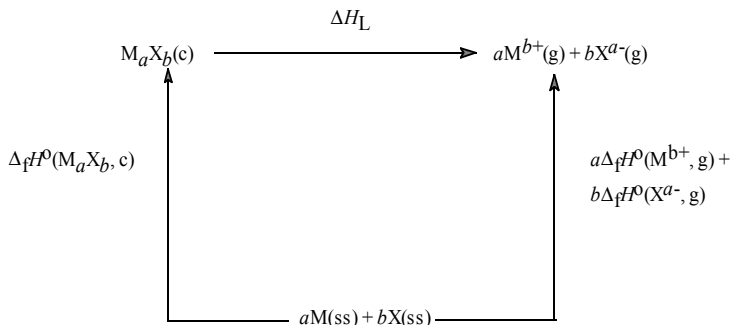
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THERMOCHEMICAL CYCLE AND CALCULATED VALUES

Table 1 contains calculated values of the lattice energies (total lattice potential energies), U_{POT} , of crystalline salts, M_aX_b . U_{POT} is expressed in units of kilojoules per mole, kJ mol^{-1} . M and X can be either simple or complex ions. Substances are arranged by chemical class.

Also listed in the table is the lattice energy, $U_{\text{POT}}^{\text{BFHC}}$, obtained from the application of the Born - Fajans - Haber cycle (BFHC) described below, using the "Standard Thermochemical Properties of Chemical Substances" table in Section 5 of this *Handbook*, References 1 through 4, and certain other data which are given in Table 3 below.

The lattice enthalpy, ΔH_L , is given by the cycle:



where (ss) is the standard state of the element concerned.

The lattice enthalpy, ΔH_L , is obtained using the equation:

$$\Delta H_L = a\Delta_f H^0(\text{M}^{b+}, \text{g}) + b\Delta_f H^0(\text{X}^{a-}, \text{g}) - \Delta_f H^0(\text{M}_a\text{X}_b, \text{c})$$

and is further related to the total lattice potential energy, U_{POT} , by the relationship:

$$\Delta H_L = U_{\text{POT}} + \left[a \left(\frac{n_M}{2} - 2 \right) + b \left(\frac{n_X}{2} - 2 \right) \right] RT$$

where n_M and n_X equal 3 for monatomic ions, 5 for linear polyatomic ions and 6 for polyatomic non-linear ions.

METHOD OF ESTIMATION OF VALUES NOT TABULATED

In cases where the lattice energy is not tabulated and we want to furnish an estimate, then the Kapustinskii equation⁵ can be used to obtain a value (in kJ mol^{-1}):

$$U_{\text{POT}} = \frac{121.4z_a z_b v}{(r_a + r_b)} \left(1 - \frac{0.0345}{(r_a + r_b)} \right)$$

where z_a and z_b are the moduli of the charges on the v ions in the lattice and r_a and r_b (in nm) are the thermochemical radii given in Table 2. The r_a for metal ions is taken to be the Goldschmidt⁶ radius.

To cite an example, if we wish to estimate the lattice energy of the salt $[\text{NH}_4^+][\text{HF}_2^-]$ using the above procedure, we see that Table 2 gives the thermochemical radius (r_a) for NH_4^+ to be 0.136 nm and that for HF_2^- (r_b) to be 0.172 nm. The lattice potential energy is then estimated to be 700 kJ mol^{-1} compared with the calculated value of 705 kJ mol^{-1} and the Born - Fajans - Haber cycle value of 658 kJ mol^{-1} .

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LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
Acetates					
Li(CH ₃ COO)	-	843	TbB ₆	7489	-
Na(CH ₃ COO)	828	807	DyB ₆	7489	-
K(CH ₃ COO)	749	726	HoB ₆	7489	-
Rb(CH ₃ COO)	715	-	ErB ₆	7489	-
Cs(CH ₃ COO)	682	-	TmB ₆	7489	-
Acetylides			YbB ₆	5146	-
CaC ₂	2911	2902	LuB ₆	7489	-
SrC ₂	2788	2782	ThB ₆	10167	-
BaC ₂	2647	2652	Borohydrides		
Azides			LiBH ₄	778	-
LiN ₃	861	875	NaBH ₄	703	694
NaN ₃	770	784	KBH ₄	655	638
KN ₃	697	-	RbBH ₄	648	-
RbN ₃	674	691	CsBH ₄	628	-
CsN ₃	665	674	Borohalides		
AgN ₃	854	910	LiBF ₄	699	749
TlN ₃	689	742	NaBF ₄	657	674
Ca(N ₃) ₂	2186	2316	KBF ₄	611	616
Sr(N ₃) ₂	2056	2187	RbBF ₄	577	590
Ba(N ₃) ₂	2021	-	CsBF ₄	556	565
Mn(N ₃) ₂	2408	2348	NH ₄ BF ₄	582	-
Cu(N ₃) ₂	2730	2738	KBCl ₄	506	497
Zn(N ₃) ₂	2840	2970	RbBCl ₄	489	486
Cd(N ₃) ₂	2446	2576	CsBCl ₄	473	-
Pb(N ₃) ₂	-	2300	Carbonates		
Bihalide Salts			Li ₂ CO ₃	2523	2254
LiHF ₂	821	847	Na ₂ CO ₃	2301	2016
NaHF ₂	755	748	K ₂ CO ₃	2084	1846
KHF ₂	657	660	Rb ₂ CO ₃	2000	1783
RbHF ₂	627	631	Cs ₂ CO ₃	1920	1722
CsHF ₂	607	-	MgCO ₃	3138	3122
NH ₄ HF ₂	705	658	CaCO ₃	2804	2811
CsHCl ₂	601	-	SrCO ₃	2720	2688
Me ₄ NHCl ₂	427	-	BaCO ₃	2615	2554
Et ₄ NHCl ₂	346	-	MnCO ₃	3046	3092
Bu ₄ NHCl ₂	290	-	FeCO ₃	3121	3169
Bicarbonates			CoCO ₃	3443	3235
NaHCO ₃	820	656	CuCO ₃	3494	-
KHCO ₃	741	573	ZnCO ₃	3121	3273
RbHCO ₃	707	522	CdCO ₃	2929	3052
CsHCO ₃	678	520	SnCO ₃	2904	-
NH ₄ HCO ₃	-	577	PbCO ₃	2728	2750
Borides			Cyanates		
CaB ₆	5146	-	LiNCO	849	-
SrB ₆	5104	-	NaNCO	807	816
BaB ₆	5021	-	KNCO	726	734
YB ₆	7447	-	RbNCO	692	-
LaB ₆	7406	-	CsNCO	661	-
CeB ₆	10083	-	NH ₄ NCO	724	-
PrB ₆	7447	—	Cyanides		
NdB ₆	7447	-	LiCN	874	-
PmB ₆	7406	-	NaCN	766	759
SmB ₆	7447	-	KCN	692	686
EuB ₆	5104	-	RbCN	638	-
GdB ₆	7489	-	CsCN	601	-
			Ca(CN) ₂	2268	2240

LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹) (continued)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
Sr(CN) ₂	2138	-	FrBr	611	-
Ba(CN) ₂	2001	2009	FrI	582	-
NH ₄ CN	617	691	CuCl	992	996
AgCN	(741)	935	CuBr	969	978
Zn(CN) ₂	2809	2817	CuI	948	966
Cd(CN) ₂	2583	2591	AgF	953	974
Formates			AgCl	910	918
Li(HCO ₂)	865	-	AgBr	897	905
Na(HCO ₂)	791	804	AgI	881	892
K(HCO ₂)	713	722	AuCl	1013	1066
Rb(HCO ₂)	685	-	AuBr	1029	1059
Cs(HCO ₂)	651	-	AuI	1027	1070
NH ₄ (HCO ₂)	715	-	InCl	-	764
Germanates			InBr	-	767
Mg ₂ GeO ₄	7991	-	InI	-	733
Ca ₂ GeO ₄	7301	7306	TlF	-	850
Sr ₂ GeO ₄	6987	-	TlCl	738	751
Ba ₂ GeO ₄	6653	6643	TlBr	720	734
Halates			TlI	692	710
LiBrO ₃	883	880	Me ₄ NCl	566	-
NaBrO ₃	803	791	Me ₄ NBr	553	-
KBrO ₃	740	722	Me ₄ NI	544	-
RbBrO ₃	720	705	PH ₄ Br	616	-
CsBrO ₃	694	681	PH ₄ I	590	-
NaClO ₃	770	785	BeF ₂	3464	3526
KClO ₃	711	721	BeCl ₂	3004	3033
RbClO ₃	690	703	BeBr ₂	2950	2914
CsClO ₃	-	679	BeI ₂	2780	2813
LiIO ₃	975	974	MgF ₂	2926	2978
NaIO ₃	883	876	MgCl ₂	2477	2540
KIO ₃	820	780	MgBr ₂	2406	2451
RbIO ₃	791	-	MgI ₂	2293	2340
CsIO ₃	761	-	CaF ₂	2640	2651
Halides			CaCl ₂	2268	2271
LiF	1030	1049	CaBr ₂	2132	-
LiCl	834	864	CaI ₂	1971	2087
LiBr	788	820	SrF ₂	2476	2513
LiI	730	764	SrCl ₂	2142	2170
NaF	910	930	SrI ₂	1984	1976
NaCl	769	790	BaF ₂	2347	2373
NaBr	732	754	BaCl ₂	2046	2069
NaI	682	705	BaBr ₂	1971	1995
KF	808	829	BaI ₂	1862	1890
KCl	701	720	RaF ₂	2284	-
KBr	671	691	RaCl ₂	2004	-
KI	632	650	RaBr ₂	1929	-
RbF	774	795	RaI ₂	1803	-
RbCl	680	695	ScCl ₂	2380	-
RbBr	651	668	ScBr ₂	2291	-
RbI	617	632	ScI ₂	2201	-
CsF	744	759	TiF ₂	2724	-
CsCl	657	670	TiCl ₂	2439	2514
CsBr	632	647	TiBr ₂	2360	2430
CsI	600	613	TiI ₂	2259	2342
FrF	715	-	VCl ₂	2607	2593
FrCl	632	-	VBr ₂	-	2534

LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹) (continued)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
VI ₂	-	2470	YF ₃	4983	-
CrF ₂	2778	2939	YCl ₃	4506	4524
CrCl ₂	2540	2601	YI ₃	4240	4258
CrBr ₂	2377	2536	TiF ₃	5644	-
CrI ₂	2269	2440	TiCl ₃	5134	5153
MoCl ₂	2737	2746	TiBr ₃	5012	5023
MoBr ₂	2742	2753	TiI ₃	4845	-
MoI ₂	2630	-	ZrCl ₃	-	4791
MnF ₂	2644	-	ZrBr ₃	-	4758
MnCl ₂	2510	2551	ZrI ₃	-	4591
MnBr ₂	2448	2482	VF ₃	5895	-
MnI ₂	2212	-	VCl ₃	5322	5329
FeF ₂	2849	2967	VBr ₃	5214	5224
FeCl ₂	2569	2641	VI ₃	5121	5136
FeBr ₂	2515	2577	NbCl ₃	5062	-
FeI ₂	2439	2491	NbBr ₃	4980	-
CoF ₂	3004	3042	NbI ₃	4860	-
CoCl ₂	2707	2706	CrF ₃	6033	6065
CoBr ₂	2640	2643	CrCl ₃	5518	5529
CoI ₂	2569	2561	CrBr ₃	5355	-
NiF ₂	3098	3089	CrI ₃	5275	5294
NiCl ₂	2753	2786	MoF ₃	6459	-
NiBr ₂	2729	2721	MoCl ₃	5246	5253
NiI ₂	2607	2637	MoBr ₃	5156	-
PdCl ₂	2778	2818	MoI ₃	5073	-
PdBr ₂	2741	2751	MnF ₃	6017	-
PdI ₂	2748	2760	MnCl ₃	5544	-
CuF ₂	3046	3102	MnBr ₃	5448	-
CuCl ₂	2774	2824	MnI ₃	5330	-
CuBr ₂	2715	2774	TcCl ₃	5270	-
CuI ₂	2640	-	TcBr ₃	5215	-
AgF ₂	2942	2967	TcI ₃	5188	-
ZnF ₂	3021	3053	FeF ₃	5870	-
ZnCl ₂	2703	2748	FeCl ₃	5364	5436
ZnBr ₂	2648	2689	FeBr ₃	5333	5347
ZnI ₂	2581	2619	FeI ₃	5117	-
CdF ₂	2809	2830	RuCl ₃	5245	5257
CdCl ₂	2552	2565	RuBr ₃	5223	5232
CdBr ₂	2507	2517	RuI ₃	5222	5235
CdI ₂	2441	2455	CoF ₃	5991	-
HgF ₂	2757	-	RhCl ₃	5641	5665
HgCl ₂	2657	2664	IrF ₃	(6112)	-
HgBr ₂	2628	2639	IrBr ₃	(4794)	-
HgI ₂	2628	2624	NiF ₃	(6111)	-
SnF ₂	2551	-	AuF ₃	(5777)	-
SnCl ₂	2297	2310	AuCl ₃	(4605)	-
SnBr ₂	2251	2256	ZnCl ₃	5832	-
SnI ₂	2193	2206	ZnBr ₃	5732	-
PbF ₂	2535	2543	ZnI ₃	5636	-
PbCl ₂	2270	2282	AlF ₃	5924	6252
PbBr ₂	2219	2230	AlCl ₃	5376	5513
PbI ₂	2163	2177	AlBr ₃	5247	5360
ScF ₃	5492	5540	AlI ₃	5070	5227
ScCl ₃	4874	4901	GaF ₃	5829	6238
ScBr ₃	4729	4761	GaCl ₃	5217	5665
ScI ₃	4640	-	GaBr ₃	4966	5569

LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹) (continued)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
GaI ₃	4611	5496	CrF ₂ Br	5753	-
InCl ₃	4736	5183	CrF ₂ I	5669	-
InBr ₃	4535	5117	CrCl ₂ Br	5448	-
InI ₃	4234	5001	CrCl ₂ I	5381	5429
TlF ₃	5493	-	CrBr ₂ I	5330	5370
TlCl ₃	5258	5278	CuFCl	2891	-
TlBr ₃	5171	-	CuFBr	2853	-
TlI ₃	5088	-	CuFI	2803	-
AsBr ₃	5497	5365	CuClBr	2753	-
AsI ₃	4824	5295	CuClI	2694	-
SbF ₃	5295	5324	CuBrI	2669	-
SbCl ₃	5032	4857	FeF ₂ Cl	5711	-
SbBr ₃	4954	4776	FeF ₂ Br	5653	-
SbI ₃	4867	4692	FeF ₂ I	5569	-
BiCl ₃	4689	4707	FeCl ₂ Br	5339	-
BiI ₃	3774	-	FeCl ₂ I	5272	-
LaF ₃	4682	-	FeBr ₂ I	5209	-
LaCl ₃	4263	4242	LiIO ₂ F ₂	845	-
LaBr ₃	4209	-	NaIO ₂ F ₂	766	756
LaI ₃	3916	3986	KIO ₂ F ₂	699	689
CeCl ₃	4394	4348	RbIO ₂ F ₂	674	-
CeI ₃	-	4061	CsIO ₂ F ₂	636	-
PrCl ₃	4322	4387	NH ₄ IO ₂ F ₂	678	-
PrI ₃	-	4101	AgIO ₂ F ₂	736	685
NdCl ₃	4343	4415	Hydrides		
SmCl ₃	4376	4450	LiH	916	918
EuCl ₃	4393	4490	NaH	807	807
GdCl ₃	4406	4495	KH	711	713
DyCl ₃	4481	4529	RbH	686	684
HoCl ₃	4501	4572	CsH	648	653
ErCl ₃	4527	4591	VH	1184	(1344)
TmCl ₃	4548	4608	NbH	1163	(1633)
TmI ₃	-	4340	PdH	979	1368
YbCl ₃	-	4651	CuH	828	1254
AcCl ₃	4096	-	TiH	996	1407
UCl ₃	4243	-	ZrH	916	1590
NpCl ₃	4268	-	HfH	904	-
PuCl ₃	4289	-	LaH	828	-
PuBr ₃	(3959)	-	TaH	1021	-
AmCl ₃	4293	-	CrH	1050	-
TiF ₄	10012	9908	NiH	929	-
TiCl ₄	9431	-	PtH	937	-
TiBr ₄	9288	9059	AgH	941	-
TiI ₄	9108	8918	AuH	1033	1108
ZrF ₄	8853	8971	TlH	745	-
ZrCl ₄	8021	8144	GeH	950	-
ZrBr ₄	7661	7984	PbH	778	-
ZrI ₄	7155	7801	BeH ₂	3205	3306
MoF ₄	8795	-	MgH ₂	2791	2718
MoCl ₄	8556	9603	CaH ₂	2410	2406
MoBr ₄	8510	9500	SrH ₂	2250	2265
MoI ₄	8427	-	BaH ₂	2121	2133
SnCl ₄	8355	8930	ScH ₂	2711	2744
SnBr ₄	7970	8852	YH ₂	(2598)	2733
PbF ₄	9519	-	LaH ₂	2380	2522
CrF ₂ Cl	5795	-	CeH ₂	2414	2509

LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹) (continued)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
PrH ₂	2448	2405	AgOH	918	845
NdH ₂	2464	2394	AuOH	1033	-
PmH ₂	2519	-	TiOH	705	874
SmH ₂	2510	2389	Zn(OH) ₂	2795	3151
GdH ₂	2494	2651	Cd(OH) ₂	2607	2909
AcH ₂	2372	-	Hg(OH) ₂	2669	-
ThH ₂	2711	2738	Sn(OH) ₂	2489	2721
PuH ₂	2519	-	Pb(OH) ₂	2376	-
AmH ₂	2544	-	Sc(OH) ₃	5063	5602
TiH ₂	2866	2864	Y(OH) ₃	4707	-
ZrH ₂	2711	2999	La(OH) ₃	4443	-
CuH ₂	2941	-	Cr(OH) ₃	5556	6299
ZnH ₂	2870	-	Mn(OH) ₃	6213	-
HgH ₂	2707	-	Al(OH) ₃	5627	-
AlH ₃	5924	5969	Ga(OH) ₃	5732	6368
FeH ₃	5724	-	In(OH) ₃	5280	-
ScH ₃	5439	-	Tl(OH) ₃	5314	-
YH ₃	5063	4910	Ti(OH) ₄	9456	-
LaH ₃	4895	4493	Zr(OH) ₄	8619	-
FeH ₃	5724	-	Mn(OH) ₄	10933	-
GaH ₃	5690	-	Sn(OH) ₄	9188	9879
InH ₃	5092	-	Imides		
TiH ₃	5092	-	CaNH	3293	-
Hydroselenides			SrNH	3146	-
NaHSe	703	732	BaNH	2975	-
KHSe	644	712	Metavanadates		
RbHSe	623	689	Li ₃ VO ₄	3945	-
CsHse	598	669	Na ₃ VO ₄	3766	-
Hydrosulphides			K ₃ VO ₄	3376	-
LiHS	768	862	Rb ₃ VO ₄	3243	-
NaHS	723	771	Cs ₃ VO ₄	3137	-
RbHS	655	682	Nitrates		
CsHS	628	657	LiNO ₃	848	854
NH ₄ HS	661	718	NaNO ₃	755	763
Ca(HS) ₂	2184	(2171)	KNO ₃	685	694
Sr(HS) ₂	2063	-	RbNO ₃	662	671
Ba(HS) ₂	1979	(1956)	CsNO ₃	648	650
Hydroxides			AgNO ₃	820	832
LiOH	1021	1028	TiNO ₃	690	707
NaOH	887	892	Mg(NO ₃) ₂	2481	2521
KOH	789	796	Ca(NO ₃) ₂	2268	2247
RbOH	766	765	Sr(NO ₃) ₂	2176	2151
CsOH	721	732	Ba(NO ₃) ₂	2062	2035
Be(OH) ₂	3477	3620	Mn(NO ₃) ₂	2318	2478
Mg(OH) ₂	2870	2998	Fe(NO ₃) ₂	-	(2580)
Ca(OH) ₂	2506	2637	Co(NO ₃) ₂	2560	2647
Sr(OH) ₂	2330	2474	Ni(NO ₃) ₂	-	2729
Ba(OH) ₂	2142	2330	Cu(NO ₃) ₂	-	2739
Ti(OH) ₂	-	2953	Zn(NO ₃) ₂	2376	2649
Mn(OH) ₂	2909	3008	Cd(NO ₃) ₂	2238	2462
Fe(OH) ₂	2653	3044	Sn(NO ₃) ₂	2155	2254
Co(OH) ₂	2786	3109	Pb(NO ₃) ₂	2067	2208
Ni(OH) ₂	2832	3186	Nitrides		
Pd(OH) ₂	-	3189	ScN	7547	7506
Cu(OH) ₂	2870	3229	LaN	6876	6793
CuOH	1006	-	TiN	8130	8033

LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹) (continued)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
ZrN	7633	7723	Nd ₂ O ₃	12736	-
VN	8283	8233	Pm ₂ O ₃	12811	-
NbN	7939	8022	Sm ₂ O ₃	12878	-
CrN	8269	8358	Eu ₂ O ₃	12945	-
Nitrites			Gd ₂ O ₃	12996	-
NaNO ₂	774	772	Tb ₂ O ₃	13071	-
KNO ₂	699	687	Dy ₂ O ₃	13138	-
RbNO ₂	724	765	Ho ₂ O ₃	13180	-
CsNO ₂	690	-	Er ₂ O ₃	13263	-
Oxides			Tm ₂ O ₃	13322	-
Li ₂ O	2799	2814	Yb ₂ O ₃	13380	-
Na ₂ O	2481	2478	Lu ₂ O ₃	13665	-
K ₂ O	2238	2232	Ac ₂ O ₃	12573	-
Rb ₂ O	2163	2161	Ti ₂ O ₃	-	14149
Cs ₂ O	2131	2063	V ₂ O ₃	15096	14520
Cu ₂ O	3273	3189	Cr ₂ O ₃	15276	14957
Ag ₂ O	3002	2910	Mn ₂ O ₃	15146	15035
Tl ₂ O	2659	2575	Fe ₂ O ₃	14309	14774
LiO ₂	(878)	(872)	Al ₂ O ₃	15916	-
NaO ₂	799	821	Ga ₂ O ₃	15590	15220
KO ₂	741	751	In ₂ O ₃	13928	-
RbO ₂	706	721	Pb ₂ O ₃	(14841)	-
CsO ₂	679	696	CeO ₂	9627	-
Li ₂ O ₂	2592	2557	ThO ₂	10397	-
Na ₂ O ₂	2309	22717	PaO ₂	10573	-
K ₂ O ₂	2114	2064	VO ₂ (g)	10644	-
Rb ₂ O ₂	2025	1994	NpO ₂	10707	-
Cs ₂ O ₂	1948	1512	PuO ₂	10786	-
MgO ₂	3356	3526	AmO ₂	10799	-
CaO ₂	3144	3132	CmO ₂	10832	-
SrO ₂	3037	2977	TiO ₂	12150	-
KO ₃	697	707	ZrO ₂	11188	-
BeO	4514	4443	MoO ₂	11648	-
MgO	3795	3791	MnO ₂	12970	-
CaO	3414	3401	SiO ₂	13125	-
SrO	3217	3223	GeO ₂	12828	-
BaO	3029	3054	SnO ₂	11807	-
TiO	3832	3811	PbO ₂	11217	-
VO	3932	3863	Perchlorates		
MnO	3724	3745	LiClO ₄	709	715
FeO	3795	3865	NaClO ₄	643	641
CoO	3837	3910	KClO ₄	599	595
NiO	3908	4010	RbClO ₄	564	576
PdO	3736	-	CsClO ₄	636	550
CuO	4135	4050	NH ₄ ClO ₄	583	580
ZnO	4142	3971	Ca(ClO ₄) ₂	1958	1971
CdO	3806	-	Sr(ClO ₄) ₂	1862	1862
HgO	3907	-	Ba(ClO ₄) ₂	1795	1769
GeO	3919	-	Permanganates		
SnO	3652	-	NaMnO ₄	661	-
PbO	3520	-	KMnO ₄	607	-
Sc ₂ O ₃	13557	13708	RbMnO ₄	586	-
Y ₂ O ₃	12705	-	CsMnO ₄	565	-
La ₂ O ₃	12452	-	Ca(MnO ₄) ₂	1937	-
Ce ₂ O ₃	12661	-	Sr(MnO ₄) ₂	1845	-
Pr ₂ O ₃	12703	-	Ba(MnO ₄) ₂	1778	-

LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹) (continued)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
Phosphates			Rb ₂ S	1929	1949
Mg ₃ (PO ₄) ₂	11632	11407	Cs ₂ S	1892	1850
Ca ₃ (PO ₄) ₂	10602	10479	(NH ₄) ₂ S	2008	(2026)
Sr ₃ (PO ₄) ₂	10125	10075	Cu ₂ S	2786	2865
Ba ₃ (PO ₄) ₂	9652	9654	Ag ₂ S	2606	2677
MnPO ₄	7397	-	Au ₂ S	2908	-
FePO ₄	7251	7300	Tl ₂ S	2298	2258
BPO ₄	8201	-	Sulphates		
AlPO ₄	7427	7507	Li ₂ SO ₄	2229	2142
GaPO ₄	7381	-	Na ₂ SO ₄	1827	1938
Selenides			K ₂ SO ₄	1700	1796
Li ₂ Se	2364	-	Rb ₂ SO ₄	1636	1748
Na ₂ Se	2130	-	Cs ₂ SO ₄	1596	1658
K ₂ Se	1933	-	(NH ₄) ₂ SO ₄	1766	1777
Rb ₂ Se	1837	-	Cu ₂ SO ₄	2276	2166
Cs ₂ Se	1745	-	Ag ₂ SO ₄	2104	1989
Ag ₂ Se	2686	-	Tl ₂ SO ₄	1828	1722
Tl ₂ Se	2209	-	Hg ₂ SO ₄	-	2127
BeSe	3431	-	CaSO ₄	2489	2480
MgSe	3071	-	SrSO ₄	2577	2484
CaSe	2858	2862	BaSO ₄	2469	2374
SrSe	2736	-	MnSO ₄	2920	2825
BaSe	2611	-	Ternary Salts		
MnSe	3176	-	Cs ₂ CuCl ₄	1393	-
Selenites			Rb ₂ ZnCl ₄	1529	-
Li ₂ SeO ₃	2171	-	Cs ₂ ZnCl ₄	1492	-
Na ₂ SeO ₃	1950	1916	Rb ₂ ZnBr ₄	1498	-
K ₂ SeO ₃	1774	1749	Cs ₂ ZnBr ₄	1454	-
Rb ₂ SeO ₃	1715	1675	Cs ₂ ZnI ₄	1386	-
Cs ₂ SeO ₃	1640	-	CsGaCl ₄	494	-
Tl ₂ SeO ₃	1879	-	NaAlCl ₄	556	-
Ag ₂ SeO ₃	2113	2148	CsAlCl ₄	486	-
BeSeO ₃	3322	-	NaFeCl ₄	492	-
MgSeO ₃	3012	2998	Rb ₂ CoCl ₄	1447	-
CaSeO ₃	2732	-	Cs ₂ CoCl ₄	1391	-
SrSeO ₃	2586	2588	K ₂ PtCl ₄	1574	1550
BaSeO ₃	2460	2451	Cs ₂ GeF ₆	1573	-
Selenates			(NH ₄) ₂ GeF ₆	1657	-
Li ₂ SeO ₄	2054	-	Cs ₂ GeCl ₆	1404	1419
Na ₂ SeO ₄	1879	-	K ₂ HfCl ₆	1345	1461
K ₂ SeO ₄	1732	-	K ₂ IrCl ₆	1442	1440
Rb ₂ SeO ₄	1686	-	Na ₂ MoCl ₆	1526	1504
Cs ₂ SeO ₄	1615	-	K ₂ MoCl ₆	1418	1412
Cu ₂ SeO ₄	2201	-	Rb ₂ MoCl ₆	1399	1399
Ag ₂ SeO ₄	2033	-	Cs ₂ MoCl ₆	1347	1347
Tl ₂ SeO ₄	1766	-	K ₂ NbCl ₆	1375	1398
Hg ₂ SeO ₄	2163	-	Rb ₂ NbCl ₆	1371	1385
BeSeO ₄	3448	-	Cs ₂ NbCl ₆	1381	1344
MgSeO ₄	2895	-	K ₂ OsCl ₆	1447	1447
CaSeO ₄	2632	-	Cs ₂ OsCl ₆	1409	-
SrSeO ₄	2489	-	K ₂ OsBr ₆	1396	-
Sulphides			K ₂ PdCl ₆	1481	1493
Li ₂ S	2464	2472	Rb ₂ PdCl ₆	1449	-
Na ₂ S	2192	2203	Cs ₂ PdCl ₆	1426	-
K ₂ S	1979	(2052)	Rb ₂ PbCl ₆	1343	1343

LATTICE ENERGIES (continued)

Table 1
LATTICE ENERGIES (kJ mol⁻¹) (continued)

Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$	Substance	Calc. U_{POT}	$U_{\text{POT}}^{\text{BHFC}}$
Cs ₂ PbCl ₆	1344	-	Rb ₂ TiCl ₆	1415	1416
(NH ₄) ₂ PbCl ₆	1355	-	Cs ₂ TiCl ₆	1402	1384
K ₂ PtCl ₆	1468	1471	Tl ₂ TiCl ₆	1560	1553
Rb ₂ PtCl ₆	1464	-	K ₂ TiBr ₆	1379	1379
Cs ₂ PtCl ₆	1444	-	Rb ₂ TiBr ₆	1341	1331
(NH ₄) ₂ PtCl ₆	1468	-	Cs ₂ TiBr ₆	1339	1306
Tl ₂ PtCl ₆	1546	-	Na ₂ UBr ₆	1504	-
Ag ₂ PtCl ₆	1773	1881	K ₂ UBr ₆	1484	-
BaPtCl ₆	2047	2070	Rb ₂ UBr ₆	1473	-
K ₂ PtBr ₆	1423	1392	Cs ₂ UBr ₆	1459	-
Ag ₂ PtBr ₆	1791	2276	K ₂ WCl ₆	1398	1423
K ₂ PtI ₆	1421	-	Rb ₂ WCl ₆	1397	1434
K ₂ ReCl ₆	1416	1442	Cs ₂ WCl ₆	1392	1366
Rb ₂ ReCl ₆	1414	-	K ₂ WBr ₆	1408	1408
Cs ₂ ReCl ₆	1398	-	Rb ₂ WBr ₆	1361	1391
K ₂ ReBr ₆	1375	1375	Cs ₂ WBr ₆	1362	1332
K ₂ SiF ₆	1670	1765	K ₂ ZrCl ₆	1339	1371
Rb ₂ SiF ₆	1639	1673	Rb ₂ ZrCl ₆	1341	-
Cs ₂ SiF ₆	1604	1498	Cs ₂ ZrCl ₆	1339	1307
Tl ₂ SiF ₆	1675	-	Tellurides		
K ₂ SnCl ₆	1363	1390	Li ₂ Te	2212	-
Rb ₂ SnCl ₆	1361	1363	Na ₂ Te	1997	2095
Cs ₂ SnCl ₆	1358	-	K ₂ Te	1830	-
Tl ₂ SnCl ₆	1437	-	Rb ₂ Te	1837	-
(NH ₄) ₂ SnCl ₆	1370	1344	Cs ₂ Te	1745	-
Rb ₂ SnBr ₆	1309	-	Cu ₂ Te	2706	2683
Cs ₂ SnBr ₆	1306	-	Ag ₂ Te	2607	2600
Rb ₂ SnI ₆	1226	-	Tl ₂ Te	2084	2172
Cs ₂ SnBr ₆	1243	-	BeTe	3319	-
K ₂ TeCl ₆	1318	1320	MgTe	2878	3081
Rb ₂ TeCl ₆	1321	-	CaTe	2721	-
Cs ₂ TeCl ₆	1323	-	Thiocyanates		
Tl ₂ TeCl ₆	1392	-	LiCNS	764	(765)
(NH ₄) ₂ TeCl ₆	1318	-	NaCNS	682	682
K ₂ RuCl ₆	1451	-	KCNS	623	616
Rb ₂ CoF ₆	1688	-	RbCNS	623	619
Cs ₂ CoF ₆	1632	-	CsCNS	623	568
K ₂ NiF ₆	1721	-	NH ₄ CNS	605	611
Rb ₂ NiF ₆	1688	-	Ca(CNS) ₂	2184	2118
Rb ₂ SbCl ₆	1357	-	Sr(CNS) ₂	2063	1957
Rb ₂ SeCl ₆	1409	-	Ba(CNS) ₂	1979	1852
Cs ₂ SeCl ₆	1397	-	Mn(CNS) ₂	2280	2351
(NH ₄) ₂ SeCl ₆	1420	-	Zn(CNS) ₂	2335	2560
(NH ₄) ₂ PoCl ₆	1338	-	Cd(CNS) ₂	2201	2374
Cs ₂ PoBr ₆	1286	-	Hg(CNS) ₂	2146	2492
Cs ₂ CrF ₆	1603	-	Sn(CNS) ₂	2117	2142
Rb ₂ MnF ₆	1688	-	Pb(CNS) ₂	2058	-
Cs ₂ MnF ₆	1620	-	Vanadates		
K ₂ MnCl ₆	1462	-	LiVO ₃	810	-
Rb ₂ MnCl ₆	1451	-	NaVO ₃	761	-
(NH ₄) ₂ MnCl ₆	1464	-	KVO ₃	686	-
Cs ₂ TeBr ₆	1306	-	RbVO ₃	657	-
Cs ₂ TeI ₆	1246	-	CsVO ₃	628	-
K ₂ TiCl ₆	1412	1447			

LATTICE ENERGIES (continued)

Table 2
THERMOCHEMICAL RADII (nm)

Ion	Radius	Ion	Radius
Singly Charged Anions			
AgF ₄ ⁻	0.231 ± 0.019	NbF ₆ ⁻	0.254 ± 0.019
AlBr ₄ ⁻	0.321 ± 0.023	Nb ₂ F ₁₁ ⁻	0.311 ± 0.038
AlCl ₄ ⁻	0.317 ± 0.019	NbO ₃ ⁻	0.194 ± 0.019
AlF ₄ ⁻	0.214 ± 0.023	NH ₂ ⁻	0.168 ± 0.019
AlH ₄ ⁻	0.226 ± 0.019	NH ₂ CH ₂ COO ⁻	0.252 ± 0.019
AlI ₄ ⁻	0.374 ± 0.019	NO ₂ ⁻	0.187 ± 0.019
AsF ₆ ⁻	0.243 ± 0.019	NO ₃ ⁻	0.200 ± 0.019
AsO ₂ ⁻	0.211 ± 0.019	O ₂ ⁻	0.165 ± 0.019
Au(CN) ₂ ⁻	0.266 ± 0.019	O ₃ ⁻	0.199 ± 0.034
AuCl ₄ ⁻	0.288 ± 0.019	OH ⁻	0.152 ± 0.019
AuF ₄ ⁻	0.240 ± 0.019	OsF ₆ ⁻	0.252 ± 0.020
AuF ₆ ⁻	0.235 ± 0.038	PaF ₆ ⁻	0.249 ± 0.019
B(OH) ₄ ⁻	0.229 ± 0.019	PdF ₆ ⁻	0.252 ± 0.019
BF ₄ ⁻	0.205 ± 0.019	PF ₆ ⁻	0.242 ± 0.019
BH ₄ ⁻	0.205 ± 0.019	PO ₃ ⁻	0.204 ± 0.019
Br ⁻	0.190 ± 0.019	PtF ₆ ⁻	0.247 ± 0.019
BrF ₄ ⁻	0.231 ± 0.019	PuF ₅ ⁻	0.239 ± 0.019
BrO ₃ ⁻	0.214 ± 0.019	ReF ₆ ⁻	0.240 ± 0.019
CF ₃ SO ₃ ⁻	0.230 ± 0.049	ReO ₄ ⁻	0.227 ± 0.019
CH ₃ CO ₂ ⁻	0.194 ± 0.019	RuF ₆ ⁻	0.242 ± 0.019
Cl ⁻	0.168 ± 0.019	S ₆ ⁻	0.305 ± 0.019
ClO ₂ ⁻	0.195 ± 0.019	SCN ⁻	0.209 ± 0.019
ClO ₃ ⁻	0.208 ± 0.019	SbCl ₆ ⁻	0.320 ± 0.019
ClO ₄ ⁻	0.225 ± 0.019	SbF ₆ ⁻	0.252 ± 0.019
ClS ₂ O ₆ ⁻	0.260 ± 0.049	Sb ₂ F ₁₁ ⁻	0.312 ± 0.038
CN ⁻	0.187 ± 0.023	Sb ₃ F ₁₄ ⁻	0.374 ± 0.038
Cr ₃ O ₈ ⁻	0.276 ± 0.019	SeCl ₅ ⁻	0.258 ± 0.038
CuBr ₄ ⁻	0.315 ± 0.019	SeCN ⁻	0.230 ± 0.019
F ⁻	0.126 ± 0.019	SeH ⁻	0.195 ± 0.019
FeCl ₄ ⁻	0.317 ± 0.019	SH ⁻	0.191 ± 0.019
GaCl ₄ ⁻	0.328 ± 0.019	SO ₃ F ⁻	0.214 ± 0.019
H ⁻	0.148 ± 0.019	S ₃ N ₃ ⁻	0.231 ± 0.038
H ₂ AsO ₄ ⁻	0.227 ± 0.019	S ₃ N ₃ O ₄ ⁻	0.252 ± 0.038
H ₂ PO ₄ ⁻	0.213 ± 0.019	TaCl ₆ ⁻	0.352 ± 0.019
HCO ₂ ⁻	0.200 ± 0.019	TaF ₆ ⁻	0.250 ± 0.019
HCO ₃ ⁻	0.207 ± 0.019	TaO ₃ ⁻	0.192 ± 0.019
HF ₂ ⁻	0.172 ± 0.019	UF ₆ ⁻	0.301 ± 0.019
HSO ₄ ⁻	0.221 ± 0.019	VF ₆ ⁻	0.235 ± 0.019
I ⁻	0.211 ± 0.019	VO ₃ ⁻	0.201 ± 0.019
I ₂ Br ⁻	0.261 ± 0.019	WCl ₆ ⁻	0.337 ± 0.019
I ₃ ⁻	0.272 ± 0.019	WF ₆ ⁻	0.246 ± 0.019
I ₄ ⁻	0.300 ± 0.019	WOF ₅ ⁻	0.241 ± 0.019
IBr ₂ ⁻	0.251 ± 0.019	Doubly Charged Anions	
ICl ₂ ⁻	0.235 ± 0.019	AmF ₆ ²⁻	0.255 ± 0.019
ICl ₄ ⁻	0.307 ± 0.019	Bi ₂ Br ₈ ²⁻	0.392 ± 0.055
IO ₂ F ₂ ⁻	0.233 ± 0.019	Bi ₆ Cl ₂₀ ²⁻	0.501 ± 0.073
IO ₃ ⁻	0.218 ± 0.019	CdCl ₄ ²⁻	0.307 ± 0.019
IO ₄ ⁻	0.231 ± 0.019	CeCl ₆ ²⁻	0.352 ± 0.019
IrF ₆ ⁻	0.242 ± 0.019	CeF ₆ ²⁻	0.249 ± 0.019
MnO ₄ ⁻	0.220 ± 0.019	CO ₃ ²⁻	0.189 ± 0.019
MoF ₆ ⁻	0.241 ± 0.019	CoCl ₄ ²⁻	0.306 ± 0.019
MoOF ₅ ⁻	0.241 ± 0.019	CoF ₄ ²⁻	0.209 ± 0.019
N ₃ ⁻	0.180 ± 0.019	CoF ₆ ²⁻	0.256 ± 0.019
NCO ⁻	0.193 ± 0.019	Cr ₂ O ₇ ²⁻	0.292 ± 0.019
NbCl ₆ ⁻	0.338 ± 0.049	CrF ₆ ²⁻	0.253 ± 0.019
		CrO ₄ ²⁻	0.229 ± 0.019

LATTICE ENERGIES (continued)

Table 2
THERMOCHEMICAL RADII (nm) (continued)

Ion	Radius	Ion	Radius
CuCl ₄ ²⁻	0.304 ± 0.019	S ₂ O ₆ ²⁻	0.283 ± 0.019
CuF ₄ ²⁻	0.213 ± 0.019	S ₂ O ₇ ²⁻	0.275 ± 0.019
GeCl ₆ ²⁻	0.335 ± 0.019	S ₂ O ₈ ²⁻	0.291 ± 0.019
GeF ₆ ²⁻	0.244 ± 0.019	S ₃ O ₆ ²⁻	0.302 ± 0.019
HfF ₆ ²⁻	0.248 ± 0.019	S ₄ O ₆ ²⁻	0.325 ± 0.019
HgI ₄ ²⁻	0.377 ± 0.019	S ₆ O ₆ ²⁻	0.382 ± 0.019
IrCl ₆ ²⁻	0.332 ± 0.019	ScF ₆ ²⁻	0.276 ± 0.019
MnCl ₆ ²⁻	0.314 ± 0.031	Se ²⁻	0.181 ± 0.019
MnF ₄ ²⁻	0.219 ± 0.019	SeBr ₆ ²⁻	0.363 ± 0.019
MnF ₆ ²⁻	0.241 ± 0.019	SeCl ₆ ²⁻	0.336 ± 0.019
MoBr ₆ ²⁻	0.364 ± 0.019	SeO ₄ ²⁻	0.229 ± 0.019
MoCl ₆ ²⁻	0.338 ± 0.019	SiF ₆ ²⁻	0.248 ± 0.019
MoF ₆ ²⁻	0.274 ± 0.019	SiO ₃ ²⁻	0.195 ± 0.019
MoO ₄ ²⁻	0.231 ± 0.019	SmF ₄ ²⁻	0.218 ± 0.019
NbCl ₆ ²⁻	0.343 ± 0.019	Sn(OH) ₆ ²⁻	0.279 ± 0.020
NH ²⁻	0.128 ± 0.019	SnBr ₆ ²⁻	0.374 ± 0.019
Ni(CN) ₄ ²⁻	0.322 ± 0.019	SnCl ₆ ²⁻	0.345 ± 0.019
NiF ₄ ²⁻	0.211 ± 0.019	SnF ₆ ²⁻	0.265 ± 0.019
NiF ₆ ²⁻	0.249 ± 0.019	SnI ₆ ²⁻	0.427 ± 0.019
O ²⁻	0.141 ± 0.019	SO ₃ ²⁻	0.204 ± 0.019
O ₂ ²⁻	0.167 ± 0.019	SO ₄ ²⁻	0.218 ± 0.019
OsBr ₆ ²⁻	0.365 ± 0.019	TcBr ₆ ²⁻	0.363 ± 0.019
OsCl ₆ ²⁻	0.336 ± 0.019	TcCl ₆ ²⁻	0.337 ± 0.019
OsF ₆ ²⁻	0.276 ± 0.019	TcF ₆ ²⁻	0.244 ± 0.019
PbCl ₄ ²⁻	0.279 ± 0.019	TcH ₉ ²⁻	0.260 ± 0.019
PbCl ₆ ²⁻	0.347 ± 0.019	TcI ₆ ²⁻	0.419 ± 0.019
PbF ₆ ²⁻	0.268 ± 0.019	Te ²⁻	0.220 ± 0.019
PdBr ₆ ²⁻	0.354 ± 0.019	TeBr ₆ ²⁻	0.383 ± 0.019
PdCl ₄ ²⁻	0.313 ± 0.019	TeCl ₆ ²⁻	0.353 ± 0.019
PdCl ₆ ²⁻	0.333 ± 0.019	TeI ₆ ²⁻	0.430 ± 0.019
PdF ₆ ²⁻	0.252 ± 0.019	TeO ₄ ²⁻	0.238 ± 0.019
PoBr ₆ ²⁻	0.380 ± 0.019	Th(NO ₃) ₆ ²⁻	0.424 ± 0.019
PoI ₆ ²⁻	0.428 ± 0.019	ThCl ₆ ²⁻	0.360 ± 0.019
Pt(NO ₂) ₃ Cl ₃ ²⁻	0.364 ± 0.019	ThF ₆ ²⁻	0.263 ± 0.019
Pt(NO ₂) ₄ Cl ₂ ²⁻	0.383 ± 0.019	TiBr ₆ ²⁻	0.356 ± 0.019
Pt(OH) ₂ ²⁻	0.333 ± 0.019	TiCl ₆ ²⁻	0.335 ± 0.019
Pt(SCN) ₆ ²⁻	0.451 ± 0.019	TiF ₆ ²⁻	0.252 ± 0.019
PtBr ₄ ²⁻	0.324 ± 0.019	UCl ₆ ²⁻	0.354 ± 0.019
PtBr ₆ ²⁻	0.363 ± 0.019	UF ₆ ²⁻	0.256 ± 0.019
PtCl ₄ ²⁻	0.307 ± 0.019	VO ₃ ²⁻	0.204 ± 0.019
PtCl ₆ ²⁻	0.333 ± 0.019	WBr ₆ ²⁻	0.363 ± 0.019
PtF ₆ ²⁻	0.245 ± 0.019	WCl ₆ ²⁻	0.339 ± 0.019
PuCl ₆ ²⁻	0.349 ± 0.019	WO ₄ ²⁻	0.237 ± 0.019
ReBr ₆ ²⁻	0.371 ± 0.019	WOCl ₅ ²⁻	0.334 ± 0.019
ReCl ₆ ²⁻	0.337 ± 0.019	ZnBr ₄ ²⁻	0.335 ± 0.019
ReF ₆ ²⁻	0.256 ± 0.019	ZnCl ₄ ²⁻	0.306 ± 0.019
ReF ₈ ²⁻	0.276 ± 0.019	ZnF ₄ ²⁻	0.219 ± 0.019
ReH ₉ ²⁻	0.257 ± 0.019	ZnI ₄ ²⁻	0.384 ± 0.019
ReI ₆ ²⁻	0.421 ± 0.026	ZrBr ₄ ²⁻	0.334 ± 0.019
RhF ₆ ²⁻	0.240 ± 0.019	ZrCl ₄ ²⁻	0.306 ± 0.019
RuCl ₆ ²⁻	0.336 ± 0.019	ZrCl ₆ ²⁻	0.348 ± 0.019
RuF ₆ ²⁻	0.248 ± 0.019	ZrF ₆ ²⁻	0.258 ± 0.019
S ²⁻	0.189 ± 0.019	Multi-Charged Anions	
S ₂ O ₃ ²⁻	0.251 ± 0.019	AlH ₆ ³⁻	0.256 ± 0.042
S ₂ O ₄ ²⁻	0.262 ± 0.019	AsO ₄ ³⁻	0.237 ± 0.042
S ₂ O ₅ ²⁻	0.270 ± 0.019	CdBr ₆ ⁴⁻	0.374 ± 0.038

LATTICE ENERGIES (continued)

Table 2
THERMOCHEMICAL RADII (nm) (continued)

Ion	Radius	Ion	Radius
CdCl ₆ ⁴⁻	0.352 ± 0.038	Br ₅ ⁺	0.229 ± 0.027
CeF ₆ ³⁻	0.278 ± 0.038	BrClCNH ₂ ⁺	0.175 ± 0.027
CeF ₇ ³⁻	0.282 ± 0.038	BrF ₂ ⁺	0.183 ± 0.027
Co(CN) ₆ ³⁻	0.349 ± 0.038	BrF ₄ ⁺	0.172 ± 0.027
Co(NO ₂) ₆ ³⁻	0.343 ± 0.038	C ₁₀ F ₈ ⁺	0.265 ± 0.027
CoCl ₅ ³⁻	0.320 ± 0.038	C ₆ F ₆ ⁺	0.228 ± 0.027
CoF ₆ ³⁻	0.258 ± 0.042	Cl(SNSCN) ₂ ⁺	0.347 ± 0.027
Cr(CN) ₆ ³⁻	0.351 ± 0.038	Cl ₂ C=NH ₂ ⁺	0.173 ± 0.027
CrF ₆ ³⁻	0.254 ± 0.042	Cl ₂ F ⁺	0.165 ± 0.027
Cu(CN) ₄ ³⁻	0.312 ± 0.038	Cl ₃ ⁺	0.182 ± 0.027
Fe(CN) ₆ ³⁻	0.347 ± 0.038	ClF ₂ ⁺	0.147 ± 0.027
FeF ₆ ³⁻	0.298 ± 0.042	ClO ₂ ⁺	0.118 ± 0.027
HfF ₇ ³⁻	0.277 ± 0.042	GaBr ₄ ⁻	0.317 ± 0.038
InF ₆ ³⁻	0.268 ± 0.038	I ₂ ⁺	0.185 ± 0.027
Ir(CN) ₆ ³⁻	0.347 ± 0.038	I ₃ ⁺	0.225 ± 0.027
Ir(NO ₂) ₆ ³⁻	0.338 ± 0.038	I ₅ ⁺	0.263 ± 0.027
Mn(CN) ₆ ³⁻	0.350 ± 0.038	IBr ₂ ⁺	0.196 ± 0.027
Mn(CN) ₆ ⁵⁻	0.401 ± 0.042	ICl ₂ ⁺	0.175 ± 0.036
MnCl ₆ ⁴⁻	0.349 ± 0.038	IF ₆ ⁺	0.209 ± 0.027
N ³⁻	0.180 ± 0.042	N(S ₃ N ₂) ₂ ⁺	0.258 ± 0.027
Ni(NO ₂) ₆ ³⁻	0.342 ± 0.038	N(SCl) ₂ ⁺	0.186 ± 0.027
Ni(NO ₂) ₆ ⁴⁻	0.383 ± 0.038	N(SeCl) ₂ ⁺	0.246 ± 0.027
NiF ₆ ³⁻	0.250 ± 0.042	N(SF ₂) ₂ ⁺	0.214 ± 0.027
O ³⁻	0.288 ± 0.038	N ₂ F ⁺	0.156 ± 0.027
P ³⁻	0.224 ± 0.042	NO ⁺	0.145 ± 0.027
PaF ₈ ³⁻	0.299 ± 0.042	NO ₂ ⁺	0.153 ± 0.027
PO ₄ ³⁻	0.230 ± 0.042	O ₂ ⁺	0.140 ± 0.027
PrF ₆ ³⁻	0.281 ± 0.038	O ₂ (SCCF ₃ Cl) ₂ ⁺	0.275 ± 0.027
Rh(NO ₂) ₆ ³⁻	0.345 ± 0.038	ONCH ₃ CF ₃ ⁺	0.200 ± 0.027
Rh(SCN) ₆ ³⁻	0.428 ± 0.042	OsOF ₅ ⁻	0.246 ± 0.038
TaF ₈ ³⁻	0.284 ± 0.042	P(CH ₃) ₃ Cl ⁺	0.197 ± 0.027
TbF ₇ ³⁻	0.290 ± 0.038	P(CH ₃) ₃ D ⁺	0.196 ± 0.027
Tc(CN) ₆ ⁵⁻	0.410 ± 0.042	PCL ₄ ⁺	0.235 ± 0.027
ThF ₇ ³⁻	0.282 ± 0.042	ReOF ₅ ⁻	0.245 ± 0.038
TiBr ₆ ³⁻	0.315 ± 0.038	S(CH ₃) ₂ Cl ⁺	0.207 ± 0.027
TlF ₆ ³⁻	0.271 ± 0.038	S(N(C ₂ H ₅) ₃) ₃ ⁺	0.439 ± 0.027
UF ₇ ³⁻	0.285 ± 0.042	S ₂ (CH ₃) ₂ Cl ⁺	0.265 ± 0.027
YF ₆ ³⁻	0.275 ± 0.038	S ₂ (CH ₃) ₂ CN ⁺	0.223 ± 0.027
ZrF ₇ ³⁻	0.273 ± 0.038	S ₂ (CH ₃) ₃ ⁺	0.233 ± 0.027
Singly Charged Cations		S ₂ Br ₅ ⁺	0.267 ± 0.027
N(CH ₃) ₄ ⁺	0.234 ± 0.019	S ₂ N ⁺	0.159 ± 0.034
N ₂ H ₅ ⁺	0.158 ± 0.019	S ₂ N ₂ C ₂ H ₃ ⁺	0.211 ± 0.027
N ₂ H ₆ ²⁺	0.158 ± 0.029	S ₂ NC ₂ (PhCH ₃) ₂ ⁺	0.310 ± 0.027
NH(C ₂ H ₅) ₃ ⁺	0.274 ± 0.019	S ₂ NC ₃ H ₄ ⁺	0.218 ± 0.027
NH ₃ C ₂ H ₅ ⁺	0.193 ± 0.019	S ₂ NC ₄ H ₈ ⁺	0.225 ± 0.027
NH ₃ C ₃ H ₇ ⁺	0.225 ± 0.019	S ₃ (CH ₃) ₃ ⁺	0.239 ± 0.027
NH ₃ CH ₃ ⁺	0.177 ± 0.019	S ₃ Br ₃ ⁺	0.245 ± 0.027
NH ₃ OH ⁺	0.147 ± 0.019	S ₃ C ₃ H ₇ ⁺	0.199 ± 0.027
NH ₄ ⁺	0.136 ± 0.019	S ₃ C ₄ F ₆ ⁺	0.261 ± 0.027
NH ₃ C ₂ H ₄ OH ⁺	0.203 ± 0.019	S ₃ CF ₃ CN ⁺	0.263 ± 0.027
As ₃ S ₄ ⁺	0.244 ± 0.027	S ₃ Cl ₃ ⁺	0.233 ± 0.027
As ₃ Se ₄ ⁺	0.253 ± 0.027	S ₃ N ₂ ⁺	0.201 ± 0.027
AsCl ₄ ⁺	0.221 ± 0.027	S ₃ N ₂ Cl ⁺	0.232 ± 0.027
Br ₂ ⁺	0.155 ± 0.027	S ₄ N ₃ ⁺	0.231 ± 0.027
Br ₃ ⁺	0.204 ± 0.027	S ₄ N ₃ (Ph) ₂ ⁺	0.316 ± 0.027
Br ₃ ⁻	0.238 ± 0.027	S ₄ N ₄ H ⁺	0.178 ± 0.027

LATTICE ENERGIES (continued)

Table 2
THERMOCHEMICAL RADII (nm) (continued)

Ion	Radius	Ion	Radius
S ₅ N ₅ ⁺	0.257 ± 0.027	XeF ⁺	0.174 ± 0.027
S ₇ I ⁺	0.262 ± 0.027	XeF ₃ ⁺	0.183 ± 0.027
Sb(NPPh ₃) ₄ ⁺	0.518 ± 0.027	XeF ₅ ⁺	0.186 ± 0.027
SBr ₃ ⁺	0.220 ± 0.027	XeOF ₃ ⁺	0.186 ± 0.027
SCH ₃ O ₂ ⁺	0.183 ± 0.027	Doubly Charged Cations	
SCH ₃ P(CH ₃) ₃ ⁺	0.248 ± 0.027	Co ₂ S ₂ (CO) ₆ ²⁺	0.263 ± 0.035
SCH ₃ PCH ₃ Cl ₂ ⁺	0.205 ± 0.027	FeW(Se) ₂ (CO) ₂ ²⁺	0.260 ± 0.035
SCI(C ₂ H ₅) ₂ ⁺	0.207 ± 0.027	I ₄ ²⁺	0.207 ± 0.035
SCI ₂ CF ₃ ⁺	0.207 ± 0.027	Mo(Te ₃)(CO) ₄ ²⁺	0.234 ± 0.035
SCI ₂ CH ₃ ⁺	0.204 ± 0.027	S ₁₉ ²⁺	0.292 ± 0.035
SCI ₃ ⁺	0.185 ± 0.027	S ₂ (S(CH ₃) ₂) ₂ ²⁺	0.230 ± 0.035
Se ₃ Br ₃ ⁺	0.253 ± 0.027	S ₂ I ₄ ²⁺	0.231 ± 0.035
Se ₃ Cl ₃ ⁺	0.245 ± 0.027	S ₃ N ₂ ²⁺	0.184 ± 0.035
Se ₃ N ₂ ⁺	0.288 ± 0.042	S ₃ NCCNS ₃ ²⁺	0.220 ± 0.035
Se ₃ NC ₁₂ ⁺	0.163 ± 0.027	S ₃ Se ²⁺	0.326 ± 0.035
Se ₆ I ⁺	0.260 ± 0.027	S ₄ N ₄ ²⁺	0.186 ± 0.035
SeBr ₃ ⁺	0.182 ± 0.027	S ₆ N ₄ ²⁺	0.232 ± 0.035
SeCl ₃ ⁺	0.192 ± 0.027	S ₈ ²⁺	0.182 ± 0.035
SeF ₃ ⁺	0.179 ± 0.027	Se ₁₀ ²⁺	0.253 ± 0.035
SeI ₃ ⁺	0.238 ± 0.027	Se ₁₇ ²⁺	0.236 ± 0.035
SeN ₂ Cl ⁺	0.196 ± 0.027	Se ₁₉ ²⁺	0.296 ± 0.035
SeNCl ₂ ⁺	0.157 ± 0.027	Se ₂ I ₄ ²⁺	0.218 ± 0.035
(SeNMe ₃) ₃ ⁺	0.406 ± 0.027	Se ₃ N ₂ ²⁺	0.182 ± 0.035
SeS ₂ N ₂ ⁺	0.282 ± 0.042	Se ₄ ²⁺	0.152 ± 0.035
SF(C ₆ F ₅) ₂ ⁺	0.294 ± 0.027	Se ₄ S ₂ N ₄ ²⁺	0.224 ± 0.035
SF ₂ CF ₃ ⁺	0.198 ± 0.027	Se ₈ ²⁺	0.186 ± 0.035
SF ₂ N(CH ₃) ₂ ⁺	0.210 ± 0.027	SeN ₂ S ₂ ²⁺	0.182 ± 0.035
SF ₃ ⁺	0.172 ± 0.027	(SNP(C ₂ H ₅) ₃) ₂ ²⁺	0.312 ± 0.035
SFS(C(CF ₃) ₂) ₂ ⁺	0.275 ± 0.027	TaBr ₆ ⁻	0.351 ± 0.049
SH ₂ C ₃ H ₇ ⁺	0.210 ± 0.027	Te(trtu) ₄ ²⁺	0.328 ± 0.035
SN ⁺	0.158 ± 0.027	Te(tu) ₄ ²⁺	0.296 ± 0.035
SNCl ₃ (CH ₃ CN) ⁻	0.290 ± 0.038	Te ₂ (esu) ₄ Br ₂ ²⁺	0.356 ± 0.035
(SNPMe ₃) ₃ ⁺	0.308 ± 0.027	Te ₂ (esu) ₄ Cl ₂ ²⁺	0.361 ± 0.035
SNSC(CH ₃)N ⁺	0.225 ± 0.027	Te ₂ (esu) ₄ I ₂ ²⁺	0.342 ± 0.035
SNSC(CN)CH ⁺	0.209 ± 0.027	Te ₂ Se ₂ ²⁺	0.192 ± 0.035
SNSC(Ph)N ⁺	0.251 ± 0.027	Te ₂ Se ₄ ²⁺	0.222 ± 0.035
SNSC(Ph)NS ₃ N ₂ ⁺	0.327 ± 0.027	Te ₂ Se ₈ ²⁺	0.252 ± 0.035
SNSC(PhCH ₃)N ⁺	0.264 ± 0.027	Te ₃ S ₃ ²⁺	0.217 ± 0.035
(Te(N(SiMe ₃) ₂) ₂) ²⁺	0.371 ± 0.027	Te ₃ Se ²⁺	0.193 ± 0.035
Te(N ₃) ₃ ⁺	0.226 ± 0.027	Te ₄ ²⁺	0.169 ± 0.035
Te ₄ Nb ₃ OTe ₂ I ₆ ⁺	0.407 ± 0.027	Te ₈ ²⁺	0.187 ± 0.035
TeBr ₃ ⁺	0.235 ± 0.027	W(CO) ₄ (h3-Te) ²⁺	0.234 ± 0.035
TeCl ₃ ⁺	0.216 ± 0.027	W ₂ (CO) ₁₀ Se ₄ ²⁺	0.290 ± 0.035
TeCl ₃ (15-crown-5) ⁺	0.282 ± 0.027	Multi-Charged Cations	
TeI ₃ ⁺	0.243 ± 0.027	I ₁₅ ³⁺	0.442 ± 0.051
Xe ₂ F ₁₁ ⁺	0.266 ± 0.027	Te ₂ (su) ₆ ⁴⁺	0.453 ± 0.034
Xe ₂ F ₃ ⁺	0.221 ± 0.027		

Ligand abbreviations: su = selenourea; esu = ethyleneselenourea; tu = thiourea; ph = phenyl.

LATTICE ENERGIES (continued)

Table 3
ANCILLARY THERMOCHEMICAL DATA (kJ mol⁻¹)

Species	State	$\Delta_f H^\circ$
AsO ₄ ³⁻	g	(289)
BrO ₃ ⁻	g	-145
ClO ₄ ⁻	g	-344
CN ⁻	g	66
CO ₃ ²⁻	g	-321
Fe(NO ₃) ₂	c	(-448)
HF ₂ ⁻	g	-774
HfCl ₆ ²⁻	g	-1640
IO ₂ F ₂ ⁻	g	-693
IO ₃ ⁻	g	-208
IrCl ₆ ²⁻	g	-785
LiCH ₃ O ₂	c	(-745)
NbCl ₆ ²⁻	g	-1224
NH ₂ CH ₂ CO ₂ ⁻	g	-564
O ₂ ²⁻	g	553
PdCl ₆ ²⁻	g	-749
PO ₄ ⁻	g	291
PtCl ₆ ²⁻	g	-774
ReBr ₆ ²⁻	g	-689
ReCl ₆ ²⁻	g	-919
Ti(OH) ₂	c	-778

THE MADELUNG CONSTANT AND CRYSTAL LATTICE ENERGY

If U is the crystal lattice energy and M is the Madelung constant, then^a

$$U = \frac{N M z_i z_j e^2}{r} (1 - 1/n)$$

Substance	Ion type	Crystal form ^b	M
Sodium chloride, NaCl	M ⁺ , X ⁻	FCC	1.74756
Cesium chloride, CsCl	M ⁺ , X ⁻	BCC	1.76267
Calcium chloride, CaCl ₂	M ⁺⁺ , 2X ⁻	Cubic	2.365
Calcium fluoride (fluorite), CaF ₂	M ⁺⁺ , 2X ⁻	Cubic	2.51939
Cadmium chloride, CdCl ₂	M ⁺⁺ , 2X ⁻	Hexagonal	2.244 ^c
Cadmium iodide (α), CdI ₂	M ⁺⁺ , 2X ⁻	Hexagonal	2.355 ^c
Magnesium fluoride, MgF ₂	M ⁺⁺ , 2X ⁻	Tetragonal	2.381 ^c
Cuprous oxide (cuprite), Cu ₂ O	2M ⁺ , X ⁻⁻	Cubic	2.22124
Zinc oxide, ZnO	M ⁺⁺ , X ⁻⁻	Hexagonal	1.4985 ^c
Sphalerite (zinc blende), ZnS	M ⁺⁺ , X ⁻⁻	FCC	1.63806
Wurtzite, ZnS	M ⁺⁺ , X ⁻⁻	Hexagonal	1.64132 ^c
Titanium dioxide (anatase), TiO ₂	M ⁴⁺ , 2X ⁻⁻	Tetragonal	2.400 ^c
Titanium dioxide (rutile), TiO ₂	M ⁴⁺ , 2X ⁻⁻	Tetragonal	2.408 ^c
β -Quartz, SiO ₂	M ⁴⁺ , 2X ⁻⁻	Hexagonal	2.2197 ^c
Corundum, Al ₂ O ₃	2M ³⁺ , 3X ⁻⁻	Rhombohedral	4.1719

^a N is Avogadro's number, z_i and z_j are the integral charges on the ions (in units of e), and e is the charge on the electron in electrostatic units ($e = 4.803 \times 10^{-10}$ esu). r is the shortest distance between cation-anion pairs in centimeters. Then U is in ergs ($1 \text{ erg} = 10^{-7} \text{ J}$).

^b FCC = face centered cubic; BCC = body centered cubic.

^c For tetragonal and hexagonal crystals the value of M depends on the details of the lattice parameters.

The Born Exponent, n is:

Ion type	n
He, Li ⁺	5
Ne, Na ⁺ , F ⁻	7
Ar, K ⁺ , Cu ⁺ , Cl ⁻	9
Kr, Rb ⁺ , Ag ⁺ , Br ⁻	10
Xe, Cs ⁺ , Au ⁺ , I ⁻	12

For a crystal with a mixed-ion type, an average of the values of n in this table is to be used (6 for LiF, for example).

ELASTIC CONSTANTS OF SINGLE CRYSTALS

H. P. R. Frederikse

This table gives selected values of elastic constants for single crystals. The values believed most reliable were selected from the original literature. The substances are arranged by crystal system and, within each system, alphabetically by name. A reference to the original literature is given for each value; a useful compilation of published values from many sources may be found in Reference 1 below.

Data are given for the single-crystal density and for the elastic constants c_{ij} , in units of 10^{11} N/m², which is equivalent to 10^{12} dyn/cm².

GENERAL REFERENCES

1. Simmons, G., and Wang, H., *Single Crystal Elastic Constants and Calculated Aggregate Properties: A Handbook, Second Edition*, The MIT Press, Cambridge, MA, 1971.
2. Gray, D.E., Ed., *American Institute of Physics Handbook, Third Edition*, McGraw-Hill, New York, 1972.

CUBIC CRYSTALS

Name	Formula	$\rho/g\text{ cm}^{-3}$	T/K	Ref.	C_{11}	C_{12}	C_{44}
Aluminum	Al	2.6970	298	1	1.0675	0.6041	0.2834
Aluminum antimonide	AlSb	4.3600	300	2	0.8939	0.4427	0.4155
Ammonium bromide	NH ₄ Br	2.4314	300	3	0.3414	0.0782	0.0722
Ammonium chloride	NH ₄ Cl	1.5279	290	4	0.3814	0.0866	0.0903
Argon	Ar	1.7710	4.2	5	0.0529	0.0135	0.0159
Barium fluoride	BaF ₂	4.8860	298	6	0.9199	0.4157	0.2568
Barium nitrate	Ba(NO ₃) ₂	3.2560	293	7	0.2925	0.2065	0.1277
Calcium fluoride	CaF ₂	3.810	298	8	1.6420	0.4398	0.8406
Calcium telluride	CaTe	5.8544	298	9	0.5351	0.3681	0.1994
Cesium	Cs	1.9800	78	10	0.0247	0.0206	0.0148
Cesium bromide	CsBr	4.4560	298	11	0.3063	0.0807	0.0750
Cesium chloride	CsCl	3.9880	298	11	0.3644	0.0882	0.0804
Cesium iodide	CsI	4.5250	298	11	0.2446	0.0661	0.0629
Chromite	FeCr ₂ O ₄	4.4500	RT	12	3.2250	1.4370	1.1670
Chromium	Cr	7.20	298	13	3.398	0.586	0.990
Cobalt oxide	CoO	6.44	298	14	2.6123	1.4699	0.8300
Cobalt zinc ferrite	CoZnFeO ₂	5.43	303	12	2.660	1.530	0.780
Copper	Cu	8.932	298	15	1.683	1.221	0.757
Gallium antimonide	GaSb	5.6137	298	16	0.8839	0.4033	0.4316
Gallium arsenide	GaAs	5.3169	298	17	1.1877	0.5372	0.5944
Gallium phosphide	GaP	4.1297	300	18	1.4120	0.6253	0.7047
Garnet (yttrium-iron)	Y ₃ Fe ₂ (FeO ₄) ₃	5.17	298	19	2.680	1.106	0.766
Germanium	Ge	5.313	298	20	1.2835	0.4823	0.6666
Gold	Au	19.283	296.5	21	1.9244	1.6298	0.4200
Indium antimonide	InSb	5.7890	298	22	0.6720	0.3670	0.3020
Indium arsenide	InAs	5.6720	293	23	0.8329	0.4526	0.3959
Indium phosphide	InP	4.78	RT	24	1.0220	0.5760	0.4600
Iridium	Ir	22.52	300	25	5.80	2.42	2.56
Iron	Fe	7.8672	298	26	2.26	1.40	1.16
Lead	Pb	11.34	296	27	0.4966	0.4231	0.1498
Lead fluoride	PbF ₂	7.79	300	28	0.8880	0.4720	0.2454
Lead nitrate	Pb(NO ₃) ₂	4.547	293	29	0.3729	0.2765	0.1347
Lead telluride	PbTe	8.2379	303.2	30	1.0795	0.0764	0.1343
Lithium	Li	0.5326	298	31	0.1350	0.1144	0.0878
Lithium bromide	LiBr	3.47	RT	32	0.3940	0.1880	0.1910
Lithium chloride	LiCl	2.068	295	33	0.4927	0.2310	0.2495
Lithium fluoride	LiF	2.638	RT	34	1.1397	0.4767	0.6364
Lithium iodide	LiI	4.061	RT	32	0.2850	0.1400	0.1350
Magnesium oxide	MgO	3.579	298	20	2.9708	0.9536	1.5613
Magnetite	Fe ₃ O ₄	5.18	RT	32	2.730	1.060	0.971
Manganese oxide	MnO	5.39	298	35	2.23	1.20	0.79
Mercury telluride	HgTe	8.079	290	36	0.548	0.381	0.204
Molybdenum	Mo	10.2284	273	37	4.637	1.578	1.092

ELASTIC CONSTANTS OF SINGLE CRYSTALS (continued)

CUBIC CRYSTALS (continued)

Name	Formula	$\rho/g\text{ cm}^{-3}$	T/K	Ref.	C_{11}	C_{12}	C_{44}
Nickel	Ni	8.91	298	15	2.481	1.549	1.242
Niobium	Nb	8.578	300	38	2.4650	1.3450	0.2873
Palladium	Pd	12.038	300	39	2.2710	1.7604	0.7173
Platinum	Pt	21.50	300	40	3.4670	2.5070	0.7650
Potassium	K	0.851	295	41	0.0370	0.0314	0.0188
Potassium bromide	KBr	2.740	298	11	0.3468	0.0580	0.0507
Potassium chloride	KCl	1.984	298	11	0.4069	0.0711	0.0631
Potassium cyanide	KCN	1.553	RT	32	0.1940	0.1180	0.0150
Potassium fluoride	KF	2.480	295	33	0.6490	0.1520	0.1232
Potassium iodide	KI	3.128	300	42	0.2710	0.0450	0.0364
Pyrite	FeS ₂	5.016	RT	43	3.818	0.310	1.094
Rubidium	Rb	1.58	170	44	0.0296	0.0250	0.0171
Rubidium bromide	RbBr	3.350	300	45	0.3152	0.0500	0.0380
Rubidium chloride	RbCl	2.797	300	45	0.3624	0.0612	0.0468
Rubidium iodide	RbI	3.551	300	45	0.2556	0.0382	0.0278
Silicon	Si	2.331	298	46	1.6578	0.6394	0.7962
Silver	Ag	10.50	300	47	1.2399	0.9367	0.4612
Silver bromide	AgBr	5.585	300	48	0.5920	0.3640	0.0616
Sodium	Na	0.971	299	49	0.0739	0.0622	0.0419
Sodium bromate	NaBrO ₃	3.339	RT	32	0.5450	0.1910	0.1500
Sodium bromide	NaBr	3.202	300	33	0.3970	0.1001	0.0998
Sodium chlorate	NaClO ₃	2.485	RT	50	0.4920	0.1420	0.1160
Sodium chloride	NaCl	2.163	298	11	0.4947	0.1288	0.1287
Sodium fluoride	NaF	2.804	300	51	0.9700	0.2380	0.2822
Sodium iodide	NaI	3.6689	300	52	0.3007	0.0912	0.0733
Spinel	MgAl ₂ O ₄	3.6193	298	53	2.9857	1.5372	1.5758
Strontium fluoride	SrF ₂	4.277	300	54	1.2350	0.4305	0.3128
Strontium nitrate	Sr(NO ₃) ₂	2.989	293	29	0.4255	0.2921	0.1590
Strontium oxide	SrO	4.99	300	55	1.601	0.435	0.590
Strontium titanate	SrTiO ₃	5.123	RT	56	3.4817	1.0064	4.5455
Tantalum	Ta	16.626	298	57	2.6023	1.5446	0.8255
Tantalum carbide	TaC	14.65	RT	58	5.05	0.73	0.79
Thallium bromide	TlBr	7.4529	298	59	0.3760	0.1458	0.0757
Thorium	Th	11.694	300	60	0.7530	0.4890	0.4780
Thorium oxide	ThO ₂	9.991	298	61	3.670	1.060	0.797
Tin telluride	SnTe	6.445	300	62	1.1250	0.0750	0.1172
Titanium carbide	TiC	4.940	RT	107	5.00	1.13	1.75
Tungsten	W	19.257	297	64	5.2239	2.0437	1.6083
Uranium carbide	UC	13.63	300	65	3.200	0.850	0.647
Uranium dioxide	UO ₂	10.97	298	66	3.960	1.210	0.641
Vanadium	V	6.022	300	67	2.287	1.190	0.432
Zinc selenide	ZnSe	5.262	298	68	0.8096	0.4881	0.4405
Zinc sulfide	ZnS	4.088	298	68	1.0462	0.6534	0.4613
Zinc telluride	ZnTe	5.636	298	68	0.7134	0.4078	0.3115
Zirconium carbide	ZrC	6.606	298	63	4.720	0.987	1.593

TETRAGONAL CRYSTALS

Name	Formula	$\rho/g\text{ cm}^{-3}$	T/K	Ref.	C_{11}	C_{12}	C_{13}	C_{16}	C_{33}	C_{44}	C_{66}
Ammonium dihydrogen arsenate (ADA)	$\text{NH}_4\text{H}_2\text{AsO}_4$	2.3110	298	69	0.6747	-0.106	0.1652		0.3022	0.0685	0.0639
Ammonium dihydrogen phosphate (ADP)	$\text{NH}_4\text{H}_2\text{PO}_4$	1.8030	293	69	0.6200	-0.050	0.1400		0.3000	0.0910	0.0610
Barium titanate	BaTiO_3	5.9988	298	70	2.7512	1.7897	1.5156		1.6486	0.5435	1.1312
Calcium molybdate	CaMoO_4	4.255	298	79	1.447	0.664	0.466	0.134	1.265	0.369	0.451
Indium	In	7.300	RT	71	0.4450	0.3950	0.4050		0.4440	0.0655	0.1220
Magnesium fluoride	MgF_2	3.177	RT	72	1.237	0.732	0.536		1.770	0.552	0.978
Nickel sulfate hexahydrate	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$	2.070	RT	73	0.3209	0.2315	0.0209		0.2931	0.1156	0.1779
Potassium dihydrogen arsenate (KDA)	KH_2AsO_4	2.867	RT	12	0.530	-0.060	-0.020		0.370	0.120	0.070
Potassium dihydrogen phosphate (KDP)	KH_2PO_4	2.388	RT	71	0.7140	-0.049	0.1290		0.5620	0.1270	0.0628
Rubidium dihydrogen phosphate (RDP)	RbH_2PO_4	2.800	298	74	0.5562	-0.064	0.0279		0.4398	0.1142	0.0350
Rutile	TiO_2	4.260	298	75	2.7143	1.7796	1.4957		4.8395	1.2443	1.9477
Tellurium oxide	TeO_2	5.99	RT	76	0.5320	0.4860	0.2120		1.0850	0.2440	0.5520
Tin (white)	Sn	7.29	288	77	0.7529	0.6156	0.4400		0.9552	0.2193	0.2336
Zircon	ZrSiO_4	4.70	RT	78	2.585	1.791	1.542		3.805	0.733	1.113

ELASTIC CONSTANTS OF SINGLE CRYSTALS (continued)

ORTHORHOMBIC CRYSTALS

Name	Formula	$\rho/g\text{ cm}^{-3}$	T/K	Ref.	C_{11}	C_{12}	C_{13}	C_{22}	C_{23}	C_{33}	C_{44}	C_{55}	C_{66}
Acenaphthene	$C_{12}H_{10}$	1.220	293	80	0.1380	0.0210	0.0410	0.1262	0.0460	0.1117	0.0265	0.0290	0.0185
Ammonium sulfate	$(NH_4)_2SO_4$	1.774	293	81	0.3607	0.1651	0.1580	0.2981	0.1456	0.3534	0.1025	0.0717	0.0974
Aragonite	$CaCO_3$	2.93	RT	82	1.5958	0.3663	0.0197	0.8697	0.1597	0.8503	0.4132	0.2564	0.4274
Barite	$BaSO_4$	4.40	RT	82	0.8941	0.4614	0.2691	0.7842	0.2676	1.0548	0.1190	0.2874	0.2778
Benzene	C_6H_6	1.061	250	83	0.0614	0.0352	0.0401	0.0656	0.0390	0.0583	0.0197	0.0378	0.0153
Benzophenone	$(C_6H_5)_2CO$	1.219	RT	32	0.1070	0.0550	0.0169	0.1000	0.0321	0.0710	0.0203	0.0155	0.0353
Bronzite	$(MgFe)SiO_3$	3.38	RT	78	1.876	0.686	0.605	1.578	0.561	2.085	0.700	0.592	0.544
Calcium sulfate	$CaSO_4$	2.962	RT	84	0.9382	0.1650	0.1520	1.845	0.3173	1.1180	0.3247	0.2653	0.0926
Celestite	$SrSO_3$	3.96	RT	12	1.044	0.773	0.605	1.061	0.619	1.286	0.135	0.279	0.266
Cesium sulfate	Cs_2SO_4	4.243	293	81	0.4490	0.1958	0.1815	0.4283	0.1800	0.3785	0.1326	0.1319	0.1323
Fosterite	Mg_2SiO_4	3.224	298	85	3.2848	0.6390	0.6880	1.9980	0.7380	2.3530	0.6515	0.8120	0.8088
Iodic acid	HIO_3	4.630	RT	73	0.3030	0.1194	0.1169	0.5448	0.0548	0.4359	0.1835	0.2193	0.1736
Lithium ammonium tartrate	$LiNH_4C_4H_4O_6 \cdot 4H_2O$	1.71	RT	12	0.3864	0.1655	0.0875	0.5393	0.2007	0.3624	0.1190	0.0667	0.2326
Magnesium sulfate heptahydrate	$MgSO_4 \cdot 7H_2O$	1.68	RT	86	0.325	0.174	0.182	0.288	0.182	0.315	0.078	0.156	0.090
Natrolite	$(Na,Al)SiO_3$	2.25	RT	78	0.716	0.261	0.297	0.632	0.297	1.378	0.196	0.248	0.423
Nickel sulfate heptahydrate	$NiSO_4 \cdot 7H_2O$	1.948	RT	86	0.353	0.198	0.201	0.311	0.201	0.335	0.091	0.172	0.099
Olivine	$(MgFe)SiO_4$	3.324	RT	87	3.240	0.590	0.790	1.980	0.780	2.490	0.667	0.810	0.793
Potassium pentaborate	$KB_5O_8 \cdot 4H_2O$	1.74	RT	71	0.582	0.229	0.174	0.359	0.231	0.255	0.164	0.046	0.057
Potassium sulfate	K_2SO_4	2.665	293	81	0.5357	0.1999	0.2095	0.5653	0.1990	0.5523	0.195	0.1879	0.1424
Rochelle salt	$NaK(C_4H_4O_6) \cdot 4H_2O$	1.79	RT	71	0.255	0.141	0.116	0.381	0.146	0.371	0.134	0.032	0.098
Rubidium sulfate	Rb_2SO_4	3.621	293	81	0.5029	0.1965	0.1999	0.5098	0.1925	0.4761	0.1626	0.1589	0.1407
Sodium ammonium tartrate	$NaNH_4C_4H_4O_6 \cdot 4H_2O$	1.587	RT	12	0.3685	0.2725	0.3083	0.5092	0.3472	0.5541	0.1058	0.0303	0.0870
Sodium tartrate	$Na_2C_4H_4O_6 \cdot 2H_2O$	1.794	RT	12	0.461	0.286	0.320	0.547	0.352	0.665	0.124	0.031	0.098
Strontium formate dihydrate	$Sr(CHO_2)_2 \cdot 2H_2O$	2.25	RT	12	0.4391	0.1037	-0.149	0.3484	-0.014	0.3746	0.1538	0.1075	0.1724
Sulfur	S	2.07	RT	12	0.240	0.133	0.171	0.205	0.159	0.483	0.043	0.087	0.076
Thallium sulfate	$TlSO_4$	6.776	293	81	0.4106	0.2573	0.2288	0.3885	0.2174	0.4268	0.1125	0.1068	0.0751
Topaz	$Al_2SiO_3(OH,F)_2$	3.52	RT	82	2.8136	1.2582	0.8464	3.8495	0.8815	2.9452	1.0811	1.3298	1.3089
Uranium (alpha)	U	19.0453	293	88	2.1486	0.4622	0.2176	1.9983	1.0764	2.6763	1.2479	0.7379	0.7454
Zinc sulfate heptahydrate	$ZnSO_4 \cdot 7H_2O$	1.970	RT	86	0.3320	0.1720	0.2000	0.2930	0.1980	0.3200	0.0780	0.1530	0.0830

ELASTIC CONSTANTS OF SINGLE CRYSTALS (continued)

ELASTIC CONSTANTS OF SINGLE CRYSTALS (continued)

MONOCLINIC CRYSTALS

Name	Formula	$\rho/\text{g cm}^{-3}$	T/K	Ref.	C_{11}	C_{12}	C_{13}	C_{15}	C_{22}
Aegirine	(NaFe)Si ₂ O ₆	3.50	RT	89	1.858	0.685	0.707	0.098	1.813
Anthracene	C ₁₄ H ₁₀	1.258	RT	90	0.0852	0.0672	0.0590	-0.0192	0.1170
Cobalt sulfate heptahydrate	CoSO ₄ ·7H ₂ O	1.948	RT	86	0.335	0.205	0.158	0.016	0.378
Diopside	(CaMg)Si ₂ O ₆	3.31	RT	91	2.040	0.884	0.0883	-0.193	1.750
Dipotassium tartrate	KHC ₄ H ₄ O ₆	1.97	RT	12	0.4294	0.1399	0.3129	-0.0105	0.3460
Feldspar (microceine)	KAlSi ₃ O ₈	2.56	RT	92	0.664	0.438	0.259	-0.033	1.710
Ferrous sulfate heptahydrate	FeSO ₄ ·7H ₂ O	1.898	RT	86	0.349	0.208	0.174	-0.020	0.376
Lithium sulfate monohydrate	Li ₂ SO ₄ ·H ₂ O	2.221	RT	32	0.5250	0.1715	0.1730	-0.0196	0.5060
Naphthalene	C ₁₀ H ₈	1.127	RT	93	0.0780	0.0445	0.0340	-0.006	0.0990
Potassium tartrate	K ₂ C ₄ H ₄ O ₆	1.987	RT	32	0.3110	0.1720	0.1690	0.0287	0.3900
Sodium thiosulfate	Na ₂ S ₂ O ₃	1.7499	RT	12	0.3323	0.1814	0.1875	0.0225	0.2953
Stilbene	(C ₆ H ₅ CH) ₂	1.60	RT	94	0.0930	0.0570	0.0670	-0.003	0.0920
Triglycine sulfate (TGS)	(NH ₂ CH ₂ COOH) ₃ · H ₂ SO ₄	1.68	RT	32	0.4550	0.1720	0.1980	-0.030	0.3210

Name	C_{23}	C_{25}	C_{33}	C_{35}	C_{44}	C_{46}	C_{55}	C_{66}
Aegirine	0.626	0.094	2.344	0.214	0.692	0.077	0.510	0.474
Anthracene	0.0375	-0.0170	0.1522	-0.0187	0.0272	0.0138	0.0242	0.0399
Cobalt sulfate heptahydrate	0.158	-0.018	0.371	-0.047	0.060	0.016	0.058	0.101
Diopside	0.482	-0.196	2.380	-0.336	0.675	-0.113	0.588	0.705
Dipotassium tartrate	0.1173	0.0176	0.6816	0.0294	0.0961	-0.0044	0.1270	0.0841
Feldspar (microceine)	0.192	-0.148	1.215	-0.131	0.143	-0.015	0.238	0.361
Ferrous sulfate heptahydrate	0.172	-0.019	0.360	-0.014	0.064	0.001	0.056	0.096
Lithium sulfate monohydrate	0.0368	0.0571	0.5400	-0.0254	0.1400	-0.0054	0.1565	0.2770
Naphthalene	0.0230	-0.0270	0.1190	0.0290	0.0330	-0.0050	0.0210	0.0415
Potassium tartrate	0.1330	0.0182	0.5540	0.0710	0.0870	0.0072	0.1040	0.0826
Sodium thiosulfate	0.1713	0.0983	0.4590	-0.0678	0.0569	-0.0268	0.1070	0.0598
Stilbene	0.0485	-0.005	0.0790	-0.005	0.0325	0.0050	0.0640	0.0245
Triglycine sulfate (TGS)	0.2080	-0.0036	0.2630	-0.0500	0.0950	-0.0026	0.1110	0.0620

ELASTIC CONSTANTS OF SINGLE CRYSTALS (continued)

HEXAGONAL CRYSTALS

Name	Formula	$\rho/g\text{ cm}^{-3}$	T/K	Ref.	C_{11}	C_{12}	C_{13}	C_{33}	C_{55}
Apatite	$\text{Ca}_5(\text{PO}_4)_3(\text{OH},\text{F},\text{Cl})$	3.218	RT	12	1.667	0.131	0.655	1.396	0.663
Beryl	$\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$	2.68	RT	12	2.800	0.990	0.670	2.480	0.658
Beryllium	Be	1.8477	300	95	2.923	0.267	0.140	3.364	1.625
Beryllium oxide	BeO	3.01	RT	96	4.70	1.68	1.19	4.94	1.53
Cadmium	Cd	8.652	300	97	1.1450	0.3950	0.3990	0.5085	0.1985
Cadmium selenide	CdSe	5.655	298	68	0.7046	0.4516	0.3930	0.8355	0.1317
Cadmium sulfide	CdS	4.824	298	98	0.8431	0.5208	0.4567	0.9183	0.1458
Cobalt	Co	8.836	298	99	3.071	1.650	1.027	3.581	0.755
Dysprosium	Dy	8.560	298	100	0.7466	0.2616	0.2233	0.7871	0.2427
Erbium	Er	9.064	298	100	0.8634	0.3050	0.2270	0.8554	0.2809
Gadolinium	Gd	7.888	298	101	0.6667	0.2499	0.2132	0.7191	0.2089
Hafnium	Hf	12.727	298	102	1.881	0.772	0.661	1.969	0.557
Ice	$\text{H}_2\text{O}(\text{solid})$	0.920	250	103	0.1410	0.0660	0.0624	0.1515	0.0288
Indium	In	7.2788	300	104	0.4535	0.4006	0.4151	0.4515	0.0651
Magnesium	Mg	1.7364	298	105	0.5950	0.2612	0.2180	0.6155	0.1635
Rhenium	Re	21.024	298	100	6.1820	2.7530	2.0780	6.8350	1.6060
Ruthenium	Ru	12.3615	298	100	5.6260	1.8780	1.6820	6.2420	1.8060
Thallium	Tl	11.560	300	106	0.4080	0.3540	0.2900	0.5280	0.0726
Titanium	Ti	4.5063	298	102	1.6240	0.9200	0.6900	1.8070	0.4670
Titanium diboride	TiB_2	4.95	RT	107	6.90	4.10	3.20	4.40	2.50
Yttrium	Y	4.472	300	108	0.7790	0.2850	0.2100	0.7690	0.2431
Zinc	Zn	7.134	295	109	1.6368	0.3640	0.5300	0.6347	0.3879
Zinc oxide	ZnO	5.6760	298	110	2.0970	1.2110	1.0510	2.1090	0.4247
Zinc sulfide	ZnS	4.089	298	96	1.2420	0.6015	0.4554	1.4000	0.2864
Zirconium	Zr	6.505	298	102	1.434	0.728	0.653	1.648	0.320

TRIGONAL CRYSTALS

Name	Formula	$\rho/g\text{ cm}^{-3}$	T/K	Ref.	C_{11}	C_{12}	C_{13}	C_{14}	C_{33}	C_{44}
Aluminum oxide	Al_2O_3	3.986	300	111	4.9735	1.6397	1.1220	-0.2358	4.9911	1.4739
Aluminum phosphate	AlPO_4	2.556	RT	73	1.0503	0.2934	0.6927	-0.1271	1.3353	0.2314
Antimony	Sb	6.70	295	112	1.0130	0.3450	0.2920	0.2090	0.4500	0.3930
Bismuth	Bi	9.80	295	112	0.6370	0.2490	0.2470	0.0717	0.3820	0.1123
Calcite	CaCO_3	2.712	300	113	1.4806	0.5578	0.5464	-0.2058	0.8557	0.3269
Hematite	Fe_2O_3	5.240	RT	82	2.4243	0.5464	0.1542	-0.1247	2.2734	0.8569
Lithium niobate	LiNbO_3	4.70	RT	114	2.030	0.530	0.750	0.090	2.450	0.600
Lithium tantalate	LiTaO_3	7.45	RT	114	2.330	0.470	0.800	-0.110	2.750	0.940
Quartz	SiO_2	2.6485	298	115	0.8680	0.0704	0.1191	-0.1804	1.0575	0.5820
Selenium	Se	4.838	300	116	0.1870	0.0710	0.2620	0.0620	0.7410	0.1490
Sodium nitrate	NaNO_3	2.27	RT	12	0.8670	0.1630	0.1600	0.0820	0.3740	0.2130
Tourmaline		3.05	RT	82	2.7066	0.6927	0.0872	-0.0774	1.6070	0.6682

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ELECTRICAL RESISTIVITY OF PURE METALS

The first part of this table gives the electrical resistivity, in units of $10^{-8} \Omega \text{ m}$, for 28 common metallic elements as a function of temperature. The data refer to polycrystalline samples. The number of significant figures indicates the accuracy of the values. However, at low temperatures (especially below 50 K) the electrical resistivity is extremely sensitive to sample purity. Thus the low-temperature values refer to samples of specified purity and treatment. The references should be consulted for further information on this point, as well as for values at additional temperatures.

The second part of the table gives resistivity values in the neighborhood of room temperature for other metallic elements that have not been studied over an extended temperature range.

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ELECTRICAL RESISTIVITY IN $10^{-8} \Omega \text{ m}$

T/K	Aluminum	Barium	Beryllium	Calcium	Cesium	Chromium	Copper
1	0.000100	0.081	0.0332	0.045	0.0026		0.00200
10	0.000193	0.189	0.0332	0.047	0.243		0.00202
20	0.000755	0.94	0.0336	0.060	0.86		0.00280
40	0.0181	2.91	0.0367	0.175	1.99		0.0239
60	0.0959	4.86	0.067	0.40	3.07		0.0971
80	0.245	6.83	0.075	0.65	4.16		0.215
100	0.442	8.85	0.133	0.91	5.28	1.6	0.348
150	1.006	14.3	0.510	1.56	8.43	4.5	0.699
200	1.587	20.2	1.29	2.19	12.2	7.7	1.046
273	2.417	30.2	3.02	3.11	18.7	11.8	1.543
293	2.650	33.2	3.56	3.36	20.5	12.5	1.678
298	2.709	34.0	3.70	3.42	20.8	12.6	1.712
300	2.733	34.3	3.76	3.45	21.0	12.7	1.725
400	3.87	51.4	6.76	4.7		15.8	2.402
500	4.99	72.4	9.9	6.0		20.1	3.090
600	6.13	98.2	13.2	7.3		24.7	3.792
700	7.35	130	16.5	8.7		29.5	4.514
800	8.70	168	20.0	10.0		34.6	5.262
900	10.18	216	23.7	11.4		39.9	6.041

T/K	Gold	Hafnium	Iron	Lead	Lithium	Magnesium	Manganese
1	0.0220	1.00	0.0225		0.007	0.0062	7.02
10	0.0226	1.00	0.0238		0.008	0.0069	18.9
20	0.035	1.11	0.0287		0.012	0.0123	54
40	0.141	2.52	0.0758		0.074	0.074	116
60	0.308	4.53	0.271		0.345	0.261	131
80	0.481	6.75	0.693	4.9	1.00	0.557	132
100	0.650	9.12	1.28	6.4	1.73	0.91	132
150	1.061	15.0	3.15	9.9	3.72	1.84	136
200	1.462	21.0	5.20	13.6	5.71	2.75	139
273	2.051	30.4	8.57	19.2	8.53	4.05	143
293	2.214	33.1	9.61	20.8	9.28	4.39	144
298	2.255	33.7	9.87	21.1	9.47	4.48	144
300	2.271	34.0	9.98	21.3	9.55	4.51	144
400	3.107	48.1	16.1	29.6	13.4	6.19	147
500	3.97	63.1	23.7	38.3		7.86	149

ELECTRICAL RESISTIVITY OF PURE METALS (continued)

<i>T/K</i>	Gold	Hafnium	Iron	Lead	Lithium	Magnesium	Manganese
600	4.87	78.5	32.9			9.52	151
700	5.82		44.0			11.2	152
800	6.81		57.1			12.8	
900	7.86					14.4	

<i>T/K</i>	Molybdenum	Nickel	Palladium	Platinum	Potassium	Rubidium	Silver
1	0.00070	0.0032	0.0200	0.002	0.0008	0.0131	0.00100
10	0.00089	0.0057	0.0242	0.0154	0.0160	0.109	0.00115
20	0.00261	0.0140	0.0563	0.0484	0.117	0.444	0.0042
40	0.0457	0.068	0.334	0.409	0.480	1.21	0.0539
60	0.206	0.242	0.938	1.107	0.90	1.94	0.162
80	0.482	0.545	1.75	1.922	1.34	2.65	0.289
100	0.858	0.96	2.62	2.755	1.79	3.36	0.418
150	1.99	2.21	4.80	4.76	2.99	5.27	0.726
200	3.13	3.67	6.88	6.77	4.26	7.49	1.029
273	4.85	6.16	9.78	9.6	6.49	11.5	1.467
293	5.34	6.93	10.54	10.5	7.20	12.8	1.587
298	5.47	7.12	10.73	10.7	7.39	13.1	1.617
300	5.52	7.20	10.80	10.8	7.47	13.3	1.629
400	8.02	11.8	14.48	14.6			2.241
500	10.6	17.7	17.94	18.3			2.87
600	13.1	25.5	21.2	21.9			3.53
700	15.8	32.1	24.2	25.4			4.21
800	18.4	35.5	27.1	28.7			4.91
900	21.2	38.6	29.4	32.0			5.64

<i>T/K</i>	Sodium	Strontium	Tantalum	Tungsten	Vanadium	Zinc	Zirconium
1	0.0009	0.80	0.10	0.000016		0.0100	0.250
10	0.0015	0.80	0.102	0.000137	0.0145	0.0112	0.253
20	0.016	0.92	0.146	0.00196	0.039	0.0387	0.357
40	0.172	1.70	0.751	0.0544	0.304	0.306	1.44
60	0.447	2.68	1.65	0.266	1.11	0.715	3.75
80	0.80	3.64	2.62	0.606	2.41	1.15	6.64
100	1.16	4.58	3.64	1.02	4.01	1.60	9.79
150	2.03	6.84	6.19	2.09	8.2	2.71	17.8
200	2.89	9.04	8.66	3.18	12.4	3.83	26.3
273	4.33	12.3	12.2	4.82	18.1	5.46	38.8
293	4.77	13.2	13.1	5.28	19.7	5.90	42.1
298	4.88	13.4	13.4	5.39	20.1	6.01	42.9
300	4.93	13.5	13.5	5.44	20.2	6.06	43.3
400		17.8	18.2	7.83	28.0	8.37	60.3
500		22.2	22.9	10.3	34.8	10.82	76.5
600		26.7	27.4	13.0	41.1	13.49	91.5
700		31.2	31.8	15.7	47.2		104.2
800		35.6	35.9	18.6	53.1		114.9
900			40.1	21.5	58.7		123.1

ELECTRICAL RESISTIVITY OF PURE METALS (continued)

Element	<i>T</i> /K	Electrical resistivity $10^{-8} \Omega \text{ m}$
Antimony	273	39
Bismuth	273	107
Cadmium	273	6.8
Cerium (β , hex)	290—300	82.8
Cerium (γ , cub)	298	74.4
Cobalt	273	5.6
Dysprosium	290—300	92.6
Erbium	290—300	86.0
Europium	290—300	90.0
Gadolinium	290—300	131
Gallium	273	13.6
Holmium	290—300	81.4
Indium	273	8.0
Iridium	273	4.7
Lanthanum	290—300	61.5
Lutetium	290—300	58.2
Mercury	298	96.1
Neodymium	290—300	64.3
Niobium	273	15.2
Osmium	273	8.1
Polonium	273	40
Praseodymium	290—300	70.0
Promethium	290—300	75 est.
Protactinium	273	17.7
Rhenium	273	17.2
Rhodium	273	4.3
Ruthenium	273	7.1
Samarium	290—300	94.0
Scandium	290—300	56.2
Terbium	290—300	115
Thallium	273	15
Thorium	273	14.7
Thulium	290—300	67.6
Tin	273	11.5
Titanium	273	39
Uranium	273	28
Ytterbium	290—300	25.0
Yttrium	290—300	59.6

ELECTRICAL RESISTIVITY OF SELECTED ALLOYS

These values were obtained by fitting all available measurements to a theoretical formulation describing the temperature and composition dependence of the electrical resistivity of metals. Some of the values listed here fall in regions of temperature and composition where no actual measurements exist. Details of the procedure may be found in the reference.

Values of the resistivity are given in units of $10^{-8} \Omega \text{ m}$. General comments in the preceding table for pure metals also apply here.

REFERENCE

C.Y. Ho, et al., *J. Phys. Chem. Ref. Data*, 12, 183-322, 1983.

Aluminum-Copper

Wt % Al	100 K	273 K	293 K	300 K	350 K	400 K
99 ^a	0.531	2.51	2.74	2.82	3.38	3.95
95 ^a	0.895	2.88	3.10	3.18	3.75	4.33
90 ^b	1.38	3.36	3.59	3.67	4.25	4.86
85 ^b	1.88	3.87	4.10	4.19	4.79	5.42
80 ^b	2.34	4.33	4.58	4.67	5.31	5.99
70 ^b	3.02	5.03	5.31	5.41	6.16	6.94
60 ^b	3.49	5.56	5.88	5.99	6.77	7.63
50 ^b	4.00	6.22	6.55	6.67	7.55	8.52
40 ^c		7.57	7.96	8.10	9.12	10.2
30 ^c		11.2	11.8	12.0	13.5	15.2
25 ^f		16.3	17.2	17.6	19.8	22.2
15 ^h			12.3			
10 ^g	8.71	10.8	11.0	11.1	11.7	12.3
5 ^c	7.92	9.43	9.61	9.68	10.2	10.7
1 ^b	3.22	4.46	4.60	4.65	5.00	5.37

Aluminum-Magnesium

Wt % Al	100 K	273 K	293 K	300 K	350 K	400 K
99 ^c	0.958	2.96	3.18	3.26	3.82	4.39
95 ^c	3.01	5.05	5.28	5.36	5.93	6.51
90 ^c	5.42	7.52	7.76	7.85	8.43	9.02
10 ^b	14.0	17.1	17.4	17.6	18.4	19.2
5 ^b	9.93	13.1	13.4	13.5	14.3	15.2
1 ^a	2.78	5.92	6.25	6.37	7.20	8.03

Copper-Gold

Wt % Cu	100 K	273 K	293 K	300 K	350 K	400 K
99 ^c	0.520	1.73	1.86	1.91	2.24	2.58
95 ^c	1.21	2.41	2.54	2.59	2.92	3.26
90 ^c	2.11	3.29	4.42	3.46	3.79	4.12
85 ^c	3.01	4.20	4.33	4.38	4.71	5.05
80 ^c	3.95	5.15	5.28	5.32	5.65	5.99
70 ^c	5.91	7.12	7.25	7.30	7.64	7.99
60 ^c	8.04	9.18	9.13	9.36	9.70	10.05
50 ^c	9.88	11.07	11.20	11.25	11.60	11.94
40 ^c	11.44	12.70	12.85	12.90	13.27	13.65
30 ^c	12.43	13.77	13.93	13.99	14.38	14.78
25 ^c	12.59	13.93	14.09	14.14	14.54	14.94
15 ^c	11.38	12.75	12.91	12.96	13.36	13.77
10 ^c	9.33	10.70	10.86	10.91	11.31	11.72
5 ^c	5.91	7.25	7.41	7.46	7.87	8.28
1 ^c	2.00	3.40	3.57	3.62	4.03	4.45

ELECTRICAL RESISTIVITY OF SELECTED ALLOYS (continued)

Copper-Nickel

	100 K	273 K	293 K	300 K	350 K	400 K
Wt % Cu						
99 ^c	1.45	2.71	2.85	2.91	3.27	3.62
95 ^c	6.19	7.60	7.71	7.82	8.22	8.62
90 ^c	12.08	13.69	13.89	13.96	14.40	14.81
85 ^c	18.01	19.63	19.83	19.90	20.32	20.70
80 ^c	23.89	25.46	25.66	25.72	26.12	26.44
70 ⁱ	35.73	36.67	36.72	36.76	36.85	36.89
60 ⁱ	45.76	45.43	45.38	43.35	45.20	45.01
50 ⁱ	50.22	50.19	50.05	50.01	49.73	49.50
40 ^c	36.77	47.42	47.73	47.82	48.28	48.49
30 ⁱ	26.73	40.19	41.79	42.34	44.51	45.40
25 ^c	22.22	33.46	35.11	35.69	39.67	42.81
15 ^c	13.49	22.00	23.35	23.85	27.60	31.38
10 ^c	9.28	16.65	17.82	18.26	21.51	25.19
5 ^c	5.20	11.49	12.50	12.90	15.69	18.78
1 ^c	1.81	7.23	8.08	8.37	10.63	13.18

Copper-Palladium

	100 K	273 K	293 K	300 K	350 K	400 K
Wt % Cu						
99 ^c	0.91	2.10	2.23	2.27	2.59	2.92
95 ^c	2.99	4.21	4.35	4.40	4.74	5.08
90 ^c	5.69	6.89	7.03	7.08	7.41	7.74
85 ^c	8.30	9.48	9.61	9.66	10.01	10.36
80 ^c	10.74	11.99	12.12	12.16	12.51	12.87
70 ^c	15.67	16.87	17.01	17.06	17.41	17.78
60 ^c	20.45	21.73	21.87	21.92	22.30	22.69
50 ^c	26.07	27.62	27.79	27.86	28.25	28.64
40 ^c	33.53	35.31	35.51	35.57	36.03	36.47
30 ^c	45.03	46.50	46.66	46.71	47.11	47.47
25 ^c	44.12	46.25	46.45	46.52	46.99	47.43
15 ^c	31.79	36.52	36.99	37.16	38.28	39.35
10 ^c	23.00	28.90	29.51	29.73	31.19	32.56
5 ^c	13.09	20.00	20.75	21.02	22.84	24.54
1 ^c	8.97	11.90	12.67	12.93	14.82	16.68

Copper-Zinc

	100 K	273 K	293 K	300 K	350 K	400 K
Wt % Cu						
99 ^b	0.671	1.84	1.97	2.02	2.36	2.71
95 ^b	1.54	2.78	2.92	2.97	3.33	3.69
90 ^b	2.33	3.66	3.81	3.86	4.25	4.63
85 ^b	2.93	4.37	4.54	4.60	5.02	5.44
80 ^b	3.44	5.01	5.19	5.26	5.71	6.17
70 ^b	4.08	5.87	6.08	6.15	6.67	7.19

Gold-Palladium

	100 K	273 K	293 K	300 K	350 K	400 K
Wt % Au						
99 ^c	1.31	2.69	2.86	2.91	3.32	3.73
95 ^c	3.88	5.21	5.35	5.41	5.79	6.17
90 ⁱ	6.70	8.01	8.17	8.22	8.56	8.93
85 ^b	9.14	10.50	10.66	10.72	11.10	11.48
80 ^b	11.23	12.75	12.93	12.99	13.45	13.93
70 ^c	16.44	18.23	18.46	18.54	19.10	19.67
60 ^b	24.64	26.70	26.94	27.02	27.63	28.23

ELECTRICAL RESISTIVITY OF SELECTED ALLOYS (continued)

Gold-Palladium (continued)

	100 K	273 K	293 K	300 K	350 K	400 K
Wt % Au						
50 ^a	23.09	27.23	27.63	27.76	28.64	29.42
40 ^a	19.40	24.65	25.23	25.42	26.74	27.95
30 ^b	14.94	20.82	21.49	21.72	23.35	24.92
25 ^b	12.72	18.86	19.53	19.77	21.51	23.19
15 ^a	8.54	15.08	15.77	16.01	17.80	19.61
10 ^a	6.54	13.25	13.95	14.20	16.00	17.81
5 ^a	4.58	11.49	12.21	12.46	14.26	16.07
1 ^a	3.01	10.07	10.85	11.12	12.99	14.80

Gold-Silver

	100 K	273 K	293 K	300 K	350 K	400 K
Wt % Au						
99 ^b	1.20	2.58	2.75	2.80	3.22	3.63
95 ^a	3.16	4.58	4.74	4.79	5.19	5.59
90 ⁱ	5.16	6.57	6.73	6.78	7.19	7.58
85 ^j	6.75	8.14	8.30	8.36	8.75	9.15
80 ^j	7.96	9.34	9.50	9.55	9.94	10.33
70 ^j	9.36	10.70	10.86	10.91	11.29	11.68
60 ^j	9.61	10.92	11.07	11.12	11.50	11.87
50 ^j	8.96	10.23	10.37	10.42	10.78	11.14
40 ^j	7.69	8.92	9.06	9.11	9.46	9.81
30 ^a	6.15	7.34	7.47	7.52	7.85	8.19
25 ^a	5.29	6.46	6.59	6.63	6.96	7.30
15 ^a	3.42	4.55	4.67	4.72	5.03	5.34
10 ^a	2.44	3.54	3.66	3.71	4.00	4.31
5 ⁱ	1.44	2.52	2.64	2.68	2.96	3.25
1 ^b	0.627	1.69	1.80	1.84	2.12	2.42

Iron-Nickel

	100 K	273 K	293 K	300 K	400 K
Wt % Fe					
99 ^a	3.32	10.9	12.0	12.4	18.7
95 ^c	10.0	18.7	19.9	20.2	26.8
90 ^c	14.5	24.2	25.5	25.9	33.2
85 ^c	17.5	27.8	29.2	29.7	37.3
80 ^c	19.3	30.1	31.6	32.2	40.0
70 ^b	20.9	32.3	33.9	34.4	42.4
60 ^c	28.6	53.8	57.1	58.2	73.9
50 ^d	12.3	28.4	30.6	31.4	43.7
40 ^d	7.73	19.6	21.6	22.5	34.0
30 ^c	5.97	15.3	17.1	17.7	27.4
25 ^b	5.62	14.3	15.9	16.4	25.1
15 ^c	4.97	12.6	13.8	14.2	21.1
10 ^c	4.20	11.4	12.5	12.9	18.9
5 ^c	3.34	9.66	10.6	10.9	16.1
1 ^b	1.66	7.17	7.94	8.12	12.8

Silver-Palladium

	100 K	273 K	293 K	300 K	350 K	400 K
Wt % Ag						
99 ^b	0.839	1.891	2.007	2.049	2.35	2.66
95 ^b	2.528	3.58	3.70	3.74	4.04	4.34
90 ^b	4.72	5.82	5.94	5.98	6.28	6.59
85 ^k	6.82	7.92	8.04	8.08	8.38	8.68
80 ^k	8.91	10.01	10.13	10.17	10.47	10.78

ELECTRICAL RESISTIVITY OF SELECTED ALLOYS (continued)

Silver-Palladium (continued)

Wt % Ag	100 K	273 K	293 K	300 K	350 K	400 K
70 ^k	13.43	14.53	14.65	14.69	14.99	15.30
60 ⁱ	19.4	20.9	21.1	21.2	21.6	22.0
50 ^k	29.3	31.2	31.4	31.5	32.0	32.4
40 ^m	40.8	42.2	42.2	42.2	42.3	42.3
30 ^b	37.1	40.4	40.6	40.7	41.3	41.7
25 ^k	32.4	36.67	37.06	37.19	38.1	38.8
15 ⁱ	21.0	27.08	26.68	27.89	29.3	30.6
10 ⁱ	14.95	21.69	22.39	22.63	24.3	25.9
5 ^b	8.91	15.98	16.72	16.98	18.8	20.5
1 ^a	3.97	11.06	11.82	12.08	13.92	15.70

^a Uncertainty in resistivity is $\pm 2\%$.

^b Uncertainty in resistivity is $\pm 3\%$.

^c Uncertainty in resistivity is $\pm 5\%$.

^d Uncertainty in resistivity is $\pm 7\%$ below 300 K and $\pm 5\%$ at 300 and 400 K.

^e Uncertainty in resistivity is $\pm 7\%$.

^f Uncertainty in resistivity is $\pm 8\%$.

^g Uncertainty in resistivity is $\pm 10\%$.

^h Uncertainty in resistivity is $\pm 12\%$.

ⁱ Uncertainty in resistivity is $\pm 4\%$.

^j Uncertainty in resistivity is $\pm 1\%$.

^k Uncertainty in resistivity is $\pm 3\%$ up to 300 K and $\pm 4\%$ above 300 K.

^m Uncertainty in resistivity is $\pm 2\%$ up to 300 K and $\pm 4\%$ above 300 K.

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS

H. P. R. Frederikse

This table lists the permittivity ϵ , frequently called the dielectric constant, of a number of inorganic solids. When the material is not isotropic, the individual components of the permittivity are given. A superscript S indicates a measurement made under constant strain ("clamped" dielectric constant). If the constraint is removed, the measurement yields ϵ^T , the "unclamped" or free dielectric constant.

The temperature of the measurement is given when available; the symbol r.t. indicates a value at nominal room temperature. The frequency of the measurement is given in the last column (i.r. indicates a measurement in the infrared).

Substances are listed in alphabetical order by chemical formula.

REFERENCE

Young, K. F. and Frederikse, H. P. R., *J. Phys. Chem. Ref. Data*, 2, 313, 1973.

Formula	Name	ϵ_{ijk}	T/K	ν/Hz
Ag ₃ AsS ₃	Silver thioarsenate (Proustite)	$\epsilon_{11}^T = 16.5, \epsilon_{11}^S = 14.5$	r.t.	2×10^7
		$\epsilon_{33}^S = 20.0, \epsilon_{33}^T = 18.0$	r.t.	2×10^7
AgBr	Silver bromide	12.50	r.t.	
AgCN	Silver cyanide	5.6	r.t.	10^6
AgCl	Silver chloride	11.15	r.t.	
AgNO ₃	Silver nitrate	9.0	293	5×10^5
AgNa(NO ₂) ₂	Silver sodium nitrite	4.5 ± 0.5	r.t.	9.4×10^9
Ag ₂ O	Silver oxide	8.8	r.t.	
(AlF) ₂ SiO ₄	Aluminum fluosilicate (topaz)	$\epsilon_{11} = 6.62$	297	7×10^3
		$\epsilon_{22} = 6.58$	297	7×10^3
		$\epsilon_{33} = 6.95$	297	7×10^3
		$\epsilon_{11} = \epsilon_{22} = 9.34$	298	$10^2 - 8 \times 10^9$
Al ₂ O ₃	Aluminum oxide (alumina)	$\epsilon_{33} = 11.54$	298	$10^2 - 8 \times 10^9$
AlPO ₄	Aluminum phosphate	$\epsilon_{11}^T = 6.05$	r.t.	10^3
AlSb	Aluminum antimonide	11.21	300	i.r.
AsF ₃	Arsenic trifluoride	5.7	r.t.	
BN	Boron nitride	7.1	r.t.	i.r.
BaCO ₃	Barium carbonate	8.53	291	2×10^5
Ba(COOH) ₂	Barium formate	$\epsilon_{11} = 7.9$	r.t.	10^3
		$\epsilon_{22} = 5.9$	r.t.	10^3
		$\epsilon_{33} = 7.5$	r.t.	10^3
BaCl ₂	Barium chloride	9.81	r.t.	
BaCl ₂ · 2H ₂ O	Barium chloride dihydrate	9.00	r.t.	10^3
BaF ₂	Barium fluoride	7.32	292	$5 \times 10^2 - 10^{11}$
Ba(NO ₃) ₂	Barium nitrate	4.95	292	2×10^5
Ba ₂ NaNb ₅ O ₁₅	Barium sodium niobate ("Bananas")	$\epsilon_{11}^S = 222, \epsilon_{11}^T = 235$	296	10^4
		$\epsilon_{22}^S = 227, \epsilon_{22}^T = 247$	296	
		$\epsilon_{33}^S = 32, \epsilon_{33}^T = 51$	296	
BaO	Barium oxide (baria)	34 ± 1	248, 333	60×10^7
BaO ₂	Barium peroxide	10.7	r.t.	2×10^6
BaS	Barium sulfide	19.23	r.t.	7.25×10^6
BaSO ₄	Barium sulfate	11.4	288	10^8
BaSnO ₃	Barium stannate	18	298	25×10^5
BaTiO ₃	Barium titanate	$\epsilon_{11}^T = 3600$	298	10^5
		$\epsilon_{11}^S = 2300$	298	2.5×10^8
		$\epsilon_{33}^T = 150$	298	10^5
		$\epsilon_{33}^S = 80$	298	2.5×10^8
Ba ₆ Ti ₂ Nb ₈ O ₃₀	Barium titanium niobate	$\epsilon_{11} = \epsilon_{22} \approx 190$	298	
		$\epsilon_{33} \approx 220$	298	
BaWO ₄	Barium tungstate	$\epsilon_{11} = \epsilon_{22} = 35.5 \pm 0.2$	297.5	1.6×10^3
		$\epsilon_{33} = 37.2 \pm 0.2$	297.5	1.6×10^3
BaZrO ₃	Barium zirconate	43	r.t.	

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	$\epsilon_{\mu k}$	T/K	ν/Hz
$\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$	Beryllium aluminum silicate (Beryl)	$\epsilon_{33} = 5.95$	297	7×10^3
		$\epsilon_{11} = \epsilon_{22} = 6.86$	297	7×10^3
BeCO_3	Beryllium carbonate	9.7	291	2×10^5
BeO	Beryllium oxide (beryllia)	7.35 ± 0.2	293	2×10^6
BiFeO_3	Bismuth iron oxide	40 ± 3	300	9.4×10^9
$\text{Bi}_{12}\text{GeO}_{20}$	Bismuth germanite	$\epsilon_{11}^S = 38$	r.t.	
$\text{Bi}(\text{GeO}_4)_3$	Bismuth germanate	16	293	
Bi_2O_3	Bismuth sesquioxide	18.2	r.t.	2×10^6
$\text{Bi}_4\text{Ti}_3\text{O}_{12}$	Bismuth titanate	112	r.t.	10^3
C	Diamond			
	Type I	5.87 ± 0.19	300	10^3
	Type IIa	5.66 ± 0.04	300	10^3
$\text{C}_4\text{H}_4\text{O}_6$	Tartaric acid	$\epsilon_{11} = \epsilon_{22} = 4.3$	298	
		$\epsilon_{33} = 4.5$	298	
		$\epsilon_{13} = 0.55$	298	
$\text{C}_6\text{H}_{14}\text{N}_2\text{O}_6$	Ethylene diamine tartrate (EDT)	$\epsilon_{11}^T = 5.0$	293	
		$\epsilon_{22}^T = 8.3$	293	
		$\epsilon_{33}^T = 6.0$	293	
		$\epsilon_{13}^T = 0.7$	293	
$\text{C}_6\text{H}_{12}\text{O}_6\text{NaBr}$	Dextrose sodium bromide	$\epsilon_{11}^T = 4.0$	r.t.	10^3
$(\text{CH}_3\text{NH}_3)\text{Al}(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$	Methyl ammonium alum (MASD)	19	197	
$\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 5\text{H}_2\text{O}$	Colemanite	$\epsilon_{11} = 20$	293	10^3
		$\epsilon_{33} = 25$	293	10^3
CaCO_3	Calcium carbonate	$\epsilon_{11} = 8.67$	r.t.	9.4×10^{10}
		$\epsilon_{22} = 8.69$	r.t.	9.4×10^{10}
		$\epsilon_{33} = 8.31$	r.t.	9.4×10^{10}
CaCeO_3	Calcium cerate	21	r.t.	
CaF_2	Calcium fluoride	6.81	300	$5 \times 10^2 - 10^{11}$
CaMoO_4	Calcium molybdate	$\epsilon_{11} = \epsilon_{22} = 24.0 \pm 0.2$	297.5	<10
		$\epsilon_{33} = 20.0 \pm 0.2$	297.5	<10
$\text{Ca}(\text{NO}_3)_2$	Calcium nitrate	6.54	292	2×10^5
CaNb_2O_6	Calcium niobate	$\epsilon_{11} = 22.8 \pm 1.9$	r.t.	$(5-500) \times 10^3$
$\text{Ca}_2\text{Nb}_2\text{O}_7$	Calcium pyroniobate	~ 45	r.t.	5×10^7
CaO	Calcium oxide	11.8 ± 0.3	283	2×10^6
CaS	Calcium sulfide	6.699	r.t.	7.25×10^6
$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Calcium sulfate dihydrate	$\epsilon_{11} = 5.10$	r.t.	
		$\epsilon_{22} = 5.24$	r.t.	
		$\epsilon_{33} = 10.30$	r.t.	
CaTiO_3	Calcium titanate	165	r.t.	
CaWO_4	Calcium tungstate	$\epsilon_{11} = \epsilon_{22} = 11.7 \pm 0.1$	297.5	1.59×10^3
		$\epsilon_{33} = 9.5 \pm 0.2$	297.5	1.59×10^3
Cd_3As_2	Cadmium arsenide	$\epsilon_{33} = 18.5$	4	
CdBr_2	Cadmium bromide	8.6	293	5×10^5
CdF_2	Cadmium fluoride	8.33 ± 0.08	300	$10^5 - 10^7$
CdS	Cadmium sulfide	$\epsilon_{11} = \epsilon_{22} = 8.7$	300	i.r.
		$\epsilon_{33} = 9.25$	300	i.r.
		$\epsilon_{11} = \epsilon_{22} = 8.37$	8	i.r.
		$\epsilon_{33} = 9.00$	8	i.r.
		$\epsilon_{11}^T = 8.48$	77	10^4
		$\epsilon_{33}^T = 9.48$	77	10^4
		$\epsilon_{11}^S = 9.02, \epsilon_{11}^T = 9.35$	298	10^4
		$\epsilon_{33}^S = 9.53, \epsilon_{33}^T = 10.33$	298	10^4
CdSe	Cadmium selenide	$\epsilon_{11}^S = 9.53, \epsilon_{11}^T = 9.70$	298	10^4
		$\epsilon_{33}^S = 10.2, \epsilon_{33}^T = 10.65$	298	10^4
CdTe	Cadmium telluride	$\epsilon_{11} = \epsilon_{22} = 10.60 \pm 0.15$	297	i.r.
		$\epsilon_{33} = 7.05 \pm 0.05$	297	i.r.
$\text{Cd}_2\text{Nb}_2\text{O}_7$	Cadmium pyroniobate	500-580	293	10^3
CeO_2	Cerium oxide	7.0	r.t.	2×10^6

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	ϵ_{ijk}	T/K	ν/Hz
CoNb ₂ O ₆	Cobalt niobate	$\epsilon_{11} = 18.4 \pm 0.6$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{22} = 21.4 \pm 1.1$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{33} = 33.0 \pm 0.7$	r.t.	$(5-500) \times 10^3$
CoO	Cobalt oxide	12.9	298	10^2-10^{10}
Cr ₂ O ₃	Chromic sesquioxide	$\epsilon_{11} = \epsilon_{22} = 13.3$	298.5	10^3
		$\epsilon_{33} = 11.9$	298.5	10^3
		8	315 (T_N)	6×10^{10}
CsAl(SO ₄) ₂ · 12H ₂ O	Cesium alum	5.0	r.t.	$20-20 \times 10^3$
CsBr	Cesium bromide	6.38	298	1.6×10^3
Cs ₂ CO ₃	Cesium carbonate	6.53	291	2×10^5
CsCl	Cesium chloride	7.2	298	
Cs ₂ H ₂ AsO ₄	Cesium dihydrogen arsenate (CDA)	4.8	273	9.5×10^9
Cs ₂ H ₂ PO ₄	Cesium dihydrogen phosphate (CDP)	6.15	285	9.5×10^9
CsH ₃ (SeO ₃) ₂	Cesium trihydrogen selenite	$\epsilon_{11} = 80$	273	10^5
		$\epsilon_{22} = 63$	273	10^5
		$\epsilon_{33} = 12$	273	10^5
CsI	Cesium iodide	6.31	298	1.6×10^3
CsNO ₃	Cesium nitrate	$\epsilon_{11} = \epsilon_{22} = 9.4$	r.t.	5×10^5
		$\epsilon_{33} = 8.3$	r.t.	5×10^5
		14.37	300	10^5-10^6
CsPbCl ₃	Cesium lead chloride	14.37	300	10^5-10^6
CuBr	Cuprous bromide	8.0	293	5×10^5
CuCl	Cuprous chloride	9.8 ± 0.5	r.t.	10^3
CuO	Cupric oxide	18.1	r.t.	2×10^6
Cu ₂ O	Cuprous oxide (Cuprite)	7.60 ± 0.06	r.t.	10^5
CuSO ₄ · 5H ₂ O	Cupric sulfate pentahydrate	6.60	r.t.	
EuF ₂	Europium fluoride	7.7 ± 0.2	298	$(1-300) \times 10^3$
Eu ₂ (MoO ₄) ₃	Europium molybdate	9.5	298	
EuS	Europium sulfide	13.10 ± 0.04	80	$5 \times 10^2-10^5$
FeO	Ferrous oxide	14.2	r.t.	2×10^6
Fe ₂ O ₃	Ferric sesquioxide	4.5	r.t.	10^5-10^7
Fe ₂ O ₃ - α	Ferric sesquioxide (hematite)	12		6×10^{10}
Fe ₃ O ₄	Ferrosferric oxide (magnetite)	20	r.t.	10^5-10^7
GaAs	Gallium arsenide	13.13	300	
		12.90	4	i.r.
GaP	Gallium phosphide	11.1	r.t.	
		10.75 ± 0.1	1.6	i.r.
GaSb	Gallium antimonide	15.69	r.t.	
		15.7	4	i.r.
Gd ₂ (MoO ₄) ₃	Gadolinium molybdate	$\epsilon^T = 10$	298	
		$\epsilon^S = 9.5$	298	10^3
Ge	Germanium	16.0 ± 0.3	4	9.2×10^9
		15.8 ± 0.2	r.t.	$500-3 \times 10^{10}$
GeO ₂	Germanium dioxide	$\epsilon_{11} = \epsilon_{22} = 7.44$	r.t.	i.r.
HIO ₃	Iodic acid	$\epsilon_{11} = 7.5$	r.t.	10^3
		$\epsilon_{22} = 12.4$	r.t.	10^3
		$\epsilon_{33} = 8.1$	r.t.	10^3
HNH ₄ (ClCH ₂ COO) ₂ H ₂ O	Hydrogen ammonium dichloroacetate	$\epsilon_{(102)} = 5.9$	r.t.	10^5
		99	243	
		117	243	
		114	243	
		193	243	
HgCl	Mercurous chloride (Calumel)	$\epsilon_{11} = \epsilon_{22} = 14.0$	r.t.	10^{12}
		6.5	r.t.	10^{12}
HgCl ₂	Mercuric chloride	$\epsilon_{11} = \epsilon_{22} = 18.0$	r.t.	i.r.
		$\epsilon_{33} = 32.5$	r.t.	i.r.
HgS	Mercurous sulfide (Cinnabar)	25.6	r.t.	10^4-10^6
HgSe	Mercurous selenide	25.6	r.t.	10^4-10^6
I ₂	Iodine	$\epsilon_{11} = 6$	r.t.	$5 \times 10^4-10^7$
		$\epsilon_{22} = 3$	r.t.	$5 \times 10^4-10^7$
		$\epsilon_{33} = 40$	r.t.	$5 \times 10^4-10^7$

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	ϵ_{ijk}	T/K	ν/Hz
InAs	Indium arsenide	14.55 ± 0.3	r.t.	i.r.
		15.15	4	i.r.
InP	Indium phosphide	12.61	r.t.	i.r.
InSb	Indium antimonide	17.88	4	i.r.
KAl(SO ₄) ₂ · 12H ₂ O	Potassium alum	6.5	r.t.	20—20 × 10 ³
KBr	Potassium bromide	4.88	300	
		4.53	4.2	
KBrO ₃	Potassium bromate	7.3	r.t.	2 × 10 ⁶
KCN	Potassium cyanide	6.15	r.t.	2 × 10 ⁶
K ₂ CO ₃	Potassium carbonate	4.96	291	2 × 10 ⁵
K ₂ C ₄ H ₄ O ₆ · 1/2 H ₂ O	Dipotassium tartrate (DKT)	$\epsilon_{11} = 6.44$	r.t.	
		$\epsilon_{22} = 5.80$	r.t.	
		$\epsilon_{33} = 6.49$	r.t.	
		$\epsilon_{13} = 0.005$	r.t.	
KCl	Potassium chloride	4.86 ± 0.02	r.t.	5 × 10 ³
		4.50	4.2	
KClO ₃	Potassium chlorate	5.1	r.t.	2 × 10 ⁶
KClO ₄	Potassium perchlorate	5.9	r.t.	2 × 10 ⁶
K ₂ CrO ₄	Potassium chromate	7.3	r.t.	6 × 10 ⁷
KCr(SO ₄) ₂ · 12H ₂ O	Potassium chrome alum	6.5	100—240	175 × 10 ³
KD ₂ AsO ₄	Potassium dideuterium arsenate (KDDA)	$\epsilon_{11} = 70$	298	
		$\epsilon_{33} = 31$	298	
KD ₂ PO ₄	Potassium dideuterium phosphate (KDDP)	50 ± 2	297	10 ³
KF	Potassium fluoride	6.05		2 × 10 ⁶
KH ₂ AsO ₄	Potassium dihydrogen arsenate (KDA)	$\epsilon_{11} = 60$	298	
		$\epsilon_{33} = 24$	298	
KH ₂ PO ₄	Potassium dihydrogen phosphate (KDP)	46	298	10 ³
		$\epsilon_{11} = 42$	r.t.	
		$\epsilon_{33} = 21$	r.t.	
K ₂ HPO ₄	Dipotassium monohydrogen orthophosphate	9.05	r.t.	2 × 10 ⁶
KI	Potassium iodide	5.00	r.t.	9.4 × 10 ¹⁰
KIO ₃	Potassium iodate	170	255	10 ⁵
		10	293	10 ⁵
		$\epsilon_{1(101)} \approx 40,70$	r.t.	10 ⁵
		16.85	r.t.	2 × 10 ⁶
(K,H)Al ₃ (SiO ₄) ₃	Mica (muscovite)	5.4	299	10 ² —3 × 10 ⁹
(K,H)Mg ₃ Al(SiO ₄) ₃	Mica (Canadian)	$\epsilon_{11} = \epsilon_{22} = 6.9$	298	10 ² —10 ⁴
		$\epsilon_{33} = 7.3$	298	10 ⁴
KNO ₂	Potassium nitrite	25	305	
KNO ₃	Potassium nitrate	4.37	293	2 × 10 ⁵
KNbO ₃	Potassium niobate	700	r.t.	
K ₃ PO ₄	Potassium orthophosphate	7.75	r.t.	2 × 10 ⁶
KSCN	Potassium thiocyanate	7.9	r.t.	2 × 10 ⁶
K ₂ SO ₄	Potassium sulfate	6.4	r.t.	2 × 10 ⁶
K ₂ S ₃ O ₆	Potassium trithionate	5.7	293	1.8 × 10 ⁶
K ₂ S ₄ O ₆	Potassium tetrathionate	5.5	293	1.8 × 10 ⁶
K ₂ S ₅ O ₆ · H ₂ O	Potassium pentathionate	7.8	293	1.8 × 10 ⁶
K ₂ S ₆ O ₆	Potassium hexathionate	7.8	293	1.8 × 10 ⁶
K ₂ SeO ₄	Potassium selenate	$\epsilon_{11} = 5.9$	r.t.	10 ³
		$\epsilon_{22} = 7.7$	r.t.	10 ³
KSr ₂ Nb ₅ O ₁₅	Potassium strontium niobate	$\epsilon_{11} = \epsilon_{11} \approx 1200$	298	
		$\epsilon_{33} \approx 800$	298	
KTaNbO ₃	Potassium tantalate niobate (KTN)	34,000	273	10 ⁴
		6,000	293	10 ⁴
KTaO ₃	Potassium tantalate	242	298	2 × 10 ⁵
LaScO ₃	Lanthanum scandate	30	r.t.	
LiBr	Lithium bromide	12.1	r.t.	2 × 10 ⁶
Li ₂ CO ₃	Lithium carbonate	4.9	291	2 × 10 ⁵

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	$\epsilon_{\mu k}$	T/K	ν/Hz
LiCl	Lithium chloride	11.05	r.t.	2×10^6
LiD	Lithium deuteride	14.0 ± 0.5	r.t.	i.r.
LiF	Lithium fluoride	9.00	298	10^2-10^7
		9.11	353	10^2-10^7
LiGaO ₂	Lithium metagallate	$\epsilon_{11}^T = 7.0, \epsilon_{22}^T = 6.0$	r.t.	
		$\epsilon_{33}^T = 9.5$	r.t.	
		$\epsilon_{11}^S = 6.8, \epsilon_{22}^S = 5.8$	r.t.	
Li ⁶ H	Lithium-6 hydride	13.2 ± 0.5	r.t.	
Li ⁷ H	Lithium-7 hydride	12.9 ± 0.5	r.t.	
LiH ₃ (SeO ₃) ₂	Lithium trihydrogen selenite	29	298	10^4
		$\epsilon_{11} = 13.0$	r.t.	
		$\epsilon_{22} = 12.9$	r.t.	
		$\epsilon_{33} = 46$	r.t.	
LiI	Lithium iodide	11.03	r.t.	2×10^6
LiIO ₃	Lithium iodate	$\epsilon_{11} = \epsilon_{22} = 65$	294.5	10^3
		$\epsilon_{33} = 554$	298	
LiNH ₄ C ₄ H ₄ O ₆ · H ₂ O	Lithium ammonium tartrate (LAT)	$\epsilon_{11}^T = 7.2$	298	
		$\epsilon_{22}^T = 8.0$	298	
		$\epsilon_{33}^T = 6.9$	298	
LiNa ₃ CrO ₄ · 6H ₂ O	Lithium trisodium chromate	8.0	r.t.	10^3
LiNa ₃ MoO ₄ · 6H ₂ O	Lithium trisodium molybdate	$\epsilon_{11} = 6.7$	r.t.	10^3
		$\epsilon_{33} = 5.3$	r.t.	10^3
LiNbO ₃	Lithium niobate	$\epsilon_{11} = \epsilon_{22} = 82$	298	10^5
		$\epsilon_{33} = 30$	298	10^5
Li ₂ SO ₄ · H ₂ O	Lithium sulfate monohydrate	$\epsilon_{11} = 5.6$	298	
		$\epsilon_{22} = 10.3$	298	
		$\epsilon_{33} = 6.5$	298	
		$\epsilon_{13} = 0.07$	298	
LiTaO ₃	Lithium tantalate	$\epsilon_{11} = \epsilon_{22} = 53$	r.t.	10^5
		$\epsilon_{33} = 46$	r.t.	10^5
		$\epsilon_{11}^S = \epsilon_{22}^S = 41$	r.t.	
		$\epsilon_{33}^S = 43$	r.t.	
		$\epsilon_{11}^T = \epsilon_{22}^T = 51$	r.t.	
		$\epsilon_{33}^T = 45$	r.t.	
LiTlC ₄ H ₄ O ₆ · H ₂ O	Lithium thallium tartrate (LTT)	$\epsilon_{11} \approx 20$	80	
Mg ₃ B ₇ O ₁₃ Cl	Magnesium borate monochloride (boracite)	$\epsilon_{11} = 14.1$	r.t.	5×10^5
MgCO ₃	Magnesium carbonate	8.1	291	2×10^5
MgNb ₂ O ₆	Magnesium niobate	$\epsilon_{11} = 16.4 \pm 0.5$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{22} = 20.9 \pm 0.5$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{33} = 32.4 \pm 0.5$	r.t.	$(5-500) \times 10^3$
MgO	Magnesium oxide (Periclase)	9.65	298	10^2-10^8
(MgO) _x Al ₂ O ₃	Spinel	8.6	r.t.	
MgSO ₄	Magnesium sulfate	8.2	r.t.	
MgSO ₄ · 7H ₂ O	Magnesium sulfate septa hydrate	5.46	r.t.	
MgTiO ₃	Magnesium titanate	13.5	r.t.	
MgWO ₄	Magnesium tungstate	$\epsilon_{11} = 18.0 \pm 1$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{22} = 18.0 \pm 1$	r.t.	$(5-500) \times 10^3$
MnNb ₂ O ₆	Manganese niobate	$\epsilon_{11} = 17.4 \pm 2$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{22} = 16.1 \pm 0.5$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{33} = 30.7 \pm 1$	r.t.	$(5-500) \times 10^3$
MnO	Manganese oxide (Pyrolusite)	12.8	r.t.	6×10^{10}
MnO ₂	Manganese dioxide	$\sim 10^4$	298	10^4
Mn ₂ O ₃	Manganese sesquioxide	8	r.t.	6×10^{10}
MnWO ₄	Manganese tungstate	$\epsilon_{11} = 19.3 \pm 1.3$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{22} = 14.3 \pm 0.5$	r.t.	$(5-500) \times 10^3$
		$\epsilon_{33} = 16.5 \pm 1.1$	r.t.	$(5-500) \times 10^3$
N(CH ₃) ₄ HgBr ₃	Tetramethylammonium tribromo mercurate (TTM)	~ 10	233-373	

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	ϵ_{ijk}	T/K	ν/Hz
$\text{N}(\text{CH}_3)_4\text{HgI}_3$	Tetramethylammonium triiodo mercurate (TTM)	~10	233—373	
$\text{N}_4(\text{CH}_2)_6$	Hexamethylene tetramine (HMTA)	2.6 ± 0.2	r.t.	10^9 — 10^{10}
$(\text{ND}_4)_2\text{BeF}_4$	Deuteroammonium fluoberyllate	$\epsilon_{11} = 10$ $\epsilon_{22} = 9$ $\epsilon_{33} = 9$	r.t. r.t. r.t.	
$(\text{ND}_4)_2\text{SO}_4$	Deuteroammonium sulfate	$\epsilon_{11} = 9$ $\epsilon_{22} = 10$ $\epsilon_{33} = 9$	r.t. r.t. r.t.	
$(\text{NH}_2 \cdot \text{CH}_2\text{COOH})_3 \cdot \text{H}_2\text{SO}_4$	Triglycine sulfate (TGS)	$\epsilon_{11} = 9$ $\epsilon_{22} = 30$ $\epsilon_{33} = 6.5$	273 273 273	10^4 10^4 10^4
$(\text{NH}_2 \cdot \text{CH}_2\text{COOH})_3 \cdot \text{H}_2\text{SeO}_4$	Triglycine selenate (TGSe)	200	293	1.6×10^3
$(\text{NH}_2 \cdot \text{CH}_2 \text{COOH})_3 \cdot \text{H}_2\text{BeF}_4$	Triglycine fluorberyllate (TGFB)	$\epsilon_{22} = 12$	273	10^4
$\text{NH}_4\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	Ammonium alum	6	r.t.	10^{12}
$(\text{NH}_4)_2\text{BeF}_4$	Ammonium fluorberyllate	$\epsilon_{11} = \epsilon_{22} = 7.8$ $\epsilon_{33} = 7.1$ $\epsilon_{11} = \epsilon_{22} = 8.8$ $\epsilon_{33} = 9.2$	123 123 293 293	10^5 10^5 10^5 10^5
NH_4Br	Ammonium bromide	7.1	r.t.	7×10^5
NH_4I	Ammonium iodide	9.8	r.t.	
$(\text{NH}_4)_2\text{C}_2\text{H}_6\text{O}_6$	Ammonium tartrate	$\epsilon_{11} = 6.45$ $\epsilon_{22} = 6.8$ $\epsilon_{33} = 6.0$	r.t. r.t. r.t.	10^3 10^3 10^3
$(\text{NH}_4)_2\text{Cd}_2(\text{SO}_4)_3$	Ammonium cadmium sulfate	10.0	r.t.	10^4
NH_4Cl	Ammonium chloride	6.9	r.t.	7×10^5
$\text{NH}_4(\text{ClCH}_2\text{COO})$	Ammonium monochloroacetate	5	r.t.	2×10^6
$\text{NH}_4\text{Cr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	Ammonium chrome alum	6.5	r.t.	175×10^3
NH_4HSO_4	Ammonium bisulfate	165	273	5×10^4
$\text{NH}_4\text{H}_2\text{AsO}_4$	Ammonium dihydrogen arsenate (ADA)	5.1 $\epsilon_{11} = \epsilon_{22} = 85$ $\epsilon_{33} = 22$	265 298 298	9.5×10^9 10^3
$\text{NH}_4\text{H}_2\text{PO}_4$	Ammonium dihydrogen phosphate (ADP)	$\epsilon_{11} = \epsilon_{22} = 57.1 \pm 0.6$ $\epsilon_{33} = 14.0 \pm 0.3$	294.5 294	10^5 — 35×10^9 10^5 — 36×10^9
$\text{ND}_4\text{D}_2\text{PO}_4$	Ammonium dideuterium phosphate (ADDP)	$\epsilon_{11} = \epsilon_{22} = 74, \epsilon_{33} = 24$	300	
NH_4NO_3	Ammonium nitrate	10.7	322	$(5-50) \times 10^3$
$(\text{NH}_4)_2\text{SO}_4$	Ammonium sulfate	$\epsilon_{11} = \epsilon_{22} = 8.0$ $\epsilon_{33} = 6.3$ $\epsilon_{11} = \epsilon_{22} = 10.0$ $\epsilon_{33} = 9.3$	123 123 293 293	10^5 10^5 10^5 10^5
$(\text{NH}_4)_2\text{UO}_2(\text{C}_2\text{O}_4)_2$	Ammonium uranyl oxalate	8.03	r.t.	10^4 — 3.3×10^6
$(\text{NH}_4)_2\text{UO}_2(\text{C}_2\text{O}_4)_2 \cdot 3\text{H}_2\text{O}$	Ammonium uranyl oxalate trihydrate	6.06	r.t.	10^4 — 3.3×10^6
NaBr	Sodium bromide	6.44	298	1.6×10^3
NaBrO_3	Sodium bromate	$\epsilon_{11}^T = 5.70$	298	10^3
NaCN	Sodium cyanide	7.55	293	10^5
NaCO_3	Sodium carbonate	8.75	291	2×10^5
$\text{NaCO}_3 \cdot 10\text{H}_2\text{O}$	Sodium carbonate decahydrate	5.3	r.t.	6×10^7
NaCl	Sodium chloride	5.9 5.45	298 4.2	10^2 — 10^7
NaClO_3	Sodium chlorate	$\epsilon_{11}^T = 5.76$ 5.28	301 r.t.	10^3 10^3
NaClO_4	Sodium perchlorate	5.76	r.t.	10^3
NaF	Sodium fluoride	5.08 ± 0.02	r.t.	5×10^3
$\text{NaH}_3(\text{SeO}_3)_2$	Sodium trihydrogen selenite	$\epsilon_{11} \approx 75$	273	2×10^5
$\text{NaD}_3(\text{SeO}_3)_2$	Sodium trideuterium selenite	$\epsilon_{11} \approx 220$	273	2×10^5
NaI	Sodium iodide	7.28 ± 0.03	r.t.	
$\text{NaK}(\text{C}_4\text{H}_2\text{D}_2\text{O}_6) \cdot 4\text{D}_2\text{O}$	Sodium potassium tartrate tetradeutrate (double deuterated Rochelle salt)	$\epsilon_{11} = 70$ $\epsilon_{22} = 8.9$	273 273	10^3 10^3

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	$\epsilon_{\mu k}$	T/K	ν/Hz
NaK(C ₄ H ₄ O ₆) · 4H ₂ O	Sodium potassium tartrate tetrahydrate (Rochelle salt)	$\epsilon_{11} = 170$	273	10 ³
		$\epsilon_{22} = 9.1$	273	10 ³
NaNH ₄ (C ₄ H ₄ O ₆) · 4H ₂ O	Sodium ammonium tartrate (Ammonium Rochelle salt)	$\epsilon_{11} = 8.4$	298	
		$\epsilon_{22} = 9.2$	298	
		$\epsilon_{33} = 9.5$	298	
NaNbO ₃	Sodium niobate	$\epsilon_{33} = 670 \pm 13$	r.t.	
NaNO ₂	Sodium nitrite	$\epsilon_{11} = \epsilon_{22} = 76 \pm 2$	r.t.	
		$\epsilon_{11} = 7.4$	r.t.	5 × 10 ⁵
		$\epsilon_{22} = 5.5$	r.t.	5 × 10 ⁵
		$\epsilon_{33} = 5.0$	r.t.	5 × 10 ⁵
NaNO ₃	Sodium nitrate	6.85	292	2 × 10 ⁵
NaSO ₄	Sodium sulfate	7.90	r.t.	
NaSO ₄ · 10H ₂ O	Sodium sulfate decahydrate	5.0	r.t.	
Na ₂ S ₂ O ₃ · 5H ₂ O	Sodium sulfate pentahydrate	7	250—290	300—10 ⁴
Na ₂ UO ₂ (C ₂ O ₄) ₂	Sodium uranyl oxalate	5.18	r.t.	
NdAlO ₃	Neodymium aluminate	17.5	r.t.	
NdScO ₃	Neodymium scandate	27	r.t.	
Ni ₃ B ₂ O ₁₃ I	Nickel iodine boracite	$\epsilon_{11} = 14$	260	
NiNb ₂ O ₆	Nickel niobate	$\epsilon_{11} = 16.0 \pm 0.5$	r.t.	(5—500) × 10 ³
		$\epsilon_{22} = 23.8 \pm 1.8$	r.t.	(5—500) × 10 ³
		$\epsilon_{33} = 31.3 \pm 2.5$	r.t.	(5—500) × 10 ³
NiO	Nickel oxide	11.9	298	10 ⁵
NiSO ₄ · 6H ₂ O	Nickel sulfate hexahydrate	$\epsilon_{11} = 6.2$	r.t.	
		$\epsilon_{33} = 6.8$	r.t.	
NiWO ₄	Nickel tungstate	$\epsilon_{11} = 17.4 \pm 2.4$	r.t.	(5—500) × 10 ³
		$\epsilon_{22} = 13.6 \pm 1.0$	r.t.	(5—500) × 10 ³
		$\epsilon_{33} = 19.7 \pm 0.6$	r.t.	(5—500) × 10 ³
P	Phosphorous (red)	4.1	r.t.	10 ⁸
		3.6	r.t.	10 ⁸
[P(CH ₃) ₄]HgBr ₃	Tetramethylphosphonium tribromo mercurate (TTM)	~10	233—373	
PbBr ₂	Lead bromide	>30	293	(0.5—3) × 10 ⁶
PbCO ₃	Lead carbonate	18.6	288	10.8
Pb(C ₂ H ₃ O ₂) ₂	Lead acetate	2.6	290—295	10 ⁶
PbCl ₂	Lead chloride	33.5	273	(0.5—3) × 10 ⁶
Pb ₂ CoWO ₆	Lead cobalt tungstate	~250	r.t.	
PbF ₂	Lead fluoride	26.3	r.t.	
PbHfO ₃	Lead hafnate	390	300	10 ⁵
		185	400	
PbI ₂	Lead iodide	20.8	293	(0.5—3) × 10 ⁶
Pb ₃ MgNb ₂ O ₉	Lead magnesium niobate	10,000	297	
PbMoO ₄	Lead molybdate	$\epsilon_{11} = 34.0 \pm 0.4$	297.5	1.6 × 10 ³
		$\epsilon_{33} = 40.6 \pm 0.2$	297.5	1.6 × 10 ³
		16.8	r.t.	(0.5—3) × 10 ⁶
Pb(NO ₃) ₂	Lead nitrate	16.8	r.t.	
PbNb ₂ O ₆	Lead niobate	$\epsilon_{33}^T = 180$	298	
PbO	Lead oxide	25.9	r.t.	2 × 10 ⁶
PbS	Lead sulfide (Galena)	190	77	i.r.
		200 ± 35	r.t.	i.r.
PbSO ₄	Lead sulfate	14.3	290—295	10 ⁶
PbSe	Lead selenide	280	r.t.	i.r.
PbTa ₂ O ₆	Lead metatantalate	$\epsilon_{11} = \epsilon_{22} \approx 300$	r.t.	10 ⁴
		$\epsilon_{33} = 150$	r.t.	10 ⁴
PbTe	Lead telluride	450	r.t.	i.r.
		40	77	10 ⁴ —15 × 10 ⁴
		430	4.2	10 ⁴ —15 × 10 ⁴
PbTiO ₃	Lead titanate	~200	r.t.	10 ³
PbWO ₄	Lead tungstate	$\epsilon_{11} = \epsilon_{22} = 23.6 \pm 0.3$	297.5	1.59 × 10 ³
		$\epsilon_{33} = 31.0 \pm 0.4$	297.5	1.59 × 10 ³
Pb(Zn _{1/3} Nb _{2/3})O ₃	Lead zinc niobate	7	300	10 ³ , 300 × 10 ³
PbZrO ₃	Lead zirconate	200	400	

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	ϵ_{ijk}	T/K	ν/Hz
RbAl(SO ₄) ₂ · 12H ₂ O	Rubidium alum	5.1	r.t.	10 ¹²
RbBr	Rubidium bromide	4.83	300	
Rb ₂ CO ₃	Rubidium carbonate	4.87 ± 0.02	r.t.	5 × 10 ³
RbCl	Rubidium chloride	4.91 ± 0.02	r.t.	5 × 10 ³
RbCr(SO ₄) ₂ · 12H ₂ O	Rubidium chrome alum	5.0	r.t.	10 ¹²
RbF	Rubidium fluoride	5.91	r.t.	2 × 10 ⁶
RbHSO ₄	Rubidium bisulfate	$\epsilon_{11} = 7$	r.t.	10 ⁵
		$\epsilon_{22} = 8$	r.t.	10 ⁵
		$\epsilon_{33} = 10$	r.t.	10 ⁵
RbH ₂ AsO ₄	Rubidium dihydrogen arsenate (RDA)	3.90	273	9.5 × 10 ⁹
RbH ₂ PO ₄	Rubidium dihydrogen phosphate (RDP)	6.15	285	9.5 × 10 ⁹
RbI	Rubidium iodide	4.94 ± 0.02	r.t.	5 × 10 ³
RbInSO ₄	Rubidium indium sulfate	6.85	r.t.	
RbNO ₃	Rubidium nitrate	20—380	433—488	10 ⁶
		30	488—538	10 ⁶
S	Sulfur	$\epsilon_{11} = 3.75$	298	10 ² —10 ³
		$\epsilon_{22} = 3.95$	298	10 ² —10 ³
		$\epsilon_{33} = 4.44$	298	10 ² —10 ³
	sublimed	3.69	298	10 ² —10 ³
SC(NH ₂) ₂	Thiourea	$\epsilon_{11} = \epsilon_{33} \approx 3$	77—300	10 ³
		$\epsilon_{22} = 35$	300	10 ³
Sb ₂ O ₃	Antimonous sesquioxide	12.8	r.t.	(1.5—2) × 10 ³
Sb ₂ S ₃	Antimonous sulfide (stibnite)	$\epsilon_{11} = \epsilon_{22} = 15$	r.t.	10 ³
		$\epsilon_{33} = 180$	r.t.	10 ³
Sb ₂ Se ₃	Antimonous selenide	~110	r.t.	(10—16.5) × 10 ⁹
SbSI	Antimonous sulfide iodide	2000	273	10 ⁵
		$\epsilon_{11} = \epsilon_{22} \approx 25$	r.t.	10 ³ —10 ⁵
		$\epsilon_{33} \approx 5 \times 10^4$	295	10 ³ —10 ⁵
Se	Selenium	$\epsilon_{11} = \epsilon_{22} = 11$	300	24 × 10 ⁹
	(monocrystal)	$\epsilon_{33} = 21$	300	24 × 10 ⁹
	(amorphous)	6.0	298	10 ² —10 ¹⁰
Si	Silicon	12.1	4.2	10 ⁷ —10 ⁹
SiC	Silicon carbide			
	cubic	9.72	r.t.	i.r.
	6H	$\epsilon_{11} = \epsilon_{22} = 9.66$	r.t.	i.r.
		$\epsilon_{33} = 10.03$	r.t.	i.r.
		9.7 ± 0.1	1.8	i.r.
Si ₃ N ₄	Silicon nitride	4.2 (film)	r.t.	10 ³
SiO	Silicon monoxide	5.8	r.t.	10 ³
SiO ₂	Silicon dioxide	$\epsilon_{11} = 4.42$	r.t.	9.4 × 10 ¹⁰
		$\epsilon_{22} = 4.41$	r.t.	9.4 × 10 ¹⁰
		$\epsilon_{33} = 4.60$	r.t.	9.4 × 10 ¹⁰
Sm ₂ (MoO ₄) ₃	Samarium molybdate	12	298	
SnO ₂	Stannic dioxide	$\epsilon_{11} = \epsilon_{22} = 14 \pm 2$	r.t.	10 ⁴ —10 ¹⁰
		$\epsilon_{33} = 9.0 \pm 0.5$	r.t.	10 ⁴ —10 ¹⁰
SnSb	Tin antimonide	147	r.t.	10 ⁴ —10 ⁶
SnTe	Tin telluride	1770 ± 300	r.t.	i.r.
Sr(COOH) ₂ · 2H ₂ O	Strontium formate dihydrate	6.1	r.t.	10 ³
SrCO ₃	Strontium carbonate	8.85	298	2 × 10 ⁵
SrCl ₂	Strontium chloride	9.19	r.t.	
Sr ₄ Cl ₂ · 6H ₂ O	Strontium chloride hexahydrate	8.52	r.t.	
SrF ₂	Strontium fluoride	6.50	300	5 × 10 ² —10 ¹¹
SrMoO ₄	Strontium molybdate	$\epsilon_{11} = \epsilon_{22} = 31.7 \pm 0.2$	297.5	1.59 × 10 ³
		$\epsilon_{33} = 41.7 \pm 0.2$	297.5	1.59 × 10 ³
		5.33	292	2 × 10 ⁵
Sr(NO ₃) ₂	Strontium nitrate	$\epsilon_{11} = 75$	r.t.	10 ³
Sr ₂ Nb ₂ O ₇	Strontium niobate	$\epsilon_{22} = 46$	r.t.	10 ³
		$\epsilon_{33} = 43$	r.t.	10 ³

PERMITTIVITY (DIELECTRIC CONSTANT) OF INORGANIC SOLIDS (continued)

Formula	Name	ϵ_{ijk}	T/K	ν/Hz
SrO	Strontium oxide	13.3 ± 0.3	273	2 × 10 ⁶
SrS	Strontium sulfide	11.3	r.t.	7.25 × 10 ⁶
SrSO ₄	Strontium sulfate	11.5	r.t.	
SrTiO ₃	Strontium titanate	332	298	10 ³
		2080	78	10 ³
SrWO ₄	Strontium tungstate	$\epsilon_{11} = \epsilon_{22} = 25.7 \pm 0.2$	297.5	1.6 × 10 ³
		$\epsilon_{33} = 34.1 \pm 0.2$	297.5	1.6 × 10 ³
Ta ₂ O ₅	Tantalum pentoxide (tantala)			
	α phase	$\epsilon_{11} = \epsilon_{22} = 30$	77	10 ³
		$\epsilon_{33} = 65$	77	10 ³
	β phase	24	292	10 ³
Tb(MoO ₄) ₃	Terbium molybdate	11	298	
		$\epsilon_{11} = \epsilon_{22} = 33$	100—200	9.4 × 10 ⁹
		$\epsilon_{33} = 53$	100—200	9.4 × 10 ⁹
Te	Tellurium	$\epsilon_{11} = \epsilon_{22} = 33$	r.t.	
		$\epsilon_{33} = 54$	r.t.	
	polycrystalline	27.5	r.t.	i.r.
	monocrystalline	28.0	r.t.	i.r.
ThO ₂	Thorium dioxide	18.9 ± 0.4	r.t.	3 × 10 ⁵
TiO ₂	Titanium dioxide (rutile)	$\epsilon_{11} = \epsilon_{22} = 86$	300	10 ⁴ —10 ⁶
		$\epsilon_{33} = 170$	300	10 ⁴ —10 ⁶
Ti ₂ O ₃	Titanium sesquioxide	30	77	6 × 10 ¹⁰
TlBr	Thallium bromide	30	293	10 ³ —10 ⁷
TlCl	Thallous chloride	32.2 ± 0.2	293	10 ³ —10 ⁵
TlI	Thallous iodide (orthorhombic)	20.7 ± 0.2	293	10 ⁴
		37.3	193	10 ⁷
TlNO ₃	Thallous nitrate	16.5	293	5 × 10 ⁵
TlSO ₄	Thallous sulfate	25.5	293	5 × 10 ⁵
UO ₂	Uranium dioxide	24	r.t.	3 × 10 ⁵
WO ₃	Tungsten trioxide	300		
YMnO ₃	Yttrium manganate	20	r.t.	2 × 10 ⁷
Y ₂ O ₃	Yttrium sesquioxide	10	r.t.	10 ⁶
YbMnO ₃	Ytterbium manganate	20	r.t.	2 × 10 ⁷
Yb ₂ O ₃	Ytterbium sesquioxide	5.0 (film)	r.t.	10 ³
ZnO	Zinc monoxide	$\epsilon_{11}^S = 8.33$	r.t.	
		$\epsilon_{33}^S = 8.84$	r.t.	
		$\epsilon_{11}^T = 9.26$	r.t.	
		$\epsilon_{33}^T = 11.0$	r.t.	
		$\epsilon_{11} = 9.26$	r.t.	
		$\epsilon_{33} = 8.2$	r.t.	
		8.15	r.t.	
ZnS	Zinc sulfide	$\epsilon_{11}^S = 8.08 \pm 2\%$	77	10 ⁴
		$\epsilon_{11}^S = 8.32 \pm 2\%$	298	10 ⁴
		$\epsilon_{11}^T = 8.14 \pm 2\%$	77	10 ⁴
		$\epsilon_{11}^T = 8.37 \pm 2\%$	298	10 ⁴
ZnSe	Zinc selenide	$\epsilon_{11}^T = \epsilon_{11}^S = 9.12 \pm 2\%$	298	10 ⁴
ZnTe	Zinc telluride	$\epsilon_{11}^T = \epsilon_{11}^S = 10.10 \pm 2\%$	r.t.	
ZnWO ₄	Zinc tungstate	$\epsilon_{22} = 16.1 \pm 0.5$	r.t.	(5—500) × 10 ²
ZrO ₂	Zirconium dioxide (zirconia)	12.5	r.t.	2 × 10 ⁶

CURIE TEMPERATURE OF SELECTED FERROELECTRIC CRYSTALS

H. P. R. Frederikse

The following table lists the major ferroelectric crystals and their Curie temperatures, T_C .

REFERENCE

Young, K. F. and Frederikse, H. P. R., *J. Phys. Chem. Ref. Data*, 2, 313, 1973.

Name or acronym	Formula	T_C /K
<i>Potassium dihydrogen phosphate group</i>		
KDP	KH_2PO_4	123
KDA	KH_2AsO_4	97
KDDP	KD_2PO_4	213
KDDA	KD_2AsO_4	162
RDP	RbH_2PO_4	146
RDA	RbH_2AsO_4	111
RDDP	RbD_2PO_4	218
RDDA	RbD_2AsO_4	178
CDP	CsH_2PO_4	159
CDA	CsH_2AsO_4	143
CDDA	CsD_2AsO_4	212
<i>Rochelle salt group</i>		
Rochelle salt	$\text{NaKC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$	255-297
Deuterated Rochelle salt	$\text{NaKC}_4\text{H}_2\text{D}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$	251-308
Ammonium Rochelle salt	$\text{NaNH}_4\text{C}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$	109
LAT	$\text{LiNH}_4\text{C}_4\text{H}_4\text{O}_6 \cdot \text{H}_2\text{O}$	106
<i>Triglycine sulfate group</i>		
TGS	$(\text{NH}_2\text{CH}_2\text{COOH})_3 \cdot \text{H}_2\text{SO}_4$	322
TGSe	$(\text{NH}_2\text{CH}_2\text{COOH})_3 \cdot \text{H}_2\text{SeO}_4$	295
TGFB	$(\text{NH}_2\text{CH}_2\text{COOH})_3 \cdot \text{H}_2\text{BeF}_4$	346
AFB	$(\text{NH}_4)_2\text{BeF}_4$	176
HADA	$\text{HNH}_4(\text{ClCH}_2\text{COO})_2$	128
<i>Perovskites and related compounds</i>		
Barium titanate	BaTiO_3	406, 278, 193
Lead titanate	PbTiO_3	765
Potassium niobate	KNbO_3	712
Potassium tantalate niobate	$\text{KTa}_{2/3}\text{Nb}_{1/3}\text{O}_3$	241, 220, 170
Lithium niobate	LiNbO_3	1483
Lithium tantalate	LiTaO_3	891
Barium titanium niobate	$\text{Ba}_6\text{Ti}_2\text{Nb}_8\text{O}_{30}$	521
Ba-Na niobate ("Bananas")	$\text{Ba}_2\text{NaNb}_5\text{O}_{15}$	833
Potassium iodate	KIO_3	485, 343, 257-263, 83
Lithium iodate	LiIO_3	529
Potassium nitrate	KNO_3	397
Sodium nitrate	NaNO_3	548
Rubidium nitrate	RbNO_3	437-487

CURIE TEMPERATURE OF SELECTED FERROELECTRIC CRYSTALS (continued)

Name or acronym	Formula	T_C/K
<i>Miscellaneous compounds</i>		
Cesium trihydrogen selenite	$CsH_3(SeO_3)_2$	143
Lithium trihydrogen selenite	$LiH_3(SeO_3)_2$	$T_C > T_{mp}$
Potassium selenate	K_2SeO_4	93
Methyl ammonium alum (MASD)	$CH_3NH_3Al(SO_4)_2 \cdot 12H_2O$	177
Ammonium cadmium sulfate	$(NH_4)_2Cd_2(SO_4)_3$	95
Ammonium bisulfate	$(NH_4)HSO_4$	271
Ammonium sulfate	$(NH_4)_2SO_4$	224
Ammonium nitrate	NH_4NO_3	398, 357, 305, 255
Colemanite	$CaB_3O_4(OH)_3 \cdot H_2O$	266
Cadmium pyroniobite	$Cd_2Nb_2O_7$	185
Gadolinium molybdate	$Gd_2(MoO_4)_3$	432

PROPERTIES OF ANTIFERROELECTRIC CRYSTALS

H. P. R. Frederikse

Some important antiferroelectric crystals are listed here with their Curie Temperatures T_C . The last column gives the constant T_0 which appears in the Curie-Weiss law describing the dielectric constant of these materials above the Curie Temperature:

$$\epsilon = \text{const.}/(T - T_0)$$

Name or acronym	Formula	T_C/K	T_0/K
ADP	$\text{NH}_4\text{H}_2\text{PO}_4$	148	
ADA	$\text{NH}_4\text{H}_2\text{AsO}_4$	216	
ADDP	$\text{NH}_4\text{D}_2\text{PO}_4$	242, 245	
ADDA	$\text{NH}_4\text{D}_2\text{AsO}_4$	299	
A_4 DDP	$\text{ND}_4\text{D}_2\text{PO}_4$	243	
A_4 DDA	$\text{ND}_4\text{D}_2\text{AsO}_4$	304	
Sodium niobate	NaNbO_3	911, 793	
Lead hafnate	PbHfO_3	476	378
Lead zirconate	PbZrO_3	503	475
Lead metaniobate	PbNb_2O_6	843	530
Lead metatantalate	PbTa_2O_6	543	533
Tungsten trioxide	WO_3	1010	
Potassium strontium niobate	$\text{KSr}_2\text{Nb}_5\text{O}_{15}$	427	413
Sodium nitrite	NaNO_2	437	437
Sodium trihydrogen selenite	$\text{NaH}_3(\text{SeO}_3)_2$	193	192
Sodium trideuterium selenite	$\text{NaD}_3(\text{SeO}_3)_2$	271	245
Ammonium trihydrogen periodate	$(\text{NH}_4)_2\text{H}_3\text{IO}_6$	245	

DIELECTRIC CONSTANTS OF GLASSES

Type	Dielectric constant at 100 MHz (20°C)	Volume resistivity (350°C megohm-cm)	Loss factor ^a
Corning 0010	6.32	10	0.015
Corning 0080	6.75	0.13	0.058
Corning 0120	6.65	100	0.012
Pyrex 1710	6.00	2,500	0.025
Pyrex 3320	4.71	—	0.019
Pyrex 7040	4.65	80	0.013
Pyrex 7050	4.77	16	0.017
Pyrex 7052	5.07	25	0.019
Pyrex 7060	4.70	13	0.018
Pyrex 7070	4.00	1,300	0.0048
Vycor 7230	3.83	—	0.0061
Pyrex 7720	4.50	16	0.014
Pyrex 7740	5.00	4	0.040
Pyrex 7750	4.28	50	0.011
Pyrex 7760	4.50	50	0.0081
Vycor 7900	3.9	130	0.0023
Vycor 7910	3.8	1,600	0.00091
Vycor 7911	3.8	4,000	0.00072
Corning 8870	9.5	5,000	0.0085
G. E. Clear (silica glass)	3.81	4,000—30,000	0.00038
Quartz (fused)	3.75 4.1 (1 MHz)	—	0.0002 (1 MHz)

^a Power factor × dielectric constant equals loss factor.

PROPERTIES OF SUPERCONDUCTORS

L. I. Berger and B. W. Roberts

The following tables include superconductive properties of selected elements, compounds, and alloys. Individual tables are given for thin films, elements at high pressures, superconductors with high critical magnetic fields, and high critical temperature superconductors.

The historically first observed and most distinctive property of a superconductive body is the near total loss of resistance at a critical temperature (T_c) that is characteristic of each material. Figure 1(a) below illustrates schematically two types of possible transitions. The sharp vertical discontinuity in resistance is indicative of that found for a single crystal of a very pure element or one of a few well annealed alloy compositions. The broad transition, illustrated by broken lines, suggests the transition shape seen for materials that are not homogeneous and contain unusual strain distributions. Careful testing of the resistivity limit for superconductors shows that it is less than 4×10^{-23} ohm cm, while the lowest resistivity observed in metals is of the order of 10^{-13} ohm cm. If one compares the resistivity of a superconductive body to that of copper at room temperature, the superconductive body is at least 10^{17} times less resistive.

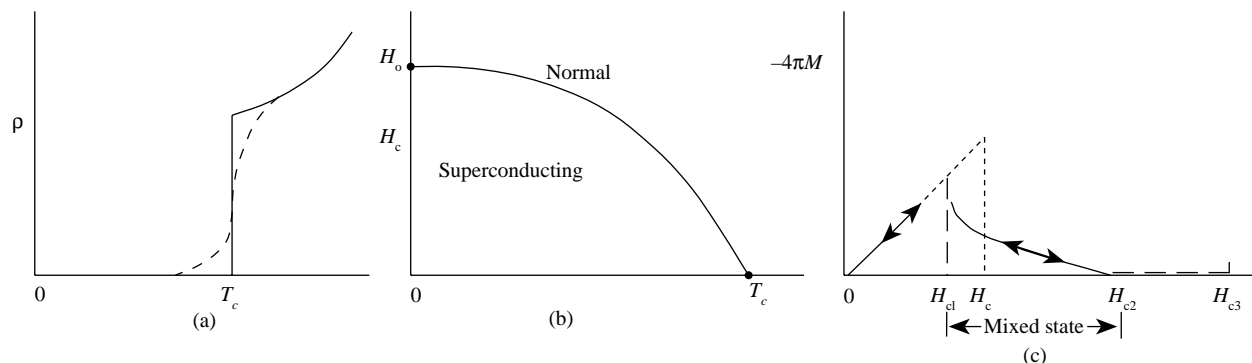


FIGURE 1. Physical properties of superconductors. (a) Resistivity vs. temperature for a pure and perfect lattice (solid line); impure and/or imperfect lattice (broken line). (b) Magnetic-field temperature dependence for Type-I or “soft” superconductors. (c) Schematic magnetization curve for “hard” or Type-II superconductors.

The temperature interval ΔT_c , over which the transition between the normal and superconductive states takes place, may be of the order of as little as 2×10^{-5} K or several K in width, depending on the material state. The narrow transition width was attained in 99.9999% pure gallium single crystals.

A Type-I superconductor below T_c , as exemplified by a pure metal, exhibits perfect diamagnetism and excludes a magnetic field up to some critical field H_c , whereupon it reverts to the normal state as shown in the H - T diagram of Figure 1(b).

The magnetization of a typical high-field superconductor is shown in Figure 1(c). The discovery of the large current-carrying capability of Nb_3Sn and other similar alloys has led to an extensive study of the physical properties of these alloys. In brief, a high-field superconductor, or Type-II superconductor, passes from the perfect diamagnetic state at low magnetic fields to a mixed state and finally to a sheathed state before attaining the normal resistive state of the metal. The magnetic field values separating the four stages are given as H_{c1} , H_{c2} , and H_{c3} . The superconductive state below H_{c1} is perfectly diamagnetic, identical to the state of most pure metals of the “soft” or Type-I superconductor. Between H_{c1} and H_{c2} a “mixed superconductive state” is found in which fluxons (a minimal unit of magnetic flux) create lines of normal flux in a superconductive matrix. The volume of the normal state is proportional to $-4\pi M$ in the “mixed state” region. Thus at H_{c2} the fluxon density has become so great as to drive the interior volume of the superconductive body completely normal. Between H_{c2} and H_{c3} the superconductor has a sheath of current-carrying superconductive material at the body surface, and above H_{c3} the normal state exists. With several types of careful measurement, it is possible to determine H_{c1} , H_{c2} , and H_{c3} . Table 6 contains some of the available data on high-field superconductive materials.

High-field superconductive phenomena are also related to specimen dimension and configuration. For example, the Type-I superconductor, Hg, has entirely different magnetization behavior in high magnetic fields when contained in the very fine sets of filamentary tunnels found in an unprocessed Vycor glass. The great majority of superconductive materials are Type-II. The elements in very pure form and a very few precisely stoichiometric and well annealed compounds are Type I with the possible exceptions of vanadium and niobium.

Metallurgical Aspects. The sensitivity of superconductive properties to the material state is most pronounced and has been used in a reverse sense to study and specify the detailed state of alloys. The mechanical state, the homogeneity, and the presence of impurity atoms and other electron-scattering centers are all capable of controlling the critical temperature and the current-carrying capabilities in high-magnetic fields. Well annealed specimens tend to show sharper transitions than those that are strained or inhomogeneous. This sensitivity to mechanical state underlines a general problem in the tabulation of properties for superconductive materials. The occasional divergent values of the critical temperature and of the critical fields quoted for a Type-II superconductor may lie in the variation in sample preparation. Critical temperatures of materials studied early in the history of superconductivity must be evaluated in light of the probable metallurgical state of the material, as well as the availability of less pure starting elements. It has been noted that recent work has given extended consideration to the metallurgical aspects of sample preparation.

Symbols in tables: T_c : Critical temperature; H_0 : Critical magnetic field in the $T = 0$ limit; θ_D : Debye temperature; and γ : Electronic specific heat.

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 1
Selective Properties of Superconductive Elements

Element	T_c (K)	H_0 (oersted)	θ_D (K)	γ (mJ mol ⁻¹ K ⁻¹)
Al	1.175 ± 0.002	104.9 ± 0.3	420	1.35
Am* (α,?)	0.6			
Am* (β,?)	1.0			
Be	0.026			0.21
Cd	0.517 ± 0.002	28 ± 1	209	0.69
Ga	1.083 ± 0.001	58.3 ± 0.2	325	0.60
Ga (β)	5.9, 6.2	560		
Ga (γ)	7	950, HF ^a		
Ga (Δ)	7.85	815, HF		
Hf	0.128	12.7		2.21
Hg (α)	4.154 ± 0.001	411 ± 2	87, 71.9	1.81
Hg (β)	3.949	339	93	1.37
In	3.408 ± 0.001	281.5 ± 2	109	1.672
Ir	0.1125 ± 0.001	16 ± 0.05	425	3.19
La (α)	4.88 ± 0.02	800 ± 10	151	9.8
La (β)	6.00 ± 0.1	1096, 1600	139	11.3
Lu	0.1 ± 0.03	350 ± 50		
Mo	0.915 ± 0.005	96 ± 3	460	1.83
Nb	9.25 ± 0.02	2060 ± 50, HF	276	7.80
Os	0.66 ± 0.03	70	500	2.35
Pa	1.4			
Pb	7.196 ± 0.006	803 ± 1	96	3.1
Re	1.697 ± 0.006	200 ± 5	4.5	2.35
Ru	0.49 ± 0.015	69 ± 2	580	2.8
Sn	3.722 ± 0.001	305 ± 2	195	1.78
Ta	4.47 ± 0.04	829 ± 6	258	6.15
Tc	7.8 ± 0.1	1410, HF	411	6.28
Th	1.38 ± 0.02	1.60 ± 3	165	4.32
Ti	0.40 ± 0.04	56	415	3.3
Tl	2.38 ± 0.02	178 ± 2	78.5	1.47
U	0.2			
V	5.40 ± 0.05	1408	383	9.82
W	0.0154 ± 0.0005	1.15 ± 0.03	383	0.90
Zn	0.85 ± 0.01	54 ± 0.3	310	0.66
Zr	0.61 ± 0.15	47	290	2.77
Zr (ω)	0.65, 0.95			

TABLE 2

Range of Critical Temperatures Observed for Superconductive Elements in Thin Films Condensed Usually at Low Temperatures

Element	T_c Range (K)	Comments	Element	T_c Range (K)	Comments
Al	1.15—5.7	HF ^a	Nb	2.0—10.1	
Be	5—9.75	HF	Pb	1.8—7.5	
Bi	6.17—6.6		Re	1.7—7	
Cd			Sn	3.5—6	
(Disordered)	0.79—0.91		Ta	<1.7—4.51	HF ^a
(Ordered)	0.53—0.59		Tc	4.6—7.7	
Ga	2.5—8.5	HF	Ti	1.3 Max	
Hg	3.87—4.5		Tl	2.33—2.96	
In	2.2—5.6	HF	V	1.8—6.02	
La	3.55—6.74		W	<1.0—4.1	
Mo	3.3—8.0		Zn	0.77—1.9	

^a HF denotes high magnetic field superconductive properties.

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 3
Elements Exhibiting Superconductivity Under or After Application of High Pressure

Element	T_c Range (K)	Pressure (kbar)	Element	T_c Range (K)	Pressure (kbar)
Al	1.98—0.075	0—62	Pb II	3.55	160
As	0.31—0.5	220—140	Re II	2.3 Max.	“Plastic” compression
	0.2—0.25	140—100			
Ba II	1—1.8	55—85	Sb (prepared 120 kbar, held below 77K)	2.6—2.7	
III	1.8—5	85—144			
IV	4.5—5.4	144—190	Sb II	3.55—3.40	85—150
Bi II	3.9	25—27	Se II	6.75, 6.95	130
III	6.55—7.25	28—38	Si	6.7—7.1	120—130
IV	7.0, 8.7—6.0	43, 43—62	Sn II	5.2—4.85	125—160
V	6.7, 8.3	48—80	III	5.30	113
VI	8.55	90, 92—101	Te II	2.4—5.1	38—55
VII(?)	8.2	30		4.1—4.2	53—62
Ce (α)	0.020—0.045	20—35	IV	4.72—4	63—80
Ce (α')	1.9—1.3	45—125	()	3.3—2.8	100—260
Cs V	1.5	>125	Tl (cubic form)	1.45	35
Ga II	6.38	≥ 35	(hexagonal form)	1.95	35
II'	7.5	≥ 35 then P removed	U	2.4—0.4	10—85
		115	Y	1.7—2.5	110—160
Ge	5.35		Zr (omega form, metastable)	1—1.7	60—130
La	5.5—12.9	0—210			
Lu	0.022—1.0	45—190			
P	5.8	170			

TABLE 4
Superconductive Compounds and Alloys

All compositions are denoted on an atomic basis, i.e., AB, AB₂, or AB₃ for compounds, unless noted. Solid solutions or odd compositions may be denoted as A_zB_{1-z} or A_zB. A series of three or more alloys is indicated as A_xB_{1-x} or by actual indication of the atomic fraction range, such as A_{0-0.6}B_{1-0.4}. The critical temperature of such a series of alloys is denoted by a range of values or possibly the maximum value.

The selection of the critical temperature from a transition in the effective permeability, or the change in resistance, or possibly the incremental changes in frequency observed by certain techniques is not often obvious from the literature. Most authors choose the mid-point of such curves as the probable critical temperature of the idealized material, while others will choose the highest temperature at which a deviation from the normal state property is observed. In view of the previous discussion concerning the variability of the superconductive properties as a function of purity and other metallurgical aspects, it is recommended that appropriate literature be checked to determine the most probable critical temperature or critical field of a given alloy.

A very limited amount of data on critical fields, H_c , is available for these compounds and alloys; these values are given at the end of the table.

A. SUPERCONDUCTORS WITH $T_c < 10$ K

Substance	T_c , K	Crystal structure type
Ag _{3.3} Al	0.34	A12-cI58 (Mn)
Ag _x Al _y Zn _{1-x-y}	0.15	Cubic
AgBi ₂	2.87—3.0	
Ag ₇ F _{0.25} N _{0.75} O _{10.25}	0.85—0.90	
Ag ₂ F	0.0.066	
Ag ₇ FO ₈	0.3	Cubic
Ag _{0.8-0.3} Ga _{0.2-0.7}	6.5—8	
Ag ₄ Ge	0.85	Hex., c.p.
Ag _{0.438} Hg _{0.562}	0.64	D8 ₂
AgIn ₂	~2.4	C16

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
$\text{Ag}_{0.1}\text{In}_{0.9}\text{Te}$ ($n = 1.4 \times 10^{22}$)*	1.2—1.89	B1
$\text{Ag}_{0.2}\text{In}_{0.8}\text{Te}$ ($n = 1.07 \times 10^{22}$)	0.77—1.00	B1
AgLa	0.94	B2-cP2 (CsCl)
AgLa (9.5 kbar)	1.2	B2
AgLu	0.33	B2-cP2
AgMo_4S_5	9.1	hR15 (Mo_6PbS_8)
$\text{Ag}_{1.2}\text{Mo}_6\text{Se}_8$	5.9	Same
$\text{Ag}_7\text{NO}_{11}$	1.04	Cubic
$\text{Ag}_x\text{Pb}_{1-x}$	7.2 max.	
Ag_4Sn	0.1	h**
$\text{Ag}_x\text{Sn}_{1-x}$	1.5—3.7	
$\text{Ag}_x\text{Sn}_{1-x}$ (film)	2.0—3.8	
AgTe ₃	2.6	Cubic
AgTh	2.2	C16-tI12 (Al_2Cu)
AgTh ₂	2.26	C16
$\text{Ag}_{0.03}\text{Tl}_{0.97}$	2.67	
$\text{Ag}_{0.94}\text{Tl}_{0.06}$	2.32	
AgY	0.33	B2-cP2 (CsCl)
$\text{Ag}_x\text{Zn}_{1-x}$	0.5—0.845	
AlAu ₄	0.4—0.7	Like A13
Al ₂ Au	0.1	C1-cF12 (CaF_2)
Al ₂ CMo ₃	9.8—10.2	A13+trace 2nd. phase)
Al ₂ CaSi	5.8	
$\text{Al}_{0.131}\text{Cr}_{0.088}\text{V}_{0.781}$	1.46	Cubic
AlGe ₂	1.75	
Al ₂ Ge ₂ U	1.6	LI ₂ -cP4 (Cu_3Au)
AlLa ₃	5.57	DO ₁₉
Al ₂ La	3.23	C15
Al ₂ Lu	1.02	C15-cF24 (Cu_2Mg)
Al ₃ Mg ₂	0.84	F.C.C.
AlMo ₃	0.58	A15
AlMo ₆ Pd	2.1	
AlN	1.55	B4
Al ₂ NNb ₃	1.3	A13
Al ₃ Nb	0.64	tI8 (Al_3Ti)
AlOs	0.39	B2
Al ₃ Os	5.90	
AlPb (film)	1.2—7	
Al ₂ Pt	0.48—0.55	C1
Al ₃ Re ₂₄	3.35	A12
AlSb	2.8	B4-tI4 (Sn)
Al ₂ Sc	1.02	C15-cF24 (Cu_2Mg)
Al ₂ Si ₂ U	1.34	LI ₂ -cP4 (Cu_3Au)
AlTh ₂	0.1	C16-tI12 (Al_2Cu)
Al ₃ Th	0.75	DO ₁₉
$\text{Al}_x\text{Ti}_y\text{V}_{1-x-y}$	2.05—3.62	Cubic
$\text{Al}_{0.108}\text{V}_{0.892}$	1.82	Cubic
Al ₂ Y	0.35	C15-cF24 (Cu_2Mg)
Al ₃ Yb	0.94	LI ₂ -cP4 (Cu_3Au)
$\text{Al}_x\text{Zn}_{1-x}$	0.5—0.845	
AlZr ₃	0.73	LI ₂
AsBiPb	9.0	
AsBiPbSb	9.0	
AsHfOs	3.2	C22-hP9 (Fe_2P)
AsHfRu	4.9	same

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
As _{0.33} InTe _{0.67} ($n = 1.24 \times 10^{22}$)	0.85—1.15	B1
As _{0.5} InTe _{0.5} ($n = 0.97 \times 10^{22}$)	0.44—0.62	B1
As ₄ La ₃	0.6	cI28 (Th ₃ P ₄)
AsNb ₃	0.3	L1 ₂ -tP32
As _{0.50} Ni _{0.06} Pd _{0.44}	1.39	C2
AsNi _{0.25} Pd _{0.75}	1.6	B8 ₁ -hP4 (NiAs)
AsOsZr	8.0	C22-hP9 (Fe ₂ P)
AsPb	8.4	
AsPd ₂ (low-temp. phase)	0.60	Hexagonal
AsPd ₂ (high-temp. phase)	1.70	C22
AsPd ₅	0.46	Complex
As ₃ Pd ₅	1.9	
AsRh	0.58	B31
AsRh _{1.4—1.6}	< 0.03—0.56	Hexagonal
AsSn	4.10	
AsSn ($n = 2.14 \times 10^{22}$)	3.41—3.65	B1
As ₂ Sn ₃	3.5—3.6; 1.21—1.17	
As ₃ Sn ₄ ($n = 0.56 \times 10^{22}$)	1.16—1.19	Rhombohedral
AsV ₃	0.20	A15-cP8 (Cr ₅ Si)
Au ₅ Ba	0.4—0.7	D2 _d
AuBe	2.64	B20
Au ₂ Bi	1.80	C15
Au ₅ Ca	0.34—0.38	C15 _b
AuGa ₂	1.6	C1-cF12 (CaF ₂)
AuGa	1.2	B31
Au _{0.40—0.92} Ge _{0.60—0.08}	<0.32—1.63	Complex
AuIn ₂	0.2	C1-cF12
AuIn	0.4—0.6	Complex
AuLu	<0.35	B2
AuNb ₃	1.2	A2
AuPb ₂	3.15	
AuPb ₂ (film)	4.3	
AuPb ₃	4.40	
AuPb ₃ (film)	4.25	
Au ₂ Pb	1.18; 6—7	C15
AuSb ₂	0.58	C2
AuSn	1.25	B8 ₁
Au _x Sn _{1-x} (film)	2.0—3.8	
Au ₅ Sn	0.7—1.1	A3
AuTa _{4,3}	0.55	A15-cP8 (Cr ₅ Si)
Au ₃ Te ₅	1.62	Cubic
AuTh ₂	3.08	C16
AuTl	1.92	
AuV ₃	0.74	A15
Au _x Zn _{1-x}	0.50—0.845	
AuZn ₃	1.21	Cubic
Au _x Zr _y	1.7—2.8	A3
AuZr ₃	0.92	A15
B ₂ Ba _{0.67} Pt ₃	5.60	hP12 (B ₂ BaPt ₃)
BCMo ₂	5.4	Orthorhombic
BCMo ₂	5.3—7.0	Same
B ₂ Ca _{0.67} Pt ₃	1.57	hP12
B ₄ ErIr ₄	2.1	tP18 (B ₄ CeCo ₄)
B ₄ ErRh ₄	4.3	oC108 (B ₄ LuRh ₄)
B ₄ ErRh ₄	8.7	tP18 (B ₄ CeCo ₄)

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
BHf	3.1	Cubic
B ₄ HoIr ₄	2.0	tP18
B ₄ HoRh ₄	1.4	oC108
B ₂ Ir ₃ La	1.65	hP6 (CaCu ₅)
B ₂ Ir ₃ Th	2.09	Same
B ₄ Ir ₄ Tm	1.6	tP18
B ₆ La	5.7	
B ₂ LaRh ₃	2.82	hP6
B ₁₂ Lu	0.48	
B ₂ LuOs	2.66	oP16 (B ₂ LuRu)
B ₂ LuOs ₃	4.62	hP6
B ₄ LuRh ₄	6.2	oC108
B ₂ LuRu	9.86	oP16
B ₄ LuRu ₄	2.0	tI72 (B ₄ LuRu ₄)
BMo	0.5 (extrapol.)	
BMo ₂	4.74	C16
BNb	8.25	B _f
B ₄ NdRh ₄	5.3	tP18
B ₂ O ₈ Sc	1.34	oP16
B ₂ O ₈ Y	2.22	oP16
B ₂ Pt ₃ Sr _{0.67}	2.78	hP12 (B ₂ BaPt ₃)
BRe ₂	2.80; 4.6	
B ₄ Rh _{3,4} Ru _{0.6}	8.38	tI72
B ₄ Rh ₄ Sm	2.7	tP18
B ₄ Rh ₄ Th	4.3	Same
B ₄ Rh ₄ Tm	9.8	Same
B ₄ Rh ₄ Tm	5.4	oC108
B _{0.3} Ru _{0.7}	2.58	D10 ₂
B ₄ Ru ₄ Sc	7.2	tI72
B ₂ Ru ₃ Th	1.79	hP6
B ₂ Ru ₃ Y	2.85	Same
B ₂ Ru Y	7.80	oP16
B ₄ Ru ₄ Y	1.4	tI72
B ₁₂ Sc	0.39	
BTa	4.0	B _f
BTa ₂	3.12	C16-tI12 (Al ₂ Cu)
B ₆ Th	0.74	
BW ₂	3.1	C16
B ₆ Y	6.5—7.1	
B ₁₂ Y	4.7	
BZr	3.4	Cubic
B ₁₂ Zr	5.82	
BaBi ₃	5.69	Tetragonal
Ba ₂ Mo ₁₅ Se ₁₉	2.75	hP15 (Mo ₆ PbS ₈)
Ba _x O ₃ Sr _{1-x} Ti (n = 4.2 × 10 ¹⁹)	<0.1—0.55	
Ba _{0.13} O ₃ W	1.9	Tetragonal
Ba _{0.14} O ₃ W	<1.25—2.2	Hexagonal
BaRh ₂	6.0	C15
Be ₂₂ Mo	2.51	Cubic (Be ₂₂ Re)
Be ₈ Nb ₅ Zr ₂	5.2	
Be _{0.98—0.92} Re _{0.02—0.08} (quenched)	9.5—9.75	Cubic
Be _{0.957} Re _{0.043}	9.62	Cubic (Be ₂₂ Re)
BeTe	5.21	Cubic
Be ₂₂ W	4.12	Cubic (Be ₂₂ Re)

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
Be ₁₃ W	4.1	Tetragonal
Bi ₃ Ca	2.0	
Bi _{0.5} Cd _{0.13} Pb _{0.25} Sn _{0.12} (weight fractions)	8.2	
BiCo	0.42—0.49	
Bi ₂ Cs	4.75	C15
Bi _x Cu _{1-x} (electrodeposited)	2.2	
BiCu	1.33—1.40	
Bi ₃ Fe	1.0	m**
Bi _{0.019} In _{0.981}	3.86	
Bi _{0.05} In _{0.95}	4.65	α-phase
Bi _{0.10} In _{0.90}	5.05	Same
Bi _{0.15—0.30} In _{0.85—0.70}	5.3—5.4	α- and β-phases
Bi _{0.34—0.48} In _{0.66—0.52}	4.0—4.1	
Bi ₃ In ₅	4.1	
BiIn ₂	5.65	β-phase
Bi ₂ Ir	1.7—2.3	
Bi ₂ Ir (quenched)	3.0—3.96	
BiK	3.6	
Bi ₂ K	3.58	C15
BiLi	2.47	L1 ₀ , α-phase
Bi _{4—9} Mg	0.7—~1.0	
Bi ₃ Mo	3—3.7	
BiNa	2.25	L1 ₀
BiNb ₃	4.5	A15-cP8 (Cr ₃ Si)
BiNb ₃ (high pressure and temperature)	3.05	A15
BiNi	4.25	B8 ₁
Bi ₃ Ni	4.06	Orthorhombic
BiNi _{0.5} Rh _{0.5}	3.0	B8 ₁ -hP4 (AsNi)
Bi _{0.5} NiSb _{0.5}	2.0	Same
Bi ₁₋₀ Pb ₀₋₁	7.26—9.14	
Bi ₁₋₀ Pb ₀₋₁ (film)	7.25—8.67	
Bi _{0.05—0.40} Pb _{0.95—0.60}	7.35—8.4	H.C.P. to ε-phase
Bi ₂ Pb	4.25	t**
BiPbSb	8.9	
Bi _{0.5} Pb _{0.31} Sn _{0.19} (weight fractions)	8.5	
Bi _{0.5} Pb _{0.25} Sn _{0.25}	8.5	
BiPd ₂	4.0	
Bi _{0.4} Pd _{0.6}	3.7—4	Hexagonal, ordered
BiPd	3.7	Orthorhombic
Bi ₂ Pd	1.70	Monoclinic, α-phase
Bi ₂ Pd	4.25	Tetragonal, β-phase
BiPd _{0.45} Pt _{0.55}	3.7	B8 ₁ -hP4 (NiAs)
BiPdSe	1.0	C2
BiPdTe	1.2	C2
BiPt	1.21	B8 ₁
Bi _{0.1} PtSb _{0.9}	2.05; 1.5	B8 ₁ -hP4 (NiAs)
BiPtSe	1.45	C2
BiPtTe	1.15	C2
Bi ₂ Pt	0.155	Hexagonal
Bi ₂ Rb	4.25	C15
BiRe ₂	1.9—2.2	
BiRh	2.06	B8 ₁

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
Bi_3Rh	3.2	Orthorhombic (NiB_3)
Bi_4Rh	2.7	Hexagonal
BiRu	5.7	m**
Bi_3Sn	3.6—3.8	
BiSn	3.8	
Bi_xSn_y	3.85—4.18	
Bi_3Sr	5.62	L1_2
Bi_3Te	0.75—1.0	
Bi_5Tl_3	6.4	
$\text{Bi}_{0.26}\text{Tl}_{0.74}$	4.4	Cubic, disordered
$\text{Bi}_{0.26}\text{Tl}_{0.74}$	4.15	L1_2 , ordered (?)
Bi_2Y_3	2.25	
Bi_3Zn	0.8—0.9	
$\text{Bi}_{0.3}\text{Zr}_{0.7}$	1.51	
BiZr_3	2.4—2.8	
BrMo_6Se_7	7.1	hP15 (Mo_6PbS_8)
$\text{Br}_3\text{Mo}_6\text{Se}_5$	7.1	Same
CCs_x	0.020—0.135	Hexagonal
CFe_3	1.30	DO_{11} -oP16 (Fe_3C)
CGaMo_2	3.7—4.1	Hexagonal
$\text{CHf}_{0.5}\text{Mo}_{0.5}$	3.4	B1
$\text{CHf}_{0.3}\text{Mo}_{0.7}$	5.5	B1
$\text{CHf}_{0.25}\text{Mo}_{0.75}$	6.6	B1
$\text{CHf}_{0.7}\text{Nb}_{0.3}$	6.1	B1
$\text{CHf}_{0.6}\text{Nb}_{0.4}$	4.5	B1
$\text{CHf}_{0.5}\text{Nb}_{0.5}$	4.8	B1
$\text{CHf}_{0.4}\text{Nb}_{0.6}$	5.6	B1
$\text{CHf}_{0.25}\text{Nb}_{0.75}$	7.0	B1
$\text{CHf}_{0.2}\text{Nb}_{0.8}$	7.8	B1
$\text{CHf}_{0.9-0.1}\text{Ta}_{0.1-0.9}$	5.0—9.0	B1
CK (excess K)	0.55	Hexagonal
C_8K	0.39	Hexagonal
C_2La	1.66	tI6 (CaC_2)
C_2Lu	3.33	Same
$\text{C}_{0.40-0.44}\text{Mo}_{0.60-0.56}$	9—13	
C_3MoRe	3.8	B1-cF8
$\text{C}_{0.6}\text{Mo}_{4.8}\text{Si}_3$	7.6	D8_8
$\text{CMo}_{0.2}\text{Ta}_{0.8}$	7.5	B1
$\text{CMo}_{0.5}\text{Ta}_{0.5}$	7.7	B1
$\text{CMo}_{0.75}\text{Ta}_{0.25}$	8.5	B1
$\text{CMo}_{0.8}\text{Ta}_{0.2}$	8.7	B1
$\text{CMo}_{0.85}\text{Ta}_{0.15}$	8.9	B1
$\text{CMo}_x\text{V}_{1-x}$	2.9—9.3	B1
$\text{CMo}_x\text{Zr}_{1-x}$	9.8	B1
$\text{C}_{0.984}\text{Nb}$	9.8	B1
CNb_2	9.1	
$\text{CNb}_x\text{Ti}_{1-x}$	<4.2—8.8	B1
$\text{CNb}_{0.1-0.9}\text{Zr}_{0.9-0.1}$	4.2—8.4	B1
CRb_x (Au)	0.023—0.151	Hexagonal
$\text{CRe}_{0.06}\text{W}$	5.0	
CRu	2.00	hP2 (CW)
$\text{C}_{0.987}\text{Ta}$	9.7	
$\text{C}_{0.848-0.987}$	2.04—9.7	
CTa (film)	5.09	B1
CTa_2	3.26	L'_3

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
CTa _{0.4} Ti _{0.6}	4.8	B1
Ct _a 1-0.4W _{0-0.6}	8.5—10.5	B1
CTa _{0.2-0.9} Zr _{0.8-0.1}	4.6—8.3	B1
CTc (excess C)	3.85	Cubic
CTi _{0.5-0.7} W _{0.5-0.3}	6.7—2.1	B1
CW	1.0	
CW ₂	2.74	L' ₃
CW ₂	5.2	F.C.C.
C ₂ Y	3.88	tI6 (CaC ₂)
Ca ₃ Co ₄ Sn ₁₃	5.9	cP40 (Pr ₃ Rh ₂ Sn ₁₃)
Ca ₃ Ge ₁₃ Rh ₄	2.1	Same
CaHg	1.6	B2-cP2 (CsCl)
CaHg ₃	1.6	hP8 (Ni ₃ Sn)
CaIr ₂	6.15	C15
Ca ₃ Ir ₄ Sn ₁₃	7.1	cP40
Ca _x O ₃ Sr _{1-x} Ti (n = 3.7—11 × 10 ¹⁹)	<0.1—0.55	
Ca _{0.1} O ₃ W	1.4—3.4	Hexagonal
CaPb	7.0	
CaRh ₂	6.40	C15
CaRh _{1.2} Sn _{4.5}	8.7	cP40
CaTl ₃	2.0	B2-cP2
Cd _{0.3-0.5} Hg _{0.7-0.5}	1.70—1.92	
CdHg	1.77; 2.15	Tetragonal
Cd _{0.0075-0.05} In _{0.9925-0.95}	3.24—3.36	Tetragonal
Cd _{0.97} Pb _{0.03}	4.2	
CdSn	3.65	
Cd _{0.17} Tl _{0.83}	2.3	
Cd _{0.18} Tl _{0.82}	2.54	
CeCo ₂	0.84	C15
CeCo _{1.67} Ni _{0.33}	0.46	C15
CeCo _{1.67} Rh _{0.33}	0.47	C15
Ce _x Gd _{1-x} Ru ₂	3.2—5.2	C15
CeIr ₃	3.34	
CeIr ₅	1.82	
Ce _{0.005} La _{0.995}	4.6	
Ce _x La _{1-x}	1.3—6.3	
Ce _x Pr _{1-x} Ru ₂	1.4—5.3	C15
Ce _x Pt _{1-x}	0.7—1.55	
CeRu ₂	6.0	C15
Ce ₃ Mo ₆ Se ₅	5.7	hR15 (Mo ₆ PbS ₈)
Ce ₂ Mo ₆ Te ₆	1.7	Same
Co _x Fe _{1-x} Si ₂	1.4 (max.)	C1
CoHf ₂	0.56	E9 ₃
CoLa ₃	4.28	
Co ₄ La ₃ Sn ₁₃	2.8	cP40
CoLu ₃	~0.35	
Co _x LuSn _y	1.5	cP40
Co _{0-0.01} Mo _{0.8} Re _{0.2}	2—10	
Co _{0.02-0.10} Nb ₃ Rh _{0.98-0.90}	2.28—1.90	A15
Co _x Ni _{1-x} Si ₂	1.4 (max.)	C1
Co _{0.5} Rh _{0.5} Si ₂	2.5	
Co _x Rh _{1-x} Si ₂	3.65 (max.)	
Co _{-0.3} So _{-0.7}	~0.35	
Co ₄ Sc ₅ Si ₁₀	5.0	tP38 (Co ₄ Sc ₅ Si ₁₀)
CoSi ₂	1.40; 1.22	C1

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
$\text{Co}_x\text{Sn}_y\text{Yb}$	2.5	cP40
Co_3Th_7	1.83	D10 ₂
$\text{Co}_x\text{Ti}_{1-x}$	2.8 (max.)	Co in α -Ti
$\text{Co}_x\text{Ti}_{1-x}$	3.8 (max.)	Co in β -Ti
CoTi_2	3.44	E9 ₃
CoTi	0.71	A2
CoU	1.7	B2, distorted
CoU_6	2.29	D2 _c
$\text{Co}_{0.28}\text{Y}_{0.72}$	0.34	
CoY_3	<0.34	
CoZr_2	6.3	C16
$\text{Co}_{0.1}\text{Zr}_{0.9}$	3.9	A3
$\text{Cr}_{0.6}\text{Ir}_{0.4}$	0.4	H.C.P.
$\text{Cr}_{0.65}\text{Ir}_{0.35}$	0.59	H.C.P.
$\text{Cr}_{0.7}\text{Ir}_{0.3}$	0.76	H.C.P.
$\text{Cr}_{0.72}\text{Ir}_{0.28}$	0.83	
Cr_3Ir	0.45	A15
$\text{Cr}_{-0.1}\text{Nb}_{1-0.9}$	4.6—9.2	A2
$\text{Cr}_{0.80}\text{Os}_{0.20}$	2.5	Cubic
Cr_3Os	4.68	A15-cP8 (Cr ₃ Si)
$\text{Cr}_x\text{Re}_{1-x}$	1.2—5.2	
$\text{Cr}_{0.4}\text{Re}_{0.6}$	2.15	D8 _b
$\text{Cr}_{0.8-0.6}\text{Rh}_{0.2-0.4}$	0.5—1.10	A3
Cr_3Rh	0.3	A15-cP8
Cr_3Ru (annealed)	3.3	A15
Cr_2Ru	2.02	D8 _b
Cr_3Ru_2	2.10	D8 _b -tP30 (CrFe)
$\text{Cr}_{0.1-0.5}\text{Ru}_{0.9-0.5}$	0.34—1.65	A3
$\text{Cr}_x\text{Ti}_{1-x}$	3.6 (max.)	Cr in α -Ti
$\text{Cr}_x\text{Ti}_{1-x}$	4.2 (max.)	Cr in β -Ti
$\text{Cr}_{0.1}\text{Ti}_{0.3}\text{V}_{0.6}$	5.6	
$\text{Cr}_{0.0175}\text{U}_{0.9825}$	0.75	β -phase
$\text{Cs}_{0.32}\text{O}_3\text{W}$	1.12	Hexagonal
$\text{Cu}_{0.15}\text{In}_{0.85}$ (film)	3.75	
$\text{Cu}_{0.04-0.08}\text{In}_{0.94-0.92}$	4.4	
CuLa	5.85	
$\text{Cu}_2\text{Mo}_6\text{O}_2\text{S}_6$	9	hR15 (Mo ₆ PbS ₈)
$\text{Cu}_2\text{Mo}_6\text{Se}_8$	5.9	Same
$\text{Cu}_x\text{Pb}_{1-x}$	5.7—7.7	
CuS	1.62	B18
CuS_2	1.48—1.53	C18
CuSSe	1.5—2.0	C18
CuSe_2	2.3—2.43	C18
CuSeTe	1.6—2.0	C18
$\text{Cu}_x\text{Sn}_{1-x}$	3.2—3.7	
$\text{Cu}_x\text{Sn}_{1-x}$ (film, made at 10K)	3.6—7	
$\text{Cu}_x\text{Sn}_{1-x}$ (film, made at 300K)	2.8—3.7	
CuTe_2	<1.25—1.3	C18
CuTh_2	3.49	C16
$\text{Cu}_{0-0.027}\text{V}$	3.9—5.3	A2
CuY	0.33	B2-cP2 (CsCl)
$\text{Cu}_x\text{Zn}_{1-x}$	0.5—0.845	
DyMo_6S_8	2.1	hR15
$\text{Er}_x\text{La}_{1-x}$	1.4—6.3	
ErMo_6S_8	2.2	hR15

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
ErMo ₆ Se ₈	6.2	hR15
Fe ₃ Lu ₂ Si ₅	6.1	tP40 (Fe ₃ Sc ₂ Si ₅)
Fe _{0-0.04} Mo _{0.8} Re _{0.2}	1—10	
Fe _{0.05} Ni _{0.05} Zr _{0.90}	~3.9	
Fe ₃ Re ₂	6.55	D8 _b -tP30 (FeCr)
Fe ₃ Sc ₂ Si ₅	4.52	tP40
Fe ₃ Si ₅ Tm	1.3	Same
Fe ₃ Si ₅ Y ₂	2.4	Same
Fe ₃ Th ₇	1.86	D10
Fe _x Ti _{1-x}	3.2 (max.)	Fe in α-Ti
Fe _x Ti _{1-x}	3.7 (max.)	Fe in β-Ti
Fe _x Ti _{0.6} V _{1-x}	6.8 (max.)	
FeU ₆	3.86	D2 _c
Fe _{0.1} Zr _{0.9}	1.0	A3
Ga _{0.5} Ge _{0.5} Nb ₃	7.3	A15
Ga ₂ Ge ₂ U	0.87	B2-cP2
GaHf ₂	0.21	C16-tI12 (Al ₂ Cu)
GaLa ₃	5.84	
Ga ₃ Lu	2.3	B2-cP2
Ga ₂ Mo	9.5	
GaMo ₃	0.76	A15
GaN (black)	5.85	B4
Ga _{0.7} Pt _{0.3}	2.9	C1
GaPt	1.74	B20
GaSb (120kbar, 77K, annealed)	4.24	A5
GaSb (unannealed)	~5.9	
Ga ₀₋₁ Sn ₁₋₀ (quenched)	3.47—4.18	
Ga ₀₋₁ Sn ₁₋₀ (annealed)	2.6—3.85	
GaTe	0.17	mC24 (GaTe)
Ga ₅ V ₂	3.55	Tetragonal (Mn ₂ Hg ₅)
GaV _{4.5}	9.15	
Ga ₃ Zr	1.38	
Ga ₃ Zr ₅	3.8	D8 _b -hP16 (Mn ₅ Si ₃)
Gd _x La _{1-x}	< 1.0—5.5	
GdMo ₆ S ₈	3.5	hR15
GdMo ₆ Se ₈	5.6	hR15
Gd _x Os ₂ Y _{1-x}	1.4—4.7	
Gd _x Ru ₂ Th _{1-x}	3.6 (max.)	C15
Ge ₁₀ As ₄ Y ₅	9.06	tP38 (C ₀ Sc ₅ Si ₁₀)
GeIr	4.7	B31
GeIrLa	1.64	tI12 (LaPtSi)
Ge ₁₀ Ir ₄ Lu ₅	2.60	tP38
Ge ₁₀ Ir ₄ Y ₅	2.62	tP38
Ge ₂ La	1.49; 2.2	Orthorhombic, distorted (Mn ₂ Hg ₅)
GeLaPt	3.53	tI12
Ge ₁₃ Lu ₃ Os ₄	3.6	cP40 (Pr ₃ Rh ₂ Sn ₁₃)
Ge ₁₀ Lu ₅ Rh ₄	2.79	tP38
Ge ₁₃ Lu ₃ Ru ₄	2.3	cP40
GeMo ₃	1.43	A15
GeNb ₂	1.9	
Ge _{0.29} Nb _{0.71}	6	A15
GePt	0.40	B31
Ge ₃ Rh ₅	2.12	Orthorhombic, related to InNi ₂

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
GeRh	0.96	B31-oP8 (MnP)
Ge ₁₃ Rh ₄ Sc ₃	1.9	c P40
Ge ₁₀ Rh ₄ Y ₅	1.35	tP38
Ge ₁₃ Ru ₄ Y ₃	1.7	cP40
Ge ₂ So	1.3	
GeTa ₃	8.0	A15-cP8 (Cr ₃ Si)
Ge ₃ Te ₄ (n = 1.06 × 10 ²²)	1.55—1.80	Rhombohedral
Ge _x Te _{1-x} (n = 8.5—64 × 10 ²⁰)	0.07—0.41	R1
GeV ₃	6.01	A15
Ge ₂ Y	3.80	C _c
Ge _{1.62} Y	2.4	
Ge ₂ Zr	0.30	oC12 (ZrSi ₂)
GeZr ₃	0.4	L1 ₂ -tP32 (Ti ₃ P)
Hf _{0.33} Nb _{0.67}	7.28	B.C.C.
Hf _{0.1} Nb _{0.9}	7.38	Same
Hf _{0.05} Nb _{0.95}	7.83	Same
Hf _{0.12} Ta _{0.88}	2.81	B.C.C.
Hf _{0.08} Ta _{0.92}	3.26	Same
Hf _{0.04} Ta _{0.96}	3.62	Same
HfIrSi	3.50	C37-cP12 (Co ₂ Si)
HfMo ₂	0.05	hP24 (Ni ₂ Mn)
HfN _{0.989}	6.6	B1
Hf _{0-0.5} Nb _{1-0.5}	8.3—9.5	A2
Hf _{0.75} Nb _{0.25}	>4.2	
HfOs ₂	2.69	C14
HfOsP	6.1	C22-hP9 (Fe ₂ P)
HfPRu	9.9	Same
HfRe ₂	4.80	C14
Hf _{0.14} Re _{0.86}	5.86	A12
Hf _{0.99-0.96} Rh _{0.01-0.04}	0.85—1.51	
Hf _{0-0.55} Ta _{1-0.45}	4.4—6.5	A2
HfV ₂	8.9—9.6	C15
Hg _x In _{1-x}	3.14—4.55	
HgIn	3.81	
Hg ₂ K	1.20	Orthorhombic
Hg ₃ K	3.18	
Hg ₄ K	3.27	
Hg ₈ K	3.42	
Hg ₃ Li	1.7	Hexagonal
HgMg ₃	0.17	hP8 (Na ₃ As)
Hg ₂ Mg	4.0	tI6 (MoSi ₂)
Hg ₃ Mg ₅	0.48	D8 _b -hP16 (Mn ₃ Si ₃)
Hg ₂ Na	1.62	Hexagonal
Hg ₄ Na	3.05	
Hg _x Pb _{1-x}	4.14—7.26	
HgSn	4.2	
Hg _x Tl _{1-x}	2.30—4.19	
Hg ₅ Tl ₂	3.86	
Ho _x La _{1-x}	1.3—6.3	
Ho _{1.2} Mo ₆ Se ₈	6.1	D10 ₂ -hR12 (Be ₃ Nb)
In _{1-0.86} Mg _{0-0.14}	3.395—3.363	
In ₂ Mo ₆ Te ₆	2.6	hR15 (Mo ₆ PbS ₈)
InNb ₃ (high pressure and temp.)	4—8; 9.2	A15
In _{0.5} Nb ₃ Zr _{0.5}	6.4	
In _{0.11} O ₃ W	< 1.25—2.8	Hexagonal

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
$\text{In}_{0.95-0.85}\text{Pb}_{0.05-0.15}$	3.6—5.05	
$\text{In}_{0.98-0.91}\text{Pb}_{0.02-0.09}$	3.45—4.2	
InPb	6.65	
InPd	0.7	B2
InSb (quenched from 170 kbar into liquid N_2)	4.8	Like A5
InSb	2.1	B4
$(\text{InSb})_{0.95-0.10}\text{Sn}_{0.05-0.90}$ (various heat treatments)	3.8—5.1	
$(\text{InSb})_{0-0.07}\text{Sn}_{1-0.93}$	3.67—3.74	
In_3Sn	~5.5	
$\text{In}_x\text{Sn}_{1-x}$	3.4—7.3	
$\text{In}_{0.82-1}\text{Te}$ ($n = 0.83-1.71 \times 10^{22}$)	1.02—3.45	B1
$\text{In}_{1.000}\text{Te}_{1.002}$	3.5—3.7	B1
In_3Te_4 ($n = 4.7 \times 10^{21}$)	1.15—1.25	Rhombohedral
$\text{In}_x\text{Tl}_{1-x}$	2.7—3.374	
$\text{In}_{0.8}\text{Tl}_{0.2}$	3.223	
$\text{In}_{0.62}\text{Tl}_{0.38}$	2.760	
$\text{In}_{0.78-0.69}\text{Tl}_{0.22-0.31}$	3.18—3.32	Tetragonal
$\text{In}_{0.69-0.62}\text{Tl}_{0.31-0.38}$	2.98—3.3	F.C.C.
Ir_2La	0.48	C15
Ir_3La	2.32	D10 ₂
Ir_3La_7	2.24	D10 ₂
Ir_5La	2.13	
IrLaSi_2	2.03	oC16 (CeNiSi ₂)
IrLaSi_3	2.7	tI10 (BaNiSn ₃)
Ir_2Lu	2.47	C15
Ir_3Lu	2.89	C15
$\text{Ir}_4\text{Lu}_5\text{Si}_{10}$	3.9	tP38 (Co ₄ Sc ₅ Si ₁₀)
IrMo	< 1.0	A3
IrMo_3	9.6	A15
IrMo_3	6.8	D8 _b
IrNb_3	1.9	A15
$\text{Ir}_{0.4}\text{Nb}_{0.6}$	9.8	D8 _b
$\text{Ir}_{0.37}\text{Nb}_{0.63}$	2.32	D8 _b
IrNb	7.9	D8 _b
$\text{Ir}_{1.15}\text{Nb}_{0.85}$	4.6	oP12 (IrTa)
$\text{Ir}_{0.02}\text{Nb}_3\text{Rh}_{0.98}$	2.43	A15
$\text{Ir}_{0.05}\text{Nb}_3\text{Rh}_{0.95}$	2.38	A15
$\text{Ir}_{0.287}\text{O}_{0.14}\text{Ti}_{0.573}$	5.5	E9 ₃
$\text{Ir}_{0.265}\text{O}_{0.035}\text{Ti}_{0.65}$	2.30	E9 ₃
$\text{Ir}_x\text{Os}_{1-x}$	0.3—0.98	
$\text{Ir}_{1.5}\text{Os}_{0.5}$	2.4	C14
IrOsY	2.6	C15
IrSiY	2.70	C37-oP12 (Co ₂ Si)
IrSiZr	2.04	Same
Ir_2Sc	2.07	C15
$\text{Ir}_{2.5}\text{Sc}$	2.46	C15
$\text{Ir}_4\text{Sc}_5\text{Si}_{10}$	8.46	tP38
$\text{Ir}_2\text{Si}_2\text{Th}$	2.14	tI10
IrSi_3Th	1.75	tI10
IrSiTh	6.50	tI12 (LaPtSi)
$\text{Ir}_2\text{Si}_2\text{Y}$	2.60	tI10 (Al4Ba)
$\text{Ir}_4\text{Si}_{10}\text{Y}_5$	3.10	tP38
$\text{Ir}_3\text{Si}_5\text{Y}_2$	2.83	oI40

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
IrSn ₂	0.65—0.78	C1
Ir ₂ Sr	5.70	C15
Ir ₇ Ta ₁₃	1.2	D8 _b -tP30 (FeCr)
Ir _{0.5} Te _{0.5}	~3	
IrTe ₃	1.18	C2
IrTh	< 0.37	B _f
Ir ₂ Th	6.50	C15
Ir ₃ Th	4.71	
Ir ₃ Th ₇	1.52	D10 ₂
Ir ₅ Th	3.93	D2 _d
IrTi ₃	5.40	A15
IrV ₂	1.39	A15
IrW ₃	3.82	
Ir _{0.28} W _{0.72}	4.49	
Ir ₂ Y	2.18; 1.38	C15
Ir _{0.69} Y _{0.31}	1.98; 1.44	C15
Ir _{0.70} Y _{0.30}	2.16	C15
Ir ₂ Y ₃	1.61	
Ir ₃ Y	3.50	D10 ₂ -hR13 (Be ₃ Nb)
Ir _x Y _{1-x}	0.3—3.7	
Ir ₂ Zr	4.10	C15
Ir _{0.1} Zr _{0.9}	5.5	A3
K ₂ Mo ₁₅ S ₁₉	3.32	hR15
K _{0.27—0.31} O ₃ W	0.50	Hexagonal
K _{0.40—0.57} O ₃ W	1.5	Tetragonal
La _{0.55} Lu _{0.45}	2.2	Hexagonal, La type
La _{0.8} Lu _{0.2}	3.4	Same
LaMg ₂	1.05	C15
LaMo ₆ S ₈	7.1	hR15
LaN	1.35	
LaOs ₂	6.5	C15
LaPt ₂	0.46	C15
La _{0.28} Pt _{0.72}	0.54	C15
LaPtSi	3.48	tI12
LaRh ₃	2.60	
LaRh ₅	1.62	
La ₇ Rh ₃	2.58	D10 ₂
LaRhSi ₂	3.42	oC16 (CeNiSi ₂)
La ₂ Rh ₃ Si ₅	4.45	oI40 (Co ₃ Si ₅ U ₂)
LaRhSi ₃	2.7	tI10 (BaNiSn ₃)
LaRh ₂ Si ₂	3.90	tI10 (Al ₄ Ba)
LaRu ₂	1.63	C15
La ₃ S ₄	6.5	D7 ₃
La ₃ Se ₄	8.6	D7 ₃
LaSi ₂	2.3	C _c
La _x Y _{1-x}	1.7—5.4	
LaZn	1.04	B2
Li ₂ Mo ₆ S ₈	4.2	hR15
LiPb	7.2	
LuOs ₂	3.49	C14
Lu _{0.275} Rh _{0.725}	1.27	C15
LuRh ₅	0.49	
Lu ₅ Rh ₄ Si ₁₀	3.95	tP38 (Co ₄ So ₅ Si ₁₀)
LuRu ₂	0.86	C14
Mg _{1.14} Mo _{6.6} S ₈	3.5	hR15

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
Mg2Nb	5.6	
Mg _{0.47} Tl _{0.53}	2.75	B2
MgZn	0.9	A3-oP4 (AuCd)
Mn _x Ti _{1-x}	2.3 (max.)	Mn in -Ti
Mn _x Ti _{1-x}	1.1—3.0	Mn in -Ti
MnU ₆	2.32	D2 _c
Mo ₂ N	5.0	F.C.C.
Mo ₆ Nb ₂ S ₈	8.6	hR15
Mo _x Nb _{1-x}	0.016—9.2	
Mo _{5.25} Nb _{0.75} Se ₈	6.2	hR15
Mo ₆ NdS ₈	8.2	hR15
Mo ₃ Os	7.2	A15
Mo _{0.62} Cs _{0.38}	5.65	D8 _b
Mo ₃ P	5.31	DO _e
Mo ₆ Pb _{1.2} Se ₈	6.75	hR15
Mo _{0.5} Pd _{0.5}	3.52	A3
Mo ₆ PrSe ₈	9.2	hR15
MoRe	7.8	D8 _b -tP30
MoRe ₃	9.25; 9.89	A12
Mo _x Re _{1-x}	1.2—12.2	
Mo _{0.42} Re _{0.58}	6.35	D8 _b
MoRh	1.97	A3
Mo _x Rh _{1-x}	1.5—8.2	B.C.C.
MoRu	9.5—10.5	A3
Mo _{0.61} Ru _{0.39}	7.18	D8 _b
Mo _{0.2} Ru _{0.8}	1.66	A3
Mo ₃ Ru ₂	7.0	D8 _b -tP30
Mo ₄ Ru ₂ Te ₈	1.7	hR15
Mo ₆ S ₈	1.85	hR15
Mo ₆ S ₈ Sc	3.6	hR15
Mo ₆ S ₈ Sm _{1.2}	2.9	hR15
Mo ₆ S ₈ Tb	2.0	hR15
Mo ₆ S ₈ Tl	8.7	hR15
Mo ₆ S ₈ Tm _{1.2}	2.1	hR15
Mo ₆ S ₈ Y _{1.2}	3.0	hR15
Mo ₆ S ₈ Yb	9.2	hR15
Mo _{6.6} S ₈ Zn ₁₁	3.6	hR15
Mo ₃ Sb ₄	2.1	
Mo ₆ Se ₈	6.3	hR15
Mo ₆ Se ₈ Sm _{1.2}	6.8	hR15
Mo ₆ Se ₈ Sn _{1.2}	6.8	hR15
Mo ₆ Se ₈ Tb	5.7	hR15
Mo ₃ Se ₃ Tl	4.0	hP14
Mo ₆ Se ₈ Tm _{1.2}	6.3	hR15
Mo ₆ Se ₈ Yb	6.2	hR15
Mo ₃ Si	1.30	A15
MoSi _{0.7}	1.34	
Mo _x SiV _{3-x}	4.54—16.0	A15
Mo _{5.25} Ta _{0.75} Te ₈	1.7	hR15
Mo ₆ Te ₈	1.7	hR15
Mo _{0.16} Ti _{0.84}	4.18; 4.25	
Mo _{0.913} Ti _{0.087}	2.95	
Mo _{0.04} Ti _{0.96}	2.0	Cubic
Mo _{0.025} Ti _{0.975}	1.8	
Mo _x U _{1-x}	0.7—2.1	

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
$\text{Mo}_x\text{V}_{1-x}$	0—~5.3	
Mo_2Zr	4.25—4.75	C15
NNb (film)	6—9	B1
$\text{N}_x\text{O}_y\text{Ti}_z$	2.9—5.6	Cubic
$\text{N}_x\text{O}_y\text{V}_z$	5.8—8.2	Cubic
$\text{N}_{0.34}\text{Re}$	4—5	F.C.C.
NTa (film)	4.84	B1
$\text{N}_{0.6-0.987}\text{Ti}$	<1.17—5.8	B1
$\text{N}_{0.82-0.99}\text{V}$	2.9—7.9	B1
NZr	9.8	B1
$\text{N}_{0.906-0.984}\text{Zr}$	3.0—9.5	B1
$\text{Na}_{0.28-0.35}\text{O}_3\text{W}$	0.56	Tetragonal
$\text{Na}_{0.28}\text{Pb}_{0.72}$	7.2	
NbO	1.25	
NbOs_2	2.52	A12
Nb_3Os	1.05	A15
$\text{Nb}_{0.6}\text{Os}_{0.4}$	1.89; 1.78	D8_b
$\text{Nb}_3\text{Os}_{0.02-0.10}\text{Rh}_{0.98-0.90}$	2.42—2.30	A15
Nb_3P	1.8	$\text{L1}_2\text{-tP32 (Ti}_3\text{P)}$
NbPRh	4.08	C37-oP12 (Co_2Si)
$\text{Nb}_{0.6}\text{Pd}_{0.4}$	1.60	D8_f plus cubic
$\text{Nb}_3\text{Pd}_{0.02-0.10}\text{Rh}_{0.92-0.90}$	2.49—2.55	A15
$\text{Nb}_{0.62}\text{Pt}_{0.38}$	4.21	D8_b
Nb_5Pt_3	3.73	D8_b
$\text{Nb}_3\text{Pt}_{0.02-0.98}\text{Rh}_{0.98-0.02}$	2.52—9.6	A15
NbRe_3	5.27	$\text{D8}_b\text{-tP30 (FeCr)}$
$\text{Nb}_{0.38-0.18}\text{Re}_{0.62-0.82}$	2.43—9.70	A15
NbRe	3.8	$\text{D8}_b\text{-tP30}$
NbReSi	5.1	oI36 (FeTiSi)
Nb_3Rh	2.64	A15
$\text{Nb}_{0.6}\text{Rh}_{0.40}$	4.21	D8_b plus other
$\text{Nb}_{0.9}\text{Rh}_{1.1}$	3.07	A3-oP4 (AuCd)
$\text{Nb}_3\text{Rh}_{0.98-0.90}\text{Ru}_{0.02-0.10}$	2.42—2.44	A15
$\text{Nb}_x\text{Ru}_{1-x}$	1.2—4.8	
NbRuSi	2.65	oI36
NbS_2	6.1—6.3	Hexagonal, NbSe_2 type
NbS_2	5.0—5.5	Hexagonal, three-layer type
Nb_3Sb	0.2	$\text{L1}_2\text{-tP32 (Ti}_3\text{P)}$
$\text{Nb}_3\text{Sb}_{0-0.7}\text{Sn}_{1-0.3}$	6.8—18	A15
NbSe_2	5.15—5.62	Hexagonal
$\text{Nb}_{1-1.05}\text{Se}_2$	2.2—7.0	Same
Nb_3Se_4	2.0	hP14
Nb_3Si	1.5	L1_2
$\text{Nb}_3\text{SiSnV}_3$	4.0	
NbSn_2	2.60	Orthorhombic
Nb_6Sn_5	2.8	$\text{oI44 (Sn}_5\text{Ti}_6)$
NbSnTaV	6.2	A15
NbSnV_2	5.5	A15
Nb_2SnV	9.8	A15
$\text{Nb}_x\text{Ta}_{1-x}$	4.4—9.2	A2
Nb_3Te_4	1.8	hP14
$\text{Nb}_x\text{Ti}_{1-x}$	0.6—9.8	
$\text{Nb}_{0.6}\text{Ti}_{0.4}$	9.8	
$\text{Nb}_x\text{U}_{1-x}$	1.95 (max.)	
$\text{Nb}_{0.88}\text{V}_{0.12}$	5.7	A2

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
Nb _{0.5} V _{1.5} Zr	4.3	C15-hP12 (MgZn ₂)
Ni _{0.3} Th _{0.7}	1.98	D10 ₂
NiZr ₂	1.52	
Ni _{0.1} Zr _{0.9}	1.5	A3
O ₃ Rb _{0.27-0.29} W	1.98	Hexagonal
OSn	3.81	tP4 (PbO)
O ₃ SrTi (n = 1.7—12.0 × 10 ¹⁹)	0.12—0.37	
O ₃ SrTi (n = 10 ¹⁸ —10 ²¹)	0.05—0.47	
O ₃ SrTi (n = 10 ²⁰)	0.47	
O ₃ Sr _{0.08} W	2—4	Hexagonal
OTi	0.58	
O ₃ Tl _{0.30} W	2.0—2.14	Hexagonal
OV ₃ Zr ₃	7.5	E9 ₃
OW ₃ (film)	3.35; 1.1	A15
OsPt _i	1.2	C22-hP9 (Fe ₂ P)
OsPZr	7.4	Same
OsReY	2.0	C14
Os ₂ Sc	4.6	C14
OsTa	1.95	A12
Os ₃ Th ₇	1.51	D10 ₂
Os _x W _{1-x}	0.9—4.1	
OsW ₃	~3	
Os ₂ Y	4.7	C14
Os ₂ Zr	3.0	C14
Os _x Zr _{1-x}	1.5—5.6	
PPb	7.8	
OsW ₂	3.81	D8 _b -tP30 (FeCr)
PPd _{3.0-3.2}	<0.35—0.7	DO ₁₁
P ₃ Pd ₇ (high temperature)	1.0	Rhombohedral
P ₃ Pd ₇ (low temperature)	0.70	Complex
PRh	1.22	
PRh ₂	1.3	C1
P ₄ Rh ₅	1.22	oP28 (CaFe ₂ O ₄)
PRhTa	4.41	C37-oP12 (Co ₂ Si)
PRhZr	1.55	Same
PRuTi	1.3	C22-hP9 (Fe ₂ P)
PRuZr	3.46	C37-oP12
PW ₃	2.26	DO _e
Pb ₂ Pd	2.95	C16
Pb ₄ Pt	2.80	Related to C16
Pb ₂ Rh	2.66	C16
PbSb	6.6	
PbTe (plus 0.1 w/o Pb)	5.19	
PbTe (plus 0.1 w/o Te)	5.24—5.27	
PbTl _{0.27}	6.43	
PbTl _{0.17}	6.73	
PbTl _{0.12}	6.88	
PbTl _{0.075}	6.98	
PbTl _{0.04}	7.06	
Pb _{1-0.26} Tl _{0-0.74}	7.20—3.68	
PbTl ₂	3.75—4.1	
Pb ₃ Zr ₅	4.60	D8 ₈
PbZr ₃	0.76	A15
Pd _{0.9} Pt _{0.1} Te ₂	1.65	C6
Pd _{0.05} Ru _{0.05} Zr _{0.9}	~9	

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
Pd _{2.2} S (quenched)	1.63	Cubic
PdSb ₂	1.25	C2
PdSb	1.5	B8 ₁
PdSbSe	1.0	C2
PdSbTe	1.2	C2
Pd ₄ Se	0.42	Tetragonal
Pd ₆₋₇ Se	0.66	Like Pd ₄ Te
Pd _{2.8} Se	2.3	
Pd _x Se _{1-x}	2.5 (max.)	
PdSi	0.93	B31
PdSn	0.41	B31
PdSn ₂	3.34	
Pd ₂ Sn	0.41	C37
Pd ₃ Sn	0.47—0.64	B8 ₂
Pd ₂ SnTm	1.77	DO ₃ -cF16 (BiF ₃)
Pd ₂ SnY	4.92	Same
Pd ₂ SnYb	1.79	Same
PdTe	2.3; 3.85	B8 ₁
PdTe _{1.02—1.08}	2.56—1.88	B8 ₁
PdTe ₂	1.69	C6
PdTe _{2.1}	1.89	C6
PdTe _{2.3}	1.85	C6
Pd _{1.1} Te	4.07	B8 ₁
Pd ₃ Te	0.76	cI2 (W)
PdTh ₂	0.85	C16
Pd _{0.1} Zr _{0.9}	7.5	A3
PtSb	2.1	B8 ₁
PtSi	0.88	B31
PtSn	0.37	B8 ₁
PtSn ₄	2.38	C16-oC20 (PdSn ₄)
Pt ₃ Ta ₇	1.5	D8 _b -tP30
PtTa ₃	0.4	A15-cP8 (Cr ₃ Si)
PtTe	0.59	Orthorhombic
PtTh	0.44	B _f
Pt ₅ Th ₇	0.98	D10 ₂
Pt ₅ Th	3.13	
PtTi ₃	0.58	A15
Pt _{0.02} U _{0.98}	0.87	β-phase
PtV _{2.5}	1.36	A15
PtV ₃	2.87—3.20	A15
PtV _{3.5}	1.26	A15
Pt _{0.5} W _{0.5}	1.45	A1
Pt _x W _{1-x}	0.4—2.7	
Pt ₂ Y ₃	0.90	
Pt ₂ Y	1.57; 1.70	C15
Pt ₃ Y ₇	0.82	D10 ₂
PtZr	3.0	A3
Re ₂ Sc	4.2	C15-hP12 (MgZn ₂)
Re ₂₄ Sc ₅	2.2	A12-cI58 (Mg)
ReSiTa	4.4	oI36 (FeTiSi)
Re ₃ Si ₅ Y ₂	1.76	tP40 (Fe ₃ Sc ₂ Si ₅)
Re ₃ Ta ₂	1.4	D8 _b -tP30 (FeCr)
Re _{0.64} Ta _{0.36}	1.46	A12
Re ₃ Ta	6.78	A12-cI58 (Mn)
Re ₂₄ Ti ₅	6.60	A12

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
$\text{Re}_x\text{Ti}_{1-x}$	6.6 (max.)	
$\text{Re}_{0.76}\text{V}_{0.24}$	4.52	D8 _b
Re_3V	6.26	D8 _b -tP30
$\text{Re}_{0.92}\text{V}_{0.08}$	6.8	A3
$\text{Re}_{0.6}\text{W}_{0.4}$	6.0	
$\text{Re}_{0.5}\text{W}_{0.5}$	5.12	D8 _b
$\text{Re}_{13}\text{W}_{12}$	5.2	D8 _b -tP30
Re_3W	9.0	A12-cl58
Re_2Y	1.83	C14
Re_2Zr	5.9	C14
Re_3Zr	7.40	A12-cl58
Re_6Zr	7.40	Same
$\text{Rh}_{17}\text{S}_{15}$	5.8	Cubic
$\text{Rh}_{-0.24}\text{Sc}_{-0.76}$	0.88; 0.92	
$\text{Rh}_4\text{Sc}_5\text{Si}_{10}$	8.54	tP38
$\text{Rh}_4\text{Sc}_3\text{Sn}_{13}$	4.5	cP40
$\text{Rh}_x\text{Se}_{1-x}$	6.0 (max.)	
RhSi_3Th	1.76	tI10
$\text{Rh}_{0.86}\text{Sc}_{1.04}\text{Th}$	6.45	tI12
$\text{Rh}_2\text{Si}_2\text{Y}$	3.11	tI10
$\text{Rh}_3\text{Si}_5\text{Y}_2$	2.70	oI40
$\text{Rh}_4\text{Sn}_{13}\text{Sr}_3$	4.3	cP40
$\text{Rh}_x\text{Sn}_y\text{Th}$	1.9	cI2 (W)
$\text{Rh}_x\text{Sn}_y\text{Th}$	2.3	cP40
$\text{Rh}_4\text{Sn}_{13}\text{Y}_3$	3.2	cP40
Rh_2Sr	6.2	C15
$\text{Rh}_{0.4}\text{Ta}_{0.6}$	2.35	D8 _b
RhTe_2	1.51	C2
$\text{Rh}_{0.67}\text{Te}_{0.33}$	0.49	
$\text{Rh}_x\text{Te}_{1-x}$	1.51 (max.)	
RhTh	0.36	B _f
Rh_3Th_7	2.15	D10 ₂
Rh_5Th	1.07	
$\text{Rh}_x\text{Ti}_{1-x}$	2.25—3.95	
$\text{Rh}_{0.02}\text{U}_{0.98}$	0.96	
RhV_3	0.38	A15
RhW	~3.4	A3
RhY_3	0.65	
Rh_2Y_3	1.48	
Rh_3Y	1.07	C15
Rh_5Y	0.56	
Rh_3Y_7	0.32	hP20 (Fe ₃ Th ₇)
$\text{Rh}_{0.005}\text{Zr}$ (annealed)	5.8	
$\text{Rh}_{-0.45}\text{Zr}_{1-0.55}$	2.1—10.8	
$\text{Rh}_{0.1}\text{Zr}_{0.9}$	9.0	H.C.P.
Ru_2Sc	1.67	C14
RuSiTa	3.15	oI36
$\text{Ru}_3\text{Si}_2\text{Th}$	3.98	hP12
$\text{Ru}_3\text{Si}_2\text{Y}$	3.51	hP12
$\text{Ru}_{1.1}\text{Sn}_{3.1}\text{Y}$	1.3	cP40
Ru_2Th	3.56	C15
RuTi	1.07	B2
$\text{Ru}_{0.05}\text{Ti}_{0.95}$	2.5	
$\text{Ru}_{0.1}\text{Ti}_{0.9}$	3.5	
$\text{Ru}_x\text{Ti}_{0.6}\text{V}_y$	6.6 (max.)	

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
Ru ₃ U	0.15	L1 ₂ -cP4
Ru _{0.45} V _{0.55}	4.0	B2
RuW	7.5	A3
Ru ₂ Y	1.52	C14
Ru ₂ Zr	1.84	C14
Ru _{0.1} Zr _{0.9}	5.7	A3
STh	0.5	B1-cF8 (NaCl)
SbSn	1.30—1.42	B1 or distorted
SbTa ₃	0.72	A15-cP8 (Cr ₃ Si)
SbTi ₃	5.8	Same
Sb ₂ Ti ₇	5.2	
Sb _{0.01—0.03} V _{0.99—0.97}	3.76—2.63	A2
SbV ₃	0.80	A15
SeTh	1.7	B1-cF8
SiMo ₃	1.4	A15-cP8
Si ₂ Th	3.2	C _c , α-phase
Si ₂ Th	2.4	C32, β-phase
SiV _{2.7} Ru _{0.3}	2.9	A15
Si ₂ W ₃	2.8; 2.84	
SiZr ₃	0.5	L1 ₂ -tP32 (Ti ₃ P)
Sn _{0.174—0.104} Ta _{0.826—0.896}	6.5—< 4.2	A15
SnTa ₃	8.35	A15, highly ordered
SnTa ₃	6.2	A15, partially ordered
SnTaV ₂	2.8	A15
SnTa ₂ V	3.7	A15
Sn _x Te _{1-x} (n = 10.5—20 × 10 ²⁰)	0.07—0.22	B1
Sn ₃ Th	3.33	L1 ₂ -cP4
SnTi ₃	5.80	A15-cP8
Sn _x Tl _{1-x}	2.37—5.2	
SnV ₃	3.8	A15
Sn _{0.02—0.057} V _{0.98—0.943}	2.87—~1.6	A2
SnZr ₃	0.92	A15-cP8
Ta _{0.025} Ti _{0.975}	1.3	Hexagonal
Ta _{0.05} Ti _{0.95}	2.9	Hexagonal
Ta _{0.05—0.75} V _{0.95—0.25}	4.30—2.65	A2
Ta _{0.8—1} W _{0.2—0}	1.2—4.4	A2
Tc _{0.1—0.4} W _{0.9—0.6}	1.25—7.18	Cubic
Tc _{0.50} W _{0.50}	7.52	α plus
Tc _{0.60} W _{0.40}	7.88	plus α
Tc ₆ Zr	9.7	A12
TeY	1.02	B1-cF8
ThTl ₃	0.87	L1 ₂ -cP4
Th _{0—0.55} Y _{1—0.45}	1.2—1.8	
Ti _{0.70} V _{0.30}	6.14	Cubic
Ti _x V _{1-x}	0.2—7.5	
Ti _{0.5} Zr _{0.5} (annealed)	1.23	
Ti _{0.5} Zr _{0.5} (quenched)	2.0	
Tl ₃ Y	1.52	L1 ₂ -cP4
V ₂ Zr	8.80	C15
V _{0.26} Zr _{0.74}	5.9	
W ₂ Zr	2.16	C15
YZn	0.33	B2-cP2 (CsCl)

* n denotes current carriers concentration in cm⁻³.

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

B. SUPERCONDUCTORS WITH $T_c > 10K$

Substance	T_c, K	Crystal structure type
Al_2CMo_3	10.0	A13
$Al_{0.5}Ge_{0.5}Nb$	12.6	A15
$Al_{-0.8}Ge_{-0.2}Nb_3$	20.7	A15
$AlNb_3$	18.0	A15 (Cr ₃ Si)
$AlNb_3$	12.0	(FeCr)
Al_xNb_{1-x}	<4.2—13.5	D8 _b
Al_xNb_{1-x}	12—17.5	A15
$Al_{0.27}Nb_{0.73-0.48}V_{0-0.25}$	14.5—17.5	A15
$AlNb_xV_{1-x}$	4.4—13.5	
$Al_{0.1}Si_{0.9}V_3$	14.05	
AlV_3	11.8	A15 (Cr ₃ Si)
$AuNb_3$	11.5	A15
$Au_{0-0.3}Nb_{1-0.7}$	1.1—11.0	
$Au_{0.02-0.98}Nb_3Rh_{0.98-0.02}$	2.53—10.9	A15
$AuNb_{3(1-x)}V_{3x}$	1.5—11.0	A15
$B_{0.03}C_{0.51}Mo_{0.47}$	12.5	
B_4LuRh_4	11.7	(B ₄ CeCo ₄)
B_2LuRu	10	
B_4Rh_4Y	11.3	(B ₄ CeCo ₄)
$B_{0.1}Si_{0.9}V_3$	15.8	A15
$BaBi_{0.2}O_3Pb_{0.8}$	13.2	
$Ba_2CaCu_2O_8Tl_2$	120	
$Ba_2Cu_3LaO_6$	80	
$Ba_2Cu_3O_7Tm$	101	
$Ba_2Cu_3O_7Y$	90	
$(Ba,La)_2CuO_4$	36	A15 (K ₂ NiF ₄)
$Bi_2CaCu_2O_8Sr_2$	110	
$Br_2Mo_6S_6$	13.8	(Mo ₆ PbS ₈)
C_3La	11.0	(C ₃ Pu ₂)
CMo	14.3	B1 (NaCl)
CMo_2	12.2	O**
$C_{0.5}MoNb_{1-x}$	10.8—12.5	B1
CMo_xTi_{1-x}	10.2(max)	B1
$CMo_{0.83}Ti_{0.17}$	10.2	B1
$C_{0-0.38}N_{1-0.62}Ta$	10.0—11.3	
CNb (whiskers)	7.5—10.5	
CNb	11.5	B1
$C_{0.7-1.0}Nb_{0.3-0}$	6—11	B1
CNb_xTa_{1-x}	8.2—13.9	
$CNb_{0.6-0.9}W_{0.4-0.1}$	12.5—11.6	B1
$C_{0.1}Si_{0.9}V_3$	16.4	A15
CTa	10.3	B1
$CTa_{1-0.4}W_{0-0.6}$	8.5—10.5	B1
$C_{0.66}Th_{0.13}Y_{0.21}$	17	(C ₃ Pu ₂)
C_3Y_2	11.5	(C ₃ Pu ₂)
CW	10	B1
$(Ca,La)_2CuO_4$	18	(K ₂ NiF ₄)
$Cu(La,Sr)_2O_4$	39	
$Cu_{1.8}Mo_6S_8$	10.8	(Mo ₆ PbS ₈)
$Cr_{0.3}Si_{2.7}$	11.3	A15
$GaNb_3$	14.5	A15 (Cr ₃ Si)
$Ga_xNb_3Sn_{1-x}$	14—18.37	A15

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c, K	Crystal structure type
GaV ₃	16.8	A15
GaV _{2.1-3.5}	6.3—14.45	A15
GeNb ₃	23.2	A15
GeNb ₃ (quenched)	6—17	A15
Ge _x Nb ₃ Sn _{1-x}	17.6—18.0	A15
Ge _{0.5} Nb ₃ Sn _{0.5}	11.3	
Ge _{0.1} Si _{0.9} V ₃	14.0	A15
GeV ₃	11	A15
InLa ₃	9.83; 10.4	LI ₂ (AuCu ₃)
InLa ₃ (0—35 kbar)	9.75—10.55	
In _{0-0.3} Nb ₃ Sn _{1-0.7}	18.0—18.19	A15
InV ₃	13.9	A15
Ir _{0.4} Nb _{0.6}	10	(FeCr)
LaMo ₆ Se ₈	11.4	(Mo ₆ PbS ₈)
LiO ₄ Ti ₂	13.7	(Al ₁₂ MgO ₄)
MoN	12; 14.8	h*
Mo ₃ Os	12.7	A15
Mo ₆ Pb _{0.9} S _{7.5}	15.2	(Mo ₆ PbS ₈)
Mo ₃ Re	10.0; 15	A15
Mo _x Re _{1-x}	1.2—12.2	
Mo _{0.55} Re _{0.48}	11.1	
Mo _{0.57} Re _{0.43}	14.0	
Mo _{-0.60} Re _{0.395}	10.6	
MoRu	9.5—10.5	A3
Mo ₃ Ru	10.6	A15
Mo ₆ Se ₈ Tl	12.2	(Mo ₆ PbS ₈)
Mo _{0.3} SiV _{2.7}	11.7	A15
Mn ₃ Si	12.5	A15
Mo ₃ Tc	15	A15
Mo _{0.3} Tc _{0.7}	12.0	A15
Mo _x Tc _{1-x}	10.8—15.8	
MoTc ₃	15.8	
NNb (whiskers)	10—14.5	
NNb (diffusion wires)	16.10	
N _{0.988} Nb	14.9; 17.3	B1
N _{0.824-0.988} Nb	14.4—15.3	B1
N _{0.7-0.795} Nb	11.3—12.9	
NNb _x O _y	13.5—17.0	B1
NNb _x O _y	6.0—11	
N _{100-42w/o} Nb _{0-58w/o} Ti	15—16.8	
N _{100-75w/o} Nb _{0-25w/o} Zr	12.5—16.35	
NNb _x Zr _{1-x}	9.8—13.8	B1
N _{0.93} Nb _{0.85} Zr _{0.15}	13.8	B1
NTa	12—14	B1
NZr	10.7	B1
Nb ₃ Pt	10.9	A15
Nb _{0.18} Re _{0.82}	10	(Mn)
Nb ₃ Si	19	A15
Nb _{0.3} SiV _{2.7}	12.8	A15
Nb ₃ Sn	18.05	A15
Nb _{0.8} Sn _{0.2}	18.18; 18.5	A15
Nb _x Sn _{1-x} (film)	2.6—18.5	o*
Nb ₃ Sn ₂	16.6	t*
NbSnTa ₂	10.8	A15
Nb ₂ SnTa	16.4	A15

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 4
Superconductive Compounds and Alloys (continued)

Substance	T_c , K	Crystal structure type
$Nb_{2.5}SnTa_{0.5}$	17.6	A15
$Nb_{2.75}SnTa_{0.25}$	17.8	A15
$Nb_{3x}SnTa_{3(1-x)}$	6.0—18.0	
$Nb_2SnTa_{0.5}V_{0.5}$	12.2	A15
$NbTc_3$	10.5	A12
$Nb_{0.75}Zr_{0.25}$	10.8	
$Nb_{0.66}Zr_{0.33}$	10.8	
$PbTa_3$	17	A15
$RhTa_3$	10	A15
$RhZr_2$	10.8; 11.3	C16 (A1 ₂ Cu)
$Rh_{0-0.45}Zr_{1-0.55}$	2.1—10.8	
$SiTi_{0.3}V_{2.7}$	10.9	A15
SiV_3	17.1	A15
$SiV_{2.7}Zr_{0.3}$	13.2	A15

TABLE 5
Critical Field Data

Substance	H_o oersteds	Substance	H_o oersteds
Ag_2F	2.5	InSb	1100
Ag_7NO_{11}	57	In_xTl_{1-x}	252—284
Al_2CMo_3	1700	$In_{0.8}Tl_{0.2}$	252
$BaBi_3$	740	$Mg_{0.47}Tl_{0.53}$	220
Bi_2Pt	10	$Mo_{0.16}Ti_{0.84}$	<985
Bi_3Sr	530	$NbSn_2$	620
Bi_5Tl_3	>400	$PbTl_{0.27}$	756
$CdSn$	>266	$PbTl_{0.17}$	796
$CoSi_2$	105	$PbTl_{0.12}$	849
$Cr_{0.1}Ti_{0.3}V_{0.6}$	1360	$PbTl_{0.075}$	880
$In_{1-0.86}Mg_{0-0.14}$	272.4—259.2	$PbTl_{0.04}$	864

TABLE 6
High Critical Magnetic-Field Superconductive Compounds and Alloys

Substance	T_c , K	H_{c1} , kOe	H_{c2} , kOe	H_{c3} , kOe	T_{obs} , K ^a
Al_2CMo_3	9.8—10.2	0.091	156		1.2
$AlNb_3$		0.375			
$Ba_xO_3Sr_{1-x}Ti$	<0.1—0.55	0.0039 max.			
$Bi_{0.5}Cd_{0.1}Pb_{0.27}Sn_{0.13}$			>24		3.06
Bi_xPb_{1-x}	7.35—8.4	0.122 max.	30 max.		4.2
$Bi_{0.56}Pb_{0.44}$	8.8		15		4.2
$Bi_{7.5w/0}Pb_{92.5w/0}$ ^b			2.32		
$Bi_{0.099}Pb_{0.901}$		0.29	2.8		
$Bi_{0.02}Pb_{0.98}$		0.46	0.73		
$Bi_{0.53}Pb_{0.32}Sn_{0.16}$			>25		3.06
$Bi_{1-0.93}Sn_{0-0.07}$			0—0.032		3.7
Bi_5Tl_3	6.4		>5.6		3.35
C_8K (excess K)	0.55		0.160 (H⊥c)		0.32
			0.730 (H||c)		0.32

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 6
High Critical Magnetic-Field Superconductive Compounds and Alloys (continued)

Substance	T_c , K	H_{c1} , kOe	H_{c2} , kOe	H_{c3} , kOe	T_{obs} , K ^a
C ₈ K	0.39		0.025 (H||c) 0.250 (H_⊥|c)		0.32 0.32
C _{0.44} Mo _{0.56}	12.5—13.5	0.087	98.5		1.2
CNb	8—10	0.12	16.9		4.2
CNb _{0.4} Ta _{0.6}	10—13.6	0.19	14.1		1.2
CTa	9—11.4	0.22	4.6		1.2
Ca _x O ₃ Sr _{1-x} Ti	<0.1—0.55	0.002—0.004			
Cd _{0.1} Hg _{0.9} (by weight)		0.23	0.34		2.04
Cd _{0.05} Hg _{0.95}		0.28	0.31		2.16
Cr _{0.10} Ti _{0.30} V _{0.60}	5.6	0.071	84.4		0
GaN	5.85	0.725			4.2
Ga _x Nb _{1-x}			>28		4.2
GaSb (annealed)	4.24		2.64		3.5
GaV _{1.95}	5.3		73 ^e		
GaV _{2.1-3.5}	6.3—14.45		230—300 ^d		0
GaV ₃		0.4	350 ^e 500 ^d		0
GaV _{4.5}	9.15		121 ^e		0
Hf _x Nb _y			>52—>102		1.2
Hf _x Ta _y			>28—>86		1.2
Hg _{0.05} Pb _{0.95}		0.235	2.3		
Hg _{0.101} Pb _{0.899}		0.23	4.3		4.2
Hg _{0.15} Pb _{0.85}	6.75		>13		2.93
In _{0.98} Pb _{0.02}	3.45	0.1		0.12	2.76
In _{0.96} Pb _{0.04}	3.68	0.1	0.12	0.25	2.94
In _{0.94} Pb _{0.06}	3.90	0.095	0.18	0.35	3.12
In _{0.913} Pb _{0.087}	4.2	~10.17	0.55	2.65	
In _{0.316} Pb _{0.684}		0.155	3.7		4.2
In _{0.17} Pb _{0.83}			2.8	5.5	4.2
In _{1.000} Te _{1.002}	3.5—3.7		1.2 ^c		0
In _{0.95} Tl _{0.05}		0.263	0.263		3.3
In _{0.90} Tl _{0.10}		0.257	0.257		3.25
In _{0.83} Tl _{0.17}		0.242	0.39		3.21
In _{0.75} Tl _{0.25}		0.216	0.50		3.16
LaN	1.35	0.45			0.76
La ₃ S ₄	6.5	≈0.15	>25		1.3
La ₃ Se ₄	8.6	≈0.2	>25		1.25
Mo _{0.52} Re _{0.48}	11.1		14—21 18—28	22—33 37—43	4.2 1.3
Mo _{0.6} Re _{0.395}	10.6		14—20 19—26	20—37 26—37	4.2 1.3
Mo _{0.5} Ti _{0.5}			75 ^c		0
Mo _{0.16} Ti _{0.84}	4.18	0.028	98.7 ^c 36—38		0 3.0
Mo _{0.913} Ti _{0.087}	2.95	0.060	15		4.2
Mo _{0.1-0.3} U _{0.9-0.7}	1.85—2.06		>25		
Mo _{0.17} Zr _{0.83}			30		
N _(12.8 w/o) Nb	15.2		>9.5		13.2
NNb (wires)	16.1		153 ^c 132 95 53 38		0 4.2 8 12
NNb _x O _{1-x}	13.5—17.0				

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 6
High Critical Magnetic-Field Superconductive Compounds and Alloys (continued)

Substance	T_c , K	H_{c1} , kOe	H_{c2} , kOe	H_{c3} , kOe	T_{obs} , K ^a
NNb _x Zr _{1-x}	9.8—13.8		4- >130		4.2
N _{0.93} Nb _{0.85} Zr _{0.15}	13.8		>130		4.2
Na _{0.086} Pb _{0.914}		0.19	6.0		
Na _{0.016} Pb _{0.984}		0.28	2.05		
Nb	9.15		2.020		1.4
			1.710		4.2
Nb		0.4—1.1	3—5.5		4.2
Nb (unstrained)		1.1—1.8	3.40	6—9.1	4.2
Nb (strained)		1.25—1.92	3.44	6.0—8.7	4.2
Nb (cold-drawn wire)		2.48	4.10	≈10	4.2
Nb (film)			>25		4.2
NbSc			>30		
Nb ₃ Sn		0.170	221		4.2
			70		14.15
			54		15
			34		16
			17		17
Nb _{0.1} Ta _{0.9}		0.084	0.154		4.195
Nb _{0.2} Ta _{0.8}			10		4.2
Nb _{0.65-0.73} Ta _{0.02-0.10} Zr _{0.25}			>70—>90		4.2
Nb _x Ti _{1-x}			148 max.		1.2
			120 max.		4.2
Nb _{0.222} U _{0.778}		1.98	23		1.2
Nb _x Zr _{1-x}			127 max.		1.2
			94 max.		4.2
O ₃ SrTi	0.43	0.0049 ^c	0.504 ^c		0
O ₃ SrTi	0.33	0.00195 ^c	0.420 ^c		0
PbSb _{1 w/o} (quenched)			>1.5		4.2
PbSb _{1 w/o} (annealed)			>0.7		4.2
PbSb _{2.8 w/o} (quenched)			>2.3		4.2
PbSb _{2.8 w/o} (annealed)			>0.7		4.2
Pb _{0.871} Sn _{0.129}		0.45	1.1		
Pb _{0.965} Sn _{0.035}		0.53	0.56		
Pb _{1-0.26} Tl _{0-0.74}	7.20—3.68		2—6.9 ^c		0
PbTl _{0.17}	6.73		4.5 ^c		0
Re _{0.26} W _{0.74}			>30		
Sb _{0.93} Sn _{0.07}			0.12		3.7
SiV ₃	17.0	0.55	156 ^c		
Sn _x Te _{1-x}		0.00043—0.00236	0.005—0.0775		0.012—0.079
Ta (99.95%)		0.425	1.850		1.3
		0.325	1.425		2.27
		0.275	1.175		2.66
		0.090	0.375		3.72
			3.55		4.2
Ta _{0.5} Nb _{0.5}			>14—138		1.2
Ta _{0.65-0} Ti _{0.35-1}	4.4—7.8				1.2
Ta _{0.5} Ti _{0.5}			138		1.2
Te	3.3	0.25 ^c			0
Tc _x W _{1-x}	5.75—7.88		8—44		4.2
Ti				2.7	4.2
Ti _{0.75} V _{0.25}	5.3	0.029 ^c	199 ^c		0
Ti _{0.775} V _{0.225}	4.7	0.024 ^c	172 ^c		0
Ti _{0.615} V _{0.385}	7.07	0.050	34		4.2
Ti _{0.516} V _{0.484}	7.20	0.062	28		4.2
Ti _{0.415} V _{0.585}	7.49	0.078	25		4.2

PROPERTIES OF SUPERCONDUCTORS (continued)

TABLE 6
High Critical Magnetic-Field Superconductive Compounds and Alloys (continued)

Substance	T_c , K	H_{c1} , kOe	H_{c2} , kOe	H_{c3} , kOe	T_{obs} , K ^a
Ti _{0.12} V _{0.88}			17.3	28.1	4.2
Ti _{0.09} V _{0.91}			14.3	16.4	4.2
Ti _{0.06} V _{0.94}			8.2	12.7	4.2
Ti _{0.03} V _{0.97}			3.8	6.8	4.2
Ti _x V _{1-x}			108 max.		1.2
V	5.31	0.8	3.4		1.79
		0.75	3.15		2
		0.45	2.2		3
		0.30	1.2		4
V _{0.26} Zr _{0.74}	≈5.9	0.238			1.05
		0.227			1.78
		0.185			3.04
		0.165			3.5
W (film)	1.7—4.1		>34		1

^a Temperature of critical field measurement.

^b w/o denotes weight percent.

^c Extrapolated.

^d Linear extrapolation.

^e Parabolic extrapolation.

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HIGH TEMPERATURE SUPERCONDUCTORS

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The following tables give properties of a number of high temperature superconductors. Table 1 lists the crystal structure (space group and lattice constants) and the critical transition temperature T_c for the more important high temperature superconductors so far studied. Table 2 gives energy gap, critical current density, and penetration depth in the superconducting state. Table 3 gives electrical and thermal properties of some of these materials in the normal state. The tables were prepared in November 1992 and updated in November 1994.

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Table 1
Structural Parameters and Approximate T_c Values of High-Temperature Superconductors

Material	Structure	T_c /K (maximum value)
$\text{La}_2\text{CuO}_{4+\delta}$	Bmab; $a = 5.355$, $b = 5.401$, $c = 13.15$ Å	39
$\text{La}_{2-x}\text{Sr}_x(\text{Ba}_y)\text{CuO}_4$	I4/mmm; $a = 3.779$, $c = 13.23$ Å	35
$\text{La}_2\text{Ca}_{1-x}\text{Sr}_x\text{Cu}_2\text{O}_6$	I4/mmm; $a = 3.825$, $c = 19.42$ Å	60
$\text{YBa}_2\text{Cu}_3\text{O}_7$	Pmmm; $a = 3.821$, $b = 3.885$, $c = 11.676$ Å	93
$\text{YBa}_2\text{Cu}_4\text{O}_8$	Ammm; $a = 3.84$, $b = 3.87$, $c = 27.24$ Å	80
$\text{Y}_2\text{Ba}_4\text{Cu}_7\text{O}_{15}$	Ammm; $a = 3.851$, $b = 3.869$, $c = 50.29$ Å	93
$\text{Bi}_2\text{Sr}_2\text{CuO}_6$	Amaa; $a = 5.362$, $b = 5.374$, $c = 24.622$ Å	10
$\text{Bi}_2\text{CaSr}_2\text{Cu}_2\text{O}_8$	A_2aa ; $a = 5.409$, $b = 5.420$, $c = 30.93$ Å	92
$\text{Bi}_2\text{Ca}_2\text{Sr}_2\text{Cu}_3\text{O}_{10}$	A_2aa ; $a = 5.39$, $b = 5.40$, $c = 37$ Å	110
$\text{Bi}_2\text{Sr}_2(\text{Ln}_{1-x}\text{Ce}_x)_2\text{Cu}_2\text{O}_{10}$	P4/mmm; $a = 3.888$, $c = 17.28$ Å	25
$\text{Tl}_2\text{Ba}_2\text{CuO}_6$	A_2aa ; $a = 5.468$, $b = 5.472$, $c = 23.238$ Å; I4/mmm; $a = 3.866$, $c = 23.239$ Å	92
$\text{Tl}_2\text{CaBa}_2\text{Cu}_2\text{O}_8$	I4/mmm; $a = 3.855$, $c = 29.318$ Å	119
$\text{Tl}_2\text{Ca}_2\text{Ba}_2\text{Cu}_3\text{O}_{10}$	I4/mmm; $a = 3.85$, $c = 35.9$ Å	128
$\text{Tl}(\text{BaLa})\text{CuO}_5$	P4/mmm; $a = 3.83$, $c = 9.55$ Å	40
$\text{Tl}(\text{SrLa})\text{CuO}_5$	P4/mmm; $a = 3.7$, $c = 9$ Å	40
$(\text{Tl}_{0.5}\text{Pb}_{0.5})\text{Sr}_2\text{CuO}_5$	P4/mmm; $a = 3.738$, $c = 9.01$ Å	40
$\text{TlCaBa}_2\text{Cu}_2\text{O}_7$	P4/mmm; $a = 3.856$, $c = 12.754$ Å	103
$(\text{Tl}_{0.5}\text{Pb}_{0.5})\text{CaSr}_2\text{Cu}_2\text{O}_7$	P4/mmm; $a = 3.80$, $c = 12.05$ Å	90
$\text{TlSr}_2\text{Y}_{0.5}\text{Ca}_{0.5}\text{Cu}_2\text{O}_7$	P4/mmm; $a = 3.80$, $c = 12.10$ Å	90
$\text{TlCa}_2\text{Ba}_2\text{Cu}_3\text{O}_8$	P4/mmm; $a = 3.853$, $c = 15.913$ Å	110
$(\text{Tl}_{0.5}\text{Pb}_{0.5})\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_9$	P4/mmm; $a = 3.81$, $c = 15.23$ Å	120
$\text{TlBa}_2(\text{La}_{1-x}\text{Ce}_x)_2\text{Cu}_2\text{O}_9$	I4/mmm; $a = 3.8$, $c = 29.5$ Å	40
$\text{Pb}_2\text{Sr}_2\text{La}_{0.5}\text{Ca}_{0.5}\text{Cu}_3\text{O}_8$	Cmmm; $a = 5.435$, $b = 5.463$, $c = 15.817$ Å	70
$\text{Pb}_2(\text{Sr},\text{La})_2\text{Cu}_2\text{O}_6$	P22 ₁ 2; $a = 5.333$, $b = 5.421$, $c = 12.609$ Å	32
$(\text{Pb},\text{Cu})\text{Sr}_2(\text{La},\text{Ca})\text{Cu}_2\text{O}_7$	P4/mmm; $a = 3.820$, $c = 11.826$ Å	50
$(\text{Pb},\text{Cu})(\text{Sr},\text{Eu})(\text{Eu},\text{Ce})\text{Cu}_2\text{O}_x$	I4/mmm; $a = 3.837$, $c = 29.01$ Å	25
$\text{Nd}_{2-x}\text{Ce}_x\text{CuO}_4$	I4/mmm; $a = 3.95$, $c = 12.07$ Å	30
$\text{Ca}_{1-x}\text{Sr}_x\text{CuO}_2$	P4/mmm; $a = 3.902$, $c = 3.35$ Å	110
$\text{Sr}_{1-x}\text{Nd}_x\text{CuO}_2$	P4/mmm; $a = 3.942$, $c = 3.393$ Å	40
$\text{Ba}_{0.6}\text{K}_{0.4}\text{BiO}_3$	Pm3m; $a = 4.287$ Å	31
$\text{Rb}_2\text{CsCu}_6\text{O}_{60}$	$a = 14.493$ Å	31
$\text{NdBa}_2\text{Cu}_3\text{O}_7$	Pmmm; $a = 3.878$, $b = 3.913$, $c = 11.753$	58

HIGH TEMPERATURE SUPERCONDUCTORS (continued)

Table 1
Structural Parameters and Approximate T_c Values of High-Temperature Superconductors
(continued)

Material	Structure	T_c /K (maximum value)
SmBaSrCu ₃ O ₇	I4/mmm; $a = 3.854, c = 11.62$	84
EuBaSrCu ₃ O ₇	I4/mmm; $a = 3.845, c = 11.59$	88
GdBaSrCu ₃ O ₇	I4/mmm; $a = 3.849, c = 11.53$	86
DyBaSrCu ₃ O ₇	Pmmm; $a = 3.802, b = 3.850, c = 11.56$	90
HoBaSrCu ₃ O ₇	Pmmm; $a = 3.794, b = 3.849, c = 11.55$	87
ErBaSrCu ₃ O ₇ (multiphase)	Pmmm; $a = 3.787, b = 3.846, c = 11.54$	82
TmBaSrCu ₃ O ₇ (multiphase)	Pmmm; $a = 3.784, b = 3.849, c = 11.55$	88
YBaSrCu ₃ O ₇	Pmmm; $a = 3.803, b = 3.842, c = 11.54$	84
HgBa ₂ CuO ₄	I4/mmm; $a = 3.878, c = 9.507$	94
HgBa ₂ CaCu ₂ O ₆ (annealed in O ₂)	I4/mmm; $a = 3.862, c = 12.705$	127
HgBa ₂ Ca ₂ Cu ₃ O ₈	Pmmm; $a = 3.85, c = 15.85$	133
HgBa ₂ Ca ₃ Cu ₄ O ₁₀	Pmmm; $a = 3.854, c = 19.008$	126

Table 2
Superconducting Properties

$J_c(0)$: Critical current density extrapolated to 0 K

λ_{ab} : Penetration depth in a - b plane

k_B : Boltzmann constant

Material	Form	Energy gap (Δ)		$10^{-6} \times J_c(0)/A\text{ cm}^{-2}$	$\lambda_{ab}/\text{\AA}$
		$2\Delta_{pp}/k_B T_c^*$	$2\Delta_{fit}/k_B T_c^\dagger$		
Y Ba ₂ Cu ₃ O ₇	Single Crystal	5–6	4–5	30 (film)	1400
Bi ₂ Sr ₂ CaCu ₂ O ₈	Single Crystal	8–9	5.5–6.5	2	2700
Tl ₂ Ba ₃ CaCu ₂ O ₈	Ceramic	6–7	4–6	10 (film, 80 K)	2000
La _{2-x} Sr _x CuO ₄ , $x = 0.15$	Ceramic	7–9	4–6		
Nd _{2-x} Ce _x CuO ₄	Ceramic	8	4–5	0.2 (film)	

* Obtained from peak to peak value.

† Obtained from fit to BCS-type relation.

Table 3
Normal State Properties

ρ_{ab} : Resistivity in the *a-b* plane
 ρ_c : Resistivity along the *c* axis
+ve: ρ_c has positive temperature coefficient of resistivity
-ve: ρ_c has negative temperature coefficient of resistivity
 n_H : Hall density
k: Thermal conductivity
in plane: Along *a-b* plane
out of plane: Perpendicular to *a-b* plane

12-89

Material	Form	$\rho_{ab}/\mu\Omega\text{cm}$		$\rho_c/\text{m}\Omega\text{cm}$	$d\rho_c/dT$	$10^{-21} \times n_H/\text{cm}^{-3}$		$k/(\text{mW}/\text{cm K})$ at 300 K	
		300 K	100 K	300 K		300 K	100 K	in plane	out of plane
YBa ₂ Cu ₃ O ₇	Single Crystal	110	35	5	+ve	11–16	4–6	120	3
	film	200–300	60–100			5–9	2–3		
YBa ₂ Cu ₄ O ₈	Single Crystal	75	20	10	-ve	14		60	8
	film	100–200	20–50			22	17		
Bi ₂ Sr ₂ CuO ₆	Single Crystal	300	150	5000	-ve	6	5	60	8
Bi ₂ Sr ₂ CaCu ₂ O ₈	Single Crystal	150	50	>1000	-ve	4	3		
Tl ₂ Ba ₂ CuO ₆	Single Crystal	300–400	50–75	200–300	+ve	3.1	2.5	50 (for <i>x</i> = 0.04)	20
Tl ₂ Ba ₂ Ca ₂ Cu ₃ O ₁₀	Ceramic	***	**				≈ 2*		
La _{2-x} Sr _x CuO ₄ , <i>x</i> = 0.12	Single Crystal	900	350	200	+ve for <i>T</i> > 225 K	2.5		50 (for <i>x</i> = 0.04)	20
La _{2-x} Sr _x CuO ₄ , <i>x</i> = 0.20	Single Crystal	400	200	80	+ve for <i>T</i> > 150 K	10			
Nd _{2-x} Ce _x CuO ₄ , <i>x</i> = 0.17	Single Crystal	500	275			8.4	6.3	250 (for <i>x</i> = 0.15)	
	film	400	160			53	17		
<i>x</i> = 0.15	film	140–180	35			32	11		

* At 200 K
** ρ ~0.4 m Ω cm at 120 K
*** ρ ~1.5 m Ω cm at 300 K

ORGANIC SUPERCONDUCTORS

H.P.R. Frederikse

Although the vast majority of organic compounds are insulators, a small number of organic solids show considerable electrical conductivity. Some of these materials appear to be superconductors. The superconducting organics fall primarily into two groups: those containing fulvalenes (pentagonal rings containing sulfur or selenium) and those based on fullerenes, involving the nearly spherical cluster C_{60} .

The transition temperatures T_c of the fulvalene derivatives are shown in Table 1. The abbreviations of the various molecular groups are listed in Table 2 and their chemical structures are depicted in Figure 1. Most of the T_c 's are between 1 and 12 K. Several of the compounds only show superconductivity under pressure.

The fullerenes are A_3C_{60} compounds, where A represents a single or a combination of alkali atoms. The C_{60} cluster is shown in Figure 2a, while Figure 2b illustrates how the alkali atoms fit into the A_3C_{60} molecule to form the $A15$ crystallographic structure. Their superconducting transition temperatures range from 8 to 31.3 K (see Table 3).

REFERENCES

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2. Williams, Jack M. et al., *Organic Superconductors (Including Fullerenes)*, Prentice Hall, Englewood Cliffs, N.J., 1992.
3. *The Fullerenes*, Ed.: Krato, H.W., Fisher, J.E., and Cox, D.E., Pergamon Press, Oxford, 1993.
4. Schluter, M. et al., in *The Fullerenes* (Ref. 3), p. 303.

Table 1
Critical Pressure and Maximum Critical Temperature of Organic Superconductors

Material	P_c /kbar	T_c /K	Material	P_c /kbar	T_c /K
(TMTSF) ₂ PF ₆	6.5	1.2	β -(ET) ₂ IBr ₂	0	2.8
(TMTSF) ₂ AsF ₆	9	1.3	β -(ET) ₂ AuI ₂	0	4.8
(TMTSF) ₂ SbF ₆	11	0.4	(ET) ₄ Hg _{2.89} Cl ₈	0	4.2
(TMTSF) ₂ TaF ₆	12	1.4	(ET) ₄ Hg _{2.89} Br ₈	12	1.8
(TMTSF) ₂ ClO ₄	0	1.4	(ET) ₃ Cl ₂ (H ₂ O) ₂	16	2
(TMTSF) ₂ ReO ₄	9.5	1.3	κ -(ET) ₂ Cu(NCS) ₂	0	10.4
(TMTSF) ₂ FSO ₃	5	3	κ -(d-ET) ₂ Cu(NCS) ₂	0	11.4
(ET) ₄ (ReO ₄) ₂	4.5	2	(DMET) ₂ Au(CN) ₂	1.5	0.9
β_L -(ET) ₂ I ₃	0	1.4	(DMET) ₂ AuI ₂	5	0.6
β_H -(ET) ₂ I ₃	0	8.1	(DMET) ₂ AuBr ₂	0	1.9
γ -(ET) ₃ I _{2.5}	0	2.5	(DMET) ₂ AuCl ₂	0	0.9
ϵ -(ET) ₂ I ₃ (I ₈) _{0.5}	0	2.5	(DMET) ₂ I ₃	0	0.6
α -(ET) ₂ I ₃ I ₂ -doped	0	3.3	(DMET) ₂ I ₂ Br ₂	0	0.7
α -(ET) ₂ I ₃	0	8	(MDT-TTF) ₂ AuI ₂	0	3.5
$\epsilon \rightarrow \beta$ -(ET) ₂ I ₃ ^a	0	6	TTF[Ni(dmit) ₂] ₂	2	1.6 ^b
θ -(ET) ₂ I ₃	0	3.6	TTF[Pd(dmit) ₂] ₂	20	6.5
κ -(ET) ₂ I ₃	0	3.6	(CH ₃) ₄ N[Ni(dmit) ₂] ₂	7	5

^a Converted from ϵ -type to β -type by thermal treatment.

^b For 7 kbar.

From Ishigura, T. and Yamaji, K., *Organic Superconductors*, Springer-Verlag, Berlin, 1990. With permission.

Table 2
List of Symbols and Abbreviations

TTF	tetrathiafulvalene
TMTSF	tetramethyltetraselenafulvalene
BEDT-TTF or "ET"	bis(ethylenedithio)tetrathiafulvalene
MDT-TTF	methylenedithiotetrathiafulvalene
DMET	[dimethyl(ethylenedithio)diselenadithiafulvalene]
dmit	4,5-dimercapto-1,3-dithiole-2-thione
T_c	transition temperature to superconducting state
P_c	minimum pressure required for superconducting transition

ORGANIC SUPERCONDUCTORS (continued)

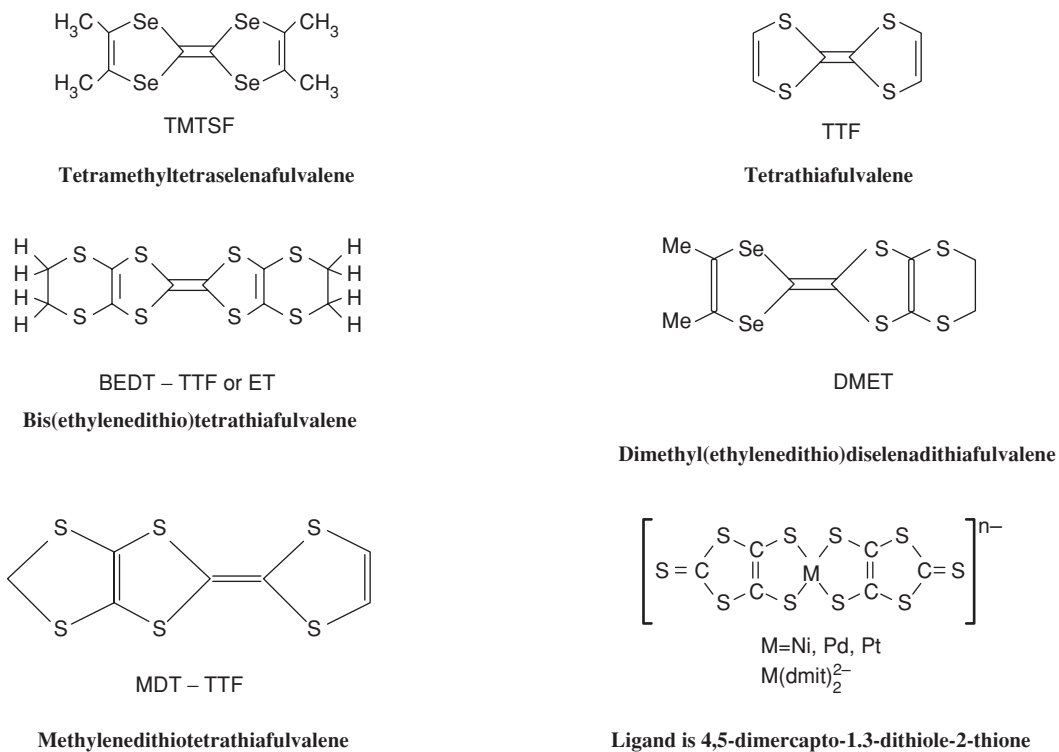


FIGURE 1. Structures of various donor molecules and acceptor species.

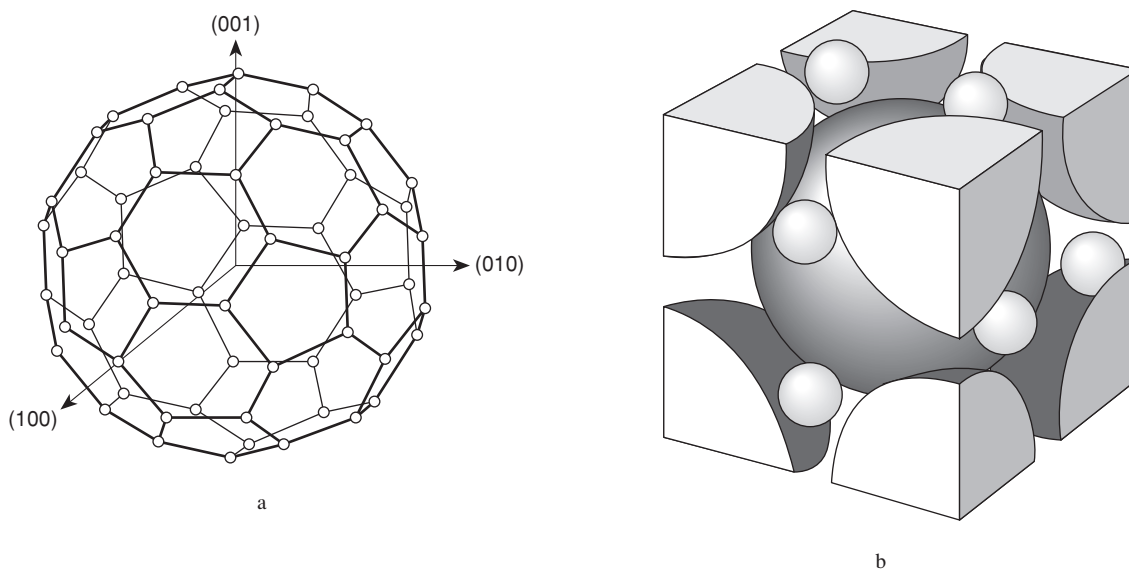


FIGURE 2. (a) C_{60} cluster placed in a fcc lattice. Each crystal axis crosses a double bond shared by two hexagons. (b) A hypothetical A_3C_{60} with the A15 structure. The structure can be seen to be an ordered defect structure of A_6C_{60} .

ORGANIC SUPERCONDUCTORS (continued)

Table 3
Unit Cell and T_c for FCC- A_3C_{60}

	Lattice parameter(s) (Å)	T_c /K
$Na_2Rb_{0.5}Cs_{0.5}C_{60}$	14.148(3)	8.0
Na_2CsC_{60} No. 1 ^a	14.132(2)	10.5
Na_2CsC_{60} No. 2 ^a	14.176(9)	14.0
K_3C_{60}	14.253(3)	19.3
K_2RbC_{60}	14.299(2)	21.8
Rb_2KC_{60} No. 1 ^a	14.336(1)	24.4
Rb_2KC_{60} No. 2 ^a	14.364(5)	26.4
Rb_3C_{60}	14.436(2)	29.4
Rb_2CsC_{60}	14.493(2)	31.3

^a Samples labeled No. 1 and No. 2 have the same nominal composition.

From Schluter, M et. al., *The Fullerenes*, Ed.: Krato, H.W., Fisher, J.E., and Cox, D.E., Pergamon Press, Oxford, 1993. With permission.

PROPERTIES OF SEMICONDUCTORS

L. I. Berger and B. R. Pamplin

The term "semiconductor" is applied to a material in which electric current is carried by electrons or holes and whose electrical conductivity, when extremely pure, rises exponentially with temperature and may be increased from its low "intrinsic" value by many orders of magnitude by "doping" with electrically active impurities.

Semiconductors are characterized by an energy gap in the allowed energies of electrons in the material which separates the normally filled energy levels of the *valence band* (where "missing" electrons behave like positively charged current carriers "holes") and the *conduction band* (where electrons behave rather like a gas of free negatively charged carriers with an effective mass dependent on the material and the direction of the electrons' motion). This energy gap depends on the nature of the material and varies with direction in anisotropic crystals. It is slightly dependent on temperature and pressure, and this dependence is usually almost linear at normal temperatures and pressures.

Data are presented in three tables. Table I "General Properties of Semiconductors" lists the main crystallographic and semiconducting properties of a large number of semiconducting materials in three main categories: "Tetrahedral Semiconductors" in which every atom is tetrahedrally co-ordinated to four nearest neighbor atoms (or atomic sites) as for example in the diamond structure; "Octahedral Semiconductors" in which every atom is octahedrally co-ordinated to six nearest neighbor atoms — as for examples the halite structure; and "Other Semiconductors."

Table II gives more detailed information about some better known semiconductors, while Table III gives some information about the electronic energy band structure parameters of the best known materials.

Table I
PHYSICO-CHEMICAL PROPERTIES OF SEMICONDUCTORS
(LISTED BY CRYSTAL STRUCTURE)

Substance	Molecular mass	Average atomic mass	Lattice parameters (Å, room temp.)	Density (g/cm ³)	Melting point (K)	Microhardness, N/mm ² (M-Mohs Scale)	Specific heat, J/kg-K (300 K)	Debye temp. (K)	Coefficient of thermal linear expansion [10 ⁻⁶ K ⁻¹ (300K)]	Thermal conductivity [mW/cm-K (300K)]
PART A. ADAMANTINE SEMICONDUCTORS										
§A1. Diamond Structure Elements (Strukturbericht symbol A4, Space Group Fd3m-O_h²)										
C		12.01	3.56683	3.51	≈3850 Transition to graphite > 980	10(M)	471.5	2340	1.18	9900(I) 23200(IIA) 13600(IIIB)
Si		28.09	5.43072	2.3283	1685 ± 2	11270	702	645	2.49	1240
Ge		72.59	5.65754	5.3234	1231	7644	321.9	374	6.1	640
α-Sn		118.69	6.4912	5.765	505.2 (Tr. 286.4)		213	230	5.4 (220 K)	
§A2. Sphalerite (Zinc Blende) Structure Compounds (Strukturbericht symbol B3 Space Group F4̄3m-T_d²)										
I VII Compounds										
CuF	82.54	41.27	4.255		1181					
CuCl	98.99	49.49	5.4057	3.53	695	2.3 (M)	490	240	12.1	8.4
CuBr	143.36	71.73	5.6905	4.98	770	2.5(M)	381	207	15.4	12.5
CuI	190.46	95.23	6.60427	5.63	878	192	276	181	19.2	16.8
AgBr	187.78	93.89		6.473	>1570 (Tr. 410)	2.5(M)	270			
AgI	234.77	117.39	6.502	5.67	831	2.5(M)	232	134	-2.5	4.2
II VI Compounds										
BeS	41.08	20.54	4.865	2.36						
BeSe	87.97	43.99	5.139	4.315						
BeTe	136.61	68.31	5.626	5.090						
BePo	(218)	(109)	5.838	7.3						
ZnO	81.37	40.69	4.63	5.675	2248	5.0 (M)	494	416	2.9	234
ZnS	97.43	48.72	5.4093	4.079	2100 (Tr. 1295)	1780	472	530	6.36	251
ZnSe	144.34	72.17	5.6676	5.42	1790	1350	339	400	7.2	140
ZnTe	192.99	96.5	6.101	6.34	1568	900	264	223	8.19	108
ZnPo	(274)	(137)	6.309							
CdS	144.46	72.23	5.832	4.826	1750	1250	330	219	4.7	200
CdSe	191.36	95.68	6.05	5.674	1512	1300	255	181	3.8	90
CdTe	240.00	120.00	6.477	5.86	1365	600	205	200	4.9	58.5
CdPo	(321)	(161)	6.665							
HgS	232.65	116.33	5.8517	7.73	1820	3(M)	210			
HgSe	279.55	139.78	6.084	8.25	1070	2.5(M)	178	151	5.46	10
HgTe	328.19	164.10	6.4623	8.17	943	300	164	242	4.6	20
III V Compounds										
BN	24.82	12.41	3.615	3.49	≈3300	10(M)	793	≈1900		200
BP(L.T.)	41.78	20.87	4.538	2.9	≈2800	37000		≈980		
BAs	85.73	42.87	4.777		≈2300	19000		≈625		

Table I
PHYSICO-CHEMICAL PROPERTIES OF SEMICONDUCTORS
(LISTED BY CRYSTAL STRUCTURE) (continued)

Substance	Molecular mass	Average atomic mass	Lattice parameters (Å, room temp.)	Density (g/cm ³)	Melting point (K)	Microhardness, N/mm ² (M-Mohs Scale)	Specific heat, J/kg·K (300 K)	Debye temp. (K)	Coefficient of thermal linear expansion [10 ⁻⁶ K ⁻¹ (300K)]	Thermal conductivity [mW/cm·K (300K)]
AIP	57.95	28.98	5.451	2.42	≈2100	5.5(M)		588		920
AlAs	101.90	50.95	5.6622	3.81	2013	5000		417	3.5	840
AlSb	148.73	74.37	6.1355	4.218	1330	4000		292	4.2	600
GaP	100.69	50.35	5.4505	4.13	1750	9450		446	5.3	752
GaAs	144.64	72.32	5.65315	5.316	1510	7500		344	5.4	560
GaSb	191.47	95.74	6.0954	5.619	980	4480	320	265	6.1	270
InP	145.79	72.90	5.86875	4.787	1330	4100		321	4.6	800
InAs	189.74	94.87	6.05838	5.66	1215	3300	268	249	4.7	290
InSb	236.57	118.29	6.47877	5.775	798	2200	144	202	4.7	160
Other sphalerite structure compounds										
MnS	87.0	43.5	5.011							
MnSe	133.9	66.95	5.82							
β-SiC	40.1	20.1	4.348	3.21	3070					
Ga ₂ Se ₃	376.32	75.26	5.429	4.92	1020	3160			8.9	50
Ga ₂ Te ₃	522.24	104.45	5.899	5.75	1063	2370				47
In ₂ Te ₃ (H.T.)	608.44	121.7	6.150	5.8	940	1660				69
MgGeP ₂	158.84	39.71	5.652							
ZnSnP ₂	246.00	61.5	5.65		1200					
ZnSnAs ₂ (H.T.)	333.90	82.38	5.851	5.53	1050					76
ZnSnSb ₂	427.56	106.89	6.281	5.67	870	2500				76

§A3. Wurtzite (Zincite) Structure Compounds (Strukturbericht symbol B4, Space Group P 6₃mc-C_{6h}²)

I VII Compounds										
CuCl	99.0	49.5	3.91	6.42						T _c 680K
CuBr	143.46	71.73	4.06	6.66						T _c 658K
CuI	190.46	95.23	4.31	7.09						
AgI	234.80	117.40	4.580	7.494						
II VI Compounds										
BeO	25.01	12.51	2.698	4.380						2800
MgTe	151.9	76.0	4.54	7.39	3.85					≈2800
ZnO	81.37	40.69	3.24950	5.2069	5.66					2250
ZnS	97.43	48.72	3.8140	6.2576	4.1					2100
ZnTe	192.99	46.50	4.27	6.99						1568
CdS	144.46	72.23	4.1348	6.7490	4.82					1748
CdSe	191.36	95.68	4.299	7.010	5.66					1512
CdTe	240.00	120.00	4.57	7.47						
III V Compounds										
BP(H.T.)	41.79	20.90	3.562	5.900						
AlN	40.99	20.50	3.111	4.978	3.26					≈2500
GaN	83.73	41.87	3.190	5.189	6.10					1500
InN	128.83	64.42	3.533	5.693	6.88					1200
Other wurtzite structure compounds										
MnS	87.0	43.5	3.985	6.45	3.248					
MnSe	133.9	66.95	4.12	6.72						
SiC	40.1	20.1	3.076	5.048						
MnTe	182.54	91.27	4.078	6.701						
Al ₂ S ₃	150.14	30.03	3.579	5.829	2.55					1400
Al ₂ Se ₃	290.84	58.17	3.890	6.30	3.91					1250

§A4. Chalcopyrite Structure Compounds (Strukturbericht symbol E1₁, Space Group I $\bar{4}$ 2d-D_{2d}¹²)

I III VI ₂ Compounds										
CuAlS ₂	154.65	38.66	5.323	10.44	3.47					2500
CuAlSe ₂	248.45	62.11	5.617	10.92	4.70					2260
CuAlTe ₂	345.73	86.43	5.976	11.80	5.50					2550
CuGaS ₂	197.39	49.35	5.360	10.49	4.35					2300
CuGaSe ₂	291.19	72.80	5.618	11.01	5.56					1970
CuGaTe ₂	388.47	97.12	6.013	11.93	5.99	4200		275	5.4	42
CuInS ₂	242.49	60.62	5.528	11.08	4.75					2400
CuInSe ₂	336.29	84.07	5.785	11.56	5.77					2050
CuInTe ₂	433.57	108.39	6.179	12.365	6.10	400		195	6.6	37
CuTlS ₂	332.05	83.01	5.580	11.17	6.32				7.1	49
CuTlSe ₂ (L.T.)	425.85	106.46	5.844	11.65	7.11					900
CuFeS ₂	183.51	45.88	5.25	10.32	4.088					
CuFeSe ₂	277.31	69.33								850

Table I
PHYSICO-CHEMICAL PROPERTIES OF SEMICONDUCTORS
(LISTED BY CRYSTAL STRUCTURE) (continued)

Substance	Molecular mass	Average atomic mass	Lattice parameters (Å, room temp.)		Density (g/cm ³)	Melting point (K)	Microhardness, N/mm ² (M-Mohs Scale)	Specific heat, J/kg·K (300 K)	Debye temp. (K)	Coefficient of thermal linear expansion [10 ⁻⁶ K ⁻¹ (300K)]	Thermal conductivity [mW/cm·K (300K)]
CuLaS ₂	266.58	66.65	5.65	10.86							
AgAlS ₂	198.97	49.74	5.707	10.28	3.94						
AgAlSe ₂	292.77	73.19	5.968	10.77	5.07	1220					
AgAlTe ₂	390.05	97.51	6.309	11.85	6.18	1000					
AgGaS ₂	241.71	60.43	5.755	10.28	4.72						
AgGaSe ₂	335.51	83.88	5.985	10.90	5.84	1120	4400				
AgGaTe ₂	432.79	108.2	6.301	11.96	6.05	990	1800	212			10
AgInS ₂ (L.T.)	286.87	71.70	5.828	11.19	5.00						
AgInSe ₂	380.61	95.15	6.102	11.69	5.81	1053	1850				30
AgInTe ₂	477.89	119.47	6.42	12.59	6.12	965			9.49, 0.69		
AgFeS ₂	227.83	56.96	5.66	10.30	4.53						
II IV V₂ Compounds											
ZnSiP ₂	155.40	38.85	5.400	10.441	3.39	1640	11000				
ZnGeP ₂	199.90	49.98	5.465	10.771	4.17	1295	8100				180
ZnSnP ₂	246.00	61.5					6500				
CdSiP ₂	202.43	50.61	5.678	10.431	4.00	≈1470	10500	282			
CdGeP ₂	246.94	61.74	5.741	10.775	4.48	1049	5650				110
CdSnP ₂	243.03	73.26	5.900	11.518			5000	195			140
ZnSiAs ₂	242.20	60.55	5.61	10.88	4.70	1311	9200				
ZnGeAs ₂	287.80	71.95	5.672	11.153	5.32	1150	6800	263			110
ZnSnAs ₂	333.90	83.48	5.8515	11.704	5.53	1048	4550	271			150
CdSiAs ₂	290.34	72.58	5.884	10.882			6850				
CdGeAs ₂	334.83	83.71	5.9427	11.2172	5.60	938	4700				48
CdSnAs ₂	380.93	95.23	6.0944	11.9182	5.72	880	3450				40

§A5. Other Ternary Semiconductors with Tetrahedral Coordination

I₂ IV VI₃ Compounds											
Cu ₂ SiS ₃ (H.T.)	251.36	41.89	3.684	6.004	3.81	1200					23
Cu ₂ SiS ₃ (L.T.)			5.290	10.156	3.63						
Cu ₂ SiTe ₃	537.98	89.66	5.95		5.47						
Cu ₂ GeS ₃ (H.T.)	295.88	49.31	5.317		4.45	1210	4550	510	254	7.2	12
Cu ₂ GeS ₃ (L.T.)			5.327	5.215	4.46						
Cu ₂ GeSe ₃	436.56	72.76	5.589	5.485	5.57	1030	3840	340	168	8.4	24
Cu ₂ GeTe ₃	582.51	97.09	5.958	5.935	5.92		2890				130
Cu ₂ SnS ₃	341.98	57.00	5.436		5.02	1110	2770	440	214	7.8	28
Cu ₂ SnSe ₃	482.66	80.44	5.687		5.94	960	2510	310	148	8.9	35
Cu ₂ SnTe ₃	628.61	104.77	6.048		6.51	680	1970				144
Ag ₂ GeSe ₃	525.21	87.54									
Ag ₂ SnSe ₃	571.31	95.22									
Ag ₂ GeTe ₃	671.13	111.86									
Ag ₂ SnTe ₃	717.23	119.54									
I₃ V VI₄ Compounds											
Cu ₃ PS ₄	349.85	40.73	7.44	6.19							
Cu ₃ AsS ₄	393.79	49.22	6.43	6.14	4.37					3.2	30.2
Cu ₃ AsSe ₄	581.37	72.67	5.570	10.957	5.61			169		9.5	19
Cu ₃ SbS ₄	440.64	55.08	5.38	16.76	4.90						
Cu ₃ SbSe ₄	628.22	78.53	5.654	11.256	6.0			131		12.4	14.6
I IV₂ V₃ Compounds											
CuSi ₂ P ₃	212.64	35.44	5.25								
CuGe ₂ P ₃	301.65	50.28	5.375		4.318	1113	8500	429	8.21	37.6	
AgGe ₂ P ₃	345.97	57.66				1015	6150				

§A6. "Defect Chalcopyrite" Structure Compounds (Strukturbericht symbol E3, Space Group I $\bar{4}$ -S₂)

ZnAl ₂ Se ₄	435.18	62.17	5.503	10.90	4.37						
ZnAl ₂ Te ₄ (?)	629.74	84.96	5.904	12.05	4.95						
ZnGa ₂ S ₄ (?)	333.06	47.58	5.274	10.44	3.80						
ZnGa ₂ Se ₄ (?)	520.66	74.38	5.496	10.99	5.21						
ZnGa ₂ Te ₄ (?)	715.22	102.17	5.937	11.87	5.67						
ZnIn ₂ Se ₄	610.86	87.27	5.711	11.42	5.44	1250					
ZnIn ₂ Te ₄	805.42	115.06	6.122	12.24	5.83	1075					
CdAl ₂ S ₄	294.61	42.09	5.564	10.32	3.06						
CdAl ₂ Se ₄	482.21	68.89	5.747	10.68	4.54						
CdAl ₂ Te ₄ (?)	676.77	97.68	6.011	12.21	5.10						

Table I
PHYSICO-CHEMICAL PROPERTIES OF SEMICONDUCTORS
(LISTED BY CRYSTAL STRUCTURE) (continued)

Substance	Molecular mass	Average atomic mass	Lattice parameters (Å, room temp.)		Density (g/cm ³)	Melting point (K)	Microhardness, N/mm ² (M-Mohs Scale)	Specific heat, J/kg·K (300 K)	Debye temp. (K)	Coefficient of thermal linear expansion [10 ⁻⁶ K ⁻¹ (300K)]	Thermal conductivity [mW/cm·K (300K)]
CdGa ₂ S ₄	380.09	54.30	5.577	10.08	4.03						
CdGa ₂ Se ₄	567.69	81.10	5.743	10.73	5.32						
CdGa ₂ Te ₄	762.25	108.89	6.093	11.81	5.77						
CdIn ₂ Te ₄	852.45	121.78	6.205	12.41	5.9	1060					
HgAl ₂ S ₄	382.79	54.68	5.488	10.26	4.11						
HgAl ₂ Se ₄	570.39	82.48	5.708	10.74	5.05						
HgAl ₂ Te ₄ (?)	764.48	109.28	6.004	12.11	5.81						
HgGa ₂ S ₄	468.27	66.90	5.507	10.23	5.00						
HgGa ₂ Se ₄	655.87	93.70	5.715	10.78	6.18						
HgIn ₂ Se ₄	746.07	106.58	5.764	11.80	6.3	1100					
HgIn ₂ Te ₄ (?)	940.63	134.38	6.186	12.37	6.3	980					
§A7. Other Adamantine Compounds											
αSiC	40.1	20.1	3.0817		3.21	3070					
			15.1183								
Hg ₅ Ga ₇ Te ₈	2163.19	144.21	6.235								
Hg ₅ In ₇ Te ₈	2253.39	150.23	6.328								
CdIn ₂ Se ₄	657.89	93.98	a = c = 5.823								
PART B. OCTAHEDRAL SEMICONDUCTORS											
§B1. HALITE STRUCTURE SEMICONDUCTORS (Strukturbericht symbol B1, Space Group Fm3m-O_h⁵)											
GeTe	200.19	100.1	5.98		6.14						
SnSe	197.65	98.83	6.020			1133					
SnTe	246.29	123.15	6.313		6.45	1080 (max)					91
PbS	239.26	119.63	5.9362		7.61	1390					23
PbSe	286.16	143.08	6.1243		8.15	1340					17
PbTe	334.8	167.4	6.454		8.16	1180					23
Selected other binary halites											
BiSe	287.94	143.97	5.99		7.98	880					
BiTe	336.58	168.29	6.47								
EuSe	230.92	115.46	6.191			2300					2.4
GdSe	236.21	118.11	5.771			2400					
NiD	60.71	30.35	4.1684		6.6	2260					
CdO	128.41	64.21	4.6953			1700					7
SrS	119.68	59.84	6.0199		3.643	3000					
PART C. OTHER SEMICONDUCTORS											
§C1. Antifluorite Structure Compounds (Fm3m - O_h⁵)											
Mg ₂ Si	76.70	25.57	6.338		1.88	1375				11.5	
Mg ₂ Ge	121.20	40.4	6.380		3.08	1388				15.0	
Mg ₂ Sn	167.3	55.77	6.765		3.53	1051				9.9	92
Mg ₂ Pb	225.81	85.27	6.836		5.1	823				10.0	
§C2. Tetradymite Structure Compounds ($\bar{R}3m - D_{3d}^5$)											
Sb ₂ Te ₃	626.3	125.26	4.25	30.3	6.44	895					
Bi ₂ Se ₃	654.84	130.97	4.14	28.7	7.51	979	167				24
Bi ₂ Te ₃	800.76	160.15	4.38	30.45	7.73	858	155	16			30
§C3. Skutterudite Structure Compounds (Im3 - T_h⁵)											
CoP ₃	151.85	37.96	7.7073			>1270					
CoAs ₃	286.70	71.65	8.2060		6.73	1230					
CoSb ₃	424.18	106.05	9.0385			1123			307		50
NiAs ₃	283.45	70.86	8.330		6.43						
RhP ₃	195.83	48.96	7.9951			>1470					
RhAs ₃	327.67	81.92	8.4427			>1270					
RhSb ₃	468.16	117.04	9.2322			1170					100
IrP ₃	285.14	71.29	8.0151		7.36	>1470					
IrAs ₃	416.98	104.25	8.4673		9.12	>1470					
IrSb ₃	557.47	139.37	9.2533		9.35	1170			303		90
§C4. Selected Multinary Compounds											
AgSbSe ₂	387.54	96.88	5.786		6.60	910					10.5
AgSbTe ₂ (or Ag ₁₉ Sb ₂₉ Te ₅₂)	484.82	121.2	6.078		7.12	830					86. 0.3
AgBiS ₂ (H.T.)	380.97	95.24	5.648								
AgBiSe ₂ (H.T.)	474.77	118.69	5.82								
AgBiTe ₂ (H.T.)	572.05	143.01	6.155								
Cu ₂ CdSnS ₄	486.43	60.80	5.586		10.83						

Table I
PHYSICO-CHEMICAL PROPERTIES OF SEMICONDUCTORS
(LISTED BY CRYSTAL STRUCTURE) (continued)

Substance	Molecular mass	Average atomic mass	Lattice parameters (Å, room temp.)	Density (g/cm ³)	Melting point (K)	Microhardness, N/mm ² (M-Mohs Scale)	Specific heat, J/kg·K (300 K)	Debye temp. (K)	Coefficient of thermal linear expansion [10 ⁻⁶ K ⁻¹ (300K)]	Thermal conductivity [mW/cm·K (300K)]
§C5. Some Elemental Semiconductors										
B		10.81	4.91	12.6	2348	9.5(M)	1277	1370	8.3	600
Se(gray)		78.96	4.36	4.95	493	350	292.6		(||C) 17.89 (⊥C) 74.09	(||C) 45.2 (⊥C) 13.1
Te		127.6	4.45	5.91	723		196.5		16.8	(||C) 33.8 (⊥C) 19.7

Table II
BASIC THERMODYNAMIC, ELECTRICAL, AND MAGNETIC PROPERTIES OF SEMICONDUCTORS (LISTED BY CRYSTAL STRUCTURE)

Substance	Heat of formation [kJ/mole (300K)]	Volume compressibility (10 ⁻¹⁰ m ² /N)	Static dielectric constant	Atomic magnetic susceptibility (10 ⁻⁶ CGS)	Index of refraction	Minimum room temperature energy gap (eV)	Mobility (Room temp.) (cm ² /V·s)	Electrons	Holes	Optical transition	Remarks
PART A. ADAMANTINE SEMICONDUCTORS											
§A1. Diamond Structure Elements (Strukturbericht symbol A4, Space Group Fd3m-O_h²)											
C	714.4	18	5.7	-5.88	2.419 (589 nm)	5.4	1800	1400		i*	
Si	324	0.306	11.8	-3.9	3.49 (589 nm)	1.107	1900	500		i	
Ge	291	0.768	16	-0.12	3.99 (589 nm)	0.67	3800	1820		i	
α-Sn	267.5		24		2.75 (589 nm)	0.0; 0.8	2500	2400			
§A2. Sphalerite (Zinc Blende) Structure Compounds (Strukturbericht symbol B3 Space Group F$\bar{4}$3m-T₂³)											
I VII Compounds											
CuF											
CuCl	481	0.26	7.9		1.93	3.17				d	Nantokite
CuBr	481	0.26	7.9		2.12	2.91				d	
CuI	439	0.27	6.5		2.346	2.95				d	Marshite
AgBr	486		12.4		2.253	2.50	4000			i	Bromirite
AgI	389	0.41	10		2.22	2.22	30			d	Miersite
II VI Compounds											
BeS					4.17					i	
BeSe					3.61					i	
BeTe					1.45		20			d	
BePo											See A3
ZnO											See also A3
ZnS	477		8.9	-9.9	2.356	3.54	180	5(400°C)		d	
ZnSe	422		9.2		2.89	2.58	540	28		d	
ZnTe	376		10.4		3.56	2.26	340	100		d	
ZnPo											
CdS											See A3
CdSe											See A3
CdTe	339		7.2		2.50	1.44	1200	50		d	
CdPo											
HgS					2.85		250			d	Metacinnabarite
HgSe	247					2.10 (α)	20000	=1.5		s	Tiemannite
HgTe	242					-0.06	25000	350		s	Coloradoite
III V Compounds											
BN	815					4.6					Borazone
BP(L.T.)						≈2.1	500	70			Ignites 470K
BAs						≈1.5					
AlP						2.45	80			i	
AlAs	627		10.9			2.16	1200	420		i	
AlSb	585	0.571	11		3.2	1.60	200-400	550		i	
GaP	635	0.110	11.1	-13.8	3.2	2.24	300	150		i	
GaAs	535	0.771	13.2	-16.2	3.30	1.35	8800	400		d	
GaSb	493	0.457	15.7	-14.2	3.8	0.67	4000	1400		d	
InP	560	0.735	12.4	-22.8	3.1	1.27	4600	150		d	
InAs	477	0.549	14.6	-27.7	3.5	0.36	33000	460		d	
InSb	447	0.442	17.7	-32.9	3.96	0.163	78000	750		d	

* i = indirect, d = direct, s = semimetal.

Table II
BASIC THERMODYNAMIC, ELECTRICAL, AND MAGNETIC PROPERTIES OF
SEMICONDUCTORS (LISTED BY CRYSTAL STRUCTURE) (continued)

Substance	Heat of formation [kJ/mole (300K)]	Volume compressibility (10^{-10} m ² /N)	Static dielectric constant	Atomic magnetic susceptibility (10^{-6} CGS)	Index of refraction	Minimum room temperature energy gap (eV)	Mobility (Room temp.) (cm ² /V·s)		Optical transition	Remarks
							Electrons	Holes		
Other sphalerite structure compounds										
MnS										See also §A3
MnSe										See also §A3
β-SiC					2.697	2.3	4000			
Ga ₂ Te ₃	271			-13.5		1.35	50			
In ₂ Te ₃ (H.T.)	198			-13.6		1.04	50			
MgGeP ₂										E1—T ^{d12}
ZnSnP ₂						2.1				Same
ZnSnAs ₂ (H.T.)						≈0.7				Same
ZnSnSb ₂						0.4				Same

§A3. Wurtzite (Zincite) Structure Compounds (Strukturbericht symbol B4, Space Group P 6₃mc-C_{6v}⁴)

I VII Compounds										
CuCl										
CuBr										
CuI										
AgI						2.63				Iodargirite
II VI Compounds										
BeO										
MgTe										
ZnO	-350					3.2	180			
ZnS	-206					3.67				
ZnTe	-163									
CdS			8.45; 9.12		2.32	2.42	350	40	d	Greenockide
CdSe						1.74	900	50	d	Cadmoseelite
CdTe						1.50	650			
III V Compounds										
BP(H.T.)										
AlN						6.02				
GaN						3.34				
InN						2.0				
Other wurtzite structure compounds										
MnS										
MnSe										
SiC					2.654					
MnTe						≈1.0				
Al ₂ S ₃	426					4.1				
Al ₂ Se ₃	367					3.1				

§A4. Chalcopyrite Structure Compounds (Strukturbericht symbol E1₁, Space Group I $\bar{4}$ 2d-D_{2d}¹²)

I III VI ₂ Compounds										
CuAlS ₂	0.106					2.5				
CuAlSe ₂						1.1				
CuAlTe ₂						0.88				
CuGaS ₂	0.106					2.38				
CuGaSe ₂	0.141					0.96, 1.63				
CuGaTe ₂	0.227					0.82, 1.0				
CuInS ₂	0.141					1.2				
CuInSe ₂	0.187					0.86, 0.92				
CuInTe ₂	0.278					0.95				
CuTlS ₂										
CuTlSe ₂ (L.T.)						1.07				
CuFeS ₂						0.53				Chalcopyrite
CuFeSe ₂						0.16				
CuLaS ₂										
AgAlS ₂										
AgAlSe ₂						0.7				
AgAlTe ₂						0.56				
AgGaS ₂	0.150					1.66				
AgGaSe ₂	0.182					1.1				
AgGaTe ₂	0.280					1.9				
AgInS ₂ (L.T.)	0.185					1.18				
AgInSe ₂	0.238					0.96, 0.52				
AgInTe ₂	0.338									
AgFeS ₂										

Table II
BASIC THERMODYNAMIC, ELECTRICAL, AND MAGNETIC PROPERTIES OF
SEMICONDUCTORS (LISTED BY CRYSTAL STRUCTURE) (continued)

Substance	Heat of formation [kJ/mole (300K)]	Volume compressibility (10^{-10} m ² /N)	Static dielectric constant	Atomic magnetic susceptibility (10^{-6} CGS)	Index of refraction	Minimum room temperature energy gap (eV)	Mobility (Room temp.) (cm ² /V-s)		Optical transition	Remarks
							Electrons	Holes		
II IV V ₂ Compounds										
ZnSiP ₂	312					2.3	1000			
ZnGeP ₂	293					2.2				
ZnSnP ₂	275					1.45				
CdSiP ₂		0.103				2.2	1000			
CdGeP ₂	289					1.8				
CdSnP ₂	270					1.5				
ZnSiAs ₂	290					1.7		50		
ZnGeAs ₂	271			-14.4		0.85				
ZnSnAs ₂	252			-18.4		0.65		300		Disorders at 910K
CdSiAs ₂		0.143				1.6				
CdGeAs ₂	266			-23.4		0.53	70	25		Disorders at 903
CdSnAs ₂	247		13.7	-21.5		0.26	22000	250		

§A5. Other Ternary Semiconductors with Tetrahedral Coordination

I ₂ IV VI ₃ Compounds										
Cu ₂ SiS ₃ (H.T.)										Wurtzite
Cu ₂ SiS ₃ (L.T.)										Tetragonal
Cu ₂ SiTe ₃										Cubic
Cu ₂ GeS ₃ (H.T.)				-18.7						Cubic
Cu ₂ GeS ₃ (L.T.)							360			Tetragonal
Cu ₂ GeSe ₃	211.5			-21.3		0.94	238			Same
Cu ₂ GeTe ₃	190.2			-23.4						Same
Cu ₂ SnS ₃				-18.2		0.91	405			Cubic
CuSnSe ₃				-21.0		0.66	870			Cubic
Cu ₂ SnTe ₃				-28.4						Cubic
Ag ₂ GeSe ₃				-29.6		0.91 (77K)				
Ag ₂ SnSe ₃				-29.5			0.81			
Ag ₂ GeTe ₃				-31.4			0.25			
Ag ₂ SnTe ₃				-31.0			0.08			
I ₃ V VI ₄ Compounds										
Cu ₃ PS ₄										Enargite
Cu ₃ AsS ₄	269.6			-15.8		1.24				
Cu ₃ AsSe ₄	161.3			-13.1		0.88				Famatinite
Cu ₃ SbS ₄				-8.3		0.74				Famatinite
Cu ₃ SbSe ₄	127.1			-20.5		0.31				
I IV ₂ V ₃ Compounds										
CuSi ₂ P ₃										E1
CuGe ₂ P ₃		0.12				0.9				E1
AgGe ₂ P ₃										

§A6. "Defect Chalcopyrite" Structure Compounds (Strukturbericht symbol E3, Space Group I $\bar{4}$ -S₆)

ZnAl ₂ Se ₄										
ZnAl ₂ Te ₄ (?)										
ZnGa ₂ S ₄ (?)						≈3.4				
ZnGa ₂ Se ₄ (?)						≈2.2				
ZnGa ₂ Te ₄ (?)						1.35				
ZnIn ₂ Se ₄	206					1.82	35			
ZnIn ₂ Te ₄	198					1.2				
CdAl ₂ S ₄										
CdAl ₂ Se ₄										
CdAl ₂ Te ₄ (?)										
CdGa ₂ S ₄	256					3.44	60			
CdGa ₂ Se ₄	216					2.43	33			
CdGa ₂ Te ₄										
CdIn ₂ Te ₄	195					(1.26 or 0.9)	4000			
HgAl ₂ S ₄										
HgAl ₂ Se ₄										
HgAl ₂ Te ₄ (?)										
HgGa ₂ S ₄	249					2.84				
HgGa ₂ Se ₄	204					1.95	400			
HgIn ₂ Se ₄	196					0.6	290			
HgIn ₂ Te ₄ (?)	188					0.86	200			

Table II
BASIC THERMODYNAMIC, ELECTRICAL, AND MAGNETIC PROPERTIES OF
SEMICONDUCTORS (LISTED BY CRYSTAL STRUCTURE) (continued)

Substance	Heat of formation [kJ/mole (300K)]	Volume compressibility (10^{-10} m ² /N)	Static dielectric constant	Atomic magnetic susceptibility (10^{-6} CGS)	Index of refraction	Minimum room temperature energy gap (eV)	Mobility (Room temp.) (cm ² /V·s)		Optical transition	Remarks
							Electrons	Holes		
§A7. Other Adamantine Compounds										
αSiC			10.2	-6.4	2.67	2.86	400			6H structure
Hg ₅ Ga ₂ Te ₈										B3 with superlattice
Hg ₅ In ₂ Te ₈						0.7	2000			B3 with superlattice
CdIn ₂ Se ₄						1.55				
PART B. OCTAHEDRAL SEMICONDUCTORS										
§B1. HALITE STRUCTURE SEMICONDUCTORS (Strukturbericht symbol B1, Space Group Fm3m-O_h⁵)										
GeTe										
SnSe										
SnTe										
PbS	435					0.5	600	600		
PbSe	393		161			0.37	1000	900		
PbTe	393		280			0.26	1600	600		Altaite
			360			0.25				
Selected other binary halites										
BiSe										
BiTe						0.4				
EuSe										
GdSe						1.8	4			
NiD						2.0 or 3.7	100			
CdO	531					2.5				
SrSW						4.1				
PART C. OTHER SEMICONDUCTORS										
§C1. Antifluorite Structure Compounds (Fm3m - O_h⁵)										
Mg ₂ Si	79.08					0.77	405	70		
Mg ₂ Ge						0.74	520	110		
Mg ₂ Sn	76.57					0.36	320	260		
Mg ₂ Pb	52.72					0.1				
§C2. Tetradymite Structure Compounds (R3m - D_{3d}⁵)										
Sb ₂ Te ₃						0.3		360		
Bi ₂ Se ₃						0.35	600			
Bi ₂ Te ₃						0.21	1140	680		R3m (166)
§C3. Skutterudite Structure Compounds (Im3-T_h⁵)										
CoP ₃						0.43				
CoAs ₃						0.69		-4000		
CoSb ₃						0.63	70	-3000		
RhP ₃								700		
RhAs ₃						0.85		-3000		
RhSb ₃						0.80		-7000		
IrSb ₃						1.18		1500		
§C4. Selected Multinary Compounds										
AgSbSe ₂						0.58				
AgSbTe ₂ (or Ag ₁₉ Sb ₂₉ Te ₅₂)						0.7, 0.27				
AgBiS ₂ (H.T.)										
AgBiSe ₂ (H.T.)										
AgBiTe ₂ (H.T.)										
Cu ₂ CdSnS ₄						1.16	<2			
§C5. Some Elemental Semiconductors										
B	397.1			-6.7	3.4	1.55	10			
Se(gray)			6.6 (0.1 GHz)	-22.1	2.5	1.5		5		P3 ₂ 1(152)
Te				-39.5	3.3	0.33	1700	1200		Same

Table III
SEMICONDUCTING PROPERTIES OF SELECTED MATERIALS

Substance	Minimum Energy Gap (eV)		$\frac{dE_g}{dT}$ $\times 10^4$ eV/°C	$\frac{dE_g}{dP}$ $\times 10^6$ eV·cm ² /kg	Density of States of Electron Effective Mass m_{e0} (m ₀)	Electron Mobility and Temperature Dependence μ_n -x cm ² /V·s	Density of States Hole Effective Mass m_{h0} (m ₀)	Hole Mobility and Temperature Dependence μ_p -x cm ² /V·s
	R.T.	0 K						
Si	1.107	1.153	-2.3	-2.0	1.1	1,900 2.6	0.56	500 2.3
Ge	0.67	0.744	-3.7	+7.3	0.55	3,800 1.66	0.3	1,820 2.33
α -Sn	0.08	0.094	-0.5		0.02	2,500 1.65	0.3	2,400 2.0
Te	0.33				0.68	1,100	0.19	560
III-V Compounds								
AlAs	2.2	2.3				1,200		420
AlSb	1.6	1.7	-3.5	-1.6	0.09	200 1.5	0.4	500 1.8
GaP	2.24	2.40	-5.4	-1.7	0.35	300 1.5	0.5	150 1.5
GaAs	1.35	1.53	-5.0	+9.4	0.068	9,000 1.0	0.5	500 2.1
GaSb	0.67	0.78	-3.5	+12	0.050	5,000 2.0	0.23	1,400 0.9
InP	1.27	1.41	-4.6	+4.6	0.067	5,000 2.0		200 2.4
InAs	0.36	0.43	-2.8	+8	0.022	33,000 1.2	0.41	460 2.3
InSb	0.165	0.23	-2.8	+15	0.014	78,000 1.6	0.4	750 2.1
II-VI Compounds								
ZnO	3.2		-9.5	+0.6	0.38	180 1.5		
ZnS	3.54		-5.3	+5.7		180		5(400°C)
ZnSe	2.58	2.80	-7.2	+6		540		28
ZnTe	2.26			+6		340		100
CdO	2.5 ± .1		-6		0.1	120		
CdS	2.42		-5	+3.3	0.165	400	0.8	
CdSe	1.74	1.85	-4.6		0.13	650 1.0	0.6	
CdTe	1.44	1.56	-4.1	+8	0.14	1,200	0.35	50
HgSe	0.30				0.030	20,000 2.0		
HgTe	0.15		-1		0.017	25,000	0.5	350
Halite Structure Compounds								
PbS	0.37	0.28	+4		0.16	800	0.1	1,000 2.2
PbSe	0.26	0.16	+4		0.3	1,500	0.34	1,500 2.2
PbTe	0.25	0.19	+4	-7	0.21	1,600	0.14	750 2.2
Others								
ZnSb	0.50	0.56			0.15	10		1.5
CdSb	0.45	0.57	-5.4		0.15	300		2,000 1.5
Bi ₂ S ₃	1.3					200		1,100
Bi ₂ Se ₃	0.27					600		675
Bi ₂ Te ₃	0.13		-0.95		0.58	1,200 1.68	1.07	510 1.95
Mg ₂ Si		0.77	-6.4		0.46	400 2.5		70
Mg ₂ Ge		0.74	-9			280 2		110
Mg ₂ Sn	0.21	0.33	-3.5		0.37	320		260
Mg ₂ Sb ₂		0.32				20		82
Zn ₃ As ₂	0.93					10 1.1		10
Cd ₃ As ₂	0.55				0.046	100,000 0.88		
GaSe	2.05		3.8					20
GaTe	1.66	1.80	-3.6			14 -5		
InSe	1.8					900		
TlSe	0.57		-3.9		0.3	30	0.6	20 1.5
CdSnAs ₂	0.23				0.05	25,000 1.7		
Ga ₂ Te ₃	1.1	1.55	-4.8					
α -In ₂ Te ₃	1.1	1.2			0.7			50 1.1
β -In ₂ Te ₃	1.0							5
Hg ₂ In ₂ Te ₈	0.5							11,000
SnO ₂								78

Table IV
BAND PROPERTIES OF SEMICONDUCTORS

PART A. DATA ON VALENCE BANDS OF SEMICONDUCTORS (ROOM TEMPERATURES)

Substance	Band Curvature Effective Mass			Energy Separation of "Split-off" Band (eV)	Measured (Light) Hole Mobility cm ² /V·s
	Heavy Holes (Expressed as fraction of free electron mass)	Light Holes	"Split-off" Band Holes		
Semiconductors with Valence Band Maximum at the Center of the Brillouin Zone ("F")					
Si	0.52	0.16	0.25	0.044	500
Ge	0.34	0.043	0.08	0.3	1,820
Sn	0.3				2,400
AlAs					
AlSb	0.4			0.7	550
GaP				0.13	100
GaAs	0.8	0.12	0.20	0.34	400
GaSb	0.23	0.06		0.7	1,400
InP				0.21	150
InAs	0.41	0.025	0.083	0.43	460
InSb	0.4	0.015		0.85	750
CdTe	0.35				50
HgTe	0.5				350

Table IV
BAND PROPERTIES OF SEMICONDUCTORS (continued)

Semiconductors with Multiple Valence Band Maxima						
Substance	Number of Equivalent Valleys and Direction	Band Curvature Longitudinal m_L	Effective Masses Transverse m_T	Anisotropy $K = m_L/m_T$	Measured (Light) Hole Mobility $cm^2/V.s$	
PbSe	4 "L" [111]	0.095	0.047	2.0	1,500	
PbTe	4 "L" [111]	0.27	0.02	10	750	
Bi ₂ Te ₃	6	0.207	~0.045	4.5	515	

PART B. DATA ON CONDUCTION BANDS OF SEMICONDUCTORS (Room Temperature Data)

Single Valley Semiconductors

Substance	Energy Gap (eV)	Effective Mass (m_0)	Mobility ($cm^2/V.s$)	Comments
GaAs	1.35	0.067	8,500	3(or 6?) equivalent [100] valleys 0.36 eV above this maximum with a mobility of ~50
InP	1.27	0.067	5,000	3(or 6?) equivalent [100] valleys 0.4 eV above this minimum.
InAs	0.36	0.022	33,000	equivalent valleys ~1.0 eV above this minimum.
InSb	0.165	0.014	78,000	
CdTe	1.44	0.11	1,000	4(or 8?) equivalent [111] valleys 0.51 eV above this minimum.

Multivalley Semiconductors

Substance	Energy Gap	Number of Equivalent Valleys and Direction	Band Curvature Longitudinal m_L	Effective Mass Transverse m_T	Anisotropy $K = m_L/m_T$	Comments
Si	1.107	6 in [100] "Δ"	0.90	0.192	4.7	
Ge	0.67	4 in [111] at "L"	1.588	0.0815	19.5	
GaSb	0.67	as Ge (?)	~1.0	~0.2	~5	
PbSe	0.26	4 in [111] at "L"	0.085	0.05	1.7	
PbTe	0.25	4 in [111] at "L"	0.21	0.029	5.5	
Bi ₂ Te ₃	0.13	6			~0.05	

Table V
RESISTIVITY OF SEMICONDUCTING MINERALS

Mineral	ρ (ohm · m)	Mineral	ρ (ohm · m)
Diamond (C)	2.7	Gersdorffite, NiAsS	1 to 160×10^{-6}
Sulfides		Glaucoodote, (Co, Fe)AsS	5 to 100×10^{-6}
Argentite, Ag ₂ S	1.5 to 2.0×10^{-3}	Antimonide	
Bismuthinite, Bi ₂ S ₃	3 to 570	Dyscrasite, Ag ₃ Sb	0.12 to 1.2×10^{-6}
Bornite, Fe ₃ S ₄ · nCu ₂ S	1.6 to 6000×10^{-6}	Arsenides	
Chalcocite, Cu ₂ S	80 to 100×10^{-6}	Allemonite, SbAs ₃	70 to 60,000
Chalcopyrite, Fe ₇ S ₈ · Cu ₂ S	150 to 9000×10^{-6}	Lollingite, FeAs ₃	2 to 270×10^{-6}
Covellite, CuS	0.30 to 83×10^{-6}	Nicollite, NiAs	0.1 to 2×10^{-6}
Galena, PbS	6.8×10^{-6} to 9.0×10^{-7}	Skutterudite, CoAs ₃	1 to 400×10^{-6}
Haverite, MnS ₂	10 to 20	Smaltite, CoAs ₂	1 to 12×10^{-6}
Marcasite, FeS ₂	1 to 150×10^{-3}	Tellurides	
Metacinnabarite, 4HgS	2×10^{-6} to 1×10^{-3}	Altaite, PbTe	20 to 200×10^{-6}
Millerite, NiS	2 to 4×10^{-7}	Calavarite, AuTe ₂	6 to 12×10^{-6}
Molybdenite, MoS ₂	0.12 to 7.5	Coloradoite, HgTe	4 to 100×10^{-6}
Pentlandite, (Fe, Ni) ₃ S ₄	1 to 11×10^{-6}	Hessite, Ag ₂ Te	4 to 100×10^{-6}
Pyrrhotite, Fe ₇ S ₈	2 to 160×10^{-6}	Nagyagite, Pb ₃ Au(S, Te) ₄	20 to 80×10^{-6}
Pyrite, FeS ₂	1.2 to 600×10^{-3}	Sylvanite, AgAuTe ₂	4 to 20×10^{-6}
Sphalerite, ZnS	2.7×10^{-3} to 1.2×10^4	Oxides	
Antimony-sulfur compounds		Braunite, Mn ₂ O ₃	0.16 to 1.0
Berthierite, FeSb ₂ S ₄	0.0083 to 2.0	Cassiterite, SnO ₂	4.5×10^{-4} to 10,000
Boulangerite, Pb ₅ Sb ₄ S ₁₁	2×10^3 to 4×10^4	Cuprite, Cu ₂ O	10 to 50
Cylindrite, Pb ₃ Sn ₂ Sb ₂ S ₁₄	2.5 to 60	Hollandite, (Ba, Na, K)Mn ₂ O ₁₈	2 to 100×10^{-3}
Franckeite, Pb ₃ Sn ₂ Sb ₂ S ₁₄	1.2 to 4	Ilmenite, FeTiO ₃	0.001 to 4
Hauheicornite, Ni ₂ (Bi, Sb) ₂ S ₈	1 to 83×10^{-6}	Magnetite, Fe ₃ O ₄	52×10^{-6}
Jamesonite, Pb ₂ FeSb ₂ S ₁₄	0.020 to 0.15	Manganite, MnO · OH	0.018 to 0.5
Tetrahedrite, Cu ₄ SbS ₄	0.30 to 30,000	Melaconite, CuO	6000
Arsenic-sulfur compounds		Psilomelane, KMnO ₄ · MnO ₂ · nH ₂ O	0.04 to 6000
Arsenopyrite, FeAsS	20 to 300×10^{-6}	Pyrolusite, MnO ₂	0.007 to 30
Cobaltite, CoAsS	6.5 to 130×10^{-3}	Rutile, TiO ₂	29 to 910
Enargite, Cu ₃ As ₄ S ₄	0.2 to 40×10^{-3}	Uraninite, UO	1.5 to 200

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DIFFUSION DATA FOR SEMICONDUCTORS

B. L. Sharma

The diffusion coefficient D in many semiconductors may be expressed by an Arrhenius-type relation

$$D = D_0 \exp(-Q/kT)$$

where D_0 is a frequency factor, Q is the activation energy for diffusion, k is the Boltzmann constant, and T is the absolute temperature. This table lists D_0 and Q for various diffusants in common semiconductors.

Abbreviations used in the table are

AES — Auger Electron Spectroscopy

DLTS — Deep Level Transient Spectroscopy

SEM — Scanning Electron Microscopy

SIMS — Secondary Ion Mass Spectrometry

$D(c)$ — Concentration Dependent Diffusion Coefficient

D_{\max} — Maximum Diffusion Coefficient

(f) — Fast Diffusion Component

(i) — Interstitial Diffusion Component

(s) — Slow Diffusion Component

(||) — Parallel to c Direction

(⊥) — Perpendicular to c Direction

Semiconductor	Diffusant	Frequency factor, D_0 (cm ² /s)	Activation energy, Q (eV)	Temperature range (°C)	Method of measurement	Ref.
Si	H	6×10^{-1}	1.03	120—1207	Electrical and SIMS	1
	Li	2.5×10^{-3}	0.65	25—1350	Electrical	2
	Na	1.65×10^{-3}	0.72	530—800	Electrical and flame photometry	3
	K	1.1×10^{-3}	0.76	740—800	Electrical and flame photometry	3
	Cu	4×10^{-2}	1.0	800—1100	Radioactive	4
		4.7×10^{-3}	0.43 (i)	300—700	Radioactive	5
	Ag	2×10^{-3}	1.6	1100—1350	Radioactive	6
	Au	2.4×10^{-4}	0.39 (i)	700—1300	Radioactive	7
		2.75×10^{-3}	2.05 (s)			
	Be	($D \sim 10^{-7}$)	—	1050	Electrical	8
	Ca	($D \sim 6 \times 10^{-14}$)	—	1100	Electrical and SIMS	1
	Zn	1×10^{-1}	1.4	980—1270	Electrical	9
	B	2.46	3.59	1100—1250	Electrical	10
		2.4×10^1	3.87	840—1250	Electrical	11
	Al	1.38	3.41	1119—1390	Electrical	12
		1.8	3.2	1025—1175	Electrical	13
	Ga	3.74×10^{-1}	3.39	1143—1393	Electrical	12
		6×10^1	3.89	900—1050	Radioactive	14
	In	7.85×10^{-1}	3.63	1180—1389	Electrical	12
		1.94×10^1	3.86	1150—1242	Radioactive	15
	Tl	1.37	3.7	1244—1338	Electrical	12
		1.65×10^1	3.9	1105—1360	Electrical	16
	Sc	8×10^{-2}	3.2	1100—1250	Radioactive	1
Ce	($D \sim 3.9 \times 10^{-13}$)	—	1050	SIMS	1	
Pr	2.5×10^{-7}	1.74	1100—1280	Electrical	1	
Pm	7.5×10^{-9}	1.2 (s)	730—1270	Radioactive	1	
	4.2×10^{-12}	0.13 (f)				
Er	2×10^{-3}	2.9	1100—1250	Radioactive	1	
Tm	8×10^{-3}	3.0	1100—1280	Radioactive	1	
Yb	2.8×10^{-5}	0.95	947—1097	Neutron activation	1	
Ti	1.45×10^{-2}	1.79	950—1200	DLTS	17	
C	3.3×10^{-1}	2.92	1070—1400	Radioactive	18	
Si (self)	1.54×10^2	4.65	855—1175	SIMS	19	
	1.6×10^3	4.77	1200—1400	Radioactive	20	
Ge	3.5×10^{-1}	3.92	855—1000	Radioactive	21	
	2.5×10^3	4.97	1030—1302	Radioactive	21	
	7.55×10^3	5.08	1100—1300	SIMS	22	
Sn	3.2×10^1	4.25	1050—1294	Neutron activation	23	

DIFFUSION DATA FOR SEMICONDUCTORS (continued)

Semiconductor	Diffusant	Frequency factor, D_0 (cm ² /s)	Activation energy, Q (eV)	Temperature range (°C)	Method of measurement	Ref.
Ge	N	2.7×10^{-3}	2.8	800—1200	Out Diffusion; SIMS	1
	P	2.02×10^1	3.87	1100—1250	Electrical	10
		1.1	3.4	900—1200	Radioactive	24
	As	7.4×10^{-2}	3.3	1130—1405	Electrical	25
		6.0×10^1	4.2	950—1350	Radioactive	26
		6.55×10^{-2}	3.44	1167—1394	Electrical	27
	Sb	2.29×10^1	4.1	900—1250	Electrical	28
		1.29×10^1	3.98	1190—1398	Radioactive	29
	Bi	2.14×10^{-1}	3.65	1190—1405	Electrical	27
		1.03×10^3	4.64	1220—1380	Electrical	16
	Cr	1.08	3.85	1190—1394	Electrical	27
		1×10^{-2}	1	1100—1250	Radioactive	30
	Mo	$(D \sim 2 \times 10^{-10})$	—	1000	DLTS	1
	W	$(D \sim 10^{-12})$	—	1100	DLTS	1
	O	7×10^{-2}	2.44	700—1250	SIMS	31
		1.4×10^{-1}	2.53	700—1160	SIMS	32
	S	5.95×10^{-3}	1.83	975—1200	Radioactive	33
	Se	9.5×10^{-1}	2.6	1050—1250	Electrical	34
	Te	5×10^{-1}	3.34	900—1250	SIMS	1
	Mn	6.9×10^{-4}	0.63	900—1200	Radioactive	35
	Fe	1.3×10^{-3}	0.68	30—1250	Radioactive	36
	Co	2×10^{-3}	0.69	700—1300	Radioactive	37
	Ni	2×10^{-3}	0.47	800—1300	Radioactive	38
		$(D \sim 5 \times 10^{-7})$	—	1000—1280	Electrical	1
	Rh	$(D \sim 10^{-6}—10^{-4})$	—	1000—1200	Electrical	39
	Pd	2.95×10^{-4}	0.22 (i)	702—1320	Nuclear Activation	1
	Pt	1.5×10^2	2.22	800—1000	Electrical	1
	Os	$(D \sim 2 \times 10^{-6})$	—	1280	Electrical	40
	Ir	4.2×10^{-2}	1.3	950—1250	Electrical	41
		1.3×10^{-3}	0.46	350—800	Electrical	42
	Li	9.1×10^{-3}	0.57	800—500	Electrical	43
		3.95×10^{-1}	2.03	700—850	Radioactive	44
	Cu	1.9×10^{-4}	0.18 (i)	750—900	Radioactive	45
		4×10^{-2}	0.99 (s)	600—700		
	Ag	4×10^{-3}	0.33 (i)	350—750	Radioactive	5
		4.4×10^{-2}	1.0 (i)	700—900	Radioactive	46, 47
		4×10^{-2}	2.23 (s)	800—900	Radioactive	48
		2.25×10^2	2.5	600—900	Radioactive	49
	Be	5×10^{-1}	2.5	720—900	Electrical	50
	Mg	$(D \sim 8 \times 10^{-9})$	—	900	Electrical	1
	Zn	5	2.7	600—900	Radioactive and electrical	51
		1.75×10^9	4.4	760—915	Radioactive	52
	B	1.8×10^9	4.55	600—900	Electrical	51
	Al	1.0×10^3	3.45	554—905	SIMS	53
		$\sim 1.6 \times 10^2$	~ 3.24	750—850	Electrical	54
	Ga	1.4×10^2	3.35	554—916	SIMS	55
		3.4×10^1	3.1	600—900	Electrical	51
	In	1.8×10^4	3.67	554—919	SIMS	56
		3.3×10^1	3.02	700—855	Radioactive	57
	Tl	1.7×10^3	3.4	800—930	Radioactive	58
Si	2.4×10^{-1}	2.9	650—900	(γ) resonance	59	
Ge (self)	2.48×10^1	3.14	549—891	Radioactive	60	
	7.8	2.95	766—928	Radioactive	61	
Sn	1.7×10^{-2}	1.9	—	Radioactive	45	
P	3.3	2.5	600—900	Electrical	51	

DIFFUSION DATA FOR SEMICONDUCTORS (continued)

Semiconductor	Diffusant	Frequency factor, D_0 (cm ² /s)	Activation energy, Q (eV)	Temperature range (°C)	Method of measurement	Ref.
GaAs	As	2.1	2.39	700—900	Electrical	62
	Sb	3.2	2.41	700—855	Radioactive	57
		1.0×10^1	2.5	600—900	Radioactive and electrical	51
	Bi	3.3	2.57	650—850	—	63
	O	4×10^{-1}	2.08	—	Optical	64
	S	($D \sim 10^{-9}$)	—	920	—	65
	Se	($D \sim 10^{-10}$)	—	920	—	65
	Te	5.6	2.43	750—900	Radioactive	66
	Fe	1.3×10^{-1}	1.08	750—900	Radioactive	67
	Co	1.6×10^{-1}	1.12	750—850	Radioactive	47
	Ni	8×10^{-1}	0.9	670—900	Electrical	68
	Li	5.3×10^{-1}	1.0	250—500	Electrical and chemical	69
	Cu	3×10^{-2}	0.53	100—500	Radioactive	69
		6×10^{-2}	0.98	450—750	Ultrasonic	69
	Ag	1.5×10^{-3}	0.6	800—1000	Radioactive	69
		4×10^{-4}	0.8	500—1150	Radioactive	69
	Au	1×10^{-3}	1.0	740—1025	Radioactive	69
	Be	7.3×10^{-6}	1.2	800—990	Electrical	69
	Mg	4×10^{-5}	1.22	800—1200	Electrical	69
	Zn	1.5×10^1	2.49	600—980	Radioactive	69
		2.5×10^{-1}	3.0	750—1000	Radioactive	69
	Cd	1.3×10^{-3}	2.2	800—1100	Radioactive	69
		5×10^{-2}	2.43	868—1149	Radioactive	69
	Hg	($D \sim 5 \times 10^{-14}$)	—	1100	Radioactive	69
	Al	($D \sim 4 \times 10^{-18}$ — 10^{-14})	4.3	850—1100	AES	70
		Ga (self)	4×10^{-5}	2.6	1025—1100	Radioactive	69
	In	1×10^7	5.6	1125—1230	Radioactive	69
		($D \sim 7 \times 10^{-11}$)	—	1000	Radioactive	69
	C	($D \sim 1.04 \times 10^{-16}$)	—	825	SIMS	69
	Si	1.1×10^{-1}	2.5	850—1050	SIMS	69
	Ge	1.6×10^{-5}	2.06	650—850	SIMS	69
	Sn	6×10^{-4}	2.5	1060—1200	Radioactive	69
		1×10^{-5}	2	800—1000	Radioactive	69
	P	($D \sim 10^{-12}$ — 10^{-10})	2.9	800—1150	Reflectance measurements	69
		As (self)	7×10^{-1}	3.2	—	Radioactive	69
	Cr	2.04×10^{-6}	0.83 (f)	750—1000	SIMS	69
			1.7 (s)	700—900	—	—
	O	7.9×10^{-3}	2.2	800—1100	Chemical analysis	69
		2×10^{-3}	1.1	700—900	Mass spectroscopy	69
	S	1.85×10^{-2}	2.6	1000—1300	Radioactive	69
1.1×10^1		2.95	750—900	Electrical	69	
Se	3×10^3	4.16	1025—1200	Radioactive	69	
Te	1.5×10^{-1}	3.5	1000—1150	Radioactive	69	
Mn	6.5×10^{-1}	2.49	850—1100	Radioactive	69	
Fe	4.2×10^{-2}	1.8	850—1150	Radioactive	69	
	2.2×10^{-3}	2.32	750—1050	Radioactive	69	
Co	5×10^2	2.5	800—1000	Radioactive	69	
	1.2×10^{-1}	2.64	750—1050	Radioactive	69	
Tm	2.3×10^{-16}	1.0	800—1000	Radioactive	69	
GaSb	Li	2.3×10^{-4}	1.9 (s)	527—657	Electrical and flame photometry	69
	Cu	1.2×10^{-1}	0.7 (f)	277—657	—	—
4.7×10^{-3}		0.9	470—650	Radioactive	69	

DIFFUSION DATA FOR SEMICONDUCTORS (continued)

Semiconductor	Diffusant	Frequency factor, D_0 (cm ² /s)	Activation energy, Q (eV)	Temperature range (°C)	Method of measurement	Ref.	
GaP	Zn	($D \sim 2 \times 10^{-13}$ — 1×10^{-11})	2	510—600	Radioactive	69	
	Cd	1.5×10^{-6}	0.72	640—800	Electrical	69	
	Ga (self)	3.2×10^3	3.15	658—700	Radioactive	69	
	In	1.2×10^{-7}	0.53	320—650	Radioactive	69	
	Sn	2.4×10^{-5}	0.8	320—650	Radioactive	69	
		1.3×10^{-5}	1.1	500—650	Radioactive	69	
	Sb (self)	3.4×10^4	3.45	658—700	Radioactive	69	
	Se	($D \sim 2.4 \times 10^{-13}$ — 1.37×10^{-11})	—	400—500	Radioactive	69	
	Te	3.8×10^{-4}	1.20	320—650	Radioactive	69	
	Fe	5×10^{-2}	1.9 (I)	500—650	Radioactive	69	
		5×10^2	2.3 (II)	500—650			
	Ag	—	—	1000—1300	Radioactive	69	
	Au	8	2.5 (I)	1050—1250	Radioactive	69	
		20	2.4 (II)	1100—1250	Diffusion (I) A face and (II) B face		
	InP	Be	($D_{\max} \sim 2.4 \times 10^{-9}$ — 8.5×10^{-8})	—	900—1000	Atomic absorption analysis	69
		Mg	5×10^{-5}	1.4	700—1050	Electrical	69
Zn		1.0	2.1	700—1300	Radioactive	69	
Ge		—	—	900—1000	Radioactive	69	
Cr		6.2×10^{-4}	1.2	900—1130	Radioactive; ESR	69	
S		3.2×10^3	4.7	1120—1305	Radioactive	69	
Mn		2.1×10^9	4.7	$T < 950$	Radioactive; ESR	69	
		1.1×10^{-6}	0.9	950—1130			
Fe		1.6×10^{-1}	2.3	980—1180	Radioactive	69	
Co		2.8×10^{-3}	2.9	850—1100	Radioactive	69	
Cu		3.8×10^{-3}	0.69	600—900	Radioactive	69	
Ag		3.6×10^{-4}	0.59	500—900	Radioactive	69	
Au		1.32×10^{-5}	0.48	600—820	Radioactive	69	
		1.37×10^{-4}	0.73	600—900	Radioactive	69	
Zn		1.6×10^{-8}	0.3	750—900	Electrical	69	
InAs			($D \sim 2 \times 10^{-9}$ — 4×10^{-8})	—	700—900	Radioactive	69
	Cd	1.8	1.9	700—900	Radioactive	69	
		1.1×10^{-7}	0.72	700—900	Electrical	69	
		($D \sim 7 \times 10^{-13}$ — 2×10^{-10})	—	450—650	Electrical	69	
	In (self)	1×10^5	3.85	830—990	Radioactive	69	
	Sn	($D \sim 3 \times 10^{-8}$)	—	550	Etching and cathodoluminescence	69	
	P (self)	7×10^{10}	5.65	900—1000	Radioactive	69	
	Cr	—	—	600—900	Radioactive	69	
	S	3.6×10^{-4}	1.94	585—708	Electrical	69	
	Se	($D \sim 2 \times 10^{-8}$)	—	550	Cathodoluminescence	69	
	Mn	—	2.9	650—750	SIMS	69	
	Fe	3	2	600—950	Radioactive	69	
		6.8×10^5	3.4	600—700	SIMS	69	
	Co	9×10^{-1}	1.8	600—950	Radioactive	69	
	Cu	3.6×10^{-3}	0.52	342—875	Radioactive	69	
		2.2×10^{-2}	0.54	525—890	Radioactive	69	
Ag	7.3×10^{-4}	0.26	450—900	Radioactive	69		
Au	5.8×10^{-3}	0.65	600—900	Radioactive	69		
Mg	1.98×10^{-6}	1.17	600—900	Electrical	69		
Zn	4.2×10^{-3}	0.96	600—900	Radioactive	69		
	3.11×10^{-3}	1.17	600—900	Electrical	69		

DIFFUSION DATA FOR SEMICONDUCTORS (continued)

Semiconductor	Diffusant	Frequency factor, D_0 (cm ² /s)	Activation energy, Q (eV)	Temperature range (°C)	Method of measurement	Ref.
InSb	Cd	7.4×10^{-4}	1.15	650—900	Radioactive	69
	Hg	1.45×10^{-5}	1.32	650—850	Radioactive	69
	In (self)	6×10^5	4.0	740—900	Radioactive	69
	Ge	3.74×10^{-6}	1.17	600—900	Electrical	69
	Sn	1.49×10^{-6}	1.17	600—900	Electrical	69
	As (self)	3×10^7	4.45	740—900	Radioactive	69
	S	6.78	2.2	600—900	Electrical	69
	Se	12.6	2.2	600—900	Electrical	69
	Te	3.43×10^{-5}	1.28	600—900	Electrical	69
	Li	7×10^{-4}	0.28	0—210	Electrical	69
	Cu	9×10^{-4}	1.08	200—500	Radioactive	69
		3×10^{-5}	0.37	230—490	Radioactive	69
	Ag	1×10^{-7}	0.25	440—510	Radioactive	69
	Au	7×10^{-4}	0.32	140—510	Radioactive	69
	Zn	5×10^{-1}	1.35	362—508	Radioactive	69
		—	1.5	355—455	SIMS	69
	Cd	1×10^{-5}	1.1	250—500	Radioactive	69
		1.3×10^{-4}	1.2	360—500	Electrical	69
	Hg	4×10^{-6}	1.17	425—500	Radioactive	69
	In (self)	6×10^{-7}	1.45	400—500	Radioactive	69
	1.8×10^{13}	4.3	475—517	Radioactive	69	
Sn	5.5×10^{-8}	0.75	390—512	Radioactive	69	
Pb	$(D \sim 2.7 \times 10^{-15})$	—	500	Radioactive	71	
Sb (self)	5.35×10^{-4}	1.91	400—500	Radioactive	69	
	3.1×10^{13}	4.3	475—517	Radioactive	69	
S	9×10^{-2}	1.4	360—500	Electrical	69	
Se	1.6	1.87	380—500	Electrical	69	
Te	1.7×10^{-7}	0.57	300—500	Radioactive	69	
Fe	1×10^{-7}	0.25	440—510	Radioactive	69	
Co	2.7×10^{-11}	0.39	420—500	Radioactive	69	
AlAs	Ga	$(D \sim 2 \times 10^{-18} \text{—} 10^{-15})$	3.6	850—1100	AES	70
	Zn	$(D \sim 9 \times 10^{-11})$	—	557	SEM	69
AlSb	Cu	3.5×10^{-3}	0.36	150—500	Radioactive	69
	Zn	3.3×10^{-1}	1.93	660—860	Radioactive	69
	Cd	$(D(c) \sim 4 \times 10^{-12} \text{—} 3 \times 10^{-10})$	—	900	Radioactive	69
	Al (self)	2	1.88	570—620	X-ray	69
	Sb (self)	1	1.7	570—620	X-ray	69
ZnS	Cu	2.6×10^{-3}	0.79	470—750	Radioactive	69
		4.3×10^{-4}	0.64	250—1200	Electroluminescence	69
		9.75×10^{-3}	1.04	400—800	Luminescence	69
	Au	1.75×10^{-4}	1.16	500—800	Radioactive	69
	Zn (self)	3×10^{-4}	1.5	925<T<940	Radioactive	69
		1.5×10^4	3.26	940<T<1030		
		1×10^{16}	6.5	1030<T<1075		
	Cd	$(D \sim 10^{-10})$	—	1100	Luminescence	72
	Al	5.69×10^{-4}	1.28	800—1000	Luminescence	69
	In	3×10^1	2.2	750—1000	Radioactive	69
	S (self)	2.16×10^4	3.15	600—800	Radioactive	69
		8×10^{-5}	2.2	740—1100	Radioactive	69
	Se	$(D \sim 5 \times 10^{-13})$	—	1070	X-ray microprobe	69
	Mn	2.3×10^3	2.46	500—800	Radioactive	69
ZnSe	Li	2.66×10^{-6}	0.49	950—980	Electrical	69
	Cu	1×10^{-4}	0.66	400—800	Luminescence	69
		1.7×10^{-5}	0.56	200—570	Radioactive	69
	Ag	2.2×10^{-2}	1.18	400—800	Luminescence	69

DIFFUSION DATA FOR SEMICONDUCTORS (continued)

Semiconductor	Diffusant	Frequency factor, D_0 (cm ² /s)	Activation energy, Q (eV)	Temperature range (°C)	Method of measurement	Ref.
ZnTe	Zn (self)	9.8	3.0	760—1150	Radioactive	69
	Cd	6.39×10^{-4}	1.87	700—950	Photoluminescence	69
	Al	2.3×10^{-2}	1.8	800—1100	Luminescence	69
	Ga	1.81×10^2	3.0	900—1100	Luminescence	69
		—	1.3	700—850	Electron probe	69
	In	($D \sim 2 \times 10^{-12}$)	—	940	—	69
	S	($D \sim 8 \times 10^{-12}$)	—	1060	X-ray microprobe	69
	Se (self)	1.3×10^1	2.5	860—1020	Radioactive	69
		2.3×10^{-1}	2.7	1000—1050	Radioactive	69
	Ni	($D \sim 1.5 \times 10^{-8}$ — 1.7×10^{-7})	—	740—910	Luminescence	69
	Li	2.9×10^{-2}	1.22 (s)	400—700	Nuclear and chemical analysis	69
			1.7×10^{-4}	0.78 (f)		
	Zn (self)	2.34	2.56	760—860	Radioactive	69
		1.4×10^1	2.69	667—1077	Radioactive	69
CdS	Al	—	2.0	700—1000	Electrical and optical	69
	In	4	1.96	1100—1300	Radioactive	69
	Te (self)	2×10^4	3.8	727—977	Radioactive	69
	Li	3×10^{-6}	0.68	610—960	Microhardness	69
	Na	($D \sim 3 \times 10^{-7}$)	—	800	Radioactive	69
	Cu	1.5×10^{-3}	0.76	400—700	Radioactive	69
		1.2×10^{-2}	1.05	300—700	Ultrasonic	69
		8×10^{-5}	0.72	20—200	Electrical	69
	Ag	2.5×10^1	1.2 (s)	300—500	Radioactive	69
		2.4×10^{-1}	0.8 (f)			
	Au	2×10^2	1.8	500—800	Radioactive	69
	Zn	1.27×10^{-9}	0.86 (s)	720—1000	Radioactive	69
		1.22×10^{-8}	0.66 (f)			
	CdSe	Cd (self)	3.4	2.0	700—1100	Radioactive	69
Ga		—	—	667—967	Optical and microprobe	69
In		6×10^1	2.3 (||)	650—930	Radioactive, optical and microprobe	69
		1×10^1	2.03 (L)			
P		6.5×10^{-4}	1.6	800—1100	Radioactive	69
S (self)		1.6×10^{-2}	2.05	800—900	Radioactive	69
		—	2.4	750—1050	Radioactive	69
Se		($D \sim 1.2 \times 10^{-9}$)	—	900	Radioactive	69
Te		1.3×10^{-7}	10.4	700—1000	Radioactive	69
Cl		($D \sim 3 \times 10^{-10}$)	—	800	Electrical	69
I		($D \sim 5 \times 10^{-12}$)	—	1000	Radioactive	69
Ni		6.75×10^{-3}	10.9	570—900	Luminescence	69
Yb		($D \sim 1.3 \times 10^{-9}$)	—	960	Photoluminescence	69
Ag		2×10^{-4}	0.53	22—400	Ultrasonic	69
CdTe	Cd (self)	1.6×10^{-3}	1.5	700—1000	Radioactive	69
		6.3×10^{-2}	1.25 (I)	600—900	Radioactive;	69
		4.12×10^{-2}	2.18 (II)	600—900	(I) saturated Cd and (II) saturated Se pressure	
	P	($D \sim 5.3 \times 10^{-12}$ — 6×10^{-11})	—	900—1000	Radioactive	69
	Se (self)	2.6×10^3	1.55	700—1000	Radioactive; saturated Se pressure	69
	Li	($D \sim 1.5 \times 10^{-10}$)	—	300	Ion microprobe	69
	Cu	3.7×10^{-4}	0.67	97—300	Radioactive	69
		8.2×10^{-8}	0.64	290—350	Ion backscattering	69
	Ag	—	—	700—800	Electrical and photo-	

DIFFUSION DATA FOR SEMICONDUCTORS (continued)

Semiconductor	Diffusant	Frequency factor, D_0 (cm ² /s)	Activation energy, Q (eV)	Temperature range (°C)	Method of measurement	Ref.	
					luminescence	69	
	Au	6.7×10^1	2.0	600—1000	Radioactive	69	
	Cd (self)	1.26	2.07	700—1000	Radioactive	69	
		3.26×10^2	2.67 (I)	650—900	Radioactive;	69	
		1.58×10^1	2.44 (II)		(I) saturated Cd and (II) saturated Te pressure		
	In	8×10^{-2}	1.61	650—1000	Radioactive	69	
		1.17×10^{-2}	2.21 (I)	500—850	Radioactive; (I) saturated Cd and (II) saturated Te pressure		
		6.48×10^{-4}	1.15 (II)			69	
	Sn	8.3×10^{-2}	2.2	700—925	Radioactive	69	
	P	$(D \sim 1.2 \times 10^{-10})$	—	900	Radioactive	69	
	As	—	—	850	—	69	
	O	5.6×10^{-9}	1.22	200—650	Mass spectrometry	69	
		6.0×10^{-10}	0.29	650—900			
	Se	1.7×10^{-4}	1.35	700—1000	Radioactive	69	
	Te (self)	8.54×10^{-7}	1.42 (I)	600—900	Radioactive; (I) saturated Cd and (II) saturated Te pressure		
						69	
		1.66×10^{-4}	1.38 (II)	500—800			
	HgSe	7.1×10^{-2}	1.6	520—800	Radioactive	69	
		Fe	$(D \sim 4 \times 10^{-8})$	0.77	900	Radioactive	69
		Sb	6.3×10^{-5}	0.85	540—630	Radioactive	69
		Se (self)	—	—	200—400	Radioactive	69
	HgTe	Ag	6×10^{-4}	0.8	250—350	Radioactive	69
		Zn	5×10^{-8}	0.6	250—350	Radioactive	69
		Cd	3.1×10^{-4}	0.66	250—350	Radioactive	69
		Hg (self)	2×10^{-8}	0.6	200—350	Radioactive	69
		In	6×10^{-6}	0.9	200—300	Radioactive	69
		Sn	1.72×10^{-6}	0.66 (s)	200—300	Radioactive	69
		Te (self)	1.8×10^{-3}	0.80 (f)			
		10^{-6}	1.4	200—400	Radioactive	69	
	PbS	Mn	1.5×10^{-4}	1.3	250—350	Radioactive	69
		Cu	4.6×10^{-4}	0.36	150—450	Electrical	69
			5×10^{-3}	0.31	100—400	Electrical	69
		Pb (self)	8.6×10^{-5}	1.52	500—800	Radioactive	69
	S (self)	6.8×10^{-5}	1.38	500—750	Radioactive	69	
	PbSe	Ni	1.78×10^1	0.95	200—500	Electrical	69
		Na	1.5×10^1	1.74 (s)	400—850	Radioactive	69
			5.6×10^{-6}	0.4 (f)			
		2×10^{-5}	0.31	93—520	Radioactive	69	
	Ag	7.4×10^{-4}	0.35	400—850	Radioactive	69	
	Pb (self)	4.98×10^{-6}	0.83	400—800	Radioactive	69	
	Sb	3.4×10^{-1}	2.0	650—850	Radioactive	69	
	Se (self)	2.1×10^{-5}	1.2	650—850	Radioactive	69	
	Cl	1.6×10^{-8}	0.45	400—850	Radioactive	69	
	Ni	$(D \sim 1 \times 10^{-10})$	—	700	Radioactive	69	
	PbTe	Na	1.7×10^{-1}	1.91	600—850	Radioactive	69
		Sn	3.1×10^{-2}	1.56	500—800	Radioactive	69
		Pb (self)	2.9×10^{-5}	0.6	250—500	Radioactive	69
		Sb	4.9×10^{-2}	1.54	500—800	Radioactive	69
		Te	2.7×10^{-6}	0.75	500—800	Radioactive	69
		Cl	$(D > 2.3 \times 10^{-10})$	—	700	Radioactive	69
		Ni	$(D > 1 \times 10^{-6})$	—	700	Radioactive	69

DIFFUSION DATA FOR SEMICONDUCTORS (continued)

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PROPERTIES OF MAGNETIC MATERIALS

H. P. R. Frederikse

Glossary of Symbols

Quantity	Symbol	Units	
		SI	emu
Magnetic field	H	$A\ m^{-1}$	Oe (oersted)
Magnetic induction	B	T (tesla)	G (gauss)
Magnetization	M	$A\ m^{-1}$	$emu\ cm^{-3}$
Spontaneous magnetization	M_s	$A\ m^{-1}$	$emu\ cm^{-3}$
Saturation magnetization	M_0	$A\ m^{-1}$	$emu\ cm^{-3}$
Magnetic flux	Φ	Wb (weber)	maxwell
Magnetic moment	m, μ	$A\ m^2$	erg/G
Coercive field	H_c	$A\ m^{-1}$	Oe
Remanence	B_r	T	G
Saturation magnetic polarization	J_s	T	G
Magnetic susceptibility	χ		
Magnetic permeability	μ	$H\ m^{-1}$ (henry/meter)	
Magnetic permeability of free space	μ_0	$H\ m^{-1}$	
Saturation magnetostriction	$\lambda (\Delta l/l)$		
Curie temperature	T_C	K	K
Néel temperature	T_N	K	K

Magnetic moment $\mu = \gamma \hbar J = g \mu_B J$

where

γ = gyromagnetic ratio; J = angular momentum; g = spectroscopic splitting factor (~2)

μ_B = bohr magneton = $9.2741 \cdot 10^{-24} J/T = 9.2741 \cdot 10^{-21} \text{ erg/G}$

Earth's magnetic field $H = 56\ A\ m^{-1} = 0.7\ \text{Oe}$

For iron: $M_0 = 1.7 \cdot 10^6\ A\ m^{-1}$; $B_r = 0.8 \cdot 10^6\ A\ m^{-1}$

1 Oe = $(1000/4\pi)\ A\ m^{-1}$; 1 G = $10^{-4}\ T$; 1 emu $cm^{-3} = 10^3\ A\ m^{-1}$

1 maxwell = $10^{-8}\ \text{Wb}$

$\mu_0 = 4\pi \cdot 10^{-7}\ H\ m^{-1}$

Relation Between Magnetic Induction and Magnetic Field

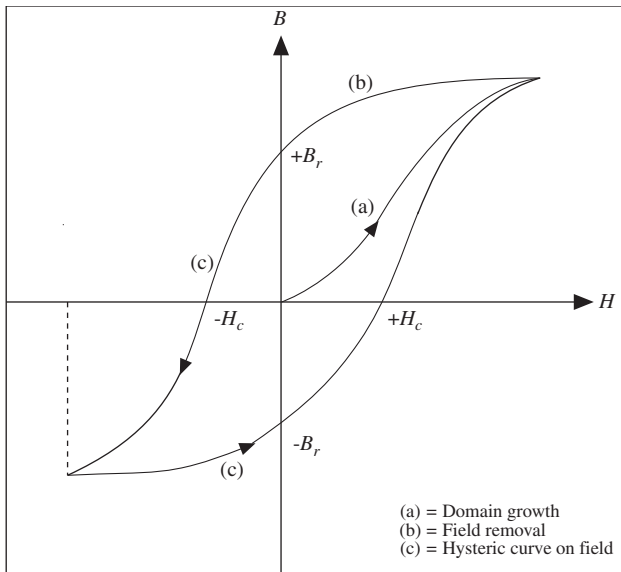


Figure 1. Typical curve representing the dependence of magnetic induction B on magnetic field H for a ferromagnetic material. When H is first applied, B follows curve **a** as the favorably oriented magnetic domains grow. This curve flattens as saturation is approached. When H is then reduced, B follows curve **b**, but retains a finite value (the remanence B_r) at $H = 0$. In order to demagnetize the material, a negative field $-H_c$ (where H_c is called the coercive field or coercivity) must be applied. As H is further decreased and then increased to complete the cycle (curve **c**), a hysteresis loop is obtained. The area within this loop is a measure of the energy loss per cycle for a unit volume of the material.

PROPERTIES OF MAGNETIC MATERIALS (continued)

Relation Between Magnetic Induction and Magnetic Field (continued)

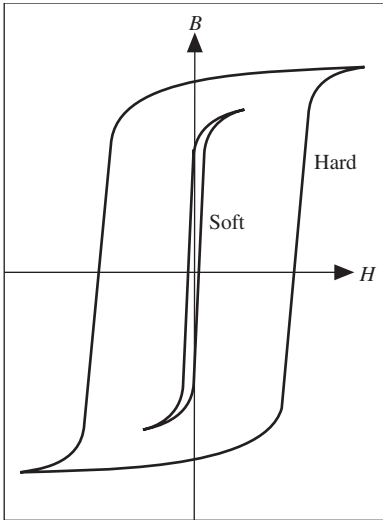


Figure 2. Schematic curve illustrating the B vs. H dependence for hard and soft magnetic materials. Hard materials have a larger remanence and coercive field, and a correspondingly large hysteresis loss.

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Ralls, K.M., Courtney, T.H., and Wulff, J., *Introduction to Materials Science and Engineering*, J. Wiley & Sons, New York, 1976, p. 577, 582. With permission.

Magnetic Susceptibility of the Elements

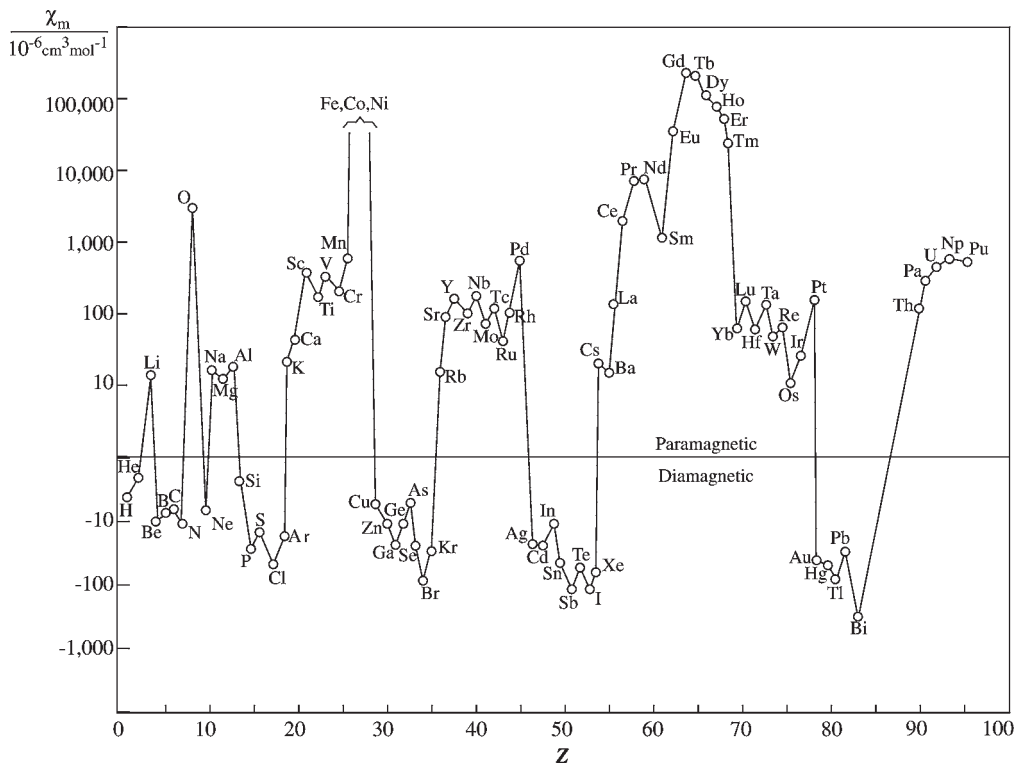


Figure 3. Molar susceptibility of the elements at room temperature (cgs units of $10^{-6} \text{ cm}^3/\text{mol}$). Values are not available for $Z=9$, 61, and 84–89; Fe, Co, and Ni ($Z=26$ –28) are ferromagnetic. Data taken from the table "Magnetic Susceptibility of the Elements and Inorganic Compounds" in Section 4.

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PROPERTIES OF MAGNETIC MATERIALS (continued)

Ground State of Ions with Partly Filled *d* or *f* Shells

Z	Element	<i>n</i>	<i>S</i>	<i>L</i>	<i>J</i>	Gr. state	<i>p</i> _{calc} ^a	<i>p</i> _{calc} ^b	<i>p</i> _{meas}
22	Ti ³⁺	1	1/2	2	3/2	² D _{3/2}	1.73	1.55	1.8
23	V ⁴⁺	1	1/2	2	3/2	² D _{3/2}	1.73	1.55	1.8
23	V ³⁺	2	1	3	2	³ F ₂	2.83	1.63	2.8
23	V ²⁺	3	3/2	3	3/2	⁴ F _{3/2}	3.87	0.77	3.8
24	Cr ³⁺	3	3/2	3	3/2	⁴ F _{3/2}	3.87	0.77	3.7
25	Mn ⁴⁺	3	3/2	3	3/2	⁴ F _{3/2}	3.87	0.77	4.0
24	Cr ²⁺	4	2	2	0	⁵ D ₀	4.90	0	4.9
25	Mn ³⁺	4	2	2	0	⁵ D ₀	4.90	0	5.0
25	Mn ²⁺	5	5/2	0	5/2	⁶ S _{5/2}	5.92	5.92	5.9
26	Fe ³⁺	5	5/2	0	5/2	⁶ S _{5/2}	5.92	5.92	5.9
26	Fe ²⁺	6	2	2	4	⁵ D ₄	4.90	6.70	5.4
27	Co ²⁺	7	3/2	3	9/2	⁴ F _{9/2}	3.87	6.54	4.8
28	Ni ²⁺	8	1	3	4	³ F ₄	2.83	5.59	3.2
29	Cu ²⁺	9	1/2	2	5/2	² D _{5/2}	1.73	3.55	1.9
							<i>p</i> _{calc} ^c		
58	Ce ³⁺	1	1/2	3	5/2	² F _{5/2}	2.54		2.4
59	Pr ³⁺	2	1	5	4	³ H ₄	3.58		3.5
60	Nd ³⁺	3	3/2	6	9/2	⁴ I _{9/2}	3.62		3.5
61	Pm ³⁺	4	2	6	4	⁵ I ₄	2.68		
62	Sm ³⁺	5	5/2	5	5/2	⁶ H _{5/2}	0.84		1.5
63	Eu ³⁺	6	3	3	0	⁷ F ₀	0.0		3.4
64	Gd ³⁺	7	7/2	0	7/2	⁸ S _{7/2}	7.94		8.0
65	Tb ³⁺	8	3	3	6	⁷ F ₆	9.72		9.5
66	Dy ³⁺	9	5/2	5	15/2	⁶ H _{15/2}	10.63		10.6
67	Ho ³⁺	10	2	6	8	⁵ I ₈	10.60		10.4
68	Er ³⁺	11	3/2	6	15/2	⁴ I _{15/2}	9.59		9.5
69	Tm ³⁺	12	1	5	6	³ H ₆	7.57		7.3
70	Yb ³⁺	13	1/2	3	7/2	² F _{7/2}	4.54		4.5

^a $p_{\text{calc}} = 2[S(S+1)]^{1/2}$

^b $p_{\text{calc}} = 2[J(J+1)]^{1/2}$

^c $p_{\text{calc}} = g[J(J+1)]^{1/2}$

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Ferro- and Antiferromagnetic Elements

M_0 is the saturation magnetization at $T = 0$ K

n_B is the number of Bohr magnetons per atom

T_C is the Curie temperature

T_N is the Néel temperature

	M_0/gauss	n_B	T_C/K	T_N/K	Comments
Fe	1752	2.22	1043		
Co	1446	1.72	1388		
Ni	510	0.62	627		
Cr				311	
Mn				100	
Ce				12.5	c-Axis antiferromagnetic
Nd				19.2	Basal plane modulation on hexagonal sites

PROPERTIES OF MAGNETIC MATERIALS (continued)

Ferro- and Antiferromagnetic Elements (continued)

	M_0/gauss	n_B	T_C/K	T_N/K	Comments
				7.8	Cubic sites order (periodicity different from high-T phase)
Sm				106	Ordering on hexagonal sites
				13.8	Cubic site order
Eu				90.5	Spiral along cube axis
Gd	1980	7	293		
Tb		9	220		Basal plane ferromagnet
				230.2	Basal plane spiral
Dy		10	87		Basal plane ferromagnet
				176	Basal plane spiral
Ho		10	20		Bunched cone structure
				133	Basal plane spiral
Er		9	32		c-Axis ferrimagnetic cone structure
				80	c-Axis modulated structure
Tm		7	32		c-Axis ferrimagnetic cone structure
				56	c-Axis modulated structure

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Selected Ferromagnetic Compounds

M_0 is the saturation magnetization at $T = 293$ K

T_C is the Curie temperature

Compound	M_0/gauss	T_C/K	Crystal system
MnB	152	578	orthorh(FeB)
MnAs	670	318	hex(FeB)
MnBi	620	630	hex(FeB)
MnSb	710	587	hex(FeB)
Mn ₄ N	183	743	
MnSi		34	cub(FeSi)
CrTe	247	339	hex(NiAs)
CrBr ₃	270	37	hex(BiI ₃)
CrI ₃		68	hex(BiI ₃)
CrO ₂	515	386	tetr(TiO ₂)
EuO	1910*	77	cub
EuS	1184*	16.5	cub
GdCl ₃	550*	2.2	orthorh
FeB		598	orthorh
Fe ₂ B		1043	tetr (CuAl ₂)
FeBe ₅		75	cub(MgCu ₂)
Fe ₃ C		483	orthorh
FeP		215	orthorh (MnP)

* At $T = 0$ K

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PROPERTIES OF MAGNETIC MATERIALS (continued)

Magnetic Properties of High-Permeability Metals and Alloys (Soft)

μ_i is the initial permeability
 μ_m is the maximum permeability
 H_c is the coercive force
 J_s is the saturation polarization
 W_H is the hysteresis loss per cycle
 T_C is the Curie temperature

Material	Composition (mass %)	μ_i/μ_0	μ_m/μ_0	$H_c/A\ m^{-1}$	J_s/T	$W_H/J\ m^{-3}$	T_C/K
Iron	Commercial 99Fe	200	6000	70	2.16	500	1043
Iron	Pure 99.9Fe	25000	350000	0.8	2.16	60	1043
Silicon-iron	96Fe-4Si	500	7000	40	1.95	50-150	1008
Silicon-iron (110) [001]	97Fe-3Si	9000	40000	12	2.01	35-140	1015
Silicon-iron {100} <100>	97Fe-3Si		100000	6	2.01		1015
Mild steel	Fe-0.1C-0.1Si-0.4Mn	800	1100	200			
Hypermik	50Fe-50Ni	4000	70000	4	1.60	22	753
Deltamax {100} <100>	50Fe-50Ni	500	200000	16	1.55		773
Isoperm {100} <100>	50Fe-50Ni	90	100	480	1.60		
78 Permalloy	78Ni-22Fe	4000	100000	4	1.05	50	651
Supermalloy	79Ni-16Fe-5Mo	100000	1000000	0.15	0.79	2	673
Mumetal	77Ni-16Fe-5Cu-2Cr	20000	100000	4	0.75	20	673
Hyperco	64Fe-35Co-0.5Cr	650	10000	80	2.42	300	1243
Permendur	50Fe-50Co	500	6000	160	2.46	1200	1253
2V-Permendur	49Fe-49Co-2V	800	4000	160	2.45	600	1253
Supermendur	49Fe-49Co-2V		60000	16	2.40	1150	1253
25Perminvar	45Ni-30Fe-25Co	400	2000	100	1.55		
7Perminvar	70Ni-23Fe-7Co	850	4000	50	1.25		
Perminvar (magnet. annealed)	43Ni-34Fe-23Co		400000	2.4	1.50		
Alfenol (or Alperm)	84Fe-16Al	3000	55000	3.2	0.8		723
Alfer	87Fe-13Al	700	3700	53	1.20		673
Aluminum-Iron	96.5Fe-3.5Al	500	19000	24	1.90		
Sendust	85Fe-10Si-5Al	36000	120000	1.6	0.89		753

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2. Gray, D.E., Ed., *American Institute of Physics Handbook, Third Edition*, McGraw Hill, New York, 1972, p. 5-224.

Applications of High-Permeability Materials

Applications

Requirements

POWER APPLICATIONS

Distribution and power transformers

Low core losses, high permeability, high saturation magnetic polarization

High-quality motors and generators, stators and armatures, switched-mode power supplies

INSTRUMENT TRANSFORMERS

Audiofrequency transformers
Pulse transformers

Low core losses, high permeability, high magnetic polarization
High permeability

PROPERTIES OF MAGNETIC MATERIALS (continued)

Applications of High-Permeability Materials (continued)

Applications

Requirements

CORES FOR INDUCTOR COILS

Audiofrequency	Low hysteresis, high permeability
Carrier frequency	Very low hysteresis and eddy current loss
Radiofrequency	High permeability at low fields

MISCELLANEOUS

Relays, switches } Earth leakage circuit }	High permeability, low remanence, low coercivity
Magnetic shielding	Low core loss for AC applications
Magnetic recording heads	High initial permeability, low or zero remanence
Magnetic amplifiers } Saturable reactors } Saturable transformers } Transformer cores }	Rectangular hysteresis loops, low hysteresis loss
Magnetic shunts for temperature compensation in magnetic circuits	Low Curie temperature, appropriate decrease in permeability with increase in temperature
Electromagnets in indicating instruments, fire detection, quartz watches, electromechanical devices	High permeability, high saturation magnetic polarization
Magnetic yokes in permanent magnet devices, such as lifting and holding magnets, loudspeakers	High permeability, high saturation magnetic polarization

REFERENCE

McCurrie, R.A., *Structure and Properties of Ferromagnetic Materials*, Academic Press, London, 1994. With permission.

Saturation Magnetostriction of Selected Materials

The tabulated parameter λ_s is related to the fractional change in length $\Delta l/l$ by $\Delta l/l = (3/2)\lambda_s(\cos^2\theta - 1/3)$, where θ is the angle of rotation.

Material	$\lambda_s \times 10^6$
Iron	-7
Fe - 3.2% Si	+9
Nickel	-33
Cobalt	-62
45 Permalloy, 45% Ni - 55% Fe	+27
Permalloy, 82% Ni - 18% Fe	0
Permendur, 49% Co - 49% Fe - 2% V	+70
Alfer, 87% Fe - 13% Al	+30
Magnetite, Fe ₃ O ₄	+40
Cobalt ferrite, CoFe ₂ O ₄	-110
SmFe ₂	-1560
TbFe ₂	+1753
Tb _{0.3} Dy _{0.7} Fe _{1.93} (Terfenol D)	+2000
Fe ₆₆ Co ₁₈ B ₁₅ Si (amorphous)	+35
Co ₇₂ Fe ₃ B ₆ A ₁₃ (amorphous)	0

REFERENCE

McCurrie, R.A., *Structure and Properties of Ferromagnetic Materials*, Academic Press, London, 1994, p. 91; additional data provided by A.E. Clark, Adelphi, MD.

PROPERTIES OF MAGNETIC MATERIALS (continued)

Properties of Various Permanent Magnetic Materials (Hard)

B_r is the remanence

BH_c is the flux coercivity

iH_c is the intrinsic coercivity

$(BH)_{\max}$ is the maximum energy product

T_C is the Curie temperature

T_{\max} is the maximum operating temperature

Composition	B_r/T	$BH_c/10^3$ A m ⁻¹	$iH_c/10^3$ A m ⁻¹	$(BH)_{\max}/$ kJ m ⁻³	$T_C/^\circ\text{C}$	$T_{\max}/^\circ\text{C}$
Alnico1 20Ni;12Al;5Co	0.72		35	25		
Alnico2 17Ni;10Al;12.5Co;6Cu	0.72		40-50	13-14		
Alnico3 24-30Ni;12-14Al;0-3Cu	0.5-0.6		40-54	10		
Alnico4 21-28Ni;11-13Al;3-5Co;2-4Cu	0.55-0.75		36-56	11-12		
Alnico5 14Ni;8Al;24Co;3Cu	1.25	53	54	40	850	520
Alnico6 16Ni;8Al;24Co;3Cu;2Ti	1.05		75	52		
Alnico8 15Ni;7Al;35Co;4Cu;5Ti	0.83	1.6	160	45		
Alnico9 15Ni;7Al;35Co;4Cu;5Ti	1.10	1.45	1.45	75	850	520
Alnico12 13.5Ni;8Al;24.5Co;2Nb	1.20		64	76.8		
BaFe ₁₂ O ₁₉ (Ferroxdur)	0.4	1.6	192	29	450	400
SrFe ₁₂ O ₁₉	0.4	2.95	3.3	30	450	400
LaCo ₅	0.91			164	567	
CeCo ₅	0.77			117	380	
PrCo ₅	1.20			286	620	
NdCo ₅	1.22			295	637	
SmCo ₅	1.00	7.9	696	196	700	250
Sm(Co _{0.76} Fe _{0.10} Cu _{0.14}) _{6.8}	1.04	4.8	5	212	800	300
Sm(Co _{0.65} Fe _{0.28} Cu _{0.05} Zr _{0.02}) _{7.7}	1.2	10	16	264	800	300
Nd ₂ Fe ₁₄ B sintered	1.22	8.4	1120	280	300	100
Fe;52Co;14V (Vicalloy II)	1.0	42		28	700	500
Fe;24Cr;15Co;3Mo (anisotropic)	1.54	67		76	630	500
Fe;28Cr;10.5Co (Chromindur II)	0.98	32		16	630	500
Fe;23Cr;15Co;3V;2Ti	1.35	4		44	630	500
Cu;20Ni;20Fe (Cunife)	0.55	4		12	410	350
Cu;21Ni;29Fe (Cunico)	0.34	0.5		8		
Pt;23Co	0.64	4		76	480	350
Mn;29.5Al;0.5C (anisotropic)	0.61	2.16	2.4	56	300	120

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1. McCurrie, R.A., *Structure and Properties of Ferromagnetic Materials*, Academic Press, London, 1994, p. 204.
2. Gray, D.E., Ed., *American Institute of Physics Handbook, Third Edition*, McGraw Hill, New York, 1972, p. 5-165.
3. Jiles, D., *Magnetism and Magnetic Materials*, Chapman & Hall, London, 1991.

Selected Ferrites

J_s is the saturation magnetic polarization

T_C is the Curie temperature

ΔH is the line width

Material	J_s/T	$T_C/^\circ\text{C}$	$\Delta H/$ kA m ⁻¹	Applications
Spinels				
γ -Fe ₂ O ₃	0.52	575		
Fe ₃ O ₄	0.60	585		
NiFe ₂ O ₄	0.34	575	350	Microwave devices
MgFe ₂ O ₄	0.14	440	70	
NiZnFe ₂ O ₄	0.50	375	120	Transformer cores
MnFe ₂ O ₄	0.50	300	50	Microwave devices

PROPERTIES OF MAGNETIC MATERIALS (continued)

Selected Ferrites (continued)

Material	J_s/T	$T_C/^\circ C$	$\Delta H/kA\ m^{-1}$	Applications
NiCoFe ₂ O ₄	0.31	590	140	Microwave devices
NiCoAlFe ₂ O ₄	0.15	450	330	Microwave devices
NiAl _{0.35} Fe _{1.65} O ₄	0.12	430	67	Microwave devices
NiAlFe ₂ O ₄	0.05	1860	32	Microwave devices
Mg _{0.9} Mn _{0.1} Fe ₂ O ₄	0.25	290	56	Microwave devices
Ni _{0.5} Zn _{0.5} Al _{0.8} Fe _{1.2} O ₄	0.14		17	Microwave devices
CuFe ₂ O ₄	0.17	455		Electromechanical transducers
CoFe ₂ O ₄	0.53	520		
LiFe ₅ O ₈	0.39	670		Microwave devices
Garnets				
Y ₃ Fe ₅ O ₁₂	0.178	280	55	Microwave devices
Y ₃ Fe ₅ O ₁₂ (single crys.)	0.178	292	0.5	Microwave devices
(Y,Al) ₃ Fe ₅ O ₁₂	0.12	250	80	Microwave devices
(Y,Gd) ₃ Fe ₅ O ₁₂	0.06	250	150	Microwave devices
Sm ₃ Fe ₅ O ₁₂	0.170	305		Microwave devices
Eu ₃ Fe ₅ O ₁₂	0.116	293		Microwave devices
GdFe ₅ O ₁₂	0.017	291		Microwave devices
Hexagonal crystals				
BaFe ₁₂ O ₁₉	0.45	430	1.5	Permanent magnets
Ba ₃ Co ₂ Fe ₂₄ O ₄₁	0.34	470	12	Microwave devices
Ba ₂ Zn ₂ Fe ₁₂ O ₂₂	0.28	130	25	Microwave devices
Ba ₃ Co _{1.35} Zn _{0.65} Fe ₂₄ O ₄₁		390	16	Microwave devices
Ba ₂ Ni ₂ Fe ₁₂ O ₂₂	0.16	500	8	Microwave devices
SrFe ₁₂ O ₁₉	0.4	450		Permanent magnets

REFERENCE

McCurrie, R.A., *Structure and Properties of Ferromagnetic Materials*, Academic Press, London, 1994.

Spinel Structure (AB₂O₄)

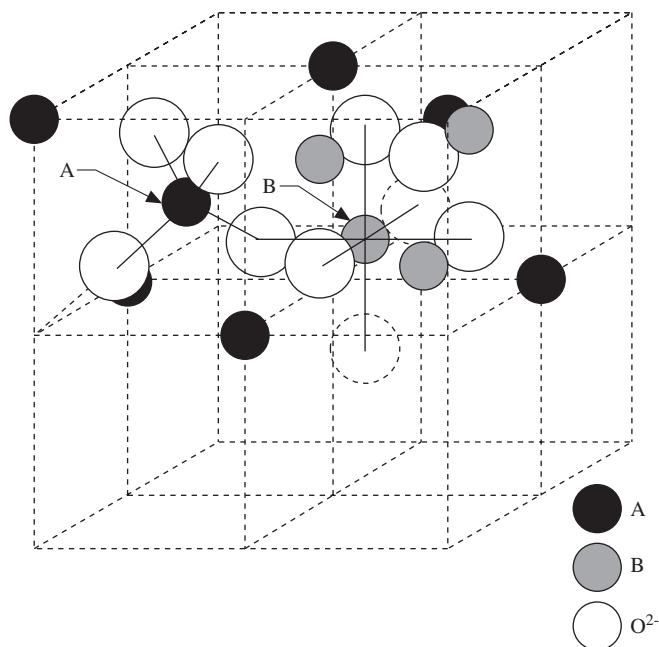


Figure 4. Arrangement of metal ions in the two octants A and B, showing tetrahedrally (A) and octahedrally (B) coordinated sites. (Reprinted from McCurrie, R.A., *Ferromagnetic Materials*, Academic Press, London, 1994. With permission.)

PROPERTIES OF MAGNETIC MATERIALS (continued)

Selected Antiferromagnetic Solids

T_N is the Néel temperature

Material	Structure	T_N/K	Material	Structure	T_N/K
Binary oxides			NiAs and related structures		
MnO	cub(fcc)	122	CrAs	orth	300
FeO	cub(fcc)	198	CrSb	hex	705-723
CoO	cub(fcc)	291	CrSe	hex	300
NiO	cub(fcc)	525	MnTe	hex	320-323
α -Mn ₂ O ₃	cub	90	NiS	hex	263
CuO	monocl	230	CrS	monocl	460
UO ₂	cub	30.8	Rutile and related structures		
Er ₂ O ₃	cub	3.4	CoF ₂	tetr	38
Gd ₂ O ₃	cub	1.6	CrF ₂	monocl	53
Perovskites			FeF ₂	tetr	79
LaCrO ₃	orth	282	MnF ₂	tetr	67
LaMnO ₃	orth	100	NiF ₂	tetr	83
LaFeO ₃	orth	750	CrCl ₂	orth	20
NdCrO ₃	orth	224	MnO ₂	tetr	84
NdFeO ₃	orth	760	FeOF	tetr	315
YbCrO ₃	orth	118	Corundum and related structures		
CaMnO ₃	cub	110	Cr ₂ O ₃	rhomb	318
EuTiO ₃	cub	5.3	α -Fe ₂ O ₃	rhomb	948
YCrO ₃	orth	141	FeTiO ₃	rhomb	68
BiFeO ₃	cub*	673	MnTiO ₃	rhomb	41
KCoF ₃	cub	125	CoTiO ₃	rhomb	38
KMnF ₃	cub*	88.3	VF ₃ and related structures		
KFeF ₃	cub	115	CoF ₃	rhomb	460
KNiF ₃	cub	275	CrF ₃	rhomb	80
NaMnF ₃	cub*	60	FeF ₃	rhomb	394
NaNiF ₃	orth	149	MnF ₃	monocl	43
RbMnF ₃	cub	82	MoF ₃	rhomb	185
Spinels			Miscellaneous		
Co ₃ O ₄	cub	40	K ₂ NiF ₄	tetr	97
NiCr ₂ O ₄	tetr	65	MnI ₂	hex	3.4
ZnCr ₂ O ₄	cub	15	CoUO ₄	orth	12
ZnFe ₂ O ₄	cub	9	CaMn ₂ O ₄	orth	225
GeFe ₂ O ₄	cub	10	CrN	cub*	273
MgV ₂ O ₄	cub	45	CeC ₂	tetr	33
MnGa ₂ O ₄	cub	33	FeSn	hex	373
			Mn ₂ P	hex	103

* Distorted.

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1. Gray, D.E., Ed., *American Institute of Physics Handbook, Third Edition*, McGraw Hill, New York, 1972, p. 5-168 to 183.
2. Kittel, C., *Introduction to Solid State Physics, 6th Edition*, J. Wiley & Sons, New York, 1986.
3. Ashcroft, N.W., and Mermin, N.D., *Solid State Physics*, Holt, Rinehart, and Winston, New York, 1976, p. 697.

ELECTRON WORK FUNCTION OF THE ELEMENTS

The electron work function Φ is a measure of the minimum energy required to extract an electron from the surface of a solid. It is defined more precisely as the energy difference between the state in which an electron has been removed to a distance from the surface of a single crystal face that is large enough that the image force is negligible but small compared to the distance to any other face (typically about 10^{-4} cm) and the state in which the electron is in the bulk solid. In general, Φ differs for each face of a monocrystalline sample.

Since Φ is dependent on the cleanliness of the surface, measurements reported in the literature often cover a considerable range. This table contains selected values for the electron work function of the elements which may be regarded as typical values for a reasonably clean surface. The method of measurement is indicated for each value. The following abbreviations appear:

TE — Thermionic emission
 PE — Photoelectric effect
 FE — Field emission
 CPD — Contact potential difference
 polycr — Polycrystalline sample
 amorp — Amorphous sample

Values in parentheses are only approximate.

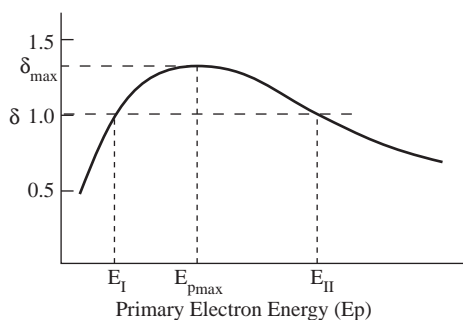
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2. Riviere, J. C., Work Function: Measurements and Results, in *Solid State Surface Science, Vol.1*, Green, M., Editor, Decker, New York, 1969.
3. Michaelson, H. B., *J. Appl. Phys.*, 48, 4729, 1977.

Element	Plane	Φ/eV	Method	Element	Plane	Φ/eV	Method	Element	Plane	Φ/eV	Method
Ag	100	4.64	PE	K	210	5.00	PE	Ru	polycr	4.71	PE
	110	4.52	PE		polycr	2.29	PE	Sb	amorp	4.55	
	111	4.74	PE		La	polycr	3.5	PE	100	4.7	
Al	100	4.20	PE	Li	polycr	2.93	FE	Sc	polycr	3.5	PE
	110	4.06	PE	Lu	polycr	(3.3)	CPD	Se	polycr	5.9	PE
As	polycr	(3.75)	PE	Mg	polycr	3.66	PE	Si	n	4.85	CPD
				111	4.26	PE	Mn	polycr	4.1	PE	p 100	(4.91)	CPD
Au	100	5.47	PE	Mo	100	4.53	PE	p 111	4.60	PE	
	110	5.37	PE	110	4.95	PE	Sm	polycr	2.7	PE	
B	polycr	(4.45)	TH	111	4.55	PE	Sn	polycr	4.42	CPD	
				112	4.36	PE	Sr	polycr	(2.59)	TH	
Ba	polycr	2.52	TH	114	4.50	PE	Ta	polycr	4.25	TH	
Be	polycr	4.98	PE	332	4.55	PE	100	4.15	TH		
Bi	polycr	4.34	PE	Na	polycr	2.36	PE	110	4.80	TH	
C	polycr	(5.0)	CPD	Nb	001	4.02	TH	111	4.00	TH	
Ca	polycr	2.87	PE	110	4.87	TH	Tb	polycr	3.0	PE	
Cd	polycr	4.08	CPD	111	4.36	TH	Te	polycr	4.95	PE	
Ce	polycr	2.9	PE	112	4.63	TH	Th	polycr	3.4	TH	
Co	polycr	5.0	PE	113	4.29	TH	Ti	polycr	4.33	PE	
Cr	polycr	4.5	PE	116	3.95	TH	Tl	polycr	(3.84)	CPD	
Cs	polycr	1.95	PE	310	4.18	TH	U	polycr	3.63	PE	
Cu	100	5.10	FE	Nd	polycr	3.2	PE	100	3.73	PE	
	110	4.48	PE	Ni	100	5.22	PE	110	3.90	PE	
	111	4.94	PE	110	5.04	PE	113	3.67	PE		
	112	4.53	PE	111	5.35	PE	V	polycr	4.3	PE	
Eu	polycr	2.5	PE	Os	polycr	5.93	PE	W	polycr	4.55	CPD
Fe	100	4.67	PE	Pb	polycr	4.25	PE	100	4.63	FE	
	111	4.81	PE	Pd	polycr	5.22	PE	110	5.22	FE	
Ga	polycr	4.32	PE	111	5.6	PE	111	4.45	FE		
Gd	polycr	2.90	CPD	Pt	polycr	5.64	PE	113	4.46	FE	
Ge	polycr	5.0	CPD	110	5.84	FE	116	4.32	TH		
Hf	polycr	3.9	PE	111	5.93	FE	Y	polycr	3.1	PE	
Hg	liquid	4.475	PE	320	5.22	FE	Zn	polycr	3.63	PE	
In	polycr	4.09	PE	331	5.12	FE	polycr	(4.9)	CPD		
Ir	100	5.67	PE	Rb	polycr	2.261	PE	Zr	polycr	4.05	PE
	110	5.42	PE	Re	polycr	4.72	TE				
	111	5.76	PE	Rh	polycr	4.98	PE				

SECONDARY ELECTRON EMISSION

The secondary emission yield, or secondary emission ratio, δ , is the average number of secondary electrons emitted from a bombarded material for every incident primary electron. It is a function of the primary electron energy E_p . The maximum yield δ_{\max} corresponds to a primary electron energy $E_{p\max}$ (see figure). The two primary electron energies corresponding to a yield of unity are denoted the first and second crossovers (E_I and E_{II}). An insulating target, or a conducting target that is electrically floating, will charge positively or negatively depending on the primary electron energy. For $E_I < E_p < E_{II}$, $\delta > 1$ and the surface charges positively provided there is a collector present that is positive with respect to the target. For $E_p < E_I$ or $E_p > E_{II}$, $\delta < 1$, and the surface charges negatively with respect to the potential of the source of primary electrons.



Element	δ_{\max}	$E_{p\max}$ (eV)	E_I (eV)	E_{II} (eV)	Element	δ_{\max}	$E_{p\max}$ (eV)	E_I (eV)	E_{II} (eV)
Ag	1.5	800	200	>2000	Li	0.5	85	None	None
Al	1.0	300	300	300	Mg	0.95	300	None	None
Au	1.4	800	150	>2000	Mo	1.25	375	150	1200
B	1.2	150	50	600	Na	0.82	300	None	None
Ba	0.8	400	None	None	Nb	1.2	375	150	1050
Bi	1.2	550	None	None	Ni	1.3	550	150	>1500
Be	0.5	200	None	None	Pb	1.1	500	250	1000
C (diamond)	2.8	750	None	>5000	Pd	>1.3	>250	120	None
C (graphite)	1.0	300	300	300	Pt	1.8	700	350	3000
C (soot)	0.45	500	None	None	Rb	0.9	350	None	None
Cd	1.1	450	300	700	Sb	1.3	600	250	2000
Co	1.2	600	200	None	Si	1.1	250	125	500
Cs	0.7	400	None	None	Sn	1.35	500	None	None
Cu	1.3	600	200	1500	Ta	1.3	600	250	>2000
Fe	1.3	400	120	1400	Th	1.1	800	None	None
Ga	1.55	500	75	None	Ti	0.9	280	None	None
Ge	1.15	500	150	900	Tl	1.7	650	70	>1500
Hg	1.3	600	350	>1200	W	1.4	650	250	>1500
K	0.7	200	None	None	Zr	1.1	350	None	None

Compound	δ_{\max}	$E_{p\max}$ (eV)	Compound	δ_{\max}	$E_{p\max}$ (eV)
Alkali halides			NaCl (layer)	6.8	600
CsCl	6.5		NaF (crystal)	14	1200
KBr (crystal)	14	1800	NaF (layer)	5.7	
KCl (crystal)	12	1600	NaI (crystal)	19	1300
KCl (layer)	7.5	1200	NaI (layer)	5.5	
KI (crystal)	10	1600	RbCl (layer)	5.8	
KI (layer)	5.6		Oxides		
LiF (crystal)	8.5		Ag ₂ O	1.0	
LiF (layer)	5.6	700	Al ₂ O ₃ (layer)	2—9	
NaBr (crystal)	24	1800	BaO (layer)	2.3—4.8	400
NaBr (layer)	6.3		BeO	3.4	2000
NaCl (crystal)	14	1200	CaO	2.2	500

SECONDARY ELECTRON EMISSION (continued)

Compound	δ_{\max}	$E_{p\max}$ (eV)	Compound	δ_{\max}	$E_{p\max}$ (eV)
Cu ₂ O	1.2	400	Others		
MgO (crystal)	20—25	1500	BaF ₂ (layer)	4.5	
MgO (layer)	3—15	400—1500	CaF ₂ (layer)	3.2	
MoO ₂	1.2		BiCs ₃	6	1000
SiO ₂ (quartz)	2.1—4	400	BiCs	1.9	1000
SnO ₂	3.2	640	GeCs	7	700
Sulfides			Rb ₃ Sb	7.1	450
MoS ₂	1.1		SbCs ₃	6	700
PbS	1.2	500	Mica	2.4	350
WS ₂	1.0		Glasses	2—3	300—450
ZnS	1.8	350			

OPTICAL PROPERTIES OF SELECTED ELEMENTS

J. H. Weaver and H. P. R. Frederikse

These tables list the index of refraction n , the extinction coefficient k , and the normal incidence reflection $R(\phi = 0)$ as a function of photon energy E , which is expressed in electron volts (eV). To convert the energy in eV to wavelength in μm , use $\lambda = 1.2398/E$. To compute the dielectric function $\tilde{\epsilon} = \epsilon_1 + i\epsilon_2$ from the complex index of refraction $\tilde{N} = n + ik$, use $\epsilon_1 = n^2 - k^2$ and $\epsilon_2 = 2nk$.

The optical constants in these tables are abridged from three more extensive tabulations:

- *Optical Properties of Metals (OPM)*, Volumes I and II, *Physics Data*, Nr. 18-1 and 18-2, J. H. Weaver, C. Krafka, D. W. Lynch, and E. E. Koch, Fachinformationzentrum, Karlsruhe, Germany.
- *Handbook of Optical Constants (HOC)*, Vol. I, 1985, and Vol. II, 1991. Edited by E. D. Palik, published by Academic Press, Inc.
- *American Institute of Physics Handbook (AIPH)*, 3rd Edition, Coord. Editor D. E. Gray, published by McGraw-Hill Book Co., New York, 1972.

The first two of these major sources provide detailed comparisons of all optical data available in the literature at the time of the compilation. For critical applications the reader should refer to the original work. References for individual metals and semiconductors are listed at the end of the tables. Generally, tabulated values for the optical properties are accurate to better than 10%. Data in parentheses are extrapolated or interpolated values. For most elements the spectral range covered is from the far infrared (0.010 or 0.10 eV) to the far ultraviolet (10, 30 or 300 eV). The intervals between successive energies in the tables are chosen in such a way that the major spectral features are preserved.

Very small values of k are expressed in exponential notation, e.g., 1.23E-5 means 1.23×10^{-5} .

The following table is convenient for identifying the energy entries in these tables with the corresponding wavelengths:

λ	E/eV	λ	E/eV
1 mm	0.00124	6000 Å	2.066
500 μm	0.00248	5000 Å	2.480
100 μm	0.01240	4000 Å	3.100
50 μm	0.02480	3000 Å	4.133
10 μm	0.12398	2000 Å	6.199
5 μm	0.24797	1000 Å	12.398
1 μm	1.240	400 Å	30.996

Energy (eV)	n	k	$R(\phi = 0)$	Energy (eV)	n	k	$R(\phi = 0)$	Energy (eV)	n	k	$R(\phi = 0)$
Aluminium[†]				2.200	1.018	6.846	0.9200	14.200	0.053	0.373	0.8312
0.040	98.595	203.701	0.9923	2.400	0.826	6.283	0.9228	14.400	0.058	0.327	0.8102
0.050	74.997	172.199	0.9915	2.600	0.695	5.800	0.9238	14.600	0.067	0.273	0.7802
0.060	62.852	150.799	0.9906	2.800	0.598	5.385	0.9242	14.800	0.086	0.211	0.7202
0.070	53.790	135.500	0.9899	3.000	0.523	5.024	0.9241	15.000	0.125	0.153	0.6119
0.080	45.784	123.734	0.9895	3.200	0.460	4.708	0.9243	15.200	0.178	0.108	0.4903
0.090	39.651	114.102	0.9892	3.400	0.407	4.426	0.9245	15.400	0.234	0.184	0.3881
0.100	34.464	105.600	0.9889	3.600	0.363	4.174	0.9246	15.600	0.300	0.073	0.3182
0.125	24.965	89.250	0.9884	3.800	0.326	3.946	0.9247	15.800	0.318	0.065	0.2694
0.150	18.572	76.960	0.9882	4.000	0.294	3.740	0.9248	16.000	0.351	0.060	0.2326
0.175	14.274	66.930	0.9879	4.200	0.267	3.552	0.9248	16.200	0.380	0.055	0.2031
0.200	11.733	59.370	0.9873	4.400	0.244	3.380	0.9249	16.400	0.407	0.050	0.1789
0.250	8.586	48.235	0.9858	4.600	0.223	3.222	0.9249	16.750	0.448	0.045	0.1460
0.300	6.759	40.960	0.9844	4.800	0.205	3.076	0.9249	17.000	0.474	0.042	0.1278
0.350	5.438	35.599	0.9834	5.000	0.190	2.942	0.9244	17.250	0.498	0.040	0.1129
0.400	4.454	31.485	0.9826	6.000	0.130	2.391	0.9257	17.500	0.520	0.038	0.1005
0.500	3.072	25.581	0.9817	6.500	0.110	2.173	0.9260	17.750	0.540	0.036	0.0899
0.600	2.273	21.403	0.9806	7.000	0.095	1.983	0.9262	18.000	0.558	0.035	0.0809
0.700	1.770	18.328	0.9794	7.500	0.082	1.814	0.9265	18.500	0.591	0.032	0.0664
0.800	1.444	15.955	0.9778	8.000	0.072	1.663	0.9269	19.000	0.620	0.030	0.0554
0.900	1.264	14.021	0.9749	8.500	0.063	1.527	0.9272	19.500	0.646	0.028	0.0467
1.000	1.212	12.464	0.9697	9.000	0.056	1.402	0.9277	20.000	0.668	0.027	0.0398
1.100	1.201	11.181	0.9630	9.500	0.049	1.286	0.9282	20.500	0.689	0.025	0.0342
1.200	1.260	10.010	0.9521	10.000	0.044	1.178	0.9286	21.000	0.707	0.024	0.0296
1.300	1.468	8.949	0.9318	10.500	0.040	1.076	0.9293	21.500	0.724	0.023	0.0258
1.400	2.237	8.212	0.8852	11.000	0.036	0.979	0.9298	22.000	0.739	0.022	0.0226
1.500	2.745	8.309	0.8678	11.500	0.033	0.883	0.9283	22.500	0.753	0.021	0.0199
1.600	2.625	8.597	0.8794	12.000	0.033	0.791	0.9224	23.000	0.766	0.021	0.0177
1.700	2.143	8.573	0.8972	12.500	0.034	0.700	0.9118	23.500	0.778	0.020	0.0157
1.800	1.741	8.205	0.9069	13.000	0.038	0.609	0.8960	24.000	0.789	0.019	0.0140
1.900	1.488	7.821	0.9116	13.500	0.041	0.517	0.8789	24.500	0.799	0.018	0.0126
2.000	1.304	7.479	0.9148	14.000	0.048	0.417	0.8486	25.000	0.809	0.018	0.0113

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
25.500	0.817	0.017	0.0102	0.39		3.67E-05		8.75	3.247	0.855	0.308
26.000	0.826	0.016	0.0092	0.40		3.58E-05		9.00	3.272	0.910	0.314
27.000	0.840	0.015	0.0076	0.41		3.25E-05		9.25	3.308	0.978	0.322
28.000	0.854	0.014	0.0063	0.4133	2.3795		0.167	9.50	3.348	1.055	0.331
29.000	0.865	0.014	0.0053	0.42		2.94E-05		9.75	3.398	1.147	0.342
30.000	0.876	0.013	0.0044	0.43		2.87E-05		10.00	3.453	1.258	0.355
35.000	0.915	0.010	0.0020	0.44		3.14E-05		10.25	3.514	1.403	0.371
40.000	0.940	0.008	0.0010	0.45		3.62E-05		10.50	3.565	1.581	0.389
45.000	0.957	0.007	0.0005	0.46		3.22E-05		10.75	3.600	1.813	0.411
50.000	0.969	0.006	0.0003	0.47		1.57E-05		11.00	3.582	2.078	0.434
55.000	0.979	0.005	0.0001	0.48		6.17E-06		11.25	3.507	2.380	0.460
60.000	0.987	0.004	0.0000	0.4959	2.3801		0.167	11.50	3.346	2.693	0.488
65.000	0.995	0.004	0.0000	0.6199	2.3813		0.167	11.75	3.090	2.986	0.518
70.000	1.006	0.004	0.0000	0.8266	2.3837		0.167	12.00	2.736	3.228	0.551
72.500	1.025	0.004	0.0002	1.240	2.3905		0.168	12.20	2.383	3.354	0.580
75.000	1.011	0.024	0.0002	1.378	2.3934		0.169	12.40	1.983	3.382	0.610
77.500	1.008	0.025	0.0002	1.459	2.3953		0.169	12.60	1.532	3.265	0.641
80.000	1.007	0.024	0.0002	1.550	2.3975		0.169	12.80	1.312	2.953	0.627
85.000	1.007	0.028	0.0002	1.653	2.4003		0.170	13.00	1.223	2.722	0.604
90.000	1.005	0.031	0.0002	1.771	2.4036		0.170	13.50	1.129	2.379	0.557
95.000	0.999	0.036	0.0003	1.889	2.4073		0.171	14.00	1.070	2.178	0.526
100.000	0.991	0.030	0.0002	1.926	2.4084		0.171	14.50	1.018	2.034	0.504
110.000	0.994	0.025	0.0002	2.066	2.4133		0.171	15.00	0.972	1.929	0.489
120.000	0.991	0.024	0.0002	2.105	2.4147		0.172	15.50	0.917	1.845	0.482
130.000	0.987	0.021	0.0001	2.271	2.4210		0.173	16.00	0.861	1.767	0.477
140.000	0.989	0.016	0.0001	2.480	2.4299		0.174	16.50	0.805	1.692	0.474
150.000	0.990	0.015	0.0001	2.650	2.4380		0.175	17.00	0.753	1.619	0.471
160.000	0.989	0.014	0.0001	2.845		3.82E-07		17.50	0.707	1.546	0.467
170.000	0.989	0.011	0.0001	3.100	2.4627		0.178	18.00	0.665	1.476	0.463
180.000	0.990	0.010	0.0000	3.434	2.4849		0.182	18.50	0.626	1.408	0.459
190.000	0.990	0.009	0.0000	3.576	2.4955		0.183	19.00	0.589	1.341	0.455
200.000	0.991	0.007	0.0000	3.961		8.97E-07		19.50	0.557	1.273	0.449
220.000	0.992	0.006	0.0000	4.160	2.5465		0.190	20.00	0.527	1.203	0.442
240.000	0.993	0.005	0.0000	4.511		1.29E-06		21.00	0.487	1.052	0.413
260.000	0.993	0.004	0.0000	4.8187	2.6205	1.47E-06	0.200	22.00	0.518	0.888	0.330
280.000	0.994	0.003	0.0000	5.00	2.6383		0.203	23.00	0.597	0.850	0.270
300.000	0.995	0.002	0.0000	5.30		2.98E-06		24.00	0.586	0.829	0.268
				5.35		6.45E-06		25.00	0.562	0.787	0.265
				5.40		1.04E-05		26.00	0.538	0.736	0.260
Carbon (diamond)²				5.50		3.41E-05		27.00	0.516	0.679	0.252
0.06199	2.3741		0.166	5.55		5.48E-04		28.00	0.501	0.616	0.239
0.06888	2.3741		0.166	5.60	2.740	1.48E-03	0.216	29.00	0.494	0.552	0.221
0.07749	2.3745		0.166	5.80	2.780	5.02E-03	0.222	30.00	0.493	0.490	0.201
0.08856	2.3750		0.166	6.00	2.826	7.99E-03	0.228				
0.1033	2.3757		0.166	6.10	2.852	8.62E-03	0.231	Cesium (evaporated)³			
0.1240	2.3765		0.166	6.20	2.879	9.30E-03	0.235	2.145	0.264	1.123	0.631
0.1550	2.3772		0.166	6.30	2.910	9.74E-03	0.239	2.271	0.278	0.950	0.561
0.1907		3.1 E-05		6.40	2.944	9.87E-03	0.243	2.845	0.425	0.438	0.235
0.2066	2.3779	5.7 E-05	0.166	6.50	2.985	1.10E-02	0.248	3.064	0.540	0.320	0.127
0.22		1.21E-04		6.60	3.031	1.47E-02	0.254	3.397	0.671	0.233	0.057
0.23		2.36E-04		6.70	3.085	2.20E-02	0.261	3.966	0.827	0.174	0.018
0.24		3.82E-04		6.80	3.146	3.44E-02	0.268	4.889	0.916	0.143	0.007
0.25		5.21E-04		6.90	3.220	5.24E-02	0.277				
0.26		2.96E-04		7.00	3.322	9.35E-02	0.289	Chromium⁴			
0.27		4.39E-04		7.10	3.444	0.210	0.304	0.06	21.19	42.00	0.962
0.28		2.75E-04		7.15	3.464	0.307	0.308	0.10	11.81	29.76	0.955
0.29		7.82E-05		7.20	3.437	0.388	0.307	0.14	15.31	26.36	0.936
0.30		1.32E-04		7.30	3.376	0.473	0.303	0.18	8.73	25.37	0.53
0.31	2.3787	1.30E-04	0.167	7.40	3.335	0.515	0.300	0.22	5.30	20.62	0.954
0.32		1.11E-04		7.50	3.321	0.533	0.299	0.26	3.91	17.12	0.951
0.33		2.99E-05		7.60	3.306	0.592	0.300	0.30	3.15	14.28	0.943
0.34		1.89E-05		7.80	3.276	0.659	0.300	0.42	3.47	8.97	0.862
0.35		2.11E-05		8.00	3.251	0.712	0.300	0.54	3.92	7.06	0.788
0.36		2.47E-05		8.25	3.232	0.765	0.301	0.66	3.96	5.95	0.736
0.37		2.80E-05		8.50	3.228	0.806	0.303	0.78	4.13	5.03	0.680
0.38		3.11E-05									

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	n	k	$R(\phi = 0)$	Energy (eV)	n	k	$R(\phi = 0)$	Energy (eV)	n	k	$R(\phi = 0)$
0.90	4.43	4.60	0.650	20.00	0.77	0.64	0.130	5.60	1.16	1.75	0.400
1.00	4.47	4.43	0.639	20.5	0.76	0.63	0.129	5.80	1.10	1.73	0.406
1.12	4.53	4.31	0.631	21.0	0.74	0.58	0.121	6.00	1.03	1.68	0.407
1.24	4.50	4.28	0.629	21.5	0.72	0.55	0.116	6.20	0.97	1.62	0.401
1.36	4.42	4.30	0.631	22.0	0.71	0.52	0.112	6.40	0.94	1.53	0.386
1.46	4.31	4.32	0.632	22.5	0.70	0.50	0.109	6.60	0.91	1.46	0.368
1.77	3.84	4.37	0.639	23.0	0.69	0.48	0.105	6.80	0.91	1.38	0.345
2.00	3.48	4.36	0.644	23.5	0.68	0.45	0.101	7.00	0.91	1.32	0.326
2.20	3.18	4.41	0.656	24.0	0.68	0.43	0.096	7.00	0.91	1.26	0.305
2.40	2.75	4.46	0.677	24.5	0.67	0.39	0.089	7.40	0.92	1.21	0.286
2.60	2.22	4.36	0.698	25.0	0.68	0.36	0.080	7.60	0.93	1.17	0.269
2.80	1.80	4.06	0.703	25.5	0.68	0.33	0.072	7.80	0.94	1.13	0.253
3.00	1.54	3.71	0.695	26.0	0.70	0.31	0.063	8.00	0.95	1.09	0.239
3.20	1.44	3.40	0.670	26.5	0.71	0.28	0.055				
3.40	1.39	3.24	0.657	27.0	0.72	0.26	0.048				
3.60	1.26	3.12	0.661	27.5	0.73	0.25	0.043	Cobalt, single crystal, $\vec{E} \perp \hat{c}$			
3.80	1.12	2.95	0.660	28.0	0.75	0.23	0.037	0.10	5.83	32.36	0.979
4.00	1.02	2.76	0.651	28.0	0.75	0.23	0.037	0.15	4.24	21.37	0.965
4.20	0.94	2.58	0.639	29.0	0.77	0.22	0.032	0.20	3.87	15.53	0.042
4.40	0.90	2.42	0.620	30.0	0.78	0.21	0.030	0.30	4.34	10.01	0.865
4.50	0.89	2.35	0.607					0.40	4.66	7.39	0.785
4.60	0.88	2.28	0.598	Cobalt, single crystal, $\vec{E} \parallel \hat{c}$				0.50	5.17	5.75	0.709
4.70	0.86	2.21	0.586	0.10	6.71	37.87	0.982	0.60	5.77	5.17	0.682
4.80	0.86	2.13	0.572	0.15	4.66	25.47	0.973	0.70	6.15	5.20	0.685
4.90	0.86	2.07	0.557	0.20	3.55	18.78	0.962	0.80	6.08	5.61	0.702
5.00	0.85	2.01	0.542	0.25	3.98	14.59	0.933	0.90	5.57	5.93	0.715
5.10	0.86	1.94	0.523	0.30	4.04	12.16	0.907	1.00	4.83	5.94	0.721
5.20	0.87	1.87	0.503	0.40	4.24	9.13	0.847	1.10	4.31	5.60	0.711
5.40	0.93	1.80	0.466	0.50	4.41	7.19	0.782	1.20	4.02	5.34	0.701
5.60	0.95	1.74	0.443	0.60	4.91	6.13	0.729	1.30	3.78	5.16	0.694
5.80	0.97	1.74	0.437	0.70	5.24	5.85	0.713	1.40	3.55	5.05	0.692
6.00	0.94	1.73	0.444	0.80	5.17	5.89	0.716	1.50	3.26	4.93	0.692
6.20	0.89	1.69	0.446	0.90	4.94	5.95	0.720	1.60	3.03	4.74	0.687
6.40	0.85	1.66	0.447	1.00	4.46	5.86	0.722	1.70	2.83	4.60	0.684
6.60	0.80	1.59	0.444	1.10	4.07	5.61	0.715	1.80	2.61	4.45	0.683
6.80	0.75	1.51	0.439	1.20	3.81	5.36	0.706	1.90	2.41	4.27	0.677
7.00	0.74	1.45	0.425	1.30	3.60	5.20	0.701	2.00	2.25	4.09	0.670
7.20	0.71	1.39	0.414	1.40	3.37	5.09	0.701	2.10	2.13	3.89	0.659
7.40	0.69	1.33	0.404	1.50	3.10	4.96	0.701	2.20	2.04	3.72	0.646
7.60	0.66	1.23	0.378	1.60	2.84	4.77	0.697	2.30	1.99	3.56	0.632
7.80	0.67	1.15	0.347	1.70	2.66	4.57	0.690	2.40	1.95	3.44	0.620
8.00	0.68	1.07	0.315	1.80	2.45	4.41	0.687	2.50	1.90	3.34	0.611
8.20	0.71	1.00	0.278	1.90	2.31	4.18	0.675	2.60	1.86	3.26	0.605
8.50	0.74	0.92	0.235	2.00	2.21	4.00	0.664	2.70	1.79	3.19	0.602
9.0	0.83	0.81	0.170	2.10	2.13	3.85	0.654	2.80	1.72	3.11	0.596
9.50	0.92	0.74	0.132	2.20	2.07	3.70	0.642	2.90	1.66	3.03	0.591
10.00	0.98	0.73	0.120	2.30	2.01	3.59	0.634	3.00	1.60	2.94	0.586
10.50	1.01	0.72	0.112	2.40	1.95	3.49	0.627	3.20	1.50	2.78	0.571
11.00	1.05	0.69	0.103	2.50	1.88	3.40	0.622	3.40	1.42	2.62	0.553
11.50	1.09	0.69	0.100	2.60	1.81	3.32	0.618	3.60	1.36	2.47	0.533
12.00	1.13	0.70	0.101	2.70	1.73	3.24	0.615	3.80	1.33	2.33	0.511
12.50	1.15	0.73	0.108	2.80	1.66	3.13	0.607	4.00	1.31	2.21	0.488
13.00	1.15	0.77	0.119	2.90	1.61	3.05	0.600	4.20	1.28	2.12	0.471
13.50	1.12	0.80	0.128	3.00	1.55	2.96	0.594	4.40	1.27	2.03	0.452
14.00	1.09	0.82	0.135	3.20	1.46	2.80	0.579	4.60	1.26	1.95	0.435
14.50	1.03	0.82	0.142	3.40	1.38	2.64	0.563	4.80	1.25	1.90	0.423
15.00	1.00	0.82	0.143	3.60	1.31	2.48	0.544	5.00	1.24	1.84	0.411
15.50	0.96	0.80	0.141	3.80	1.28	2.33	0.519	5.20	1.22	1.80	0.403
16.00	0.92	0.77	0.139	4.00	1.26	2.20	0.495	5.40	1.21	1.78	0.399
16.50	0.31	0.75	0.134	4.20	1.25	2.10	0.471	5.60	1.17	1.76	0.400
17.00	0.90	0.73	0.132	4.40	1.24	2.01	0.452	5.80	1.11	1.74	0.406
17.50	0.88	0.72	0.130	4.60	1.24	1.94	0.435	6.00	1.04	1.69	0.407
18.00	0.87	0.70	0.129	4.80	1.23	1.88	0.423	6.20	0.98	1.62	0.401
18.50	0.84	0.69	0.130	5.00	1.22	1.83	0.411	6.40	0.94	1.54	0.386
19.00	0.82	0.68	0.131	5.20	1.21	1.79	0.403	6.60	0.92	1.46	0.368
				5.40	1.19	1.77	0.399	6.80	0.91	1.38	0.345

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
7.00	0.91	1.32	0.326	27.00	0.88	0.38	0.043	0.02108		1.60E-03	
7.20	0.91	1.26	0.305	28.00	0.86	0.35	0.039	0.02232		1.55E-03	
7.40	0.92	1.21	0.285	29.00	0.85	0.30	0.032	0.02356		1.53E-03	
7.60	0.93	1.17	0.269	30.00	0.86	0.26	0.025	0.02480		1.50E-03	
7.80	0.94	1.13	0.253	31.00	0.88	0.24	0.020	0.02604		1.25E-03	
				32.00	0.89	0.22	0.017	0.02728		8.50E-04	
				33.00	0.90	0.21	0.015	0.02852		6.50E-04	
Copper⁶				34.00	0.91	0.20	0.014	0.02976		7.00E-04	
0.10	29.69	71.57	0.980	35.00	0.92	0.20	0.013	0.03100	3.9827	8.50E-04	0.358
0.50	1.71	17.63	0.979	36.00	0.92	0.19	0.012	0.03224		1.55E-03	
1.00	0.44	8.48	0.976	37.00	0.92	0.19	0.011	0.03348		2.75E-03	
1.50	0.26	5.26	0.965	38.00	0.93	0.18	0.010	0.03472		3.55E-03	
1.70	0.22	4.43	0.958	39.00	0.93	0.17	0.009	0.03596	(3.9900)	3.05E-03	0.359
1.75	0.21	4.25	0.956	40.00	0.93	0.17	0.009	0.03720		2.75E-03	
1.80	0.21	4.04	0.952	41.00	0.94	0.16	0.008	0.03844		2.70E-03	
1.85	0.22	3.85	0.947	42.00	0.94	0.16	0.007	0.03968	(3.9930)	2.90E-03	0.359
1.90	0.21	3.67	0.943	43.00	0.94	0.15	0.007	0.04092		2.95E-03	
2.00	0.27	3.24	0.910	44.00	0.95	0.15	0.007	0.04215		3.20E-03	
2.10	0.47	2.81	0.814	45.00	0.95	0.15	0.006	0.04339		6.30E-03	
2.20	0.83	2.60	0.673	46.00	0.95	0.15	0.006	0.04463		3.40E-03	
2.30	1.04	2.59	0.618	47.00	0.95	0.14	0.006	0.04587	(3.9955)	2.50E-03	0.360
2.40	1.12	2.60	0.602	48.00	0.95	0.14	0.006	0.04711		2.10E-03	
2.60	1.15	2.50	0.577	49.00	0.95	0.14	0.005	0.04835		2.00E-03	
2.80	1.17	2.36	0.545	50.00	0.95	0.13	0.005	0.04959		8.00E-04	
3.00	1.18	2.21	0.509	51.00	0.95	0.13	0.005	0.05083		1.40E-03	
3.20	1.23	2.07	0.468	52.00	0.95	0.13	0.005	0.05207		1.35E-03	
3.40	1.27	1.95	0.434	53.00	0.96	0.12	0.004	0.05331		1.10E-03	
3.60	1.31	1.87	0.407	54.00	0.96	0.12	0.004	0.05455		8.00E-04	
3.80	1.34	1.81	0.387	55.00	0.96	0.12	0.004	0.05579		6.00E-04	
4.00	1.34	1.72	0.364	56.00	0.96	0.11	0.004	0.05703		9.0 E-04	
4.20	1.42	1.64	0.336	57.00	0.96	0.11	0.004	0.05827		6.5 E-04	
4.40	1.49	1.64	0.329	58.00	0.96	0.11	0.004	0.05951		4.6 E-04	
4.60	1.52	1.67	0.334	59.00	0.97	0.11	0.003	0.06075		4.0 E-04	
4.80	1.53	1.71	0.345	60.00	0.97	0.11	0.003	0.06199	3.9992	3.98E-04	0.360
5.00	1.47	1.78	0.366	61.00	0.97	0.11	0.003	0.06323		4.0 E-04	
5.20	1.38	1.80	0.380	62.00	0.97	0.11	0.003	0.06447		4.3 E-04	
5.40	1.28	1.78	0.389	63.00	0.96	0.10	0.003	0.06571		4.4 E-04	
5.60	1.18	1.74	0.391	64.00	0.96	0.10	0.003	0.06695	(4.0000)	4.3 E-04	0.360
5.80	1.10	1.67	0.389	65.00	0.97	0.10	0.003	0.06819		3.1 E-04	
6.00	1.04	1.59	0.380	66.00	0.97	0.10	0.003	0.06943		3.3 E-04	
6.50	0.96	1.37	0.329	67.00	0.97	0.09	0.003	0.07067		3.8 E-04	
7.00	0.97	1.20	0.271	68.00	0.97	0.09	0.002	0.07191		3.3 E-04	
7.50	1.00	1.09	0.230	69.00	0.97	0.09	0.002	0.07315		2.5 E-04	
8.00	1.03	1.03	0.206	70.00	0.97	0.09	0.002	0.07439		1.9 E-04	
8.50	1.03	0.98	0.189	75.00	0.98	0.09	0.002	0.07514		1.58E-04	
9.00	1.03	0.92	0.171	80.00	0.98	0.09	0.002	0.07749	4.0009	9.55E-05	0.360
9.50	1.03	0.87	0.154	85.00	0.97	0.09	0.002	0.07999	4.0011	1.71E-04	0.360
10.00	1.04	0.82	0.139	90.00	0.96	0.08	0.002	0.08266	4.0013	9.78E-05	0.360
11.00	1.07	0.75	0.118					0.08551	4.0015	5.77E-05	0.360
12.00	1.09	0.73	0.111					0.08920		3.98E-05	
13.00	1.08	0.72	0.109	Gallium (liquid)⁷				0.09460		4.59E-05	
14.00	1.06	0.72	0.111	1.425	2.40	9.20	0.900	0.09840		3.51E-05	
14.50	1.03	0.72	0.111	1.550	2.09	8.50	0.898				
15.00	1.01	0.71	0.111	1.771	1.65	7.60	0.898	0.1	4.0063	3.70E-05	0.361
15.50	0.98	0.69	0.109	2.066	1.25	6.60	0.897	0.2	4.0108		0.361
16.00	0.95	0.67	0.106	2.480	0.89	5.60	0.898	0.3	4.0246		0.362
17.00	0.91	0.62	0.097	3.100	0.59	4.50	0.896	0.4	4.0429		0.364
18.00	0.89	0.56	0.084					0.5	(4.074)		0.367
19.00	0.88	0.51	0.071	Germanium, single crystal⁸				0.6	(4.104)	6.58E-07	0.370
20.00	0.88	0.45	0.059	0.01240	(4.0065)	3.00E-03	0.361	0.7	4.180	1.27E-04	0.377
21.00	0.90	0.41	0.048	0.01364	4.0063	2.40E-03	0.361	0.8	4.275	5.67E-03	0.385
22.00	0.92	0.38	0.040	0.01488	(4.0060)	1.70E-03	0.361	0.9	4.285	7.45E-02	0.386
23.00	0.94	0.37	0.035	0.01612	(4.0060)	1.55E-03	0.361	1.0	4.325	8.09E-02	0.390
24.00	0.96	0.37	0.035	0.01736	(4.0060)	1.50E-03	0.361	1.1	4.385	0.103	0.395
25.00	0.96	0.40	0.040	0.01860		1.50E-03		1.2	4.420	0.123	0.398
26.00	0.92	0.40	0.044	0.01984		1.60E-03		1.3	4.495	0.167	0.405

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
1.4	4.560	0.190	0.411	40.0		0.0604		8.80	1.31	0.86	0.140
1.5	4.635	0.298	0.418					9.00	1.30	0.83	0.133
1.6	4.763	0.345	0.428	Gold, electropolished, Au (110)⁹				9.20	1.31	0.81	0.126
1.7	4.897	0.401	0.439	0.10	8.17	82.83	0.995	9.40	1.33	0.78	0.122
1.8	5.067	0.500	0.453	0.20	2.13	41.73	0.995	9.60	1.36	0.78	0.121
1.9	5.380	0.540	0.475	0.30	0.99	27.82	0.995	9.80	1.37	0.79	0.124
2.0	5.588	0.933	0.495	0.40	0.59	20.83	0.995	10.00	1.37	0.80	0.126
2.1	5.748	1.634	0.523	0.50	0.39	16.61	0.994	10.20	1.36	0.80	0.127
2.2	5.283	2.049	0.516	0.60	0.28	13.78	0.994	10.40	1.35	0.80	0.125
2.3	5.062	2.318	0.519	0.70	0.22	11.75	0.994	10.60	1.34	0.79	0.123
2.4	4.610	2.455	0.508	0.80	0.18	10.21	0.993	10.80	1.34	0.77	0.120
2.5	4.340	2.384	0.492	0.90	0.15	9.01	0.993	11.00	1.34	0.76	0.116
2.6	4.180	2.309	0.480	1.00	0.13	8.03	0.992	11.20	1.34	0.74	0.113
2.7	4.082	2.240	0.471	1.20	0.10	6.54	0.991	11.40	1.35	0.73	0.111
2.8	4.035	2.181	0.464	1.40	0.08	5.44	0.989	11.60	1.36	0.72	0.109
2.9	4.037	2.140	0.461	1.60	0.08	4.56	0.986	11.80	1.38	0.71	0.108
3.0	4.082	2.145	0.463	1.80	0.09	3.82	0.979	12.00	1.39	0.71	0.109
3.1	4.141	2.215	0.471	2.00	0.13	3.16	0.953	12.40	1.44	0.73	0.115
3.2	4.157	2.340	0.482	2.10	0.18	2.84	0.925	12.80	1.45	0.79	0.127
3.3	4.128	2.469	0.490	2.20	0.24	2.54	0.880	13.20	1.42	0.84	0.137
3.4	4.070	2.579	0.497	2.40	0.50	1.86	0.647	13.60	1.37	0.86	0.140
3.5	4.020	2.667	0.502	2.50	0.82	1.59	0.438	14.00	1.33	0.86	0.140
3.6	3.985	2.759	0.509	2.60	1.24	1.54	0.331	14.40	1.29	0.86	0.139
3.7	3.958	2.863	0.517	2.70	1.43	1.72	0.356	14.80	1.26	0.84	0.135
3.8	3.936	2.986	0.527	2.80	1.46	1.77	0.368	15.20	1.24	0.83	0.132
3.9	3.920	3.137	0.539	2.90	1.50	1.79	0.368	15.60	1.22	0.81	0.127
4.0	3.905	3.336	0.556	3.00	1.54	1.80	0.369	16.00	1.21	0.79	0.123
4.1	3.869	3.614	0.579	3.10	1.54	1.81	0.371	16.40	1.20	0.78	0.119
4.2	3.745	4.009	0.612	3.20	1.54	1.80	0.368	16.80	1.19	0.76	0.116
4.3	3.338	4.507	0.659	3.30	1.55	1.78	0.362	17.20	1.19	0.75	0.114
4.4	2.516	4.669	0.705	3.40	1.56	1.76	0.356	17.60	1.19	0.74	0.111
4.5	1.953	4.297	0.713	3.50	1.58	1.73	0.349	18.00	1.19	0.74	0.109
4.6	1.720	3.960	0.702	3.60	1.62	1.73	0.346	18.40	1.19	0.73	0.109
4.7	1.586	3.709	0.690	3.70	1.64	1.75	0.351	18.80	1.20	0.74	0.110
4.8	1.498	3.509	0.677	3.80	1.63	1.79	0.360	19.20	1.21	0.76	0.116
4.9	1.435	3.342	0.664	3.90	1.59	1.81	0.366	19.60	1.21	0.80	0.125
5.0	1.394	3.197	0.650	4.00	1.55	1.81	0.369	20.00	1.18	0.83	0.133
5.1	1.370	3.073	0.636	4.10	1.51	1.79	0.368	20.40	1.14	0.85	0.141
5.2	1.364	2.973	0.622	4.20	1.48	1.78	0.367	20.80	1.10	0.87	0.149
5.3	1.371	2.897	0.609	4.30	1.45	1.77	0.368	21.20	1.05	0.88	0.156
5.4	1.383	2.854	0.600	4.40	1.41	1.76	0.370	21.60	1.00	0.88	0.162
5.5	1.380	2.842	0.598	4.50	1.35	1.74	0.370	22.00	0.94	0.86	0.164
5.6	1.360	2.846	0.602	4.60	1.30	1.69	0.364	22.40	0.89	0.83	0.163
5.7	1.293	2.163	0.479	4.70	1.27	1.64	0.354	22.80	0.85	0.79	0.157
5.8	1.209	2.873	0.632	4.80	1.25	1.59	0.344	23.20	0.82	0.75	0.149
5.9	1.108	2.813	0.641	4.90	1.23	1.54	0.332	23.60	0.80	0.70	0.138
6.0	1.30	2.34	0.517	5.00	1.22	1.49	0.319	24.00	0.80	0.66	0.125
6.5	1.10	2.05	0.489	5.20	1.21	1.40	0.295	24.40	0.80	0.62	0.113
7.0	1.00	1.80	0.448	5.40	1.21	1.33	0.275	24.80	0.80	0.58	0.101
7.5		1.60		5.60	1.21	1.27	0.256	25.20	0.82	0.56	0.090
8.0	0.92	1.40	0.348	5.80	1.21	1.20	0.236	25.60	0.83	0.54	0.084
8.5	0.92	1.20	0.282	6.00	1.22	1.14	0.218	26.00	0.84	0.52	0.079
9.0	0.92	1.14	0.262	6.20	1.24	1.09	0.203	26.40	0.85	0.51	0.074
9.5		1.00		6.40	1.25	1.05	0.190	26.80	0.85	0.50	0.071
10.0	0.93	0.86	0.167	6.60	1.27	1.01	0.177	27.20	0.86	0.49	0.068
20.0		0.237		6.80	1.30	0.97	0.167	27.60	0.86	0.49	0.065
22.0		0.179		7.00	1.34	0.95	0.162	28.00	0.87	0.48	0.063
24.0		0.144		7.20	1.36	0.95	0.161	28.40	0.88	0.48	0.062
26.0		0.110		7.40	1.38	0.96	0.164	28.80	0.88	0.48	0.062
28.0		0.0747		7.60	1.38	0.98	0.169	29.20	0.88	0.48	0.062
30.0		0.1020		7.80	1.35	0.99	0.171	29.60	0.87	0.48	0.064
32.0		0.0999		8.00	1.31	0.96	0.165	30.00	0.86	0.48	0.064
34.0		0.0856		8.20	1.30	0.92	0.155				
36.0		0.0740		8.40	1.30	0.89	0.147				
38.0		0.0651		8.60	1.31	0.88	0.144				
								Hafnium, single crystal, E \parallel \hat{c} ¹⁰			
								0.52	1.48	4.11	0.747

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	
0.56	1.84	3.29	0.615	8.20	1.43	1.01	0.178	1.40	3.61	3.36	0.561	
0.60	2.34	2.62	0.486	8.40	1.45	1.01	0.180	1.50	3.55	3.13	0.540	
0.66	3.21	2.13	0.428	8.60	1.47	1.02	0.183	1.60	3.58	3.01	0.529	
0.70	3.70	2.03	0.441	8.80	1.48	1.04	0.186	1.70	3.63	2.98	0.526	
0.76	4.31	2.10	0.476	9.00	1.49	1.07	0.193	1.80	3.66	3.02	0.530	
0.80	4.61	2.31	0.504	9.20	1.50	1.10	0.201	1.90	3.63	3.14	0.541	
0.86	4.71	2.70	0.533	9.40	1.48	1.14	0.211	2.00	3.51	3.26	0.551	
0.90	4.64	2.85	0.541	9.60	1.46	1.18	0.222	2.10	3.35	3.33	0.558	
0.95	4.54	2.96	0.545	9.80	1.41	1.21	0.230	2.20	3.18	3.36	0.563	
1.00	4.45	3.00	0.545	10.00	1.36	1.22	0.235	2.30	2.99	3.39	0.568	
1.10	4.28	3.08	0.547	10.20	1.32	1.22	0.238	2.40	2.78	3.35	0.569	
1.20	4.08	3.10	0.544	10.40	1.28	1.22	0.240	2.50	2.65	3.26	0.562	
1.30	3.87	3.04	0.536	10.60	1.24	1.21	0.241	2.60	2.54	3.22	0.560	
1.40	3.72	2.95	0.525	10.80	1.20	1.20	0.242	2.70	2.42	3.17	0.559	
1.50	3.60	2.85	0.514	11.00	1.16	1.19	0.242	2.80	2.31	3.13	0.558	
1.60	3.52	2.73	0.500	11.20	1.13	1.17	0.241	2.90	2.20	3.08	0.558	
1.70	3.52	2.61	0.488	11.40	1.10	1.16	0.241	3.00	2.08	3.05	0.561	
1.80	3.57	2.56	0.485	11.60	1.07	1.14	0.239	3.10	1.94	2.98	0.560	
1.90	3.63	2.59	0.489	11.80	1.04	1.12	0.238	3.20	1.83	2.88	0.555	
2.00	3.65	2.67	0.498	12.00	1.02	1.10	0.236	3.30	1.74	2.78	0.547	
2.10	3.64	2.81	0.511	12.40	0.96	1.06	0.232	3.40	1.68	2.69	0.538	
2.20	3.53	2.99	0.526	12.80	0.92	1.01	0.225	3.50	1.62	2.61	0.529	
2.30	3.34	3.09	0.534	13.20	0.88	0.96	0.218	3.60	1.57	2.52	0.519	
2.40	3.15	3.11	0.537	13.60	0.84	0.90	0.205	3.70	1.53	2.45	0.510	
2.50	2.99	3.13	0.540	14.00	0.83	0.83	0.186	3.80	1.49	2.38	0.501	
2.60	2.83	3.12	0.542	14.40	0.83	0.80	0.172	3.90	1.45	2.32	0.493	
2.70	2.68	3.10	0.542	14.80	0.81	0.76	0.167	4.00	1.41	2.25	0.484	
2.80	2.54	3.08	0.543	15.20	0.79	0.70	0.153	4.10	1.38	2.18	0.474	
2.90	2.40	3.04	0.544	15.60	0.79	0.64	0.132	4.20	1.35	2.11	0.462	
3.00	2.27	3.00	0.544	16.00	0.83	0.60	0.111	4.30	1.33	2.05	0.451	
3.10	2.14	2.95	0.544	16.40	0.81	0.60	0.114	4.40	1.31	1.99	0.438	
3.20	2.00	2.89	0.544	16.80	0.79	0.55	0.105	4.50	1.30	1.93	0.427	
3.30	1.87	2.79	0.538	17.20	0.79	0.50	0.089	4.60	1.29	1.88	0.415	
3.40	1.78	2.68	0.528	17.60	0.80	0.46	0.077	4.70	1.28	1.82	0.402	
3.50	1.71	2.58	0.517	18.00	0.81	0.42	0.064	4.80	1.28	1.77	0.389	
3.60	1.66	2.48	0.503	18.40	0.84	0.38	0.051	4.90	1.27	1.73	0.379	
3.70	1.63	2.40	0.491	18.80	0.87	0.34	0.040	5.00	1.27	1.69	0.367	
3.80	1.60	2.33	0.481	19.00	0.89	0.33	0.036	5.20	1.27	1.62	0.349	
3.90	1.56	2.27	0.473	19.60	0.93	0.32	0.030	5.40	1.27	1.57	0.335	
4.00	1.52	2.21	0.466	20.00	0.94	0.31	0.027	5.60	1.26	1.52	0.322	
4.10	1.48	2.14	0.455	20.60	0.97	0.30	0.023	5.80	1.24	1.48	0.313	
4.20	1.45	2.07	0.442	21.00	0.99	0.29	0.022	6.00	1.21	1.42	0.302	
4.30	1.43	2.01	0.431	21.60	1.01	0.28	0.020	6.20	1.19	1.36	0.285	
4.40	1.41	1.95	0.420	22.00	1.03	0.28	0.020	6.40	1.18	1.29	0.265	
4.50	1.39	1.89	0.407	22.60	1.06	0.28	0.020	6.60	1.19	1.22	0.244	
4.60	1.39	1.83	0.394	23.00	1.07	0.28	0.021	6.80	1.21	1.18	0.230	
4.70	1.39	1.79	0.382	23.60	1.09	0.29	0.022	7.00	1.22	1.14	0.217	
4.80	1.38	1.75	0.373	24.00	1.09	0.30	0.023	7.20	1.23	1.10	0.206	
4.90	1.38	1.71	0.364	24.60	1.10	0.31	0.024	7.40	1.26	1.06	0.194	
5.00	1.37	1.68	0.356					7.60	1.28	1.04	0.187	
5.20	1.36	1.61	0.341					7.80	1.30	1.02	0.180	
5.40	1.35	1.55	0.324					8.00	1.33	1.00	0.174	
5.60	1.35	1.51	0.314					8.20	1.35	0.99	0.173	
5.80	1.32	1.48	0.308					8.40	1.38	0.99	0.173	
6.00	1.28	1.41	0.295					8.60	1.40	1.00	0.174	
6.20	1.26	1.35	0.278					8.80	1.42	1.02	0.178	
6.40	1.26	1.28	0.258					9.00	1.43	1.04	0.184	
6.60	1.27	1.22	0.240					9.20	1.45	1.08	0.193	
6.80	1.28	1.16	0.224					9.40	1.43	1.12	0.204	
7.00	1.31	1.13	0.212					9.60	1.40	1.16	0.214	
7.20	1.33	1.10	0.204					9.80	1.37	1.19	0.223	
7.40	1.34	1.07	0.197					10.00	1.32	1.21	0.230	
7.60	1.36	1.05	0.191					10.20	1.27	1.21	0.234	
7.80	1.37	1.02	0.183					10.40	1.23	1.20	0.235	
8.00	1.40	1.01	0.179					10.60	1.19	1.20	0.237	
				→ Hafnium, single crystal, $E \perp \hat{c}$								
				0.52	2.25	4.65	0.723					
				0.56	2.34	3.66	0.623					
				0.60	2.84	2.89	0.512					
				0.66	3.71	2.35	0.469					
				0.70	4.26	2.21	0.482					
				0.76	4.97	2.33	0.521					
				0.80	5.41	2.62	0.554					
				0.86	5.46	3.36	0.593					
				0.90	5.22	3.62	0.601					
				0.95	4.95	3.72	0.602					
				1.00	4.76	3.76	0.602					
				1.10	4.43	3.80	0.601					
				1.20	4.07	3.74	0.594					
				1.30	3.79	3.55	0.578					

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
10.80	1.15	1.19	0.237	2.40	2.07	4.14	0.689	17.60	1.30	0.87	0.140
11.00	1.12	1.17	0.237	2.50	1.98	4.00	0.682	18.00	1.30	0.93	0.154
11.20	1.08	1.16	0.237	2.60	1.91	3.86	0.673	18.40	1.27	0.97	0.166
11.40	1.05	1.14	0.236	2.70	1.85	3.73	0.665	18.80	1.24	1.00	0.176
11.60	1.03	1.12	0.235	2.80	1.81	3.61	0.655	19.20	1.20	1.03	0.187
11.80	1.00	1.10	0.233	2.90	1.77	3.51	0.646	19.60	1.15	1.05	0.197
12.00	0.97	1.08	0.231	3.00	1.73	3.43	0.640	20.00	1.10	1.06	0.205
12.40	0.92	1.04	0.226	3.20	1.62	3.26	0.629	20.50	1.04	1.05	0.210
12.80	0.88	0.99	0.219	3.40	1.53	3.05	0.610	21.00	0.99	1.04	0.215
13.20	0.83	0.94	0.211	3.60	1.52	2.81	0.573	21.50	0.94	1.02	0.220
13.60	0.80	0.88	0.196	3.80	1.61	2.69	0.541	22.00	0.89	1.00	0.222
14.00	0.79	0.81	0.177	4.00	1.64	2.68	0.535	22.50	0.84	0.99	0.228
14.40	0.80	0.77	0.160	4.20	1.58	2.71	0.549	23.00	0.79	0.96	0.232
14.80	0.77	0.73	0.154	4.40	1.45	2.68	0.561	23.50	0.76	0.92	0.228
15.20	0.76	0.68	0.140	4.60	1.31	2.60	0.567	24.00	0.73	0.87	0.223
15.60	0.76	0.61	0.119	4.80	1.18	2.49	0.570	24.50	0.70	0.83	0.218
16.00	0.81	0.58	0.099	5.00	1.10	2.35	0.559	25.00	0.69	0.79	0.209
16.40	0.78	0.57	0.102	5.20	1.04	2.22	0.543	25.50	0.68	0.76	0.200
16.80	0.77	0.53	0.092	5.40	1.00	2.09	0.522	26.00	0.67	0.72	0.192
17.20	0.77	0.48	0.077	5.60	0.98	1.98	0.499	26.50	0.67	0.69	0.181
17.60	0.79	0.44	0.065	5.80	0.96	1.86	0.474	27.00	0.66	0.66	0.174
18.00	0.80	0.39	0.053	6.00	0.95	1.78	0.454	27.50	0.66	0.63	0.166
18.40	0.82	0.36	0.041	6.20	0.94	1.68	0.427	28.00	0.66	0.61	0.158
18.80	0.86	0.33	0.032	6.40	0.94	1.59	0.401	28.50	0.66	0.59	0.151
19.00	0.88	0.32	0.030	6.60	0.94	1.50	0.375	29.00	0.65	0.57	0.148
19.60	0.91	0.31	0.025	6.80	0.95	1.42	0.345	29.50	0.64	0.55	0.145
20.00	0.93	0.30	0.023	7.00	0.97	1.34	0.318	30.00	0.64	0.53	0.140
20.60	0.96	0.29	0.021	7.20	0.99	1.27	0.290	32.00	0.62	0.44	0.119
21.00	0.97	0.29	0.020	7.40	1.02	1.20	0.262	34.00	0.64	0.35	0.091
21.60	1.00	0.28	0.019	7.60	1.03	1.14	0.241	36.00	0.69	0.27	0.059
22.00	1.01	0.28	0.019	7.80	1.08	1.06	0.208	38.00	0.73	0.24	0.044
22.60	1.03	0.27	0.018	8.00	1.13	1.03	0.191	40.00	0.76	0.22	0.034
23.00	1.05	0.28	0.019	8.20	1.18	1.00	0.179				
23.60	1.06	0.28	0.020	8.40	1.22	0.98	0.171				
24.00	1.07	0.29	0.021	8.60	1.26	0.96	0.164	Iron⁵			
24.60	1.09	0.30	0.022	8.80	1.29	0.95	0.160	0.10	6.41	33.07	0.978
				9.00	1.33	0.94	0.157	0.15	6.26	22.82	0.956
				9.20	1.36	0.95	0.159	0.20	3.68	18.23	0.958
				9.40	1.39	0.95	0.161	0.26	4.98	13.68	0.911
Iridium¹¹				9.60	1.42	0.97	0.163	0.30	4.87	12.05	0.892
0.10	28.49	60.62	0.975	9.80	1.44	0.99	0.169	0.36	4.68	10.44	0.867
0.15	15.32	45.15	0.973	10.00	1.45	1.01	0.175	0.40	4.42	9.75	0.858
0.20	9.69	35.34	0.972	10.20	1.45	1.04	0.182	0.50	4.14	8.02	0.817
0.25	6.86	28.84	0.969	10.40	1.44	1.07	0.187	0.60	3.93	6.95	0.783
0.30	5.16	24.25	0.967	10.60	1.43	1.09	0.193	0.70	3.78	6.17	0.752
0.35	4.11	20.79	0.964	10.80	1.41	1.12	0.200	0.80	3.65	5.60	0.725
0.40	3.42	18.06	0.960	11.00	1.38	1.13	0.206	0.90	3.52	5.16	0.700
0.45	3.05	15.82	0.954	11.20	1.34	1.14	0.208	1.00	3.43	4.79	0.678
0.50	2.98	14.06	0.944	11.40	1.31	1.13	0.208	1.10	3.33	4.52	0.660
0.60	2.79	11.58	0.925	11.60	1.28	1.12	0.206	1.20	3.24	4.26	0.641
0.70	2.93	9.78	0.895	11.80	1.25	1.10	0.203	1.30	3.16	4.07	0.626
0.80	3.14	8.61	0.862	12.00	1.24	1.08	0.199	1.40	3.12	3.87	0.609
0.90	3.19	7.88	0.840	12.40	1.21	1.05	0.191	1.50	3.05	3.77	0.601
1.00	3.15	7.31	0.822	12.80	1.19	1.01	0.181	1.60	3.00	3.60	0.585
1.10	3.04	6.84	0.808	13.20	1.18	0.98	0.173	1.70	2.98	3.52	0.577
1.20	2.96	6.41	0.791	13.60	1.17	0.95	0.165	1.80	2.92	3.46	0.573
1.30	2.85	6.07	0.779	14.00	1.16	0.91	0.155	1.90	2.89	3.37	0.563
1.40	2.72	5.74	0.767	14.40	1.17	0.88	0.147	2.00	2.85	3.36	0.563
1.50	2.65	5.39	0.750	14.80	1.18	0.87	0.142	2.10	2.80	3.34	0.562
1.60	2.68	5.08	0.728	15.20	1.19	0.84	0.136	2.20	2.74	3.33	0.563
1.70	2.69	4.92	0.716	15.60	1.20	0.83	0.133	2.30	2.65	3.34	0.567
1.80	2.64	4.81	0.710	16.00	1.21	0.83	0.131	2.40	2.56	3.31	0.567
1.90	2.57	4.68	0.704	16.40	1.23	0.82	0.129	2.50	2.46	3.31	0.570
2.00	2.50	4.57	0.699	16.80	1.25	0.82	0.127	2.60	2.34	3.30	0.576
2.10	2.40	4.48	0.697	17.20	1.28	0.83	0.131	2.70	2.23	3.25	0.575
2.20	2.29	4.38	0.695					2.80	2.12	3.23	0.580
2.30	2.18	4.26	0.692								

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
2.90	2.01	3.17	0.580	13.17	0.84	0.79	0.161	24.00	0.74	0.27	0.045
3.00	1.88	3.12	0.583	13.33	0.84	0.78	0.160	24.17	0.74	0.26	0.044
3.10	1.78	3.04	0.580	13.50	0.83	0.77	0.159	24.33	0.74	0.26	0.043
3.20	1.70	2.96	0.576	13.67	0.82	0.76	0.157	24.50	0.74	0.25	0.042
3.30	1.62	2.87	0.572	13.83	0.81	0.75	0.154	24.67	0.75	0.25	0.040
3.40	1.55	2.79	0.565	14.00	0.81	0.73	0.151	24.83	0.75	0.24	0.039
3.50	1.50	2.70	0.556	14.17	0.80	0.72	0.149	25.00	0.75	0.24	0.038
3.60	1.47	2.63	0.548	14.33	0.80	0.71	0.146	26.00	0.76	0.21	0.031
3.70	1.43	2.56	0.542	14.50	0.79	0.79	0.144	27.00	0.78	0.18	0.026
3.83	1.38	2.49	0.534	14.67	0.79	0.69	0.141	28.00	0.79	0.16	0.021
4.00	1.30	2.39	0.527	14.83	0.78	0.67	0.138	29.00	0.81	0.14	0.017
4.17	1.26	2.27	0.510	15.00	0.78	0.66	0.135	30.00	0.82	0.13	0.014
4.33	1.23	2.18	0.494	15.17	0.78	0.65	0.131				
4.50	1.20	2.10	0.482	15.33	0.78	0.64	0.238				
4.67	1.16	2.02	0.470	15.50	0.77	0.63	0.126	Lithium¹²			
4.83	1.14	1.93	0.451	15.67	0.77	0.62	0.123	0.14	0.659	38.0	0.998
5.00	1.14	1.87	0.435	15.83	0.77	0.61	0.119	0.54	0.661	12.6	0.984
5.17	1.12	1.81	0.425	16.00	0.77	0.60	0.116	0.75	0.561	7.68	0.963
5.33	1.11	1.75	0.408	16.17	0.78	0.58	0.112	1.05	0.448	5.58	0.946
5.50	1.09	1.17	0.401	16.33	0.78	0.58	0.110	1.35	0.338	4.36	0.935
5.67	1.09	1.65	0.383	16.50	0.78	0.57	0.107	1.65	0.265	3.55	0.925
5.83	1.10	1.61	0.373	16.67	0.77	0.56	0.106	1.95	0.221	2.94	0.913
6.00	1.09	1.59	0.366	16.83	0.78	0.55	0.103	2.25	0.206	2.48	0.892
6.17	1.08	1.57	0.365	17.00	0.78	0.55	0.102	2.55	0.217	2.11	0.854
6.33	1.04	1.55	0.365	17.17	0.78	0.54	0.100	2.85	0.247	1.82	0.797
6.50	1.02	1.51	0.358	17.33	0.78	0.54	0.098	3.15	0.304	1.60	0.715
6.67	1.00	1.47	0.351	17.50	0.77	0.53	0.097	3.45	0.334	1.45	0.656
6.83	0.97	1.43	0.346	17.67	0.77	0.52	0.095	3.75	0.345	1.32	0.611
7.00	0.96	1.39	0.333	17.83	0.78	0.51	0.092	4.05	0.346	1.21	0.578
7.17	0.94	1.35	0.327	18.00	0.78	0.51	0.091	4.35	0.333	1.11	0.557
7.33	0.94	1.30	0.311	18.17	0.78	0.51	0.090	4.65	0.317	1.01	0.540
7.50	0.94	1.26	0.298	18.33	0.78	0.50	0.089	4.95	0.302	0.906	0.520
7.67	0.94	1.23	0.288	18.50	0.77	0.50	0.089	5.25	0.299	0.795	0.484
7.83	0.94	1.21	0.279	18.67	0.77	0.50	0.088	5.55	0.310	0.688	0.434
8.00	0.94	1.18	0.272	18.83	0.77	0.49	0.087	5.85	0.342	0.594	0.365
8.17	0.94	1.16	0.265	19.00	0.77	0.49	0.087	6.15	0.376	0.522	0.306
8.33	0.94	1.14	0.258	19.17	0.76	0.49	0.088	6.45	0.408	0.460	0.256
8.50	0.94	1.12	0.251	19.33	0.76	0.48	0.087	6.75	0.440	0.407	0.214
8.67	0.94	1.10	0.246	19.50	0.75	0.47	0.086	7.05	0.466	0.364	0.183
8.83	0.92	1.08	0.240	19.67	0.75	0.47	0.085	7.35	0.492	0.320	0.155
9.00	0.93	1.07	0.236	19.83	0.75	0.46	0.084	7.65	0.517	0.282	0.131
9.17	0.92	1.06	0.233	20.00	0.74	0.45	0.083	7.95	0.545	0.246	0.109
9.33	0.91	1.04	0.231	20.17	0.74	0.44	0.081	8.25	0.572	0.214	0.091
9.50	0.90	1.02	0.226	20.33	0.74	0.44	0.081	8.55	0.601	0.189	0.075
9.67	0.90	1.00	0.221	20.50	0.74	0.42	0.080	8.85	0.624	0.163	0.063
9.83	0.89	0.99	0.218	20.67	0.73	0.43	0.079	9.15	0.657	0.144	0.050
10.00	0.88	0.97	0.213	20.83	0.73	0.42	0.078	9.45	0.680	0.130	0.042
10.17	0.87	0.94	0.203	21.00	0.73	0.41	0.077	9.75	0.708	0.119	0.034
10.33	0.87	0.91	0.196	21.17	0.72	0.40	0.076	10.1	0.726	0.108	0.029
10.50	0.87	0.89	0.189	21.33	0.72	0.39	0.074	10.4	0.743	0.102	0.025
10.67	0.88	0.87	0.179	21.50	0.72	0.38	0.073	10.6	0.753	0.080	0.022
10.83	0.89	0.85	0.170	21.67	0.72	0.38	0.071				
11.00	0.91	0.83	0.162	21.83	0.72	0.37	0.070	Magnesium (evaporated)¹³			
11.17	0.92	0.83	0.159	22.00	0.72	0.36	0.068	2.145	0.48	3.71	0.880
11.33	0.93	0.84	0.159	22.17	0.71	0.35	0.067	2.270	0.57	3.47	0.843
11.50	0.93	0.84	0.160	22.33	0.72	0.34	0.064	2.522	0.53	2.92	0.805
11.67	0.93	0.84	0.162	22.50	0.72	0.34	0.063	2.845	0.52	2.65	0.777
11.83	0.92	0.84	0.163	22.67	0.72	0.33	0.062	3.064	0.52	2.05	0.681
12.00	0.91	0.84	0.163	22.83	0.72	0.32	0.059	5.167	0.10	1.60	0.894
12.17	0.90	0.84	0.165	23.00	0.72	0.31	0.058	5.636	0.15	1.50	0.832
12.33	0.89	0.83	0.164	23.17	0.72	0.30	0.056	6.200	0.20	1.40	0.765
12.50	0.98	0.83	0.165	23.33	0.72	0.29	0.054	6.889	0.25	1.30	0.693
12.67	0.87	0.82	0.166	23.50	0.73	0.28	0.050	7.750	0.20	1.20	0.722
12.83	0.86	0.81	0.166	23.67	0.73	0.28	0.049	8.857	0.15	0.95	0.730
13.00	0.85	0.80	0.162	23.83	0.74	0.27	0.047	10.335	0.25	0.40	0.419

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
Manganese¹⁴				2.4	1.384	4.407	0.779	17.0	1.177	0.367	0.034
0.64	3.89	5.95	0.738	2.6	1.186	4.090	0.779	17.5	1.184	0.366	0.034
0.77	3.78	5.41	0.710	2.8	1.027	3.802	0.779	18.0	1.191	0.367	0.035
0.89	3.65	5.02	0.688	3.0	0.898	3.538	0.777	18.5	1.195	0.367	0.035
1.02	3.48	4.74	0.673	3.2	0.798	3.294	0.773	19.0	1.200	0.366	0.035
1.14	3.30	4.53	0.662	3.4	0.713	3.074	0.770	19.5	1.208	0.364	0.035
1.26	3.10	4.35	0.653	3.6	0.644	2.860	0.763	Molybdenum¹⁶			
1.39	2.97	4.18	0.643	3.8	0.589	2.665	0.755	0.10	18.53	68.51	0.985
1.51	2.83	4.03	0.634	4.0	0.542	2.502	0.749	0.15	8.78	47.54	0.985
1.64	2.70	3.91	0.627	4.2	0.507	2.341	0.738	0.20	5.10	35.99	0.985
1.76	2.62	3.78	0.617	4.4	0.477	2.195	0.727	0.25	3.36	28.75	0.984
1.88	2.56	3.65	0.606	4.6	0.452	2.058	0.715	0.30	2.44	23.80	0.983
2.01	2.51	3.54	0.596	4.8	0.431	1.929	0.701	0.34	2.00	20.84	0.982
2.13	2.47	3.43	0.585	5.0	0.414	1.806	0.685	0.38	1.70	18.44	0.980
2.26	2.39	3.33	0.577	5.2	0.401	1.687	0.666	0.42	1.57	16.50	0.978
2.38	2.32	3.23	0.567	5.4	0.394	1.569	0.642	0.46	1.46	14.91	0.975
2.50	2.25	3.14	0.559	5.6	0.386	1.454	0.617	0.50	1.37	13.55	0.971
2.63	2.19	3.06	0.552	5.7	0.386	1.396	0.601	0.54	1.35	12.36	0.966
2.75	2.11	2.98	0.545	5.8	0.386	1.341	0.585	0.58	1.34	11.34	0.960
2.88	2.06	2.90	0.536	5.9	0.385	1.287	0.569	0.62	1.38	10.44	0.952
3.00	2.00	2.82	0.528	6.0	0.386	1.232	0.551	0.66	1.43	9.67	0.942
3.12	1.96	2.74	0.518	6.1	0.388	1.176	0.531	0.70	1.48	8.99	0.932
3.25	1.92	2.67	0.509	6.2	0.390	1.118	0.510	0.74	1.51	8.38	0.921
3.37	1.89	2.59	0.498	6.3	0.399	1.058	0.481	0.78	1.60	7.83	0.906
3.50	1.89	2.51	0.484	6.4	0.412	1.002	0.450	0.82	1.64	7.35	0.892
3.62	1.87	2.45	0.475	6.5	0.428	0.949	0.418	0.86	1.70	6.89	0.876
3.74	1.86	2.38	0.463	6.6	0.436	0.898	0.392	0.90	1.74	6.48	0.859
3.87	1.86	2.32	0.451	6.7	0.438	0.836	0.367	1.00	1.94	5.58	0.805
3.99	1.86	2.25	0.438	6.8	0.459	0.756	0.320	1.10	2.15	4.85	0.743
4.12	1.86	2.19	0.427	6.9	0.510	0.676	0.255	1.20	2.44	4.22	0.671
4.24	1.85	2.14	0.417	7.0	0.585	0.617	0.191	1.30	2.77	3.74	0.608
4.36	1.85	2.08	0.406	7.1	0.663	0.589	0.148	1.40	3.15	3.40	0.562
4.49	1.86	2.03	0.395	7.2	0.717	0.584	0.128	1.50	3.53	3.30	0.550
4.61	1.85	1.99	0.388	7.3	0.769	0.575	0.111	1.60	3.77	3.41	0.562
4.74	1.84	1.94	0.378	7.4	0.817	0.574	0.100	1.70	3.84	3.51	0.570
4.86	1.83	1.91	0.372	7.5	0.860	0.580	0.094	1.80	3.81	3.58	0.576
4.98	1.82	1.86	0.362	7.6	0.893	0.597	0.093	1.90	3.74	3.58	0.576
5.11	1.82	1.82	0.354	7.8	0.929	0.623	0.096	2.00	3.68	3.52	0.571
5.23	1.81	1.79	0.348	8.0	0.946	0.639	0.098	2.10	3.68	3.45	0.565
5.36	1.78	1.76	0.342	8.2	0.952	0.645	0.099	2.20	3.76	3.41	0.562
5.48	1.74	1.73	0.337	8.4	0.953	0.638	0.097	2.30	3.79	3.61	0.578
5.60	1.73	1.70	0.331	8.6	0.956	0.624	0.093	2.40	3.59	3.78	0.594
5.73	1.72	1.67	0.325	8.8	0.965	0.607	0.087	2.50	3.36	3.73	0.591
5.85	1.70	1.64	0.319	9.0	0.975	0.588	0.082	2.60	3.22	3.61	0.582
5.98	1.67	1.61	0.313	9.2	0.988	0.568	0.076	2.70	3.13	3.51	0.573
6.10	1.63	1.58	0.307	9.4	1.009	0.548	0.069	2.80	3.08	3.42	0.565
6.22	1.62	1.55	0.301	9.6	1.044	0.541	0.066	2.90	3.05	3.33	0.566
6.35	1.59	1.52	0.295	9.8	1.061	0.557	0.069	3.00	3.04	3.27	0.550
6.47	1.55	1.50	0.292	10.0	1.062	0.567	0.071	3.10	3.03	3.21	0.544
6.60	1.48	1.47	0.288	10.2	1.054	0.569	0.072	3.20	3.05	3.18	0.540
Mercury (liquid)¹⁵				10.4	1.045	0.561	0.070	3.30	3.06	3.18	0.540
0.2	13.99	14.27	0.869	10.6	1.041	0.550	0.068	3.40	3.06	3.19	0.541
0.3	11.37	11.95	0.846	10.8	1.039	0.537	0.065	3.50	3.06	3.21	0.543
0.4	9.741	10.65	0.830	11.0	1.039	0.523	0.062	3.60	3.05	3.23	0.546
0.5	8.528	9.805	0.818	11.5	1.050	0.491	0.055	3.70	3.04	3.27	0.550
0.6	7.574	9.195	0.808	12.0	1.064	0.467	0.050	3.80	3.04	3.31	0.554
0.8	6.086	8.312	0.796	12.5	1.078	0.445	0.045	3.90	3.04	3.40	0.564
1.0	4.962	7.643	0.789	13.0	1.092	0.430	0.042	4.00	3.01	3.51	0.576
1.2	4.050	7.082	0.786	13.5	1.104	0.416	0.040	4.20	2.77	3.77	0.610
1.4	3.324	6.558	0.785	14.0	1.115	0.404	0.038	4.40	2.39	3.88	0.640
1.6	2.746	6.054	0.783	14.5	1.125	0.394	0.037	4.60	2.06	3.84	0.658
1.8	2.284	5.582	0.782	15.0	1.135	0.383	0.035	4.80	1.75	3.76	0.678
2.0	1.910	5.150	0.782	15.5	1.146	0.374	0.034	5.00	1.46	3.62	0.695
2.2	1.620	4.751	0.780	16.0	1.159	0.368	0.034	5.20	1.22	3.42	0.706
				16.5	1.170	0.367	0.034				

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
5.40	1.07	3.20	0.706	27.00	0.73	0.29	0.050	4.80	1.53	2.11	0.435
5.60	0.96	2.99	0.700	27.50	0.76	0.28	0.041	5.00	1.40	2.10	0.449
5.80	0.89	2.80	0.688	28.00	0.79	0.27	0.036	5.20	1.27	2.04	0.454
6.00	0.85	2.64	0.674	28.50	0.81	0.26	0.031	5.40	1.16	1.94	0.449
6.20	0.81	2.50	0.660	29.00	0.83	0.26	0.028	5.60	1.09	1.83	0.435
6.40	0.79	2.36	0.641	29.50	0.86	0.26	0.025	5.80	1.04	1.73	0.417
6.60	0.78	2.24	0.619	30.00	0.88	0.26	0.023	6.20	1.00	1.54	0.371
6.80	0.78	2.13	0.592	31.00	0.92	0.29	0.024	6.40	1.01	1.46	0.345
7.00	0.80	2.04	0.568	32.00	0.92	0.32	0.030	6.60	1.01	1.40	0.325
7.20	0.81	1.98	0.548	33.00	0.90	0.33	0.032	6.80	1.02	1.35	0.308
7.40	0.81	1.95	0.542	34.00	0.91	0.34	0.034	7.00	1.03	1.30	0.291
7.60	0.75	1.90	0.552	35.00	0.87	0.37	0.043	7.20	1.03	1.27	0.282
7.80	0.71	1.81	0.542	36.00	0.82	0.34	0.043	7.40	1.03	1.24	0.273
8.00	0.69	1.73	0.530	37.00	0.81	0.30	0.038	7.60	1.02	1.22	0.265
8.20	0.67	1.65	0.512	38.00	0.81	0.27	0.033	7.80	1.01	1.18	0.256
8.40	0.66	1.57	0.495	39.00	0.82	0.25	0.029	8.00	1.01	1.15	0.248
8.60	0.65	1.49	0.475	40.00	0.83	0.23	0.025	8.20	1.00	1.13	0.242
8.80	0.65	1.41	0.450					8.40	0.99	1.11	0.235
9.00	0.65	1.33	0.420	Nickel¹⁷				8.60	0.98	1.08	0.228
9.20	0.67	1.25	0.385	0.10	9.54	45.82	0.983	8.80	0.97	1.05	0.220
9.40	0.69	1.19	0.355	0.15	5.45	30.56	0.978	9.00	0.97	1.01	0.211
9.60	0.71	1.12	0.320	0.20	4.12	22.48	0.969	9.20	0.96	0.99	0.203
9.80	0.74	1.05	0.285	0.25	4.25	17.68	0.950	9.40	0.95	0.96	0.194
10.00	0.77	0.99	0.250	0.30	4.19	15.05	0.934	9.60	0.95	0.93	0.185
10.20	0.81	0.93	0.217	0.35	4.03	13.05	0.918	9.80	0.95	0.89	0.175
10.40	0.86	0.88	0.188	0.40	3.84	11.43	0.900	10.00	0.95	0.87	0.166
10.60	0.91	0.83	0.162	0.50	4.03	9.64	0.864	10.20	0.95	0.83	0.155
10.80	0.98	0.79	0.138	0.60	3.84	8.35	0.835	10.40	0.95	0.80	0.145
11.00	1.05	0.77	0.125	0.70	3.59	7.48	0.813	10.60	0.97	0.76	0.129
11.20	1.12	0.78	0.123	0.80	3.38	6.82	0.794	10.80	0.99	0.75	0.123
11.40	1.18	0.80	0.125	0.90	3.18	6.23	0.774	11.00	1.01	0.73	0.115
11.60	1.23	0.85	0.135	1.00	3.06	5.74	0.753	11.25	1.04	0.72	0.111
11.80	1.25	0.89	0.145	1.10	2.97	5.38	0.734	11.50	1.05	0.71	0.109
12.00	1.26	0.92	0.154	1.20	2.85	5.10	0.721	11.75	1.07	0.71	0.108
12.40	1.25	0.98	0.168	1.30	2.74	4.85	0.708	12.00	1.07	0.71	0.108
12.80	1.23	1.00	0.178	1.40	2.65	4.63	0.695	12.25	1.07	0.71	0.107
13.20	1.20	1.02	0.185	1.50	2.53	4.47	0.688	12.50	1.08	0.71	0.106
13.60	1.17	1.02	0.187	1.60	2.43	4.31	0.679	12.75	1.08	0.71	0.106
14.00	1.15	1.01	0.185	1.70	2.28	4.18	0.677	13.00	1.08	0.71	0.105
14.40	1.13	1.00	0.182	1.80	2.14	4.01	0.670	13.25	1.08	0.71	0.105
14.80	1.13	0.99	0.179	1.90	2.02	3.82	0.659	13.50	1.07	0.70	0.105
15.00	1.14	0.99	0.179	2.00	1.92	3.65	0.649	13.75	1.07	0.70	0.105
15.60	1.15	1.01	0.184	2.10	1.85	3.48	0.634	14.00	1.07	0.71	0.106
16.00	1.14	1.04	0.194	2.20	1.80	3.33	0.620	14.25	1.06	0.70	0.106
16.60	1.10	1.10	0.216	2.30	1.75	3.19	0.605	14.50	1.05	0.70	0.106
17.00	1.04	1.12	0.233	2.40	1.71	3.06	0.590	14.75	1.04	0.70	0.107
17.60	0.94	1.14	0.257	2.50	1.67	2.93	0.575	15.00	1.03	0.70	0.107
18.00	0.87	1.12	0.270	2.60	1.65	2.81	0.557	15.25	1.02	0.69	0.106
18.60	0.77	1.08	0.283	2.70	1.64	2.71	0.542	15.50	1.01	0.69	0.105
19.00	0.71	1.02	0.284	2.80	1.63	2.61	0.525	15.75	1.00	0.68	0.104
19.60	0.66	0.94	0.275	2.90	1.62	2.52	0.509	16.00	0.99	0.67	0.103
20.00	0.64	0.89	0.264	3.00	1.61	2.44	0.495	16.50	0.98	0.66	0.101
20.60	0.62	0.81	0.245	3.10	1.61	2.36	0.480	17.00	0.96	0.64	0.098
21.00	0.61	0.77	0.234	3.20	1.61	2.30	0.467	17.50	0.94	0.63	0.096
21.60	0.61	0.71	0.215	3.30	1.61	2.23	0.454	18.00	0.92	0.61	0.092
22.00	0.60	0.69	0.207	3.40	1.62	2.17	0.441	18.50	0.91	0.58	0.087
22.60	0.59	0.63	0.195	3.50	1.63	2.11	0.428	19.00	0.90	0.56	0.082
23.00	0.58	0.60	0.185	3.60	1.64	2.07	0.416	19.50	0.90	0.54	0.077
23.60	0.58	0.53	0.166	3.70	1.66	2.02	0.405	20.00	0.89	0.51	0.071
24.00	0.58	0.49	0.151	3.80	1.69	1.99	0.397	20.50	0.89	0.49	0.066
24.60	0.60	0.43	0.124	3.90	1.72	1.98	0.393	21.00	0.90	0.47	0.061
25.00	0.62	0.39	0.106	4.00	1.73	1.98	0.392	21.50	0.91	0.46	0.057
25.60	0.66	0.35	0.085	4.20	1.74	2.01	0.396	22.00	0.91	0.45	0.055
26.00	0.68	0.33	0.072	4.40	1.71	2.06	0.409	22.50	0.91	0.44	0.053
26.50	0.71	0.31	0.060	4.60	1.63	2.09	0.421	23.00	0.92	0.44	0.051

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
3.40	2.93	3.79	0.607	20.00	0.96	1.10	0.239	2.50	1.41	3.48	0.685
3.60	2.75	3.45	0.577	20.40	0.93	1.09	0.240	2.60	1.37	3.36	0.676
3.80	2.73	3.32	0.562	20.80	0.89	1.05	0.240	2.70	1.32	3.25	0.668
4.00	2.71	3.34	0.565	21.20	0.86	1.02	0.237	2.80	1.29	3.13	0.658
4.20	2.53	3.44	0.584	21.60	0.83	0.99	0.235	2.90	1.26	3.03	0.648
4.40	2.24	3.44	0.599	22.00	0.80	0.96	0.230	3.00	1.23	2.94	0.639
4.60	2.01	3.31	0.598	22.40	0.78	0.93	0.226	3.10	1.20	2.85	0.630
4.80	1.88	3.19	0.592	22.80	0.77	0.90	0.220	3.20	1.17	2.77	0.622
5.00	1.74	3.12	0.596	23.20	0.75	0.88	0.217	3.30	1.14	2.68	0.613
5.20	1.58	3.00	0.597	23.60	0.75	0.86	0.211	3.40	1.12	2.60	0.602
5.40	1.46	2.88	0.593	24.00	0.73	0.84	0.209	3.50	1.10	2.52	0.591
5.60	1.36	2.77	0.589	24.40	0.72	0.82	0.207	3.60	1.08	2.45	0.581
5.80	1.27	2.65	0.582	24.80	0.70	0.80	0.205	3.70	1.07	2.38	0.570
6.00	1.20	2.54	0.575	25.20	0.69	0.77	0.202	3.80	1.06	2.31	0.558
6.20	1.13	2.44	0.571	25.60	0.67	0.75	0.199	3.90	1.05	2.25	0.547
6.40	1.06	2.33	0.562	26.00	0.66	0.72	0.195	4.00	1.03	2.19	0.537
6.60	1.01	2.21	0.548	26.40	0.65	0.69	0.189	4.20	1.04	2.09	0.510
6.80	0.97	2.11	0.532	26.80	0.63	0.66	0.183	4.40	1.03	2.01	0.493
7.00	0.95	2.00	0.514	27.20	0.65	0.62	0.165	4.60	1.03	1.94	0.476
7.20	0.92	1.91	0.497	28.00	0.64	0.59	0.156	4.80	1.01	1.90	0.470
7.40	0.91	1.81	0.476	28.40	0.64	0.57	0.148	5.00	0.96	1.86	0.472
7.60	0.90	1.72	0.451	28.80	0.65	0.55	0.140	5.20	0.90	1.79	0.474
7.80	0.90	1.63	0.426	29.20	0.65	0.53	0.134	5.40	0.85	1.70	0.463
8.00	0.91	1.55	0.400	29.60	0.65	0.51	0.128	5.60	0.81	1.62	0.449
8.20	0.91	1.48	0.375	30.00	0.65	0.49	0.121	5.80	0.78	1.54	0.437
8.40	0.94	1.40	0.344	31.00	0.65	0.45	0.111	6.00	0.76	1.45	0.418
8.60	0.96	1.34	0.319	32.00	0.66	0.41	0.095	6.20	0.74	1.37	0.397
8.80	0.98	1.29	0.296	33.00	0.68	0.37	0.079	6.40	0.73	1.29	0.375
9.00	1.01	1.24	0.274	34.00	0.70	0.34	0.068	6.60	0.72	1.21	0.350
9.20	1.04	1.19	0.255	35.00	0.72	0.31	0.057	6.80	0.73	1.13	0.316
9.40	1.08	1.16	0.238	36.00	0.74	0.29	0.048	7.00	0.73	1.05	0.287
9.60	1.10	1.14	0.229	37.00	0.77	0.27	0.040	7.20	0.75	0.98	0.255
9.80	1.13	1.11	0.217	38.00	0.79	0.26	0.035	7.40	0.77	0.91	0.223
10.00	1.16	1.10	0.209	39.00	0.81	0.26	0.031	7.60	0.79	0.85	0.195
10.20	1.19	1.08	0.203	40.00	0.84	0.26	0.026	7.80	0.83	0.78	0.163
10.30	1.20	1.08	0.201					8.00	0.88	0.73	0.133
10.40	1.22	1.08	0.200	Palladium¹⁹				8.20	0.94	0.70	0.117
10.50	1.23	1.09	0.201	0.10	4.13	54.15	0.994	8.40	0.96	0.70	0.114
10.60	1.24	1.10	0.203	0.15	3.13	35.82	0.990	8.60	1.00	0.65	0.097
10.80	1.25	1.11	0.206	0.20	3.07	26.59	0.983	8.80	1.04	0.65	0.094
11.00	1.24	1.13	0.213	0.26	3.11	20.15	0.971	9.00	1.07	0.64	0.090
11.20	1.23	1.14	0.217	0.30	3.56	17.27	0.955	9.50	1.12	0.65	0.089
11.40	1.19	1.15	0.223	0.36	3.98	14.41	0.932	10.00	1.14	0.65	0.088
11.60	1.17	1.12	0.216	0.40	4.27	13.27	0.916	10.50	1.16	0.65	0.087
11.80	1.16	1.10	0.211	0.46	4.27	12.11	0.902	11.00	1.18	0.64	0.086
12.00	1.15	1.08	0.205	0.50	4.10	11.44	0.896	11.50	1.19	0.65	0.087
12.40	1.14	1.03	0.191	0.56	3.92	10.49	0.883	12.00	1.20	0.66	0.089
12.80	1.15	1.01	0.183	0.60	3.80	9.96	0.876	12.50	1.19	0.67	0.091
13.20	1.16	0.98	0.174	0.72	3.51	8.70	0.854	13.00	1.18	0.67	0.091
13.60	1.17	0.97	0.170	0.80	3.35	8.06	0.840	13.50	1.18	0.67	0.092
14.00	1.17	0.96	0.169	1.00	2.99	6.89	0.811	14.00	1.17	0.67	0.093
14.40	1.16	0.94	0.165	1.10	2.81	6.46	0.800	14.50	1.15	0.68	0.095
14.80	1.16	0.91	0.156	1.20	2.65	6.10	0.790	15.00	1.13	0.69	0.098
15.20	1.17	0.89	0.148	1.30	2.50	5.78	0.781	15.50	1.10	0.68	0.096
15.60	1.20	0.86	0.140	1.40	2.34	5.50	0.774	16.00	1.08	0.66	0.092
16.00	1.25	0.87	0.140	1.50	2.17	5.22	0.767	16.50	1.06	0.63	0.086
16.40	1.28	0.90	0.147	1.60	2.08	4.95	0.755	17.00	1.07	0.61	0.081
16.80	1.28	0.94	0.157	1.70	2.00	4.72	0.745	17.50	1.06	0.61	0.080
17.20	1.27	0.97	0.167	1.80	1.92	4.54	0.737	18.00	1.07	0.59	0.077
17.60	1.26	1.01	0.178	1.90	1.82	4.35	0.729	18.50	1.07	0.59	0.077
18.00	1.23	1.04	0.189	2.00	1.75	4.18	0.721	19.00	1.08	0.59	0.077
18.40	1.19	1.08	0.200	2.10	1.67	4.03	0.714	19.50	1.08	0.61	0.080
18.80	1.14	1.10	0.210	2.20	1.60	3.88	0.707	20.00	1.07	0.65	0.090
19.20	1.10	1.10	0.219	2.30	1.53	3.75	0.700	20.50	1.03	0.67	0.098
19.60	1.05	1.11	0.227	2.40	1.47	3.61	0.693	21.00	0.99	0.67	0.103

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
21.50	0.95	0.66	0.103	6.00	1.38	1.40	0.276	28.50	0.75	0.59	0.121
22.00	0.91	0.64	0.103	6.20	1.39	1.35	0.261	29.00	0.75	0.58	0.118
22.50	0.88	0.62	0.101	6.40	1.42	1.29	0.246	29.50	0.74	0.58	0.120
23.00	0.86	0.59	0.097	6.60	1.45	1.26	0.236	30.00	0.73	0.58	0.124
23.50	0.85	0.56	0.091	6.80	1.48	1.24	0.231				
24.00	0.84	0.54	0.086	7.00	1.50	1.24	0.230				
25.00	0.81	0.51	0.084	7.20	1.50	1.25	0.231	Potassium²¹			
26.40	0.80	0.43	0.066	7.40	1.49	1.23	0.228	0.55	0.139	7.10	0.989
27.80	0.81	0.38	0.052	7.60	1.48	1.22	0.225	0.58	0.119	6.72	0.990
29.20	0.82	0.35	0.046	7.80	1.48	1.20	0.221	0.63	0.106	6.32	0.990
				8.00	1.47	1.18	0.216	0.67	0.091	5.79	0.990
Platinum²⁰				8.20	1.47	1.17	0.212	0.73	0.079	5.30	0.989
0.10	13.21	44.72	0.976	8.40	1.47	1.15	0.209	0.81	0.066	4.75	0.989
0.15	8.18	31.16	0.969	8.60	1.47	1.14	0.205	0.92	0.056	4.19	0.988
0.20	5.90	23.95	0.962	8.80	1.47	1.13	0.202	1.05	0.044	3.58	0.987
0.25	4.70	19.40	0.954	9.00	1.48	1.12	0.200	1.23	0.040	3.04	0.985
0.30	3.92	16.16	0.945	9.20	1.49	1.11	0.198	1.44	0.040	2.56	0.979
0.35	3.28	13.66	0.936	9.40	1.49	1.12	0.200	1.65	0.044	2.19	0.970
0.40	2.81	11.38	0.922	9.60	1.49	1.13	0.203	1.87	0.050	1.84	0.955
0.45	3.03	9.31	0.882	9.80	1.48	1.15	0.207	2.07	0.053	1.62	0.943
0.50	3.91	7.71	0.813	10.00	1.46	1.15	0.209	2.27	0.049	1.43	0.938
0.55	4.58	7.14	0.777	10.20	1.43	1.16	0.211	2.45	0.046	1.28	0.933
0.60	5.13	6.75	0.753	10.40	1.40	1.15	0.210	2.64	0.043	1.14	0.928
0.65	5.52	6.66	0.746	10.60	1.37	1.14	0.207	2.82	0.043	1.02	0.919
0.70	5.71	6.83	0.751	10.80	1.35	1.12	0.203	2.95	0.041	0.898	0.913
0.75	5.57	7.02	0.759	11.00	1.33	1.10	0.199	3.06	0.041	0.799	0.905
0.80	5.31	7.04	0.762	11.20	1.31	1.08	0.194	3.40	0.052	0.549	0.852
0.85	5.05	6.98	0.763	11.40	1.30	1.06	0.188	3.71	0.089	0.288	0.719
0.90	4.77	6.91	0.765	11.60	1.29	1.04	0.183	3.97	0.287	0.091	0.310
0.95	4.50	6.77	0.763	11.80	1.29	1.01	0.177	4.00	0.34	0.08	0.245
1.00	4.25	6.62	0.762	12.00	1.29	1.00	0.173	4.065	0.38	0.07	0.204
1.10	3.86	6.24	0.753	12.40	1.29	0.97	0.165	4.133	0.41	0.07	0.177
1.20	3.55	5.92	0.746	12.80	1.29	0.94	0.158	4.203	0.45	0.06	0.145
1.30	3.29	5.61	0.736	13.20	1.31	0.93	0.155	4.275	0.48	0.06	0.125
1.40	3.10	5.32	0.725	13.60	1.31	0.93	0.155	4.350	0.52	0.05	0.101
1.50	2.92	5.07	0.716	14.00	1.31	0.93	0.155	4.428	0.55	0.05	0.085
1.60	2.76	4.84	0.706	14.40	1.30	0.93	0.156	4.509	0.58	0.05	0.072
1.70	2.63	4.64	0.697	14.80	1.27	0.93	0.157	4.592	0.61	0.05	0.060
1.80	2.51	4.43	0.686	14.80	1.27	0.93	0.157	4.679	0.64	0.04	0.049
1.90	2.38	4.26	0.678	15.20	1.27	0.93	0.155	4.769	0.66	0.04	0.043
2.00	2.30	4.07	0.664	15.60	1.25	0.92	0.151	4.862	0.68	0.04	0.037
2.10	2.23	3.92	0.654	16.00	1.24	0.89	0.146	4.959	0.70	0.04	0.032
2.20	2.17	3.77	0.642	16.50	1.24	0.87	0.142	5.061	0.72	0.04	0.027
2.30	2.10	3.67	0.636	17.00	1.25	0.86	0.138	5.166	0.74	0.04	0.023
2.40	2.03	3.54	0.626	17.50	1.27	0.85	0.135	5.276	0.76	0.04	0.019
2.50	1.96	3.42	0.616	18.00	1.31	0.88	0.142	5.391	0.78	0.04	0.016
2.60	1.91	3.30	0.605	18.50	1.30	0.94	0.157	5.510	0.79	0.05	0.015
2.70	1.87	3.20	0.595	19.00	1.28	0.99	0.171	5.637	0.81	0.05	0.012
2.80	1.83	3.10	0.585	19.50	1.23	1.03	0.184	5.767	0.83	0.05	0.009
2.90	1.79	3.01	0.575	20.00	1.18	1.06	0.197	6.048	0.85	0.05	0.007
3.00	1.75	2.92	0.565	20.50	1.11	1.09	0.212	6.199	0.87	0.05	0.006
3.20	1.68	2.76	0.546	21.00	1.03	1.10	0.226	6.358	0.88	0.05	0.005
3.40	1.63	2.62	0.527	21.50	0.94	1.08	0.238	6.526	0.90	0.06	0.004
3.60	1.58	2.48	0.507	22.00	0.87	1.04	0.240	6.702	0.91	0.06	0.003
3.80	1.53	2.37	0.491	22.50	0.81	0.98	0.235	6.888	0.92	0.06	0.003
4.00	1.49	2.25	0.472	23.00	0.77	0.92	0.226	7.085	0.92	0.06	0.003
4.20	1.45	2.14	0.452	23.50	0.75	0.87	0.213	7.293	0.93	0.06	0.002
4.40	1.43	2.04	0.432	24.00	0.74	0.82	0.201	7.514	0.93	0.06	0.002
4.60	1.39	1.95	0.415	24.50	0.73	0.77	0.187	7.749	0.94	0.06	0.002
4.80	1.38	1.85	0.392	25.00	0.73	0.73	0.174	7.999	0.94	0.06	0.002
5.00	1.36	1.76	0.372	25.50	0.73	0.70	0.162	8.260	0.94	0.06	0.002
5.20	1.36	1.67	0.350	26.00	0.74	0.67	0.150	8.551	0.94	0.06	0.002
5.40	1.36	1.61	0.332	26.50	0.74	0.65	0.142	8.856	0.94	0.05	0.002
5.60	1.36	1.54	0.315	27.00	0.74	0.63	0.136	9.184	0.94	0.05	0.002
5.80	1.36	1.47	0.295	27.50	0.74	0.62	0.130	9.537	0.94	0.04	0.001
				28.00	0.75	0.60	0.125	9.919	0.94	0.04	0.001

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	n	k	R($\phi = 0$)	Energy (eV)	n	k	R($\phi = 0$)	Energy (eV)	n	k	R($\phi = 0$)
10.33	0.94	0.03	0.001	7.60	1.12	1.99	0.470	31.00	0.62	0.29	0.086
11.0		0.03		7.80	1.08	1.89	0.454	32.00	0.66	0.26	0.065
12.0		0.028		8.00	1.05	1.80	0.435	33.00	0.68	0.24	0.054
				8.20	1.05	1.71	0.411	34.00	0.72	0.21	0.041
→				8.40	1.05	1.62	0.386	35.00	0.76	0.20	0.031
Rhenium, single crystal, E || \hat{c}^z				8.60	1.06	1.55	0.360	36.00	0.79	0.20	0.025
0.10	6.06	51.03	0.991	8.80	1.09	1.48	0.336	37.00	0.82	0.19	0.021
0.15	4.66	33.96	0.984	9.00	1.11	1.43	0.317	38.00	0.85	0.20	0.018
0.20	4.16	25.36	0.975	9.20	1.13	1.39	0.301	39.00	0.89	0.21	0.016
0.25	4.03	20.10	0.962	9.40	1.16	1.34	0.281	40.00	0.88	0.26	0.022
0.30	4.37	16.69	0.943	9.60	1.18	1.32	0.274	42.00	0.88	0.26	0.022
0.35	4.50	14.53	0.925	9.80	1.20	1.29	0.264	44.00	0.89	0.29	0.026
0.40	4.53	12.96	0.909	10.00	1.23	1.26	0.252	46.00	0.85	0.32	0.035
0.45	4.53	11.78	0.893	10.20	1.25	1.25	0.246	48.00	0.82	0.30	0.036
0.50	4.53	10.88	0.878	10.40	1.28	1.25	0.242	50.00	0.80	0.30	0.038
0.55	4.50	10.26	0.867	10.60	1.29	1.25	0.242	52.00	0.78	0.30	0.044
0.60	4.29	9.75	0.861	10.80	1.30	1.26	0.244	54.00	0.72	0.30	0.055
0.65	4.07	9.35	0.856	11.00	1.30	1.27	0.247	56.00	0.66	0.24	0.061
0.70	3.80	8.94	0.853	11.20	1.29	1.28	0.249	58.00	0.65	0.16	0.055
0.75	3.48	8.55	0.850	11.40	1.28	1.28	0.252	→			
0.80	3.21	8.10	0.846	11.60	1.26	1.28	0.252	Rhenium, single crystal, E ⊥ \hat{c}^z			
0.85	2.96	7.68	0.841	11.80	1.24	1.26	0.249	0.10	4.25	42.83	0.991
0.90	2.73	7.24	0.835	12.00	1.23	1.24	0.244	0.15	3.28	28.08	0.984
0.95	2.56	6.79	0.826	12.40	1.22	1.21	0.237	0.20	3.28	20.66	0.971
1.00	2.45	6.36	0.813	12.80	1.21	1.18	0.230	0.25	3.47	16.27	0.951
1.10	2.38	5.61	0.778	13.20	1.22	1.16	0.222	0.30	3.73	13.44	0.926
1.20	2.35	5.02	0.742	13.60	1.22	1.13	0.215	0.35	3.93	11.54	0.900
1.30	2.39	4.54	0.702	14.00	1.24	1.12	0.209	0.40	3.99	10.15	0.875
1.40	2.44	4.13	0.662	14.40	1.27	1.11	0.204	0.45	4.17	9.03	0.846
1.50	2.50	3.79	0.624	14.80	1.29	1.15	0.213	0.50	4.34	8.26	0.821
1.60	2.59	3.49	0.587	15.20	1.29	1.19	0.225	0.55	4.45	7.73	0.801
1.70	2.70	3.27	0.557	15.60	1.26	1.22	0.236	0.60	4.53	7.40	0.788
1.80	2.82	3.10	0.535	16.00	1.23	1.25	0.248	0.65	4.44	7.26	0.784
1.90	2.90	3.00	0.520	16.40	1.19	1.27	0.259	0.70	4.13	7.09	0.784
2.00	2.97	2.91	0.510	16.80	1.14	1.29	0.269	0.75	3.77	6.75	0.779
2.10	3.03	2.86	0.504	17.00	1.12	1.30	0.275	0.80	3.55	6.32	0.766
2.20	3.06	2.84	0.501	17.40	1.07	1.30	0.286	0.85	3.39	5.95	0.752
2.30	3.07	2.82	0.499	18.00	0.99	1.30	0.300	0.90	3.26	5.61	0.737
2.40	3.06	2.81	0.498	18.40	0.93	1.29	0.311	0.95	3.17	5.27	0.719
2.50	3.02	2.80	0.497	18.80	0.87	1.28	0.321	1.00	3.09	4.96	0.701
2.60	2.96	2.77	0.493	19.20	0.81	1.25	0.330	1.10	3.05	4.39	0.658
2.70	2.89	2.68	0.482	19.60	0.77	1.21	0.332	1.20	3.08	3.89	0.613
2.80	2.89	2.57	0.468	20.00	0.73	1.18	0.333	1.30	3.20	3.56	0.578
2.90	2.99	2.47	0.457	20.40	0.70	1.14	0.332	1.40	3.23	3.38	0.559
3.00	3.11	2.57	0.470	20.80	0.67	1.11	0.332	1.50	3.23	3.12	0.532
3.20	2.90	2.68	0.482	21.20	0.64	1.08	0.334	1.60	3.29	2.88	0.507
3.40	2.83	2.50	0.459	21.60	0.61	1.04	0.335	1.70	3.38	2.72	0.491
3.60	2.93	2.48	0.457	22.00	0.58	1.01	0.340	1.80	3.47	2.59	0.480
3.80	2.86	2.56	0.467	22.40	0.55	0.97	0.341	1.90	3.54	2.50	0.473
4.00	2.81	2.51	0.460	22.80	0.53	0.93	0.338	2.00	3.63	2.43	0.469
4.20	2.86	2.55	0.466	23.20	0.51	0.89	0.334	2.10	3.74	2.40	0.470
4.40	2.81	2.74	0.489	23.60	0.50	0.85	0.329	2.20	3.83	2.38	0.472
4.60	2.56	2.83	0.504	24.00	0.48	0.80	0.319	2.30	3.93	2.44	0.481
4.80	2.41	2.71	0.493	24.40	0.48	0.76	0.207	2.40	4.00	2.55	0.492
5.00	2.39	2.68	0.488	24.80	0.47	0.72	0.296	2.50	4.01	2.70	0.505
5.20	2.34	2.75	0.500	25.20	0.47	0.68	0.282	2.60	3.90	2.84	0.514
5.40	2.20	2.81	0.515	25.60	0.47	0.65	0.270	2.70	3.74	2.92	0.517
5.60	2.02	2.84	0.530	26.00	0.47	0.61	0.255	2.80	3.57	2.88	0.511
5.80	1.83	2.80	0.538	26.40	0.48	0.57	0.240	2.90	3.49	2.75	0.497
6.00	1.65	2.71	0.541	26.80	0.48	0.54	0.225	3.00	3.53	2.71	0.493
6.20	1.54	2.59	0.532	27.20	0.49	0.51	0.208	3.20	3.55	2.84	0.506
6.40	1.45	2.50	0.526	27.60	0.50	0.48	0.193	3.40	3.34	2.88	0.508
6.80	1.32	2.31	0.508	28.00	0.51	0.45	0.176	3.60	3.25	2.83	0.501
7.00	1.26	2.23	0.500	29.00	0.54	0.39	0.145	3.80	3.24	2.84	0.502
7.20	1.20	2.15	0.493	30.00	0.57	0.33	0.114	4.00	3.19	2.94	0.513
7.40	1.16	2.06	0.480								

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
4.20	3.05	3.06	0.526	22.80	0.55	0.92	0.325	3.00	1.53	4.29	0.753
4.40	2.88	3.15	0.539	23.20	0.53	0.89	0.322	3.10	1.41	4.20	0.760
4.60	2.67	3.18	0.548	23.60	0.52	0.85	0.317	3.20	1.30	4.09	0.764
4.80	2.44	3.17	0.554	24.00	0.50	0.82	0.314	3.30	1.20	3.97	0.767
5.00	2.25	3.12	0.556	24.40	0.49	0.79	0.309	3.40	1.11	3.84	0.769
5.20	2.10	3.04	0.555	24.80	0.48	0.75	0.303	3.50	1.04	3.71	0.768
5.40	1.96	2.96	0.553	25.20	0.47	0.72	0.295	3.60	0.99	3.58	0.764
5.60	1.84	2.88	0.551	25.60	0.47	0.68	0.286	3.70	0.95	3.45	0.759
5.80	1.73	2.81	0.549	26.00	0.46	0.64	0.276	3.80	0.91	3.34	0.753
6.00	1.61	2.74	0.549	26.40	0.46	0.61	0.263	3.90	0.88	3.23	0.747
6.20	1.51	2.64	0.545	26.80	0.46	0.57	0.249	4.00	0.86	3.12	0.739
6.40	1.42	2.56	0.541	27.20	0.47	0.53	0.231	4.20	0.83	2.94	0.722
6.80	1.28	2.37	0.526	27.60	0.48	0.50	0.216	4.40	0.80	2.76	0.706
7.00	1.22	2.28	0.517	28.00	0.49	0.47	0.198	4.60	0.78	2.60	0.684
7.20	1.16	2.19	0.508	29.00	0.51	0.41	0.164	4.80	0.79	2.46	0.659
7.40	1.12	2.08	0.493	30.00	0.55	0.34	0.129	5.00	0.79	2.34	0.635
7.60	1.12	1.98	0.468	31.00	0.59	0.29	0.097	5.20	0.79	2.23	0.613
7.80	1.08	1.93	0.463	32.00	0.64	0.26	0.072	5.40	0.80	2.14	0.591
8.00	1.05	1.83	0.443	33.00	0.67	0.24	0.060	5.60	0.80	2.06	0.573
8.20	1.05	1.74	0.418	34.00	0.70	0.22	0.047	5.80	0.79	2.00	0.561
8.40	1.05	1.66	0.397	35.00	0.74	0.20	0.036	6.00	0.76	1.93	0.556
8.60	1.06	1.58	0.372	36.00	0.77	0.19	0.029	6.20	0.73	1.85	0.544
8.80	1.07	1.52	0.351	37.00	0.80	0.19	0.023	6.40	0.70	1.77	0.534
9.00	1.09	1.46	0.327	38.00	0.84	0.19	0.018	6.60	0.68	1.69	0.518
9.20	1.11	1.41	0.309	39.00	0.88	0.21	0.016	6.80	0.67	1.60	0.498
9.40	1.14	1.36	0.290	40.00	0.87	0.25	0.023	7.00	0.66	1.52	0.476
9.60	1.17	1.31	0.273	42.00	0.87	0.25	0.023	7.20	0.66	1.43	0.452
9.80	1.20	1.27	0.258	44.00	0.88	0.28	0.026	7.40	0.66	1.35	0.423
10.00	1.24	1.24	0.244	46.00	0.84	0.31	0.035	7.60	0.67	1.27	0.394
10.20	1.29	1.22	0.234	48.00	0.82	0.30	0.036	7.80	0.68	1.20	0.363
10.40	1.33	1.23	0.233	50.00	0.80	0.30	0.039	8.00	0.69	1.12	0.329
10.60	1.36	1.25	0.238	52.00	0.77	0.30	0.044	8.20	0.71	1.04	0.288
10.80	1.38	1.28	0.245	54.00	0.71	0.29	0.055	8.40	0.74	0.97	0.252
11.00	1.37	1.31	0.253	56.00	0.66	0.23	0.061	8.60	0.78	0.89	0.212
11.20	1.36	1.33	0.259	58.00	0.64	0.16	0.055	8.80	0.83	0.83	0.179
11.40	1.33	1.34	0.264					9.00	0.88	0.77	0.148
11.60	1.31	1.34	0.266	Rhodium¹¹				9.20	0.95	0.73	0.125
11.80	1.28	1.33	0.266	0.10	18.48	69.43	0.986	9.40	1.01	0.71	0.110
12.00	1.26	1.32	0.264	0.20	8.66	37.46	0.977	9.60	1.07	0.69	0.102
12.40	1.23	1.29	0.257	0.30	5.85	25.94	0.967	9.80	1.12	0.69	0.098
12.80	1.22	1.26	0.251	0.40	4.74	19.80	0.955	10.00	1.17	0.69	0.098
13.20	1.20	1.23	0.245	0.50	4.20	16.07	0.941	10.60	1.26	0.73	0.106
13.60	1.19	1.20	0.236	0.60	3.87	13.51	0.925	11.00	1.29	0.76	0.113
14.00	1.20	1.16	0.225	0.70	3.67	11.72	0.908	11.60	1.32	0.80	0.124
14.40	1.22	1.13	0.214	0.80	3.63	10.34	0.887	12.00	1.32	0.82	0.127
14.80	1.27	1.12	0.207	0.90	3.62	9.36	0.867	12.60	1.32	0.82	0.129
15.20	1.31	1.17	0.218	1.00	3.71	8.67	0.848	13.00	1.32	0.83	0.131
15.60	1.31	1.23	0.234	1.10	3.67	8.26	0.837	13.60	1.32	0.85	0.134
16.00	1.28	1.28	0.251	1.20	3.51	7.94	0.832	14.00	1.32	0.86	0.138
16.40	1.24	1.33	0.270	1.30	3.26	7.63	0.829	14.60	1.30	0.89	0.144
16.80	1.17	1.37	0.288	1.40	3.01	7.31	0.827	15.00	1.28	0.90	0.147
17.00	1.14	1.38	0.297	1.50	2.78	6.97	0.823	15.60	1.25	0.90	0.147
17.40	1.06	1.39	0.314	1.60	2.60	6.64	0.818	16.00	1.24	0.89	0.147
18.00	0.95	1.38	0.334	1.70	2.42	6.33	0.813	16.50	1.23	0.88	0.145
18.40	0.88	1.36	0.346	1.80	2.30	6.02	0.805	17.00	1.22	0.88	0.144
18.80	0.82	1.33	0.355	1.90	2.20	5.76	0.798	17.50	1.22	0.87	0.143
19.20	0.76	1.29	0.360	2.00	2.12	5.51	0.789	18.00	1.23	0.88	0.145
19.60	0.72	1.25	0.363	2.10	2.05	5.30	0.780	18.50	1.25	0.92	0.155
20.00	0.67	1.21	0.369	2.20	2.00	5.11	0.772	19.00	1.24	0.98	0.172
20.40	0.64	1.15	0.364	2.30	1.94	4.94	0.765	19.50	1.18	1.05	0.193
20.80	0.61	1.10	0.357	2.40	1.90	4.78	0.756	20.00	1.10	1.09	0.213
21.20	0.60	1.06	0.349	2.50	1.88	4.65	0.748	20.50	1.00	1.09	0.230
21.60	0.58	1.02	0.342	2.60	1.85	4.55	0.743	21.00	0.91	1.05	0.234
22.00	0.57	0.98	0.336	2.70	1.80	4.49	0.742	21.50	0.86	1.00	0.228
22.40	0.56	0.95	0.328	2.90	1.63	4.36	0.748	22.00	0.83	0.95	0.219

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
22.50	0.81	0.92	0.214	4.20	1.29	3.08	0.649	26.00	0.68	0.63	0.154
23.00	0.79	0.90	0.213	4.40	1.22	2.93	0.639	27.00	0.67	0.57	0.140
23.50	0.75	0.87	0.214	4.60	1.16	2.79	0.628	28.00	0.66	0.51	0.124
24.00	0.73	0.84	0.210	4.80	1.11	2.67	0.617	29.00	0.67	0.46	0.107
24.50	0.70	0.81	0.208	5.00	1.06	2.56	0.607	30.00	0.67	0.43	0.097
25.00	0.69	0.77	0.202	5.20	1.01	2.46	0.600	31.00	0.67	0.37	0.084
25.50	0.67	0.74	0.195	5.40	0.95	2.35	0.593	32.00	0.69	0.33	0.070
26.00	0.66	0.70	0.188	5.60	0.92	2.23	0.576	33.00	0.71	0.30	0.058
26.50	0.65	0.66	0.176	5.80	0.90	2.14	0.559	34.00	0.73	0.27	0.048
27.00	0.65	0.64	0.168	6.00	0.88	2.05	0.545	35.00	0.75	0.25	0.039
27.50	0.65	0.61	0.159	6.20	0.87	1.98	0.531	36.00	0.77	0.24	0.035
28.00	0.65	0.59	0.152	6.40	0.84	1.91	0.521	37.00	0.79	0.23	0.039
29.00	0.65	0.54	0.137	6.60	0.82	1.84	0.510	38.00	0.80	0.22	0.027
30.00	0.66	0.51	0.127	6.80	0.79	1.77	0.500	39.00	0.82	0.22	0.024
31.00	0.64	0.49	0.127	7.00	0.76	1.69	0.489	40.00	0.83	0.22	0.022
32.00	0.61	0.44	0.126	7.20	0.75	1.61	0.472				
33.00	0.60	0.37	0.110	7.40	0.73	1.54	0.455	→			
34.00	0.65	0.30	0.074	7.60	0.73	1.46	0.433	Ruthenium, single crystal, E \perp \hat{c}⁵			
35.00	0.69	0.28	0.058	7.80	0.73	1.39	0.411	0.10	11.85	50.81	0.983
36.00	0.73	0.27	0.049	8.00	0.72	1.33	0.391	0.20	6.68	27.18	0.966
37.00	0.74	0.28	0.047	8.20	0.72	1.26	0.366	0.30	4.94	18.92	0.950
38.00	0.74	0.27	0.045	8.40	0.73	1.20	0.342	0.40	3.90	14.51	0.933
39.00	0.75	0.25	0.041	8.60	0.74	1.14	0.318	0.50	3.27	11.63	0.915
				8.80	0.74	1.08	0.295	0.60	2.98	9.54	0.888
				9.00	0.75	1.02	0.267	0.70	2.82	7.99	0.856
→				9.20	0.77	0.97	0.243	0.80	2.73	6.71	0.815
Ruthenium, single crystal, E \parallel \hat{c}⁹				9.40	0.79	0.91	0.217	0.90	2.82	5.54	0.751
0.10	11.50	51.38	0.984	9.60	0.82	0.86	0.190	1.00	3.17	4.59	0.670
0.20	5.93	27.14	0.970	9.80	0.85	0.81	0.167	1.10	3.69	3.91	0.604
0.30	4.33	18.50	0.953	10.00	0.88	0.76	0.144	1.20	4.28	3.66	0.585
0.40	3.60	13.97	0.933	10.20	0.92	0.72	0.125	1.30	4.66	3.72	0.593
0.50	3.18	11.04	0.909	10.40	0.96	0.69	0.110	1.40	4.86	3.79	0.601
0.60	3.28	8.89	0.865	10.60	1.01	0.67	0.100	1.50	4.99	3.89	0.609
0.70	3.62	7.73	0.822	10.80	1.05	0.66	0.094	1.60	5.08	4.03	0.618
0.80	3.42	7.02	0.801	11.00	1.09	0.65	0.090	1.70	5.12	4.22	0.629
0.90	3.25	6.12	0.766	11.20	1.12	0.65	0.088	1.80	5.10	4.45	0.642
1.00	3.39	5.33	0.715	11.40	1.15	0.65	0.087	1.90	4.96	4.78	0.660
1.10	3.66	4.83	0.675	11.60	1.18	0.65	0.088	2.00	4.61	5.06	0.677
1.20	3.84	4.57	0.654	11.80	1.21	0.66	0.090	2.10	4.21	5.09	0.682
1.30	3.94	4.38	0.638	12.00	1.23	0.67	0.092	2.20	3.94	5.00	0.681
1.40	4.02	4.19	0.624	12.40	1.26	0.69	0.098	2.30	3.69	4.97	0.684
1.50	4.16	4.07	0.614	12.80	1.27	0.72	0.104	2.40	3.44	4.88	0.684
1.60	4.33	4.08	0.615	13.20	1.28	0.74	0.108	2.50	3.27	4.77	0.681
1.70	4.42	4.21	0.624	13.60	1.28	0.75	0.111	2.60	3.14	4.66	0.677
1.80	4.40	4.38	0.636	14.00	1.28	0.76	0.114	2.70	3.06	4.59	0.674
1.90	4.29	4.61	0.651	14.40	1.27	0.76	0.114	2.80	2.99	4.59	0.676
2.00	4.04	4.81	0.667	14.80	1.27	0.76	0.114	2.90	2.87	4.64	0.686
2.10	3.69	4.90	0.679	15.00	1.27	0.76	0.114	3.00	2.64	4.69	0.701
2.20	3.35	4.82	0.683	15.60	1.28	0.77	0.115	3.10	2.40	4.64	0.710
2.30	3.09	4.70	0.681	16.00	1.30	0.78	0.118	3.20	2.18	4.55	0.717
2.40	2.89	4.55	0.677	16.50	1.32	0.80	0.123	3.30	2.00	4.43	0.721
2.50	2.74	4.40	0.671	17.00	1.34	0.85	0.136	3.40	1.84	4.30	0.723
2.60	2.64	4.25	0.663	17.50	1.32	0.93	0.155	3.50	1.71	4.16	0.723
2.70	2.58	4.14	0.656	18.00	1.26	0.99	0.173	3.60	1.60	4.03	0.722
2.80	2.54	4.05	0.650	18.50	1.18	1.02	0.185	3.70	1.50	3.90	0.721
2.90	2.48	4.03	0.650	19.00	1.11	1.02	0.192	3.80	1.41	3.77	0.718
3.00	2.38	4.03	0.656	19.50	1.05	1.02	0.199	3.90	1.35	3.64	0.713
3.10	2.26	4.00	0.661	20.00	0.99	1.02	0.208	4.00	1.29	3.53	0.707
3.20	2.13	3.96	0.666	20.50	0.92	0.99	0.212	4.20	1.21	3.31	0.694
3.30	2.00	3.91	0.671	21.00	0.86	0.94	0.209	4.40	1.16	3.13	0.679
3.40	1.87	3.83	0.673	21.50	0.83	0.90	0.203	4.60	1.13	2.97	0.662
3.50	1.76	3.74	0.674	22.00	0.81	0.86	0.193	4.80	1.09	2.86	0.652
3.60	1.66	3.65	0.675	23.00	0.77	0.79	0.182	5.00	1.03	2.75	0.648
3.70	1.57	3.55	0.673	24.00	0.74	0.74	0.171	5.20	0.97	2.64	0.643
3.80	1.49	3.45	0.672	25.00	0.71	0.69	0.163	5.40	0.91	2.52	0.635
3.90	1.42	3.35	0.668					5.60	0.88	2.40	0.622
4.00	1.37	3.24	0.661								

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	$R(\phi = 0)$	Energy (eV)	<i>n</i>	<i>k</i>	$R(\phi = 0)$	Energy (eV)	<i>n</i>	<i>k</i>	$R(\phi = 0)$
5.80	0.86	2.29	0.605	34.00	0.67	0.28	0.065	7.0	1.84	1.45	0.276
6.00	0.84	2.20	0.591	35.00	0.70	0.26	0.054	8.0	1.35	1.68	0.353
6.20	0.82	2.11	0.576	36.00	0.72	0.25	0.047	9.0	1.35	1.64	0.342
6.40	0.81	2.04	0.564	37.00	0.73	0.23	0.041	10.0	0.92	1.07	0.238
6.60	0.78	1.97	0.556	38.00	0.75	0.22	0.035	12.0	1.00	1.10	0.232
6.80	0.76	1.89	0.545	39.00	0.77	0.22	0.031	14.0	0.81	0.91	0.211
7.00	0.73	1.82	0.538	40.00	0.79	0.22	0.028	16.0	0.65	0.61	0.160
7.20	0.70	1.75	0.527					18.0	0.65	0.48	0.120
7.40	0.68	1.67	0.513	→				20.0	0.69	0.36	0.076
7.60	0.67	1.59	0.496	Selenium, single crystal, E ∥ \hat{c}^{22}				22.0	0.81	0.25	0.030
7.80	0.66	1.51	0.476	0.01364	2.914	0.248	0.242	24.0	0.91	0.18	0.011
8.00	0.66	1.44	0.454	0.01488	3.175	9.95E-02	0.272	26.0	0.86	0.15	0.012
8.20	0.65	1.36	0.430	0.01612	3.263	2.13E-03	0.282	28.0	0.85	0.13	0.011
8.40	0.66	1.29	0.403	0.01736	3.306	3.81E-02	0.287	30.0	0.87	0.11	0.008
8.60	0.66	1.22	0.378	0.01860	3.330	7.04E-03	0.290				
8.80	0.68	1.15	0.346	0.01984	3.346	4.23E-02	0.291	→			
9.00	0.69	1.09	0.317	0.02108	3.358	3.40E-03	0.293	Selenium, single crystal, E ⊥ \hat{c}^{22}			
9.20	0.70	1.02	0.286	0.02232	3.366	5.31E-02	0.294	0.01364	2.854	0.0239	0.231
9.40	0.73	0.95	0.251	0.02356	3.372	1.96E-03	0.294	0.01488	2.932	0.0325	0.241
9.60	0.77	0.89	0.216	0.02480	3.377	2.39E-02	0.295	0.01612	3.140	0.1750	0.269
9.80	0.82	0.84	0.185	0.02604	3.380		0.295	0.01736	2.959	1.3300	0.321
10.00	0.86	0.81	0.163	0.02728		1.16E-02		0.01860	2.111	0.2550	0.133
10.20	0.90	0.77	0.143	0.02976		7.96E-03		0.01984	2.356	0.0746	0.164
10.40	0.94	0.74	0.127	0.03224		8.57E-03		0.02108	2.462	0.0276	0.178
10.60	0.99	0.72	0.115	0.03472		2.70E-02		0.02232	2.502	0.0442	0.184
10.80	1.04	0.71	0.108	0.03720	3.397	1.72E-02	0.297	0.02356	2.543	0.0097	0.190
11.00	1.08	0.70	0.104	0.04463		1.13E-02		0.02480	2.550	0.0239	0.191
11.20	1.11	0.70	0.102	0.04959	3.403	2.79E-03	0.298	0.02604	2.582		0.195
11.40	1.14	0.70	0.101	0.05703		1.56E-03		0.02728	2.600	0.0101	0.198
11.60	1.17	0.71	0.102	0.06199	3.405	1.35E-03	0.298	0.02976	2.576	9.95E-03	0.194
11.80	1.20	0.72	0.104	0.06819		5.79E-04		0.03224	2.598	1.16E-02	0.197
12.00	1.22	0.73	0.107	0.07439	3.407	4.44E-04	0.298	0.03472	2.607	1.68E-02	0.199
12.40	1.25	0.76	0.113	0.08059		4.41E-04		0.03720	2.613	1.54E-02	0.199
12.80	1.26	0.78	0.118	0.08679	3.408	4.32E-04	0.298	0.04463		1.17E-02	
13.20	1.27	0.81	0.124	0.09299		2.44E-04		0.04959	2.627	3.58E-03	0.201
13.60	1.27	0.83	0.129	0.09919	3.409	3.23E-04	0.299	0.05703		8.65E-04	
14.00	1.26	0.84	0.132	0.1116	3.409	2.87E-04	0.299	0.06199	2.632	2.07E-03	0.202
14.40	1.25	0.84	0.132	0.1240	3.410	2.71E-04	0.299	0.06819		2.89E-04	
14.80	1.25	0.84	0.133	0.2480	3.417	2.67E-04	0.299	0.07439	2.635	1.59E-04	0.202
15.00	1.25	0.84	0.133	0.3720	3.427	1.90E-04	0.301	0.08059		1.35E-04	
15.60	1.25	0.85	0.134	0.4959	3.442	1.41E-04	0.302	0.08679	2.636	1.42E-04	0.202
16.00	1.27	0.85	0.134	0.6199	3.462	1.12E-04	0.304	0.09299		1.04E-04	
16.50	1.28	0.89	0.145	0.7439	3.486	9.42E-05	0.307	0.09919	2.637	8.95E-05	0.203
17.00	1.28	0.94	0.158	0.8679	3.516	8.07E-05	0.310	0.1116	2.638	8.84E-05	0.203
17.50	1.25	1.00	0.175	0.9919	3.551	7.11E-05	0.314	0.1240	2.639	8.51E-05	0.203
18.00	1.19	1.04	0.190	1.116	3.592	6.37E-05	0.319	0.2480	2.645	5.97E-05	0.204
18.50	1.12	1.05	0.200	1.240	3.640	5.81E-05	0.324	0.3720	2.652	5.44E-05	0.205
19.00	1.07	1.05	0.205	1.50		1.33E-04		0.4959	2.654	4.58E-05	0.205
19.50	1.02	1.04	0.212	1.60		1.59E-04		0.6199	2.675	3.82E-05	0.208
20.00	0.97	1.04	0.219	1.70		6.27E-04		0.7439	2.692	3.32E-05	0.210
20.50	0.91	1.03	0.228	1.80	4.46	2.20E-02	0.402	0.8679	2.713	2.96E-05	0.213
21.00	0.85	1.01	0.234	2.0	4.79	0.76	0.438	0.9919	2.739	2.69E-05	0.216
21.50	0.80	0.97	0.234	2.2	4.49	1.19	0.431	1.116	2.772	2.48E-05	0.221
22.00	0.77	0.94	0.233	2.4	4.28	1.21	0.417	1.240	2.816	2.31E-05	0.226
23.00	0.71	0.87	0.229	2.6	4.40	1.32	0.430	1.50		7.37E-05	
24.00	0.67	0.79	0.218	2.8	4.59	1.70	0.462	1.60		8.63E-05	
25.00	0.64	0.73	0.205	3.0	4.44	2.29	0.490	1.70		3.60E-04	
26.00	0.61	0.66	0.194	3.2	3.92	2.59	0.493	1.80	3.32	0.11	0.289
27.00	0.60	0.59	0.177	3.4	3.69	2.76	0.502	2.00	3.38	0.65	0.310
28.00	0.60	0.53	0.155	3.6	3.39	3.01	0.521	2.20	3.07	0.73	0.282
29.00	0.61	0.48	0.134	3.8	(3.00)			2.40	2.93	0.61	0.259
30.00	0.62	0.45	0.123	4.0	(2.65)			2.60	3.00	0.53	0.263
31.00	0.61	0.40	0.114	4.2	(2.30)			2.80	3.12	0.58	0.279
32.00	0.63	0.34	0.093	4.5	1.92	2.78	0.528	3.00	3.30	0.70	0.305
33.00	0.65	0.31	0.077	5.0	1.50	2.31	0.482	3.20	3.35	1.01	0.328
				6.0	1.57	1.49	0.288	3.40	3.22	1.24	0.334

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
3.60	3.06	1.47	0.344	1.033	3.5193		0.311	24.31	0.752	0.0243	0.020
3.80	2.84	1.66	0.351	1.1	(3.5341)	1.30E-05	0.312	26.38	0.803	0.0178	0.012
4.00	2.51	1.81	0.356	1.2		1.80E-04		28.18	0.834	0.0152	0.008
4.20	2.18	1.83	0.352	1.3		2.26E-03		30.24	0.860	0.0138	0.006
4.50	1.75	1.94	0.382	1.4		7.75E-03		31.79	0.877	0.0132	0.004
5.00	1.25	1.50	0.316	1.5	3.673	5.00E-03	0.327	34.44	0.899	0.0121	0.003
6.00	1.32	0.73	0.107	1.6	3.714	8.00E-03	0.331	36.47	0.913	0.0113	0.002
7.00	1.62	0.61	0.105	1.7	3.752	1.00E-02	0.335	38.75	0.925	0.0104	0.002
8.00	1.81	0.69	0.135	1.8	3.796	0.013	0.340	40.00	0.930	0.0100	0.001
9.00	1.66	1.02	0.182	1.9	3.847	0.016	0.345				
10.00	1.72	0.95	0.171	2.0	3.906	0.022	0.351	Silver⁶			
12.00	1.25	1.02	0.181	2.1	3.969	0.030	0.357	0.10	9.91	90.27	0.995
14.00	0.98	0.92	0.178	2.2	4.042	0.032	0.364	0.20	2.84	45.70	0.995
16.00	0.68	0.96	0.274	2.3	4.123	0.048	0.372	0.30	1.41	30.51	0.994
18.00	0.61	0.65	0.191	2.4	4.215	0.060	0.380	0.40	0.91	22.89	0.993
20.00	0.73	0.48	0.094	2.5	4.320	0.073	0.390	0.50	0.67	18.32	0.992
22.00	0.78	0.39	0.060	2.6	4.442	0.090	0.400	1.00	0.28	9.03	0.987
24.00	0.78	0.32	0.046	2.7	4.583	0.130	0.412	1.50	0.27	5.79	0.969
26.00	0.78	0.26	0.036	2.8	4.753	0.163	0.426	2.00	0.27	4.18	0.944
28.00	0.80	0.19	0.023	2.9	4.961	0.203	0.442	2.50	0.24	3.09	0.914
30.00	0.79	0.14	0.020	3.0	5.222	0.269	0.461	3.00	0.23	2.27	0.864
				3.1	5.570	0.387	0.486	3.25	0.23	1.86	0.816
Silicon, single crystal²³				3.2	6.062	0.630	0.518	3.50	0.21	1.42	0.756
0.01240	3.4185	2.90E-04	0.300	3.3	6.709	1.321	0.561	3.60	0.23	1.13	0.671
0.01488	3.4190	2.30E-04	0.300	3.4	6.522	2.705	0.592	3.70	0.30	0.77	0.475
0.01736	3.4192	1.90E-04	0.300	3.5	5.610	3.014	0.575	3.77	0.53	0.40	0.154
0.01984	3.4195	1.70E-04	0.300	3.6	5.296	2.987	0.564	3.80	0.73	0.30	0.053
0.02480	3.4197		0.300	3.7	5.156	3.058	0.563	3.90	1.30	0.36	0.040
0.03100	3.4199		0.300	3.8	5.065	3.182	0.568	4.00	1.61	0.60	0.103
0.04092	3.4200		0.300	3.9	5.016	3.346	0.577	4.10	1.73	0.85	0.153
0.04463		1.08E-04		4.0	5.010	3.587	0.591	4.20	1.75	1.06	0.194
0.04959	3.4201	9.15E-05	0.300	4.1	5.020	3.979	0.614	4.30	1.73	1.13	0.208
0.05703		1.56E-04		4.2	4.888	4.639	0.652	4.50	1.69	1.28	0.238
0.06199	3.4204	2.86E-04	0.300	4.3	4.086	5.395	0.703	4.75	1.61	1.34	0.252
0.06943		3.84E-04		4.4	3.120	5.344	0.726	5.00	1.55	1.36	0.257
0.07439		7.16E-04		4.5	2.451	5.082	0.740	5.50	1.45	1.34	0.257
0.08059	(3.4207)	1.52E-04	0.300	4.6	1.988	4.678	0.742	6.00	1.34	1.28	0.246
0.08679		1.02E-04		4.7	1.764	4.278	0.728	6.50	1.25	1.18	0.225
0.09299		2.59E-04		4.8	1.658	3.979	0.710	7.00	1.18	1.06	0.196
0.09919		1.77E-04		4.9	1.597	3.749	0.693	7.50	1.14	0.91	0.157
0.1054		1.53E-04		5.0	1.570	3.565	0.675	8.00	1.16	0.75	0.114
0.1116		2.02E-04		5.1	1.571	3.429	0.658	9.00	1.33	0.56	0.074
0.1178		1.22E-04		5.2	1.589	3.354	0.646	10.00	1.46	0.56	0.082
0.1240	3.4215	6.76E-05	0.300	5.3	1.579	3.353	0.647	11.00	1.52	0.56	0.088
0.1364		5.49E-05		5.4	1.471	3.366	0.663	12.00	1.61	0.59	0.100
0.1488		2.41E-05		5.5	1.340	3.302	0.673	13.00	1.66	0.64	0.112
0.1612		2.49E-05		5.6	1.247	3.206	0.675	14.00	1.72	0.78	0.141
0.1736	(3.4230)	1.68E-05	0.300	5.7	1.180	3.112	0.673	14.50	1.64	0.88	0.152
0.1798		2.45E-05		5.8	1.133	3.045	0.672	15.00	1.56	0.92	0.156
0.1860		2.66E-06		5.9	1.083	2.982	0.673	16.00	1.42	0.91	0.151
0.1922		1.74E-06		6.0	1.010	2.909	0.677	17.00	1.33	0.86	0.139
0.1984		8.46E-07		6.5	0.847	2.73	0.688	18.00	1.28	0.80	0.124
0.2046		5.64E-07		7.0	0.682	2.45	0.691	19.00	1.27	0.75	0.111
0.2108	(3.4244)	4.17E-07	0.300	7.5	0.563	2.21	0.693	20.00	1.29	0.71	0.103
0.2170		4.05E-07		8.0	0.478	2.00	0.691	21.00	1.35	0.75	0.112
0.2232		3.94E-07		8.5	0.414	1.82	0.688	21.50	1.37	0.80	0.124
0.2294		3.26E-07		9.0	0.367	1.66	0.683	22.00	1.34	0.87	0.141
0.2356		2.97E-07		9.5	0.332	1.51	0.672	22.50	1.26	0.93	0.157
0.2418		2.82E-07		10.0	0.306	1.38	0.661	23.00	1.17	0.94	0.163
0.2480	3.4261	1.99E-07	0.300	12.0	0.257	0.963	0.590	23.50	1.10	0.93	0.165
0.3100	3.4294		0.301	14.0	0.275	0.641	0.460	24.00	1.04	0.90	0.165
0.3626	3.4327		0.301	16.0	0.345	0.394	0.297	24.50	0.99	0.87	0.160
0.4568	3.4393	2.50E-09	0.302	18.0	0.455	0.219	0.159	25.00	0.95	0.83	0.154
0.6199	3.4490		0.303	20.0	0.567	0.0835	0.079	25.50	0.91	0.78	0.144
0.8093	3.4784		0.306	22.14	0.675	0.0405	0.038	26.00	0.90	0.74	0.133

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
26.50	0.89	0.69	0.121	6.358	0.454		0.141	3.20	2.73	2.31	0.432
27.00	0.89	0.65	0.109	6.526	0.485		0.120	3.40	2.61	2.33	0.435
27.50	0.89	0.62	0.099	6.702	0.533		0.093	3.60	2.49	2.30	0.430
28.00	0.90	0.59	0.090	6.888	0.574		0.073	3.80	2.40	2.22	0.418
28.50	0.91	0.57	0.084	7.130	0.616		0.056	4.00	2.36	2.14	0.406
29.00	0.92	0.56	0.079	7.328	0.641		0.048	4.20	2.35	2.06	0.392
30.00	0.93	0.54	0.074	7.583	0.674		0.038	4.40	2.39	2.01	0.384
31.00	0.93	0.53	0.072	7.847	0.700		0.031	4.60	2.45	2.00	0.384
32.00	0.92	0.53	0.072	8.015	0.710		0.029	4.80	2.53	2.06	0.394
33.00	0.90	0.51	0.071	8.634	0.762		0.018	5.00	2.58	2.20	0.416
34.00	0.88	0.49	0.067	9.143	0.800		0.012	5.20	2.52	2.44	0.450
35.00	0.86	0.45	0.061	9.709	0.819		0.010	5.40	2.31	2.61	0.480
36.00	0.89	0.44	0.055	10.20	0.843		0.007	5.60	2.06	2.67	0.501
38.00	0.89	0.39	0.043	11.08	0.870		0.005	5.80	1.83	2.63	0.510
40.00	0.90	0.37	0.039	11.83	0.887		0.004	6.00	1.63	2.56	0.515
42.00	0.90	0.35	0.036	12.73	0.907		0.002	6.20	1.48	2.45	0.512
44.00	0.90	0.33	0.033	13.05	0.913		0.002	6.40	1.37	2.33	0.504
46.00	0.90	0.32	0.031	13.42	0.914		0.002	6.60	1.29	2.22	0.492
48.00	0.89	0.31	0.030	13.73	0.917		0.002	6.80	1.23	2.11	0.478
50.00	0.88	0.29	0.027	14.07	0.922		0.002	7.00	1.18	2.01	0.462
52.00	0.89	0.28	0.024	14.83	0.934		0.001	7.20	1.15	1.91	0.445
54.00	0.88	0.17	0.024	15.05	0.936		0.001	7.40	1.13	1.82	0.425
56.00	0.87	0.26	0.024	15.46	0.942		0.001	7.60	1.12	1.75	0.406
58.00	0.87	0.24	0.021	16.21	0.948		0.001	7.80	1.11	1.68	0.390
60.00	0.87	0.22	0.018	18.10	0.964		0.000	8.00	1.11	1.61	0.370
62.00	0.88	0.21	0.016	21.12	0.979		0.000	8.20	1.12	1.55	0.350
64.00	0.88	0.21	0.016	25.51	0.993		0.000	8.40	1.13	1.50	0.332
66.00	0.88	0.21	0.016	26.95	1.00		0.000	8.60	1.14	1.45	0.317
68.00	0.87	0.21	0.017	27.68	1.01		0.000	8.80	1.17	1.41	0.301
70.00	0.83	0.20	0.021	28.37	1.01		0.000	9.00	1.19	1.40	0.294
72.00	0.85	0.18	0.016	29.52	1.02		0.000	9.20	1.21	1.38	0.289
74.00	0.85	0.17	0.014					9.40	1.21	1.38	0.287
76.00	0.85	0.16	0.013	Tantalum¹⁶				9.60	1.21	1.38	0.285
78.00	0.85	0.15	0.013	0.10	10.14	66.39	0.984	9.80	1.21	1.37	0.285
80.00	0.85	0.14	0.012	0.15	9.45	46.41	0.9834	10.00	1.20	1.37	0.286
85.00	0.85	0.11	0.011	0.20	5.77	35.46	0.982	10.20	1.19	1.37	0.286
90.00	0.85	0.08	0.009	0.26	3.67	27.53	0.981	10.40	1.18	1.37	0.287
95.00	0.86	0.06	0.007	0.30	2.87	23.90	0.980	10.60	1.16	1.36	0.288
100.00	0.87	0.04	0.005	0.38	2.03	18.87	0.978	10.80	1.15	1.36	0.289
				0.50	1.37	14.26	0.974	11.00	1.13	1.35	0.290
Sodium²⁴				0.58	1.15	12.19	0.970	11.20	1.11	1.35	0.292
0.55	0.262	9.97	0.990	0.70	0.96	9.92	0.962	11.40	1.09	1.34	0.293
0.58	0.241	9.45	0.989	0.78	0.89	8.77	0.956	11.60	1.07	1.33	0.294
0.63	0.207	8.80	0.990	0.90	0.84	7.38	0.942	11.80	1.05	1.32	0.295
0.67	0.175	8.09	0.990	1.00	0.89	6.47	0.992	12.00	1.02	1.31	0.296
0.73	0.147	7.42	0.990	1.10	0.93	5.75	0.899	12.20	1.00	1.29	0.295
0.81	0.123	6.67	0.989	1.20	0.98	5.14	0.872	12.40	0.98	1.28	0.294
0.92	0.099	5.82	0.989	1.30	1.00	4.62	0.842	12.60	0.96	1.26	0.292
1.05	0.078	5.11	0.989	1.40	1.04	4.15	0.805	12.80	0.94	1.24	0.289
1.23	0.064	4.35	0.987	1.50	1.09	3.73	0.762	13.00	0.93	1.22	0.286
1.44	0.053	3.72	0.986	1.60	1.15	3.33	0.707	13.60	0.91	1.16	0.272
1.65	0.050	3.22	0.983	1.70	1.24	2.95	0.640	14.00	0.90	1.15	0.272
1.87	0.049	2.76	0.978	1.80	1.35	2.60	0.560	14.60	0.85	1.15	0.285
2.07	0.053	2.48	0.971	1.90	1.57	2.24	0.460	15.00	0.80	1.13	0.293
2.27	0.059	2.23	0.961	2.00	1.83	1.99	0.388	15.60	0.72	1.08	0.301
2.45	0.063	2.07	0.953	2.10	2.10	1.84	0.354	16.00	0.68	1.04	0.304
2.64	0.066	1.88	0.943	2.20	2.36	1.81	0.351	16.60	0.63	0.97	0.301
2.82	0.068	1.76	0.936	2.30	2.56	1.86	0.365	17.00	0.60	0.92	0.296
2.95	0.068	1.63	0.928	2.40	2.68	1.92	0.378	17.60	0.60	0.92	0.296
3.06	0.069	1.54	0.921	2.50	2.75	1.98	0.388	18.00	0.55	0.79	0.274
3.20	0.065	1.47	0.921	2.60	2.80	2.02	0.395	18.60	0.53	0.71	0.254
3.40	0.061	1.33	0.916	2.70	2.84	2.08	0.405	19.00	0.53	0.65	0.236
3.71	0.055	1.13	0.908	2.80	2.85	2.14	0.412	19.60	0.53	0.57	0.207
3.97	0.049	1.01	0.908	2.90	2.84	2.20	0.420	20.00	0.54	0.52	0.185
6.199	0.390		0.193	3.00	2.81	2.24	0.425	20.60	0.55	0.44	0.153

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
1.10	3.47	3.40	0.560	11.00	0.79	0.72	0.152	0.86	2.92	4.37	0.661
1.20	3.35	3.30	0.550	11.20	0.81	0.69	0.139	0.90	3.11	4.44	0.660
1.30	3.28	3.25	0.546	11.40	0.81	0.69	0.139	0.94	3.15	4.43	0.658
1.40	3.17	3.28	0.549	11.60	0.79	0.68	0.139	0.98	3.15	4.36	0.653
1.50	2.98	3.32	0.557	11.80	0.78	0.67	0.137	1.00	3.14	4.32	0.649
1.60	2.74	3.30	0.559	12.00	0.77	0.65	0.132	1.10	3.05	4.04	0.627
1.70	2.54	3.23	0.557	12.80	0.76	0.55	0.106	1.20	3.00	3.64	0.590
1.80	2.36	3.11	0.550	13.20	0.76	0.52	0.097	1.30	3.12	3.24	0.545
1.90	2.22	2.99	0.540	13.60	0.76	0.48	0.087	1.40	3.29	2.96	0.515
2.00	2.11	2.88	0.530	14.00	0.77	0.45	0.077	1.50	3.48	2.79	0.500
2.10	2.01	2.77	0.520	14.40	0.77	0.42	0.069	1.60	3.67	2.68	0.494
2.20	1.92	2.67	0.509	14.80	0.79	0.38	0.058	1.70	3.84	2.79	0.507
2.30	1.86	2.56	0.495	15.20	0.79	0.36	0.052	1.80	3.82	2.91	0.518
2.40	1.81	2.47	0.483	15.60	0.79	0.32	0.045	1.90	3.70	2.94	0.518
2.50	1.78	2.39	0.471	16.00	0.83	0.31	0.037	2.00	3.60	2.89	0.512
2.60	1.75	2.34	0.462	16.40	0.84	0.28	0.030	2.10	3.54	2.84	0.506
2.70	1.71	2.29	0.456	16.80	0.87	0.27	0.025	2.20	3.49	2.76	0.497
2.80	1.68	2.25	0.451	17.20	0.90	0.25	0.020	2.30	3.49	2.72	0.494
2.90	1.63	2.21	0.447	17.60	0.93	0.25	0.017	2.40	3.45	2.72	0.493
3.00	1.59	2.17	0.444	18.00	0.94	0.24	0.165	2.50	3.38	2.68	0.487
3.10	1.55	2.15	0.442	18.40	0.94	0.23	0.017	2.60	3.34	2.62	0.480
3.20	1.50	2.12	0.442	18.80	0.95	0.24	0.016	2.70	3.31	2.55	0.472
3.30	1.44	2.09	0.442	19.20	0.96	0.25	0.016	2.80	3.31	2.49	0.466
3.40	1.37	2.06	0.443	19.60	0.97	0.25	0.017	2.90	3.32	2.45	0.461
3.50	1.30	2.01	0.443	20.00	0.98	0.27	0.018	3.00	3.35	2.42	0.459
3.60	1.24	1.96	0.441	20.40	0.98	0.27	0.019	3.10	3.39	2.41	0.460
3.70	1.17	1.90	0.436	20.60	1.00	0.29	0.020	3.20	3.43	2.45	0.465
3.80	1.11	1.83	0.430	21.20	0.99	0.31	0.023	3.30	3.45	2.55	0.476
3.85	1.08	1.78	0.423	21.60	0.99	0.31	0.024	3.40	3.39	2.66	0.485
3.90	1.06	1.73	0.413	22.00	0.98	0.32	0.025	3.50	3.24	2.70	0.488
4.00	1.04	1.62	0.389	22.40	0.98	0.33	0.027	3.60	3.13	2.67	0.482
4.20	1.05	1.45	0.333	22.80	0.97	0.33	0.028	3.70	3.05	2.62	0.476
4.40	1.13	1.33	0.284	23.20	0.96	0.34	0.030	3.80	2.99	2.56	0.468
4.60	1.17	1.29	0.265	23.60	0.95	0.35	0.031	3.90	2.96	2.50	0.460
4.80	1.21	1.23	0.244	24.00	0.92	0.35	0.033	4.00	2.95	2.43	0.451
5.00	1.24	1.21	0.236	24.5	0.91	0.34	0.032	4.20	3.02	2.33	0.440
5.20	1.27	1.20	0.228	25.0	0.91	0.33	0.032	4.40	3.13	2.32	0.442
5.40	1.17	1.16	0.228	25.5	0.89	0.33	0.032	4.60	3.24	2.41	0.455
5.60	1.24	1.21	0.234	26.0	0.89	0.33	0.032	4.80	3.33	2.57	0.475
5.80	1.21	1.22	0.241	26.5	0.88	0.32	0.032	5.00	3.40	2.85	0.505
6.00	1.15	1.21	0.244	27.0	0.86	0.31	0.032	5.20	3.27	3.27	0.548
6.20	1.11	1.18	0.240	27.5	0.85	0.30	0.033	5.40	2.92	3.58	0.586
6.40	1.08	1.14	0.232	28.0	0.84	0.29	0.033	5.60	2.43	3.70	0.618
6.60	1.04	1.06	0.212	28.5	0.82	0.26	0.029	5.80	2.00	3.61	0.637
6.80	1.05	1.02	0.198	29.0	0.83	0.25	0.027	6.00	1.70	3.42	0.643
7.00	1.06	0.97	0.182	30.0	0.84	0.22	0.022	6.20	1.47	3.24	0.646
7.20	1.07	0.95	0.175					6.40	1.32	3.04	0.640
7.40	1.11	0.94	0.167					6.60	1.21	2.87	0.631
7.60	1.09	0.92	0.165	Tungsten²⁷				6.80	1.12	2.70	0.619
7.80	1.11	0.93	0.165	0.10	14.06	54.71	0.983	7.00	1.06	2.56	0.607
8.00	1.10	0.94	0.169	0.20	3.87	28.30	0.981	7.20	1.01	2.43	0.593
8.20	1.10	0.95	0.171	0.25	2.56	22.44	0.980	7.40	0.98	2.30	0.573
8.40	1.08	0.95	0.175	0.30	1.83	18.32	0.979	7.60	0.95	2.18	0.556
8.60	1.04	0.96	0.181	0.34	1.71	15.71	0.973	7.80	0.93	2.06	0.533
8.80	1.02	0.95	0.181	0.38	1.86	13.88	0.963	8.00	0.94	1.95	0.505
9.00	1.00	0.94	0.182	0.42	1.92	12.63	0.954	8.20	0.94	1.86	0.481
9.20	0.97	0.93	0.182	0.46	1.69	11.59	0.952	8.40	0.96	1.76	0.449
9.40	0.95	0.91	0.181	0.50	1.40	10.52	0.952	8.60	0.99	1.70	0.422
9.60	0.94	0.90	0.179	0.54	1.23	9.45	0.948	8.80	1.01	1.65	0.401
9.80	0.91	0.88	0.179	0.58	1.17	8.44	0.938	9.00	1.01	1.60	0.388
10.00	0.89	0.88	0.180	0.62	1.28	7.52	0.917	9.20	1.02	1.55	0.369
10.20	0.86	0.85	0.178	0.66	1.45	6.78	0.888	9.40	1.03	1.50	0.352
10.40	0.85	0.83	0.175	0.70	1.59	6.13	0.856	9.60	1.05	1.44	0.329
10.60	0.81	0.79	0.167	0.74	1.83	5.52	0.810	9.80	1.09	1.38	0.307
10.80	0.80	0.76	0.162	0.78	2.12	5.00	0.759	10.00	1.13	1.34	0.287
				0.82	2.36	4.61	0.710				

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
10.20	1.19	1.33	0.274	Vanadium⁹				13.50	0.87	0.53	0.079
10.40	1.24	1.34	0.270	0.10	12.83	45.89	0.978	14.00	0.86	0.51	0.075
10.60	1.27	1.36	0.274	0.20	3.90	24.30	0.975	14.50	0.86	0.49	0.070
10.80	1.29	1.39	0.282	0.28	2.13	17.35	0.973	15.00	0.86	0.47	0.065
11.00	1.28	1.42	0.290	0.36	1.54	13.32	0.966	15.50	0.86	0.46	0.062
11.20	1.27	1.44	0.297	0.44	1.28	10.74	0.957	16.00	0.85	0.45	0.061
11.40	1.25	1.46	0.305	0.52	1.16	8.93	0.945	16.50	0.84	0.43	0.059
11.60	1.22	1.48	0.313	0.60	1.10	7.59	0.929	17.00	0.84	0.41	0.056
11.80	1.20	1.48	0.318	0.68	1.07	6.54	0.909	17.50	0.83	0.40	0.054
12.00	1.16	1.48	0.323	0.76	1.08	5.67	0.882	18.00	0.82	0.38	0.051
12.40	1.10	1.47	0.329	0.80	1.10	5.30	0.864	18.50	0.82	0.37	0.048
12.80	1.04	1.44	0.333	0.90	1.18	4.50	0.811	19.00	0.82	0.35	0.045
13.20	0.98	1.40	0.332	1.00	1.34	3.80	0.730	19.50	0.82	0.34	0.043
13.60	0.94	1.35	0.325	1.10	1.60	3.26	0.632	20.00	0.81	0.32	0.041
14.00	0.91	1.28	0.312	1.20	1.93	2.88	0.543	20.50	0.81	0.31	0.038
14.40	0.90	1.23	0.296	1.30	2.25	2.71	0.498	21.00	0.81	0.29	0.036
14.80	0.90	1.17	0.276	1.40	2.48	2.72	0.491	21.50	0.81	0.28	0.033
15.20	0.93	1.13	0.255	1.50	2.57	2.79	0.499	22.00	0.81	0.27	0.032
15.60	0.97	1.12	0.246	1.60	2.57	2.84	0.507	22.50	0.81	0.25	0.029
16.00	0.98	1.14	0.249	1.70	2.52	2.88	0.512	23.00	0.82	0.24	0.027
16.40	0.97	1.17	0.260	1.80	2.45	2.88	0.515	23.50	0.82	0.23	0.025
16.80	0.94	1.19	0.273	1.90	2.36	2.85	0.514	24.00	0.82	0.22	0.024
17.20	0.90	1.21	0.289	2.00	2.34	2.81	0.509	24.50	0.83	0.21	0.022
17.60	0.85	1.21	0.304	2.10	2.31	2.78	0.506	25.00	0.83	0.20	0.020
18.00	0.80	1.20	0.317	2.20	2.28	2.80	0.510	25.50	0.83	0.19	0.019
18.40	0.74	1.18	0.330	2.30	2.23	2.83	0.516	26.00	0.83	0.18	0.018
18.80	0.69	1.15	0.340	2.40	2.15	2.88	0.528	26.50	0.84	0.17	0.016
19.20	0.64	1.11	0.347	2.50	2.02	2.91	0.540	27.00	0.84	0.16	0.015
19.60	0.60	1.07	0.353	2.60	1.89	2.92	0.552	27.50	0.85	0.16	0.014
20.00	0.56	1.02	0.354	2.70	1.74	2.89	0.561	28.00	0.85	0.15	0.013
20.40	0.54	0.97	0.350	2.80	1.61	2.85	0.569	28.50	0.86	0.14	0.012
20.80	0.52	0.92	0.342	2.90	1.48	2.80	0.577	29.00	0.86	0.14	0.011
21.20	0.50	0.87	0.331	3.00	1.36	2.73	0.582	29.50	0.86	0.13	0.010
21.60	0.50	0.82	0.318	3.20	1.16	2.55	0.585	30.00	0.87	0.13	0.009
22.00	0.49	0.77	0.303	3.40	0.99	2.37	0.586	31.00	0.88	0.12	0.008
22.40	0.49	0.73	0.287	3.60	0.87	2.17	0.575	32.00	0.90	0.11	0.007
22.80	0.49	0.69	0.272	3.80	0.80	1.96	0.547	33.00	0.90	0.10	0.005
23.20	0.49	0.66	0.263	4.00	0.78	1.76	0.503	34.00	0.91	0.10	0.005
23.60	0.48	0.62	0.252	4.20	0.80	1.60	0.449	35.00	0.92	0.09	0.004
24.00	0.49	0.57	0.234	4.40	0.83	1.47	0.400	36.00	0.94	0.10	0.004
24.40	0.50	0.53	0.213	4.60	0.87	1.38	0.355	37.00	0.94	0.10	0.004
24.80	0.51	0.49	0.191	4.80	0.90	1.31	0.326	38.00	0.95	0.11	0.004
25.20	0.53	0.46	0.171	5.00	0.91	1.26	0.304	39.00	0.95	0.12	0.004
25.60	0.55	0.43	0.150	5.25	0.93	1.18	0.271	40.00	0.95	0.13	0.005
26.00	0.57	0.40	0.132	5.50	0.94	1.14	0.258				
26.40	0.59	0.38	0.117	5.75	0.96	1.09	0.235				
26.80	0.61	0.37	0.105	6.00	0.98	1.06	0.223	→			
27.00	0.62	0.36	0.099	6.25	0.97	1.02	0.212	Zinc, E || \hat{c}²⁸			
27.50	0.64	0.34	0.085	6.50	0.97	0.98	0.199	0.7514	1.9241	7.5619	0.883
28.00	0.67	0.32	0.073	6.75	0.97	0.94	0.185	0.827	1.7921	6.9973	0.874
28.50	0.69	0.31	0.065	7.00	0.98	0.91	0.175	0.866	1.5571	6.7753	0.881
29.00	0.71	0.30	0.057	7.33	0.97	0.89	0.170	0.952	1.4824	6.2296	0.868
29.50	0.73	0.30	0.052	7.66	0.98	0.87	0.162	0.992	1.5762	5.8843	0.847
30.00	0.75	0.29	0.047	8.00	0.98	0.85	0.155	1.033	1.5407	5.3192	0.823
31.00	0.78	0.29	0.042	8.33	0.98	0.81	0.146	1.078	1.5853	4.9013	0.793
32.00	0.79	0.29	0.040	8.66	0.98	0.81	0.145	1.127	1.7768	4.5307	0.748
33.00	0.82	0.28	0.033	9.00	0.96	0.79	0.142	1.181	1.9808	4.2004	0.701
34.00	0.84	0.29	0.032	9.50	0.94	0.77	0.136	1.240	2.8821	3.4766	0.575
35.00	0.85	0.31	0.033	10.00	0.91	0.74	0.133	1.305	3.2039	3.0042	0.520
36.00	0.85	0.32	0.036	10.50	0.89	0.71	0.126	1.377	2.9459	3.5761	0.584
37.00	0.84	0.33	0.039	11.00	0.87	0.65	0.112	1.459	3.2523	4.2447	0.640
38.00	0.83	0.33	0.040	11.50	0.88	0.58	0.091	1.550	3.8086	4.6212	0.657
39.00	0.81	0.33	0.042	12.00	0.90	0.58	0.089	1.653	3.7577	4.6239	0.659
40.00	0.80	0.33	0.045	12.50	0.89	0.57	0.086	1.722	3.5908	4.4614	0.650
				13.00	0.88	0.55	0.082	1.823	3.4234	4.3234	0.642
								1.937	3.0132	3.9974	0.624
								1.984	1.8562	3.9706	0.690

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)	Energy (eV)	<i>n</i>	<i>k</i>	<i>R</i> ($\phi = 0$)
2.066	1.4856	4.0555	0.737	0.80	4.03	1.42	0.168	9.20	1.63	0.90	0.025
2.094	1.2525	3.9961	0.762	0.90	3.74	1.37	0.149	9.40	1.60	0.89	0.024
2.119	1.0017	3.8683	0.789	0.96	3.69	1.36	0.145	9.60	1.57	0.89	0.023
2.275	0.7737	3.9129	0.832	1.00	3.66	1.35	0.143	9.80	1.52	0.87	0.021
2.445	0.6395	3.4013	0.821	1.10	3.65	1.35	0.142	10.00	1.47	0.86	0.020
2.666	0.4430	3.1379	0.851	1.20	3.53	1.33	0.134	10.20	1.42	0.84	0.018
2.917	0.3589	2.8140	0.853	1.30	3.25	1.27	0.116	10.40	1.35	0.82	0.016
3.220	0.3069	2.5088	0.847	1.40	3.10	1.25	0.106	10.50	1.32	0.81	0.016
3.594	0.2737	2.1737	0.828	1.50	3.02	1.23	0.100	10.60	1.28	0.80	0.015
4.065	0.2510	1.8528	0.799	1.60	2.88	1.20	0.091	10.80	1.23	0.78	0.014
4.678	0.2354	1.6357	0.776	1.70	2.68	1.16	0.078	11.00	1.19	0.77	0.014
				1.80	2.49	1.12	0.067	11.20	1.16	0.76	0.013
				2.00	2.14	1.03	0.047	11.40	1.13	0.75	0.013
				2.10	1.99	1.00	0.040	11.60	1.11	0.74	0.013
				2.20	1.87	0.97	0.034	11.80	1.09	0.74	0.013
				2.30	1.78	0.94	0.030	12.00	1.08	0.73	0.013
				2.40	1.71	0.92	0.027	12.40	1.05	0.72	0.012
				2.50	1.62	0.90	0.024	12.80	1.01	0.71	0.012
				2.60	1.54	0.88	0.022	13.20	0.98	0.70	0.012
				2.70	1.46	0.86	0.019	13.60	0.95	0.69	0.013
				2.80	1.40	0.84	0.018	14.00	0.92	0.68	0.013
				2.90	1.34	0.82	0.016	14.40	0.89	0.67	0.013
				3.00	1.30	0.81	0.016	14.80	0.90	0.67	0.013
				3.10	1.26	0.80	0.015	15.20	0.92	0.68	0.013
				3.30	1.19	0.77	0.014	15.60	0.95	0.69	0.013
				3.40	1.16	0.76	0.013	16.00	0.98	0.70	0.012
				3.50	1.13	0.75	0.013	16.40	1.01	0.71	0.012
				3.60	1.10	0.74	0.013	16.80	1.04	0.72	0.012
				3.70	1.07	0.73	0.013	17.20	1.09	0.74	0.013
				3.80	1.04	0.72	0.012	17.60	1.13	0.75	0.013
				3.90	1.01	0.71	0.012	18.00	1.17	0.76	0.014
				4.00	0.98	0.70	0.012	18.40	1.21	0.78	0.014
				4.20	0.94	0.68	0.013	18.80	1.24	0.79	0.014
				4.40	0.89	0.67	0.013	19.20	1.27	0.80	0.015
				4.60	0.85	0.65	0.014	19.60	1.29	0.80	0.015
				4.80	0.81	0.64	0.014	20.00	1.30	0.81	0.015
				5.00	0.78	0.63	0.015	20.60	1.29	0.80	0.015
				5.20	0.77	0.62	0.016	21.00	1.27	0.80	0.015
				5.40	0.77	0.62	0.016	21.60	1.23	0.78	0.014
				5.60	0.80	0.63	0.014	22.00	1.20	0.77	0.014
				5.80	0.87	0.66	0.013	22.60	1.15	0.76	0.013
				6.00	1.00	0.71	0.012	23.00	1.12	0.75	0.013
				6.20	1.11	0.75	0.013	23.60	1.08	0.73	0.013
				6.40	1.23	0.78	0.014	24.00	1.05	0.73	0.013
				6.60	1.33	0.81	0.016	24.60	1.02	0.71	0.012
				6.80	1.42	0.84	0.018	25.00	1.00	0.71	0.012
				7.00	1.49	0.86	0.020	25.60	0.97	0.69	0.012
				7.20	1.54	0.88	0.022	26.00	0.95	0.69	0.013
				7.40	1.58	0.89	0.023	26.60	0.91	0.67	0.013
				7.60	1.61	0.90	0.024	27.00	0.88	0.66	0.013
				7.80	1.63	0.90	0.025	27.60	0.84	0.65	0.014
				8.00	1.66	0.91	0.026	28.00	0.83	0.64	0.014
				8.20	1.67	0.91	0.026	28.60	0.82	0.64	0.014
				8.40	1.68	0.92	0.026	29.00	0.81	0.64	0.014
				8.60	1.68	0.92	0.026	29.60	0.82	0.64	0.014
				8.80	1.66	0.91	0.026	30.00	0.82	0.64	0.014
				9.00	1.65	0.91	0.025				
Zinc, E \perp \hat{c}²⁸											
0.751	1.4469	7.4158	0.905	2.10	1.99	1.00	0.040	11.60	1.11	0.74	0.013
0.827	1.4744	6.9688	0.892	2.20	1.87	0.97	0.034	11.80	1.09	0.74	0.013
0.866	1.3628	6.6886	0.892	2.30	1.78	0.94	0.030	12.00	1.08	0.73	0.013
0.952	1.3165	6.2212	0.881	2.40	1.71	0.92	0.027	12.40	1.05	0.72	0.012
0.992	1.3835	5.8910	0.863	2.50	1.62	0.90	0.024	12.80	1.01	0.71	0.012
1.033	1.2889	5.4001	0.850	2.60	1.54	0.88	0.022	13.20	0.98	0.70	0.012
1.078	1.3095	4.9025	0.822	2.70	1.46	0.86	0.019	13.60	0.95	0.69	0.013
1.127	1.6897	4.4062	0.746	2.80	1.40	0.84	0.018	14.00	0.92	0.68	0.013
1.181	1.9701	4.0176	0.684	2.90	1.34	0.82	0.016	14.40	0.89	0.67	0.013
1.240	2.8717	3.2873	0.555	3.00	1.30	0.81	0.016	14.80	0.90	0.67	0.013
1.305	3.3991	2.7684	0.497	3.10	1.26	0.80	0.015	15.20	0.92	0.68	0.013
1.377	3.1807	3.4709	0.569	3.30	1.19	0.77	0.014	15.60	0.95	0.69	0.013
1.459	3.5064	4.1994	0.630	3.40	1.16	0.76	0.013	16.00	0.98	0.70	0.012
1.550	4.1241	4.7768	0.664	3.50	1.13	0.75	0.013	16.40	1.01	0.71	0.012
1.653	4.0269	4.8027	0.667	3.60	1.10	0.74	0.013	16.80	1.04	0.72	0.012
1.722	3.9369	4.6356	0.657	3.70	1.07	0.73	0.013	17.20	1.09	0.74	0.013
1.823	3.7549	4.3042	0.635	3.80	1.04	0.72	0.012	17.60	1.13	0.75	0.013
1.937	3.4512	4.1942	0.631	3.90	1.01	0.71	0.012	18.00	1.17	0.76	0.014
1.984	3.2515	4.2980	0.644	4.00	0.98	0.70	0.012	18.40	1.21	0.78	0.014
2.066	2.0802	4.7231	0.738	4.20	0.94	0.68	0.013	18.80	1.24	0.79	0.014
2.094	1.7084	4.7923	0.774	4.40	0.89	0.67	0.013	19.20	1.27	0.80	0.015
2.119	1.3329	4.4751	0.791	4.60	0.85	0.65	0.014	19.60	1.29	0.80	0.015
2.275	0.9725	4.2879	0.825	4.80	0.81	0.64	0.014	20.00	1.30	0.81	0.015
2.455	0.7568	3.7627	0.824	5.00	0.78	0.63	0.015	20.60	1.29	0.80	0.015
2.666	0.5470	3.4277	0.845	5.20	0.77	0.62	0.016	21.00	1.27	0.80	0.015
2.917	0.4774	3.0476	0.834	5.40	0.77	0.62	0.016	21.60	1.23	0.78	0.014
3.220	0.3911	2.7463	0.835	5.60	0.80	0.63	0.014	22.00	1.20	0.77	0.014
3.594	0.3147	2.3041	0.821	5.80	0.87	0.66	0.013	22.60	1.15	0.76	0.013
4.065	0.3013	2.0077	0.789	6.00	1.00	0.71	0.012	23.00	1.12	0.75	0.013
4.678	0.2806	1.7997	0.770	6.20	1.11	0.75	0.013	23.60	1.08	0.73	0.013
				6.40	1.23	0.78	0.014	24.00	1.05	0.73	0.013
				6.60	1.33	0.81	0.016	24.60	1.02	0.71	0.012
				6.80	1.42	0.84	0.018	25.00	1.00	0.71	0.012
				7.00	1.49	0.86	0.020	25.60	0.97	0.69	0.012
				7.20	1.54	0.88	0.022	26.00	0.95	0.69	0.013
				7.40	1.58	0.89	0.023	26.60	0.91	0.67	0.013
				7.60	1.61	0.90	0.024	27.00	0.88	0.66	0.013
				7.80	1.63	0.90	0.025	27.60	0.84	0.65	0.014
				8.00	1.66	0.91	0.026	28.00	0.83	0.64	0.014
				8.20	1.67	0.91	0.026	28.60	0.82	0.64	0.014
				8.40	1.68	0.92	0.026	29.00	0.81	0.64	0.014
				8.60	1.68	0.92	0.026	29.60	0.82	0.64	0.014
				8.80	1.66	0.91	0.026	30.00	0.82	0.64	0.014
				9.00	1.65	0.91	0.025				
Zirconium (Polycrystalline)²⁸											
0.10	6.18	1.76	0.300	6.80	1.42	0.84	0.018	25.00	1.00	0.71	0.012
0.15	3.37	1.30	0.123	7.00	1.49	0.86	0.020	25.60	0.97	0.69	0.012
0.20	2.34	1.08	0.058	7.20	1.54	0.88	0.022	26.00	0.95	0.69	0.013
0.26	2.24	1.06	0.052	7.40	1.58	0.89	0.023	26.60	0.91	0.67	0.013
0.30	2.59	1.14	0.073	7.60	1.61	0.90	0.024	27.00	0.88	0.66	0.013
0.36	3.17	1.26	0.110	7.80	1.63	0.90	0.025	27.60	0.84	0.65	0.014
0.40	3.09	1.24	0.105	8.00	1.66	0.91	0.026	28.00	0.83	0.64	0.014
0.46	3.36	1.30	0.123	8.20	1.67	0.91	0.026	28.60	0.82	0.64	0.014
0.50	4.13	1.44	0.175	8.40	1.68	0.92	0.026	29.00	0.81	0.64	0.014
0.56	5.01	1.58	0.231	8.60	1.68	0.92	0.026	29.60	0.82	0.64	0.014
0.60	5.18	1.61	0.242	8.80	1.66	0.91	0.026	30.00	0.82	0.64	0.014
0.70	4.54	1.51	0.202	9.							

OPTICAL PROPERTIES OF SELECTED ELEMENTS (continued)

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ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS

When a crystal is subjected to a stress field, an electric field, or a magnetic field, the resulting optical effects are in general dependent on the orientation of these fields with respect to the crystal axes. It is useful, therefore, to express the optical properties in terms of the refractive index ellipsoid (or indicatrix):

$$\frac{x^2}{n_x^2} + \frac{y^2}{n_y^2} + \frac{z^2}{n_z^2} = 1$$

or

$$\sum_{ij} B_{ij} x_i y_j = 1 \quad (i, j = 1, 2, 3)$$

where

$$B_{ij} = \left[\frac{1}{\epsilon} \right]_{ij} = \left[\frac{1}{n^2} \right]_{ij}$$

ϵ is the dielectric constant or permeability; the quantity B_{ij} has the name impermeability.

A crystal exposed to a *stress* \mathbf{S} will show a change of its impermeability. The photo-elastic (or elasto-optic) constants, P_{ijkl} , are defined by

$$\Delta \left[\frac{1}{\epsilon} \right]_{ij} = \Delta \left[\frac{1}{n^2} \right]_{ij} = \sum_{kl} P_{ijkl} S_{kl}$$

where n is the refractive index and S_{kl} are the strain tensor elements; the P_{ijkl} are the elements of a 4th rank tensor.

When a crystal is subjected to an *electric field* \mathbf{E} two possible changes of the refractive index may occur depending on the symmetry of the crystal.

1. All materials, including isotropic solids and polar liquids, show an electro-optic birefringence (Kerr effect) which is proportional to the square of the electric field, \mathbf{E} :

$$\left[\frac{1}{n^2} \right]_{ij} = \sum_{k,l=1,2,3} K_{ijkl} E_k E_l = \sum_{k,l=1,2,3} g_{ijkl} P_k P_l$$

where E_k and E_l are the components of the electric field and P_k and P_l the electric polarizations. The coefficients, K_{ijkl} , are the quadratic electro-optic coefficients, while the constants g_{ijkl} are known as the Kerr constants.

2. The other electro-optic effect only occurs in the 20 piezo-electric crystal classes (no center of symmetry). This effect is known as the Pockels effect. The optical impermeability changes linearly with the static field

$$\Delta \left[\frac{1}{n^2} \right]_{ij} = \sum_k r_{ij,k} E_k$$

The coefficients $r_{ij,k}$ have the name (linear) electro-optic coefficients.

The values of the electro-optic coefficients depend on the boundary conditions. If the superscripts T and S denote respectively the conditions of zero stress (free) and zero strain (clamped) one finds:

$$r_{ij}^T = r_{ij}^S + q_{ik}^E e_{jk} = r_{ij}^S + P_{ik}^E d_{jk}$$

where $e_{jk} = (\partial T_k / \partial E_j)_S$ and $d_{jk} = (\partial S_k / \partial E_j)_T$ are the appropriate piezo-electric coefficients.

The interaction between a *magnetic field* and a light wave propagating in a solid or in a liquid gives rise to a rotation of the plane of polarization. This effect is known as *Faraday rotation*. It results from a difference in propagation velocity for left and right circular polarized light.

The Faraday rotation, θ_F , is linearly proportional to the magnetic field H :

$$\theta_F = V l H$$

where l is the light path length and V is the *Verdet* constant (minutes/oersted-cm).

For ferromagnetic, ferrimagnetic, and antiferromagnetic materials the magnetic field in the above expression is replaced by the magnetization M and the magneto-optic coefficient in this case is known as the Kund constant K :

$$\text{Specific Faraday rotation } F = KM$$

In the tables below the *Faraday rotation* is listed at the saturation magnetization per unit length, together with the absorption coefficient α , the temperature T , the critical temperature T_C (or T_N), and the wavelength of the measurement.

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

In the tables which follow, the properties are presented in groups:

- Elasto-optic coefficients (photoelastic constants)
- Linear electro-optic coefficients (Pockels constants)
- Quadratic electro-optic coefficients (Kerr constants)
- Magneto-optic coefficients:
 - Verdet constants
 - Faraday rotation parameters

Within each group, materials are classified by crystal system or physical state. References are given at the end of each group of tables.

ELASTO-OPTIC COEFFICIENTS (PHOTOELASTIC CONSTANTS)

Name							
Cubic (43m, 432, m3m)	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{44}	$p_{11}p_{12}$	Ref.
Sodium fluoride	NaF	0.633	0.08	0.20	-0.03	-0.12	1
Sodium chloride	NaCl	0.589	0.115	0.159	-0.011	-0.042	2
Sodium bromide	NaBr	0.589	0.148	0.184	-0.0036	-0.035	1
Sodium iodide	NaI	0.589	—	—	0.0048	-0.0141	3
Potassium fluoride	KF	0.546	0.26	0.20	-0.029	0.06	1
Potassium chloride	KCl	0.633	0.22	0.16	-0.025	0.06	4
Potassium bromide	KBr	0.589	0.212	0.165	-0.022	0.047	5
Potassium iodide	KI	0.590	0.212	0.171	—	0.041	6
Rubidium chloride	RbCl	0.589	0.288	0.172	-0.041	0.116	7,8
Rubidium bromide	RbBr	0.589	0.293	0.185	-0.034	0.108	7,8
Rubidium iodide	RbI	0.589	0.262	0.167	-0.023	0.095	7,8
Lithium fluoride	LiF	0.589	0.02	0.13	-0.045	-0.11	5
Lithium chloride	LiCl	0.589	—	—	-0.0177	-0.0407	3
Ammonium chloride	NH ₄ Cl	0.589	0.142	0.245	0.042	-0.103	9
Cadmium telluride	CdTe	1.06	-0.152	-0.017	-0.057	-0.135	10
Calcium fluoride	CaF ₂	0.55-0.65	0.038	0.226	0.0254	-0.183	11
Copper chloride	CuCl	0.633	0.120	0.250	-0.082	-0.130	12
Copper bromide	CuBr	0.633	0.072	0.195	-0.083	-0.123	12
Copper iodide	CuI	0.633	0.032	0.151	-0.068	-0.119	12
Diamond	C	0.540-0.589	-0.278	0.123	-0.161	-0.385	13
Germanium	Ge	3.39	-0.151	-0.128	-0.072	-0.023	14
Gallium arsenide	GaAs	1.15	-0.165	-0.140	-0.072	-0.025	15
Gallium phosphide	GaP	0.633	-0.151	-0.082	-0.074	-0.069	15
Strontium fluoride	SrF ₂	0.633	0.080	0.269	0.0185	-0.189	16
Strontium titanate	SrTiO ₃	0.633	0.15	0.095	0.072	—	17
KRS-5	Tl(Br,I)	0.633	-0.140	0.149	-0.0725	-0.289	18,20
KRS-6	Tl(Br,Cl)	0.633	-0.451	-0.337	-0.164	-0.114	19,20
Zinc sulfide	Zn	0.633	0.091	-0.01	0.075	0.101	15
Rare Gases	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{44}	$p_{11}p_{12}$	Ref.
Neon (T = 24.3 K)	Ne	0.488	0.157	0.168	0.004	-0.011	21
Argon (T = 82.3 K)	Ar	0.488	0.256	0.302	0.015	-0.046	22
Krypton (T = 115.6 K)	Kr	0.488	0.34	0.34	0.037	0	21
Xenon (T = 160.5 K)	Xe	0.488	0.284	0.370	0.029	-0.086	22
Garnets	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{44}	$p_{11}p_{12}$	Ref.
GdG	Gd ₃ Ga ₅ O ₁₂	0.514	-0.086	-0.027	-0.078	-0.059	23
YIG	Y ₃ Fe ₅ O ₁₂	1.15	0.025	0.073	0.041	—	15
YGG	Y ₃ Ga ₅ O ₁₂	0.633	0.091	0.019	0.079	—	17
YAG	Y ₃ Al ₅ O ₁₂	0.633	-0.029	0.0091	-0.0615	-0.038	15

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

ELASTO-OPTIC COEFFICIENTS (PHOTOELASTIC CONSTANTS) (continued)

Name									
Cubic (23, m3)	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{44}	p_{13}			Ref.
Barium nitrate	Ba(NO ₃) ₂	0.589	—	$p_{11}p_{22} = 0.992$	-0.0205	$p_{11}p_{13} = 0.713$			13
Lead nitrate	Pb(NO ₃) ₂	0.589	0.162	0.24	-0.0198	0.20			24,25
Sodium bromate	NaBrO ₃	0.589	0.185	0.218	-0.0139	0.213			26
Sodium chlorate	NaClO ₃	0.589	0.162	0.24	-0.0198	0.20			26
Strontium nitrate	Sr(NO ₃) ₂	0.41	0.178	0.362	-0.014	0.316			27
Hexagonal (mmc, 6mm)	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{13}	p_{31}	p_{33}	p_{44}	Ref.
Beryl	Be ₃ Al ₂ Si ₆ O ₁₈	0.589	0.0099	0.175	0.191	0.313	0.023	-0.152	28
Cadmium sulfide	CdS	0.633	-0.142	-0.066	-0.057	-0.041	-0.20	-0.099	15,2
Zinc oxide	ZnO	0.633	± 0.222	± 0.099	-0.111	± 0.088	-0.235	0.0585	30
Zinc sulfide	ZnS	0.633	-0.115	0.017	0.025	0.0271	-0.13	-0.0627	31
Trigonal (3m, 32, $\bar{3}m$)	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{13}	p_{14}			p_{31}
Sapphire	Al ₂ O ₃	0.644	-0.23	-0.03	0.02	0.00			-0.04
Calcite	CaCO ₃	0.514	0.062	0.147	0.186	-0.011			0.241
Lithium niobate	LiNbO ₃	0.633	± 0.034	± 0.072	± 0.139	± 0.066			± 0.178
Lithium tantalate	LiTaO ₃	0.633	-0.081	0.081	0.093	-0.026			0.089
Cinnabar	HgS	0.633			± 0.445				
Quartz	SiO ₂	0.589	0.16	0.27	0.27	-0.030			0.29
Proustite	Ag ₃ AsS ₃	0.633	± 0.10	± 0.19	± 0.22				
Sodium nitrite	NaNO ₃	0.633			± 0.21	± 0.215	± 0.027		
Tellurium	Te	10.6	0.155	0.130	—	—			—
Trigonal (3m, 32, $\bar{3}m$) (continued)		p_{33}	p_{41}	p_{44}			Ref.		
Sapphire		-0.20	0.01	-0.10			15,32		
Calcite		0.139	-0.036	-0.058			33		
Lithium niobate		+0.060	± 0.154	± 0.300			15,34		
Lithium tantalate		-0.044	-0.085	0.028			15,35		
Cinnabar		+0.115	—	—			36		
Quartz		0.10	-0.047	-0.079			37		
Proustite		+0.20	—	—			38		
Sodium nitrite			0.055	-0.06			39		
Tellurium			—	—			15		
Tetragonal (4/mmm, 42m, 422)	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{13}			p_{31}	
Ammonium dihydrogen phosphate	ADP	0.589	0.319	0.277	0.169			0.197	
Barium titanate	BaTiO ₃	0.633	0.425	—	—			—	
Cesium dihydrogen arsenate	CDA	0.633	0.267	0.225	0.200			0.195	
Magnesium fluoride	MgF ₂	0.546	—	—	—			—	
Calomel	Hg ₂ Cl ₂	0.633	± 0.551	± 0.440	± 0.256			± 0.137	
Potassium dihydrogen phosphate	KDP	0.589	0.287	0.282	0.174			0.241	
Rubidium dihydrogen arsenate	RDA	0.633	0.227	0.239	0.200			0.205	
Rubidium dihydrogen phosphate	RDP	0.633	0.273	0.240	0.218			0.210	
Strontium barium niobate	Sr _{0.75} Ba _{0.25} Nb ₂ O ₆	0.633	0.16	0.10	0.08			0.11	
Strontium barium niobate	Sr _{0.5} Ba _{0.5} Nb ₂ O ₆	0.633	0.06	0.08	0.17			0.09	
Tellurium oxide	TeO ₂	0.633	0.0074	0.187	0.340			0.090	
Rutile	TiO ₂	0.633	0.017	0.143	-0.139			-0.080	

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

ELASTO-OPTIC COEFFICIENTS (PHOTOELASTIC CONSTANTS) (continued)

Name								
Tetragonal (4/mmm, $\bar{4}2m, 422$) (continued)								
	p_{33}	p_{44}	p_{66}	Ref.				
Ammonium dihydrogen phosphate	0.167	-0.058	-0.091	40				
Barium titanate	—	—	—	41				
Cesium dihydrogen arsenate	0.227	—	—	42				
Magnesium fluoride	—	± 0.0776	± 0.0488	43				
Calomel	± 0.010	—	± 0.047	44				
Potassium dihydrogen phosphate	0.122	-0.019	-0.064	45				
Rubidium dihydrogen arsenate	0.182	—	—	41				
Rubidium dihydrogen phosphate	0.208	—	—	41				
Strontium barium niobate	0.47	—	—	46				
Strontium barium niobate	0.23	—	—	46				
Tellurium oxide	0.240	-0.17	-0.046	47				
Rutile	-0.057	-0.009	-0.060	48				
Tetragonal (4, $\bar{4}$, 4/m)								
	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{13}	p_{16}	p_{31}	
Cadmium molybdate	CdMoO ₄	0.633	0.12	0.10	0.13	—	0.11	
Lead molybdate	PbMoO ₄	0.633	0.24	0.24	0.255	0.017	0.175	
Sodium bismuth molybdate	NaBi(MoO ₄) ₂	0.633	0.243	0.205	0.25	—	0.21	
Tetragonal (4, $\bar{4}$, 4/m) (continued)								
	p_{33}	p_{44}	p_{45}	p_{61}	p_{66}	Ref.		
Cadmium molybdate	0.18	—	—	—	—	49		
Lead molybdate	0.300	0.067	-0.01	0.013	0.05	52		
Sodium bismuth molybdate	0.29	—	—	—	—	—		
Orthorhombic (222, m22, mmm)								
	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{13}	p_{21}	p_{22}	p_{23}
Ammonium chlorate	NH ₄ ClO ₄	0.633	—	0.24	0.18	0.23	—	0.20
Ammonium sulfate	(NH ₄) ₂ SO ₄	0.633	0.26	0.19	± 0.260	± 0.230	± 0.27	± 0.254
Rochelle salt	NaKC ₄ H ₄ O ₆	0.589	0.35	0.41	0.42	0.37	0.28	0.34
Iodic acid (α)	HIO ₃	0.633	0.302	0.496	0.339	0.263	0.412	0.304
Sulfur (α)	S	0.633	0.324	0.307	0.268	0.272	0.301	0.310
Barite	BaSO ₄	0.589	0.21	0.25	0.16	0.34	0.24	0.19
Topaz	Al ₂ SiO ₄ (OH,F) ₂	—	-0.085	0.069	0.052	0.095	-0.120	0.065
Orthorhombic (222, m22, mmm) (continued)								
	p_{31}	p_{32}	p_{33}	p_{44}	p_{55}	p_{66}	Ref.	
Ammonium chlorate	0.19	0.18	± 0.02	$\leq \pm 0.02$	—	± 0.04	51	
Ammonium sulfate	0.20	± 0.26	0.26	0.015	± 0.0015	0.012	52	
Rochelle salt	0.36	0.35	0.36	-0.030	0.0046	-0.025	53	
Iodic Acid (α)	0.251	0.345	0.336	0.084	-0.030	0.098	54	
Sulfur (α)	0.203	0.232	0.270	0.143	0.019	0.118	54	
Barite	0.28	0.22	0.31	0.002	-0.012	0.037	55	
Topaz	0.095	0.085	-0.083	-0.095	-0.031	0.098	28	
Monoclinic (2, m, 2/m)								
	Formula	$\lambda/\mu\text{m}$					Ref.	
Taurine	C ₂ H ₇ NO ₃ S	0.589	$p_{11} = 0.313$		$p_{25} = -0.0025$		$p_{51} = -0.014$	
			$p_{12} = 0.251$		$p_{31} = 0.362$		$p_{52} = 0.006$	
			$p_{13} = 0.270$		$p_{32} = 0.275$		$p_{53} = 0.0048$	
			$p_{15} = -0.10$		$p_{33} = 0.308$		$p_{55} = 0.047$	

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

ELASTO-OPTIC COEFFICIENTS (PHOTOELASTIC CONSTANTS) (continued)

Name						
Monoclinic (2,m,2/m)						
	Formula	$\lambda/\mu\text{m}$				
Taurine (continued)			$p_{21} = 0.281$	$p_{35} = -0.003$	$p_{64} = 0.0024$	
			$p_{22} = 0.252$	$p_{44} = 0.0025$	$p_{66} = 0.0028$	
			$p_{23} = 0.272$	$p_{46} = -0.0056$		
Isotropic						
	Formula	$\lambda/\mu\text{m}$	p_{11}	p_{12}	p_{44}	Ref.
Fused silica	SiO ₂	0.633	0.121	0.270	-0.075	15
Water	H ₂ O	0.633	± 0.31	± 0.31		15
Polystyrene		0.633	± 0.30	± 0.31		25
Lucite		0.633	± 0.30	0.28		25
Orpiment	As ₂ S ₃ -glass	1.15	0.308	0.299	0.0045	15
Tellurium oxide	TeO ₂ -glass	0.633	0.257	0.241	0.0079	56
Laser glasses	LGS-247-2	0.488	± 0.168	± 0.230		57
	LGS-250-3		± 0.135	± 0.198		
	LGS-1		± 0.214	± 0.250		
	KGSS-1621		± 0.205	± 0.239		
Dense flint glasses (examples)	LaSF	0.633	0.088	0.147	-0.030	58
	SF ₄		0.215	0.243	-0.014	
	U10502		0.172	0.179	-0.004	
	TaFd ₇		0.099	0.138	-0.020	

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ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

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LINEAR ELECTRO-OPTIC COEFFICIENTS

Name			
Cubic ($\bar{4}3m$)	Formula	$\lambda/\mu\text{m}$	r_{41} pm/V
Cuprous bromide	CuBr	0.525	0.85
Cuprous chloride	CuCl	0.633	3.6
Cuprous iodide	CuI	0.55	-5.0
Eulytite (BSO)	Bi ₄ Si ₃ O ₁₂	0.63	0.54
Germanium eulytite (BGO)	Bi ₄ Ge ₃ O ₁₂	0.63	1.0
Gallium arsenide	GaAs	10.6	1.6
Gallium phosphide	GaP	0.56	-1.07
Hexamethylenetetramine	C ₆ H ₁₂ N ₄	0.633	0.78
Sphalerite	ZnS	0.65	2.1
Zinc selenide	ZnSe	0.546	2.0
Zinc telluride	ZnTe	3.41	4.2
Cadmium telluride	CdTe	3.39	6.8

Cubic (23)	Formula	$\lambda/\mu\text{m}$	r_{41} pm/V
Ammonium chloride (77 K)	NH ₄ Cl	—	1.5
Ammonium cadmium langbeinite	(NH ₄) ₂ Cd ₂ (SO ₄) ₃	0.546	0.70
Ammonium manganese langbeinite	(NH ₄) ₂ Mn ₂ (SO ₄) ₃	0.546	0.53
Thallium cadmium langbeinite	Tl ₂ Cd ₂ (SO ₄) ₃	0.546	0.37
Potassium magnesium langbeinite	K ₂ Mg ₂ (SO ₄) ₃	0.546	0.40
Bismuth monogermanate	Bi ₁₂ GeO ₂₀	—	3.3
Bismuth monosilicate	Bi ₁₂ SiO ₂₀	—	3.3
Sodium chlorate	NaClO ₃	0.589	0.4
Sodium uranyl acetate	NaUO ₂ (CH ₃ COO) ₃	0.546	0.87

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

LINEAR ELECTRO-OPTIC COEFFICIENTS (continued)

Name						
Cubic (23)						
	Formula	$\lambda/\mu\text{m}$	r_{41} pm/V			
Trenhydrobromide	$\text{N}(\text{CH}_2\text{CH}_2\text{NH}_2)_3\text{3HBr}$	—	1.5			
Trenhydrochloride	$\text{N}(\text{CH}_2\text{CH}_2\text{NH}_2)_3\text{3HCl}$	—	1.7			
Tetragonal ($\bar{4}2\text{m}$)						
	Formula	T_{tran} K	r_{41} pm/V	r_{63} pm/V		
Ammonium dihydrogen phosphate (ADP)	$\text{NH}_4\text{H}_2\text{PO}_4$	148	24.5	-8.5		
Ammonium dideuterium phosphate (AD*P)	$\text{NH}_4\text{D}_2\text{PO}_4$	242	—	11.9		
Ammonium dihydrogen arsenate (ADA)	$\text{NH}_4\text{H}_2\text{AsO}_4$	—	—	9.2		
Cesium dihydrogen arsenate (CsDA)	CsH_2AsO_4	143	—	18.6		
Cesium dideuterium arsenate (CsD*A)	CsD_2AsO_4	212	—	36.6		
Potassium dihydrogen phosphate (KDP)	KH_2PO_4	123	8.6	-10.5		
Potassium dideuterium phosphate (KD*P)	KD_2PO_4	222	8.8	23.8		
Potassium dihydrogen arsenate (KDA)	KH_2AsO_4	97	12.5	10.9		
Potassium dideuterium arsenate (KD*A)	KD_2AsO_4	162	—	18.2		
Rubidium dihydrogen phosphate (RDP)	RbH_2PO_4	147	—	15.5		
Rubidium dihydrogen arsenate (RDA)	RbH_2AsO_4	110	—	13.0		
Rubidium dideuterium arsenate (RD*A)	RbD_2AsO_4	178	—	21.4		
Tetragonal (4mm)						
	Formula	T_{tran} K	r_{13} pm/V	r_{33} pm/V	r_{51} pm/V	
Barium titanate	BaTiO_3	406	8	28	—	
Potassium lithium niobate	$\text{K}_3\text{Li}_2\text{Nb}_5\text{O}_{15}$	693	8.9	5.9	—	
Lead titanate	PbTiO_3	765	13.8	5.9	—	
Strontium barium niobate (SBN75)	$\text{Sr}_{0.75}\text{Ba}_{0.25}\text{Nb}_2\text{O}_6$	330	6.7	1340	42	
Strontium barium niobate (SBN46)	$\text{Sr}_{0.46}\text{Ba}_{0.54}\text{Nb}_2\text{O}_6$	602	~180	35	—	
Hexagonal (6mm)						
	Formula	r_{13} pm/V	r_{33} pm/V	r_{42} pm/V	r_{51} pm/V	
Greenockite	CdS	3.1	2.9	2.0	3.7	
Greenockite (const. strain)	CdS	1.1	2.4	—	—	
Wurzite	ZnS	0.9	1.8	—	—	
Zincite	ZnO	-1.4	+2.6	—	—	
Hexagonal (6)						
	Formula	r_{13} pm/V	r_{33} pm/V	r_{42} pm/V	r_{51} pm/V	
Lithium iodate	LiIO_3	4.1	6.4	1.4	3.3	
Lithium potassium sulfate	LiKSO_4	$r_{13}=r_{33}=1.6$	—	—	—	
Trigonal (3m)						
	Formula	T_{tran} K	r_{13} pm/V	r_{22} pm/V	r_{33} pm/V	r_{42} pm/V
Cesium nitrate	CsNO_3	425	—	0.43	—	—
Lithium niobate	LiNbO_3	1483	8.6	7.0	30.8	28
Lithium tantalate	LiTaO_3	890	8.4	—	30.5	—
Lithium sodium sulfate	LiNaSO_4	—	—	<0.02	—	—
Tourmaline	—	—	—	0.3	—	—
Trigonal (32)						
	Formula	T_{tran} K	r_{11} pm/V	r_{41} pm/V		
Cesium tartrate	$\text{Cs}_2\text{C}_4\text{H}_4\text{O}_6$	—	1.0	—		
Cinnabar	HgS	659	3.1	1.5		

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

LINEAR ELECTRO-OPTIC COEFFICIENTS (continued)

Name		T_{tran} K	r_{11} pm/V	r_{41} pm/V			
Trigonal (32)							
Potassium dithionate	$\text{K}_2\text{S}_2\text{O}_6$	—	0.26	—			
Strontium dithionate	$\text{SrS}_2\text{O}_6 \cdot 4\text{H}_2\text{O}$	—	0.1	—			
Quartz	SiO_2	1140	-0.47	0.2			
Selenium	Se	398	2.5				
Orthorhombic (222)		T_{tran} K	r_{41} pm/V	r_{52} pm/V	r_{63} pm/V		
Ammonium oxalate	$(\text{NH}_4)_2\text{C}_2\text{O}_4 \cdot 4\text{H}_2\text{O}$	—	230	330	250		
Rochelle salt	$\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$	$T_u = 297$ $T_l = 255$	-2.0	-1.7	+0.32		
Orthorhombic (mm2)		T_{trans} K	r_{13} pm/V	r_{23} pm/V	r_{33} pm/V	r_{42} pm/V	r_{51} pm/V
Barium sodium niobate (BSN)	$\text{Ba}_2\text{NaNbO}_{15}$	833	15	13	48	92	90
Potassium niobate	KNbO_3	476	28	1.3	64	380	105
Monoclinic (2)		T_{trans} K	r_{22} pm/V	r_{32} pm/V			
Calcium pyroniobate	$\text{Ca}_2\text{Nb}_2\text{O}_7$	—	0.33	13.7			
Triglycine sulfate (TGS)	$(\text{NH}_2\text{CH}_2\text{COOH})_3 \cdot \text{H}_2\text{SO}_4$	322	7.2	13.6			

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QUADRATIC ELECTRO-OPTIC COEFFICIENTS

Kerr Constants of Ferroelectric Crystals^{1,2}

Name	Formula	T_{tran} K	λ μm	g_{11} 10^{10} esu	g_{12} 10^{10} esu	$g_{11} \cdot g_{12}$ 10^{10} esu	g_{44} 10^{10} esu
Barium titanate	BaTiO_3	406	0.633	1.33	-0.11	1.44	—
Strontium titanate	SrTiO_3	—	0.633	—	—	1.56	—
Potassium tantalate niobate	$\text{KTa}_{0.65}\text{Nb}_{0.35}\text{O}_3$	330	0.633	1.50	-0.42	1.92	1.63
Potassium tantalate	KTaO_3	13	0.633	—	—	1.77	1.33
Lithium niobate	LiNbO_3	1483	—	0.94	0.25	0.7	0.6
Lithium tantalate	LiTaO_3	938	—	1.0	0.17	0.8	0.7
Barium sodium niobate (BSN)	$\text{Ba}_{0.8}\text{Na}_{0.4}\text{Nb}_{206}$	833	—	1.55	0.44	1.11	

Kerr Constants of Selected Liquids²

K is the Kerr constant at a wavelength of 589 nm and at room temperature; ϵ is the static dielectric constant; T_m is the melting point; and T_b is the normal boiling point

Name	Molecular formula	K 10^{-7} esu	ϵ	T_m $^\circ\text{C}$	T_b $^\circ\text{C}$
Carbon disulfide	CS_2	+3.23	2.63	-111.5	+46.3
Acetone	$\text{C}_3\text{H}_6\text{O}$	+16.3	21.0	-94.8	+56.1
Methyl ethyl ketone	$\text{C}_4\text{H}_8\text{O}$	+13.6	18.56	-86.67	+79.6

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

QUADRATIC ELECTRO-OPTIC COEFFICIENTS (continued)

Kerr Constants of Selected Liquids (continued)²

Name	Molecular formula	K 10^{-7} esu	ϵ	T_m °C	T_b °C
Pyridine	C ₅ H ₅ N	+20.4	13.26	-42	+115.23
Ethyl cyanoacetate	C ₅ H ₇ NO ₂	+38.8	31.6	-22.5	205
<i>o</i> -Dichlorobenzene	C ₆ H ₄ Cl ₂	+42.6	10.12	-16.7	180
Benzenesulfonyl chloride	C ₆ H ₅ ClO ₂ S	+89.9	28.90	+14.5	247
Nitrobenzene	C ₆ H ₅ NO ₂	+326	35.6	+5.7	210.8
Ethyl 3-aminocrotonate	C ₆ H ₁₁ NO ₂	+31.0	—	+33.9	210
Paraldehyde	C ₆ H ₁₂ O ₃	-23.0	14.7	+12.6	124
			12.0 ^a		
Benzaldehyde	C ₇ H ₆ O	+80.8	17.85	-26	179.05
			14.1 ^a		
<i>p</i> -Chlorotoluene	C ₇ H ₇ Cl	+23.0	6.25	+7.5	162.4
<i>o</i> -Nitrotoluene	C ₇ H ₇ NO ₂	+174	26.26	-10	222.3
<i>m</i> -Nitrotoluene	C ₇ H ₇ NO ₂	+177	24.95	+15.5	232
<i>p</i> -Nitrotoluene	C ₇ H ₇ NO ₂	+222	22.2	+51.6	238.3
Benzyl alcohol	C ₇ H ₈ O	-15.4	11.92	-15.3	205.8
			10.8 ^a		
<i>m</i> -Cresol	C ₇ H ₈ O	+21.2	12.44	+11.8	202.27
			5.0 ^a		
<i>m</i> -Chloroacetophenone	C ₈ H ₇ ClO	+69.1			
Acetophenone	C ₈ H ₈ O	+66.6	17.44	+19.7	202.3
			15.8 ^a		
Quinoline	C ₉ H ₇ N	+15.0	9.16	-14.78	237.16
Ethyl salicylate	C ₉ H ₁₀ O ₃	+19.6	8.48	+1.3	231.5
Carvone	C ₁₀ H ₁₄ O	+23.6	11.2	<0	230
Ethyl benzoylacetate	C ₁₁ H ₁₂ O ₃	+16.0	13.50	<0	270
Water	H ₂ O	+4.0	80.10	0.00	100.0

^a Dielectric constant at radiofrequencies (10⁸-10⁹ Hz).

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MAGNETO-OPTIC CONSTANTS

Verdet Constants of Non-Magnetic Crystals¹

V is the Verdet constant; n is the refractive index; and λ is the wavelength

Material	T K	λ nm	n	V min/Oe cm
Al ₂ O ₃	300	546.1	1.771	0.0240
	300	589.3	1.768	0.0210
BaTaO ₃	403	427		0.95
	403	496		0.38
	403	620		0.18
	403	826		0.072
	300	442	2.077	0.289
Bi ₄ Ge ₃ O ₁₂	300	632.8	2.048	0.099
	300	1064	2.031	0.026
	300	589.3	2.417	0.0233
C (diamond)	300	589.3	2.417	0.0233
CaCO ₃	300	589.3	1.658	0.019
CaF ₂	300	589.3	1.434	0.0088
Cd _{0.55} Mn _{0.45} Te	300	632.8		6.87

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

**MAGNETO-OPTIC CONSTANTS (continued)
Verdet Constants of Non-Magnetic Crystals (continued)¹**

Material	T K	λ nm	n	V min/Oe cm
CuCl	300	546.1	1.93	0.20
GaSe	298	632.8		0.80
KAl(SO ₄) ₂ ·12H ₂ O	300	589.3	1.456	0.0124
KBr	300	546.1	1.564	0.0500
	300	589.3	1.560	0.0425
KCl	300	589.3	1.490	0.0275
KI	300	546.1	1.673	0.083
	300	589.3	1.666	0.070
KTaO ₃	296	352		0.44
	296	413		0.19
	296	496		0.096
	296	620		0.051
	296	826		0.022
LaF ₃	300	325	1.639	0.054
(H||c)	300	442	1.615	0.028
	300	632.8	1.601	0.012
	300	1064	1.592	0.006
MgAl ₂ O ₄	300	589.3	1.718	0.021
NH ₄ AlSO ₄ ·12H ₂ O	300	589.3	1.459	0.0128
NH ₄ Br	300	589.3	1.711	0.0504
NH ₄ Cl	300	546.1		0.0410
	300	589.3	1.643	0.0362
NaBr	300	546.1		0.0621
NaCl	300	546.1		0.0410
	300	589.3	1.544	0.0345
NaClO ₃	300	546.1		0.0105
	300	589.3	1.515	0.0081
NiSO ₄ ·6H ₂ O	297	546.1		0.0256
	297	589.3	1.511	0.0221
SiO ₂	300	546.1	1.546	0.0195
	300	589.3	1.544	0.0166
SrTiO ₃	298	413	2.627	0.78
	298	496		0.31
	298	620		0.14
	298	826		0.066
ZnS	300	546.1		0.287
	300	589.3	2.368	0.226
ZnSe	300	476	2.826	1.50
	300	496	2.759	1.04
	300	514	2.721	0.839
	300	587	2.627	0.529
	300	632.8	2.592	0.406

Verdet Constants of Rare-Earth Aluminum Garnets at Various Wavelengths¹

The absorption coefficient α for these materials ranges from 0.2 to 0.6 cm⁻¹ at 300 K

Material	T/K	V in min/Oe cm							
		$\lambda = 405$ nm	450 nm	480 nm	520 nm	546 nm	578 nm	635 nm	670 nm
Tb ₂ Al ₅ O ₁₂	300	-2.266	-1.565	-1.290	-1.039	-0.912	-0.787	-0.620	-0.542
	77		-102.16	-83.45	-3.425	-3.051	-2.603	-2.008	-1.815
	4.2				-64.80	-58.35	-53.77	48.39	-45.15
	1.45		-200.95	-172.52	-139.28	-125.07	-111.27	97.47	-93.42
Dy ₃ Al ₅ O ₁₂	300	-1.241	-0.942	-0.803	-0.667	-0.592	-0.518	-0.411	-0.359
Ho ₃ Al ₅ O ₁₂	300	-0.709	-0.320	-0.260	-0.335	-0.304	-0.299		-0.206

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

MAGNETO-OPTIC CONSTANTS (continued)
Verdet Constants of Rare-Earth Aluminum Garnets at Various Wavelengths (continued)¹

Material	T/K	V in min/Oe cm							
		$\lambda = 405$ nm	450 nm	480 nm	520 nm	546 nm	578 nm	635 nm	670 nm
Er ₃ Al ₅ O ₁₂	300	-0.189	-0.240	-0.154	-0.162	-0.157	-0.145	-0.105	-0.089
Tm ₃ Al ₅ O ₁₂	300	+0.151	+0.103	+0.093	0.076	0.069	+0.059	+0.048	
Yb ₃ Al ₅ O ₁₂	298	0.287	0.215	0.186	0.140	0.133	0.116	0.094	
	77	0.718	0.540	0.481	0.393	0.342	0.302	0.239	

Verdet Constants for KDP-Type Crystals¹

Measurements refer to T = 298 K and
 $\lambda = 632.8$ nm, with $k \parallel [001]$

Material	V min/Oe cm
KH ₂ PO ₄ (KDP)	0.0124
KH _{0.3} D _{1.7} PO ₄ (KD*P)	0.145
NH ₄ H ₂ PO ₄ (ADP)	0.138
KH ₂ AsO ₄ (KDA)	0.238
KH _{0.1} D _{1.9} AsO ₄ (KD*A)	0.245
NH ₄ H ₂ AsO ₄ (ADH)	0.244

Verdet Constants of Gases²

Values refer to T = 0°C and P = 101.325 kPa (760 mmHg); n_D is the refractive index at a wavelength of 589 nm

Gas	$(n_D - 1) \times 10^3$	$10^6 \times V$ min/Oe cm
He	0.036	+0.40
Ar	2.81	+9.36
H ₂		+6.29
N ₂	0.297	+6.46
O ₂	0.272	+5.69
Air	0.293	+6.27
Cl ₂	0.773	+31.9
HCl	0.447	+21.5
H ₂ S	0.63	+41.5
NH ₃	0.376	+19.0
CO	0.34	+11.0
CO ₂	0.45	+9.39
NO	0.297	-58
CH ₄	0.444	+17.4
n-C ₄ H ₁₀		+44.0

Verdet Constants of Liquids²

n_D is the refractive index at a wavelength of 589 nm and a temperature of 20°C, unless otherwise indicated. V is the Verdet constant

Liquid	λ /nm	T/°C	$10^2 \times V$ min/Oe cm	n_D
P	589	33	+13.3	
S	589	114	+8.1	1.929 (110°C)
H ₂ O	589	20	+1.309	1.3328
D ₂ O	589	19.7	+1.257	1.3384
H ₃ PO ₄	578	97.4	+1.35	
CS ₂	589	20	+4.255	1.6255
CCl ₄	578-589	25.1	+1.60	1.463 (15°C)
SbCl ₅	578	18	+7.45	1.601 (14°C)
TiCl ₄	578	17	-1.65	1.61
TiBr ₄	578	46	-5.3	
Methanol	589	18.7	+0.958	1.3289
Acetone	578-589	20.0	+1.116	1.3585
Toluene	578-589	15.0	+2.71	1.4950
Benzene	578-589	15.0	+3.00	1.5005
Chlorobenzene	589	15	+2.92	1.5246
Nitrobenzene	589	15	+2.17	1.5523
Bromoform	589	17.9	+3.13	1.5960

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

MAGNETO-OPTIC CONSTANTS (continued)

Verdet Constants of Rare Earth Paramagnetic Crystals¹

n is the refractive index, and V is the Verdet constant at the wavelength and temperature indicated

Rare Earth	Host	T/K	λ /nm	n	V min/Oe cm	
Ce ³⁺ (30%)	CaF ₂	300	325	1.516	-0.956	
		300	442	1.502	-0.297	
		300	633	1.494	-0.111	
		300	1064	1.489	-0.035	
Ce ³⁺	CeF ₃	300	442	1.613	-1.05	
		300	633	1.598	-0.406	
		77	633		-1.418	
Pr ³⁺ (5%)	CaF ₂	300	1064	1.589	-0.113	
		300	266	1.471	-0.172	
		300	325	1.461	-0.0818	
		300	442	1.451	-0.0089	
		300	633	1.445	-0.0168	
Nd ³⁺ (2.9%)	CaF ₂	300	1064	1.441	-0.0045	
		4.2	426		-0.19	
		Nd ³⁺	300	442	1.60	-0.553
			290	633	1.59	-0.209
Eu ³⁺ (3%)	CaF ₂	77	633		-0.755	
		300	1064	1.58	-0.097	
		4.2	430		29	
		4.2	440		22	
Eu ²⁺	EuF ₂	300	450		-4.5	
		300	500		-2.6	
		300	550		-1.6	
		300	600		-1.1	
		300	650		-0.8	
		300	1064		-0.19	
Tb ³⁺	KTb ₃ F ₁₀	300	325	1.531	-2.174	
		300	442	1.518	-0.933	
		300	633	1.510	-0.386	
		77	633		-1.94	
Tb ³⁺	LiTbF ₄	300	1064	1.505	-0.114	
		300	325	1.493	-1.9	
		300	442	1.481	-0.98	
		300	633	1.473	-0.44	
		300	1064	1.469	-0.13	
Tb ³⁺	Tb ₃ Ga ₅ O ₁₂	300	500	1.989	-0.749	
		300	570	1.981	-0.581	
		300	633	1.976	-0.461	
		300	830	1.967	-0.21	
		300	1060	1.954	-0.12	

MAGNETO-OPTIC CONSTANTS (continued)

Verdet Constants of Paramagnetic Glasses¹The Verdet constant V is given at room temperature for the wavelengths indicatedRare earth phosphate glasses of composition $R_2O_3 \cdot xP_2O_5$, where x is given in the second column

R	x	Verdet constant V in min/Oe cm									
		$\lambda = 405$ nm	$\lambda = 436$ nm	$\lambda = 480$ nm	$\lambda = 500$ nm	$\lambda = 520$ nm	$\lambda = 546$ nm	$\lambda = 578$ nm	$\lambda = 600$ nm	$\lambda = 635$ nm	$\lambda = 670$ nm
La		0.037	0.030	0.024	0.022	0.020	0.018	0.015	-0.014	0.013	—
Ce	2.67	-0.672	0.510	-0.366	-0.326	-0.287	-0.253	-0.217	-0.197	-0.173	-0.150
Pr	3.09	-0.447	-0.332	-0.283	-0.261	-0.236	-0.208	-0.182	-0.170	-0.150	-0.132
Nd	2.92	-0.250	-0.209	-0.167	-0.155	-0.136	-0.134	-0.094	-0.080	-0.080	-0.071
Sm	2.87	0.026	0.024	0.020	0.020	0.017	0.015	0.014	0.012	0.011	0.010
Eu	2.93	-0.025	-0.017	-0.010	-0.006	-0.006	-0.005	-0.004	-0.003	-0.002	-0.002
Gd	3.01	0.018	0.015	0.014	0.012	0.012	0.011	0.011	0.010	0.009	0.009
Tb	2.94	-0.560	-0.458	-0.357	-0.323	-0.295	-0.261	-0.226	-0.206	-0.190	-0.164
Dy	2.51	-0.540	-0.453	-0.359	-0.331	-0.301	0.268	-0.237	-0.217	-0.197	-0.173
Ho	2.94	-0.299	-0.313	-0.156	-0.153	-0.138	-0.138	-0.119	-0.110	-0.098	-0.084
Er	3.01	-0.139	-0.121	-0.100	-0.111	-0.095	-0.062	-0.060	-0.057	-0.051	-0.044
Tm	2.79	0.019	0.013	0.012	0.009	0.008	0.006	0.005	0.004	0.004	0.007
Yb	3.01	0.087	0.072	0.056	0.050	0.045	0.041	0.036	0.032	0.029	0.024

The following are rare earth borate glasses with composition:

for La and Pr: $R_2O_3 \cdot xP_2O_5$; for Tb-Pr and Dy-Pr: $R_2O_3 \cdot xB_2O_3$; and for other elements: $R_2O_3 \cdot 0.85La_2O_3 \cdot xB_2O_3$.

La	3.04	0.043	0.036	0.029	0.026	0.023	0.022	0.019	0.018	0.016	0.014
Pr-La	5.44	-0.380	-0.307	-0.230	-0.220	-0.201	-0.178	-0.153	-0.146	-0.128	-0.110
Nd-La	5.41	-0.180	-0.147	-0.120	-0.111	-0.096	-0.094	-0.100	-0.059	-0.056	-0.046
Sm-La	4.97	0.032	0.030	0.025	0.024	0.022	0.019	0.017	0.016	0.014	0.012
Eu-La	4.69	-0.081	-0.060	-0.038	-0.033	-0.029	-0.024	0.019	-0.016	0.014	-0.012
Gd-La	4.71	0.032	0.026	0.024	0.022	0.021	0.020	0.018	0.017	0.015	0.013
Tb-La	4.73	-0.512	-0.419	-0.319	-0.288	-0.262	-0.234	-0.205	-0.186	-0.167	-0.142
Dy-La	4.88	-0.436	-0.361	-0.299	-0.273	-0.246	-0.220	-0.193	-0.177	-0.159	-0.138
Ho-La	4.36	-0.269	-0.252	-0.123	-0.131	-0.112	-0.128	-0.104	-0.096	—	-0.074
Er-La	4.50	-0.093	-0.078	-0.068	-0.082	—	-0.045	-0.042	-0.040	-0.035	-0.034
Tm-La	4.75	0.060	0.046	0.039	0.034	0.031	0.026	0.023	0.021	0.018	0.016
Yb-La	8.58	0.115	0.094	0.073	0.066	0.060	0.054	0.046	0.043	0.037	0.033
Tb-Pr	4.99	-0.940	-0.786	-0.560	-0.536	-0.489	-0.436	-0.380	-0.348	-0.306	-0.265
Dy-Pr	4.63	-0.850	—	—	-0.497	-0.465	-0.413	-0.358	-0.332	-0.290	-0.252
Pr	2.56	-0.843	-0.646	-0.471	-0.480	-0.432	-0.390	-0.334	-0.317	-0.271	-0.243

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

MAGNETO-OPTIC CONSTANTS (continued)

Verdet Constants of Diamagnetic Glasses¹

The Verdet constant V is given at room temperature for the wavelengths indicated

Glass type	Composition (wt. %)	Verdet constant V in min/Oe cm			
		$\lambda = 325$ nm	$\lambda = 442$ nm	$\lambda = 633$ nm	$\lambda = 1064$ nm
SiO ₂	100% SiO ₂			0.013	
B ₂ O ₃	100% B ₂ O ₃			0.010	
CdO	47.5% CdO, 52.5% P ₂ O ₅	0.079	0.033	0.022	
ZnO	36.4% ZnO, 63.6% P ₂ O ₅	0.072	0.044	0.020	
TeO ₂	88.9% TeO ₂ , 11.1% P ₂ O ₅		0.196	0.076	0.022
ZrF ₄	63.1% ZrF ₄ , 14.9% BaF ₂ , 7.2% LaF ₃ , 1.9% AlF ₃ , 9.1% PbF ₂ , 3.8% LiF			0.011	
			$\lambda = 700$ nm	$\lambda = 853$ nm	$\lambda = 1060$ nm
Bi ₂ O ₃	95% Bi ₂ O ₃ , 5% B ₂ O ₃		0.086	0.051	0.033
PbO	95% PbO, 5% B ₂ O ₃		0.093	0.061	0.031
	82% PbO, 18% SiO ₂		0.077	0.045	0.027
	50% PbO, 15% K ₂ O, 35% SiO ₂		0.032	0.020	0.011
Tl ₂ O	95% Tl ₂ O, 5% B ₂ O ₃		0.092	0.061	0.032
	82% Tl ₂ O, 18% SiO ₂		0.100	0.067	0.043
	50% Tl ₂ O, 15% K ₂ O, 35% SiO ₂		0.036	0.022	0.012
SnO	76% SnO, 13% B ₂ O ₃ , 11% SiO ₂		0.071	0.046	0.026
TeO ₃	75% TeO ₂ , 25% Sb ₂ O ₃		0.076	0.052	0.032
	80% TeO ₂ , 20% ZnCl ₂		0.073	0.046	0.025
	84% TeO ₂ , 16% BaO		0.056	0.041	0.029
	70% TeO ₂ , 30% WO ₃		0.052	0.035	0.022
	20% TeO ₂ , 80% PbO		0.128	0.075	0.048
Sb ₂ O ₃	25% Sb ₂ O ₃ , 75% TeO ₂		0.076	0.050	0.032
	75% Sb ₂ O ₃ , 75% Cs ₂ O, 5% Al ₂ O ₃		0.074	0.044	0.025
	75% Sb ₂ O ₃ , 10% Cs ₂ O, 10% Rb ₂ O, 5% Al ₂ O ₃		0.078	0.052	0.030

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

MAGNETO-OPTIC CONSTANTS (continued)

Verdet Constants of Commercial Glasses¹

This table gives the density, ρ , refractive index at 589 nm, n_D , and Verdet constant, V , for the wavelengths indicated; the data refer to room temperature

Glass type	ρ g/cm ³	n_D	V in min/Oe cm				
			$\lambda = 365.0$ nm	$\lambda = 404.7$ nm	$\lambda = 435.8$ nm	$\lambda = 546.1$ nm	$\lambda = 578.0$ nm
BSC	2.49	1.5096	0.0499	0.0392	0.0333	0.02034	0.01798
HC	2.53	1.5189	0.0561	0.0440	0.0372	0.0225	0.01995
LBC	2.87	1.5406	0.0609	0.0477	0.0403	0.0245	0.0216
LF	3.23	1.5785	0.1143	0.0850	0.0693	0.0394	0.0344
BLF	3.48	1.6047	0.1112	0.0832	0.0685	0.0393	0.0344
DBC	3.56	1.6122	0.0662	0.0517	0.0435	0.0261	0.0231
DF	3.63	1.6203	0.1473	0.1076	0.0872	0.0485	0.0423
EDF	3.9	1.6533	0.1725	0.1248	0.1007	0.0556	0.0483

The composition of the glasses in weight percent is:

Glass type	SiO ₂	B ₂ O ₃	K ₂ O	CaO	Al ₂ O ₃	As ₂ O ₃	Na ₂ O	BaO	ZnO	PbO
BSC	69.6	6.7	20.5	2.9	0.3	0.1	—	—	—	—
HC	72.0	—	10.1	11.4	0.3	0.2	6.1	—	—	—
LBC	57.1	1.8	13.7	0.3	0.2	0.1	—	26.9	—	—
LF	52.5	—	9.5	0.3	0.2	0.1	—	—	—	37.6
BLF	45.2	—	7.8	—	—	0.4	—	16.0	8.3	22.2
DBC	36.2	7.7	0.2	0.2	3.5	0.7	—	44.6	6.7	—
DF	46.3	—	1.1	0.3	0.2	0.1	5.0	—	—	47.0
EDF	40.6	—	7.5	0.2	0.2	0.2	0.1	—	—	51.5

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FARADAY ROTATION Ferro-, Ferri-, and Antiferromagnetic Solids

Material	T_c K	$4\pi M_s$ gauss	F deg/cm	α cm ⁻¹	$2F/\alpha$	T K	λ nm
Fe	1043	21,800	4.4×10^5	6.5×10^5	1.4	300	500
			6.5×10^5	5.0×10^5	2.6	300	1000
			7×10^5	4.2×10^5	3.3	300	1500
Co	1390	18,200	7×10^5	3.5×10^5	4.0	300	2000
			2.9×10^5	—	—	300	500
			5.5×10^5	6.1×10^5	1.8	300	1000
			5.5×10^5	4.5×10^5	2.4	300	1500
Ni	633	6,400	5.5×10^5	3.6×10^5	2.7	300	2000
			0.8×10^5	—	—	300	500
			2.6×10^5	5.8×10^5	0.9	300	1000
Permalloy (Ni/Fe = 82/18)	803	10,700	1.5×10^5	4.8×10^5	0.6	300	1500
			1×10^5	4.1×10^5	0.25	300	2000
			1.2×10^5	6×10^5	0.4	300	500

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

**FARADAY ROTATION (continued)
Ferro-, Ferri-, and Antiferromagnetic Solids (continued)**

Material	T_c K	$4\pi M_s$ gauss	F deg/cm	α cm^{-1}	$2F/\alpha$	T K	λ nm
Ni/Fe = 100/0		6,000	1.2×10^5	7.05×10^5	0.34	300	632.8
Ni/Fe = 80/20		10,800	2.2×10^5	7.10×10^5	0.62	300	632.8
Ni/Fe = 60/40		14,900	2.9×10^5	7.54×10^5	0.77	300	632.8
Ni/Fe = 40/60		14,400	2.2×10^5	8.17×10^5	0.54	300	632.8
Ni/Fe = 20/80		19,400	3.3×10^5	8.10×10^5	0.81	300	632.8
Ni/Fe = 0/100	639	21,600	3.5×10^5	8.13×10^5	0.86	300	632.8
MnBi		7,700	4.2×10^5	6.1×10^5	1.4	300	450
			7.5×10^5	4.2×10^5	3.6	300	900
MnAs	313	—	0.44×10^5	5.0×10^5	0.174	300	500
			0.62×10^5	4.4×10^5	0.28	300	900
CrTe	334	1015	0.5×10^5	2.0×10^5	0.5	300	550
			0.4×10^5	1.2×10^5	0.7	300	900
FeRh	333	—	0.9×10^5	3.3×10^5	0.56	348	700
Y ₃ Fe ₅ O ₁₂ (YIG)	560	2500	2400	1500	3.2	300	555
			1250	1400	1.8	300	625
			750	450	3.3	300	770
			175	<0.06	> 3×10^3	300	5000
							to 1500
Gd ₃ Fe ₅ O ₁₂ (GdIG)	T _n = 564 T = 286	7300	-2000	6000	0.6	300	500
			-1050	900	2.3	300	600
			-300	100	6.0	300	800
			-80	70	2.3	300	1000
NiFe ₂ O ₄	858	3350	2.0×10^4	5.9×10^4	0.7	300	286
			-1.0×10^4	10×10^4	0.2	300	500
			-120	38	6	300	1500
			+75	15	10	300	3000
			+110	32	7	300	5000
CoFe ₂ O ₄	793	4930	2.75×10^4	12×10^4	0.5	300	286
			3.6×10^4	17×10^4	0.4	300	400
			-2.5×10^4	6×10^4	0.8	300	660
MgFe ₂ O ₄	593-713 ^e	1450 ^e	-60	100	1	300	2500
			0	12	0	300	4000
			+35	6	11	300	6000
Li _{0.5} Fe _{2.5} O ₄	863-953 ^e	3240 ^e to 3900	-440	150	6	300	1500
			+10	85	0.2	300	3000
			+110	44	5	300	5000
			+135	80	3	300	7000
BaFe ₁₂ O ₁₉	723	—	-50	-38	3	300	2000
			+75	20	7.5	300	3000
			+150	20	15	300	5000
			+165	22	15	300	7000
Ba ₂ Zn ₂ Fe ₁₂ O ₁₉	—	—	90	120	1.5	300	5000
			75	65	2.0	300	7000
RbNiF ₃	220	1250	360	35	20	77	450 ^a
			70	10	14	77	600 ^a
			310	70	9	77	800 ^a
			75	25	6	77	1000 ^a
RbNi _{0.75} Co _{0.25} F ₃	109	—	180	9	40	77	600 ^b
RbFeF ₃	102	—	3400	7	900	82	300 ^c
			1600	3	1100	82	400 ^c
			620	1.5	830	82	600 ^c
			300	2.5	240	82	800 ^c
FeF ₃	365	40	670	14	95	300	349 ^d
		at 300 K	180	4.4	82	300	522.5 ^d
CrCl ₃	16.8	3880	2000	200	20	1.5	410

ELASTO-OPTIC, ELECTRO-OPTIC, AND MAGNETO-OPTIC CONSTANTS (continued)

**FARADAY ROTATION (continued)
Ferro-, Ferri-, and Antiferromagnetic Solids (continued)**

Material	T_c K	$4\pi M_s$ gauss	F deg/cm	α cm ⁻¹	$2F/\alpha$	T K	λ nm
			-500	300	3	1.5	450
			-1000	70	30	1.5	590
CrBr ₃	32.5	3390	3×10^5	3×10^3	200	1.5	478
			1.6×10^5	1.4×10^4	23	1.5	500
CrI ₃	68	2690	1.1×10^5	6.3×10^3	35	1.5	970
			0.8×10^5	3×10^3	53	1.5	1000
FeBO ₃	348	115	3200	140	45	300	500
		at 300 K	450	38	24	300	700
EuO	69	23700	-1.0×10^5	0.5×10^4	40	5	1100
			5×10^5	9.7×10^4	10	5	700
			0.5×10^5	7.8×10^4	1.3	5	500
			3×10^4	>0.5	~105	20	2500
			660	>1.0	1300	20	10600
EuS	16.3	—	-1.6×10^5	0	—	6	825
			-9.6×10^5	3.3×10^4	58	6	690
			$+5.5 \times 10^5$	1.2×10^5	9.2	6	563
EuSe	7.0	13,200	1.45×10^5	80	3600	4.2	750
			0.95×10^5	60	3170	4.2	800

^a Measured along the C-axis (magnetic hard axis).

^b Measured along the C-axis (magnetic easy axis).

^c Measured along the C-axis ([100]-direction at room temperature).

^d Strong natural birefringence interferes with the Faraday effect.

^e Depends on heat treatment.

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NONLINEAR OPTICAL CONSTANTS

H. P. R. Frederikse

The relation between the polarization density P of a dielectric medium and the electric field E is linear when E is small, but becomes nonlinear as E acquires values comparable with interatomic electric fields (10^5 to 10^8 V/cm). Under these conditions the relation between P and E can be expanded in a Taylor's series

$$P = \epsilon_0 \chi^{(1)} E + 2\chi^{(2)} E^2 + 4\chi^{(3)} E^3 + \dots \quad (1)$$

where ϵ_0 is the permittivity of free space, while $\chi^{(1)}$ is the linear and $\chi^{(2)}$, $\chi^{(3)}$ etc. the nonlinear optical susceptibilities.

If we consider two optical fields, the first $E_j^{\omega_1}$ (along the j -direction at frequency ω_1) and the second $E_k^{\omega_2}$ (along the k -direction at frequency ω_2) one can write the second term of the Taylor's series as follows

$$P_i(\omega_1\omega_2) = 2\chi_{ijk}^{\omega_3=\omega_1\pm\omega_2} E_j^{\omega_1} E_k^{\omega_2}$$

When $\omega_1 \neq \omega_2$ the (parametric) mixing of the two fields gives rise to two new polarizations at the frequencies $\omega_3 = \omega_1 + \omega_2$ and $\omega_3' = \omega_1 - \omega_2$. When the two frequencies are equal, $\omega_1 = \omega_2 = \omega$, the result is Second Harmonic Generation (SHG) $\chi_{ijk}(2\omega, \omega, \omega)$, while equal and opposite frequencies, $\omega_1 = \omega$ and $\omega_2 = -\omega$ leads to Optical Rectification (OR): $\chi_{ijk}(0, \omega, -\omega)$. In the SHG case the following convention is adopted: the second order nonlinear coefficient d is equal to one half of the second order nonlinear susceptibility

$$d_{ijk} = 1/2 \chi^{(2)}$$

Because of the symmetry of the indices j and k one can replace these two by a single index (subscript) m . Consequently the notation for the SHG nonlinear coefficient in reduced form is d_{im} where m takes the values 1 to 6. Only noncentrosymmetric crystals can possess a nonvanishing d_{ijk} tensor (third rank). The unit of the SHG coefficients is m/V (in the MKSQ/SI system).

In centrosymmetric media the dominant nonlinearity is of the third order. This effect is represented by the third term in the Taylor's series (Equation 1); it is the result of the interaction of a number of optical fields (one to three) producing a new frequency $\omega_4 = \omega_1 + \omega_2 + \omega_3$. The third order polarization is given by

$$P_j(\omega_1\omega_2\omega_3) = g_4 \chi_{jklm} E_k^{\omega_1} E_l^{\omega_2} E_m^{\omega_3}$$

Third Harmonic Generation (THG) is achieved when $\omega_1 = \omega_2 = \omega_3 = \omega$. In this case the constant $g_4 = 1/4$. The third order nonlinear coefficient C is related to the third order susceptibility as follows

$$C_{jklm} = 1/4 \chi_{jklm}$$

This coefficient is a fourth rank tensor. In the THG case the matrices must be invariant under permutation of the indices k , l , and m ; as a result the notation for the third order nonlinear coefficient can be simplified to C_{jn} . The unit of C_{jn} is $\text{m}^2 \cdot \text{V}^{-2}$ (in the MKSQ/SI system).

Applications of second order nonlinear optical materials include the generation of higher (up to sixth) optical harmonics, the mixing of monochromatic waves to generate sum or difference frequencies (frequency conversion), the use of two monochromatic waves to amplify a third wave (parametric amplification) and the addition of feedback to such an amplifier to create an oscillation (parametric oscillation).

Third order nonlinear optical materials are used for THG, self-focusing, four wave mixing, optical amplification, and optical conjugation. Many of these effects — as well as the variation and modulation of optical propagation caused by mechanical, electric, and magnetic fields (see the preceding table on "Elasto-Optic, Electro-Optic, and Magneto-Optic Constants") are used in the areas of optical communication, optical computing, and optical imaging.

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NONLINEAR OPTICAL CONSTANTS (continued)

Selected SHG Coefficients of NLO Crystals*

Material	Symmetry class	$d_{im} \times 10^{12}$ m/V	λ μm
GaAs	$\bar{4}3\text{m}$	$d_{14} = 134.1 \pm 42$	10.6
GaP	$\bar{4}3\text{m}$	$d_{14} = 71.8 \pm 12.3$	1.058
InAs	$\bar{4}3\text{m}$	$d_{14} = 364 \pm 47$	1.058
		$d_{14} = 210$	10.6
ZnSe	$\bar{4}3\text{m}$	$d_{14} = 78.4 \pm 29.3$	10.6
		$d_{36} = 26.6 \pm 1.7$	1.058
β -ZnS	$\bar{4}3\text{m}$	$d_{14} = 30.6 \pm 8.4$	10.6
		$d_{36} = 20.7 \pm 1.3$	1.058
ZnTe	$\bar{4}3\text{m}$	$d_{14} = 92.2 \pm 33.5$	10.6
		$d_{14} = 83.2 \pm 8.4$	1.058
		$d_{36} = 89.6 \pm 5.7$	1.058
CdTe	$\bar{4}3\text{m}$	$d_{14} = 167.6 \pm 63$	10.6
Bi ₄ GeO ₁₂	$\bar{4}3\text{m}$	$d_{14} = 1.28$	1.064
N ₄ (CH ₂) ₆ (hexamine)	43m	$d_{14} = 4.1$	1.06
LiIO ₃	6	$d_{33} = -7.02$	1.06
		$d_{31} = -5.53 \pm 0.3$	1.064
ZnO	6 mm	$d_{33} = -5.86 \pm 0.16$	1.058
		$d_{31} = 1.76 \pm 0.16$	1.058
		$d_{15} = 1.93 \pm 0.16$	1.058
α -ZnS	6 mm	$d_{33} = 11.37 \pm 0.07$	1.058
		$d_{33} = 37.3 \pm 12.6$	10.6
		$d_{31} = -18.9 \pm 6.3$	10.6
		$d_{15} = 21.37 \pm 8.4$	10.6
CdS	6 mm	$d_{33} = 25.8 \pm 1.6$	1.058
		$d_{31} = -13.1 \pm 0.8$	1.058
		$d_{15} = 14.4 \pm 0.8$	1.058
CdSe	6 mm	$d_{33} = 54.5 \pm 12.6$	10.6
		$d_{31} = -26.8 \pm 2.7$	10.6
BaTiO ₃	4 mm	$d_{33} = 6.8 \pm 1.0$	1.064
		$d_{31} = 15.7 \pm 1.8$	1.064
		$d_{15} = 17.0 \pm 1.8$	1.064
PbTiO ₃	4 mm	$d_{33} = 7.5 \pm 1.2$	1.064
		$d_{31} = 37.6 \pm 5.6$	1.064
		$d_{15} = 33.3 \pm 5$	1.064
K ₃ Li ₂ Nb ₅ O ₁₅	4 mm	$d_{33} = 11.2 \pm 1.6$	1.064
		$d_{31} = 6.18 \pm 1.28$	1.064
		$d_{15} = 5.45 \pm 0.54$	1.064
K _{0.8} Na _{0.2} Ba ₂ Nb ₅ O ₁₅	4 mm	$d_{31} = 13.6 \pm 1.6$	1.064
SrBaNb ₅ O ₁₅	4 mm	$d_{33} = 11.3 \pm 3.3$	1.064
		$d_{31} = 4.31 \pm 1.32$	1.064
		$d_{15} = 5.98 \pm 2$	1.064
NH ₄ H ₂ PO ₄ (ADP)	$\bar{4}2\text{m}$	$d_{36} = 0.53$	1.064
		$d_{36} = 0.85$	0.694
KH ₂ PO ₄ (KDP)	$\bar{4}2\text{m}$	$d_{36} = 0.44$	1.064
		$d_{36} = 0.47 \pm 0.07$	0.694
KD ₂ PO ₄ (KD*P)	$\bar{4}2\text{m}$	$d_{36} = 0.38 \pm 0.016$	1.058
		$d_{36} = 0.34 \pm 0.06$	0.694
		$d_{14} = 0.37$	1.058
KH ₂ AsO ₄ (KDA)	$\bar{4}2\text{m}$	$d_{36} = 0.43 \pm 0.025$	1.06
		$d_{36} = 0.39 \pm 0.4$	0.694
CdGeAs ₂	$\bar{4}2\text{m}$	$d_{36} = 351 \pm 105$	10.6
AgGaS ₂	$\bar{4}2\text{m}$	$d_{36} = 18 \pm 2.7$	10.6
AgGaSe ₂	$\bar{4}2\text{m}$	$d_{36} = 37.4 \pm 6.0$	10.6
(NH ₂) ₂ CO (urea)	$\bar{4}2\text{m}$	$d_{36} = 1.3$	1.06
AlPO ₄	32	$d_{11} = 0.35 \pm 0.03$	1.058
Se	32	$d_{11} = 97 \pm 25$	10.6

NONLINEAR OPTICAL CONSTANTS (continued)

Selected SHG Coefficients of NLO Crystals (continued)*

Material	Symmetry class	$d_{im} \times 10^{12}$ m/V	λ μm
Te	32	$d_{11} = 650 \pm 30$	10.6
SiO ₂ (quartz)	32	$d_{11} = 0.335$	1.064
HgS	32	$d_{11} = 50.3 \pm 17$	10.6
(C ₆ H ₅ CO) ₂ [benzil]	32	$d_{11} = 3.6 \pm 0.5$	1.064
β -BaB ₂ O ₄ [BBO]	3 m	$d_{22} = 2.22 \pm 0.09$ $d_{31} = 0.16 \pm 0.08$	1.06
LiNbO ₃	3 m	$d_{33} = 34.4$ $d_{31} = -5.95$ $d_{22} = 2.76$	1.06
LiTaO ₃	3 m	$d_{33} = -16.4 \pm 2$ $d_{31} = -1.07 \pm 0.2$ $d_{22} = +1.76 \pm 0.2$	1.058
Ag ₃ AsS ₃ [proustite]	3 m	$d_{31} = 11.3 \pm 2.5$ $d_{22} = 18.0 \pm 2.5$	10.6
Ag ₃ SbS ₃ [pyrargelite]	3m	$d_{31} = 12.6 \pm 4$ $d_{22} = 13.4 \pm 4$	10.6
α -HIO ₃	222	$d_{36} = 5.15 \pm 0.16$	1.064
NO ₂ · CH ₃ NOC ₅ H ₄ · (POM)	222	$d_{36} = 6.4 \pm 1.0$	1.064
Ba ₂ NaNb ₅ O ₁₅ [Banana]	mm 2	$d_{33} = -17.6 \pm 1.28$ $d_{31} = -12.8 \pm 1.28$	1.064
C ₆ H ₄ (NO ₂) ₂ [MDB]	mm 2	$d_{33} = 0.74$ $d_{32} = 2.7$	1.064
Gd ₂ (MoO ₄) ₃	mm 2	$d_{31} = 1.78$ $d_{33} = -0.044 \pm 0.008$ $d_{32} = +2.42 \pm 0.36$	1.064
KNbO ₃	mm 2	$d_{31} = -2.49 \pm 0.37$ $d_{33} = -19.58 \pm 1.03$ $d_{32} = +11.34 \pm 1.03$	1.064
KTiOPO ₄ [KTP]	mm 2	$d_{31} = -12.88 \pm 1.03$ $d_{33} = 13.7$ $d_{32} = \pm 5.0$	1.06
NO ₂ C ₆ H ₄ · NH ₂ [mNA]	mm 2	$d_{31} = \pm 6.5$ $d_{33} = 13.12 \pm 1.28$ $d_{32} = 1.02 \pm 0.22$	1.06
C ₁₀ H ₁₂ N ₃ O ₆ [MAP]	2	$d_{31} = 12.48 \pm 1.28$ $d_{23} = 10.67 \pm 1.3$ $d_{22} = 11.7 \pm 1.3$	1.064
(NH ₂ CH ₂ COOH) ₃ H ₂ SO ₄ [TGS]	2	$d_{21} = 2.35 \pm 0.5$ $d_{25} = -0.35 \pm 0.3$ $d_{23} = 0.32$	1.064

* These data are taken from References 1 and 2.

NONLINEAR OPTICAL CONSTANTS (continued)

Selected THG Coefficients of Some NLO Materials*

Material	NLO process	$C_{jn} \times 10^{20}$ m^2/V^{-2}	λ μm
NH ₄ H ₂ PO ₄ [ADP]	(-3 ω , ω , ω , ω)	$C_{11} = 0.0104$	1.06
		$C_{18} = 0.0098$	1.06
C ₆ H ₆ [benzene]	(-3 ω , ω , ω , ω)	$C_{11} = 0.0184 \pm 0.0042$	1.89
CdGeAs ₂ p-type: $5 \times 10^{16} \text{ cm}^{-3}$	(-3 ω , ω , ω , ω)	$C_{11} = 182 \pm 84$	10.6
		$C_{16} = 175$	10.6
		$C_{18} = -35$	10.6
C ₄₀ H ₅₆ [β -carotene]	(-3 ω , ω , ω , ω)	$C_{11} = 0.263 \pm 0.08$	1.89
GaAs high-resistivity	(-3 ω , ω , ω , $-\omega$)	$C_{11} = 62 \pm 31$	1.06
Ge	(-3 ω , ω , ω , $-\omega$)	$C_{11} = 23.5 \pm 12$	1.06
LiIO ₃	(-3 ω , ω , ω , $-\omega$)	$C_{12} = 0.2285$	1.06
		$C_{35} = 6.66 \pm 1$	1.06
KBr	(-3 ω , ω , ω , $-\omega$)	$C_{11} = 0.0392$	1.06
		$C_{18}/C_{11} = 0.3667$	1.06
KCl	(-3 ω , ω , ω , $-\omega$)	$C_{11} = 0.0168$	1.06
		$C_{18}/C_{11} = 0.28$	1.06
KH ₂ PO ₄ [KDP]	(-3 ω , ω , ω , $-\omega$)	$C_{11} - 3C_{18} = 0.04$	1.06
Si p-type: 10^{14} cm^{-3}	(-3 ω , ω , ω , $-\omega$)	$C_{11} = 82.8 \pm 25$	1.06
NaCl	(-3 ω , ω , ω , $-\omega$)	$C_{11} = 0.0168$	1.06
		$C_{18}/C_{11} = 0.4133$	1.06
NaF	(-3 ω , ω , ω , $-\omega$)	$C_{11} = 0.0035$	1.06

* These data are taken from Reference 1.

PHASE DIAGRAMS

H. P. R. Frederikse

A phase is a structurally homogeneous portion of matter. Regardless of the number of chemical constituents of a gas, there is only one vapor phase. This is true also for the liquid form of a pure substance, although a mixture of several liquid substances may exist as one or several phases, depending on the interactions among the substances. On the other hand a pure solid may exist in several phases at different temperatures and pressures because of differences in crystal structure (Reference 1). At the phase transition temperature, T_{tr} , the chemical composition of the solid remains the same, but often a change in the physical properties will take place. Such changes are found in ferroelectric crystals (example $BaTiO_3$) which develop a spontaneous polarization below T_{tr} , in superconductors (example Pb) which lose all electrical resistance below the transition point, and in many other classes of solids.

In quite a few cases it is difficult to bring about the phase transition, and the high- (or low-) temperature phase persists in its metastable form. Many liquids remain in the liquid state for shorter or longer periods of time when cooled below the melting point (supercooling). However, often the slightest disturbance will cause solidification. Persistence of the high temperature phase in solid-solid transitions is usually of much longer duration. An example of this behavior is found in white tin; although gray tin is the thermodynamically stable form below T_{tr} (286.4 K), the metal remains in its undercooled, white tin state all the way to $T = 0$ K, and crystals of gray tin are very difficult to produce.

A *phase diagram* is a map which indicates the areas of stability of the various phases as a function of external conditions (temperature and pressure). Pure materials, such as mercury, helium, water, and methyl alcohol are considered one-component systems and they have *unary* phase diagrams. The equilibrium phases in two-component systems are presented in *binary* phase diagrams. Because many important materials consist of three, four, and more components, many attempts have been made to deduce their multicomponent phase diagrams. However, the vast majority of systems with three or more components are very complex, and no overall maps of the phase relationships have been worked out.

It has been shown during the last 20 to 25 years that very useful partial phase diagrams of complex systems can be obtained by means of thermodynamic modeling (References 2, 3). Especially for complicated, multicomponent alloy systems the CALPHAD method has proved to be a successful approach for producing valuable portions of very intricate phase diagrams (Reference 4). With this method thermodynamic descriptions of the free energy functions of various phases are obtained which are consistent with existing (binary) phase diagram information and other thermodynamic data. Extrapolation methods are then used to extend the thermodynamic functions into a ternary system. Comparison of the results of this procedure with available experimental data is then used to fine-tune the phase diagram and add ternary interaction functions if necessary. In principle this approximation strategy can be extended to four, five, and more component systems.

The nearly two dozen phase diagrams shown below present the reader with examples of some important types of single and multicomponent systems, especially for ceramics and metal alloys. This makes it possible to draw attention to certain features like the kinetic aspects of phase transitions (see Figure 22, which presents a time-temperature-transformation, or TTT, diagram for the precipitation of α -phase particles from the β -phase in a Ti-Mo alloy; Reference 1, pp.358-360). The general references listed below and the references to individual figures contain phase diagrams for many additional systems.

GENERAL REFERENCES

1. Ralls, K.M., Courtney, T.H., and Wulff, J., *Introduction to Materials Science and Engineering*, Chapters 16 and 17, John Wiley & Sons, New York, 1976.
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5. Baker, H., Editor, *ASM Handbook, Volume 3: Alloy Phase Diagrams*, ASM International, Materials Park, OH, 1992.
6. Massalski, T.B., Editor, *Binary Alloy Phase Diagrams, Second Edition*, ASM International, Materials Park, OH, 1990.
7. Roth, R.S., Editor, *Phase Diagrams for Ceramists*, Vol. I (1964) to Volume XI (1995), American Ceramic Society, Waterville, OH.

REFERENCES TO INDIVIDUAL PHASE DIAGRAMS

- Figure 1. Carbon: Reference 7, Vol. X (1994), Figure 8930. Reprinted with permission.
- Figure 2. Si-Ge : Ref.5, p. 2.231. Reprinted with permission.
- Figure 3. H_2O (ice): See figure.
- Figure 4. SiO_2 : Reference 7, Vol. XI (1995), Figure 9174. Reprinted with permission.
- Figure 5. Fe-O: Darken, L.S., and Gurry, R.W., *J. Am. Chem. Soc.*, 68, 798, 1946. Reprinted with permission.
- Figure 6. Ti-O: Reference 5, p. 2.324. Reprinted with permission.
- Figure 7. BaO- TiO_2 : Reference 7, Vol. III (1975), Figure 4302. Reprinted with permission.
- Figure 8. MgO- Al_2O_3 : Reference 7, Vol. XI (1995), Figure 9239. Reprinted with permission.
- Figure 9. Y_2O_3 - ZrO_2 : Reference 7, Vol. XI (1995), Figure 9348. Reprinted with permission.
- Figure 10. Si-N-Al-O (Sialon): Reference 7, Vol. X (1994), Figure 8759. Reprinted with permission.
- Figure 11. PbO - ZrO_2 - TiO_2 (PZT): Reference 7, Vol. III (1975), Figure 4587. Reprinted with permission.
- Figure 12. Al-Si-Ca-O: Reference 7 (1964), Vol. I, Figure 630. Reprinted with permission.
- Figure 13. Y-Ba-Cu-O: Whittler, J.D., and Roth, R.S., *Phase Diagrams for High T_c Superconductors*, Figure S-082, American Ceramic Society, Waterville, OH, 1990. Reprinted with permission.
- Figure 14. Al-Cu: Reference 5, p. 2.44. Reprinted with permission.
- Figure 15. Fe-C: Ralls, K.M., Courtney, T.H., and Wulff, J., *Introduction to Materials Science and Engineering*, Figure 16.13, John Wiley & Sons, New York, 1976. Reprinted with permission.
- Figure 16. Fe-Cr: Reference 5, p. 2.152. Reprinted with permission.

PHASE DIAGRAMS (continued)

Figure 17. Cu-Sn: Reference 5, p. 2.178. Reprinted with permission.

Figure 18. Cu-Ni: Reference 5, p. 2.173. Reprinted with permission.

Figure 19. Pb-Sn (solder): Reference 5, p. 2.335. Reprinted with permission.

Figure 20. Cu-Zn (brass): Subramanian, P.R., Chakrabarti, D.J., and Laughlin, D.E., Editors, *Phase Diagrams of Binary Copper Alloys*, p. 487, ASM International, Materials Park, OH, 1994. Reprinted with permission.

Figure 21. Co-Sm: Reference 5, p. 2.148. Reprinted with permission.

Figure 22. Ti-Mo: Reference 5, p. 2.296; Reference 1, p. 359. Reprinted with permission.

Figure 23. Fe-Cr-Ni: Reference 5, Figure 48. Reprinted with permission.

Figure 1

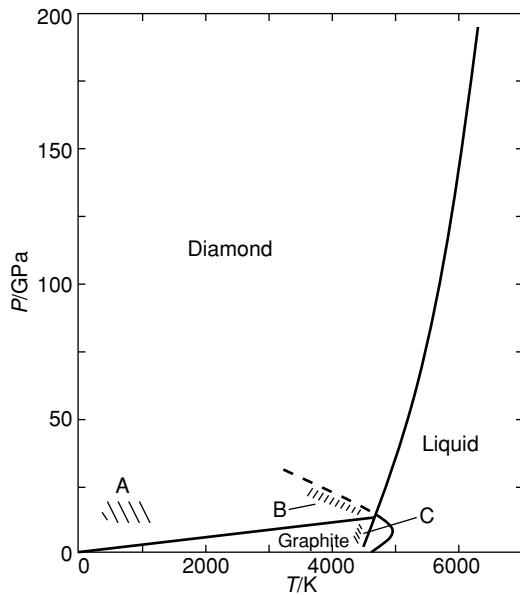


Figure 1. Phase diagram of carbon. (A) Martensitic transition: hex graphite → hex diamond. (B) Fast graphite-to-diamond transition. (C) Fast diamond-to-graphite transition.

Figure 2

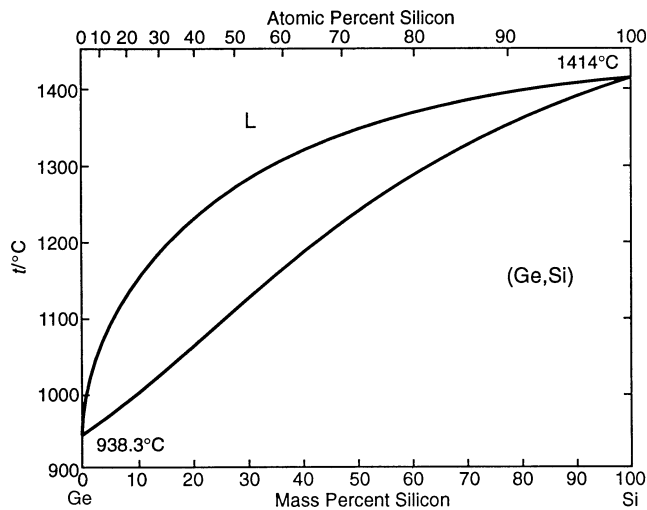


Figure 2. Si-Ge system.

Phase	Composition, mass % Si	Pearson symbol	Space group
(Ge,Si)	0 to 100	<i>cF8</i>	<i>Fd$\bar{3}m$</i>
High-pressure phases			
GeII	—	<i>tI4</i>	<i>I4₁/amd</i>
SiII	—	<i>tI4</i>	<i>I4₁/amd</i>

PHASE DIAGRAMS (continued)

FIGURE 3

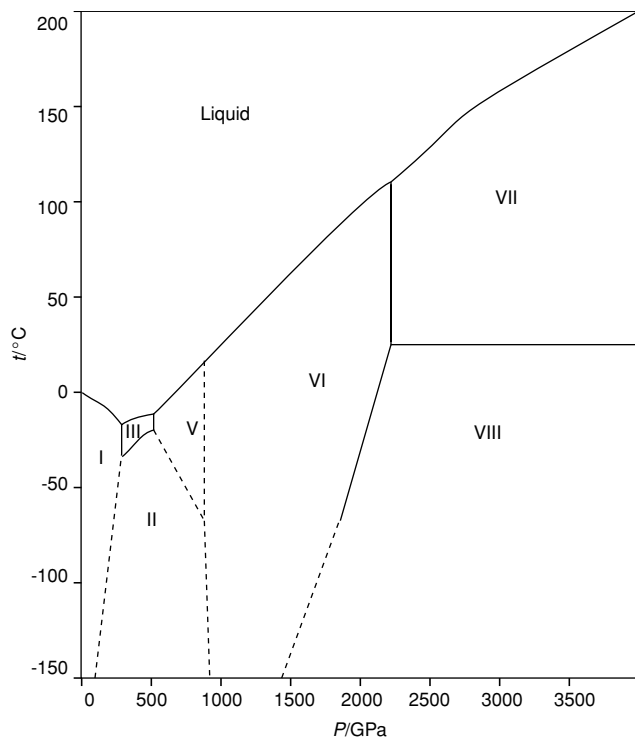


Figure 3. Diagram of the principal phases of ice. Solid lines are measured boundaries between stable phases; dotted lines are extrapolated. Ice IV is a metastable phase which exists in the region of ice V. Ice IX exists in the region below -100°C and pressures in the range 200–400 MPa. Ice X exists at pressures above 44 GPa. See Table 1 for the coordinates of the triple points, where liquid water is in equilibrium with two adjacent solid phases.

Table 1. Crystal Structure, Density, and Transition Temperatures for the Phases of Ice

Phase	Crystal system	Cell parameters	Z	n	$\rho/\text{g cm}^{-3}$	Triple points
Ih	Hexagonal	$a = 4.513; c = 7352$	4	4	0.93	I-III: $-21.99^{\circ}\text{C}, 209.9 \text{ MPa}$
Ic	Cubic	$a = 6.35$	8	4	0.94	
II	Rhombohedral	$a = 7.78; \alpha = 113.1^{\circ}$	12	4	1.18	
III	Tetragonal	$a = 6.73; c = 6.83$	12	4	1.15	III-V: $-16.99^{\circ}\text{C}, 350.1 \text{ MPa}$
IV	Rhombohedral	$a = 7.60; \alpha = 70.1^{\circ}$	16	4	1.27	
V	Monoclinic	$a = 9.22; b = 7.54, c = 10.35; \beta = 109.2^{\circ}$	28	4	1.24	V-VI: $0.16^{\circ}\text{C}, 632.4 \text{ MPa}$
VI	Tetragonal	$a = 6.27; c = 5.79$	10	4	1.31	VI-VII: $82^{\circ}\text{C}, 2216 \text{ MPa}$
VII	Cubic	$a = 3.41$	2	8	1.56	
VIII	Tetragonal	$a = 4.80; c = 6.99$	8	8	1.56	
IX	Tetragonal	$a = 6.73; c = 6.83$	12	4	1.16	
X	Cubic	$a = 2.83$	2	8	2.51	

REFERENCES

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4. Hobbs, P.V., *Ice Physics*, Oxford University Press, Oxford, 1974.

PHASE DIAGRAMS (continued)

Figure 4

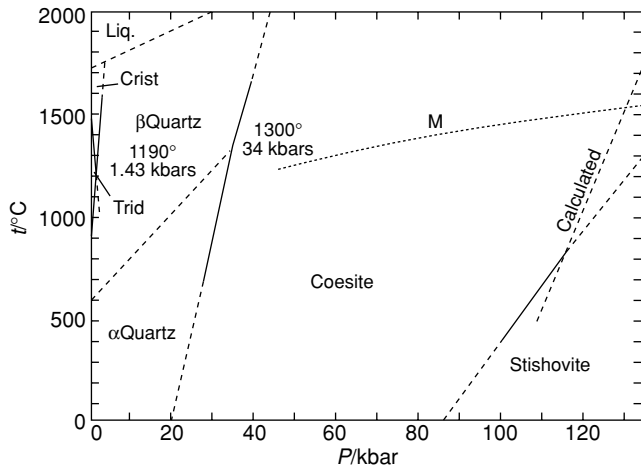


Figure 4. SiO₂ system. Crist = cristobalite; Trid = tridymite.

Figure 5

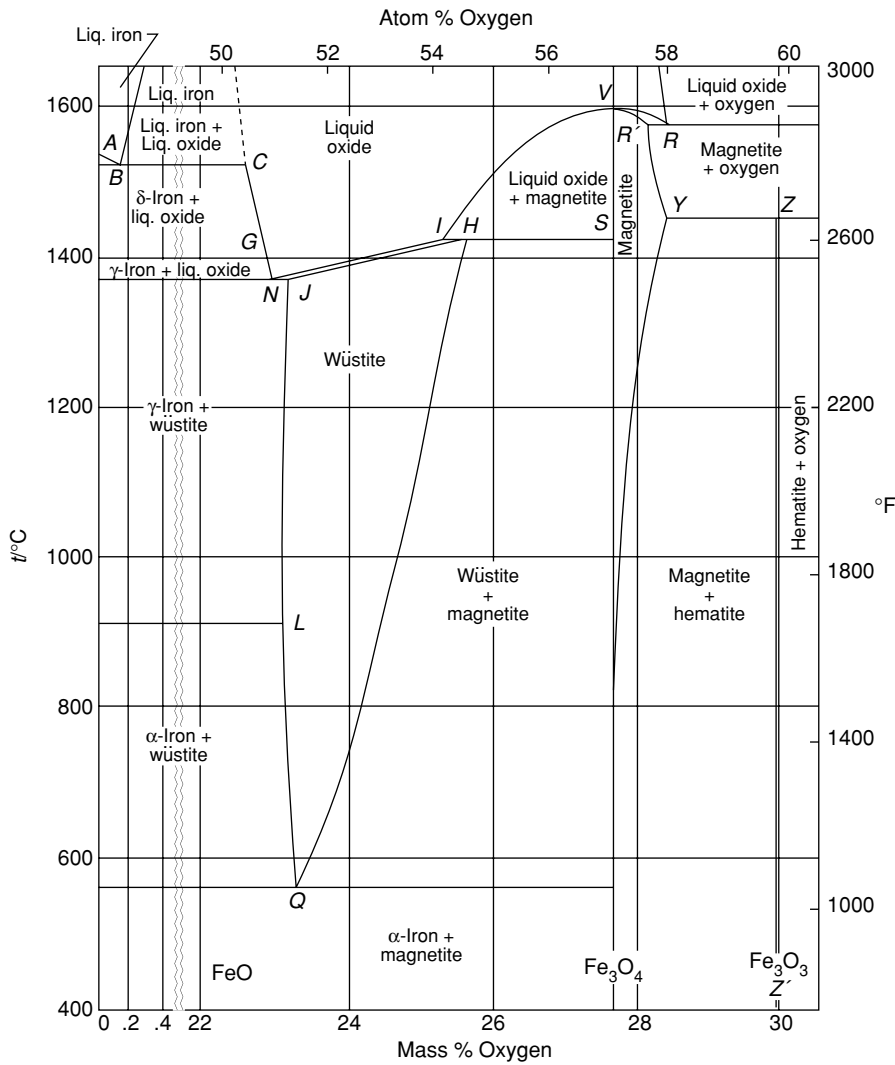


Figure 5. Fe-O system.

PHASE DIAGRAMS (continued)

Figure 5 (continued)

Point	$t/^\circ\text{C}$	% O	$p_{\text{CO}_2}/p_{\text{CO}}$	Point	$t/^\circ\text{C}$	% O	$p_{\text{CO}_2}/p_{\text{CO}}$	$p_{\text{O}_2}/\text{atm}$
A	1539			Q	560	23.26	1.05	
B	1528	0.16	0.209	R	1583	28.30		1
C	1528	22.60	0.209	R'	1583	28.07		1
G	1400 ^a	22.84	0.263	S	1424	27.64	16.2	
H	1424	25.60	16.2	V	1597	27.64		0.0575
I	1424	25.31	16.2	Y	1457	28.36		1
J	1371	23.16	0.282	Z	1457	30.04		1
L	911 ^a	23.10	0.447	Z'		30.6		
N	1371	22.91	0.282					

^a Values for pure iron.

Figure 6

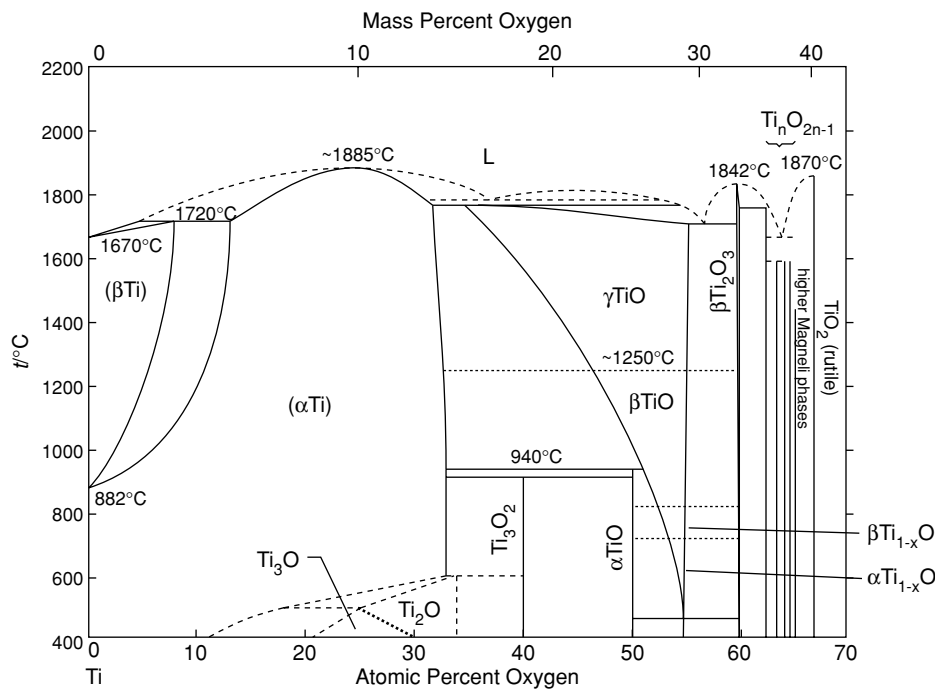


Figure 6. Ti-O system.

Phase	Composition, mass % O	Pearson symbol	Space group
(βTi)	0 to 3	<i>cI2</i>	<i>Im</i> $\bar{3}m$
(αTi)	0 to 13.5	<i>hP2</i>	<i>P63/mmc</i>
Ti ₃ O	~8 to ~13	<i>hP~16</i>	<i>P</i> $\bar{3}c$
Ti ₂ O	~10 to 14.4	<i>hP3</i>	<i>P</i> $\bar{3}m1$
γTiO	15.2 to 29.4	<i>cF8</i>	<i>Fm</i> $\bar{3}m$
Ti ₃ O ₂	~18	<i>hP~5</i>	<i>P6/mmm</i>
βTiO	~24 to ~29.4	<i>c**</i>	—
αTiO	~25.0	<i>mC16</i>	<i>A2/m</i> or <i>B*</i> / <i>*</i>
βTi _{1-x} O	~29.5	<i>oI12</i>	<i>I222</i>
αTi _{1-x} O	~29.5	<i>tI18</i>	<i>I4/m</i>
βTi ₂ O ₃	33.2 to 33.6	<i>hR30</i>	<i>R</i> $\bar{3}c$
αTi ₂ O ₃	33.2 to 33.6	<i>hR30</i>	<i>R</i> $\bar{3}c$
βTi ₃ O ₅	35.8	<i>m**</i>	—
αTi ₃ O ₅	35.8	<i>mC32</i>	<i>C2/m</i>
α'Ti ₃ O ₅	35.8	<i>mC32</i>	<i>Cc</i>

PHASE DIAGRAMS (continued)

Figure 6 (continued)

Phase	Composition, mass % O	Pearson symbol	Space group
$\gamma\text{Ti}_4\text{O}_7$	36.9	<i>aP44</i>	$P\bar{1}$
$\beta\text{Ti}_4\text{O}_7$	36.9	<i>aP44</i>	$P\bar{1}$
$\alpha\text{Ti}_4\text{O}_7$	36.9	<i>aP44</i>	$P\bar{1}$
$\gamma\text{Ti}_5\text{O}_9$	37.6	<i>aP28</i>	$P\bar{1}$
$\beta\text{Ti}_6\text{O}_{11}$	38.0	<i>aC68</i>	$A\bar{1}$
Ti_7O_{13}	38.3	<i>aP40</i>	$P\bar{1}$
Ti_8O_{15}	38.5	<i>aC92</i>	$A\bar{1}$
Ti_9O_{17}	38.7	<i>aP52</i>	$P\bar{1}$
Rutile TiO_2	40.1	<i>tP6</i>	PA_2/mnm
Metastable phases			
Anatase	—	<i>tI12</i>	$I4_1/amd$
Brookite	—	<i>oP24</i>	$Pbca$
High-pressure phases			
$\text{TiO}_2\text{-II}$	—	<i>oP12</i>	$Pbcn$
$\text{TiO}_2\text{-III}$	—	<i>hP-48</i>	—

FIGURE 7

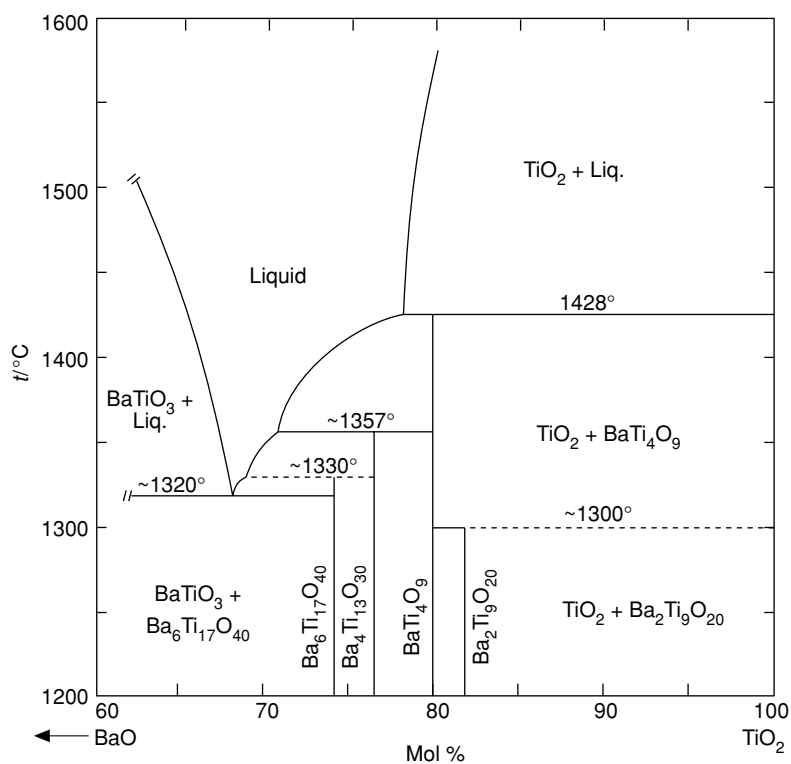


Figure 7. BaO-TiO₂ system.

PHASE DIAGRAMS (continued)

Figure 8

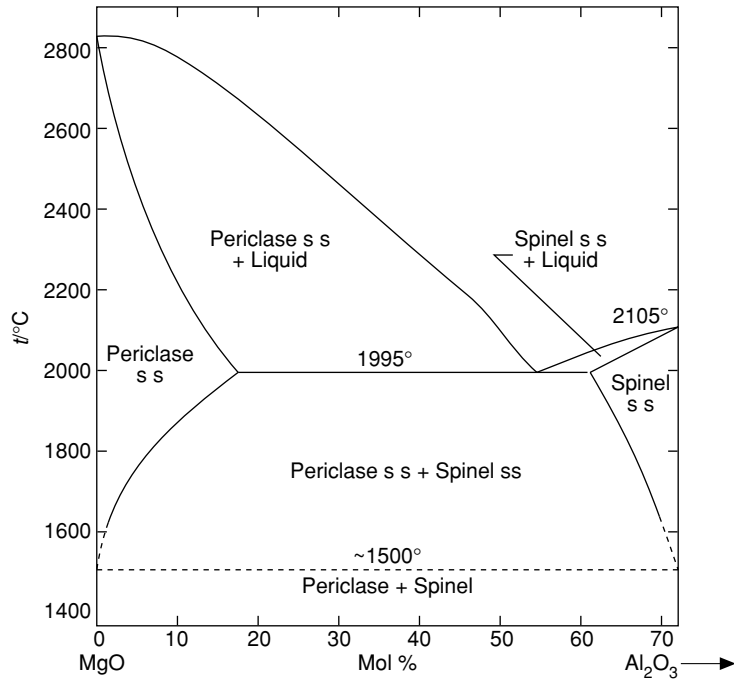


Figure 8. MgO-Al₂O₃ system.

Figure 9

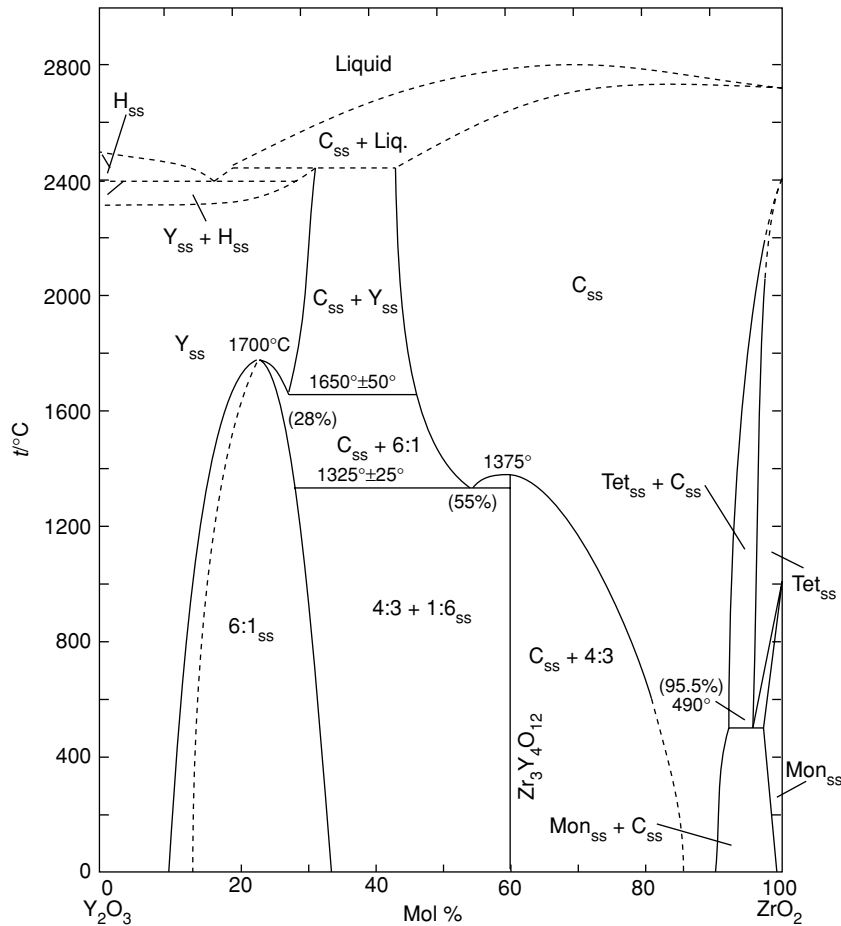


Figure 9. Y₂O₃-ZrO₂ system. C_{ss} = cubic ZrO₂ ss (fluorite-type ss); Y_{ss} = cubic Y₂O₃ ss; Tet_{ss} = tetragonal ZrO₂ ss; Mon_{ss} = monoclinic ZrO₂ ss; H_{ss} = hexagonal Y₂O₃ ss; 3:4 = Zr₃Y₄O₁₂; 1:6 = Zr₆Y₆O₁₁ ss.

PHASE DIAGRAMS (continued)

Figure 10

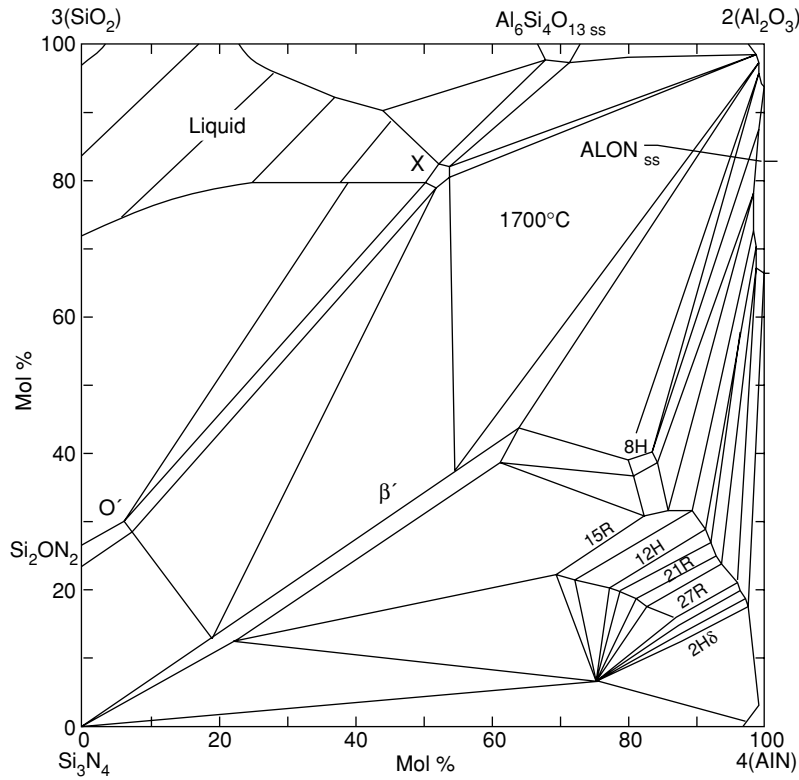


Figure 10. $3(\text{SiO}_2)\text{-Si}_3\text{N}_4\text{-4(AlN)-2(Al}_2\text{O}_3)$ system. "Behavior" diagram at 1700°C . The labels 8H, 15R, 12H, 21R, 27R, 2H^δ indicate defect AlN polytypes. β' = 3-sialon ($\text{Si}_{6-x}\text{Al}_x\text{O}_x\text{N}_{8-x}$); O' = sialon of Si_2ON_2 type; X = SiAlO_2N ("nitrogen mullite"). ALON ss = aluminum oxynitride ss extending from approximately $\text{Al}_7\text{O}_9\text{N}$ to $\text{Al}_3\text{O}_3\text{N}$.

Figure 11

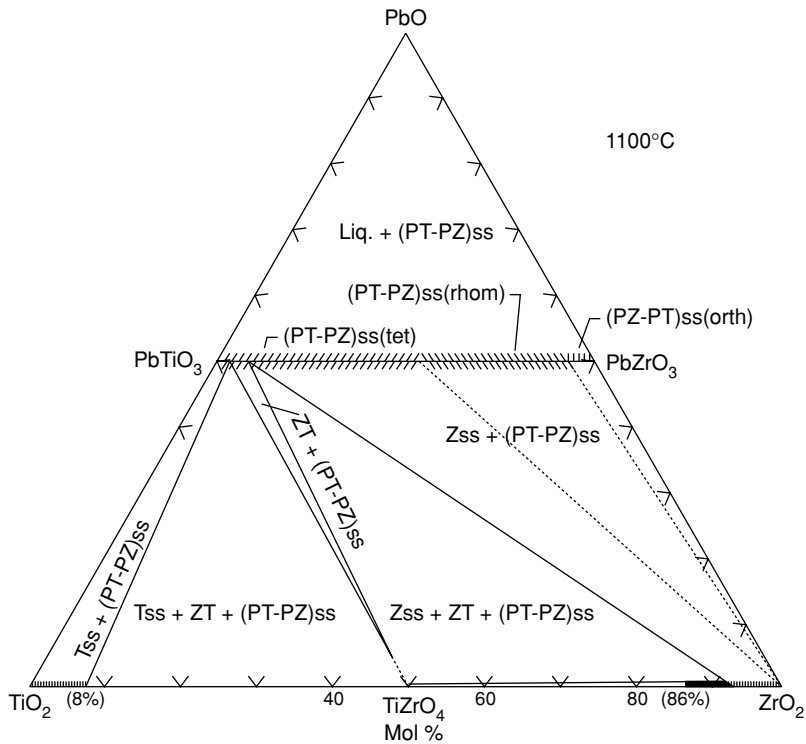


Figure 11. $\text{PbO-ZrO}_2\text{-TiO}_2$ (PZT) system, subsolidus at 1100°C . $P = \text{PbO}$; $T = \text{TiO}_2$; $Z = \text{ZrO}_2$.

PHASE DIAGRAMS (continued)

Figure 12

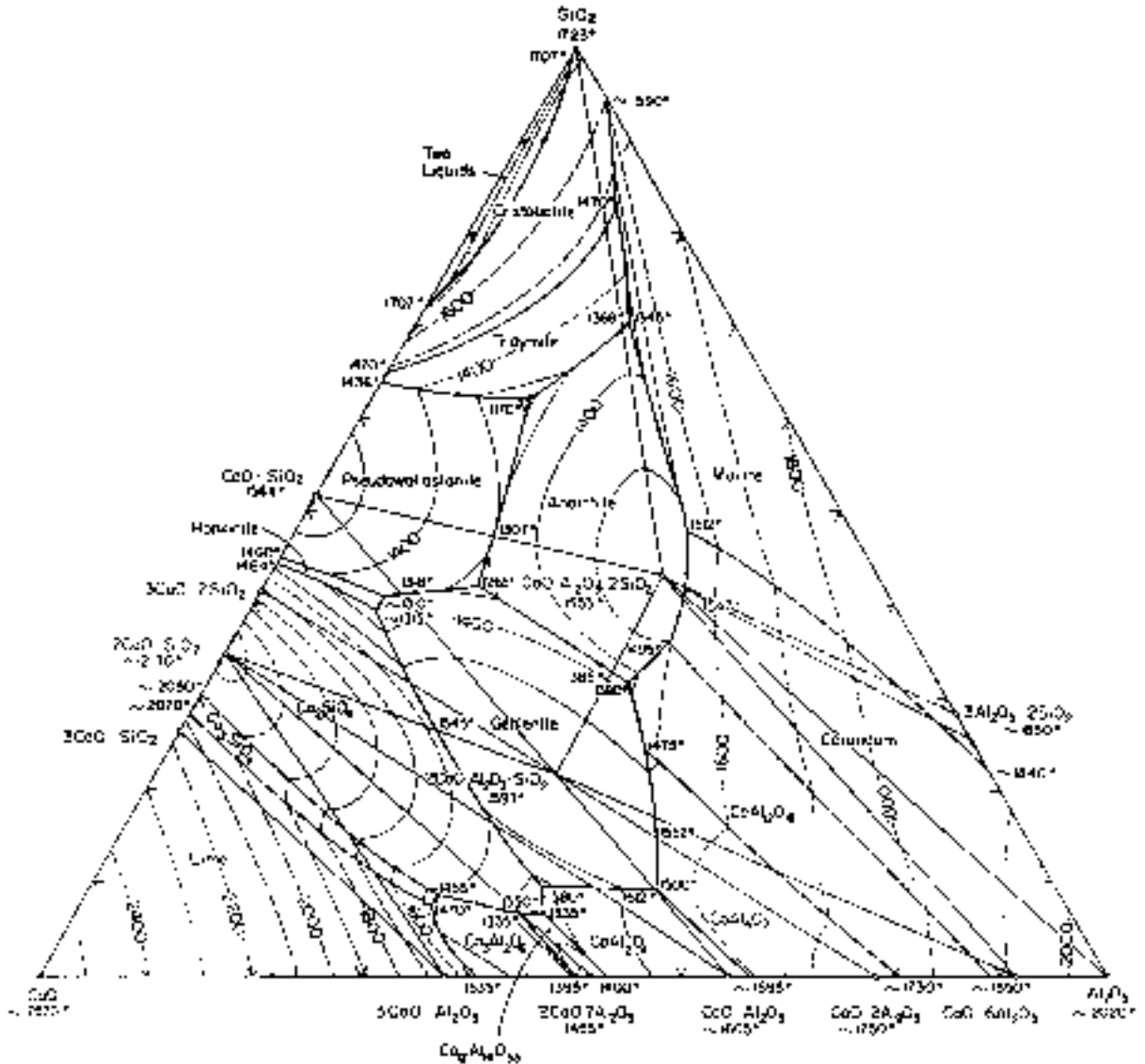


Figure 12. CaO-Al₂O₃-SiO₂ system (temperatures in °C).

Crystalline Phases

Notation	Oxide formula
Cristobalite	SiO ₂
Tridymite	
Pseudowollastonite	CaO-SiO ₂
Rankinite	3CaO-2SiO ₂
Lime	CaO
Corundum	Al ₂ O ₃
Mullite	3Al ₂ O ₃ -2SiO ₂
Anorthite	CaO-Al ₂ O ₃ -2SiO ₂
Gehlenite	2CaO-Al ₂ O ₃ -SiO ₂

Temperatures up to approximately 1550°C are on the Geophysical Laboratory Scale; those above 1550°C are on the 1948 International Scale.

PHASE DIAGRAMS (continued)

Figure 13

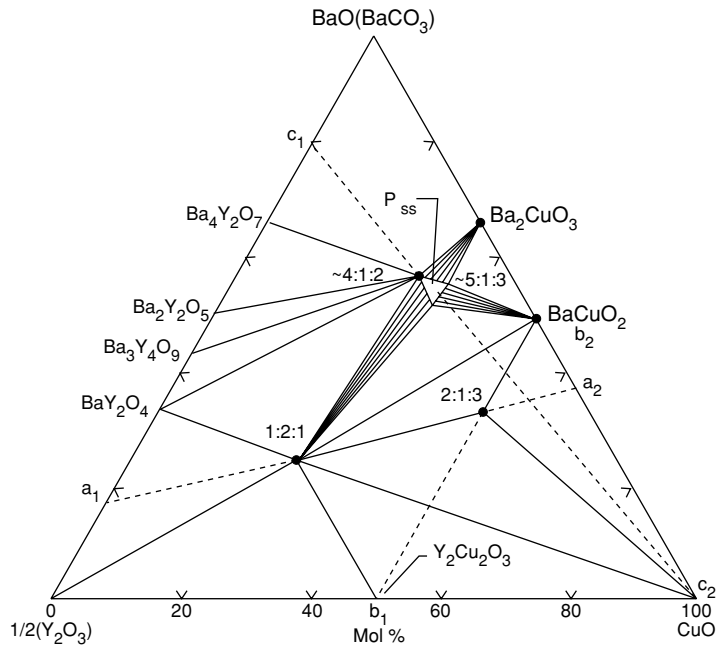


Figure 13. BaO-Y₂O₃-CuO system. 2:1:3 = Ba₂YCu₃O_{7-x}; 1:2:1 = BaY₂CuO₅; 4:1:2 = Ba₄YCu₂O_{7.5+x}; and 5:1:3 = Ba₅YCu₃O_{9.5+x}. The superconducting 2:1:3 phase was prepared using barium peroxide.

Figure 14

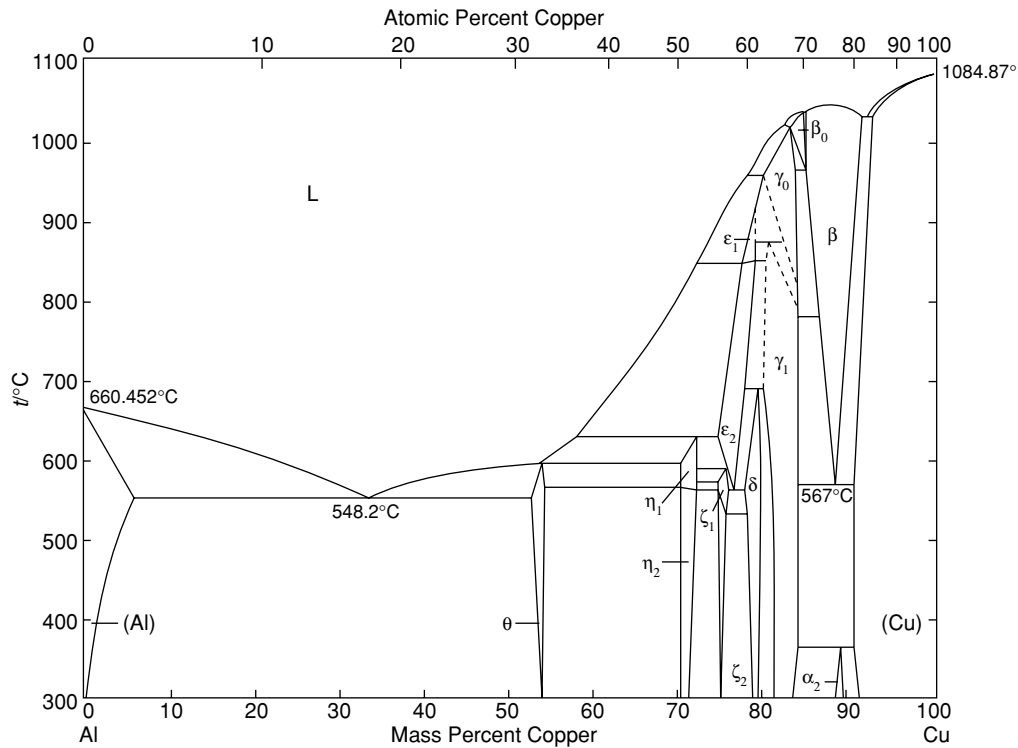


Figure 14. Al-Cu system.

PHASE DIAGRAMS (continued)

Figure 14 (continued)

Phase	Composition, wt % Cu	Pearson symbol	Space group
(Al)	0 to 5.65	<i>cF4</i>	<i>Fm$\bar{3}m$</i>
θ	52.5 to 53.7	<i>tI12</i>	<i>I4/mcm</i>
η_1	70.0 to 72.2	<i>oP16</i> or <i>oC16</i>	<i>Pban</i> or <i>Cmmm</i>
η_2	70.0 to 72.1	<i>mC20</i>	<i>C2/m</i>
ζ_1	74.4 to 77.8	<i>hP42</i>	<i>P6/mmm</i>
ζ_2	74.4 to 75.2	(a)	—
ϵ_1	77.5 to 79.4	(b)	—
ϵ_2	72.2 to 78.7	<i>hP4</i>	<i>P63/mmc</i>
δ	77.4 to 78.3	(c)	<i>R$\bar{3}m$</i>
γ_0	77.8 to 84	(d)	—
γ_1	79.7 to 84	<i>cP52</i>	<i>P$\bar{4}3m$</i>
β_0	83.1 to 84.7	(d)	—
β	85.0 to 91.5	<i>cI2</i>	<i>Im$\bar{3}m$</i>
α_2	88.5 to 89	(e)	—
(Cu)	90.6 to 100	<i>cF4</i>	<i>Fm$\bar{3}m$</i>
Metastable phases			
θ'	—	<i>tP6</i>	—
β'	—	<i>cF16</i>	<i>Fm$\bar{3}m$</i>
Al_3Cu_2	61 to 70	<i>hP5</i>	<i>P$\bar{3}m1$</i>

(a) Monoclinic? (b) Cubic? (c) Rhombohedral. (d) Unknown. (e) $D0_{22}$ -type long-period superlattice.

Figure 15

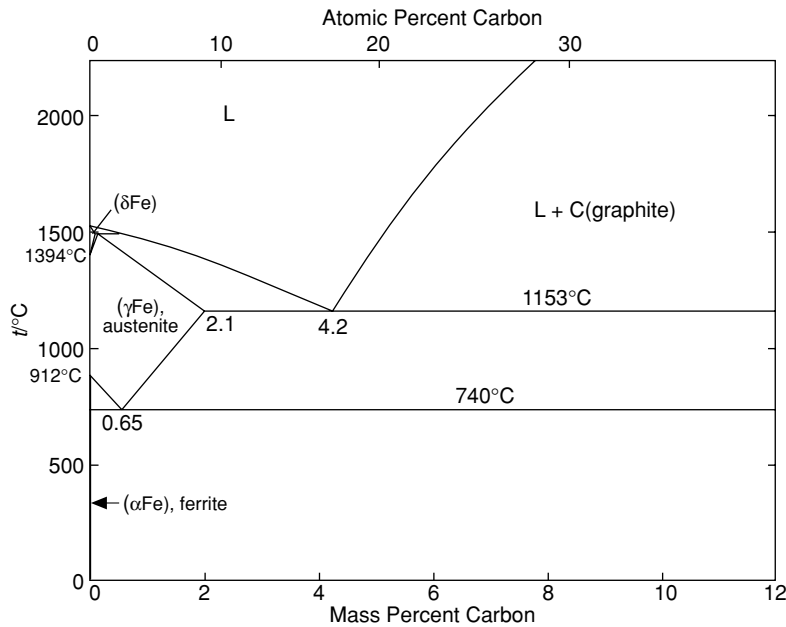


Figure 15. Fe-C system.

Phase	Composition, mass % C	Pearson symbol	Space group
(δFe)	0 to 0.09	<i>cI2</i>	<i>Im$\bar{3}m$</i>
(γFe), austenite	0 to 2.1	<i>cF4</i>	<i>Fm$\bar{3}m$</i>
(αFe), ferrite	0 to 0.021	<i>cI2</i>	<i>Im$\bar{3}m$</i>
(C)	100	<i>hP4</i>	<i>P6₃/mmc</i>
Metastable/high-pressure phases			
(εFe)	0	<i>hP2</i>	<i>P6₃/mmc</i>
Martensite	< 2.1	<i>tI4</i>	<i>I4/mmm</i>

PHASE DIAGRAMS (continued)

Figure 15 (continued)

Phase	Composition, mass % C	Pearson symbol	Space group
Fe ₄ C	5.1	<i>cP</i> 5	$P\bar{4}3m$
Fe ₃ C (θ)	6.7	<i>oP</i> 16	<i>Pnma</i>
Fe ₅ C ₂ (χ)	7.9	<i>mC</i> 28	<i>C2/c</i>
Fe ₇ C ₃	8.4	<i>hP</i> 20	<i>P6₃mc</i>
Fe ₇ C ₃	8.4	<i>oP</i> 40	<i>Pnma</i>
Fe ₂ C (η)	9.7	<i>oP</i> 6	<i>Pnmm</i>
Fe ₂ C (ϵ)	9.7	<i>hP</i> *	<i>P6₃22</i>
Fe ₂ C	9.7	<i>hP</i> *	<i>P3m1</i>
(C)	100	<i>cF</i> 8	$Fd\bar{3}m$

Figure 16

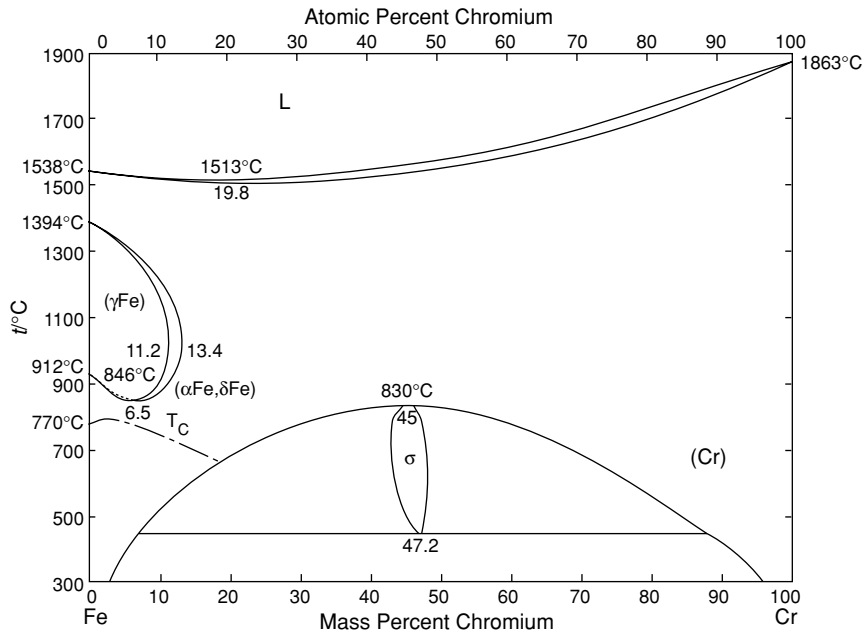


Figure 16. Fe-Cr system.

Phase	Composition, mass % Cr	Pearson symbol	Space group
(aFe, Cr)	0 to 100	<i>cI</i> 2	$Im\bar{3}m$
(γ Fe)	0 to 11.2	<i>cF</i> 4	$Fm\bar{3}m$
σ	42.7 to 48.2	<i>tP</i> 30	$P4_2/mnm$

PHASE DIAGRAMS (continued)

Figure 17

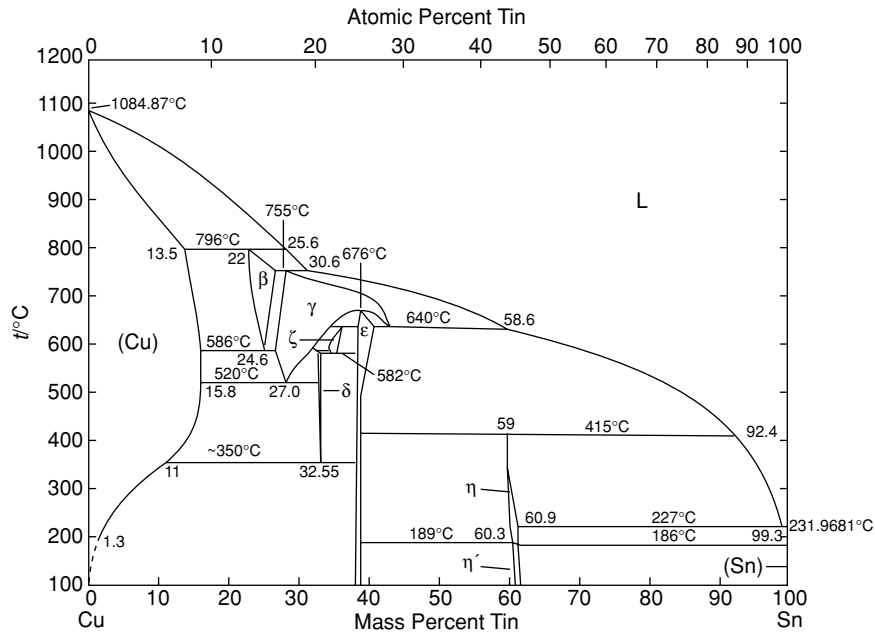


Figure 17. Cu-Sn system.

Phase	Composition, mass % Sn	Pearson symbol	Space group
α	0 to 15.8	<i>cF4</i>	<i>Fm$\bar{3}m$</i>
β	22.0 to 27.0	<i>cI2</i>	<i>Im$\bar{3}m$</i>
γ	25.5 to 41.5	<i>cF16</i>	<i>Fm$\bar{3}m$</i>
δ	32 to 33	<i>cF416</i>	<i>F$\bar{4}3m$</i>
ζ	32.2 to 35.2	<i>hP26</i>	<i>P6$_3$</i>
ϵ	27.7 to 39.5	<i>oC80</i>	<i>Cmcm</i>
η	59.0 to 60.9	<i>hP4</i>	<i>P6$_3/mmc$</i>
η'	44.8 to 60.9	(a)	—
(β Sn)	~100	<i>tI4</i>	<i>I4$_1/amd$</i>
(α Sn)	100	<i>cF8</i>	<i>Fd$\bar{3}m$</i>

(a) Hexagonal; superlattice based on NiAs-type structure.

PHASE DIAGRAMS (continued)

Figure 18

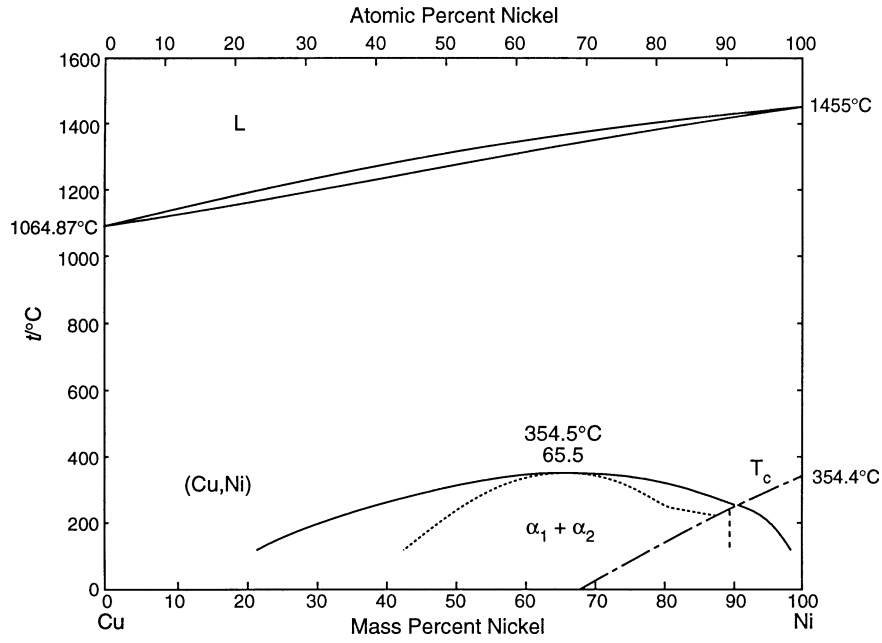


Figure 18. Cu-Ni system.

Phase	Composition, mass % Ni	Pearson symbol	Space group
(Cu, Ni) (above 354.5°C)	0 to 100	<i>cF4</i>	<i>Fm$\bar{3}m$</i>

Figure 19

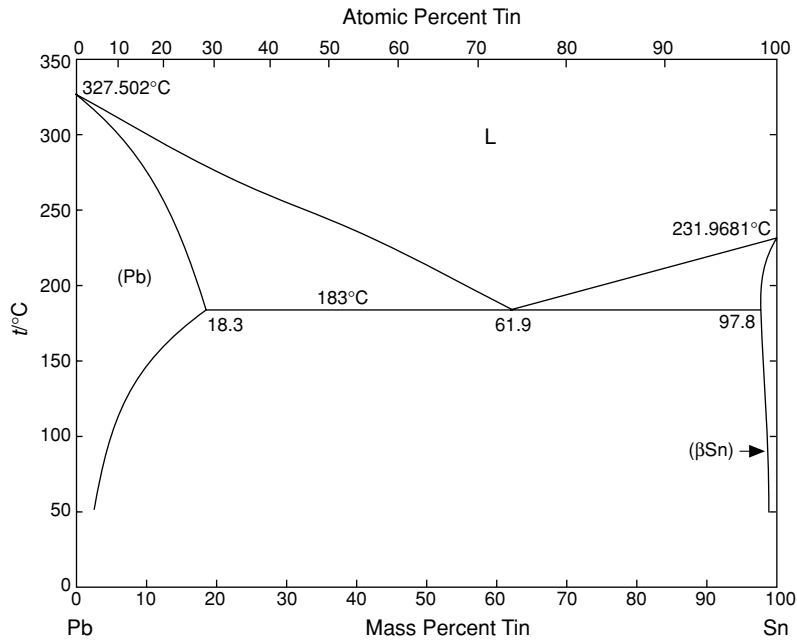


Figure 19. Pb-Sn system.

PHASE DIAGRAMS (continued)

Figure 19 (continued)

Phase	Composition, mass % Sn	Pearson symbol	Space group
(Pb)	0 to 18.3	<i>cF4</i>	<i>Fm$\bar{3}m$</i>
(β Sn)	97.8 to 100	<i>tI4</i>	<i>I4$_1/amd$</i>
(α Sn)	100	<i>cF8</i>	<i>Fd$\bar{3}m$</i>
High-pressure phases			
ϵ (a)	52 to 74	<i>hP1</i>	<i>P6/mmm</i>
ϵ' (b)	52	<i>hP2</i>	<i>P6$_3/mmc$</i>

(a) From phase diagram calculated at 2500 MPa. (b) This phase was claimed for alloys at 350°C and 5500 MPa.

Figure 20

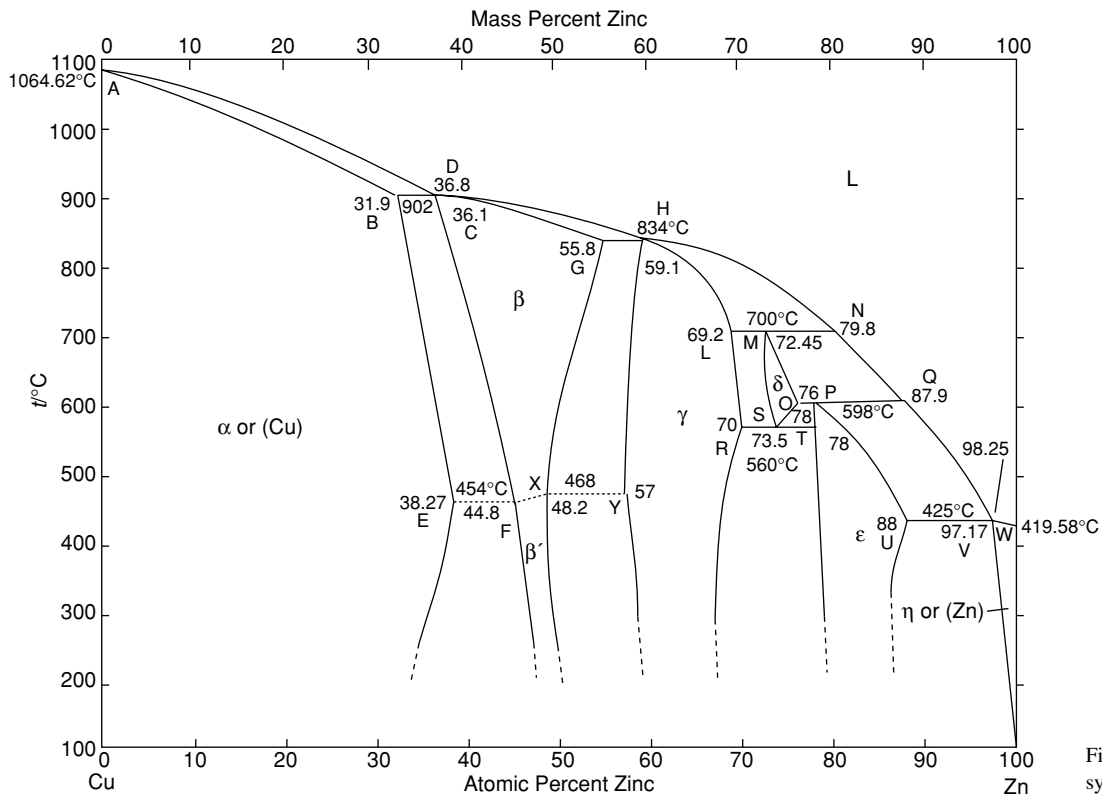


Figure 20. Cu-Zn system.

Phase	Composition, mass % Zn	Pearson symbol	Space group
α or (Cu)	0 to 38.95	<i>cF4</i>	<i>Fm$\bar{3}m$</i>
β	36.8 to 56.5	<i>cI2</i>	<i>Im$\bar{3}m$</i>
β'	45.5 to 50.7	<i>cP2</i>	<i>Pm$\bar{3}m$</i>
γ	57.7 to 70.6	<i>cI52</i>	<i>I$\bar{4}3m$</i>
δ	73.02 to 76.5	<i>hP3</i>	<i>P$\bar{6}$</i>
ϵ	78.5 to 88.3	<i>hP2</i>	<i>P6$_3/mmc$</i>
η or (Zn)	97.25 to 100	<i>hP2</i>	<i>P6$_3/mmc$</i>

PHASE DIAGRAMS (continued)

Figure 21

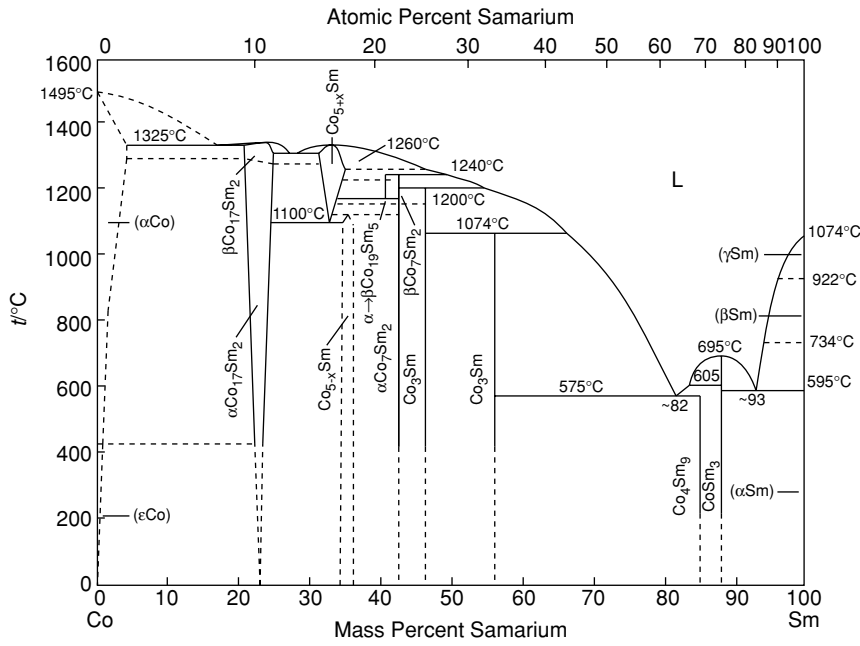


Figure 21. Co-Sm system.

Phase	Composition, mass % Sm	Pearson symbol	Space group
(α Co)	0 to ~3.7	<i>cF4</i>	$Fm\bar{3}m$
(ϵ Co)	~0	<i>hP2</i>	$P6_3/mmc$
β Co ₁₇ Sm ₂	~23.0	<i>hP38</i>	$P6_3/mmc$
α Co ₁₇ Sm ₂	~23.0	<i>hR19</i>	$R\bar{3}m$
		<i>hP8</i>	$P6/mmm$
Co _{5+x} Sm	~33 to 34	—	—
Co _{5-x} Sm	~34 to 35	—	—
Co ₁₉ Sm ₅	~40.1	<i>hR24</i>	$R\bar{3}m$
		<i>hP48</i>	$P6_3/mmc$
α Co ₇ Sm ₂	~42.1	<i>hR18</i>	$R\bar{3}m$
β Co ₇ Sm ₂	~42.1	<i>hP36</i>	$P6_3/mmc$
Co ₃ Sm	46	<i>hR12</i>	$R\bar{3}m$
Co ₂ Sm	56.0	<i>hR4</i>	$R\bar{3}m$
		<i>cF24</i>	$Fd\bar{3}m$
Co ₄ Sm ₉	~85.1	<i>o**</i>	—
CoSm ₃	88	<i>oP16</i>	$Pnma$
(γ Sm)	~100	<i>cI2</i>	$Im\bar{3}m$
(β Sm)	~100	<i>hP2</i>	$P6_3/mmc$
(α Sm)	~100	<i>hR3</i>	$R\bar{3}m$
Other reported phases			
Co ₅ Sm	~33.8	<i>hP6</i>	$P6/mmm$
Co ₂ Sm ₅	~86.4	<i>mC28</i>	$C2/c$

PHASE DIAGRAMS (continued)

Figure 22

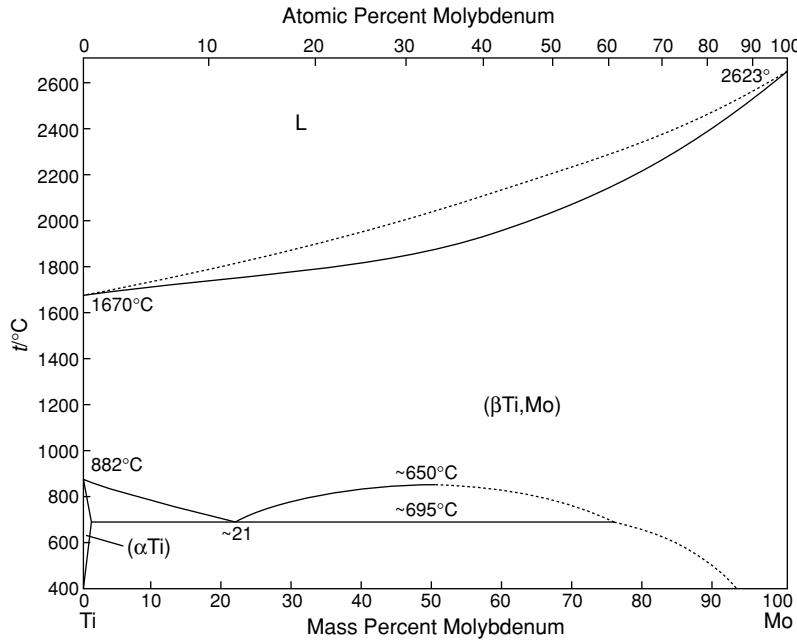
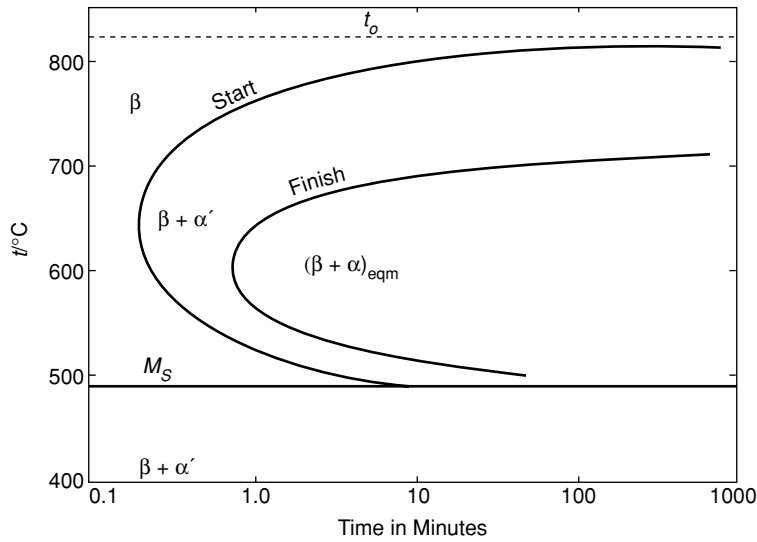


Figure 22. Ti-Mo system.

Phase	Composition, mass % Mo	Pearson symbol	Space group
(βTi, Mo)	0 to 100	<i>cI2</i>	<i>Im$\bar{3}m$</i>
(αTi)	0 to 0.8	<i>hP2</i>	<i>P6$_3$/mmc</i>
α'	(a)	<i>hP2</i>	<i>P6$_3$/mmc</i>
α''	(a)	<i>oC4</i>	<i>Cmcm</i>
ω	(a)	<i>hP3</i>	<i>P6/mmm</i>

(a) Metastable.



Experimental time-temperature-transformation (TTT) diagram for Ti-Mo. The start and finish times of the isothermal precipitation reaction vary with temperature as a result of the temperature dependence of the nucleation and growth processes. Precipitation is complete, at any temperature, when the equilibrium fraction of α is established in accordance with the lever rule. The solid horizontal line represents the athermal (or nonthermally activated) martensitic transformation that occurs when the β phase is quenched.

PHASE DIAGRAMS (continued)

Figure 23

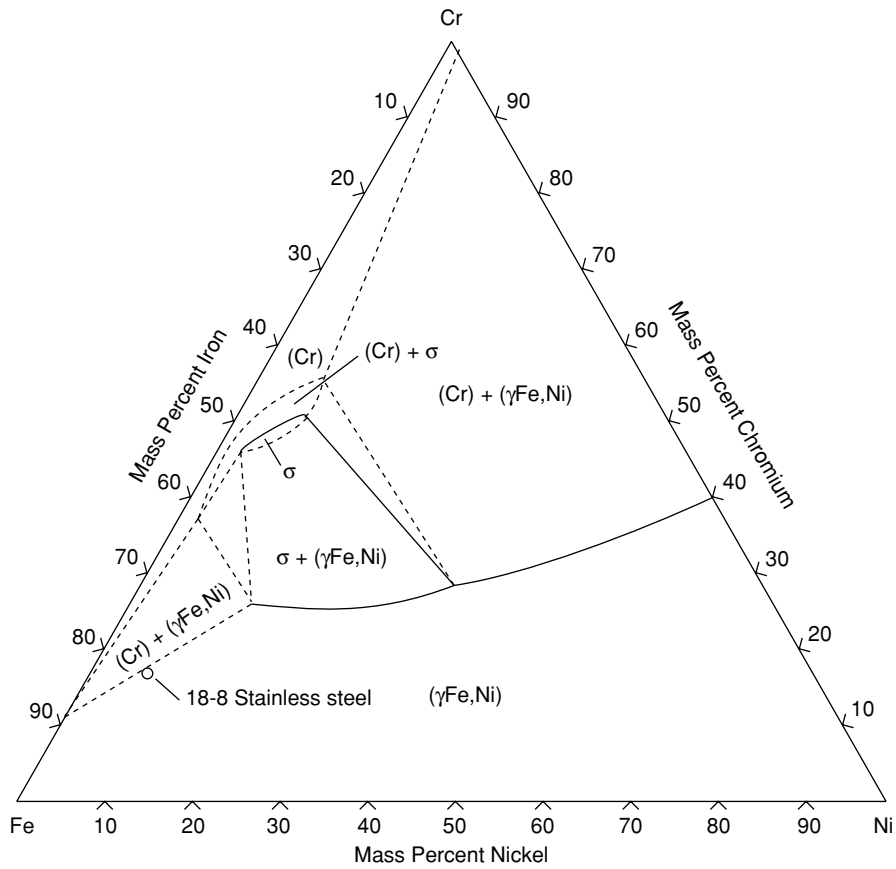


Figure 23. The isothermal section at 900°C (1652°F) of the iron-chromium-nickel ternary phase diagram, showing the nominal composition of 18-8 stainless steel.

HEAT CAPACITY OF SELECTED SOLIDS

This table gives the molar heat capacity at constant pressure of representative metals, semiconductors, and other crystalline solids as a function of temperature in the range 200 to 600 K.

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3. DIPPR Database of Pure Compound Properties, Design Institute for Physical Properties Data, American Institute of Chemical Engineers, New York, 1987.

Name	C_p in J/mol K						
	200 K	250 K	300 K	350 K	400 K	500 K	600 K
Aluminum	21.33	23.08	24.25	25.11	25.78	26.84	27.89
Aluminum oxide	51.12	67.05	79.45	88.91	96.14	106.17	112.55
Anthracene	138.6	173.9	210.7	248.8	288.4		
Benzoic acid	102.7	123.5	147.4	172.0			
Beryllium	9.98	13.58	16.46	18.53	19.95	21.94	23.34
Biphenyl	131.0	162.5	197.2				
Boron	5.99	8.82	11.40	13.65	15.69	18.72	20.78
Calcium	24.54	25.41	25.94	26.32	26.87	28.49	30.38
Calcium carbonate	66.50	75.66	83.82	91.51	96.97	104.52	109.86
Calcium oxide	33.64	38.59	42.18	45.07	46.98	49.33	50.72
Cesium chloride	50.13	51.34	52.48	53.58	54.68	56.90	59.10
Chromium	19.86	22.30	23.47	24.39	25.23	26.63	27.72
Cobalt	22.23	23.98	24.83	25.68	26.53	28.20	29.66
Copper	22.63	23.77	24.48	24.95	25.33	25.91	26.48
Copper oxide	34.80		42.41	44.95	46.78	49.19	50.83
Copper sulfate	77.01	89.25	99.25	107.65	114.93	127.19	136.31
Germanium			23.25	23.85	24.31	24.96	25.45
Gold			25.41	25.37	25.51	26.06	26.65
Graphite	5.01	6.82	8.58	10.24	11.81	14.62	16.84
Hexachlorobenzene	162.7	183.6	202.4				
Iodine	51.57	53.24	54.51	58.60			
Iron	21.59	23.74	25.15	26.28	27.39	29.70	32.05
Lead	25.87	26.36	26.85	27.30	27.72	28.55	29.40
Lithium	21.57	23.42	24.64	25.96	27.60	29.28	
Lithium chloride	43.35	46.08	48.10	49.66	50.97	53.34	55.59
Magnesium	22.72	24.02	24.90	25.57	26.14	27.17	28.18
Magnesium oxide			37.38	40.59	42.77	45.56	47.30
Manganese	23.05	24.95	26.35	27.52	28.53	30.29	31.90
Naphthalene	105.8	134.1	167.8	204.1			
Potassium	27.00	28.01	29.60				
Potassium chloride	48.44	50.10	51.37	52.31	53.08	54.71	56.35
Silicon	15.64	18.22	20.04	21.28	22.14	23.33	24.15
Silicon dioxide	32.64	39.21	44.77	49.47	53.43	59.64	64.42
Silver			25.36	25.55	25.79	26.36	26.99
Sodium	22.45	27.01	28.20	30.14			
Sodium chloride	46.89	48.85	50.21	51.25	52.14	53.96	55.81
Tantalum	24.08	24.86	25.31	25.60	25.84	26.35	26.84
Titanium	22.37	24.07	25.28	26.17	26.86	27.88	28.60
Tungsten	22.49	23.69	24.30	24.65	24.92	25.36	25.79
Vanadium	21.88	23.70	24.93	25.68	26.23	26.94	27.49
Zinc	24.05	25.02	25.45	25.88	26.35	27.39	28.59
Zirconium	23.87	24.69	25.22	25.61	25.93	26.56	27.28

THERMAL AND PHYSICAL PROPERTIES OF PURE METALS

This table gives the following properties for the metallic elements:

t_m :	Melting point in °C
t_b :	Normal boiling point in °C, at a pressure of 101.325 kPa (760 Torr)
$\Delta_{\text{fus}}H$:	Enthalpy of fusion at the melting point in J/g
ρ_{25} :	Density at 25°C in g/cm ³
α :	Coefficient of linear expansion at 25°C in K ⁻¹ (the quantity listed is $10^6 \times \alpha$)
c_p :	Specific heat capacity at constant pressure at 25°C in J/g K
λ :	Thermal conductivity at 27°C in W/cm K

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9. Hellwege, K. H., Ed., *Landolt Börnstein, Numerical Values and Functions in Physics, Chemistry, Astronomy, Geophysics, and Technology*, Vol. 2, Part 1, Mechanical-Thermal Properties of State, 1971 (density).
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Metal (symbol)	Atomic weight	t_m °C	t_b °C	$\Delta_{\text{fus}}H$ J/g	ρ_{25} g/cm ³	$\alpha \times 10^6$ K ⁻¹	c_p J/g K	λ W/cm K
Actinium (Ac)		1051	3198		10		0.12	
Aluminum (Al)	26.98	660.32	2519	399.9	2.70	23.1	0.904	2.37
Antimony (Sb)	121.76	630.63	1587	162.5	6.68	11.0	0.207	0.243
Barium (Ba)	137.33	727	1897	51.8	3.62	20.6	0.205	0.184
Beryllium (Be)	9.01	1287	2471	876.0	1.85	11.3	1.82	2.00
Bismuth (Bi)	208.98	271.40	1564	53.3	9.79	13.4	0.122	0.0787
Cadmium (Cd)	112.41	321.07	767	55.2	8.69	30.8	0.231	0.968
Calcium (Ca)	40.08	842	1484	213.1	1.54	22.3	0.646	2.00
Cerium (Ce)	140.11	798	3443	39.0	6.77	6.3	0.192	0.113
Cesium (Cs)	132.91	28.44	671	15.7	1.93	97	0.242	0.359
Chromium (Cr)	52.00	1907	2671	404	7.15	4.9	0.450	0.937
Cobalt (Co)	58.93	1495	2927	272.5	8.86	13.0	0.421	1.00
Copper (Cu)	63.55	1084.62	2562	203.5	8.96	16.5	0.384	4.01
Dysprosium (Dy)	162.50	1412	2567	68.1	8.55	9.9	0.170	0.107
Erbium (Er)	167.26	1529	2868	119	9.07	12.2	0.168	0.145
Europium (Eu)	151.96	822	1529	60.6	5.24	35.0	0.182	0.139 ^a
Gadolinium (Gd)	157.25	1313	3273	63.6	7.90	9.4 ^b	0.235	0.105
Gallium (Ga)	69.72	29.76	2204	80.0	5.91	18	0.374	0.406
Gold (Au)	196.97	1064.18	2856	64.6	19.3	14.2	0.129	3.17
Hafnium (Hf)	178.49	2233	4603	152.4	13.3	5.9	0.144	0.230
Holmium (Ho)	164.93	1474	2700	103 ^a	8.80	11.2	0.165	0.162
Indium (In)	114.82	156.60	2072	28.6	7.31	32.1	0.233	0.816
Iridium (Ir)	192.22	2446	4428	213.9	22.5	6.4	0.131	1.47
Iron (Fe)	55.85	1538	2861	247.3	7.87	11.8	0.449	0.802
Lanthanum (La)	138.91	918	3464	44.6	6.15	12.1	0.195	0.134
Lead (Pb)	207.20	327.46	1749	23.1	11.3	28.9	0.127	0.353
Lithium (Li)	6.94	180.5	1342	432	0.534	46	3.57	0.847
Lutetium (Lu)	174.97	1663	3402	126 ^a	9.84	9.9	0.154	0.164
Magnesium (Mg)	24.30	650	1090	348.9	1.74	24.8	1.024	1.56

THERMAL AND PHYSICAL PROPERTIES OF PURE METALS (continued)

Metal (symbol)	Atomic weight	t_m °C	t_b °C	$\Delta_{fus} H$ J/g	ρ_{25} g/cm³	$\alpha \times 10^6$ K⁻¹	c_p J/g K	λ W/cm K
Manganese (Mn)	54.94	1246	2061	235.0	7.3	21.7	0.479	0.0782
Mercury (Hg)	200.59	-38.83	356.73	11.4	13.5336	60.4	0.139	0.0834
Molybdenum (Mo)	95.94	2623	4639	390.7	10.2	4.8	0.251	1.38
Neodymium (Nd)	144.24	1021	3074	49.5	7.01	9.6	0.191	0.165
Neptunium (Np)		644		13.5	20.2			0.063
Nickel (Ni)	58.69	1455	2913	290.3	8.90	13.4	0.445	0.907
Niobium (Nb)	92.91	2477	4744	323	8.57	7.3	0.265	0.537
Osmium (Os)	190.23	3033	5012	304.1	22.59	5.1	0.130	0.876
Palladium (Pd)	106.42	1554.9	2963	157.3	12.0	11.8	0.244	0.718
Platinum (Pt)	195.08	1768.4	3825	113.6	21.5	8.8	0.133	0.716
Plutonium (Pu)		640	3228	11.6	19.7	46.7		0.0674
Polonium (Po)		254	962		9.20	23.5		0.20
Potassium (K)	39.10	63.38	759	59.6	0.89	83.3	0.757	1.024
Praseodymium (Pr)	140.91	931	3520	48.9	6.77	6.7	0.193	0.125
Promethium (Pm)		1042	3000 ^a		7.26	11 ^a	0.19 ^a	0.15 ^a
Protactinium (Pa)	231.04	1572		53.4	15.4			
Radium (Ra)		700			5			
Rhenium (Re)	186.21	3186	5596	324.5	20.8	6.2	0.137	0.479
Rhodium (Rh)	102.91	1964	3695	258.4	12.4	8.2	0.243	1.50
Rubidium (Rb)	85.47	39.30	688	25.6	1.53		0.364	0.582
Ruthenium (Ru)	101.07	2334	4150	381.8	12.1	6.4	0.238	1.17
Samarium (Sm)	150.36	1074	1794	57.3	7.52	12.7	0.196	0.133
Scandium (Sc)	44.96	1541	2836	314	2.99	10.2	0.567	0.158
Silver (Ag)	107.87	961.78	2162	104.6	10.5	18.9	0.235	4.29
Sodium (Na)	22.99	97.72	883	113.1	0.97	71	1.225	1.41
Strontium (Sr)	87.62	777	1382	84.8	2.64	22.5	0.306	0.353
Tantalum (Ta)	180.95	3017	5458	202.1	16.4	6.3	0.140	0.575
Technetium (Tc)		2157	4265	339.7	11			0.506
Terbium (Tb)	158.93	1356	3230	67.9	8.23	10.3	0.182	0.111
Thallium (Tl)	204.38	304	1473	20.3	11.8	29.9	0.129	0.461
Thorium (Th)	232.04	1750	4788	59.5	11.7	11.0	0.118	0.540
Thulium (Tm)	168.93	1545	1950	99.7	9.32	13.3	0.160	0.169
Tin (Sn)	118.71	231.93	2602	60.4	7.26	22.0	0.227	0.666
Titanium (Ti)	47.88	1668	3287	295.6	4.51	8.6	0.522	0.219
Tungsten (W)	183.84	3422	5555	284.5	19.3	4.5	0.132	1.74
Uranium (U)	238.03	1135	4131	38.4	19.1	13.9	0.116	0.276
Vanadium (V)	50.94	1910	3407	422	6.0	8.4	0.489	0.307
Ytterbium (Yb)	173.04	819	1196	44.3	6.90	26.3	0.154	0.385
Yttrium (Y)	88.91	1522	3345	128	4.47	10.6	0.298	0.172
Zinc (Zn)	65.39	419.53	907	108.1	7.14	30.2	0.388	1.16
Zirconium (Zr)	91.22	1855	4409	230.2	6.52	5.7	0.278	0.227

^a Estimated.

^b At 100°C.

THERMAL CONDUCTIVITY OF METALS AND SEMICONDUCTORS AS A FUNCTION OF TEMPERATURE

This table gives the temperature dependence of the thermal conductivity of several metals and of carbon, germanium, and silicon. For graphite, separate entries are given for the thermal conductivity parallel (\parallel) and perpendicular (\perp) to the layer planes. The thermal conductivity of all these materials is very sensitive to impurities at low temperatures, especially below 100 K. Therefore, the values given here should be regarded as typical values for a highly purified specimen; the thermal conductivity of different specimens can vary by more than an order of magnitude in the low-temperature range. See Reference 2 for details.

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Thermal Conductivity in W/cm K

T/K	Carbon (C)									
	Ag	Al	Au	Diamond (type)			Pyrolytic graphite		Cr	Cu
				I	IIa	IIb	\parallel	\perp		
1	39.4	41.1	5.46						0.402*	42.2
2	78.3	81.8	10.9	0.0138*	0.033*	0.0200*			0.803	84.0
3	115	121	16.1	0.0461	0.111	0.0676			1.20	125
4	147	157	20.9	0.108	0.261	0.160			1.60	162
5	172	188	25.2	0.206	0.494	0.307			2.00	195
6	187	213	28.5	0.344	0.820	0.510			2.39	222
7	193	229	30.9	0.523	1.24	0.778			2.27	239
8	190	237	32.3	0.762	1.77	1.12			3.14	248
9	181	239	32.7	1.05	2.41	1.53			3.50	249
10	168	235	32.4	1.40	3.17	2.03	0.811	0.0116	3.85	243
15	96.0	176	24.6	3.96	8.65	5.66			5.24	171
20	51.0	117	15.8	7.87	16.8	11.2	4.20	0.0397	5.93	108
30	19.3	49.5	7.55	18.8	38.9	26.5	9.86	0.0786	5.49	44.5
40	10.5	24.0	5.15	29.4	65.9	44.0	16.4	0.120	4.25	21.7
50	7.0	13.5	4.21	35.3	92.1	59.1	23.1	0.152	3.17	12.5
60	5.5	8.5	3.74	37.4	112	67.5	29.8	0.173	2.48	8.29
70	4.97	5.85	3.48	36.9	119	69.1	36.6	0.181	2.07	6.47
80	4.71	4.32	3.32	35.1	117	65.7	42.8	0.181	1.84	5.57
90	4.60	3.42	3.28	32.7	109	60.0	47.5	0.176	1.69	5.08
100	4.50	3.02	3.27	30.0	100	54.2	49.7	0.168	1.59	4.82
150	4.32	2.48	3.25	19.5	60.2	32.5	45.1	0.125	1.29	4.29
200	4.30	2.37	3.23	14.1	40.3	22.6	32.3	0.0923	1.11	4.13
250	4.29	2.35	3.21	11.0	29.7	17.0	24.4	0.0711	1.00	4.06
300	4.29	2.37	3.17	8.95	23.0	13.5	19.5	0.0570	0.937	4.01
350	4.27	2.40	3.14	7.55*	18.5*	11.1*	16.2	0.0477	0.929	3.96
400	4.25	2.40	3.11	6.5*	15.4*	9.32*	13.9	0.0409	0.909	3.93
500	4.19	2.36	3.04				10.8	0.0322	0.860	3.86
600	4.12	2.31	2.98				8.92	0.0268	0.807	3.79
800	3.96	2.18	2.84				6.67	0.0201	0.713	3.66
1000	3.79		2.70				5.34	0.0160	0.654	3.52
1200	3.61*		2.55				4.48	0.0134	0.619	3.39
1400							3.84	0.0116	0.588	
1600							3.33	0.0100	0.556	
1800							2.93	0.00895	0.526*	
2000							2.62	0.00807	0.494*	

**THERMAL CONDUCTIVITY OF METALS AND SEMICONDUCTORS AS A
FUNCTION OF TEMPERATURE (continued)**

T/K	Fe	Ge ^a	Mg	Ni	Pb	Pt	Si ^a	Sn	Ti	W
1	1.71	0.274	9.86	2.17	27.9	2.31	0.0693*	183	0.0144*	14.4
2	3.42	2.06	19.6	4.34	44.6	4.60	0.454	323	0.0288*	28.7
3	5.11	5.35	29.0	6.49	35.8	6.79	1.38	297	0.0432	42.8
4	6.77	8.77	37.6	8.59	22.2	8.8	2.97	181	0.0575	56.3
5	8.39	11.6	45.0	10.6	13.8	10.5	5.27	117	0.0719	68.7
6	9.93	13.9	50.8	12.5	8.10	11.8	8.23	76	0.0863	79.5
7	11.4	15.5	54.7	14.2	4.86	12.6	11.7	52	0.101	88.0
8	12.7	16.6	56.7	15.8	3.20	12.9	15.5	36	0.115	93.8
9	13.9	17.3	57.0	17.1	2.30	12.8	19.5	26	0.129	96.8
10	14.8	17.7	55.8	18.1	1.78	12.3	23.3	19.3	0.143	97.1
15	17.0	17.3	41.1	19.5	0.845	8.41	41.6	6.3	0.212	72.0
20	15.4	14.9	27.2	16.5	0.591	4.95	49.8	3.2	0.275	40.5
30	10.0	10.8	12.9	9.56	0.477	2.15	48.1	1.79	0.365	14.4
40	6.23	7.98	7.19	5.82	0.451	1.39	35.3	1.33	0.390	6.92
50	4.05	6.15	4.65	4.00	0.436	1.09	26.8	1.15	0.374	4.27
60	2.85	4.87	3.27	3.08	0.425	0.947	21.1	1.04	0.355	3.14
70	2.16	3.93	2.49	2.50	0.416	0.862	16.8	0.96	0.340	2.58
80	1.75	3.25	2.02	2.10	0.409	0.815	13.4	0.915	0.326	2.29
90	1.50	2.70	1.78	1.83	0.403	0.789	10.8	0.880	0.315	2.17
100	1.34	2.32	1.69	1.64	0.397	0.775	8.84	0.853	0.305	2.08
150	1.04	1.32	1.61	1.22	0.379	0.740	4.09	0.779	0.270	1.92
200	0.94	0.968	1.59	1.07	0.367	0.726	2.64	0.733	0.245	1.85
250	0.865	0.749	1.57	0.975	0.360	0.718	1.91	0.696	0.229	1.80
300	0.802	0.599	1.56	0.907	0.353	0.716	1.48	0.666	0.219	1.74
350	0.744	0.495	1.55	0.850	0.347	0.717	1.19	0.642	0.210	1.67
400	0.695	0.432	1.53	0.802	0.340	0.718	0.989	0.622	0.204	1.59
500	0.613	0.338	1.51	0.722	0.328	0.723	0.762	0.596	0.197	1.46
600	0.547	0.273	1.49	0.656	0.314	0.732	0.619		0.194	1.37
800	0.433	0.198	1.46*	0.676		0.756	0.422		0.197	1.25
1000	0.323	0.174		0.718		0.787	0.312		0.207	1.18
1200	0.283	0.174		0.762		0.826	0.257		0.220	1.12
1400	0.312			0.804		0.871	0.235		0.236	1.08
1600	0.330					0.919	0.221		0.253	1.04
1800	0.345*					0.961			0.270*	1.01
2000						0.994*				0.98

^a Values below 300 K are typical values.

* Extrapolated.

THERMAL CONDUCTIVITY OF ALLOYS AS A FUNCTION OF TEMPERATURE

This table lists the thermal conductivity of selected alloys at various temperatures. The indicated compositions refer to weight percent. Since the thermal conductivity is sensitive to exact composition and processing history, especially at low temperatures, these values should be considered approximate.

REFERENCES

1. Powell, R. L., and Childs, G. E., in *American Institute of Physics Handbook, 3rd Edition*, Gray, D. E., Ed., McGraw-Hill, New York, 1972.
2. Ho, C. Y., et al., *J. Phys. Chem. Ref. Data*, 7, 959, 1978.

Thermal conductivity in W/m K

Alloy	4 K	20 K	77 K	194 K	273 K	373 K	573 K	973 K
Aluminum:	1100	50	240	270	220	220		
	2024	3.2	17	56	95	130		
	3003	11	58	140	150	160		
	5052	4.8	25	77	120	140		
	5083, 5086	3	17	55	95	120		
	Duralumin	5.5	30	91	140	160	180	
Bismuth:	Rose metal		5.5	8.3	14	16		
	Wood's metal	4	17	23				
Copper:	electrolytic tough pitch	330	1300	550	400	390	380	350
	free cutting, leaded	200	800	460	380	380		
	phosphorus, deoxidized	7.5	42	120	190	220		
	brass, leaded	2.3	12	39	70	120		
	bronze, 68% Cu; 32% Zn	2.3	16	48	92	110		
	beryllium	2	17	36	70	90	113	172
	german silver	0.75	7.5	17	20	23	25	30
	silicon bronze A		3.4	11	23	30		
	manganin	0.48	3.2	14	17	22		
	constantan	0.9	8.6	17	19	22		
Ferrous:	commercial pure iron	15	72	106	82	76	66	54
	plain carbon steel(AISI 1020)	13	20	58	65	65		
	plain carbon steel(AISI 1095)		8.5	31	41	45		
	3% Ni; 0.7% Cr; 0.6% Mo		6	22		33	35	36
	4% Si					20	24	28
	stainless steel	0.3	2	8	13	14	16	19
Gold:	27% Ni; 15% Cr		1.7	55	11	12	16	21
	colbalt thermocouple	1.2	8.6	20				
	65% Au; 35% Ag		12	24		61	89	
Indium:	85.5% In; 14.5% Pb	1.9	7.8	24	41			
Lead:	60% Pb; 40% Sn (soft solder)		28	44				
	64.35% Pb; 35.65% In	0.8	3.26	9.1		20.2		
Nickel:	80% Ni; 20% Cr					12	14	17
	contracid	0.2	2	7.3	9.5	13		
	inconel	0.5	4.2	12.5	13	15	16	19
	monel	0.9	7.1	15	20	21	24	30
Platinum:	90% Pt; 10% Ir					31	31.4	
	90% Pt; 10% Rh					30.1	30.5	
Silver:	silver solder		12	34	58			
	normal Ag thermocouple	48	230	310				
Tin:	60% Sn; 40% Pb	16	55	51				
Titanium:	5.5% Al; 2.5% Sn; 0.2% Fe		1.8	4.3	6.4	7.8	8.4	10.8
	4.7% Mn; 3.99% Al; 0.14% C		1.7	4.5	6.5	8.5		

THERMAL CONDUCTIVITY OF CRYSTALLINE DIELECTRICS

This table lists the thermal conductivity of a number of crystalline dielectrics, including some which find use as optical materials. Values are given at temperatures for which data are available.

REFERENCE

Powell, R. L., and Childs, G. E., in *American Institute of Physics Handbook, 3rd Edition*, Gray, D. E., Ed., McGraw-Hill, New York, 1972.

Material	T/K	Ther. cond. W/m K	Material	T/K	Ther. cond. W/m K
AgCl	223	1.3	BeO	4.2	0.3
	273	1.2		20	16
	323	1.1		77	270
	373	1.1		373	210
Al,B silicate (tourmaline) || to c axis	398	2.9	573	120	
	540	3.2	1273	29	
	723	3.5	Bi ₂ Te ₃	80	6.4
Al,Be silicate (beryl)	315	6.4		204	2.8
	Al,F silicate (topaz) to c axis	315		17.7	303
		358	15.6	370	4.6
Al,Fe silicate (garnet)	417	13.3	C (diamond) type I	4.2	13
	315	35.8		20	800
	358	35.4		77	3550
377	35.6	194		1450	
Al ₂ O ₃ (sapphire): 36° to c axis	4.2	110	273	1000	
	20	3500	CaCO ₃ || to c axis	83	25
	35	6000		273	5.5
	77	1100		⊥ to c axis	83	17
	⊥ to c axis	373	2.6	194	6.5
523		3.9	273	4.6	
773		5.8	373	3.6	
Al ₂ O ₃ (sintered)		4.2	0.5	CaF ₂	83	39
	20	23	223		18
	77	150	273		10
	194	48	323	9.2	
	273	35	373	9	
	373	26	CaWO ₄ (scheelite)	422	11.3
	973	8		CdTe	160	7.0
Ar	8	6.0	297	3.6	
	10	3.7	422	2.9	
	20	1.4	CsBr	223	1.2
	77	0.31		273	0.94
As ₂ S ₃ (glass)	283	0.16	323	0.81	
	323	0.21	373	0.77	
	373	0.27	CsI	223	1.4
BN	1047	36.2		273	1.2
	1475	22.7		323	1
	1928	21.9		373	0.95
	2111	18.5	Cu ₂ O (cuprite)	102	3.74
BaF ₂	225	20		163	7.76
	260	13.4		299	5.58
	305	10.9	360	4.86	
BaTiO ₃	370	10.5	Fe ₃ O ₄ (magnetite)	4.5	27.4
	5	4.2		20.5	293.0
	30	24.0		126.5	7.4
	40	25.0		304	7.0
	100	12.0	Glass: phoenix	4.2	0.095
	250	4.8		20	0.13
300	6.2	77		0.37	

THERMAL CONDUCTIVITY OF CRYSTALLINE DIELECTRICS (continued)

Material	T/K	Ther. cond. W/m K	Material	T/K	Ther. cond. W/m K
plastic perspex	4.2	0.058	NaCl	4.2	440
	20	0.074		20	300
pyrex	77	0.44		77	30
	194	0.88		273	6.4
	273	1		323	5.6
H ₂ (para + 0.5% ortho)	2.5	100	373	5.4	
	3	150	NaF	5	1100
	4	200	50	250	
	6	30	100	90	
	10	3	Ne	2	3.0
H ₂ O (ice)	173	3.5	3	4.6	
	223	2.8	4.2	4.2	
	273	2.2	10	0.8	
He ³ (high pressure)	0.6	25	20	0.3	
	1	2	NH ₄ Cl	77	17
	1.5	0.57	194	23	
He ⁴ (high pressure)	2	0.21	230	38	
	0.5	42	273	27	
	0.8	120	NH ₄ H ₂ PO ₄		
I ₂	1	24	|| to optic axis	315	0.71
	2	0.18	339	0.71	
	300	0.45	⊥ to optic axis	313	1.26
KBr	325	0.42	342	1.34	
	350	0.4	NiO	4.2	5.9
	2	150	40	400	
	4.2	360	194	82	
	100	12	SiO ₂ (quartz)		
KCl	273	5	|| to c axis	20	720
	323	4.8	194	20	
	373	4.8	273	12	
	4.2	500	⊥ to c axis	20	370
	25	140	194	10	
KI	80	35	273	6.8	
	194	10	SiO ₂ (fused silica)	4.2	0.25
	273	7.0	20	0.7	
	323	6.5	77	0.8	
	373	6.3	194	1.2	
	4.2	700	273	1.4	
	80	13	373	1.6	
Kr	194	4.6	673	1.8	
	273	3.1	SrTiO ₃	5	2.4
	4.2	0.48	30	21.0	
	10	1.7	40	19.2	
LaF ₃	20	1.2	100	18.5	
	77	0.36	250	12.5	
	78	7.8	300	11.2	
LiF	197	5.0	TlBr	316	0.59
	274	5.4	TlCl	311	0.75
MgO·Al ₂ O ₃ (spinel)	4.2	620	TiO ₂ (rutile)		
	20	1800	|| to optic axis	4.2	200
	77	150	20	1000	
MnO	373	13	273	13	
	773	8.5	⊥ to optic axis	4.2	160
MnO	4.2	0.25	20	690	
	40	55	273	9	
	120	8			
	573	3.5			

THERMAL CONDUCTIVITY OF CERAMICS AND OTHER INSULATING MATERIALS

Thermal conductivity values for ceramics, refractory oxides, and miscellaneous insulating materials are given here. The thermal conductivity refers to samples with density indicated in the second column. Since most of these materials are highly variable, the values should only be considered as a rough guide.

REFERENCES

1. Powell, R. L., and Childs, G. E., in *American Institute of Physics Handbook, 3rd Edition*, Gray, D. E., Ed., McGraw-Hill, New York, 1972.
2. Perry, R. H., and Green, D., *Perry's Chemical Engineers' Handbook, Sixth Edition*, McGraw-Hill, New York, 1984.

Material	Dens. g/cm ³	t °C	Ther. cond. W/m K	Material	Dens. g/cm ³	t °C	Ther. cond. W/m K	
Alumina (Al ₂ O ₃)	3.8	100	30	Diatomite	0.2	0	0.05	
		400	13			400	0.09	
		1300	6			0.5	0	0.09
		1800	7.4				400	0.16
Al ₂ O ₃ + MgO	3.5	100	17	Ebonite	1.2	0	0.16	
		800	7.6	Felt, flax	0.2	30	0.05	
		100	15		0.3	30	0.04	
Asbestos	0.4	400	10	Fuller's earth	0.53	30	0.1	
		1000	5.6	Glass wool	0.2	-200 to 20	0.005	
		-100	0.07			50	0.04	
Asbestos + 85% MgO	0.3	0	0.09			100	0.05	
		100	0.10			300	0.08	
		30	0.08	Graphite				
Asphalt	2.1	20	0.06	100 mesh	0.48	40	0.18	
Beryllia (BeO)	2.8	100	210	20-40 mesh	0.7	40	1.29	
		400	90	Linoleum cork	0.54	20	0.08	
		1000	20	Magnesia (MgO)		100	36	
		1800	15			400	18	
		50	64			1200	5.8	
Brick, dry	1.54	200	40			1700	9.2	
		600	23	MgO + SiO ₂		100	5.3	
		0	0.04			400	3.5	
						1500	2.3	
Brick, refractory:	1.99	1000	1.3	Mica:				
		400	1.2	muscovite		100	0.72	
alosite	0.77	1000	1.3			300	0.65	
		100	0.2			600	0.69	
aluminous	0.4	500	0.24	phlogopite		100	0.66	
		100	0.08	Canadian		300	0.19	
diatomaceous	2	500	0.1			600	0.2	
		400	1	Micanite		30	0.3	
fireclay	0.77	1000	1.2	Mineral wool	0.15	30	0.04	
		200	2	Perlite, expanded	0.1	-200 to 20	0.002	
silicon carbide	2	600	2.4	Plastics:				
		200	0.26	bakelite	1.3	20	1.4	
vermiculite	0.77	600	0.31	celluloid	1.4	30	0.02	
		100	16	polystyrene foam	0.05	-200 to 20	0.033	
		400	9	mylar foil	0.05	-200 to 20	0.0001	
Calcium oxide	2	1000	7.5	nylon		-253	0.10	
		90	0.55			-193	0.23	
Cement mortar	0.2	20	0.055			25	0.30	
Charcoal	1.35	20	0.26	polytetrafluoroethylene		-253	0.13	
Coal	1.6	0	0.8			-193	0.16	
Concrete	0.05	0	0.03			25	0.26	
Cork	0.35	100	0.04			230	2.5	
		0	0.06	urethane foam	0.07	20	0.06	
Cotton wool	0.08	100	0.08	Porcelain		90	1	
		30	0.04					

THERMAL CONDUCTIVITY OF CERAMICS AND OTHER INSULATING MATERIALS (continued)

Material	Dens. g/cm ³	<i>t</i> °C	Ther. cond. W/m K	Material	Dens. g/cm ³	<i>t</i> °C	Ther. cond. W/m K
Rock:				Uranium dioxide		100	9.8
basalt		20	2			400	5.5
chalk		20	0.92			1000	3.4
granite	2.8	20	2.2	Wood:			
limestone	2	20	1	balsa, ⊥	0.11	30	0.04
sandstone	2.2	20	1.3	fir, ⊥	0.54	20	0.14
slate, ⊥		95	1.4	fir, ||	0.54	20	0.35
slate, ||		95	2.5	oak		20	0.16
Rubber:				plywood		20	0.11
sponge	0.2	20	0.05	pine, ⊥	0.45	60	0.11
92 percent		25	0.16	pine, ||	0.45	60	0.26
Sand, dry	1.5	20	0.33	walnut, ⊥	0.65	20	0.14
Sawdust	0.2	30	0.06	Wool	0.09	30	0.04
Shellac		20	0.23	Zinc oxide		200	17
Silica aerogel	0.1	-200 to 20	0.003			800	5.3
Snow	0.25	0	0.16	Zirconia (ZrO ₂)		100	2
Steel wool	0.1	55	0.09			400	2
Thoria (ThO ₂)		100	10			1500	2.5
		400	5.8	Zirconia + silica		200	5.6
		1500	2.4			600	4.6
Titanium dioxide		100	6.5			1500	3.7
		400	3.8				
		1200	3.3				

THERMAL CONDUCTIVITY OF GLASSES

This table gives the composition of various types of glasses and the thermal conductivity k as a function of temperature. Because of the variability of glasses, the data should be regarded as only approximate.

Type of glass	Composition		t °C	k W/m K
	SiO ₂ (wt%)	Other oxides (wt%)		
Vitreous silica	100		-150	0.85
			-100	1.05
			-50	1.20
			0	1.30
			50	1.40
Vycor glass	96	B ₂ O ₃ 3	-100	1.00
			0	1.25
			100	1.40
Pyrex type chemically-resistant borosilicate glasses	80-81	B ₂ O ₃ 12-13	-100	0.90
		Na ₂ O 4	0	1.10
		Al 2	100	1.25
Borosilicate crown glasses	60-65	B ₂ O ₃ 15-20	-100	0.65-0.75
			0	0.90-0.95
			100	1.00-1.05
	65-70	B ₂ O ₃ 10-15	-100	0.75-0.80
			0	0.95-1.00
			100	1.05-1.15
	70-75	B ₃ O ₃ 5-10	-100	0.80-0.85
			0	1.05-1.10
			100	1.15-1.20
Zinc crown glasses (i)	55-65	ZnO 5-15	-100	0.88-0.92
		Remainder: B ₂ O ₃ , Al ₂ O ₃	0	1.10-1.15
			100	1.15-1.25
		ZnO 5-15	-100	0.60-0.70
		Remainder: Na ₂ O, K ₂ O	0	0.70-0.90
			100	0.85-0.95
	65-75	ZnO 15-25	-100	0.88-0.92
		Remainder: B ₂ O ₃ , Al ₂ O ₃	0	1.10-1.15
			100	1.15-1.20
		ZnO 15-25	-100	0.65-0.80
		Remainder: Na ₂ O, K ₂ O	0	0.85-0.95
			100	0.90-1.05
Zinc crown glasses (ii)	65-75	ZnO 5-15	-100	0.88-0.92
		Remainder: B ₂ O ₃ , Al ₂ O ₃	0	1.15-1.15
			100	1.20-1.30
	75-85	ZnO 5-15	-100	0.70-0.85
		Remainder: Na ₂ O, K ₂ O	0	0.90-1.05
			100	1.00-1.15

THERMAL CONDUCTIVITY OF GLASSES (continued)

Type of glass	Composition		<i>t</i> °C	<i>k</i> W/m K		
	SiO ₂ (wt%)	Other oxides (wt%)				
Barium crown glasses		ZnO	15–25	–100	0.90–0.95	
		Remainder:		0	1.15–1.15	
		B ₂ O ₃ , Al ₂ O ₃		100	1.20–1.25	
			ZnO	15–25	–100	0.65–0.85
			Remainder:		0	0.85–1.00
			Na ₂ O, K ₂ O		100	1.05–1.20
	Barium crown glasses	31	B ₂ O ₃	12	–100	0.55
			Al ₂ O ₃	8	0	0.70
			BaO	48	100	0.80
		41	B ₂ O ₃	6	–100	0.60
			Al ₂ O ₃	2	0	0.75
			ZnO	8	100	0.85
BaO			43			
47		B ₂ O ₃	4	–100	0.65	
		Na ₂ O	1	0	0.75	
		K ₂ O	7	100	0.90	
		ZnO	8			
		BaO	32			
65	B ₂ O ₃	2	–100	0.70		
	Na ₂ O	5	0	0.90		
	K ₂ O	15	100	1.00		
	ZnO	2				
	BaO	10				
Borate glasses						
Borate flint glass	9	B ₂ O ₃	36	–100	0.55	
		Na ₂ O	1	0	0.65	
		K ₂ O	2	100	0.80	
		PbO	36			
		Al ₂ O ₃	10			
		ZnO	6			
Borate flint glass	0	B ₂ O ₃	56	–100	0.50	
		Al ₂ O ₃	12	0	0.65	
		PbO	32	100	0.85	
Borate flint glass	0	B ₂ O ₃	43	–100	0.40	
		Al ₂ O ₃	5	0	0.55	
		PbO	52	100	0.70	
Borate glass	4	B ₂ O ₃	55	–100	0.65	
		Al ₂ O ₃	14	0	0.80	
		PbO	11	100	0.90	
		K ₂ O	4			
		ZnO	12			
Borate crown glass	0	B ₂ O ₃	64	–100	0.50	
		Na ₂ O	8	0	0.65	
		K ₂ O	3	100	0.85	
		BaO	4			
		PbO	3			
		Al ₂ O ₃	18			

THERMAL CONDUCTIVITY OF GLASSES (continued)

Type of glass	Composition		<i>t</i> °C	<i>k</i> W/m K	
	SiO ₂ (wt%)	Other oxides (wt%)			
Light borate crown glass	0	B ₂ O ₃	69	-100	0.55
		Na ₂ O	8	0	0.70
		BaO	5	100	0.90
		Al ₂ O ₃	18		
Zinc borate glass	0	B ₂ O ₃	40	-100	0.65
		ZnO	60	0	0.75
				100	0.85
Phosphate crown glasses Potash phosphate glass	0	P ₂ O ₅	70	0	0.75
		B ₂ O ₃	3	100	0.85
		K ₂ O	12		
		Al ₂ O ₃	10		
		MgO	4		
Baryta phosphate glass	0	P ₂ O ₅	60	45	0.75
		B ₂ O ₃	3		
		Al ₂ O ₃	8		
		BaO	28		
Soda-lime glasses	75	Na ₂ O	17	-100	0.75
		CaO	8	0	0.95
				100	1.10
	75	Na ₂ O	12	-100	0.90
		CaO	13	0	1.10
				100	1.15
	72	Na ₂ O	15	-100	0.80
		CaO	11	0	1.00
		Al ₂ O ₃	2	100	1.15
	65	Na ₂ O	25	-100	0.65
		CaO	10	0	0.85
				100	0.95
	65	Na ₂ O	15	-100	0.85
		CaO	20	0	1.00
				100	1.10
60	Na ₂ O	20	-100	0.75	
	CaO	20	0	0.90	
			100	1.00	
Other crown glasses Crown glass	75	Na ₂ O	9	-100	0.80
		K ₂ O	11	0	1.00
		CaO	5	100	1.10
High dispersion crown glass	68	Na ₂ O	16	-100	0.65
		ZnO	3	0	0.85
		PbO	13	100	1.00

THERMAL CONDUCTIVITY OF GLASSES (continued)

Type of glass	Composition		<i>t</i> °C	<i>k</i> W/m K
	SiO ₂ (wt%)	Other oxides (wt%)		
Miscellaneous flint glasses				
(i) Silicate flint glasses				
Light flint glasses	65	PbO 25 Others 10	-100 0 100	0.65–0.70 0.88–0.92 1.00–1.05
	55	PbO 35 Others 10	-100 0 100	0.60–0.65 0.75–0.85 0.88–0.92
Ordinary flint glass	45	PbO 45 Others 10	-100 0 100	0.50–0.60 0.65–0.75 0.80–0.85
Heavy flint glass	35	PbO 60 Others 5	-100 0 100	0.45–0.50 0.60–0.65 0.70–0.75
Very heavy flint glasses	25	PbO 73 Others 2	-100 0 100	0.40–0.45 0.55–0.60 0.63–0.67
	20	PbO 80	-100 0 100	0.40 0.50 0.60
(ii) Borosilicate flint glass	33	B ₂ O ₃ 31 PbO 25 Al ₂ O ₃ 7 K ₂ O 3 Na ₂ O 1	-100 0 100	0.65 0.85 0.95
(iii) Barium flint glass	50	BaO 24 PbO 6 K ₂ O 8 Na ₂ O 3 ZnO 8 Sb ₂ O ₃ 1	-100 0 100	0.60 0.70 0.85
Other glasses				
Potassium glass	59	K ₂ O 33 CaO 8	50	0.88–0.92
Iron glasses	63	Fe ₂ O ₃ 10 Na ₂ O 17 MgO 4 CaO 3 Al ₂ O ₃ 2	-100 0 100	0.80 0.95 1.05
	67	Fe ₂ O ₃ 15 Na ₂ O 18	0 100	0.88–0.92 1.00–1.05
	62	Fe ₂ O ₃ 20 Na ₂ O 18	0 100	0.85–0.90 0.95–1.00
Rock glasses				
Obsidian			0	1.35
Artificial diabase			100	1.25

COMMERCIAL METALS AND ALLOYS

This table gives typical values of mechanical, thermal, and electrical properties of several common commercial metals and alloys. Values refer to ambient temperature (0 to 25°C). All values should be regarded as typical, since these properties are dependent on the particular type of alloy, heat treatment, and other factors. Values for individual specimens can vary widely.

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Common name	Thermal conductivity W/cm K	Density g/cm ³	Coeff. of linear expansion 10 ⁻⁶ /°C	Electrical resistivity μΩ cm	Modulus of elasticity GPa	Tensile strength MPa	Approx. melting point °C
Ingot iron	0.7	7.86	11.7	9.7	205	-	1540
Plain carbon steel AISI-SAE 1020	0.52	7.86	11.7	18	205	450	1515
Stainless steel type 304	0.15	7.9	17.3	72	195	550	1425
Cast gray iron	0.47	7.2	10.5	67	90	180	1175
Malleable iron		7.3	12	30	170	345	1230
Hastelloy C	0.12	8.94	11.3	125	200	780	1350
Inconel	0.15	8.25	11.5	103	200	800	1370
Aluminum alloy 3003, rolled	1.9	2.73	23.2	3.7	70	110	650
Aluminum alloy 2014, annealed	1.9	2.8	23.0	3.4	70	185	650
Aluminum alloy 360	1.5	2.64	21.0	7.5	70	325	565
Copper, electrolytic (ETP)	3.9	8.94	16.5	1.7	120	300	1080
Yellow brass (high brass)	1.2	8.47	20.3	6.4	100	300-800	930
Aluminum bronze	0.7	7.8	16.4	12	120	400-600	1050
Beryllium copper 25	0.8	8.23	17.8	7	130	500-1400	925
Cupronickel 30%	0.3	8.94	16.2		150	400-600	1200
Red brass, 85%	1.6	8.75	18.7	11	90	300-700	1000
Chemical lead	0.35	11.34	29.3	21	13	17	327
Antimonial lead (hard lead)	0.3	10.9	26.5	23	20	47	290
Solder 50-50	0.5	8.89	23.4	15	-	42	215
Magnesium alloy AZ31B	1.0	1.77	26	9	45	260	620
Monel	0.3	8.84	14.0	58	180	545	1330
Nickel (commercial)	0.9	8.89	13.3	10	200	460	1440
Cupronickel 55-45 (constantan)	0.2	8.9	18.8	49	160	-	1260
Titanium (commercial)	1.8	4.5	8.5	43	110	330-500	1670
Zinc (commercial)	1.1	7.14	32.5	6	-	130	419
Zirconium (commercial)	0.2	6.5	5.85	41	95	450	1855

HARDNESS OF MINERALS AND CERAMICS

There are several hardness scales for describing the resistance of a material to indentation or scratching. This table lists a number of common materials in order of increasing hardness. Values are given, when available, on three different hardness scales: the original Mohs Scale (range 1 to 10); the modified Mohs Scale (range 1 to 15), and the Knoop Hardness Scale. In the last case, a load of 100 g is assumed.

REFERENCE

Shackelford, J. F. and Alexander, W., *CRC Materials Science and Engineering Handbook*, CRC Press, Boca Raton, FL, 1991.

Material	Formula	Mohs	Modified mohs	Knoop
Graphite	C	0.5		
Talc	3MgO·4SiO ₂ ·H ₂ O	1	1	
Alabaster	CaSO ₄ ·2H ₂ O	1.7		
Gypsum	CaSO ₄ ·2H ₂ O	2	2	32
Halite (rock salt)	NaCl	2		
Stibnite (antimonite)	Sb ₂ S ₃	2.0		
Galena	PbS	2.5		
Mica		2.8		
Calcite	CaCO ₃	3	3	135
Barite	BaSO ₄	3.3		
Marble		3.5		
Aragonite	CaCO ₃	3.5		
Dolomite	CaMg(CO ₃) ₂	3.5		
Fluorite	CaF ₂	4	4	163
Magnesia	MgO	5		370
Apatite	CaF ₂ ·3Ca ₃ (PO ₄) ₂	5	5	430
Opal		5		
Feldspar (orthoclase)	K ₂ O·Al ₂ O ₃ ·6SiO ₂	6	6	560
Augite		6		
Hematite	Fe ₂ O ₃	6		750
Magnetite	Fe ₃ O ₄	6		
Rutile	TiO ₂	6.2		
Pyrite	FeS ₂	6.3		
Agate	SiO ₂	6.5		
Uranium dioxide	UO ₂	6.7		600
Silica (fused)	SiO ₂		7	
Quartz	SiO ₂	7	8	820
Flint		7		
Silicon	Si	7		
Andalusite	Al ₂ OSiO ₄	7.5		
Zircon	ZrSiO ₄	7.5		
Zirconia	ZrO ₂			1200
Aluminum nitride	AlN			1225
Beryl	Be ₃ Al ₂ Si ₆ O ₁₈	7.8		
Beryllia	BeO			1300
Topaz	Al ₂ SiO ₄ (OH,F) ₂	8	9	1340
Garnet	Al ₂ O ₃ ·3FeO·3SiO ₂		10	1360
Emery	Al ₂ O ₃ (impure)	8		
Zirconium nitride	ZrN	8+		1510
Zirconium boride	ZrB ₂			1560
Titanium nitride	TiN	9		1770
Zirconia (fused)	ZrO ₂		11	
Tantalum carbide	TaC			1800
Tungsten carbide	WC			1880
Corundum (alumina)	Al ₂ O ₃	9		2025
Zirconium carbide	ZrC			2150
Alumina (fused)	Al ₂ O ₃		12	
Beryllium carbide	Be ₂ C			2400

HARDNESS OF MINERALS AND CERAMICS (continued)

Material	Formula	Mohs	Modified mohs	Knoop
Titanium carbide	TiC			2470
Carborundum (silicon carbide)	SiC	9.3	13	2500
Aluminum boride	AlB			2500
Tantalum boride	TaB ₂			2600
Boron carbide	B ₄ C		14	2800
Boron	B	9.5		
Titanium boride	TiB ₂			2850
Diamond	C	10	15	7000

ORGANIC MAGNETS

J.S. Miller

Magnetic ordering, e.g., ferromagnetism, like superconductivity, is a property of a solid, not of an individual molecule or ion, and very rarely occurs for organic compounds. In contrast to superconductivity, where all electron spins pair to form a perfect diamagnetic material, magnetic ordering requires unpaired electron spins; hence, superconductivity and ferromagnetism are mutually exclusive.

The vast majority of organic compounds are diamagnetic (i.e., all electron spins are paired), and a relative few possess unpaired electrons (designated by an arrow, \uparrow) and are paramagnetic (PM), i.e., they are oriented in random directions. A few organic solids, however, exhibit strong magnetic behavior and magnetically order as ferromagnets (FO) with all spins aligned in the same direction. In some cases the spins align in the opposite direction and compensate to form an antiferromagnet (AF). In some cases these spins are not opposed to each other and do not compensate and lead to a canted antiferromagnet or weak ferromagnet (WF). If the number of spins that align in one direction differs from the number of spins that align in the opposite direction, the spins cannot compensate and a ferrimagnet (FI) results. Metamagnets (MM) are antiferromagnets in which all the spins become aligned like a ferromagnet in an applied magnetic field. Above the ordering or critical temperature, T_c , all magnets are paramagnets (PM). Organic magnets all possess electron spins in p -orbitals, but these may be in conjunction with metal ion-based spins.

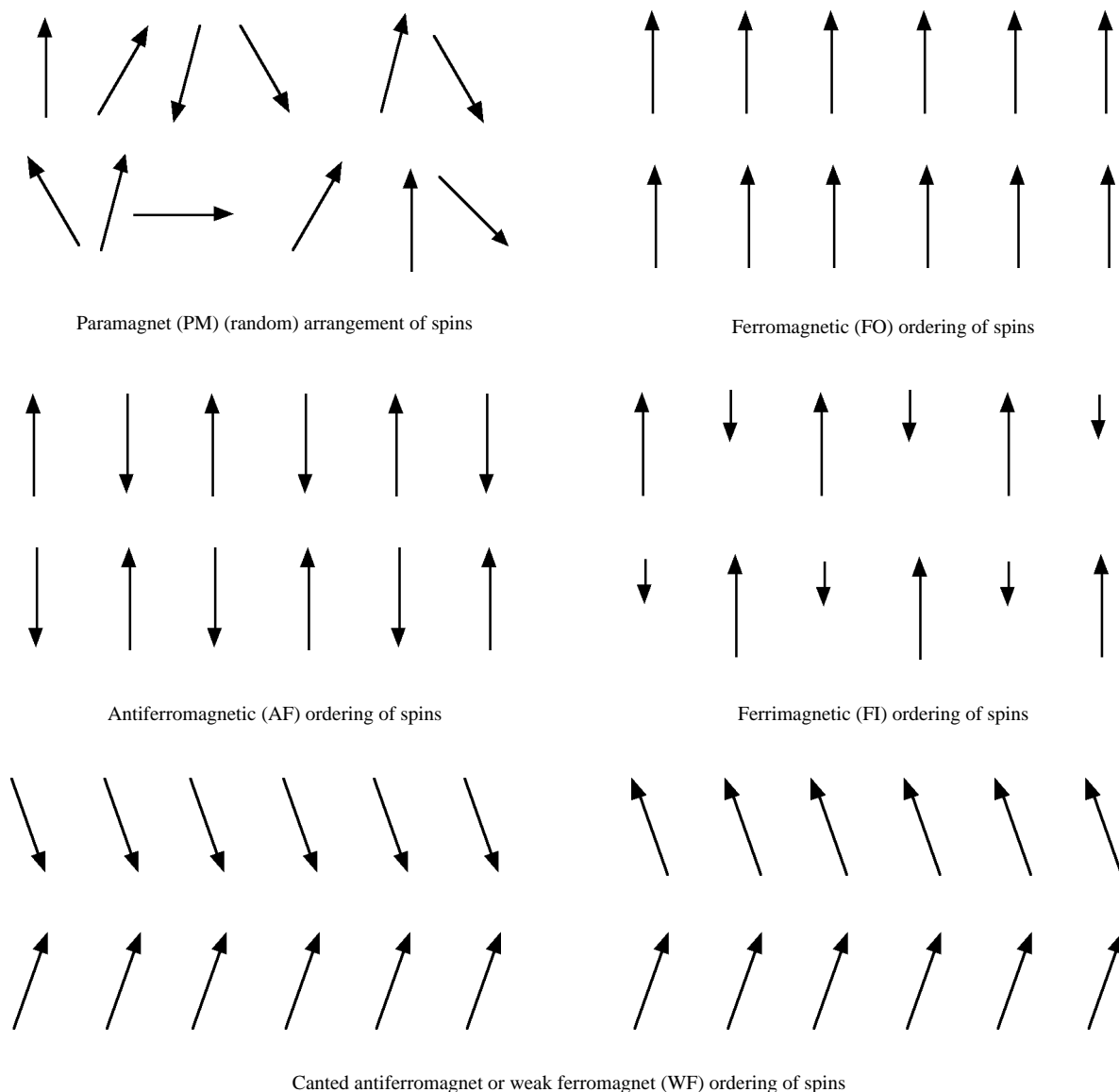


Figure 1. Schematic illustration of the different types of magnetic behavior.

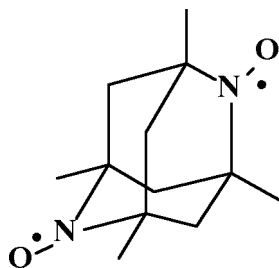
ORGANIC MAGNETS (continued)

Summary of the Critical Temperature, T_c , Saturation Magnetization, M_s , Coercive Field, H_{cr} , and Remanent Magnetization, M_r , for Selected Organic-Based Magnets

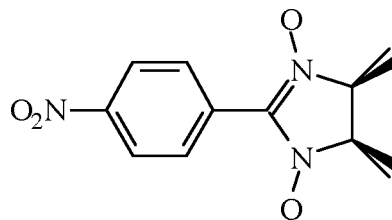
Magnet	Type	T_c /K	M_s /A m ⁻¹	H_{cr} /T	M_r /A m ⁻¹
α -1,3,5,7-Tetramethyl-2,6-diazaadamantane- <i>N,N'</i> -doxyl	FO	1.48	48,300	<0.00001	—
β -2-(4'-Nitrophenyl)-4,4,5,5-tetramethyl-4,5-dihydro-1H-imidazol-1-oxyl-3- <i>N</i> -oxide	FO	0.6	22,300	0.00008	<200
{Fe ^{III} [C ₅ (CH ₃) ₅] ₂ }[TCNE]	FO	4.8	37,600	0.10	2,300
{Mn ^{III} [C ₅ (CH ₃) ₅] ₂ }[TCNE]	FO	8.8	58,200	0.12	3,700
{Cr ^{III} [C ₅ (CH ₃) ₅] ₂ }[TCNE]	FO	3.65	46,300	—	—
α -{Fe ^{III} [C ₅ (CH ₃) ₅] ₂ }[TCNQ]	MM	2.55	34,200	—	—
β -{Fe ^{III} [C ₅ (CH ₃) ₅] ₂ }[TCNQ]	FO	3.0	21,600	—	—
Tanol subarate	MM	0.38	20,700	—	—
NCC ₆ F ₄ CN ₂ S ₂	WF	35.5	45	0.00009	—
Mn ^{II} (hfac) ₂ NITC ₂ H ₅	FI	7.8	39,400	0.03	27,600
Mn ^{II} (hfac) ₂ NIT(<i>i</i> -C ₃ H ₈)	FI	7.6	42,400	<0.0005	<420
[Mn(hfac) ₂] ₃ {[ON[C ₆ H ₃ (<i>t</i> -C(CH ₃) ₃) ₂ NO] ₂ }	FI	46	24,400	—	—
[MnTPP][TCNE]·2C ₆ H ₅ CH ₃	FI	13	18,400	2.4	10,300
V[TCNE] _{<i>x</i>} ·yCH ₂ Cl ₂ (<i>x</i> ~ 2; <i>y</i> ~ 0.5)	FI	~400	28,200	0.0015 - 0.006	1,650
Mn[TCNE] _{<i>x</i>} ·yCH ₂ Cl ₂ (<i>x</i> ~ 2; <i>y</i> ~ 0.5)	FI	75	52,000	0.002	270
Fe[TCNE] _{<i>x</i>} ·yCH ₂ Cl ₂ (<i>x</i> ~ 2; <i>y</i> ~ 0.5)	FI	97	46,300	0.23	3
Co[TCNE] _{<i>x</i>} ·yCH ₂ Cl ₂ (<i>x</i> ~ 2; <i>y</i> ~ 0.5)	FI	44	22,000	0.65	—

List of Symbols and Abbreviations

M_s	Saturation magnetization at 2 K
H_{cr}	Coercive Field
T_c	Critical Temperature
M_r	Remanent magnetization at 2 K
TCNE	Tetracyanoethylene
TCNQ	7,7,8,8-Tetracyano- <i>p</i> -quinodimethane
hfac	Hexafluoroacetate
NIT	Nitronyl nitroxide
FO	Ferromagnet
FI	Ferrimagnet
MM	Metamagnet
WF	Weak ferromagnet

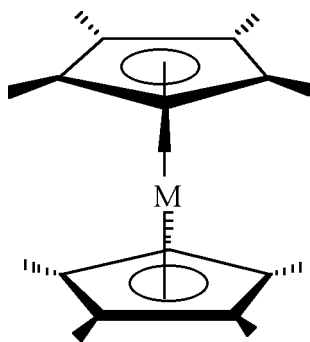


1,3,5,7-Tetramethyl-2,6-diazaadamantane-*N,N'*-doxyl

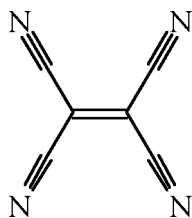


2-(4'-Nitrophenyl)-4,4,5,5-tetramethyl-4,5-dihydro-1H-imidazol-1-oxyl-3-*N*-oxide

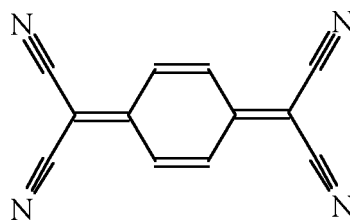
ORGANIC MAGNETS (continued)



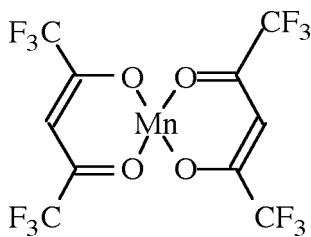
$M[C_5(CH_3)_5]_2$ ($M = Cr, Mn, Fe$)



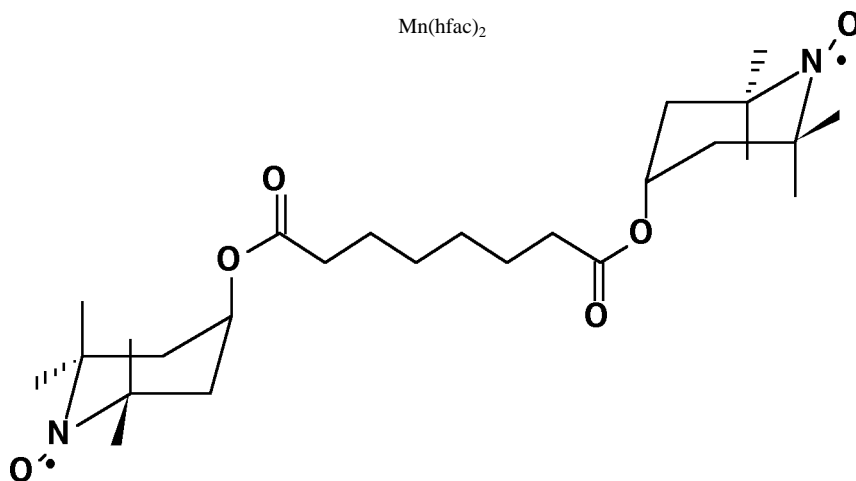
TCNE



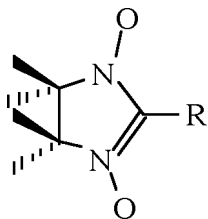
TCNQ



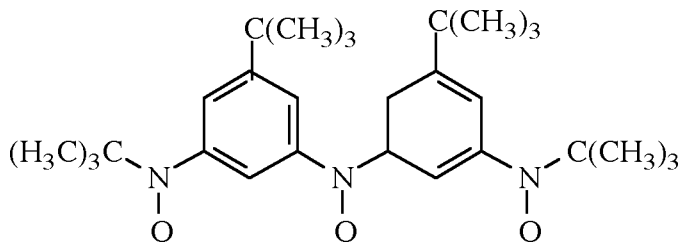
$Mn(hfac)_2$



Tanol subarate

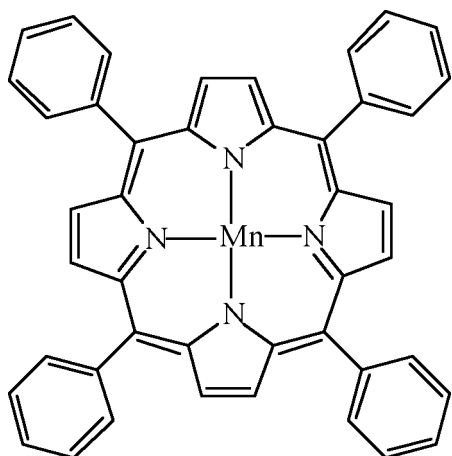


NITR ($R = C_2H_5, i-C_3H_8, n-C_3H_8$)

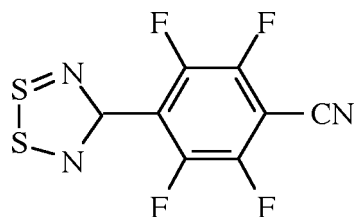


$\{ON[C_6H_3(t-C(CH_3)_3)_2NO]_2\}$

ORGANIC MAGNETS (continued)



MnTPP



NCC₆F₄CN₂S₂

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OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS

L. I. Berger

Optical properties of materials are closely related to their dielectric properties. The complex dielectric function (relative permittivity) of a material is equal to

$$\varepsilon(\omega) = \varepsilon'(\omega) - j\varepsilon''(\omega),$$

where $\varepsilon'(\omega)$ and $\varepsilon''(\omega)$ are its real and imaginary parts, respectively, and ω is the angular frequency of the applied electric field. For a non-absorbing medium, the index of refraction is $n = (\varepsilon\mu)^{1/2}$, where μ is the relative magnetic permeability of the medium (material); in the majority of dielectrics, $\mu \cong 1$.

For many applications, the most important optical properties of materials are the index of refraction, the extinction coefficient, k , and the reflectivity, R . The common index of refraction of a material is equal to the ratio of the phase velocity of propagation of an electromagnetic wave of a given frequency in vacuum to that in the material. Hence, $n \cong 1$. The optical properties of highly conductive materials like metals and semiconductors (at photon energy range above the energy gap) differ from those of optically transparent media. Free electrons absorb the incident electromagnetic wave in a thin surface layer (a few hundred nanometers thick) and then release the absorbed energy in the form of secondary waves reflected from the surface. Thus, the light reflection becomes very strong; for example, highly conductive sodium reflects 99.8% of the incident wave (at 589 nm). Introduction of the effective index of refraction, $n_{\text{eff}} = (\varepsilon')^{1/2} = n - jk$, where $\varepsilon' = \varepsilon - j\delta/\omega$, ε_0 , δ is the electrical conductivity of the material in S/m, and $\varepsilon_0 = 8.8542 \cdot 10^{-12}$ F/m is the permittivity of vacuum, allows one to apply the expressions of the optics of transparent media to the conductive materials. It is clear that the effective index of refraction may be smaller than 1. For example, $n = 0.05$ for pure sodium and $n = 0.18$ for pure silver (at 589.3 nm). At very high photon energies, the quantum effects, such as the internal photoeffect, start playing a greater role, and the optical properties of these materials become similar to those of insulators (low reflectance, existence of Brewster's angle, etc.).

The extinction coefficient characterizes absorption of the electromagnetic wave energy in the process of propagation of a wave through a material. The wave intensity, I , after it passes a distance x in an isotropic medium is equal to

$$I = I_0 \exp(-\alpha x),$$

where I_0 is the intensity at $x = 0$ and α is called the absorption coefficient. For many applications, the extinction coefficient, k , which is equal to

$$k = \alpha \frac{\lambda}{4\pi},$$

where λ is the wavelength of the wave in the medium, is more commonly used for characterization of the electromagnetic losses in materials.

Reflection of an electromagnetic wave from the interface between two media depends on the media indices of refraction and on the angle of incidence. It is characterized by the reflectivity, which is equal to the ratio of the intensity of the wave reflected back into the first medium to the intensity of the wave approaching the interface. For polarized light and two non-absorbing media,

$$R = \frac{(N_1 - N_2)^2}{(N_1 + N_2)^2},$$

where $N_1 = n_1/\cos\theta_1$ and $N_2 = n_2/\cos\theta_2$ for the wave polarized in the plane of incidence, and $N_1 = n_1\cos\theta_1$ and $N_2 = n_2\cos\theta_2$ for the wave polarized normal to the plane of incidence; θ_1 and θ_2 are the angles between the normal to the interface in the point of incidence and the directions of the beams in the first and second medium, respectively. The reflectivity at normal incidence in this case is

$$R = [(n_1 - n_2)/(n_1 + n_2)]^2$$

For any two opaque (absorbing) media, the normal incidence reflectivity is

$$R = \frac{(n_1 - n_2)^2 + k_2^2}{(n_1 + n_2)^2 + k_2^2}.$$

In the majority of experiments, the first medium is air ($n \approx 1$), and hence,

$$R = \frac{(1 - n)^2 + k^2}{(1 + n)^2 + k^2}.$$

The data on n and k in the following table are abridged from the sources listed in the references. The reflectivity at normal incidence, R , has been calculated from the last equation. For convenience, the energy E , wavenumber $\bar{\nu}$, and wavelength λ are given for the incidence radiation.

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
Crystalline Arsenic Selenide (As₂Se₃) [Ref. 1]*											
2.194	17700	0.565					0.30				
2.168	17480	0.572					0.25				
2.141	17270	0.579					0.20				
2.123	17120	0.584					0.17				
2.098	16920	0.591					0.13				
2.094	16890	0.592						0.26			
2.091	16860	0.593						0.26			
2.073	16720	0.598					0.10				
2.060	16610	0.602						0.20			
2.049	16530	0.605					0.079	0.17			
2.036	16420	0.609						0.15			
2.023	16310	0.613						0.12			
2.013	16230	0.616					0.050				
2.009	16210	0.617						0.097			
2.000	16130	0.620						0.082			
1.987	16030	0.624						0.063			
1.977	15940	0.627					0.031				
1.974	15920	0.628						0.051			
1.962	15820	0.632						0.038			
1.953	15750	0.635						0.030			
1.949	15720	0.636					0.020				
1.937	15630	0.640						0.022			
1.925	15530	0.644						0.017			
1.922	15500	0.645					0.012				
1.905	15360	0.651					8.6·10 ⁻³				
1.893	15270	0.655					6.4				
1.881	15170	0.659					5.2				
1.859	14990	0.667					3.1				
1.848	14900	0.671						1.7·10 ⁻³			
1.845	14880	0.672					2.0				
1.842	14860	0.673						1.2·10 ⁻³			
1.831	14770	0.677					1.3·10 ⁻³	9.0·10 ⁻⁴			
1.826	14730	0.679						6.4			
1.821	14680	0.681						4.7			
1.818	14660	0.682					8.6·10 ⁻⁴				
1.815	14640	0.683						3.4			
1.807	14580	0.686					5.5				
1.802	14530	0.688					4.1				
0.06199	500.0	20.0		3.2	2.9		1.7·10 ⁻³	1.8·10 ⁻³		0.27	0.24
0.05904	476.2	21.0		3.1	2.9		2.1·10 ⁻³	2.2·10 ⁻³		0.26	0.24
0.05636	454.5	22.0		3.1	2.9		2.5·10 ⁻³	2.6·10 ⁻³		0.26	0.24
0.05391	434.8	23.0		3.1	2.9		3.0·10 ⁻³	3.1·10 ⁻³			
0.04592	370.4	27.0		3.0	2.8		6.3·10 ⁻³	6.4·10 ⁻³		0.25	0.22
0.04428	357.1	28.0		3.0	2.8		7.6·10 ⁻³	7.7·10 ⁻³		0.25	0.22
0.04275	344.8	29.0		3.0	2.8		0.0092	0.0093		0.25	0.22
0.04133	333.3	30.0		3.0	2.7		0.011	0.011		0.25	0.21
0.03542	285.7	35.0		2.7	2.5			0.037	0.034	0.21	0.18
0.03100	250.0	40.0		1.9	1.7			0.38	1.0	0.19	0.18
0.03061	247.0	40.5		2.0	2.6			0.33	0.95	0.12	0.25
0.03024	244.0	41.0		1.7	2.4			0.41	0.46	0.088	0.18
0.02883	232.6	43.0		1.2	1.3			2.2	0.94	0.50	0.16
0.02850	229.9	43.5		1.6	1.2			2.8	1.4	0.56	0.29
0.02818	227.3	44.0		2.3	1.2		3.3	2.0		0.58	0.48
0.02755	222.2	45.0		4.2	2.0		2.5	3.3		0.50	0.60
0.02480	200.0	50.0		6.5	4.0		3.6	0.26		0.62	0.36
0.02254	181.8	55.0		4.5	3.5		0.17	0.10		0.40	0.31

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n</i> _a	<i>n</i> _c	<i>k</i>	<i>k</i> _a	<i>k</i> _c	<i>R</i>	<i>R</i> _a	<i>R</i> _c
0.02066	166.7	60.0		4.0	3.2		0.089	0.10		0.36	0.27
0.01907	153.8	65.0		3.8	3.1		0.097	0.16		0.34	0.26
0.01771	142.9	70.0		3.6	3.0		0.19	0.30		0.32	0.25
0.01653	133.3	75.0		3.7	3.0		0.41	0.44		0.34	0.26
0.01550	125.0	80.0		3.8	3.1		0.29	0.40		0.34	0.27
0.01459	117.6	85.0		3.6	2.9		0.20	0.34		0.32	0.24
0.01378	111.1	90.0		3.2	2.6		0.43	0.49		0.28	0.21
0.01305	105.3	95.0		4.7	3.0		1.5	1.5		0.46	0.34
0.01240	100.0	100.0		4.4	2.7		0.22	0.81		0.40	0.25
0.01181	95.24	105.0		4.2	3.0		0.094	3.9		0.38	0.62
0.01127	90.91	110.0		4.1	5.3		0.059	0.70		0.37	0.47
0.01033	83.33	120.0		3.9	4.2		0.034	0.13		0.35	0.38
0.009537	76.92	130.0		3.9	4.0		0.024	0.069		0.35	0.36
0.008856	71.43	140.0		3.9	3.8		0.019	0.048		0.35	0.34
0.007749	63.50	160.0		3.8	3.7		0.014	0.032		0.34	0.33
0.006888	55.55	180.0		3.8	3.7		0.011	0.024		0.34	0.33
0.006199	50.0	200.0		3.8	3.6		0.0091	0.019		0.34	0.32

*Indices a and c relate to the radiation electric field parallel to the a and c axes of the crystal, respectively.

Vitreous Arsenic Selenide (As₂Se₃) [Ref. 1]

2.056	16580	0.603				0.12					
2.026	16340	0.612				0.11					
2.006	16180	0.618				0.099					
1.990	16050	0.623				9.0					
1.925	15530	0.644				5.6					
1.826	14730	0.679				1.4					
1.810	14600	0.685				0.012					
1.794	14470	0.691				0.0089					
1.771	14290	0.700				6.2					
1.715	13830	0.723				2.6					
1.701	13720	0.729				0.0022					
1.647	13280	0.753				0.00046					
1.629	13140	0.761	3.07			4.0			0.62		
1.596	12870	0.777	3.06			2.7			0.49		
1.579	12740	0.785	3.05			1.9			0.39		
1.562	12590	0.794	3.05			0.00013			0.26		
1.544	12450	0.803	3.04			0.000094			0.25		
1.529	12330	0.811	3.03			6.3			0.78		
1.512	12200	0.820	3.03			4.2			0.64		
1.494	12050	0.830	3.02			2.8			0.50		
1.476	11910	0.840	3.01			1.8			0.38		
1.378	11110	0.90	2.98								
1.240	10000	1.00	2.93								
1.127	9091	1.10	2.90								
1.051	8475	1.18	2.89								
1.033	8333	1.20	2.88								
0.2555	1980	5.05				1.6·10 ⁻⁷					
0.2380	1919	5.21				9.9·10 ⁻⁸					
0.2344	1890	5.29				1.1·10 ⁻⁷					
0.1345	1085	9.22				4.4					
0.1339	1080	9.26				3.7					
0.1333	1075	9.30				4.4					
0.1308	1055	9.48				4.5					
0.1215	980	10.20				8.9					
0.1203	970	10.31				9.9·10 ⁻⁷					
0.1196	965	10.36				1.0·10 ⁻⁶					

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n</i> _a	<i>n</i> _c	<i>k</i>	<i>k</i> _a	<i>k</i> _c	<i>R</i>	<i>R</i> _a	<i>R</i> _c
0.1178	950	10.53				1.1					
0.1116	900	11.11				1.8					
0.1004	810	12.35				4.9					
0.09919	800	12.50				7.0·10 ⁻⁶					
0.09795	790	12.66				1.0·10 ⁻⁵					
0.09671	780	12.82				1.5					
0.09299	750	13.33				3.7					
0.08555	690	14.49				6.9					
0.08431	680	14.71				5.9					
0.08059	650	15.38				6.1					
0.07811	630	15.87				6.3					
0.07687	620	16.13				7.7					
0.07563	610	16.39				7.8					
0.07439	600	16.67				9.3·10 ⁻⁵					
0.07315	590	16.95	2.8			1.2·10 ⁻⁴			0.22		
0.07191	580	17.24	2.8			1.4			0.32		
0.07067	570	17.54	2.8			1.8			0.37		
0.06943	560	17.86	2.8			2.8			0.50		
0.06633	535	18.69	2.8			5.2			0.73		
0.06571	530	18.87	2.8			7.2·10 ⁻⁴			0.22		
0.06509	525	19.05	2.8			1.2·10 ⁻³			0.22		
0.06447	520	19.23	2.8			1.7			0.35		
0.06075	490	20.41	2.7			4.9			0.71		
0.06024	485.9	20.58	2.7			5.2			0.73		
0.05331	430	23.26	2.7			1.4			0.31		
0.05269	425	23.53	2.7			1.1·10 ⁻³			0.21		
0.05207	420	23.81	2.7			8.5·10 ⁻⁴			0.21		
0.05145	415	24.10	2.7			7.3			0.84		
0.05083	410	24.39	2.7			8.3			0.87		
0.05021	405	24.69	2.7			9.4·10 ⁻⁴			0.21		
0.04959	400	25.0	2.7			1.2·10 ⁻³			0.21		
0.04862	392.2	25.5	2.6			1.6			0.33		
0.04679	377.4	26.5	2.6			5.0			0.73		
0.04592	370.4	27.0	2.6			8.0·10 ⁻³			0.20		
0.04509	363.6	27.5	2.6			1.2·10 ⁻²			0.20		
0.04428	357.1	28.0	2.6			1.7			0.34		
0.03875	312.5	32.0	2.5			8.2			0.87		
0.03815	307.7	32.5	2.5			9.3·10 ⁻³			0.18		
0.03757	303.0	33.0	2.4			0.11			0.17		
0.02988	241.0	41.5	2.2			0.89			0.20		
0.02952	238.1	42.0	2.2			1.0			0.22		
0.02725	219.8	45.5	3.2			1.8			0.39		
0.02362	190.5	52.5	3.6			0.30			0.32		
0.01937	156.2	64.0	3.2			0.10			0.27		
0.01922	155.0	64.5	3.2			9.6·10 ⁻²			0.27		
0.01907	153.8	65.0	3.2			9.4			0.88		
0.01734	139.9	71.5	3.1			8.7			0.87		
0.01653	133.3	75.0	3.1			9.4			0.88		
0.01642	132.5	75.5	3.1			0.096			0.26		
0.01494	120.5	83.0	3.0			0.15			0.25		
0.01246	100.5	99.5	3.2			0.60			0.26		
0.007606	61.35	163.0	3.3			0.12			0.29		
0.006199	50.00	200.0	3.2								
0.004592	37.04	270.0	3.1			0.072			0.26		
0.002799	22.57	443.0	3.0			4.5			0.67		
0.001826	14.73	679.0	3.0			2.8			0.50		
0.001273	10.27	974.0	3.0			2.1			0.41		
0.0006491	5.236	1910.0	3.0			1.1·10 ⁻²			0.25		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n</i> _a	<i>n</i> _c	<i>k</i>	<i>k</i> _a	<i>k</i> _c	<i>R</i>	<i>R</i> _a	<i>R</i> _c
0.0004376	3.530	2833.0	3.0			7.5·10 ⁻³			0.25		
0.0002903	2.341	4271.0	3.0			5.0			0.71		
0.0001716	1.384	7224.0	3.0			3.1			0.53		
0.00009047	0.7297	13704	3.0			1.6·10 ⁻³			0.25		
0.00005621	0.4534	22056	3.0			9.9·10 ⁻⁴			0.25		
0.00002774	0.2237	44699	3.0			5.2			0.72		
0.00001439	0.1161	86153	3.0			2.6			0.47		

Vitreous Arsenic Sulfide (As₂S₃) - [Ref. 2]

4.959	40000	0.2500	2.48			1.21			0.27		
3.100	25000	0.40	3.09			0.34			0.27		
2.48	20000	0.4999	2.83			0.013			0.23		
1.879	15150	0.66	2.59			1.7·10 ⁻⁶			0.20		
1.240	10000	1.0	2.48			2.4·10 ⁻⁷			0.18		
0.6199	5000	2.0	2.43						0.17		
0.3100	2500	4.0	2.41						0.17		
0.2480	2000	5.0	2.41						0.17		
0.1736	1400	7.143	2.40			7.4·10 ⁻⁷			0.17		
0.1240	1000	10.00	2.38			1.3·10 ⁻⁴			0.17		
0.09299	750	13.33	2.35			3.0·10 ⁻³			0.16		
0.07439	600	16.67	2.31			4.6·10 ⁻⁴			0.16		
0.04959	400.0	25.0	1.79			0.2			0.085		
0.03757	303.0	33.0	3.59			1.4			0.38		
0.03100	250.0	40.0	2.98			0.15			0.25		
0.02480	200.0	50	2.66			0.11			0.21		
0.02066	166.7	60	2.64			0.57			0.22		
0.01771	142.9	70	2.99			0.17			0.25		
0.01550	125.0	80	2.89			0.14			0.24		
0.01378	111.1	90	2.84			0.12			0.23		
0.01240	100	100	2.81			0.10			0.23		
0.008183	66	152	2.76			0.072			0.22		
0.004029	32.5	308	2.74			0.044			0.22		
0.002418	19.5	513	2.74			0.031			0.22		
0.001984	16	625	2.74			0.025			0.22		
0.001048	8.45	1180	2.73			8.8·10 ⁻³			0.22		
0.0001033	0.833	12000	2.73			1.3·10 ⁻³			0.22		
4.129·10 ⁻¹²	3.33·10 ⁻⁸	3·10 ⁻¹¹	2.73						0.22		

Cadmium Telluride (CdTe) - [Ref. 3]

4.9	39520	0.2530	2.48			2.04			0.39		
4.1	33070	0.3024	2.33			1.59			0.32		
3.9	31460	0.3179	2.57			1.90			0.37		
3.5	28230	0.3542	2.89			1.52			0.34		
3.1	25000	0.4000	3.43			1.02			0.34		
3.0	24200	0.4133	3.37			0.861			0.32		
2.755	22220	0.45	3.080			0.485			0.27		
2.75	22180	0.4509	3.23			0.636			0.29		
2.610	21050	0.475	3.045								
2.5	20160	0.4959	3.14			0.525			0.28		
2.25	18150	0.5510	3.05			0.411			0.26		
1.771	14290	0.70	2.861			0.210			0.23		
1.512	12200	0.82	2.880			0.040			0.23		
1.50	12100	0.8266	2.98			0.319			0.25		
1.475	11900	0.840	2.905			0.00134			0.24		
1.47	11860	0.8434				0.000671					
1.465	11820	0.8463				3.37					

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
1.46	11780	0.8492				1.89					
1.459	11760	0.850	2.948						0.24		
1.455	11740	0.8521				1.08·10 ⁻⁴					
1.45	11690	0.8551	2.9565			5.10·10 ⁻⁵			0.24		
1.445	11650	0.8580				2.73					
1.442	11630	0.860	2.952						0.24		
1.44	11610	0.8610	2.9479			1.37			0.32		
1.43	11530	0.8670	2.9402						0.24		
1.30	10490	0.9537	2.8720						0.23		
1.24	10000	1.0	2.840						0.23		
1.20	9679	1.033	2.8353						0.23		
1.10	8872	1.127	2.8050						0.23		
1.00	8065	1.240	2.7793						0.22		
0.90	7259	1.378	2.7537						0.22		
0.80	6452	1.550	2.7384						0.22		
0.70	5646	1.771	2.7223						0.21		
0.60	4839	2.066	2.7086						0.21		
0.50	4033	2.480	2.6972						0.21		
0.40	3226	3.100	2.6878						0.21		
0.30	2420	4.133	2.6800						0.21		
0.20	1613	6.199	2.6722						0.21		
0.10	806.5	12.40	2.6535						0.20		
0.09	725.9	13.78	2.6482						0.20		
0.06819	550	18.18	2.623						0.20		
0.0573	462	21.6				3.8·10 ⁻⁶					
0.05	403.3	24.80	2.5801						0.19		
0.0469	378	26.5				8.0·10 ⁻⁵					
0.04592	370.3	27				9.88·10 ⁻⁵					
0.04133	333.3	30	2.55916			2.86·10 ⁻⁴			0.19		
0.04092	330	30.30	2.531			3.34			0.57		
0.03720	300	33.33	2.494			4.97			0.73		
0.03647	294.1	34.00				8.93					
0.03596	290	34.48	2.478			5.77·10 ⁻³			0.18		
0.03493	281.7	35.5				7.91					
0.03472	280	35.71	2.459			6.76			0.83		
0.03100	250	40	2.378			1.18·10 ⁻²			0.17		
0.02917	235.3	42.5				6.93					
0.02852	230	43.48	2.289			1.87			0.36		
0.02728	220	45.45	2.224			2.47·10 ⁻²			0.14		
0.02604	210	47.62	2.137			3.4·10 ⁻²			0.13		
0.02480	200	50.00	2.013			4.97·10 ⁻²			0.11		
0.02384	192.3	52.0				6.21					
0.01798	145	68.97	1.8			5.2			0.79		
0.01736	140	71.43	6.778			4.50			0.66		
0.01550	125	80.0	4.598			0.294			0.41		
0.01364	110	90.91	3.868			9.47·10 ⁻²			0.35		
0.01240	100	100	3.649			5.68·10 ⁻²			0.32		
0.009919	80	125	3.415			0.0262			0.30		
0.008679	70	142.9	3.348			0.0189			0.29		
0.007439	60	166.7	3.299			1.39			0.35		
0.006199	50	200	3.263			1.03			0.32		
0.004959	40	250	3.236			7.52·10 ⁻³			0.28		
0.003720	30	333.3	3.217						0.28		
0.023015	18.563		538.71			3.2096			0.28		
0.001550	12.50	800				6.18					

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E/eV</i>	$\bar{\nu}/\text{cm}^{-1}$	$\lambda/\mu\text{m}$	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
Gallium Arsenide (GaAs) - [Ref. 4]											
155		0.007999				0.0181					
145		0.008551				0.0203					
130		0.009537				0.0224					
110		0.01127				0.0278					
90		0.01378				0.0323					
70		0.01771				0.0376					
40		0.03100				0.0426					
23		0.05391	1.037			0.228					
7.0		0.1771	1.063			1.838					
6.0	48390	0.2066	1.264			2.472			0.61		
5.00	40330	0.2480	2.273			4.084			0.67		
4.00	32260	0.3100	3.601			1.920			0.42		
3.00	24200	0.4133	4.509			1.948			0.47		
2.50	20160	0.4959	4.333			0.441			0.39		
2.00	16130	0.6199	3.878			0.211			0.35		
1.80	14520	0.8888	3.785			0.151			0.34		
1.60	12900	0.7749	3.700			0.091			0.33		
1.50	12100	0.8266	3.666			0.080			0.33		
1.40	11290	0.8856	3.6140			1.69·10 ⁻³			0.32		
1.20	9679	1.033	3.4920						0.31		
1.00	8065	1.240	3.4232						0.30		
0.80	6452	1.550	3.3737						0.29		
0.50	4033	2.480	3.3240						0.29		
0.25	2016	4.959	3.2978						0.29		
0.15	1210	8.266	3.2831						0.28		
0.100	806.5	12.40	3.2597			4.93·10 ⁻⁶			0.28		
0.090	725.9	13.78	3.2493			1.64·10 ⁻⁵			0.28		
0.070	564.6	17.71	3.2081			2.32·10 ⁻⁴			0.28		
0.060	483.9	20.66	3.1609			3.45·10 ⁻³			0.27		
0.0495	399.2	25.05	3.058			2.07·10 ⁻³			0.26		
0.03968	320	31.25	2.495			2.43·10 ⁻²			0.18		
0.03496	282	35.46	0.307			294·10 ⁻²					
0.02976	240	41.67	4.57			4.26·10 ⁻²			0.41		
0.02066	166.7	60	3.77			3.89·10 ⁻³			0.34		
0.01550	125	80	3.681			1.84·10 ⁻³			0.33		
0.008266	66.67	150	3.62			2.14·10 ⁻³			0.32		
0.002480	20	500	3.607			1.3·10 ⁻³			0.32		
0.001240	10	1000	3.606						0.32		

Gallium Phosphide (GaP) - [Ref. 5]

154.0		0.00805				1.7·10 ⁻²					
110.0		0.0113				2.15·10 ⁻²					
100.0		0.0124				215·10 ⁻²					
80.0		0.0155				3.0·10 ⁻²					
50.0		0.0248				4.7·10 ⁻²					
27.0		0.0459				9.3·10 ⁻²					
25.0		0.0496				0.122					
20.0		0.0620				0.180					
15.0		0.0826	0.748			0.628					
5.5	44360	0.2254	1.543			3.556			0.68		
4.68	37750	0.2649	4.181			2.634			0.50		
3.50	28230	0.3542	5.050			0.819			0.46		
3.00	24200	0.4133	4.081			0.224			0.37		
2.78	22420	0.4460	3.904			0.103			0.35		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

E/eV	$\bar{\nu}/cm^{-1}$	$\lambda/\mu m$	n	n_a	n_c	k	k_a	k_c	R	R_a	R_c
2.621	21140	0.473	3.73			$6.37 \cdot 10^{-3}$			0.33		
2.480	20000	0.500	3.590			$2.47 \cdot 10^{-3}$			0.32		
2.18	17580	0.5687	3.411			$2.8 \cdot 10^{-7}$			0.30		
2.000	16130	0.62	3.3254						0.29		
1.6	12900	0.7749	3.209						0.28		
1.240	10000	1.0	3.1192						0.26		
0.6888	5556	1.8	3.0439						0.26		
0.4769	3846	2.6	3.0271						0.25		
0.1907	1538	6.5	2.995			$4.29 \cdot 10^{-4}$			0.25		
0.1550	1250	8.0	2.984						0.25		
0.1240	1000	10	2.964						0.25		
0.06199	500	20	2.615			$7.16 \cdot 10^{-3}$			0.20		
0.03100	250	40	3.594			$1.81 \cdot 10^{-2}$			0.32		
0.02480	200	50	3.461			$5.77 \cdot 10^{-3}$			0.30		
0.01727	139.27	71.80	3.3922			$4.34 \cdot 10^{-3}$			0.30		
0.01168	94.21	106.1	3.3621			$4.26 \cdot 10^{-3}$			0.29		
0.006199	50.00	200	3.3447			$1.3 \cdot 10^{-4}$			0.29		
0.004133	33.33	300	3.3413						0.29		
0.001240	10.00	1000	3.3319						0.29		

Indium Antimonide (InSb) - [Ref. 6]

155		0.007999				$4.77 \cdot 10^{-3}$					
60		0.02066				$7.30 \cdot 10^{-2}$					
25		0.04959	1.15			.015					
24		0.05166	1.15			0.18					
15		0.08266	0.97			0.230					
10		0.1240	0.74			0.88					
5.00	40330	0.2480	1.307			2.441			0.53		
4.50	36290	0.2755	1.443			2.894			0.60		
4.00	32260	0.3100	2.632			3.694			0.61		
3.34	26940	0.3712	3.528			2.280			0.45		
2.84	22910	0.4366	3.340			2.021			0.45		
1.80	14520	0.6888	4.909			1.396			0.47		
1.50	12100	0.8266	4.418			0.643			0.41		
0.6	4839	2.066	4.03						0.36		
0.2480	2000	5.0	4.14			$9.1 \cdot 10^{-2}$			0.37		
0.1907	1538	6.5	4.30			$6.3 \cdot 10^{-2}$			0.39		
0.1653	1333	7.5	4.18			$2.7 \cdot 10^{-2}$			0.38		
0.06199	500	20.00	3.869			$2.0 \cdot 10^{-3}$			0.35		
0.03100	250	40.00	2.98			$2.6 \cdot 10^{-3}$			0.25		
0.02480	200	50.00	2.22			0.165			0.14		
0.02244	181	55.25	3.05			7.59			0.84		
0.02207	178	56.18	9.61			4.20			0.70		
0.02033	164	60.98	4.94			0.140			0.44		
0.01054	85	117.6	2.12			0.423			0.14		
0.005579	45	222.2	1.02			5.59			0.88		
0.001860	15	666.7	6.03			17.9			0.93		
0.001240	10	1000	10.7			24.0			0.94		

Indium Arsenide (InAs) - [Ref. 7]

25		0.04959				1.139			0.168		
20		0.06199				1.125			0.225		
15		0.08266				0.894			0.336		
10		0.1240				0.835			1.071		
6	48390	0.2066	1.434			2.112			0.45		
5.0	40330	0.2480	1.524			2.871			0.58		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n</i> _a	<i>n</i> _c	<i>k</i>	<i>k</i> _a	<i>k</i> _c	<i>R</i>	<i>R</i> _a	<i>R</i> _c
4.0	32260	0.3100	3.313			1.799			0.39		
3.5	28230	0.3542	3.008			1.754			0.37		
3.0	24200	0.4133	3.197			2.034			0.41		
2.5	20160	0.4959	4.364			1.786			0.45		
2.44	19680	0.5081	4.489			1.446			0.44		
1.86	15000	0.6666	3.889			0.554			0.36		
1.8	14520	0.6888	3.851			0.530			0.35		
1.7	13710	0.7293	3.798			0.493			0.35		
1.6	12900	0.7749	3.755			0.463			0.34		
1.5	12100	0.8266	3.714			0.432			0.34		
1.2	9679	1.033	3.613						0.32		
1.0	8065	1.240	3.548						0.31		
0.6	4839	2.066				0.161					
0.35	2823	3.542	3.608			9.58·10 ⁻³			0.32		
0.32	2581	3.875	3.512			1.23·10 ⁻⁴			0.31		
0.20	1613	6.199	3.427						0.30		
0.1240	1000	10.00	3.402						0.30		
0.06199	500	20.00	3.334						0.29		
0.04959	400	25.00	3.264						0.28		
0.04339	350	28.57	3.182			5.46·10 ⁻³			0.27		
0.03720	300	33.33	2.988						0.25		
0.03100	250	40.00	1.970			6.37·10 ⁻²			0.11		
0.02765	222	44.84	5.90			6.53			0.74		
0.02480	200	50.00	6.91			0.30			0.56		
0.01984	160	62.50	5.27			0.41			0.47		
0.01860	150	66.67	5.27			0.51			0.47		
0.01736	140	71.43	3.99			1.1·10 ⁻²			0.36		
0.01488	120	83.33	3.91			6.6·10 ⁻³			0.35		
0.01240	100	100.0	3.85			4.3·10 ⁻³			0.35		
0.009919	80	125.0	3.817						0.34		
0.007439	60	166.7	3.793						0.34		
0.004959	40	250.0	3.778						0.34		
0.002480	20	500	3.769						0.37		
0.001240	10	1000	3.766						0.34		

Indium Phosphide (InP) - [Ref. 8]

20		0.06199	0.793			0.494					
15		0.08266	0.695			0.574					
10		0.1240	0.806			1.154					
5.5	44360	0.2254	1.426			2.562			0.79		
5.0	40330	0.2480	2.131			3.495			0.61		
4.0	32260	0.3100	3.141			1.730			0.38		
3.0	24200	0.4133	4.395			1.247			0.43		
2.0	16130	0.6199	3.549			0.317			0.32		
1.5	12100	0.8266	3.456			0.203			0.31		
1.25	10085	0.9915	3.324						0.29		
1.00	8068	1.239	3.220						0.28		
0.50	4034	2.479	3.114						0.26		
0.30	2420	4.131	3.089						0.26		
0.10	806.8	12.39	3.012						0.25		
0.075	605.1	16.53	2.932						0.24		
0.060	484.1	20.66	2.780			1.46·10 ⁻²			0.22		
0.050	403.4	24.79	2.429			3.35·10 ⁻²			0.17		
0.03992	322	31.06	0.307			3.57					
0.03496	282	35.46	3.89			0.282			0.35		
0.03100	250	40.00	4.27			3.0·10 ⁻²			0.39		
0.02728	220	45.45	3.93			1.3·10 ⁻²			0.35		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n</i> _a	<i>n</i> _c	<i>k</i>	<i>k</i> _a	<i>k</i> _c	<i>R</i>	<i>R</i> _a	<i>R</i> _c
0.02480	200	50.0	3.81			8.7·10 ⁻³			0.34		
0.02418	195	51.28	3.19						0.27		
0.02232	180	55.56	3.19						0.27		
0.01860	150	66.67	3.65						0.32		
0.01240	100	100	3.57						0.32		
0.009919	80	125.0	3.551						0.31		
0.007439	60	166.7	3.538						0.31		
0.004959	40	250.0	3.529						0.31		
0.002480	20	500	3.523						0.31		
0.001240	10	1000.0	3.522						0.31		

Lead Selenide (PbSe) - [Ref. 9]

14.5		0.08551	0.72			0.20					
10		0.1240	0.68			0.50					
5	40330	0.2480	0.54			1.2					
2.0	16130	0.6199	3.65			2.9			0.51		
1.65	13310	0.7514	4.51			1.73			0.46		
1.5	12100	0.8266	4.64			2.64			0.52		
1.0	8065	1.240	4.65			1.1			0.44		
0.75	6049	1.653				0.269					
0.62	5001	2.000	4.59			0.770			0.42		
0.48	3871	2.583	4.90						0.44		
0.40	3226	3.100	4.91						0.44		
0.32	2581	3.875	4.98			0.173			0.44		
0.20	1613	6.199	4.82						0.43		
0.1190	960	10.42	4.74			1.20·10 ⁻³			0.42		
0.09919	800	12.50	4.72			2.09·10 ⁻³			0.42		
0.07935	640	15.63	4.68			4.12·10 ⁻³			0.42		
0.05951	480	20.83	4.59			1.00·10 ⁻²			0.41		
0.04959	400	25.00	4.49			1.77·10 ⁻²			0.40		
0.03968	320	31.25	4.31			3.62·10 ⁻²			0.39		
0.02976	240	41.67	3.89			9.61·10 ⁻²			0.24		
0.01984	160	62.50	2.34			0.56			0.18		
0.009919	80	125.0	1.73			7.38			0.88		
0.007935	64	156.3	2.91			10.1			0.90		
0.004959	40	250.0	11.2			14.6			0.88		
0.002480	20	500.0	12.6			12.2					
0.001736	14	714.3	14.1			16.6					
0.001240	10	1000	17.4			21.1					

Lead Sulfide (PbS) - [Ref. 10]

150		0.008266				3.86·10 ⁻³					
125		0.009919				5.59·10 ⁻³					
100		0.01240				1.54·10 ⁻²					
80		0.01550				2.88·10 ⁻²					
60		0.02066				6.17·10 ⁻²					
25		0.04959	0.845			0.171					
18.0		0.06888	0.846			0.294					
14.0		0.08856	0.651			0.665					
10.0		0.1240	0.879			1.050					
4.95	39920	0.2505	1.52			2.10			0.43		
4.0	32260	0.3100	1.73			2.83			0.55		
3.00	24200	0.4133	3.88			3.00			0.53		
2.90	23390	0.4275	4.12			2.70			0.51		
2.75	22180	0.4509	4.25			2.33			0.48		
2.55	20570	0.4862	4.35			2.00			0.47		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
2.00	16130	0.6199	4.29			1.48			0.43		
1.60	12910	0.7749	4.62			0.94			0.43		
1.24	10000	1.00	4.43			0.597			0.41		
1.03	8333	1.2	4.30			0.458			0.39		
0.650	5263	1.9	4.24			0.318			0.39		
0.496	4000	2.5	4.30			0.235			0.39		
0.400	3226	3.1	4.30			2.27·10 ⁻²			0.39		
0.3100	2500	4.0	4.16			6.38·10 ⁻⁴			0.38		
0.2480	2000	5	4.115			9.25·10 ⁻⁴			0.37		
0.1240	1000	10	4.01			6.32·10 ⁻³			0.36		
0.1033	833.3	12	3.90			1.14·10 ⁻²			0.35		
0.08059	650	15.38	3.90						0.35		
0.06819	550	18.18	3.81						0.34		
0.04959	400	25.00	3.53						0.31		
0.03720	300	33.33	2.99						0.25		
0.02480	200.0	50	0.514			1.59					
0.01378	111.1	90	1.175			8.48			0.94		
0.01240	100.0	100	1.79			10.51			0.94		
0.008856	71.43	140	17.41			17.94			0.89		
0.006199	50.0	200	16.27			2.20			0.79		
0.003100	25.00	400	12.96			0.495			0.73		
0.001653	13.33	750	12.44			0.228			0.72		
0.001240	10.00	1000	12.35			0.167			0.72		
0.0006199	5.000	2000	12.27			0.0815			0.72		

Lead Telluride (PbTe) - [Ref. 11]

150		0.008266				2.37·10 ⁻³					
125		0.009919				9.71·10 ⁻³					
100		0.01240				4.39·10 ⁻²					
75		0.01653				6.43·10 ⁻²					
50		0.02480				6.87·10 ⁻²					
30		0.04133				7.77·10 ⁻²					
15		0.08266	0.72			0.17					
10		0.1240	0.66			0.60					
7.5		0.1653	0.8			0.92					
5.0	40330	0.2480	0.72			1.0					
3.0	24200	0.4133	1.0			2.2					
2.5	20160	0.4959	1.35			2.86			0.61		
1.5	12100	0.8266	3.8			3.1			0.53		
1.0	8065	1.240	4.55			2.2			0.49		
0.80	6452	1.550	6.25			0.71			0.53		
0.60	4839	2.066	6.10			0.521			0.52		
0.40	3226	3.100	6.075			0.331			0.52		
0.30	2420	4.133	5.95			3.55·10 ⁻²			0.51		
0.20	1613	6.199	5.77						0.50		
0.15	1210	8.266	5.76						0.50		
0.1017	820	12.20	5.47			9.16·10 ⁻³			0.48		
0.08927	720	13.89	5.38			1.37·10 ⁻²			0.47		
0.06943	560	17.86	5.13			3.06·10 ⁻²			0.45		
0.04959	400	25.00	4.50			9.6·10 ⁻²			0.40		
0.03968	320	31.25	3.58			0.23			0.32		
0.02976	240	41.67	1.01			1.9					
0.009919	80	125.0	2.95			16.6			0.96		
0.007439	60	166.7	4.9			22.5			0.96		
0.006199	50	200.0	6.9			27.2			0.97		
0.004959	40	250.0	11.6			34.8			0.97		
0.003720	30	333.3	27.7			35.7			0.95		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
0.002480	20	500.0	27.6			39.1			0.95		
0.001240	10	1000	45.1			57.8			0.97		
Lithium Fluoride (LiF) - [Ref. 12]											
2000		6.199·10 ⁻⁴	0.9999347			4.33·10 ⁻⁶					
1496		8.287·10 ⁻⁴	0.999883			1.28·10 ⁻⁵					
1016		1.220·10 ⁻³	0.999757			5.18·10 ⁻⁵					
725		1.710·10 ⁻³	0.999643			1.62·10 ⁻⁴					
504		2.460·10 ⁻³	0.999162			4.96·10 ⁻⁵					
303		4.092·10 ⁻³	0.99752			3.12·10 ⁻⁴					
250		4.959·10 ⁻³	0.99632			6.17·10 ⁻⁵					
200		6.199·10 ⁻³				2.12·10 ⁻³					
150		8.265·10 ⁻³	0.9899			3.54·10 ⁻³					
100		1.240·10 ⁻²	0.9801			1.32·10 ⁻²					
75		1.653·10 ⁻²				2.63·10 ⁻²					
50		2.480·10 ⁻²				7.89·10 ⁻²					
25		4.959·10 ⁻²	0.558			0.521					
20		6.199·10 ⁻²	1.20			0.58			0.10		
15.1		8.211·10 ⁻²	1.08			0.68			0.10		
13		9.537·10 ⁻²	1.04			1.64					
12.0		0.1033	2.28			0.11			0.15		
11.0		0.1127	1.77			8.07·10 ⁻⁷			0.08		
10.00		0.12398	1.606			7.70·10 ⁻⁷			0.05		
9		0.1375	1.53						0.04		
7		0.1771	1.46								
4.959	40000	0.250	1.4189						0.03		
4.000	32260	0.31	1.4073						0.03		
2.952	23810	0.42	1.3978						0.03		
2.000	16130	0.62	1.3915						0.03		
0.9919	8000	1.25	1.3851								
0.7999	6452	1.55	1.3858						0.03		
0.4959	4000	2.5	1.3731						0.02		
0.4000	3226	3.1	1.3650								
0.3100	2500	4.0	1.3493								
0.2480	2000	5.0	1.3266			1.8·10 ⁻⁶			0.02		
0.2000	1613	6.2	1.2912								
0.1698	1370	7.3	1.2499								
0.1494	1205	8.3	1.2036								
0.1240	1000	10.0	1.1005			2.6·10 ⁻³					
0.1127	909.1	11.0	1.0208			8.0·10 ⁻³					
0.1033	833.3	12.0				1.9·10 ⁻²					
0.09537	769.2	13.0				3.7·10 ⁻²					
0.08679	700	14.29	0.508			7.74·10 ⁻²					
0.07439	600	16.67	0.124			0.804					
0.06199	500	20.00	0.306			1.47			0.68		
0.05579	450	22.22	0.191			1.88			0.85		
0.04959	400	25.00	0.208			2.71			0.91		
0.03720	300	33.33	8.76			3.91			0.68		
0.03100	250	40.00	4.64			0.287			0.42		
0.02480	200	50.00	3.69			0.102			0.33		
0.01240	100.0	100	3.067			0.106			0.26		
0.06199	50.0	200	3.067			4.0·10 ⁻²			0.26		
0.04959	40.00	250	3.067			2.2·10 ⁻²			0.26		
0.02480	20.00	500	3.067			6.3·10 ⁻³					
0.01378	11.11	900				3.1·10 ⁻³					
4.798·10 ⁻⁴	3.870	2584	3.023			1.19·10 ⁻³			0.25		
1.464·10 ⁻⁴	1.181	8469	3.023			6.20·10 ⁻⁴			0.25		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E/eV</i>	$\bar{\nu}$ /cm ⁻¹	$\lambda/\mu\text{m}$	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
4.053·10 ⁻⁵	0.3269	30590	3.023			2.63·10 ⁻⁴			0.25		
1.861·10 ⁻⁷	1.501·10 ⁻³	6.662·10 ⁶	3.018			1.6·10 ⁻⁵					
3.718·10 ⁻⁸	2.999·10 ⁻⁴	3.335·10 ⁷	3.018			1.6·10 ⁻⁵					
Potassium Chloride (KCl) - [Ref. 13]											
2860.3		4.3347·10 ⁻⁴				3.93·10 ⁻⁶					
2855.3		4.3423·10 ⁻⁴				3.39·10 ⁻⁶					
2849.3		4.3514·10 ⁻⁴				4.61·10 ⁻⁶					
2835.8		4.3721·10 ⁻⁴				5.85·10 ⁻⁶					
2832.3		4.3775·10 ⁻⁴				5.85·10 ⁻⁶					
2829.8		4.3814·10 ⁻⁴				1.57·10 ⁻⁶					
2828.3		4.3837·10 ⁻⁴				4.19·10 ⁻⁷					
219		5.661·10 ⁻³				1.82·10 ⁻³					
215		5.767·10 ⁻³				1.84·10 ⁻³					
212.5		5.834·10 ⁻³				2.19·10 ⁻³					
211		5.876·10 ⁻³				1.82·10 ⁻³					
185.1		6.7·10 ⁻³	0.99874						1.01·10 ⁻³		
109.7		1.13·10 ⁻²	0.99578						4.22·10 ⁻³		
43		0.02883	0.96			3.0·10 ⁻²					
40		0.03179	0.925			1.8·10 ⁻²					
29.9		0.04147	0.756			0.145					
20.1		0.06168	0.910			0.495					
15.1		0.08211	0.965			0.344					
10.0		0.1240	1.16			0.38			0.035		
9.0		0.1378	1.99			0.50			0.13		
8.0		0.1550	1.15			0.46			0.048		
7.0		0.1771	2.0			8.46·10 ⁻⁷			0.11		
6.199	50000	0.20	1.71739						0.070		
4.959	40000	0.25	1.58972								
3.999	32260	0.31	1.54005								
2.952	23810	0.42	1.50701								
2.695	21740	0.46	1.50115						0.040		
2.616	21100	0.474				7.6·10 ⁻¹¹					
2.384	19230	0.52	1.49501								
2.066	16670	0.60	1.48969						0.039		
1.550	12500	0.80	1.48291						0.038		
1.033	8333	1.2	1.47813						0.037		
0.5166	4167	2.4	1.47464						0.037		
0.2480	2000	5.0	1.47048						0.036		
0.2000	1.613	6.2	1.46796						0.036		
0.1512	1220	8.2	1.46260						0.035		
0.09999	806.5	12.4	1.44611						0.033		
0.07560	609.8	16.4	1.42295						0.030		
0.04959	400.0	25.0	1.34059			6.57·10 ⁻⁴			0.021		
0.03999	322.6	31.0	1.2431						0.012		
0.02976	240	41.67	0.85			0.16					
0.02728	220	45.45	0.53			0.35					
0.02232	180	55.56	0.31			1.05					
0.01860	150	66.67	0.44			4.0					
0.01612	130	76.92	4.1			0.32			0.37		
0.01240	100	100.0	2.7			0.11			0.21		
0.008679	70	142.9	2.4			9.2·10 ⁻²			0.17		
0.006199	50	200.0	2.2						0.14		
0.001240	10.00	1000				9.0·10 ⁻³					
0.0006199	5.000	2000				3.7·10 ⁻³					
0.0004133	3.333	3000				2.0·10 ⁻³					

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
Silicon Dioxide (Glass) - [Ref. 14]											
2000		6.199·10 ⁻⁴	0.99993			1.503·10 ⁻⁵					
1860		6.665·10 ⁻⁴	0.99991			1.936·10 ⁻⁵					
1609		7.705·10 ⁻⁴	0.99989			9.941·10 ⁻⁶					
1496		8.287·10 ⁻⁴	0.99987			1.308·10 ⁻⁵					
1204		1.030·10 ⁻³	0.99980			2.916·10 ⁻⁵					
1093		1.134·10 ⁻³	0.99975			4.155·10 ⁻⁵					
1016		1.220·10 ⁻³	0.99971			5.423·10 ⁻⁵					
798		1.554·10 ⁻³	0.99954			1.289·10 ⁻⁴					
597		2.077·10 ⁻³	0.99917			3.560·10 ⁻⁴					
396		3.131·10 ⁻³	0.99812			4.04·10 ⁻⁴					
303		4.092·10 ⁻³	0.99678			9.91·10 ⁻⁴					
201		6.168·10 ⁻³	0.99269			3.63·10 ⁻³					
151.2		8.2·10 ⁻³	0.9871			7.3·10 ⁻³					
99.99		1.24·10 ⁻²	0.9813			7.0·10 ⁻³					
49.59		2.50·10 ⁻²	0.9164			6.5·10 ⁻²					
40.00		3.10·10 ⁻²	0.907			9.2·10 ⁻²					
31.00		4.00·10 ⁻²	0.851			0.156					
25.00		0.04959	0.733			0.325					
20.00		0.06199	0.859			0.585					
15.00		0.08266	1.168			0.711			0.10		
13.00		0.09537	1.368			0.747			0.11		
11.00		0.1127	1.739			0.569			0.11		
10.00		0.1240	2.330			0.323			0.17		
9.00		0.1378	1.904			1.89·10 ⁻²			0.097		
7.00		0.1771	1.600						0.053		
6.00	48390	0.2066	1.543						0.046		
4.9939	40278.4	0.248272	1.50841						0.041		
4.1034	33096.1	0.302150	1.48719						0.038		
3.0640	24712.3	0.404656	1.46961						0.036		
2.5504	20570.5	0.486133	1.46313						0.035		
2.4379	19662.5	0.508582	1.46187						0.035		
2.2705	18312.5	0.546074	1.46008						0.035		
2.1489	17332.3	0.576959	1.45885						0.035		
2.1411	17269.2	0.579065	1.45877						0.035		
2.1102	17019.5	0.587561	1.45847						0.035		
2.1041	16970.4	0.589262	1.45841						0.035		
1.9257	15531.6	0.643847	1.45671						0.035		
1.8892	15237.6	0.656272	1.45637						0.035		
1.8566	14974.2	0.667815	1.45608						0.034		
1.7549	14153.9	0.706519	1.45515						0.034		
1.4550	11735.6	0.852111	1.45248						0.034		
1.0985	8860.06	1.12866	1.44888						0.034		
0.60243	4858.9	2.0581	1.43722						0.032		
0.35354	2851.4	3.5070	1.40568						0.028		
0.2976	2400	4.176	1.383			1.07·10 ⁻⁴			0.026		
0.2728	2200	4.545	1.365			2.56·10 ⁻⁴			0.024		
0.2480	2000	5.000	1.342			3.98·10 ⁻³			0.021		
0.2232	1800	5.556	1.306			5.63·10 ⁻³					
0.1984	1600	6.250	1.239			6.52·10 ⁻³					
0.1736	1400	7.143	1.053			1.06·10 ⁻²					
0.1674	1350	7.407	0.9488			1.48·10 ⁻²					
0.1612	1300	7.692	0.7719			3.72·10 ⁻²					
0.1500	1210	8.265	0.4530			0.704			0.30		
0.1401	1130	8.850	0.3563			1.53			0.66		
0.1302	1050	9.524	2.760			1.65			0.35		
0.1209	975	10.26	2.448			0.231			0.18		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E/eV</i>	$\bar{\nu}/\text{cm}^{-1}$	$\lambda/\mu\text{m}$	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
0.1091	880	11.36	1.784			7.75·10 ⁻²			0.079		
0.09919	800	12.50	1.753			0.343			0.089		
0.08989	725	13.79	1.698			0.175			0.071		
0.06943	560	17.86	1.337			0.298			0.036		
0.06199	500	20.00	0.6616						0.882		
0.04959	400	25.0				0.397			0.23		
0.03720	300	33.33	2.210			6.7·10 ⁻²			0.14		
0.01240	100	100.0	1.967			1.59·10 ⁻²			0.11		
0.007439	60	166.7	1.959			8.62·10 ⁻³			0.11		
0.002480	20	500.0	1.955			7.96·10 ⁻³			0.10		

Silicon Monoxide (Noncrystalline) - [Ref. 15]

25		0.04959	0.8690			0.2717					
20		0.06199	0.8853			0.4919					
17.5		0.07085	0.9825			0.5961					
15		0.08266	1.132			0.6651			0.092		
12.5		0.09919	1.283			0.6523			0.090		
10		0.1240	1.378			0.6843			0.10		
7.5		0.1653	1.593			0.7473			0.12		
5	40330	0.2480	2.001			0.6052			0.15		
4	32260	0.3100	2.141			0.4006			0.15		
3	24200	0.4133	2.116			0.1211			0.13		
2.8	22580	0.4428	2.085			0.08374			0.12		
2.6	20970	0.4769	2.053			0.05544			0.12		
2.4	19360	0.5166	2.021			0.03533			0.11		
2.2	17740	0.5636	1.994			0.02153			0.11		
2	16130	0.6199	1.969			0.01175			0.11		
1.8	14520	0.6888	1.948			0.00523			0.10		
1.6	12900	0.7749	1.929			0.00151			0.10		
1.240	10000	1.000	1.87						0.092		
0.6199	5000	2.000	1.84						0.087		
0.3100	2500	4.000	1.80						0.082		
0.2480	2000	5.000	1.75						0.074		
0.2066	1667	6.000	1.70						0.067		
0.1771	1492	7.000	1.60						0.053		
0.1653	1333	7.500	1.42								
0.1459	1176	8.500	0.90			0.18					
0.1305	1053	9.500	1.20			1.20			0.024		
0.1240	1000	10.00	2.00			1.38			0.27		
0.1181	952.4	10.50	2.85			0.90			0.27		
0.1153	930.2	10.75	2.86			0.58			0.25		
0.1127	909.1	11.00	2.82			0.40			0.24		
0.1078	869.6	11.50	2.50			0.20			0.19		
0.1033	833.3	12.00	2.13			0.14			0.13		
0.09537	769.2	13.00	2.04			0.20			0.12		
0.08856	714.3	14.00	2.01			0.30			0.12		

Noncrystalline Silicon Nitride (Si₃N₄) - [Ref. 16]

24		0.05166	0.655			0.420			0.28		
23		0.05391	0.625			0.481			0.22		
22		0.05636	0.611			0.560			0.16		
21		0.05904	0.617			0.647			0.19		
20		0.06199	0.635			0.743			0.21		
19		0.06526	0.676			0.841			0.23		
18		0.06888	0.735			0.936			0.26		
17		0.07293	0.810			1.03			0.25		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E/eV</i>	$\bar{\nu}/\text{cm}^{-1}$	$\lambda/\mu\text{m}$	<i>n</i>	<i>n_a</i>	<i>n_c</i>	<i>k</i>	<i>k_a</i>	<i>k_c</i>	<i>R</i>	<i>R_a</i>	<i>R_c</i>
16		0.07749	0.902			1.11			0.26		
15		0.08266	1.001			1.18			0.26		
14		0.08856	1.111			1.26			0.26		
13		0.09537	1.247			1.35			0.27		
12	96790	0.1033	1.417			1.43			0.28		
11	88720	0.1127	1.657			1.52			0.29		
10.5	84690	0.1181	1.827			1.53			0.29		
10	80650	0.1240	2.000			1.49			0.29		
9.5	76620	0.1305	2.162			1.44			0.28		
9	72590	0.1378	2.326			1.32			0.27		
8	64520	0.1550	2.651			0.962			0.26		
7	56460	0.1771	2.752			0.493			0.23		
6	48390	0.2066	2.541			0.102			0.19		
5	40330	0.2480	2.278			4.9·10 ⁻³			0.15		
4.75	38310	0.2610	2.234			1.2·10 ⁻³			0.15		
4.5	36290	0.2755	2.198			2.2·10 ⁻⁴			0.14		
4	32260	0.3100	2.141						0.13		
3.5	28230	0.3542	2.099						0.13		
3	24200	0.4133	2.066						0.12		
2.5	20160	0.4959	2.041						0.12		
2	16130	0.6199	2.022						0.11		
1.5	12100	0.8266	2.008						0.11		
1	8065	1.240	1.998						0.11		

Sodium Chloride (NaCl) - [Ref. 17]

209.5		5.918·10 ⁻³				2.54·10 ⁻³					
206		6.019·10 ⁻³				2.62·10 ⁻³					
203		6.107·10 ⁻³				2.08·10 ⁻³					
200		6.199·10 ⁻³				1.92·10 ⁻³					
26.0		0.04769	0.83			0.15			0.015		
25.0		0.04959	0.83			0.18			0.018		
22.0		0.05636	0.83			0.31			0.057		
20.0		0.06199	0.88			0.34			0.036		
18.0		0.06888	0.89			0.33			0.033		
16.1		0.07700	0.74			0.45			0.084		
14.0		0.08856	0.98			0.89			0.17		
12.0		0.1033	1.22			0.79			0.12		
10.0		0.1240	1.55			0.71			0.12		
8.00		0.1550	1.38			1.10			0.20		
6.00	48390	0.2066	1.75						0.074		
5.00	40330	0.2480	1.65						0.060		
2.952	23810	0.42	1.56324						0.048		
2.480	20000	0.50	1.55157						0.047		
2.214	17860	0.56	1.54613						0.046		
2.000	16130	0.62	1.54228						0.045		
1.771	14290	0.70	1.53865						0.045		
1.675	13510	0.74	1.53728						0.045		
1.550	12500	0.80	1.53560						0.045		
1.240	10000	1.00	1.53200						0.044		
1.033	8333	1.2	1.53000						0.044		
0.6888	5556	1.8	1.52712						0.043		
0.4959	4000	2.5	1.52531						0.043		
0.4000	3226	3.1	1.52395						0.043		
0.3263	2632	3.8	1.52226			(1.8±0.2)·10 ⁻³			0.043		
0.2952	2381	4.2	1.52121						0.043		
0.2755	2222	4.5	1.52036						0.043		
0.2480	2000	5.0	1.51883						0.042		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n</i> _a	<i>n</i> _c	<i>k</i>	<i>k</i> _a	<i>k</i> _c	<i>R</i>	<i>R</i> _a	<i>R</i> _c
0.1240	1000	10.0	1.49473						0.039		
0.1033	833.3	12.0	1.48000						0.037		
0.08856	714.3	14.0	1.46188						0.035		
0.07749	625.0	16.0	1.4399						0.033		
0.06888	555.5	18.0	1.41364						0.029		
0.06199	500.0	20.0	1.3822						0.026		
0.04959	400	25.0	1.27			3.5·10 ⁻³			0.014		
0.04215	340	29.41	1.12			1.7·10 ⁻²			0.0032		
0.03720	300	33.33	0.85			0.85			0.18		
0.03410	275	36.36	0.59			0.22			0.084		
0.03286	265	37.74	0.42			0.50			0.26		
0.03224	260	38.46	0.45			0.45			0.22		
0.02480	200	50.00	0.14			1.99			0.89		
0.02108	170	58.82	1.35			6.03			0.87		
0.01984	160	62.50	6.92			2.14			0.59		
0.01922	155	64.52	5.50			0.87			0.49		
0.01860	150	66.67	4.52			0.380			0.41		
0.01736	140	71.43	3.72			0.219			0.33		
0.01612	130	76.92	3.31			0.135			0.29		
0.01488	120	83.33	3.02			0.110			0.25		
0.01240	100	100.0	2.74			0.087			0.22		
0.009919	80	125.0	2.57			0.077			0.19		
0.07439	60	166.7	2.48			0.055			0.18		
0.04959	40	250.00	2.44			0.041			0.18		
0.002480	20	500.0	2.43			0.024			0.17		
0.001240	10	1000	2.43			0.006			0.17		
0.001033	8.333	1200				8.8·10 ⁻³					
0.0006888	5.556	1800				5.4·10 ⁻³					
0.0006199	5.000	2000	2.43						0.17		
0.0004959	4.000	2500				4.4·10 ⁻³					
0.0004797	3.869	2584	2.43			2.1·10 ⁻³			0.17		
0.0003875	3.125	3200				3.3·10 ⁻³					
0.0001464	1.181	8469	2.43			5.8·10 ⁻⁴			0.17		
0.00004053	0.3269	30590	2.43			2.5·10 ⁻⁴					

Cubic Zinc Sulfide (ZnS) - [Ref. 18]

2000		6.199·10 ⁻⁴	0.999904			1.76·10 ⁻⁵					
1204		1.030·10 ⁻³	0.999777			1.00·10 ⁻⁴					
1016		1.220·10 ⁻³	0.999838			3.61·10 ⁻⁵					
901		1.376·10 ⁻³	0.999647			5.42·10 ⁻⁵					
798		1.554·10 ⁻³	0.999520			8.28·10 ⁻⁵					
707		1.754·10 ⁻³	0.999372			1.25·10 ⁻⁴					
597		2.077·10 ⁻³	0.999160			2.19·10 ⁻⁴					
377		9.50·10 ⁻³	0.99789			9.50·10 ⁻⁴					
201		6.168·10 ⁻³	0.99553			4.82·10 ⁻³					
100		1.240·10 ⁻²	0.99061			1.17·10 ⁻²					
61.99		2.000·10 ⁻²	0.964			3.32·10 ⁻²			6.2·10 ⁻⁴		
41.33		3.000·10 ⁻²	0.941			5.10·10 ⁻²					
31.00		4.000·10 ⁻²	0.847			9.95·10 ⁻²					
24.80		5.000·10 ⁻²	0.796			0.171			2.2·10 ⁻²		
17.71		7.000·10 ⁻²	0.747			0.431			7.7·10 ⁻²		
13.78		9.000·10 ⁻²	0.758			0.824			0.20		
12.40		0.1000	0.862			0.876			0.19		
9.919		0.125	1.02			1.36			0.31		
8.266		0.150	1.41			1.47			0.29		
6.199		0.200	2.32			1.62			0.32		
6.00	48390	0.2066	2.24			1.65			0.59		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

<i>E</i> /eV	$\bar{\nu}$ /cm ⁻¹	λ /μm	<i>n</i>	<i>n</i> _a	<i>n</i> _c	<i>k</i>	<i>k</i> _a	<i>k</i> _c	<i>R</i>	<i>R</i> _a	<i>R</i> _c
4.00	32260	0.3100	2.70			0.44			0.22		
3.00	24200	0.4133	2.54			4·10 ⁻²			0.19		
2.50	20160	0.4959	2.42			3·10 ⁻²			0.17		
2.30	18550	0.5391	2.3950						0.17		
2.00	16130	0.6199	2.3576						0.16		
1.75	14110	0.7085	2.3319						0.16		
1.55	12500	0.7999	2.3146			3.50·10 ⁻⁶			0.16		
1.40	11290	0.8856	2.3033						0.16		
1.240	10000	1.000	2.2907			3.02·10 ⁻⁶			0.15		
1.00	8065	1.240	2.2795						0.15		
0.80	6452	1.550	2.2706						0.15		
0.6199	5000	2.000	2.2631			6.2·10 ⁻⁶			0.15		
0.45	3629	2.755	2.2587						0.15		
0.30	2420	4.133	2.2529						0.15		
0.20	1613	6.199	2.2443						0.15		
0.1550	1250	8.0	2.2213			4.5·10 ⁻⁶			0.14		
0.1240	1000	10.00	2.1986			8.8·10 ⁻⁶			0.14		
0.100	806.5	12.4	2.1969						0.14		
0.09	725.9	13.78	2.1793						0.14		
0.07999	645.2	15.5	2.1518			3.82·10 ⁻³			0.14		
0.07	564.6	17.71	2.1040						0.13		
0.06075	490	20.41	2.03			8.0·10 ⁻³			0.12		
0.05	403.3	24.80	1.6866						0.065		
0.03546	286	34.97	3.29			8.3·10 ⁻²			0.28		
0.03472	280	35.71	9.54			5.2·10 ⁻²			0.66		
0.02480	200	50.00	3.48			3.1·10 ⁻²			0.31		
0.01240	100	100.0	3.06			5.8·10 ⁻³			0.26		
0.004955	40	250.0	2.903			6.2·10 ⁻³			0.24		
0.004339	35	285.7	2.899			7.0·10 ⁻³			0.24		
0.003720	30	333.3	2.896						0.24		
0.003100	25	400.0	2.894						0.24		
0.002480	20	500.0	2.892						0.24		
0.001860	15	666.7	2.890						0.24		

Polytetrafluoroethylene (Teflon) - [Ref. 19]

4.960	40000	0.250							0.970		
4.769	38462	0.260							0.972		
4.593	37037	0.270							0.975		
4.426	35714	0.280							0.978		
4.276	34483	0.290							0.980		
4.133	33333	0.300							0.983		
4.000	32258	0.310							0.986		
3.875	31250	0.320							0.988		
3.758	30303	0.330							0.990		
3.647	29412	0.340							0.991		
3.543	28571	0.350							0.992		
3.444	27778	0.360							0.992		
3.351	27027	0.370							0.993		
2.255	18182	0.550							0.993		
2.067	16667	0.600							0.992		
1.378	11111	0.900							0.992		
1.305	10526	0.950							0.991		
1.078	8696	1.150							0.991		
1.033	8333	1.200							0.990		
0.9920	8000	1.250							0.990		
0.9538	7692	1.300							0.989		
0.9185	7407	1.350							0.988		

OPTICAL PROPERTIES OF SELECTED INORGANIC AND ORGANIC SOLIDS (continued)

E/eV	$\bar{\nu}/cm^{-1}$	$\lambda/\mu m$	n	n_a	n_c	k	k_a	k_c	R	R_a	R_c
0.8857	7143	1.400							0.988		
0.8552	6897	1.450							0.989		
0.8267	6667	1.500							0.989		
0.8000	6452	1.550							0.988		
0.7750	6250	1.600							0.988		
0.7515	6061	1.650							0.987		
0.7294	5882	1.700							0.986		
0.7086	5714	1.750							0.986		
0.6889	5556	1.800							0.985		
0.6703	5405	1.850							0.980		
0.6526	5263	1.900							0.978		
0.6359	51282	1.950							0.978		
0.6200	5000	2.000							0.970		
0.6049	4878	2.050							0.959		
0.5905	4762	2.100							0.951		
0.5767	4651	2.150							0.946		
0.5636	4545	2.200							0.966		
0.5511	44444	2.250							0.965		
0.5487	44247	2.260							0.964		
0.5439	4386	2.280							0.963		
0.5415	4367	2.290							0.961		
0.5368	4329	2.310							0.959		
0.5345	4310	2.320							0.957		
0.5322	4292	2.330							0.956		
0.5299	4274	2.340							0.954		
0.5277	4255	2.350							0.951		
0.5232	4219	2.370							0.950		
0.5188	4184	2.390							0.949		
0.5167	4167	2.400							0.947		
0.5061	4082	2.450							0.946		
0.4960	4000	2.500							0.945		

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FERMI ENERGY AND RELATED PROPERTIES OF METALS

Lev. I. Berger

In the classical Drude theory of metals, the Maxwell-Boltzmann velocity distribution of electrons is used. It states that the number of electrons per unit volume with velocities in the range of $d\vec{v}$ about any magnitude \vec{v} at temperature T is

$$f_B(\vec{v})d\vec{v} = n \left(\frac{m}{2\pi k_B T} \right) \exp\left(-\frac{mv^2}{2k_B T} \right) d\vec{v}$$

where n is the total number of conduction electrons in a unit volume of a metal, m is the free electron mass, and k_B is the Boltzmann constant. In an attempt to explain a substantial discrepancy between the experimental data on the specific heat of metals and the values calculated on the basis of the Drude model, Sommerfeld suggested a model of the metal in which the Pauli exclusion principle is applied to free electrons. In this case, the Maxwell-Boltzmann distribution is replaced by the Fermi-Dirac distribution:

$$f(\vec{v})d\vec{v} = 2 \left(\frac{m}{h} \right)^3 d\vec{v} \left\{ \exp\left[\left(\frac{mv^2}{2} - k_B T_0 \right) / k_B T \right] + 1 \right\}^{-1}$$

Here h is the Planck constant and T_0 is a characteristic temperature which is determined by the normalization condition

$$n = \int d\vec{v} \cdot f(\vec{v})$$

The magnitude of T_0 is quite high; usually, $T_0 > 10^4$ K. So, at common temperatures ($T < 10^3$ K), the free electron density of a metal is much smaller than in the case of the Maxwell-Boltzmann distribution. This allows us to explain why the experimental data on specific heat for metals are close to those for insulators.

The maximum kinetic energy the electrons of a metal may possess at $T = 0$ K is called the Fermi energy, e.g.,

$$E_F = \frac{\hbar^2 k_F^2}{2m} = \left(\frac{e^2}{2k_B} \right) (k_F r_B)^2$$

where k_F is the Fermi momentum or the Fermi wave vector

$$k_F = (3\pi^2 n)^{1/3}$$

e is the electron charge, and r_B is the Bohr radius

$$r_B = \hbar^2 / me^2 = 0.529 \cdot 10^{-10} \text{ m}$$

Another, more common expression for the Fermi energy is

$$E_F = \frac{1}{2} m v_F^2$$

where $v_F = \hbar k_F / m$ is the Fermi velocity which can be expressed using the concept of the electron radius, r_s . It is equal to radius of a sphere occupied by one free electron. If the total volume of a metal sample is V and the number of conduction electrons in this volume is N , then the volume per electron is equal to

$$\frac{V}{N} = \frac{1}{n} = \frac{4}{3} \pi r_s^3$$

and

$$r_s = \left(\frac{3}{4\pi n} \right)^{1/3}$$

The following table contains information pertinent to the Sommerfeld model for some metals. The magnitudes of T_0 are calculated using the expression

$$T_0 = \frac{E_F}{k_B} = \frac{58.2 \cdot 10^4}{(r_s / r_B)^2} \text{ K}$$

FERMI ENERGY AND RELATED PROPERTIES OF METALS (continued)

Ground State Properties of the Electron Gas in Some Metals

Metal	Valency	$n/10^{28} \text{ m}^{-3}$	r_s/pm	r_s/r_B	E_F/eV	$T_0/10^4 \text{ K}$	$k_F/10^{10} \text{ m}^{-1}$	$v_F/10^6 \text{ m/s}$
Li ^a	1	4.70	172	3.25	4.74	5.51	1.12	1.29
Na ^b	1	2.65	208	3.93	3.24	3.77	0.92	1.07
K ^b	1	1.40	257	4.86	2.12	2.46	0.75	0.86
Rb ^b	1	1.15	275	5.20	1.85	2.15	0.70	0.81
Cs ^b	1	0.91	298	5.62	1.59	1.84	0.65	0.75
Cu	1	8.47	141	2.67	7.00	8.16	1.36	1.57
Ag	1	5.86	160	3.02	5.49	6.38	1.20	1.39
Au	1	5.90	159	3.01	5.53	6.42	1.21	1.40
Be	2	24.7	99	1.87	14.3	16.6	1.94	2.25
Mg	2	8.61	141	2.66	7.08	8.23	1.36	1.58
Ca	2	4.61	173	3.27	4.69	5.44	1.11	1.28
Sr	2	3.55	189	3.57	3.93	4.57	1.02	1.18
Ba	2	3.15	196	3.71	3.64	4.23	0.98	1.13
Nb	1	5.56	163	3.07	5.32	6.18	1.18	1.37
Fe	2	17.0	112	2.12	11.1	13.0	1.71	1.98
Mn ^c	2	16.5	113	2.14	10.9	12.7	1.70	1.96
Zn	2	13.2	122	2.30	9.47	11.0	1.58	1.83
Cd	2	9.27	137	2.59	7.47	8.68	1.40	1.62
Hg ^d	2	8.65	140	2.65	7.13	8.29	1.37	1.58
Al	3	18.1	110	2.07	11.7	13.6	1.75	2.03
Ga	3	15.4	116	2.19	10.4	12.1	1.66	1.92
In	3	11.5	127	2.41	8.63	10.0	1.51	1.74
Tl	3	10.5	131	2.48	8.15	9.46	1.46	1.69
Sn	4	14.8	117	2.22	10.2	11.8	1.64	1.90
Pb	4	13.2	122	2.30	9.47	11.0	1.58	1.83
Bi	5	14.1	119	2.25	9.90	11.5	1.61	1.87
Sb	5	16.5	113	2.14	10.9	12.7	1.70	1.96

^a At 78 K.

^b At 5 K.

^c α -phase.

The data in the table are for atmospheric pressure and room temperature unless otherwise noted.

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NOMENCLATURE FOR ORGANIC POLYMERS

Robert B. Fox and Edward S. Wilks

Organic polymers have traditionally been named on the basis of the monomer used, a hypothetical monomer, or a semi-systematic structure. Alternatively, they may be named in the same way as organic compounds, i.e., on the basis of a structure as drawn. The former method, often called “source-based nomenclature” or “monomer-based nomenclature”, sometimes results in ambiguity and multiple names for a single material. The latter method, termed “structure-based nomenclature”, generates a sometimes cumbersome unique name for a given polymer, independent of its source. Within their limitations, both types of names are acceptable and well-documented.¹ The use of stereochemical descriptors with both types of polymer nomenclature has been published.²

Traditional Polymer Names

Monomer-Based Names

“Polystyrene” is the name of a homopolymer made from the single monomer styrene. When the name of a monomer comprises two or more words, the name should be enclosed in parentheses, as in “poly(methyl methacrylate)” or “poly(4-bromostyrene)” to identify the monomer more clearly. This method can result in several names for a given polymer: thus, “poly(ethylene glycol)”, “poly(ethylene oxide)”, and “poly(oxirane)” describe the same polymer. Sometimes, the name of a hypothetical monomer is used, as in “poly(vinyl alcohol)”. Even though a name like “poly-ethylene” covers a multitude of materials, the system does provide understandable names when a single monomer is involved in the synthesis of a single polymer. When one monomer can yield more than one polymer, e.g. 1,3-butadiene or acrolein, some sort of structural notation must be used to identify the product, and one is not far from a formal structure-based name.

Copolymers, Block Polymers, and Graft Polymers. When more than one monomer is involved, monomer-based names are more complex. Some common polymers have been given names based on an apparent structure, as with “poly(ethylene terephthalate)”. A better system has been approved by the IUPAC.¹ With this method, the arrangement of the monomeric units is introduced through use of an italicized connective placed between the names of the monomers. For monomer names represented by A, B, and C, the various types of arrangements are shown in Table 1.

Table 1. IUPAC Source-Based Copolymer Classification

No.	Copolymer Type	Connective	Example
1	Unspecified or unknown	-co-	poly(A-co-B)
2	Random (obeys Bernoullian distribution)	-ran-	poly(A-ran-B)
3	Statistical (obeys known statistical laws)	-stat-	poly(A-stat-B)
4	Alternating (for two monomeric units)	-alt-	poly(A-alt-B)
5	Periodic (ordered sequence for 2 or more monomeric units)	-per-	poly(A-per-B-per-C)
6	Block (linear block arrangement)	-block-	polyA-block-polyB
7	Graft (side chains connected to main chains)	-graft-	polyA-graft-polyB

Table 2 contains examples of common or semi-systematic names of copolymers. The systematic names of comonomers may also be used; thus, the polyacrylonitrile-*block*-polybutadiene-*block*-polystyrene polymer in Table 2 may also be named poly(prop-2-enenitrile)-*block*-polybuta-1,3-diene-*block*-poly(ethenylbenzene). IUPAC does not require alphabetized names of comonomers within a polymer name; many names are thus possible for some copolymers.

These connectives may be used in combination and with small, non-repeating (i.e. non-polymeric) junction units; see, for example, Table 2, line 8. A long dash may be used in place of the connective *-block-*; thus, in Table 2, the polymers of lines 7 and 8 may also be written as shown on lines 9 and 10.

Table 2. Examples of Source-Based Copolymer Nomenclature

No.	Copolymer name
1	poly(propene-co-methacrylonitrile)
2	poly[(acrylic acid)-ran-(ethyl acrylate)]
3	poly(butene-stat-ethylene-stat-styrene)
4	poly[(sebacic acid)-alt-butanediol]
5	poly[(ethylene oxide)-per-(ethylene oxide)-per-tetrahydrofuran]
6	polyisoprene-graft-poly(methacrylic acid)
7	polyacrylonitrile-block-polybutadiene-block-polystyrene
8	polystyrene-block-dimethylsilylene-block-polybutadiene
9	polyacrylonitrile—polybutadiene—polystyrene
10	polystyrene—dimethylsilylene—polybutadiene

IUPAC also recommends an alternative scheme for naming copolymers that comprises use of “copoly” as a prefix followed by the names of the comonomers, a solidus (an oblique stroke) to separate comonomer names, and addition before “copoly” of any applicable connectives listed in Table 2 except *-co-*.

Table 3 gives the same examples shown in Table 2 but with the alternative format. Comonomer names need not be parenthesized.

NOMENCLATURE FOR ORGANIC POLYMERS (continued)

Table 3. Examples of Source-Based Copolymer Nomenclature (Alternative Format)

No.	Polymer name
1	copoly(propene/methacrylonitrile)
2	-copoly(acrylic acid/ethyl acrylate)
3	-copoly(butene/ethylene/styrene)
4	-copoly(sebacic acid/butanediol)
5	-copoly(acrylonitrile/butadiene/styrene)
6	-copoly(ethylene oxide/ethylene oxide/tetrahydrofuran)
7	-copoly(isoprene/methacrylic acid)

Table 4. Connectives for Non-Linear Macromolecules and Macromolecular Assemblies

No.	Type	Connective
1	Branched (type unspecified)	branch
2	Branched with branch point of functionality f	f-branch
3	Comb	comb
4	Cross-link	ι (Greek iota)
5	Cyclic	cyclo
6	Interpenetrating polymer network	ipn
7	Long-chain branched	l-branch
8	Network	net
9	Polymer blend	blend
10	Polymer-polymer complex	compl
11	Semi-interpenetrating polymer network	sipn
12	Short-chain branched	sh-branch
13	Star	star
14	Star with f arms	f-star

Non-linear polymers are named by using the italicized connective as a *prefix* to the source-based name of the polymer component or components to which the prefix applies; some examples are listed in Table 5.

Table 5. Non-Linear Macromolecules

No.	Polymer Name	Polymer Structural Features
1	poly(methacrylic acid)- <i>comb</i> -polyacrylonitrile	Comb polymer with a poly(methacrylic acid) backbone and polyacrylonitrile side chains
2	<i>comb</i> -poly[ethylene- <i>stat</i> -(vinyl chloride)]	Comb polymer with unspecified backbone composition and statistical ethylene/vinyl chloride copolymer side chains
3	polybutadiene- <i>comb</i> -(polyethylene; polypropene)	Comb polymer with butadiene backbone and side chains of polyethylene and polypropene
4	<i>star</i> -(polyA; polyB; polyC; polyD; polyE)	Star polymer with arms derived from monomers A, B, C, D, and E, respectively
5	<i>star</i> -(polyA- <i>block</i> -polyB- <i>block</i> -polyC)	Star polymer with every arm comprising a tri-block segment derived from comonomers A, B, and C
6	<i>star</i> -poly(propylene oxide)	A star polymer prepared from propylene oxide
7	5- <i>star</i> -poly(propylene oxide)	A 5-arm star polymer prepared from propylene oxide
8	<i>star</i> -(polyacrylonitrile; polypropylene) (M_n 10000; 25000)	A star polymer containing polyacrylonitrile arms of MW 10000 and polypropylene arms of MW 25000

Macromolecular assemblies held together by forces other than covalent bonds are named by inserting the appropriate italicized connective between names of individual components; Table 6 gives examples.

Table 6. Examples of Polymer Blends and Nets

No.	Polymer Name
1	polyethylene- <i>blend</i> -polypropene
2	poly(methacrylic acid)- <i>blend</i> -poly(ethyl acrylate)
3	<i>net</i> -poly(4-methylstyrene- ι -divinylbenzene)
4	<i>net</i> -poly(styrene- <i>alt</i> -(maleic anhydride))- ι -(polyethylene glycol; polypropylene glycol)
5	<i>net</i> -poly(ethyl methacrylate)- <i>sipn</i> -polyethylene
6	[<i>net</i> -poly(butadiene- <i>stat</i> -styrene)]- <i>ipn</i> -[<i>net</i> -poly(4-methylstyrene- ι -divinylbenzene)]

Structure-Based Polymer Nomenclature

Regular Single-Strand Polymers

Structure-based nomenclature has been approved by the IUPAC⁴ and is currently being updated; it is used by *Chemical Abstracts*.⁵ Monomer names are not used. To the extent that a polymer chain can be described by a repeating unit in the chain, it can be named “poly(repeating unit)”. For regular single-strand polymers, “repeating unit” is a bivalent group; for regular double-strand (ladder and spiro) polymers, “repeating unit” is usually a tetravalent group.⁹

Since there are usually many possible repeating units in a given chain, it is necessary to select one, called the “constitutional repeating unit” (CRU) to provide a unique and unambiguous name, “poly(CRU)”, where “CRU” is a recitation of the names of successive units as one proceeds through the CRU from left to right. For this purpose, a portion of the main chain structure that includes at least two repeating sequences is written out. These sequences will typically be composed of bivalent subunits such as $-\text{CH}_2-$, $-\text{O}-$, and groups from ring systems, each of which can be named by the usual nomenclature rules.^{6,7}

Where a chain is simply one long sequence comprising repetition of a single subunit, that subunit is itself the CRU, as in “poly(methylene)” or “poly(1,4-phenylene)”. In chains having more than one kind of subunit, a seniority system is used to determine the beginning of the CRU and the direction in which to move along the main chain atoms (following the shortest path in rings) to complete the CRU. Determination of the first, most senior, subunit, is based on a descending order of seniority: (1) heterocyclic rings, (2) hetero atoms, (3) carbocyclic rings, and, lowest, (4) acyclic carbon chains.

Within each of these classes, there is a further order of seniority that follows the usual rules of nomenclature.

Heterocycles: A nitrogen-containing ring system is senior to a ring system not containing nitrogen.^{4,9} Further descending order of seniority is determined by:

- (i) the highest number of rings in the ring system
- (ii) the largest individual ring in the ring system
- (iii) the largest number of hetero atoms
- (iv) the greatest variety of hetero atoms

Hetero atoms: The senior bivalent subunit is the one nearest the top, right-hand corner of the Periodic Table; the order of seniority is: O, S, Se, Te, N, P, As, Sb, Bi, Si, Ge, Sn, Pb, B, Hg.

Carbocycles: Seniority⁴ is determined by:

- (i) the highest number of rings in the ring system
- (ii) the largest individual ring in the ring system
- (iii) degree of ring saturation; an unsaturated ring is senior to a saturated ring of the same size

Carbon chains: Descending order of seniority is determined by:

- (i) chain length (longer is senior to shorter)
- (ii) highest degree of unsaturation
- (iii) number of substituents (higher number is senior to lower number)
- (iv) ascending order of locants
- (v) alphabetical order of names of substituent groups

Among equivalent ring systems, preference is given to the one having lowest locants for the free valences in the subunit, and among otherwise identical ring systems, the one having least hydrogenation is senior. Lowest locants in unsaturated chains are also given preference. Lowest locants for substituents are the final determinant of seniority.

Direction within the repeating unit depends upon the shortest path, which is determined by counting main chain atoms, both cyclic and acyclic, from the most senior subunit to another subunit of the same kind or to a subunit next lower in seniority. When identification and orientation of the CRU have been accomplished, the CRU is named by writing, in sequence, the names of the largest possible subunits within the CRU from left to right. For example, the main chain of the polymer traditionally named “poly(ethylene terephthalate)” has the structure shown in Figure 1.

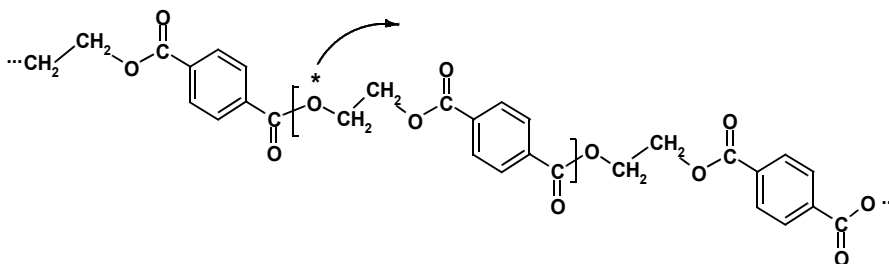


Figure 1. Structure-based name: poly(oxyethyleneoxyterephthaloyl); traditional name: poly(ethylene terephthalate)

NOMENCLATURE FOR ORGANIC POLYMERS (continued)

The CRU in Figure 1 is enclosed in brackets and read from left to right. It is selected because (1) either backbone oxygen atom qualifies as the “most senior subunit”, (2) the shortest path length from either -O- to the other -O- is via the ethylene subunit. Orientation of the CRU is thus defined by (1) beginning at the -O- marked with an asterisk, and (2) reading in the direction of the arrow. The structure-based name of this polymer is therefore “poly(oxyethyleneoxyterephthaloyl)”, not much longer than the traditional name and much more adaptable to the complexities of substitution. As organic nomenclature evolves, more systematic names may be used for subunits, e.g. “ethane-1,2-diyl” instead of “ethylene”. IUPAC still prefers “ethylene” for the -CH₂-CH₂- unit, however, but also accepts “ethane-1,2-diyl”.

Structure-based nomenclature can also be used when the CRU backbone has no carbon atoms. An example is the polymer traditionally named “poly(dimethylsiloxane)”, which on the basis of structure would be named “poly(oxydimethylsilylene)” or “poly(oxydimethylsilanediy)”. This nomenclature method has also been applied to inorganic and coordination polymers⁸ and to double-strand (ladder and spiro) organic polymers.⁹

Irregular Single-Strand Polymers

Polymers that cannot be described by the repetition of a single CRU or comprise units not all connected identically in a directional sense can also be named on a structure basis.¹⁰ These include copolymers, block and graft polymers, and star polymers. They are given names of the type “poly(A/B/C...)”, where A, B, C, etc. are the names of the component constitutional units, the number of which are minimized. The constitutional units may include regular or irregular blocks as well as atoms or atomic groupings, and each is named by the method described above or by the rules of organic nomenclature.

The solidus denotes an unspecified arrangement of the units within the main chain.¹⁰ For example, a statistical copolymer derived from styrene and vinyl chloride with the monomeric units joined head-to-tail is named “poly(1-chloroethylene/1-phenylethylene)”. A polymer obtained by 1,4- polymerization and both head-to-head and head-to-tail 1,2- polymerization of 1,3-butadiene would be named “poly(but-1-ene-1,4-diyl/1-vinylethylene/2-vinylethylene)”.¹² In graphic representations of these polymers, shown in Figure 2, the hyphens or dashes at each end of each CRU depiction are shown *completely within* the enclosing parentheses; this indicates that they are not necessarily the terminal bonds of the macromolecule.

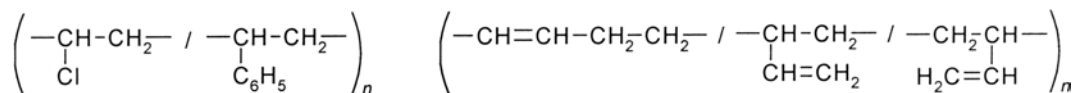


Figure 2. Graphic Representations of Copolymers

A long hyphen is used to separate components in names of block polymers, as in “poly(A)—poly(B)—poly(C)”, or “poly(A)—X—poly(B)” in which X is a non-polymeric junction unit, e.g. dimethylsilylene.

In graphic representations of these polymers, the blocks are shown connected when the bonding is known (Figure 3, for example); when the bonding between the blocks is unknown, the blocks are separated by solidi and are shown *completely within* the outer set of enclosing parentheses (Figure 4, for example).^{10,13}

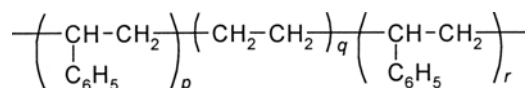


Figure 3. polystyrene—polyethylene—polystyrene

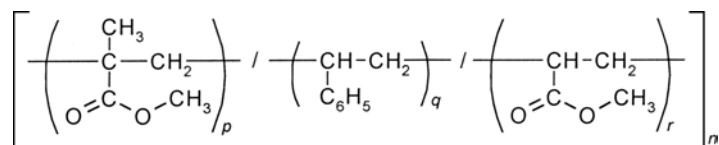


Figure 4. poly[poly(methyl methacrylate)—polystyrene—poly(methyl acrylate)]

Graft polymers are named in the same way as a substituted polymer but without the ending “yl” for the grafted chain; the name of a regular polymer, comprising Z units in which some have grafts of “poly(A)”, is “poly[Z/poly(A)Z]”. Star polymers are treated as a central unit with substituent blocks, as in “tetrakis(polyethylene)silane”.^{10,13}

NOMENCLATURE FOR ORGANIC POLYMERS (continued)

Other Nomenclature Articles and Publications

In addition to the *Chemical Abstracts* and IUPAC documents cited above and listed below, other articles on polymer nomenclature are available. A 1999 article lists significant documents on polymer nomenclature published during the last 50 years in books, encyclopedias, and journals by *Chemical Abstracts*, IUPAC, and individual authors.¹⁴ A comprehensive review of source-based and structure-based nomenclature for all of the major classes of polymers,¹⁵ and a short tutorial on the correct identification, orientation, and naming of most commonly encountered constitutional repeating units were both published in 2000.¹⁶

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SOLVENTS FOR COMMON POLYMERS

Abbreviations: HC: hydrocarbons; MEK: methyl ethyl ketone; THF: tetrahydrofuran; DMF: dimethylformamide; DMSO: dimethylsulfoxide

Polyethylene (HDPE)	HC and halogenated HC
Polypropylene (atactic)	HC and halogenated HC
Polybutadiene	HC, THF, ketones
Polystyrene	ethylbenzene, CHCl ₃ , CCl ₄ , THF, MEK
Polyacrylates	aromatic HC, chlorinated HC, THF, esters, ketones
Polymethacrylates	aromatic HC, chlorinated HC, THF, esters, MEK
Polyacrylamide	water
Poly(vinyl ethers)	halogenated HC, MEK, butanol
Poly(vinyl alcohol)	glycols (hot), DMF
Poly(vinyl acetate)	aromatic HC, chlorinated HC, THF, esters, DMF
Poly(vinyl chloride)	THF, DMF, DMSO
Poly(vinylidene chloride)	THF (hot), dioxane, DMF
Poly(vinyl fluoride)	DMF, DMSO (hot)
Polyacrylonitrile	DMF, DMSO
Poly(oxyethylene)	aromatic HC, CHCl ₃ , alcohols, esters, DMF
Poly(2,6-dimethylphenylene oxide)	aromatic HC, halogenated HC
Poly(ethylene terephthalate)	phenol, DMSO (hot)
Polyurethanes (linear)	aromatic HC, THF, DMF
Polyureas	phenol, formic acid
Polysiloxanes	HC, THF, DMF
Poly[bis(2,2,2-trifluoroethoxy)-phosphazene]	THF, ketones, ethyl acetate

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS

Robert B. Fox

Polymer names are based on the IUPAC structure-based nomenclature system described in the table "Naming Organic Polymers". Within each category, names are listed in alphabetical order. Source-based and trivial names are also given (in italics) for the most common polymers. The table does not include polymers for which T_g is not clearly defined because of variability of structure or because of reactions taking place near the glass transition.

All values of T_g cited in this table have been determined by differential scanning calorimetry (DSC) except those values indicated by:

- (D) dynamic method
- (Dil) dilatometry
- (M) mechanical method

Polymer name	Glass transition temperature (T_g /K)
ACYCLIC CARBON CHAINS	
<i>Polyalkadienes</i>	
Poly(alkenylene) <i>Polyalkadiene</i> $-\text{[CH=CHCH}_2\text{CH}_2\text{]}-$	
Poly(<i>cis</i> -1-butenylene)	171
<i>cis</i> -1,3-polybutadiene [PBD]	
Poly(<i>trans</i> -1-butenylene)	215
<i>trans</i> -1,3-polybutadiene [PBD]	
Poly(1-chloro- <i>cis</i> -1-butenylene)	253
<i>cis</i> -1,3-polychloroprene	
Poly(1-chloro- <i>trans</i> -1-butenylene)	233
<i>trans</i> -1,3-polychloroprene	
Poly(1-methyl- <i>cis</i> -1-butenylene)	200
<i>cis</i> -1,3-polyisoprene	
Poly(1-methyl- <i>trans</i> -1-butenylene)	207
<i>trans</i> -1,3-polyisoprene	
Poly(1,4,4-trifluoro-1-butenylene)	238
<i>Polyalkenes</i>	
Poly(alkylethylene) <i>Poly(alkylethylene)</i> $-\text{[RCHCH}_2\text{]}-$	
Poly(1-benzylethylene)	333
Poly(1-butyloethylene)	223
Poly(1-cyclohexylethylene) (atactic)	393
Poly(1-cyclohexylethylene) (isotactic)	406 (D)
Poly(1,1-dimethylethylene)	200
<i>Polyisobutylene</i> [PIB]	
Poly(ethylene)	148
Poly(methylene)	155
Poly(1-phenethylethylene)	283
Poly(propylene) (isotactic)	272
Poly(propylene) (syndiotactic)	ca. 265
Poly[1-(2-pyridyl)ethylene]	377
Poly[1-(4-pyridyl)ethylene]	415
Poly(1-vinylethylene)	273
<i>Polyacrylics</i>	
Poly[1-(alkoxycarbonyl)ethylene] <i>Poly(alkyl acrylate)</i> $-\text{[(ROCO)CHCH}_2\text{]}-$	
Poly[1-(benzyloxycarbonyl)ethylene]	279
Poly[1-(butoxycarbonyl)ethylene]	219 (M)
<i>Poly(butyl acrylate)</i> [PBA]	

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS (continued)

Polymer name	Glass transition temperature (T_g/K)
Poly[1-(<i>sec</i> -butoxycarbonyl)ethylene]	251
Poly[1-(butoxycarbonyl)-1-cyanoethylene]	358
Poly[1-(butylcarbamoyl)ethylene]	319 (M)
Poly(1-carbamoylethylene)	438
<i>Polyacrylamide</i> [PAM]	
Poly(1-carboxyethylene)	379
<i>Poly(acrylic acid)</i> [PAA]	
Poly[1-(2-chlorophenoxy)carbonyl]ethylene]	326
Poly[1-(4-chlorophenoxy)carbonyl]ethylene]	331
Poly[1-(4-cyanobenzoyloxy)carbonyl]ethylene]	317
Poly[1-(2-cyanoethoxy)carbonyl]ethylene]	277
Poly[1-(cyanomethoxy)carbonyl]ethylene]	433 Dil
Poly[1-(4-cyanophenoxy)carbonyl]ethylene]	363
Poly[1-(cyclohexyloxy)carbonyl]ethylene]	292
Poly[1-(2,4-dichlorophenoxy)carbonyl]ethylene]	333
Poly[1-(dimethylcarbamoyl)ethylene]	362
Poly[1-(ethoxycarbonyl)ethylene]	249
<i>Poly(ethyl acrylate)</i> [PEA]	
Poly[1-(ethoxycarbonyl)-1-fluoroethylene]	316
Poly[1-(2-ethoxycarbonylphenoxy)carbonyl]ethylene]	303
Poly[1-(3-ethoxycarbonylphenoxy)carbonyl]ethylene]	297
Poly[1-(4-ethoxycarbonylphenoxy)carbonyl]ethylene]	310
Poly[1-(2-ethoxyethoxy)carbonyl]ethylene]	223
Poly[1-(3-ethoxypropoxy)carbonyl]ethylene]	218
Poly[1-(isopropoxy)carbonyl]ethylene]	267-270
Poly[1-(methoxycarbonyl)ethylene]	283
<i>Poly(methyl acrylate)</i> [PMA]	
Poly[1-(2-methoxycarbonylphenoxy)carbonyl]ethylene]	319
Poly[1-(3-methoxycarbonylphenoxy)carbonyl]ethylene]	311
Poly[1-(4-methoxycarbonylphenoxy)carbonyl]ethylene]	340
Poly[1-(2-methoxyethoxy)carbonyl]ethylene]	223
Poly[1-(4-methoxyphenoxy)carbonyl]ethylene]	324
Poly[1-(3-methoxypropoxy)carbonyl]ethylene]	198
Poly[1-(2-naphthyloxy)carbonyl]ethylene]	358
Poly[1-(pentachlorophenoxy)carbonyl]ethylene]	420
Poly[1-(phenethoxy)carbonyl]ethylene]	270
Poly[1-(phenoxy)carbonyl]ethylene]	330
Poly[1-(<i>m</i> -tolyl)oxy)carbonyl]ethylene]	298
Poly[1-(<i>o</i> -tolyl)oxy)carbonyl]ethylene]	325
Poly[1-(<i>p</i> -tolyl)oxy)carbonyl]ethylene]	316
Poly[1-(2,2,2-trifluoroethoxy)carbonyl]ethylene]	263
 <i>Polymethacrylics</i>	
Poly[1-(alkoxycarbonyl)-1-methylethylene] <i>Poly(alkyl methacrylate)</i> –[(ROCO)(Me)CCH ₂]–	
Poly[1-(benzoyloxy)carbonyl]-1-methylethylene]	327
Poly[1-(2-bromoethoxy)carbonyl]-1-methylethylene]	325
Poly[(1-(butoxycarbonyl)-1-methylethylene]	293
<i>Poly(butyl methacrylate)</i> [PBMA]	
Poly[1-(<i>sec</i> -butoxycarbonyl)-1-methylethylene]	333
Poly[1-(<i>tert</i> -butoxycarbonyl)-1-methylethylene]	391
Poly[1-(2-chloroethoxy)carbonyl]-1-methylethylene]	ca 315
Poly[1-(2-cyanoethoxy)carbonyl]-1-methylethylene]	364
Poly[1-(4-cyanophenoxy)carbonyl]-1-methylethylene]	428
Poly[1-(cyclohexyloxy)carbonyl]-1-methylethylene] (atactic)	356
Poly[1-(cyclohexyloxy)carbonyl]-1-methylethylene] (isotactic)	324

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS (continued)

Polymer name	Glass transition temperature (T_g /K)
Poly[1-(dimethylaminoethoxycarbonyl)-1-methylethylene]	292
Poly[1-(ethoxycarbonyl)-1-ethylethylene]	300
Poly[1-(ethoxycarbonyl)-1-methylethylene] (atactic) <i>Poly(ethyl methacrylate)</i> [PEMA]	338
Poly[1-(ethoxycarbonyl)-1-methylethylene] (isotactic)	285
Poly[1-(ethoxycarbonyl)-1-methylethylene] (syndiotactic)	339
Poly[1-(hexyloxycarbonyl)-1-methylethylene]	268
Poly[1-(isobutoxycarbonyl)-1-methylethylene]	326
Poly[1-(isopropoxycarbonyl)-1-methylethylene]	354
Poly[1-(methoxycarbonyl)-1-methylethylene] (atactic) <i>Poly(methyl methacrylate)</i> [PMMA]	378
Poly[1-(methoxycarbonyl)-1-methylethylene] (isotactic)	311
Poly[1-(methoxycarbonyl)-1-methylethylene] (syndiotactic)	378
Poly[1-(4-methoxycarbonylphenoxy)-1-methylethylene]	379
Poly[1-(methoxycarbonyl)-1-phenylethylene] (atactic)	391
Poly[1-(methoxycarbonyl)-1-phenylethylene] (isotactic)	397
Poly[1-methyl-1-(phenethoxycarbonyl)ethylene]	299
Poly[1-methyl-1-(phenoxycarbonyl)ethylene]	383
 <i>Polyvinyl ethers, alcohols, and ketones</i>	
Poly(1-alkoxyethylene) <i>Poly(alkyl vinyl ether)</i> –[ROCHCH ₂]–	
Poly(1-hydroxyethylene) <i>Poly(vinyl alcohol)</i> –[HOCHCH ₂]–	
Poly(1-alkanoylethylene) <i>Poly(alkyl vinyl ketone)</i> –[RCOCHCH ₂]–	
Poly(1-butoxyethylene)	218
Poly(1- <i>sec</i> -butoxyethylene)	253
Poly(1- <i>tert</i> -butoxyethylene)	361
Poly[1-(butylthio)ethylene]	253
Poly(1-ethoxyethylene)	230
Poly[1-(4-ethylbenzoyl)ethylene]	325
Poly(1-hydroxyethylene)	358 (D)
<i>Poly(vinyl alcohol)</i> [PVA]	
Poly(hydroxymethylene)	407
Poly(1-isopropoxyethylene)	270
Poly[1-(4-methoxybenzoyl)ethylene]	319 (M)
Poly(1-methoxyethylene)	242
<i>Poly(methyl vinyl ether)</i> [PMVE]	
Poly[1-(methylthio)ethylene]	272
Poly(1-propoxyethylene)	224
Poly[1-(trifluoromethoxy)trifluoroethylene]	268
<i>Polyvinyl halides and nitriles</i>	
Poly(1-haloethylene) <i>Poly(vinyl halide)</i> –[XCHCH ₂]–	
Poly(1-cyanoethylene) <i>Poly(acrylonitrile)</i> –[NCCHCH ₂]–	
Poly(1-chloroethylene)	354
<i>Poly(vinyl chloride)</i> [PVC]	
Poly(chlorotrifluoroethylene)	373
Poly(1-cyanoethylene)	370
<i>Polyacrylonitrile</i> [PAN]	
Poly(1-cyano-1-methylethylene)	393
<i>Polymethacrylonitrile</i>	
Poly(1,1-dichloroethylene)	255
<i>Poly(vinylidene chloride)</i>	
Poly(1,1-difluoroethylene)	ca 233
<i>Poly(vinylidene fluoride)</i>	
Poly(1-fluoroethylene)	314 (M)
<i>Poly(vinyl fluoride)</i>	

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS (continued)

Polymer name	Glass transition temperature (T_g /K)
Poly(1-hexafluoropropylene)	425
Poly[1-(2-iodoethyl)ethylene]	343
Poly(tetrafluoroethylene)	(160)
Poly[1-(trifluoromethyl)ethylene]	300
<i>Polyvinyl esters</i>	
Poly[1-(alkanoyloxy)ethylene] <i>Poly(vinyl alkanoate)</i> –[RCOOCHCH ₂]–	
Poly(1-acetoxyethylene)	305
<i>Poly(vinyl acetate)</i> [PVAc]	
Poly[1-(benzoyloxy)ethylene]	344
Poly[1-(4-bromobenzoyloxy)ethylene]	365
Poly[1-(2-chlorobenzoyloxy)ethylene]	335
Poly[1-(3-chlorobenzoyloxy)ethylene]	338
Poly[1-(4-chlorobenzoyloxy)ethylene]	357
Poly[1-(cyclohexanoyloxy)ethylene]	349 (M)
Poly[1-(4-ethoxybenzoyloxy)ethylene]	343
Poly[1-(4-ethylbenzoyloxy)ethylene]	326
Poly[1-(4-isopropylbenzoyloxy)ethylene]	342
Poly[1-(2-methoxybenzoyloxy)ethylene]	338
Poly[1-(3-methoxybenzoyloxy)ethylene]	ca 317
Poly[1-(4-methoxybenzoyloxy)ethylene]	360
Poly[1-(4-methylbenzoyloxy)ethylene]	343
Poly[1-(4-nitrobenzoyloxy)ethylene]	395
Poly[1-(propionoyloxy)ethylene]	283 (M)
<i>Polystyrenes</i>	
Poly(1-phenylethylene) <i>Polystyrene</i> –[C ₆ H ₅ CHCH ₂]–	
Poly[1-(4-acetylphenyl)ethylene]	389 (M)
Poly[1-(4-benzoylphenyl)ethylene]	371 (M)
Poly[1-(4-bromophenyl)ethylene]	391
Poly[1-(4-butoxyphenyl)ethylene]	ca 320 (M)
Poly[1-(4-butoxycarbonylphenyl)ethylene]	349 (M)
Pol[(1-(4-butylphenyl)ethylene)]	279
Poly[1-(4-carboxyphenyl)ethylene]	386 (M)
Poly[1-(2-chlorophenyl)ethylene]	392
Poly[1-(3-chlorophenyl)ethylene]	363
Poly[1-(4-chlorophenyl)ethylene]	383
Poly[1-(2,4-dichlorophenyl)ethylene]	406
Poly[1-(2,5-dichlorophenyl)ethylene]	379
Poly[1-(2,6-dichlorophenyl)ethylene]	440
Poly[1-(3,4-dichlorophenyl)ethylene]	401
Poly[1-(2,4-dimethylphenyl)ethylene]	385
Poly[1-(4-(dimethylamino)phenyl)ethylene]	398 (M)
Poly[1-(4-ethoxyphenyl)ethylene]	ca 359 (M)
Poly[1-(4-ethoxycarbonylphenyl)ethylene]	367 (M)
Poly[1-(4-fluorophenyl)ethylene]	368
Poly[1-(4-iodophenyl)ethylene]	429
Poly[1-(4-methoxyphenyl)ethylene]	386
Poly[1-(4-methoxycarbonylphenyl)ethylene]	386 (M)
Poly(1-methyl-1-phenylethylene)	373
<i>Poly(α-methylstyrene)</i>	
Poly[1-(2-(methylamino)phenyl)ethylene]	462 (M)
Poly(1-phenylethylene)	373
<i>Polystyrene</i> [PS]	

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS (continued)

Polymer name	Glass transition temperature (T_g /K)
Poly[1-(4-propoxyphenyl)ethylene]	343 (M)
Poly[1-(4-propoxycarbonylphenyl)ethylene]	365 (M)
Poly(1- <i>o</i> -tolylethylene)	409
 CHAINS WITH CARBOCYCLIC UNITS	
Poly(arylenealkylene) $[-Ar-(CH_2)_n]-$	
Poly[1-(2-bromo-1,4-phenylene)ethylene]	353 (M)
Poly[1-(2-chloro-1,4-phenylene)ethylene]	343 (M)
Poly[1-(2-cyano-1,4-phenylene)ethylene]	363 (M)
Poly[1-(2,5-dimethyl-1,4-phenylene)ethylene]	373 (M)
Poly[1-(2-ethyl-1,4-phenylene)ethylene]	298 (M)
Poly[1-(1,4-naphthylene)ethylene]	433 (M)
Poly[1-(1,4-phenylene)ethylene]	ca 353 (M)
 CHAINS WITH HETEROATOM UNITS	
<i>Main chain oxide units</i>	
Poly(oxyalkylene) <i>Poly(alkylene oxide)</i> $[-O(CH_2)_n]-$	
Poly[oxy(1,1-bis(chloromethyl)trimethylene)]	265
Poly[oxy(1-(bromomethyl)ethylene)]	259
Poly[oxy(1-(butoxymethyl)ethylene)]	194
Poly[oxy(1-butylethylene)]	203
Poly[oxy(1- <i>tert</i> -butylethylene)]	308
Poly[oxy(1-(chloromethyl)ethylene)]	251
<i>Poly(epichlorohydrin)</i>	
Poly[oxy(2,6-dimethoxy-1,4-phenylene)]	440
Poly[oxy(1,1-dimethylethylene)]	264
Poly[oxy(2,6-dimethyl-1,4-phenylene)]	482
Poly[oxy(2,6-diphenyl-1,4-phenylene)]	493
Poly[oxy(1-ethylethylene)]	203
Poly(oxyethylidene)	243
<i>Polyacetaldehyde</i>	
Poly[oxy(1-(methoxymethyl)ethylene)]	211
Poly[oxy(2-methyl-6-phenyl-1,4-phenylene)]	428
Poly[oxy(1-methyltrimethylene)]	223 (D)
Poly[oxy(2-methyltrimethylene)]	218
Poly(oxy-1,4-phenylene)	358
<i>Poly(phenylene oxide)</i> [PPO]	
Poly[oxy(1-phenylethylene)]	313
Poly(oxytetramethylene)	189
<i>Poly(tetrahydrofuran)</i> [PTMO]	
Poly(oxytrimethylene)	195
 <i>Main-chain ester or anhydride units</i>	
Poly(oxyalkyleneoxyalkanediyl) <i>Poly(alkylene alkanedioate)</i> $[-[O(CH_2)_mOCO(CH_2)_nCO]-$	
Poly(oxyadipoyloxydecamethylene)	217
Poly(oxyadipoyloxy-1,4-phenyleneisopropylidene-1,4-phenylene)	341
Poly(oxycarbonyloxy-1,4-phenylene-isopropylidene-1,4-phenylene)	422
<i>Bisphenol A polycarbonate</i>	
Poly(oxycarbonylpentamethylene)	213
Poly(oxycarbonyl-1,4-phenylenemethylene-1,4-phenylene)	395
Poly(oxycarbonyl-1,4-phenyleneisopropylidene-1,4-phenylene)	333

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS (continued)

Polymer name	Glass transition temperature (T_g /K)
Poly[oxy(2,6-dimethyl-1,4-phenyleneisopropylidene-3,5-dimethyl-1,4-phenylene)oxysebacoyl]	318
Poly(oxyethylenecarbonyl-1,4-cyclohexylenecarbonyl) (trans)	291
Poly(oxyethyleneoxycarbonyl-1,4-naphthylenecarbonyl)	337
Poly(oxyethyleneoxycarbonyl-1,5-naphthylenecarbonyl)	344
Poly(oxyethyleneoxycarbonyl-2,6-naphthylenecarbonyl)	386
Poly(oxyethyleneoxycarbonyl-2,7-naphthylenecarbonyl)	392
Poly(oxyethyleneoxyterephthaloyl)	342
<i>Poly(ethylene terephthalate)</i> [PET]	
Poly(oxyisophthaloyl)	403 (D)
Poly(oxy(1-oxo-2,2-dimethyltrimethylene))	263
<i>Poly(pivalolactone)</i>	
Poly(oxy-1,4-phenyleneisopropylidene-1,4-phenyleneoxysebacoyl)	280
Poly(oxy-1,4-phenyleneoxy-1,4-phenyleneoxy-carbonyl-1,4-phenylene) [PEEK]	416
Poly(oxypropyleneoxyterephthaloyl)	341
Poly[oxyterephthaloyloxy(2,6-dimethyl-1,4-phenyleneisopropylidene-3,5-dimethyl-1,4-(D)phenylene)]	498
Poly(oxyterephthaloyloxyoctamethylene)	318 (D)
Poly(oxyterephthaloyloxy-1,4-phenyleneisopropylidene-1,4-phenylene)	478
<i>Poly(bisphenol A terephthalate)</i>	
Poly(oxytetramethyleneoxyterephthaloyl)	323
<i>Poly(butylene terephthalate)</i> [PBT]	
<i>Main-chain amide units</i>	
<i>Poly(iminoalkyleneiminoalkanediol) Poly(alkylene alkanediamide)-[NH(CH₂)_mNHCO(CH₂)_nCO]-</i>	
Poly(iminoadipoyliminodecamethylene)	313
<i>Nylon 10,6</i>	
Poly(iminoadipoyliminohexamethylene)	ca 323
<i>Nylon 6,6</i>	
Poly(iminoadipoyliminooctamethylene)	318
<i>Nylon 8,6</i>	
Poly[iminoadipoyliminotrimethylene(methylimino)trimethylene]	278
Poly(iminocarbonyl-1,4-cyclohexylenemethylene)	466
Poly[iminocarbonyl-1,4-phenylene(2-oxoethylene)iminohexamethylene]	377
Poly(iminoethylene-1,4-phenyleneethyleneiminoisobacoyl)	378 (D)
Poly(iminohexamethyleneiminoazelaoyl)	331
<i>Nylon 6,9</i>	
Poly(iminohexamethyleneiminododecanediol)	319
<i>Nylon 6, 12</i>	
Poly(iminohexamethyleneiminopimeloyl)	331
<i>Nylon 6,7</i>	
Poly(iminohexamethyleneiminosebacoyl)	323
<i>Nylon 6,10</i>	
Poly(iminohexamethyleneiminosuberoyl)	330
<i>Nylon 6,8</i>	
Poly(iminoisophthaloylimino-4,4'-biphenylene)	558
Poly(iminoisophthaloyliminohexamethylene)	390
Poly(iminoisophthaloyliminomethylene-1,4-cyclohexylenemethylene)	481
Poly(iminoisophthaloyliminomethylene-1,3-phenylenemethylene)	438 (M)
Poly[iminomethylene(2,5-dimethyl-1,4-phenylene)methyleneiminosuberoyl]	351
Poly(imino-1,5-naphthyleneiminoisophthaloyl)	598
Poly(imino-1,5-naphthyleneiminoterephthaloyl)	578
Poly(iminooctamethyleneiminodecanediol)	333
<i>Nylon 8,10</i>	
Poly(iminooxalyliminohexamethylene)	430
<i>Nylon 6,2</i>	
Poly[imino(1-oxohexamethylene)]	326
<i>Nylon 6</i>	

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS (continued)

Polymer name	Glass transition temperature (T_g /K)
Poly[imino(1-oxodecamethylene)]	315
<i>Nylon 10</i>	
Poly[imino(1-oxoheptamethylene)]	325
<i>Nylon 7</i>	
Poly[imino(1-oxo-3-methyltrimethylene)]	369
Poly[imino(1-oxononamethylene)]	319
<i>Nylon 9</i>	
Poly[imino(1-oxooctamethylene)]	323
<i>Nylon 8</i>	
Poly[imino(1-oxotrimethylene)]	384
<i>Nylon 3</i>	
Poly(iminopentamethyleneiminoadipoyl)	318
<i>Nylon 5,6</i>	
Poly[iminopentamethyleneiminocarbonyl-1,4-phenylene(2-oxoethylene)]	376
Poly(imino-1,3-phenyleneiminoisophthaloyl)	553 (M)
Poly(imino-1,4-phenyleneiminoterephthaloyl)	618
Poly(iminopimeloyliminoheptamethylene)	328
<i>Nylon 7,7</i>	
Poly(iminoterephthaloylimino-4,4'-biphenylene)	613
Poly(iminotetramethyleneiminoadipoyl)	316
<i>Nylon 4,6</i>	
Poly[iminotetramethyleneiminocarbonyl-1,4-phenylene(2-oxoethylene)]	357
Poly(iminotrimethyleneiminoadipoyliminotrimethylene)	307
Poly[iminotrimethyleneiminocarbonyl-1,4-phenylene(2-oxoethylene)]	382
Poly(oxy-1,4-phenyleneiminoterephthaloyl-imino-1,4-phenylene)	613
Poly(sulfonylimino-1,4-phenyleneiminoadipoylimino-1,4-phenylene)	467
<i>Main-chain urethane units</i>	
Poly(oxyalkyleneoxycarbonyliminoalkyleneiminocarbonyl)-[O(CH ₂) _m OCONH(CH ₂) _n NHCO]-	
Poly(oxyethyleneoxycarbonyliminohexamethyleneiminocarbonyl)	329
Poly[oxyethyleneoxycarbonylimino(6-methyl-1,3-phenylene)iminocarbonyl]	325
Poly(oxyethyleneoxycarbonylimino-1,4-phenylenemethylene-1,4-phenyleneiminocarbonyl)	412
Poly(oxyhexamethyleneoxycarbonyliminohexamethyleneiminocarbonyl)	332
Poly[oxyhexamethyleneoxycarbonylimino(6-methyl-1,3-phenylene)iminocarbonyl]	305
Poly(oxyhexamethyleneoxycarbonylimino-1,4-phenylenemethylene-1,4-phenyleneiminocarbonyl)	364
Poly(oxyoctamethyleneoxycarbonyliminohexamethyleneiminocarbonyl)	331
Poly[oxyoctamethyleneoxycarbonylimino(6-methyl-1,3-phenylene)iminocarbonyl]	337
Poly(oxyoctamethyleneoxycarbonylimino-1,4-phenylenemethylene-1,4-phenyleneiminocarbonyl)	352
Poly(oxytetramethyleneoxycarbonyliminohexamethyleneiminocarbonyl)	332
Poly[oxytetramethyleneoxycarbonylimino(6-methyl-1,3-phenylene)iminocarbonyl]	315
Poly(oxytetramethyleneoxycarbonylimino-1,4-phenylenemethylene-1,4-phenyleneiminocarbonyl)	382
<i>Main-chain siloxanes</i>	
Poly[oxy(dialkylsilylene)] <i>Poly(dialkylsiloxane)</i> -[O(R ₂ Si)]-	
Poly[oxy(dimethylsilylene)]	148
<i>Poly(dimethylsiloxane)</i> [PDMS]	
Poly[oxy(dimethylsilylene)oxy-1,4-phenylene]	363 (M)
Poly[oxy(dimethylsilylene)oxy-1,4-phenyleneisopropylidene-1,4-phenylene]	318 (M)
Poly[oxy(diphenylsilylene)]	238
<i>Poly(diphenylsiloxane)</i>	
Poly[oxy(diphenylsilylene)-1,3-phenylene]	ca 331
Poly[oxy((methyl)phenylsilylene)]	187
Poly[oxy((methyl)-3,3,3-trifluoropropylsilylene)]	<193

GLASS TRANSITION TEMPERATURE FOR SELECTED POLYMERS (continued)

Polymer name	Glass transition temperature (T_g /K)
<i>Main-chain sulfur-containing units</i>	
Poly(dithioethylene)	223
Poly(dithiomethylene-1,4-phenylenemethylene)	296
Poly(oxy-4,4'-biphenylene-1,4-phenylenesulfonyl-1,4-phenylene)	503 (M)
Poly(oxycarbonyloxy-1,4-phenylenethio-1,4-phenylene)	ca 383
Poly(oxyethylenedithioethylene)	220 (M)
Poly[oxy(2-hydroxytrimethylene)oxy-1,4-phenylenesulfonyl-1,4-phenylene]	428
Poly(oxymethyleneoxyethylenedithioethylene)	214
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenylenecarbonyl-1,4-phenylene)	478 (M)
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenyleneisopropylidene-1,4-phenylene)	438 (M)
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenylene)	487
Poly(oxy-1,4-phenylenesulfonyl-4,4'-biphenylenesulfonyl-1,4-phenylene)	533
Poly[oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy(2,6-dimethyl-1,4-phenylene)isopropylidene (3,5-dimethyl-1,4-phenylene)]	508 (M)
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenylenecarbonyl-1,4-phenylene)	478 (M)
Poly[oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenylene(hexafluoroisopropylidene)1,4-phenylene]	478 (M)
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenyleneisopropylidene-1,4-phenylene)	449
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenylenemethylene-1,4-phenylene)	453 (M)
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenylenethio-1,4-phenylene)	448 (M)
Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxyterephthaloyl)	522
Poly(oxytetramethylenedithiotetramethylene)	197
Poly(sulfonyl-1,2-cyclohexylene)	401
Poly(sulfonyl-1,3-cyclohexylene)	381
Poly(sulfonyl-1,4-phenylenemethylene-1,4-phenylene)	497
Poly(thio-1,3-cyclohexylene)	221
Poly[thio(difluoromethylene)]	155
Poly(thioethylene)	223
Poly[thio(1-ethylethylene)]	218
Poly[thio(1-methyl-3-oxotrimethylene)]	285
Poly[thio(1-methyltrimethylene)]	214
Pol[(thio(1-oxohexamethylene)]	292
Poly(thio-1,4-phenylene)	370
Poly(thiopropylene)	226
<i>Main-chain heterocyclic units</i>	
Poly(1,3-dioxa-4,6-cyclohexylenemethylene)	378
<i>Poly(vinyl formal)</i>	
Poly[(2,6-dioxopiperidine-1,4-diyl)trimethylene]	363
Poly[(2-methyl-1,3-dioxa-4,6-cyclohexylene)methylene]	355
<i>Poly(vinyl acetal)</i>	
Poly(1,4-piperazinediylcarbonyloxyethyleneoxycarbonyl)	333
Poly(1,4-piperazinediylisophthaloyl)	465 (M)
Poly[(2-propyl-1,3-dioxa-4,6-cyclohexylene)methylene]	322
<i>Poly(vinyl butyral)</i>	
Poly(3,6-pyridazinediyl-1,4-phenyleneisopropylidene-1,4-phenyleneoxy)	453 (M)
Poly(2,5-pyridinediylcarbonyliminohexamethyleneiminocarbonyl)	322

DIELECTRIC CONSTANT OF SELECTED POLYMERS

This table lists typical values of the dielectric constant (more properly called relative permittivity) of some important polymers. Values are given for frequencies of 1 kHz, 1 MHz, and 1 GHz; in most cases the dielectric constant at frequencies below 1 kHz does not differ significantly from the value at 1 kHz. Since the dielectric constant of a polymeric material can vary with density, degree of crystallinity, and other details of a particular sample, the values given here should be regarded only as typical or average values.

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Name	<i>t</i> /°C	1 kHz	1 MHz	1 GHz
Polyacrylonitrile	25	5.5	4.2	
Polyamides (nylons)	25	3.50	3.14	2.8
	84	11	4.4	2.8
Polybutadiene	25	2.5		
Polycarbonate	23	2.92	2.8	
Polychloroprene (neoprene)	25	6.6	6.3	4.2
Polychlorotrifluoroethylene	23	2.65	2.46	2.39
Polyethylene	23	2.3		
Poly(ethylene terephthalate) (Mylar)	23	3.25	3.0	2.8
Polyisoprene (natural rubber)	27	2.6	2.5	2.4
Poly(methyl methacrylate)	27	3.12	2.76	2.6
	80	3.80	2.7	2.6
Polyoxymethylene (polyformaldehyde)	25	3.8		
Poly(phenylene oxide)	23	2.59	2.59	
Polypropylene	25	2.3	2.3	2.3
Polystyrene	25	2.6	2.6	2.6
Polysulfones	25	3.13	2.10	
Polytetrafluoroethylene (teflon)	25	2.1	2.1	2.1
Poly(vinyl acetate)	50		3.5	
	150		8.3	
Poly(vinyl chloride)	25	3.39	2.9	2.8
	100	5.3	3.3	2.7
Poly(vinylidene chloride)	23	4.6	3.2	2.7
Poly(vinylidene fluoride)	23	12.2	8.9	4.7

PRESSURE-VOLUME-TEMPERATURE RELATIONSHIP FOR POLYMER MELTS

Christian Wohlfarth

Numerous theoretical equations of state for polymer liquids have been developed. These, at the minimum, have to provide accurate fitting functions to experimental data. However, for the purpose of this table, the empirical Tait equation along with a polynomial expression for the zero pressure isobar is used. This equation is able to represent the experimental data for the melt state within the limits of experimental errors, i.e., the maximum deviations between measured and calculated specific volumes are about 0.001-0.002 cm³/g.

The general form of the Tait equation is:

$$V(P,T) = V(0,T)\{1 - C \ln[1 + P/B(T)]\} \quad (1)$$

where the coefficient C is usually taken to be a universal constant equal to 0.0894. T is the absolute temperature in K and P the pressure in MPa. The volume V is the specific volume in cm³/g. The Tait parameter $B(T)$ has the very simple meaning that it is inversely proportional to the compressibility κ at constant temperature and zero pressure:

$$\kappa(0,T) = -[1/V(0,T)](dV/dP) = C/B(T) \quad (2)$$

The $B(T)$ function is usually given by:

$$B(T) = B_0 \exp[-B_1(T-273.15)] \quad (3)$$

but, sometimes a polynomial expression is used:

$$B(T) = b_0 + b_1(T-273.15) + b_2(T-273.15)^2 \quad (4)$$

The zero-pressure isobar $V(0,T)$ is usually given by:

$$V(0,T) = A_0 + A_1(T-273.15) + A_2(T-273.15)^2 \quad (5)$$

where A_0, A_1, A_2 are specific constants for a given polymer (the expression $T-273.15$ is used because fitting to the zero-pressure isobar is usually done in terms of Celsius temperature). Other forms for $V(0,T)$ are also found in the literature, such as

$$V(0,T) = A_3 \exp[A_4(T-273.15)] \quad (6)$$

or

$$V(0,T) = A_5 \exp(A_6 T^{1.5}) \quad (7)$$

where A_3 and A_4 or A_5 and A_6 are again specific constants for a given polymer.

The Tait equation is particularly useful to calculate derivative quantities, such as the isothermal compressibility and the thermal expansivity coefficients. The isothermal compressibility $\kappa(P,T)$ is derived from equation (1) as:

$$\kappa(P,T) = -(1/V)(dV/dP) = 1/\{[P + B(T)][1/C - \ln(1 + P/B(T))]\} \quad (8)$$

and the thermal expansivity $\alpha(P,T)$ as:

$$\alpha(P,T) = (1/V)(dV/dT) = \alpha(0,T) - PB_1\kappa(P,T) \quad (9)$$

where $\alpha(0,T)$ represents the thermal expansivity at zero (atmospheric) pressure and is calculated from any suitable fit for the zero-pressure volume, such as equations (5) through (7) above.

Because polymer melt PVT-behavior depends only slightly on polymer molar mass above the oligomeric region, usually no information is given in the original literature for the average molar mass of the polymers.

Table 1 summarizes the polymers or copolymers considered here and the experimental ranges of pressure and temperature over which data are available. In Table 2 the Tait-equation functions, with parameters obtained from the fit, are given for 90 polymer or copolymer melts.

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PRESSURE-VOLUME-TEMPERATURE RELATIONSHIP FOR POLYMER MELTS (continued)

Table 1

Names of the Polymers, Abbreviation Used, and Range of Experimental Data Applied in the Determination of the Equation Constants

Polymer	Symbol	T/K	P/MPa	Ref.
Butylene succinate/butylene adipate copolymer				
20 mol% adipate	BSBA20	394-493	0.1-100	11
Ethylene/propylene copolymer (50 wt%)	EP50	413-523	0.1-63	4
Ethylene/styrene copolymer				
1.7 mol% styrene	ES2	403-473	0.1-170	12
3.5 mol% styrene	ES4	403-473	0.1-200	12
6.0 mol% styrene	ES6	403-473	0.1-200	12
13.8 mol% styrene	ES14	403-473	0.1-200	12
21.5 mol% styrene	ES22	353-473	0.1-200	12
29.4 mol% styrene	ES29	343-473	0.1-200	12
Ethylene/vinyl acetate copolymer				
18 wt% vinyl acetate	EVA18	385-491	0.1-177	4
25 wt% vinyl acetate	EVA25	367-506	0.1-177	4
28 wt% vinyl acetate	EVA28	367-508	0.1-177	4
40 wt% vinyl acetate	EVA40	348-508	0.1-177	4
Polyamide-6	PA6	509-569	0.1-196	4
Polyamide-11	PA11	478-542	0.1-200	5
Polyamide-66	PA66	519-571	0.1-196	4
<i>cis</i> -1,4-Polybutadiene	cPBD	277-328	0.1-284	4
Polybutadiene, 8% 1,2-content	PBD-8	298-473	0.1-200	6
Polybutadiene, 24% 1,2-content	PBD-24	298-473	0.1-200	6
Polybutadiene, 40% 1,2-content	PBD-40	298-473	0.1-200	6
Polybutadiene, 50% 1,2-content	PBD-50	298-473	0.1-200	6
Polybutadiene, 87% 1,2-content	PBD-87	298-473	0.1-200	6
Poly(1-butene), isotactic	iPB	406-519	0.1-196	4
Poly(butyl methacrylate)	PnBMA	307-473	0.1-200	4
Poly(butylene succinate)	PBS	413-493	0.1-100	11
Poly(butylene terephthalate)	PBT	508-576	0.1-200	3
Poly(ϵ -caprolactone)	PCL	373-421	0.1-200	4
Polycarbonate-bisphenol-A	PC	424-613	0.1-177	4
Polycarbonate-bisphenol-chloral	BCPC	428-557	0.1-200	4
Polycarbonate-hexafluorobisphenol-A	HFPC	432-553	0.1-200	4
Polycarbonate-tetramethylbisphenol-A	TMPC	491-563	0.1-160	4
Poly(cyclohexyl methacrylate)	PcHMA	396-471	0.1-200	4
Poly(2,5-dimethylphenylene oxide)	PPO	473-593	0.1-177	4
Poly(dimethyl siloxane)	PDMS	298-343	0.1-100	4
Poly(dimethyl siloxane) $M_n = 1000$	PDMS-10	304-420	0.1-250	10
Poly(dimethyl siloxane) $M_n = 4000$	PDMS-40	298-418	0.1-250	10
Poly(dimethyl siloxane) $M_n = 6000$	PDMS-60	291-423	0.1-250	10
Poly(epichlorohydrin)	PECH	333-413	0.1-200	4
Poly(ether ether ketone)	PEEK	619-671	0.1-200	4
Poly(ethyl acrylate)	PEA	310-490	0.1-196	4
Poly(ethyl methacrylate)	PEMA	386-434	0.1-196	4
Polyethylene, high density	HDPE	413-476	0.1-196	4
Polyethylene, linear	LPE	415-473	0.1-200	4
Polyethylene, linear, high MW	HMLPE	410-473	0.1-200	4
Polyethylene, branched	BPE	398-471	0.1-200	4
Polyethylene, low density	LDPE	394-448	0.1-196	4
Polyethylene, low density, type A	LDPE-A	385-498	0.1-196	1
Polyethylene, low density, type B	LDPE-B	385-498	0.1-196	1
Polyethylene, low density, type C	LDPE-C	385-498	0.1-196	1
Poly(ethylene oxide)	PEO	361-497	0.1- 68	4
Poly(ethylene terephthalate)	PET	547-615	0.1-196	4
Poly(4-hexylstyrene)	P4HS	303-403	30-100	4
Polyisobutylene	PIB	326-383	0.1-100	4

PRESSURE-VOLUME-TEMPERATURE RELATIONSHIP FOR POLYMER MELTS (continued)

Table 1

Names of the Polymers, Abbreviation Used, and Range of Experimental Data Applied in the Determination of the Equation Constants

Polymer	Symbol	T/K	P/MPa	Ref.
Polyisoprene, 8% 3,4-content	PI-8	298-473	0.1-200	6
Polyisoprene, 14% 3,4-content	PI-14	298-473	0.1-200	6
Polyisoprene, 41% 3,4-content	PI-41	298-473	0.1-200	6
Polyisoprene, 56% 3,4-content	PI-56	298-473	0.1-200	6
Poly(methyl acrylate)	PMA	310-493	0.1-196	4
Poly(methyl methacrylate)	PMMA	387-432	0.1-200	4
Poly(4-methyl-1-pentene)	P4MP	514-592	0.1-196	4
Poly(α -methylstyrene)	P α MS	473-533	0.1-170	7
Poly(<i>o</i> -methylstyrene)	PoMS	412-471	0.1-180	4
Polyoxymethylene	POM	463-493	0.1-196	2
Phenoxy ^a	PH	341-573	0.1-177	4
Polysulfone ^b	PSF	475-644	0.1-196	4
Polyarylate ^c	PAr	450-583	0.1-177	4
Polypropylene, atactic	aPP	353-393	0.1-100	4
Polypropylene, isotactic	iPP	443-570	0.1-196	4
Polystyrene	PS	388-469	0.1-200	4
Poly(tetrafluoroethylene)	PTFE	603-645	0.1- 39	4
Poly(tetrahydrofuran)	PTHF	335-439	0.1- 78	4
Poly(vinyl acetate)	PVAc	308-373	0.1- 80	4
Poly(vinyl chloride)	PVC	373-423	0.1-200	4
Poly(vinyl methyl ether)	PVME	303-471	0.1-200	4
Poly(vinylidene fluoride)	PVdF	451-521	0.1-200	5
Styrene/acrylonitrile copolymer				
2.7 wt% acrylonitrile	SAN3	378-539	0.1-200	4
5.7 wt% acrylonitrile	SAN6	370-540	0.1-200	4
15.3 wt% acrylonitrile	SAN15	405-531	0.1-200	4
18.0 wt% acrylonitrile	SAN18	377-528	0.1-200	4
40 wt% acrylonitrile	SAN40	373-543	0.1-200	4
70 wt% acrylonitrile	SAN70	373-544	0.1-200	4
Styrene/butadiene copolymer				
10 wt% styrene	SBR10	393-533	0.1-196	8
23.5 wt% styrene	SBR23	393-533	0.1-196	8
60 wt% styrene	SBR60	393-533	0.1-196	8
85 wt% styrene	SBR85	393-533	0.1-196	8
Styrene/methyl methacrylate copolymer				
20 wt% methyl methacrylate	SMMA20	383-543	0.1-200	4
60 wt% methyl methacrylate	SMMA60	383-543	0.1-200	4
<i>N</i> -Vinylcarbazole/4-ethylstyrene copolymer				
50 mol% ethylstyrene	VCES50	393-443	30-100	9
<i>N</i> -Vinylcarbazole/4-hexylstyrene copolymer				
80 mol% hexylstyrene	VCHS80	313-423	30-100	9
67 mol% hexylstyrene	VCHS67	333-423	30-100	9
60 mol% hexylstyrene	VCHS60	383-453	30-100	9
50 mol% hexylstyrene	VCHS50	373-443	30-100	9
40 mol% hexylstyrene	VCHS40	423-493	30-100	9
33 mol% hexylstyrene	VCHS33	463-523	30-100	9
20 mol% hexylstyrene	VCHS20	473-523	30-100	9
<i>N</i> -Vinylcarbazole/4-octylstyrene copolymer				
50 mol% octylstyrene	VCOS50	403-453	30-100	9
<i>N</i> -Vinylcarbazole/4-pentylstyrene copolymer				
50 mol% pentylstyrene	VCPS50	383-443	30-100	9
Vinylidene fluoride/hexafluoropropylene copolymer				
3.1 mol% hexafluoropropylene	VdFHFP3	433-493	0.1-120	13
10.5 mol% hexafluoropropylene	VdFHFP11	433-493	0.1-120	13

^aPhenoxy = Poly(oxy-2-hydroxytrimethyleneoxy-1,4-phenyleneisopropylidene-1,4-phenylene)

^bPolysulfone = Poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenyleneisopropylidene-1,4-phenylene)

^cPolarylate = Poly(oxyterephthaloyl/isophthaloyl T/I=50/50)oxy-1,4-phenyleneisopropylidene-1,4-phenylene

PRESSURE-VOLUME-TEMPERATURE RELATIONSHIP FOR POLYMER MELTS (continued)

Table 2
Tait Equation Parameter Functions for Polymer Melts

Polymer	$V(0,T)/\text{cm}^3\text{g}^{-1}$	$B(T)/\text{MPa}$
BSBA20	$0.6775 \exp(7.110 \cdot 10^{-4}T)$	$903.5 \exp(-4.441 \cdot 10^{-3}T)$
EP50	$1.2291 + 5.799 \cdot 10^{-5}(T-273.15) + 1.964 \cdot 10^{-6}(T-273.15)^2$	$487.0 \exp[-8.103 \cdot 10^{-3}(T-273.15)]$
ES2	$1.17640 - 6.3389 \cdot 10^{-4}T + 1.7815 \cdot 10^{-6}T^2$	$278.02 \exp[-6.449 \cdot 10^{-3}(T-273.15)]$
ES4	$1.36913 - 1.5928 \cdot 10^{-3}T + 2.8859 \cdot 10^{-6}T^2$	$281.50 \exp[-6.694 \cdot 10^{-3}(T-273.15)]$
ES6	$1.00930 + 4.2123 \cdot 10^{-5}T + 8.8038 \cdot 10^{-7}T^2$	$258.51 \exp[-5.502 \cdot 10^{-3}(T-273.15)]$
ES14	$0.98570 - 5.9468 \cdot 10^{-5}T + 9.8460 \cdot 10^{-7}T^2$	$240.72 \exp[-5.059 \cdot 10^{-3}(T-273.15)]$
ES22	$0.93220 + 6.4243 \cdot 10^{-5}T + 7.7144 \cdot 10^{-7}T^2$	$241.50 \exp[-4.732 \cdot 10^{-3}(T-273.15)]$
ES29	$0.96947 - 1.8184 \cdot 10^{-4}T + 1.0626 \cdot 10^{-6}T^2$	$250.23 \exp[-4.948 \cdot 10^{-3}(T-273.15)]$
EVA18	$1.02391 \exp(2.173 \cdot 10^{-5}T^{1.5})$	$188.2 \exp[-4.537 \cdot 10^{-3}(T-273.15)]$
EVA25	$1.00416 \exp(2.244 \cdot 10^{-5}T^{1.5})$	$184.4 \exp[-4.734 \cdot 10^{-3}(T-273.15)]$
EVA28	$1.00832 \exp(2.241 \cdot 10^{-5}T^{1.5})$	$183.5 \exp[-4.457 \cdot 10^{-3}(T-273.15)]$
EVA40	$1.06332 \exp(2.288 \cdot 10^{-5}T^{1.5})$	$205.1 \exp[-4.989 \cdot 10^{-3}(T-273.15)]$
PA6	$0.7597 \exp[4.701 \cdot 10^{-4}(T-273.15)]$	$376.7 \exp[-4.660 \cdot 10^{-3}(T-273.15)]$
PA11	$0.9581 \exp[6.664 \cdot 10^{-4}(T-273.15)]$	$254.7 \exp[-4.178 \cdot 10^{-3}(T-273.15)]$
PA66	$0.7657 \exp[6.600 \cdot 10^{-4}(T-273.15)]$	$316.4 \exp[-5.040 \cdot 10^{-3}(T-273.15)]$
cPBD	$1.0970 \exp[6.600 \cdot 10^{-4}(T-273.15)]$	$177.7 \exp[-3.593 \cdot 10^{-3}(T-273.15)]$
PBD-8	$1.1004 + 6.718 \cdot 10^{-4}(T-273.15) + 6.584 \cdot 10^{-7}(T-273.15)^2$	$200.0 \exp[-4.606 \cdot 10^{-3}(T-273.15)]$
PBD-24	$1.1049 + 6.489 \cdot 10^{-4}(T-273.15) + 7.099 \cdot 10^{-7}(T-273.15)^2$	$193.0 \exp[-4.519 \cdot 10^{-3}(T-273.15)]$
PBD-40	$1.1013 + 6.593 \cdot 10^{-4}(T-273.15) + 5.776 \cdot 10^{-7}(T-273.15)^2$	$188.0 \exp[-4.437 \cdot 10^{-3}(T-273.15)]$
PBD-50	$1.1037 + 5.955 \cdot 10^{-4}(T-273.15) + 7.789 \cdot 10^{-7}(T-273.15)^2$	$183.0 \exp[-4.425 \cdot 10^{-3}(T-273.15)]$
PBD-87	$1.1094 + 6.729 \cdot 10^{-4}(T-273.15) + 4.470 \cdot 10^{-7}(T-273.15)^2$	$175.0 \exp[-4.538 \cdot 10^{-3}(T-273.15)]$
iPB	$1.1417 \exp[6.751 \cdot 10^{-4}(T-273.15)]$	$167.5 \exp[-4.533 \cdot 10^{-3}(T-273.15)]$
PnBMA	$0.9341 + 5.5254 \cdot 10^{-4}(T-273.15) + 6.5803 \cdot 10^{-6}(T-273.15)^2 + 1.5691 \cdot 10^{-10}(T-273.15)^3$	$226.7 \exp[-5.344 \cdot 10^{-3}(T-273.15)]$
PBS	$0.6821 \exp(6.728 \cdot 10^{-4}T)$	$729.1 \exp(-4.232 \cdot 10^{-3}T)$
PBT	$0.9640 - 1.017 \cdot 10^{-3}(T-273.15) + 3.065 \cdot 10^{-6}(T-273.15)^2$	$263.0 \exp[-3.444 \cdot 10^{-3}(T-273.15)]$
PCL	$0.9049 \exp[6.392 \cdot 10^{-4}(T-273.15)]$	$189.0 \exp[-3.931 \cdot 10^{-3}(T-273.15)]$
PC	$0.73565 \exp(1.859 \cdot 10^{-5}T^{1.5})$	$310.0 \exp[-4.078 \cdot 10^{-3}(T-273.15)]$
BCPC	$0.6737 + 3.634 \cdot 10^{-4}(T-273.15) + 2.370 \cdot 10^{-7}(T-273.15)^2$	$363.4 \exp[-4.921 \cdot 10^{-3}(T-273.15)]$
HFPC	$0.6111 + 4.898 \cdot 10^{-4}(T-273.15) + 1.730 \cdot 10^{-7}(T-273.15)^2$	$236.6 \exp[-5.156 \cdot 10^{-3}(T-273.15)]$
TMPC	$0.8497 + 5.073 \cdot 10^{-4}(T-273.15) + 3.832 \cdot 10^{-7}(T-273.15)^2$	$231.4 \exp[-4.242 \cdot 10^{-3}(T-273.15)]$
PcHMA	$0.8793 + 4.0504 \cdot 10^{-4}(T-273.15) + 7.774 \cdot 10^{-7}(T-273.15)^2 - 7.7534 \cdot 10^{-10}(T-273.15)^3$	$295.2 \exp[-5.220 \cdot 10^{-3}(T-273.15)]$
PPO	$0.78075 \exp(2.151 \cdot 10^{-5}T^{1.5})$	$227.8 \exp[-4.290 \cdot 10^{-3}(T-273.15)]$
PDMS	$1.0079 \exp[9.121 \cdot 10^{-4}(T-273.15)]$	$89.4 \exp[-5.701 \cdot 10^{-3}(T-273.15)]$
PDMS-10	$0.8343 + 5.991 \cdot 10^{-4}(T-273.15) + 5.734 \cdot 10^{-7}(T-273.15)^2$	$542.63 \exp[-6.69 \cdot 10^{-3}(T-273.15)]$
PDMS-40	$0.8018 + 7.072 \cdot 10^{-4}(T-273.15) + 3.635 \cdot 10^{-7}(T-273.15)^2$	$482.73 \exp[-6.09 \cdot 10^{-3}(T-273.15)]$
PDMS-60	$0.8146 + 5.578 \cdot 10^{-4}(T-273.15) + 5.774 \cdot 10^{-7}(T-273.15)^2$	$482.73 \exp[-6.09 \cdot 10^{-3}(T-273.15)]$
PECH	$0.7216 \exp[5.825 \cdot 10^{-4}(T-273.15)]$	$238.3 \exp[-4.171 \cdot 10^{-3}(T-273.15)]$
PEEK	$0.7158 \exp[6.690 \cdot 10^{-4}(T-273.15)]$	$388.0 \exp[-4.124 \cdot 10^{-3}(T-273.15)]$
PEA	$0.8756 \exp[7.241 \cdot 10^{-4}(T-273.15)]$	$193.2 \exp[-4.839 \cdot 10^{-3}(T-273.15)]$
PEMA	$0.8614 \exp[7.468 \cdot 10^{-4}(T-273.15)]$	$260.9 \exp[-5.356 \cdot 10^{-3}(T-273.15)]$
HDPE	$1.1595 + 8.0394 \cdot 10^{-4}(T-273.15)$	$179.9 \exp[-4.739 \cdot 10^{-3}(T-273.15)]$
LPE	$0.9172 \exp[7.806 \cdot 10^{-4}(T-273.15)]$	$176.7 \exp[-4.661 \cdot 10^{-3}(T-273.15)]$
HMLPE	$0.8992 \exp[8.502 \cdot 10^{-4}(T-273.15)]$	$168.3 \exp[-4.292 \cdot 10^{-3}(T-273.15)]$
BPE	$0.9399 \exp[7.341 \cdot 10^{-4}(T-273.15)]$	$177.1 \exp[-4.699 \cdot 10^{-3}(T-273.15)]$
LDPE	$1.1944 + 2.841 \cdot 10^{-4}(T-273.15) + 1.872 \cdot 10^{-6}(T-273.15)^2$	$202.2 \exp[-5.243 \cdot 10^{-3}(T-273.15)]$
LDPE-A	$1.1484 \exp[6.950 \cdot 10^{-4}(T-273.15)]$	$192.9 \exp[-4.701 \cdot 10^{-3}(T-273.15)]$
LDPE-B	$1.1524 \exp[6.700 \cdot 10^{-4}(T-273.15)]$	$196.6 \exp[-4.601 \cdot 10^{-3}(T-273.15)]$
LDPE-C	$1.1516 \exp[6.730 \cdot 10^{-4}(T-273.15)]$	$186.7 \exp[-4.391 \cdot 10^{-3}(T-273.15)]$
PEO	$0.8766 \exp[7.087 \cdot 10^{-4}(T-273.15)]$	$207.7 \exp[-3.947 \cdot 10^{-3}(T-273.15)]$
PET	$0.6883 + 5.90 \cdot 10^{-4}(T-273.15)$	$369.7 \exp[-4.150 \cdot 10^{-3}(T-273.15)]$
P4HS	$0.8251 + 6.77 \cdot 10^{-4}T$	$103.1 \exp[-2.417 \cdot 10^{-3}(T-273.15)]$
PIB	$1.0750 \exp[5.651 \cdot 10^{-4}(T-273.15)]$	$200.3 \exp[-4.329 \cdot 10^{-3}(T-273.15)]$
PI-8	$1.1030 + 6.488 \cdot 10^{-4}(T-273.15) + 5.125 \cdot 10^{-7}(T-273.15)^2$	$188.0 \exp[-4.541 \cdot 10^{-3}(T-273.15)]$
PI-14	$1.0943 + 6.293 \cdot 10^{-4}(T-273.15) + 6.231 \cdot 10^{-7}(T-273.15)^2$	$202.0 \exp[-4.653 \cdot 10^{-3}(T-273.15)]$
PI-41	$1.0951 + 6.188 \cdot 10^{-4}(T-273.15) + 6.629 \cdot 10^{-7}(T-273.15)^2$	$199.0 \exp[-4.622 \cdot 10^{-3}(T-273.15)]$
PI-56	$1.0957 + 6.655 \cdot 10^{-4}(T-273.15) + 5.661 \cdot 10^{-7}(T-273.15)^2$	$200.0 \exp[-4.644 \cdot 10^{-3}(T-273.15)]$
PMA	$0.8365 \exp[6.795 \cdot 10^{-4}(T-273.15)]$	$235.8 \exp[-4.493 \cdot 10^{-3}(T-273.15)]$

PRESSURE-VOLUME-TEMPERATURE RELATIONSHIP FOR POLYMER MELTS (continued)

Table 2
Tait Equation Parameter Functions for Polymer Melts

Polymer	$V(0,T)/\text{cm}^3\text{g}^{-1}$	$B(T)/\text{MPa}$
PMMA	$0.8254 + 2.8383 \cdot 10^{-4}(T-273.15) + 7.792 \cdot 10^{-7}(T-273.15)^2$	$287.5 \exp[-4.146 \cdot 10^{-3}(T-273.15)]$
P4MP	$1.4075 - 9.095 \cdot 10^{-4}(T-273.15) + 3.497 \cdot 10^{-6}(T-273.15)^2$	$37.67 + 0.2134(T-273.15) - 7.0445 \cdot 10^{-4}(T-273.15)^2$
PαMS	$0.89365 + 3.4864 \cdot 10^{-4}(T-273.15) + 5.0184 \cdot 10^{-7}(T-273.15)^2$	$297.7 \exp[-4.074 \cdot 10^{-3}(T-273.15)]$
PoMS	$0.9396 \exp[5.306 \cdot 10^{-4}(T-273.15)]$	$261.9 \exp[-4.114 \cdot 10^{-3}(T-273.15)]$
POM	$0.7484 \exp[6.770 \cdot 10^{-4}(T-273.15)]$	$305.6 \exp[-4.326 \cdot 10^{-3}(T-273.15)]$
PH	$0.76644 \exp(1.921 \cdot 10^{-5}T^{1.5})$	$359.9 \exp[-4.378 \cdot 10^{-3}(T-273.15)]$
PSF	$0.7644 + 3.419 \cdot 10^{-4}(T-273.15) + 3.126 \cdot 10^{-7}(T-273.15)^2$	$365.9 \exp[-3.757 \cdot 10^{-3}(T-273.15)]$
PAr	$0.73381 \exp(1.626 \cdot 10^{-5}T^{1.5})$	$296.9 \exp[-3.375 \cdot 10^{-3}(T-273.15)]$
aPP	$1.1841 - 1.091 \cdot 10^{-4}(T-273.15) + 5.286 \cdot 10^{-6}(T-273.15)^2$	$162.1 \exp[-6.604 \cdot 10^{-3}(T-273.15)]$
iPP	$1.1606 \exp[6.700 \cdot 10^{-4}(T-273.15)]$	$149.1 \exp[-4.177 \cdot 10^{-3}(T-273.15)]$
PS	$0.9287 \exp[5.131 \cdot 10^{-4}(T-273.15)]$	$216.9 \exp[-3.319 \cdot 10^{-3}(T-273.15)]$
PTFE	$0.3200 + 9.5862 \cdot 10^{-4}(T-273.15)$	$425.2 \exp[-9.380 \cdot 10^{-3}(T-273.15)]$
PTHF	$1.0043 \exp[6.691 \cdot 10^{-4}(T-273.15)]$	$178.6 \exp[-4.223 \cdot 10^{-3}(T-273.15)]$
PVAc	$0.82496 + 5.820 \cdot 10^{-4}(T-273.15) + 2.940 \cdot 10^{-7}(T-273.15)^2$	$204.9 \exp[-4.346 \cdot 10^{-3}(T-273.15)]$
PVC	$0.7196 + 5.581 \cdot 10^{-5}(T-273.15) + 1.468 \cdot 10^{-6}(T-273.15)^2$	$294.2 \exp[-5.321 \cdot 10^{-3}(T-273.15)]$
PVME	$0.9585 \exp[6.653 \cdot 10^{-4}(T-273.15)]$	$215.8 \exp[-4.588 \cdot 10^{-3}(T-273.15)]$
PVdF	$0.5790 \exp[8.051 \cdot 10^{-4}(T-273.15)]$	$244.0 \exp[-5.210 \cdot 10^{-3}(T-273.15)]$
SAN3	$0.9233 + 3.936 \cdot 10^{-4}(T-273.15) + 5.685 \cdot 10^{-7}(T-273.15)^2$	$239.8 \exp[-4.376 \cdot 10^{-3}(T-273.15)]$
SAN6	$0.9211 + 4.370 \cdot 10^{-4}(T-273.15) + 5.846 \cdot 10^{-7}(T-273.15)^2$	$226.9 \exp[-4.286 \cdot 10^{-3}(T-273.15)]$
SAN15	$0.9044 + 4.207 \cdot 10^{-4}(T-273.15) + 4.077 \cdot 10^{-7}(T-273.15)^2$	$238.4 \exp[-3.943 \cdot 10^{-3}(T-273.15)]$
SAN18	$0.9016 + 4.036 \cdot 10^{-4}(T-273.15) + 4.206 \cdot 10^{-7}(T-273.15)^2$	$240.4 \exp[-3.858 \cdot 10^{-3}(T-273.15)]$
SAN40	$0.8871 + 3.406 \cdot 10^{-4}(T-273.15) + 4.938 \cdot 10^{-7}(T-273.15)^2$	$289.3 \exp[-4.431 \cdot 10^{-3}(T-273.15)]$
SAN70	$0.8528 + 3.616 \cdot 10^{-4}(T-273.15) + 2.634 \cdot 10^{-7}(T-273.15)^2$	$335.4 \exp[-3.923 \cdot 10^{-3}(T-273.15)]$
SBR10	$0.9053 \exp(2.437 \cdot 10^{-5}T^{1.5})$	$530.3 \exp[-3.99 \cdot 10^{-3}(T-273.15)]$
SBR23	$0.8986 \exp(2.317 \cdot 10^{-5}T^{1.5})$	$551.6 \exp[-4.17 \cdot 10^{-3}(T-273.15)]$
SBR60	$0.8812 \exp(2.031 \cdot 10^{-5}T^{1.5})$	$486.0 \exp[-4.34 \cdot 10^{-3}(T-273.15)]$
SBR85	$0.8704 \exp(1.846 \cdot 10^{-5}T^{1.5})$	$356.7 \exp[-4.24 \cdot 10^{-3}(T-273.15)]$
SMMA20	$0.9063 + 3.570 \cdot 10^{-4}(T-273.15) + 6.532 \cdot 10^{-7}(T-273.15)^2$	$232.0 \exp[-4.143 \cdot 10^{-3}(T-273.15)]$
SMMA60	$0.8610 + 3.350 \cdot 10^{-4}(T-273.15) + 6.980 \cdot 10^{-7}(T-273.15)^2$	$261.0 \exp[-4.611 \cdot 10^{-3}(T-273.15)]$
VCE50	$0.6676 + 6.63 \cdot 10^{-4}T$	$5281.7 \exp[-9.264 \cdot 10^{-3}(T-273.15)]$
VCHS80	$0.7753 + 6.17 \cdot 10^{-4}T$	$247.6 \exp[-2.604 \cdot 10^{-3}(T-273.15)]$
VCHS67	$0.8028 + 6.50 \cdot 10^{-4}T$	$581.7 \exp[-4.553 \cdot 10^{-3}(T-273.15)]$
VCHS60	$0.8213 + 6.23 \cdot 10^{-4}T$	$229.1 \exp[-2.133 \cdot 10^{-3}(T-273.15)]$
VCHS50	$0.7827 + 5.05 \cdot 10^{-4}T$	$136.0 \exp[-1.083 \cdot 10^{-3}(T-273.15)]$
VCHS40	$0.7805 + 4.92 \cdot 10^{-4}T$	$155.0 \exp[-1.605 \cdot 10^{-3}(T-273.15)]$
VCHS33	$0.7710 + 4.86 \cdot 10^{-4}T$	$460.4 \exp[-3.453 \cdot 10^{-3}(T-273.15)]$
VCHS20	$0.6416 + 5.42 \cdot 10^{-4}T$	$489.8 \exp[-3.193 \cdot 10^{-3}(T-273.15)]$
VCOS50	$0.7081 + 7.40 \cdot 10^{-4}T$	$666.5 \exp[-4.503 \cdot 10^{-3}(T-273.15)]$
VCPS50	$0.7814 + 4.36 \cdot 10^{-4}T$	$880.1 \exp[-4.393 \cdot 10^{-3}(T-273.15)]$
VdFHFP3	$0.587 + 4.138 \cdot 10^{-4}(T-273.15)$	$157.7 \exp[-2.83 \cdot 10^{-3}(T-273.15)]$
VdFHFP11	$0.577 + 4.543 \cdot 10^{-4}(T-273.15)$	$207.1 \exp[-4.15 \cdot 10^{-3}(T-273.15)]$

ASTRONOMICAL CONSTANTS

Victor Abalakin

The constants in this table are based primarily on the set of constants adopted by the International Astronomical Union (IAU) in 1976. Updates have been made when new data were available. All values are given in SI Units; thus masses are expressed in kilograms and distances in meters. The astronomical unit of time is a time interval of one day (1 d) equal to 86400 s. An interval of 36525 d is one Julian century (1 cy).

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1. Seidelmann, P. K., *Explanatory Supplement to the Astronomical Almanac*, University Science Books, Mill Valley, CA, 1990.
2. Lang, K. R., *Astrophysical Data: Planets and Stars*, Springer-Verlag, New York, 1992.

Defining constants

Gaussian gravitational constant	$k = 0.01720209895 \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$
Speed of light	$c = 299792458 \text{ m s}^{-1}$

Primary constants

Light-time for unit distance (1 AU)	$\tau_A = 499.004782 \text{ s}$
Equatorial radius of earth	$a_e = 6378140 \text{ m}$
Equatorial radius of earth (IUGG value)	$a_e = 6378136 \text{ m}$
Dynamical form-factor for earth	$J_2 = 0.001082626$
Geocentric gravitational constant	$GE = 3.986005 \times 10^{14} \text{ m}^3 \text{ s}^{-2}$
Constant of gravitation	$G = 6.672 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$
Ratio of mass of moon to that of earth	$\mu = 0.01230002$
	$1/\mu = 81.300587$
General precession in longitude, per Julian century, at standard epoch J2000	$\rho = 5029''.0966$
Obliquity of the ecliptic at standard epoch J2000	$\epsilon = 23^\circ 26' 21''.448$

Derived constants

Constant of nutation at standard epoch J2000	$N = 9''.2025$
Unit distance ($AU = c\tau_A$)	$AU = 1.49597870 \times 10^{11} \text{ m}$
Solar parallax ($\pi_0 = \arcsin(a_e/AU)$)	$\pi_0 = 8''.794148$
Constant of aberration for standard epoch J2000	$\kappa = 20''.49552$
Flattening factor for the earth	$f = 1/298.257 = 0.00335281$
Heliocentric gravitational constant ($GS = A^3k^2/D^2$)	$GS = 1.32712438 \times 10^{20} \text{ m}^3 \text{ s}^{-2}$
Ratio of mass of sun to that of the earth ($S/E = (GS)/(GE)$)	$S/E = 332946.0$
Ratio of mass of sun to that of earth + moon	$(S/E)/(1 + \mu) = 328900.5$
Mass of the sun ($S = (GS)/G$)	$S = 1.9891 \times 10^{30} \text{ kg}$

Ratios of mass of sun to masses of the planets

Mercury	6023600
Venus	408523.5
Earth + moon	328900.5
Mars	3098710
Jupiter	1047.355
Saturn	3498.5
Uranus	22869
Neptune	19314
Pluto	3000000

PROPERTIES OF THE SOLAR SYSTEM

The following tables give various properties of the planets and characteristics of their orbits in the solar system. Certain properties of the sun and of the earth's moon are also included.

Explanations of the column headings:

- *Den.*: mean density in g/cm³
- *Radius*: radius at the equator in km
- *Flattening*: degree of oblateness, defined as $(r_e - r_p)/r_e$, where r_e and r_p are the equatorial and polar radii, respectively
- *Potential coefficients*: coefficients in the spherical harmonic representation of the gravitational potential U by the equation

$$U(r, \phi) = (GM/r) [1 - \sum J_n (a/r)^n P_n(\sin \phi)]$$

where G is the gravitational constant, r the distance from the center of the planet, a the radius of the planet, M the mass, ϕ the latitude, and P_n the Legendre polynomial of degree n .

- *Gravity*: acceleration due to gravity at the surface
- *Escape velocity*: velocity needed at the surface of the planet to escape the gravitational pull
- *Dist. to sun*: semi-major axis of the elliptical orbit (1 AU = 1.496×10^8 km)
- e : eccentricity of the orbit
- *Ecliptic angle*: angle between the planetary orbit and the plane of the earth's orbit around the sun
- *Inclin.*: angle between the equatorial plane and the plane of the planetary orbit
- *Rot. period*: period of rotation of the planet measured in earth days
- *Albedo*: ratio of the light reflected from the planet to the light incident on it
- T_{sur} : mean temperature at the surface
- P_{sur} : pressure of the atmosphere at the surface

The following general information on the solar system is of interest:

Mass of the earth = $M_e = 5.9742 \times 10^{24}$ kg
 Total mass of planetary system = 2.669×10^{27} kg = $447 M_e$
 Total angular momentum of planetary system = 3.148×10^{43} kg m²/s
 Total kinetic energy of the planets = 1.99×10^{35} J
 Total rotational energy of planets = 0.7×10^{35} J

Properties of the sun:

Mass = 1.9891×10^{30} kg = $332946.0 M_e$
 Radius = 6.9599×10^8 m
 Surface area = 6.087×10^{18} m²
 Volume = 1.412×10^{27} m³
 Mean density = 1.409 g/cm³
 Gravity at surface = 27398 cm/s²
 Escape velocity at surface = 6.177×10^5 m/s
 Effective temperature = 5780 K
 Total radiant power emitted (luminosity) = 3.86×10^{26} W
 Surface flux of radiant energy = 6.340×10^7 W/m²
 Flux of radiant energy at the earth (Solar Constant) = 1373 W/m²

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1. Seidelmann, P. K., Editor, *Explanatory Supplement to the Astronomical Almanac*, University Science Books, Mill Valley, CA, 1992.
2. Lang, K. R., *Astrophysical Data: Planets and Stars*, Springer-Verlag, New York, 1992.
3. Allen, C. W., *Astrophysical Quantities, Third Edition*, Athlone Press, London, 1977.

PROPERTIES OF THE SOLAR SYSTEM (continued)

Planet	Mass 10 ²⁴ kg	Den. g/cm ³	Radius km	Flattening	Potential coefficients			Gravity cm/s ²	Escape vel. km/s
					10 ³ J ₂	10 ⁶ J ₃	10 ⁶ J ₄		
Mercury	0.33022	5.43	2439.7	0				370	4.25
Venus	4.8690	5.24	6051.9	0	0.027			887	10.4
Earth	5.9742	5.515	6378.140	0.00335364	1.08263	-2.54	-1.61	980	11.2
(Moon)	0.073483	3.34	1738	0	0.2027			162	2.37
Mars	0.64191	3.94	3397	0.00647630	1.964	36		371	5.02
Jupiter	1898.8	1.33	71492	0.0648744	14.75	-580		2312	59.6
Saturn	568.50	0.70	60268	0.0979624	16.45	-1000		896	35.5
Uranus	86.625	1.30	25559	0.0229273	12			777	21.3
Neptune	102.78	1.76	24764	0.0171	4			1100	23.3
Pluto	0.015	1.1	1151	0				72	1.1

Planet	Dist. to sun AU	ε	Ecliptic angle	Inclin.	Rot. period d	Albedo	No. of satellites
Mercury	0.38710	0.2056	7.00°	0°	58.6462	0.106	0
Venus	0.72333	0.0068	3.39°	177.3°	-243.01	0.65	0
Earth	1.00000	0.0167		23.45°	0.99726968	0.367	1
(Moon)				6.68°	27.321661	0.12	
Mars	1.52369	0.0933	1.85°	25.19°	1.02595675	0.150	2
Jupiter	5.20283	0.048	1.31°	3.12°	0.41354	0.52	16
Saturn	9.53876	0.056	2.49°	26.73°	0.4375	0.47	18
Uranus	19.19139	0.046	0.77°	97.86°	-0.65	0.51	15
Neptune	30.06107	0.010	1.77°	29.56°	0.768	0.41	8
Pluto	39.52940	0.248	17.15°	118°	-6.3867	0.3	1

Planet	T _{sur} K	P _{sur} bar	Atmospheric composition									
			CO ₂	N ₂	O ₂	H ₂ O	H ₂	He	Ar	Ne	CO	
Mercury	440	2 × 10 ⁻¹⁵						2%	98%			
Venus	730	90	96.4%	3.4%	69 ppm	0.1%				4 ppm		20 ppm
Earth	288	1	0.03%	78.08%	20.95%	0 to 3%				0.93%	18 ppm	1 ppm
Mars	218	0.007	95.32%	2.7%	0.13%	0.03%				1.6%	3 ppm	0.07%
Jupiter	129							86.1%	13.8%			
Saturn	97							92.4%	7.4%			
Uranus	58							89%	11%			
Neptune	56							89%	11%			
Pluto	50	1 × 10 ⁻⁵										

SATELLITES OF THE PLANETS

This table gives characteristics of the known satellites of the planets. The parameters covered are:

- Orbital period in units of earth days. An R following the value indicates a retrograde motion.
- Distance from the planet, as measured by the semi-major axis of the orbit.
- Eccentricity of the orbit.
- Inclination of the satellite orbit with respect to the equator of the planet.
- Mass of the satellite relative to the planet.
- Radius of the satellite in km.
- Mean density of the satellite.
- Geometric albedo, which is a measure of the fraction of incident sunlight reflected by the satellite.

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1. Seidelmann, P. K., Editor, *Explanatory Supplement to the Astronomical Almanac*, University Science Books, Mill Valley, CA, 1992.
2. Lang, K. R., *Astrophysical Data: Planets and Stars*, Springer-Verlag, New York, 1992.
3. Burns, J. A., and Matthews, M. S., Eds., *Satellites*, University of Arizona Press, Tucson, 1986.

Planet	Satellite	Orb. Period d	Distance 10 ³ km	Eccentricity	Inclination	Rel. mass	Radius km	Den. g/cm ³	Albedo
Earth	Moon	27.321661	384.400	0.054900489	18.28-28.58°	0.01230002	1738	3.34	0.12
Mars	I Phobos	0.31891023	9.378	0.015	1.0°	1.5 × 10 ⁻⁸	13.5 × 10.8 × 9.4	<2	0.06
	II Deimos	1.2624407	23.459	0.0005	0.9-2.7°	3 × 10 ⁻⁹	7.5 × 6.1 × 5.5	<2	0.07
Jupiter	I Io	1.769137786	422	0.004	0.04°	4.68 × 10 ⁻⁵	1815	3.55	0.61
	II Europa	3.551181041	671	0.009	0.47°	2.52 × 10 ⁻⁵	1569	3.04	0.64
	III Ganymede	7.15455296	1070	0.002	0.21°	7.80 × 10 ⁻⁵	2631	1.93	0.42
	IV Callisto	16.6890184	1883	0.007	0.51°	5.66 × 10 ⁻⁵	2400	1.83	0.20
	V Amalthea	0.49817905	181	0.003	0.40°	3.8 × 10 ⁻⁹	135 × 83 × 75		0.05
	VI Himalia	250.5662	11480	0.15798	27.63°	5.0 × 10 ⁻⁹	93		0.03
	VII Elara	259.6528	11737	0.20719	24.77°	4 × 10 ⁻¹⁰	38		0.03
	VIII Pasiphae	735 R	23500	0.378	145°	1 × 10 ⁻¹⁰	25		
	IX Sinope	758 R	23700	0.275	153°	0.4 × 10 ⁻¹⁰	18		
	X Lysithea	259.22	11720	0.107	29.02°	0.4 × 10 ⁻¹⁰	18		
	XI Carme	692 R	22600	0.20678	164°	0.5 × 10 ⁻¹⁰	20		
	XII Ananke	631 R	21200	0.16870	147°	0.2 × 10 ⁻¹⁰	15		
	XIII Leda	238.72	11094	0.14762	26.07°	0.03 × 10 ⁻¹⁰	8		
	XIV Thebe	0.6745	222	0.015	0.8°	4 × 10 ⁻¹⁰	55 × 45		0.05
	XV Adrastea	0.29826	129			0.1 × 10 ⁻¹⁰	12.5 × 10 × 7.5		0.05
	XVI Metis	0.294780	128			0.5 × 10 ⁻¹⁰	20		0.05
Saturn	I Mimas	0.942421813	185.52	0.0202	1.53°	8.0 × 10 ⁻⁸	196	1.44	0.5
	II Enceladus	1.370217855	238.02	0.00452	1.86°	1.3 × 10 ⁻⁷	250	1.13	1.0
	III Tethys	1.887802160	294.66	0.00000	1.86°	1.3 × 10 ⁻⁶	530	1.20	0.9
	IV Dione	2.736914742	377.40	0.002230	0.02°	1.85 × 10 ⁻⁶	560	1.41	0.7
	V Rhea	4.517500436	527.04	0.00100	0.35°	4.4 × 10 ⁻⁶	765	1.33	0.7
	VI Titan	15.94542068	1221.83	0.029192	0.33°	2.38 × 10 ⁻⁴	2575	1.88	0.21
	VII Hyperion	21.2766088	1481.1	0.104	0.43°	3 × 10 ⁻⁸	205 × 130 × 110		0.3
	VIII Iapetus	79.3301825	3561.3	0.02828	14.72°	3.3 × 10 ⁻⁶	730	1.15	0.2
	IX Phoebe	550.48 R	12952	0.16326	177°	7 × 10 ⁻¹⁰	110		0.06

SATELLITES OF THE PLANETS (continued)

Planet	Satellite	Orb. Period d	Distance 10 ³ km	Eccentricity	Inclination	Rel. mass	Radius km	Den. g/cm ³	Albedo
	X	Janus	0.6945	151.472	0.007		110 × 100 × 80		0.8
	XI	Epimetheus	0.6942	151.422	0.009		70 × 60 × 50		0.8
	XII	Helene	2.7369	377.40	0.005		18 × 16 × 15		0.7
	XIII	Telesto	1.8878	294.66			17 × 14 × 13		0.5
	XIV	Calypso	1.8878	294.66			17 × 11 × 11		0.6
	XV	Atlas	0.6019	137.670	0.000		20 × 10		0.9
	XVI	Prometheus	0.6130	139.353	0.003		70 × 50 × 40		0.6
	XVII	Pandora	0.6285	141.700	0.004		55 × 45 × 35		0.9
	XVIII	Pan	0.5750	133.583			10		0.5
Uranus	I	Ariel	2.52037935	191.02	0.0034	1.56 × 10 ⁻⁵	579	1.55	0.34
	II	Umbriel	4.1441772	266.30	0.0050	1.35 × 10 ⁻⁵	586	1.58	0.18
	III	Titania	8.7058717	435.91	0.0022	4.06 × 10 ⁻⁵	790	1.69	0.27
	IV	Oberon	13.4632389	583.52	0.0008	3.47 × 10 ⁻⁵	762	1.64	0.24
	V	Miranda	1.41347925	129.39	0.0027	0.08 × 10 ⁻⁵	240	1.25	0.27
	VI	Cordelia	0.335033	49.77	<0.001		13		0.07
	VII	Ophelia	0.376409	53.79	0.010		15		0.07
	VIII	Bianca	0.434577	59.17	<0.001		21		0.07
	IX	Cressida	0.463570	61.78	<0.001		31		0.07
	X	Desdemona	0.473651	62.68	<0.001		27		0.07
	XI	Juliet	0.493066	64.35	<0.001		42		0.07
	XII	Portia	0.513196	66.09	<0.001		54		0.07
	XIII	Rosalind	0.558459	69.94	<0.001		27		0.07
	XIV	Belinda	0.623525	75.26	<0.001		33		0.07
	XV	Puck	0.761832	86.01	<0.001		77		0.07
Neptune	I	Triton	5.8768541 R	354.76	0.000016	2.09 × 10 ⁻⁴	1353	2.05	0.7
	II	Nereid	360.13619	5513.4	0.7512	2 × 10 ⁻⁷	170		0.4
	III	Naiad	0.294396	117.6	<0.001		29		0.06
	IV	Thalassa	0.311485	73.6	<0.001		40		0.06
	V	Despina	0.334655	52.6	<0.001		74		0.06
	VI	Galatea	0.428745	62.0	<0.001		79		0.06
	VII	Larissa	0.554654	50.0	<0.0014		104 × 89		0.06
	VIII	Proteus	1.122315	48.2	<0.001		218 × 208 × 201		0.06
Pluto	I	Charon	6.38725	19.6	<0.001	0.22	593		0.5

MASS, DIMENSIONS, AND OTHER PARAMETERS OF THE EARTH

This table is a collection of data on various properties of the Earth. Most of the values are given in SI units. Note that 1 AU (astronomical unit) = 149,597,870 km.

REFERENCES

1. Seidelmann, P. K., Editor, *Explanatory Supplement to the Astronomical Almanac*, University Science Books, Mill Valley, CA, 1992.
2. Lang, K. R., *Astrophysical Data: Planets and Stars*, Springer-Verlag, New York, 1992.

Quantity	Symbol	Value	Unit
Mass	M	$5.9742 \cdot 10^{27}$	g
Major orbital semi-axis	a_{orb}	1.000000	AU
		$1.4959787 \cdot 10^8$	km
Distance from sun at perihelion	r_{π}	0.9833	AU
Distance from sun at aphelion	r_{α}	1.0167	AU
Moment of perihelion passage	T_{π}	Jan. 2, 4 h 52 min	
Moment of aphelion passage	T_{α}	July 4, 5 h 05 min	
Sidereal rotation period around sun	P_{orb}	$31.5581 \cdot 10^6$	s
		365.25636	d
Mean rotational velocity	U_{orb}	29.78	km/s
Mean equatorial radius	\bar{a}	6378.140	km
Mean polar compression (flattening factor)	α	1/298.257	
Difference in equatorial and polar semi-axes	$a - c$	21.385	km
Compression of meridian of major equatorial axis	α_a	1/295.2	
Compression of meridian of minor equatorial axis	α_b	1/298.0	
Equatorial compression	ϵ	1/30 000	
Difference in equatorial semi-axes	$a - b$	213	m
Difference in polar semi-axes	$c_N - c_S$	~70	m
Polar asymmetry	η	$\sim 1 \cdot 10^{-5}$	
Mean acceleration of gravity at equator	g_e	9.78036	m/s ²
Mean acceleration of gravity at poles	g_p	9.83208	m/s ²
Difference in acceleration of gravity at pole and at equator	$g_p - g_e$	5.172	cm/s ²
Mean acceleration of gravity for entire surface of terrestrial ellipsoid	g	9.7978	m/s ²
Mean radius	R	6371.0	km
Area of surface	S	$5.10 \cdot 10^8$	km ²
Volume	V	$1.0832 \cdot 10^{12}$	km ³
Mean density	ρ	5.515	g/cm ³
Sidereal rotational period	P	86,164.09	s
Rotational angular velocity	ω	$7.292116 \cdot 10^{-5}$	rad/s
Mean equatorial rotational velocity	v	0.46512	km/s
Rotational angular momentum	L	$5.861 \cdot 10^{33}$	J s
Rotational energy	E	$2.137 \cdot 10^{29}$	J
Ratio of centrifugal force to force of gravity at equator	q_c	$0.0034677 = 1/288$	
Moment of inertia	I	$8.070 \cdot 10^{37}$	kg m ²
Relative braking of earth's rotation due to tidal friction	$\Delta\omega_c/\omega$	$-4.2 \cdot 10^{-8}$	century ⁻¹
Relative secular acceleration of earth's rotation	$\Delta\omega_r/\omega$	$+1.4 \cdot 10^{-8}$	century ⁻¹
Not secular braking of earth's rotation	$\Delta\omega/\omega$	$-2.8 \cdot 10^{-8}$	century ⁻¹
Probable value of total energy of tectonic deformation of earth	E_t	$\sim 1 \cdot 10^{23}$	J/century
Secular loss of heat of earth through radiation into space	$\Delta'E_k$	$1 \cdot 10^{23}$	J/century
Portion of earth's kinetic energy transformed into heat as a result of lunar and solar tides in the hydrosphere	$\Delta''E_k$	$1.3 \cdot 10^{23}$	J/century

MASS, DIMENSIONS, AND OTHER PARAMETERS OF THE EARTH (continued)

Quantity	Symbol	Value	Unit
Differences in duration of days in March and August	ΔP	0.0025 (March-August)	s
Corresponding relative annual variation in earth's rotational velocity	$\Delta^*\omega/\omega$	$2.9 \cdot 10^{-8}$ (Aug.-March)	
Presumed variation in earth's radius between August and March	Δ^*R	-9.2 (Aug.-March)	cm
Annual variation in level of world ocean	Δh_o	~10 (Sept.-March)	cm
Area of continents	S_C	$1.49 \cdot 10^8$	km ²
Area of world ocean	S_o	29.2	% of surface
		$3.61 \cdot 10^8$	km ²
Mean height of continents above sea level	h_C	70.8	% of surface
Mean depth of world ocean	h_o	875	m
Mean thickness of lithosphere within the limits of the continents	$h_{c.l.}$	3794	m
Mean thickness of lithosphere within the limits of the ocean	$h_{o.l.}$	35	km
Mean rate of thickening of continental lithosphere	$\Delta h/\Delta t$	4.7	km
Mean rate of horizontal extension of continental lithosphere	$\Delta l/\Delta t$	10 - 40	m/10 ⁶ y
Mass of crust	m_1	0.75 - 20	km/10 ⁶ y
Mass of mantle		$2.36 \cdot 10^{22}$	kg
Amount of water released from the mantle and core in the course of geological time		$4.05 \cdot 10^{24}$	kg
Total reserve of water in the mantle		$3.40 \cdot 10^{21}$	kg
Present content of free and bound water in the earth's lithosphere		$2 \cdot 10^{23}$	kg
Mass of hydrosphere	m_h	$2.4 \cdot 10^{21}$	kg
Amount of oxygen bound in the earth's crust		$1.664 \cdot 10^{21}$	kg
Amount of free oxygen		$1.300 \cdot 10^{21}$	kg
Mass of atmosphere	m_a	$1.5 \cdot 10^{18}$	kg
Mass of biosphere	m_b	$5.136 \cdot 10^{18}$	kg
Mass of living matter in the biosphere		$1.148 \cdot 10^{16}$	kg
Density of living matter on dry land		$3.6 \cdot 10^{14}$	kg
Density of living matter in ocean		0.1	g/cm ²
Age of the earth		$15 \cdot 10^{-8}$	g/cm ³
Age of oldest rocks		$4.55 \cdot 10^9$	y
Age of most ancient fossils		$4.0 \cdot 10^9$	y
		$3.4 \cdot 10^9$	y

GEOLOGICAL TIME SCALE

Period or Epoch	Beginning and end, in 10 ⁶ years	Key events
Cenozoic era		
Quaternian		
Contemporary	0–10,000 y ± 2,000 y	
Pleistocene	10,000–1,000,000 y ± 50,000 y	Homo Erectus breakout
Tertiary		
Pliocene	1.8–5.3	Ape man fossils
Miocene	5–25	Origin of grass
Oligocene	25–37	Rise of cats, dogs, pigs
Eocene	37–55	Debut of hoofed mammals
Paleocene	55–67	Earliest primates
Mesozoic era		
Cretaceous	67–138	Demise of dinosaurs
Jurassic	138–208	First birds
Triassic	208–245	Appearance of dinosaurs
Paleozoic era		
Permian	245–290	Flowers, insect pollination
Carboniferous	290–360	First conifers
Devonian	360–410	First vertebrates ashore
Silurian	410–435	Spore-bearing plants
Ordovician	435–520	First animals ashore
Cambrian	520–570	Vertebrates appear
Pre-Cambrian		
Pre-Cambrian III (Proterozoic)	570–2500	First plants, jellyfish
Pre-Cambrian II (Archean)	2500–3800	Photosynthetic bacteria
Pre-Cambrian I (Hadean)	3800–4450	Earth formed 4600 million years ago

Reference: Calder, N., *Timescale - An Atlas of the Fourth Dimension*, Viking Press, New York, 1983.

ACCELERATION DUE TO GRAVITY

The acceleration due to gravity is tabulated here as a function of latitude and height above the earth's surface. Values were calculated from the expression

$$g/(\text{m/s}^2) = 9.780356 (1 + 0.0052885 \sin^2 \phi - 0.0000059 \sin^2 2 \phi) - 0.003086 H$$

where ϕ is the latitude and H is the height in kilometers.

REFERENCE

Jursa, A. S., Ed., *Handbook of Geophysics and the Space Environment*, 4th ed., Air Force Geophysics Laboratory, 1985, p. 14-17.

ϕ	$H = 0$	$H = 1 \text{ km}$	$H = 5 \text{ km}$	$H = 10 \text{ km}$
0	9.78036	9.77727	9.76493	9.74950
5	9.78075	9.77766	9.76532	9.74989
10	9.78191	9.77882	9.76648	9.75105
15	9.78381	9.78072	9.76838	9.75295
20	9.78638	9.78330	9.77095	9.75552
25	9.78956	9.78647	9.77413	9.75870
30	9.79324	9.79016	9.77781	9.76238
35	9.79732	9.79424	9.78189	9.76646
40	9.80167	9.79858	9.78624	9.77081
45	9.80616	9.80307	9.79073	9.77530
50	9.81065	9.80757	9.79522	9.77979
55	9.81501	9.81193	9.79958	9.78415
60	9.81911	9.81602	9.80368	9.78825
65	9.82281	9.81972	9.80738	9.79195
70	9.82601	9.82292	9.81058	9.79515
75	9.82860	9.82551	9.81317	9.79774
80	9.83051	9.82743	9.81508	9.79965
85	9.83168	9.82860	9.81625	9.80082
90	9.83208	9.82899	9.81665	9.80122

DENSITY, PRESSURE, AND GRAVITY AS A FUNCTION OF DEPTH WITHIN THE EARTH

This table gives the density ρ , pressure p , and acceleration due to gravity g as a function of depth below the earth's surface, as calculated from the model of the structure of the earth in Reference 1. The model assumes a radius of 6371 km for the earth. The boundary between the crust and mantle (the Mohorovicic discontinuity) is taken as 21 km, while in reality it varies considerable with location.

REFERENCES

1. Anderson, D. L., and Hart, R. S., *J. Geophys. Res.*, 81, 1461, 1976.
2. Carmichael, R. S., *CRC Practical Handbook of Physical Properties of Rocks and Minerals*, p.467, CRC Press, Boca Raton, FL, 1989.

Depth km	ρ g/cm ³	p kbar	g cm/s ²	Depth km	ρ g/cm ³	p kbar	g cm/s ²
Crust				1771	4.96	752	994
0	1.02	0	981	2071	5.12	903	1002
3	1.02	3	982	2371	5.31	1061	1017
3	2.80	3	982	2671	5.45	1227	1042
21	2.80	5	983	2886	5.53	1352	1069
Mantle (solid)				Outer core (liquid)			
21	3.49	5	983	2886	9.96	1352	1069
41	3.51	12	983	2971	10.09	1442	1050
61	3.52	19	984	3371	10.63	1858	953
81	3.48	26	984	3671	11.00	2154	874
101	3.44	33	984	4071	11.36	2520	760
121	3.40	39	985	4471	11.69	2844	641
171	3.37	56	987	4871	11.99	3116	517
221	3.34	73	989	5156	12.12	3281	427
271	3.37	89	991	Inner core (solid)			
321	3.47	106	993	5156	12.30	3281	427
371	3.59	124	994	5371	12.48	3385	355
571	3.95	199	999	5771	12.52	3529	218
871	4.54	328	997	6071	12.53	3592	122
1171	4.67	466	992	6371	12.58	3617	0
1471	4.81	607	991				

OCEAN PRESSURE AS A FUNCTION OF DEPTH AND LATITUDE

The following table is based upon an ocean model which takes into account the equation of state of standard seawater and the dependence on latitude of the acceleration of gravity. The tabulated pressure value is the excess pressure over the ambient atmospheric pressure at the surface.

REFERENCES

1. *International Oceanographic Tables, Volume 4*, Unesco Technical Papers in Marine Science No. 40, Unesco, Paris, 1987.
2. Saunders, P.M., and Fofonoff, N.P., *Deep-Sea Res.* 23, 109-111, 1976.

Depth (meters)	Pressure in MPa at the Specified Latitude						
	0°	15°	30°	45°	60°	75°	90°
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
500	5.0338	5.0355	5.0404	5.0471	5.0537	5.0586	5.0605
1000	10.0796	10.0832	10.0930	10.1064	10.1198	10.1296	10.1333
1500	15.1376	15.1431	15.1577	15.1778	15.1980	15.2127	15.2182
2000	20.2076	20.2148	20.2344	20.2613	20.2882	20.3080	20.3153
2500	25.2895	25.2985	25.3231	25.3568	25.3905	25.4153	25.4244
3000	30.3831	30.3940	30.4236	30.4641	30.5047	30.5345	30.5453
3500	35.4886	35.5012	35.5358	35.5832	35.6307	35.6654	35.6782
4000	40.6056	40.6201	40.6598	40.7140	40.7683	40.8082	40.8229
4500	45.7342	45.7505	45.7952	45.8564	45.9176	45.9626	45.9791
5000	50.8742	50.8924	50.9421	51.0102	51.0785	51.1285	51.1469
5500	56.0255	56.0456	56.1004	56.1755	56.2508	56.3059	56.3262
6000	61.1882	61.2100	61.2700	61.3521	61.4344	61.4947	61.5168
6500	66.3619	66.3857	66.4508	66.5399	66.6292	66.6947	66.7187
7000	71.5467	71.5724	71.6427	71.7388	71.8352	71.9059	71.9318
7500	76.7426	76.7701	76.8456	76.9488	77.0523	77.1282	77.1560
8000	81.9493	81.9788	82.0594	82.1697	82.2804	82.3614	82.3911
8500	87.1669	87.1983	87.2841	87.4016	87.5193	87.6057	87.6373
9000	92.3950	92.4284	92.5194	92.6440	92.7689	92.8606	92.8941
9500	97.6346	97.6698	97.7661	97.8978	98.0300	98.1269	98.1624
10000	102.8800	102.9170	103.0185	103.1572	103.2961	103.3981	103.4355

PROPERTIES OF SEAWATER

In addition to the dependence on temperature and pressure, the physical properties of seawater vary with the concentration of the dissolved constituents. A convenient parameter for describing the composition is the salinity, S , which is defined in terms of the electrical conductivity of the seawater sample. The defining equation for the practical salinity is:

$$S = a_0 + a_1K^{1/2} + a_2K + a_3K^{3/2} + a_4K^2 + a_5K^{5/2},$$

where K is the ratio of the conductivity of the seawater sample at 15°C and atmospheric pressure to the conductivity of a potassium chloride solution in which the mass fraction of KCl is 0.0324356, at the same temperature and pressure. The values of the coefficients are:

$$\begin{aligned} a_0 &= 0.0080 & a_3 &= 14.0941 \\ a_1 &= -0.1692 & a_4 &= -7.0261 \\ a_2 &= 25.3851 & a_5 &= 2.7081 \\ & & \Sigma a_i &= 35.0000 \end{aligned}$$

Thus when $K = 1$, $S = 35$ exactly (S is normally quoted in units of ‰, i.e., parts per thousand). The value of S can be roughly equated with the mass of dissolved material in grams per kilogram of seawater. Salinity values in the open oceans at mid latitudes typically fall between 34 and 36.

It is customary in oceanography to define the pressure at a given point as the pressure due to the column of water between that point and the surface. Thus by convention $P = 0$ at the sea surface. To a good approximation the pressure in decibars (dbar) can be equated to the depth in meters. Thus at 45° latitude the pressure is 5000 dbar at 4902 m, 10000 dbar at 9700 m.

The freezing point of seawater varies with salinity and pressure as follows (freezing point in °C):

P/dbar	$S = 0$	5	10	15	20	25	30	35	40
0	0.000	-0.274	-0.542	-0.812	-1.083	-1.358	-1.638	-1.922	-2.212
50	-0.038	-0.311	-0.580	-0.849	-1.121	-1.396	-1.676	-1.960	-2.250
100	-0.075	-0.349	-0.618	-0.887	-1.159	-1.434	-1.713	-1.998	-2.287
500	-0.377	-0.650	-0.919	-1.188	-1.460	-1.735	-2.014	-2.299	-2.589

The first table below gives several properties of seawater as a function of temperature for a salinity of 35. The second and third give density and electrical conductivity as a function of salinity at several temperatures, and the last lists typical concentrations of the main constituents of seawater as a function of salinity.

REFERENCES

1. *The Practical Salinity Scale 1978 and the International Equation of State of Seawater 1980*, Unesco Technical Papers in Marine Science No. 36, Unesco, Paris, 1981; sections No. 37, 38, 39, and 40 in this series give background papers and detailed tables.
2. Kennish, M. J., *CRC Practical Handbook of Marine Science*, CRC Press, Boca Raton, FL, 1989.
3. Poisson, A. *IEEE J. Ocean. Eng.* OE-5, 50, 1981.
4. Webster, F., in *AIP Physics Desk Reference*, E. R. Cohen, D. R. Lide and G. L. Trigg, eds., Springer-Verlag, New York, 2002.

Properties of Seawater as a Function of Temperature at Salinity $S = 35$ and Normal Atmospheric Pressure

ρ = density in g/cm^3

$\beta = (1/\rho) (d\rho/dS)$ = fractional change in density per unit change in salinity

$\alpha = (1/\rho) (d\rho/dt)$ = fractional change in density per unit change in temperature ($^{\circ}\text{C}^{-1}$)

κ = electrical conductivity in S/cm

η = viscosity in mPa s (equal to cP)

c_p = specific heat in $\text{J/kg } ^{\circ}\text{C}$

v = speed of sound in m/s

$t/^{\circ}\text{C}$	$\rho/\text{g cm}^{-3}$	$10^7\beta$	$10^7\alpha/^{\circ}\text{C}^{-1}$	$\kappa/\text{S cm}^{-1}$	$\eta/\text{mPa s}$	$c_p/\text{J kg}^{-1} ^{\circ}\text{C}^{-1}$	$v/\text{m s}^{-1}$
0	1.028106	7854	526	0.029048	1.892	3986.5	1449.1
5	1.027675	7717	1136	0.033468	1.610		
10	1.026952	7606	1668	0.038103	1.388	3986.3	1489.8
15	1.025973	7516	2141	0.042933	1.221		
20	1.024763	7444	2572	0.047934	1.085	3993.9	1521.5
25	1.023343	7385	2970	0.053088	0.966		
30	1.021729	7338	3341	0.058373	0.871	4000.7	1545.6
35	1.019934	7300	3687				
40		7270	4004			4003.5	1563.2

PROPERTIES OF SEAWATER (continued)

Density of Surface Seawater in g/cm³ as a Function of Temperature and Salinity

<i>t</i> /°C	<i>S</i> = 0	<i>S</i> = 5	<i>S</i> = 10	<i>S</i> = 15	<i>S</i> = 20	<i>S</i> = 25	<i>S</i> = 30	<i>S</i> = 35	<i>S</i> = 40
0	0.999843	1.003913	1.007955	1.011986	1.016014	1.020041	1.024072	1.028106	1.032147
5	0.999967	1.003949	1.007907	1.011858	1.015807	1.019758	1.023714	1.027675	1.031645
10	0.999702	1.003612	1.007501	1.011385	1.015269	1.019157	1.023051	1.026952	1.030862
15	0.999102	1.002952	1.006784	1.010613	1.014443	1.018279	1.022122	1.025973	1.029834
20	0.998206	1.002008	1.005793	1.009576	1.013362	1.017154	1.020954	1.024763	1.028583
25	0.997048	1.000809	1.004556	1.008301	1.012050	1.015806	1.019569	1.023343	1.027128
30	0.995651	0.999380	1.003095	1.006809	1.010527	1.014252	1.017985	1.021729	1.025483
35	0.994036	0.997740	1.001429	1.005118	1.008810	1.012509	1.016217	1.019934	1.023662
40	0.992220	0.995906	0.999575	1.003244	1.006915	1.010593	1.014278	1.017973	1.021679

Electrical Conductivity of Seawater in S/cm as a Function of Temperature and Salinity

<i>t</i> /°C	<i>S</i> = 5	<i>S</i> = 10	<i>S</i> = 15	<i>S</i> = 20	<i>S</i> = 25	<i>S</i> = 30	<i>S</i> = 35	<i>S</i> = 40
0	0.004808	0.009171	0.013357	0.017421	0.021385	0.025257	0.029048	0.032775
5	0.005570	0.010616	0.015441	0.020118	0.024674	0.029120	0.033468	0.037734
10	0.006370	0.012131	0.017627	0.022947	0.028123	0.033171	0.038103	0.042935
15	0.007204	0.013709	0.019905	0.025894	0.031716	0.037391	0.042933	0.048355
20	0.008068	0.015346	0.022267	0.028948	0.035438	0.041762	0.047934	0.053968
25	0.008960	0.017035	0.024703	0.032097	0.039276	0.046267	0.053088	0.059751
30	0.009877	0.018771	0.027204	0.035330	0.043213	0.050888	0.058373	0.065683

Composition of Seawater and Ionic Strength at Various Salinities (Ref. 2)

Constituent	Expressed as molality			As grams per kilogram of seawater		
	<i>S</i> = 30	<i>S</i> = 35	<i>S</i> = 40	<i>S</i> = 30	<i>S</i> = 35	<i>S</i> = 40
Cl ⁻	0.482	0.562	0.650	16.58	19.33	22.36
Br ⁻	0.00074	0.00087	0.00100	0.057	0.067	0.078
F ⁻		0.00007			0.001	
SO ₄ ²⁻	0.0104	0.0114	0.0122	0.97	1.06	1.14
HCO ₃ ⁻	0.00131	0.00143	0.00100	0.078	0.085	0.059
NaSO ₄ ⁻	0.0085	0.0108	0.0139	0.98	1.25	1.60
KSO ₄ ⁻	0.00010	0.00012	0.00015	0.013	0.016	0.020
Na ⁺	0.405	0.472	0.544	9.03	10.53	12.13
K ⁺	0.00892	0.01039	0.01200	0.338	0.394	0.455
Mg ²⁺	0.0413	0.0483	0.0561	9.74	1.139	1.323
Ca ²⁺	0.00131	0.00143	0.00154	0.051	0.056	0.060
Sr ²⁺	0.00008	0.00009	0.00011	0.007	0.008	0.009
MgHCO ₃ ⁺	0.00028	0.00036	0.00045	0.023	0.030	0.037
MgSO ₄	0.00498	0.00561	0.00614	0.582	0.655	0.717
CaSO ₄	0.00102	0.00115	0.00126	0.135	0.152	0.166
NaHCO ₃	0.00015	0.00020	0.00024	0.012	0.016	0.020
H ₃ BO ₃	0.00032	0.00037	0.00042	0.019	0.022	0.025
Ionic strength	0.5736	0.6675	0.7701			

ABUNDANCE OF ELEMENTS IN THE EARTH'S CRUST AND IN THE SEA

This table gives the estimated abundance of the elements in the continental crust (in mg/kg, equivalent to parts per million by mass) and in seawater near the surface (in mg/L). Values represent the median of reported measurements. The concentrations of the less abundant elements may vary with location by several orders of magnitude.

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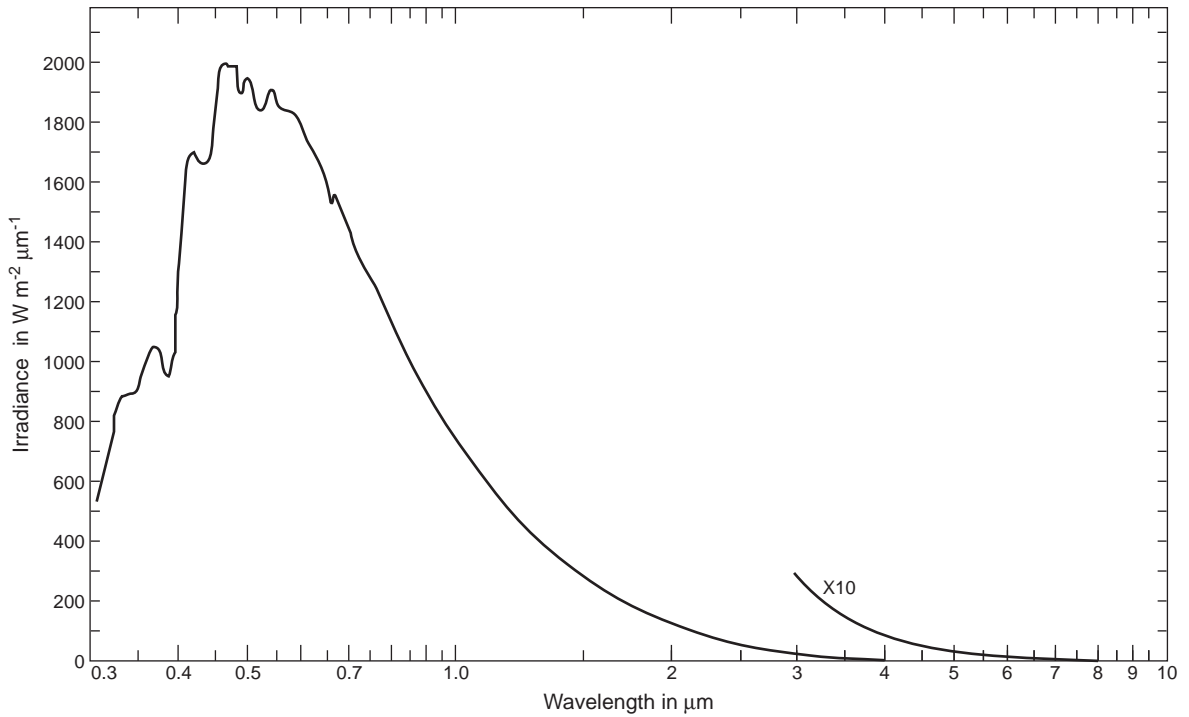
Element	Abundance		Element	Abundance	
	Crust mg/kg	Sea mg/L		Crust mg/kg	Sea mg/L
Ac	5.5×10^{-10}		N	1.9×10^1	5×10^{-1}
Ag	7.5×10^{-2}	4×10^{-5}	Na	2.36×10^4	1.08×10^4
Al	8.23×10^4	2×10^{-3}	Nb	2.0×10^1	1×10^{-5}
Ar	3.5	4.5×10^{-1}	Nd	4.15×10^1	2.8×10^{-6}
As	1.8	3.7×10^{-3}	Ne	5×10^{-3}	1.2×10^{-4}
Au	4×10^{-3}	4×10^{-6}	Ni	8.4×10^1	5.6×10^{-4}
B	1.0×10^1	4.44	O	4.61×10^5	8.57×10^5
Ba	4.25×10^2	1.3×10^{-2}	Os	1.5×10^{-3}	
Be	2.8	5.6×10^{-6}	P	1.05×10^3	6×10^{-2}
Bi	8.5×10^{-3}	2×10^{-5}	Pa	1.4×10^{-6}	5×10^{-11}
Br	2.4	6.73×10^1	Pb	1.4×10^1	3×10^{-5}
C	2.00×10^2	2.8×10^1	Pd	1.5×10^{-2}	
Ca	4.15×10^4	4.12×10^2	Po	2×10^{-10}	1.5×10^{-14}
Cd	1.5×10^{-1}	1.1×10^{-4}	Pr	9.2	6.4×10^{-7}
Ce	6.65×10^1	1.2×10^{-6}	Pt	5×10^{-3}	
Cl	1.45×10^2	1.94×10^4	Ra	9×10^{-7}	8.9×10^{-11}
Co	2.5×10^1	2×10^{-5}	Rb	9.0×10^1	1.2×10^{-1}
Cr	1.02×10^2	3×10^{-4}	Re	7×10^{-4}	4×10^{-6}
Cs	3	3×10^{-4}	Rh	1×10^{-3}	
Cu	6.0×10^1	2.5×10^{-4}	Rn	4×10^{-13}	6×10^{-16}
Dy	5.2	9.1×10^{-7}	Ru	1×10^{-3}	7×10^{-7}
Er	3.5	8.7×10^{-7}	S	3.50×10^2	9.05×10^2
Eu	2.0	1.3×10^{-7}	Sb	2×10^{-1}	2.4×10^{-4}
F	5.85×10^2	1.3	Sc	2.2×10^1	6×10^{-7}
Fe	5.63×10^4	2×10^{-3}	Se	5×10^{-2}	2×10^{-4}
Ga	1.9×10^1	3×10^{-5}	Si	2.82×10^5	2.2
Gd	6.2	7×10^{-7}	Sm	7.05	4.5×10^{-7}
Ge	1.5	5×10^{-5}	Sn	2.3	4×10^{-6}
H	1.40×10^3	1.08×10^5	Sr	3.70×10^2	7.9
He	8×10^{-3}	7×10^{-6}	Ta	2.0	2×10^{-6}
Hf	3.0	7×10^{-6}	Tb	1.2	1.4×10^{-7}
Hg	8.5×10^{-2}	3×10^{-5}	Te	1×10^{-3}	
Ho	1.3	2.2×10^{-7}	Th	9.6	1×10^{-6}
I	4.5×10^{-1}	6×10^{-2}	Ti	5.65×10^3	1×10^{-3}
In	2.5×10^{-1}	2×10^{-2}	Tl	8.5×10^{-1}	1.9×10^{-5}
Ir	1×10^{-3}		Tm	5.2×10^{-1}	1.7×10^{-7}
K	2.09×10^4	3.99×10^2	U	2.7	3.2×10^{-3}
Kr	1×10^{-4}	2.1×10^{-4}	V	1.20×10^2	2.5×10^{-3}
La	3.9×10^1	3.4×10^{-6}	W	1.25	1×10^{-4}
Li	2.0×10^1	1.8×10^{-1}	Xe	3×10^{-5}	5×10^{-5}
Lu	8×10^{-1}	1.5×10^{-7}	Y	3.3×10^1	1.3×10^{-5}
Mg	2.33×10^4	1.29×10^3	Yb	3.2	8.2×10^{-7}
Mn	9.50×10^2	2×10^{-4}	Zn	7.0×10^1	4.9×10^{-3}
Mo	1.2	1×10^{-2}	Zr	1.65×10^2	3×10^{-5}

SOLAR SPECTRAL IRRADIANCE

The solar luminosity (total radiant power emitted) is $3.86 \cdot 10^{26}$ W, of which 1373 W/m^2 reaches the top of the earth's atmosphere. To a zeroth approximation the sun can be considered a black body with an effective temperature of 5780 K, which implies a peak in the radiation at around $0.520 \text{ }\mu\text{m}$ (5200 \AA). The actual solar spectral emission is more complex, especially at ultraviolet and shorter wavelengths. The graph below, which was taken from Reference 1, summarizes the solar irradiance at the top of the atmosphere in the range 0.3 to $10 \text{ }\mu\text{m}$.

REFERENCES

1. Jursa, A.S., ed., *Handbook of Geophysics and the Space Environment*, Air Force Geophysics Laboratory, 1985.
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U.S. STANDARD ATMOSPHERE (1976)

A Standard Atmosphere is a hypothetical vertical distribution of atmospheric temperature, pressure, and density which is roughly representative of year-round, midlatitude conditions. Typical uses are to serve as a basis for pressure altimeter calibrations, aircraft performance calculations, aircraft and rocket design, ballistic tables, meteorological diagrams, and various types of atmospheric modeling. The air is assumed to be dry and to obey the perfect gas law and the hydrostatic equation which, taken together, relate temperature, pressure, and density with vertical position. The atmosphere is considered to rotate with the earth and to be an average over the diurnal cycle, the semiannual variation, and the range from active to quiet geomagnetic and sunspot conditions.

The U.S. Standard Atmosphere, 1976 is an idealized, steady-state representation of mean annual conditions of the earth's atmosphere from the surface to 1000 km at latitude 45°N, as it is assumed to exist during a period with moderate solar activity. The defining meteorological elements are sea-level temperature and pressure and a temperature-height profile to 1000 km. The 1976 Standard Atmosphere uses the following sea-level values which have been standard for many decades:

Temperature — 288.15 K (15°C)
 Pressure — 101325 Pa (1013.25 mbar, 760 mm of Hg, or 29.92 in. of Hg)
 Density — 1225 g/m³ (1.225 g/L)
 Mean molar mass — 28.964 g/mol

The parameters included in this condensed version of the U.S. Standard Atmosphere are:

Z — Height (geometric) above mean sea level in meters
 T — Temperature in kelvins
 P — Pressure in pascals (1 Pa = 0.01 millibars)
 ρ — Density in kilograms per cubic meter (1 kg/m³ = 1 g/L)
 n — Number density in molecules per cubic meter
 ν — Mean collision frequency in collisions per second
 l — Mean free path in meters
 η — Absolute viscosity in pascal seconds (1 Pa s = 1000 cP)
 k — Thermal conductivity in joules per meter second kilogram (W/m K)
 v_s — Speed of sound in meters per second
 g — Acceleration of gravity in meters per second square

The sea-level composition (percent by volume) is taken to be:

N ₂ — 78.084%	He — 0.000524
O ₂ — 20.9476	Kr — 0.000114
Ar — 0.934	Xe — 0.0000087
CO ₂ — 0.0314	CH ₄ — 0.0002
Ne — 0.001818	H ₂ — 0.00005

The T and P columns for the troposphere and lower stratosphere were generated from the following formulas:

	T/K	P/Pa
$H \leq 11000$ m	$288.15 - 0.0065 H$	$101325(288.15/T)^{-5.25577}$
11000 m $< H \leq 20000$ m	216.65	$22632 e^{-0.00015768832(H-11000)}$
20000 m $< H \leq 32000$ m	$216.65 + 0.0010(H-20000)$	$5474.87(216.65/T)^{34.16319}$

where $H = rZ/(r + Z)$ is the geopotential height in meters and r is the mean earth radius at 45° N latitude, taken as 6356766 m. For altitudes up to 32 km, $\rho = 0.003483677(P/T)$ in the units used here. Formulas for the other quantities may be found in the references.

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1. COESA, U.S. Standard Atmosphere, 1976, U.S. Government Printing Office, Washington, D.C., 1976.
2. Jursa, A.S., ed., *Handbook of Geophysics and the Space Environment*, Air Force Geophysics Laboratory, 1985.

Z/m	T/K	P/Pa	$\rho/\text{kg m}^{-3}$	n/m^{-3}	v/s^{-1}	l/m	$\eta/\text{Pa s}$	$k/\text{J m}^{-1}\text{s}^{-1}\text{K}^{-1}$	$\nu_g/\text{m s}^{-1}$	$g/\text{m s}^{-2}$
-5000	320.68	1.778E+05	1.931	4.015E+25	1.151E+10	4.208E-08	1.942E-05	0.02788	359.0	9.822
-4500	317.42	1.685E+05	1.849	3.845E+25	1.096E+10	4.395E-08	1.927E-05	0.02763	357.2	9.830
-4000	314.17	1.596E+05	1.770	3.680E+25	1.044E+10	4.592E-08	1.912E-05	0.02738	355.3	9.819
-3500	310.91	1.511E+05	1.693	3.520E+25	9.933E+09	4.800E-08	1.897E-05	0.02713	353.5	9.818
-3000	307.66	1.430E+05	1.619	3.366E+25	9.448E+09	5.019E-08	1.882E-05	0.02688	351.6	9.816
-2500	304.41	1.352E+05	1.547	3.217E+25	8.982E+09	5.252E-08	1.867E-05	0.02663	349.8	9.814
-2000	301.15	1.278E+05	1.478	3.102E+25	8.623E+09	5.447E-08	1.852E-05	0.02638	347.9	9.813
-1500	297.90	1.207E+05	1.411	2.935E+25	8.106E+09	5.757E-08	1.836E-05	0.02613	346.0	9.811
-1000	294.65	1.139E+05	1.347	2.801E+25	7.693E+09	6.032E-08	1.821E-05	0.02587	344.1	9.810
-500	291.40	1.075E+05	1.285	2.672E+25	7.298E+09	6.324E-08	1.805E-05	0.02562	342.2	9.808
0	288.15	1.013E+05	1.225	2.547E+25	6.919E+09	6.633E-08	1.789E-05	0.02533	340.3	9.807
500	284.90	9.546E+04	1.167	2.427E+25	6.556E+09	6.961E-08	1.774E-05	0.02511	338.4	9.805
1000	281.65	8.988E+04	1.112	2.311E+25	6.208E+09	7.310E-08	1.758E-05	0.02485	336.4	9.804
1500	278.40	8.456E+04	1.058	2.200E+25	5.874E+09	7.680E-08	1.742E-05	0.02459	334.5	9.802
2000	275.15	7.950E+04	1.007	2.093E+25	5.555E+09	8.073E-08	1.726E-05	0.02433	332.5	9.801
2500	271.91	7.469E+04	0.957	1.990E+25	5.250E+09	8.491E-08	1.710E-05	0.02407	330.6	9.799
3000	268.66	7.012E+04	0.909	1.891E+25	4.959E+09	8.937E-08	1.694E-05	0.02381	328.6	9.797
3500	265.41	6.579E+04	0.863	1.795E+25	4.680E+09	9.411E-08	1.678E-05	0.02355	326.6	9.796
4000	262.17	6.166E+04	0.819	1.704E+25	4.414E+09	9.917E-08	1.661E-05	0.02329	324.6	9.794
4500	258.92	5.775E+04	0.777	1.616E+25	4.160E+09	1.046E-07	1.645E-05	0.02303	322.6	9.793
5000	255.68	5.405E+04	0.736	1.531E+25	3.918E+09	1.103E-07	1.628E-05	0.02277	320.6	9.791
5500	252.43	5.054E+04	0.697	1.450E+25	3.687E+09	1.165E-07	1.612E-05	0.02250	318.5	9.790
6000	249.19	4.722E+04	0.660	1.373E+25	3.467E+09	1.231E-07	1.595E-05	0.02224	316.5	9.788
6500	245.94	4.408E+04	0.664	1.299E+25	3.258E+09	1.302E-07	1.578E-05	0.02197	314.4	9.787
7000	242.70	4.111E+04	0.590	1.227E+25	3.058E+09	1.377E-07	1.561E-05	0.02170	312.3	9.785
7500	239.46	3.830E+04	0.557	1.159E+25	2.869E+09	1.458E-07	1.544E-05	0.02144	310.2	9.784
8000	236.22	3.565E+04	0.526	1.093E+25	2.689E+09	1.545E-07	1.527E-05	0.02117	308.1	9.782
8500	232.97	3.315E+04	0.496	1.031E+25	2.518E+09	1.639E-07	1.510E-05	0.02090	306.0	9.781
9000	229.73	3.080E+04	0.467	9.711E+24	2.356E+09	1.740E-07	1.493E-05	0.02063	303.9	9.779
9500	226.49	2.858E+04	0.440	9.141E+24	2.202E+09	1.848E-07	1.475E-05	0.02036	301.7	9.777
10000	223.25	2.650E+04	0.414	8.598E+24	2.056E+09	1.965E-07	1.458E-05	0.02009	299.5	9.776
10500	220.01	2.454E+04	0.389	8.079E+24	1.918E+09	2.091E-07	1.440E-05	0.01982	297.4	9.774
11000	216.77	2.270E+04	0.365	7.585E+24	1.787E+09	2.227E-07	1.422E-05	0.01954	295.2	9.773
11500	216.65	2.098E+04	0.337	7.016E+24	1.653E+09	2.408E-07	1.422E-05	0.01953	295.1	9.771
12000	216.65	1.940E+04	0.312	6.486E+24	1.528E+09	2.605E-07	1.422E-05	0.01953	295.1	9.770
12500	216.65	1.793E+04	0.288	5.996E+24	1.412E+09	2.818E-07	1.422E-05	0.01953	295.1	9.768
13000	216.65	1.658E+04	0.267	5.543E+24	1.306E+09	3.048E-07	1.422E-05	0.01953	295.1	9.767
13500	216.65	1.533E+04	0.246	5.124E+24	1.207E+09	3.297E-07	1.422E-05	0.01953	295.1	9.765
14000	216.65	1.417E+04	0.228	4.738E+24	1.116E+09	3.566E-07	1.422E-05	0.01953	295.1	9.764
14500	216.65	1.310E+04	0.211	4.380E+24	1.032E+09	3.857E-07	1.422E-05	0.01953	295.1	9.762
15000	216.65	1.211E+04	0.195	4.049E+24	9.538E+08	4.172E-07	1.422E-05	0.01953	295.1	9.761
16000	216.65	1.035E+04	0.166	3.461E+24	8.153E+08	4.881E-07	1.422E-05	0.01953	295.1	9.758
17000	216.65	8.850E+03	0.142	2.959E+24	6.969E+08	5.710E-07	1.422E-05	0.01953	295.1	9.754
18000	216.65	7.565E+03	0.122	2.529E+24	5.958E+08	6.680E-07	1.422E-05	0.01953	295.1	9.751
19000	216.65	6.467E+03	0.104	2.162E+24	5.093E+08	7.814E-07	1.422E-05	0.01953	295.1	9.748

Z/m	T/K	P/Pa	$\rho/\text{kg m}^{-3}$	n/m^{-3}	v/s^{-1}	l/m	$\eta/\text{Pa s}$	$k/\text{J m}^{-1}\text{s}^{-1}\text{K}^{-1}$	$v_s/\text{m s}^{-1}$	$g/\text{m s}^{-2}$
20000	216.65	5.529E+03	8.891E-02	1.849E+24	4.354E+08	9.139E-07	1.422E-05	0.01953	295.1	9.745
21000	217.58	4.729E+03	7.572E-02	1.574E+24	3.716E+08	1.073E-06	1.427E-05	0.01961	295.1	9.742
22000	218.57	4.048E+03	6.451E-02	1.341E+24	3.173E+08	1.260E-06	1.432E-05	0.01970	296.4	9.739
23000	219.57	3.467E+03	5.501E-02	1.144E+24	2.712E+08	1.477E-06	1.438E-05	0.01978	297.1	9.736
24000	220.56	2.972E+03	4.694E-02	9.759E+23	2.319E+08	1.731E-06	1.443E-05	0.01986	297.7	9.733
25000	221.55	2.549E+03	4.008E-02	8.334E+23	1.985E+08	2.027E-06	1.448E-05	0.01995	298.4	9.730
26000	222.54	2.188E+03	3.426E-02	7.123E+23	1.700E+08	2.372E-06	1.454E-05	0.02003	299.1	9.727
27000	223.54	1.880E+03	2.930E-02	6.092E+23	1.458E+08	2.773E-06	1.459E-05	0.02011	299.7	9.724
28000	224.53	1.610E+03	2.508E-02	5.214E+23	1.250E+08	3.240E-06	1.465E-05	0.02020	300.4	9.721
29000	225.52	1.390E+03	2.148E-02	4.466E+23	1.073E+08	3.783E-06	1.470E-05	0.02028	301.1	9.718
30000	226.51	1.197E+03	1.841E-02	3.828E+23	9.219E+07	4.414E-06	1.475E-05	0.02036	301.7	9.715
31000	227.50	1.031E+03	1.579E-02	3.283E+23	7.925E+07	5.146E-06	1.481E-05	0.02044	302.4	9.712
32000	228.49	8.891E+02	1.356E-02	2.813E+23	6.818E+07	5.995E-06	1.486E-05	0.02053	303.0	9.709
33000	230.97	7.673E+02	1.157E-02	2.406E+23	5.852E+07	7.021E-06	1.499E-05	0.02073	304.7	9.706
34000	233.74	6.634E+02	9.887E-03	2.056E+23	5.030E+07	8.218E-06	1.514E-05	0.02096	306.5	9.703
35000	236.51	5.746E+02	8.463E-03	1.760E+23	4.331E+07	9.601E-06	1.529E-05	0.02119	308.3	9.700
36000	239.28	4.985E+02	7.258E-03	1.509E+23	3.736E+07	1.120E-05	1.543E-05	0.02142	310.1	9.697
38000	244.82	3.771E+02	5.367E-03	1.116E+23	2.794E+07	1.514E-05	1.572E-05	0.02188	313.7	9.690
40000	250.35	2.871E+02	3.996E-03	8.308E+22	2.104E+07	2.034E-05	1.601E-05	0.02233	317.2	9.684
42000	255.88	2.200E+02	2.995E-03	6.227E+22	1.594E+07	2.713E-05	1.629E-05	0.02278	320.7	9.678
44000	261.40	1.695E+02	2.295E-03	4.697E+22	1.215E+07	3.597E-05	1.657E-05	0.02323	324.1	9.672
46000	266.93	1.313E+02	1.714E-03	3.564E+22	9.318E+06	4.740E-05	1.685E-05	0.02376	327.5	9.666
48000	270.65	1.023E+02	1.317E-03	2.738E+22	7.208E+06	6.171E-05	1.704E-05	0.02397	329.8	9.660
50000	270.65	7.978E+01	1.027E-03	2.135E+22	5.620E+06	7.913E-05	1.703E-05	0.02397	329.8	9.654
52000	269.03	6.221E+01	8.056E-04	1.675E+22	4.397E+06	1.009E-04	1.696E-05	0.02384	328.8	9.648
54000	263.52	4.834E+01	6.390E-04	1.329E+22	3.452E+06	1.272E-04	1.660E-05	0.02340	325.4	9.642
56000	258.02	3.736E+01	5.045E-04	1.049E+22	2.696E+06	1.611E-04	1.640E-05	0.02296	322.0	9.636
58000	252.52	2.872E+01	3.963E-04	8.239E+21	2.095E+06	2.051E-04	1.612E-05	0.02251	318.6	9.632
60000	247.02	2.196E+01	3.097E-04	6.439E+21	1.620E+06	2.624E-04	1.584E-05	0.02206	315.1	9.624
65000	233.29	1.093E+01	1.632E-04	3.393E+21	8.294E+05	4.979E-04	1.512E-05	0.02093	306.2	9.609
70000	219.59	5.221	8.283E-05	1.722E+21	4.084E+05	9.810E-04	1.438E-05	0.01978	297.1	9.594
75000	208.40	2.388	3.992E-05	8.300E+20	1.918E+05	2.035E-03	1.376E-05	0.01883	289.4	9.579
80000	198.64	1.052	1.846E-05	3.838E+20	8.656E+04	4.402E-03	1.321E-05	0.01800	282.5	9.564
85000	188.89	4.457E-01	8.220E-06	1.709E+20	3.766E+04	9.886E-03	1.265E-05	0.01716	275.5	9.550
90000	186.87	1.836E-01	3.416E-06	7.116E+19	1.560E+04	2.370E-02				9.535
95000	188.42	7.597E-02	1.393E-06	2.920E+19	6.440E+03	5.790E-02				9.520
100000	195.08	3.201E-02	5.604E-07	1.189E+19	2.680E+03	1.420E-01				9.505
110000	240.00	7.104E-03	9.708E-08	2.144E+18	5.480E+02	7.880E-01				9.476
120000	360.00	2.538E-03	2.222E-08	5.107E+17	1.630E+02	3.310				9.447
130000	469.27	1.251E-03	8.152E-09	1.930E+17	7.100E+01	8.800				9.418
140000	559.63	7.203E-04	3.831E-09	9.322E+16	3.800E+01	1.800E+01				9.389
150000	634.39	4.542E-04	2.076E-09	5.186E+16	2.300E+01	3.300E+01				9.360
160000	696.29	3.040E-04	1.233E-09	3.162E+16	1.500E+01	5.300E+01				9.331
170000	747.57	2.121E-04	7.815E-10	2.055E+16	1.000E+01	8.200E+01				9.302
180000	790.07	1.527E-04	5.194E-10	1.400E+16	7.200	1.200E+02				9.274

Z/m	T/K	P/Pa	$\rho/\text{kg m}^{-3}$	n/m^{-3}	v/s^{-1}	l/m	$\eta/\text{Pa s}$	$k/\text{J m}^{-1}\text{s}^{-1}\text{K}^{-1}$	$\nu_s/\text{m s}^{-1}$	$g/\text{m s}^{-2}$
190000	825.16	1.127E-04	3.581E-10	9.887E+15	5.200	1.700E+02				9.246
200000	854.56	8.474E-05	2.541E-10	7.182E+15	3.900	2.400E+02				9.218
220000	899.01	5.015E-05	1.367E-10	4.040E+15	2.300	4.200E+02				9.162
240000	929.73	3.106E-05	7.858E-11	2.420E+15	1.400	7.000E+02				9.106
260000	950.99	1.989E-05	4.742E-11	1.515E+15	9.300E-01	1.100E+03				9.051
280000	965.75	1.308E-05	2.971E-11	9.807E+14	6.100E-01	1.700E+03				8.997
300000	976.01	8.770E-06	1.916E-11	6.509E+14	4.200E-01	2.600E+03				8.943
320000	983.16	5.980E-06	1.264E-11	4.405E+14	2.900E-01	3.800E+03				8.889
340000	988.15	4.132E-06	8.503E-12	3.029E+14	2.000E-01	5.600E+03				8.836
360000	991.65	2.888E-06	5.805E-12	2.109E+14	1.400E-01	8.000E+03				8.784
380000	994.10	2.038E-06	4.013E-12	1.485E+14	1.000E-01	1.100E+04				8.732
400000	995.83	1.452E-06	2.803E-12	1.056E+14	7.200E-02	1.600E+04				8.680
450000	998.22	6.447E-07	1.184E-12	4.678E+13	3.300E-02	3.600E+04				8.553
500000	999.24	3.024E-07	5.215E-13	2.192E+13	1.600E-02	7.700E+04				8.429
550000	999.67	1.514E-07	2.384E-13	1.097E+13	8.400E-03	1.500E+05				8.307
600000	999.85	8.213E-08	1.137E-13	5.950E+12	4.800E-03	2.800E+05				8.188
650000	999.93	4.887E-08	5.712E-14	3.540E+12	3.100E-03	4.800E+05				8.072
700000	999.97	3.191E-08	3.070E-14	2.311E+12	2.200E-03	7.300E+05				7.958
750000	999.98	2.260E-08	1.788E-14	1.637E+12	1.700E-03	1.000E+06				7.846
800000	999.99	1.704E-08	1.136E-14	1.234E+12	1.400E-03	1.400E+06				7.737
850000	1000.00	1.342E-08	7.824E-15	9.717E+11	1.200E-03	1.700E+06				7.630
900000	1000.00	1.087E-08	5.759E-15	7.876E+11	1.000E-03	2.100E+06				7.525
950000	1000.00	8.982E-09	4.453E-15	6.505E+11	8.700E-04	2.600E+06				7.422
1000000	1000.00	7.514E-09	3.561E-15	5.442E+11	7.500E-04	3.100E+06				7.322

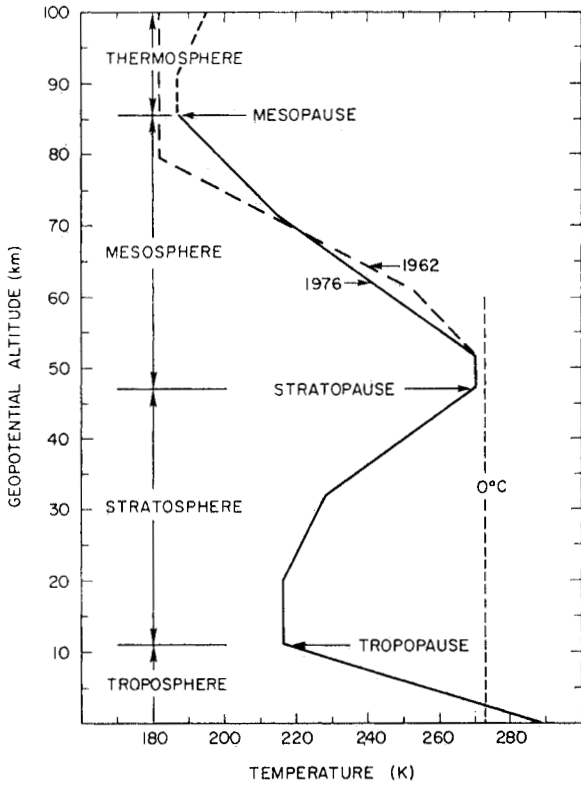


FIGURE 1. Temperature-height profile for U.S. Standard Atmosphere.

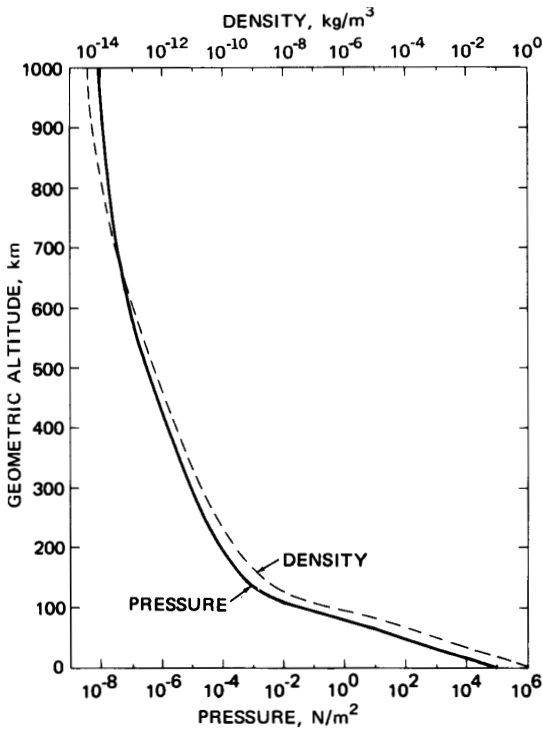


FIGURE 2. Total pressure and mass density as a function of geometric altitude.

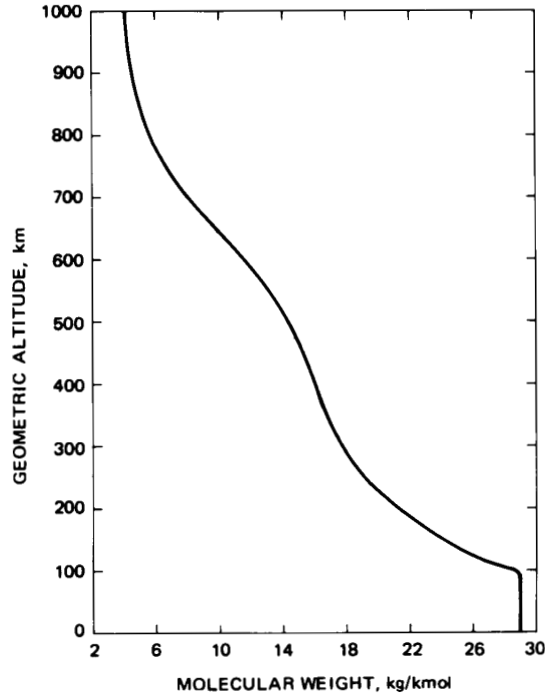


FIGURE 3. Mean molecular weight as a function of geometric altitude.

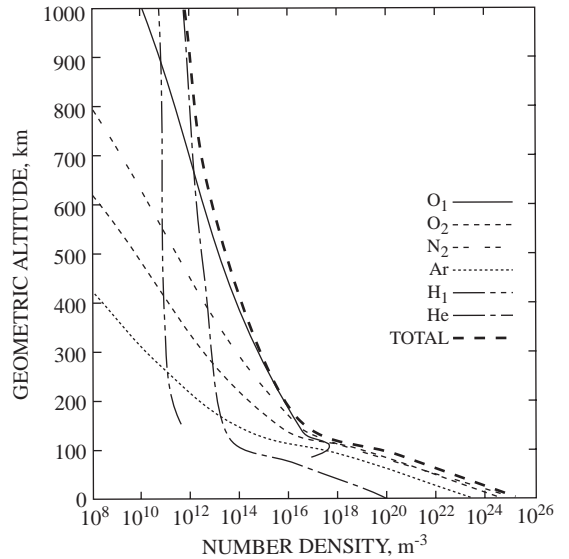


FIGURE 4. Number density of individual species and total number density as a function of geometric altitude.

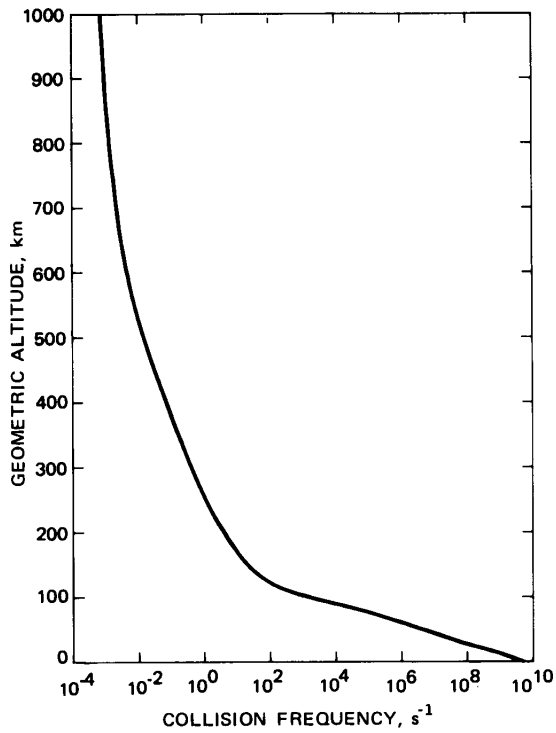


FIGURE 5. Collision frequency as a function of geometric altitude.

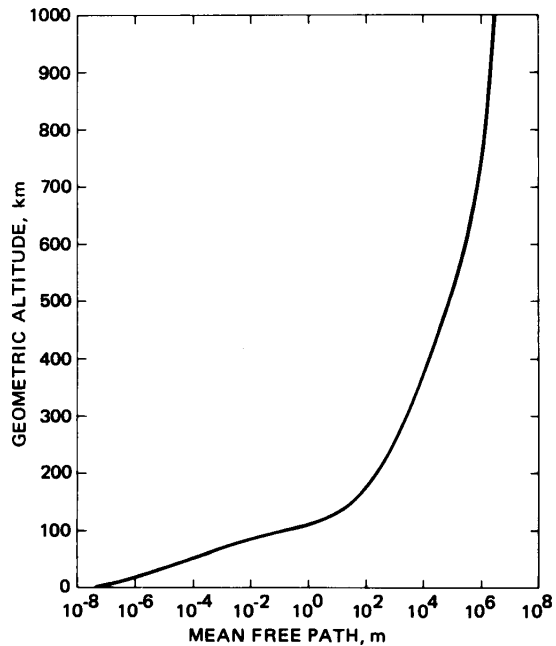


FIGURE 6. Mean free path as a function of geometric altitude.

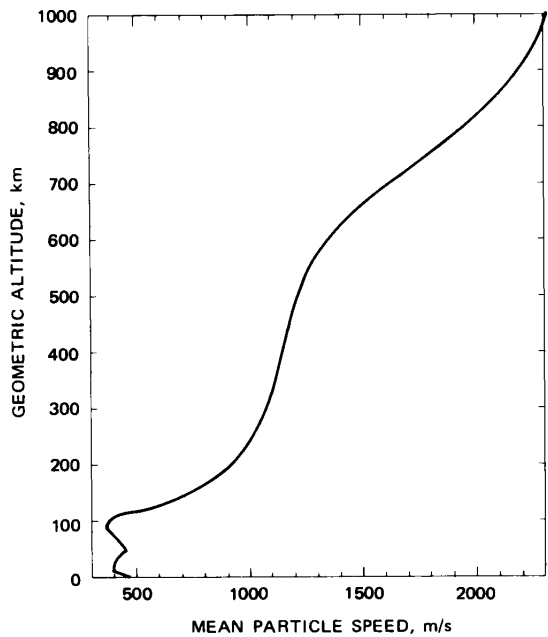


FIGURE 7. Mean air-particle speed as a function of geometric altitude.

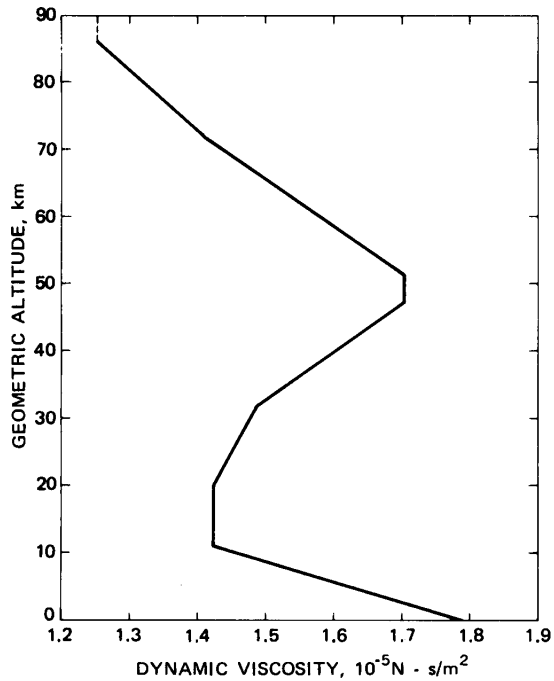


FIGURE 8. Dynamic viscosity as a function of geometric altitude.

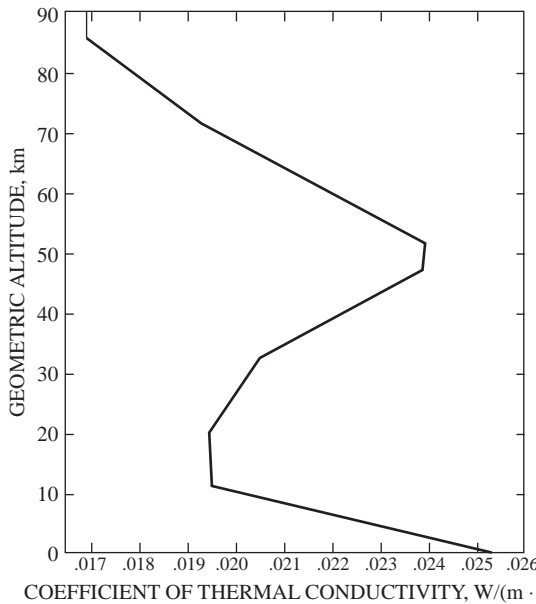


FIGURE 9. Coefficient of thermal conductivity as a function of geometric altitude.

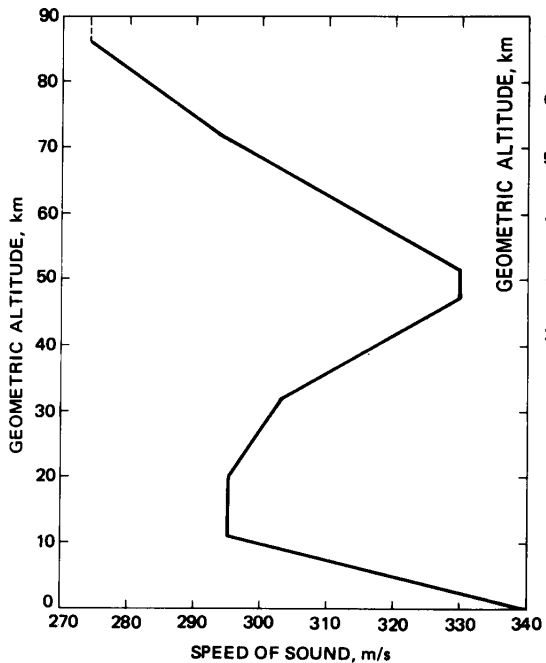


FIGURE 10. Speed of sound as a function of geometric altitude.

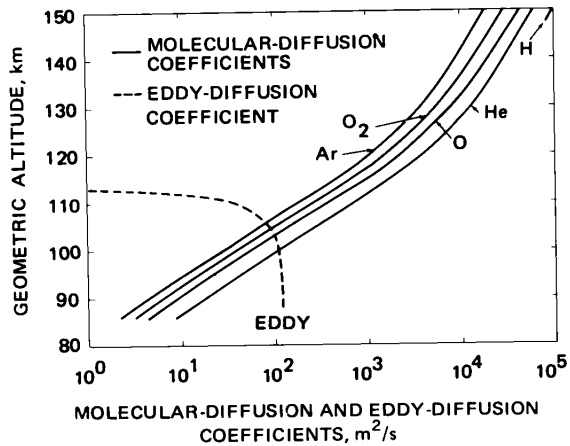


FIGURE 11. Molecular-diffusion and eddy-diffusion coefficients as a function of geometric altitude.

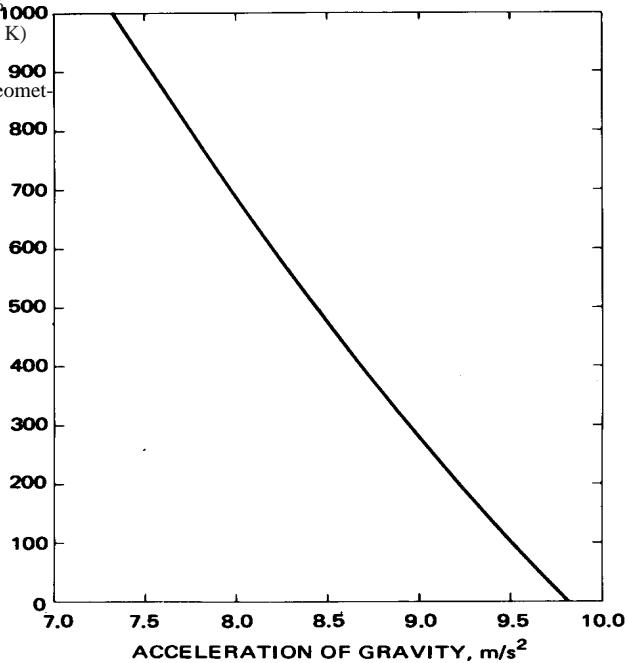


FIGURE 12. Acceleration of gravity as a function of geometric altitude.

GEOGRAPHICAL AND SEASONAL VARIATION IN SOLAR RADIATION

This table gives the amount of solar radiation reaching a unit area at the top of the earth's atmosphere per day as a function of latitude and approximate date. It is based upon a solar constant (total energy per unit area at the earth's average orbital distance) of 1373 W/m². Absorption of radiation by the atmosphere is not taken into consideration.

REFERENCE

List, R.J., *Smithsonian Meteorological Tables, Seventh Edition*, Smithsonian Institution Press, Washington, D.C., 1962.

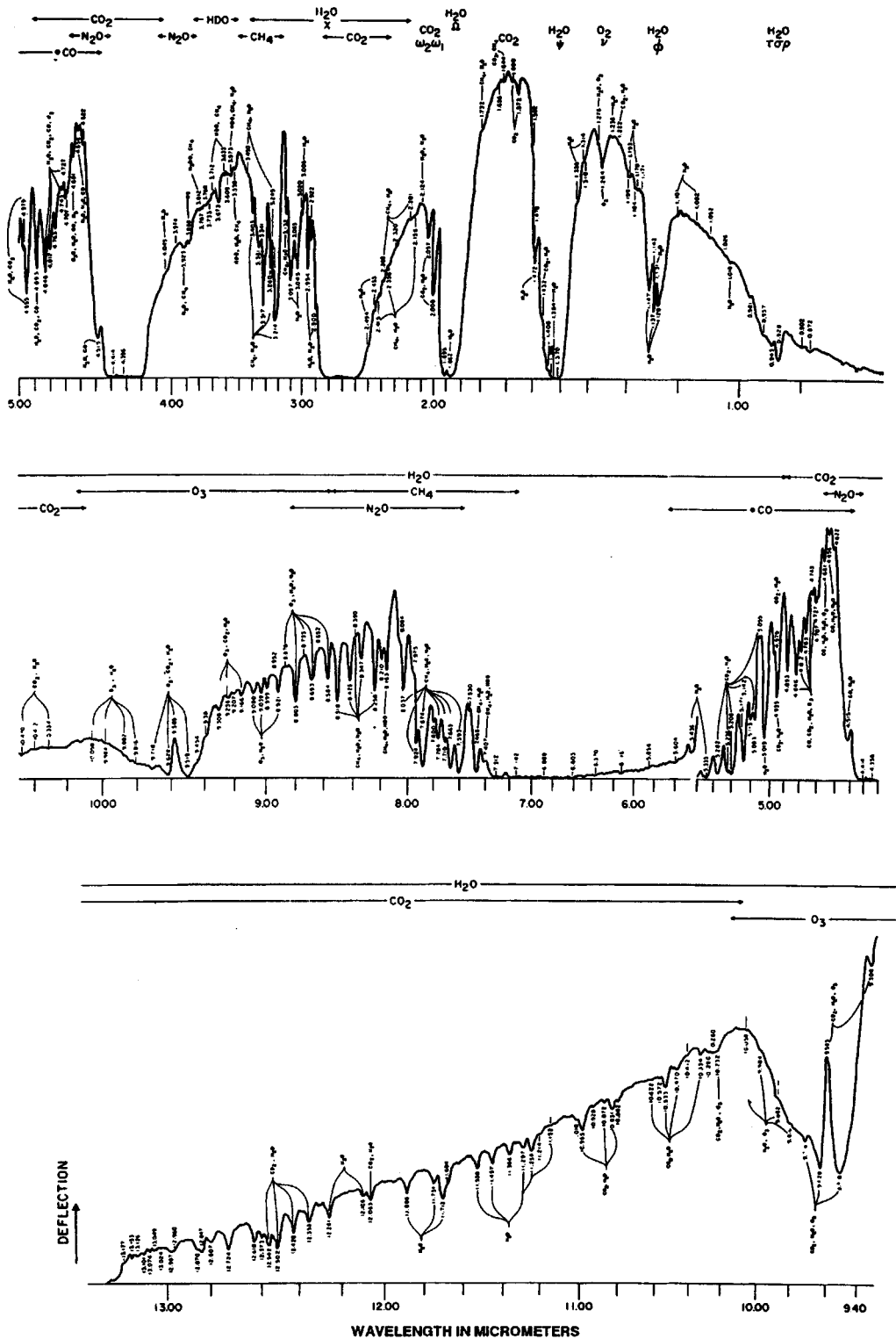
Daily Solar Radiation in MJ/m²

Lat.	Mar. 21	Apr. 13	May 6	May 29	Jun. 2	Jul. 15	Aug. 8	Aug. 31
90°		18.0	32.8	42.4	45.7	42.2	32.5	17.7
80	6.6	18.0	32.3	41.8	45.0	41.6	32.0	17.7
70	13.0	22.3	31.8	39.9	43.0	39.7	31.5	22.0
60	19.0	27.0	34.4	39.7	41.6	39.4	34.0	26.7
50	24.4	31.1	36.8	40.7	42.0	40.5	36.5	30.8
40	29.1	34.3	38.6	41.3	42.1	41.1	38.3	33.9
30	32.9	36.7	39.4	41.1	41.4	40.8	39.1	36.3
20	35.7	38.0	39.2	39.7	39.7	39.5	38.9	37.5
10	37.4	38.1	37.9	37.4	37.1	37.2	37.6	37.7
0	38.0	37.1	35.5	34.1	33.5	34.0	35.2	36.6
-10	37.4	35.0	32.3	30.0	29.2	29.9	32.0	34.6
-20	35.7	31.8	28.0	25.2	24.1	25.1	27.8	31.5
-30	32.9	27.8	23.1	19.7	18.5	19.7	22.8	27.4
-40	29.1	22.8	17.5	14.0	12.6	13.9	17.4	22.6
-50	24.4	17.3	11.7	8.2	7.0	8.2	11.6	17.2
-60	19.0	11.4	5.9	2.9	2.0	2.9	5.9	11.3
-70	13.0	5.4	1.0				1.0	5.3
-80	6.6	0.3						0.3
-90								

Lat.	Sep. 23	Oct. 16	Nov. 8	Nov. 30	Dec. 22	Jan. 13	Feb. 4	Feb. 26
90°								
80	6.5	0.3						0.3
70	12.9	5.5	1.0				1.0	5.6
60	18.8	11.6	6.2	3.1	2.1	3.1	6.2	11.7
50	24.1	17.6	12.1	8.7	7.5	8.7	12.3	17.8
40	28.7	23.1	18.2	14.8	13.5	14.9	18.4	23.5
30	32.5	28.2	23.9	20.9	19.8	21.0	24.1	28.4
20	35.3	32.3	29.1	26.6	25.7	26.7	29.3	32.7
10	37.0	35.5	33.5	31.8	31.1	31.9	33.8	35.9
0	37.6	37.6	36.9	36.1	35.8	36.3	37.3	38.0
-10	37.0	38.6	39.4	39.5	39.6	39.7	39.7	39.1
-20	35.3	38.5	40.7	42.0	42.4	42.2	41.1	39.0
-30	32.5	37.2	40.9	43.3	44.2	43.5	41.3	37.7
-40	28.7	34.8	40.1	43.6	45.0	43.8	40.5	35.2
-50	24.1	31.5	38.3	43.1	44.8	43.2	38.6	31.9
-60	18.8	27.3	35.7	41.9	44.4	42.1	36.0	27.7
-70	12.9	22.6	33.0	42.2	45.9	42.4	33.3	22.9
-80	6.5	18.2	33.5	44.2	48.1	44.4	33.8	18.4
-90		18.2	34.0	44.8	48.8	45.1	34.4	18.4

INFRARED ABSORPTION BY THE EARTH'S ATMOSPHERE

This graph summarizes the absorption by various atmospheric constituents in the wavelength range from 1 to 13 μm (wavenumber range 10,000 to 770 cm^{-1}). The vertical scale is in arbitrary units and does not take into account the wavelength variation of either the solar background radiation or the infrared detector response. Thus the intensities of the absorption bands have only qualitative significance.



ATMOSPHERIC CONCENTRATION OF CARBON DIOXIDE, 1958-2000

The data in this table were taken at the Mauna Loa Observatory in Hawaii and represent averages adjusted to the 15th of each month. The last column gives the average over the year. The concentration of CO₂ is given in parts per million by volume. Data from other measurement sites may be found in Reference 1.

The first graph illustrates the seasonal variation of CO₂ concentration and the steady increase over the last 40 years. The second graph summarizes the growth in the emissions of CO₂ into the atmosphere as a result of burning of fossil fuels (Reference 2).

REFERENCES

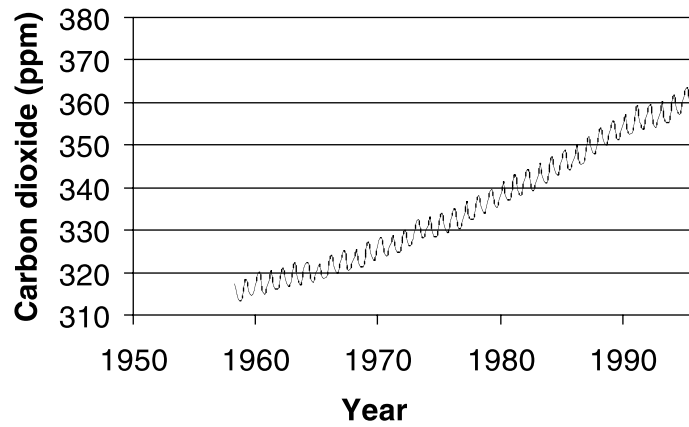
1. Keeling, C.D., and Whorf, T.P., Atmospheric CO₂ records from sites in the SIO air sampling network. In *Trends: A Compendium of Data on Global Change, 2001*. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, TN; <cdiac.esd.ornl.gov/ftp/maunaloa-co2/>.
2. Marland, G., Boden, T. A., and Andres, R. J., Global, Regional, and National CO₂ Emissions. In *Trends: A Compendium of Data on Global Change, 2001*. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, TN; <cdiac.esd.ornl.gov/trends/emis/tre_glob.htm>

CO₂ Concentration in ppm at Mauna Loa

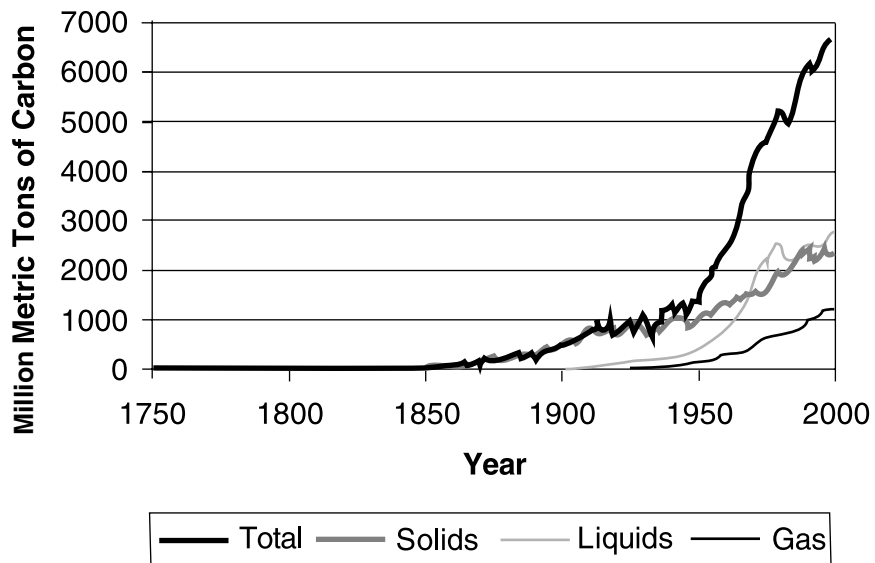
Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1958			315.71	317.45	317.50		315.85	314.93	313.19		313.34	314.67	
1959	315.58	316.47	316.65	317.72	318.29	318.16	316.55	314.80	313.84	313.34	314.82	315.59	315.98
1960	316.43	316.97	317.58	319.03	320.03	319.59	318.18	315.91	314.16	313.84	315.00	316.19	316.91
1961	316.89	317.70	318.54	319.48	320.58	319.77	318.58	316.79	314.99	315.31	316.10	317.01	317.65
1962	317.94	318.56	319.69	320.58	321.01	320.61	319.61	317.40	316.26	315.42	316.69	317.69	318.45
1963	318.74	319.08	319.86	321.39	322.24	321.47	319.74	317.77	316.21	315.99	317.06	318.36	318.99
1964	319.57				322.24	321.89	320.44	318.70	316.70	316.87	317.68	318.71	
1965	319.44	320.44	320.89	322.13	322.16	321.87	321.21	318.87	317.81	317.30	318.87	319.42	320.03
1966	320.62	321.59	322.39	323.70	324.07	323.75	322.41	320.37	318.64	318.10	319.79	321.03	321.37
1967	322.33	322.50	323.04	324.42	325.00	324.09	322.55	320.92	319.26	319.39	320.72	321.96	322.18
1968	322.57	323.15	323.89	325.03	325.57	325.36	324.14	322.11	320.33	320.25	321.33	322.90	323.05
1969	324.00	324.42	325.64	326.66	327.38	326.70	325.89	323.67	322.38	321.78	322.85	324.12	324.62
1970	325.06	325.98	326.93	328.14	328.07	327.66	326.35	324.69	323.10	323.07	324.01	325.13	325.68
1971	326.17	326.68	327.18	327.78	328.92	328.57	327.37	325.43	323.36	323.57	324.80	326.01	326.32
1972	326.77	327.63	327.75	329.72	330.07	329.09	328.05	326.32	324.84	325.20	326.50	327.55	327.46
1973	328.54	329.56	330.30	331.50	332.48	332.07	330.87	329.31	327.51	327.18	328.16	328.64	329.68
1974	329.35	330.71	331.48	332.65	333.08	332.25	331.18	329.40	327.44	327.37	328.46	329.58	330.25
1975	330.40	331.41	332.04	333.31	333.96	333.59	331.91	330.06	328.56	328.34	329.49	330.76	331.15
1976	331.74	332.56	333.50	334.58	334.87	334.34	333.05	330.94	329.30	328.94	330.31	331.68	332.15
1977	332.92	333.41	334.70	336.07	336.74	336.27	334.93	332.75	331.58	331.16	332.40	333.85	333.90
1978	334.97	335.39	336.64	337.76	338.01	337.89	336.54	334.68	332.76	332.54	333.92	334.95	335.50
1979	336.23	336.76	337.96	338.89	339.47	339.29	337.73	336.09	333.91	333.86	335.29	336.73	336.85
1980	338.01	338.36	340.08	340.77	341.46	341.17	339.56	337.60	335.88	336.02	337.10	338.21	338.69
1981	339.23	340.47	341.38	342.51	342.91	342.25	340.49	338.43	336.69	336.85	338.36	339.61	339.93
1982	340.75	341.61	342.70	343.57	344.13	343.35	342.06	339.82	337.97	337.86	339.26	340.49	341.13
1983	341.37	342.52	343.10	344.94	345.75	345.32	343.99	342.39	339.86	339.99	341.16	342.99	342.78
1984	343.70	344.50	345.29	347.08	347.43	346.79	345.40	343.28	341.07	341.35	342.98	344.22	344.42
1985	344.97	346.00	347.43	348.35	348.93	348.25	346.56	344.69	343.09	342.80	344.24	345.56	345.91
1986	346.29	346.96	347.86	349.55	350.21	349.54	347.94	345.91	344.86	344.17	345.66	346.90	347.15
1987	348.02	348.47	349.42	350.99	351.84	351.25	349.52	348.11	346.44	346.36	347.81	348.96	348.93
1988	350.43	351.72	352.22	353.59	354.22	353.79	352.39	350.44	348.72	348.88	350.07	351.34	351.48
1989	352.76	353.07	353.68	355.42	355.67	355.13	353.90	351.67	349.80	349.99	351.30	352.53	352.91
1990	353.66	354.70	355.39	356.20	357.16	356.22	354.82	352.91	350.96	351.18	352.83	354.21	354.19
1991	354.72	355.75	357.16	358.60	359.33	358.24	356.18	354.03	352.16	352.21	353.75	355.49	355.59
1992	355.98	356.72	357.81	359.15	359.66	359.25	357.03	355.00	353.01	353.31	354.16	355.40	356.37
1993	356.70	357.16	358.38	359.46	360.28	359.59	357.58	355.52	353.70	353.98	355.33	356.80	357.04
1994	358.36	358.91	359.97	361.27	361.68	360.94	359.55	357.49	355.84	355.99	357.58	359.04	358.89
1995	359.96	361.00	361.64	363.45	363.79	363.26	361.90	359.46	358.06	357.75	359.56	360.70	360.88
1996	362.05	363.25	364.02	364.72	365.41	364.97	363.65	361.49	359.46	359.60	360.76	362.33	362.64
1997	363.18	364.00	364.56	366.36	366.80	365.62	364.47	362.51	360.19	360.77	362.43	364.28	363.76
1998	365.32	366.15	367.31	368.61	369.30	368.87	367.64	365.77	363.90	364.23	365.46	366.97	366.63
1999	368.15	368.86	369.58	371.12	370.97	370.32	369.25	366.91	364.60	365.09	366.63	367.96	368.29
2000	369.08	369.40	370.45	371.59	371.75	371.62	370.04	368.04	366.53	366.63	368.20	369.43	369.40

ATMOSPHERIC CONCENTRATION OF CARBON DIOXIDE, 1958-2000 (continued)

CO₂ Concentration at Mauna Loa



CO₂ Emissions from Burning of Fossil Fuels



MEAN TEMPERATURES IN THE UNITED STATES, 1900-1992

Historical records of atmospheric temperatures have been analyzed to obtain mean temperatures in °C for 23 climatically distinct regions of the United States. The table below gives the average over these 23 regions, which cover completely the contiguous 48 states. Data for the individual regions and for other parts of the world may be found in the references.

The data are presented as temperature anomalies, i.e., as deviations (in °C) from the average temperature at each individual recording station over a 1961-1990 reference period. The trend in the temperature anomaly thus gives an indication of the long-term variation in average temperatures.

CY Mean: Calendar year mean (January-December)

Winter: December-February

Spring: March-May

Summer: June-August

Fall: September-November

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2. Carbon Dioxide Information Analysis Center, WWW site <<http://cdiac.esd.ornl.gov/ftp/trends93>>.

Year	CY Mean	Winter	Spring	Summer	Fall
1900	0.46		0.21	0.27	0.85
1901	-0.21	0.07	-0.46	0.48	-0.28
1902	-0.14	-0.69	0.48	-0.58	0.12
1903	-0.77	-0.84	0.10	-0.83	-1.02
1904	-0.72	-1.86	-0.39	-0.92	-0.21
1905	-0.45	-1.86	0.67	-0.32	-0.25
1906	-0.04	0.23	-0.69	-0.42	-0.10
1907	-0.23	1.09	-0.61	-0.85	-0.39
1908	-0.11	0.73	0.36	-0.64	-0.59
1909	-0.36	0.82	-1.06	0.06	0.01
1910	-0.14	-2.08	0.95	-0.55	0.13
1911	0.02	0.52	0.20	-0.19	-0.62
1912	-0.88	-1.50	-0.75	-0.76	-0.51
1913	-0.23	-0.74	-0.65	-0.07	0.22
1914	-0.05	0.48	0.04	0.14	0.32
1915	-0.11	-0.37	-0.18	-1.16	0.31
1916	-0.77	-0.29	-0.36	-0.30	-1.23
1917	-1.34	-1.93	-1.75	-0.73	-1.04
1918	-0.14	-2.02	0.30	0.03	-0.09
1919	-0.16	0.69	0.00	0.12	-0.13
1920	-0.37	-0.83	-0.96	-0.67	0.02
1921	0.87	1.56	0.83	0.52	0.32
1922	0.01	-0.44	0.15	0.16	0.41
1923	-0.10	0.23	-1.02	-0.07	-0.09
1924	-1.01	0.13	-1.27	-0.64	-0.53
1925	0.20	-0.44	0.57	0.05	-0.41
1926	-0.01	0.97	-0.58	-0.27	0.02
1927	0.20	1.11	0.41	-0.83	0.83
1928	-0.08	-0.40	-0.28	-0.43	-0.08
1929	-0.68	-1.94	0.30	-0.39	-0.78
1930	-0.12	0.07	0.09	-0.07	-0.25
1931	0.81	1.16	-0.71	0.51	1.41
1932	-0.14	1.75	-0.58	0.26	-0.78
1933	0.35	-0.60	-0.08	0.45	0.54
1934	0.86	1.45	0.77	0.86	0.82
1935	0.12	0.84	0.12	0.31	-0.47
1936	-0.10	-2.23	0.48	1.00	-0.32
1937	-0.13	-0.65	-0.24	0.66	-0.03
1938	0.71	1.31	0.98	0.39	0.08
1939	0.38	0.36	0.34	0.18	0.15
1940	0.06	0.03	-0.10	0.18	0.12

MEAN TEMPERATURES IN THE UNITED STATES, 1901-1992 (continued)

Year	CY Mean	Winter	Spring	Summer	Fall
1941	0.79	1.56	0.44	0.28	0.85
1942	0.01	0.35	0.22	0.08	0.06
1943	-0.17	0.20	-0.46	0.54	-0.79
1944	0.04	0.61	-0.38	-0.20	0.43
1945	-0.02	0.30	0.25	-0.47	0.08
1946	0.53	-0.26	1.21	-0.21	0.18
1947	0.10	0.47	-0.42	0.03	0.85
1948	-0.22	-0.67	-0.01	0.02	-0.15
1949	0.05	-0.77	0.39	0.33	0.23
1950	-0.37	0.39	-1.02	-0.86	0.13
1951	-0.45	0.05	-0.69	-0.30	-0.70
1952	0.03	0.68	-0.40	0.49	-1.22
1953	0.61	1.91	0.03	0.31	0.31
1954	0.57	1.47	-0.22	0.36	0.70
1955	-0.25	-0.33	0.12	0.19	-0.60
1956	-0.05	-0.16	-0.42	0.01	-0.37
1957	0.45	1.02	0.44	0.25	-0.13
1958	0.14	0.93	0.06	0.11	0.45
1959	0.12	-0.60	0.16	0.50	-0.52
1960	-0.27	0.43	-0.98	0.01	0.56
1961	-0.01	-0.02	-0.17	0.18	-0.29
1962	-0.04	-0.52	-0.09	-0.41	0.65
1963	-0.06	-1.35	0.61	0.12	1.38
1964	-0.27	-1.30	-0.24	-0.08	-0.40
1965	-0.03	-0.07	-0.56	-0.42	0.28
1966	-0.34	-0.31	-0.25	-0.07	-0.13
1967	-0.13	0.23	-0.05	-0.37	-0.32
1968	-0.28	-0.31	-0.16	-0.12	0.01
1969	-0.06	-0.36	-0.54	0.12	-0.16
1970	-0.12	-0.17	-0.44	0.32	-0.07
1971	-0.04	-0.08	-0.99	0.01	0.56
1972	-0.13	0.20	0.26	-0.19	0.05
1973	0.48	-0.23	0.47	0.22	0.90
1974	0.16	0.52	0.74	-0.32	-0.39
1975	-0.09	0.63	-0.79	0.03	-0.20
1976	-0.62	0.88	-0.09	-0.54	-1.72
1977	0.32	-1.95	1.07	0.60	0.68
1978	-0.37	-1.31	0.23	0.09	0.21
1979	-0.53	-2.92	0.09	-0.21	-0.07
1980	0.18	0.72	-0.25	0.43	-0.04
1981	0.64	0.90	0.80	0.57	0.36
1982	-0.08	-0.86	0.03	-0.11	0.06
1983	0.40	2.33	-0.36	0.58	0.94
1984	0.21	-0.78	-0.30	0.31	0.07
1985	-0.26	-0.78	1.24	-0.23	0.05
1986	0.93	0.22	1.22	0.45	0.49
1987	0.67	1.52	0.97	0.33	-0.17
1988	-0.07	-0.26	-0.06	0.57	0.04
1989	-0.30	-0.28	0.36	0.12	-0.27
1990	0.72	0.41	0.72	0.41	0.66
1991	0.77	0.32	1.36	0.56	-0.31
1992		2.48	0.82	-0.70	

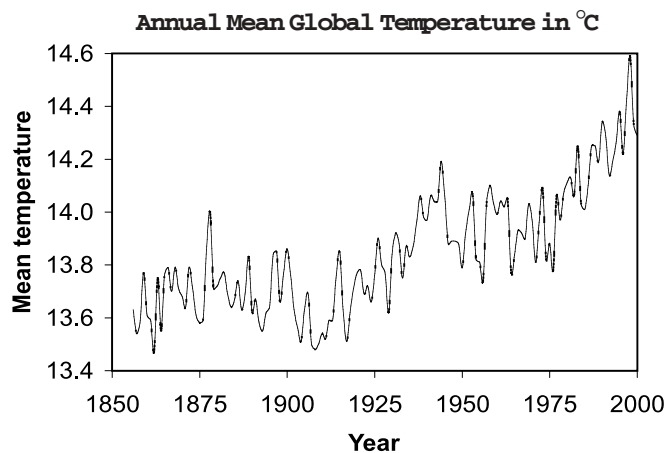
GLOBAL TEMPERATURE TREND, 1856-2000

This table and graph summarize the trend in annual mean global surface temperature from 1856 to 2000. The values were calculated from mean temperature anomalies by assuming an absolute global mean of 14.00°C, which is the best estimate for the 1961–1990 period. The 95% confidence interval for the annual mean temperature values since 1951 is $\pm 0.12^\circ\text{C}$; prior to 1900 this interval is $\pm 0.18^\circ\text{C}$.

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Year	t/°C	Year	t/°C	Year	t/°C	Year	t/°C	Year	t/°C
1856	13.63	1887	13.63	1918	13.62	1949	13.88	1980	14.11
1857	13.54	1888	13.69	1919	13.71	1950	13.79	1981	14.13
1858	13.58	1889	13.83	1920	13.77	1951	13.92	1982	14.06
1859	13.77	1890	13.62	1921	13.78	1952	14.01	1983	14.25
1860	13.61	1891	13.67	1922	13.69	1953	14.07	1984	14.03
1861	13.59	1892	13.58	1923	13.72	1954	13.82	1985	14.01
1862	13.47	1893	13.55	1924	13.66	1955	13.81	1986	14.10
1863	13.75	1894	13.62	1925	13.76	1956	13.74	1987	14.25
1864	13.55	1895	13.64	1926	13.90	1957	14.04	1988	14.25
1865	13.76	1896	13.84	1927	13.80	1958	14.10	1989	14.19
1866	13.79	1897	13.85	1928	13.77	1959	14.03	1990	14.34
1867	13.70	1898	13.66	1929	13.62	1960	13.99	1991	14.29
1868	13.79	1899	13.77	1930	13.84	1961	14.04	1992	14.14
1869	13.71	1900	13.86	1931	13.92	1962	14.02	1993	14.19
1870	13.68	1901	13.76	1932	13.88	1963	14.05	1994	14.26
1871	13.64	1902	13.63	1933	13.75	1964	13.77	1995	14.38
1872	13.79	1903	13.56	1934	13.87	1965	13.84	1996	14.22
1873	13.71	1904	13.51	1935	13.83	1966	13.93	1997	14.43
1874	13.61	1905	13.63	1936	13.87	1967	13.92	1998	14.59
1875	13.58	1906	13.69	1937	13.96	1968	13.90	1999	14.33
1876	13.59	1907	13.50	1938	14.06	1969	14.03	2000	14.29
1877	13.87	1908	13.48	1939	13.98	1970	13.97		
1878	14.00	1909	13.50	1940	13.97	1971	13.81		
1879	13.71	1910	13.54	1941	14.06	1972	13.96		
1880	13.72	1911	13.52	1942	14.04	1973	14.09		
1881	13.75	1912	13.59	1943	14.04	1974	13.82		
1882	13.77	1913	13.59	1944	14.19	1975	13.88		
1883	13.69	1914	13.75	1945	14.06	1976	13.78		
1884	13.64	1915	13.85	1946	13.88	1977	14.06		
1885	13.67	1916	13.63	1947	13.89	1978	13.97		
1886	13.74	1917	13.51	1948	13.89	1979	14.07		



ATMOSPHERIC ELECTRICITY

Hans Dolezalek, Hannes Tammet, John Latham, and Martin A. Uman

I. SURVEY AND GLOBAL CIRCUIT

Hans Dolezalek

The science of atmospheric electricity originated in 1752 by an experimental proof of a related earlier hypothesis (that lightning is an electrical event). In spite of a large effort, in part by such eminent physicists as Coulomb, Lord Kelvin, and many others, an overall, proven theory able to generate models with sufficient resolution is not yet available. Generally accepted and encompassing text books are now more than 20 years old. The voluminous proceedings of the, so far, nine international atmospheric electricity conferences (1954 to 1992) give much valuable detail and demonstrate impressive progress, as do a number of less comprehensive textbooks published in the last 20 years, but a general theory as indicated above is not yet created. Only now, certain related measuring techniques and mathematical possibilities are emerging.

Applications to practical purposes do exist in the field of lightning research (including the electromagnetic radiation emanating from lightning) by the establishment of lightning-location networks and by the now developing possibility to detect electrified clouds which pose hazards to aircraft. Application of atmospheric electricity to other parts of meteorology seems to be promising but so far has seldom been instituted. Because some atmospheric electric signals propagate around the earth and because of the existence of a global circuit, applications for the monitoring of global change processes and conditions are now being proposed. Significant secular changes in the global circuit would indicate a change in the global climate; the availability of many old data (about a span of 100 years) could help detect a long term trend.

The concept of the "global circuit" is based on the theory of the global spherical capacitor: both, the solid (and liquid) earth as one electrode, and the high atmospheric layers (about the ionosphere) as the other, are by orders of magnitude more electrically conductive than the atmosphere between them. According to the "classical picture of atmospheric electricity", this capacitor is continuously charged by the common action of all thunderstorms to a d.c. voltage difference of several hundred kilovolts, the earth being negative. The much smaller but still existing conductivity of the atmosphere allows a current flowing from the ionosphere to the ground, integrated for all sink areas of the whole earth, of the order of 1.5 kA. In this way, a global circuit is created with many generators and sink-areas both interspaced and distributed over the whole globe, all connected to two nodes: ionosphere and ground. Within the scope of the global circuit, for each location, the current density (order of several pA/m²) is determined by the voltage difference between ionosphere and ground (which is the same for all locations but varying in time) and the columnar resistance reaching from the ground up to the ionosphere (in the order of 10¹⁷ Ω m²).

Natural processes, especially meteorological processes and some human activity, which produce or move electric charges ("space charges") or affect the ion distribution, constitute local generators and thereby "local circuits", horizontally and/or in parallel or antiparallel to the local part of the global circuit. In many cases, the local currents are much stronger than the global ones, making the measurement of the global current at a given location and/or during a period of time very difficult or, often, impossible. The strongest local circuits usually occur with certain weather conditions (precipitation, fog, high wind, blown-up dust or snow, heavy cloudiness) which make measurement of the global circuit impossible everywhere; but even in their absence local generators exist in varying magnitudes and of different characters. The separation of the local and global shares in the measured values of current density is a central problem of the science of atmospheric electricity. Aerological measurements are of high value in this regard.

The above description is within the "classical picture" of atmospheric electricity, a group of hypotheses to explain the electricification of the atmosphere. It is probably fundamentally correct but certainly not complete; it has not yet been confirmed by systems of measurements resulting in no inner contradictions. In particular, extraterrestrial influences must be permitted; their general significance is still under debate.

Within this "classical picture" a kind of electric standard atmosphere may be constructed as shown in Table 1.

Values with a star, *, are rough average values from measurement. A star in parentheses, (*), points to a typical value from one or a few measurements. All other values have been calculated from starred values, under the assumption that at 2 km 50% and at 12 km 90% of the columnar resistance is reached. Voltage drop along one of the partial columns can be calculated by subtracting the value for the lower column from that of the upper one. Columnar resistances, conductances, and capacitances are valid for that particular part of the column which is indicated at the left. Capacitances are calculated with the formula for plate capacitors, and this fact must be considered also for the time constants for columns.

According to measurements, U , the potential difference between 0 m and 65 km may vary by a factor of approximately 2. The total columnar resistance, R_c , is estimated to vary up to a factor of 3, the variation being due to either reduction of conductivity in the exchange layer (about lowest 2 km of this table) or to the presence of high mountains; in both cases the variation is caused in the troposphere. Smaller variations in the stratosphere and mesosphere are being discussed because of aerosols there. The air-earth current density in fair weather varies by a factor of 3 to 6 accordingly. Conductivity near the ground varies by a factor of about 3 but only decreasing; increase of conductivity due to extraordinary radioactivity is a singular event. The field strength near the ground varies as a consequence of variations of air-earth current density and conductivity from about 1/3 to about 10 times of the value quoted in the table. Conductivity near the ground shows a diurnal and an annual variation which depends strongly on the locality: air-earth current density shows a diurnal and annual variation because the earth-ionosphere potential difference undergoes such variations, and also because the columnar resistance is supposed to have a diurnal and probably an annual variation.

Conductivities and air-earth current densities on high mountains are greater than at sea level by factors of up to 10. Conductivity decreases when atmospheric humidity increases. Values for space charges are not quoted because measurements are too few to allow calculation of average values. Values of parameters over the oceans are still rather uncertain.

Theoretically, in fair-weather conditions, Ohm's law must be fulfilled for the electric field, the conduction current density, and the electrical conductivity of the atmosphere. Deviations point to shortcomings in the applied measuring techniques. Data which are representative for a large area (in the extreme, "globally representative data", i.e. data on the global circuit), can on the ground be obtained only by stations on an open plane and only if local generators are either small or constant or are independently measured. Certain measurements with instrumented aircraft provide globally representative information valid for the period of the actual measurement.

TABLE 1

Electrical Parameters of the Clear (Fair-Weather) Atmosphere, Pertinent to the Classical Picture of Atm. Electricity (Electric Standard Atmosphere)

Part of atmosphere for which the values are calculated (elements are in free, cloudless atmosphere)	Currents, I , in A; and current densities, i , in A/m ²	Potential differences, U , in V; field strength E in V/m; $U = 0$ at sea level	Resistances, R , in Ω ; columnar resistances, R_c , in Ω m ² and resistivities, ρ , in Ω m	Conductances, G , in Ω^{-1} ; columnar conductances G_c , in Ω^{-1} m ² ; total conductivities, γ , in Ω^{-1} m ⁻¹	Capacitances, C , in F; columnar capacitances, C_c , in F m ⁻² and capacitivities, ϵ , in F m ⁻¹	Time constants τ , in seconds
Volume element at about sea level, 1 m ³	$i = 3 \times 10^{-12}$ *	$E_0 = 1.2 \times 10^{25}$ *	$\rho_0 = 4 \times 10^{13}$	$\gamma_0 = 2.5 \times 10^{-14}$	$\epsilon_0 = 8.9 \times 10^{-12}$ *	$\tau_0 = 3.6 \times 10^2$
Lower column of 1 m ² cross section from sea level to 2 km height	$i = 3 \times 10^{-12}$	At upper end: $U_1 = 1.8 \times 10^5$	$R_{c1} = 6 \times 10^{16}$	$G_{c1} = 1.7 \times 10^{-17}$	$C_{c1} = 4.4 \times 10^{-15}$	$\tau_{c1} = 2.6 \times 10^2$
Volume element at about 2 km height, 1 m ³	$i = 3 \times 10^{-12}$	$E_2 = 6.6 \times 10^1$	$\rho_2 = 2.2 \times 10^{13(*)}$	$\gamma_2 = 4.5 \times 10^{-14}$	$\epsilon_2 = 8.9 \times 10^{-12}$	$\tau_2 = 2 \times 10^2$
Center column of 1 m ² cross section from 2 to 12 km	$i = 3 \times 10^{-12}$	At upper end: $U_m = 3.15 \times 10^5$	$R_{cm} = 4.5 \times 10^{16}$	$G_{cm} = 5 \times 10^{-17}$	$C_{cm} = 8.8 \times 10^{-16}$	$\tau_{cm} = 1.8 \times 10^1$
Volume element at about 12 km height, 1 m ³	$i = 3 \times 10^{-12}$	$E_{12} = 3.9 \times 10^0$	$\rho_{12} = 1.3 \times 10^{12(*)}$	$\gamma_{12} = 7.7 \times 10^{-13}$	$\epsilon_{12} = 8.9 \times 10^{-12}$	$\tau_{12} = 1.2 \times 10^1$
Upper column of 1 m ² cross section from 12 to 65 km height	$i = 3 \times 10^{-12}$	At upper end: $U_u = 3.5 \times 10^5$	$R_{cu} = 1.5 \times 10^{16}$	$G_{cu} = 2.5 \times 10^{-17}$	$C_{cu} = 1.67 \times 10^{-16}$	$\tau_{cu} = 6.7 \times 10^0$
Whole column of 1 m ² cross section from 0 to 65 km height	$i = 3 \times 10^{-12}$	At upper end: $U = 3.5 \times 10^5$	$R_c = 1.2 \times 10^{17}$	$G_c = 8.3 \times 10^{-18}$	$C_c = 1.36 \times 10^{-16}$	$\tau_c = 1.64 \times 10^1$
Total spherical capacitor area: 5×10^{14} m ²	$I = 1.5 \times 10^3$	$U = 3.5 \times 10^5$ *	$R = 2.4 \times 10^2$	$G = 4.2 \times 10^{-3}$	$C = 6.8 \times 10^{-2}$	$\tau = 1.64 \times 10^1$

Note: All currents and fields listed are part of the global circuit, i.e., circuits of local generators are not included. Values are subject to variations due to latitude and altitude of the point of observation above sea level, locality with respect to sources of disturbances, meteorological and climatological factors, and man-made changes. For more explanations, see text.

ATMOSPHERIC ELECTRICITY (continued)

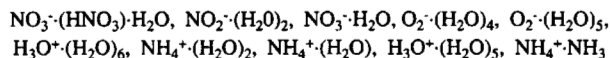
II. AIR IONS Hannes Tammet

The term "air ions" signifies all airborne particles which are the carriers of the electrical current in the air and have drift velocities determined by the electric field.

The probability of electrical dissociation of molecules in the atmospheric air under thermodynamic equilibrium is near to zero. The average ionization at the ground level over the ocean is $2 \cdot 10^6$ ion pairs $m^{-3}s^{-1}$. This ionization is produced mainly by cosmic rays. Over the continents the ionizing radiation from soil and from radioactive substances in the air each add about $4 \cdot 10^6 m^{-3}s^{-1}$. The total average ionization rate of $10^7 m^{-3}s^{-1}$ is equivalent to 17 $\mu R/h$ which is a customary expression of the background level of the ionizing radiations. The ionization rate over the ground varies in space due to the radioactivity of soil, and in time depending on the exchange of air between the atmosphere and radon-containing soil. Radioactive pollution increases the ionization rate. A temporary increase of about 10 times was registered in Sweden after the Chernobyl accident in 1986. The emission of Kr^{85} from nuclear power plants can noticeably increase the global ionization rate in the next century. The ionization rate decreases with altitude near the ground and increases at higher altitudes up to 15 km, where it has a maximum about $5 \cdot 10^7 m^{-3}s^{-1}$. Solar X-ray and extreme UV radiation cause a new increase at altitudes over 60 km.

Local sources of air ions are point discharges in strong electric fields, fluidization of charged drops from waves, etc.

The enhanced chemical activity of an ion results in a chain of ion-molecule reactions with the colliding neutrals, and, in the first microsecond of the life of an air ion, a charged molecular cluster called the *cluster ion* is formed. According to theoretical calculations in the air free from exotic trace gases the following cluster ions should be dominant:



A measurable parameter of air ions is the electrical mobility k , characterizing the drift velocity in the unit electric field. The mobility is inversely proportional to the density of air, and the results of measurements are as a rule reduced to normal conditions. According to mobility the air ions are called: fast or small or light ions with mobility $k > 5 \cdot 10^{-5} m^2 V^{-1} s^{-1}$, intermediate ions, and slow or large or heavy ions with mobility $k < 10^{-6} m^2 V^{-1} s^{-1}$. The boundary between intermediate and slow ions is conventional.

Cluster ions are fast ions. The masses of cluster ions may be measured with mass spectrometers, but the possible ion-molecule reactions during the passage of the air through nozzles to the vacuum chamber complicate the measurement. Mass and mobility of cluster ions are highly correlated. The experimental results⁵ can be expressed by the empirical formula

$$m \approx \frac{850 u}{\left[0.3 + k / (10^{-4} m^2 V^{-1} s^{-1})\right]^3}$$

where u is the unified atomic mass unit.

The value of the transport cross-section of a cluster ion is needed to calculate its mobility according to the kinetic theory of Chapman and Enskog. The theoretical estimation of transport cross-sections is rough and cannot be used to identify the chemical structures of cluster ions. Mass spectrometry is the main technique of identification of cluster ions.²

Märk and Castleman (1986) presented an overview of over 1000 publications on the experimental studies of cluster ions. Most of them present information about ions of millisecond age range. The low concentration makes it difficult to get detailed information about masses and mobilities of the natural atmospheric ions at ground level. The results of a 1-year continuous measurement⁶ are as follows:

	+ ions	- ions	unit
Average mobility	1.36	1.56	$10^{-4} m^2 V^{-1} s^{-1}$
The corresponding mass	190	130	u
The corresponding diameter	0.69	0.61	nm
The average concentration	400	360	$10^6 m^{-3}$
The corresponding conductivity	8.7	9.0	fS

The distribution of tropospheric cluster ions according to the mobility and estimated mass is depicted in Figure 1.

The problems and results of direct mass spectrometry of natural cluster ions are analysed by Eisele (1986) for ground level and by Meyerott, Reagan and Joiner (1980) for stratospheric measurements. Air ions in the high atmosphere are a subject of ionospheric physics.

During its lifetime (about 1 min), a cluster ion at ground level collides with nearly 10^{12} molecules. Thus the cluster ions are able to concentrate trace gases of very low concentration if they have an extra high electron or proton affinity. For example, Eisele (1986) demonstrated that a considerable fraction of positive atmospheric cluster ions in the unpolluted atmosphere at ground level probably consist of a molecule derived from pyridine. The concentration of these constituents is estimated to be about 10^{-12} . Therefore, air-ion mass and mobility spectrometry is considered as a promising technique for trace analysis in the air. Mass and mobility spectrometry of millisecond-age air ions has been developed as a technique of chemical analysis known as "plasma chromatography" (Carr, 1984). The sensitivity of the detection grows with the age of the cluster ions measured.

The mechanisms of annihilation of cluster ions are ion-ion recombination (on the average 3%) and sedimentation on aerosol particles (on the average 97% of cluster ions at ground level). The result of the combination of a cluster ion and neutral particle is a charged particle called an *aerosol ion*. In conditions of detailed thermodynamic equilibrium the probability that a spherical particle of diameter d carries q elementary charges is calculated from the Boltzmann distribution:

$$p_q(d) = (2 \pi d/d_0)^{1/2} \exp(-q^2 d_0/2d)$$

ATMOSPHERIC ELECTRICITY (continued)

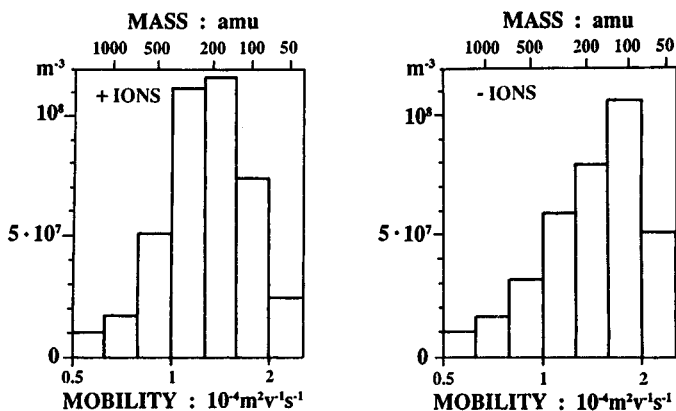


Figure 1. Average mobility and mass spectra of natural tropospheric cluster ions. Concentrations of the mobility fractions were measured in a rural site every 5 min over 1 year.⁶ Ion mass is estimated according to the above empirical formula.

where $d_0 = 115$ nm (at 18°C). The supposition about the detailed equilibrium is an approximation and the formula is not valid for particles less than d_0 . On the basis of numerical calculations by Hoppel and Frick (1990) the following charge probabilities can be derived:

d	3	10	30	100	300	1000	3000	nm
p_0	98	90	70	42	24	14	8	%
$p_{-1} + p_1$	2	10	30	48	41	25	15	%
$p_{-2} + p_2$	0	0	0	10	23	21	14	%
$p_{q > 2}$	0	0	0	0	12	40	63	%
k_1	15000	1900	250	28	5.1	1.11	0.33	$10^{-9} \text{m}^2 \text{V}^{-1} \text{s}^{-1}$

The last line of the table presents the mobility of a particle carrying one elementary charge. The distribution of the atmospheric aerosol ions over mobility is demonstrated in Figure 2.

Although the concentration of aerosol in continental air at ground level is an order of magnitude higher than the concentration of cluster ions, the mobilities of aerosol ions are so small that their percentage in air conductivity is less than 1%.

A specific class of aerosol ions are condensed aerosol ions produced as a result of the condensation of gaseous matter on the cluster ions. In aerosol physics the process is called ion-induced nucleation; it is considered as one among the processes of gas-to-particle conversion. The condensed aerosol ions have an inherent charge. Their sizes and mobilities are between the sizes and mobilities of cluster ions and of ordinary aerosol ions. Water and standard constituents of atmospheric air are not able to condense on the cluster ions in the real atmosphere. Thus the concentration of condensed aerosol ions depends on the trace constituents in the air and is very low in unpolluted air. Knowledge about condensed aerosol ions is poor because of measurement difficulties.

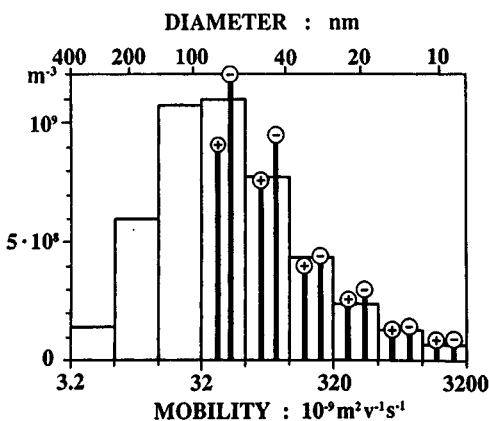


Figure 2. Mobility and size spectra of tropospheric aerosol ions.⁶ The wide bars mark the fraction concentrations theoretically estimated on the basis of the standard size distribution of tropospheric aerosol. The pin bars with head + and - mark average values of positive and negative aerosol ion fraction concentrations measured in a rural site every 5 min during 4 months.

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ATMOSPHERIC ELECTRICITY (continued)

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III. THUNDERSTORM ELECTRICITY

John Latham

The development of improved radar techniques and instruments for in-cloud electrical and physical measurements, coupled with a much clearer recognition by the research community that establishment of the mechanism or mechanisms responsible for electric field development in thunderclouds, culminating in lightning, is inextricably linked to the concomitant dynamical and microphysical evolution of the clouds, has led to significant progress over the past decade.

Field studies indicate that in most thunderclouds the electrical development is associated with the process of glaciation, which can occur in a variety of incompletely understood ways. In the absence of ice, field growth is slow, individual hydrometeor charges are low, and lightning is produced only rarely. Precipitation — in the solid form, as graupel — also appears to be a necessary ingredient for significant electrification, as does significant convective activity and mixing between the clouds and their environments, via entrainment.

Increasingly, the view is being accepted that charge transfer leading to field-growth is largely a consequence of rebounding collisions between graupel pellets and smaller vapor-grown ice crystals, followed by the separation under gravity of these two types of hydrometeor. These collisions occur predominantly within the temperature range -15 to -30°C, and for significant charge transfer need to occur in the presence of supercooled cloud droplets.

The field evidence is inconsistent with an inductive mechanism, and extensive laboratory studies indicate that the principal charging mechanism is non-inductive and associated — in ways yet to be identified — with differences in surface characteristics of the interacting hydrometeors.

Laboratory studies indicate that the two most favored sites for corona emission leading to the lightning discharge are the tips of ephemeral liquid filaments, produced during the glancing collisions of supercooled raindrops, and protuberances on large ice crystals or graupel pellets. The relative importance of these alternatives will depend on the hydrometeor characteristics and the temperature in the regions of strongest fields; these features are themselves dependent on air-mass characteristics and climatological considerations.

A recently identified but unresolved question is why, in continental Northern Hemisphere thunderclouds at least, the sign of the charge brought to ground by lightning is predominantly negative in summer but more evenly balanced in winter.

IV. LIGHTNING

Martin A. Uman

From both ground-based weather-station data and satellite measurements, it has been estimated that there are about 100 lightning discharges, both cloud and ground flashes, over the whole earth each second; representing an average global lightning flash density of about $6 \text{ km}^{-2}\text{yr}^{-1}$. Most of this lightning occurs over the earth's land masses. For example, in central Florida, where thunderstorms occur about 90 days/yr, the flash density for discharges to earth is about $15 \text{ km}^{-2}\text{yr}^{-1}$. Some tropical areas of the earth have thunderstorms up to 300 days/yr.

Lightning can be defined as a transient, high-current electric discharge whose path length is measured in kilometers and whose most common source is the electric charge separated in the ordinary thunderstorm or cumulonimbus cloud. Well over half of all lightning discharges occur totally within individual thunderstorm clouds and are referred to as intracloud discharges. Cloud-to-ground lightning, however, has been studied more extensively than any other lightning form because of its visibility and its more practical interest. Cloud-to-cloud and cloud-to-air discharges are less common than intracloud or cloud-to-ground lightning.

Lightning between the cloud and earth can be categorized in terms of the direction of motion, upward or downward, and the sign of the charge, positive or negative, of the developing discharge (called a *leader*) which initiates the overall event. Over 90% of the worldwide cloud-to-ground discharges is initiated in the thundercloud by downward-moving negatively-charged leaders and subsequently results in the lowering of negative charge to earth. Cloud-to-ground lightning can also be initiated by downward-moving positive leaders, less than 10% of the worldwide cloud-to-ground lightning being of this type although the exact percentage is a function of season and latitude. Lightning between cloud and ground can also be initiated by leaders which develop upward from the earth. These upward-initiated discharges are relatively rare, may be of either polarity, and generally occur from mountaintops and tall man-made structures.

We discuss next the most common type of cloud-to-ground lightning. A negative cloud-to-ground discharge or *flash* has an overall duration of some tenths of a second and is made up of various components, among which are typically three or four high-current pulses called *strokes*. Each stroke lasts about a millisecond, the separation time between strokes being typically several tens of milliseconds. Such lightning often appears to "flicker" because the human eye can just resolve the individual light pulse associated with each stroke. A drawing of the components of a negative cloud-to-ground flash is found in Figure 3. Some values for salient parameters are found in Table 1. The negatively-charged *stepped leader* initiates the first stroke in a flash by propagating from cloud to ground through virgin air in a series of discrete steps. Photographically observed leader steps in clear

ATMOSPHERIC ELECTRICITY (continued)

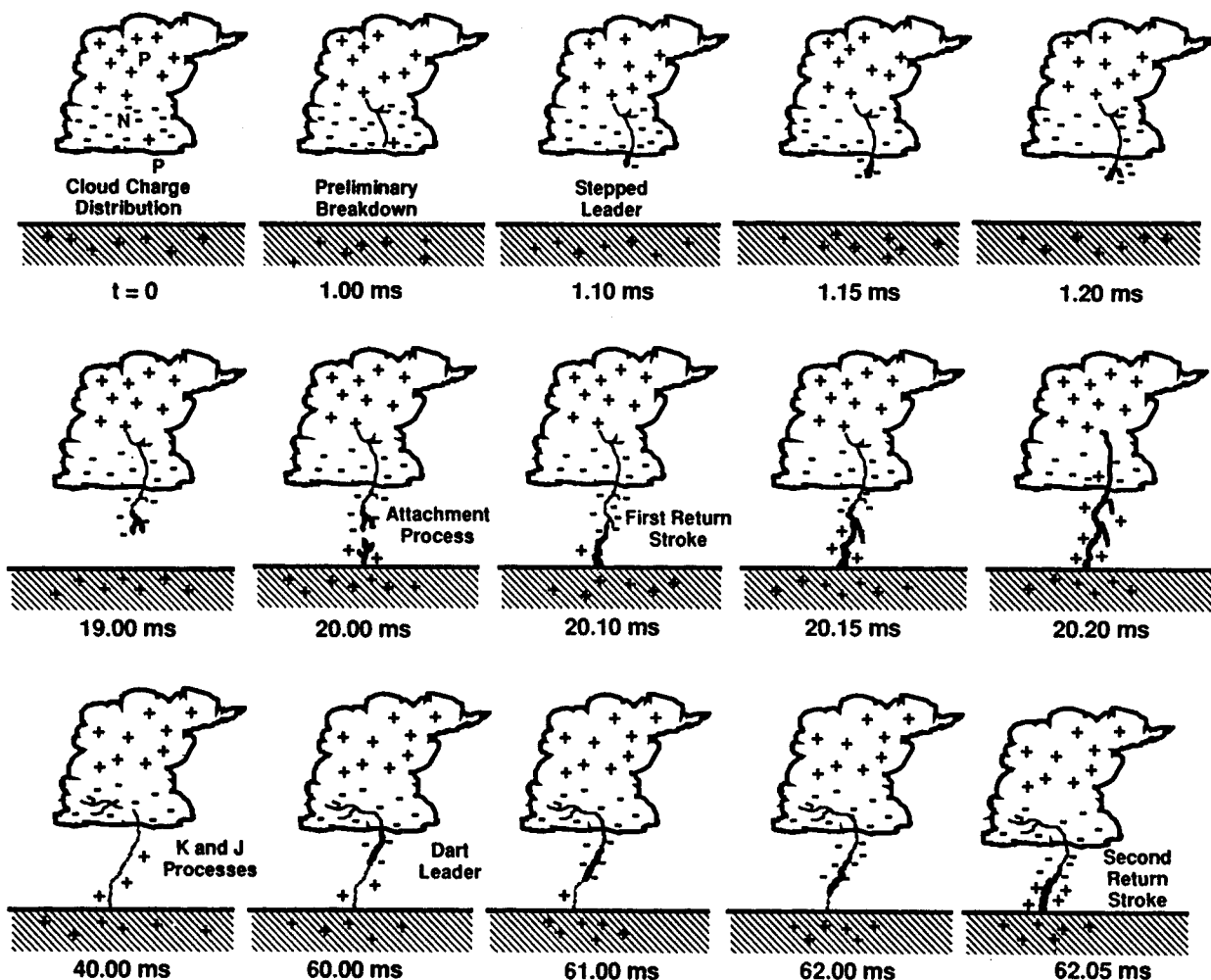


Figure 3. Sequence of steps in cloud-to-ground lightning.

air are typically $1 \mu\text{s}$ in duration and tens of meters in length, with a pause time between steps of about $50 \mu\text{s}$. A fully developed stepped leader lowers up to 10 or more coulombs of negative cloud charge toward ground in tens of milliseconds with an average downward speed of about $2 \times 10^5 \text{ m/s}$. The average leader current is in the 100 to 1000 A range. The steps have pulse currents of at least 1 kA. Associated with these currents are electric- and magnetic-field pulses with widths of about $1 \mu\text{s}$ or less and risetimes of about $0.1 \mu\text{s}$ or less. The stepped leader, during its trip toward ground, branches in a downward direction, resulting in the characteristic downward-branched geometrical structure commonly observed. The electric potential of the bottom of the negatively-charged leader channel with respect to ground has a magnitude in excess of 10^7 V . As the leader tip nears ground, the electric field at sharp objects on the ground or at irregularities of the ground itself exceeds the breakdown value of air, and one or more upward-moving discharges (often called upward leaders) are initiated from those points, thus beginning the *attachment process*. An understanding of the physics of the attachment process is central to an understanding of the operation of lightning protection of ground-based objects and the effects of lightning on humans and animals, since it is the attachment process that determines where the lightning connects to objects on the ground and the value of the early currents which flow. When one of the upward-moving discharges from the ground (or from a lightning rod or an individual) contacts the tip of the downward-moving stepped leader, typically some tens of meters above the ground, the leader tip is effectively connected to ground potential. The negatively-charged leader channel is then discharged to earth when a ground potential wave, referred to as the *first return stroke*, propagates continuously up the leader path. The upward speed of a return stroke near the ground is typically near one third the speed of light, and the speed decreases with height. The first return stroke produces a peak current near ground of typically 30 kA, with a time from zero to peak of a few microseconds. Currents measured at the ground fall to half of the peak value in about $50 \mu\text{s}$, and currents of the order of hundreds of amperes may flow for times of a few milliseconds up to several hundred milliseconds. The longer-lasting currents are known as *continuing currents*. The rapid release of return stroke energy heats the leader channel to a temperature near 30,000 K and creates a high-pressure channel which expands and generates the shock waves that eventually become thunder, as further discussed later. The return stroke effectively lowers to ground the charge originally deposited onto the stepped-

ATMOSPHERIC ELECTRICITY (continued)

leader channel and additionally initiates the lowering of other charge which may be available to the top of its channel. First return-stroke electric fields exhibit a microsecond scale rise to peak with a typical peak value of 5 V/m, normalized to a distance of 100 km by an inverse distance relationship. Roughly half of the field rise to peak, the so-called "fast transition", takes place in tenths of a microsecond, an observation that can only be made if the field propagation is over a highly conducting surface such as salt water.

After the first return-stroke current has ceased to flow, the flash, including charge motion in the cloud, may end. The lightning is then called a single-stroke flash. On the other hand, if additional charge is made available to the top of the channel, a continuous or *dart leader* may propagate down the residual first-stroke channel at a typical speed of about 1×10^7 m/s. The dart leader lowers a charge of the order of 1 C by virtue of a current of about 1 kA. The dart leader then initiates the second (or any subsequent) return stroke. Subsequent return-stroke currents generally have faster zero-to-peak rise times than do first-stroke currents, but similar maximum rates of change, about 100 kA/ μ s. Some leaders begin as dart leaders, but toward the end of their trip toward ground become stepped leaders. These leaders are known as *dart-stepped leaders* and may have different ground termination points (and separate upward leaders) from the first stroke. Most often the dart-stepped leaders are associated with the second stroke of the flash. Nearly half of all flashes exhibit more than one termination point on ground with the distance between separate terminations being up to several kilometers. Subsequent return-stroke radiated electric and magnetic fields are similar to, but usually a factor of two or so smaller, than first return-stroke fields. About one third of all multiple-stroke flashes has at least one subsequent stroke which is larger than the first stroke.

Cloud-to-ground flashes that lower positive charge, though not common, are of considerable practical interest because their peak currents and total charge transfer can be much larger than for the more common negative ground flash. The largest recorded peak currents, those in the 200- to 300-kA range, are due to the return strokes of positive lightning. Such positive flashes to ground are initiated by downward-moving leaders which do not exhibit the distinct steps of their negative counterparts. Rather, they show a luminosity which is more or less continuous but modulated in intensity. Positive flashes are generally composed of a single stroke followed by a period of continuing current. Positive flashes are probably initiated from the upper positive charge in the thundercloud charge dipole when that cloud charge is horizontally separated from the negative charge beneath it, the source of the usual negative cloud-to-ground lightning. Positive flashes are relatively common in winter thunderstorms (snow storms), which produce few flashes overall, and are relatively uncommon in summer thunderstorms. The fraction of positive lightning in summer thunderstorms apparently increases with increasing latitude and with increasing height of the ground above sea level.

Distant lightning return stroke fields are often referred to as sferics (called "atmospherics" in the older literature). The peak in the sferic frequency spectrum is near 5 kHz due to the bipolar or ringing nature of the distant return-stroke electromagnetic signal and to the effects of propagation.

Thunder, the acoustic radiation associated with lightning, is sometimes divided into the categories "audible", sounds that one can hear, and "infrasonic", below a few tens of hertz, a frequency range that is inaudible. This division is made because it is thought that the mechanisms that produce audible and infrasonic thunder are different. Audible thunder is thought to be due to the expansion of a rapidly heated return stroke channel, as noted earlier, whereas infrasonic thunder is thought to be associated with the conversion to sound of the energy stored in the electrostatic field of the thundercloud when lightning rapidly reduces that cloud field.

The technology of artificially initiating lightning by firing upward small rocket trailing grounded wire of a few hundred meters length has been well-developed during the past decade. Such "triggered" flashes are similar to natural upward-initiated discharges from tall structure. They often contain subsequent strokes which, when they occur, are similar to the subsequent strokes in natural lightning. These triggered subsequent strokes have been the subject of considerable recent research.

Also in the past 10 years or so sophisticated lightning locating equipment has been installed throughout the world. For example, all ground flashes in the U.S. are now centrally monitored for research, for better overall weather prediction, and for hazard warning for aviation, electric utilities and other lightning-sensitive facilities.

Information on lightning physics can be found in M. A. Uman, *The Lightning Discharge*, Academic Press, San Diego, 1987; on lightning death and injury in *Medical Aspects of Lightning Injury*, editors C. Andrews, M. A. Cooper, M. Darveniza, and D. Mackerras, CRC Press, 1992. Ground flash location information for the U.S., in real time or archived, is available from Geomet Data Service of Tucson, AZ, which is also a source of the names of providers of those data in other countries.

Table 2 has data for cloud-to-ground lightning discharges bringing negative charge to earth. The values listed are intended to convey a rough feeling for the various physical parameters of lightning. No great accuracy is claimed since the results of different investigators are often not in good agreement. These values may, in fact, depend on the particular environment in which the lightning discharge is generated. The choice of some of the entries in the table is arbitrary.

ATMOSPHERIC ELECTRICITY (continued)

TABLE 2 Data for Cloud-to-Ground Lightning Discharges

	Minimum ^a	Representative values	Maximum ^a
Stepped leader			
Length of step, m	3	50	200
Time interval between steps, μ s	30	50	125
Average speed of propagation of stepped leader, m/s ^b	1.0×10^5	2.0×10^5	3.0×10^6
Charge deposited on stepped-leader channel, coulombs	3	5	20
Dart leader			
Speed of propagation, m/s ^b	1.0×10^6	1.0×10^7	2.4×10^7
Charge deposited on dart-leader channel, coulombs	0.2	1	6
Return stroke^c			
Speed of propagation, m/s ^b	2.0×10^7	1.0×10^8	2.0×10^8
Maximum current rate of increase, kA/ μ s	<1	100	400
Time to peak current, μ s	<1	2	30
Peak current, kA	2	30	200
Time to half of peak current, μ s	10	50	250
Charge transferred excluding continuing current, coulombs	0.02	3	20
Channel length, km	2	5	15
Lightning flash			
Number of strokes per flash	1	4	26
Time interval between strokes in absence of continuing current, ms	3	60	100
Time duration of flash, s	10^{-2}	0.5	2
Charge transferred including continuing current, coulombs	3	30	200

^a The words maximum and minimum are used in the sense that most measured values fall between these limits.

^b Speeds of propagation are generally determined from photographic data and are "two-dimensional". Since many lightning flashes are not vertical, values stated are probably slight underestimates of actual values.

^c First return strokes have longer times to current peak and generally larger charge transfer than do subsequent return strokes.

Adapted from Uman, M. A., *Lightning*, Dover Paperbook, New York, 1986, and Uman, M. A., *The Lightning Discharge*, Academic Press, San Diego, 1987.

SPEED OF SOUND IN VARIOUS MEDIA

The speed of sound in various solids, liquids, and gases is given in these tables. While only a single parameter v is needed for liquids and gases, sound propagation in isotropic solids is characterized by three velocity parameters. For a solid of infinite extent (or of finite extent if all dimensions are much larger than a wavelength, there are two relevant quantities,

v_1 : velocity of longitudinal waves
 v_s : velocity of shear waves.

For a cylindrical rod with diameter much smaller than a wavelength,

v_{ext} : velocity of extensional waves along the rod. (Torsional waves in the rod are propagated at the same speed as shear waves in an infinite solid.)

Table 1 lists values for a variety of solid materials. Table 2 covers gases liquids and gases; values for cryogenic liquids are given at the normal boiling point. Table 3 gives the speed of sound in pure water and in seawater of salinity $S = 3.5\%$ as a function of temperature. All values are in meters per second and are given for normal atmospheric pressure.

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TABLE 1
Speed of Sound in Solids at Room Temperature

Name	$v_1/\text{m s}^{-1}$	$v_s/\text{m s}^{-1}$	$v_{\text{ext}}/\text{m s}^{-1}$	Name	$v_1/\text{m s}^{-1}$	$v_s/\text{m s}^{-1}$	$v_{\text{ext}}/\text{m s}^{-1}$
Metals							
Aluminum, rolled	6420	3040	5000	Steel, 347 Stainless	5790	3100	5000
Beryllium	12890	8880	12870	Steel, K9	5940	3250	5250
Brass (70 Cu, 30 Zn)	4700	2110	3480	Tin, rolled	3320	1670	2730
Constantan	5177	2625	4270	Titanium	6070	3125	5090
Copper, annealed	4760	2325	3810	Tungsten, annealed	5220	2890	4620
Copper, rolled	5010	2270	3750	Tungsten, drawn	5410	2640	4320
Duralumin 17S	6320	3130	5150	Zinc, rolled	4210	2440	3850
Gold, hard-drawn	3240	1200	2030				
Iron, cast	4994	2809	4480	Other materials			
Iron, electrolytic	5950	3240	5120	Fused silica	5968	3764	5760
Iron, Armco	5960	3240	5200	Glass, heavy silicate flint	3980	2380	3720
Lead, annealed	2160	700	1190	Glass, light borate crown	5100	2840	4540
Lead, rolled	1960	690	1210	Glass, pyrex	5640	3280	5170
Magnesium, annealed	5770	3050	4940	Lucite	2680	1100	1840
Molybdenum	6250	3350	5400	Nylon 6-6	2620	1070	1800
Monel metal	5350	2720	4400	Polyethylene	1950	540	920
Nickel	6040	3000	4900	Polystyrene	2350	1120	1840
Platinum	3260	1730	2800	Rubber, butyl	1830		
Silver	3650	1610	2680	Rubber, gum	1550		
Steel (1% C)	5940	3220	5180	Rubber, neoprene	1600		
				Tungsten carbide	6655	3980	6220

SPEED OF SOUND IN VARIOUS MEDIA (continued)

TABLE 2
Speed of Sound in Liquids and Gases

Name	$t/^\circ\text{C}$	$v/\text{m s}^{-1}$	Name	$t/^\circ\text{C}$	$v/\text{m s}^{-1}$
Liquids			Pentane	20	1008
Acetone	20	1203	Propane	-42.1	1158
Argon	-185.9	813	1-Propanol	20	1223
Benzene	25	1310	Tetrachloromethane	25	930
Bromobenzene	20	1169	Trichloromethane	25	987
Butane	-0.5	1034	1-Undecene	20	1275
1-Butanol	20	1258	Water	25	1497
Carbon disulphide	25	1140	Water (sea, $S = 3.5\%$)	25	1535
Chlorobenzene	20	1311	Gases at 1 atm		
Cyclohexane	19	1280	Air, dry	25	346
1-Decene	20	1250	Ammonia	0	415
Diethyl ether	25	976	Argon	27	323
Ethane	-88.6	1326	Carbon monoxide	0	338
Ethanol	20	1162	Carbon dioxide	0	259
Ethylene	-103.8	1309	Chlorine	0	206
Ethylene glycol	25	1658	Deuterium	0	890
Fluorobenzene	20	1183	Ethane	27	312
Glycerol	25	1904	Ethylene	27	331
Helium	-268.9	180	Helium	0	965
Heptane	20	1162	Hydrogen	27	1310
1-Heptene	20	1128	Hydrogen bromide	0	200
Hexane	20	1083	Hydrogen chloride	0	296
Hydrogen	-252.9	1101	Hydrogen iodide	0	157
Iodobenzene	20	1114	Hydrogen sulfide	0	289
Mercury	25	1450	Methane	27	450
Methane	-161.5	1337	Neon	0	435
Methanol	20	1121	Nitric oxide	10	325
Nitrobenzene	25	1463	Nitrogen	27	353
Nitrogen	-195.8	939	Nitrous oxide	0	263
1-Nonene	20	1218	Oxygen	27	330
Octane	20	1197	Sulfur dioxide	0	213
1-Octene	20	1184	Water (steam)	100	473
Oxygen	-183.0	906			
1-Pentadecene	20	1351			

TABLE 3
Speed of Sound in Water and Seawater ($S = 3.5\%$) at Different Temperatures

$t/^\circ\text{C}$	$v/\text{m s}^{-1}$	
	Water	Seawater
0	1401.0	1449.4
10	1447.8	1490.4
20	1483.2	1522.2
25	1497.4	1535.1
30	1509.5	1546.2
40	1528.4	
50	1541.4	
60	1549.5	
70	1553.2	
80	1552.8	

ATTENUATION AND SPEED OF SOUND IN AIR AS A FUNCTION OF HUMIDITY AND FREQUENCY

This table gives the attenuation and speed of sound as a function of frequency at various values of relative humidity. All values refer to still air at 20°C.

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Frequency (Hz)	Attenuation (dB/km)	Speed (m/s)	Frequency (Hz)	Attenuation (dB/km)	Speed (m/s)
Relative humidity 0%			Relative humidity 60%		
20	0.51	343.477	20	0.02	344.182
40	1.07	343.514	40	0.06	344.183
50	1.26	343.525	50	0.09	344.183
63	1.43	343.536	63	0.15	344.184
100	1.67	343.550	100	0.34	344.185
200	1.84	343.559	200	0.99	344.190
400	1.96	343.561	400	1.94	344.197
630	2.11	343.562	630	2.57	344.200
800	2.27	343.562	800	2.94	344.201
1250	2.82	343.562	1250	4.01	344.202
2000	4.14	343.562	2000	6.55	344.203
4000	8.84	343.564	4000	18.73	344.204
6300	14.89	343.565	6300	42.51	344.204
10000	26.28	343.566	10000	101.84	344.206
12500	35.81	343.566	12500	155.67	344.208
16000	52.15	343.567	16000	247.78	344.211
20000	75.37	343.567	20000	373.78	344.215
40000	267.01	343.567	40000	1195.37	344.238
63000	644.66	343.567	63000	2220.64	344.262
80000	1032.14	343.567	80000	2951.71	344.274
Relative humidity 30%			Relative humidity 100%		
20	0.03	343.807	20	0.01	344.685
40	0.11	343.808	40	0.04	344.685
50	0.17	343.810	50	0.06	344.685
63	0.25	343.810	63	0.09	344.685
100	0.50	343.814	100	0.22	344.686
200	1.01	343.821	200	0.77	344.689
400	1.59	343.826	400	2.02	344.695
630	2.24	343.827	630	3.05	344.699
800	2.85	343.828	800	3.57	344.701
1250	5.09	343.828	1250	4.59	344.704
2000	10.93	343.829	2000	6.29	344.705
4000	38.89	343.831	4000	13.58	344.706
6300	90.61	343.836	6300	27.72	344.706
10000	204.98	343.846	10000	63.49	344.706
12500	294.08	343.854	12500	96.63	344.707
16000	422.51	343.865	16000	154.90	344.708
20000	563.66	343.877	20000	237.93	344.709
40000	1110.97	343.911	40000	884.28	344.718
63000	1639.47	343.924	63000	1973.62	344.731
80000	2083.08	343.929	80000	2913.01	344.742

SPEED OF SOUND IN DRY AIR

The values in this table were calculated from the equation of state for dry air (average molecular weight 28.96) treated as a real gas. Values refer to standard atmospheric pressure. The speed of sound varies only slightly with pressure; at two atmospheres and -100°C the value decreases by 0.13%, while at two atmospheres and 80°C the speed increases by 0.04%.

REFERENCE

Sytchev, V.V., Vasserman, A.A., Kozlov, A.D., Spiridonov, G.A., and Tsymarny, V.A., *Thermodynamic Properties of Air*, Hemisphere Publishing Corp., New York, 1987.

$t/^\circ\text{C}$	$v_s/\text{m s}^{-1}$	$t/^\circ\text{C}$	$v_s/\text{m s}^{-1}$	$t/^\circ\text{C}$	$v_s/\text{m s}^{-1}$
-100	263.5	-35	309.5	30	349.1
-95	267.3	-30	312.7	35	352.0
-90	271.1	-25	315.9	40	354.8
-85	274.8	-20	319.1	45	357.6
-80	278.5	-15	322.3	50	360.4
-75	282.1	-10	325.4	55	363.2
-70	285.7	-5	328.4	60	365.9
-65	289.2	0	331.5	65	368.6
-60	292.7	5	334.5	70	371.3
-55	296.1	10	337.5	75	374.0
-50	299.5	15	340.4	80	376.7
-45	302.9	20	343.4		
-40	306.2	25	346.3		

MUSICAL SCALES

EQUAL TEMPERED CHROMATIC SCALE

A₄ = 440 Hz

American Standard pitch. Adopted by the American Standards Association in 1936

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C ₀	16.35	C ₂	65.41	C ₄	261.63	C ₆	1046.50
C# ₀	17.32	C# ₂	69.30	C# ₄	277.18	C# ₆	1108.73
D ₀	18.35	D ₂	73.42	D ₄	293.66	D ₆	1174.66
D# ₀	19.45	D# ₂	77.78	D# ₄	311.13	D# ₆	1244.51
E ₀	20.60	E ₂	82.41	E ₄	329.63	E ₆	1318.51
F ₀	21.83	F ₂	87.31	F ₄	349.23	F ₆	1396.91
F# ₀	23.12	F# ₂	92.50	F# ₄	369.99	F# ₆	1479.98
G ₀	24.50	G ₂	98.00	G ₄	392.00	G ₆	1567.98
G# ₀	25.96	G# ₂	103.83	G# ₄	415.30	G# ₆	1661.22
A ₀	27.50	A ₂	110.00	A ₄	440.00	A ₆	1760.00
A# ₀	29.14	A# ₂	116.54	A# ₄	466.16	A# ₆	1864.66
B ₀	30.87	B ₂	123.47	B ₄	493.88	B ₆	1975.53
C ₁	32.70	C ₃	130.81	C ₅	523.25	C ₇	2093.00
C# ₁	34.65	C# ₃	138.59	C# ₅	554.37	C# ₇	2217.46
D ₁	36.71	D ₃	146.83	D ₅	587.33	D ₇	2349.32
D# ₁	38.89	D# ₃	155.56	D# ₅	622.25	D# ₇	2489.02
E ₁	41.20	E ₃	164.81	E ₅	659.26	E ₇	2637.02
F ₁	43.65	F ₃	174.61	F ₅	698.46	F ₇	2793.83
F# ₁	46.25	F# ₃	185.00	F# ₅	739.99	F# ₇	2959.96
G ₁	49.00	G ₃	196.00	G ₅	783.99	G ₇	3135.96
G# ₁	51.91	G# ₃	207.65	G# ₅	830.61	G# ₇	3322.44
A ₁	55.00	A ₃	220.00	A ₅	880.00	A ₇	3520.00
A# ₁	58.27	A# ₃	233.08	A# ₅	932.33	A# ₇	3729.31
B ₁	61.74	B ₃	246.94	B ₅	987.77	B ₇	3951.07
						C ₈	4186.01

EQUAL TEMPERED CHROMATIC SCALE

A₄ = 435 Hz

International Pitch, adopted 1891

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C ₀	16.17	C ₂	64.66	C ₄	258.65	C ₆	1034.61
C# ₀	17.13	C# ₂	68.51	C# ₄	274.03	C# ₆	1096.13
D ₀	18.15	D ₂	72.58	D ₄	290.33	D ₆	1161.31

D# ₀	19.22	D# ₂	76.90	D# ₄	307.59	D# ₆	1230.37
E ₀	20.37	E ₂	81.47	E ₄	325.88	E ₆	1303.53
F ₀	21.58	F ₂	86.31	F ₄	345.26	F ₆	1381.04
F# ₀	22.86	F# ₂	91.45	F# ₄	365.79	F# ₆	1463.16
G ₀	24.22	G ₂	96.89	G ₄	387.54	G ₆	1550.16
G# ₀	25.66	G# ₂	102.65	G# ₄	410.59	G# ₆	1642.34
A ₀	27.19	A ₂	108.75	A ₄	435.00	A ₆	1740.00
A# ₀	28.80	A# ₂	115.22	A# ₄	460.87	A# ₆	1843.47
B ₀	30.52	B ₂	122.07	B ₄	488.27	B ₆	1953.08
C ₁	32.33	C ₃	129.33	C ₅	517.31	C ₇	2069.22
C# ₁	34.25	C# ₃	137.02	C# ₅	548.07	C# ₇	2192.26
D ₁	36.29	D ₃	145.16	D ₅	580.66	D ₇	2322.62
D# ₁	38.45	D# ₃	153.80	D# ₅	615.18	D# ₇	2460.73
E ₁	40.74	E ₃	162.94	E ₅	651.76	E ₇	2607.05
F ₁	43.16	F ₃	172.63	F ₅	690.52	F ₇	2762.08
F# ₁	45.72	F# ₃	182.89	F# ₅	731.58	F# ₇	2926.32
G ₁	48.44	G ₃	193.77	G ₅	775.08	G ₇	3100.33
G# ₁	51.32	G# ₃	205.29	G# ₅	821.17	G# ₇	3284.68
A ₁	54.38	A ₃	217.50	A ₅	870.00	A ₇	3480.00
A# ₁	57.61	A# ₃	230.43	A# ₅	921.73	A# ₇	3686.93
B ₁	61.03	B ₃	244.14	B ₅	976.54	B ₇	3906.17
						C ₈	4138.44

SCIENTIFIC OR JUST SCALE

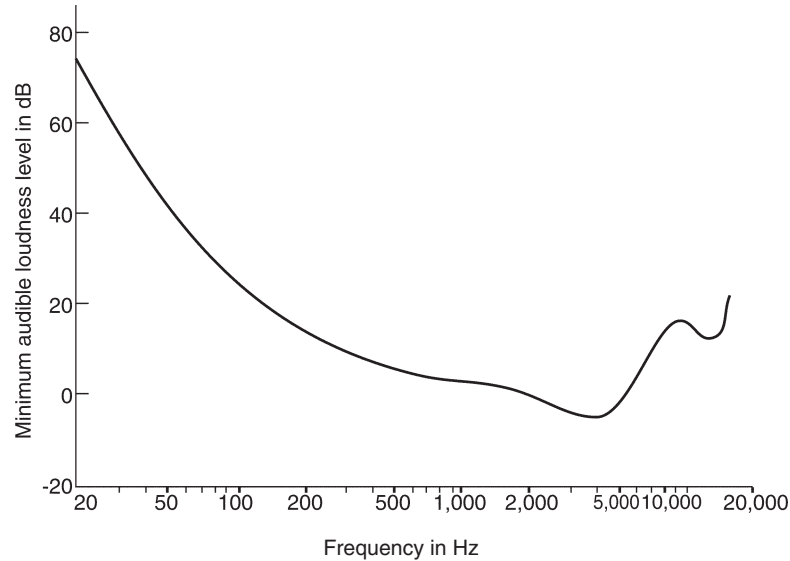
C₄ = 256 Hz

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C ₀	16	C ₂	64	C ₄	256	C ₆	1024
D ₀	18	D ₂	72	D ₄	288	D ₆	1152
E ₀	20	E ₂	80	E ₄	320	E ₆	1280
F ₀	21.33	F ₂	85.33	F ₄	341.33	F ₆	1365.33
G ₀	24	G ₂	96	G ₄	384	G ₆	1536
A ₀	26.67	A ₂	106.67	A ₄	426.67	A ₆	1706.67
B ₀	30	B ₂	120	B ₄	480	B ₆	1920
C ₁	32	C ₃	128	C ₅	512	C ₇	2048
D ₁	36	D ₃	144	D ₅	576	D ₇	2304
E ₁	40	E ₃	160	E ₅	640	E ₇	2560
F ₁	42.67	F ₃	170.67	F ₅	682.67	F ₇	2730.67
G ₁	48	G ₃	192	G ₅	768	G ₇	3072
A ₁	53.33	A ₃	213.33	A ₅	853.33	A ₇	3413.33
B ₁	60	B ₃	240	B ₅	960	B ₇	3840
						C ₈	4096

CHARACTERISTICS OF HUMAN HEARING

The human ear is sensitive to sound waves with frequencies in the range from a few hertz to almost 20 kHz. Auditory response is usually expressed in terms of the *loudness level* of a sound, which is a measure of the sound pressure. The reference level, which is given in the unit *phon*, is a pure tone of frequency 1000 Hz with sound pressure of 20 μPa (in cgs units, $2 \cdot 10^{-4} \text{ dyn/cm}^2$); loudness level is usually expressed in decibels (dB) relative to this reference level. If a normal observer perceives an arbitrary sound to be equally loud as this reference sound, the sound is said to have the loudness level of the reference. The sensitivity of the typical human ear ranges from about 0 dB, the threshold loudness level, to about 140 dB, the level at which pain sets in. The minimum detectable level thus represents a sound wave of pressure 20 μPa and intensity (power density) 10^{-16} W/cm^2 .

The following figure illustrates the frequency dependence of the threshold for an average young adult.



The relation between loudness level and frequency for a typical person is expressed by the following table:

Sound pressure level in dB relative to 20 μPa	Frequency in Hz					
	125	500	1000	4000	8000	10000
10			10	18		
20		16	20	28	11	
30	4	27	30	37	21	17
40	17	39	40	45	30	26
50	34	52	50	54	38	35
60	52	65	60	64	47	44
70	70	76	70	73	56	54
80	86	86	80	83	66	64
90	98	96	90	94	77	74
100	108	105	100	106	88	86

Thus, a 10,000 Hz tone at a pressure level of 50 dB seems equally loud as a 1000 Hz tone at a pressure of 35 dB.

The term *noise* refers to any unwanted sound, either a pure tone or a mixture of frequencies. Since the sensitivity of the ear is frequency dependent, as illustrated by the above table, noise level is expressed in a frequency-weighted scale, known as A-weighting. Decibel readings on this scale are designated as dBA. Typical noise levels from various sources are illustrated in this table:

CHARACTERISTICS OF HUMAN HEARING (continued)

Source	Noise level in dBA
Rocket engine	200
Jet aircraft engine	160
Light aircraft, cruising	140
Tractor, 150 hp	115
Electric motor, 100 hp at 2600 rpm	105
Pneumatic drill	100
Subway train	90
Vacuum cleaner	85
Heavy automobile traffic	75
Conversational speech	65
Whispered speech	40
Background noise, recording studio	25-30

Recommended noise thresholds in the workplace have been established by the American Conference of Government Industrial Hygienists. Some examples of the maximum safe levels for different daily exposure times are given below.

Duration of exposure	Max. level in dBa
24 h	80
8 h	85
4 h	88
1 h	94
30 min	97
15 min	100
2 min	109
28 s	115
0.11 s	139

No exposure greater than 140 dBA is permitted. Further details may be found in Reference 3.

REFERENCES

1. Anderson, H. L., Editor, *A Physicist's Desk Reference*, American Institute of Physics, New York, 1989, chap. 2.
2. Gray, D. E., Ed., *American Institute of Physics Handbook, Third Edition*, McGraw Hill, New York, 1972, chap. 3.
3. *Threshold Limit Values for Chemical Substances and Physical Agents; Biological Exposure Indices*, 1999 Edition, American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634.

INTERSTELLAR MOLECULES

Frank J. Lovas and Lewis E. Snyder

A number of molecules have been detected in the interstellar medium, in circumstellar envelopes around evolved stars, and comae and tails of comets through observation of their microwave, infrared, or optical spectra. The following list gives the molecules and the particular isotopic species that have been reported thus far. Molecules are listed by molecular formula in the Hill order. All species not footnoted otherwise are observed in interstellar clouds, while some are also found in comets and circumstellar clouds. The list was last updated in November 2002.

REFERENCES

1. Lovas, F. J., "Recommended Rest Frequencies for Observed Interstellar Molecule Microwave Transitions - 1991 Revision", *J. Phys. Chem. Ref. Data* 21, 181-272, 1992.
2. Snyder, L. E., "Cometary Molecules", Internat. Astron. Union Symposium No. 150, *Astrochemistry of Cosmic Phenomena*, ed. P.D. Singh, Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 427-434 (1992).

Molecular formula	Name	Isotopic species	Molecular formula	Name	Isotopic species
AlCl	Aluminum monochloride	AlCl ^a Al ³⁷ Cl ^a			H ₂ C ³⁴ S HDCS
AlF	Aluminum monofluoride	AlF ^a	CH ₃	Methyl	CH ₃ ^a
AlNC	Aluminum isocyanide	AlNC ^a	CH ₃ N	Methanimine	CH ₂ NH ¹³ CH ₂ NH
CH	Methyldiyne	CH			NH ₂ CHO NH ₂ ¹³ CHO
CH ⁺	Methylidyne	CH ⁺	CH ₃ NO	Formamide	
CHN	Hydrogen cyanide	HCN H ¹³ CN HC ¹⁵ N DCN	CH ₃ O ⁺	Hydroxy methylion	H ₂ COH ⁺
		HNC H ¹⁵ NC HN ¹³ C DNC D ¹⁵ NC	CH ₄	Methane	CH ₄
CHN	Hydrogen isocyanide	HNC H ¹⁵ NC HN ¹³ C DNC D ¹⁵ NC	CH ₄ O	Methanol	CH ₃ OH ¹³ CH ₃ OH CH ₃ ¹⁸ OH CH ₂ DOH CH ₃ OD CHD ₂ OH
CHNO	Isocyanic acid	HNCO DNCO	CH ₄ S	Methanethiol	CH ₃ SH
CHNS	Isothiocyanic acid	HNCS	CH ₅ N	Methylamine	CH ₃ NH ₂
CHO	Oxomethyl	HCO	CMgN	Magnesium cyanide	MgCN ^a
CHO ⁺	Oxomethylion	HCO ⁺ H ¹³ CO ⁺ HC ¹⁷ O ⁺ HC ¹⁸ O ⁺ DCO ⁺ D ¹³ CO ⁺ HOC ⁺ HOCO ⁺	CMgN	Magnesium isocyanide	²⁴ MgNC ^a ²⁵ MgNC ^a ²⁶ MgNC ^a
CHO ⁺	Hydroxymethylidyne	HOC ⁺	CN	Cyanide radical	CN ¹³ CN C ¹⁵ N CN ^{+b}
CHO ₂ ⁺	Hydroxyoxomethylion	HOCO ⁺	CN ⁺	Cyanide radical ion	CN ^{+b}
CHS ⁺	Thiooxomethylion	HCS ⁺	CNNa	Sodium cyanide	NaCN ^a
CH ₂	Methylene	CH ₂	CNSi	Silicon cyanide	SiCN ^a
CH ₂ N ⁺	Iminomethylion	HCNH ⁺	CN ₂	Cyanoimidogen	NCN ^b
CH ₂ N	Methylene amidogen	CH ₂ N	CO	Carbon monoxide	CO ¹³ CO C ¹⁷ O C ¹⁸ O ¹³ C ¹⁸ O
CH ₂ N ₂	Cyanamide	NH ₂ CN	CO ⁺	Carbon monoxide ion	CO ⁺
CH ₂ O	Formaldehyde	H ₂ CO H ₂ ¹³ CO H ₂ C ¹⁸ O HDCO D ₂ CO HCOOH H ¹³ COOH HCOOD DCOOH	COS	Carbon oxysulfide	OCS OC ³⁴ S O ¹³ CS ¹⁸ OCS
CH ₂ O ₂	Formic acid	HCOOH H ¹³ COOH HCOOD DCOOH	CO ₂	Carbon dioxide	CO ₂
CH ₂ S	Thioformaldehyde	H ₂ CS H ₂ ¹³ CS	CO ₂ ⁺	Carbon dioxide ion	CO ₂ ^{+b}
			CP	Carbon phosphide	CP ^a
			CS	Carbon monosulfide	CS C ³³ S

INTERSTELLAR MOLECULES (continued)

Molecular formula	Name	Isotopic species	Molecular formula	Name	Isotopic species
		C ³⁴ S	C ₃ H ₄	Propyne	CH ₃ CCH
		C ³⁶ S			CH ₃ C ¹³ CH
		¹³ CS			¹³ CH ₃ CCH
		¹³ C ³⁴ S			CH ₂ DCCH
CSi	Silicon carbide	SiC ^a	C ₃ H ₅ N	Propanenitrile (ethyl cyanide)	CH ₃ CH ₂ CN
C ₂	Dicarbon	C ₂	C ₃ H ₆ O	Acetone	(CH ₃) ₂ CO
C ₂ H	Ethynyl	C ₂ H	C ₃ N	Cyanoethynyl	CCCN
		¹³ CCH	C ₃ O	1,2-Propadienylidene, 3-oxo	CCCO
		C ¹³ CH	C ₃ S	1,2-Propadienylidene, 3-thioxo	CCCS
		C ₂ D	C ₃ Si	Silicon tricarbon	SiC ₃
C ₂ HN	Cyanomethylene	HCCN	C ₄ H	1,3-Butadiynyl radical	HCCCC
C ₂ H ₂	Acetylene	HCCH			H ¹³ CCCC
C ₂ H ₂ N	Cyanomethyl	CH ₂ CN			HC ¹³ CCC
C ₂ H ₂ O	Ketene	H ₂ CCO			HCC ¹³ CC
C ₂ H ₃ N	Acetonitrile	CH ₃ CN			HCCC ¹³ C
		¹³ CH ₃ CN			DCCCC
		CH ₃ ¹³ CN	C ₄ H ₂	Butatrienylidene	H ₂ CCCC
		CH ₃ C ¹⁵ N	C ₄ H ₂	1,3-Butadiyne	HCCCCH ^a
		CH ₂ DCN	C ₄ H ₃ N	2-Butynenitrile	CH ₃ CCCN
C ₂ H ₃ N	Isocyanomethane	CH ₃ NC	C ₄ Si	Silicon tetracarbide	SiC ₄ ^a
C ₂ H ₄	Ethylene	H ₂ CCH ₂	C ₅	Pentacarbon	C ₅ ^a
C ₂ H ₄ O	Acetaldehyde	CH ₃ CHO	C ₅ H	2,4-Pentadiynylidyne	HCCCCC
C ₂ H ₄ O	Ethylene oxide	<i>c</i> -C ₂ H ₄ O ^c	C ₅ HN	2,4-Pentadiynenitrile	HCCCCCN
C ₂ H ₄ O	Ethenol	CH ₂ CHOH			H ¹³ CCCCCN
C ₂ H ₄ O ₂	Methyl formate	CH ₃ OCHO			HC ¹³ CCCCN
C ₂ H ₄ O ₂	Acetic acid	CH ₃ COOH			HCC ¹³ CCCN
C ₂ H ₄ O ₂	Glycolaldehyde	CH ₂ OHCHO			HCCC ¹³ CCN
C ₂ H ₆	Ethane	CH ₃ CH ₃ ^b			HCCCC ¹³ CN
C ₂ H ₆ O	<i>trans</i> -Ethanol	<i>t</i> -CH ₃ CH ₂ OH			DCCCCCN
C ₂ H ₆ O	<i>gauche</i> -Ethanol	<i>g</i> -CH ₃ CH ₂ OH	C ₅ H ₄	1,3-Pentadiyne	CH ₃ C ₄ H
C ₂ H ₆ O	Dimethyl ether	CH ₃ OCH ₃	C ₅ N	1,3-Butadiynylum, 4-cyano	C ₅ N
C ₂ H ₆ O ₂	Ethylene glycol	HOCH ₂ CH ₂ OH	C ₆ H	1,3,5-Hexatriynyl	HCCCCCC
C ₂ O	Oxoethenylidene	CCO	C ₆ H ₂	1,3,5-Hexatriyne	HCCCCCCH ^a
C ₂ S	Thioxoethenylidene	CCS	C ₆ H ₂	1,2,3,4,5-Hexapentaenylidene	H ₂ CCCCCC
		CC ³⁴ S	C ₆ H ₆	Benzene	C ₆ H ₆
C ₂ Si	Silicon dicarbide	<i>c</i> -SiC ₂	C ₇ H	2,4,6-Heptatriynylidyne	HCCCCCCC
		<i>c</i> - ²⁹ SiC ₂	C ₇ HN	2,4,6-Heptatriynenitrile	HC ₇ N
		<i>c</i> - ³⁰ SiC ₂	C ₈ H	1,3,5,7-Octatetraynyl	HC ₈
		<i>c</i> -Si ¹³ CC	C ₉ HN	2,4,6,8-Nonatetraynenitrile	HC ₉ N
C ₃	Tricarbon	C ₃	C ₁₁ HN	2,4,6,8,10-Undecapentaynenitrile	HC ₁₁ N
C ₃ H	Cyclopropenylidyne	<i>c</i> -C ₃ H ^c	ClH	Hydrogen chloride	H ³⁵ Cl
C ₃ H	Propenylidyne	<i>l</i> -C ₃ H ^d	ClK	Potassium chloride	H ³⁷ Cl
C ₃ HN	Cyanoacetylene	HCCCN			K ³⁵ Cl ^a
		H ¹³ CCCN	ClNa	Sodium chloride	K ³⁷ Cl
		HC ¹³ CCN			Na ³⁵ Cl ^a
		HCC ¹³ CN			Na ³⁷ Cl ^a
		HCCC ¹⁵ N	FH	Hydrogen fluoride	HF
		DCCCN	FeO	Iron monoxide	FeO
C ₃ HN	Isocyanoacetylene	HCCNC	HLi	Lithium hydride	⁷ LiH
C ₃ HN	1,2-Propadienylidene, 3-imino	HNCCC	HN	Imidogen	HN
C ₃ H ₂	Cyclopropenylidene	<i>c</i> -C ₃ H ₂ ^c	HNO	Nitrosyl hydride	HNO
		<i>c</i> -H ¹³ CCCH	HN ₂ ⁺	Hydrodinotrogen(1+)	N ₂ H ⁺
		<i>c</i> -HC ¹³ CCH			¹⁵ NNH ⁺
		<i>c</i> -C ₃ HD			N ¹⁵ NH ⁺
C ₃ H ₂	Propadienylidene	<i>l</i> -H ₂ CCC	HO	Hydroxyl	N ₂ D ⁺
C ₃ H ₂ N ⁺	Protonated cyanoacetylene	HCCCNH ⁺			OH
C ₃ H ₂ O	2-Propynal	HCCCHO			¹⁷ OH
C ₃ H ₃ N	Acrylonitrile (vinyl cyanide)	CH ₂ CHCN			¹⁸ OH

INTERSTELLAR MOLECULES (continued)

Molecular formula	Name	Isotopic species	Molecular formula	Name	Isotopic species
HO ⁺	Oxoniumylidene	HO ⁺ ^b	NS	Nitrogen sulfide	NS
HS	Mercapto	SH			N ³⁴ S
H ₂	Hydrogen	H ₂	NSi	Silicon nitride	SiN ^a
H ₂ N	Amidogen	NH ₂	N ₂ ⁺	Nitrogen ion	N ₂ ⁺ ^b
H ₂ O	Water	H ₂ O	N ₂ O	Nitrous oxide	N ₂ O
		H ₂ ¹⁸ O	OS	Sulfur monoxide	SO
		HDO			³⁴ SO
H ₂ O ⁺	Oxoniumyl	H ₂ O ⁺ ^b			³³ SO
H ₂ S	Hydrogen sulfide	H ₂ S	OS ⁺	Sulfur monoxide ion	S ¹⁸ O
		H ₂ ³⁴ S	OSi	Silicon monoxide	SO ⁺
		HDS			SiO
H ₃ ⁺	Trihydrogen ion	H ₃ ⁺			²⁹ SiO
		H ₂ D ⁺			³⁰ SiO
H ₃ N	Ammonia	NH ₃	O ₂ S	Sulfur dioxide	SO ₂
		¹⁵ NH ₃			³³ SO ₂
		NH ₂ D			³⁴ SO ₂
		NHD ₂			OS ¹⁸ O
		ND ₃	SSi	Silicon monosulfide	SiS
H ₃ O ⁺	Oxonium hydride	H ₃ O ⁺			Si ³³ S
H ₄ Si	Silane	SiH ₄ ^a			Si ³⁴ S
NO	Nitric oxide	NO			²⁹ SiS
NP	Phosphorus nitride	NP			³⁰ SiS
			S ₂	Disulfur	S ₂ ^b

l- before the isotopic species indicates a linear configuration, while *c*- indicates a cyclic molecule.

^a Reported only in circumstellar clouds.

^b Reported only in comets.

STANDARD ITS-90 THERMOCOUPLE TABLES

The Instrument Society of America (ISA) has assigned standard letter designations to a number of thermocouple types having specified emf-temperature relations. These designations and the approximate metal compositions which meet the required relations, as well as the useful temperature ranges, are given below:

Type B	(Pt + 30% Rh) vs. (Pt + 6% Rh)	0 to 1820°C
Type E	(Ni + 10% Cr) vs. (Cu + 43% Ni)	-270 to 1000°C
Type J	Fe vs. (Cu + 43% Ni)	-210 to 1200°C
Type K	(Ni + 10% Cr) vs. (Ni + 2% Al + 2% Mn + 1% Si)	-270 to 1372°C
Type N	(Ni + 14% Cr + 1.5% Si) vs. (Ni + 4.5% Si + 0.1% Mg)	-270 to 1300°C
Type R	(Pt + 13% Rh) vs. Pt	-50 to 1768°C
Type S	(Pt + 10% Rh) vs. Pt	-50 to 1768°C
Type T	Cu vs. (Cu + 43% Ni)	-270 to 400°C

The compositions are given in weight percent, and the positive leg is listed first. It should be emphasized that the standard letter designations do not imply a precise composition but rather that the specified emf-temperature relation is satisfied.

The first set of tables below lists, for each thermocouple type, the emf as a function of temperature on the International Temperature Scale of 1990 (ITS-90). The coefficients in the equation used to generate the table are also given. The second set of tables gives the inverse relationships, i.e., the coefficients in the polynomial equation which expresses the temperature as a function of thermocouple emf. The accuracy of these equations is also stated.

Further details and tables at closer intervals may be found in Reference 1.

REFERENCES

1. Burns, G. W., Seroger, M. G., Strouse, G. F., Croarkin, M. C., and Guthrie, W.F., *Temperature-Electromotive Force Reference Functions and Tables for the Letter-Designated Thermocouple Types Based on the ITS-90*, Nat. Inst. Stand. Tech. (U.S.) Monogr. 175, 1993.
2. Schooley, J. F., *Thermometry*, CRC Press, Boca Raton, FL, 1986.

Type B thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

<i>t</i> /°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	-0.002	-0.003	-0.002	-0.000	0.002	0.006	0.011	0.017	0.025	0.033
100	0.033	0.043	0.053	0.065	0.078	0.092	0.107	0.123	0.141	0.159	0.178
200	0.178	0.199	0.220	0.243	0.267	0.291	0.317	0.344	0.372	0.401	0.431
300	0.431	0.462	0.494	0.527	0.561	0.596	0.632	0.669	0.707	0.746	0.787
400	0.787	0.828	0.870	0.913	0.957	1.002	1.048	1.095	1.143	1.192	1.242
500	1.242	1.293	1.344	1.397	1.451	1.505	1.561	1.617	1.675	1.733	1.792
600	1.792	1.852	1.913	1.975	2.037	2.101	2.165	2.230	2.296	2.363	2.431
700	2.431	2.499	2.569	2.639	2.710	2.782	2.854	2.928	3.002	3.078	3.154
800	3.154	3.230	3.308	3.386	3.466	3.546	3.626	3.708	3.790	3.873	3.957
900	3.957	4.041	4.127	4.213	4.299	4.387	4.475	4.564	4.653	4.743	4.834
1000	4.834	4.926	5.018	5.111	5.205	5.299	5.394	5.489	5.585	5.682	5.780
1100	5.780	5.878	5.976	6.075	6.175	6.276	6.377	6.478	6.580	6.683	6.786
1200	6.786	6.890	6.995	7.100	7.205	7.311	7.417	7.524	7.632	7.740	7.848
1300	7.848	7.957	8.066	8.176	8.286	8.397	8.508	8.620	8.731	8.844	8.956
1400	8.956	9.069	9.182	9.296	9.410	9.524	9.639	9.753	9.868	9.984	10.099
1500	10.099	10.215	10.331	10.447	10.563	10.679	10.796	10.913	11.029	11.146	11.263
1600	11.263	11.380	11.497	11.614	11.731	11.848	11.965	12.082	12.199	12.316	12.433
1700	12.433	12.549	12.666	12.782	12.898	13.014	13.130	13.246	13.361	13.476	13.591
1800	13.591	13.706	13.820								

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots + c_nt^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and $c_0, c_1, c_2, c_3, \dots$ are the coefficients. These coefficients are extracted from NIST Monograph 175.

	0°C to 630.615°C	630.615°C to 1820°C
c_0	= 0.000 000 000 0	-3.893 816 862 1
c_1	= $-2.465\ 081\ 834\ 6 \times 10^{-4}$	$2.857\ 174\ 747\ 0 \times 10^{-2}$
c_2	= $5.904\ 042\ 117\ 1 \times 10^{-6}$	$-8.488\ 510\ 478\ 5 \times 10^{-5}$
c_3	= $-1.325\ 793\ 163\ 6 \times 10^{-9}$	$1.578\ 528\ 016\ 4 \times 10^{-7}$
c_4	= $1.566\ 829\ 190\ 1 \times 10^{-12}$	$-1.683\ 534\ 486\ 4 \times 10^{-10}$
c_5	= $-1.694\ 452\ 924\ 0 \times 10^{-15}$	$1.110\ 979\ 401\ 3 \times 10^{-13}$
c_6	= $6.299\ 034\ 709\ 4 \times 10^{-19}$	$-4.451\ 543\ 103\ 3 \times 10^{-17}$
c_7	=	$9.897\ 564\ 082\ 1 \times 10^{-21}$
c_8	=	$-9.379\ 133\ 028\ 9 \times 10^{-25}$

Type E thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

$t/^\circ\text{C}$	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-8.825	-9.063	-9.274	-9.455	-9.604	-9.718	-9.797	-9.835			
-100	-5.237	-5.681	-6.107	-6.516	-6.907	-7.279	-7.632	-7.963	-8.273	-8.561	-8.825
0	0.000	-0.582	-1.152	-1.709	-2.255	-2.787	-3.306	-3.811	-4.302	-4.777	-5.237
$t/^\circ\text{C}$	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.591	1.192	1.801	2.420	3.048	3.685	4.330	4.985	5.648	6.319
100	6.319	6.998	7.685	8.379	9.081	9.789	10.503	11.224	11.951	12.684	13.421
200	13.421	14.164	14.912	15.664	16.420	17.181	17.945	18.713	19.484	20.259	21.036
300	21.036	21.817	22.600	23.386	24.174	24.964	25.757	26.552	27.348	28.146	28.946
400	28.946	29.747	30.550	31.354	32.159	32.965	33.772	34.579	35.387	36.196	37.005
500	37.005	37.815	38.624	39.434	40.243	41.053	41.862	42.671	43.479	44.286	45.093
600	45.093	45.900	46.705	47.509	48.313	49.116	49.917	50.718	51.517	52.315	53.112
700	53.112	53.908	54.703	55.497	56.289	57.080	57.870	58.659	59.446	60.232	61.017
800	61.017	61.801	62.583	63.364	64.144	64.922	65.698	66.473	67.246	68.017	68.787
900	68.787	69.554	70.319	71.082	71.844	72.603	73.360	74.115	74.869	75.621	76.373
1000	76.373										

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots c_n t^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and $c_0, c_1, c_2, c_3, \dots$ are the coefficients. These coefficients are extracted from NIST Monograph 175.

	-270°C to 0°C	0°C to 1000°C
c_0	= 0.000 000 000 0	0.000 000 000 0
c_1	= 5.866 550 870 8 × 10 ⁻²	5.866 550 871 0 × 10 ⁻²
c_2	= 4.541 097 712 4 × 10 ⁻⁵	4.503 227 558 2 × 10 ⁻⁵
c_3	= -7.799 804 868 6 × 10 ⁻⁷	2.890 840 721 2 × 10 ⁻⁸
c_4	= -2.580 016 084 3 × 10 ⁻⁸	-3.305 689 665 2 × 10 ⁻¹⁰
c_5	= -5.945 258 305 7 × 10 ⁻¹⁰	6.502 440 327 0 × 10 ⁻¹³
c_6	= -9.321 405 866 7 × 10 ⁻¹²	-1.919 749 550 4 × 10 ⁻¹⁶
c_7	= -1.028 760 553 4 × 10 ⁻¹³	-1.253 660 049 7 × 10 ⁻¹⁸
c_8	= -8.037 012 362 1 × 10 ⁻¹⁶	2.148 921 756 9 × 10 ⁻²¹
c_9	= -4.397 949 739 1 × 10 ⁻¹⁸	-1.438 804 178 2 × 10 ⁻²⁴
c_{10}	= -1.641 477 635 5 × 10 ⁻²⁰	3.596 089 948 1 × 10 ⁻²⁸
c_{11}	= -3.967 361 951 6 × 10 ⁻²³	.....
c_{12}	= -5.582 732 872 1 × 10 ⁻²⁶	.....
c_{13}	= -3.465 784 201 3 × 10 ⁻²⁹	.....

Type J thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

$t/^\circ\text{C}$	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-7.890	-8.095									
-100	-4.633	-5.037	-5.426	-5.801	-6.159	-6.500	-6.821	-7.123	-7.403	-7.659	-7.890
0	0.000	-0.501	-0.995	-1.482	-1.961	-2.431	-2.893	-3.344	-3.786	-4.215	-4.633

$t/^\circ\text{C}$	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.507	1.019	1.537	2.059	2.585	3.116	3.650	4.187	4.726	5.269
100	5.269	5.814	6.360	6.909	7.459	8.010	8.562	9.115	9.669	10.224	10.779
200	10.779	11.334	11.889	12.445	13.000	13.555	14.110	14.665	15.219	15.773	16.327
300	16.327	16.881	17.434	17.986	18.538	19.090	19.642	20.194	20.745	21.297	21.848
400	21.848	22.400	22.952	23.504	24.057	24.610	25.164	25.720	26.276	26.834	27.393
500	27.393	27.953	28.516	29.080	29.647	30.216	30.788	31.362	31.939	32.519	33.102
600	33.102	33.689	34.279	34.873	35.470	36.071	36.675	37.284	37.896	38.512	39.132
700	39.132	39.755	40.382	41.012	41.645	42.281	42.919	43.559	44.203	44.848	45.494
800	45.494	46.141	46.786	47.431	48.074	48.715	49.353	49.989	50.622	51.251	51.877
900	51.877	52.500	53.119	53.735	54.347	54.956	55.561	56.164	56.763	57.360	57.953
1000	57.953	58.545	59.134	59.721	60.307	60.890	61.473	62.054	62.634	63.214	63.792
1100	63.792	64.370	64.948	65.525	66.102	66.679	67.255	67.831	68.406	68.980	69.553
1200	69.553										

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots + c_nt^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and c_0, c_1, c_2, c_3 , etc. are the coefficients. These coefficients are extracted from NIST Monograph 175.

	-210°C to 760°C	760°C to 1200°C
$c_0 =$	0.000 000 000 0	$2.964\ 562\ 568\ 1 \times 10^2$
$c_1 =$	$5.038\ 118\ 781\ 5 \times 10^{-2}$	$-1.497\ 612\ 778\ 6$
$c_2 =$	$3.047\ 583\ 693\ 0 \times 10^{-5}$	$3.178\ 710\ 392\ 4 \times 10^{-3}$
$c_3 =$	$-8.568\ 106\ 572\ 0 \times 10^{-8}$	$-3.184\ 768\ 670\ 1 \times 10^{-6}$
$c_4 =$	$1.322\ 819\ 529\ 5 \times 10^{-10}$	$1.572\ 081\ 900\ 4 \times 10^{-9}$
$c_5 =$	$-1.705\ 295\ 833\ 7 \times 10^{-13}$	$-3.069\ 136\ 905\ 6 \times 10^{-13}$
$c_6 =$	$2.094\ 809\ 069\ 7 \times 10^{-16}$	.....
$c_7 =$	$-1.253\ 839\ 533\ 6 \times 10^{-19}$	.....
$c_8 =$	$1.563\ 172\ 569\ 7 \times 10^{-23}$	.....

Type K thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

$t/^\circ\text{C}$	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-5.891	-6.035	-6.158	-6.262	-6.344	-6.404	-6.441	-6.458			
-100	-3.554	-3.852	-4.138	-4.411	-4.669	-4.913	-5.141	-5.354	-5.550	-5.730	-5.891
0	0.000	-0.392	-0.778	-1.156	-1.527	-1.889	-2.243	-2.587	-2.920	-3.243	-3.554

$t/^\circ\text{C}$	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.397	0.798	1.203	1.612	2.023	2.436	2.851	3.267	3.682	4.096
100	4.096	4.509	4.920	5.328	5.735	6.138	6.540	6.941	7.340	7.739	8.138
200	8.138	8.539	8.940	9.343	9.747	10.153	10.561	10.971	11.382	11.795	12.209
300	12.209	12.624	13.040	13.457	13.874	14.293	14.713	15.133	15.554	15.975	16.397
400	16.397	16.820	17.243	17.667	18.091	18.516	18.941	19.366	19.792	20.218	20.644
500	20.644	21.071	21.497	21.924	22.350	22.776	23.203	23.629	24.055	24.480	24.905
600	24.905	25.330	25.755	26.179	26.602	27.025	27.447	27.869	28.289	28.710	29.129
700	29.129	29.548	29.965	30.382	30.798	31.213	31.628	32.041	32.453	32.865	33.275
800	33.275	33.685	34.093	34.501	34.908	35.313	35.718	36.121	36.524	36.925	37.326
900	37.326	37.725	38.124	38.522	38.918	39.314	39.708	40.101	40.494	40.885	41.276
1000	41.276	41.665	42.053	42.440	42.826	43.211	43.595	43.978	44.359	44.740	45.119
1100	45.119	45.497	45.873	46.249	46.623	46.995	47.367	47.737	48.105	48.473	48.838
1200	48.838	49.202	49.565	49.926	50.286	50.644	51.000	51.355	51.708	52.060	52.410
1300	52.410	52.759	53.106	53.451	53.795	54.138	54.479	54.819			

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots c_n t^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and c_0, c_1, c_2, c_3 , etc. are the coefficients. In the 0°C to 1372°C range there is also an exponential term that must be evaluated and added to the equation. The exponential term is of the form: $c_0 \exp[c_1(t-126.9686)^2]$, where t is the temperature in °C and c_0 and c_1 are the coefficients. These coefficients are extracted from NIST Monograph 175.

	-270°C to 0°C	0°C to 1372°C	0°C to 1372°C (exponential term)
c_0 =	0.000 000 000 0	$-1.760\ 041\ 368\ 6 \times 10^{-2}$	$1.185\ 976 \times 10^{-1}$
c_1 =	$3.945\ 012\ 802\ 5 \times 10^{-2}$	$3.892\ 120\ 497\ 5 \times 10^{-2}$	$-1.183\ 432 \times 10^{-4}$
c_2 =	$2.362\ 237\ 359\ 8 \times 10^{-5}$	$1.855\ 877\ 003\ 2 \times 10^{-5}$	.....
c_3 =	$-3.285\ 890\ 678\ 4 \times 10^{-7}$	$-9.945\ 759\ 287\ 4 \times 10^{-8}$	.....
c_4 =	$-4.990\ 482\ 877\ 7 \times 10^{-9}$	$3.184\ 094\ 571\ 9 \times 10^{-10}$	.....
c_5 =	$-6.750\ 905\ 917\ 3 \times 10^{-11}$	$-5.607\ 284\ 488\ 9 \times 10^{-13}$	.....
c_6 =	$-5.741\ 032\ 742\ 8 \times 10^{-13}$	$5.607\ 505\ 905\ 9 \times 10^{-16}$	.....
c_7 =	$-3.108\ 887\ 289\ 4 \times 10^{-15}$	$-3.202\ 072\ 000\ 3 \times 10^{-19}$	.....
c_8 =	$-1.045\ 160\ 936\ 5 \times 10^{-17}$	$9.715\ 114\ 715\ 2 \times 10^{-23}$	.....
c_9 =	$-1.988\ 926\ 687\ 8 \times 10^{-20}$	$-1.210\ 472\ 127\ 5 \times 10^{-26}$	.....
c_{10} =	$-1.632\ 269\ 748\ 6 \times 10^{-23}$	.....	.....

Type N thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

$t/^\circ\text{C}$	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-3.990	-4.083	-4.162	-4.226	-4.277	-4.313	-4.336	-4.345			
-100	-2.407	-2.612	-2.808	-2.994	-3.171	-3.336	-3.491	-3.634	-3.766	-3.884	-3.990
0	0.000	-0.260	-0.518	-0.772	-1.023	-1.269	-1.509	-1.744	-1.972	-2.193	-2.407

$t/^\circ\text{C}$	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.261	0.525	0.793	1.065	1.340	1.619	1.902	2.189	2.480	2.774
100	2.774	3.072	3.374	3.680	3.989	4.302	4.618	4.937	5.259	5.585	5.913
200	5.913	6.245	6.579	6.916	7.255	7.597	7.941	8.288	8.637	8.988	9.341
300	9.341	9.696	10.054	10.413	10.774	11.136	11.501	11.867	12.234	12.603	12.974
400	12.974	13.346	13.719	14.094	14.469	14.846	15.225	15.604	15.984	16.366	16.748
500	16.748	17.131	17.515	17.900	18.286	18.672	19.059	19.447	19.835	20.224	20.613
600	20.613	21.003	21.393	21.784	22.175	22.566	22.958	23.350	23.742	24.134	24.527
700	24.527	24.919	25.312	25.705	26.098	26.491	26.883	27.276	27.669	28.062	28.455
800	28.455	28.847	29.239	29.632	30.024	30.416	30.807	31.199	31.590	31.981	32.371
900	32.371	32.761	33.151	33.541	33.930	34.319	34.707	35.095	35.482	35.869	36.256
1000	36.256	36.641	37.027	37.411	37.795	38.179	38.562	38.944	39.326	39.706	40.087
1100	40.087	40.466	40.845	41.223	41.600	41.976	42.352	42.727	43.101	43.474	43.846
1200	43.846	44.218	44.588	44.958	45.326	45.694	46.060	46.425	46.789	47.152	47.513
1300	47.513										

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots c_nt^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and $c_0, c_1, c_2, c_3, \dots$ are the coefficients. These coefficients are extracted from NIST Monograph 175.

	-270°C to 0°C	0°C to 1300°C
c_0	= 0.000 000 000 0	0.000 000 000 0
c_1	= $2.615\ 910\ 596\ 2 \times 10^{-2}$	$2.592\ 939\ 460\ 1 \times 10^{-2}$
c_2	= $1.095\ 748\ 422\ 8 \times 10^{-5}$	$1.571\ 014\ 188\ 0 \times 10^{-5}$
c_3	= $-9.384\ 111\ 155\ 4 \times 10^{-8}$	$4.382\ 562\ 723\ 7 \times 10^{-8}$
c_4	= $-4.641\ 203\ 975\ 9 \times 10^{-11}$	$-2.526\ 116\ 979\ 4 \times 10^{-10}$
c_5	= $-2.630\ 335\ 771\ 6 \times 10^{-12}$	$6.431\ 181\ 933\ 9 \times 10^{-13}$
c_6	= $-2.265\ 343\ 800\ 3 \times 10^{-14}$	$-1.006\ 347\ 151\ 9 \times 10^{-15}$
c_7	= $-7.608\ 930\ 079\ 1 \times 10^{-17}$	$9.974\ 533\ 899\ 2 \times 10^{-19}$
c_8	= $-9.341\ 966\ 783\ 5 \times 10^{-20}$	$-6.086\ 324\ 560\ 7 \times 10^{-22}$
c_9	=	$2.084\ 922\ 933\ 9 \times 10^{-25}$
c_{10}	=	$-3.068\ 219\ 615\ 1 \times 10^{-29}$

Type R thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

<i>t</i> /°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
0	0.000	-0.051	-0.100	-0.145	-0.188	-0.226					
<i>t</i> /°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.054	0.111	0.171	0.232	0.296	0.363	0.431	0.501	0.573	0.647
100	0.647	0.723	0.800	0.879	0.959	1.041	1.124	1.208	1.294	1.381	1.469
200	1.469	1.558	1.648	1.739	1.831	1.923	2.017	2.112	2.207	2.304	2.401
300	2.401	2.498	2.597	2.696	2.796	2.896	2.997	3.099	3.201	3.304	3.408
400	3.408	3.512	3.616	3.721	3.827	3.933	4.040	4.147	4.255	4.363	4.471
500	4.471	4.580	4.690	4.800	4.910	5.021	5.133	5.245	5.357	5.470	5.583
600	5.583	5.697	5.812	5.926	6.041	6.157	6.273	6.390	6.507	6.625	6.743
700	6.743	6.861	6.980	7.100	7.220	7.340	7.461	7.583	7.705	7.827	7.950
800	7.950	8.073	8.197	8.321	8.446	8.571	8.697	8.823	8.950	9.077	9.205
900	9.205	9.333	9.461	9.590	9.720	9.850	9.980	10.111	10.242	10.374	10.506
1000	10.506	10.638	10.771	10.905	11.039	11.173	11.307	11.442	11.578	11.714	11.850
1100	11.850	11.986	12.123	12.260	12.397	12.535	12.673	12.812	12.950	13.089	13.228
1200	13.228	13.367	13.507	13.646	13.786	13.926	14.066	14.207	14.347	14.488	14.629
1300	14.629	14.770	14.911	15.052	15.193	15.334	15.475	15.616	15.758	15.899	16.040
1400	16.040	16.181	16.323	16.464	16.605	16.746	16.887	17.028	17.169	17.310	17.451
1500	17.451	17.591	17.732	17.872	18.012	18.152	18.292	18.431	18.571	18.710	18.849
1600	18.849	18.988	19.126	19.264	19.402	19.540	19.677	19.814	19.951	20.087	20.222
1700	20.222	20.356	20.488	20.620	20.749	20.877	21.003				

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots c_n t^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and $c_0, c_1, c_2, c_3, \dots$ are the coefficients. These coefficients are extracted from NIST Monograph 175.

	-50°C to 1064.18°C	1064.18°C to 1664.5°C	1664.5°C to 1768.1°C
$c_0 =$	0.000 000 000 00.	2.951 579 253 16	$1.522\ 321\ 182\ 09 \times 10^2$
$c_1 =$	$5.289\ 617\ 297\ 65 \times 10^{-3}$	$-2.520\ 612\ 513\ 32 \times 10^{-3}$	$-2.688\ 198\ 885\ 45 \times 10^{-1}$
$c_2 =$	$1.391\ 665\ 897\ 82 \times 10^{-5}$	$1.595\ 645\ 018\ 65 \times 10^{-5}$	$1.712\ 802\ 804\ 71 \times 10^{-4}$
$c_3 =$	$-2.388\ 556\ 930\ 17 \times 10^{-8}$	$-7.640\ 859\ 475\ 76 \times 10^{-9}$	$-3.458\ 957\ 064\ 53 \times 10^{-8}$
$c_4 =$	$3.569\ 160\ 010\ 63 \times 10^{-11}$	$2.053\ 052\ 910\ 24 \times 10^{-12}$	$-9.346\ 339\ 710\ 46 \times 10^{-15}$
$c_5 =$	$-4.623\ 476\ 662\ 98 \times 10^{-14}$	$-2.933\ 596\ 681\ 73 \times 10^{-16}$	.....
$c_6 =$	$5.007\ 774\ 410\ 34 \times 10^{-17}$	.....	.....
$c_7 =$	$-3.731\ 058\ 861\ 91 \times 10^{-20}$	.....	.....
$c_8 =$	$1.577\ 164\ 823\ 67 \times 10^{-23}$	.....	.....
$c_9 =$	$-2.810\ 386\ 252\ 51 \times 10^{-27}$	.....	.....

Type S thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

$t/^\circ\text{C}$	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
0	0.000	-0.053	-0.103	-0.150	-0.194	-0.236					

$t/^\circ\text{C}$	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.055	0.113	0.173	0.235	0.299	0.365	0.433	0.502	0.573	0.646
100	0.646	0.720	0.795	0.872	0.950	1.029	1.110	1.191	1.273	1.357	1.441
200	1.441	1.526	1.612	1.698	1.786	1.874	1.962	2.052	2.141	2.232	2.323
300	2.323	2.415	2.507	2.599	2.692	2.786	2.880	2.974	3.069	3.164	3.259
400	3.259	3.355	3.451	3.548	3.645	3.742	3.840	3.938	4.036	4.134	4.233
500	4.233	4.332	4.432	4.532	4.632	4.732	4.833	4.934	5.035	5.137	5.239
600	5.239	5.341	5.443	5.546	5.649	5.753	5.857	5.961	6.065	6.170	6.275
700	6.275	6.381	6.486	6.593	6.699	6.806	6.913	7.020	7.128	7.236	7.345
800	7.345	7.454	7.563	7.673	7.783	7.893	8.003	8.114	8.226	8.337	8.449
900	8.449	8.562	8.674	8.787	8.900	9.014	9.128	9.242	9.357	9.472	9.587
1000	9.587	9.703	9.819	9.935	10.051	10.168	10.285	10.403	10.520	10.638	10.757
1100	10.757	10.875	10.994	11.113	11.232	11.351	11.471	11.590	11.710	11.830	11.951
1200	11.951	12.071	12.191	12.312	12.433	12.554	12.675	12.796	12.917	13.038	13.159
1300	13.159	13.280	13.402	13.523	13.644	13.766	13.887	14.009	14.130	14.251	14.373
1400	14.373	14.494	14.615	14.736	14.857	14.978	15.099	15.220	15.341	15.461	15.582
1500	15.582	15.702	15.822	15.942	16.062	16.182	16.301	16.420	16.539	16.658	16.777
1600	16.777	16.895	17.013	17.131	17.249	17.366	17.483	17.600	17.717	17.832	17.947
1700	17.947	18.061	18.174	18.285	18.395	18.503	18.609				

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots c_nt^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and c_0, c_1, c_2, c_3 , etc. are the coefficients. These coefficients are extracted from NIST Monograph 175.

	-50°C to 1064.18°C	1064.18°C to 1664.5°C	1664.5°C to 1768.1°C
$c_0 =$	0.000 000 000 00	1.329 004 440 85	$1.466\ 282\ 326\ 36 \times 10^2$
$c_1 =$	$5.403\ 133\ 086\ 31 \times 10^{-3}$	$3.345\ 093\ 113\ 44 \times 10^{-3}$	$-2.584\ 305\ 167\ 52 \times 10^{-1}$
$c_2 =$	$1.259\ 342\ 897\ 40 \times 10^{-5}$	$6.548\ 051\ 928\ 18 \times 10^{-6}$	$1.636\ 935\ 746\ 41 \times 10^{-4}$
$c_3 =$	$-2.324\ 779\ 686\ 89 \times 10^{-8}$	$-1.648\ 562\ 592\ 09 \times 10^{-9}$	$-3.304\ 390\ 469\ 87 \times 10^{-8}$
$c_4 =$	$3.220\ 288\ 230\ 36 \times 10^{-11}$	$1.299\ 896\ 051\ 74 \times 10^{-14}$	$-9.432\ 236\ 906\ 12 \times 10^{-15}$
$c_5 =$	$-3.314\ 651\ 963\ 89 \times 10^{-14}$	.....	.....
$c_6 =$	$2.557\ 442\ 517\ 86 \times 10^{-17}$	.....	.....
$c_7 =$	$-1.250\ 688\ 713\ 93 \times 10^{-20}$	.....	.....
$c_8 =$	$2.714\ 431\ 761\ 45 \times 10^{-24}$	.....	.....

Type T thermocouples: emf-temperature (°C) reference table and equations

Thermocouple emf in Millivolts as a Function of Temperature in Degrees Celsius (ITS-90)

Reference Junctions at 0°C

$t/^\circ\text{C}$	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-5.603	-5.753	-5.888	-6.007	-6.105	-6.180	-6.232	-6.258			
-100	-3.379	-3.657	-3.923	-4.177	-4.419	-4.648	-4.865	-5.070	-5.261	-5.439	-5.603
0	0.000	-0.383	-0.757	-1.121	-1.475	-1.819	-2.153	-2.476	-2.788	-3.089	-3.379

$t/^\circ\text{C}$	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.391	0.790	1.196	1.612	2.036	2.468	2.909	3.358	3.814	4.279
100	4.279	4.750	5.228	5.714	6.206	6.704	7.209	7.720	8.237	8.759	9.288
200	9.288	9.822	10.362	10.907	11.458	12.013	12.574	13.139	13.709	14.283	14.862
300	14.862	15.445	16.032	16.624	17.219	17.819	18.422	19.030	19.641	20.255	20.872
400	20.872										

Temperature Ranges and Coefficients of Equations Used to Compute the Above Table

The equations are of the form: $E = c_0 + c_1t + c_2t^2 + c_3t^3 + \dots + c_nt^n$, where E is the emf in millivolts, t is the temperature in degrees Celsius (ITS-90), and $c_0, c_1, c_2, c_3, \dots$ are the coefficients. These coefficients are extracted from NIST Monograph 175.

	-270°C to 0°C	0°C to 400°C
$c_0 =$	0.000 000 000 0	0.000 000 000 0
$c_1 =$	$3.874\ 810\ 636\ 4 \times 10^{-2}$	$3.874\ 810\ 636\ 4 \times 10^{-2}$
$c_2 =$	$4.419\ 443\ 434\ 7 \times 10^{-5}$	$3.329\ 222\ 788\ 0 \times 10^{-5}$
$c_3 =$	$1.184\ 432\ 310\ 5 \times 10^{-7}$	$2.061\ 824\ 340\ 4 \times 10^{-7}$
$c_4 =$	$2.003\ 297\ 355\ 4 \times 10^{-8}$	$-2.188\ 225\ 684\ 6 \times 10^{-9}$
$c_5 =$	$9.013\ 801\ 955\ 9 \times 10^{-10}$	$1.099\ 688\ 092\ 8 \times 10^{-11}$
$c_6 =$	$2.265\ 115\ 659\ 3 \times 10^{-11}$	$-3.081\ 575\ 877\ 2 \times 10^{-14}$
$c_7 =$	$3.607\ 115\ 420\ 5 \times 10^{-13}$	$4.547\ 913\ 529\ 0 \times 10^{-17}$
$c_8 =$	$3.849\ 393\ 988\ 3 \times 10^{-15}$	$-2.751\ 290\ 167\ 3 \times 10^{-20}$
$c_9 =$	$2.821\ 352\ 192\ 5 \times 10^{-17}$	.....
$c_{10} =$	$1.425\ 159\ 477\ 9 \times 10^{-19}$	.....
$c_{11} =$	$4.876\ 866\ 228\ 6 \times 10^{-22}$	.....
$c_{12} =$	$1.079\ 553\ 927\ 0 \times 10^{-24}$	.....
$c_{13} =$	$1.394\ 502\ 706\ 2 \times 10^{-27}$	.....
$c_{14} =$	$7.979\ 515\ 392\ 7 \times 10^{-31}$	.....

Type B thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	250°C	700°C
Range:	to	to
	700°C	1820°C
emf	0.291 mV	2.431 mV
Range:	to	to
	2.431 mV	13.820 mV
$c_0 =$	$9.842\ 332\ 1 \times 10^1$	$2.131\ 507\ 1 \times 10^2$
$c_1 =$	$6.997\ 150\ 0 \times 10^2$	$2.851\ 050\ 4 \times 10^2$
$c_2 =$	$-8.476\ 530\ 4 \times 10^2$	$-5.274\ 288\ 7 \times 10^1$
$c_3 =$	$1.005\ 264\ 4 \times 10^3$	9.916 080 4
$c_4 =$	$-8.334\ 595\ 2 \times 10^2$	-1.296 530 3
$c_5 =$	$4.550\ 854\ 2 \times 10^2$	$1.119\ 587\ 0 \times 10^{-1}$
$c_6 =$	$-1.552\ 303\ 7 \times 10^2$	$-6.062\ 519\ 9 \times 10^{-3}$
$c_7 =$	$2.988\ 675\ 0 \times 10^1$	$1.866\ 169\ 6 \times 10^{-4}$
$c_8 =$	-2.474 286 0	$-2.487\ 858\ 5 \times 10^{-6}$

Type E thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	-200°C	0°C
Range:	to	to
	0°C	1000°C
emf	-8.825 mV	0.0 mV
Range:	to	to
	0.0 mV	76.373 mV
$c_0 =$	0.000 000 0	0.000 000 0
$c_1 =$	$1.697\ 728\ 8 \times 10^1$	$1.705\ 703\ 5 \times 10^1$
$c_2 =$	$-4.351\ 497\ 0 \times 10^{-1}$	$-2.330\ 175\ 9 \times 10^{-1}$
$c_3 =$	$-1.585\ 969\ 7 \times 10^{-1}$	$6.543\ 558\ 5 \times 10^{-3}$
$c_4 =$	$-9.250\ 287\ 1 \times 10^{-2}$	$-7.356\ 274\ 9 \times 10^{-5}$
$c_5 =$	$-2.608\ 431\ 4 \times 10^{-2}$	$-1.789\ 600\ 1 \times 10^{-6}$
$c_6 =$	$-4.136\ 019\ 9 \times 10^{-3}$	$8.403\ 616\ 5 \times 10^{-8}$
$c_7 =$	$-3.403\ 403\ 0 \times 10^{-4}$	$-1.373\ 587\ 9 \times 10^{-9}$
$c_8 =$	$-1.156\ 489\ 0 \times 10^{-5}$	$1.062\ 982\ 3 \times 10^{-11}$
$c_9 =$	.....	$-3.244\ 708\ 7 \times 10^{-14}$

Type J thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	-210°C	0°C	760°C
Range:	to	to	to
	0°C	760°C	1200°C
emf	-8.095 mV	0.0 mV	42.919 mV
Range:	to	to	to
	0.0 mV	42.919 mV	69.553 mV
$c_0 =$	0.000 000 0	0.000 000	$-3.113\ 581\ 87 \times 10^3$
$c_1 =$	$1.952\ 826\ 8 \times 10^1$	$1.978\ 425 \times 10^1$	$3.005\ 436\ 84 \times 10^2$
$c_2 =$	-1.228 618 5	$-2.001\ 204 \times 10^{-1}$	-9.947 732 30
$c_3 =$	-1.075 217 8	$1.036\ 969 \times 10^{-2}$	$1.702\ 766\ 30 \times 10^{-1}$
$c_4 =$	$-5.908\ 693\ 3 \times 10^{-1}$	$-2.549\ 687 \times 10^{-4}$	$-1.430\ 334\ 68 \times 10^{-3}$
$c_5 =$	$-1.725\ 671\ 3 \times 10^{-1}$	$3.585\ 153 \times 10^{-6}$	$4.738\ 860\ 84 \times 10^{-6}$
$c_6 =$	$-2.813\ 151\ 3 \times 10^{-2}$	$-5.344\ 285 \times 10^{-8}$	.....
$c_7 =$	$-2.396\ 337\ 0 \times 10^{-3}$	$5.099\ 890 \times 10^{-10}$	.....
$c_8 =$	$-8.382\ 332\ 1 \times 10^{-5}$	.....	.....

Type K thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	-200°C	0°C	500°C
Range:	to	to	to
	0°C	500°C	1372°C
emf	-5.891 mV	0.0 mV	20.644 mV
Range:	to	to	to
	0.0 mV	20.644 mV	54.886 mV
$c_0 =$	0.000 000 0	0.000 000 0	$-1.318\ 058 \times 10^2$
$c_1 =$	$2.517\ 346\ 2 \times 10^1$	$2.508\ 355 \times 10^1$	$4.830\ 222 \times 10^1$
$c_2 =$	-1.166 287 8	$7.860\ 106 \times 10^{-2}$	-1.646 031
$c_3 =$	-1.083 363 8	$-2.503\ 131 \times 10^{-1}$	$5.464\ 731 \times 10^{-2}$
$c_4 =$	$-8.977\ 354\ 0 \times 10^{-1}$	$8.315\ 270 \times 10^{-2}$	$-9.650\ 715 \times 10^{-4}$
$c_5 =$	$-3.734\ 237\ 7 \times 10^{-1}$	$-1.228\ 034 \times 10^{-2}$	$8.802\ 193 \times 10^{-6}$
$c_6 =$	$-8.663\ 264\ 3 \times 10^{-2}$	$9.804\ 036 \times 10^{-4}$	$-3.110\ 810 \times 10^{-8}$
$c_7 =$	$-1.045\ 059\ 8 \times 10^{-2}$	$-4.413\ 030 \times 10^{-5}$	.....
$c_8 =$	$-5.192\ 057\ 7 \times 10^{-4}$	$1.057\ 734 \times 10^{-6}$	.....
$c_9 =$	.....	$-1.052\ 755 \times 10^{-8}$	.....

Type N thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	-200°C	0°C	600°C
Range:	to	to	to
	0°C	600°C	1300°C
emf	-3.990 mV	0.0 mV	20.613 mV
Range:	to	to	to
	0.0 mV	20.613 mV	47.513 mV
$c_0 =$	0.000 000 0	0.000 00	$1.972\ 485 \times 10^1$
$c_1 =$	$3.843\ 684\ 7 \times 10^1$	$3.868\ 96 \times 10^1$	$3.300\ 943 \times 10^1$
$c_2 =$	1.101 048 5	-1.082 67	$-3.915\ 159 \times 10^{-1}$
$c_3 =$	5.222 931 2	$4.702\ 05 \times 10^{-2}$	$9.855\ 391 \times 10^{-3}$
$c_4 =$	7.206 052 5	$-2.121\ 69 \times 10^{-6}$	$-1.274\ 371 \times 10^{-4}$
$c_5 =$	5.848 858 6	$-1.172\ 72 \times 10^{-4}$	$7.767\ 022 \times 10^{-7}$
$c_6 =$	2.775 491 6	$5.392\ 80 \times 10^{-6}$	.....
$c_7 =$	$7.707\ 516\ 6 \times 10^{-1}$	$-7.981\ 56 \times 10^{-8}$	.....
$c_8 =$	$1.158\ 266\ 5 \times 10^{-1}$	.....	.....
$c_9 =$	$7.313\ 886\ 8 \times 10^{-3}$	.....	.....

Type R thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	-50°C	250°C	1064°C	1664.5°C
Range:	to	to	to	to
	250°C	1200°C	1664.5°C	1768.1°C
emf	-0.226 mV	1.923 mV	11.361 mV	19.739 mV
Range:	to	to	to	to
	1.923 mV	13.228 mV	19.739 mV	21.103 mV
$c_0 =$	0.000 000 0	$1.334\ 584\ 505 \times 10^1$	$-8.199\ 599\ 416 \times 10^1$	$3.406\ 177\ 836 \times 10^4$
$c_1 =$	$1.889\ 138\ 0 \times 10^2$	$1.472\ 644\ 573 \times 10^2$	$1.553\ 962\ 042 \times 10^2$	$-7.023\ 729\ 171 \times 10^3$
$c_2 =$	$-9.383\ 529\ 0 \times 10^1$	$-1.844\ 024\ 844 \times 10^1$	-8.342 197 663	$5.582\ 903\ 813 \times 10^2$
$c_3 =$	$1.306\ 861\ 9 \times 10^2$	4.031 129 726	$4.279\ 433\ 549 \times 10^{-1}$	$-1.952\ 394\ 635 \times 10^1$
$c_4 =$	$-2.270\ 358\ 0 \times 10^2$	$-6.249\ 428\ 360 \times 10^{-1}$	$-1.191\ 577\ 910 \times 10^{-2}$	$2.560\ 740\ 231 \times 10^{-1}$
$c_5 =$	$3.514\ 565\ 9 \times 10^2$	$6.468\ 412\ 046 \times 10^{-2}$	$1.492\ 290\ 091 \times 10^{-4}$	.....
$c_6 =$	$-3.895\ 390\ 0 \times 10^2$	$-4.458\ 750\ 426 \times 10^{-3}$	.....	.....
$c_7 =$	$2.823\ 947\ 1 \times 10^2$	$1.994\ 710\ 149 \times 10^{-4}$	.....	.....
$c_8 =$	$-1.260\ 728\ 1 \times 10^2$	$-5.313\ 401\ 790 \times 10^{-6}$	.....	.....
$c_9 =$	$3.135\ 361\ 1 \times 10^1$	$6.481\ 976\ 217 \times 10^{-8}$	.....	.....
$c_{10} =$	-3.318 776 9	.....	.....	.....

Type S thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	-50°C	250°C	1064°C	1664.5°C
Range:	to	to	to	to
	250°C	1200°C	1664.5°C	1768.1°C
emf	-0.235 mV	1.874 mV	10.332 mV	17.536 mV
Range:	to	to	to	to
	1.874 mV	11.950 mV	17.536 mV	18.693 mV
$c_0 =$	0.000 000 00	$1.291\ 507\ 177 \times 10^1$	$-8.087\ 801\ 117 \times 10^1$	$5.333\ 875\ 126 \times 10^4$
$c_1 =$	$1.849\ 494\ 60 \times 10^2$	$1.466\ 298\ 863 \times 10^2$	$1.621\ 573\ 104 \times 10^2$	$-1.235\ 892\ 298 \times 10^4$
$c_2 =$	$-8.005\ 040\ 62 \times 10^1$	$-1.534\ 713\ 402 \times 10^1$	-8.536 869 453	$1.092\ 657\ 613 \times 10^3$
$c_3 =$	$1.022\ 374\ 30 \times 10^2$	3.145 945 973	$4.719\ 686\ 976 \times 10^{-1}$	$-4.265\ 693\ 686 \times 10^1$
$c_4 =$	$-1.522\ 485\ 92 \times 10^2$	$-4.163\ 257\ 839 \times 10^{-1}$	$-1.441\ 693\ 666 \times 10^{-2}$	$6.247\ 205\ 420 \times 10^{-1}$
$c_5 =$	$1.888\ 213\ 43 \times 10^2$	$3.187\ 963\ 771 \times 10^{-2}$	$2.081\ 618\ 890 \times 10^{-4}$	.....
$c_6 =$	$-1.590\ 859\ 41 \times 10^2$	$-1.291\ 637\ 500 \times 10^{-3}$	.....	.....
$c_7 =$	$8.230\ 278\ 80 \times 10^1$	$2.183\ 475\ 087 \times 10^{-5}$	.....	.....
$c_8 =$	$-2.341\ 819\ 44 \times 10^1$	$-1.447\ 379\ 511 \times 10^{-7}$	.....	.....
$c_9 =$	2.797 862 60	$8.211\ 272\ 125 \times 10^{-9}$	.....	.....

Type T thermocouples: coefficients (c_i) of polynomials for the computation of temperatures in °C as a function of the thermocouple emf in various temperature and emf ranges

Temperature	-200°C	0°C
Range:	to	to
	0°C	400°C
emf	-5.603 mV	0.0 mV
Range:	to	to
	0.0 mV	20.872 mV
$c_0 =$	0.000 000 0	0.000 000
$c_1 =$	$2.594\ 919\ 2 \times 10^1$	$2.592\ 800 \times 10^1$
$c_2 =$	$-2.131\ 696\ 7 \times 10^{-1}$	$-7.602\ 961 \times 10^{-1}$
$c_3 =$	$7.901\ 869\ 2 \times 10^{-1}$	$4.637\ 791 \times 10^{-2}$
$c_4 =$	$4.252\ 777\ 7 \times 10^{-1}$	$-2.165\ 394 \times 10^{-3}$
$c_5 =$	$1.330\ 447\ 3 \times 10^{-1}$	$6.048\ 144 \times 10^{-5}$
$c_6 =$	$2.024\ 144\ 6 \times 10^{-2}$	$-7.293\ 422 \times 10^{-7}$
$c_7 =$	$1.266\ 817\ 1 \times 10^{-3}$	.....

PROPERTIES OF COMMON LABORATORY SOLVENTS

This table give properties of 200 organic solvents which are frequently used in laboratory and industrial applications. Compounds are listed in alphabetical order by the most common name; synonyms are given in some cases. The properties tabulated are:

MF:	Molecular formula
CAS RN:	Chemical Abstracts Service Registry Number
M_r :	Molecular weight
t_m :	Melting point in °C
t_b :	Normal boiling point in °C
ρ :	Density in g/cm ³ at the temperature in °C indicated by the superscript
c_p :	Specific heat capacity of the liquid at constant pressure at 25°C in J/g K
vp:	Vapor pressure at 25°C in kPa (1 kPa = 7.50 mmHg)
μ :	Electric dipole moment in debye units. Values in parentheses are measurements on the pure liquid or in solution; these are less reliable than the other values, which were obtained in the gas phase.
FP:	Flash point temperature in °C. The fact that no flash point is listed does not necessarily mean that the substance is nonflammable, because some liquids will burn if the quantity is large or impurities are present.
Fl. Lim.:	Flammable (explosive) range in air in percent by volume
Ign. Temp.:	Autoignition temperature in °C
TLV:	Threshold limit for allowable airborne concentration, given in parts per million by volume at 25°C and atmospheric pressure (see table "Threshold Limit Values for Airborne Contaminants" in Section 16)

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Name	MF	CAS RN	M_r	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$\rho/\text{g cm}^{-3}$	$c_p/\text{J g}^{-1}\text{K}^{-1}$	vp/kPa	μ/D	FP/ $^\circ\text{C}$	Fl. Lim.	Ign. Temp./ $^\circ\text{C}$	TLV
Acetal (1,1-Diethoxyethane)	C ₆ H ₁₄ O ₂	105-57-7	118.18	-100	102.2	0.8254 ²⁰	2.01	3.68	(1.4)	-21	2-10%	230	
Acetic acid	C ₂ H ₄ O ₂	64-19-7	60.05	17	118	1.0492 ²⁰	2.06	2.07	1.70	39	4-20%	463	10
Acetone	C ₃ H ₆ O	67-64-1	58.08	-95	56	0.7899 ²⁰	2.18	30.8	2.88	-20	3-13%	465	750
Acetonitrile	C ₂ H ₃ N	75-05-8	41.05	-44	82	0.7857 ²⁰	2.23	11.8	3.92	6	3-16%	524	40
Acetylacetone	C ₅ H ₈ O ₂	123-54-6	100.12	-23	138	0.9721 ²⁵	2.08	1.02	(2.8)	34		340	
Acrylonitrile	C ₃ H ₃ N	107-13-1	53.06	-83.5	77.3	0.8060 ²⁰	2.05	14.1	3.87	0	3-17%	481	2
Adiponitrile	C ₆ H ₈ N ₂	111-69-3	108.14	1	295	0.9676 ²⁰	1.19	<0.01		93	2-5%	550	2
Allyl alcohol	C ₃ H ₆ O	107-18-6	58.08	-129	97.0	0.8540 ²⁰	2.39	3.14	1.60	21	3-18%	378	2
Allylamine	C ₃ H ₇ N	107-11-9	57.10	-88.2	53.3	0.758 ²⁰		33.1	1.2	-29	2-22%	374	
2-Aminoisobutanol	C ₄ H ₁₁ NO	124-68-5	89.14	25.5	165.5	0.934 ²⁰				67			
Benzal chloride	C ₇ H ₆ Cl ₂	98-87-3	161.03	-17	205	1.26 ²⁵		0.06	(2.1)				
Benzaldehyde	C ₇ H ₆ O	100-52-7	106.12	-26	179.0	1.0415 ¹⁰	1.62	0.17	(3.0)	63		192	
Benzene	C ₆ H ₆	71-43-2	78.11	6	80	0.8765 ²⁰	1.74	12.7	0	-11	1-8%	498	10
Benzonitrile	C ₇ H ₅ N	100-47-0	103.12	-12.7	191.1	1.0093 ¹⁵	1.60	0.11	4.18				
Benzyl chloride	C ₇ H ₇ Cl	100-44-7	126.59	-45	179	1.1004 ²⁰	1.44	0.16	(1.8)	67	1%-	585	1
Bromochloromethane	CH ₂ BrCl	74-97-5	129.38	-87.9	68.0	1.9344 ²⁰	0.41	19.5	(1.7)				200
Bromoform (Tribromomethane)	CHBr ₃	75-25-2	252.73	8.0	149	2.899 ¹⁵	0.52	0.73	0.99	83			0.5

PROPERTIES OF COMMON LABORATORY SOLVENTS (continued)

Name	MF	CAS RN	M_r	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$\rho/\text{g cm}^{-3}$	$c_p/\text{J g}^{-1}\text{K}^{-1}$	vp/kPa	μ/D	FP/ $^\circ\text{C}$	Fl. Lim.	Ign. Temp./ $^\circ\text{C}$	TLV
Butyl acetate	C ₆ H ₁₂ O ₂	123-86-4	116.16	-78	126	0.8825 ²⁰	1.96	1.66	(1.9)	22	2-8%	425	150
Butyl alcohol	C ₄ H ₁₀ O	71-36-3	74.12	-90	118	0.8098 ²⁰	2.39	0.86	1.66	37	1-11%	343	50
<i>sec</i> -Butyl alcohol	C ₄ H ₁₀ O	78-92-2	74.12	-114.7	99.5	0.8063 ²⁰	2.66	2.32	(1.8)	24	2-10%	405	100
<i>tert</i> -Butyl alcohol	C ₄ H ₁₀ O	75-65-0	74.12	26	82	0.7887 ²⁰	2.97	5.52	(1.7)	11	2-8%	478	100
Butylamine	C ₄ H ₁₁ N	109-73-9	73.14	-49	77	0.7414 ²⁰	2.45	12.2	1.0	-12	2-10%	312	5
<i>tert</i> -Butylamine	C ₄ H ₁₁ N	75-64-9	73.14	-67	44	0.6958 ²⁰	2.63	48.4	(1.3)	-9	2-9%	380	
Butyl methyl ketone	C ₆ H ₁₂ O	591-78-6	100.16	-56	128	0.8113 ²⁰	2.13	1.54	(2.7)	25	1-8%	423	5
<i>p</i> - <i>tert</i> -Butyltoluene	C ₁₁ H ₁₆	98-51-1	148.25	-52	190	0.8612 ²⁰		0.09	=0	68			10
γ -Butyrolactone	C ₄ H ₆ O ₂	96-48-0	86.09	-43.3	204	1.1284 ¹⁶	1.64	0.43	4.27	98			
Caprolactam	C ₆ H ₁₁ NO	105-60-2	113.16	69	270		1.38	<0.01	(3.9)	125			5
Carbon disulfide	CS ₂	75-15-0	76.14	-112	46	1.2632 ²⁰	1.00	48.2	0	-30	1-50%	90	10
Carbon tetrachloride	CCl ₄	56-23-5	153.82	-23	77	1.5940 ²⁰	0.85	15.2	0				5
1-Chloro-1,1-difluoroethane	C ₂ H ₃ ClF ₂	75-68-3	100.50	-131	-10	1.107 ²⁵	1.30	351	2.14				
Chlorobenzene	C ₆ H ₅ Cl	108-90-7	112.56	-45	132	1.1058 ²⁰	1.33	1.6	1.69	28	1-10%	593	10
Chloroform	CHCl ₃	67-66-3	119.38	-64	61	1.4832 ²⁰	0.96	26.2	1.04				10
Chloropentafluoroethane	C ₂ ClF ₅	76-15-3	154.47	-99	-38	1.5678 ⁻⁴²	1.19	912	0.52				1000
Cumene (Isopropylbenzene)	C ₉ H ₁₂	98-82-8	120.19	-96.0	152	0.8618 ²⁰	1.75	0.61	0.79	36	1-7%	424	50
Cyclohexane	C ₆ H ₁₂	110-82-7	84.16	7	81	0.7785 ²⁰	1.84	13.0	=0	-20	1-8%	245	300
Cyclohexanol	C ₆ H ₁₂ O	108-93-0	100.16	25	161	0.9624 ²⁰	2.08	0.10		68	1-9%	300	50
Cyclohexanone	C ₆ H ₁₀ O	108-94-1	98.14	-31	155	0.9478 ²⁰	1.86	0.53	2.87	44	1-9%	420	25
Cyclohexylamine	C ₆ H ₁₃ N	108-91-8	99.18	-18	134	0.8191 ²⁰		1.20	(1.3)	31	1-9%	293	10
Cyclopentane	C ₅ H ₁₀	287-92-3	70.13	-93.8	49.3	0.7457 ²⁰	1.84	42.3	=0	<-7	2%-	361	600
Cyclopentanone	C ₅ H ₈ O	120-92-3	84.12	-51.3	130.5	0.9487 ²⁰	1.84	1.55	3.3	26			
<i>p</i> -Cymene	C ₁₀ H ₁₄	99-87-6	134.22	-69	177	0.8573 ²⁰	1.76	0.19	=0	47	1-6%	436	
<i>cis</i> -Decalin	C ₁₀ H ₁₈	493-01-6	138.25	-42.9	195.8	0.8965 ²⁰	1.68	0.10	=0				
<i>trans</i> -Decalin	C ₁₀ H ₁₈	493-02-7	138.25	-30.3	187.3	0.8699 ²⁰	1.65	0.16	=0	54	1-5%	255	
Diacetone alcohol	C ₆ H ₁₂ O ₂	123-42-2	116.16	-44	168	0.9387 ²⁰	1.91	0.22	(3.2)	58	2-7%	643	50
1,2-Dibromoethane	C ₂ H ₄ Br ₂	106-93-4	187.86	9.9	131.6	2.1791 ²⁰	0.72	1.55	(1.2)				
Dibromofluoromethane	CHBrF ₂	1868-53-7	191.83	-78	64.9	2.421 ²⁰							
Dibromomethane	CH ₂ Br ₂	74-95-3	173.83	-52.5	97	2.4969 ²⁰	0.61	6.12	1.43				
1,2-Dibromotetrafluoroethane	C ₂ Br ₂ F ₄	124-73-2	259.82	-110.4	47.3	2.149 ²⁵	0.69	43.4					
Dibutylamine	C ₈ H ₁₉ N	111-92-2	129.25	-62	160	0.7670 ²⁰	2.27	0.34	(1.0)	47	1-6%		
<i>o</i> -Dichlorobenzene	C ₆ H ₄ Cl ₂	95-50-1	147.00	-17	180	1.3059 ²⁰	1.10	0.18	2.50	66	2-9%	648	25
1,1-Dichloroethane	C ₂ H ₄ Cl ₂	75-34-3	98.96	-97	57	1.1757 ²⁰	1.28	30.5	2.06	-17	5-11%	458	100
1,2-Dichloroethane	C ₂ H ₄ Cl ₂	107-06-2	98.96	-36	84	1.2351 ²⁰	1.30	10.6	(1.8)	13	6-16%	413	10
1,1-Dichloroethylene	C ₂ H ₂ Cl ₂	75-35-4	96.94	-122.5	31.6	1.213 ²⁰	1.15	80.0	1.34	-15	7-16%	570	5
<i>cis</i> -1,2-Dichloroethylene	C ₂ H ₂ Cl ₂	156-59-2	96.94	-80	60	1.2837 ²⁰	1.20	26.8	1.90	6	3-15%	460	200
<i>trans</i> -1,2-Dichloroethylene	C ₂ H ₂ Cl ₂	156-60-5	96.94	-50	49	1.2565 ²⁰	1.20	44.2	0	2	6-13%	460	200
Dichloroethyl ether	C ₄ H ₈ Cl ₂ O	111-44-4	143.01	-52	179	1.22 ²⁰	1.54	0.14	(2.6)	55	3%-	369	5
Dichloromethane	CH ₂ Cl ₂	75-09-2	84.93	-95	40	1.3266 ²⁰	1.19	58.2	1.60		13-23%	556	50
1,2-Dichloropropane	C ₃ H ₆ Cl ₂	78-87-5	112.99	-100	96	1.1560 ²⁰	1.32	6.62	(1.8)	16	3-15%	557	75
1,2-Dichlorotetrafluoroethane	C ₂ Cl ₂ F ₄	76-14-2	170.92	-94	4	1.518 ⁴	0.96	215	0.5				1000
Diethanolamine	C ₄ H ₁₁ NO ₂	111-42-2	105.14	28	269	1.0966 ²⁰	2.22	<0.01	(2.8)	172	2-13%	662	0.46
Diethylamine	C ₄ H ₁₁ N	109-89-7	73.14	-50	55	0.7056 ²⁰	2.31	30.1	0.92	-23	2-10%	312	5
Diethyl carbonate	C ₅ H ₁₀ O ₃	105-58-8	118.13	-43	126	0.9752 ²⁰	1.80	1.63	1.10	25			
Diethylene glycol	C ₄ H ₁₀ O ₃	111-46-6	106.12	-10	246	1.1197 ¹⁵	2.31	<0.01	(2.3)	124	2-17%	224	
Diethylene glycol dimethyl ether	C ₆ H ₁₄ O ₃	111-96-6	134.18	-68	162	0.9434 ²⁰	2.04	0.31	(2.0)	67			
Diethylene glycol monoethyl ether	C ₆ H ₁₄ O ₃	111-90-0	134.18		196	0.9885 ²⁰	2.24	0.02	(1.6)	96			

PROPERTIES OF COMMON LABORATORY SOLVENTS (continued)

Name	MF	CAS RN	M_r	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$\rho/\text{g cm}^{-3}$	$c_p/\text{J g}^{-1}\text{K}^{-1}$	vp/kPa	μ/D	FP/ $^\circ\text{C}$	Fl. Lim.	Ign. Temp./ $^\circ\text{C}$	TLV
Diethylene glycol monoethyl ether acetate	C ₈ H ₁₆ O ₄	112-15-2	176.21	-25	218.5	1.0096 ²⁰		0.03	(1.8)	110		425	
Diethylene glycol monomethyl ether	C ₅ H ₁₂ O ₃	111-77-3	120.15		193	1.035 ²⁰	2.26	0.02	(1.6)	96	1-23%	240	
Diethylenetriamine	C ₄ H ₁₃ N ₃	111-40-0	103.17	-39	207	0.9569 ²⁰	2.46	0.03	(1.9)	98	2-7%	358	1
Diethyl ether	C ₄ H ₁₀ O	60-29-7	74.12	-116	34	0.7138 ²⁰	2.33	71.7	1.15	-45	2-36%	180	400
Diisobutyl ketone	C ₉ H ₁₈ O	108-83-8	142.24	-42	169	0.8062 ²⁰	2.09	0.23	(2.7)	49	1-7%	396	25
Diisopropyl ether	C ₆ H ₁₄ O	108-20-3	102.18	-87	69	0.7241 ²⁰	2.12	19.9	1.13	-28	1-8%	443	250
<i>N,N</i> -Dimethylacetamide	C ₄ H ₉ NO	127-19-5	87.12	-20	165	0.9366 ²⁵	2.02	0.07	(3.7)	70	2-12%	490	10
Dimethylamine	C ₂ H ₇ N	124-40-3	45.08	-92	7	0.6804 ⁰	3.05	203	1.01	20	3-14%	400	5
Dimethyl disulfide	C ₂ H ₆ S ₂	624-92-0	94.20	-85	109.8	1.0625 ²⁰	1.55	3.82	(1.8)	24			
<i>N,N</i> -Dimethylformamide	C ₃ H ₇ NO	68-12-2	73.09	-60	153	0.944 ²⁵	2.06	0.44	3.82	58	2-15%	445	10
Dimethyl sulfoxide	C ₂ H ₆ OS	67-68-5	78.14	19	189	1.1014 ²⁰	1.96	0.08	3.96	95	3-42%	215	
1,4-Dioxane	C ₄ H ₈ O ₂	123-91-1	88.11	12	101	1.0337 ²⁰	1.74	4.95	0	12	2-22%	180	25
1,3-Dioxolane	C ₃ H ₆ O ₂	646-06-0	74.08	-95	78	1.060 ²⁰	1.59	14.6	1.19	2			
Dipentene	C ₁₀ H ₁₆	7705-14-8	136.24	-95.5	178	0.8402 ²¹	1.83	0.26		45		237	
Epichlorohydrin	C ₃ H ₅ ClO	106-89-8	92.52	-26	116	1.1812 ²⁰	1.42	2.2	(1.8)	31	4-21%	411	2
Ethanolamine (Glycinol)	C ₂ H ₇ NO	141-43-5	61.08	11	171	1.0180 ²⁰	3.20	0.05	(2.3)	86	3-24%	410	3
Ethyl acetate	C ₄ H ₈ O ₂	141-78-6	88.11	-84	77	0.9003 ²⁰	1.94	12.6	1.78	-4	2-12%	426	400
Ethyl acetoacetate	C ₆ H ₁₀ O ₃	141-97-9	130.14	-45	180.8	1.0368 ¹⁰	1.91	0.09		57	1-10%	295	
Ethyl alcohol	C ₂ H ₆ O	64-17-5	46.07	-114	78	0.7893 ²⁰	2.44	7.87	1.69	13	3-19%	363	1000
Ethylamine	C ₂ H ₇ N	75-04-7	45.08	-81	17	0.686 ¹⁷	2.88	142	1.22	<-18	4-14%	385	5
Ethylbenzene	C ₈ H ₁₀	100-41-4	106.17	-95	136	0.8670 ²⁰	1.73	1.28	0.59	21	1-7%	432	100
Ethyl bromide	C ₂ H ₅ Br	74-96-4	108.97	-118.6	38.5	1.4604 ²⁰	0.93	62.5	2.03		7-8%	511	5
Ethyl chloride	C ₂ H ₅ Cl	75-00-3	64.51	-139	12	0.909 ¹²	1.62	160	2.05	-50	4-15%	519	1000
Ethylene carbonate	C ₃ H ₄ O ₃	96-49-1	88.06	36.4	248	1.3214 ³⁹	1.52	<0.01	(4.9)	143			
Ethylenediamine	C ₂ H ₈ N ₂	107-15-3	60.10	11	117	0.8979 ²⁰	2.87	1.62	1.99	40	3-12%	385	10
Ethylene glycol	C ₂ H ₆ O ₂	107-21-1	62.07	-13	197	1.1088 ²⁰	2.41	0.01	2.28	111	3-22%	398	50
Ethylene glycol diethyl ether	C ₆ H ₁₄ O ₂	629-14-1	118.18	-74	119.4	0.8484 ²⁰	2.19	4.33		35			
Ethylene glycol dimethyl ether	C ₄ H ₁₀ O ₂	110-71-4	90.12	-58	85	0.8691 ²⁰	2.14	9.93		-2		202	
Ethylene glycol monobutyl ether	C ₆ H ₁₄ O ₂	111-76-2	118.18	-75	168	0.9015 ²⁰	2.38	0.15	(2.1)	69	4-13%	238	25
Ethylene glycol monoethyl ether	C ₄ H ₁₀ O ₂	110-80-5	90.12	-70	135	0.9297 ²⁰	2.34	0.71	(2.1)	43	3-18%	235	5
Ethylene glycol ethyl ether acetate	C ₆ H ₁₂ O ₃	111-15-9	132.16	-62	156	0.9740 ²⁰	2.85	0.24	(2.2)	56	2-8%	379	5
Ethylene glycol monomethyl ether	C ₃ H ₈ O ₂	109-86-4	76.10	-85	124	0.9647 ²⁰	2.25	1.31	2.36	39	2-14%	285	5
Ethylene glycol monomethyl ether acetate	C ₅ H ₁₀ O ₃	110-49-6	118.13	-70	143	1.0074 ¹⁹	2.62	0.67	(2.1)	49	2-12%	392	5
Ethyl formate	C ₃ H ₆ O ₂	109-94-4	74.08	-80	54	0.9168 ²⁰	2.02	32.3	1.9	-20	3-16%	455	100
Furan	C ₄ H ₄ O	110-00-9	68.08	-86	31	0.9514 ²⁰	1.69	80.0	0.66	<0	2-14%		
Furfural	C ₅ H ₄ O ₂	98-01-1	96.09	-37	162	1.1594 ²⁰	1.70	0.29	(3.5)	60	2-19%	316	2
Furfuryl alcohol	C ₅ H ₆ O ₂	98-00-0	98.10	-31	171	1.1296 ²⁰	2.08	0.10	(1.9)	75	2-16%	491	10
Glycerol	C ₃ H ₈ O ₃	56-81-5	92.09	18	290	1.2613 ²⁰	2.38	<0.01	(2.6)	199	3-19%	370	
Heptane	C ₇ H ₁₆	142-82-5	100.20	-91	98	0.6837 ²⁰	2.24	6.09	=0	-4	1-7%	204	400
1-Heptanol	C ₇ H ₁₆ O	111-70-6	116.20	-34	176.4	0.8219 ²⁰	2.34						
Hexane	C ₆ H ₁₄	110-54-3	86.18	-95	69	0.6548 ²⁵	2.27	20.2	=0	-22	1-8%	225	50
1-Hexanol (Caproyl alcohol)	C ₆ H ₁₄ O	111-27-3	102.18	-44.6	157.6	0.8136 ²⁰	2.35	0.11		63			
Hexylene glycol	C ₆ H ₁₄ O ₂	107-41-5	118.18	-50	197	0.923 ¹⁵	2.84	<0.01	(2.9)	102	1-9%	306	25
Hexyl methyl ketone	C ₈ H ₁₆ O	111-13-7	128.21	-16	172.5	0.820 ²⁰	2.13		(2.7)	52			
Isobutyl acetate	C ₆ H ₁₂ O ₂	110-19-0	116.16	-99	117	0.8712 ²⁰	2.01	2.39	(1.9)	18	1-11%	421	150
Isobutyl alcohol	C ₄ H ₁₀ O	78-83-1	74.12	-108	108	0.8018 ²⁰	2.44	1.39	1.64	28	2-11%	415	50

PROPERTIES OF COMMON LABORATORY SOLVENTS (continued)

Name	MF	CAS RN	M_r	t_m /°C	t_b /°C	ρ /g cm ⁻³	c_p /J g ⁻¹ K ⁻¹	vp/kPa	μ /D	FP/°C	Fl. Lim.	Ign. Temp./°C	TLV
Isobutylamine	C ₄ H ₁₁ N	78-81-9	73.14	-87	68	0.724 ²⁵	2.50	19.0	(1.3)	-9	2-12%	378	
Isopentyl acetate	C ₇ H ₁₄ O ₂	123-92-2	130.19	-79	143	0.876 ¹⁵	1.91	0.73	(1.9)	25	1-8%	360	100
Isophorone	C ₉ H ₁₆ O	78-59-1	138.21	-8	215	0.9255 ²⁰	1.83	0.06		84	1-4%	460	5
Isopropyl acetate	C ₅ H ₁₀ O ₂	108-21-4	102.13	-73	89	0.8718 ²⁰	1.95	8.1		2	2-8%	460	250
Isopropyl alcohol	C ₃ H ₈ O	67-63-0	60.10	-90	82	0.7855 ²⁰	2.58	6.02	1.56	12	2-13%	399	400
Isoquinoline	C ₉ H ₇ N	119-65-3	129.16	26.47	243.2	1.0910 ³⁰	1.52		2.73				
<i>d</i> -Limonene (Citrene)	C ₁₀ H ₁₆	5989-27-5	136.24	-97	178	0.8411 ²⁰	1.83	0.28		49			
2,6-Lutidine	C ₇ H ₉ N	108-48-5	107.16	-6.1	144.1	0.9226 ²⁰	1.73	0.75	(1.7)				
Mesitylene	C ₉ H ₁₂	108-67-8	120.19	-45	165	0.8652 ²⁰	1.74	0.33	0	50	1-5%	559	25
Mesityl oxide	C ₆ H ₁₀ O	141-79-7	98.14	-59	130	0.8653 ²⁰	2.17	1.47	(2.8)	31	1-7%	344	15
Methyl acetate	C ₃ H ₆ O ₂	79-20-9	74.08	-98	57	0.9342 ²⁰	1.92	28.8	1.72	-10	3-16%	454	200
Methylal	C ₃ H ₈ O ₂	109-87-5	76.10	-105	42	0.8593 ²⁰	2.12	53.1	(0.7)	-32	2-14%	237	1000
Methyl alcohol	CH ₄ O	67-56-1	32.04	-98	65	0.7914 ²⁰	2.53	16.9	1.70	11	6-36%	464	200
Methylamine	CH ₃ N	74-89-5	31.06	-93	-6	0.656 ²⁵	3.29	353	1.31	0	5-21%	430	5
Methyl benzoate	C ₈ H ₈ O ₂	93-58-3	136.15	-15	199	1.0933 ¹⁵	1.63	0.05	(1.9)	83			
Methylcyclohexane	C ₇ H ₁₄	108-87-2	98.19	-127	101	0.7694 ²⁰	1.88	6.18	=0	-4	1-7%	250	400
Methyl ethyl ketone	C ₄ H ₈ O	78-93-3	72.11	-87	80	0.8054 ²⁰	2.20	12.6	2.78	-9	1-11%	404	200
<i>N</i> -Methylformamide	C ₂ H ₅ NO	123-39-7	59.07	-3.8	199.5	1.011 ¹⁹	2.10		3.83				
Methyl formate	C ₂ H ₄ O ₂	107-31-3	60.05	-99	32	0.9742 ²⁰	1.98	78.1	1.77	-19	5-23%	449	100
Methyl iodide	CH ₃ I	74-88-4	141.94	-66.4	42.5	2.279 ²⁰	0.89	53.9	1.62				2
Methyl isobutyl ketone	C ₆ H ₁₂ O	108-10-1	100.16	-84	116	0.7978 ²⁰	2.13	2.64		18	1-8%	448	50
Methyl isopentyl ketone	C ₇ H ₁₄ O	110-12-3	114.19		144	0.888 ²⁰	2.07	0.69		36	1-8%	191	50
2-Methylpentane	C ₆ H ₁₄	107-83-5	86.18	-153.7	60.2	0.650 ²⁵	2.25	28.2	=0	<-29	1-7%	264	
4-Methyl-2-pentanol	C ₆ H ₁₄ O	108-11-2	102.18	-90	132	0.8075 ²⁰	2.67	0.70		41	1-6%		25
Methyl pentyl ketone	C ₇ H ₁₄ O	110-43-0	114.19	-35	151	0.8111 ²⁰	2.04	0.49	(2.6)	39	1-8%	393	50
Methyl propyl ketone	C ₅ H ₁₀ O	107-87-9	86.13	-77	102	0.809 ²⁰	2.14	4.97	(2.7)	7	2-8%	452	200
<i>N</i> -Methyl-2-pyrrolidone	C ₅ H ₉ NO	872-50-4	99.13	-24	202	1.0230 ²⁵	3.11	0.04	(4.1)	96	1-10%	346	
Morpholine	C ₄ H ₉ NO	110-91-8	87.12	-5	128	1.0005 ²⁰	1.89	1.34	1.55	37	1-11%	290	20
Nitrobenzene	C ₆ H ₅ NO ₂	98-95-3	123.11	6	211	1.2037 ²⁰	1.51	0.03	4.22	88	2-9%	482	1
Nitroethane	C ₂ H ₅ NO ₂	79-24-3	75.07	-90	114	1.0448 ²⁵	1.79	2.79	3.23	28	3-17%	414	100
Nitromethane	CH ₃ NO ₂	75-52-5	61.04	-29	101	1.1371 ²⁰	1.75	4.79	3.46	35	7-22%	418	20
1-Nitropropane	C ₃ H ₇ NO ₂	108-03-2	89.09	-108	131.1	0.9961 ²⁵	1.97	1.36	3.66	36	2%-	421	25
2-Nitropropane	C ₃ H ₇ NO ₂	79-46-9	89.09	-91	120	0.9821 ²⁵	1.91	2.3	3.73	24	3-11%	428	10
Octane	C ₈ H ₁₈	111-65-9	114.23	-57	126	0.6986 ²⁵	2.23	1.86	=0	13	1-7%	206	300
1-Octanol	C ₈ H ₁₈ O	111-87-5	130.23	-15.5	195.1	0.8262 ²⁵	2.34	0.01	(1.8)	81			
Pentachloroethane	C ₂ HCl ₅	76-01-7	202.29	-29	160	1.6796 ²⁰	0.86	0.48	0.92				
Pentamethylene glycol	C ₅ H ₁₂ O ₂	111-29-5	104.15	-18	239	0.9914 ²⁰	3.08		(2.5)	129		335	
Pentane	C ₅ H ₁₂	109-66-0	72.15	-130	36	0.6262 ²⁰	2.32	68.3	=0	<-40	2-8%	260	600
1-Pentanol	C ₅ H ₁₂ O	71-41-0	88.15	-79	138	0.8144 ²⁰	2.36	0.26	(1.7)	33	1-10%	300	
Pentyl acetate	C ₇ H ₁₄ O ₂	628-63-7	130.19	-71	149	0.8756 ²⁰	2.00	0.60	1.75	16	1-8%	360	100
2-Picoline	C ₆ H ₇ N	109-06-8	93.13	-67	129	0.9443 ²⁰	1.70	1.5	1.85	39		538	
α -Pinene	C ₁₀ H ₁₆	80-56-8	136.24	-64	156	0.8539 ²⁵		0.64		35		275	
β -Pinene	C ₁₀ H ₁₆	127-91-3	136.24	-61.5	166	0.860 ²⁵		0.61		38		275	
Piperidine	C ₅ H ₁₁ N	110-89-4	85.15	-11	106	0.8606 ²⁰	2.11	4.28	(1.2)	16	1-10%		
Propanenitrile	C ₃ H ₅ N	107-12-0	55.08	-93	97	0.7818 ²⁰	2.17	6.14	4.05	2	3-14%	512	
Propyl acetate	C ₅ H ₁₀ O ₂	109-60-4	102.13	-93	102	0.8878 ²⁰	1.92	4.49	(1.8)	13	2-8%	450	200
Propyl alcohol	C ₃ H ₈ O	71-23-8	60.10	-126	97	0.8035 ²⁰	2.39	2.76	1.55	23	2-14%	412	200
Propylamine	C ₃ H ₉ N	107-10-8	59.11	-83	47	0.7173 ²⁰	2.75	42.1	1.17	-37	2-10%	318	
Propylbenzene	C ₉ H ₁₂	103-65-1	120.19	-99.5	159.2	0.8620 ²⁰	1.79		=0	30	1-6%	450	

PROPERTIES OF COMMON LABORATORY SOLVENTS (continued)

Name	MF	CAS RN	M_r	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$	$\rho/\text{g cm}^{-3}$	$c_p/\text{J g}^{-1}\text{K}^{-1}$	vp/kPa	μ/D	FP/ $^\circ\text{C}$	Fl. Lim.	Ign. Temp./ $^\circ\text{C}$	TLV
Propylene glycol	C ₃ H ₈ O ₂	57-55-6	76.10	-60	188	1.0361 ²⁰	2.51	0.02	(2.2)	99	3-13%	371	
Pseudocumene	C ₉ H ₁₂	95-63-6	120.19	-44	169	0.8758 ²⁰	1.79	0.30	=0	44	1-6%	500	25
Pyridine	C ₅ H ₅ N	110-86-1	79.10	-42	115	0.9819 ²⁰	1.68	2.76	2.21	20	2-12%	482	5
Pyrrole	C ₄ H ₅ N	109-97-7	67.09	-23.4	129.7	0.9698 ²⁰	1.90	1.10	1.74	39			
Pyrrolidine	C ₄ H ₉ N	123-75-1	71.12	-57.8	86.5	0.8586 ²⁰	2.20	8.40	(1.6)	3			
2-Pyrrolidone	C ₄ H ₇ NO	616-45-5	85.11	25	251	1.120 ²⁰	1.99		(3.5)	129			
Quinoline	C ₉ H ₇ N	91-22-5	129.16	-14.78	237.1	1.0977 ¹⁵	1.51		2.29			480	
Styrene	C ₈ H ₈	100-42-5	104.15	-31	145	0.9060 ²⁰	1.75	0.81		31	1-7%	490	50
Sulfolane	C ₄ H ₈ O ₂ S	126-33-0	120.17	28	287	1.2723 ¹⁸	1.50	<0.01	(4.8)	177			
α -Terpinene	C ₁₀ H ₁₆	99-86-5	136.24		174	0.8375 ¹⁹							
1,1,1,2-Tetrachloro-2,2-difluoroethane	C ₂ Cl ₄ F ₂	76-11-9	203.83	40.6	91.5	1.649 ²⁵		7.36					500
1,1,2,2-Tetrachloro-1,2-difluoroethane	C ₂ Cl ₄ F ₂	76-12-0	203.83	26	93	1.6447 ²⁵	0.85	7.51					500
1,1,1,2-Tetrachloroethane	C ₂ H ₂ Cl ₄	630-20-6	167.85	-70	131	1.5406 ²⁰	0.92	1.6			5-12%		
1,1,2,2-Tetrachloroethane	C ₂ H ₂ Cl ₄	79-34-5	167.85	-44	146	1.5953 ²⁰	0.97	0.62	1.32		20-54%		1
Tetrachloroethylene	C ₂ Cl ₄	127-18-4	165.83	-22	121	1.6227 ²⁰	0.86	2.42	0				50
Tetraethylene glycol	C ₈ H ₁₈ O ₅	112-60-7	194.23	-6.2	328	1.1285 ¹⁵	2.21			182			
Tetrahydrofuran	C ₄ H ₈ O	109-99-9	72.11	-108	65	0.8892 ²⁰	1.72	21.6	1.75	-14	2-12%	321	200
1,2,3,4-Tetrahydronaphthalene	C ₁₀ H ₁₂	119-64-2	132.21	-36	208	0.9660 ²⁵	1.65	0.05	=0	71	1-5%	385	
Tetrahydropyran	C ₅ H ₁₀ O	142-68-7	86.13	-45	88	0.8814 ²⁰	1.82	9.54	1.74	-20			
Tetramethylsilane	C ₄ H ₁₂ Si	75-76-3	88.22	-99.0	26.6	0.648 ¹⁹	2.31	94.2	0				
Toluene	C ₇ H ₈	108-88-3	92.14	-95	111	0.8669 ²⁰	1.70	3.79	0.37	4	1-7%	480	50
<i>o</i> -Toluidine	C ₇ H ₉ N	95-53-4	107.16	-16.3	200.3	0.9984 ²⁰	1.96	0.04	(1.6)	85		482	2
Triacetin	C ₉ H ₁₄ O ₆	102-76-1	218.21	-78	259	1.1583 ²⁰	1.76	<0.01		138	1%-	433	
Tributylamine	C ₁₂ H ₂₇ N	102-82-9	185.35	-70	217	0.7770 ²⁰		0.01	(0.8)	86	1-5%		
1,1,1-Trichloroethane	C ₂ H ₃ Cl ₃	71-55-6	133.40	-30	74	1.3390 ²⁰	1.08	16.5	1.76		8-13%	537	350
1,1,2-Trichloroethane	C ₂ H ₃ Cl ₃	79-00-5	133.40	-37	114	1.4397 ²⁰	1.13	3.1	(1.4)	32	6-28%	460	10
Trichloroethylene	C ₂ HCl ₃	79-01-6	131.39	-85	87	1.4642 ²⁰	0.95	9.91	(0.8)	32	8-11%	420	50
Trichlorofluoromethane	CCl ₃ F	75-69-4	137.37	-111	24	1.478 ²⁴	0.89	106	0.46				1000
1,1,2-Trichlorotrifluoroethane	C ₂ Cl ₃ F ₃	76-13-1	187.38	-35	48	1.5635 ²⁵	0.91	44.8					1000
Triethanolamine	C ₆ H ₁₅ NO ₃	102-71-6	149.19	21	335	1.1242 ²⁰	2.61	<0.01	(3.6)	179	1-10%		0.5
Triethylamine	C ₁₀ H ₂₂ O ₂	121-44-8	101.19	-115	89	0.7275 ²⁰	2.17	7.70	0.66	-7	1-8%	249	1
Triethylene glycol	C ₆ H ₁₄ O ₄	112-27-6	150.17	-7	285	1.1274 ¹⁵	2.18			177	1-9%	371	
Triethyl phosphate	C ₆ H ₁₅ O ₄ P	78-40-0	182.16	-56.4	215.5	1.0695 ²⁰			(3.1)	115		454	
Trimethylamine	C ₃ H ₉ N	75-50-3	59.11	-117	3	0.627 ²⁵	2.33	215	0.61	-7	2-12%	190	5
Trimethylene glycol	C ₃ H ₈ O ₂	504-63-2	76.10	-26.7	214.4	1.0538 ²⁰			(2.5)			400	
Trimethyl phosphate	C ₃ H ₉ O ₄ P	512-56-1	140.08	-46	197.2	1.2144 ²⁰		0.11	(3.2)	107			
Veratrole	C ₈ H ₁₀ O ₂	91-16-7	138.17	22.5	206	1.0810 ²⁵			(1.3)				
<i>o</i> -Xylene	C ₈ H ₁₀	95-47-6	106.17	-25	144	0.8802 ¹⁰	1.75	0.88	0.64	32	1-7%	463	100
<i>m</i> -Xylene	C ₈ H ₁₀	108-38-3	106.17	-48	139	0.8642 ²⁰	1.72	1.13	=0	27	1-7%	527	100
<i>p</i> -Xylene	C ₈ H ₁₀	106-42-3	106.17	13	138	0.8611 ²⁰	1.71	1.19	0	27	1-7%	528	100

DEPENDENCE OF BOILING POINT ON PRESSURE

The normal boiling point of a liquid is defined as the temperature at which the vapor pressure reaches standard atmospheric pressure, 101.325 kPa. The change in boiling point with pressure may be calculated from the representation of the vapor pressure by the Antoine Equation,

$$\ln p = A_1 - A_2/(T + A_3)$$

where p is the vapor pressure, T the absolute temperature, and A_1 , A_2 , and A_3 are constants. This table, which has been calculated using the Antoine constants in Reference 1, gives values of $\Delta t/\Delta p$ for a number of liquids, in units of both °C/kPa and °C/mmHg. The correction to the boiling point is generally accurate to 0.1 to 0.2 °C as long as the pressure is within 10% of standard atmospheric pressure.

A slightly less accurate estimate of $\Delta t/\Delta p$ may be obtained from the Clausius-Clapeyron equation, with the assumption that the change in volume upon vaporization equals the ideal-gas volume of the vapor. This leads to the equation

$$\Delta t/\Delta p = RT_b^2/p_0 \Delta_{\text{vap}}H(T_b)$$

where R is the molar gas constant, p_0 is 101.325 kPa, T_b is the normal boiling point temperature (absolute), and $\Delta_{\text{vap}}H(T_b)$ is the molar enthalpy of vaporization at the normal boiling point. Values of the last quantity may be obtained from the table "Enthalpy of Vaporization" in Section 6.

REFERENCE

1. Lide, D.R., and Kehiaian, H.V., *CRC Handbook of Thermophysical and Thermochemical Data*, CRC Press, Boca Raton, FL, 1994, pp. 49-59.

Compound	t_b °C	$\Delta t/\Delta p$		Compound	t_b °C	$\Delta t/\Delta p$	
		°C/kPa	°C/mmHg			°C/kPa	°C/mmHg
Acetaldehyde	20.1	0.261	0.0348	1-Hexanol	157.6	0.318	0.0424
Acetic acid	117.9	0.324	0.0432	Hydrogen fluoride	20.1	0.276	0.0368
Acetone	56.0	0.289	0.0385	Iodomethane	42.5	0.291	0.0388
Acetonitrile	81.6	0.316	0.0421	Isobutane	-11.7	0.254	0.0339
Ammonia	-33.33	0.198	0.0264	Methanol	64.6	0.251	0.0335
Aniline	184.1	0.378	0.0504	Methyl acetate	56.8	0.282	0.0376
Anisole	153.7	0.367	0.0489	Methyl formate	31.7	0.582	0.0776
Benzaldehyde	179.0	0.392	0.0523	<i>N</i> -Methylaniline	196.2	0.396	0.0528
Benzene	80.0	0.321	0.0428	<i>N</i> -Methylformamide	199.5	0.371	0.0495
Bromine	58.8	0.300	0.0400	Nitrobenzene	210.8	0.418	0.0557
Butane	-0.5	0.267	0.0356	Nitromethane	101.1	0.320	0.0427
1-Butanol	117.7	0.278	0.0371	1-Octanol	195.1	0.360	0.0480
Carbon disulfide	46.2	0.304	0.0405	Pentane	36.0	0.289	0.0385
Chlorine	-34.04	0.224	0.0299	1-Pentanol	137.9	0.296	0.0395
Chlorobenzene	131.7	0.365	0.0487	Phenol	181.8	0.349	0.0465
1-Chlorobutane	78.6	0.321	0.0428	Propane	-42.1	0.224	0.0299
Chloroethane	12.3	0.262	0.0349	1-Propanol	97.2	0.261	0.0348
Chloroethylene	-13.3	0.241	0.0321	2-Propanol	82.3	0.247	0.0329
Cyclohexane	80.7	0.328	0.0437	Pyridine	115.2	0.340	0.0453
Cyclohexanol	160.8	0.344	0.0459	Pyrrole	129.7	0.330	0.0440
Cyclohexanone	155.4	0.382	0.0509	Pyrrolidine	86.5	0.309	0.0412
Decane	174.1	0.388	0.0517	Styrene	145.1	0.369	0.0492
Dibutyl ether	140.2	0.363	0.0484	Sulfur dioxide	-10.05	0.221	0.0295
Dichloromethane	39.6	0.276	0.0368	Tetrachloroethylene	121.3	0.354	0.0472
Diethyl ether	34.5	0.278	0.0371	Tetrachloromethane	76.8	0.325	0.0433
Dimethyl sulfoxide	189.0	0.379	0.0505	Toluene	110.6	0.353	0.0471
1,4-Dioxane	101.5	0.321	0.0428	Trichloroethylene	87.2	0.330	0.0440
Dipropyl ether	90.0	0.326	0.0435	Trichloromethane	61.1	0.302	0.0403
Ethanol	78.2	0.249	0.0332	Trimethylamine	2.8	0.248	0.0331
Ethyl acetate	77.1	0.300	0.0400	Water	100.0	0.276	0.0368
Ethylene glycol	197.3	0.331	0.0441	<i>o</i> -Xylene	144.5	0.373	0.0497
Heptane	98.5	0.336	0.0448	<i>m</i> -Xylene	139.1	0.368	0.0491
Hexafluorobenzene	80.2	0.305	0.0407	<i>p</i> -Xylene	138.3	0.369	0.0492
Hexane	68.7	0.314	0.0419				

EBULLIOSCOPIC CONSTANTS FOR CALCULATION OF BOILING POINT ELEVATION

The boiling point T_b of a dilute solution of a non-volatile, non-dissociating solute is elevated relative to that of the pure solvent. If the solution is ideal (i.e., follows Raoult's Law), the amount of elevation depends only on the number of particles of solute present. Hence the change in boiling point ΔT_b can be expressed as

$$\Delta T_b = E_b m_2$$

where m_2 is the molality (moles of solute per kilogram of solvent) and E_b is the Ebullioscopic Constant, a characteristic property of the solvent. The Ebullioscopic Constant may be calculated from the relation

$$E_b = R T_b^2 M / \Delta_{\text{vap}} H$$

where R is the molar gas constant, T_b is the normal boiling point temperature (absolute) of the solvent, M the molar mass of the solvent, and $\Delta_{\text{vap}} H$ the molar enthalpy (heat) of vaporization of the solvent at its normal boiling point.

This table lists E_b values for some common solvents, as calculated from data in the table "Enthalpy of Vaporization" in Section 6.

Compound	$E_b/\text{K kg mol}^{-1}$	Compound	$E_b/\text{K kg mol}^{-1}$
Acetic acid	3.22	Hexane	2.90
Acetone	1.80	Iodomethane	4.31
Acetonitrile	1.44	Methanol	0.86
Aniline	3.82	Methyl acetate	2.21
Anisole	4.20	<i>N</i> -Methylaniline	4.3
Benzaldehyde	4.24	<i>N</i> -Methylformamide	2.2
Benzene	2.64	Nitrobenzene	5.2
1-Butanol	2.17	Nitromethane	2.09
Carbon disulfide	2.42	1-Octanol	5.06
Chlorobenzene	4.36	Phenol	3.54
1-Chlorobutane	3.13	1-Propanol	1.66
Cyclohexane	2.92	2-Propanol	1.58
Cyclohexanol	3.5	Pyridine	2.83
Decane	6.10	Pyrrole	2.33
Dichloromethane	2.42	Pyrrolidine	2.32
Diethyl ether	2.20	Tetrachloroethylene	6.18
Dimethyl sulfoxide	3.22	Tetrachloromethane	5.26
1,4-Dioxane	3.01	Toluene	3.40
Ethanol	1.23	Trichloroethylene	4.52
Ethyl acetate	2.82	Trichloromethane	3.80
Ethylene glycol	2.26	Water	0.513
Heptane	3.62	<i>o</i> -Xylene	4.25

CRYOSCOPIC CONSTANTS FOR CALCULATION OF FREEZING POINT DEPRESSION

The freezing point T_f of a dilute solution of a non-volatile, non-dissociating solute is depressed relative to that of the pure solvent. If the solution is ideal (i.e., follows Raoult's Law), this lowering is a function only of the number of particles of solute present. Thus the absolute value of the lowering of freezing point ΔT_f can be expressed as

$$\Delta T_f = E_f m_2$$

where m_2 is the molality (moles of solute per kilogram of solvent) and E_f is the Cryoscopic Constant, a characteristic property of the solvent. The Cryoscopic Constant may be calculated from the relation

$$E_f = R T_f^2 M / \Delta_{\text{fus}} H$$

where R is the molar gas constant, T_b is the freezing point temperature (absolute) of the solvent, M the molar mass of the solvent, and $\Delta_{\text{fus}} H$ the molar enthalpy (heat) of fusion of the solvent.

This table lists cryoscopic constants for selected substances, as calculated from data in the table "Enthalpy of Fusion" in Section 6.

Compound	$E_f/\text{K kg mol}^{-1}$	Compound	$E_f/\text{K kg mol}^{-1}$
Acetamide	3.92	1,4-Dioxane	4.63
Acetic acid	3.63	Diphenylamine	8.38
Acetophenone	5.16	Ethylene glycol	3.11
Aniline	5.23	Formamide	4.25
Benzene	5.07	Formic acid	2.38
Benzonitrile	5.35	Glycerol	3.56
Benzophenone	8.58	Methylcyclohexane	2.60
(+)-Camphor	37.8	Naphthalene	7.45
1-Chloronaphthalene	7.68	Nitrobenzene	6.87
<i>o</i> -Cresol	5.92	Phenol	6.84
<i>m</i> -Cresol	7.76	Pyridine	4.26
<i>p</i> -Cresol	7.20	Quinoline	6.73
Cyclohexane	20.8	Succinonitrile	19.3
Cyclohexanol	42.2	1,1,2,2-Tetrabromoethane	21.4
<i>cis</i> -Decahydronaphthalene	6.42	1,1,2,2-Tetrachloro-1,2-difluoroethane	41.0
<i>trans</i> -Decahydronaphthalene	4.70	Toluene	3.55
Dibenzyl ether	6.17	<i>p</i> -Toluidine	4.91
<i>p</i> -Dichlorobenzene	7.57	Tribromomethane	15.0
Diethanolamine	3.16	Water	1.86
Dimethyl sulfoxide	3.85	<i>p</i> -Xylene	4.31

FREEZING POINT LOWERING BY ELECTROLYTES IN AQUEOUS SOLUTION

REFERENCE

Forsythe, W. E., *Smithsonian Physical Tables, Ninth Edition*, Smithsonian Institution, Washington, 1956.

Compound	Lowering of freezing point of water (in °C) as function of molality (mol/kg)									
	0.05	0.10	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00
CaCl ₂	0.25	0.49	1.27	2.66	4.28	6.35	10.78	15.27	20.42	28.08
CuSO ₄	0.13	0.23	0.47	0.96						
HCl	0.18	0.36	0.90	1.86	2.90	4.02	6.63	9.94		
HNO ₃	0.18	0.35	0.88	1.80	2.78	3.80	5.98	8.34	10.95	13.92
H ₂ SO ₄	0.20	0.39	0.96	1.95	3.04	4.28	7.35	11.35	16.32	
KBr	0.18	0.36	0.92	1.78						
KCl	0.17	0.35	0.86	1.68	2.49	3.29	4.88	6.50	8.14	9.77
KNO ₃	0.17	0.33	0.78	1.47	2.11	2.66				
K ₂ SO ₄	0.23	0.43	1.01	1.87						
LiCl	0.18	0.35	0.88	1.80	2.78					
MgSO ₄	0.13	0.24	0.55	1.01	1.50	2.08	3.41			
NH ₄ Cl	0.17	0.34	0.85	1.70	2.55					
NaCl	0.18	0.35	0.85	1.68	2.60					
NaNO ₃	0.18	0.36	0.80	1.62	2.63	3.10				

DETERMINATION OF RELATIVE HUMIDITY FROM DEW POINT

The relative humidity of a water vapor-air mixture is defined as 100 times the partial pressure of water divided by the saturation vapor pressure of water at the same temperature. The relative humidity may be determined from the dew point t_{dew} , which is the temperature at which liquid water first condenses when the mixture is cooled from an initial temperature t . This table gives relative humidity as a function of the dew point depression $t - t_{\text{dew}}$ for several values of the dew point. Values are calculated from the vapor pressure table in Section 6.

$t - t_{\text{dew}}$	$t_{\text{dew}}/^{\circ}\text{C}$					$t - t_{\text{dew}}$	$t_{\text{dew}}/^{\circ}\text{C}$				
	-10	0	10	20	30		-10	0	10	20	30
0.0	100	100	100	100	100	8.2	54	56	59	61	63
0.2	99	99	99	99	99	8.4	53	56	58	60	63
0.4	97	97	97	98	98	8.6	52	55	57	60	62
0.6	95	96	96	96	97	8.8	51	54	57	59	61
0.9	94	94	95	95	96	9.0	51	53	56	58	61
1.0	92	93	94	94	94	9.2	50	53	55	58	60
1.2	91	92	92	93	93	9.4	49	52	55	57	59
1.4	90	90	91	92	92	9.6	48	51	54	56	59
1.6	88	89	90	91	91	9.8	48	51	53	56	58
1.8	87	88	89	90	90	10.0	47	50	53	55	57
2.0	86	87	88	88	89	10.5	45	48	51	54	56
2.2	84	85	86	87	89	11.0	44	47	49	52	55
2.4	83	84	85	86	87	11.5	42	45	48	51	53
2.6	82	83	84	85	86	12.0	41	44	47	49	52
2.8	80	82	83	84	85	12.5	39	42	45	48	50
3.0	79	81	82	83	84	13.0	38	41	44	46	49
3.2	78	80	81	82	83	13.5	37	40	43	45	48
3.4	77	79	80	81	82	14.0	35	38	41	44	47
3.6	76	77	79	80	82	14.5	34	37	40	43	45
3.8	75	76	78	79	81	15.0	33	36	39	42	44
4.0	73	75	77	78	80	15.5	32	35	38	40	
4.2	72	74	76	77	79	16.0	31	34	37	39	
4.4	71	73	75	77	78	16.5	30	33	36	38	
4.6	70	72	74	76	77	17.0	29	32	35	37	
4.8	69	71	73	75	76	17.5	28	31	34	36	
5.0	69	70	72	74	75	18.0	27	30	33	35	
5.2	67	69	71	73	75	18.5	26	29	32	34	
5.4	66	68	70	72	74	19.0	25	28	31	33	
5.6	65	67	69	71	73	19.5	24	27	30	33	
5.9	64	66	69	70	72	20.0	24	26	29	32	
6.0	63	66	68	70	71	21.0	22	25	27	30	
6.2	62	65	67	69	71	22.0	21	23	26	29	
6.4	61	64	66	68	70	23.0	19	22	24	27	
6.6	60	63	65	67	69	24.0	18	21	23	26	
6.8	60	62	64	66	68	25.0	17	19	22	24	
7.0	59	61	63	66	68	26.0	16	18	21	23	
7.2	58	60	63	65	67	27.0	15	17	20	22	
7.4	57	60	62	64	66	28.0	14	16	19	21	
7.6	56	59	61	63	65	29.0	13	15	18	20	
7.8	55	58	60	63	65	30.0	12	14	17	19	
8.0	54	57	60	62	64						

DETERMINATION OF RELATIVE HUMIDITY FROM WET AND DRY BULB TEMPERATURES

Relative humidity may be determined by comparing temperature readings of wet and dry bulb thermometers. The following table, extracted from more extensive U.S. National Weather Service tables, gives the relative humidity as a function of air temperature t_d (dry bulb) and the difference $t_d - t_w$ between dry and wet bulb temperatures. The data assume a pressure near normal atmospheric pressure and an instrumental configuration with forced ventilation.

$t_d/^\circ\text{C}$	$(t_d - t_w)/^\circ\text{C}$											
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
-10	83	67	51	35	19							
-8	86	71	57	43	29	15						
-6	88	74	61	49	37	25	8					
-4	89	77	66	55	44	33	23	12				
-2	90	79	69	60	50	40	31	22	12			
0	91	81	72	64	55	46	38	29	21	13	5	
2	91	84	76	68	60	52	44	37	29	22	14	7
4	92	85	78	71	63	57	49	43	36	29	22	16
6	93	86	79	73	66	60	54	48	41	35	29	24
8	93	87	81	75	69	63	57	51	46	40	35	29
10	94	88	82	77	71	66	60	55	50	44	39	34
12	94	89	83	78	73	68	63	58	53	48	43	39
14	95	90	85	79	75	70	65	60	56	51	47	42
16	95	90	85	81	76	71	67	63	58	54	50	46
18	95	91	86	82	77	73	69	65	61	57	53	49
20	96	91	87	83	78	74	70	66	63	59	55	51
22	96	92	87	83	80	76	72	68	64	61	57	54
24	96	92	88	84	80	77	73	69	66	62	59	56
26	96	92	88	85	81	78	74	71	67	64	61	58
28	96	93	89	85	82	78	75	72	69	65	62	59
30	96	93	89	86	83	79	76	73	70	67	64	61
35	97	94	90	87	84	81	78	75	72	69	67	64
40	97	94	91	88	85	82	80	77	74	72	69	67

$t_d/^\circ\text{C}$	$(t_d - t_w)/^\circ\text{C}$											
	6.5	7.0	7.5	8.0	8.5	9.0	10.0	11.0	12.0	13.0	14.0	15.0
4	9											
6	17	11	5									
8	24	19	14	8								
10	29	24	20	15	10	6						
12	34	29	25	21	16	12	5					
14	38	34	30	26	22	18	10					
16	42	38	34	30	26	23	15	8				
18	45	41	38	34	30	27	20	14	7			
20	48	44	41	37	34	31	24	18	12	6		
22	50	47	44	40	37	34	28	22	17	11	6	
24	53	49	46	43	40	37	31	26	20	15	10	5
26	54	51	49	46	43	40	34	29	24	19	14	10
28	56	53	51	48	45	42	37	32	27	22	18	13
30	58	55	52	50	47	44	39	35	30	25	21	17
32	60	57	54	51	49	46	41	37	32	28	24	20
34	61	58	56	53	51	48	43	39	35	30	26	23
36	62	59	57	54	52	50	45	41	37	33	29	25
38	63	61	58	56	54	51	47	43	39	35	31	27
40	64	62	59	57	54	53	48	44	40	36	33	29

CONSTANT HUMIDITY SOLUTIONS

Anthony Wexler

An excess of a water soluble salt in contact with its saturated solution and contained within an enclosed space produces a constant relative humidity and water vapor pressure according to

$$RH = A \exp(B/T)$$

where RH is the percent relative humidity (generally accurate to $\pm 2\%$), T is the temperature in kelvin, and the constants A and B and the range of valid temperatures are given in the table below. The vapor pressure, p , can be calculated from

$$p = (RH/100) \times p_0$$

where p_0 is the vapor pressure of pure water at temperature T as given in the table in Section 6 titled "Vapor Pressure of Water from 0 to 370°C".

REFERENCES

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2. Greenspan, L., *J. Res. National Bureau of Standards*, 81A, 89, 1977.
3. Broul, et al., *Solubility of Inorganic Two-Component Systems*, Elsevier, New York, 1981.
4. Wagman, D. D. et al., *J. Phys. Chem. Ref. Data*, Vol. 11, Suppl. 2, 1982.

Compound	Temperature range (°C)	RH 25°C	A	B
NaOH · H ₂ O	15—60	6	5.48	27
LiBr · 2H ₂ O	10—30	6	0.23	996
ZnBr ₂ · 2H ₂ O	5—30	8	1.69	455
KOH · 2H ₂ O	5—30	9	0.014	1924
LiCl · H ₂ O	20—65	11	14.53	-75
CaBr ₂ · 6H ₂ O	11—22	16	0.17	1360
LiI · 3H ₂ O	15—65	18	0.15	1424
CaCl ₂ · 6H ₂ O	15—25	29	0.11	1653
MgCl ₂ · 6H ₂ O	5—45	33	29.26	34
NaI · 2H ₂ O	5—45	38	3.62	702
Ca(NO ₃) ₂ · 4H ₂ O	10—30	51	1.89	981
Mg(NO ₃) ₂ · 6H ₂ O	5—35	53	25.28	220
NaBr · 2H ₂ O	0—35	58	20.49	308
NH ₄ NO ₃	10—40	62	3.54	853
KI	5—30	69	29.35	254
SrCl ₂ · 6H ₂ O	5—30	71	31.58	241
NaNO ₃	10—40	74	26.94	302
NaCl	10—40	75	69.20	25
NH ₄ Cl	10—40	79	35.67	235
KBr	5—25	81	40.98	203
(NH ₄) ₂ SO ₄	10—40	81	62.06	79
KCl	5—25	84	49.38	159
Sr(NO ₃) ₂ · 4H ₂ O	5—25	85	28.34	328
BaCl ₂ · 2H ₂ O	5—25	90	69.99	75
CsI	5—25	91	70.77	75
KNO ₃	0—50	92	43.22	225
K ₂ SO ₄	10—50	97	86.75	34

STANDARD SALT SOLUTIONS FOR HUMIDITY CALIBRATION

Saturated aqueous solutions of inorganic salts are convenient secondary standards for calibration of instruments for measurement of relative humidity. The International Union of Pure and Applied Chemistry has recommended salt solutions for calibrations in the range of 10% to 90% relative humidity, and the American Society for Testing and Materials has published similar standards. The data in this table are taken from the IUPAC recommendations, except for K_2CO_3 and K_2SO_4 , which are ASTM recommendations.

Details on the preparation and use of these standards may be found in References 1 and 2. Data for other salts are given in Reference 3.

REFERENCES

1. Marsh, K. N., Editor, *Recommended Reference Materials for the Realization of Physicochemical Properties*, Blackwell Scientific Publications, Oxford, 1987, pp.157-162.
2. *Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions*, ASTM Standard E 104-85, Reapproved 1991.
3. Greenspan, L., *J. Res. Nat. Bur. Stand.*, 81A, 89, 1977.

$t/^\circ\text{C}$	Relative Humidity in %						
	LiCl	MgCl ₂	K ₂ CO ₃	Mg(NO ₃) ₂	NaCl	KCl	K ₂ SO ₄
0		33.66±0.33	43.1±0.7	60.35±0.55	75.51±0.34	88.61±0.53	98.8±2.1
5		33.60±0.28	43.1±0.5	58.86±0.43	75.65±0.27	87.67±0.45	98.5±0.9
10		33.47±0.24	43.1±0.4	57.36±0.33	75.67±0.22	86.77±0.39	98.2±0.8
15		33.30±0.21	43.2±0.3	55.87±0.27	75.61±0.18	85.92±0.33	97.9±0.6
20	11.31±0.31	33.07±0.18	43.2±0.3	54.38±0.23	75.47±0.14	85.11±0.29	97.6±0.5
25	11.30±0.27	32.78±0.16	43.2±0.4	52.89±0.22	75.29±0.12	84.34±0.26	97.3±0.5
30	11.28±0.24	32.44±0.14	43.2±0.5	51.40±0.24	75.09±0.11	83.62±0.25	97.0±0.4
35	11.25±0.22	32.05±0.13		49.91±0.29	74.87±0.12	82.95±0.25	96.7±0.4
40	11.21±0.21	31.60±0.13		48.42±0.37		82.32±0.25	96.4±0.4
45	11.16±0.21	31.10±0.13		46.93±0.47		81.74±0.28	96.1±0.4
50	11.10±0.22	30.54±0.14		45.44±0.60		81.20±0.31	95.8±0.5
55	11.03±0.23	29.93±0.16				80.70±0.35	
60	10.95±0.26	29.26±0.18				80.25±0.41	
65	10.86±0.29	28.54±0.21				79.85±0.48	
70	10.75±0.33	27.77±0.25				79.49±0.57	
75	10.64±0.38	26.94±0.29				79.17±0.66	
80	10.51±0.44	26.05±0.34				78.90±0.77	

LOW TEMPERATURE BATHS FOR MAINTAINING CONSTANT TEMPERATURE

A liquid-solid slurry is a convenient means of maintaining a constant temperature environment below room temperature. The following is a list of readily available organic liquids suitable for this purpose, arranged in order of their melting (freezing) points t_m . The normal boiling points t_b are also given.

Compound	$t_m/^\circ\text{C}$	$t_b/^\circ\text{C}$
Isopentane (2-Methylbutane)	-159.9	27.8
Methylcyclopentane	-142.5	71.8
3-Chloropropene (Allyl chloride)	-134.5	45.1
Pentane	-129.7	36.0
Allyl alcohol	-129	97.0
Ethanol	-114.1	78.2
Carbon disulfide	-111.5	46
Isobutyl alcohol	-108	107.8
Toluene	-94.9	110.6
Acetone	-94.8	56.0
Ethyl acetate	-83.6	77.1
Dry ice + acetone	-78	
<i>p</i> -Cymene	-68.9	177.1
Trichloromethane (Chloroform)	-63.6	61.1
<i>N</i> -Methylaniline	-57	196.2
Chlorobenzene	-45.2	131.7
Anisole	-37.5	153.7
Bromobenzene	-30.6	156.0
Tetrachloromethane (Carbon tetrachloride)	-23	76.8
Benzonitrile	-12.7	191.1

WIRE TABLES

The resistance per unit length of wires of various metals is tabulated here. Values were calculated from resistivity values in the tables "Electrical Resistivity of Pure Metals" and "Electrical Resistivity of Selected Alloys", which appear in Section 12. In practice, resistance may vary because of differing heat treatments and metal composition. The values in the table refer to 20°C, but values at other temperatures may be calculated from the following resistivity data:

Metal	Resistivity in $10^{-8} \Omega \text{ m}$ at temperature			
	0°C	20°C	25°C	100°C
Aluminum	2.417	2.650	2.709	3.56
Brass (70% Cu, 30% Zn)	5.87	6.08	6.13	6.91
Constantan (60% Cu, 40% Ni)	45.43	45.38	45.35	45.11
Copper	1.543	1.678	1.712	2.22
Nichrome (79% Ni, 21% Cr)	107.3	107.5	107.6	108.3
Platinum	9.6	10.5	10.7	13.6
Silver	1.467	1.587	1.617	2.07
Tungsten	4.82	5.28	5.39	7.18

Resistance per unit length at 20°C in Ω/m

B & S Gauge	Diameter (mm)	Aluminum	Brass	Constantan	Copper	Nichrome	Platinum	Silver	Tungsten
0	8.252	0.000495	0.00114	0.00848	0.000314	0.0201	0.00196	0.000297	0.00099
2	6.543	0.000788	0.00181	0.0135	0.000499	0.0320	0.00312	0.000472	0.00157
4	5.189	0.00125	0.00287	0.0214	0.000793	0.0508	0.00496	0.000750	0.00250
6	4.115	0.00199	0.00457	0.0341	0.00126	0.0808	0.00789	0.00119	0.00397
8	3.264	0.00317	0.00727	0.0542	0.00200	0.128	0.0125	0.00190	0.00631
10	2.588	0.00504	0.0115	0.0863	0.00319	0.204	0.0200	0.00302	0.0100
12	2.053	0.00800	0.0184	0.137	0.00507	0.325	0.0317	0.00479	0.0159
14	1.628	0.0127	0.0292	0.218	0.00806	0.516	0.0504	0.00762	0.0254
16	1.291	0.0202	0.0464	0.347	0.0128	0.821	0.0802	0.0121	0.0403
18	1.024	0.0322	0.0738	0.551	0.0204	1.30	0.127	0.0193	0.0641
20	0.8118	0.0512	0.117	0.877	0.0324	2.08	0.203	0.0307	0.102
22	0.6439	0.0814	0.187	1.39	0.0515	3.30	0.322	0.0487	0.162
24	0.5105	0.129	0.297	2.22	0.0820	5.25	0.513	0.0775	0.258
26	0.4049	0.206	0.472	3.52	0.130	8.35	0.815	0.123	0.410
28	0.3211	0.327	0.751	5.60	0.207	13.3	1.30	0.196	0.652
30	0.2548	0.520	1.19	8.90	0.329	21.1	2.06	0.311	1.03
32	0.2019	0.828	1.90	14.2	0.524	33.6	3.28	0.496	1.65
34	0.1601	1.32	3.02	22.5	0.833	53.4	5.22	0.788	2.62
36	0.1270	2.09	4.80	35.8	1.32	84.9	8.29	1.25	4.17
38	0.1007	3.33	7.63	57.0	2.11	135	13.2	1.99	6.63
40	0.07988	5.29	12.1	90.5	3.35	214	20.9	3.17	10.5

CHARACTERISTICS OF PARTICLES AND PARTICLE DISPERSOIDS

		Particle Diameter, microns (μ)																								
		0.0001			0.001			0.01			0.1			1			10			100			1,000			10,000
Equivalent Sizes	Gas Dispersoids																									
	Soil:	Atterberg or International Std. Classification System adopted by Internat. Soc. Soil Sci. Since 1934																								
Electromagnetic Waves	Solid:	X-Rays → Ultraviolet → Visible → Near Infrared → Far Infrared → Microwaves (Radar, etc.)																								
	Liquid:	Solar Radiation																								
Technical Definitions	Fume:																									
	Mist:																									
Common Atmospheric Dispersoids	Dust:	Smog → Clouds and Fog → Mist → Drizzle → Rain																								
	Spray:																									
Typical Particles and Gas Dispersoids	Rosin Smoke:																									
	Oil Smokes:																									
Methods for Particle Size Analysis	Tobacco Smoke:																									
	Metallurgical Dusts and Fumes:																									
Types of Gas Cleaning Equipment	Ammonium Chloride Fume:																									
	Cement Dust:																									
Terminal Gravitational Settling* for spheres, sp. gr. 2.0	Sulfuric Concentrator Mist:																									
	Beach Sand:																									
Particle Diffusion Coefficient,* cm²/sec.	Carbon Black:																									
	Contact Sulfuric Mist:																									
Stokes-Cunningham factor included in values given for air but not included for water	Paint Pigments:																									
	Flotation Ores:																									
Viruses	Zinc Oxide Fume:																									
	Insecticide Dusts:																									
Impingers	Silica:																									
	Ground Talc:																									
Electroformed Sieves	Spray Dried Milk:																									
	Plant Spores:																									
Microscope	Alkali Fume:																									
	Milled Flour:																									
Centrifuge	Aitken Nuclei:																									
	Atmospheric Dust:																									
Turbidimetry⁺⁺	Sea Salt Nuclei:																									
	Nebulizer Drops:																									
Permeability⁺	Combustion Nuclei:																									
	Lung Damaging Dust:																									
Scanners	Viruses:																									
	Bacteria:																									
Visible to Eye	Human Hair:																									
	Hydraulic Nozzle Drops:																									
Machine Tools (Micrometers, Calipers, etc.)	Red Blood Cell Diameter (Adults): 7.5 μ \pm 0.3 μ																									
	Human Hair:																									
Electrical Conductivity	Ultrasonics (very limited industrial application):																									
	Centrifugal Separators:																									
Setting Chambers	Liquid Scubbers:																									
	Cloth Collectors:																									
Common Air Filters	Packed Beds:																									
	High Efficiency Air Filters:																									
Impingement Separators	Thermal Precipitation (used only for sampling):																									
	Mechanical Separators:																									
Electrical Precipitators	In Air at 25°C. 1 atm.	Reynolds Number	10 ⁻¹²	10 ⁻¹¹	10 ⁻¹⁰	10 ⁻⁹	10 ⁻⁸	10 ⁻⁷	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	10 ⁻¹	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴							
	Setting Velocity, cm/sec.	2	3	5	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	10 ⁻¹	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁸	10 ⁹							
Common Air Filters	In Water at 25°C.	Reynolds Number	10 ⁻¹⁵	10 ⁻¹⁴	10 ⁻¹³	10 ⁻¹²	10 ⁻¹¹	10 ⁻¹⁰	10 ⁻⁹	10 ⁻⁸	10 ⁻⁷	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	10 ⁻¹	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴				
	Setting Velocity, cm/sec.	10 ⁻¹⁰	10 ⁻⁹	10 ⁻⁸	10 ⁻⁷	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	10 ⁻¹	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰				
Common Air Filters	In Air at 25°C. 1 atm.	Diffusion Coefficient, cm ² /sec.	6	3	2	1	5	3	2	10 ⁻¹	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻⁵	10 ⁻⁶	10 ⁻⁷	10 ⁻⁸	10 ⁻⁹	10 ⁻¹⁰	10 ⁻¹¹						
	In Water at 25°C.	Diffusion Coefficient, cm ² /sec.	4	3	2	10 ⁻⁵	10 ⁻⁶	10 ⁻⁷	10 ⁻⁸	10 ⁻⁹	10 ⁻¹⁰	10 ⁻¹¹	10 ⁻¹²	10 ⁻¹³	10 ⁻¹⁴	10 ⁻¹⁵	10 ⁻¹⁶	10 ⁻¹⁷	10 ⁻¹⁸	10 ⁻¹⁹	10 ⁻²⁰					

DENSITY OF VARIOUS SOLIDS

This table gives the range of density for miscellaneous solid materials whose characteristics depend on the source or method of preparation.

REFERENCES

1. Forsythe, W. E., *Smithsonian Physical Tables, Ninth Edition*, Smithsonian Institution, Washington, 1956.
2. Kaye, G. W. C., and Laby, T. H., *Tables of Physical and Chemical Constants, 16th Edition*, Longman, London, 1995.
3. Brandrup, J., and Immergut, E. H., *Polymer Handbook, Third Edition*, John Wiley & Sons, New York, 1989.

Material	$\rho / \text{g cm}^{-3}$	Material	$\rho / \text{g cm}^{-3}$	Material	$\rho / \text{g cm}^{-3}$
Agate	2.5-2.7	Pyrex	2.23	Soapstone	2.6-2.8
Alabaster,		Granite	2.64-2.76	Solder	8.7-9.4
carbonate	2.69-2.78	Graphite	2.30-2.72	Starch	1.53
sulfate	2.26-2.32	Gum arabic	1.3-1.4	Steel, stainless	7.8
Albite	2.62-2.65	Gypsum	2.31-2.33	Sugar	1.59
Amber	1.06-1.11	Hematite	4.9-5.3	Talc	2.7-2.8
Amphiboles	2.9-3.2	Hornblende	3.0	Tallow, beef	0.94
Anorthite	2.74-2.76	Ice	0.917	Tar	1.02
Asbestos	2.0-2.8	Iron, cast	7.0-7.4	Topaz	3.5-3.6
Asbestos slate	1.8	Ivory	1.83-1.92	Tourmaline	3.0-3.2
Asphalt	1.1-1.5	Kaolin	2.6	Tungsten carbide	14.0-15.0
Basalt	2.4-3.1	Leather, dry	0.86	Wax, sealing	1.8
Beeswax	0.96-0.97	Lime, slaked	1.3-1.4	Wood (seasoned)	
Beryl	2.69-2.70	Limestone	2.68-2.76	alder	0.42-0.68
Biotite	2.7-3.1	Linoleum	1.18	apple	0.66-0.84
Bone	1.7-2.0	Magnetite	4.9-5.2	ash	0.65-0.85
Brasses	8.44-8.75	Malachite	3.7-4.1	balsa	0.11-0.14
Brick	1.4-2.2	Marble	2.6-2.84	bamboo	0.31-0.40
Bronzes	8.74-8.89	Meerschaum	0.99-1.28	basswood	0.32-0.59
Butter	0.86-0.87	Mica	2.6-3.2	beech	0.70-0.90
Calamine	4.1-4.5	Muscovite	2.76-3.00	birch	0.51-0.77
Calcspars	2.6-2.8	Ochre	3.5	blue gum	1.00
Camphor	0.99	Opal	2.2	box	0.95-1.16
Cardboard	0.69	Paper	0.7-1.15	butternut	0.38
Celluloid	1.4	Paraffin	0.87-0.91	cedar	0.49-0.57
Cement, set	2.7-3.0	Peat blocks	0.84	cherry	0.70-0.90
Chalk	1.9-2.8	Pitch	1.07	dogwood	0.76
Charcoal,		Polyamides	1.15-1.25	ebony	1.11-1.33
oak	0.57	Polyethylene	0.92-0.97	elm	0.54-0.60
pine	0.28-0.44	Poly(methyl methacrylate)	1.19	hickory	0.60-0.93
Cinnabar	8.12	Polypropylene	0.91-0.94	holly	0.76
Clay	1.8-2.6	Polystyrene	1.06-1.12	juniper	0.56
Coal,		Polytetrafluoroethylene	2.28-2.30	larch	0.50-0.56
anthracite	1.4-1.8	Poly(vinyl acetate)	1.19	locust	0.67-0.71
bituminous	1.2-1.5	Poly(vinyl chloride)	1.39-1.42	logwood	0.91
Coke	1.0-1.7	Porcelain	2.3-2.5	mahogany	0.66-0.85
Copal	1.04-1.14	Porphyry	2.6-2.9	maple	0.62-0.75
Cork	0.22-0.26	Pyrite	4.95-5.10	oak	0.60-0.90
Corundum	3.9-4.0	Quartz	2.65	pear	0.61-0.73
Diamond	3.51	Resin	1.07	pine, pitch	0.83-0.85
Dolomite	2.84	Rock salt	2.18	white	0.35-0.50
Ebonite	1.15	Rubber,		yellow	0.37-0.60
Emery	4.0	hard	1.19	plum	0.66-0.78
Epidote	3.25-3.50	soft	1.1	poplar	0.35-0.50
Feldspar	2.55-2.75	pure gum	0.91-0.93	satinwood	0.95
Flint	2.63	Neoprene	1.23-1.25	spruce	0.48-0.70
Fluorite	3.18	Sandstone	2.14-2.36	sycamore	0.40-0.60
Galena	7.3-7.6	Serpentine	2.50-2.65	teak, Indian	0.66-0.98
Garnet	3.15-4.3	Silica, fused,	2.21	walnut	0.64-0.70
Gelatin	1.27	Silicon carbide	3.16	water gum	1.00
Glass,		Slag	2.0-3.9	willow	0.40-0.60
common	2.4-2.8	Slate	2.6-3.3	Wood's metal	9.70
lead	3-4				

DIELECTRIC STRENGTH OF INSULATING MATERIALS

L. I. Berger

The loss of the dielectric properties by a sample of a gaseous, liquid, or solid insulator as a result of application to the sample of an electric field* greater than a certain critical magnitude is called *dielectric breakdown*. The critical magnitude of electric field at which the breakdown of a material takes place is called the *dielectric strength* of the material (or *breakdown voltage*). The dielectric strength of a material depends on the specimen thickness (as a rule, thin films have greater dielectric strength than that of thicker samples of a material), the electrode shape**, the rate of the applied voltage increase, the shape of the voltage vs. time curve, and the medium surrounding the sample, e.g., air or other gas (or a liquid — for solid materials only).

Breakdown in Gases

The current carriers in gases are free electrons and ions generated by external radiation. The equilibrium concentration of these particles at normal pressure is about 10^3 cm^{-3} , and hence the electrical conductivity is very small, of the order of $10^{-16} - 10^{-15} \text{ S/cm}$. But in a strong electric field, these particles acquire kinetic energy along their free pass, large enough to ionize the gas molecules. The new charged particles ionize more molecules; this avalanche-like process leads to formation between the electrodes of channels of conducting plasma (streamers), and the electrical resistance of the space between the electrodes decreases virtually to zero.

Because the dielectric strength (breakdown voltage) of gases strongly depends on the electrode geometry and surface condition and the gas pressure, it is generally accepted to present the data for a particular gas as a fraction of the dielectric strength of either nitrogen or sulfur hexafluoride measured at the same conditions. In Table 1, the data are presented in comparison with the dielectric strength of nitrogen, which is considered equal to 1.00. For convenience to the reader, a few average magnitudes of the dielectric strength of some gases are expressed in kilovolts per millimeter. The data in the table relate to the standard conditions, unless indicated otherwise.

Breakdown in Liquids

If a liquid is pure, the breakdown mechanism in it is similar to that in gases. If a liquid contains liquid impurities in the form of small drops with greater dielectric constant than that of the main liquid, the breakdown is the result of formation of ellipsoids from these drops by the electric field. In a strong enough electric field, these ellipsoids merge and form a high-conductivity channel between the electrodes. The current increases the temperature in the channel, liquid boils, and the current along the steam canal leads to breakdown. Formation of a conductive channel (bridge) between the electrodes is observed also in liquids with solid impurities. If a liquid contains gas impurities in the form of small bubbles, breakdown is the result of heating of the liquid in strong electric fields. In the locations with the highest current density, the liquid boils, the size of the gas bubbles increases, they merge and form gaseous channels between the electrodes, and the breakdown medium is again the gas plasma.

Breakdown in Solids

It is known that the current in solid insulators does not obey Ohm's law in strong electric fields. The current density increases almost exponentially with the electric field, and at a certain field magnitude it jumps to very high magnitudes at which a specimen of a material is destroyed. The two known kinds of electric breakdown are thermal and electrical breakdowns. The former is the result of material heating by the electric current. Destruction of a sample of a material happens when, at a certain voltage, the amount of heat produced by the current exceeds the heat release through the sample surface; the breakdown voltage in this case is proportional to the square root of the ratio of the thermal conductivity and electrical conductivity of the material. The electrical breakdown results from the tunneling of the charge carriers from electrodes or from the valence band or from the impurity levels into the conduction band, or by the impact ionization. The tunnel effect breakdown happens mainly in thin layers, e.g., in thin p-n junctions. Otherwise, the impact ionization mechanism dominates. For this mechanism, the dielectric strength of an insulator can be estimated using Boltzmann's kinetic equation for electrons in a crystal.

In the following tables, the dielectric strength values are for room temperature and normal atmospheric pressure, unless indicated otherwise.

* The unit of electric field in the SI system is newton per coulomb or volt per meter.

** For example, the U.S. standard ASTM D149 is based on use of symmetrical electrodes, while per U.K. standard BS2918 one electrode is a plane and the other is a rod with the axis normal to the plane.

Table 1
Dielectric Strength of Gases

Material	Dielectric* Strength	Ref.	Material	Dielectric* Strength	Ref.
Nitrogen, N ₂	1.00		Trichlorofluoromethane, CCl ₃ F	3.50	1
Hydrogen, H ₂	0.50	1,2		4.53	2
Helium, He	0.15	1	Trichloromethane, CHCl ₃	4.2	1
Oxygen, O ₂	0.92	2		4.39	2
Air	0.97	6	Methylamine, CH ₃ NH ₂	0.81	1
Air (flat electrodes), kV/mm	3.0	3	Difluoromethane, CH ₂ F ₂	0.79	2
Air, kV/mm	0.4-0.7	4	Trifluoromethane, CHF ₃	0.71	2
Air, kV/mm	1.40	5	Bromochlorodifluoromethane, CF ₂ ClBr	3.84	2
Neon, Ne	0.25	1	Chlorodifluoromethane, CHClF ₂	1.40	1
	0.16	2		1.11	2
Argon, Ar	0.18	2	Dichlorofluoromethane, CHCl ₂ F	1.33	1
Chlorine, Cl ₂	1.55	1		2.61	2
Carbon monoxide, CO	1.02	1	Chlorofluoromethane, CH ₂ ClF	1.03	1
	1.05	2	Hexafluoroethane, C ₂ F ₆	1.82	1
Carbon dioxide, CO ₂	0.88	1		2.55	2
	0.82	2	Ethyne (Acetylene), C ₂ H ₂	1.10	1
	0.84	6		1.11	2
Nitrous oxide, N ₂ O	1.24	2	Chloropentafluoroethane, C ₂ ClF ₅	2.3	1
Sulfur dioxide, SO ₂	2.63	2		3.0	6
	2.68	6	Dichlorotetrafluoroethane, C ₂ Cl ₂ F ₄	2.52	1
Sulfur monochloride, S ₂ Cl ₂	1.02	1	Chlorotrifluoroethylene, C ₂ ClF ₃	1.82	2
(at 12.5 Torr)			1,1,1-Trichloro-2,2,2-trifluoroethane	6.55	2
Thionyl fluoride, SOF ₂	2.50	1	1,1,2-Trichloro-1,2,2-trifluoroethane	6.05	2
Sulfur hexafluoride, SF ₆	2.50	1	Chloroethane, C ₂ H ₅ Cl	1.00	1
	2.63	2	1,1-Dichloroethane	2.66	2
Sulfur hexafluoride, SF ₆ , kV/mm	8.50	7	Trifluoroacetonitrile, CF ₃ CN	3.5	1
	9.8	8	Acetonitrile, CH ₃ CN	2.11	2
Perchloryl fluoride, ClO ₃ F	2.73	1	Dimethylamine, (CH ₃) ₂ NH	1.04	1
Tetrachloromethane, CCl ₄	6.33	1	Ethylamine, C ₂ H ₅ NH ₂	1.01	1
	6.21	2	Ethylene oxide (oxirane), CH ₃ CHO	1.01	1
Tetrafluoromethane, CF ₄	1.01	1	Perfluoropropene, C ₃ F ₆	2.55	2
Methane, CH ₄	1.00	1	Octafluoropropane, C ₃ F ₈	2.19	1
	1.13	2		2.47	2
Bromotrifluoromethane, CF ₃ Br	1.35	1	3,3,3-Trifluoro-1-propene, CH ₂ CHCF ₃	2.11	2
	1.97	2	Pentafluoroisocynoethane, C ₂ F ₅ NC	4.5	1
Bromomethane, CH ₃ Br	0.71	2	1,1,1,4,4,4-Hexafluoro-2-butyne, CF ₃ CCCF ₃	5.84	2
Chloromethane, CH ₃ Cl	1.29	2	Octafluorocyclobutane, C ₄ F ₈	3.34	2
Iodomethane, CH ₃ I	3.02	2	1,1,1,2,3,4,4,4-Octafluoro-2-butene	2.8	1
Iodomethane, CH ₃ I, at 370 Torr	2.20	7	Decafluorobutane, C ₄ F ₁₀	3.08	1
Dichloromethane, CH ₂ Cl ₂	1.92	2	Perfluorobutanenitrile, C ₃ F ₇ CN	5.5	1
Dichlorodifluoromethane, CCl ₂ F ₂	2.42	1	Perfluoro-2-methyl-1,3-butadiene, C ₅ F ₈	5.5	1
	2.63	2,6	Hexafluorobenzene, C ₆ F ₆	2.11	2
Chlorotrifluoromethane, CClF ₃	1.43	1	Perfluorocyclohexane, C ₆ F ₁₂ , (saturated vapor)	6.18	2
	1.53	2			

*Relative to nitrogen, unless units of kV/mm are indicated.

Table 2
Dielectric Strength of Liquids

Material	Dielectric strength kV/mm	Ref.	Material	Dielectric strength kV/mm	Ref.
Helium, He, liquid, 4.2 K	10	9		20.4	15
Static	10	11		179	17,18
Dynamic	5	11	Ethylbenzene, C ₈ H ₁₀	226	17,18
	23	12	Propylbenzene, C ₉ H ₁₂	250	17,18
Nitrogen, N ₂ , liquid, 77K			Isopropylbenzene, C ₉ H ₁₂	238	17,18
Coaxial cylinder electrodes	20	10	Decane, C ₁₀ H ₂₂	192	17,18
Sphere to plane electrodes	60	10	Synthetic Paraffin Mixture		
Water, H ₂ O, distilled	65-70	13	Synfluid 2cSt PAO	29.5	37
Carbon tetrachloride, CCl ₄	5.5	14	Butylbenzene, C ₁₀ H ₁₄	275	17,18
	16.0	15	Isobutylbenzene, C ₁₀ H ₁₄	222	17,18
Hexane, C ₆ H ₁₄	42.0	16	Silicone oils—polydimethylsiloxanes, (CH ₃) ₃ Si-O-[Si(CH ₃) ₂] _x -O-Si(CH ₃) ₃		
Two 2.54 cm diameter spherical electrodes, 50.8 μm space	156	17,18	Polydimethylsiloxane silicone fluid	15.4	20
Cyclohexane, C ₆ H ₁₂	42-48	16	Dimethyl silicone	24.0	21,22
2-Methylpentane, C ₆ H ₁₄	149	17,18	Phenylmethyl silicone	23.2	22
2,2-Dimethylbutane, C ₆ H ₁₄	133	17,18	Silicone oil, Basilone M50	10-15	23
2,3-Dimethylbutane, C ₆ H ₁₄	138	17,18	Mineral insulating oils	11.8	6
Benzene, C ₆ H ₆	163	17,18	Polybutene oil for capacitors	13.8	6
Chlorobenzene, C ₆ H ₅ Cl	7.1	14	Transformer dielectric liquid	28-30	6
	18.8	15	Isopropylbiphenyl capacitor oil	23.6	6
2,2,4-Trimethylpentane, C ₈ H ₁₈	140	17,18	Transformer oil	110.7	24
Phenylxylylethane	23.6	19	Transformer oil Agip ITE 360	9-12.6	23
Heptane, C ₇ H ₁₆	166	17,18	Perfluorinated hydrocarbons		
2,4-Dimethylpentane, C ₇ H ₁₆	133	17,18	Fluorinert FC 6001	8.0	23
Toluene, C ₆ H ₅ CH ₃	199	17,18	Fluorinert FC 77	10.7	23
	46	16	Perfluorinated polyethers		
	12.0	14	Galden XAD (Mol. wt. 800)	10.5	23
	20.4	15	Galden D40 (Mol. wt. 2000)	10.2	23
Octane, C ₈ H ₁₈	16.6	14	Castor oil	65	25

Table 3
Dielectric Strength of Solids

Material	Dielectric strength kV/mm	Ref	Material	Dielectric strength kV/mm	Ref
Sodium chloride, NaCl, crystalline	150	26	Phlogopite, amber, natural	118	6
Potassium bromide, KBr, crystalline	80	26	Fluorophlogopite, synthetic	118	6
Ceramics			Glass-bonded mica	14.0-15.7	6
Alumina (99.9% Al ₂ O ₃)	13.4	6,27a	Thermoplastic Polymers		
Aluminum silicate, Al ₂ SiO ₅	5.9	6	Polypropylene	23.6	6
Berillia (99% BeO)	13.8	6,27b	Amide polymer nylon 6/6, dry	23.6	6
Boron nitride, BN	37.4	6	Polyamide-imide copolymer	22.8	6
Cordierite, Mg ₂ Al ₄ Si ₅ O ₁₈	7.9	6,27c	Modified polyphenylene oxide	21.7	6
Forsterite, Mg ₂ SiO ₄	9.8	28	Polystyrene	19.7	6
Porcelain	35-160	26	Polymethyl methacrylate	19.7	6
Steatite, Mg ₃ Si ₄ O ₁₁ •H ₂ O	9.1-15.4	6	Polyetherimide	18.9	6
Titanates of Mg, Ca, Sr, Ba, and Pb	20-120	3	Amide polymer nylon 11(dry)	16.7	6
Barium titanate, glass bonded	>30	36	Polysulfone	16.7	6
Zirconia, ZrO ₂	11.4	29	Styrene-acrylonitrile copolymer	16.7	6
Glasses			Acrylonitrile-butadiene-styrene	16.7	6
Fused silica, SiO ₂	470-670	26	Polyethersulfone	15.7	6
Alkali-silicate glass	200	26	Polybutylene terephthalate	15.7	6
Standard window glass	9.8-13.8	28	Polystyrene-butadiene copolymer	15.7	6
Micas			Acetal homopolymer	15.0	6
Muscovite, ruby, natural	118	6	Acetal copolymer	15.0	6

Table 3
Dielectric Strength of Solids (continued)

Material	Dielectric strength kV/mm	Ref.	Material	Dielectric strength kV/mm	Ref.
Polyphenylene sulfide	15.0	6	Varnishes		
Polycarbonate	15.0	6	Vacuum-pressure impregnated baking		
Acetal homopolymer resin (molding resin)	15.0	6	type solventless polyester varnish		
Acetal copolymer resin	15.0	6	Rigid, two-part	70.9	6
Thermosetting Molding Compounds			Semiflexible high-bond thixotropic	78.7	6
Glass-filled allyl	15.7	6	Rigid high-bond high-flash	68.9	6
(Type GDI-30 per MIL-M-14G)			freon-resistant		
Glass-filled epoxy, electrical grade	15.4	6	Baking type epoxy varnish		
Glass-filled phenolic	15.0	6	Solventless, rigid, low viscosity,	90.6	6
(Type GPI-100 per MIL-M-14G)			one-part		
Glass-filled alkyd/polyester	14.8	6	Solventless, semiflexible, one-part	82.7	6
(Type MAI-60 per MIL-M-14G)			Solventless, semirigid, chemical	106.3	6
Glass-filled melamine	13.4	6	resistant, low dielectric constant		
(Type MMI-30 per MIL-M-14G)			Solvable, for hermetic electric motors	181.1	6
Extrusion Compounds for High-Temperature Insulation			Polyurethane coating		
Polytetrafluoroethylene	19.7	6	Clear conformal, fast cure		
Perfluoroalkoxy polymer	21.7	6	Standard conditions	78.7	6
Fluorinated ethylene-propylene copolymer	19.7	6	Immersion conditions	47.2	6
Ethylene-tetrafluoroethylene copolymer	15.7	6	Insulating Films and Tapes		
Polyvinylidene fluoride	10.2	6	Low-density polyethylene film	300	31
Ethylene-chlorotrifluoroethylene	19.3	6	(40 μm thick)		
copolymer			Poly- <i>p</i> -xylylene film	410-590	32
Polychlorotrifluoroethylene	19.7	6	Aromatic polymer films		
Extrusion Compounds for Low-Temperature Insulation			Kapton H (Du Pont)	389-430	33
Polyvinyl chloride			Ultem (GE Plastic and Roem AG)	437-565	33
Flexible	11.8-15.7	30	Hostaphan (Hoechst AG)	338-447	33
Rigid	13.8-19.7	30	Amorphous Stabar K2000	404-422	33
Polyethylene	18.9	28	(ICI film)		
Polyethylene, low-density	21.7	6	Stabar S100 (ICI film)	353-452	33
	300	31	Polyetherimide film (26 μm)	486	34
Polyethylene, high-density	19.7	6	Parylene N/D (poly- <i>p</i> -xylylene/poly-		
Polypropylene/polyethylene copolymer	23.6	6	dichloro- <i>p</i> -xylylene) 25 μm film	275	6
Embedding Compounds			Cellulose acetate film	157	6
Basic epoxy resin:	19.7	6	Cellulose triacetate film	157	6
bisphenol-A/epichlorohydrin			Polytetrafluoroethylene film	87-173	6
polycondensate			Perfluoroalkoxy film	157-197	6
Cycloaliphatic epoxy: alicyclic	19.7	6	Fluorinated ethylene-propylene	197	6
diepoxy carboxylate			copolymer film		
Polyetherketone	18.9	30	Ethylene-tetrafluoroethylene film	197	6
Polyurethanes			Ethylene-chlorotrifluoroethylene	197	6
Two-component, polyol-cured	25.4	6	copolymer film		
Two-part solventless,	24.0	6	Polychlorotrifluoroethylene film	118-153.5	6
polybutylene-based			High-voltage rubber insulating tape	28	6
Silicones			Composites		
Clear two-part heat curing electrical	21.7	6	Isophthalic polyester (vinyl toluene		
grade silicone embedding resin			monomer) filled with		
Red insulating enamel (MIL-E-22118)			Calcium carbonate, CaCO ₃	15.0	38
Dry	47.2	6	Gypsum, CaSO ₄	14.4	38
Wet	11.8	6	Alumina trihydrate	15.4	38
Enamels			Clay	14.4	38
Red enamel, fast cure			BPA fumarate polyester (vinyl toluene		
Standard conditions	78.7	6	monomer) filled with		
Immersion conditions	47.2	6	Calcium carbonate	6.1	38
Black enamel			Gypsum	5.9	38
Standard conditions	70.9	6	Alumina trihydrate	11.8	38
Immersion conditions	47.2	6	Clay	12.6	38

Table 3
Dielectric Strength of Solids (continued)

Material	Dielectric strength kV/mm	Ref.	Material	Dielectric strength kV/mm	Ref.
Polysulfone resin—30% glass fiber	16.5-18.7	38	Butyl rubber	23.6	6
Polyamid resin (Nylon 66)— 30% carbon fiber	13.0	38	Neoprene	15.7-27.6	6
Polyimide thermoset resin, glass reinforced	12.0	39	Silicone rubber	26-36	6
Polyester resin (thermoplastic)— 40% glass fiber	20.0	38	Room-temperature vulcanized silicone rubber	9.2-10.9	35
Epoxy resin (diglycidyl ether of bisphenol A), glass reinforced	16.0	40	Ureas (from carbamide to tetraphenylurea)	11.8-15.7	28
Various Insulators			Dielectric papers		
Rubber, natural	100-215	26	Aramid paper, calendered	28.7	6
			Aramid paper, uncalendered	12.2	6
			Aramid with Mica	39.4	6

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ALLOCATION OF FREQUENCIES IN THE RADIO SPECTRUM

In the United States the National Telecommunications and Information Administration (NTIA) has responsibility for assigning each portion of the radio spectrum (9 kHz to 300 GHz) for different uses. These assignments must be compatible with the rules of the International Telecommunications Union (ITU), to which the United States is bound by treaty. The current assignments are given in a wall chart (Reference 1) and may also be found on the NTIA web site (Reference 2). The list below summarizes the broad features of the spectrum allocation, with particular attention to those sections of scientific interest. The references should be consulted for details of the allocations in the frequency bands listed here, which in some cases are quite complex.

REFERENCES

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2. <http://www.ntia.doc.gov/osmhome/allochrt.html>

Frequency range	Allocation
9 - 19.95 kHz	Maritime communication, navigation
19.95 - 20.05 kHz	Standard frequency and time signal (also at 60 kHz and 2.5, 5, 10, 15, 20, 25 MHz)
20.05 - 535 kHz	Maritime and aeronautical communication, navigation
535 - 1605 kHz	AM radio broadcasting
1605 - 3500 kHz	Mobile communication and navigation, amateur radio (1800-1900 kHz)
3.5 - 4.0 MHz	Amateur radio
4.0 - 5.95 MHz	Mobile communication
5.95 - 13.36 MHz	Mobile communication, amateur, short-wave broadcasting
13.36 - 13.41 MHz	Radioastronomy
13.41 - 25.55 MHz	Mobile communication, amateur, short-wave broadcasting
25.55 - 25.67 MHz	Radioastronomy
25.67 - 37.5 MHz	Mobile communication, amateur, short-wave broadcasting
37.5 - 38.25 MHz	Radioastronomy
38.25 - 50.0 MHz	Mobile communication
50.0 - 54.0 MHz	Amateur
54.0 - 72.0 MHz	TV channels 2-4
72.0 - 73.0 MHz	Mobile communication
73.0 - 74.6 MHz	Radioastronomy
74.6 - 76.0 MHz	Mobile communication
76.0 - 88.0 MHz	TV channels 5-6
88.0 - 108.0 MHz	FM radio broadcasting
108.0 - 118.0 MHz	Aeronautical navigation
118.0 - 174.0 MHz	Mobile communication, space research, meteorological satellites
174.0 - 216.0 MHz	TV channels 7-13
216.0 - 400.05 MHz	Mobile communication
400.05 - 400.15 MHz	Standard frequency and time satellite (also 20 and 25 GHz)
400.15 - 406.1 MHz	Meteorological aids (radiosonde)
406.1 - 410.0 MHz	Radioastronomy
410.0 - 470.0 MHz	Mobile communication, amateur
470.0 - 512.0 MHz	TV channels 14-20
512.0 - 608.0 MHz	TV channels 21-36
608.0 - 614.0 MHz	Radioastronomy
614.0 - 806.0 MHz	TV channels 38-69
806 - 1400 MHz	Mobile communication, navigation
1400 - 1427 MHz	Radioastronomy, space research
1427 - 1660 MHz	Various navigation and satellite applications
1660 - 1710 MHz	Radioastronomy, space research, meteorology
1710 - 2655 MHz	Various navigation and satellite applications
2655 - 2700 MHz	Radioastronomy, space research
2.7 - 4.99 GHz	Various navigation and satellite applications
4.99 - 5.0 GHz	Radioastronomy, space research
5.0 - 10.6 GHz	Various navigation and satellite applications
10.6 - 10.7 GHz	Radioastronomy, space research
10.7 - 15.35 GHz	Various navigation and satellite applications
15.35 - 15.4 GHz	Radioastronomy, space research
15.4 - 22.21 GHz	Various navigation and satellite applications

ALLOCATION OF FREQUENCIES IN THE RADIO SPECTRUM (continued)

Frequency range	Allocation
22.21 - 22.5 GHz	Radioastronomy, space research
22.25 - 23.6 GHz	Various navigation and satellite applications
23.6 - 24.0 GHz	Radioastronomy, space research
24.0 - 31.3 GHz	Various navigation and satellite applications
31.3 - 31.8 GHz	Radioastronomy, space research
31.8 - 42.5 GHz	Various navigation and satellite applications
42.5 - 43.5 GHz	Radioastronomy
43.5 - 51.4 GHz	Various navigation and satellite applications
51.4 - 54.25 GHz	Radioastronomy, space research
54.25 - 58.2 GHz	Space research
58.2 - 59.0 GHz	Radioastronomy, space research
59.0 - 64.0 GHz	Satellite applications
64.0 - 65.0 GHz	Radioastronomy, space research
65.0 - 72.77 GHz	Various navigation and satellite applications
72.77 - 72.91 GHz	Radioastronomy, space research
72.91 - 86.0 GHz	Various navigation and satellite applications
86.0 - 92.0 GHz	Radioastronomy, space research
92.0 - 105.0 GHz	Various navigation and satellite applications
105.0 - 116.0 GHz	Radioastronomy, space research
116.0 - 164.0 GHz	Various navigation and satellite applications
164.0 - 168.0 GHz	Radioastronomy, space research
168.0 - 182.0 GHz	Various navigation and satellite applications
182.0 - 185.0 GHz	Radioastronomy, space research
185.0 - 217.0 GHz	Various navigation and satellite applications
217.0 - 231.0 GHz	Radioastronomy, space research
231.0 - 265.0 GHz	Various navigation and satellite applications
265.0 - 275.0 GHz	Radioastronomy
275.0 - 300.0 GHz	Mobile communications

CORRECTION OF BAROMETER READINGS TO 0°C TEMPERATURE

The following corrections are used to reduce the reading of a mercury barometer with a brass scale to 0°C. The number in the table should be subtracted from the observed height of the mercury column to give the true pressure in mmHg (1mmHg = 133.322 Pa). The table is calculated from the formula

$$\Delta h = -0.0001634 ht / (1 + 0.0001818 t),$$

where h is the observed column height in mm and t the Celsius temperature. This relation is based on thermal expansion coefficients of $181.8 \cdot 10^{-6} \text{ }^\circ\text{C}^{-1}$ for mercury and $18.4 \cdot 10^{-6} \text{ }^\circ\text{C}^{-1}$ for brass.

$t/^\circ\text{C}$	Observed Height in mm																		
	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13
2	0.20	0.21	0.21	0.21	0.22	0.22	0.22	0.23	0.23	0.23	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.26	0.26
3	0.30	0.31	0.31	0.32	0.32	0.33	0.33	0.34	0.34	0.35	0.35	0.36	0.36	0.37	0.37	0.38	0.38	0.39	0.39
4	0.40	0.41	0.42	0.42	0.43	0.44	0.44	0.45	0.46	0.46	0.47	0.48	0.48	0.49	0.50	0.50	0.51	0.52	0.52
5	0.51	0.51	0.52	0.53	0.54	0.55	0.56	0.56	0.57	0.58	0.59	0.60	0.60	0.61	0.62	0.63	0.64	0.64	0.65
6	0.61	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.71	0.72	0.73	0.74	0.75	0.76	0.77	0.78
7	0.71	0.72	0.73	0.74	0.75	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.85	0.86	0.87	0.88	0.89	0.90	0.91
8	0.81	0.82	0.84	0.85	0.86	0.87	0.89	0.90	0.91	0.93	0.94	0.95	0.97	0.98	0.99	1.01	1.02	1.03	1.04
9	0.91	0.92	0.94	0.95	0.97	0.98	1.00	1.01	1.03	1.04	1.06	1.07	1.09	1.10	1.12	1.13	1.15	1.16	1.17
10	1.01	1.03	1.04	1.06	1.08	1.09	1.11	1.13	1.14	1.16	1.17	1.19	1.21	1.22	1.24	1.26	1.27	1.29	1.30
11	1.11	1.13	1.15	1.17	1.18	1.20	1.22	1.24	1.26	1.27	1.29	1.31	1.33	1.35	1.36	1.38	1.40	1.42	1.44
12	1.21	1.23	1.25	1.27	1.29	1.31	1.33	1.35	1.37	1.39	1.41	1.43	1.45	1.47	1.49	1.51	1.53	1.55	1.57
13	1.31	1.34	1.36	1.38	1.40	1.42	1.44	1.46	1.48	1.50	1.53	1.55	1.57	1.59	1.61	1.63	1.65	1.67	1.70
14	1.41	1.44	1.46	1.48	1.51	1.53	1.55	1.57	1.60	1.62	1.64	1.67	1.69	1.71	1.73	1.76	1.78	1.80	1.83
15	1.52	1.54	1.56	1.59	1.61	1.64	1.66	1.69	1.71	1.74	1.76	1.78	1.81	1.83	1.86	1.88	1.91	1.93	1.96
16	1.62	1.64	1.67	1.69	1.72	1.75	1.77	1.80	1.82	1.85	1.88	1.90	1.93	1.96	1.98	2.01	2.03	2.06	2.09
17	1.72	1.74	1.77	1.80	1.83	1.86	1.88	1.91	1.94	1.97	1.99	2.02	2.05	2.08	2.10	2.13	2.16	2.19	2.22
18	1.82	1.85	1.88	1.91	1.93	1.96	1.99	2.02	2.05	2.08	2.11	2.14	2.17	2.20	2.23	2.26	2.29	2.32	2.35
19	1.92	1.95	1.98	2.01	2.04	2.07	2.10	2.13	2.17	2.20	2.23	2.26	2.29	2.32	2.35	2.38	2.41	2.44	2.48
20	2.02	2.05	2.08	2.12	2.15	2.18	2.21	2.25	2.28	2.31	2.34	2.38	2.41	2.44	2.47	2.51	2.54	2.57	2.60
21	2.12	2.15	2.19	2.22	2.26	2.29	2.32	2.36	2.39	2.43	2.46	2.50	2.53	2.56	2.60	2.63	2.67	2.70	2.73
22	2.22	2.26	2.29	2.33	2.36	2.40	2.43	2.47	2.51	2.54	2.58	2.61	2.65	2.69	2.72	2.76	2.79	2.83	2.86
23	2.32	2.36	2.40	2.43	2.47	2.51	2.54	2.58	2.62	2.66	2.69	2.73	2.77	2.81	2.84	2.88	2.92	2.96	2.99
24	2.42	2.46	2.50	2.54	2.58	2.62	2.66	2.69	2.73	2.77	2.81	2.85	2.89	2.93	2.97	3.01	3.05	3.08	3.12
25	2.52	2.56	2.60	2.64	2.68	2.72	2.77	2.81	2.85	2.89	2.93	2.97	3.01	3.05	3.09	3.13	3.17	3.21	3.25
26	2.62	2.66	2.71	2.75	2.79	2.83	2.88	2.92	2.96	3.00	3.04	3.09	3.13	3.17	3.21	3.26	3.30	3.34	3.38
27	2.72	2.77	2.81	2.85	2.90	2.94	2.99	3.03	3.07	3.12	3.16	3.20	3.25	3.29	3.34	3.38	3.42	3.47	3.51
28	2.82	2.87	2.91	2.96	3.00	3.05	3.10	3.14	3.19	3.23	3.28	3.32	3.37	3.41	3.46	3.51	3.55	3.60	3.64
29	2.92	2.97	3.02	3.06	3.11	3.16	3.21	3.25	3.30	3.35	3.39	3.44	3.49	3.54	3.58	3.63	3.68	3.72	3.77
30	3.02	3.07	3.12	3.17	3.22	3.27	3.32	3.36	3.41	3.46	3.51	3.56	3.61	3.66	3.71	3.75	3.80	3.85	3.90
31	3.12	3.17	3.22	3.27	3.32	3.37	3.43	3.48	3.53	3.58	3.63	3.68	3.73	3.78	3.83	3.88	3.93	3.98	4.03
32	3.22	3.28	3.33	3.38	3.43	3.48	3.54	3.59	3.64	3.69	3.74	3.79	3.85	3.90	3.95	4.00	4.05	4.11	4.16
33	3.32	3.38	3.43	3.48	3.54	3.59	3.64	3.70	3.75	3.81	3.86	3.91	3.97	4.02	4.07	4.13	4.18	4.23	4.29
34	3.42	3.48	3.53	3.59	3.64	3.70	3.75	3.81	3.87	3.92	3.98	4.03	4.09	4.14	4.20	4.25	4.31	4.36	4.42
35	3.52	3.58	3.64	3.69	3.75	3.81	3.86	3.92	3.98	4.03	4.09	4.15	4.21	4.26	4.32	4.38	4.43	4.49	4.55
36	3.62	3.68	3.74	3.80	3.86	3.92	3.97	4.03	4.09	4.15	4.21	4.27	4.32	4.38	4.44	4.50	4.56	4.62	4.68
37	3.72	3.78	3.84	3.90	3.96	4.02	4.08	4.14	4.20	4.26	4.32	4.38	4.44	4.50	4.56	4.62	4.68	4.74	4.80
38	3.82	3.88	3.95	4.01	4.07	4.13	4.19	4.25	4.32	4.38	4.44	4.50	4.56	4.62	4.69	4.75	4.81	4.87	4.93
39	3.92	3.99	4.05	4.11	4.18	4.24	4.30	4.37	4.43	4.49	4.56	4.62	4.68	4.75	4.81	4.87	4.94	5.00	5.06
40	4.02	4.09	4.15	4.22	4.28	4.35	4.41	4.48	4.54	4.61	4.67	4.74	4.80	4.87	4.93	5.00	5.06	5.13	5.19

METALS AND ALLOYS WITH LOW MELTING TEMPERATURE

L. I. Berger

Metal or Alloy System	Composition, %*		Melting Temperature °C	Comments	Ref.
	Weight	Atomic			
Hg	100	100	-38.84		
Cs-K	77.0-23.0	50.0-50.0	-37.5	Eutectic (?)	1
Cs-Na	94.5-5.5	75.0-25.0	-30.0	Eutectic	2
K-Na	76.7-23.3	65.9-34.1	-12.65	Eutectic	3
Na-Rb	8.0-92.0	24.4-75.6	-5	Eutectic	4
Ga-In-Sn	62.5-21.5-16.0	73.6-15.3-11.1	11	Eutectic	5
Ga-Sn-Zn	82.0-12.0-6.0	86.0-7.3-6.7	17	Eutectic	5
Cs	100	100	28.44		
Ga	100	100	29.77		
K-Rb	32.0-68.0	50-50	33	Eutectic	4
Bi-Cd-In-Pb-Sn	44.7-5.3-19.1-22.6-8.3	35.1-8.2-27.3-17.9-11.5	46.7	Eutectic	6
Bi-In-Pb-Sn	49.5-21.3-17.6-11.6	39.2-30.7-14.0-16.2	58.2	Eutectic	6
Bi-In-Sn	32.5-51.0-16.5	21.1-60.1-18.8	60.5	Eutectic	7
K	100	100	63.38		
Bi-Cd-Pb-Sn	50.0-12.5-25.0-12.5	41.5-19.3-21.0-18.2	70	Wood's alloy	6
Bi-In	33.0-67.0	21.3-78.7	72	Eutectic	8
Bi-Cd-Pb	51.6-8.2-40.2	48.1-14.2-37.7	91.5	Eutectic	6
Bi-Pb-Sn	52.5-32.0-15.5	46.8-28.7-24.5	95	Eutectic	6
Na	100	100	97.8		
Bi-Cd-Sn	54.0-20.0-26.0	39.4-27.2-33.4	102.5	Eutectic	6
In-Sn	51.8-48.2	52.6-47.4	119	Eutectic	9
Cd-In	25.3-74.7	25.7-74.3	120	Eutectic	10
Bi-Pb	55.5-44.5	55.3-44.7	124	Eutectic	11
Bi-Sn-Zn	56.0-40.0-4.0	40.2-50.6-9.2	130	Eutectic	6, 7
Bi-Sn	70-30	57.0-43.0	138.5	Eutectic	6, 12
Bi-Cd	60.3-39.7	45.0-55.0	145.5	Eutectic	13, 14
In	100	100	156.6		
Li	100	100	180.5		
Pb-Sn	38.1-61.9	26.1-73.9	183	Eutectic	6,15
Bi-Tl	48.0-52.0	47.5-52.5	185	Eutectic	13
Sn-Zn	91.0-9.0	85.0-15.0	198	Eutectic	14
Sb-Sn	8.0-92.0	7.8-92.2	199	White Metal	16
Au-Pb	14.6-85.4	15.2-84.8	212	Eutectic	17
Ag-Sn	3.5-96.5	3.8-96.2	221	Eutectic	13,18
Bi-Pb-Sb-Sn	48.0-28.5-9.0-14.5	40.8-24.5-13.1-21.6	226	Matrix Alloy	6
Cu-Sn	0.75-99.25	1.3-98.7	227	Eutectic	13, 19
Sn	100	100	231.9		

*The useful expression for correlations between the atomic and weight concentrations of an alloy components are:

$$f(a, A_k) = \frac{f(w, A_k)}{M_k \sum_{i=1}^N \frac{f(w, A_i)}{M_i}} \quad \text{and} \quad f(w, A_k) = \frac{M_k \cdot f(a, A_k)}{\sum_{i=1}^N M_i \cdot f(a, A_i)} \quad (i = 1, \dots, k, \dots, N)$$

where $f(a, A_i)$ and $f(w, A_i)$ are the atomic and weight concentrations of component A_i , respectively, and M_i is the atomic weight of this component.

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FLAME TEMPERATURES

This table gives the adiabatic flame temperature for stoichiometric mixtures of various fuels and oxidizers. The temperatures are calculated from thermodynamic and transport properties under ideal adiabatic conditions, using methods described in the reference.

REFERENCE

Fristrom, R. M., *Flame Structures and Processes*, Oxford University Press, New York, 1995.

Adiabatic Flame Temperature in K for Various Fuel-Oxidizer Combinations

Fuel	Oxidizer					
	Air	O ₂	F ₂	Cl ₂	N ₂ O	NO
Organic liquids and gases						
Acetaldehyde	2288					
Acetone	2253					
Acetylene	2607					
Benzene	2363					
Butane	2248					
Carbon disulfide	2257					
Cyanogen	2596	4855				
Cyclohexane	2250					
Cyclopropane	2370					
Decane	2286					
Ethane	2244					
Ethanol	2238					
Ethylene	2375					
Hexane	2238					
Methane	2236					
Methanol	2222					
Oxirane	2177					
Pentane	2250					
Propane	2250					
Toluene	2344					
Solids						
Aluminum		4005				
Lithium		2711				
Phosphorus (white)		3242				
Zirconium		4278				
Other						
Ammonia		2845				
Carbon monoxide	1388					
Diborane		3350				
Hydrazine		3037				
Hydrogen	2169	3000	4006	2493	2965	3127
Hydrogen sulfide	2091	3414				
Phosphine		3139				
Silane		3043				

DENSITY OF ETHANOL-WATER MIXTURES

This table gives the density of mixtures of ethanol and water as a function of composition and temperature. The composition is specified in weight percent of ethanol, i.e., mass of ethanol per 100 g of solution. Values from the reference have been converted to true densities.

REFERENCE

Washburn, E. W., Ed., *International Critical Tables of Numerical Data of Physics, Chemistry, and Technology*, Vol. 3, McGraw-Hill, New York, 1926-1932.

Weight % Ethanol	Density in g/cm ³						
	10 °C	15 °C	20 °C	25 °C	30 °C	35 °C	40 °C
0	0.99970	0.99910	0.99820	0.99705	0.99565	0.99403	0.99222
5	0.99095	0.99029	0.98935	0.98814	0.98667	0.98498	0.98308
10	0.98390	0.98301	0.98184	0.98040	0.97872	0.97682	0.97472
15	0.97797	0.97666	0.97511	0.97331	0.97130	0.96908	0.96667
20	0.97249	0.97065	0.96861	0.96636	0.96392	0.96131	0.95853
25	0.96662	0.96421	0.96165	0.95892	0.95604	0.95303	0.94988
30	0.95974	0.95683	0.95379	0.95064	0.94738	0.94400	0.94052
35	0.95159	0.94829	0.94491	0.94143	0.93787	0.93422	0.93048
40	0.94235	0.93879	0.93515	0.93145	0.92767	0.92382	0.91989
45	0.93223	0.92849	0.92469	0.92082	0.91689	0.91288	0.90881
50	0.92159	0.91773	0.91381	0.90982	0.90577	0.90165	0.89747
55	0.91052	0.90656	0.90255	0.89847	0.89434	0.89013	0.88586
60	0.89924	0.89520	0.89110	0.88696	0.88275	0.87848	0.87414
65	0.88771	0.88361	0.87945	0.87524	0.87097	0.86664	0.86224
70	0.87599	0.87184	0.86763	0.86337	0.85905	0.85467	0.85022
75	0.86405	0.85985	0.85561	0.85131	0.84695	0.84254	0.83806
80	0.85194	0.84769	0.84341	0.83908	0.83470	0.83027	0.82576
85	0.83948	0.83522	0.83093	0.82658	0.82218	0.81772	0.81320
90	0.82652	0.82225	0.81795	0.81360	0.80920	0.80476	0.80026
95	0.81276	0.80850	0.80422	0.79989	0.79553	0.79112	0.78668
100	0.79782	0.79358	0.78932	0.78504	0.78073	0.77639	0.77201

HANDLING AND DISPOSAL OF CHEMICALS IN LABORATORIES

Robert Joyce and Blaine C. McKusick

The following material has been extracted from two books prepared under the auspices of the Committee on Hazardous Substances in the Laboratory of the National Academy of Sciences — National Research Council. Readers are referred to these books for full details:

Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington, 1981.
Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, 1983.

The permission of the National Academy Press to use these extracts is gratefully acknowledged.

INCOMPATIBLE CHEMICALS

The term “incompatible chemicals” refers to chemicals that can react with each other

- Violently
- With evolution of substantial heat
- To produce flammable products
- To produce toxic products

Good laboratory safety practice requires that incompatible chemicals be stored, transported, and disposed of in ways that will prevent their coming together in the event of an accident. Tables 1 and 2 give some basic guidelines for the safe handling of acids, bases, reactive metals, and other chemicals. Neither of these tables is exhaustive, and additional information on incompatible chemicals can be found in the following references.

1. L. Bretherick, *Handbook of Reactive Chemical Hazards*, 3rd ed., Butterworths, London–Boston, 1985.
2. L. Bretherick, Ed., *Hazards in the Chemical Laboratory*, 3rd ed., Royal Society of Chemistry, London, 1981.
3. *Manual of Hazardous Chemical Reactions, A Compilation of Chemical Reactions Reported to be Potentially Hazardous*, National Fire Protection Association, NFPA 491M, 1975, NFPA, 470 Atlantic Avenue, Boston, MA 02210.

TABLE 1
General Classes of Incompatible Chemicals

A	B
Acids	Bases, reactive metals
Oxidizing agents ^a	Reducing agents ^a
Chlorates	Ammonia, anhydrous and aqueous
Chromates	Carbon
Chromium trioxide	Metals
Dichromates	Metal hydrides
Halogens	Nitrites
Halogenating agents	Organic compounds
Hydrogen peroxide	Phosphorus
Nitric acid	Silicon
Nitrates	Sulfur
Perchlorates	
Peroxides	
Permanganates	
Persulfates	

^a The examples of oxidizing and reducing agents are illustrative of common laboratory chemicals; they are not intended to be exhaustive.

HANDLING AND DISPOSAL OF CHEMICALS IN LABORATORIES (continued)

TABLE 2
Examples of Incompatible Chemicals

Chemical	Is incompatible with
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanaganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric and sulfuric acid mixtures
Alkali and alkaline earth metals (such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See Chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Everything
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury

HANDLING AND DISPOSAL OF CHEMICALS IN LABORATORIES (continued)

TABLE 2
Examples of Incompatible Chemicals (continued)

Chemical	Is incompatible with
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate (see also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, surfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartartic acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents

EXPLOSION HAZARDS

Table 3 lists some common classes of laboratory chemicals that have potential for producing a violent explosion when subjected to shock or friction. These chemicals should never be disposed of as such, but should be handled by procedures given in *Prudent Practices for Disposal of Chemicals from Laboratories*, National Academy Press, 1983, chapters 6 and 7. Additional information on these, as well as on some less common classes of explosives, can be found in L. Bretherick, *Handbook of Reactive Chemical Hazards*, 3rd ed., Butterworths, London-Boston, 1985.

Table 4 lists some illustrative combinations of common laboratory reagents that can produce explosions when they are brought together or that form reaction products that can explode without any apparent external initiating action. This list is not exhaustive, and additional information on potentially explosive reagent combinations can be found in *Manual of Hazardous Chemical Reactions, A Compilation of Chemical Reactions Reported to be Potentially Hazardous*, National Fire Protection Association, NFPA 491M, 1975, NFPA, 470 Atlantic Avenue, Boston, MA 02210.

WATER-REACTIVE CHEMICALS

Table 5 lists some common laboratory chemicals that react violently with water and that should always be stored and handled so that they do not come into contact with liquid water or water vapor. Procedures for decomposing laboratory quantities are given in *Prudent Practices for Disposal of Chemicals from Laboratories*, chapter 6; the pertinent section of that chapter is given in parentheses.

PYROPHORIC CHEMICALS

Many members of the classes of readily oxidized, common laboratory chemicals listed in Table 6 ignite spontaneously in air. A more extensive list can be found in L. Bretherick, *Handbook of Reactive Chemical Hazards*, 3rd ed., Butterworths, London-Boston, 1985. Pyrophoric chemicals should be stored in tightly closed containers under an inert atmosphere (or, for some, an inert liquid), and all transfers and manipulations of them must be carried out under an inert atmosphere or liquid. Suggested procedures for decomposing them are given in *Prudent Practices for Disposal of Chemicals from Laboratories*, chapter 6; the pertinent section of that chapter is given in parentheses.

HANDLING AND DISPOSAL OF CHEMICALS IN LABORATORIES (continued)

TABLE 3
Shock-Sensitive Compounds

Acetylenic compounds, especially polyacetylenes, haloacetylenes, and heavy metal salts of acetylenes (copper, silver, and mercury salts are particularly sensitive)

Acyl nitrates

Alkyl nitrates, particularly polyol nitrates such as nitrocellulose and nitroglycerine

Alkyl and acyl nitrites

Alkyl perchlorates

Amminemetal oxosalts: metal compounds with coordinated ammonia, hydrazine, or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate, or other oxidizing group

Azides, including metal, nonmetal, and organic azides

Chlorite salts of metals, such as AgClO_2 and $\text{Hg}(\text{ClO}_2)_2$

Diazo compounds such as CH_2N_2

Diazonium salts, when dry

Fulminates (silver fulminate, AgCNO , can form in the reaction mixture from the Tollens' test for aldehydes if it is allowed to stand for some time; this can be prevented by adding dilute nitric acid to the test mixture as soon as the test has been completed)

Hydrogen peroxide becomes increasingly treacherous as the concentration rises above 30%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals

N-Halogen compounds such as difluoroamino compounds and halogen azides

N-Nitro compounds such as *N*-nitromethylamine, nitrourea, nitroguanidine, and nitric amide

Oxo salts of nitrogenous bases: perchlorates, dichromates, nitrates, iodates, chlorites, chlorates, and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.

Perchlorate salts. Most metal, nonmetal, and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials

Peroxides and hydroperoxides, organic (see Chapter 6, Section II.P)

Peroxides (solid) that crystallize from or are left from evaporation of peroxidizable solvents (see Chapter 6 and Appendix I)

Peroxides, transition-metal salts

Picrates, especially salts of transition and heavy metals, such as Ni, Pb, Hg, Cu, and Zn; picric acid is explosive but is less sensitive to shock or friction than its metal salts and is relatively safe as a water-wet paste (see Chapter 7)

Polynitroalkyl compounds such as tetranitromethane and dinitroacetonitrile

Polynitroaromatic compounds, especially polynitro hydrocarbons, phenols, and amines

TABLE 4
Potentially Explosive Combinations of Some Common Reagents

Acetone + chloroform in the presence of base

Acetylene + copper, silver, mercury, or their salts

Ammonia (including aqueous solutions) + Cl_2 , Br_2 , or I_2

Carbon disulfide + sodium azide

Chlorine + an alcohol

Chloroform or carbon tetrachloride + powdered Al or Mg

Decolorizing carbon + an oxidizing agent

Diethyl ether + chlorine (including a chlorine atmosphere)

Dimethyl sulfoxide + an acyl halide, SOCl_2 , or POCl_3

Dimethyl sulfoxide + CrO_3

Ethanol + calcium hypochlorite

Ethanol + silver nitrate

Nitric acid + acetic anhydride or acetic acid

Picric acid + a heavy-metal salt, such as of Pb, Hg, or Ag

Silver oxide + ammonia + ethanol

Sodium + a chlorinated hydrocarbon

Sodium hypochlorite + an amine

TABLE 5
Water-Reactive Chemicals

Alkali metals (III.D)
 Alkali metal hydrides (III.C.2)
 Alkali metal amides (III.C.7)
 Metal alkyls, such as lithium alkyls and aluminum alkyls (IV.A)
 Grignard reagents (IV.A)
 Halides of nonmetals, such as BCl_3 , BF_3 , PCl_3 , PCl_5 , SiCl_4 , S_2Cl_2 (III.F)
 Inorganic acid halides, such as POCl_3 , SOCl_2 , SO_2Cl_2 (III.F)
 Anhydrous metal halides, such as AlCl_3 , TiCl_4 , ZrCl_4 , SnCl_4 (III.E)
 Phosphorus pentoxide (III.I)
 Calcium carbide (IV.E)
 Organic acid halides and anhydrides of low molecular weight (II.J)

TABLE 6
Classes of Pyrophoric Chemicals

Grignard reagents, RMgX (IV.A)
 Metal alkyls and aryls, such as RLi , RNa , R_3Al , R_2Zn (IV.A)
 Metal carbonyls, such as $\text{Ni}(\text{CO})_4$, $\text{Fe}(\text{CO})_5$, $\text{Co}_2(\text{CO})_8$ (IV.B)
 Alkali metals such as Na , K (III.D.I)
 Metal powders, such as Al , Co , Fe , Mg , Mn , Pd , Pt , Ti , Sn , Zn , Zr (III.D.2)
 Metal hydrides, such as NaH , LiAlH_4 (IV.C.2)
 Nonmetal hydrides, such as B_2H_6 and other boranes, PH_3 , AsH_3 (III.G)
 Nonmetal alkyls, such as R_3B , R_3P , R_3As (IV.C)
 Phosphorus (white) (III.H)

HAZARDS FROM PEROXIDE FORMATION

Many common laboratory chemicals can form peroxides when allowed access to air over a period of time. A single opening of a container to remove some of the contents can introduce enough air for peroxide formation to occur. Some types of compounds form peroxides that are treacherously and violently explosive in concentrated solution or as solids. Accordingly, peroxide-containing liquids should never be evaporated near to or to dryness. Peroxide formation can also occur in many polymerizable unsaturated compounds, and these peroxides can initiate a runaway, sometimes explosive, polymerization reaction. Procedures for testing for peroxides and for removing small amounts from laboratory chemicals are given in Prudent Practices for Disposal of Chemicals from Laboratories, chapter 6, Section II.P.

Table 7 provides a list of structural characteristics in organic compounds that can peroxidize. These structures are listed in approximate order of decreasing hazard. Reports of serious incidents involving the last five structural types are extremely rare, but these structures are listed because laboratory workers should be aware that they can form peroxides that can influence the course of experiments in which they are used.

Table 8 gives examples of common laboratory chemicals that are prone to form peroxides on exposure to air. The lists are not exhaustive, and analogous organic compounds that have any of the structural features given in Table 7 should be tested for peroxides before being used as solvents or reagents, or before being distilled. The recommended retention times begin with the date of synthesis or of opening the original container.

DISPOSAL OF TOXIC CHEMICALS

It is often desirable to precipitate toxic cations or hazardous anions from solution to facilitate recovery or disposal. Table 9 lists precipitants for many common cations, and Table 10 gives precipitants for some hazardous anions. Many cations can be precipitated as sulfides by adding sodium sulfide solution (preferable to the highly toxic hydrogen sulfide) to a neutral solution of the cation (Table 11). Control of pH is important because some sulfides will redissolve in excess sulfide ion. After precipitation, excess sulfide can be destroyed by addition of hypochlorite.

Most metal cations are precipitated as hydroxides or oxides at high pH. Since many of these precipitates will redissolve in excess base, it is often necessary to control pH. Table 12 shows the recommended pH range for precipitating many cations in their most common oxidation state. The notation "1 N" in the right-hand column indicates that the precipitate will not dissolve in 1 N sodium hydroxide (pH 14).

The distinctions between high and low toxicity or hazard are based on toxicological and other data, and are relative. There is no implication of a sharp distinction between high and low, or that any cations or anions are totally without hazard.

TABLE 7
Types of Chemicals That Are Prone to Form Peroxides

A. Organic structures (in approximate order of decreasing hazard)

1.	$\begin{array}{c} \text{H} \\ | \\ \diagdown \text{C} - \text{O} - \diagup \end{array}$	Ethers and acetals with a hydrogen atoms
2.	$\begin{array}{c} \text{H} \\ | \\ \diagdown \text{C} = \text{C} - \text{C} \diagup \\ | \end{array}$	Olefins with allylic hydrogen atoms
3.	$\begin{array}{c} \text{X} \\ | \\ \diagdown \text{C} = \text{C} - \diagup \end{array}$	Chloroolefins and fluoroolefins
4.	$\text{CH}_2 = \text{C} \diagup \diagdown$	Vinyl halides, esters, and ethers
5.	$\begin{array}{c} \diagdown \text{C} = \text{C} - \text{C} = \text{C} \diagup \\ | \end{array}$	Dienes
6.	$\begin{array}{c} \text{H} \\ | \\ \diagdown \text{C} = \text{C} - \text{C} \equiv \text{CH} \diagup \\ | \end{array}$	Vinylacetylenes with α hydrogen atoms
7.	$\begin{array}{c} \text{H} \\ | \\ \diagdown \text{C} - \text{C} \equiv \text{CH} \diagup \\ | \end{array}$	Alkylacetylenes with α hydrogen atoms
8.	$\begin{array}{c} \text{H} \\ | \\ \diagdown \text{C} - \text{Ar} \diagup \\ | \end{array}$	Alkylarenes that contain tertiary hydrogen atoms
9.	$\begin{array}{c} | \\ - \text{C} - \text{H} \\ | \end{array}$	Alkanes and cycloalkanes that contain tertiary hydrogen atoms
10.	$\begin{array}{c} | \\ \diagdown \text{C} = \text{C} - \text{CO}_2\text{R} \diagup \\ | \end{array}$	Acrylates and methacrylates
11.	$\begin{array}{c} \text{H} \\ | \\ \diagdown \text{C} - \text{OH} \diagup \\ | \end{array}$	Secondary alcohols
12.	$\begin{array}{c} \text{O} \quad \text{H} \\ || \quad | \\ - \text{C} - \text{C} \diagup \diagdown \\ | \end{array}$	Ketones that contain a hydrogen atoms
13.	$\begin{array}{c} \text{H} \\ | \\ - \text{C} = \text{O} \end{array}$	Aldehydes
14.	$\begin{array}{c} \text{O} \quad \text{H} \quad \text{H} \\ || \quad | \quad | \\ - \text{C} - \text{N} - \text{C} \diagup \diagdown \\ | \end{array}$	Ureas, amides, and lactams that have a hydrogen atom on a carbon atom attached to nitrogen

TABLE 7
Types of Chemicals That Are Prone to Form Peroxides (continued)

B. Inorganic substances

1. Alkali metals, especially potassium, rubidium, and cesium (see Chapter 6, Section III.D)
2. Metal amides (see Chapter 6, Section III.C.7)
3. Organometallic compounds with a metal atom bonded to carbon (see Chapter 6, Section IV)
4. Metal alkoxides

TABLE 8
Common Peroxide-Forming Chemicals

LIST A

Severe Peroxide Hazard on Storage with Exposure to Air

Discard within 3 months

- | | |
|---------------------------------------|--|
| • Diisopropyl ether (isopropyl ether) | • Sodium amide (sodamide) |
| • Divinylacetylene (DVA) ^a | • Vinylidene chloride (1,1-dichloro-ethylene) ^a |
| • Potassium metal | |
| • Potassium amide | |

LIST B

Peroxide Hazard on Concentration; Do Not Distill or Evaporate Without First Testing for the Presence of Peroxides

Discard or test for peroxides after 6 months

- | | |
|--|---|
| • Acetaldehyde diethyl acetal | • Dioxane |
| • Cumene (isopropylbenzene) | • Ethylene glycol dimethyl ether (glyme) |
| • Cyclohexene | • Ethylene glycol ether acetates |
| • Cyclopentene | • Ethylene glycol monoethers (cello-solves) |
| • Decalin (decahydronaphthalene) | • Furan |
| • Diacetylene | • Methylacetylene |
| • Dicyclopentadiene | • Methylcyclopentane |
| • Diethyl ether (ether) | • Methyl isobutyl ketone |
| • Diethylene glycol dimethyl ether (diglyme) | • Tetrahydrofuran (THF) |
| | • Tetralin (tetrahydronaphthalene) |
| | • Vinyl ethers ^a |

LIST C

Hazard of Rapid Polymerization Initiated by Internally Formed Peroxides^a

a. Normal Liquids; Discard or test for peroxides after 6 months^b

- | | |
|---|-----------------|
| • Chloroprene (2-chloro-1,3-butadiene) ^c | • Vinyl acetate |
| • Styrene | • Vinylpyridine |

b. Normal Gases; Discard after 12 months^d

- | | |
|--|-------------------------------------|
| • Butadiene ^c | • Vinylacetylene (MVA) ^c |
| • Tetrafluoroethylene (TFE) ^c | • Vinyl chloride |

^a Polymerizable monomers should be stored with a polymerization inhibitor from which the monomer can be separated by distillation just before use.

^b Although common acrylic monomers such as acrylonitrile, acrylic acid, ethyl acrylate, and methyl methacrylate can form peroxides, they have not been reported to develop hazardous levels in normal use and storage.

^c The hazard from peroxides in these compounds is substantially greater when they are stored in the liquid phase, and if so stored without an inhibitor they should be considered as in LIST A.

TABLE 8
Common Peroxide-Forming Chemicals (continued)

^d Although air will not enter a gas cylinder in which gases are stored under pressure, these gases are sometimes transferred from the original cylinder to another in the laboratory, and it is difficult to be sure that there is no residual air in the receiving cylinder. An inhibitor should be put into any such secondary cylinder before one of these gases is transferred into it; the supplier can suggest inhibitors to be used. The hazard posed by these gases is much greater if there is a liquid phase in such a secondary container, and even inhibited gases that have been put into a secondary container under conditions that create a liquid phase should be discarded within 12 months.

Note: Laboratory workers should label all containers of peroxidizable solvents or reagents with one of the following:

[LIST A]

	Peroxidizable compound	
	Received	Opened
Date	_____	_____
	Discard 3 months after opening	

[LISTS B AND C]

	Peroxidizable compound	
	Received	Opened
Date	_____	_____
	Discard or test for peroxides 6 months after opening	

TABLE 9
Relative Toxicity of Cations

High toxic hazard	Precipitant ^a	Low toxic hazard	Precipitant ^a
Antimony	OH ⁻ , S ²⁻	Aluminum	OH ⁻
Arsenic	S ²⁻	Bismuth	OH ⁻ , S ²⁻
Barium	SO ₄ ²⁻ , CO ₃ ²⁻	Calcium	SO ₄ ²⁻ , CO ₃ ²⁻
Beryllium	OH ⁻	Cerium	OH ⁻
Cadmium	OH ⁻ , S ²⁻	Cesium	
Chromium (III) ^b	OH ⁻	Copper ^c	OH ⁻ , S ²⁻
Cobalt (II) ^b	OH ⁻ , S ²⁻	Gold	OH ⁻ , S ²⁻
Gallium	OH ⁻	Iron ^c	OH ⁻ , S ²⁻
Germanium	OH ⁻ , S ²⁻	Lanthanides	OH ⁻
Hafnium	OH ⁻	Lithium	
Indium	OH ⁻ , S ²⁻	Magnesium	OH ⁻
Iridium	OH ⁻ , S ²⁻	Molybdenum (VI) ^{b,d}	
Lead	OH ⁻ , S ²⁻	Niobium (V)	OH ⁻
Manganese (II) ^b	OH ⁻ , S ²⁻	Palladium	OH ⁻ , S ²⁻
Mercury	OH ⁻ , S ²⁻	Potassium	
Nickel	OH ⁻ , S ²⁻	Rubidium	
Osmium (IV) ^{b,e}	OH ⁻ , S ²⁻	Scandium	OH ⁻
Platinum (II) ^b	OH ⁻ , S ²⁻	Sodium	
Rhenium (VII) ^b	S ²⁻	Strontium	SO ₄ ²⁻ , CO ₃ ²⁻
Rhodium (III) ^b	OH ⁻ , S ²⁻	Tantalum	OH ⁻
Ruthenium (III) ^b	OH ⁻ , S ²⁻	Tin	OH ⁻ , S ²⁻
Selenium	S ²⁻	Titanium	OH ⁻
Silver	Cl ⁻ , OH ⁻ , S ²⁻	Yttrium	OH ⁻
Tellurium	S ²⁻	Zinc ^c	OH ⁻ , S ²⁻
Thallium	OH ⁻ , S ²⁻	Zirconium	OH ⁻
Tungsten (VI) ^{b,d}			
Vanadium	OH ⁻ , S ²⁻		

HANDLING AND DISPOSAL OF CHEMICALS IN LABORATORIES (continued)

TABLE 9
Relative Toxicity of Cations (continued)

- ^a Precipitants are listed in order of preference:
 OH⁻ = base (sodium hydroxide or sodium carbonate)
 S²⁻ = sulfide
 Cl⁻ = chloride
 SO₄²⁻ = sulfate
 CO₃²⁻ = carbonate
- ^b The precipitant is for the indicated valence state.
- ^c Maximum tolerance levels have been set for these low-toxicity ions by the U.S. Public Health Service, and large amounts should not be put into public sewer systems. The small amounts typically used in laboratories will not normally affect water supplies.
- ^d These ions are best precipitated as calcium molybdate or calcium tungstate.
- ^e CAUTION: OsO₄, a volatile, extremely poisonous substance, is formed from almost any osmium compound under acid conditions in the presence of air.

TABLE 10
Relative Hazard of Anions

High-hazard anions			
Ion	Hazard type ^a	Precipitant	Low-hazard anions
Aluminum hydride, AlH ₄ ⁻	F	—	Bisulfite, HSO ₃ ⁻
Amide, NH ₂ ⁻	F, E ^b	—	Borate, BO ₃ ³⁻ , B ₄ O ₇ ²⁻
Arsenate, AsO ₃ ³⁻ , AsO ₄ ³⁻	T	Cu ²⁺ , Fe ²⁺	Bromide, Br ⁻
Arsenite, AsO ₂ ³⁻ , AsO ₃ ³⁻	T	Pb ²⁺	Carbonate, CO ₃ ²⁻
Azide, N ₃ ⁻	E, T	—	Chloride, Cl ⁻
Borohydride, BH ₄ ⁻	F	—	Cyanate, OCN ⁻
Bromate, BrO ₃ ⁻	O, E	—	Hydroxide, OH ⁻
Chlorate, ClO ₃ ⁻	O, E	—	Iodide, I ⁻
Chromate, CrO ₄ ²⁻ , Cr ₂ O ₇ ²⁻	T, O	^c	Oxide, O ²⁻
Cyanide, CN ⁻	T	—	Phosphate, PO ₄ ³⁻
Ferricyanide, Fe(CN) ₆ ³⁻	T	Fe ²⁺	Sulfate, SO ₄ ²⁻
Ferrocyanide, Fe(CN) ₆ ⁴⁻	T	Fe ³⁺	Sulfite, SO ₃ ²⁻
Fluoride, F ⁻	T	Ca ²⁺	Thiocyanate, SCN ⁻
Hydride, H ⁻	F	—	
Hydroperoxide, O ₂ H ⁻	O, E	—	
Hydrosulfide, SH ⁻	T	—	
Hypochlorite, OCl ⁻	O	—	
Iodate, IO ₃ ⁻	O, E	—	
Nitrate, NO ₃ ⁻	O	—	
Nitrite, NO ₂ ⁻	T, O	—	
Perchlorate, ClO ₄ ⁻	O, E	—	
Permanganate, MnO ₄ ⁻	T, O	^d	
Peroxide, O ₂ ²⁻	O, E	—	
Persulfate, S ₂ O ₈ ²⁻	O	—	
Selenate, SeO ₄ ²⁻	T	Pb ²⁺	
Selenide, Se ²⁻	T	Cu ²⁺	
Sulfide, S ²⁻	T	^e	

^a Toxic, T; oxidant, O; flammable, F; explosive, E.

^b Metal amides readily form explosive peroxides on exposure to air.

^c Reduce and precipitate as Cr(III); see Table 9.

^d Reduce and precipitate as Mn(II); see Table 9.

^e See Table 11.

TABLE 11
Precipitation of Sulfides

Precipitated at pH 7	Not precipitated at low pH	Forms a soluble complex at high pH
Ag ⁺		
As ^{3+*}		X
Au ³⁺		X
Bi ³⁺		
Cd ²⁺		
Co ²⁺	X	
Cr ^{3+*}		
Cu ²⁺		
Fe ^{2+*}	X	
Ge ²⁺		X
Hg ²⁺		X
In ³⁺	X	
Ir ⁴⁺		X
Mn ^{2+*}	X	
Mo ³⁺		X
Ni ²⁺	X	
Os ⁴⁺		
Pb ²⁺		
Pd ^{2+*}		
Pt ^{2+*}		X
Re ⁴⁺		
Rh ^{2+*}		
Ru ⁴⁺		
Sb ^{3+*}		X
Se ²⁺		X
Sn ²⁺		X
Te ⁴⁺		X
Tl ³⁺	X	
V ^{4+*}		
Zn ²⁺	X	

*Higher oxidation states of this ion are reduced by sulfide ion and precipitated as this sulfide.

TABLE 12
pH Range for Precipitation of Metal Hydroxides and Oxides

	1	2	3	4	5	6	7	8	9	10	
Ag ¹⁺											
Al ³⁺											
As ³⁺	Not precipitated (precipitate as sulfide)										
As ⁵⁺	Not precipitated (precipitate as sulfide)										
Au ³⁺											
Be ²⁺											
Bi ³⁺											
Cd ²⁺											
Co ²⁺											
Cr ³⁺											
Cu ¹⁺											

TABLE 12
pH Range for Precipitation of Metal
Hydroxides and Oxides (continued)

	1	2	3	4	5	6	7	8	9	10	
Cu ²⁺								—————→			1 N
Fe ²⁺								—————→			1 N
Fe ³⁺								—————→			1 N
Ga ³⁺								—————			
Ge ³⁺							—————				
Hf ⁴⁺							—————				
Hg ¹⁺								—————→			1 N
Hg ²⁺								—————→			1 N
In ³⁺							—————→				pH 13
Ir ⁴⁺							—————				
Mg ²⁺									—————→		1 N
Mn ²⁺								—————→			1 N
Mn ⁴⁺								—————→			1 N
Mo ⁶⁺	Not precipitated (precipitate as Ca salt)										
Nb ⁵⁺		—————→									
Ni ²⁺									—————→		1 N
Os ⁴⁺								—————			
Pb ²⁺								—————			
Pd ²⁺								—————			
Pd ⁴⁺								—————			
Pt ²⁺								—————			
Re ³⁺							—————→				1 N
Re ⁷⁺	Not precipitated (precipitate as sulfide)										
Rh ³⁺								—————			
Ru ³⁺								—————→			1 N
Sb ³⁺								—————			
Sb ⁵⁺								—————			
Sc ³⁺								—————→			1 N
Se ⁴⁺	Not precipitated (precipitate as sulfide)										
Se ⁶⁺	Not precipitated (precipitate as sulfide)										
Sn ²⁺								—————			
Sn ⁴⁺								—————			
Ta ⁵⁺		—————→									
Te ⁴⁺	Not precipitated (precipitate as sulfide)										
Te ⁶⁺	Not precipitated (precipitate as sulfide)										
Th ⁴⁺							—————→				1 N
Ti ³⁺								—————→			1 N
Ti ⁴⁺								—————→			1 N
Tl ¹⁺									—————→		1 N
V ⁴⁺								—————			
V ⁵⁺								—————			
W ⁶⁺	Not precipitated (precipitate as Ca salt)										
Zn ²⁺								—————			
Zr ⁴⁺							—————				

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D. T. Burns, A. Townsend, and A. H. Carter, *Inorganic Reaction Chemistry*, Vol. 2, Ellis Horwood, New York, 1981.

HANDLING AND DISPOSAL OF CHEMICALS IN LABORATORIES (continued)

FIRE HAZARDS

Flammable solvents are a common source of laboratory fires. The relative ease with which some common laboratory solvents can be ignited is indicated by the following properties.

Flash Point— The lowest temperature, as determined by standard tests, at which a liquid emits vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid in a test vessel. Note that many of these common chemicals have flash points below room temperature.

Ignition Temperature— The minimum temperature required to initiate self-sustained combustion, regardless of the heat source.

Flammable Limits— The lower flammable limit is the minimum concentration (percent by volume) of a vapor in air below which a flame is not propagated when an ignition source is present. Below this concentration the mixture is too lean to burn. The upper flammable limit is the maximum concentration (percent by volume) of the vapor in air above which a flame is not propagated. Above this concentration the mixture is too rich to burn. The flammable range comprises all concentrations between these two limits. This range becomes wider with increasing temperature and in oxygen-rich atmospheres. Table 13 lists these properties for a few common laboratory chemicals.

GLOVE MATERIALS

It is good safety practice (and mandated in some laboratories) to wear rubber gloves while handling chemicals that can cause injury when in contact with, or absorbed through, the skin. The various common rubbers are not equally resistant to all chemicals. Table 14 provides guidelines for selecting the best, and avoiding the poorest, glove material for handling a given chemical.

RESPIRATORS

In the event of a laboratory accident or spill, it will be necessary for someone to enter the contaminated area for cleanup. If significant quantities of a chemical are spilled, or even minor quantities of a known toxic material, it is essential to wear the correct kind of respirator equipment when entering the area. If it is not known whether the contamination is of a chemical "Immediately dangerous to life or health", the prudent course is to assume that it is, and to use the corresponding type of respirator. Guidelines are presented in Table 15.

TABLE 13
Flash Points, Boiling Points, Ignition Temperatures, and Flammable Limits of
Some Common Laboratory Chemicals

Chemical	Flash point (°C)	Boiling point (°C)	Ignition temp. (°C)	Flammable limit (percent by volume in air)	
				Lower	Upper
Acetaldehyde	-37.8	21.1	175.0	4.0	60.0
Acetone	-19.0	56.0	538.0	2.6	12.8
Benzene	-11.1	80.1	560.0	1.4	8.0
Carbon disulfide	-30.0	45.8	90.0	1.0	44.0
Cyclohexane	-18.0	80.7	260.0	1.3	8.0
Diethyl ether	-45.0	34.4	160.0	1.8	48.0
Ethanol	12.0	78.3	363.0	3.3	19.0
<i>n</i> -Heptane	-3.9	98.4	204.0	1.0	6.7
<i>n</i> -Hexane	-21.7	68.7	223.0	1.2	7.5
Isopropyl alcohol	11.7	82.2	398.9	2.0	12.0
Methanol	11.1	64.5	385.0	6.0	36.5
Methyl ethyl ketone	-6.1	79.6	515.6	1.9	11.0
Pentane	-40.0	36.1	260.0	1.4	7.8
Styrene	31.0	145.0	490.0	1.1	6.1
Toluene	4.4	110.6	530.0	1.3	7.0
<i>p</i> -Xylene	25.0	132.4	529.0	1.1	7.0

Note: For a more extensive listing, see the table "Properties of Common Solvents" in Section 15.

TABLE 14
Resistance to Chemicals of Common Glove Materials
(E = Excellent, G = Good, F = Fair, P = Poor)

Chemical	Natural rubber	Neoprene	Nitrile	Vinyl
Acetaldehyde	G	G	E	G
Acetic acid	E	E	E	E
Acetone	G	G	G	F
Acrylonitrile	P	G	—	F
Ammonium hydroxide (sat)	G	E	E	E
Aniline	F	G	E	G
Benzaldehyde	F	F	E	G
Benzene ^a	P	F	G	F
Benzyl chloride ^a	F	P	G	P
Bromine	G	G	—	G
Butane	P	E	—	P
Butyraldehyde	P	G	—	G
Calcium hypochlorite	P	G	G	G
Carbon disulfide	P	P	G	F
Carbon tetrachloride ^a	P	F	G	F
Chlorine	G	G	—	G
Chloroacetone	F	E	—	P
Chloroform ^a	P	F	G	P
Chromic acid	P	F	F	E
Cyclohexane	F	E	—	P
Dibenzyl ether	F	G	—	P
Dibutyl phthalate	F	G	—	P
Diethanolamine	F	E	—	E
Diethyl ether	F	G	E	P
Dimethyl sulfoxide ^b	—	—	—	—
Ethyl acetate	F	G	G	F
Ethylene dichloride ^a	P	F	G	
Ethylene glycol	G	G	E	E
Ethylene trichloride ^a	P	P	—	P
Fluorine	G	G	—	G
Formaldehyde	G	E	E	E
Formic acid	G	E	E	E
Glycerol	G	G	E	E
Hexane	P	E	—	P
Hydrobromic acid (40%)	G	E	—	E
Hydrochloric acid (conc)	G	G	G	E
Hydrofluoric acid (30%)	G	G	G	E
Hydrogen peroxide	G	G	G	E
Iodine	G	G	—	G
Methylamine	G	G	E	E
Methyl cellosolve	F	E	—	P
Methyl chloride ^a	P	E	—	P
Methyl ethyl ketone	F	G	G	P
Methylene chloride ^a	F	F	G	F
Monoethanolamine	F	E	—	E
Morpholine	F	E	—	E
Naphthalene ^a	G	G	E	G
Nitric acid (conc)	P	P	P	G
Perchloric acid	F	G	F	E
Phenol	G	E	—	E
Phosphoric acid	G	E	—	E
Potassium hydroxide (sat)	G	G	G	E

TABLE 14
Resistance to Chemicals of Common Glove Materials
(E = Excellent, G = Good, F = Fair, P = Poor) (continued)

Chemical	Natural rubber	Neoprene	Nitrile	Vinyl
Propylene dichloride ^a	P	F	—	P
Sodium hydroxide	G	G	G	E
Sodium hypochlorite	G	P	F	G
Sulfuric acid (conc)	G	G	F	G
Toluene ^a	P	F	G	F
Trichloroethylene ^a	P	F	G	F
Tricresyl phosphate	P	F	—	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	E	—	P

^a Aromatic and halogenated hydrocarbons will attack all types of natural and synthetic glove materials. Should swelling occur, the user should change to fresh gloves and allow the swollen gloves to dry and return to normal.

^b No data on the resistance to dimethyl sulfoxide of natural rubber, neoprene, nitrile rubber, or vinyl materials are available; the manufacturer of the substance recommends the use of butyl rubber gloves.

TABLE 15
Guide for Selection of Respirators

Type of hazard	Type of respirator
Oxygen deficiency	Self-contained breathing apparatus Hose mask with blower Combination of air-line respirator and auxiliary self-contained air supply or air-storage receiver with alarm
Gas and vapor contaminants Immediately dangerous to life or health	Self-contained breathing apparatus Hose mask with blower Air-purifying full-facepiece respirator with chemical canister (gas mask) Self-rescue mouthpiece respirator (for escape only) Combination of air-line respirator and auxiliary self-contained air supply or air-storage receiver with alarm
Not immediately dangerous to life or health	Air-line respirator Hose mask with blower Air-purifying half-mask or mouthpiece respirator with chemical cartridge
Particulate Contaminants Immediately dangerous to life or health	Self-contained breathing apparatus Hose mask with blower Air-purifying full-facepiece respirator with appropriate filter Self-rescue mouthpiece respirator (for escape only) Combination of air-line respirator and auxiliary self-contained air supply or air-storage receiver with alarm

TABLE 15
Guide for Selection of Respirators (continued)

Type of hazard	Type of respirator
Not immediately dangerous to life or health	Air-purifying half-mask or mouthpiece respirator with filter pad or cartridge Air-line respirator Air-line abrasive-blasting respirator Hose mask with blower
Combination of gas, vapor, and particulate contaminants Immediately dangerous to life or health	Self-contained breathing apparatus Hose mask with blower Air-purifying full-facepiece respirator with chemical canister and appropriate filter (gas mask with filter) Self-rescue mouthpiece respirator (for escape only) Combination of air-line respirator and auxiliary self-contained air supply or air-storage receiver with alarm
Not immediately dangerous to life or health	Air-line respirator Hose mask without blower Air-purifying half-mask or mouthpiece respirator with chemical cartridge and appropriate filter

Source: ANSI Standard Z88.2 (1969).

FLAMMABILITY OF CHEMICAL SUBSTANCES

This table gives properties related to the flammability of about 900 chemical substances. The properties listed are:

t_B : Normal boiling point in °C (at 101.325 kPa pressure).

FP: Flash point, which is the minimum temperature at which the vapor pressure of a liquid is sufficient to form an ignitable mixture with air near the surface of the liquid. Flash point is not an intrinsic physical property but depends on the conditions of measurement (see Reference 1).

Fl. Limits: Flammable limits (often called explosive limits), which specify the range of concentration of the vapor in air (in percent by volume) for which a flame can propagate. Below the lower flammable limit, the gas mixture is too lean to burn; above the upper flammable limit, the mixture is too rich. Values refer to ambient temperature and pressure and are dependent on the precise test conditions. A ? indicates that one of the limits is not known.

IT: Ignition temperature (sometimes called autoignition temperature), which is the minimum temperature required for self-sustained combustion in the absence of an external ignition source. As in the case of flash point, the value depends on specified test conditions.

Even in cases where very careful measurements of flash point have been replicated in several laboratories, observed values can differ by 3 to 6°C (Reference 4). For more typical measurements, larger uncertainties should be assumed in both flash points and autoignition temperatures. The absence of a flash point entry in this table does not mean that the substance is nonflammable, but only that no reliable value is available.

Compounds are listed by molecular formula following the Hill convention. Substances not containing carbon are listed first, followed by those that contain carbon. To locate an organic compound by name or CAS Registry Number when the molecular formula is not known, use the table "Physical Constants of Organic Compounds" in Section 3 and its indexes to determine the molecular formula.

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3. Daubert, T.E., Danner, R.P., Sibul, H.M., and Stebbins, C.C., *Physical and Thermodynamic Properties of Pure Compounds: Data Compilation*, extant 1994 (core with 4 supplements), Taylor & Francis, Bristol, PA.
4. *Report of Investigation: Flash Point Reference Materials*, National Institute of Standards and Technology, Standard Reference Materials Program, Gaithersburg, MD, 1995.

Mol. Form.	Name	t_B /°C	FP/°C	Fl. Limits	IT/°C
Compounds not containing carbon					
B ₂ H ₆	Diborane	-92.4	-90	1-98%	≈40
B ₅ H ₉	Pentaborane(9)	60	30	0.4-?	35
BrH ₃ Si	Bromosilane	1.9	<0		≈20
Br ₃ HSi	Tribromosilane	109			≈20
Cl ₂ H ₂ Si	Dichlorosilane	8.3		4.1-99%	36
Cl ₃ HSi	Trichlorosilane	33	-50		104
GeH ₄	Germane	-88.1			≈20
Ge ₂ H ₆	Digermane	29			≈50
H ₂	Hydrogen	-252.8		4-74%	
H ₂ S	Hydrogen sulfide	-59.55		4-44%	260
H ₂ S ₂	Hydrogen disulfide	70.7	<22		
H ₂ Te	Hydrogen telluride	-2			-50
H ₃ N	Ammonia	-33.33		16-25%	
H ₃ P	Phosphine	-87.75		1.8-?	
H ₄ N ₂	Hydrazine	113.55	38	5-100%	
H ₄ P ₂	Diphosphine	63.5			≈20
H ₄ Si	Silane	-111.9	-112	1.4-?	≈20
H ₆ Si ₂	Disilane	-14.3	-14		≈20
H ₈ Si ₃	Trisilane	52.9	<0		≈20
P	Phosphorus (white)	280.5			38
Compounds containing carbon					
CHN	Hydrogen cyanide	26	-18	6-40%	538
CH ₂ Cl ₂	Dichloromethane	40		13-23%	556
CH ₂ N ₂	Cyanamide		141		

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
CH ₂ O	Formaldehyde	-19.1	85	7.0-73%	424
(CH ₂ O) _x	Paraformaldehyde		70	7.0-73%	300
CH ₂ O ₂	Formic acid	101	50	18-57%	434
CH ₃ Br	Bromomethane	3.5		10-16%	537
CH ₃ Cl	Chloromethane	-24.0		8.1-17.4%	632
CH ₃ Cl ₃ Si	Methyltrichlorosilane	65.6	-9	7.6->20%	>404
CH ₃ NO	Formamide	220	154		
CH ₃ NO ₂	Nitromethane	101.1	35	7.3-?	418
CH ₄	Methane	-161.5		5.0-15.0%	537
CH ₂ Cl ₂ Si	Dichloromethylsilane	41	-9	6.0-55%	316
CH ₄ O	Methanol	64.6	11	6.0-36%	464
CH ₄ S	Methanethiol	5.9	-18	3.9-21.8%	
CH ₅ N	Methylamine	-6.3	0	4.9-20.7%	430
CH ₆ N ₂	Methylhydrazine	87.5	-8	2.5-92%	194
CO	Carbon monoxide	-191.5		12.5-74%	609
COS	Carbon oxysulfide	-50		12-29%	
CS ₂	Carbon disulfide	46	-30	1.3-50.0%	90
C ₂ ClF ₃	Chlorotrifluoroethylene	-27.8		8.4-16.0%	
C ₂ F ₄	Tetrafluoroethylene	-75.9		10.0-50.0%	200
C ₂ HCl ₃	Trichloroethylene	87.2		8-10.5%	420
C ₂ HCl ₃ O	Dichloroacetyl chloride	108	66		
C ₂ H ₂	Acetylene	-84.7		2.5-100%	305
C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	31.6	-28	6.5-15.5%	570
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	60.1	6	3-15%	460
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	48.7	2	6-13%	460
C ₂ H ₂ F ₂	1,1-Difluoroethylene	-85.7		5.5-21.3%	
C ₂ H ₃ Br	Bromoethylene	15.8		9-15%	530
C ₂ H ₃ Cl	Chloroethylene	-13.3	-78	3.6-33.0%	472
C ₂ H ₃ ClF ₂	1-Chloro-1,1-difluoroethane	-9.7		6-18%	632
C ₂ H ₃ ClO	Acetyl chloride	50.7	4		390
C ₂ H ₃ Cl ₂ NO ₂	1,1-Dichloro-1-nitroethane	123.5	76		
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	74.0		8-10.5%	500
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	113.8	32	6-28%	460
C ₂ H ₃ Cl ₃ Si	Trichlorovinylsilane	91.5	21		
C ₂ H ₃ F	Fluoroethylene	-72		2.6-21.7%	
C ₂ H ₃ N	Acetonitrile	81.6	6	3.0-16.0%	524
C ₂ H ₃ NO	Methyl isocyanate	39.5	-7	5.3-26%	534
C ₂ H ₄	Ethylene	-103.7		2.7-36%	450
C ₂ H ₄ CINO ₂	1-Chloro-1-nitroethane	124.5	56		
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	57.4	-17	5.4-11.4%	458
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	83.5	13	6.2-16%	413
C ₂ H ₄ O	Acetaldehyde	20.1	-39	4.0-60%	175
C ₂ H ₄ O	Ethylene oxide	10.6	-20	3.0-100%	429
C ₂ H ₄ O ₂	Acetic acid	117.9	39	4.0-19.9%	463
C ₂ H ₄ O ₂	Methyl formate	31.7	-19	4.5-23%	449
C ₂ H ₄ O ₃	Ethaneperoxy acid	110	41		
C ₂ H ₅ Br	Bromoethane	38.5		6.8-8.0%	511
C ₂ H ₅ Cl	Chloroethane	12.3	-50	3.8-15.4%	519
C ₂ H ₅ ClO	Ethylene chlorohydrin	128.6	60	4.9-15.9%	425
C ₂ H ₅ Cl ₃ Si	Trichloroethylsilane	100.5	22		
C ₂ H ₅ N	Ethyleneimine	56	-11	3.3-54.8%	320
C ₂ H ₅ NO ₂	Nitroethane	114.0	28	3.4-17%	414
C ₂ H ₅ NO ₂	Ethyl nitrite	18	-35	4.0-50%	90
C ₂ H ₅ NO ₃	Ethyl nitrate	87.2	10	4-?	
C ₂ H ₆	Ethane	-88.6		3.0-12.5%	472
C ₂ H ₆ Cl ₂ Si	Dichlorodimethylsilane	70.3	<21	3.4-9.5%	
C ₂ H ₆ O	Ethanol	78.2	13	3.3-19%	363
C ₂ H ₆ O	Dimethyl ether	-24.8	-41	3.4-27.0%	350
C ₂ H ₆ OS	2-Mercaptoethanol	158	74		
C ₂ H ₆ OS	Dimethyl sulfoxide	189	95	2.6-42%	215
C ₂ H ₆ O ₂	Ethylene glycol	197.3	111	3.2-22%	398

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₂ H ₆ O ₄ S	Dimethyl sulfate		83		188
C ₂ H ₆ S	Ethanethiol	35.1	-17	2.8-18.0%	300
C ₂ H ₆ S	Dimethyl sulfide	37.3	-37	2.2-19.7%	206
C ₂ H ₆ S ₂	Dimethyl disulfide	109.8	24		
C ₂ H ₇ N	Ethylamine	16.5	-16	3.5-14%	385
C ₂ H ₇ N	Dimethylamine	6.8	20	2.8-14.4%	400
C ₂ H ₇ NO	Ethanolamine	171	86	3.0-23.5%	410
C ₂ H ₈ N ₂	1,2-Ethanediamine	117	40	2.5-12.0%	385
C ₂ H ₈ N ₂	1,1-Dimethylhydrazine	63.9	-15	2-95%	249
C ₂ N ₂	Cyanogen	-21.1		6.6-32%	
C ₃ H ₃ Br	3-Bromo-1-propyne	89	10	3.0-?	324
C ₃ H ₃ N	2-Propenenitrile	77.3	0	3.0-17.0%	481
C ₃ H ₄	Propyne	-23.2		2.1-12.5%	
C ₃ H ₄ CIN	3-Chloropropanenitrile	175.5	76		
C ₃ H ₄ Cl ₂	2,3-Dichloropropene	94	15	2.6-7.8%	
C ₃ H ₄ O	Propargyl alcohol	113.6	36		
C ₃ H ₄ O	Acrolein	52.6	-26	2.8-31%	220
C ₃ H ₄ O ₂	Propenoic acid	141	50	2.4-8.0%	438
C ₃ H ₄ O ₂	2-Oxetanone	162	74	2.9-?	
C ₃ H ₄ O ₃	Ethylene carbonate	248	143		
C ₃ H ₅ Br	3-Bromopropene	70.1	-1	4.4-7.3%	295
C ₃ H ₅ Cl	2-Chloropropene	22.6	-37	4.5-16%	
C ₃ H ₅ Cl	3-Chloropropene	45.1	-32	2.9-11.1%	485
C ₃ H ₅ ClO	Epichlorohydrin	118	31	3.8-21.0%	411
C ₃ H ₅ ClO	Propanoyl chloride	80	12		
C ₃ H ₅ ClO ₂	2-Chloropropanoic acid	185	107		500
C ₃ H ₅ ClO ₂	Ethyl chloroformate	95	16		500
C ₃ H ₅ ClO ₂	Methyl chloroacetate	129.5	57	7.5-18.5%	
C ₃ H ₅ Cl ₂ NO ₂	1,1-Dichloro-1-nitropropane	145	66		
C ₃ H ₅ Cl ₃	1,2,3-Trichloropropane	157	71	3.2-12.6%	
C ₃ H ₅ Cl ₃ Si	Trichloro-2-propenylsilane	117.5	35		
C ₃ H ₅ N	Propanenitrile	97.1	2	3.1-14%	512
C ₃ H ₅ NO	3-Hydroxypropanenitrile	221	129		
C ₃ H ₅ N ₃ O ₉	Trinitroglycerol				270
C ₃ H ₆	Propene	-47.6		2.0-11.1%	455
C ₃ H ₆	Cyclopropane	-32.8		2.4-10.4%	498
C ₃ H ₆ CINO ₂	1-Chloro-1-nitropropane	142	62		
C ₃ H ₆ CINO ₂	2-Chloro-2-nitropropane		57		
C ₃ H ₆ Cl ₂	1,2-Dichloropropane	96.4	21	3.4-14.5%	557
C ₃ H ₆ Cl ₂ O	1,3-Dichloro-2-propanol	176	74		
C ₃ H ₆ N ₂	Dimethylcyanamide	163.5	71		
C ₃ H ₆ O	Allyl alcohol	97.0	21	2.5-18.0%	378
C ₃ H ₆ O	Methyl vinyl ether	5.5			287
C ₃ H ₆ O	Propanal	48	-30	2.6-17%	207
C ₃ H ₆ O	Acetone	56.0	-20	2.5-12.8%	465
C ₃ H ₆ O	Methyloxirane	35	-37	3.1-27.5%	449
C ₃ H ₆ O ₂	Propanoic acid	141.1	52	2.9-12.1%	465
C ₃ H ₆ O ₂	Ethyl formate	54.4	-20	2.8-16.0%	455
C ₃ H ₆ O ₂	Methyl acetate	56.8	-10	3.1-16%	454
C ₃ H ₆ O ₂	1,3-Dioxolane	78	2		
C ₃ H ₆ O ₃	Dimethyl carbonate	90.5	19		
C ₃ H ₆ O ₃	1,3,5-Trioxane	114.5	45	3.6-29%	414
C ₃ H ₇ Br	1-Bromopropane	71.1			490
C ₃ H ₇ Cl	1-Chloropropane	46.5	<-18	2.6-11.1%	520
C ₃ H ₇ Cl	2-Chloropropane	35.7	-32	2.8-10.7%	593
C ₃ H ₇ ClO	2-Chloro-1-propanol	133.5	52		
C ₃ H ₇ ClO	1-Chloro-2-propanol	127	52		
C ₃ H ₇ Cl ₃ Si	Trichloropropylsilane	123.5	37		
C ₃ H ₇ N	Allylamine	53.3	-29	2.2-22%	374
C ₃ H ₇ NO	N,N-Dimethylformamide	153	58	2.2-15.2%	445
C ₃ H ₇ NO ₂	1-Nitropropane	131.1	36	2.2-?	421

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	t_B /°C	FP/°C	Fl. Limits	IT/°C
C ₃ H ₇ NO ₂	2-Nitropropane	120.2	24	2.6-11.0%	428
C ₃ H ₇ NO ₃	Propyl nitrate	110	20	2-100%	175
C ₃ H ₈	Propane	-42.1	-104	2.1-9.5%	450
C ₃ H ₈ O	1-Propanol	97.2	23	2.2-13.7%	412
C ₃ H ₈ O	2-Propanol	82.3	12	2.0-12.7%	399
C ₃ H ₈ O	Ethyl methyl ether	7.4	-37	2.0-10.1%	190
C ₃ H ₈ O ₂	1,2-Propylene glycol	187.6	99	2.6-12.5%	371
C ₃ H ₈ O ₂	1,3-Propylene glycol	214.4			400
C ₃ H ₈ O ₂	Ethylene glycol monomethyl ether	124.1	39	1.8-14%	285
C ₃ H ₈ O ₂	Dimethoxymethane	42	-32	2.2-13.8%	237
C ₃ H ₈ O ₃	Glycerol	290	199	3-19%	370
C ₃ H ₉ BO ₃	Trimethyl borate	67.5	-8		
C ₃ H ₉ ClSi	Trimethylchlorosilane	60	-28		395
C ₃ H ₉ N	Propylamine	47.2	-37	2.0-10.4%	318
C ₃ H ₉ N	Isopropylamine	31.7	-37		402
C ₃ H ₉ N	Trimethylamine	2.8	-5	2.0-11.6%	190
C ₃ H ₉ NO	3-Amino-1-propanol	187.5	80		
C ₃ H ₉ NO	1-Amino-2-propanol	159.4	77		374
C ₃ H ₉ NO	<i>N</i> -Methyl-2-ethanolamine	158	74		
C ₃ H ₉ O ₃ P	Trimethyl phosphite	111.5	54		
C ₃ H ₉ O ₄ P	Trimethyl phosphate	197.2	107		
C ₃ H ₁₀ N ₂	1,3-Propanediamine	139.8	24		
C ₄ Cl ₆	Hexachloro-1,3-butadiene	215			610
C ₄ H ₂ O ₃	Maleic anhydride	202	102	1.4-7.1%	477
C ₄ H ₄	1-Buten-3-yne	5.1		21-100%	
C ₄ H ₄ N ₂	Succinonitrile	266	132		
C ₄ H ₄ O	Furan	31.5	-36	2.3-14.3%	
C ₄ H ₄ O ₂	Diketene	126.1	34		
C ₄ H ₄ S	Thiophene	84.0	-1		
C ₄ H ₅ Cl	2-Chloro-1,3-butadiene	59.4	-20	4.0-20.0%	
C ₄ H ₅ N	2-Butenenitrile	120.5	16		
C ₄ H ₅ N	Methylacrylonitrile	90.3	1	2-6.8%	
C ₄ H ₅ N	Pyrole	129.7	39		
C ₄ H ₆	1,3-Butadiene	-4.4		2.0-12.0%	420
C ₄ H ₆	2-Butyne	26.9	-31	1.4-?	
C ₄ H ₆ O	Divinyl ether	28.3	<-30	1.7-27%	360
C ₄ H ₆ O	Ethoxyacetylene	50	<-7		
C ₄ H ₆ O	<i>trans</i> -2-Butenal	102.2	13	2.1-15.5%	232
C ₄ H ₆ O	3-Buten-2-one	81.4	-7	2.1-15.6%	491
C ₄ H ₆ O	Vinyloxirane	68	<-50		
C ₄ H ₆ O ₂	Methacrylic acid	162.5	77	1.6-8.8%	68
C ₄ H ₆ O ₂	Vinyl acetate	72.5	-8	2.6-13.4%	402
C ₄ H ₆ O ₂	Methyl acrylate	80.7	-3	2.8-25%	468
C ₄ H ₆ O ₂	2,3-Butanedione	88	27		
C ₄ H ₆ O ₂	gamma-Butyrolactone	204	98		
C ₄ H ₆ O ₃	Acetic anhydride	139.5	49	2.7-10.3%	316
C ₄ H ₆ O ₃	Propylene carbonate	242	135		
C ₄ H ₆ O ₆	<i>L</i> -Tartaric acid		210		425
C ₄ H ₇ Br	1-Bromo-2-butene	104.5		4.6-12.0%	
C ₄ H ₇ BrO ₂	Ethyl bromoacetate	168.5	48		
C ₄ H ₇ Cl	2-Chloro-1-butene	58.5	-19	2.3-9.3%	
C ₄ H ₇ Cl	3-Chloro-2-methylpropene	71.5	-12	3.2-8.1%	
C ₄ H ₇ ClO	2-Chloroethyl vinyl ether	108	27		
C ₄ H ₇ ClO ₂	Ethyl chloroacetate	144.3	64		
C ₄ H ₇ N	Butanenitrile	117.6	24	1.6-?	501
C ₄ H ₇ N	2-Methylpropanenitrile	103.9	8		482
C ₄ H ₇ NO	Acetone cyanohydrin		74	2.2-12.0%	688
C ₄ H ₇ NO	2-Pyrrolidone	251	129		
C ₄ H ₈	1-Butene	-6.2		1.6-10.0%	385
C ₄ H ₈	<i>cis</i> -2-Butene	3.7		1.7-9.0%	325
C ₄ H ₈	<i>trans</i> -2-Butene	0.8		1.8-9.7%	324

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₄ H ₈	Isobutene	-6.9		1.8-9.6%	465
C ₄ H ₈	Cyclobutane	12.6	<10	1.8-?	
C ₄ H ₈ Cl ₂	1,2-Dichlorobutane	124.1			275
C ₄ H ₈ Cl ₂	1,4-Dichlorobutane	161	52		
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether	178.5	55	2.7-?	369
C ₄ H ₈ O	2-Buten-1-ol	121.5	27	4.2-35.3%	349
C ₄ H ₈ O	2-Methyl-2-propenol	114.5	33		
C ₄ H ₈ O	Ethyl vinyl ether	35.5	<-46	1.7-28%	202
C ₄ H ₈ O	1,2-Epoxybutane	63.4	-22	1.7-19%	439
C ₄ H ₈ O	Butanal	74.8	-22	1.9-12.5%	218
C ₄ H ₈ O	Isobutanal	64.5	-18	1.6-10.6%	196
C ₄ H ₈ O	2-Butanone	79.5	-9	1.4-11.4%	404
C ₄ H ₈ O	Tetrahydrofuran	65	-14	2-11.8%	321
C ₄ H ₈ OS	1,4-Oxathiane	147	42		
C ₄ H ₈ O ₂	Butanoic acid	163.7	72	2.0-10.0%	443
C ₄ H ₈ O ₂	2-Methylpropanoic acid	154.4	56	2.0-9.2%	481
C ₄ H ₈ O ₂	Propyl formate	80.9	-3		455
C ₄ H ₈ O ₂	Isopropyl formate	68.2	-6		485
C ₄ H ₈ O ₂	Ethyl acetate	77.1	-4	2.0-11.5%	426
C ₄ H ₈ O ₂	Methyl propanoate	79.8	-2	2.5-13%	469
C ₄ H ₈ O ₂	3-Hydroxybutanal		66		250
C ₄ H ₈ O ₂	1,4-Dioxane	101.5	12	2.0-22%	180
C ₄ H ₈ O ₂ S	Sulfolane	287.3	177		
C ₄ H ₈ O ₃	Methyl lactate	144.8	49	2.2-?	385
C ₄ H ₈ O ₃	Ethylene glycol monoacetate	188	102		
C ₄ H ₉ Br	1-Bromobutane	101.6	18	2.6-6.6%	265
C ₄ H ₉ Br	2-Bromobutane	91.2	21		
C ₄ H ₉ Cl	1-Chlorobutane	78.6	-12	1.9-10.1%	240
C ₄ H ₉ Cl	2-Chlorobutane	68.2	-10		
C ₄ H ₉ Cl	1-Chloro-2-methylpropane	68.5	-6	2.0-8.7%	
C ₄ H ₉ Cl	2-Chloro-2-methylpropane	50.9	0		
C ₄ H ₉ Cl ₃ Si	Butyltrichlorosilane	148.5	54		
C ₄ H ₉ N	Pyrolidone	86.5	3		
C ₄ H ₉ NO	<i>N</i> -Ethylacetamide	205	110		
C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide	165	70	1.8-11.5%	490
C ₄ H ₉ NO	Butanal oxime	154	58		
C ₄ H ₉ NO	2-Butanone oxime	152.5	≈70		
C ₄ H ₉ NO	Morpholine	128	37	1.4-11.2%	290
C ₄ H ₉ NO ₂	<i>N</i> -Acetyethanolamine		179		460
C ₄ H ₉ NO ₃	Butyl nitrate	133	36		
C ₄ H ₁₀	Butane	-0.5	-60	1.9-8.5%	287
C ₄ H ₁₀	Isobutane	-11.7	-87	1.8-8.4%	460
C ₄ H ₁₀ N ₂	Piperazine	146	81		
C ₄ H ₁₀ O	1-Butanol	117.7	37	1.4-11.2%	343
C ₄ H ₁₀ O	2-Butanol	99.5	24	1.7-9.8%	405
C ₄ H ₁₀ O	2-Methyl-1-propanol	107.8	28	1.7-10.6%	415
C ₄ H ₁₀ O	2-Methyl-2-propanol	82.4	11	2.4-8.0%	478
C ₄ H ₁₀ O	Diethyl ether	34.5	-45	1.9-36.0%	180
C ₄ H ₁₀ O	Methyl propyl ether	39.1	-20	2.0-14.8%	
C ₄ H ₁₀ O ₂	1,2-Butanediol	190.5	40		
C ₄ H ₁₀ O ₂	1,3-Butanediol	207.5	121		395
C ₄ H ₁₀ O ₂	1,4-Butanediol	235	121		
C ₄ H ₁₀ O ₂	2,3-Butanediol	182.5			402
C ₄ H ₁₀ O ₂	Ethylene glycol monoethyl ether	135	43	3-18%	235
C ₄ H ₁₀ O ₂	Ethylene glycol dimethyl ether	85	-2		202
C ₄ H ₁₀ O ₂	<i>tert</i> -Butyl hydroperoxide		27		
C ₄ H ₁₀ O ₂ S	2,2'-Thiodiethanol	282	160		298
C ₄ H ₁₀ O ₃	Diethylene glycol	245.8	124	2-17%	224
C ₄ H ₁₀ O ₄ S	Diethyl sulfate	208	104		436
C ₄ H ₁₀ S	1-Butanethiol	98.5	2		
C ₄ H ₁₀ S	2-Butanethiol	85	-23		

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₄ H ₁₀ S	2-Methyl-1-propanethiol	88.5	2		
C ₄ H ₁₀ S	2-Methyl-2-propanethiol	64.3	<-29		
C ₄ H ₁₀ Se	Diethyl selenide	108		2.5-?	
C ₄ H ₁₁ N	Butylamine	77.0	-12	1.7-9.8%	312
C ₄ H ₁₁ N	<i>sec</i> -Butylamine	63.5	-9		
C ₄ H ₁₁ N	<i>tert</i> -Butylamine	44.0	-9	1.7-8.9%	380
C ₄ H ₁₁ N	Isobutylamine	67.7	-9	2-12%	378
C ₄ H ₁₁ N	Diethylamine	55.5	-23	1.8-10.1%	312
C ₄ H ₁₁ NO	2-Amino-1-butanol	178	74		
C ₄ H ₁₁ NO	2-Amino-2-methyl-1-propanol	165.5	67		
C ₄ H ₁₁ NO ₂	Diethanolamine	268.8	172	2-13%	662
C ₄ H ₁₂ Sn	Tetramethylstannane	78	-12	1.9-?	
C ₄ H ₁₃ N ₃	Diethylenetriamine	207	98	2-6.7%	358
C ₅ H ₄ O ₂	Furfural	161.7	60	2.1-19.3%	316
C ₅ H ₅ N	Pyridine	115.2	20	1.8-12.4%	482
C ₅ H ₆	2-Methyl-1-buten-3-yne	32	<-7		
C ₅ H ₆ N ₂	2-Methylpyrazine	137	50		
C ₅ H ₆ O	3-Methylfuran	66	-30		
C ₅ H ₆ O ₂	Furfuryl alcohol	171	75	1.8-16.3%	491
C ₅ H ₇ N	1-Methylpyrrole	115	16		
C ₅ H ₇ NO	2-Furanmethanamine	145.5	37		
C ₅ H ₇ NO ₂	Ethyl cyanoacetate	205	110		
C ₅ H ₈	2-Methyl-1,3-butadiene	34.0	-54	1.5-8.9%	395
C ₅ H ₈	1-Pentyne	40.1	<-20		
C ₅ H ₈	Cyclopentene	44.2	-29		395
C ₅ H ₈ O	3-Methyl-3-buten-2-one	98		1.8-9.0%	
C ₅ H ₈ O	Cyclopentanone	130.5	26		
C ₅ H ₈ O	3,4-Dihydro-2H-pyran	86	-18		
C ₅ H ₈ O ₂	Allyl acetate	103.5	22		374
C ₅ H ₈ O ₂	Isopropenyl acetate	94	26		432
C ₅ H ₈ O ₂	Vinyl propanoate	91.2	1		
C ₅ H ₈ O ₂	Ethyl acrylate	99.4	10	1.4-14%	372
C ₅ H ₈ O ₂	Methyl methacrylate	100.5	10	1.7-8.2%	
C ₅ H ₈ O ₂	2,4-Pentanedione	138	34		340
C ₅ H ₈ O ₃	Methyl acetoacetate	171.7	77		280
C ₅ H ₉ NO	<i>N</i> -Methyl-2-pyrrolidone	202	96	1-10%	346
C ₅ H ₁₀	1-Pentene	29.9	-18	1.5-8.7%	275
C ₅ H ₁₀	<i>cis</i> -2-Pentene	36.9	<-20		
C ₅ H ₁₀	<i>trans</i> -2-Pentene	36.3	<-20		
C ₅ H ₁₀	2-Methyl-1-butene	31.2	-20		
C ₅ H ₁₀	3-Methyl-1-butene	20.1	-7	1.5-9.1%	365
C ₅ H ₁₀	2-Methyl-2-butene	38.5	-20		
C ₅ H ₁₀	Cyclopentane	49.3	-25	1.5-?	361
C ₅ H ₁₀ Cl ₂	1,5-Dichloropentane	179	>27		
C ₅ H ₁₀ N ₂	3-(Dimethylamino)propanenitrile	173	65		
C ₅ H ₁₀ O	Cyclopentanol	140.4	51		
C ₅ H ₁₀ O	Pentanal	103	12		222
C ₅ H ₁₀ O	2-Pentanone	102.2	7	1.5-8.2%	452
C ₅ H ₁₀ O	3-Pentanone	101.9	13	1.6-?	450
C ₅ H ₁₀ O	Tetrahydropyran	88	-20		
C ₅ H ₁₀ O	2-Methyltetrahydrofuran	78	-11		
C ₅ H ₁₀ O ₂	Pentanoic acid	186.1	96		400
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid	176.5			416
C ₅ H ₁₀ O ₂	Butyl formate	106.1	18	1.7-8.2%	322
C ₅ H ₁₀ O ₂	Isobutyl formate	98.2	5	2-9%	320
C ₅ H ₁₀ O ₂	Propyl acetate	101.5	13	1.7-8%	450
C ₅ H ₁₀ O ₂	Isopropyl acetate	88.6	2	1.8-8%	460
C ₅ H ₁₀ O ₂	Ethyl propanoate	99.1	12	1.9-11%	440
C ₅ H ₁₀ O ₂	Methyl butanoate	102.8	14		
C ₅ H ₁₀ O ₂	3-Ethoxypropanal	135.2	38		
C ₅ H ₁₀ O ₂	Tetrahydrofurfuryl alcohol	178	75	1.5-9.7%	282

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	t_B /°C	FP/°C	Fl. Limits	IT/°C
C ₅ H ₁₀ O ₃	Diethyl carbonate	126	25		
C ₅ H ₁₀ O ₃	Ethylene glycol monomethyl ether acetate	143	49	1.5-12.3%	392
C ₅ H ₁₀ O ₃	Ethyl lactate	154.5	46	1.5-?	400
C ₅ H ₁₁ Br	1-Bromopentane	129.8	32		
C ₅ H ₁₁ Cl	1-Chloropentane	107.8	13	1.6-8.6%	260
C ₅ H ₁₁ Cl	2-Chloro-2-methylbutane	85.6		1.5-7.4%	345
C ₅ H ₁₁ Cl	1-Chloro-3-methylbutane	98.9	<21	1.5-7.4%	
C ₅ H ₁₁ Cl ₃ Si	Trichloropentylsilane	172	63		
C ₅ H ₁₁ N	Piperidine	106.2	16		
C ₅ H ₁₁ N	N-Methylpyrrolidine	81	-14		
C ₅ H ₁₁ NO	4-Methylmorpholine	116	24		
C ₅ H ₁₁ NO ₂	Isopentyl nitrite	99.2			210
C ₅ H ₁₂	Pentane	36.0	-40	1.4-8.0%	260
C ₅ H ₁₂	Isopentane	27.8	-51	1.4-7.6%	420
C ₅ H ₁₂	Neopentane	9.4	-65	1.4-7.5%	450
C ₅ H ₁₂ N ₂	1-Methylpiperazine	138	42		
C ₅ H ₁₂ N ₂ O	Tetramethylurea	176.5	77		
C ₅ H ₁₂ O	1-Pentanol	137.9	33	1.2-10.0%	300
C ₅ H ₁₂ O	2-Pentanol	119.3	34	1.2-9.0%	343
C ₅ H ₁₂ O	3-Pentanol	116.2	41	1.2-9.0%	435
C ₅ H ₁₂ O	2-Methyl-1-butanol	128	50		385
C ₅ H ₁₂ O	3-Methyl-1-butanol	131.1	43	1.2-9.0%	350
C ₅ H ₁₂ O	2-Methyl-2-butanol	102.4	19	1.2-9.0%	437
C ₅ H ₁₂ O	3-Methyl-2-butanol	112.9	38		
C ₅ H ₁₂ O	2,2-Dimethyl-1-propanol	113.5	37		
C ₅ H ₁₂ O	Ethyl propyl ether	63.2	<-20	1.7-9.0%	
C ₅ H ₁₂ O ₂	1,5-Pentanediol	239	129		335
C ₅ H ₁₂ O ₂	2-Isopropoxyethanol	145	33		
C ₅ H ₁₂ O ₂	2,2-Dimethyl-1,3-propanediol	208	129		399
C ₅ H ₁₂ O ₃	Diethylene glycol monomethyl ether	193	96	1.38-22.7%	240
C ₅ H ₁₂ S	1-Pentanethiol	126.6	18		
C ₅ H ₁₂ S	3-Methyl-2-butanethiol		3		
C ₅ H ₁₃ N	Pentylamine	104.3	-1	2.2-22%	
C ₅ H ₁₃ N	Butylmethylamine	91	13		
C ₆ H ₂ Cl ₄	1,2,4,5-Tetrachlorobenzene	244.5	155		
C ₆ H ₃ ClN ₂ O ₄	1-Chloro-2,4-dinitrobenzene	315	194	2.0-22%	
C ₆ H ₃ Cl ₃	1,2,4-Trichlorobenzene	213.5	105	2.5-6.6%	571
C ₆ H ₄ ClNO ₂	1-Chloro-4-nitrobenzene	242	127		
C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	180	66	2.2-9.2%	648
C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	173	72		
C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	174	66		
C ₆ H ₄ Cl ₂ O	2,4-Dichlorophenol	210	114		
C ₆ H ₅ Br	Bromobenzene	156.0	51		565
C ₆ H ₅ Cl	Chlorobenzene	131.7	28	1.3-9.6%	593
C ₆ H ₅ ClO	<i>o</i> -Chlorophenol	174.9	64		
C ₆ H ₅ ClO	<i>p</i> -Chlorophenol	220	121		
C ₆ H ₅ Cl ₂ N	3,4-Dichloroaniline	272	166		
C ₆ H ₅ Cl ₃ Si	Trichlorophenylsilane	201	91		
C ₆ H ₅ F	Fluorobenzene	84.7	-15		
C ₆ H ₅ NO ₂	Nitrobenzene	210.8	88	1.8-?	482
C ₆ H ₅ N ₃ O ₄	2,4-Dinitroaniline		224		
C ₆ H ₆	1,5-Hexadien-3-yne	85	<-20	1.5-?	
C ₆ H ₆	Benzene	80.0	-11	1.2-7.8%	498
C ₆ H ₆ N ₂ O ₂	<i>p</i> -Nitroaniline	332	199		
C ₆ H ₆ O	Phenol	181.8	79	1.8-8.6%	715
C ₆ H ₆ O ₂	1,2-Benzenediol	245	127		
C ₆ H ₆ O ₂	Resorcinol		127	1.4-?	608
C ₆ H ₆ O ₂	<i>p</i> -Hydroquinone	287	165		516
C ₆ H ₇ N	Aniline	184.1	70	1.3-11%	615
C ₆ H ₇ N	2-Methylpyridine	129.3	39		538
C ₆ H ₇ N	4-Methylpyridine	145.3	57		

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	t_B /°C	FP/°C	Fl. Limits	IT/°C
C ₆ H ₈ ClN	Aniline, hydrochloride		193		
C ₆ H ₈ Cl ₂ O ₂	Hexanedioyl dichloride		72		
C ₆ H ₈ N ₂	Adiponitrile	295	93	1.0-?	550
C ₆ H ₈ N ₂	<i>o</i> -Phenylenediamine	257	156	1.5-?	
C ₆ H ₈ N ₂	Phenylhydrazine	243.5	88		
C ₆ H ₈ N ₂	2,5-Dimethylpyrazine	155	64		
C ₆ H ₈ O	2,5-Dimethylfuran	93.5	7		
C ₆ H ₈ O ₄	Dimethyl maleate	202	113		
C ₆ H ₁₀	1,4-Hexadiene	65	-21	2.0-6.1%	
C ₆ H ₁₀	2-Methyl-1,3-pentadiene	75.8	-12		
C ₆ H ₁₀	4-Methyl-1,3-pentadiene	76.5	-34		
C ₆ H ₁₀	2-Hexyne	84.5	-10		
C ₆ H ₁₀	Cyclohexene	82.9	-12	1.2-?	310
C ₆ H ₁₀ O	Diallyl ether	94	-7		
C ₆ H ₁₀ O	Cyclohexanone	155.4	44	1.1-9.4%	420
C ₆ H ₁₀ O	Mesityl oxide	130	31	1.4-7.2%	344
C ₆ H ₁₀ O ₂	Vinyl butanoate	116.7	20	1.4-8.8%	
C ₆ H ₁₀ O ₂	Ethyl 2-butenate	136.5	2		
C ₆ H ₁₀ O ₂	Ethyl methacrylate	117	20		
C ₆ H ₁₀ O ₂	2,5-Hexanedione	194	79		499
C ₆ H ₁₀ O ₃	Ethyl acetoacetate	180.8	57	1.4-9.5%	295
C ₆ H ₁₀ O ₃	Propanoic anhydride	170	63	1.3-9.5%	285
C ₆ H ₁₀ O ₄	Adipic acid	337.5	196		420
C ₆ H ₁₀ O ₄	Diethyl oxalate	185.7	76		
C ₆ H ₁₀ O ₄	Ethylene glycol diacetate	190	88	1.6-8.4%	482
C ₆ H ₁₁ Cl	Chlorocyclohexane	142	32		
C ₆ H ₁₁ NO	Caprolactam	270	125		
C ₆ H ₁₁ NO ₂	Nitrocyclohexane	205	88		
C ₆ H ₁₁ NO ₂	4-Acetylmorpholine		113		
C ₆ H ₁₂	1-Hexene	63.4	-26	1.2-6.9%	253
C ₆ H ₁₂	<i>cis</i> -2-Hexene	68.8	-21		
C ₆ H ₁₂	2-Methyl-1-pentene	62.1	-28		300
C ₆ H ₁₂	4-Methyl-1-pentene	53.9	-7		300
C ₆ H ₁₂	4-Methyl- <i>cis</i> -2-pentene	56.3	-32		
C ₆ H ₁₂	4-Methyl- <i>trans</i> -2-pentene	58.6	-29		
C ₆ H ₁₂	2-Ethyl-1-butene	64.7	<-20		315
C ₆ H ₁₂	2,3-Dimethyl-1-butene	55.6	<-20		360
C ₆ H ₁₂	2,3-Dimethyl-2-butene	73.3	<-20		401
C ₆ H ₁₂	Cyclohexane	80.7	-20	1.3-8%	245
C ₆ H ₁₂	Methylcyclopentane	71.8	-29	1.0-8.35%	258
C ₆ H ₁₂	Ethylcyclobutane	70.8	-15	1.2-7.7%	210
C ₆ H ₁₂	2-Methyl-2-pentene	67.3	<-7		
C ₆ H ₁₂ Cl ₂ O ₂	1,2-Bis(2-chloroethoxy)ethane	232	121		
C ₆ H ₁₂ O	<i>cis</i> -3-Hexen-1-ol	156.5	54		
C ₆ H ₁₂ O	Butyl vinyl ether	94	-9		255
C ₆ H ₁₂ O	Isobutyl vinyl ether	83	-9		
C ₆ H ₁₂ O	Hexanal	131	32		
C ₆ H ₁₂ O	2-Ethylbutanal		21	1.2-7.7%	
C ₆ H ₁₂ O	2-Methylpentanal	117	17		199
C ₆ H ₁₂ O	2-Hexanone	127.6	25	1-8%	423
C ₆ H ₁₂ O	3-Hexanone	123.5	35	1-8%	
C ₆ H ₁₂ O	4-Methyl-2-pentanone	116.5	18	1.2-8.0%	448
C ₆ H ₁₂ O	Cyclohexanol	160.8	68	1-9%	300
C ₆ H ₁₂ O ₂	Hexanoic acid	205.2	102		380
C ₆ H ₁₂ O ₂	2-Methylpentanoic acid	195.6	107		378
C ₆ H ₁₂ O ₂	Diethylacetic acid	194	99		400
C ₆ H ₁₂ O ₂	Pentyl formate	130.4	26		
C ₆ H ₁₂ O ₂	Butyl acetate	126.1	22	1.7-7.6%	425
C ₆ H ₁₂ O ₂	<i>sec</i> -Butyl acetate	112	31	1.7-9.8%	
C ₆ H ₁₂ O ₂	Isobutyl acetate	116.5	18	1.3-10.5%	421
C ₆ H ₁₂ O ₂	Propyl propanoate	122.5	79		

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₆ H ₁₂ O ₂	Ethyl butanoate	121.5	24		463
C ₆ H ₁₂ O ₂	Ethyl 2-methylpropanoate	110.1	13		
C ₆ H ₁₂ O ₂	Diacetone alcohol	167.9	58	1.8-6.9%	643
C ₆ H ₁₂ O ₃	Ethylene glycol monoethyl ether acetate	156.4	56	2-8%	379
C ₆ H ₁₂ O ₃	Paraldehyde	124.3	36	1.3-?	238
C ₆ H ₁₂ S	Cyclohexanethiol	158.9	43		
C ₆ H ₁₃ Cl	1-Chlorohexane	135	35		
C ₆ H ₁₃ N	Cyclohexylamine	134	31	1.9-9.4%	293
C ₆ H ₁₃ NO	<i>N</i> -Butylacetamide	229	116		
C ₆ H ₁₃ NO	2,6-Dimethylmorpholine	146.6	44		
C ₆ H ₁₃ NO	<i>N</i> -Ethylmorpholine	138.5	32		
C ₆ H ₁₃ NO ₂	4-Morpholineethanol	227	99		
C ₆ H ₁₄	Hexane	68.7	-22	1.1-7.5%	225
C ₆ H ₁₄	2-Methylpentane	60.2	<-29	1.0-7.0%	264
C ₆ H ₁₄	3-Methylpentane	63.2	-7	1.2-7.0%	278
C ₆ H ₁₄	2,2-Dimethylbutane	49.7	-48	1.2-7.0%	405
C ₆ H ₁₄	2,3-Dimethylbutane	57.9	-29	1.2-7.0%	405
C ₆ H ₁₄ N ₂ O	1-Piperazineethanol	246	124		
C ₆ H ₁₄ O	1-Hexanol	157.6	63		
C ₆ H ₁₄ O	2-Methyl-1-pentanol	149	54	1.1-9.65%	310
C ₆ H ₁₄ O	4-Methyl-2-pentanol	131.6	41	1.0-5.5%	
C ₆ H ₁₄ O	2-Ethyl-1-butanol	147	57		
C ₆ H ₁₄ O	Dipropyl ether	90.0	21	1.3-7.0%	188
C ₆ H ₁₄ O	Diisopropyl ether	68.5	-28	1.4-7.9%	443
C ₆ H ₁₄ O	Butyl ethyl ether	92.3	4		
C ₆ H ₁₄ O ₂	2,5-Hexanediol	218	110		
C ₆ H ₁₄ O ₂	2-Methyl-2,4-pentanediol	197.1	102	1-9%	306
C ₆ H ₁₄ O ₂	Ethylene glycol monobutyl ether	168.4	69	4-13%	238
C ₆ H ₁₄ O ₂	1,1-Diethoxyethane	102.2	-21	1.6-10.4%	230
C ₆ H ₁₄ O ₂	Ethylene glycol diethyl ether	119.4	27		205
C ₆ H ₁₄ O ₃	1,2,6-Hexanetriol		191		
C ₆ H ₁₄ O ₃	Diethylene glycol monoethyl ether	196	96		
C ₆ H ₁₄ O ₃	Diethylene glycol dimethyl ether	162	67		
C ₆ H ₁₄ O ₃	Trimethylolpropane		149		
C ₆ H ₁₄ O ₄	Triethylene glycol	285	177	0.9-9.2%	371
C ₆ H ₁₅ N	Hexylamine	132.8	29		
C ₆ H ₁₅ N	Butylethylamine	107.5	18		
C ₆ H ₁₅ N	Dipropylamine	109.3	17		299
C ₆ H ₁₅ N	Diisopropylamine	83.9	-1	1.1-7.1%	316
C ₆ H ₁₅ N	Triethylamine	89	-7	1.2-8.0%	249
C ₆ H ₁₅ NO ₂	Diisopropanolamine	250	127		374
C ₆ H ₁₅ NO ₃	Triethanolamine	335.4	179	1-10%	
C ₆ H ₁₅ N ₃	1-Piperazineethanamine	220	93		
C ₆ H ₁₅ O ₄ P	Triethyl phosphate	215.5	115		454
C ₆ H ₁₆ N ₂	<i>N,N</i> -Diethylethylenediamine	144	46		
C ₇ H ₃ ClF ₃ NO ₂	1-Chloro-4-nitro-2-(trifluoromethyl)benzene	232	135		
C ₇ H ₄ ClF ₃	1-Chloro-2-(trifluoromethyl)benzene	152.2	59		
C ₇ H ₄ F ₃ NO ₂	1-Nitro-3-(trifluoromethyl)benzene	202.8	103		
C ₇ H ₅ ClO	Benzoyl chloride	197.2	72		
C ₇ H ₅ ClO	4-Chlorobenzaldehyde	213.5	88		
C ₇ H ₅ Cl ₃	(Trichloromethyl)benzene	221	127		211
C ₇ H ₅ F ₃	(Trifluoromethyl)benzene	102.1	12		
C ₇ H ₆ N ₂ O ₄	1-Methyl-2,4-dinitrobenzene		207		
C ₇ H ₆ O	Benzaldehyde	179.0	63		192
C ₇ H ₆ O ₂	Benzoic acid	249.2	121		570
C ₇ H ₆ O ₂	Salicylaldehyde	197	78		
C ₇ H ₆ O ₃	Salicylic acid	157	157	1.1-?	540
C ₇ H ₇ Br	<i>o</i> -Bromotoluene	181.7	79		
C ₇ H ₇ Br	<i>p</i> -Bromotoluene	184.3	85		
C ₇ H ₇ Cl	(Chloromethyl)benzene	179	67	1.1-?	585
C ₇ H ₇ NO ₂	<i>o</i> -Nitrotoluene	222	106		

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₇ H ₇ NO ₂	<i>m</i> -Nitrotoluene	232	106		
C ₇ H ₇ NO ₂	<i>p</i> -Nitrotoluene	238.3	106		
C ₇ H ₈	Toluene	110.6	4	1.1-7.1%	480
C ₇ H ₈	Bicyclo[2.2.1]hepta-2,5-diene	89.5	-21		
C ₇ H ₈ O	<i>o</i> -Cresol	191.0	81	1.4-?	599
C ₇ H ₈ O	<i>m</i> -Cresol	202.2	86	1.1-?	558
C ₇ H ₈ O	<i>p</i> -Cresol	201.9	86	1.1-?	558
C ₇ H ₈ O	Benzyl alcohol	205.3	93		436
C ₇ H ₈ O	Anisole	153.7	52		475
C ₇ H ₈ O ₂	4-Methoxyphenol	243	132		421
C ₇ H ₈ O ₃ S	<i>p</i> -Toluenesulfonic acid		184		
C ₇ H ₉ N	<i>o</i> -Methylaniline	200.3	85		482
C ₇ H ₉ N	<i>p</i> -Methylaniline	200.4	87		482
C ₇ H ₉ NO	<i>o</i> -Anisidine	224	118		
C ₇ H ₁₀ O	3-Cyclohexene-1-carboxaldehyde	105	57		
C ₇ H ₁₀ O ₄	3,3-Diacetoxy-1-propene	180	82		
C ₇ H ₁₂	4-Methylcyclohexene	102.7	-1		
C ₇ H ₁₂ O ₂	Butyl acrylate	145	29	1.7-9.9%	292
C ₇ H ₁₂ O ₂	Isobutyl acrylate	132	30		427
C ₇ H ₁₂ O ₂	Cyclohexyl formate	162	51		
C ₇ H ₁₂ O ₄	Diethyl malonate	200	93		
C ₇ H ₁₄	1-Heptene	93.6	-1		260
C ₇ H ₁₄	<i>trans</i> -2-Heptene	98	<0		
C ₇ H ₁₄	Cycloheptane	118.4	<21	1.1-6.7%	
C ₇ H ₁₄	Methylcyclohexane	100.9	-4	1.2-6.7%	250
C ₇ H ₁₄	Ethylcyclopentane	103.5	<21	1.1-6.7%	260
C ₇ H ₁₄ O	2-Heptanone	151.0	39	1.1-7.9%	393
C ₇ H ₁₄ O	3-Heptanone	147	46		
C ₇ H ₁₄ O	4-Heptanone	144	49		
C ₇ H ₁₄ O	5-Methyl-2-hexanone	144	36	1.0-8.2%	191
C ₇ H ₁₄ O	<i>cis</i> -2-Methylcyclohexanol	165	65		296
C ₇ H ₁₄ O	<i>trans</i> -2-Methylcyclohexanol	167.5	65		296
C ₇ H ₁₄ O	<i>cis</i> -3-Methylcyclohexanol	174.5	70		295
C ₇ H ₁₄ O	<i>trans</i> -3-Methylcyclohexanol	174.5	70		295
C ₇ H ₁₄ O	<i>cis</i> -4-Methylcyclohexanol	173	70		295
C ₇ H ₁₄ O	<i>trans</i> -4-Methylcyclohexanol	174	70		295
C ₇ H ₁₄ O ₂	Pentyl acetate	149.2	16	1.1-7.5%	360
C ₇ H ₁₄ O ₂	Isopentyl acetate	142.5	25	1.0-7.5%	360
C ₇ H ₁₄ O ₂	<i>sec</i> -Pentyl acetate	130.5	32		
C ₇ H ₁₄ O ₂	Butyl propanoate	146.8	32		426
C ₇ H ₁₄ O ₂	Propyl butanoate	143.0	37		
C ₇ H ₁₅ NO ₂	Ethyl <i>N</i> -butylcarbamate	202	92		
C ₇ H ₁₆	Heptane	98.5	-4	1.05-6.7%	204
C ₇ H ₁₆	2-Methylhexane	90.0	-1	1.0-6.0%	280
C ₇ H ₁₆	3-Methylhexane	92	-4		280
C ₇ H ₁₆	2,3-Dimethylpentane	89.7	-56	1.1-6.7%	335
C ₇ H ₁₆	2,4-Dimethylpentane	80.4	-12		
C ₇ H ₁₆	2,2,3-Trimethylbutane	80.8	<0		412
C ₇ H ₁₆ N ₂ O	4-Morpholinepropanamine	220	104		
C ₇ H ₁₆ O	2-Heptanol	159	71		
C ₇ H ₁₆ O	3-Heptanol	157	60		
C ₇ H ₁₆ O	2,4-Dimethyl-3-pentanol	138.7	49		
C ₇ H ₁₆ O	2,3,3-Trimethyl-2-butanol	131	<0		375
C ₇ H ₁₇ N	Heptylamine	156	54		
C ₇ H ₁₈ N ₂	<i>N,N</i> -Diethyl-1,3-propanediamine	168.5	59		
C ₈ H ₄ O ₃	Phthalic anhydride	295	152	1.7-10.5%	570
C ₈ H ₆ O ₄	Phthalic acid		168		
C ₈ H ₆ O ₄	Terephthalic acid		260		496
C ₈ H ₇ ClO	α -Chloroacetophenone	247	118		
C ₈ H ₇ N	Benzeneacetonitrile	233.5	113		
C ₈ H ₈	Styrene	145	31	0.9-6.8%	490

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₈ H ₈ O	Phenyloxirane	194.1	74		498
C ₈ H ₈ O	Benzeneacetaldehyde	195	71		
C ₈ H ₈ O	Acetophenone	202	77		570
C ₈ H ₈ O ₂	Benzeneacetic acid	265.5	>100		
C ₈ H ₈ O ₂	Phenyl acetate	196	80		
C ₈ H ₈ O ₂	Methyl benzoate	199	83		
C ₈ H ₈ O ₂	2-Methoxybenzaldehyde	243.5	118		
C ₈ H ₈ O ₃	Methyl salicylate	222.9	96		454
C ₈ H ₉ Cl	1-Chloro-4-ethylbenzene	184.4	64		
C ₈ H ₉ NO	Acetanilide	304	169		530
C ₈ H ₉ NO ₂	Methyl 2-aminobenzoate	256	>100		
C ₈ H ₁₀	Ethylbenzene	136.1	21	0.8-6.7%	432
C ₈ H ₁₀	<i>o</i> -Xylene	144.5	32	0.9-6.7%	463
C ₈ H ₁₀	<i>m</i> -Xylene	139.1	27	1.1-7.0%	527
C ₈ H ₁₀	<i>p</i> -Xylene	138.3	27	1.1-7.0%	528
C ₈ H ₁₀ O	<i>p</i> -Ethylphenol	217.9	104		
C ₈ H ₁₀ O	Benzeneethanol	218.2	96		
C ₈ H ₁₀ O	α -Methylbenzyl alcohol	205	93		
C ₈ H ₁₀ O	Phenetole	169.8	63		
C ₈ H ₁₀ O	Benzyl methyl ether	170	135		
C ₈ H ₁₀ O	4-Methylanisole	175.5	60		
C ₈ H ₁₀ O ₂	2-Phenoxyethanol	245	121		
C ₈ H ₁₁ N	<i>N</i> -Ethylaniline	203.0	85		
C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	194.1	63		371
C ₈ H ₁₁ N	2,3-Xylidine	221.5	97	1.0-?	
C ₈ H ₁₁ N	2,6-Xylidine	215	96		
C ₈ H ₁₁ N	α -Methylbenzylamine	187	79		
C ₈ H ₁₁ N	5-Ethyl-2-picoline	178.3	68	1.1-6.6%	
C ₈ H ₁₁ NO	<i>N</i> -Phenylethanolamine	279.5	152		
C ₈ H ₁₁ NO	<i>o</i> -Phenetidine	232.5	115		
C ₈ H ₁₁ NO	<i>p</i> -Phenetidine	254	116		
C ₈ H ₁₂	1,5-Cyclooctadiene	150.8	35		
C ₈ H ₁₂	4-Vinylcyclohexene	128	16		269
C ₈ H ₁₂ O ₄	Diethyl maleate	223	121		350
C ₈ H ₁₂ O ₄	Diethyl fumarate	214	104		
C ₈ H ₁₄ O ₂	Cyclohexyl acetate	173	58		335
C ₈ H ₁₄ O ₂	Butyl methacrylate	160	52		
C ₈ H ₁₄ O ₃	Butanoic anhydride	200	54	0.9-5.8%	279
C ₈ H ₁₄ O ₃	2-Methylpropanoic anhydride	183	59	1.0-6.2%	329
C ₈ H ₁₄ O ₃	Butyl acetoacetate		85		
C ₈ H ₁₄ O ₄	Ethyl succinate	217.7	90		
C ₈ H ₁₄ O ₅	Diethylene glycol diacetate	200	135		
C ₈ H ₁₄ O ₆	Diethyl tartrate	281	93		
C ₈ H ₁₅ ClO	Octanoyl chloride	195.6	82		
C ₈ H ₁₆	1-Octene	121.2	21		230
C ₈ H ₁₆	2,4,4-Trimethyl-1-pentene	101.4	-5	0.8-4.8%	391
C ₈ H ₁₆	2,4,4-Trimethyl-2-pentene	104.9	2		305
C ₈ H ₁₆	Ethylcyclohexane	131.9	35	0.9-6.6%	238
C ₈ H ₁₆	<i>cis</i> -1,2-Dimethylcyclohexane	129.8	16		304
C ₈ H ₁₆	<i>trans</i> -1,2-Dimethylcyclohexane	123.5	11		304
C ₈ H ₁₆	<i>cis</i> -1,4-Dimethylcyclohexane	124.4	16		
C ₈ H ₁₆	Propylcyclopentane	131			269
C ₈ H ₁₆ O	Octanal	171	52		
C ₈ H ₁₆ O	2-Ethylhexanal	163	44	0.85-7.2%	190
C ₈ H ₁₆ O	2-Octanone	172.5	52		
C ₈ H ₁₆ O ₂	Hexyl acetate	171.5	45		
C ₈ H ₁₆ O ₂	sec-Hexyl acetate	147.5	45		
C ₈ H ₁₆ O ₂	2-Ethylbutyl acetate	162.5	54		
C ₈ H ₁₆ O ₂	Pentyl propanoate	168.6	41		378
C ₈ H ₁₆ O ₂	Butyl butanoate	166	53		

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	t_B /°C	FP/°C	Fl. Limits	IT/°C
C ₈ H ₁₆ O ₂	Isobutyl butanoate	156.9	50		
C ₈ H ₁₆ O ₂	Isobutyl isobutanoate	148.6	38	0.96-7.59%	432
C ₈ H ₁₆ O ₂	Ethyl hexanoate	167	49		
C ₈ H ₁₆ O ₂	1,4-Cyclohexanedimethanol	283	167		316
C ₈ H ₁₆ O ₃	Pentyl lactate		79		
C ₈ H ₁₆ O ₄	Diethylene glycol monoethyl ether acetate	218.5	110		425
C ₈ H ₁₇ Cl	1-Chlorooctane	181.5	70		
C ₈ H ₁₇ Cl	3-(Chloromethyl)heptane	172	60		
C ₈ H ₁₈	Octane	125.6	13	1.0-6.5%	206
C ₈ H ₁₈	2,3-Dimethylhexane	115.6	7		438
C ₈ H ₁₈	2,4-Dimethylhexane	109.5	10		
C ₈ H ₁₈	3-Ethyl-2-methylpentane	115.6	<21		460
C ₈ H ₁₈	2,2,3-Trimethylpentane	110	<21		346
C ₈ H ₁₈	2,2,4-Trimethylpentane	99.2	-12		418
C ₈ H ₁₈	2,3,3-Trimethylpentane	114.8	<21		425
C ₈ H ₁₈ O	1-Octanol	195.1	81		
C ₈ H ₁₈ O	2-Octanol	180	88		
C ₈ H ₁₈ O	2-Ethyl-1-hexanol	184.6	73	0.88-9.7%	231
C ₈ H ₁₈ O	Dibutyl ether	140.2	25	1.5-7.6%	194
C ₈ H ₁₈ O ₂	2-Ethyl-1,3-hexanediol	244	127		360
C ₈ H ₁₈ O ₂	2,2,4-Trimethyl-1,3-pentanediol	235	113		346
C ₈ H ₁₈ O ₂	Di- <i>tert</i> -butyl peroxide	111	18		
C ₈ H ₁₈ O ₃	Diethylene glycol diethyl ether	188	82		
C ₈ H ₁₈ O ₄	2,5,8,11-Tetraoxadodecane	216	111		
C ₈ H ₁₈ O ₅	Tetraethylene glycol	328	182		
C ₈ H ₁₈ S	1-Octanethiol	199.1	69		
C ₈ H ₁₈ S	Dibutyl sulfide	185	76		
C ₈ H ₁₉ N	Octylamine	179.6	60		
C ₈ H ₁₉ N	Dibutylamine	159.6	47	1.1-6%	
C ₈ H ₁₉ N	Diisobutylamine	139.6	29		
C ₈ H ₁₉ N	2-Ethylhexylamine	169.2	60		
C ₈ H ₂₀ O ₄ Si	Ethyl silicate	168.8	52		
C ₈ H ₂₃ N ₅	Tetraethylenepentamine	341.5	163		321
C ₉ H ₆ N ₂ O ₂	Toluene-2,4-diisocyanate	251	127	0.9-9.5%	
C ₉ H ₇ N	Quinoline	237.1			480
C ₉ H ₁₀	<i>o</i> -Methylstyrene	169.8	53	0.8-11.0%	538
C ₉ H ₁₀	<i>m</i> -Methylstyrene	164	53	0.8-11.0%	538
C ₉ H ₁₀	<i>p</i> -Methylstyrene	172.8	53	0.8-11.0%	538
C ₉ H ₁₀	Isopropenylbenzene	165.4	54	1.9-6.1%	574
C ₉ H ₁₀ O	1-Phenyl-1-propanone	217.5	99		
C ₉ H ₁₀ O	4-Methylacetophenone	226	96		
C ₉ H ₁₀ O ₂	Ethyl benzoate	212	88		490
C ₉ H ₁₀ O ₂	Benzyl acetate	213	90		460
C ₉ H ₁₀ O ₂	Methyl 2-phenylacetate	216.5	91		
C ₉ H ₁₁ NO	4-Methylacetanilide	307	168		
C ₉ H ₁₂	Propylbenzene	159.2	30	0.8-6.0%	450
C ₉ H ₁₂	Isopropylbenzene	152.4	36	0.9-6.5%	424
C ₉ H ₁₂	<i>o</i> -Ethyltoluene	165.2			440
C ₉ H ₁₂	<i>m</i> -Ethyltoluene	161.3			480
C ₉ H ₁₂	<i>p</i> -Ethyltoluene	162			475
C ₉ H ₁₂	1,2,3-Trimethylbenzene	176.1	44	0.8-6.6%	470
C ₉ H ₁₂	1,2,4-Trimethylbenzene	169.3	44	0.9-6.4%	500
C ₉ H ₁₂	1,3,5-Trimethylbenzene	164.7	50	1-5%	559
C ₉ H ₁₂ O	α -Ethylbenzyl alcohol	219	100		
C ₉ H ₁₂ O ₂	Ethylene glycol monobenzyl ether	256	129		352
C ₉ H ₁₂ O ₃ S	Ethyl <i>p</i> -toluenesulfonate		158		
C ₉ H ₁₃ N	Amphetamine	203	<100		
C ₉ H ₁₄ O	Phorone	197.5	85		
C ₉ H ₁₄ O	Isophorone	215.2	84	0.8-3.8%	460
C ₉ H ₁₄ O ₆	Triacetin	259	138	1.0-?	433
C ₉ H ₁₆	Octahydroindene	167			296

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₉ H ₁₆ O ₂	Allyl hexanoate	186	66		
C ₉ H ₁₈	1-Nonene	146.9	26		
C ₉ H ₁₈	Propylcyclohexane	156.7			248
C ₉ H ₁₈	Isopropylcyclohexane	154.8			283
C ₉ H ₁₈	Butylcyclopentane	156.6			250
C ₉ H ₁₈ O	2-Nonanone	195.3	60	0.9-5.9%	360
C ₉ H ₁₈ O	Diisobutyl ketone	169.4	49	0.8-7.1%	396
C ₉ H ₁₈ O ₂	Pentyl butanoate	186.4	57		
C ₉ H ₁₈ O ₂	Isopentyl butanoate	179	59		
C ₉ H ₁₈ O ₂	Butyl 3-methylbutanoate		53		
C ₉ H ₂₀	Nonane	150.8	31	0.8-2.9%	205
C ₉ H ₂₀	3-Ethyl-4-methylhexane	140	24		
C ₉ H ₂₀	4-Ethyl-2-methylhexane	133.8	<21	0.7-?	280
C ₉ H ₂₀	2,2,5-Trimethylhexane	124.0	13		
C ₉ H ₂₀	3,3-Diethylpentane	146.3		0.7-5.7%	290
C ₉ H ₂₀	3-Ethyl-2,4-dimethylpentane	136.7	390		
C ₉ H ₂₀	2,2,3,3-Tetramethylpentane	140.2	<21	0.8-4.9%	430
C ₉ H ₂₀	2,2,3,4-Tetramethylpentane	133.0	<21		
C ₉ H ₂₁ BO ₃	Triisopropyl borate	140	28		
C ₉ H ₂₁ N	Tripropylamine	156	41		
C ₉ H ₂₁ NO ₃	Triisopropanolamine		160		320
C ₁₀ H ₇ Cl	1-Chloronaphthalene	259	121		>558
C ₁₀ H ₈	Naphthalene	217.9	79	0.9-5.9%	526
C ₁₀ H ₈ O	2-Naphthol	285	153		
C ₁₀ H ₉ N	1-Naphthalenamine	300.8	157		
C ₁₀ H ₁₀ O ₂	Safrole	234.5	100		
C ₁₀ H ₁₀ O ₄	Dimethyl phthalate	283.7	146	0.9-?	490
C ₁₀ H ₁₀ O ₄	Dimethyl isophthalate	282	138		
C ₁₀ H ₁₀ O ₄	Dimethyl terephthalate	288	153		518
C ₁₀ H ₁₁ NO ₂	Acetoacetanilide		185		
C ₁₀ H ₁₂	1,2,3,4-Tetrahydronaphthalene	207.6	71	0.8-5.0%	385
C ₁₀ H ₁₂ O ₂	Isopropyl benzoate	216	99		
C ₁₀ H ₁₂ O ₂	Ethyl phenylacetate	227	99		
C ₁₀ H ₁₄	Butylbenzene	183.3	71	0.8-5.8%	410
C ₁₀ H ₁₄	sec-Butylbenzene	173.3	52	0.8-6.9%	418
C ₁₀ H ₁₄	tert-Butylbenzene	169.1	60	0.7-5.7%	450
C ₁₀ H ₁₄	Isobutylbenzene	172.7	55	0.8-6.0%	427
C ₁₀ H ₁₄	p-Cymene	177.1	47	0.7-5.6%	436
C ₁₀ H ₁₄	1,2,3,4-Tetramethylbenzene	205	74		427
C ₁₀ H ₁₄	1,2,3,5-Tetramethylbenzene	198	71		427
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	196.8	54		
C ₁₀ H ₁₄	o-Diethylbenzene	184	57		395
C ₁₀ H ₁₄	m-Diethylbenzene	181.1	56		450
C ₁₀ H ₁₄	p-Diethylbenzene	183.7	55	0.7-6.0%	430
C ₁₀ H ₁₄ O	Butyl phenyl ether	210	82		
C ₁₀ H ₁₄ O ₂	4-tert-Butyl-1,2-benzenediol	285	130		
C ₁₀ H ₁₅ N	N-Butylaniline	243.5	107		
C ₁₀ H ₁₅ N	N,N-Diethylaniline	216.3	85		630
C ₁₀ H ₁₅ NO ₂	N-Phenyl-N,N-diethanolamine		196	0.7-?	387
C ₁₀ H ₁₆	Dipentene	178	45		237
C ₁₀ H ₁₆	d-Limonene	178	45	0.7-6.1%	237
C ₁₀ H ₁₆	α-Pinene	156.2	33		255
C ₁₀ H ₁₆	β-Pinene	166	38		275
C ₁₀ H ₁₆	β-Phellandrene	171.5	49		
C ₁₀ H ₁₆ O	Camphor	207.4	66	0.6-3.5%	466
C ₁₀ H ₁₈	trans-Decahydronaphthalene	187.3	54	0.7-5.4%	255
C ₁₀ H ₁₈ O	Borneol		66		
C ₁₀ H ₁₈ O	Linalol	198	71		
C ₁₀ H ₁₈ O	α-Terpineol	220	90		
C ₁₀ H ₁₈ O	Cineole	176.4	48		

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₁₀ H ₁₈ O	<i>trans</i> -Geraniol	230	>100		
C ₁₀ H ₁₈ O ₄	Dibutyl oxalate	241	104		
C ₁₀ H ₁₉ NO ₂	<i>N-tert</i> -Butylaminoethyl methacrylate		96		
C ₁₀ H ₂₀	1-Decene	170.5	<55		235
C ₁₀ H ₂₀	Butylcyclohexane	180.9			246
C ₁₀ H ₂₀	Isobutylcyclohexane	171.3			274
C ₁₀ H ₂₀	<i>tert</i> -Butylcyclohexane	171.5			342
C ₁₀ H ₂₀ O	Citronellol	224	96		
C ₁₀ H ₂₀ O ₂	2-Ethylhexyl acetate	199	71	0.76-8.14%	268
C ₁₀ H ₂₀ O ₂	Ethyl octanoate	208.5	79		
C ₁₀ H ₂₁ N	<i>N</i> -Butylcyclohexanamine		93		
C ₁₀ H ₂₂	Decane	174.1	51	0.8-5.4%	210
C ₁₀ H ₂₂	2-Methylnonane	167.1			210
C ₁₀ H ₂₂	3-Ethyloctane	166.5			230
C ₁₀ H ₂₂	4-Ethyloctane	163.7			229
C ₁₀ H ₂₂ O	1-Decanol	231.1	82		288
C ₁₀ H ₂₂ O	Dipentyl ether	190	57		170
C ₁₀ H ₂₂ O ₂	Ethylene glycol dibutyl ether	203.3	85		
C ₁₀ H ₂₂ O ₅	Tetraethylene glycol dimethyl ether	275.3	141		
C ₁₀ H ₂₂ S	Dipentyl sulfide		85		
C ₁₀ H ₂₃ N	Decylamine	220.5	99		
C ₁₀ H ₂₃ N	Dipentylamine	202.5	51		
C ₁₁ H ₁₀	1-Methylnaphthalene	244.7			529
C ₁₁ H ₁₂ O ₃	Ethyl benzoylacetate		141		
C ₁₁ H ₁₄ O ₂	Butyl benzoate	250.3	107		
C ₁₁ H ₁₆	<i>p-tert</i> -Butyltoluene	190	68		
C ₁₁ H ₁₆	Pentylbenzene	205.4	66		
C ₁₁ H ₁₆	1,3-Diethyl-5-methylbenzene	205			455
C ₁₁ H ₁₆	Pentamethylbenzene	232	93		427
C ₁₁ H ₁₆ O	4- <i>tert</i> -Butyl-2-methylphenol	237	118		
C ₁₁ H ₁₇ N	<i>p-tert</i> -Pentylaniline	260.5	102		
C ₁₁ H ₂₀ O ₂	2-Ethylhexyl acrylate		82		252
C ₁₁ H ₂₂	Pentylcyclohexane	203.7			239
C ₁₁ H ₂₂ O	2-Undecanone	231.5	89		
C ₁₁ H ₂₂ O ₂	Nonyl acetate	210	68		
C ₁₁ H ₂₄	Undecane	195.9	69		
C ₁₁ H ₂₄	2-Methyldecane	189.3			225
C ₁₁ H ₂₄ O	2-Undecanol	228	113		
C ₁₂ H ₆ Br	4-Bromo-1,1'-Biphenyl	310	144		
C ₁₂ H ₁₀	Biphenyl	256.1	113	0.6-5.8%	540
C ₁₂ H ₁₀ Cl ₂ Si	Dichlorodiphenylsilane	305	142		
C ₁₂ H ₁₀ O	<i>o</i> -Phenylphenol	286	124		530
C ₁₂ H ₁₀ O	Diphenyl ether	258.0	112	0.8-1.5%	618
C ₁₂ H ₁₁ N	2-Aminobiphenyl	299			450
C ₁₂ H ₁₁ N	Diphenylamine	302	153		634
C ₁₂ H ₁₂	1-Ethyl-naphthalene	258.6			480
C ₁₂ H ₁₄ O ₄	Diethyl phthalate	295	161	0.7-?	457
C ₁₂ H ₁₄ O ₄	Diethyl terephthalate	302	117		
C ₁₂ H ₁₆	Cyclohexylbenzene	240.1	99		
C ₁₂ H ₁₆ O ₃	Pentyl salicylate	270	132		
C ₁₂ H ₁₇ NO	<i>N</i> -Butyl- <i>N</i> -phenylacetamide	281	141		
C ₁₂ H ₁₈	1,5,9-Cyclododecatriene	240	71		
C ₁₂ H ₂₀ O ₄	Dibutyl maleate	280	141		
C ₁₂ H ₂₂ O ₄	Dimethyl sebacate		145		
C ₁₂ H ₂₂ O ₆	Dibutyl tartrate	320	91		284
C ₁₂ H ₂₃ N	Dicyclohexylamine		>99		
C ₁₂ H ₂₄	1-Dodecene	213.8	79		
C ₁₂ H ₂₄ O ₂	Ethyl decanoate	241.5	>100		
C ₁₂ H ₂₅ Br	1-Bromododecane	276	144		
C ₁₂ H ₂₆	Dodecane	216.3	74	0.6-?	203
C ₁₂ H ₂₆ O	1-Dodecanol	259	127		275

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/ $^\circ\text{C}$	Fl. Limits	IT/ $^\circ\text{C}$
C ₁₂ H ₂₆ O	2-Butyl-1-octanol	246.5	110		
C ₁₂ H ₂₆ O ₃	Diethylene glycol dibutyl ether	256	118		310
C ₁₂ H ₂₆ S	1-Dodecanethiol	277	128		
C ₁₂ H ₂₇ BO ₃	Tributyl borate	234	93		
C ₁₂ H ₂₇ N	Tributylamine	216.5	63		
C ₁₂ H ₂₇ O ₄ P	Tributyl phosphate	289	146		
C ₁₃ H ₁₂	2-Methylbiphenyl	255.5	137		502
C ₁₃ H ₁₂	Diphenylmethane	265.0	130		485
C ₁₃ H ₁₄ N ₂	<i>p,p'</i> -Diaminodiphenylmethane	398	220		
C ₁₃ H ₂₆	1-Tridecene	232.8	79		
C ₁₃ H ₂₆ O	2-Tridecanone	263	107		
C ₁₃ H ₂₈	Tridecane	235.4	79		
C ₁₃ H ₂₈ O	1-Tridecanol		121		
C ₁₄ H ₈ O ₂	9,10-Anthracenedione	377	185		
C ₁₄ H ₁₀	Anthracene	339.9	121	0.6-?	540
C ₁₄ H ₁₀	Phenanthrene	340	171		
C ₁₄ H ₁₂ O ₂	Benzyl benzoate	323.5	148		480
C ₁₄ H ₁₂ O ₃	Benzyl salicylate	320	>100		
C ₁₄ H ₁₄	1,1-Diphenylethane	272.6	>100		440
C ₁₄ H ₁₄ O	Dibenzyl ether	298	135		
C ₁₄ H ₁₆	1-Butylnaphthalene	289.3	360		
C ₁₄ H ₁₆ N ₂ O ₂	<i>o</i> -Dianisidine		206		
C ₁₄ H ₂₃ N	<i>N,N</i> -Dibutylaniline	274.8	110		
C ₁₄ H ₂₈	1-Tetradecene	233	110		235
C ₁₄ H ₃₀	Tetradecane	253.5	112	0.5-?	200
C ₁₄ H ₃₀ O	1-Tetradecanol	289	141		
C ₁₅ H ₁₈	1-Pentyl-naphthalene	307	124		
C ₁₅ H ₂₄	Nonylbenzene	280.5	99		
C ₁₅ H ₂₄ O	2,6-Di- <i>tert</i> -butyl-4-methylphenol	265	127		
C ₁₅ H ₂₆ O ₆	Tributyryl	307.5	180	0.5-?	407
C ₁₅ H ₃₃ N	Tripropylamine	242.5	102		
C ₁₆ H ₁₄ O	1,3-Diphenyl-2-buten-1-one	342.5	177		
C ₁₆ H ₁₈	2-Butyl-1,1'-biphenyl		>100		430
C ₁₆ H ₂₂ O ₄	Dibutyl phthalate	340	157	0.5-?	402
C ₁₆ H ₂₆	Decylbenzene	298	107		
C ₁₆ H ₃₄	Hexadecane	286.8	136		202
C ₁₆ H ₃₄ O	Diocetyl ether	283	>100		205
C ₁₆ H ₃₅ N	Bis(2-ethylhexyl)amine		132		
C ₁₇ H ₂₀ N ₂ O	<i>N,N'</i> -Diethylcarbanilide		150		
C ₁₇ H ₃₄ O	2-Heptadecanone	320	120		
C ₁₇ H ₃₆ O	1-Heptadecanol	333	154		
C ₁₈ H ₁₄	<i>o</i> -Terphenyl	332	163		
C ₁₈ H ₁₄	<i>m</i> -Terphenyl	363	191		
C ₁₈ H ₁₅ O ₃ P	Triphenyl phosphite	360	218		
C ₁₈ H ₁₅ O ₄ P	Triphenyl phosphate		220		
C ₁₈ H ₁₅ P	Triphenylphosphine		180		
C ₁₈ H ₃₀	Dodecylbenzene	328	140		
C ₁₈ H ₃₂ O ₇	Butyl citrate		157		368
C ₁₈ H ₃₄ O ₂	Oleic acid	360	189		363
C ₁₈ H ₃₄ O ₄	Dibutyl sebacate	344.5	178	0.4-?	365
C ₁₈ H ₃₆ O ₂	Stearic acid		196		395
C ₁₈ H ₃₇ Cl ₃ Si	Trichlorooctadecylsilane		89		
C ₁₈ H ₃₈	Octadecane	316.3	>100		227
C ₁₈ H ₃₈ O	1-Octadecanol				450
C ₁₉ H ₁₆	Triphenylmethane	359	>100		
C ₁₉ H ₃₈ O	2-Nonadecanone		124		
C ₁₉ H ₃₈ O ₂	Methyl stearate	443	153		
C ₁₉ H ₄₀	Nonadecane	329.9	>100		230
C ₂₀ H ₁₄ O ₄	Diphenyl phthalate		224		
C ₂₀ H ₂₈	1-Decylnaphthalene	379	177		
C ₂₀ H ₄₂	Eicosane	343	>100		232

FLAMMABILITY OF CHEMICAL SUBSTANCES (continued)

Mol. Form.	Name	$t_B/^\circ\text{C}$	FP/$^\circ\text{C}$	Fl. Limits	IT/$^\circ\text{C}$
C ₂₁ H ₂₁ O ₄ P	Tri- <i>o</i> -cresyl phosphate	410	225		385
C ₂₁ H ₂₆ O ₃	4-Octylphenyl salicylate		216		416
C ₂₁ H ₃₂ O ₂	Methyl abietate		180		
C ₂₂ H ₄₂ O ₂	Butyl oleate		180		
C ₂₂ H ₄₂ O ₄	Bis(2-ethylhexyl) adipate		206	0.4-?	377
C ₂₂ H ₄₄ O ₂	Butyl stearate	343	160		355
C ₂₃ H ₄₆ O ₂	Pentyl stearate		185		
C ₂₄ H ₂₀ Sn	Tetraphenylstannane	420	232		
C ₂₄ H ₃₈ O ₄	Bis(2-ethylhexyl) phthalate	384	218		
C ₂₅ H ₄₈ O ₄	Bis(2-ethylhexyl) azelate		227	0.3-?	374

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS

Several organizations recommend limits of exposure to airborne contaminants in the workplace. These include the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), and the non-governmental organization, American Conference of Governmental Industrial Hygienists (ACGIH). The threshold limit value (TLV) for a substance is defined as the concentration level under which the majority of workers may be repeatedly exposed, day after day, without adverse effects. The TLV recommendations are given in two forms:

- Time-weighted average (TWA) concentration for a normal 8-h workday and 40-h workweek.
- Short-term exposure limit (STEL), which should not be exceeded for more than 15 min.

Both kinds of limits are specified for some substances.

The following table gives threshold limit values for a number of substances that may be encountered in the atmosphere of a chemical laboratory or industrial facility. All values refer to the concentration in air at 25°C and normal atmospheric pressure. Data for gases are given both in parts per million by volume (ppm) and in mass concentration (mg/m³). Values for liquids refer to mists or aerosols, and those for solids to dusts or fumes; both are stated in mg/m³. A "C" following a value indicates a ceiling limit which should not be exceeded even for very brief periods because of acute toxic effects of the substance.

Substances are listed by systematic name, which is followed by molecular formula in the Hill format and Chemical Abstracts Service Registry Number. Common synonyms are given in brackets [] for some compounds.

REFERENCES

1. *2000 TLV's and BEI's*, American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634, 2000.
2. *NIOSH Pocket Guide to Chemical Hazards*, U.S. Department of Health and Human Services, National Institute for Occupational Health and Safety, U.S. Government Printing Office, Washington, DC, 1994.
3. *Chemical Information Manual*, U.S. Department of Labor, Occupational Safety and Health Administration, Washington, DC, 1991.

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Abate [Temephos]	C ₁₆ H ₂₀ O ₆ P ₂ S ₃	3383-96-8		10		
Acetaldehyde	C ₂ H ₄ O	75-07-0			25 C	45 C
Acetic acid	C ₂ H ₄ O ₂	64-19-7	10	25	15	37
Acetic anhydride	C ₄ H ₆ O ₃	108-24-7	5	21		
Acetone	C ₃ H ₆ O	67-64-1	500	1188	750	1780
Acetone cyanohydrin	C ₄ H ₇ NO	75-86-5			4.7 C	5 C
Acetonitrile	C ₂ H ₃ N	75-05-8	40	67	60	101
Acetophenone	C ₈ H ₈ O	98-86-2	10	49		
2-(Acetyloxy)benzoic acid [Aspirin]	C ₉ H ₈ O ₄	50-78-2		5		
Acrolein [2-Propenal]	C ₃ H ₄ O	107-02-8			0.1 C	0.23 C
Acrylamide	C ₃ H ₅ NO	79-06-1		0.03		
Acrylic acid [2-Propenoic acid]	C ₃ H ₄ O ₂	79-10-7	2	5.9		
Acrylonitrile [Propenenitrile]	C ₃ H ₃ N	107-13-1	2	4.3		
Adipic acid	C ₆ H ₁₀ O ₄	124-04-9		5		
Adiponitrile	C ₆ H ₈ N ₂	111-69-3	2	9		
Aldrin	C ₁₂ H ₈ Cl ₆	309-00-2		0.25		
Allyl alcohol [2-Propen-1-ol]	C ₃ H ₆ O	107-18-6	0.5	1.2		
Allyl glycidyl ether	C ₆ H ₁₀ O ₂	106-92-3	1	5		
Allyl propyl disulfide	C ₆ H ₁₂ S ₂	2179-59-1	2	12	3	18
Aluminum (metal dust)	Al	7429-90-5		10		
Aluminum oxide	Al ₂ O ₃	1344-28-1		10		
4-Amino-3,5,6-trichloropyridinecarboxylic acid [Picloram]	C ₆ H ₃ Cl ₃ N ₂ O ₂	1918-02-1		10		
Ammonia	H ₃ N	7664-41-7	25	17	35	24
Ammonium chloride	ClH ₄ N	12125-02-9		10		20
Ammonium perfluorooctanoate	C ₈ H ₄ F ₁₅ NO ₂	3825-26-1		0.01		
Ammonium sulfamate	H ₆ N ₂ O ₃ S	7773-06-0		10		
Aniline	C ₆ H ₇ N	62-53-3	2	7.6		
Antimony	Sb	7440-36-0		0.5		
Arsenic	As	7440-38-2		0.01		
Arsine	AsH ₃	7784-42-1	0.05	0.16		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Atrazine	C ₈ H ₁₄ ClN ₅	1912-24-9		5		
Azinphos-methyl	C ₁₀ H ₁₂ N ₃ O ₃ PS ₂	86-50-0		0.2		
Barium	Ba	7440-39-3		0.5		
Barium sulfate	BaO ₄ S	7727-43-7		10		
Benomyl	C ₁₄ H ₁₈ N ₄ O ₃	17804-35-2	0.84	10		
Benzene	C ₆ H ₆	71-43-2	0.5	1.6	2.5	8
1,3-Benzenedimethanamine [<i>m</i> -Xylene diamine]	C ₈ H ₁₂ N ₂	1477-55-0				0.1 C
Benzenethiol [Phenyl mercaptan]	C ₆ H ₆ S	108-98-5	0.5	2.3		
<i>p</i> -Benzoquinone [Quinone]	C ₆ H ₄ O ₂	106-51-4	0.1	0.44		
Benzoyl chloride	C ₇ H ₅ ClO	98-88-4			0.5 C	2.8 C
Benzoyl peroxide	C ₁₄ H ₁₀ O ₄	94-36-0		5		
Benzyl acetate	C ₉ H ₁₀ O ₂	140-11-4	10	61		
Beryllium	Be	7440-41-7		0.002		0.01
Biphenyl	C ₁₂ H ₁₀	92-52-4	0.2	1.3		
Bis(4-amino-3-chlorophenyl)methane [4,4-Methylene bis(2-chloroaniline)]	C ₁₃ H ₁₂ Cl ₂ N ₂	101-14-4	0.01	0.11		
Bis(2-chloroethyl) ether [2,2'-Dichlorethyl ether]	C ₄ H ₈ Cl ₂ O	111-44-4	5	29	10	58
Bis(chloromethyl) ether	C ₂ H ₄ Cl ₂ O	542-88-1	0.001	0.0047		
Bis(2-dimethylaminoethyl) ether [DMAEE]	C ₈ H ₂₀ N ₂ O	3033-62-3	0.05	0.33	0.15	1.0
Bis(2-ethylhexyl) phthalate [Di- <i>sec</i> -octyl phthalate]	C ₂₄ H ₃₈ O ₄	117-81-7		5		10
Bismuth telluride	Bi ₂ Te ₃	1304-82-1		10		
Boron oxide	B ₂ O ₃	1303-86-2		10		
Boron tribromide	BBr ₃	10294-33-4			1 C	10 C
Boron trifluoride	BF ₃	7637-07-2			1 C	2.8 C
Bromacil	C ₉ H ₁₃ BrN ₂ O ₂	314-40-9		10		
Bromine	Br ₂	7726-95-6	0.1	0.66	0.2	1.3
Bromine pentafluoride	BrF ₅	7789-30-2	0.1	0.72		
Bromochloromethane [Halon 1011]	CH ₂ BrCl	74-97-5	200	1060		
2-Bromo-2-chloro-1,1,1-trifluoroethane [Halothane]	C ₂ HBrClF ₃	151-67-7	50	404		
Bromoethane [Ethyl bromide]	C ₂ H ₅ Br	74-96-4	5	22		
Bromoethene [Vinyl bromide]	C ₂ H ₃ Br	593-60-2	0.5	2.2		
Bromomethane [Methyl bromide]	CH ₃ Br	74-83-9	1	3.9		
Bromotrifluoromethane	CBrF ₃	75-63-8	1000	6090		
1,3-Butadiene	C ₄ H ₆	106-99-0	2	4.4		
Butane	C ₄ H ₁₀	106-97-8	800	1900		
1-Butanethiol [Butyl mercaptan]	C ₄ H ₁₀ S	109-79-5	0.5	1.8		
1-Butanol	C ₄ H ₁₀ O	71-36-3			50 C	152 C
2-Butanol [<i>sec</i> -Butyl alcohol]	C ₄ H ₁₀ O	78-92-2	100	303		
2-Butanone [Methyl ethyl ketone]	C ₄ H ₈ O	78-93-3	200	590	300	885
<i>trans</i> -2-Butenal [Crotonaldehyde]	C ₄ H ₆ O	4170-30-3			0.3 C	0.9 C
3-Buten-2-one	C ₄ H ₆ O	78-94-4			0.2 C	0.6 C
Butyl acetate	C ₆ H ₁₂ O ₂	123-86-4	150	713	200	950
<i>sec</i> -Butyl acetate	C ₆ H ₁₂ O ₂	105-46-4	200	950		
<i>tert</i> -Butyl acetate	C ₆ H ₁₂ O ₂	540-88-5	200	950		
Butyl acrylate	C ₇ H ₁₂ O ₂	141-32-2	2	10		
Butylamine	C ₄ H ₁₁ N	109-73-9			5 C	15 C
<i>tert</i> -Butyl chromate	C ₈ H ₁₈ CrO ₄	1189-85-1				0.1 C
Butyl glycidyl ether	C ₇ H ₁₄ O ₂	2426-08-6	25	133		
Butyl lactate	C ₇ H ₁₄ O ₃	138-22-7	5	30		
<i>o</i> - <i>sec</i> -Butylphenol	C ₁₀ H ₁₄ O	89-72-5	5	31		
<i>p</i> - <i>tert</i> -Butyltoluene	C ₁₁ H ₁₆	98-51-1	1	6.1		
Cadmium	Cd	7440-43-9		0.01		
Calcium carbonate	CCaO ₃	1317-65-3		10		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Calcium chromate	CaCrO ₄	13765-19-0		0.003		
Calcium cyanamide	CCaN ₂	156-62-7		0.5		
Calcium hydroxide	CaH ₂ O ₂	1305-62-0		5		
Calcium metasilicate	CaO ₃ Si	1344-95-2		10		
Calcium oxide	CaO	1305-78-8		2		
Calcium sulfate	CaO ₄ S	7778-18-9		10		
Camphor	C ₁₀ H ₁₆ O	76-22-2	2	12	4	24
Caprolactam	C ₆ H ₁₁ NO	105-60-2	5 (gas)	1 (solid)	10 (gas)	3 (solid)
Captafol	C ₁₀ H ₉ Cl ₄ NO ₂ S	2425-06-1		0.1		
Captan	C ₉ H ₈ Cl ₃ NO ₂ S	133-06-2		5		
Carbaryl	C ₁₂ H ₁₁ NO ₂	63-25-2		5		
Carbofuran	C ₁₂ H ₁₃ NO ₃	1563-66-2		0.1		
Carbon black	C	1333-86-4		3.5		
Carbon dioxide	CO ₂	124-38-9	5000	9000	30,000	54,000
Carbon disulfide	CS ₂	75-15-0	10	31		
Carbon monoxide	CO	630-08-0	25	29		
Carbonyl chloride [Phosgene]	CCl ₂ O	75-44-5	0.1	0.40		
Carbonyl fluoride	CF ₂ O	353-50-4	2	5.4	5	13
Cesium hydroxide	CsHO	21351-79-1		2		
Chlordane	C ₁₀ H ₆ Cl ₈	57-74-9		0.5		
Chlorine	Cl ₂	7782-50-5	0.5	1.5	1	2.9
Chlorine dioxide	ClO ₂	10049-04-4	0.1	0.28	0.3	0.83
Chlorine trifluoride	ClF ₃	7790-91-2			0.1 C	0.38 C
Chloroacetaldehyde	C ₂ H ₃ ClO	107-20-0			1 C	3.2 C
Chloroacetone	C ₃ H ₅ ClO	78-95-5			1 C	3.8 C
α-Chloroacetophenone	C ₈ H ₇ ClO	532-27-4	0.05	0.32		
Chloroacetyl chloride	C ₂ H ₂ Cl ₂ O	79-04-9	0.05	0.23	0.15	0.69
Chlorobenzene	C ₆ H ₅ Cl	108-90-7	10	46		
o-Chlorobenzylidene malononitrile	C ₁₀ H ₅ ClN ₂	2698-41-1			0.05 C	0.39 C
2-Chloro-1,3-butadiene [Chloroprene]	C ₄ H ₅ Cl	126-99-8	10	36		
Chlorodifluoromethane	CHClF ₂	75-45-6	1000	3540		
Chloroethane [Ethyl chloride]	C ₂ H ₅ Cl	75-00-3	100	264		
2-Chloroethanol [Ethylene chlorohydrin]	C ₂ H ₅ ClO	107-07-3			1 C	3.3 C
Chloroethene [Vinyl chloride]	C ₂ H ₃ Cl	75-01-4	1	2.5		
Chloromethane [Methyl chloride]	CH ₃ Cl	74-87-3	50	103	100	207
(Chloromethyl)benzene [Benzyl chloride]	C ₇ H ₇ Cl	100-44-7	1	5.2		
1-Chloro-4-nitrobenzene	C ₆ H ₄ ClNO ₂	100-00-5	0.1	0.64		
1-Chloro-1-nitropropane	C ₃ H ₆ ClNO ₂	600-25-9	2	10		
Chloropentafluoroethane	C ₂ ClF ₅	76-15-3	1000	6320		
2-Chloropropanoic acid	C ₃ H ₅ ClO ₂	598-78-7	0.1	0.44		
3-Chloropropene [Allyl chloride]	C ₃ H ₅ Cl	107-05-1	1	3	2	6
2-Chlorostyrene	C ₈ H ₇ Cl	2039-87-4	50	283	75	425
o-Chlorotoluene	C ₇ H ₇ Cl	95-49-8	50	259		
Chlorpyrifos	C ₉ H ₁₁ Cl ₃ NO ₃ PS	2921-88-2		0.2		
Chromium	Cr	7440-47-3		0.5		
Chromyl chloride	Cl ₂ CrO ₂	14977-61-8	0.025	0.16		
Clopidol	C ₇ H ₇ Cl ₂ NO	2971-90-6		10		
Cobalt	Co	7440-48-4		0.02		
Cobalt carbonyl	C ₈ Co ₂ O ₈	10210-68-1		0.1		
Cobalt hydrocarbonyl	C ₄ HCoO ₄	16842-03-8		0.1		
Copper	Cu	7440-50-8		0.2		
Cresol (all isomers)	C ₇ H ₈ O	1319-77-3	5	22		
Crufomate	C ₁₂ H ₁₉ ClNO ₃ P	299-86-5		5		
Cyanamide	CH ₂ N ₂	420-04-2		2		
Cyanogen	C ₂ N ₂	460-19-5	10	21		
Cyanogen chloride	CClN	506-77-4			0.3 C	0.75 C
Cyclohexane	C ₆ H ₁₂	110-82-7	300	1030		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Cyclohexanol	C ₆ H ₁₂ O	108-93-0	50	206		
Cyclohexanone	C ₆ H ₁₀ O	108-94-1	25	100		
Cyclohexene	C ₆ H ₁₀	110-83-8	300	1010		
Cyclohexylamine	C ₆ H ₁₃ N	108-91-8	10	41		
Cyclonite [Hexahydro-1,3,5-trinitro-1,3,5-triazine]	C ₃ H ₆ N ₆ O ₆	121-82-4		0.5		
1,3-Cyclopentadiene	C ₅ H ₆	542-92-7	75	203		
Cyclopentane	C ₅ H ₁₀	287-92-3	600	1720		
Cyhexatin	C ₁₈ H ₃₄ OSn	13121-70-5		5		
Decaborane(14)	B ₁₀ H ₁₄	17702-41-9	0.05	0.25	0.15	0.75
Diacetone alcohol	C ₆ H ₁₂ O ₂	123-42-2	50	238		
4,4'-Diaminodiphenylmethane [4,4-Methylene dianiline]	C ₁₃ H ₁₄ N ₂	101-77-9	0.1	0.81		
Diazinon	C ₁₂ H ₂₁ N ₂ O ₃ PS	333-41-5		0.1		
Diazomethane	CH ₂ N ₂	334-88-3	0.2	0.34		
Diborane	B ₂ H ₆	19287-45-7	0.1	0.11		
Dibromodifluoromethane	CB ₂ F ₂	75-61-6	100	858		
2-Dibutylaminoethanol	C ₁₀ H ₂₃ NO	102-81-8	0.5	3.5		
2,6-Di- <i>tert</i> -butyl-4-methylphenol	C ₁₅ H ₂₄ O	128-37-0		10		
Dibutylphenyl phosphate	C ₁₄ H ₂₃ O ₄ P	2528-36-1	0.3	3.5		
Dibutyl phosphate	C ₈ H ₁₉ O ₄ P	107-66-4	1	8.6	2	17
Dibutyl phthalate	C ₁₆ H ₂₂ O ₄	84-74-2		5		
Dichloroacetylene	C ₂ Cl ₂	7572-29-4			0.1 C	0.39 C
<i>o</i> -Dichlorobenzene	C ₆ H ₄ Cl ₂	95-50-1	25	150	50	301
<i>p</i> -Dichlorobenzene	C ₆ H ₄ Cl ₂	106-46-7	10	60		
1,4-Dichloro-2-butene (unspecified isomer)	C ₄ H ₆ Cl ₂	764-41-0	0.005	0.026		
Dichlorodifluoromethane	CCl ₂ F ₂	75-71-8	1000	4950		
1,3-Dichloro-5,5-dimethyl hydantoin	C ₅ H ₆ Cl ₂ N ₂ O ₂	118-52-5		0.2		0.4
Dichlorodiphenyltrichloroethane [DDT]	C ₁₄ H ₉ Cl ₅	50-29-3		1		
1,1-Dichloroethane [Ethylidene dichloride]	C ₂ H ₄ Cl ₂	75-34-3	100	405		
1,2-Dichloroethane [Ethylene dichloride]	C ₂ H ₄ Cl ₂	107-06-2	10	40		
1,1-Dichloroethene [Vinylidene chloride]	C ₂ H ₂ Cl ₂	75-35-4	5	20		
1,2-Dichloroethylene (both isomers)	C ₂ H ₂ Cl ₂	540-59-0	200	793		
Dichlorofluoromethane	CHCl ₂ F	75-43-4	10	42		
Dichloromethane [Methylene chloride]	CH ₂ Cl ₂	75-09-2	50	174		
1,1-Dichloro-1-nitroethane	C ₂ H ₃ Cl ₂ NO ₂	594-72-9	2	12		
(2,4-Dichlorophenoxy)acetic acid	C ₈ H ₆ Cl ₂ O ₃	94-75-7		10		
1,2-Dichloropropane	C ₃ H ₆ Cl ₂	78-87-5	75	347	110	508
2,2-Dichloropropanoic acid	C ₃ H ₄ Cl ₂ O ₂	75-99-0		5		
1,3-Dichloropropene (both isomers)	C ₃ H ₄ Cl ₂	542-75-6	1	4.5		
1,2-Dichloro-1,1,2,2-tetrafluoroethane	C ₂ Cl ₂ F ₄	76-14-2	1000	7000		
Dichlorvos	C ₄ H ₇ Cl ₂ O ₄ P	62-73-7	0.1	0.90		
Dicrotophos	C ₈ H ₁₆ NO ₅ P	141-66-2		0.25		
<i>m</i> -Dicyanobenzene [<i>m</i> -Phthalodinitrile]	C ₈ H ₄ N ₂	626-17-5		5		
Dicyclopentadiene	C ₁₀ H ₁₂	77-73-6	5	27		
Dieldrin	C ₁₂ H ₈ Cl ₆ O	60-57-1		0.25		
Diethanolamine	C ₄ H ₁₁ NO ₂	111-42-2	0.46	2		
Diethylamine	C ₄ H ₁₁ N	109-89-7	5	15	15	45
2-Diethylaminoethanol	C ₆ H ₁₅ NO	100-37-8	2	9.6		
Diethylenetriamine [Bis(2-aminoethyl)amine]	C ₄ H ₁₃ N ₃	111-40-0	1	4.2		
Diethyl ether	C ₄ H ₁₀ O	60-29-7	400	1210	500	1520
Diethyl phthalate	C ₁₂ H ₁₄ O ₄	84-66-2		5		
1,1-Difluoroethene	C ₂ H ₂ F ₂	75-38-7	500	1310		
Diglycidyl ether	C ₆ H ₁₀ O ₃	2238-07-5	0.1	0.53		
Diisopropylamine	C ₆ H ₁₅ N	108-18-9	5	21		
Diisopropyl ether	C ₆ H ₁₄ O	108-20-3	250	1040	310	1300
Dimethoxymethane [Methylal]	C ₃ H ₈ O ₂	109-87-5	1000	3110		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Dimethyl mercury	C ₂ H ₆ Hg	593-74-8		0.01		0.03
<i>N,N</i> -Dimethylacetamide	C ₄ H ₉ NO	127-19-5	10	36		
Dimethylamine	C ₂ H ₇ N	124-40-3	5	9.2	15	27.6
<i>N,N</i> -Dimethylaniline	C ₈ H ₁₁ N	121-69-7	5	25	10	50
2,2-Dimethylbutane	C ₆ H ₁₄	75-83-2	500	1760	1000	3500
2,3-Dimethylbutane	C ₆ H ₁₄	79-29-8	500	1760	1000	3500
<i>N,N</i> -Dimethylformamide	C ₃ H ₇ NO	68-12-2	10	30		
2,6-Dimethyl-4-heptanone [Diisobutyl ketone]	C ₉ H ₁₈ O	108-83-8	25	145		
1,1-Dimethylhydrazine	C ₂ H ₈ N ₂	57-14-7	0.01	0.025		
Dimethyl phthalate	C ₁₀ H ₁₀ O ₄	131-11-3		5		
Dimethyl sulfate	C ₂ H ₆ O ₄ S	77-78-1	0.1	0.52		
Dinitrobenzene (all isomers)	C ₆ H ₄ N ₂ O ₄	25154-54-5	0.15	1.0		
Dinitrotoluene (all isomers)	C ₇ H ₆ N ₂ O ₄	25321-14-6		0.2		
1,4-Dioxane	C ₄ H ₈ O ₂	123-91-1	20	72		
Dioxathion	C ₁₂ H ₂₆ O ₆ P ₂ S ₄	78-34-2		0.2		
Diphenylamine	C ₁₂ H ₁₁ N	122-39-4		10		
Diphenyl ether	C ₁₂ H ₁₀ O	101-84-8	1	7	2	14
4,4'-Diphenylmethane diisocyanate	C ₁₅ H ₁₀ N ₂ O ₂	101-68-8	0.005	0.051		
Dipropylene glycol monomethyl ether	C ₇ H ₁₆ O ₃	34590-94-8	100	600	150	900
Diquat	C ₁₂ H ₁₂ N ₂	231-36-7		0.5		
Disulfiram	C ₁₀ H ₂₀ N ₂ S ₄	97-77-8		2		
Disulfoton	C ₈ H ₁₉ O ₂ PS ₃	298-04-4		0.1		
Diuron	C ₉ H ₁₀ Cl ₂ N ₂ O	330-54-1		10		
Divinyl benzene (all isomers)	C ₁₀ H ₁₀	1321-74-0	10	53		
Endosulfan	C ₉ H ₆ Cl ₆ O ₃ S	115-29-7		0.1		
Endrin	C ₁₂ H ₈ Cl ₆ O	72-20-8		0.1		
Enflurane	C ₃ H ₂ ClF ₅ O	13838-16-9	75	566		
Epichlorohydrin [(Chloromethyl)oxirane]	C ₃ H ₅ ClO	106-89-8	0.5	1.9		
1,2-Epoxy-4-(epoxyethyl)cyclohexane [Vinylcyclohexene dioxide]	C ₈ H ₁₂ O ₂	106-87-6	0.1	0.57		
1,2-Ethanediamine [Ethylenediamine]	C ₂ H ₈ N ₂	107-15-3	10	25		
Ethanethiol [Ethyl mercaptan]	C ₂ H ₆ S	75-08-1	0.5	1.3		
Ethanol	C ₂ H ₆ O	64-17-5	1000	1880		
Ethanolamine	C ₂ H ₇ NO	141-43-5	3	7.5	6	15
Ethion	C ₉ H ₂₂ O ₄ P ₂ S ₄	563-12-2		0.4		
Ethoxydimethylsilane	C ₄ H ₁₂ OSi	14857-34-2	0.5	2.1	1.5	6.4
Ethyl acetate	C ₄ H ₈ O ₂	141-78-6	400	1440		
Ethyl acrylate	C ₅ H ₈ O ₂	140-88-5	5	20	15	61
Ethylamine	C ₂ H ₇ N	75-04-7	5	9.2	15	27.6
Ethylbenzene	C ₈ H ₁₀	100-41-4	100	434	125	543
Ethyl <i>tert</i> -butyl ether [ETBE]	C ₆ H ₁₄ O	637-92-3	5	20		
Ethylene glycol	C ₂ H ₆ O ₂	107-21-1				100 C
Ethylene glycol dinitrate	C ₂ H ₄ N ₂ O ₆	628-96-6	0.05	0.31		
Ethylene glycol monobutyl ether [2-Butoxyethanol]	C ₆ H ₁₄ O ₂	111-76-2	20	97		
Ethylene glycol monoethyl ether [2-Ethoxyethanol]	C ₄ H ₁₀ O ₂	110-80-5	5	18		
Ethylene glycol monoethyl ether acetate [2-Ethoxyethyl acetate]	C ₆ H ₁₂ O ₃	111-15-9	5	27		
Ethylene glycol monomethyl ether [2-Methoxyethanol]	C ₃ H ₈ O ₂	109-86-4	5	16		
Ethylene glycol monomethyl ether acetate [2-Methoxyethyl acetate]	C ₅ H ₁₀ O ₃	110-49-6	5	24		
Ethyleneimine	C ₂ H ₅ N	151-56-4	0.5	0.88		
Ethylene oxide [Oxirane]	C ₂ H ₄ O	75-21-8	1	1.8		
Ethyl formate	C ₃ H ₆ O ₂	109-94-4	100	303		
Ethylidene norbornene	C ₉ H ₁₂	16219-75-3			5 C	25 C

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
<i>N</i> -Ethylmorpholine	C ₆ H ₁₃ NO	100-74-3	5	24		
Ethyl <i>p</i> -nitrophenyl benzenethiophosphate [EPN]	C ₁₄ H ₁₄ NO ₄ PS	2104-64-5		0.1		
Ethyl silicate	C ₈ H ₂₀ O ₄ Si	78-10-4	10	85		
Fenamiphos	C ₁₃ H ₂₂ NO ₃ PS	22224-92-6		0.1		
Fensulfothion	C ₁₁ H ₁₇ O ₄ PS ₂	115-90-2		0.1		
Fenthion	C ₁₀ H ₁₅ O ₃ PS ₂	55-38-9		0.2		
Ferbam	C ₉ H ₁₈ FeN ₃ S ₆	14484-64-1		10		
Ferrocene [Dicyclopentadienyl iron]	C ₁₀ H ₁₀ Fe	102-54-5		10		
Fluorine	F ₂	7782-41-4	1	1.6	2	3.1
Fluorine monoxide [Oxygen difluoride]	F ₂ O	7783-41-7			0.05 C	0.11 C
Fonofos	C ₁₀ H ₁₅ OPS ₂	944-22-9		0.1		
Formaldehyde	CH ₂ O	50-00-0			0.3 C	0.37 C
Formamide	CH ₃ NO	75-12-7	10	18		
Formic acid	CH ₂ O ₂	64-18-6	5	9.4	10	19
Furfural [2-Furaldehyde]	C ₅ H ₄ O ₂	98-01-1	2	7.9		
Furfuryl alcohol [2-Furanmethanol]	C ₅ H ₆ O ₂	98-00-0	10	40	15	60
Germane [Germanium tetrahydride]	GeH ₄	7782-65-2	0.2	0.63		
Glycerol	C ₃ H ₈ O ₃	56-81-5		10		
Graphite	C	7440-44-0		2		
Hafnium	Hf	7440-58-6		0.5		
Heptachlor	C ₁₀ H ₅ Cl ₇	76-44-8		0.05		
Heptane	C ₇ H ₁₆	142-82-5	400	1640	500	2050
2-Heptanone [Methyl pentyl ketone]	C ₇ H ₁₄ O	110-43-0	50	233		
3-Heptanone [Ethyl butyl ketone]	C ₇ H ₁₄ O	106-35-4	50	233	75	350
4-Heptanone [Dipropyl ketone]	C ₇ H ₁₄ O	123-19-3	50	233		
Hexachlorobenzene	C ₆ Cl ₆	118-74-1		0.002		
Hexachloro-1,3-butadiene	C ₄ Cl ₆	87-68-3	0.02	0.21		
1,2,3,4,5,6-Hexachlorocyclohexane [Lindane]	C ₆ H ₆ Cl ₆	58-89-9		0.5		
Hexachloro-1,3-cyclopentadiene	C ₅ Cl ₆	77-47-4	0.01	0.11		
Hexachloroethane [Perchloroethane]	C ₂ Cl ₆	67-72-1	1	9.7		
Hexachloronaphthalene (all isomers)	C ₁₀ H ₂ Cl ₆	1335-87-1		0.2		
Hexamethylene diisocyanate	C ₈ H ₁₂ N ₂ O ₂	822-06-0	0.005	0.034		
Hexane	C ₆ H ₁₄	110-54-3	50	176		
1,6-Hexanediamine [Hexamethylenediamine]	C ₆ H ₁₆ N ₂	124-09-4	0.5	2.3		
2-Hexanone [Butyl methyl ketone]	C ₆ H ₁₂ O	591-78-6	5	20	10	40
1-Hexene	C ₆ H ₁₂	592-41-6	30	103		
<i>sec</i> -Hexyl acetate	C ₈ H ₁₆ O ₂	108-84-9	50	295		
Hydrazine	H ₄ N ₂	302-01-2	0.01	0.013		
Hydrazoic acid	HN ₃	7782-79-8			0.11 C	0.19 C
Hydrogen bromide	BrH	10035-10-6			3 C	9.9 C
Hydrogen chloride	ClH	7647-01-0			5 C	7.5 C
Hydrogen cyanide	CHN	74-90-8			4.7 C	5 C
Hydrogen fluoride	FH	7664-39-3			3 C	2.3 C
Hydrogen peroxide	H ₂ O ₂	7722-84-1	1	1.4		
Hydrogen selenide	H ₂ Se	7783-07-5	0.05	0.16		
Hydrogen sulfide	H ₂ S	7783-06-4	10	14	15	21
<i>p</i> -Hydroquinone [1,4-Benzenediol]	C ₆ H ₆ O ₂	123-31-9		2		
2-Hydroxypropyl acrylate	C ₆ H ₁₀ O ₃	999-61-1	0.5	2.8		
Indene	C ₉ H ₈	95-13-6	10	48		
Indium	In	7440-74-6		0.1		
Iodine	I ₂	7553-56-2			0.1 C	1.0 C
Iodomethane [Methyl iodide]	CH ₃ I	74-88-4	2	12		
Iron(III) oxide	Fe ₂ O ₃	1309-37-1		5		
Iron pentacarbonyl	C ₅ FeO ₅	13463-40-6	0.1	0.23	0.2	0.45
Isobutyl acetate	C ₆ H ₁₂ O ₂	110-19-0	150	713		
Isopentane	C ₅ H ₁₂	78-78-4	600	1770		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Isopentyl acetate [Isoamyl acetate]	C ₇ H ₁₄ O ₂	123-92-2	100	532		
Isophorone	C ₉ H ₁₄ O	78-59-1			5 C	28 C
Isophorone diisocyanate	C ₁₂ H ₁₈ N ₂ O ₂	4098-71-9	0.005	0.045		
Isopropenylbenzene [α -Methyl styrene]	C ₉ H ₁₀	98-83-9	50	242	100	483
2-Isopropoxyethanol	C ₅ H ₁₂ O ₂	109-59-1	25	106		
Isopropyl acetate	C ₅ H ₁₀ O ₂	108-21-4	250	1040	310	1290
Isopropylamine	C ₃ H ₉ N	75-31-0	5	12	10	24
<i>N</i> -Isopropylaniline	C ₉ H ₁₃ N	768-52-5	2	11		
Isopropylbenzene [Cumene]	C ₉ H ₁₂	98-82-8	50	246		
Isopropyl glycidyl ether	C ₆ H ₁₂ O ₂	4016-14-2	50	238	75	356
Kaolin		1332-58-7		2		
Ketene	C ₂ H ₂ O	463-51-4	0.5	0.86	1.5	2.6
Lead	Pb	7439-92-1		0.05		
Lead(II) arsenate	As ₂ O ₈ Pb ₃	7784-40-9		0.15		
Lead(II) chromate	CrO ₄ Pb	7758-97-6		0.075		
Lithium hydride	HLi	7580-67-8		0.025		
Magnesium carbonate [Magnesite]	CMgO ₃	546-93-0		10		
Magnesium oxide	MgO	1309-48-4		10		
Malathion	C ₁₀ H ₁₉ O ₆ PS ₂	121-75-5		10		
Maleic anhydride	C ₄ H ₂ O ₃	108-31-6	0.1	4		
Manganese	Mn	7439-96-5		0.2		
Manganese cyclopentadienyl tricarbonyl	C ₈ H ₅ MnO ₃	12079-65-1		0.4		
Mercury	Hg	7439-97-6		0.025		
Mesityl oxide	C ₆ H ₁₀ O	141-79-7	15	60	25	100
Methacrylic acid [2-Methylpropenoic acid]	C ₄ H ₆ O ₂	79-41-4	20	70		
Methanethiol [Methyl mercaptan]	CH ₄ S	74-93-1	0.5	0.98		
Methanol	CH ₄ O	67-56-1	200	262	250	328
Methomyl	C ₅ H ₁₀ N ₂ O ₂ S	16752-77-5		2.5		
<i>o</i> -Methoxyaniline [<i>o</i> -Anisidine]	C ₇ H ₉ NO	90-04-0	0.1	0.5		
<i>p</i> -Methoxyaniline [<i>p</i> -Anisidine]	C ₇ H ₉ NO	104-94-9	0.1	0.5		
Methoxychlor	C ₁₆ H ₁₅ Cl ₃ O ₂	72-43-5		10		
4-Methoxyphenol	C ₇ H ₈ O ₂	150-76-5		5		
Methyl acetate	C ₃ H ₆ O ₂	79-20-9	200	606	250	757
Methyl acrylate	C ₄ H ₆ O ₂	96-33-3	2	7		
2-Methylacrylonitrile	C ₄ H ₅ N	126-98-7	1	2.7		
Methylamine	CH ₅ N	74-89-5	5	6.4	15	19
<i>o</i> -Methylaniline [<i>o</i> -Toluidine]	C ₇ H ₉ N	95-53-4	2	8.8		
<i>m</i> -Methylaniline [<i>m</i> -Toluidine]	C ₇ H ₉ N	108-44-1	2	8.8		
<i>p</i> -Methylaniline [<i>p</i> -Toluidine]	C ₇ H ₉ N	106-49-0	2	8.8		
<i>N</i> -Methylaniline	C ₇ H ₉ N	100-61-8	0.5	2.2		
3-Methyl-1-butanol [Isoamyl alcohol]	C ₅ H ₁₂ O	123-51-3	100	361	125	452
3-Methyl-2-butanone [Methyl isopropyl ketone]	C ₅ H ₁₀ O	563-80-4	200	705		
Methyl <i>tert</i> -butyl ether [MTBE]	C ₅ H ₁₂ O	1634-04-4	40	144		
Methyl 2-cyanoacrylate	C ₅ H ₅ NO ₂	137-05-3	0.2	0.9		
Methylcyclohexane	C ₇ H ₁₄	108-87-2	400	1610		
Methylcyclohexanol (all isomers)	C ₇ H ₁₄ O	25639-42-3	50	234		
2-Methylcyclohexanone	C ₇ H ₁₂ O	583-60-8	50	229	75	344
2-Methylcyclopentadienyl manganese tricarbonyl	C ₉ H ₇ MnO ₃	12108-13-3		0.8		
Methyl demeton	C ₆ H ₁₅ O ₃ PS ₂	8022-00-2		0.5		
2-Methyl-3,5-dinitrobenzamide [Dinitolmide]	C ₈ H ₇ N ₃ O ₅	148-01-6		5		
2-Methyl-4,6-dinitrophenol [Dinitro- <i>o</i> -cresol]	C ₇ H ₆ N ₂ O ₅	534-52-1		0.2		
Methylene bis(4-cyclohexylisocyanate)	C ₁₅ H ₂₂ N ₂ O ₂	5124-30-1	0.005	0.054		
Methyl ethyl ketone peroxide	C ₈ H ₁₈ O ₂	1338-23-4			0.2 C	1.5 C
Methyl formate	C ₂ H ₄ O ₂	107-31-3	100	246	150	368
6-Methyl-1-heptanol [Isooctyl alcohol]	C ₈ H ₁₈ O	26952-21-6	50	266		
5-Methyl-3-heptanone	C ₈ H ₁₆ O	541-85-5	25	131		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
5-Methyl-2-hexanone [Methyl isopentyl ketone]	C ₇ H ₁₄ O	110-12-3	50	234		
Methylhydrazine	CH ₆ N ₂	60-34-4	0.01	0.019		
Methyl isocyanate	C ₂ H ₃ NO	624-83-9	0.02	0.047		
Methyl methacrylate	C ₅ H ₈ O ₂	80-62-6	50	205	100	410
Methyloxirane [1,2-Propylene oxide]	C ₃ H ₆ O	75-56-9	20	48		
Methyl parathion	C ₈ H ₁₀ NO ₃ PS	298-00-0		0.2		
2-Methylpentane	C ₆ H ₁₄	107-83-5	500	1760	1000	3500
3-Methylpentane	C ₆ H ₁₄	96-14-0	500	1760	1000	3500
2-Methyl-2,4-pentanediol [Hexylene glycol]	C ₆ H ₁₄ O ₂	107-41-5			25 C	121 C
4-Methyl-2-pentanol [Methyl isobutyl carbinol]	C ₆ H ₁₄ O	108-11-2	25	104	40	167
4-Methyl-2-pentanone [Isobutyl methyl ketone]	C ₆ H ₁₂ O	108-10-1	50	205	75	307
2-Methyl-1-propanol [Isobutyl alcohol]	C ₄ H ₁₀ O	78-83-1	50	152		
2-Methyl-2-propanol [<i>tert</i> -Butyl alcohol]	C ₄ H ₁₀ O	75-65-0	100	303		
Methylstyrene (all isomers)	C ₉ H ₁₀	25013-15-4	50	242	100	483
<i>N</i> -Methyl- <i>N</i> ,2,4,6-tetranitroaniline [Tetryl]	C ₇ H ₅ N ₅ O ₈	479-45-8		1.5		
Metribuzin	C ₈ H ₁₄ N ₄ OS	21087-64-9		5		
Mevinphos	C ₇ H ₁₃ O ₆ P	7786-34-7	0.01	0.092	0.03	0.27
Mica		12001-26-2		3		
Molybdenum	Mo	7439-98-7		10		
Monocrotophos	C ₇ H ₁₄ NO ₃ P	6923-22-4		0.25		
Morpholine	C ₄ H ₆ NO	110-91-8	20	71		
Naled	C ₄ H ₇ Br ₂ Cl ₂ O ₄ P	300-76-5		3		
Naphthalene	C ₁₀ H ₈	91-20-3	10	52	15	79
1-Naphthalenylthiourea [ANTU]	C ₁₁ H ₁₀ N ₂ S	86-88-4		0.3		
Neopentane	C ₅ H ₁₂	463-82-1	600	1770		
Nickel	Ni	7440-02-0		1.5		
Nickel carbonyl	C ₄ NiO ₄	13463-39-3	0.05	0.12		
Nickel(III) sulfide	Ni ₃ S ₂	12035-72-2		0.14		
Nicotine	C ₁₀ H ₁₄ N ₂	54-11-5		0.5		
Nitrapyrin	C ₆ H ₃ Cl ₄ N	1929-82-4		10		20
Nitric acid	HNO ₃	7697-37-2	2	5.2	4	10
Nitric oxide	NO	10102-43-9	25	31		
<i>p</i> -Nitroaniline	C ₆ H ₆ N ₂ O ₂	100-01-6		3		
Nitrobenzene	C ₆ H ₅ NO ₂	98-95-3	1	5		
Nitroethane	C ₂ H ₅ NO ₂	79-24-3	100	307		
Nitrogen dioxide	NO ₂	10102-44-0	3	5.6	5	9.4
Nitrogen trifluoride	F ₃ N	7783-54-2	10	29		
Nitromethane	CH ₃ NO ₂	75-52-5	20	50		
1-Nitropropane	C ₃ H ₇ NO ₂	108-03-2	25	91		
2-Nitropropane	C ₃ H ₇ NO ₂	79-46-9	10	36		
Nitrotoluene (all isomers)	C ₇ H ₇ NO ₂	1321-12-6	2	11		
Nitrous oxide	N ₂ O	10024-97-2	50	90		
Nonane (all isomers)	C ₉ H ₂₀	111-84-2	200	1050		
Octachloronaphthalene	C ₁₀ Cl ₈	2234-13-1		0.1		0.3
Octane (all isomers)	C ₈ H ₁₈	111-65-9	300	1400	375	1750
Osmium(VIII) oxide [Osmium tetroxide]	O ₄ Os	20816-12-0	0.0002	0.0016	0.0006	0.0047
Oxalic acid	C ₂ H ₂ O ₄	144-62-7		1		2
2-Oxetanone [β-Propiolactone]	C ₃ H ₄ O ₂	57-57-8	0.5	1.5		
Oxiranemethanol [Glycidol]	C ₃ H ₆ O ₂	556-52-5	2	6.1		
Ozone	O ₃	10028-15-6	0.1	0.2		
Paraquat	C ₁₂ H ₁₄ N ₂	4685-14-7		0.5		
Parathion	C ₁₀ H ₁₄ NO ₃ PS	56-38-2		0.1		
Pentaborane(9)	B ₅ H ₉	19624-22-7	0.005	0.013	0.015	0.039
Pentachloronaphthalene (unspecified isomer)	C ₁₀ H ₃ Cl ₅	1321-64-8		0.5		
Pentachloronitrobenzene	C ₆ Cl ₅ NO ₂	82-68-8		0.5		
Pentachlorophenol	C ₆ HCl ₅ O	87-86-5		0.5		
Pentaerythritol	C ₅ H ₁₂ O ₄	115-77-5		10		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Pentanal [Valeraldehyde]	C ₅ H ₁₀ O	110-62-3	50	176		
Pentane	C ₅ H ₁₂	109-66-0	600	1770	750	2210
Pentanedial [Glutaraldehyde]	C ₅ H ₈ O ₂	111-30-8			0.05 C	0.2 C
2-Pentanone [Methyl propyl ketone]	C ₅ H ₁₀ O	107-87-9	200	705	250	881
3-Pentanone [Diethyl ketone]	C ₅ H ₁₀ O	96-22-0	200	700	300	1050
Pentyl acetate (all isomers)	C ₇ H ₁₄ O ₂	628-63-7	50	265	100	530
Perchloromethyl mercaptan	CCl ₄ S	594-42-3	0.1	0.76		
Perchloryl fluoride	ClFO ₃	7616-94-6	3	13	6	25
Perfluoroacetone [Hexafluoroacetone]	C ₃ F ₆ O	684-16-2	0.1	0.68		
Perfluoroisobutene	C ₄ F ₈	382-21-8			0.01 C	0.082 C
Phenol	C ₆ H ₆ O	108-95-2	5	19		
10 <i>H</i> -Phenothiazine	C ₁₂ H ₉ NS	92-84-2		5		
Phenylenediamine (all isomers)	C ₆ H ₈ N ₂	25265-76-3		0.1		
Phenyl glycidyl ether	C ₉ H ₁₀ O ₂	122-60-1	0.1	0.6		
Phenylhydrazine	C ₆ H ₈ N ₂	100-63-0	0.1	0.44		
Phenylphosphine	C ₆ H ₇ P	638-21-1			0.05 C	0.23 C
Phorate	C ₇ H ₁₇ O ₂ PS ₃	298-02-2		0.05		0.2
Phosphine	H ₃ P	7803-51-2	0.3	0.42	1	1.4
Phosphoric acid	H ₃ O ₄ P	7664-38-2		1		3
Phosphorus (white)	P	7723-14-0	0.02	0.1		
Phosphorus(III) chloride [Phosphorus trichloride]	Cl ₃ P	7719-12-2	0.2	1.1	0.5	2.8
Phosphorus(V) chloride [Phosphorus pentachloride]	Cl ₅ P	10026-13-8	0.1	0.85		
Phosphorus(V) oxychloride [Phosphoryl chloride]	Cl ₃ OP	10025-87-3	0.1	0.63		
Phosphorus(V) sulfide	P ₂ S ₅	1314-80-3		1		3
Phthalic anhydride	C ₈ H ₄ O ₃	85-44-9	1	6.1		
Piperazine dihydrochloride	C ₄ H ₁₂ Cl ₂ N ₂	142-64-3		5		
2-Pivaloyl-1,3-indandione [Pindone]	C ₁₄ H ₁₄ O ₃	83-26-1		0.1		
Platinum	Pt	7440-06-4		1		
Potassium hydroxide	HKO	1310-58-3		2 C		
Propane	C ₃ H ₈	74-98-6	2500	4500		
Propanoic acid	C ₃ H ₆ O ₂	79-09-4	10	30		
1-Propanol	C ₃ H ₈ O	71-23-8	200	492	250	614
2-Propanol [Isopropyl alcohol]	C ₃ H ₈ O	67-63-0	400	983	500	1230
Propargyl alcohol [2-Propyn-1-ol]	C ₃ H ₄ O	107-19-7	1	2.3		
Propoxur	C ₁₁ H ₁₅ NO ₃	114-26-1		0.5		
Propyl acetate	C ₅ H ₁₀ O ₂	109-60-4	200	835	250	1040
1,2-Propylene glycol dinitrate	C ₃ H ₆ N ₂ O ₆	6423-43-4	0.05	0.34		
Propylene glycol monomethyl ether	C ₄ H ₁₀ O ₂	107-98-2	100	369	150	553
Propyleneimine	C ₃ H ₇ N	75-55-8	2	4.7		
Propyl nitrate	C ₃ H ₇ NO ₃	627-13-4	25	107	40	172
Propyne [Methylacetylene]	C ₃ H ₄	74-99-7	1000	1640		
2-Pyridinamine [2-Aminopyridine]	C ₅ H ₆ N ₂	504-29-0	0.5	1.9		
Pyridine	C ₅ H ₅ N	110-86-1	5	16		
Pyrocatechol [Catechol]	C ₆ H ₆ O ₂	120-80-9	5	23		
Resorcinol	C ₆ H ₆ O ₂	108-46-3	10	45	20	90
Rhodium	Rh	7440-16-6		1		
Ronnel	C ₈ H ₈ Cl ₃ O ₃ PS	299-84-3		10		
Rotenone	C ₂₃ H ₂₂ O ₆	83-79-4		5		
Selenium	Se	7782-49-2		0.2		
Selenium hexafluoride	F ₆ Se	7783-79-1	0.12	0.95		
Sesone	C ₈ H ₇ Cl ₂ NaO ₅ S	136-78-7		10		
Silane	H ₄ Si	7803-62-5	5	6.6		
Silicon	Si	7440-21-3		10		
Silicon carbide	CSi	409-21-2		10		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Silicon dioxide (α -quartz)	O ₂ Si	14808-60-7		0.05		
Silicon dioxide (tridymite)	O ₂ Si	15468-32-3		0.05		
Silicon dioxide (cristobalite)	O ₂ Si	14464-46-1		0.05		
Silicon dioxide (vitreous)	O ₂ Si	60676-86-0		0.1		
Silver	Ag	7440-22-4		0.1		
Sodium azide	N ₃ Na	26628-22-8				0.29 C
Sodium fluoroacetate	C ₂ H ₂ FNaO ₂	62-74-8		0.05		
Sodium hydrogen sulfite	HNaO ₃ S	7631-90-5		5		
Sodium hydroxide	HNaO	1310-73-2				2 C
Sodium metabisulfite	Na ₂ O ₅ S ₂	7681-57-4		5		
Sodium pyrophosphate	Na ₄ O ₇ P ₂	7722-88-5		5		
Sodium tetraborate decahydrate	B ₄ H ₂₀ Na ₂ O ₁₇	1303-96-4		5		
Stibine	H ₃ Sb	7803-52-3	0.1	0.51		
Strontium chromate	CrO ₄ Sr	7789-06-2		0.002		
Strychnine	C ₂₁ H ₂₂ N ₂ O ₂	57-24-9		0.15		
Styrene	C ₈ H ₈	100-42-5	20	85	40	170
Sucrose	C ₁₂ H ₂₂ O ₁₁	57-50-1		10		
Sulfotep	C ₈ H ₂₀ O ₅ P ₂ S ₂	3689-24-5		0.2		
Sulfur chloride	Cl ₂ S ₂	10025-67-9			1 C	5.5 C
Sulfur decafluoride	F ₁₀ S ₂	5714-22-7			0.01 C	0.10 C
Sulfur dioxide	O ₂ S	7446-09-5	2	5.2	5	13
Sulfur hexafluoride	F ₆ S	2551-62-4	1000	6000		
Sulfur tetrafluoride	F ₄ S	7783-60-0			0.1 C	0.44 C
Sulfuric acid	H ₂ O ₄ S	7664-93-9		1		3
Sulfuryl fluoride	F ₂ O ₂ S	2699-79-8	5	21	10	42
Sulprofos	C ₁₂ H ₁₉ O ₂ PS ₃	35400-43-2		1		
Talc		14807-96-6		2		
Tantalum	Ta	7440-25-7		5		
Tantalum(V) oxide	O ₅ Ta ₂	1314-61-0		5		
Tellurium	Te	13494-80-9		0.1		
Tellurium hexafluoride	F ₆ Te	7783-80-4	0.02	0.10		
Terephthalic acid	C ₈ H ₆ O ₄	100-21-0		10		
Terphenyl (all isomers)	C ₁₈ H ₁₄	26140-60-3			0.53 C	5 C
1,1,2,2-Tetrabromoethane [Acetylene tetrabromide]	C ₂ H ₂ Br ₄	79-27-6	1	14		
Tetrabromomethane [Carbon tetrabromide]	CBr ₄	558-13-4	0.1	1.4	0.3	4.1
1,1,1,2-Tetrachloro-2,2-difluoroethane	C ₂ Cl ₄ F ₂	76-11-9	500	4170		
1,1,2,2-Tetrachloro-1,2-difluoroethane	C ₂ Cl ₄ F ₂	76-12-0	500	4170		
1,1,2,2-Tetrachloroethane	C ₂ H ₂ Cl ₄	79-34-5	1	6.9		
Tetrachloroethene [Perchloroethylene]	C ₂ Cl ₄	127-18-4	25	170	100	685
Tetrachloromethane [Carbon tetrachloride]	CCl ₄	56-23-5	5	31	10	63
Tetrachloronaphthalene (all isomers)	C ₁₀ H ₄ Cl ₄	1335-88-2		2		
Tetraethyl lead	C ₈ H ₂₀ Pb	78-00-2		0.1		
Tetraethyl pyrophosphate [TEPP]	C ₈ H ₂₀ O ₇ P ₂	107-49-3		0.05		
Tetrahydrofuran [Oxolane]	C ₄ H ₈ O	109-99-9	200	590	250	737
Tetramethyl lead	C ₄ H ₁₂ Pb	75-74-1		0.15		
Tetramethyl silicate	C ₄ H ₁₂ O ₄ Si	681-84-5	1	6		
Tetramethyl succinonitrile	C ₈ H ₁₂ N ₂	3333-52-6	0.5	2.8		
Tetranitromethane	CN ₄ O ₈	509-14-8	0.005	0.04		
Thallium	Tl	7440-28-0		0.1		
4,4'-Thiobis(6- <i>tert</i> -butyl- <i>m</i> -cresol)	C ₂₂ H ₃₀ O ₂ S	96-69-5		10		
Thioglycolic acid	C ₂ H ₄ O ₂ S	68-11-1	1	3.8		
Thionyl chloride	Cl ₂ OS	7719-09-7			1 C	4.9 C
Thiram	C ₆ H ₁₂ N ₂ S ₄	137-26-8		1		
Tin	Sn	7440-31-5		2		
Titanium(IV) oxide [Titanium dioxide]	O ₂ Ti	13463-67-7		10		
Toluene	C ₇ H ₈	108-88-3	50	188		

THRESHOLD LIMITS FOR AIRBORNE CONTAMINANTS (continued)

Substance	Molecular Formula	CAS Reg. No.	Time-Weighted Average		Short-Term Exposure Limit	
			ppm	mg/m ³	ppm	mg/m ³
Toluene-2,4-diisocyanate	C ₉ H ₆ N ₂ O ₂	584-84-9	0.005	0.036	0.02	0.14
1 <i>H</i> -1,2,4-Triazol-3-amine	C ₂ H ₄ N ₄	61-82-5		0.2		
Tribromomethane [Bromoform]	CHBr ₃	75-25-2	0.5	5.2		
Tributyl phosphate	C ₁₂ H ₂₇ O ₄ P	126-73-8	0.2	2.2		
Trichloroacetic acid	C ₂ HCl ₃ O ₂	76-03-9	1	6.7		
1,2,4-Trichlorobenzene	C ₆ H ₃ Cl ₃	120-82-1			5 C	37 C
1,1,1-Trichloroethane [Methyl chloroform]	C ₂ H ₃ Cl ₃	71-55-6	350	1910	450	2460
1,1,2-Trichloroethane	C ₂ H ₃ Cl ₃	79-00-5	10	55		
Trichloroethene	C ₂ HCl ₃	79-01-6	50	269	100	537
Trichlorofluoromethane	CCl ₃ F	75-69-4			1000 C	5620 C
Trichloromethane [Chloroform]	CHCl ₃	67-66-3	10	49		
(Trichloromethyl)benzene [Benzotrichloride]	C ₇ H ₅ Cl ₃	98-07-7			0.01 C	0.08 C
Trichloronaphthalene (all isomers)	C ₁₀ H ₅ Cl ₃	1321-65-9		5		
Trichloronitromethane [Chloropicrin]	CCl ₃ NO ₂	76-06-2	0.1	0.67		
2,4,5-Trichlorophenoxyacetic acid	C ₈ H ₅ Cl ₃ O ₃	93-76-5		10		
1,2,3-Trichloropropane	C ₃ H ₅ Cl ₃	96-18-4	10	60		
1,1,2-Trichloro-1,2,2-trifluoroethane	C ₂ Cl ₃ F ₃	76-13-1	1000	7670	1250	9590
Tri- <i>o</i> -cresyl phosphate	C ₂₁ H ₂₁ O ₄ P	78-30-8		0.1		
Triethanolamine	C ₆ H ₁₅ NO ₃	102-71-6		5		
Triethylamine	C ₆ H ₁₅ N	121-44-8	1	4.1	3	12
Triiodomethane [Iodoform]	CHI ₃	75-47-8	0.6	10		
Trimellitic anhydride [1,2,4-Benzenetricarboxylic anhydride]	C ₉ H ₄ O ₅	552-30-7				0.04 C
Trimethylamine	C ₃ H ₉ N	75-50-3	5	12	15	36
Trimethylbenzene (all isomers)	C ₉ H ₁₂	25551-13-7	25	123		
Trimethyl phosphite	C ₃ H ₉ O ₃ P	121-45-9	2	10		
Trinitroglycerol [Nitroglycerin]	C ₃ H ₅ N ₃ O ₉	55-63-0	0.05	0.46		
2,4,6-Trinitrophenol [Picric acid]	C ₆ H ₃ N ₃ O ₇	88-89-1		0.1		
2,4,6-Trinitrotoluene [TNT]	C ₇ H ₅ N ₃ O ₆	118-96-7		0.1		
Triphenylamine	C ₁₈ H ₁₅ N	603-34-9		5		
Triphenyl phosphate	C ₁₈ H ₁₅ O ₄ P	115-86-6		3		
Tungsten	W	7440-33-7		5		10
Uranium	U	7440-61-1		0.2		0.6
Vanadium(V) oxide	O ₅ V ₂	1314-62-1		0.05		
Vinyl acetate	C ₄ H ₆ O ₂	108-05-4	10	35	15	53
4-Vinylcyclohexene	C ₈ H ₁₂	100-40-3	0.1	0.44		
Warfarin	C ₁₉ H ₁₆ O ₄	81-81-2		0.1		
Xylene (all isomers)	C ₈ H ₁₀	1330-20-7	100	434	150	651
Xylidine (all isomers)	C ₈ H ₁₁ N	1300-73-8	0.5	2.5		
Yttrium	Y	7440-65-5		1		
Zinc chloride	Cl ₂ Zn	7646-85-7		1		2
Zinc chromate, basic	CrH ₂ O ₄ Zn	13530-65-9		0.045		
Zinc oxide	OZn	1314-13-2		5		10
Zirconium	Zr	7440-67-7		5		10

OCTANOL-WATER PARTITION COEFFICIENTS

The octanol-water partition coefficient, P , is a widely used parameter for correlating biological effects of organic substances. It is a property of the two-phase system in which water and 1-octanol are in equilibrium at a fixed temperature and the substance is distributed between the water-rich and octanol-rich phases. P is defined as the ratio of the equilibrium concentration of the substance in the octanol-rich phase to that in the water-rich phase, in the limit of zero concentration. In general, P tends to be large for compounds with extended non-polar structures (such as long chain or multi-ring hydrocarbons) and small for compounds with highly polar groups. Thus P (or, in its more common form of expression, $\log P$) provides a measure of the lipophilic vs. hydrophilic nature of a compound, which is an important consideration in assessing the potential toxicity. A discussion of methods of measurement and accuracy considerations for $\log P$ may be found in Reference 1.

This table gives selected values of $\log P$ for about 450 organic compounds, including many of environmental importance. All values refer to a nominal temperature of 25°C. The source of each value is indicated in the last column. These references contain data on many more compounds than are included here.

Compounds are listed by molecular formula following the Hill convention. To locate a compound by name or CAS Registry Number when the molecular formula is not known, use the table "Physical Constants of Organic Compounds" in Section 3 and its indexes to determine the molecular formula.

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Mol. Form.	Name	$\log P$	Ref.	Mol. Form.	Name	$\log P$	Ref.
CCl ₂ F ₂	Dichlorodifluoromethane	2.16	2	C ₂ H ₄ O	Acetaldehyde	0.45	1
CCl ₃ F	Trichlorofluoromethane	2.53	2	C ₂ H ₄ O	Ethylene oxide	-0.30	1
CCl ₄	Tetrachloromethane	2.64	2	C ₂ H ₄ O ₂	Acetic acid	-0.17	1
CHBr ₃	Tribromomethane	2.38	2	C ₂ H ₅ Br	Bromoethane	1.6	2
CHCl ₃	Trichloromethane	1.97	2	C ₂ H ₅ Cl	Chloroethane	1.43	2
CH ₂ BrCl	Bromochloromethane	1.41	2	C ₂ H ₅ I	Iodoethane	2	2
CH ₂ Br ₂	Dibromomethane	2.3	2	C ₂ H ₅ NO	Acetamide	-1.26	1
CH ₂ Cl ₂	Dichloromethane	1.25	2	C ₂ H ₅ NO ₂	Nitroethane	0.18	1
CH ₂ F ₂	Difluoromethane	0.20	1	C ₂ H ₆ O	Ethanol	-0.30	1
CH ₂ I ₂	Diiodomethane	2.5	2	C ₂ H ₆ O	Dimethyl ether	0.10	1
CH ₂ O	Formaldehyde	0.35	1	C ₂ H ₆ OS	Dimethyl sulfoxide	-1.35	1
CH ₂ O ₂	Formic acid	-0.54	1	C ₂ H ₆ O ₂ S	Dimethyl sulfone	-1.41	1
CH ₃ Br	Bromomethane	1.19	2	C ₂ H ₇ N	Ethylamine	-0.13	1
CH ₃ Cl	Chloromethane	0.91	2	C ₂ H ₇ N	Dimethylamine	-0.38	1
CH ₃ F	Fluoromethane	0.51	1	C ₃ H ₃ N	2-Propenenitrile	0.25	1
CH ₃ I	Iodomethane	1.5	2	C ₃ H ₄ Cl ₂	<i>cis</i> -1,3-Dichloropropene	2.03	2
CH ₃ NO	Formamide	-1.51	1	C ₃ H ₄ O	Propargyl alcohol	-0.38	1
CH ₃ NO ₂	Nitromethane	-0.33	1	C ₃ H ₄ O	Acrolein	-0.01	1
CH ₄ O	Methanol	-0.74	1	C ₃ H ₅ Br	3-Bromopropene	1.79	1
CH ₅ N	Methylamine	-0.57	1	C ₃ H ₅ ClO	Epichlorohydrin	0.30	2
C ₂ Cl ₃ F ₃	1,1,2-Trichlorotrifluoroethane	3.16	2	C ₃ H ₅ Cl ₃	1,2,3-Trichloropropane	2.63	2
C ₂ Cl ₄	Tetrachloroethylene	2.88	2	C ₃ H ₅ N	Propanenitrile	0.16	1
C ₂ Cl ₆	Hexachloroethane	4.00	4	C ₃ H ₅ NO	Acrylamide	-0.78	1
C ₂ HCl ₃	Trichloroethylene	2.53	2	C ₃ H ₆ Cl ₂	1,2-Dichloropropane	2.0	2
C ₂ HCl ₅	Pentachloroethane	2.89	2	C ₃ H ₆ O	Allyl alcohol	0.17	1
C ₂ H ₂ Cl ₂	1,1-Dichloroethylene	2.13	2	C ₃ H ₆ O	Propanal	0.59	1
C ₂ H ₂ Cl ₂	<i>cis</i> -1,2-Dichloroethylene	1.86	2	C ₃ H ₆ O	Acetone	-0.24	1
C ₂ H ₂ Cl ₂	<i>trans</i> -1,2-Dichloroethylene	1.93	2	C ₃ H ₆ O	Methyloxirane	0.03	1
C ₂ H ₂ Cl ₄	1,1,2,2-Tetrachloroethane	2.39	2	C ₃ H ₆ O ₂	Propanoic acid	0.33	1
C ₂ H ₃ Cl	Chloroethylene	1.38	2	C ₃ H ₆ O ₂	Methyl acetate	0.18	1
C ₂ H ₃ Cl ₃	1,1,1-Trichloroethane	2.49	2	C ₃ H ₇ Br	1-Bromopropane	2.1	2
C ₂ H ₃ Cl ₃	1,1,2-Trichloroethane	2.38	2	C ₃ H ₇ Br	2-Bromopropane	1.9	2
C ₂ H ₃ N	Acetonitrile	-0.34	1	C ₃ H ₇ Cl	1-Chloropropane	2.04	1
C ₂ H ₄ Cl ₂	1,1-Dichloroethane	1.79	2	C ₃ H ₇ Cl	2-Chloropropane	1.90	1
C ₂ H ₄ Cl ₂	1,2-Dichloroethane	1.48	2	C ₃ H ₇ I	1-Iodopropane	2.5	2

OCTANOL-WATER PARTITION COEFFICIENTS (continued)

Mol. Form.	Name	log <i>P</i>	Ref.	Mol. Form.	Name	log <i>P</i>	Ref.
C ₃ H ₇ N	Allylamine	0.03	1	C ₅ H ₁₀	Cyclopentane	3.00	1
C ₃ H ₇ NO	<i>N,N</i> -Dimethylformamide	-1.01	1	C ₅ H ₁₀ O	2-Pentanone	0.84	1
C ₃ H ₇ NO	<i>N</i> -Methylacetamide	-1.05	1	C ₅ H ₁₀ O	3-Pentanone	0.82	1
C ₃ H ₇ NO ₂	1-Nitropropane	0.87	1	C ₅ H ₁₀ O	3-Methyl-2-butanone	0.56	1
C ₃ H ₈ O	1-Propanol	0.25	1	C ₅ H ₁₀ O	Tetrahydropyran	0.82	1
C ₃ H ₈ O	2-Propanol	0.05	1	C ₅ H ₁₀ O	2-Methyltetrahydrofuran	1.85	2
C ₃ H ₈ S	1-Propanethiol	1.81	1	C ₅ H ₁₀ O ₂	Pentanoic acid	1.39	1
C ₃ H ₉ N	Propylamine	0.48	1	C ₅ H ₁₀ O ₂	Propyl acetate	1.24	1
C ₃ H ₉ N	Isopropylamine	0.26	1	C ₅ H ₁₀ O ₂	Ethyl propanoate	1.21	1
C ₃ H ₉ N	Ethylmethylamine	0.15	1	C ₅ H ₁₀ O ₃	Diethyl carbonate	1.21	1
C ₃ H ₉ N	Trimethylamine	0.16	1	C ₅ H ₁₁ Br	1-Bromopentane	3.37	1
C ₄ H ₄ O	Furan	1.34	1	C ₅ H ₁₁ F	1-Fluoropentane	2.33	1
C ₄ H ₄ S	Thiophene	1.81	1	C ₅ H ₁₁ N	Piperidine	0.84	1
C ₄ H ₅ N	Pyrrrole	0.75	1	C ₅ H ₁₁ NO ₂	1-Nitropentane	2.01	1
C ₄ H ₆	1,3-Butadiene	1.99	1	C ₅ H ₁₂	Pentane	3.45	1
C ₄ H ₆	2-Butyne	1.46	1	C ₅ H ₁₂	Neopentane	3.11	1
C ₄ H ₆ O	2,5-Dihydrofuran	0.46	1	C ₅ H ₁₂ O	1-Pentanol	1.51	1
C ₄ H ₆ O ₂	Methacrylic acid	0.93	1	C ₅ H ₁₂ O	2-Pentanol	1.25	1
C ₄ H ₆ O ₂	Vinyl acetate	0.73	1	C ₅ H ₁₂ O	3-Pentanol	1.21	1
C ₄ H ₆ O ₂	Methyl acrylate	0.80	1	C ₅ H ₁₂ O	3-Methyl-1-butanol	1.28	1
C ₄ H ₇ N	Butanenitrile	0.60	1	C ₅ H ₁₂ O	2-Methyl-2-butanol	0.89	1
C ₄ H ₈	<i>cis</i> -2-Butene	2.33	1	C ₅ H ₁₂ O	3-Methyl-2-butanol	1.28	1
C ₄ H ₈	<i>trans</i> -2-Butene	2.31	1	C ₅ H ₁₂ O	2,2-Dimethyl-1-propanol	1.31	1
C ₄ H ₈	Isobutene	2.35	1	C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether	0.94	1
C ₄ H ₈ Cl ₂ O	Bis(2-chloroethyl) ether	1.12	2	C ₅ H ₁₃ N	Pentylamine	1.49	1
C ₄ H ₈ O	Ethyl vinyl ether	1.04	1	C ₆ Cl ₆	Hexachlorobenzene	5.47	5
C ₄ H ₈ O	Butanal	0.88	1	C ₆ HCl ₅	Pentachlorobenzene	5.03	5
C ₄ H ₈ O	2-Butanone	0.29	1	C ₆ HCl ₅ O	Pentachlorophenol	5.07	4
C ₄ H ₈ O	Tetrahydrofuran	0.46	1	C ₆ H ₂ Cl ₄	1,2,3,4-Tetrachlorobenzene	4.55	5
C ₄ H ₈ O ₂	Butanoic acid	0.79	1	C ₆ H ₂ Cl ₄	1,2,3,5-Tetrachlorobenzene	4.65	5
C ₄ H ₈ O ₂	Propyl formate	0.83	1	C ₆ H ₂ Cl ₄	1,2,4,5-Tetrachlorobenzene	4.51	5
C ₄ H ₈ O ₂	Ethyl acetate	0.73	1	C ₆ H ₃ Cl ₃	1,2,3-Trichlorobenzene	4.04	5
C ₄ H ₉ Br	1-Bromobutane	2.75	1	C ₆ H ₃ Cl ₃	1,2,4-Trichlorobenzene	3.98	5
C ₄ H ₉ Cl	1-Chlorobutane	2.64	2	C ₆ H ₃ Cl ₃	1,3,5-Trichlorobenzene	4.02	5
C ₄ H ₉ F	1-Fluorobutane	2.58	1	C ₆ H ₄ Cl ₂	<i>o</i> -Dichlorobenzene	3.38	5
C ₄ H ₉ I	1-Iodobutane	3	2	C ₆ H ₄ Cl ₂	<i>m</i> -Dichlorobenzene	3.48	5
C ₄ H ₉ N	Pyrrrolidine	0.46	1	C ₆ H ₄ Cl ₂	<i>p</i> -Dichlorobenzene	3.38	5
C ₄ H ₉ NO	Butanamide	-0.21	1	C ₆ H ₄ Cl ₂ O	2,4-Dichlorophenol	3.23	4
C ₄ H ₉ NO	<i>N,N</i> -Dimethylacetamide	-0.77	1	C ₆ H ₅ Br	Bromobenzene	2.99	2
C ₄ H ₉ NO ₂	1-Nitrobutane	1.47	1	C ₆ H ₅ Cl	Chlorobenzene	2.84	1
C ₄ H ₁₀	Isobutane	2.8	2	C ₆ H ₅ F	Fluorobenzene	2.27	2
C ₄ H ₁₀ O	1-Butanol	0.84	1	C ₆ H ₅ I	Iodobenzene	3.28	2
C ₄ H ₁₀ O	2-Butanol	0.65	1	C ₆ H ₅ NO ₂	Nitrobenzene	1.85	1
C ₄ H ₁₀ O	2-Methyl-1-propanol	0.76	1	C ₆ H ₆	Benzene	2.13	1
C ₄ H ₁₀ O	2-Methyl-2-propanol	0.35	1	C ₆ H ₆ O	Phenol	1.48	4
C ₄ H ₁₀ O	Diethyl ether	0.89	1	C ₆ H ₆ S	Benzenethiol	2.52	1
C ₄ H ₁₀ S	1-Butanethiol	2.28	1	C ₆ H ₇ N	Aniline	0.90	1
C ₄ H ₁₀ S	Diethyl sulfide	1.95	1	C ₆ H ₇ N	2-Methylpyridine	1.11	1
C ₄ H ₁₁ N	Butylamine	0.86	1	C ₆ H ₇ N	3-Methylpyridine	1.20	1
C ₄ H ₁₁ N	<i>tert</i> -Butylamine	0.40	1	C ₆ H ₇ N	4-Methylpyridine	1.22	1
C ₄ H ₁₁ N	Diethylamine	0.58	1	C ₆ H ₈	1,4-Cyclohexadiene	2.3	2
C ₅ H ₅ N	Pyridine	0.65	1	C ₆ H ₈ O	5-Hexyn-2-one	0.58	1
C ₅ H ₆ O	2-Methylfuran	1.85	1	C ₆ H ₈ O	2-Cyclohexen-1-one	0.61	1
C ₅ H ₇ N	1-Methylpyrrrole	1.21	1	C ₆ H ₈ O	2-Ethylfuran	2.40	1
C ₅ H ₈	1,4-Pentadiene	2.48	1	C ₆ H ₁₀	1,5-Hexadiene	2.8	2
C ₅ H ₈	1-Pentyne	1.98	1	C ₆ H ₁₀	1-Hexyne	2.73	2
C ₅ H ₈ O ₂	Methyl methacrylate	1.38	1	C ₆ H ₁₀	Cyclohexene	2.86	1
C ₅ H ₈ O ₂	Ethyl acrylate	1.32	1	C ₆ H ₁₀ O	5-Hexen-2-one	1.02	1
C ₅ H ₉ N	Pentanenitrile	0.94	1	C ₆ H ₁₀ O	Cyclohexanone	0.81	1
C ₅ H ₁₀	1-Pentene	2.2	2	C ₆ H ₁₀ O ₂	Ethyl methacrylate	1.94	1

OCTANOL-WATER PARTITION COEFFICIENTS (continued)

Mol. Form.	Name	log <i>P</i>	Ref.	Mol. Form.	Name	log <i>P</i>	Ref.
C ₆ H ₁₁ Br	Bromocyclohexane	3.20	1	C ₇ H ₁₆	Heptane	4.50	1
C ₆ H ₁₁ N	Hexanenitrile	1.66	1	C ₇ H ₁₆ O	1-Heptanol	2.62	1
C ₆ H ₁₂	1-Hexene	3.40	1	C ₇ H ₁₆ O	2-Heptanol	2.31	1
C ₆ H ₁₂	4-Methyl-1-pentene	2.5	2	C ₇ H ₁₆ O	3-Heptanol	2.24	1
C ₆ H ₁₂	Cyclohexane	3.44	1	C ₇ H ₁₆ O	4-Heptanol	2.22	1
C ₆ H ₁₂	Methylcyclopentane	3.37	2	C ₇ H ₁₇ N	Heptylamine	2.57	1
C ₆ H ₁₂ O	Cyclohexanol	1.23	1	C ₈ H ₆	Phenylacetylene	2.40	1
C ₆ H ₁₂ O	Hexanal	1.78	1	C ₈ H ₆ O	Benzofuran	2.67	1
C ₆ H ₁₂ O	2-Hexanone	1.38	1	C ₈ H ₆ S	Benzo[b]thiophene	3.12	1
C ₆ H ₁₂ O	4-Methyl-2-pentanone	1.31	1	C ₈ H ₇ N	Benzeneacetonitrile	1.56	1
C ₆ H ₁₂ O ₂	Hexanoic acid	1.92	1	C ₈ H ₇ N	Indole	2.14	1
C ₆ H ₁₂ O ₂	Butyl acetate	1.82	1	C ₈ H ₈	Styrene	3.05	1
C ₆ H ₁₃ Br	1-Bromohexane	3.80	1	C ₈ H ₈ O	Acetophenone	1.63	1
C ₆ H ₁₃ N	Cyclohexylamine	1.49	1	C ₈ H ₈ O	2-Methylbenzaldehyde	2.26	1
C ₆ H ₁₄	Hexane	4.00	1	C ₈ H ₈ O	Benzeneacetaldehyde	1.78	1
C ₆ H ₁₄	3-Methylpentane	3.60	2	C ₈ H ₈ O	2,3-Dihydrobenzofuran	2.14	1
C ₆ H ₁₄	2,2-Dimethylbutane	3.82	1	C ₈ H ₈ O	Phenyloxirane	1.61	1
C ₆ H ₁₄	2,3-Dimethylbutane	3.85	2	C ₈ H ₈ O ₂	<i>o</i> -Toluic acid	2.32	4
C ₆ H ₁₄ O	1-Hexanol	2.03	1	C ₈ H ₈ O ₂	<i>m</i> -Toluic acid	2.37	1
C ₆ H ₁₄ O	2-Hexanol	1.76	1	C ₈ H ₈ O ₂	<i>p</i> -Toluic acid	2.34	1
C ₆ H ₁₄ O	3-Hexanol	1.65	1	C ₈ H ₈ O ₂	Benzeneacetic acid	1.41	1
C ₆ H ₁₄ O	3,3-Dimethyl-2-butanol	1.48	1	C ₈ H ₈ O ₂	Phenyl acetate	1.49	1
C ₆ H ₁₄ O	Dipropyl ether	2.03	1	C ₈ H ₈ O ₂	Methyl benzoate	2.20	1
C ₆ H ₁₄ O	Diisopropyl ether	1.52	1	C ₈ H ₁₀	Ethylbenzene	3.15	1
C ₆ H ₁₅ N	Hexylamine	2.06	1	C ₈ H ₁₀	<i>o</i> -Xylene	3.12	1
C ₆ H ₁₅ N	Dipropylamine	1.67	1	C ₈ H ₁₀	<i>m</i> -Xylene	3.20	1
C ₆ H ₁₅ N	Triethylamine	1.45	1	C ₈ H ₁₀	<i>p</i> -Xylene	3.15	1
C ₇ H ₅ BrO ₂	2-Bromobenzoic acid	2.20	4	C ₈ H ₁₀ O	<i>o</i> -Ethylphenol	2.47	1
C ₇ H ₅ BrO ₂	3-Bromobenzoic acid	2.87	4	C ₈ H ₁₀ O	<i>m</i> -Ethylphenol	2.50	1
C ₇ H ₅ BrO ₂	4-Bromobenzoic acid	2.86	4	C ₈ H ₁₀ O	<i>p</i> -Ethylphenol	2.50	1
C ₇ H ₅ N	Benzonitrile	1.56	1	C ₈ H ₁₀ O	2,4-Xylenol	2.35	1
C ₇ H ₆ O	Benzaldehyde	1.48	1	C ₈ H ₁₀ O	2,5-Xylenol	2.34	1
C ₇ H ₆ O ₂	Benzoic acid	1.88	4	C ₈ H ₁₀ O	2,6-Xylenol	2.36	1
C ₇ H ₆ O ₂	Phenyl formate	1.26	1	C ₈ H ₁₀ O	3,4-Xylenol	3.23	1
C ₇ H ₆ O ₃	Salicylic acid	2.20	4	C ₈ H ₁₀ O	3,5-Xylenol	2.35	1
C ₇ H ₇ Br	(Bromomethyl)benzene	2.92	1	C ₈ H ₁₀ O	Benzeneethanol	1.36	1
C ₇ H ₇ Cl	<i>o</i> -Chlorotoluene	3.42	1	C ₈ H ₁₀ O	α -Methylbenzyl alcohol	1.42	1
C ₇ H ₇ Cl	<i>m</i> -Chlorotoluene	3.28	1	C ₈ H ₁₀ O	3-Methylbenzenemethanol	1.60	1
C ₇ H ₇ Cl	<i>p</i> -Chlorotoluene	3.33	1	C ₈ H ₁₀ O	4-Methylbenzenemethanol	1.58	1
C ₇ H ₇ Cl	(Chloromethyl)benzene	2.30	1	C ₈ H ₁₀ O	Phenetole	2.51	1
C ₇ H ₇ NO ₂	<i>p</i> -Nitrotoluene	2.42	1	C ₈ H ₁₀ O	Benzyl methyl ether	1.35	1
C ₇ H ₈	Toluene	2.73	1	C ₈ H ₁₀ O	2-Methylanisole	2.74	1
C ₇ H ₈	1,3,5-Cycloheptatriene	2.63	2	C ₈ H ₁₀ O	3-Methylanisole	2.66	1
C ₇ H ₈ O	<i>o</i> -Cresol	1.98	1	C ₈ H ₁₀ O	4-Methylanisole	2.81	1
C ₇ H ₈ O	<i>m</i> -Cresol	1.98	1	C ₈ H ₁₁ N	<i>p</i> -Ethylaniline	1.96	1
C ₇ H ₈ O	<i>p</i> -Cresol	1.97	1	C ₈ H ₁₁ N	<i>N,N</i> -Dimethylaniline	2.31	1
C ₇ H ₈ O	Benzyl alcohol	1.05	1	C ₈ H ₁₁ N	Benzeneethanamine	1.41	1
C ₇ H ₈ O	Anisole	2.11	1	C ₈ H ₁₄ O ₂	Butyl methacrylate	2.88	1
C ₇ H ₉ N	Benzylamine	1.09	1	C ₈ H ₁₅ N	Octanenitrile	2.75	1
C ₇ H ₉ N	<i>o</i> -Methylaniline	1.32	1	C ₈ H ₁₆	1-Octene	4.57	1
C ₇ H ₉ N	<i>m</i> -Methylaniline	1.40	1	C ₈ H ₁₆	Cyclooctane	4.45	2
C ₇ H ₉ N	<i>p</i> -Methylaniline	1.39	1	C ₈ H ₁₆ O	2-Octanone	2.37	1
C ₇ H ₉ N	<i>N</i> -Methylaniline	1.66	1	C ₈ H ₁₆ O ₂	Octanoic acid	3.05	1
C ₇ H ₁₄	1-Heptene	3.99	1	C ₈ H ₁₇ Br	1-Bromooctane	4.89	1
C ₇ H ₁₄	Methylcyclohexane	3.88	1	C ₈ H ₁₈	Octane	5.15	1
C ₇ H ₁₄ O	2-Heptanone	1.98	1	C ₈ H ₁₈ O	1-Octanol	3.07	1
C ₇ H ₁₄ O	5-Methyl-2-hexanone	1.88	1	C ₈ H ₁₈ O	2-Octanol	2.90	1
C ₇ H ₁₅ Br	1-Bromoheptane	4.36	1	C ₈ H ₁₈ O	4-Octanol	2.68	1
C ₇ H ₁₅ Cl	1-Chloroheptane	4.15	1	C ₈ H ₁₈ O	Dibutyl ether	3.21	1
C ₇ H ₁₅ I	1-Iodoheptane	4.70	1	C ₉ H ₇ N	Quinoline	2.03	1

OCTANOL-WATER PARTITION COEFFICIENTS (continued)

Mol. Form.	Name	log P	Ref.	Mol. Form.	Name	log P	Ref.
C ₉ H ₇ N	Isoquinoline	2.08	1	C ₁₂ H ₂ Cl ₈	2,2',3,3',5,5',6,6'- Octachlorobiphenyl	7.10	3
C ₉ H ₈	Indene	2.92	1	C ₁₂ H ₃ Cl ₇	2,2',3,3',4,4',6-Heptachlorobiphenyl	6.70	3
C ₉ H ₈ O ₂	<i>trans</i> -Cinnamic acid	2.13	1	C ₁₂ H ₄ Cl ₆	2,2',3,3',4,4'-Hexachlorobiphenyl	7.00	3
C ₉ H ₉ N	Benzenepropanenitrile	1.72	1	C ₁₂ H ₄ Cl ₆	2,2',4,4',6,6'-Hexachlorobiphenyl	7.00	3
C ₉ H ₁₀	Indan	3.33	1	C ₁₂ H ₄ Cl ₆	2,2',3,3',6,6'-Hexachlorobiphenyl	6.70	3
C ₉ H ₁₀ O	1-Phenyl-1-propanone	2.19	1	C ₁₂ H ₅ Cl ₅	2,3,4,5,6-Pentachlorobiphenyl	6.30	3
C ₉ H ₁₀ O	1-Phenyl-2-propanone	1.44	1	C ₁₂ H ₅ Cl ₅	2,2',4,5,5'-Pentachlorobiphenyl	6.40	3
C ₉ H ₁₀ O	4-Methylacetophenone	2.19	1	C ₁₂ H ₆ Cl ₄	2,3,4,5-Tetrachlorobiphenyl	5.72	3
C ₉ H ₁₀ O ₂	2-Phenylpropanoic acid	1.80	1	C ₁₂ H ₆ Cl ₄	2,2',4',5-Tetrachlorobiphenyl	5.73	7
C ₉ H ₁₀ O ₂	Benzyl acetate	1.96	1	C ₁₂ H ₇ Cl ₃	2,4,5-Trichlorobiphenyl	5.60	3
C ₉ H ₁₀ O ₂	4-Methylphenyl acetate	2.11	1	C ₁₂ H ₇ Cl ₃	2,4,6-Trichlorobiphenyl	5.47	3
C ₉ H ₁₀ O ₂	Ethyl benzoate	2.64	1	C ₁₂ H ₈ Cl ₂	2,5-Dichlorobiphenyl	5.10	3
C ₉ H ₁₂	Propylbenzene	3.69	1	C ₁₂ H ₈ Cl ₂	2,6-Dichlorobiphenyl	5.00	3
C ₉ H ₁₂	Isopropylbenzene	3.66	1	C ₁₂ H ₈ O	Dibenzofuran	4.12	1
C ₉ H ₁₂	<i>o</i> -Ethyltoluene	3.53	1	C ₁₂ H ₉ Cl	2-Chlorobiphenyl	4.52	1
C ₉ H ₁₂	<i>p</i> -Ethyltoluene	3.63	2	C ₁₂ H ₉ Cl	3-Chlorobiphenyl	4.58	1
C ₉ H ₁₂	1,2,3-Trimethylbenzene	3.60	1	C ₁₂ H ₉ Cl	4-Chlorobiphenyl	4.61	1
C ₉ H ₁₂	1,2,4-Trimethylbenzene	3.63	1	C ₁₂ H ₉ N	Carbazole	3.72	1
C ₉ H ₁₂	1,3,5-Trimethylbenzene	3.42	1	C ₁₂ H ₁₀	Acenaphthene	3.96	4
C ₉ H ₁₂ O	2-Propylphenol	2.93	1	C ₁₂ H ₁₀	Biphenyl	3.76	6
C ₉ H ₁₂ O	4-Propylphenol	3.20	1	C ₁₂ H ₁₀ N ₂	Azobenzene	3.82	1
C ₉ H ₁₂ O	2,3,6-Trimethylphenol	2.67	1	C ₁₂ H ₁₀ O	Diphenyl ether	4.21	1
C ₉ H ₁₂ O	2,4,6-Trimethylphenol	2.46	1	C ₁₂ H ₁₀ S	Diphenyl sulfide	4.45	1
C ₉ H ₁₂ O	Benzenepropanol	1.88	1	C ₁₂ H ₁₁ N	Diphenylamine	3.44	4
C ₉ H ₁₃ N	<i>N,N</i> -Dimethylbenzylamine	1.98	1	C ₁₂ H ₁₂	1-Ethyl-naphthalene	4.40	1
C ₉ H ₁₃ N	Amphetamine	1.76	1	C ₁₂ H ₁₂	1,2-Dimethylnaphthalene	4.31	1
C ₉ H ₁₈	1-Nonene	5.15	1	C ₁₂ H ₁₂	1,4-Dimethylnaphthalene	4.37	1
C ₉ H ₁₈ O	2-Nonanone	3.16	1	C ₁₂ H ₁₄ O	4-Phenylcyclohexanone	2.45	1
C ₉ H ₁₈ O	5-Methyl-2-octanone	2.92	1	C ₁₂ H ₁₈	Hexylbenzene	5.52	1
C ₉ H ₂₀	Nonane	5.65	1	C ₁₂ H ₁₈	Hexamethylbenzene	4.69	4
C ₉ H ₂₀ O	1-Nonanol	4.02	1	C ₁₂ H ₂₂ O	Cyclododecanone	4.10	1
C ₉ H ₂₁ N	Tripropylamine	2.79	1	C ₁₂ H ₂₄ O ₂	Dodecanoic acid	4.6	1
C ₁₀ H ₇ Cl	1-Chloronaphthalene	3.90	1	C ₁₂ H ₂₆ O	1-Dodecanol	5.13	1
C ₁₀ H ₇ Cl	2-Chloronaphthalene	3.98	1	C ₁₃ H ₈ O	9H-Fluoren-9-one	3.58	1
C ₁₀ H ₈	Naphthalene	3.34	4	C ₁₃ H ₉ N	Acridine	3.40	1
C ₁₀ H ₈	Azulene	3.22	1	C ₁₃ H ₁₀	9H-Fluorene	4.20	4
C ₁₀ H ₈ O	1-Naphthol	2.84	1	C ₁₃ H ₁₀ O	Benzophenone	3.18	1
C ₁₀ H ₈ O	2-Naphthol	2.70	1	C ₁₃ H ₁₀ O ₂	Phenyl benzoate	3.59	1
C ₁₀ H ₁₂ O ₂	Isopropyl benzoate	3.18	1	C ₁₃ H ₁₁ NO	<i>N</i> -Phenylbenzamide	2.62	1
C ₁₀ H ₁₄	Butylbenzene	4.26	1	C ₁₃ H ₁₂	Diphenylmethane	4.14	1
C ₁₀ H ₁₄	<i>tert</i> -Butylbenzene	4.11	1	C ₁₃ H ₁₂	4-Methylbiphenyl	4.63	1
C ₁₀ H ₁₄	Isobutylbenzene	4.01	2	C ₁₃ H ₁₂ O	Diphenylmethanol	2.67	1
C ₁₀ H ₁₄	<i>p</i> -Cymene	4.10	1	C ₁₃ H ₁₂ O	Benzyl phenyl ether	3.79	1
C ₁₀ H ₁₄	1,2,4,5-Tetramethylbenzene	4.10	2	C ₁₄ H ₁₀	Anthracene	4.56	4
C ₁₀ H ₁₄	1,2,3,4-Tetramethylbenzene	4.00	1	C ₁₄ H ₁₀	Phenanthrene	4.52	4
C ₁₀ H ₁₄	1,2,3,5-Tetramethylbenzene	4.10	1	C ₁₄ H ₁₂	<i>trans</i> -Stilbene	4.81	1
C ₁₀ H ₁₄ O	4-Butylphenol	3.65	1	C ₁₄ H ₁₂	1-Methylfluorene	4.97	1
C ₁₀ H ₂₀ O	2-Decanone	3.77	1	C ₁₄ H ₁₂ O	2-Phenylacetophenone	3.18	1
C ₁₀ H ₂₀ O ₂	Decanoic acid	4.09	1	C ₁₄ H ₁₂ O ₂	Benzyl benzoate	3.97	1
C ₁₀ H ₂₂	Decane	6.25	1	C ₁₄ H ₁₄	1,2-Diphenylethane	4.70	1
C ₁₀ H ₂₂ O	1-Decanol	4.57	1	C ₁₄ H ₁₄	4,4'-Dimethylbiphenyl	5.09	1
C ₁₁ H ₉ N	4-Phenylpyridine	2.59	1	C ₁₄ H ₂₂	Octylbenzene	6.30	1
C ₁₁ H ₁₀	1-Methylnaphthalene	3.87	1	C ₁₄ H ₂₈ O ₂	Tetradecanoic acid	6.1	1
C ₁₁ H ₁₀	2-Methylnaphthalene	4.00	1	C ₁₅ H ₁₂	2-Methylantracene	5.15	2
C ₁₁ H ₁₆	Pentylbenzene	4.90	1	C ₁₅ H ₁₂	9-Methylantracene	5.07	1
C ₁₁ H ₁₆	Pentamethylbenzene	4.56	1	C ₁₅ H ₁₂	1-Methylphenanthrene	5.14	2
C ₁₁ H ₂₂ O	2-Undecanone	4.09	1	C ₁₆ H ₁₀	Fluoranthene	5.07	4
C ₁₁ H ₂₂ O ₂	Methyl decanoate	4.41	1	C ₁₆ H ₁₀	Pyrene	5.08	4
C ₁₂ Cl ₁₀	Decachlorobiphenyl	8.26	3	C ₁₆ H ₁₄	9,10-Dimethylantracene	5.69	1
C ₁₂ HCl ₉	2,2',3,3',4,5,5',6,6'- Nonachlorobiphenyl	8.16	3	C ₁₆ H ₃₂ O ₂	Hexadecanoic acid	7.17	1

OCTANOL-WATER PARTITION COEFFICIENTS (continued)

Mol. Form.	Name	log <i>P</i>	Ref.	Mol. Form.	Name	log <i>P</i>	Ref.
C ₁₇ H ₁₂	11H-Benzo[a]fluorene	5.40	1	C ₁₈ H ₃₆ O ₂	Stearic acid	8.23	1
C ₁₇ H ₁₂	11H-Benzo[b]fluorene	5.75	1	C ₁₉ H ₁₆ O	Triphenylmethanol	3.68	1
C ₁₈ H ₁₂	Benz[a]anthracene	5.91	1	C ₂₀ H ₁₂	Perylene	6.25	1
C ₁₈ H ₁₂	Chrysene	5.73	4	C ₂₀ H ₁₂	Benzo[a]pyrene	6.20	4
C ₁₈ H ₁₂	Naphthacene	5.76	1	C ₂₀ H ₃₂ O ₂	Arachidonic acid	6.98	1
C ₁₈ H ₁₂	Triphenylene	5.49	4	C ₂₀ H ₄₀ O ₂	Arachidic acid	9.29	1
C ₁₈ H ₁₅ N	Triphenylamine	5.74	1	C ₂₁ H ₁₆	1,2-Dihydro-3-methylbenz[j] aceanthrylene	6.75	1
C ₁₈ H ₃₀ O ₂	Linolenic acid	6.46	1	C ₂₂ H ₁₂	Benzo[ghi]perylene	6.90	1
C ₁₈ H ₃₂ O ₂	Linoleic acid	7.05	1	C ₂₄ H ₁₂	Coronene	6.05	4
C ₁₈ H ₃₄ O ₂	Oleic acid	7.64	1				

PROTECTION AGAINST IONIZING RADIATION

The following data and rules of thumb are helpful in estimating the penetrating capability of and danger of exposure to various types of ionizing radiation. More precise data should be used for critical applications.

Alpha Particles

Alpha particles of at least 7.5 MeV are required to penetrate the epidermis, the protective layer of skin, 0.07 mm thick.

Electrons

Electrons of at least 70 keV are required to penetrate the epidermis, the protective layer of skin, 0.07 mm thick.

The range of electrons in g/cm^2 is approximately equal to the maximum energy (E) in MeV divided by 2.

The range of electrons in air is about 3.65 m per MeV; for example, a 3 MeV electron has a range of about 11 m in air.

A chamber wall thickness of 30 mg/cm^2 will transmit 70% of the initial fluence of 1 MeV electrons and 20% of that of 0.4 MeV electrons.

When electrons of 1 to 2 MeV pass through light materials such as water, aluminum, or glass, less than 1% of their energy is dissipated as bremsstrahlung.

The bremsstrahlung from 1 Ci of ^{32}P aqueous solution in a glass bottle is about 1 mR/h at 1 meter distance.

When electrons from a 1 Ci source of ^{90}Sr - ^{90}Y are absorbed, the bremsstrahlung hazard is approximately equal to that presented by the gamma radiation from 12 mg of radium. The average energy of the bremsstrahlung is about 300 keV.

Gamma Rays

The air-scattered radiation (sky-shine) from a 100 Ci ^{60}Co source placed 1 ft behind a 4 ft high shield is about 100 mrad/h at 6 ft from the outside of the shield.

Within $\pm 20\%$ for point source gamma emitters with energies between 0.07 and 4 MeV, the exposure rate (R/h) at 1 ft is $6C \cdot E \cdot n$ where C is the activity in curies, E is the energy in MeV, and n is the number of gammas per disintegration.

Neutrons

An approximate HVL (thickness of absorber for which the neutron flux falls to half its initial value) for 1 MeV neutrons is 3.2 cm of paraffin; that for 5 MeV neutrons is 6.9 cm of paraffin).

Miscellaneous

The activity of any radionuclide is reduced to less than 1% after 7 half-lives (i.e., $2^{-7} = 0.8\%$).

For nuclides with a half-life greater than 6 days, the change in activity in 24 hours will be less than 10%.

10 HVL (half-value layers) attenuates approximately by 10^{-3} .

There is 0.64 mm^3 of radon gas at STP in transient equilibrium with 1 Ci of radium.

The natural background from all sources in most parts of the world leads to an equivalent dose rate of about 0.04 to 4 mSv per year for the average person. About 84% of this comes from terrestrial sources, the remainder from cosmic rays. The U. S. average is about 3.6 mSv/yr but can range up to 50 mSv/yr in some areas. A passenger in a plane flying at 12,000 meters receives 5 $\mu\text{Sv}/\text{hr}$ from cosmic rays (as compared to about 0.03 $\mu\text{Sv}/\text{hr}$ at sea level).

The ICRP recommended exposure limit to man-made sources of ionizing radiation (Reference 2) is 20 mSv/yr averaged over 5 years, with the dose in any one year not to exceed 50 mSv.

A whole-body dose of about 3 Gy over a short time interval will typically lead to 50% mortality in 30 days assuming no medical treatment.

Units

The gray (Gy) is the SI unit of absorbed dose; it is a measure of the mean energy imparted to a sample of irradiated matter, divided by the mass of the sample. Gy is a special name for the SI unit J/kg.

The sievert (Sv) is the SI unit of equivalent dose, which is defined as the absorbed dose multiplied by a weighting factor that expresses the long-term biological risk from low-level chronic exposure to a specified type of radiation. The Sv is another special name for J/kg.

1 curie (Ci) = $3.7 \cdot 10^{10}$ becquerel (Bq); i.e., $3.7 \cdot 10^{10}$ disintegrations per second.

1 roentgen (R) = $2.58 \cdot 10^{-4}$ coulomb per kilogram (C/kg); a measure of the charge (positive or negative) liberated by x-ray or gamma radiation in air, divided by the mass of air.

1 rad = 0.01 Gy

1 rem = 0.01 Sv

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ANNUAL LIMITS ON INTAKES OF RADIONUCLIDES

K. F. Eckerman

The following table lists, for workers, the annual limits on oral and inhalation intakes (ALI) for selected radionuclides based on the occupational radiation protection guidance of the International Commission on Radiological Protection (References 1 and 2). An intake of one ALI corresponds to an annual whole body dose of 0.02 Sv (2 rem).

The ALI is expressed in the SI unit of activity, the becquerel (Bq), and in the conventional unit, the microcurie (μCi); $1 \mu\text{Ci} = 3.7 \cdot 10^4 \text{ Bq}$. The chemical form of inhaled radionuclides is, in most instances, stated in terms of the rate of absorption to blood from the lungs and the fractional absorption from the small intestine. Type F, M, and S denote chemical forms which are absorbed from the lungs at rates characterized as fast, moderate, and slow, respectively. The time to absorb 90% of the deposited radionuclide, in the absence of radioactive decay, corresponds to about 10 minutes, 150 days, and 7000 days for Type F, M, and S compounds, respectively. Type F compounds can be considered to be more soluble than M or S, S being the most insoluble. Chemical form consideration for ingestion is specified by the fractional absorption from the small intestine, denoted as f_1 . The f_1 values range from 10^{-5} to 1. Higher fractional absorption is associated with greater solubility of the compound.

REFERENCES

1. *1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, Annals of the ICRP 21, (1-3)*, Pergamon Press, Oxford, 1991.
2. *Dose Coefficients for Intakes of Radionuclides by Workers, ICRP Publication 68, Annals of the ICRP, 24(4)*, Pergamon Press, Oxford, 1995.

	Physical half-life	Inhalation intakes			Oral intakes		
		Chemical form Type/ f_1	ALI		Chemical form f_1	ALI	
			Bq	μCi		Bq	μCi
^3H	12.3 y	HT gas	1.1E+13	3.0E+08	1.000	1.1E+13	3.0E+08
^{11}C	0.340 h	HTO vapor	1.1E+09	3.0E+04	1.000	8.3E+08	2.3E+04
		CO	1.7E+10	4.5E+05			
		CO ₂	9.1E+09	2.5E+05			
		Organic compounds	6.2E+09	1.7E+05			
^{14}C	5730 y	CO	2.5E+10	6.8E+05	1.000	3.4E+07	9.3E+02
		CO ₂	3.1E+09	8.3E+04			
		Organic compounds	3.4E+07	9.3E+02			
^{18}F	1.83 h	F 1.000	3.7E+08	1.0E+04	1.000	4.1E+08	1.1E+04
		M 1.000	2.2E+08	6.1E+03			
		S 1.000	2.2E+08	5.8E+03			
^{22}Na	2.60 y	F 1.000	1.0E+07	2.7E+02	1.000	6.3E+06	1.7E+02
^{24}Na	15.0 h	F 1.000	3.8E+07	1.0E+03	1.000	4.7E+07	1.3E+03
^{32}P	14.3 d	F 0.800	1.8E+07	4.9E+02	0.800	8.3E+06	2.3E+02
		M 0.800	6.9E+06	1.9E+02			
^{35}S	87.4 d	Inorganic compounds					
		F 0.800	2.5E+08	6.8E+03	0.800	1.4E+08	3.9E+03
		M 0.800	1.8E+07	4.9E+02	0.100	1.1E+08	2.8E+03
		Vapor	1.7E+08	4.5E+03			
^{42}K	12.4 h	Organic compounds			1.000	2.6E+07	7.0E+02
		F 1.000	1.0E+08	2.7E+03	1.000	4.7E+07	1.3E+03
		F 1.000	7.7E+07	2.1E+03	1.000	8.0E+07	2.2E+03
^{45}Ca	163 d	M 0.300	8.7E+06	2.4E+02	0.300	2.6E+07	7.1E+02
^{47}Ca	4.53 d	M 0.300	9.5E+06	2.6E+02	0.300	1.3E+07	3.4E+02
^{51}Cr	27.7 d	F 0.100	6.7E+08	1.8E+04	0.100	5.3E+08	1.4E+04
		M 0.100	5.9E+08	1.6E+04	0.010	5.4E+08	1.5E+04
		S 0.100	5.6E+08	1.5E+04			
^{54}Mn	312 d	F 0.100	1.8E+07	4.9E+02	0.100	2.8E+07	7.6E+02
		M 0.100	1.7E+07	4.5E+02			
^{52}Fe	8.28 h	F 0.100	2.9E+07	7.8E+02	0.100	1.4E+07	3.9E+02
		M 0.100	2.1E+07	5.7E+02			
^{55}Fe	2.70 y	F 0.100	2.2E+07	5.9E+02	0.100	6.1E+07	1.6E+03
		M 0.100	6.1E+07	1.6E+03			

ANNUAL LIMITS ON INTAKES OF RADIONUCLIDES (continued)

	Physical half-life	Inhalation intakes			Oral intakes		
		Chemical form Type/ f_1	ALI		Chemical form f_1	ALI	
			Bq	μ Ci		Bq	μ Ci
⁵⁹ Fe	44.5 d	F 0.100	6.7E+06	1.8E+02	0.100	1.1E+07	3.0E+02
		M 0.100	6.3E+06	1.7E+02			
⁵⁷ Co	271 d	M 0.100	5.1E+07	1.4E+03	0.100	9.5E+07	2.6E+03
		S 0.050	3.3E+07	9.0E+02			
⁵⁸ Co	70.8 d	M 0.100	1.4E+07	3.9E+02	0.100	2.7E+07	7.3E+02
		S 0.050	1.2E+07	3.2E+02			
⁶⁰ Co	5.27 y	M 0.100	2.8E+06	7.6E+01	0.100	5.9E+06	1.6E+02
		S 0.050	1.2E+06	3.2E+01			
⁶⁴ Cu	12.7 h	F 0.500	2.9E+08	7.9E+03	0.500	1.7E+08	4.5E+03
		M 0.500	1.3E+08	3.6E+03			
		S 0.500	1.3E+08	3.6E+03			
⁵⁹ Ni	75000 y	F 0.050	9.1E+07	2.5E+03	0.050	3.2E+08	8.6E+03
		M 0.050	2.1E+08	5.8E+03			
		Vapor	2.4E+07	6.5E+02			
⁶³ Ni	96.0 y	F 0.050	3.8E+07	1.0E+03	0.050	1.3E+08	3.6E+03
		M 0.050	6.5E+07	1.7E+03			
		Vapor	1.0E+07	2.7E+02			
⁶⁵ Zn	244 d	S 0.500	7.1E+06	1.9E+02	0.500	5.1E+06	1.4E+02
⁶⁷ Ga	3.26 d	F 0.001	1.8E+08	4.9E+03	0.001	1.1E+08	2.8E+03
		M 0.001	7.1E+07	1.9E+03			
⁶⁸ Ga	1.13 h	F 0.001	4.1E+08	1.1E+04	0.001	2.0E+08	5.4E+03
		M 0.001	2.5E+08	6.7E+03			
⁶⁸ Ge	288 d	F 1.000	2.4E+07	6.5E+02	1.000	1.5E+07	4.2E+02
		M 1.000	2.5E+06	6.8E+01			
⁷⁵ Se	120 d	F 0.800	1.4E+07	3.9E+02	0.800	7.7E+06	2.1E+02
		M 0.800	1.2E+07	3.2E+02			
⁷⁹ Se	65000 y	F 0.800	1.3E+07	3.4E+02	0.800	6.9E+06	1.9E+02
		M 0.800	6.5E+06	1.7E+02			
⁸⁶ Rb	18.6 d	F 1.000	1.5E+07	4.2E+02	1.000	7.1E+06	1.9E+02
		F 0.300	3.6E+07	9.7E+02			
⁸⁵ Sr	64.8 d	S 0.010	3.1E+07	8.4E+02	0.010	6.1E+07	1.6E+03
		F 0.300	9.1E+08	2.5E+04			
^{87m} Sr	2.80 h	S 0.010	5.7E+08	1.5E+04	0.010	6.1E+08	1.6E+04
		F 0.300	1.4E+07	3.9E+02			
⁸⁹ Sr	50.5 d	S 0.010	3.6E+06	9.7E+01	0.010	8.7E+06	2.4E+02
		F 0.300	6.7E+05	1.8E+01			
⁹⁰ Sr	29.1 y	S 0.010	2.6E+05	7.0E+00	0.010	7.4E+06	2.0E+02
		F 0.800	5.6E+07	1.5E+03			
⁹⁹ Mo	2.75 d	S 0.050	1.8E+07	4.9E+02	0.050	1.7E+07	4.5E+02
		F 0.800	1.0E+09	2.7E+04			
^{99m} Tc	6.02 h	M 0.800	6.9E+08	1.9E+04	0.800	9.1E+08	2.5E+04
		F 0.800	5.0E+07	1.4E+03			
⁹⁹ Tc	213000 y	M 0.800	6.3E+06	1.7E+02	0.800	2.6E+07	6.9E+02
		F 0.050	2.0E+06	5.5E+01			
¹⁰⁶ Ru	1.01 y	M 0.050	1.2E+06	3.2E+01	0.050	2.9E+06	7.7E+01
		S 0.050	5.7E+05	1.5E+01			
¹¹¹ In	2.83 d	F 0.020	9.1E+07	2.5E+03	0.020	6.9E+07	1.9E+03
		M 0.020	6.5E+07	1.7E+03			
^{113m} In	1.66 h	F 0.020	1.1E+09	2.8E+04	0.020	7.1E+08	1.9E+04
		M 0.020	6.3E+08	1.7E+04			
¹¹³ Sn	115 d	F 0.020	2.5E+07	6.8E+02	0.020	2.7E+07	7.4E+02
		M 0.020	1.1E+07	2.8E+02			
¹²³ I	13.2 h	F 1.000	1.8E+08	4.9E+03	1.000	9.5E+07	2.6E+03
		Vapor	9.5E+07	2.6E+03			
¹²⁵ I	60.1 d	F 1.000	2.7E+06	7.4E+01	1.000	1.3E+06	3.6E+01
		Vapor	1.4E+06	3.9E+01			
¹²⁹ I	1.57·10 ⁷ y	F 1.000	3.9E+05	1.1E+01	1.000	1.8E+05	4.9E+00

ANNUAL LIMITS ON INTAKES OF RADIONUCLIDES (continued)

	Physical half-life	Inhalation intakes			Oral intakes		
		Chemical form Type/ f_1	ALI		Chemical form f_1	ALI	
			Bq	μCi		Bq	μCi
¹³¹ I	8.04 d	Vapor	2.1E+05	5.6E+00	1.000	9.1E+05	2.5E+01
		F 1.000	1.8E+06	4.9E+01			
¹²⁹ Cs	1.34 d	Vapor	1.0E+06	2.7E+01	1.000	3.3E+08	9.0E+03
		F 1.000	2.5E+08	6.7E+03			
¹³⁴ Cs	2.06 y	F 1.000	2.1E+06	5.6E+01	1.000	1.1E+06	2.8E+01
¹³⁶ Cs	13.1 d	F 1.000	1.1E+07	2.8E+02	1.000	6.7E+06	1.8E+02
¹³⁷ Cs	30.0 y	F 1.000	3.0E+06	8.1E+01	1.000	1.5E+06	4.2E+01
¹⁴¹ Ce	32.5 d	M 5.0E-04	7.4E+06	2.0E+02	5.0E-04	2.8E+07	7.6E+02
		S 5.0E-04	6.5E+06	1.7E+02			
¹⁴⁴ Ce	284 d	M 5.0E-04	8.7E+05	2.4E+01	5.0E-04	3.8E+06	1.0E+02
		S 5.0E-04	6.9E+05	1.9E+01			
¹³³ Ba	10.7 y	F 0.100	1.1E+07	3.0E+02	0.100	2.0E+07	5.4E+02
¹⁴⁰ Ba	12.7 d	F 0.100	1.3E+07	3.4E+02	0.100	8.0E+06	2.2E+02
¹⁶⁹ Yb	32.0 d	M 5.0E-04	9.5E+06	2.6E+02	5.0E-04	2.8E+07	7.6E+02
		S 5.0E-04	8.3E+06	2.3E+02			
¹⁹⁸ Au	2.69 d	F 0.100	5.1E+07	1.4E+03	0.100	2.0E+07	5.4E+02
		M 0.100	2.0E+07	5.5E+02			
^{198m} Au	2.30 d	S 0.100	1.8E+07	4.9E+02	0.100	1.5E+07	4.2E+02
		F 0.100	3.4E+07	9.2E+02			
¹⁹⁷ Hg	2.67 d	M 0.100	1.0E+07	2.7E+02	0.400	1.2E+08	3.2E+03
		S 0.100	1.1E+07	2.8E+02			
¹⁹⁷ Hg	2.67 d	Inorganic compounds	2.4E+08	6.4E+03	1.000	2.0E+08	5.5E+03
		F 0.400			0.400	1.2E+08	3.2E+03
¹⁹⁷ Hg	2.67 d	Vapor	4.5E+06	1.2E+02	0.020	8.7E+07	2.4E+03
		Organic compounds	F 0.020	2.0E+08				5.4E+03
²⁰³ Hg	46.6 d	M 0.020	7.1E+07	1.9E+03	1.000	1.1E+07	2.8E+02
		Inorganic compounds	F 0.400	2.7E+07				7.2E+02
²⁰³ Hg	46.6 d	Vapor	2.9E+06	7.7E+01	0.400	1.8E+07	4.9E+02
		Organic compounds	F 0.020	3.4E+07				9.2E+02
²⁰¹ Tl	3.04 d	M 0.020	1.1E+07	2.8E+02	0.020	3.7E+07	1.0E+03
²⁰¹ Tl	3.04 d	F 1.000	2.6E+08	7.1E+03	1.000	2.1E+08	5.7E+03
²¹⁰ Pb	22.3 y	F 0.200	1.8E+04	4.9E-01	0.200	2.9E+04	7.9E-01
²⁰⁷ Bi	38.0 y	F 0.050	2.4E+07	6.4E+02	0.050	1.5E+07	4.2E+02
		M 0.050	6.3E+06	1.7E+02			
²¹⁰ Po	138 d	F 0.100	2.8E+04	7.6E-01	0.100	8.3E+04	2.3E+00
		M 0.100	9.1E+03	2.5E-01			
²²⁴ Ra	3.66 d	M 0.200	8.3E+03	2.3E-01	0.200	3.1E+05	8.3E+00
²²⁶ Ra	1600 y	M 0.200	1.7E+03	4.5E-02	0.200	7.1E+04	1.9E+00
²²⁸ Ra	5.75 y	M 0.200	1.2E+04	3.2E-01	0.200	3.0E+04	8.1E-01
²²⁸ Th	1.91 y	M 5.0E-04	8.7E+02	2.4E-02	5.0E-04	2.9E+05	7.7E+00
		S 2.0E-04	6.3E+02	1.7E-02			
²³⁰ Th	77000 y	M 5.0E-04	7.1E+02	1.9E-02	5.0E-04	9.5E+04	2.6E+00
		S 2.0E-04	2.8E+03	7.5E-02			
²³² Th	1.40·10 ¹⁰ y	M 5.0E-04	6.9E+02	1.9E-02	5.0E-04	9.1E+04	2.5E+00
		S 2.0E-04	1.7E+03	4.5E-02			
²³⁴ U	2.44·10 ⁵ y	F 0.020	3.1E+04	8.4E-01	0.020	4.1E+05	1.1E+01
		M 0.020	9.5E+03	2.6E-01			
²³⁴ U	2.44·10 ⁵ y	S 0.002	2.9E+03	7.9E-02	0.002	2.4E+06	6.5E+01

ANNUAL LIMITS ON INTAKES OF RADIONUCLIDES (continued)

	Physical half-life	Inhalation intakes			Oral intakes		
		Chemical form Type/ f_1	ALI		Chemical form f_1	ALI	
			Bq	μ Ci		Bq	μ Ci
²³⁵ U	7.04·10 ⁸ y	F 0.020	3.3E+04	9.0E-01	0.020	4.3E+05	1.2E+01
		M 0.020	1.1E+04	3.0E-01	0.002	2.4E+06	6.5E+01
		S 0.002	3.3E+03	8.9E-02			
²³⁸ U	4.47·10 ⁹ y	F 0.020	3.4E+04	9.3E-01	0.020	4.5E+05	1.2E+01
		M 0.020	1.3E+04	3.4E-01	0.002	2.6E+06	7.1E+01
		S 0.002	3.5E+03	9.5E-02			
²³⁷ Np	2.14·10 ⁶ y	M 5.0E-04	1.3E+03	3.6E-02	5.0E-04	1.8E+05	4.9E+00
²³⁹ Np	2.36 d	M 5.0E-04	1.8E+07	4.9E+02	5.0E-04	2.5E+07	6.8E+02
²³⁸ Pu	87.7 y	M 5.0E-04	6.7E+02	1.8E-02	5.0E-04	8.7E+04	2.4E+00
		S 1.0E-05	1.8E+03	4.9E-02	1.0E-05	2.3E+06	6.1E+01
					1.0E-04	4.1E+05	1.1E+01
²³⁹ Pu	24100 y	M 5.0E-04	6.3E+02	1.7E-02	5.0E-04	8.0E+04	2.2E+00
		S 1.0E-05	2.4E+03	6.5E-02	1.0E-05	2.2E+06	6.0E+01
					1.0E-04	3.8E+05	1.0E+01
²⁴¹ Pu	14.4 y	M 5.0E-04	3.4E+04	9.3E-01	5.0E-04	4.3E+06	1.2E+02
		S 1.0E-05	2.4E+05	6.4E+00	1.0E-05	1.8E+08	4.9E+03
					1.0E-04	2.1E+07	5.6E+02
²⁴¹ Am	432 y	M 5.0E-04	7.4E+02	2.0E-02	5.0E-04	1.0E+05	2.7E+00
²⁴⁴ Cm	18.1 y	M 5.0E-04	1.2E+03	3.2E-02	5.0E-04	1.7E+05	4.5E+00
²⁵² Cf	2.64 y	M 5.0E-04	1.5E+03	4.2E-02	5.0E-04	2.2E+05	6.0E+00

CHEMICAL CARCINOGENS

The following substances are listed in the *10th Report on Carcinogens*, released in December 2002 by the National Institute of Environmental Health Sciences (NIEHS) under the National Toxicology Program (NTP). Substances are grouped in two classes:

- Known to be human carcinogens: There is sufficient evidence of carcinogenicity from studies in humans which indicates a causal relationship between exposure to the substance and human cancer.

- Reasonably anticipated to be human carcinogens: There is limited evidence of carcinogenicity from studies in humans which indicates that causal interpretation is credible, but that alternative explanations, such as chance, bias, or confounding factors, could not be adequately excluded; or there is sufficient evidence of carcinogenicity from studies in experimental animals.

The NTP report also lists many poorly defined materials such as soots, tars, mineral oils, coke oven emissions, etc. These materials are not included here.

The table lists the name normally used in the *Handbook of Chemistry and Physics*, followed by additional names by which the substance is known. In many cases the primary name given here is different from that used in the NTP report; however, names used in the NTP report appear in the *Other names* column. The Chemical Abstracts Service Registry Number (CAS RN), given in the last column, is taken from the NTP report. Extensive details on each substance are given in the reference.

REFERENCE

Public Health Service, National Toxicology Program, *10th Report on Carcinogens*, available on the Internet at <http://ehp.niehs.nih.gov/roc/toc10.html>

Substance	Other names	CAS RN
Known to be Human Carcinogens		
Aflatoxins		1402-68-2
4-Aminobiphenyl	<i>p</i> -Biphenylamine	92-67-1
Arsenic compounds, inorganic		
Asbestos		1332-21-4
Azathioprine	1H-Purine, 6-[(1-methyl-4-nitro-1H-imidazol-5-yl)thio]-	446-86-6
Benzene		71-43-2
<i>p</i> -Benzidine	[1,1'-Biphenyl]-4,4'-diamine	92-87-5
Beryllium and beryllium compounds		7440-41-7
Bis(2-chloroethyl) sulfide	Mustard gas	505-60-2
Bis(chloromethyl) ether		542-88-1
1,3-Butadiene		106-99-0
1,4-Butanediol dimethylsulfonate	Myleran; Busulfan	55-98-1
Cadmium and cadmium compounds		7440-43-9
Chlorambucil		305-03-3
Chloroethene	Vinyl chloride; Chloroethylene	75-01-4
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea	MeCCNU; Urea,	13909-09-6
Chloromethyl methyl ether		107-30-2
Chromium hexavalent compounds		
Cyclophosphamide	2H-1,3,2-Oxazaphosphorin-2-amine, <i>N,N</i> -bis(2-chloroethyl)tetrahydro-, 2-oxide	50-18-0
Cyclosporin A	Cyclosporine	59865-13-3
Diethylstilbestrol		56-53-1
Erionite		66733-21-9
Estrogens, steroidal		
Melphalan	<i>L</i> -Phenylalanine, 4-[bis(2-chloroethyl)amino]-	148-82-3
Methoxsalen (with UV therapy)	PUVA; 9-Methoxy-7H-furo[3,2- <i>g</i>][1]benzopyran-7-one	298-81-7
2-Naphthylamine	2-Aminonaphthalene; β -Naphthylamine	91-59-8
Nickel compounds		
Oxirane	Ethylene oxide	75-21-8
Radon		10043-92-2
Silicon dioxide (respirable size)	Quartz; Silica	14808-60-7
Silicon dioxide (respirable size)	Cristobalite; Silica	14464-46-1
Silicon dioxide (respirable size)	Tridymite; Silica	15468-32-3
Tamoxifen		10540-29-1
2,3,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin	TCDD; Dioxin	1746-01-6
Thorium(IV) oxide	Thorium dioxide	1314-20-1
Triethylenethiophosphoramide	Thiotepa; Tris(1-aziridinyl)phosphine, sulfide	52-24-4

CHEMICAL CARCINOGENS (continued)

Substance	Other names	CAS RN
Reasonably Anticipated to be Human Carcinogens		
Acetaldehyde	Ethanal	75-07-0
2-(Acetylamino)fluorene		53-96-3
Acrylamide	2-Propenamide	79-06-1
Acrylonitrile	Propenenitrile	107-13-1
Adriamycin	Doxorubicin	23214-92-8
2-Amino-9,10-anthracenedione	2-Aminoanthraquinone	117-79-3
1-Amino-2-methyl-9,10-anthracenedione	1-Amino-2-methylantraquinone	82-28-0
2-Amino-3-methyl-3 <i>H</i> -imidazo[4,5- <i>f</i>]quinoline	IQ	76180-96-6
Azacitidine	5-Azacytidine; 1,3,5-Triazine-2(1 <i>H</i>)-one, 4-amino-1- <i>beta</i> - <i>D</i> -ribofuranosyl-	320-67-2
Benz[<i>a</i>]anthracene		56-55-3
Benzo[<i>b</i>]fluoranthene	Benz[<i>e</i>]acephenanthrylene	205-99-2
Benzo[<i>j</i>]fluoranthene		205-82-3
Benzo[<i>k</i>]fluoranthene	2,3,1',8'-Binaphthylene	207-08-9
Benzo[<i>a</i>]pyrene		50-32-8
2,2'-Bioxirane	Diepoxybutane	1464-53-5
Bis(4-amino-3-chlorophenyl)methane	4,4-Methylene-bis(2-chloraniline); MBOCA	101-14-4
2,2-Bis(bromomethyl)-1,3-propanediol	BBMP; Pentaerythritol dibromide	3296-90-0
Bis(2-chloroethyl)methylamine	Nitrogen mustard hydrochloride	55-86-7
<i>N,N'</i> -Bis(2-chloroethyl)- <i>N</i> -nitrosoarea	BCNU; Carmustine	154-93-8
Bis[4-(dimethylamino)phenyl]methane	Michler's Base; 4,4-Methylenebis(<i>N,N</i> -dimethylbenzenamine)	101-61-1
1,3-Bis(2,3-epoxypropoxy)benzene	Diglycidyl resorcinol ether	101-90-6
Bis(2-ethylhexyl) phthalate	DEHP; Di(2-ethylhexyl) phthalate	117-81-7
Bromodichloromethane		75-27-4
Bromoethene	Vinyl bromide	593-60-2
<i>tert</i> -Butyl-4-hydroxyanisole	BHA; Butylated hydroxyanisole	25013-16-5
Chloramphenicol		56-75-7
Chlorendic acid	5-Norbornene-2,3-dicarboxylic acid, 1,4,5,6,7,7-hexachloro-	115-28-6
Chlorinated paraffins (C ₁₂ , 60% Cl)		108171-26-2
4-Chloro-1,2-benzenediamine	4-Chloro- <i>o</i> -phenylenediamine	95-83-0
2-Chloro-1,3-butadiene	Chloroprene	126-99-8
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosoarea	CCNU; Lomustine; Belustine	13010-47-4
4-Chloro-2-methylaniline	<i>p</i> -Chloro- <i>o</i> -toluidine	95-69-2
4-Chloro-2-methylaniline hydrochloride	<i>p</i> -Chloro- <i>o</i> -toluidine hydrochloride	3165-93-3
1-Chloro-2-methylpropene	Dimethylvinyl chloride	513-37-1
3-Chloro-2-methylpropene		563-47-3
Chlorozotocin	<i>D</i> -Glucose, 2-[[[(2-chloroethyl)nitrosoamino]carbonyl]amino]-2-deoxy-	54749-90-5
C.I. Basic Red 9, monohydrochloride		569-61-9
Cupferron		135-20-6
Dacarbazine	1 <i>H</i> -Imidazole-4-carboxamide, 5-(3,3-dimethyl-1-triazenyl)-	4342-03-4
<i>cis</i> -Diaminedichloroplatinum	Cisplatin	15663-27-1
2,4-Diaminoanisole sulfate	1,3-Benzenediamine, 4-methoxy, sulfate	39156-41-7
4,4'-Diaminodiphenyl ether	4,4-Oxydianiline	101-80-4
4,4'-Diaminodiphenylmethane	4,4'-Methylenedianiline	101-77-9
Dibenz[<i>a,h</i>]acridine		226-36-8
Dibenz[<i>a,j</i>]acridine		224-42-0
Dibenz[<i>a,h</i>]anthracene		53-70-3
7 <i>H</i> -Dibenzo[<i>c,g</i>]carbazole		194-59-2
Dibenzo[<i>a,e</i>]pyrene	Naphtho[1,2,3,4- <i>def</i>]chrysene	192-65-4
Dibenzo[<i>a,h</i>]pyrene	Dibenzo[<i>b,def</i>]chrysene	189-64-0
Dibenzo[<i>a,i</i>]pyrene	Benzo[<i>rst</i>]pentaphene	189-55-9
Dibenzo[<i>a,l</i>]pyrene	Dibenzo[<i>def,p</i>]chrysene	191-30-0
1,2-Dibromo-3-chloropropane		96-12-8
1,2-Dibromoethane	Ethylene dibromide; EDB	106-93-4
2,3-Dibromo-1-propanol	DBP	96-13-9
2,3-Dibromo-1-propanol, phosphate (3:1)	Tris(2,3-dibromopropyl) phosphate	126-72-7
<i>p</i> -Dichlorobenzene	1,4-Dichlorobenzene	106-46-7
3,3'-Dichloro- <i>p</i> -benzidine	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-	91-94-1

CHEMICAL CARCINOGENS (continued)

Substance	Other names	CAS RN
3,3'-Dichloro- <i>p</i> -benzidine dihydrochloride	3,3'-Dichloro-[1,1'-biphenyl]-4,4'-diamine dihydrochloride	612-83-9
1,2-Dichloroethane	Ethylene dichloride	107-06-2
Dichloromethane	Methylene chloride	75-09-2
1,3-Dichloropropene (unspecified isomer)		542-75-6
Diethyl sulfate		64-67-5
2,3-Dihydro-6-propyl-2-thioxo-4(1H)-pyrimidinone	Propylthiouracil	51-52-5
1,8-Dihydroxy-9,10-anthracenedione	Danthron; 1,8-Dihydroxyanthraquinone	117-10-2
1,2-Dimethoxy-4-allylbenzene	Methyleugenol	93-15-2
3,3'-Dimethoxybenzidine	Dianisidine	119-90-4
<i>p</i> -(Dimethylamino)azobenzene		60-11-7
2',3-Dimethyl-4-aminoazobenzene	<i>o</i> -Aminoazotoluene; 4- <i>o</i> -Tolylazo- <i>o</i> -toluidine	97-56-3
Dimethylcarbamic chloride	Dimethylcarbamoyl chloride	79-44-7
1,1-Dimethylhydrazine	UDMH	57-14-7
Dimethyl sulfate		77-78-1
1,6-Dinitropyrene		42397-64-8
1,8-Dinitropyrene		42397-65-9
1,4-Dioxane		123-91-1
1,2-Diphenylhydrazine	Hydrazobenzene	122-66-7
Disperse Blue No. 1	9,10-Anthracenedione, 1,4,5,8-tetraamino-	2475-45-8
Epichlorohydrin	(Chloromethyl)oxirane	106-89-8
1,2-Epoxy-4-(epoxyethyl)cyclohexane	4-Vinyl-1-cyclohexene dioxide	106-87-6
<i>N</i> -(4-Ethoxyphenyl)acetamide	Phenacetin	62-44-2
Ethyl carbamate	Urethane	51-79-6
Ethyl methanesulfonate		62-50-0
<i>N</i> -Ethyl- <i>N</i> -nitrosourea	ENU; <i>N</i> -Nitroso- <i>N</i> -ethylurea	759-73-9
Fluoroethene	Vinyl fluoride	75-02-5
Formaldehyde		50-00-0
Furan		110-00-9
Hexachlorobenzene	Perchlorobenzene	118-74-1
1,2,3,4,5,6-Hexachlorocyclohexane, (1 α ,2 α ,3 β ,4 α ,5 α ,6 β)	Lindane; γ -Hexachlorocyclohexane	58-89-9
1,2,3,4,5,6-Hexachlorocyclohexane, (1 α ,2 α ,3 β ,4 α ,5 β ,6 β)	α -Hexachlorocyclohexane	319-84-6
1,2,3,4,5,6-Hexachlorocyclohexane, (1 α ,2 β ,3 α ,4 β ,5 α ,6 β)	β -Hexachlorocyclohexane	319-85-7
Hexachlorocyclohexane (other isomers)		608-73-1
Hexachloroethane	Perchloroethane	67-72-1
Hexamethylphosphoric triamide	Hexamethylphosphoramide; Tris(dimethylamino)phosphine oxide	680-31-9
Hydrazine		302-01-2
Hydrazine sulfate		10034-93-2
2-Imidazolidinethione	Ethylene thiourea	96-45-7
Indeno[1,2,3- <i>cd</i>]pyrene	1,10-(1,2-Phenylene)pyrene	193-39-5
Kepone	Chlordecone	143-50-0
Lead(II) acetate		301-04-2
Lead(II) phosphate		7446-27-7
<i>o</i> -Methoxyaniline hydrochloride	<i>o</i> -Anisidine hydrochloride	134-29-2
2-Methoxy-5-methylaniline	<i>p</i> -Cresidine; 5-Methyl- <i>o</i> -anisidine	120-71-8
<i>o</i> -Methylaniline	<i>o</i> -Toluidine	95-53-4
<i>o</i> -Methylaniline hydrochloride	<i>o</i> -Toluidine hydrochloride	636-21-5
2-Methyl-1,3-butadiene	Isoprene	78-79-5
5-Methylchrysene		3697-24-3
4,4-Methylenedianiline dihydrochloride	Benzenamine, 4,4'-methylenedi-, dihydrochloride	13552-44-8
Methyl methanesulfonate		66-27-3
<i>N</i> -Methyl- <i>N'</i> -nitro- <i>N</i> -nitrosoguanidine		70-25-7
<i>N</i> -Methyl- <i>N</i> -nitrosourea	<i>N</i> -Nitroso- <i>N</i> -methylurea	684-93-5
Methyloxirane	1,2-Propylene oxide	75-56-9
Metronidazole	2-Methyl-5-nitro-1 <i>H</i> -imidazole-1-ethanol	443-48-1

CHEMICAL CARCINOGENS (continued)

Substance	Other names	CAS RN
Mirex	1,3,4-Metheno-1H-cyclobuta[cd]pentalene, 1,1a,2,2,3,3a,4,5,5,5a,5b,6-dodecachlorooctahydro-	2385-85-5
Nickel (metallic)		7440-02-0
Nitritotriacetic acid	<i>N,N</i> -Bis(carboxymethyl)glycine	139-13-9
2-Nitroanisole	1-Methoxy-2-nitrobenzene	91-23-6
6-Nitrochrysene		7496-02-8
Nitrofen	Benzene, 2,4-dichloro-1-(4-nitrophenoxy)-	1836-75-5
2-Nitropropane		79-46-9
1-Nitropyrene		5522-43-0
4-Nitropyrene		57835-92-4
<i>N</i> -Nitrosodibutylamine		924-16-3
<i>N</i> -Nitrosodiethanolamine	Ethanol, 2,2'-(nitrosoimino)-	1116-54-7
<i>N</i> -Nitrosodiethylamine	DEN; Diethylnitrosamine	55-18-5
<i>N</i> -Nitrosodimethylamine	DMN; Dimethylnitrosamine	62-75-9
4-(<i>N</i> -Nitrosomethylamino)-1-(3-pyridyl)-1-butanone	NNK; Ketone, 3-pyridyl-3-(<i>N</i> -methyl- <i>N</i> -nitrosamino)propyl	64091-91-4
<i>N</i> -Nitroso- <i>N</i> -methylvinylamine	Ethenamine, <i>N</i> -methyl- <i>N</i> -nitroso-	4549-40-0
4-Nitrosomorpholine	<i>N</i> -Nitrosomorpholine	59-89-2
<i>N</i> -Nitrosornicotine		16543-55-8
<i>N</i> -Nitrosopiperidine	1-Nitrosopiperidine	100-75-4
<i>N</i> -Nitroso- <i>N</i> -propyl-1-propanamine	<i>N</i> -Nitrosodipropylamine	621-64-7
<i>N</i> -Nitrosopyrrolidine		930-55-2
<i>N</i> -Nitrososarcosine	Glycine, <i>N</i> -methyl- <i>N</i> -nitroso-	13256-22-9
Norethisterone	19-Norpregn-4-en-20-yn-3-one, 17-hydroxy-, (17 α)-	68-22-4
Ochratoxin A		303-47-9
2-Oxetanone	β -Propiolactone	57-57-8
Oxiranemethanol	Glycidol	556-52-5
Oxymetholone	Androstan-3-one, 17-hydroxy-2-(hydroxymethylene)-17-methyl-	434-07-1
Phenazopyridine hydrochloride	2,6-Pyridinediamine, 3-(phenylazo)-, monohydrochloride	136-40-3
Phenolphthalein	3,3-Bis(4-hydroxyphenyl)-1(3 <i>H</i>)-isobenzofuranone	77-09-8
Phenoxybenzamine hydrochloride	Benzenemethanamine, <i>N</i> -(2-chloroethyl)- <i>N</i> -(1-methyl-2-phenoxyethyl)-, hydrochloride	63-92-3
Phenyloxirane	Styrene-7,8-oxide	96-09-3
Phenytoin	5,5-Diphenyl-2,4-imidazolidinedione	57-41-0
Polybrominated biphenyls	PBBs	
Polychlorinated biphenyls	PCBs	1336-36-3
Procarbazine hydrochloride		366-70-1
Progesterone	Pregn-4-ene-3,20-dione	57-83-0
1,3-Propane sultone	1,2-Oxathiolane, 2,2-dioxide	1120-71-4
Propyleneimine	2-Methylaziridine	75-55-8
Reserpine		50-55-5
Safrole	5-(2-Propenyl)-1,3-benzodioxole	94-59-7
Selenium sulfide		7446-34-6
Streptozotocin	<i>D</i> -Glucopyranose, 2-deoxy-2-[[[(methylnitrosoamino)carbonyl]amino]-	18883-66-4
Sulfallate	<i>N,N</i> -Diethyldithiocarbamic acid, 2-chloroallyl ester	95-06-7
Tetrachloroethene	Perchloroethylene	127-18-4
Tetrachloromethane	Carbon tetrachloride	56-23-5
Tetrafluoroethene	Tetrafluoroethylene	116-14-3
<i>N,N,N',N'</i> -Tetramethyl-4,4'-diaminobenzophenone	Bis(dimethylamino)benzophenone; Michler's Ketone	90-94-8
Tetranitromethane		509-14-8
Thioacetamide		62-55-5
Thiourea		62-56-6
<i>o</i> -Tolidine	3,3-Dimethylbenzidine	119-93-7
Toluene-2,4-diamine	2,4-Diaminotoluene	95-80-7
Toluene diisocyanate (unspecified isomer)		26471-62-5
Toxaphene	Polychlorocamphene	8001-35-2
1 <i>H</i> -1,2,4-Triazol-3-amine	Amitrole	61-82-5
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	DDT; Dichlorodiphenyltrichloroethane	50-29-3

CHEMICAL CARCINOGENS (continued)

Substance	Other names	CAS RN
Trichloroethene	Trichloroethylene	79-01-6
Trichloromethane	Chloroform	67-66-3
(Trichloromethyl)benzene	Benzotrichloride	98-07-7
2,4,6-Trichlorophenol		88-06-2
1,2,3-Trichloropropane		96-18-4

MISCELLANEOUS MATHEMATICAL CONSTANTS

π CONSTANTS

$\pi = 3.14159\ 26535\ 89793\ 23846\ 26433\ 83279\ 50288\ 41971\ 69399\ 37511$
 $1/\pi = 0.31830\ 98861\ 83790\ 67153\ 77675\ 26745\ 02872\ 40689\ 19291\ 48091$
 $\pi^2 = 9.86960\ 44010\ 89358\ 61883\ 44909\ 99876\ 15113\ 53136\ 99407\ 24079$
 $\log_e \pi = 1.14472\ 98858\ 49400\ 17414\ 34273\ 51353\ 05871\ 16472\ 94812\ 91531$
 $\log_{10} \pi = 0.49714\ 98726\ 94133\ 85435\ 12682\ 88290\ 89887\ 36516\ 78324\ 38044$
 $\log_{10} \sqrt{2\pi} = 0.39908\ 99341\ 79057\ 52478\ 25035\ 91507\ 69595\ 02099\ 34102\ 92128$

CONSTANTS INVOLVING e

$e = 2.71828\ 18284\ 59045\ 23536\ 02874\ 71352\ 66249\ 77572\ 47093\ 69996$
 $1/e = 0.36787\ 94411\ 71442\ 32159\ 55237\ 70161\ 46086\ 74458\ 11131\ 03177$
 $e^2 = 7.38905\ 60989\ 30650\ 22723\ 04274\ 60575\ 00781\ 31803\ 15570\ 55185$
 $M = \log_{10} e = 0.43429\ 44819\ 03251\ 82765\ 11289\ 18916\ 60508\ 22943\ 97005\ 80367$
 $1/M = \log_e 10 = 2.30258\ 50929\ 94045\ 68401\ 79914\ 54684\ 36420\ 76011\ 01488\ 62877$
 $\log_{10} M = 9.63778\ 43113\ 00536\ 78912\ 29674\ 98645\ -10$

π^e AND e^π CONSTANTS

$\pi^e = 22.45915\ 77183\ 61045\ 47342\ 71522$
 $e^\pi = 23.14069\ 26327\ 79269\ 00572\ 90864$
 $e^{-\pi} = 0.04321\ 39182\ 63772\ 24977\ 44177$
 $e^{1/2\pi} = 4.81047\ 73809\ 65351\ 65547\ 30357$
 $i^i = e^{-1/2\pi} = 0.20787\ 95763\ 50761\ 90854\ 69556$

NUMERICAL CONSTANTS

$\sqrt{2} = 1.41421\ 35623\ 73095\ 04880\ 16887\ 24209\ 69807\ 85696\ 71875\ 37695$
 $\sqrt[3]{2} = 1.25992\ 10498\ 94873\ 16476\ 72106\ 07278\ 22835\ 05702\ 51464\ 70151$
 $\log_e 2 = 0.69314\ 71805\ 59945\ 30941\ 72321\ 21458\ 17656\ 80755\ 00134\ 36026$
 $\log_{10} 2 = 0.30102\ 99956\ 63981\ 19521\ 37388\ 94724\ 49302\ 67881\ 89881\ 46211$
 $\sqrt{3} = 1.73205\ 08075\ 68877\ 29352\ 74463\ 41505\ 87236\ 69428\ 05253\ 81039$
 $\sqrt[3]{3} = 1.44224\ 95703\ 07408\ 38232\ 16383\ 10780\ 10958\ 83918\ 69253\ 49935$
 $\log_e 3 = 1.09861\ 22886\ 68109\ 69139\ 52452\ 36922\ 52570\ 46474\ 90557\ 82275$
 $\log_{10} 3 = 0.47712\ 12547\ 19662\ 43729\ 50279\ 03255\ 11530\ 92001\ 28864\ 19070$

OTHER CONSTANTS

Euler's Constant $\gamma = 0.57721\ 56649\ 01532\ 86061$
 $\log_e \gamma = -0.54953\ 93129\ 81644\ 82234$
Golden Ratio $\phi = 1.61803\ 39887\ 49894\ 84820\ 45868\ 34365\ 63811\ 77203\ 09180$

EXPONENTIAL AND HYPERBOLIC FUNCTIONS AND THEIR COMMON LOGARITHMS

x	e^x		e^{-x} (value)	$\sinh x$		$\cosh x$		$\tanh x$ (value)
	Value	\log^{10}		Value	\log^{10}	value	\log^{10}	
0.00	1.0000	0.00000	1.00000	0.0000	— ∞	1.0000	0.00000	0.00000
0.01	1.0101	.00434	0.99005	.0100	$\bar{2}.00001$	1.0001	.00002	.01000
0.02	1.0202	.00869	.98020	.0200	$\bar{2}.30106$	1.0002	.00009	.02000
0.03	1.0305	.01303	.97045	.0300	$\bar{2}.47719$	1.0005	.00020	.02999
0.04	1.0408	.01737	.96079	.0400	$\bar{2}.60218$	1.0008	.00035	.03998
0.05	1.0513	.02171	.95123	.0500	$\bar{2}.69915$	1.0013	.00054	.04996
0.06	1.0618	.02606	.94176	.0600	$\bar{2}.77841$	1.0018	.00078	.05993
0.07	1.0725	.03040	.93239	.0701	$\bar{2}.84545$	1.0025	.00106	.06989
0.08	1.0833	.03474	.92312	.0801	$\bar{2}.90355$	1.0032	.00139	.07983
0.09	1.0942	.03909	.91393	.0901	$\bar{2}.95483$	1.0041	.00176	.08976
0.10	1.1052	.04343	.90484	.1002	$\bar{1}.00072$	1.0050	.00217	.09967
0.11	1.1163	.04777	.89583	.1102	$\bar{1}.04227$	1.0061	.00262	.10956
0.12	1.1275	.05212	.88692	.1203	$\bar{1}.08022$	1.0072	.00312	.11943
0.13	1.1388	.05646	.87809	.1304	$\bar{1}.11517$	1.0085	.00366	.12927
0.14	1.1503	.06080	.86936	.1405	$\bar{1}.14755$	1.0098	.00424	.13909
0.15	1.1618	.06514	.86071	.1506	$\bar{1}.17772$	1.0113	.00487	.14889
0.16	1.1735	.06949	.85214	.1607	$\bar{1}.20597$	1.0128	.00554	.15865
0.17	1.1853	.07383	.84366	.1708	$\bar{1}.23254$	1.0145	.00625	.16838
0.18	1.1972	.07817	.83527	.1810	$\bar{1}.25762$	1.0162	.00700	.17808
0.19	1.2092	.08252	.82696	.1911	$\bar{1}.28136$	1.0181	.00779	.18775
0.20	1.2214	.08686	.81873	.2013	$\bar{1}.30392$	1.0201	.00863	.19738
0.21	1.2337	.09120	.81058	.2115	$\bar{1}.32541$	1.0221	.00951	.20697
0.22	1.2461	.09554	.80252	.2218	$\bar{1}.34592$	1.0243	.01043	.21652
0.23	1.2586	.09989	.79453	.2320	$\bar{1}.36555$	1.0266	.01139	.22603
0.24	1.2712	.10423	.78663	.2423	$\bar{1}.38437$	1.0289	.01239	.23550
0.25	1.2840	.10857	.77880	.2526	$\bar{1}.40245$	1.0314	.01343	.24492
0.26	1.2969	.11292	.77105	.2629	$\bar{1}.41986$	1.0340	.01452	.25430
0.27	1.3100	.11726	.76338	.2733	$\bar{1}.43663$	1.0367	.01564	.26362
0.28	1.3231	.12160	.75578	.2837	$\bar{1}.45282$	1.0395	.01681	.27291
0.29	1.3364	.12595	.74826	.2941	$\bar{1}.46847$	1.0423	.01801	.28213
0.30	1.3499	.13029	.74082	.3045	$\bar{1}.48362$	1.0453	.01926	.29131
0.31	1.3634	.13463	.73345	.3150	$\bar{1}.49830$	1.0484	.02054	.30044
0.32	1.3771	.13897	.72615	.3255	$\bar{1}.51254$	1.0516	.02187	.30951
0.33	1.3910	.14332	.71892	.3360	$\bar{1}.52637$	1.0549	.02323	.31852
0.34	1.4049	.14766	.71177	.3466	$\bar{1}.53981$	1.0584	.02463	.32748
0.35	1.4191	.15200	.70469	.3572	$\bar{1}.55290$	1.0619	.02607	.33638
0.36	1.4333	.15635	.69768	.3678	$\bar{1}.56564$	1.0655	.02755	.34521
0.37	1.4477	.16069	.69073	.3785	$\bar{1}.57807$	1.0692	.02907	.35399
0.38	1.4623	.16503	.68386	.3892	$\bar{1}.59019$	1.0731	.03063	.36271
0.39	1.4770	.16937	.67706	.4000	$\bar{1}.60202$	1.0770	.03222	.37136
0.40	1.4918	.17372	.67032	.4108	$\bar{1}.61358$	1.0811	.03385	.37995
0.41	1.5063	.17806	.66365	.4216	$\bar{1}.62488$	1.0852	.03552	.38847
0.42	1.5220	.18240	.65705	.4325	$\bar{1}.63594$	1.0895	.03723	.39693
0.43	1.5373	.18675	.65051	.4434	$\bar{1}.64677$	1.0939	.03897	.40532
0.44	1.5527	.19109	.64404	.4543	$\bar{1}.65738$	1.0984	.04075	.41364
0.45	1.5683	.19543	.63763	.4653	$\bar{1}.66777$	1.1030	.04256	.42190
0.46	1.5841	.19978	.63128	.4764	$\bar{1}.67797$	1.1077	.04441	.43008
0.47	1.6000	.20412	.62500	.4875	$\bar{1}.68797$	1.1125	.04630	.43820
0.48	1.6161	.20846	.61878	.4986	$\bar{1}.69779$	1.1174	.04822	.44624
0.49	1.6323	.21280	.61263	.5098	$\bar{1}.70744$	1.1225	.05018	.45422
0.50	1.6487	.21715	.60653	.5211	$\bar{1}.71692$	1.1276	.05217	.46212
0.51	1.6653	.22149	.60050	.5324	$\bar{1}.72624$	1.1329	.05419	.46995
0.52	1.6820	.22583	.59452	.5438	$\bar{1}.73540$	1.1383	.05625	.47770
0.53	1.6989	.23018	.58860	.5552	$\bar{1}.74442$	1.1438	.05834	.48538
0.54	1.7160	.23452	.58275	.5666	$\bar{1}.75330$	1.1494	.06046	.49299
0.55	1.7333	.23886	.57695	.5782	$\bar{1}.76204$	1.1551	.06262	.50052
0.56	1.7507	.24320	.57121	.5897	$\bar{1}.77065$	1.1609	.06481	.50798
0.57	1.7683	.24755	.56553	.6014	$\bar{1}.77914$	1.1669	.06703	.51536
0.58	1.7860	.25189	.55990	.6131	$\bar{1}.78751$	1.1730	.06929	.52267
0.59	1.8040	.25623	.55433	.6248	$\bar{1}.79576$	1.1792	.07157	.52990
0.60	1.8221	.26058	.54881	.6367	$\bar{1}.80390$	1.1855	.07389	.53705
0.61	1.8404	.26492	.54335	.6485	$\bar{1}.81194$	1.1919	.07624	.54413
0.62	1.8589	.26926	.53794	.6605	$\bar{1}.81987$	1.1984	.07861	.55113
0.63	1.8776	.27361	.53259	.6725	$\bar{1}.82770$	1.2051	.08102	.55805
0.64	1.8965	.27795	.52729	.6846	$\bar{1}.83543$	1.2119	.08346	.56490
0.65	1.9155	.28229	.52205	.6967	$\bar{1}.84308$	1.2188	.08593	.57167
0.66	1.9348	.28664	.51685	.7090	$\bar{1}.85063$	1.2258	.08843	.57836
0.67	1.9542	.29098	.51171	.7213	$\bar{1}.85809$	1.2330	.09095	.58498
0.68	1.9739	.29532	.50662	.7336	$\bar{1}.86548$	1.2402	.09351	.59152
0.69	1.9937	.29966	.50158	.7461	$\bar{1}.87278$	1.2476	.09609	.59798
0.70	2.0138	.30401	.49659	.7586	$\bar{1}.88000$	1.2552	.09870	.60437
0.71	2.0340	.30835	.49164	.7712	$\bar{1}.88715$	1.2628	.10134	.61068
0.72	2.0544	.31269	.48675	.7838	$\bar{1}.89423$	1.2706	.10401	.61691

EXPONENTIAL AND HYPERBOLIC FUNCTIONS AND THEIR COMMON LOGARITHMS

(continued)

x	e^x		e^{-x} (value)	$\sinh x$		$\cosh x$		$\tanh x$ (value)
	Value	\log^{10}		Value	\log^{10}	Value	\log^{10}	
0.73	2.0751	.31703	.48191	.7966	̄.90123	1.2785	.10670	.62307
0.74	2.0959	.32138	.47711	.8094	̄.90817	1.2865	.10942	.62915
0.75	2.1170	.32572	.47237	.8223	̄.91504	1.2947	.11216	.63515
0.76	2.1383	.33006	.46767	.8353	̄.92185	1.3030	.11493	.64108
0.77	2.1598	.33441	.46301	.8484	̄.92859	1.3114	.11773	.64693
0.78	2.1815	.33875	.45841	.8615	̄.93527	1.3199	.12055	.65271
0.79	2.2034	.34309	.45384	.8748	̄.94190	1.3286	.12340	.65841
0.80	2.2255	.34744	.44933	.8881	̄.94846	1.3374	.12627	.66404
0.81	2.2479	.35178	.44486	.9015	̄.95498	1.3464	.12917	.66959
0.82	2.2705	.35612	.44043	.9150	̄.96144	1.3555	.13209	.67507
0.83	2.2933	.36046	.43605	.9286	̄.96784	1.3647	.13503	.68048
0.84	2.3164	.36481	.43171	.9423	̄.97420	1.3740	.13800	.68581
0.85	2.3396	.36915	.42741	.9561	̄.98051	1.3835	.14099	.69107
0.86	2.3632	.37349	.42316	.9700	̄.98677	1.3932	.14400	.69626
0.87	2.3869	.37784	.41895	.9840	̄.99299	1.4029	.14704	.70137
0.88	2.4100	.38218	.41478	.9981	̄.99916	1.4128	.15009	.70642
0.89	2.4351	.38652	.41066	1.0122	0.00528	1.4229	.15317	.71139
0.90	2.4596	.39087	.40657	1.0265	.01137	1.4331	.15627	.71630
0.91	2.4843	.39521	.40242	1.0409	.01741	1.4434	.15939	.72113
0.92	2.5093	.39955	.39832	1.0554	.02341	1.4539	.16254	.72590
0.93	2.5345	.40389	.39425	1.0700	.02937	1.4645	.16570	.73059
0.94	2.5600	.40824	.39020	1.0847	.03530	1.4753	.16888	.73522
0.95	2.5857	.41258	.38614	1.0995	.04119	1.4862	.17208	.73978
0.96	2.6117	.41692	.38209	1.1144	.04704	1.4973	.17531	.74428
0.97	2.6379	.42127	.37808	1.1294	.05286	1.5085	.17855	.74870
0.98	2.6645	.42561	.37411	1.1446	.05864	1.5199	.18181	.75307
0.99	2.6912	.42995	.37018	1.1598	.06439	1.5314	.18509	.75736
1.00	2.7183	.43429	.36628	1.1752	.07011	1.5431	.18839	.76159
1.01	2.7456	.43864	.36242	1.1907	.07580	1.5549	.19171	.76576
1.02	2.7732	.44298	.35860	1.2063	.08146	1.5669	.19504	.76987
1.03	2.8011	.44732	.35481	1.2220	.08708	1.5790	.19839	.77391
1.04	2.8292	.45167	.35105	1.2379	.09268	1.5913	.20176	.77789
1.05	2.8577	.45601	.34732	1.2539	.09825	1.6038	.20515	.78181
1.06	2.8864	.46035	.34361	1.2700	.10379	1.6164	.20855	.78566
1.07	2.9154	.46470	.34001	1.2862	.10930	1.6292	.21197	.78946
1.08	2.9447	.46904	.33642	1.3025	.11479	1.6421	.21541	.79320
1.09	2.9743	.47338	.33287	1.3190	.12025	1.6552	.21886	.79688
1.10	3.0042	.47772	.32937	1.3356	.12569	1.6685	.22233	.80050
1.11	3.0344	.48207	.32591	1.3524	.13111	1.6820	.22582	.80406
1.12	3.0659	.48641	.32248	1.3693	.13649	1.6956	.22931	.80757
1.13	3.0977	.49075	.31908	1.3863	.14186	1.7093	.23283	.81102
1.14	3.1298	.49510	.31572	1.4035	.14720	1.7233	.23636	.81441
1.15	3.1622	.49944	.31240	1.4208	.15253	1.7374	.23990	.81775
1.16	3.1949	.50378	.30911	1.4382	.15783	1.7517	.24346	.82104
1.17	3.2279	.50812	.30585	1.4558	.16311	1.7662	.24703	.82427
1.18	3.2611	.51247	.30262	1.4735	.16836	1.7808	.25062	.82745
1.19	3.2945	.51681	.29942	1.4914	.17360	1.7957	.25422	.83058
1.20	3.3281	.52115	.29624	1.5095	.17882	1.8107	.25784	.83365
1.21	3.3619	.52550	.29309	1.5276	.18402	1.8258	.26146	.83668
1.22	3.3959	.52984	.28997	1.5460	.18920	1.8412	.26510	.83966
1.23	3.4301	.53418	.28688	1.5645	.19437	1.8568	.26876	.84258
1.24	3.4645	.53853	.28382	1.5831	.19951	1.8725	.27242	.84546
1.25	3.4991	.54287	.28078	1.6019	.20464	1.8884	.27610	.84828
1.26	3.5339	.54721	.27776	1.6209	.20975	1.9045	.27979	.85106
1.27	3.5689	.55155	.27476	1.6400	.21485	1.9208	.28349	.85380
1.28	3.6041	.55590	.27178	1.6593	.21993	1.9373	.28721	.85648
1.29	3.6394	.56024	.26882	1.6788	.22499	1.9540	.29093	.85913
1.30	3.6749	.56458	.26587	1.6984	.23004	1.9709	.29467	.86172
1.31	3.7105	.56893	.26293	1.7182	.23507	1.9880	.29842	.86428
1.32	3.7463	.57327	.26000	1.7381	.24009	2.0053	.30217	.86678
1.33	3.7821	.57761	.25708	1.7583	.24509	2.0228	.30594	.86925
1.34	3.8180	.58195	.25417	1.7786	.25008	2.0404	.30972	.87167
1.35	3.8540	.58630	.25127	1.7991	.25505	2.0583	.31352	.87405
1.36	3.8902	.59064	.24838	1.8198	.26002	2.0764	.31732	.87639
1.37	3.9265	.59498	.24549	1.8406	.26496	2.0947	.32113	.87869
1.38	3.9749	.59933	.24261	1.8617	.26990	2.1132	.32495	.88095
1.39	4.0149	.60367	.23974	1.8829	.27482	2.1320	.32878	.88317
1.40	4.0552	.60801	.23688	1.9043	.27974	2.1509	.33262	.88535
1.41	4.0960	.61236	.23403	1.9259	.28464	2.1700	.33647	.88749
1.42	4.1371	.61670	.23119	1.9477	.28952	2.1894	.34033	.88960
1.43	4.1787	.62104	.22836	1.9697	.29440	2.2090	.34420	.89167

EXPONENTIAL AND HYPERBOLIC FUNCTIONS AND THEIR COMMON LOGARITHMS

(continued)

x	e^x		e^{-x} (value)	$\sinh x$		$\cosh x$		$\tanh x$ (value)
	Value	\log^{10}		Value	\log^{10}	Value	\log^{10}	
1.44	4.2207	.62538	.23693	1.9919	.29926	2.2288	.34807	.89370
1.45	4.2631	.62973	.23457	2.0143	.30412	2.2488	.35196	.89569
1.46	4.3060	.63407	.23224	2.0369	.30896	2.2691	.35585	.89765
1.47	4.3492	.63841	.22993	2.0597	.31379	2.2896	.35976	.89958
1.48	4.3929	.64276	.22764	2.0827	.31862	2.3103	.36367	.90147
1.49	4.4371	.64710	.22537	2.1059	.32343	2.3312	.36759	.90332
1.50	4.4817	.65144	.22313	2.1293	.32823	2.3524	.37151	.90515
1.51	4.5267	.65578	.22091	2.1529	.33303	2.3738	.37545	.90694
1.52	4.5722	.66013	.21871	2.1768	.33781	2.3955	.37939	.90870
1.53	4.6182	.66447	.21654	2.2008	.34258	2.4174	.38334	.91042
1.54	4.6646	.66881	.21438	2.2251	.34735	2.4395	.38730	.91212
1.55	4.7115	.67316	.21225	2.2496	.35211	2.4619	.39126	.91379
1.56	4.7588	.67750	.21014	2.2743	.35686	2.4845	.39524	.91542
1.57	4.8066	.68184	.20805	2.2993	.36160	2.5073	.39921	.91703
1.58	4.8550	.68619	.20598	2.3245	.36633	2.5305	.40320	.91860
1.59	4.9037	.69053	.20393	2.3499	.37105	2.5538	.40719	.92015
1.60	4.9530	.69487	.20190	2.3756	.37577	2.5775	.41119	.92167
1.61	5.0028	.69921	.19989	2.4015	.38048	2.6013	.41520	.92316
1.62	5.0531	.70356	.19790	2.4276	.38518	2.6255	.41921	.92462
1.63	5.1039	.70790	.19593	2.4540	.38987	2.6499	.42323	.92606
1.64	5.1552	.71224	.19398	2.4806	.39456	2.6746	.42725	.92747
1.65	5.2070	.71659	.19205	2.5075	.39923	2.6995	.43129	.92886
1.66	5.2593	.72093	.19014	2.5346	.40391	2.7247	.43532	.93022
1.67	5.3122	.72527	.18825	2.5620	.40857	2.7502	.43937	.93155
1.68	5.3656	.72961	.18637	2.5896	.41323	2.7760	.44341	.93286
1.69	5.4195	.73396	.18452	2.6175	.41788	2.8020	.44747	.93415
1.70	5.4739	.73830	.18268	2.6456	.42253	2.8283	.45153	.93541
1.71	5.5290	.74264	.18087	2.6740	.42717	2.8549	.45559	.93665
1.72	5.5845	.74699	.17907	2.7027	.43180	2.8818	.45966	.93786
1.73	5.6407	.75133	.17728	2.7317	.43643	2.9090	.46374	.93906
1.74	5.6973	.75567	.17552	2.7609	.44105	2.9364	.46782	.94023
1.75	5.7546	.76002	.17377	2.7904	.44567	2.9642	.47191	.94138
1.76	5.8124	.76436	.17204	2.8202	.45028	2.9922	.47600	.94250
1.77	5.8709	.76870	.17033	2.8503	.45488	3.0206	.48009	.94361
1.78	5.9299	.77304	.16864	2.8806	.45948	3.0492	.48419	.94470
1.79	5.9895	.77739	.16696	2.9112	.46408	3.0782	.48830	.94576
1.80	6.0496	.78173	.16530	2.9422	.46867	3.1075	.49241	.94681
1.81	6.1104	.78607	.16365	2.9734	.47325	3.1371	.49652	.94783
1.82	6.1719	.79042	.16203	3.0049	.47783	3.1669	.50064	.94884
1.83	6.2339	.79476	.16041	3.0367	.48241	3.1972	.50476	.94983
1.84	6.2965	.79910	.15882	3.0689	.48698	3.2277	.50889	.95080
1.85	6.3598	.80344	.15724	3.1013	.49154	3.2585	.51302	.95175
1.86	6.4237	.80779	.15567	3.1340	.49610	3.2897	.51716	.95268
1.87	6.4883	.81213	.15412	3.1671	.50066	3.3212	.52130	.95359
1.88	6.5535	.81647	.15259	3.2005	.50521	3.3530	.52544	.95449
1.89	6.6194	.82082	.15107	3.2341	.50976	3.3852	.52959	.95537
1.90	6.6859	.82516	.14957	3.2682	.51430	3.4177	.53374	.95624
1.91	6.7531	.82950	.14808	3.3025	.51884	3.4506	.53789	.95709
1.92	6.8210	.83385	.14661	3.3372	.52338	3.4838	.54205	.95792
1.93	6.8895	.83819	.14515	3.3722	.52791	3.5173	.54621	.95873
1.94	6.9588	.84253	.14370	3.4075	.53244	3.5512	.55038	.95953
1.95	7.0287	.84687	.14227	3.4432	.53696	3.5855	.55455	.96032
1.96	7.0993	.85122	.14086	3.4792	.54148	3.6201	.55872	.96109
1.97	7.1707	.85556	.13946	3.5156	.54600	3.6551	.56290	.96185
1.98	7.2427	.85990	.13807	3.5523	.55051	3.6904	.56707	.96259
1.99	7.3155	.86425	.13670	3.5894	.55502	3.7261	.57126	.96331
2.00	7.3891	.86859	.13534	3.6269	.55953	3.7622	.57544	.96403
2.01	7.4633	.87293	.13399	3.6647	.56403	3.7987	.57963	.96473
2.02	7.5383	.87727	.13266	3.7028	.56853	3.8355	.58382	.96541
2.03	7.6141	.88162	.13134	3.7414	.57303	3.8727	.58802	.96609
2.04	7.6906	.88596	.13003	3.7803	.57753	3.9103	.59221	.96675
2.05	7.7679	.89030	.12873	3.8196	.58202	3.9483	.59641	.96740
2.06	7.8460	.89465	.12745	3.8593	.58650	3.9867	.60061	.96803
2.07	7.9248	.89899	.12619	3.8993	.59099	4.0255	.60482	.96865
2.08	8.0045	.90333	.12493	3.9398	.59547	4.0647	.60903	.96926
2.09	8.0849	.90768	.12369	3.9806	.59995	4.1043	.61324	.96986
2.10	8.1662	.91202	.12246	4.0219	.60443	4.1443	.61745	.97045
2.11	8.2482	.91636	.12124	4.0635	.60890	4.1847	.62167	.97103
2.12	8.3311	.92070	.12003	4.1056	.61337	4.2256	.62589	.97159
2.13	8.4149	.92505	.11884	4.1480	.61784	4.2669	.63011	.97215
2.14	8.4994	.92939	.11765	4.1909	.62231	4.3085	.63433	.97269
2.15	8.5849	.93373	.11648	4.2342	.62677	4.3507	.63856	.97323

EXPONENTIAL AND HYPERBOLIC FUNCTIONS AND THEIR COMMON LOGARITHMS

(continued)

x	e^x		e^{-x} (value)	$\sinh x$		$\cosh x$		$\tanh x$ (value)
	Value	\log^{10}		Value	\log^{10}	Value	\log^{10}	
2.16	8.6711	.93808	.11533	4.2779	.63123	4.3932	.64278	.97375
2.17	8.7583	.94242	.11418	4.3221	.63569	4.4362	.64701	.97426
2.18	8.8463	.94676	.11304	4.3666	.64015	4.4797	.65125	.97477
2.19	8.9352	.95110	.11192	4.4116	.64460	4.5236	.65548	.97526
2.20	9.0250	.95545	.11080	4.4571	.64905	4.5679	.65972	.97574
2.21	9.1157	.95979	.10970	4.5030	.65350	4.6127	.66396	.97622
2.22	9.2073	.96413	.10861	4.5494	.65795	4.6580	.66820	.97668
2.23	9.2999	.96848	.10753	4.5962	.66240	4.7037	.67244	.97714
2.24	9.3933	.97282	.10646	4.6434	.66684	4.7499	.67668	.97759
2.25	9.4877	.97716	.10540	4.6912	.67128	4.7966	.68093	.97803
2.26	9.5831	.98151	.10435	4.7394	.67572	4.8437	.68518	.97846
2.27	9.6794	.98585	.10331	4.7880	.68016	4.8914	.68943	.97888
2.28	9.7767	.99019	.10228	4.8372	.68459	4.9395	.69368	.97929
2.29	9.8749	.99453	.10127	4.8868	.68903	4.9881	.69794	.97970
2.30	9.9742	.99888	.10026	4.9370	.69346	5.0372	.70219	.98010
2.31	10.074	1.00322	.99926	4.9876	.69789	5.0868	.70645	.98049
2.32	10.176	1.00756	.99827	5.0387	.70232	5.1370	.71071	.98087
2.33	10.278	1.01191	.99730	5.0903	.70675	5.1876	.71497	.98124
2.34	10.381	1.01625	.99633	5.1425	.71117	5.2388	.71923	.98161
2.35	10.486	1.02059	.99537	5.1951	.71559	5.2905	.72349	.98197
2.36	10.591	1.02493	.99442	5.2483	.72002	5.3427	.72776	.98233
2.37	10.697	1.02928	.99348	5.3020	.72444	5.3954	.73203	.98267
2.38	10.805	1.03362	.99255	5.3562	.72885	5.4487	.73630	.98301
2.39	10.913	1.03796	.99163	5.4109	.73327	5.5026	.74056	.98335
2.40	11.023	1.04231	.99072	5.4662	.73769	5.5569	.74484	.98367
2.41	11.134	1.04665	.98982	5.5221	.74210	5.6119	.74911	.98400
2.42	11.246	1.05099	.98892	5.5785	.74652	5.6674	.75338	.98431
2.43	11.359	1.05534	.98804	5.6354	.75093	5.7235	.75766	.98462
2.44	11.473	1.05968	.98716	5.6929	.75534	5.7801	.76194	.98492
2.45	11.588	1.06402	.98629	5.7510	.75975	5.8373	.76621	.98522
2.46	11.705	1.06836	.98543	5.8097	.76415	5.8951	.77049	.98551
2.47	11.822	1.07271	.98458	5.8689	.76856	5.9535	.77477	.98579
2.48	11.941	1.07705	.98374	5.9288	.77296	6.0125	.77906	.98607
2.49	12.061	1.08139	.98291	5.9892	.77737	6.0721	.78334	.98635
2.50	12.182	1.08574	.98208	6.0502	.78177	6.1323	.78762	.98661
2.51	12.305	1.09008	.98127	6.1118	.78617	6.1931	.79191	.98688
2.52	12.429	1.09442	.98046	6.1741	.79057	6.2545	.79619	.98714
2.53	12.554	1.09877	.97966	6.2369	.79497	6.3166	.80048	.98739
2.54	12.680	1.10311	.97887	6.3004	.79937	6.3793	.80477	.98764
2.55	12.807	1.10745	.97808	6.3645	.80377	6.4426	.80906	.98788
2.56	12.936	1.11179	.97730	6.4293	.80816	6.5066	.81335	.98812
2.57	13.066	1.11614	.97654	6.4946	.81256	6.5712	.81764	.98835
2.58	13.197	1.12048	.97577	6.5607	.81695	6.6365	.82194	.98858
2.59	13.330	1.12482	.97502	6.6274	.82134	6.7024	.82623	.98881
2.60	13.464	1.12917	.97427	6.6947	.82573	6.7690	.83052	.98903
2.61	13.599	1.13351	.97353	6.7628	.83012	6.8363	.83482	.98924
2.62	13.736	1.13785	.97280	6.8315	.83451	6.9043	.83912	.98946
2.63	13.874	1.14219	.97208	6.9008	.83890	6.9729	.84341	.98966
2.64	14.013	1.14654	.97136	6.9709	.84329	7.0423	.84771	.98987
2.65	14.154	1.15088	.97065	7.0417	.84768	7.1123	.85201	.99007
2.66	14.296	1.15522	.96995	7.1132	.85206	7.1831	.85631	.99026
2.67	14.440	1.15957	.96925	7.1854	.85645	7.2546	.86061	.99045
2.68	14.585	1.16391	.96856	7.2583	.86083	7.3268	.86492	.99064
2.69	14.732	1.16825	.96788	7.3319	.86522	7.3998	.86922	.99083
2.70	14.880	1.17260	.96721	7.4063	.86960	7.4735	.87352	.99101
2.71	15.029	1.17694	.96654	7.4814	.87398	7.5479	.87783	.99118
2.72	15.180	1.18128	.96587	7.5572	.87836	7.6231	.88213	.99136
2.73	15.333	1.18562	.96522	7.6338	.88274	7.6991	.88644	.99153
2.74	15.487	1.18997	.96457	7.7112	.88712	7.7758	.89074	.99170
2.75	15.643	1.19431	.96393	7.7894	.89150	7.8533	.89505	.99186
2.76	15.800	1.19865	.96329	7.8683	.89588	7.9316	.89936	.99202
2.77	15.959	1.20300	.96266	7.9480	.90026	8.0106	.90367	.99218
2.78	16.119	1.20734	.96204	8.0285	.90463	8.0905	.90798	.99233
2.79	16.281	1.21168	.96142	8.1098	.90901	8.1712	.91229	.99248
2.80	16.445	1.21602	.96081	8.1919	.91339	8.2527	.91660	.99263
2.81	16.610	1.22037	.96020	8.2749	.91776	8.3351	.92091	.99278
2.82	16.777	1.22471	.95961	8.3586	.92213	8.4182	.92522	.99292
2.83	16.945	1.22905	.95901	8.4432	.92651	8.5022	.92953	.99306
2.84	17.116	1.23340	.95843	8.5287	.93088	8.5871	.93385	.99320
2.85	17.288	1.23774	.95784	8.6150	.93525	8.6728	.93816	.99333
2.86	17.462	1.24208	.95727	8.7021	.93963	8.7594	.94247	.99346

EXPONENTIAL AND HYPERBOLIC FUNCTIONS AND THEIR COMMON LOGARITHMS

(continued)

x	e^x		e^{-x} (value)	$\sinh x$		$\cosh x$		$\tanh x$ (value)
	Value	\log^{10}		Value	\log^{10}	Value	\log^{10}	
2.87	17.637	1.24643	.05670	8.7902	.94400	8.8469	.94679	.99359
2.88	17.814	1.25077	.05613	8.8791	.94837	8.9352	.95110	.99372
2.89	17.993	1.25511	.05558	8.9689	.95274	9.0244	.95542	.99384
2.90	18.174	1.25945	.05502	9.0596	.95711	9.1146	.95974	.99396
2.91	18.357	1.26380	.05448	9.1512	.96148	9.2056	.96405	.99408
2.92	18.541	1.26814	.05393	9.2437	.96584	9.2976	.96837	.99420
2.93	18.728	1.27248	.05340	9.3371	.97021	9.3905	.97269	.99431
2.94	18.916	1.27683	.05287	9.4315	.97458	9.4844	.97701	.99443
2.95	19.106	1.28117	.05234	9.5268	.97895	9.5791	.98133	.99454
2.96	19.298	1.28551	.05182	9.6231	.98331	9.6749	.98565	.99464
2.97	19.492	1.28985	.05130	9.7203	.98768	9.7716	.98997	.99475
2.98	19.688	1.29420	.05079	9.8185	.99205	9.8693	.99429	.99485
2.99	19.886	1.29854	.05029	9.9177	.99641	9.9680	.99861	.99496
3.00	20.086	1.30288	.04979	10.018	1.00078	10.068	1.00293	.99505
3.05	21.115	1.32460	.04736	10.534	1.02259	10.581	1.02454	.99552
3.10	22.198	1.34631	.04505	11.076	1.04440	11.122	1.04616	.99595
3.15	23.336	1.36803	.04285	11.647	1.06620	11.690	1.06779	.99633
3.20	24.533	1.38974	.04076	12.246	1.08799	12.287	1.08943	.99668
3.25	25.790	1.41146	.03877	12.876	1.10977	12.915	1.11108	.99700
3.30	27.113	1.43317	.03688	13.538	1.13155	13.575	1.13273	.99728
3.35	28.503	1.45489	.03508	14.234	1.15332	14.269	1.15439	.99754
3.40	29.964	1.47660	.03337	14.965	1.17509	14.999	1.17605	.99777
3.45	31.500	1.49832	.03175	15.734	1.19685	15.766	1.19772	.99799
3.50	33.115	1.52003	.03020	16.543	1.21860	16.573	1.21940	.99818
3.55	34.813	1.54175	.02872	17.392	1.24036	17.421	1.24107	.99835
3.60	36.598	1.56346	.02732	18.286	1.26211	18.313	1.26275	.99851
3.65	38.475	1.58517	.02599	19.224	1.28385	19.250	1.28444	.99865
3.70	40.447	1.60689	.02472	20.211	1.30559	20.236	1.30612	.99878
3.75	42.521	1.62860	.02352	21.249	1.32733	21.272	1.32781	.99889
3.80	44.701	1.65032	.02237	22.339	1.34907	22.362	1.34951	.99900
3.85	46.993	1.67203	.02128	23.486	1.37081	23.507	1.37120	.99909
3.90	49.402	1.69375	.02024	24.691	1.39254	24.711	1.39290	.99918
3.95	51.935	1.71546	.01925	25.958	1.41427	25.977	1.41459	.99926
4.00	54.598	1.73718	.01832	27.290	1.43600	27.308	1.43629	.99933
4.10	60.340	1.78061	.01657	30.162	1.47946	30.178	1.47970	.99945
4.20	66.686	1.82404	.01500	33.336	1.52291	33.351	1.52310	.99955
4.30	73.700	1.86747	.01357	36.843	1.56636	36.857	1.56652	.99963
4.40	81.451	1.91090	.01227	40.719	1.60980	40.732	1.60993	.99970
4.50	90.017	1.95433	.01111	45.003	1.65324	45.014	1.65335	.99975
4.60	99.484	1.99775	.01005	49.737	1.69668	49.747	1.69677	.99980
4.70	109.95	2.04118	.00910	54.969	1.74012	54.978	1.74019	.99983
4.80	121.51	2.08461	.00823	60.751	1.78355	60.759	1.78361	.99986
4.90	134.29	2.12804	.00745	67.141	1.82699	67.149	1.82704	.99989
5.00	148.41	2.17147	.00674	74.203	1.87042	74.210	1.87046	.99991
5.10	164.02	2.21490	.00610	82.008	1.91389	82.014	1.91389	.99993
5.20	181.27	2.25833	.00552	90.633	1.95729	90.639	1.95731	.99994
5.30	200.34	2.30176	.00499	100.17	2.00074	100.17	2.00074	.99995
5.40	221.41	2.34519	.00452	110.70	2.04415	110.71	2.04417	.99996
5.50	244.69	2.38862	.00409	122.34	2.08758	122.35	2.08760	.99997
5.60	270.43	2.43205	.00370	135.21	2.13101	135.22	2.13103	.99997
5.70	298.87	2.47548	.00335	149.43	2.17444	149.44	2.17445	.99998
5.80	330.30	2.51891	.00303	165.15	2.21787	165.15	2.21788	.99998
5.90	365.04	2.56234	.00274	182.52	2.26130	182.52	2.26131	.99998
6.00	403.43	2.60577	.00248	201.71	2.30473	201.72	2.30474	.99999
6.25	518.01	2.71434	.00193	259.01	2.41331	259.01	2.41331	.99999
6.50	665.14	2.82291	.00150	332.57	2.52188	332.57	2.52189	1.00000
6.75	854.06	2.93149	.00117	427.03	2.63046	427.03	2.63046	1.00000
7.00	1096.6	3.04006	.00091	548.32	2.73904	548.32	2.73903	1.00000
7.50	1808.0	3.25721	.00055	904.02	2.95618	904.02	2.95618	1.00000
8.00	2981.0	3.47436	.00034	1490.5	3.17333	1490.5	3.17333	1.00000
8.50	4914.8	3.69150	.00020	2457.4	3.39047	2457.4	3.39047	1.00000
9.00	8103.1	3.90865	.00012	4051.5	3.60762	4051.5	3.60762	1.00000
9.50	13360.	4.12580	.00007	6679.9	3.82477	6679.9	3.82477	1.00000
10.00	22026.	4.34294	.00005	11013.	4.04191	11013.	4.04191	1.00000

NATURAL TRIGONOMETRIC FUNCTIONS TO FOUR PLACES

x radians	x degrees	sin x	cos x	tan x	cot x	sec x	csc x		
.0000	0° 00'	.0000	1.0000	.0000	—	1.000	—	90° 00'	1.5708
.0029	10	.0029	1.0000	.0029	343.8	1.000	343.8	50	1.5679
.0058	20	.0058	1.0000	.0058	171.9	1.000	171.9	40	1.5650
.0087	30	.0087	1.0000	.0087	114.6	1.000	114.6	30	1.5621
.0116	40	.0116	.9999	.0116	85.94	1.000	85.95	20	1.5592
.0145	50	.0145	.9999	.0145	68.75	1.000	68.76	10	1.5563
.0175	1° 00'	.0175	.9998	.0175	57.29	1.000	57.30	89° 00'	1.5533
.0204	10	.0204	.9998	.0204	49.10	1.000	49.11	50	1.5504
.0233	20	.0233	.9997	.0233	42.96	1.000	42.98	40	1.5475
.0262	30	.0262	.9997	.0262	38.19	1.000	38.20	30	1.5446
.0291	40	.0291	.9996	.0291	34.37	1.000	34.38	20	1.5417
.0320	50	.0320	.9995	.0320	31.24	1.001	31.26	10	1.5388
.0349	2° 00'	.0349	.9994	.0349	28.64	1.001	28.65	88° 00'	1.5359
.0378	10	.0378	.9993	.0378	26.43	1.001	26.45	50	1.5330
.0407	20	.0407	.9992	.0407	24.54	1.001	24.56	40	1.5301
.0436	30	.0436	.9990	.0437	22.90	1.001	22.93	30	1.5272
.0465	40	.0465	.9989	.0466	21.47	1.001	21.49	20	1.5243
.0495	50	.0494	.9988	.0495	20.21	1.001	20.23	10	1.5213
.0524	3° 00'	.0523	.9986	.0524	19.08	1.001	19.11	87° 00'	1.5184
.0553	10	.0552	.9985	.0553	18.07	1.002	18.10	50	1.5155
.0582	20	.0581	.9983	.0582	17.17	1.002	17.20	40	1.5126
.0611	30	.0610	.9981	.0612	16.35	1.002	16.38	30	1.5097
.0640	40	.0640	.9980	.0641	15.60	1.002	15.64	20	1.5068
.0669	50	.0669	.9978	.0670	14.92	1.002	14.96	10	1.5039
.0698	4° 00'	.0698	.9976	.0699	14.30	1.002	14.34	86° 00'	1.5010
.0727	10	.0727	.9974	.0729	13.73	1.003	13.76	50	1.4981
.0756	20	.0756	.9971	.0758	13.20	1.003	13.23	40	1.4952
.0785	30	.0785	.9969	.0787	12.71	1.003	12.75	30	1.4923
.0814	40	.0814	.9967	.0816	12.25	1.003	12.29	20	1.4893
.0844	50	.0843	.9964	.0846	11.83	1.004	11.87	10	1.4864
.0873	5° 00'	.0872	.9962	.0875	11.43	1.004	11.47	85° 00'	1.4835
.0902	10	.0901	.9959	.0904	11.06	1.004	11.10	50	1.4806
.0931	20	.0929	.9957	.0934	10.71	1.004	10.76	40	1.4777
.0960	30	.0958	.9954	.0963	10.39	1.005	10.43	30	1.4748
.0989	40	.0987	.9951	.0992	10.08	1.005	10.13	20	1.4719
.1018	50	.1016	.9948	.1022	9.788	1.005	9.839	10	1.4690
.1047	6° 00'	.1045	.9945	.1051	9.514	1.006	9.567	84° 00'	1.4661
.1076	10	.1074	.9942	.1080	9.255	1.006	9.309	50	1.4632
.1105	20	.1103	.9939	.1110	9.010	1.006	9.065	40	1.4603
.1134	30	.1132	.9936	.1139	8.777	1.006	8.834	30	1.4573
.1164	40	.1161	.9932	.1169	8.556	1.007	8.614	20	1.4544
.1193	50	.1190	.9929	.1198	8.345	1.007	8.405	10	1.4515
.1222	7° 00'	.1219	.9925	.1228	8.144	1.008	8.206	83° 00'	1.4486
.1251	10	.1248	.9922	.1257	7.953	1.008	8.016	50	1.4457
.1280	20	.1276	.9918	.1287	7.770	1.008	7.834	40	1.4428
.1309	30	.1305	.9914	.1317	7.596	1.009	7.661	30	1.4399
.1338	40	.1334	.9911	.1346	7.429	1.009	7.496	20	1.4370
.1367	50	.1363	.9907	.1376	7.269	1.009	7.337	10	1.4341
.1396	8° 00'	.1392	.9903	.1405	7.115	1.010	7.185	82° 00'	1.4312
.1425	10	.1421	.9899	.1435	6.968	1.010	7.040	50	1.4283
.1454	20	.1449	.9894	.1465	6.827	1.011	6.900	40	1.4254
.1484	30	.1478	.9890	.1495	6.691	1.011	6.765	30	1.4224
.1513	40	.1507	.9886	.1524	6.561	1.012	6.636	20	1.4195
.1542	50	.1536	.9881	.1554	6.435	1.012	6.512	10	1.4166
.1571	9° 00'	.1564	.9877	.1584	6.314	1.012	6.392	81° 00'	1.4137
.1600	10	.1593	.9872	.1614	6.197	1.013	6.277	50	1.4108
.1629	20	.1622	.9868	.1644	6.084	1.013	6.166	40	1.4079
.1658	30	.1650	.9863	.1673	5.976	1.014	6.059	30	1.4050
.1687	40	.1679	.9858	.1703	5.871	1.014	5.955	20	1.4021
.1716	50	.1708	.9853	.1733	5.769	1.015	5.855	10	1.3992
.1745	10° 00'	.1736	.9848	.1763	5.671	1.015	5.759	80° 00'	1.3963
.1774	10	.1765	.9843	.1793	5.576	1.016	5.665	50	1.3934
.1804	20	.1794	.9838	.1823	5.485	1.016	5.575	40	1.3904
.1833	30	.1822	.9833	.1853	5.396	1.017	5.487	30	1.3875
.1862	40	.1851	.9827	.1883	5.309	1.018	5.403	20	1.3846
.1891	50	.1880	.9822	.1914	5.226	1.018	5.320	10	1.3817
.1920	11° 00'	.1908	.9816	.1944	5.145	1.019	5.241	79° 00'	1.3788
.1949	10	.1937	.9811	.1974	5.066	1.019	5.164	50	1.3759
.1978	20	.1965	.9805	.2004	4.989	1.020	5.089	40	1.3730
.2007	30	.1994	.9799	.2035	4.915	1.020	5.016	30	1.3701

cos x sin x cot x tan x csc x sec x x degrees x radians

NATURAL TRIGONOMETRIC FUNCTIONS TO FOUR PLACES (continued)

x radians	x degrees	sin x	cos x	tan x	cot x	sec x	csc x		
.2036	40	.2022	.9793	.2065	3.843	1.021	4.945	20	1.3672
.2065	50	.2051	.9787	.2095	4.773	1.022	4.876	10	1.3643
.2094	12° 00'	.2079	.9781	.2126	4.705	1.022	4.810	78° 00'	1.3614
.2123	10	.2108	.9775	.2156	4.638	1.023	4.745	50	1.3584
.2153	20	.2136	.9769	.2186	4.574	1.024	4.682	40	1.3555
.2182	30	.2164	.9763	.2217	4.511	1.025	4.620	30	1.3526
.2211	40	.2193	.9757	.2247	4.449	1.025	4.560	20	1.3497
.2240	50	.2221	.9750	.2278	4.390	1.026	4.502	10	1.3468
.2269	13° 00'	.2250	.9744	.2309	4.331	1.026	4.445	77° 00'	1.3439
.2298	10	.2278	.9737	.2339	4.275	1.027	4.390	50	1.3410
.2327	20	.2306	.9730	.2370	4.219	1.028	4.336	40	1.3381
.2356	30	.2334	.9724	.2401	4.165	1.028	4.284	30	1.3352
.2385	40	.2363	.9717	.2432	4.113	1.029	4.232	20	1.3323
.2414	50	.2391	.9710	.2462	4.061	1.030	4.182	10	1.3294
.2443	14° 00'	.2419	.9703	.2493	4.011	1.031	4.134	76° 00'	1.3265
.2473	10	.2447	.9696	.2524	3.962	1.031	4.086	50	1.3235
.2502	20	.2476	.9689	.2555	3.914	1.032	4.039	40	1.3206
.2531	30	.2404	.9681	.2586	3.867	1.033	3.994	30	1.3177
.2560	40	.2532	.9674	.2617	3.821	1.034	3.950	20	1.3148
.2589	50	.2560	.9667	.2648	3.776	1.034	3.906	10	1.3119
.2618	15° 00'	.2588	.9659	.2679	3.732	1.035	3.864	75° 00'	1.3090
.2647	10	.2616	.9652	.2711	3.689	1.036	3.822	50	1.3061
.2676	20	.2644	.9644	.2732	3.647	1.037	3.782	40	1.3032
.2705	30	.2672	.9636	.2773	3.606	1.038	3.742	30	1.3003
.2734	40	.2700	.9628	.2805	3.566	1.039	3.703	20	1.2974
.2763	50	.2728	.9621	.2836	3.526	1.039	3.665	10	1.2945
.2793	16° 00'	.2756	.9613	.2867	3.487	1.040	3.628	74° 00'	1.2915
.2822	10	.2784	.9605	.2899	3.450	1.041	3.592	50	1.2886
.2851	20	.2812	.9596	.2931	3.412	1.042	3.556	40	1.2857
.2880	30	.2840	.9588	.2962	3.376	1.043	3.521	30	1.2828
.2909	40	.2868	.9580	.2994	3.340	1.044	3.487	20	1.2799
.2938	50	.2896	.9572	.3026	3.305	1.045	3.453	10	1.2770
.2967	17° 00'	.2924	.9563	.3057	3.271	1.046	3.420	73° 00'	1.2741
.2996	10	.2952	.9555	.3089	3.237	1.047	3.388	50	1.2712
.3025	20	.2979	.9546	.3121	3.204	1.048	3.356	40	1.2683
.3054	30	.3007	.9537	.3153	3.172	1.049	3.326	30	1.2654
.3083	40	.3035	.9528	.3185	3.140	1.049	3.295	20	1.2625
.3113	50	.3062	.9520	.3217	3.108	1.050	3.265	10	1.2595
.3142	18° 00'	.3090	.9511	.3249	3.078	1.051	3.236	72° 00'	1.2566
.3171	10	.3118	.9502	.3281	3.047	1.052	3.207	50	1.2537
.3200	20	.3145	.9492	.3314	3.018	1.053	3.179	40	1.2508
.3229	30	.3173	.9483	.3346	2.989	1.054	3.152	30	1.2479
.3258	40	.3201	.9474	.3378	2.960	1.056	3.124	20	1.2450
.3287	50	.3228	.9465	.3411	2.932	1.057	3.098	10	1.2421
.3316	19° 00'	.3256	.9455	.3443	2.904	1.058	3.072	71° 00'	1.2392
.3345	10	.3283	.9446	.3476	2.877	1.059	3.046	50	1.2363
.3374	20	.3311	.9436	.3508	2.850	1.060	3.021	40	1.2334
.3403	30	.3338	.9426	.3541	2.824	1.061	2.996	30	1.2305
.3432	40	.3365	.9417	.3574	2.798	1.062	2.971	20	1.2275
.3462	50	.3393	.9407	.3607	2.773	1.063	2.947	10	1.2246
.3491	20° 00'	.3420	.9397	.3640	2.747	1.064	2.924	70° 00'	1.2217
.3520	10	.3448	.9387	.3673	2.723	1.065	2.901	50	1.2188
.3549	20	.3475	.9377	.3706	2.699	1.066	2.878	40	1.2159
.3578	30	.3502	.9367	.3739	2.675	1.068	2.855	30	1.2130
.3607	40	.3529	.9356	.3772	2.651	1.069	2.833	20	1.2101
.3636	50	.3557	.9346	.3805	2.628	1.070	2.812	10	1.2072
.3665	21° 00'	.3584	.9336	.3839	2.605	1.071	2.790	69° 00'	1.2043
.3694	10	.3611	.9325	.3872	2.583	1.072	2.769	50	1.2014
.3723	20	.3638	.9315	.3906	2.560	1.074	2.749	40	1.1985
.3752	30	.3665	.9304	.3939	2.539	1.075	2.729	30	1.1956
.3782	40	.3692	.9293	.3973	2.517	1.076	2.709	20	1.1926
.3811	50	.3719	.9283	.4006	2.496	1.077	2.689	10	1.1897
.3840	22° 00'	.3746	.9272	.4040	2.475	1.079	2.669	68° 00'	1.1868
.3869	10	.3773	.9261	.4074	2.455	1.080	2.650	50	1.1839
.3898	20	.3800	.9250	.4108	2.434	1.081	2.632	40	1.1810
.3927	30	.3827	.9239	.4142	2.414	1.082	2.613	30	1.1781
.3956	40	.3854	.9228	.4176	2.394	1.084	2.595	20	1.1752
.3985	50	.3881	.9216	.4210	2.375	1.085	2.577	10	1.1723
.4014	23° 00'	.3907	.9205	.4245	2.356	1.086	2.559	67° 00'	1.1694
.4043	10	.3934	.9194	.4279	2.337	1.088	2.542	50	1.1665

cos x sin x cot x tan x csc x sec x x degrees x radians

NATURAL TRIGONOMETRIC FUNCTIONS TO FOUR PLACES (continued)

x		x							x	
radians	degrees	sin x	cos x	tan x	cot x	sec x	csc x	degrees	radians	
.4072	20	.3961	.9182	.4314	2.318	1.089	2.525	40	1.1636	
.4102	30	.3987	.9171	.4348	2.300	1.090	2.508	30	1.1606	
.4131	40	.4014	.9159	.4383	2.282	1.092	2.491	20	1.1577	
.4160	50	.4041	.9147	.4417	2.264	1.093	2.475	10	1.1548	
.4189	24° 00'	.4067	.9135	.4452	2.246	1.095	2.459	66° 00'	1.1519	
.4218	10	.4094	.9124	.4487	2.229	1.096	2.443	50	1.1490	
.4247	20	.4120	.9112	.4522	2.211	1.097	2.427	40	1.1461	
.4276	30	.4147	.9100	.4557	2.194	1.099	2.411	30	1.1432	
.4305	40	.4173	.9088	.4592	2.177	1.100	2.396	20	1.1403	
.4334	50	.4200	.9075	.4628	2.161	1.102	2.381	10	1.1374	
.4363	25° 00'	.4226	.9063	.4663	2.145	1.103	2.366	65° 00'	1.1345	
.4392	10	.4253	.9051	.4699	2.128	1.105	2.352	50	1.1316	
.4422	20	.4279	.9038	.4734	2.112	1.106	2.337	40	1.1286	
.4451	30	.4305	.9026	.4770	2.097	1.108	2.323	30	1.1257	
.4480	40	.4331	.9013	.4806	2.081	1.109	2.309	20	1.1228	
.4509	50	.4358	.9001	.4841	2.066	1.111	2.295	10	1.1199	
.4538	26° 00'	.4384	.8988	.4877	2.050	1.113	2.281	64° 00'	1.1170	
.4567	10	.4410	.8975	.4913	2.035	1.114	2.268	50	1.1141	
.4596	20	.4436	.8962	.4950	2.020	1.116	2.254	40	1.1112	
.4625	30	.4462	.8949	.4986	2.006	1.117	2.241	30	1.1083	
.4654	40	.4488	.8936	.5022	1.991	1.119	2.228	20	1.1054	
.4683	50	.4514	.8923	.5059	1.977	1.121	2.215	10	1.1025	
.4712	27° 00'	.4540	.8910	.5095	1.963	1.122	2.203	63° 00'	1.0996	
.4741	10	.4566	.8897	.5132	1.949	1.124	2.190	50	1.0966	
.4771	20	.4592	.8884	.5169	1.935	1.126	2.178	40	1.0937	
.4800	30	.4617	.8870	.5206	1.921	1.127	2.166	30	1.0908	
.4829	40	.4643	.8857	.5243	1.907	1.129	2.154	20	1.0879	
.4858	50	.4669	.8843	.5280	1.894	1.131	2.142	10	1.0850	
.4887	28° 00'	.4695	.8829	.5317	1.881	1.133	2.130	62° 00'	1.0821	
.4916	10	.4720	.8816	.5354	1.868	1.134	2.118	50	1.0792	
.4945	20	.4746	.8802	.5392	1.855	1.136	2.107	40	1.0763	
.4974	30	.4772	.8788	.5430	1.842	1.138	2.096	30	1.0734	
.5003	40	.4797	.8774	.5467	1.829	1.140	2.085	20	1.0705	
.5032	50	.4823	.8760	.5505	1.816	1.142	2.074	10	1.0676	
.5061	29° 00'	.4848	.8746	.5543	1.804	1.143	2.063	61° 00'	1.0647	
.5091	10	.4874	.8732	.5581	1.792	1.145	2.052	50	1.0617	
.5120	20	.4899	.8718	.5619	1.780	1.147	2.041	40	1.0588	
.5149	30	.4924	.8704	.5658	1.767	1.149	2.031	30	1.0559	
.5178	40	.4950	.8689	.5696	1.756	1.151	2.020	20	1.0530	
.5207	50	.4975	.8675	.5735	1.744	1.153	2.010	10	1.0501	
.5236	30° 00'	.5000	.8660	.5774	1.732	1.155	2.000	60° 00'	1.0472	
.5265	10	.5025	.8646	.5812	1.720	1.157	1.990	50	1.0443	
.5294	20	.5050	.8631	.5851	1.709	1.159	1.980	40	1.0414	
.5323	30	.5075	.8616	.5890	1.698	1.161	1.970	30	1.0385	
.5352	40	.5100	.8601	.5930	1.686	1.163	1.961	20	1.0356	
.5381	50	.5125	.8587	.5969	1.675	1.165	1.951	10	1.0327	
.5411	31° 00'	.5150	.8572	.6009	1.664	1.167	1.942	59° 00'	1.0297	
.5440	10	.5175	.8557	.6048	1.653	1.169	1.932	50	1.0268	
.5469	20	.5200	.8542	.6088	1.643	1.171	1.923	40	1.0239	
.5498	30	.5225	.8526	.6128	1.632	1.173	1.914	30	1.0210	
.5527	40	.5250	.8511	.6168	1.621	1.175	1.905	20	1.0181	
.5556	50	.5275	.8496	.6208	1.611	1.177	1.896	10	1.0152	
.5585	32° 00'	.5299	.8480	.6249	1.600	1.179	1.887	58° 00'	1.0123	
.5614	10	.5324	.8465	.6289	1.590	1.181	1.878	50	1.0094	
.5643	20	.5348	.8450	.6330	1.580	1.184	1.870	40	1.0065	
.5672	30	.5373	.8434	.6371	1.570	1.186	1.861	30	1.0036	
.5701	40	.5398	.8418	.6412	1.560	1.188	1.853	20	1.0007	
.5730	50	.5422	.8403	.6453	1.550	1.190	1.844	10	.9977	
.5760	33° 00'	.5446	.8397	.6494	1.540	1.192	1.836	57° 00'	.9948	
.5789	10	.5471	.8371	.6536	1.530	1.195	1.828	50	.9919	
.5818	20	.5495	.8355	.6577	1.520	1.197	1.820	40	.9890	
.5847	30	.5519	.8339	.6619	1.511	1.199	1.812	30	.9861	
.5876	40	.5544	.8323	.6661	1.501	1.202	1.804	20	.9832	
.5905	50	.5568	.8307	.6703	1.492	1.204	1.796	10	.9803	
.5934	34° 00'	.5592	.8290	.6745	1.483	1.206	1.788	56° 00'	.9774	
.5963	10	.5616	.8274	.6787	1.473	1.209	1.781	50	.9745	
.5992	20	.5640	.8258	.6830	1.464	1.211	1.773	40	.9716	
.6021	30	.5664	.8241	.6873	1.455	1.213	1.766	30	.9687	
.6050	40	.5688	.8225	.6916	1.446	1.216	1.758	20	.9657	
.6080	50	.5712	.8208	.6959	1.437	1.218	1.751	10	.9628	

NATURAL TRIGONOMETRIC FUNCTIONS TO FOUR PLACES (continued)

x radians	x degrees	sin x	cos x	tan x	cot x	sec x	csc x		
.6109	35° 00'	.5736	.8192	.7002	1.428	1.221	1.743	55° 00'	.9599
.6138	10	.5760	.8175	.7046	1.419	1.223	1.736	50	.9570
.6167	20	.5783	.8158	.7089	1.411	1.226	1.729	40	.9541
.6196	30	.5807	.8141	.7133	1.402	1.228	1.722	30	.9512
.6225	40	.5831	.8124	.7177	1.393	1.231	1.715	20	.9483
.6254	50	.5854	.8107	.7221	1.385	1.233	1.708	10	.9454
.6283	36° 00'	.5878	.8090	.7265	1.376	1.236	1.701	54° 00'	.9425
.6312	10	.5901	.8073	.7310	1.368	1.239	1.695	50	.9396
.6341	20	.5925	.8056	.7355	1.360	1.241	1.688	40	.9367
.6370	30	.5948	.8039	.7400	1.351	1.244	1.681	30	.9338
.6400	40	.5972	.8021	.7445	1.343	1.247	1.675	20	.9308
.6429	50	.5995	.8004	.7490	1.335	1.249	1.668	10	.9279
.6458	37° 00'	.6018	.7986	.7536	1.327	1.252	1.662	53° 00'	.9250
.6487	10	.6041	.7969	.7581	1.319	1.255	1.655	50	.9221
.6516	20	.6065	.7951	.7627	1.311	1.258	1.649	40	.9192
.6545	30	.6088	.7934	.7673	1.303	1.260	1.643	30	.9163
.6574	40	.6111	.7916	.7719	1.295	1.263	1.636	20	.9134
.6603	50	.6134	.7898	.7766	1.288	1.266	1.630	10	.9105
.6632	38° 00'	.6157	.7880	.7813	1.280	1.269	1.624	52° 00'	.9076
.6661	10	.6180	.7862	.7860	1.272	1.272	1.618	50	.9047
.6690	20	.6202	.7844	.7907	1.265	1.275	1.612	40	.9018
.6720	30	.6225	.7826	.7954	1.257	1.278	1.606	30	.8988
.6749	40	.6248	.7808	.8002	1.250	1.281	1.601	20	.8959
.6778	50	.6271	.7790	.8050	1.242	1.284	1.595	10	.8930
.6807	39° 00'	.6293	.7771	.8098	1.235	1.287	1.589	51° 00'	.8901
.6836	10	.6316	.7753	.8146	1.228	1.290	1.583	50	.8872
.6865	20	.6338	.7735	.8195	1.220	1.293	1.578	40	.8843
.6894	30	.6361	.7716	.8243	1.213	1.296	1.572	30	.8814
.6923	40	.6383	.7698	.8292	1.206	1.299	1.567	20	.8785
.6952	50	.6406	.7679	.8342	1.199	1.302	1.561	10	.8756
.6981	40° 00'	.6428	.7660	.8391	1.192	1.305	1.556	50° 00'	.8727
.7010	10	.6450	.7642	.8441	1.185	1.309	1.550	50	.8698
.7039	20	.6472	.7623	.8491	1.178	1.312	1.545	40	.8668
.7069	30	.6494	.7604	.8541	1.171	1.315	1.540	30	.8639
.7098	40	.6517	.7585	.8591	1.164	1.318	1.535	20	.8610
.7127	50	.6539	.7566	.8642	1.157	1.322	1.529	10	.8581
.7156	41° 00'	.6561	.7547	.8693	1.150	1.325	1.524	49° 00'	.8552
.7185	10	.6583	.7528	.8744	1.144	1.328	1.519	50	.8523
.7214	20	.6604	.7509	.8796	1.137	1.332	1.514	40	.8494
.7243	30	.6626	.7490	.8847	1.130	1.335	1.509	30	.8465
.7272	40	.6648	.7470	.8899	1.124	1.339	1.504	20	.8436
.7301	50	.6670	.7451	.8952	1.117	1.342	1.499	10	.8407
.7330	42° 00'	.6691	.7431	.9004	1.111	1.346	1.494	48° 00'	.8378
.7359	10	.6713	.7412	.9057	1.104	1.349	1.490	50	.8348
.7389	20	.6734	.7392	.9110	1.098	1.353	1.485	40	.8319
.7418	30	.6756	.7373	.9163	1.091	1.356	1.480	30	.8290
.7447	40	.6777	.7353	.9217	1.085	1.360	1.476	20	.8261
.7476	50	.6799	.7333	.9271	1.079	1.364	1.471	10	.8232
.7505	43° 00'	.6820	.7314	.9325	1.072	1.367	1.466	47° 00'	.8203
.7534	10	.6841	.7294	.9380	1.066	1.371	1.462	50	.8174
.7563	20	.6862	.7274	.9435	1.060	1.375	1.457	40	.8145
.7592	30	.6884	.7254	.9490	1.054	1.379	1.453	30	.8116
.7621	40	.6905	.7234	.9545	1.048	1.382	1.448	20	.8087
.7650	50	.6926	.7214	.9601	1.042	1.386	1.444	10	.8058
.7679	44° 00'	.6947	.7193	.9657	1.036	1.390	1.440	46° 00'	.8029
.7709	10	.6967	.7173	.9713	1.030	1.394	1.435	50	.7999
.7738	20	.6988	.7153	.9770	1.024	1.398	1.431	40	.7970
.7767	30	.7009	.7133	.9827	1.018	1.402	1.427	30	.7941
.7796	40	.7030	.7112	.9884	1.012	1.406	1.423	20	.7912
.7825	50	.7050	.7092	.9942	1.006	1.410	1.418	10	.7883
.7854	45° 00'	.7071	.7071	1.0000	1.0000	1.414	1.414	45° 00'	.7854

cos x
sin x
cot x
tan x
csc x
sec x
x
x

degrees
radians

RELATION OF ANGULAR FUNCTIONS IN TERMS OF ONE ANOTHER

TRIGONOMETRIC FUNCTIONS

Function	$\sin \alpha$	$\cos \alpha$	$\tan \alpha$	$\cot \alpha$	$\sec \alpha$	$\csc \alpha$
$\sin \alpha$	$\sin \alpha$	$\pm\sqrt{1 - \cos^2 \alpha}$	$\frac{\tan \alpha}{\pm\sqrt{1 + \tan^2 \alpha}}$	$\frac{1}{\pm\sqrt{1 + \cot^2 \alpha}}$	$\frac{\pm\sqrt{\sec^2 \alpha - 1}}{\sec \alpha}$	$\frac{1}{\csc \alpha}$
$\cos \alpha$	$\pm\sqrt{1 - \sin^2 \alpha}$	$\cos \alpha$	$\frac{1}{\pm\sqrt{1 + \tan^2 \alpha}}$	$\frac{\cot \alpha}{\pm\sqrt{1 + \cot^2 \alpha}}$	$\frac{1}{\sec \alpha}$	$\frac{\pm\sqrt{\csc^2 \alpha - 1}}{\csc \alpha}$
$\tan \alpha$	$\frac{\sin \alpha}{\pm\sqrt{1 - \sin^2 \alpha}}$	$\frac{\pm\sqrt{1 - \cos^2 \alpha}}{\cos \alpha}$	$\tan \alpha$	$\frac{1}{\cot \alpha}$	$\pm\sqrt{\sec^2 \alpha - 1}$	$\frac{1}{\pm\sqrt{\csc^2 \alpha - 1}}$
$\cot \alpha$	$\frac{\pm\sqrt{1 - \sin^2 \alpha}}{\sin \alpha}$	$\frac{\cos \alpha}{\pm\sqrt{1 - \cos^2 \alpha}}$	$\frac{1}{\tan \alpha}$	$\cot \alpha$	$\frac{1}{\pm\sqrt{\sec^2 \alpha - 1}}$	$\pm\sqrt{\csc^2 \alpha - 1}$
$\sec \alpha$	$\frac{1}{\pm\sqrt{1 - \sin^2 \alpha}}$	$\frac{1}{\cos \alpha}$	$\pm\sqrt{1 + \tan^2 \alpha}$	$\frac{\pm\sqrt{1 + \cot^2 \alpha}}{\cot \alpha}$	$\sec \alpha$	$\frac{\csc \alpha}{\pm\sqrt{\csc^2 \alpha - 1}}$
$\csc \alpha$	$\frac{1}{\sin \alpha}$	$\frac{1}{\pm\sqrt{1 - \cos^2 \alpha}}$	$\frac{\pm\sqrt{1 + \tan^2 \alpha}}{\tan \alpha}$	$\pm\sqrt{1 + \cot^2 \alpha}$	$\frac{\sec \alpha}{\pm\sqrt{\sec^2 \alpha - 1}}$	$\csc \alpha$

Note: The choice of sign depends upon the quadrant in which the angle terminates.

HYPERBOLIC FUNCTIONS

Function	$\sinh x$	$\cosh x$	$\tanh x$
$\sinh x =$	$\sinh x$	$\pm\sqrt{\cosh^2 x - 1}$	$\frac{\tanh x}{\sqrt{1 - \tanh^2 x}}$
$\cosh x =$	$\sqrt{1 + \sinh^2 x}$	$\cosh x$	$\frac{1}{\sqrt{1 - \tanh^2 x}}$
$\tanh x =$	$\frac{\sinh x}{\sqrt{1 + \sinh^2 x}}$	$\pm\frac{\sqrt{\cosh^2 x - 1}}{\cosh x}$	$\tanh x$
$\operatorname{cosech} x =$	$\frac{1}{\sinh x}$	$\pm\frac{1}{\sqrt{\cosh^2 x - 1}}$	$\frac{\sqrt{1 - \tanh^2 x}}{\tanh x}$
$\operatorname{sech} x =$	$\frac{1}{\sqrt{1 + \sinh^2 x}}$	$\frac{1}{\cosh x}$	$\frac{\sqrt{1 - \tanh^2 x}}{\sqrt{1 - \tanh^2 x}}$
$\operatorname{coth} x =$	$\frac{\sqrt{1 + \sinh^2 x}}{\sinh x}$	$\frac{\pm \cosh x}{\sqrt{\cosh^2 x - 1}}$	$\frac{1}{\tanh x}$
Function	$\operatorname{cosech} x$	$\operatorname{sech} x$	$\operatorname{coth} x$
$\sinh x =$	$\frac{1}{\operatorname{cosech} x}$	$\pm\frac{\sqrt{1 - \operatorname{sech}^2 x}}{\operatorname{sech} x}$	$\frac{\pm 1}{\sqrt{\operatorname{coth}^2 x - 1}}$
$\cosh x =$	$\pm\frac{\sqrt{\operatorname{cosech}^2 x + 1}}{\operatorname{cosech} x}$	$\frac{1}{\operatorname{sech} x}$	$\pm\frac{\operatorname{coth} x}{\sqrt{\operatorname{coth}^2 x - 1}}$
$\tanh x =$	$\frac{1}{\sqrt{\operatorname{cosech}^2 x + 1}}$	$\pm\sqrt{1 - \operatorname{sech}^2 x}$	$\frac{1}{\operatorname{coth} x}$
$\operatorname{cosech} x =$	$\operatorname{cosech} x$	$\pm\frac{\operatorname{sech} x}{\sqrt{1 - \operatorname{sech}^2 x}}$	$\pm\frac{\sqrt{\operatorname{coth}^2 x - 1}}{1}$
$\operatorname{sech} x =$	$\pm\frac{\operatorname{cosech} x}{\sqrt{\operatorname{cosech}^2 x + 1}}$	$\operatorname{sech} x$	$\pm\frac{\sqrt{\operatorname{coth}^2 x - 1}}{\operatorname{coth} x}$
$\operatorname{coth} x =$	$\sqrt{\operatorname{cosech}^2 x + 1}$	$\pm\frac{1}{\sqrt{1 - \operatorname{sech}^2 x}}$	$\operatorname{coth} x$

Whenever two signs are shown, choose + sign if x is positive, - sign if x is negative.

Derivatives*

In the following formulas u, v, w represent functions of x , while a, c, n represent fixed real numbers. All arguments in the trigonometric functions are measured in radians, and all inverse trigonometric and hyperbolic functions represent principal values.

$$1. \frac{d}{dx}(a) = 0$$

$$2. \frac{d}{dx}(x) = 1$$

$$3. \frac{d}{dx}(au) = a \frac{du}{dx}$$

$$4. \frac{d}{dx}(u + v - w) = \frac{du}{dx} + \frac{dv}{dx} - \frac{dw}{dx}$$

$$5. \frac{d}{dx}(uv) = u \frac{dv}{dx} + v \frac{du}{dx}$$

$$6. \frac{d}{dx}(uvw) = uv \frac{dw}{dx} + vw \frac{du}{dx} + uw \frac{dv}{dx}$$

$$7. \frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2} = \frac{1}{v} \frac{du}{dx} - \frac{u}{v^2} \frac{dv}{dx}$$

$$8. \frac{d}{dx}(u^n) = nu^{n-1} \frac{du}{dx}$$

$$9. \frac{d}{dx}(\sqrt{u}) = -\frac{1}{2\sqrt{u}} \frac{du}{dx}$$

$$10. \frac{d}{dx}\left(\frac{1}{u}\right) = -\frac{1}{u^2} \frac{du}{dx}$$

$$11. \frac{d}{dx}\left(\frac{1}{u^n}\right) = -\frac{n}{u^{n+1}} \frac{du}{dx}$$

$$12. \frac{d}{dx}\left(\frac{u^n}{v^m}\right) = \frac{u^{n-1}}{v^{m+1}} \left(nv \frac{du}{dx} - mu \frac{dv}{dx} \right)$$

$$13. \frac{d}{dx}(u^n v^m) = u^{n-1} v^{m-1} \left(nv \frac{du}{dx} + mu \frac{dv}{dx} \right)$$

$$14. \frac{d}{dx}[f(u)] = \frac{d}{du}[f(u)] \cdot \frac{du}{dx}$$

* Let $y=f(x)$ and $\frac{dy}{dx} = \frac{d[f(x)]}{dx} = f'(x)$ define respectively a function and its derivative for any value x in their common domain. The differential for the function at such a value x is accordingly defined as

$$dy = d[f(x)] = \frac{dy}{dx} dx = \frac{d[f(x)]}{dx} dx = f'(x) dx$$

Each derivative formula has an associated differential formula. For example, formula 6 above has the differential formula

$$d(uvw) = uv dw + vw du + uw dv$$

DERIVATIVES (Continued)

$$15. \frac{d^2}{dx^2}[f(u)] = \frac{df(u)}{du} \cdot \frac{d^2u}{dx^2} + \frac{d^2f(u)}{du^2} \cdot \left(\frac{du}{dx}\right)^2$$

$$16. \frac{d^n}{dx^n}[uv] = \binom{n}{0} v \frac{d^n u}{dx^n} + \binom{n}{1} \frac{dv}{dx} \frac{d^{n-1} u}{dx^{n-1}} + \binom{n}{2} \frac{d^2 v}{dx^2} \frac{d^{n-2} u}{dx^{n-2}} \\ + \cdots + \binom{n}{k} \frac{d^k v}{dx^k} \frac{d^{n-k} u}{dx^{n-k}} + \cdots + \binom{n}{n} u \frac{d^n v}{dx^n}$$

where $\binom{n}{r} = \frac{n!}{r!(n-r)!}$ the binomial coefficient, n non-negative integer and $\binom{n}{0} = 1$.

$$17. \frac{du}{dx} = \frac{1}{\frac{dx}{du}} \quad \text{if } \frac{dx}{du} \neq 0$$

$$18. \frac{d}{dx}(\log_a u) = (\log_a e) \frac{1}{u} \frac{du}{dx}$$

$$19. \frac{d}{dx}(\log_e u) = \frac{1}{u} \frac{du}{dx}$$

$$20. \frac{d}{dx}(a^u) = a^u (\log_e a) \frac{du}{dx}$$

$$21. \frac{d}{dx}(e^u) = e^u \frac{du}{dx}$$

$$22. \frac{d}{dx}(u^v) = v u^{v-1} \frac{du}{dx} + (\log_e u) u^v \frac{dv}{dx}$$

$$23. \frac{d}{dx}(\sin u) = \frac{du}{dx}(\cos u)$$

$$24. \frac{d}{dx}(\cos u) = -\frac{du}{dx}(\sin u)$$

$$25. \frac{d}{dx}(\tan u) = \frac{du}{dx}(\sec^2 u)$$

$$26. \frac{d}{dx}(\cot u) = -\frac{du}{dx}(\csc^2 u)$$

$$27. \frac{d}{dx}(\sec u) = \frac{du}{dx} \sec u \cdot \tan u$$

$$28. \frac{d}{dx}(\csc u) = -\frac{du}{dx} \csc u \cdot \cot u$$

$$29. \frac{d}{dx}(\text{vers } u) = \frac{du}{dx} \sin u$$

$$30. \frac{d}{dx}(\arcsin u) = \frac{1}{\sqrt{1-u^2}} \frac{du}{dx}, \quad \left(-\frac{\pi}{2} \leq \arcsin u \leq \frac{\pi}{2}\right)$$

DERIVATIVES (Continued)

31. $\frac{d}{dx}(\arccos u) = -\frac{1}{\sqrt{1-u^2}} \frac{du}{dx}, \quad (0 \leq \arccos u \leq \pi)$
32. $\frac{d}{dx}(\arctan u) = \frac{1}{1+u^2} \frac{du}{dx}, \quad \left(-\frac{\pi}{2} < \arctan u < \frac{\pi}{2}\right)$
33. $\frac{d}{dx}(\operatorname{arccot} u) = -\frac{1}{1+u^2} \frac{du}{dx}, \quad (0 \leq \operatorname{arccot} u \leq \pi)$
34. $\frac{d}{dx}(\operatorname{arcsec} u) = \frac{1}{u\sqrt{u^2-1}} \frac{du}{dx}, \quad \left(0 \leq \operatorname{arcsec} u < \frac{\pi}{2}, -\pi \leq \operatorname{arcsec} u < -\frac{\pi}{2}\right)$
35. $\frac{d}{dx}(\operatorname{arccsc} u) = -\frac{1}{u\sqrt{u^2-1}} \frac{du}{dx}, \quad \left(0 < \operatorname{arccsc} u \leq \frac{\pi}{2}, -\pi < \operatorname{arccsc} u \leq -\frac{\pi}{2}\right)$
36. $\frac{d}{dx}(\operatorname{arcvers} u) = \frac{1}{\sqrt{2u-u^2}} \frac{du}{dx}, \quad (0 \leq \operatorname{arcvers} u \leq \pi)$
37. $\frac{d}{dx}(\sinh u) = \frac{du}{dx}(\cosh u)$
38. $\frac{d}{dx}(\cosh u) = \frac{du}{dx}(\sinh u)$
39. $\frac{d}{dx}(\tanh u) = \frac{du}{dx}(\operatorname{sech}^2 u)$
40. $\frac{d}{dx}(\operatorname{coth} u) = -\frac{du}{dx}(\operatorname{csch}^2 u)$
41. $\frac{d}{dx}(\operatorname{sech} u) = -\frac{du}{dx}(\operatorname{sech} u \cdot \tanh u)$
42. $\frac{d}{dx}(\operatorname{csch} u) = -\frac{du}{dx}(\operatorname{csch} u \cdot \operatorname{coth} u)$
43. $\frac{d}{dx}(\sinh^{-1} u) = \frac{d}{dx}[\log(u + \sqrt{u^2+1})] = \frac{1}{\sqrt{u^2+1}} \frac{du}{dx}$
44. $\frac{d}{dx}(\cosh^{-1} u) = \frac{d}{dx}[\log(u + \sqrt{u^2-1})] = \frac{1}{\sqrt{u^2-1}} \frac{du}{dx}, \quad (u > 1, \cosh^{-1} u > 0)$
45. $\frac{d}{dx}(\tanh^{-1} u) = \frac{d}{dx}\left[\frac{1}{2} \log \frac{1+u}{1-u}\right] = \frac{1}{1-u^2} \frac{du}{dx}, \quad (u^2 < 1)$
46. $\frac{d}{dx}(\operatorname{coth}^{-1} u) = \frac{d}{dx}\left[\frac{1}{2} \log \frac{u+1}{u-1}\right] = \frac{1}{1-u^2} \frac{du}{dx}, \quad (u^2 > 1)$
47. $\frac{d}{dx}(\operatorname{sech}^{-1} u) = \frac{d}{dx}\left[\log \frac{1+\sqrt{1-u^2}}{u}\right] = -\frac{1}{u\sqrt{1-u^2}} \frac{du}{dx}, \quad (0 < u < 1, \operatorname{sech}^{-1} u > 0)$
48. $\frac{d}{dx}(\operatorname{csch}^{-1} u) = \frac{d}{dx}\left[\log \frac{1+\sqrt{1+u^2}}{u}\right] = -\frac{1}{|u|\sqrt{1+u^2}} \frac{du}{dx}$

$$49. \frac{d}{dq} \int_p^q f(x) dx = f(q), \quad [p \text{ constant}]$$

$$50. \frac{d}{dp} \int_p^q f(x) dx = -f(p), \quad [q \text{ constant}]$$

$$51. \frac{d}{da} \int_p^q f(x, a) dx = \int_p^q \frac{\partial}{\partial a} [f(x, a)] dx + f(q, a) \frac{dq}{da} - f(p, a) \frac{dp}{da}$$

INTEGRATION

The following is a brief discussion of some integration techniques. A more complete discussion can be found in a number of good text books. However, the purpose of this introduction is simply to discuss a few of the important techniques which may be used, in conjunction with the integral table which follows, to integrate particular functions.

No matter how extensive the integral table, it is a fairly uncommon occurrence to find in the table the exact integral desired. Usually some form of transformation will have to be made. The simplest type of transformation, and yet the most general, is substitution. Simple forms of substitution, such as $y = ax$, are employed almost unconsciously by experienced users of integral tables. Other substitutions may require more thought. In some sections of the tables, appropriate substitutions are suggested for integrals which are similar to, but not exactly like, integrals in the table. Finding the right substitution is largely a matter of intuition and experience.

Several precautions must be observed when using substitutions:

1. Be sure to make the substitution in the dx term, as well as everywhere else in the integral.
2. Be sure that the function substituted is one-to-one and continuous. If this is not the case, the integral must be restricted in such a way as to make it true. See the example following.
3. With definite integrals, the limits should also be expressed in terms of the new dependent variable. With indefinite integrals, it is necessary to perform the reverse substitution to obtain the answer in terms of the original independent variable. This may also be done for definite integrals, but it is usually easier to change the limits.

Example:

$$\int \frac{x^4}{\sqrt{a^2 - x^2}} dx$$

Here we make the substitution $x = |a| \sin \theta$. Then $dx = |a| \cos \theta d\theta$, and

$$\sqrt{a^2 - x^2} = \sqrt{a^2 - a^2 \sin^2 \theta} = |a| \sqrt{1 - \sin^2 \theta} = |a \cos \theta|$$

Notice the absolute value signs. It is very important to keep in mind that a square root radical always denotes the positive square root, and to assure the sign is always kept positive. Thus $\sqrt{x^2} = |x|$. Failure to observe this is a common cause of errors in integration.

Notice also that the indicated substitution is not a one-to-one function, that is, it does not have a unique inverse. Thus we must restrict the range of θ in such a way as to make the function one-to-one. Fortunately, this is easily done by solving for θ

$$\theta = \sin^{-1} \frac{x}{|a|}$$

and restricting the inverse sine to the principal values, $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$.

Thus the integral becomes

$$\int \frac{a^4 \sin^4 \theta |a| \cos \theta d\theta}{|a| |\cos \theta|}$$

Now, however, in the range of values chosen for θ , $\cos \theta$ is always positive. Thus we may remove the absolute value signs from $\cos \theta$ in the denominator. (This is one of the reasons that the principal values of the inverse trigonometric functions are defined as they are.)

Then the $\cos \theta$ terms cancel, and the integral becomes

$$a^4 \int \sin^4 \theta d\theta$$

By application of integral formulas 299 and 296, we integrate this to

$$-a^4 \frac{\sin^3 \theta \cos \theta}{4} - \frac{3a^4}{8} \cos \theta \sin \theta + \frac{3a^4}{8} \theta + C$$

We now must perform the inverse substitution to get the result in terms of x . We have

$$\theta = \sin^{-1} \frac{x}{|a|}$$

$$\sin \theta = \frac{x}{|a|}$$

Then

$$\cos \theta = \pm \sqrt{1 - \sin^2 \theta} = \pm \sqrt{1 - \frac{x^2}{a^2}} = \pm \frac{\sqrt{a^2 - x^2}}{|a|}.$$

Because of the previously mentioned fact that $\cos \theta$ is positive, we may omit the \pm sign. The reverse substitution then produces the final answer

$$\int \frac{x^4}{\sqrt{a^2 - x^2}} dx = -\frac{1}{4}x^3 \sqrt{a^2 - x^2} - \frac{3}{8}a^2 x \sqrt{a^2 - x^2} + \frac{3a^4}{8} \sin^{-1} \frac{x}{|a|} + C.$$

Any rational function of x may be integrated, if the denominator is factored into linear and irreducible quadratic factors. The function may then be broken into partial fractions, and the individual partial fractions integrated by use of the appropriate formula from the integral table. See the section on partial fractions for further information.

Many integrals may be reduced to rational functions by proper substitutions. For example,

$$z = \tan \frac{x}{2}$$

will reduce any rational function of the six trigonometric functions of x to a rational function of z . (Frequently there are other substitutions which are simpler to use, but this one will always work. See integral formula number 484.)

Any rational function of x and $\sqrt{ax+b}$ may be reduced to a rational function of z by making the substitution

$$z = \sqrt{ax+b}.$$

Other likely substitutions will be suggested by looking at the form of the integrand.

The other main method of transforming integrals is integration by parts. This involves applying formula number 5 or 6 in the accompanying integral table. The critical factor in this method is the choice of the functions u and v . In order for the method to be successful, $v = \int dv$ and $\int v du$ must be easier to integrate than the original integral. Again, this choice is largely a matter of intuition and experience.

Example:

$$\int x \sin x \, dx$$

Two obvious choices are $u = x$, $dv = \sin x \, dx$, or $u = \sin x$, $dv = x \, dx$. Since a preliminary calculation indicates that $\int v \, du$ in the second choice would be more, rather than less, complicated than the original integral (it would contain x^2), we use the first choice.

$$\begin{aligned} u &= x & du &= dx \\ dv &= \sin x \, dx & v &= -\cos x \\ \int x \sin x \, dx &= \int u \, dv = uv - \int v \, du = -x \cos x + \int \cos x \, dx \\ &= \sin x - x \cos x \end{aligned}$$

Of course, this result could have been obtained directly from the integral table, but it provides a simple example of the method. In more complicated examples the choice of u and v may not be so obvious, and several different choices may have to be tried. Of course, there is no guarantee that any of them will work.

Integration by parts may be applied more than once, or combined with substitution. A fairly common case is illustrated by the following example.

Example:

$$\int e^x \sin x \, dx$$

Let

$$\begin{aligned} u &= e^x & \text{Then } du &= e^x \, dx \\ dv &= \sin x \, dx & v &= -\cos x \\ \int e^x \sin x \, dx &= \int u \, dv = uv - \int v \, du = -e^x \cos x + \int e^x \cos x \, dx \end{aligned}$$

In this latter integral,

$$\begin{aligned} \text{Let } u &= e^x & \text{Then } du &= e^x \, dx \\ dv &= \cos x \, dx & v &= \sin x \\ \int e^x \sin x \, dx &= -e^x \cos x + \int e^x \cos x \, dx = -e^x \cos x + \int u \, dv \\ &= -e^x \cos x + uv - \int v \, du \\ &= -e^x \cos x + e^x \sin x - \int e^x \sin x \, dx \end{aligned}$$

This looks as if a circular transformation has taken place, since we are back at the same integral we started from. However, the above equation can be solved algebraically for the required integral:

$$\int e^x \sin x \, dx = \frac{1}{2}(e^x \sin x - e^x \cos x)$$

In the second integration by parts, if the parts had been chosen as $u = \cos x$, $dv = e^x \, dx$, we would indeed have made a circular transformation, and returned to the starting place.

In general, when doing repeated integration by parts, one should never choose the function u at any stage to be the same as the function v at the previous stage, or a constant times the previous v .

The following rule is called the extended rule for integration by parts. It is the result of $n + 1$ successive applications of integration by parts.

If

$$\begin{aligned} g_1(x) &= \int g(x) dx, & g_2(x) &= \int g_1(x) dx, \\ g_3(x) &= \int g_2(x) dx, \dots, & g_m(x) &= \int g_{m-1}(x) dx, \dots, \end{aligned}$$

then

$$\begin{aligned} \int f(x) \cdot g(x) dx &= f(x) \cdot g_1(x) - f'(x) \cdot g_2(x) + f''(x) \cdot g_3(x) - + \dots \\ &+ (-1)^n f^{(n)}(x) g_{n+1}(x) + (-1)^{n+1} \int f^{(n+1)}(x) g_{n+1}(x) dx. \end{aligned}$$

A useful special case of the above rule is when $f(x)$ is a polynomial of degree n . Then $f^{(n+1)}(x) = 0$, and

$$\int f(x) \cdot g(x) dx = f(x) \cdot g_1(x) - f'(x) \cdot g_2(x) + f''(x) \cdot g_3(x) - + \dots + (-1)^n f^{(n)}(x) g_{n+1}(x) + C$$

Example:

If $f(x) = x^2$, $g(x) = \sin x$

$$\int x^2 \sin x dx = -x^2 \cos x + 2x \sin x + 2 \cos x + C$$

Another application of this formula occurs if

$$f''(x) = af(x) \quad \text{and} \quad g''(x) = bg(x),$$

where a and b are unequal constants. In this case, by a process similar to that used in the above example for $\int e^x \sin x dx$, we get the formula

$$\int f(x)g(x) dx = \frac{f(x) \cdot g'(x) - f'(x) \cdot g(x)}{b - a} + C$$

This formula could have been used in the example mentioned. Here is another example.

Example:

If $f(x) = e^{2x}$, $g(x) = \sin 3x$, then $a = 4$, $b = -9$, and

$$\int e^{2x} \sin 3x dx = \frac{3 e^{2x} \cos 3x - 2 e^{2x} \sin 3x}{-9 - 4} + C = \frac{e^{2x}}{13} (2 \sin 3x - 3 \cos 3x) + C$$

The following additional points should be observed when using this table.

1. A constant of integration is to be supplied with the answers for indefinite integrals.
2. Logarithmic expressions are to base $e = 2.71828 \dots$, unless otherwise specified, and are to be evaluated for the absolute value of the arguments involved therein.
3. All angles are measured in radians, and inverse trigonometric and hyperbolic functions represent principal values, unless otherwise indicated.
4. If the application of a formula produces either a zero denominator or the square root of a negative number in the result, there is usually available another form of the answer which

avoids this difficulty. In many of the results, the excluded values are specified, but when such are omitted it is presumed that one can tell what these should be, especially when difficulties of the type herein mentioned are obtained.

5. When inverse trigonometric functions occur in the integrals, be sure that any replacements made for them are strictly in accordance with the rules for such functions. This causes little difficulty when the argument of the inverse trigonometric function is positive, since then all angles involved are in the first quadrant. However, if the argument is negative, special care must be used. Thus if $u > 0$,

$$\sin^{-1} u = \cos^{-1} \sqrt{1 - u^2} = \csc^{-1} \frac{1}{u}, \text{ etc.}$$

However, if $u < 0$,

$$\sin^{-1} u = -\cos^{-1} \sqrt{1 - u^2} = -\pi - \csc^{-1} \frac{1}{u}, \text{ etc.}$$

See the section on inverse trigonometric functions for a full treatment of the allowable substitutions.

6. In integrals 340–345 and some others, the right side includes expressions of the form

$$A \tan^{-1}[B + C \tan f(x)].$$

In these formulas, the \tan^{-1} does not necessarily represent the principal value. Instead of always employing the principal branch of the inverse tangent function, one must instead use that branch of the inverse tangent function upon which $f(x)$ lies for any particular choice of x .

Example:

$$\begin{aligned} \int_0^{4\pi} \frac{dx}{2 + \sin x} &= \frac{2}{\sqrt{3}} \tan^{-1} \left[\frac{2 \tan \frac{x}{2} + 1}{\sqrt{3}} \right]_0^{4\pi} \\ &= \frac{2}{\sqrt{3}} \left[\tan^{-1} \frac{2 \tan 2\pi + 1}{\sqrt{3}} - \tan^{-1} \frac{2 \tan 0 + 1}{\sqrt{3}} \right] \\ &= \frac{2}{\sqrt{3}} \left[\frac{13\pi}{6} - \frac{\pi}{6} \right] = \frac{4\pi}{\sqrt{3}} = \frac{4\sqrt{3}\pi}{3} \end{aligned}$$

Here

$$\tan^{-1} \frac{2 \tan 2\pi + 1}{\sqrt{3}} = \tan^{-1} \frac{1}{\sqrt{3}} = \frac{13\pi}{6},$$

since $f(x) = 2\pi$; and

$$\tan^{-1} \frac{2 \tan 0 + 1}{\sqrt{3}} = \tan^{-1} \frac{1}{\sqrt{3}} = \frac{\pi}{6},$$

since $f(x) = 0$.

7. B_n and E_n where used in Integrals represents the Bernoulli and Euler numbers as defined in tables of Bernoulli and Euler polynomials contained in certain mathematics reference and hand-books, as for example, Beyer, W. H., *Handbook of Mathematical Sciences*, 5th ed., CRC Press, Inc., West Palm Beach 1978, 577–583.

INTEGRALS

ELEMENTARY FORMS

1. $\int a \, dx = ax$
2. $\int a \cdot f(x) \, dx = a \int f(x) \, dx$
3. $\int \phi(y) \, dx = \int \frac{\phi(y)}{y'} \, dy$, where $y' = \frac{dy}{dx}$
4. $\int (u + v) \, dx = \int u \, dx + \int v \, dx$, where u and v are any functions of x
5. $\int u \, dv = u \int dv - \int v \, du = uv - \int v \, du$
6. $\int u \frac{dv}{dx} \, dx = uv - \int v \frac{du}{dx} \, dx$
7. $\int x^n \, dx = \frac{x^{n+1}}{n+1}$, except $n = -1$
8. $\int \frac{f'(x) \, dx}{f(x)} = \log f(x)$, ($df(x) = f'(x) \, dx$)
9. $\int \frac{dx}{x} = \log x$
10. $\int \frac{f'(x) \, dx}{2\sqrt{f(x)}} = \sqrt{f(x)}$, ($df(x) = f'(x) \, dx$)
11. $\int e^x \, dx = e^x$
12. $\int e^{ax} \, dx = e^{ax}/a$
13. $\int b^{ax} \, dx = \frac{b^{ax}}{a \log b}$, ($b > 0$)
14. $\int \log x \, dx = x \log x - x$
15. $\int a^x \log a \, dx = a^x$, ($a > 0$)
16. $\int \frac{dx}{a^2 + x^2} = \frac{1}{a} \tan^{-1} \frac{x}{a}$
17. $\int \frac{dx}{a^2 - x^2} = \begin{cases} \frac{1}{a} \tanh^{-1} \frac{x}{a} \\ \text{or} \\ \frac{1}{2a} \log \frac{a+x}{a-x}, \end{cases} \quad (a^2 > x^2)$
18. $\int \frac{dx}{x^2 - a^2} = \begin{cases} -\frac{1}{a} \coth^{-1} \frac{x}{a} \\ \text{or} \\ \frac{1}{2a} \log \frac{x-a}{x+a}, \end{cases} \quad (x^2 > a^2)$

INTEGRALS (Continued)

$$19. \int \frac{dx}{\sqrt{a^2 - x^2}} = \begin{cases} \sin^{-1} \frac{x}{|a|} \\ \text{or} \\ -\cos^{-1} \frac{x}{|a|}, \end{cases} \quad (a^2 > x^2)$$

$$20. \int \frac{dx}{\sqrt{x^2 \pm a^2}} = \log(x + \sqrt{x^2 \pm a^2})$$

$$21. \int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{|a|} \sec^{-1} \frac{x}{a}$$

$$22. \int \frac{dx}{x\sqrt{a^2 \pm x^2}} = -\frac{1}{a} \log \left(\frac{a + \sqrt{a^2 \pm x^2}}{x} \right)$$

FORMS CONTAINING $(a + bx)$

For forms containing $a + bx$, but not listed in the table, the substitution $u = \frac{a + bx}{x}$ may prove helpful.

$$23. \int (a + bx)^n dx = \frac{(a + bx)^{n+1}}{(n+1)b}, \quad (n \neq -1)$$

$$24. \int x(a + bx)^n dx = \frac{1}{b^2(n+2)}(a + bx)^{n+2} - \frac{a}{b^2(n+1)}(a + bx)^{n+1}, \quad (n \neq -1, -2)$$

$$25. \int x^2(a + bx)^n dx = \frac{1}{b^3} \left[\frac{(a + bx)^{n+3}}{n+3} - 2a \frac{(a + bx)^{n+2}}{n+2} + a^2 \frac{(a + bx)^{n+1}}{n+1} \right]$$

$$26. \int x^m(a + bx)^n dx = \begin{cases} \frac{x^{m+1}(a + bx)^n}{m+n+1} + \frac{an}{m+n+1} \int x^m(a + bx)^{n-1} dx \\ \text{or} \\ \frac{1}{a(n+1)} \left[-x^{m+1}(a + bx)^{n+1} + (m+n+2) \int x^m(a + bx)^{n+1} dx \right] \\ \text{or} \\ \frac{1}{b(m+n+1)} \left[x^m(a + bx)^{n+1} - ma \int x^{m-1}(a + bx)^n dx \right] \end{cases}$$

$$27. \int \frac{dx}{a + bx} = \frac{1}{b} \log(a + bx)$$

$$28. \int \frac{dx}{(a + bx)^2} = -\frac{1}{b(a + bx)}$$

$$29. \int \frac{dx}{(a + bx)^3} = -\frac{1}{2b(a + bx)^2}$$

$$30. \int \frac{x dx}{a + bx} = \begin{cases} \frac{1}{b^2} [a + bx - a \log(a + bx)] \\ \text{or} \\ \frac{x}{b} - \frac{a}{b^2} \log(a + bx) \end{cases}$$

INTEGRALS (Continued)

31. $\int \frac{x dx}{(a+bx)^2} = \frac{1}{b^2} \left[\log(a+bx) + \frac{a}{a+bx} \right]$
32. $\int \frac{x dx}{(a+bx)^n} = \frac{1}{b^2} \left[\frac{-1}{(n-2)(a+bx)^{n-2}} + \frac{a}{(n-1)(a+bx)^{n-1}} \right], \quad n \neq 1, 2$
33. $\int \frac{x^2 dx}{a+bx} = \frac{1}{b^3} \left[\frac{1}{2}(a+bx)^2 - 2a(a+bx) + a^2 \log(a+bx) \right]$
34. $\int \frac{x^2 dx}{(a+bx)^2} = \frac{1}{b^3} \left[a+bx - 2a \log(a+bx) - \frac{a^2}{a+bx} \right]$
35. $\int \frac{x^2 dx}{(a+bx)^3} = \frac{1}{b^3} \left[\log(a+bx) + \frac{2a}{a+bx} - \frac{a^2}{2(a+bx)^2} \right]$
36. $\int \frac{x^2 dx}{(a+bx)^n} = \frac{1}{b^3} \left[\frac{-1}{(n-3)(a+bx)^{n-3}} + \frac{2a}{(n-2)(a+bx)^{n-2}} - \frac{a^2}{(n-1)(a+bx)^{n-1}} \right], \quad n \neq 1, 2, 3$
37. $\int \frac{dx}{x(a+bx)} = -\frac{1}{a} \log \frac{a+bx}{x}$
38. $\int \frac{dx}{x(a+bx)^2} = \frac{1}{a(a+bx)} - \frac{1}{a^2} \log \frac{a+bx}{x}$
39. $\int \frac{dx}{x(a+bx)^3} = \frac{1}{a^3} \left[\frac{1}{2} \left(\frac{2a+bx}{a+bx} \right)^2 + \log \frac{x}{a+bx} \right]$
40. $\int \frac{dx}{x^2(a+bx)} = -\frac{1}{ax} + \frac{b}{a^2} \log \frac{a+bx}{x}$
41. $\int \frac{dx}{x^3(a+bx)} = \frac{2bx-a}{2a^2x^2} + \frac{b^2}{a^3} \log \frac{x}{a+bx}$
42. $\int \frac{dx}{x^2(a+bx)^2} = -\frac{a+2bx}{a^2x(a+bx)} + \frac{2b}{a^3} \log \frac{a+bx}{x}$

FORMS CONTAINING $c^2 \pm x^2, x^2 - c^2$

43. $\int \frac{dx}{c^2+x^2} = \frac{1}{c} \tan^{-1} \frac{x}{c}$
44. $\int \frac{dx}{c^2-x^2} = \frac{1}{2c} \log \frac{c+x}{c-x}, \quad (c^2 > x^2)$
45. $\int \frac{dx}{x^2-c^2} = \frac{1}{2c} \log \frac{x-c}{x+c}, \quad (x^2 > c^2)$
46. $\int \frac{x dx}{c^2 \pm x^2} = \pm \frac{1}{2} \log(c^2 \pm x^2)$
47. $\int \frac{x dx}{(c^2 \pm x^2)^{n+1}} = \mp \frac{1}{2n(c^2 \pm x^2)^n}$
48. $\int \frac{dx}{(c^2 \pm x^2)^n} = \frac{1}{2c^2(n-1)} \left[\frac{x}{(c^2 \pm x^2)^{n-1}} + (2n-3) \int \frac{dx}{(c^2 \pm x^2)^{n-1}} \right]$
49. $\int \frac{dx}{(x^2-c^2)^n} = \frac{1}{2c^2(n-1)} \left[-\frac{x}{(x^2-c^2)^{n-1}} - (2n-3) \int \frac{dx}{(x^2-c^2)^{n-1}} \right]$
50. $\int \frac{x dx}{x^2-c^2} = \frac{1}{2} \log(x^2-c^2)$

INTEGRALS (Continued)

$$51. \int \frac{x dx}{(x^2 - c^2)^{n+1}} = -\frac{1}{2n(x^2 - c^2)^n}$$

FORMS CONTAINING $a + bx$ and $c + dx$

$$u = a + bx, \quad v = c + dx, \quad k = ad - bc$$

If $k = 0$, then $v = \frac{c}{a}u$

$$52. \int \frac{dx}{u \cdot v} = \frac{1}{k} \cdot \log\left(\frac{v}{u}\right)$$

$$53. \int \frac{x dx}{u \cdot v} = \frac{1}{k} \left[\frac{a}{b} \log(u) - \frac{c}{d} \log(v) \right]$$

$$54. \int \frac{dx}{u^2 \cdot v} = \frac{1}{k} \left(\frac{1}{u} + \frac{d}{k} \log \frac{v}{u} \right)$$

$$55. \int \frac{x dx}{u^2 \cdot v} = \frac{-a}{bku} - \frac{c}{k^2} \log \frac{v}{u}$$

$$56. \int \frac{x^2 dx}{u^2 \cdot v} = \frac{a^2}{b^2ku} + \frac{1}{k^2} \left[\frac{c^2}{d} \log(v) + \frac{a(k-bc)}{b^2} \log(u) \right]$$

$$57. \int \frac{dx}{u^m \cdot v^n} = \frac{1}{k(m-1)} \left[\frac{-1}{u^{m-1} \cdot v^{n-1}} - (m+n-2)b \int \frac{dx}{u^m \cdot v^{n-1}} \right]$$

$$58. \int \frac{u}{v} dx = \frac{bx}{d} + \frac{k}{d^2} \log(v)$$

$$59. \int \frac{u^m dx}{v^n} = \begin{cases} \frac{-1}{k(n-1)} \left[\frac{u^{m+1}}{v^{n-1}} + b(n-m-2) \int \frac{u^m}{v^{n-1}} dx \right] \\ \text{or} \\ \frac{-1}{d(n-m-1)} \left[\frac{u^m}{v^{n-1}} + mk \int \frac{u^{m-1}}{v^n} dx \right] \\ \text{or} \\ \frac{-1}{d(n-1)} \left[\frac{u^m}{v^{n-1}} - mb \int \frac{u^{m-1}}{v^{n-1}} dx \right] \end{cases}$$

FORMS CONTAINING $(a + bx^n)$

$$60. \int \frac{dx}{a + bx^2} = \frac{1}{\sqrt{ab}} \tan^{-1} \frac{x\sqrt{ab}}{a}, \quad (ab > 0)$$

$$61. \int \frac{dx}{a + bx^2} = \begin{cases} \frac{1}{2\sqrt{-ab}} \log \frac{a + x\sqrt{-ab}}{a - x\sqrt{-ab}}, & (ab < 0) \\ \text{or} \\ \frac{1}{\sqrt{-ab}} \tanh^{-1} \frac{x\sqrt{-ab}}{a}, & (ab < 0) \end{cases}$$

$$62. \int \frac{dx}{a^2 + b^2x^2} = \frac{1}{ab} \tan^{-1} \frac{bx}{a}$$

$$63. \int \frac{x dx}{a + bx^2} = \frac{1}{2b} \log(a + bx^2)$$

$$64. \int \frac{x^2 dx}{a + bx^2} = \frac{x}{b} - \frac{a}{b} \int \frac{dx}{a + bx^2}$$

$$65. \int \frac{dx}{(a + bx^2)^2} = \frac{x}{2a(a + bx^2)} + \frac{1}{2a} \int \frac{dx}{a + bx^2}$$

INTEGRALS (Continued)

$$66. \int \frac{dx}{a^2 - b^2x^2} = \frac{1}{2ab} \log \frac{a + bx}{a - bx}$$

$$67. \int \frac{dx}{(a + bx^2)^{m+1}} = \begin{cases} \frac{1}{2ma(a + bx^2)^m} + \frac{2m-1}{2ma} \int \frac{dx}{(a + bx^2)^m} \\ \text{or} \\ \frac{(2m)!}{(m!)^2} \left[\frac{x}{2a} \sum_{r=1}^m \frac{r!(r-1)!}{(4a)^{m-r}(2r)!(a + bx^2)^r} + \frac{1}{(4a)^m} \int \frac{dx}{a + bx^2} \right] \end{cases}$$

$$68. \int \frac{x dx}{(a + bx^2)^{m+1}} = -\frac{1}{2bm(a + bx^2)^m}$$

$$69. \int \frac{x^2 dx}{(a + bx^2)^{m+1}} = \frac{-x}{2mb(a + bx^2)^m} + \frac{1}{2mb} \int \frac{dx}{(a + bx^2)^m}$$

$$70. \int \frac{dx}{x(a + bx^2)} = \frac{1}{2a} \log \frac{x^2}{a + bx^2}$$

$$71. \int \frac{dx}{x^2(a + bx^2)} = -\frac{1}{ax} - \frac{b}{a} \int \frac{dx}{a + bx^2}$$

$$72. \int \frac{dx}{x(a + bx^2)^{m+1}} = \begin{cases} \frac{1}{2am(a + bx^2)^m} + \frac{1}{a} \int \frac{dx}{x(a + bx^2)^m} \\ \text{or} \\ \frac{1}{2a^{m+1}} \left[\sum_{r=1}^m \frac{a^r}{r(a + bx^2)^r} + \log \frac{x^2}{a + bx^2} \right] \end{cases}$$

$$73. \int \frac{dx}{x^2(a + bx^2)^{m+1}} = \frac{1}{a} \int \frac{dx}{x^2(a + bx^2)^m} - \frac{b}{a} \int \frac{dx}{(a + bx^2)^{m+1}}$$

$$74. \int \frac{dx}{a + bx^3} = \frac{k}{3a} \left[\frac{1}{2} \log \frac{(k+x)^3}{a + bx^3} + \sqrt{3} \tan^{-1} \frac{2x-k}{k\sqrt{3}} \right], \quad \left(k = \sqrt[3]{\frac{a}{b}} \right)$$

$$75. \int \frac{x dx}{a + bx^3} = \frac{1}{3bk} \left[\frac{1}{2} \log \frac{a + bx^3}{(k+x)^3} + \sqrt{3} \tan^{-1} \frac{2x-k}{k\sqrt{3}} \right], \quad \left(k = \sqrt[3]{\frac{a}{b}} \right)$$

$$76. \int \frac{x^2 dx}{a + bx^3} = \frac{1}{3b} \log(a + bx^3)$$

$$77. \int \frac{dx}{a + bx^4} = \frac{k}{2a} \left[\frac{1}{2} \log \frac{x^2 + 2kx + 2k^2}{x^2 - 2kx + 2k^2} + \tan^{-1} \frac{2kx}{2k^2 - x^2} \right], \quad \left(ab > 0, k = \sqrt[4]{\frac{a}{4b}} \right)$$

$$78. \int \frac{dx}{a + bx^4} = \frac{k}{2a} \left[\frac{1}{2} \log \frac{x+k}{x-k} + \tan^{-1} \frac{x}{k} \right], \quad \left(ab < 0, k = \sqrt[4]{-\frac{a}{b}} \right)$$

$$79. \int \frac{x dx}{a + bx^4} = \frac{1}{2bk} \tan^{-1} \frac{x^2}{k}, \quad \left(ab > 0, k = \sqrt{\frac{a}{b}} \right)$$

$$80. \int \frac{x dx}{a + bx^4} = \frac{1}{4bk} \log \frac{x^2 - k}{x^2 + k}, \quad \left(ab < 0, k = \sqrt{-\frac{a}{b}} \right)$$

$$81. \int \frac{x^2 dx}{a + bx^4} = \frac{1}{4bk} \left[\frac{1}{2} \log \frac{x^2 - 2kx + 2k^2}{x^2 + 2kx + 2k^2} + \tan^{-1} \frac{2kx}{2k^2 - x^2} \right], \quad \left(ab > 0, k = \sqrt[4]{\frac{a}{4b}} \right)$$

INTEGRALS (Continued)

$$82. \int \frac{x^2 dx}{a + bx^4} = \frac{1}{4bk} \left[\log \frac{x-k}{x+k} + 2 \tan^{-1} \frac{x}{k} \right], \quad (ab < 0, k = \sqrt[4]{-\frac{a}{b}})$$

$$83. \int \frac{x^3 dx}{a + bx^4} = \frac{1}{4b} \log(a + bx^4)$$

$$84. \int \frac{dx}{x(a + bx^n)} = \frac{1}{an} \log \frac{x^n}{a + bx^n}$$

$$85. \int \frac{dx}{(a + bx^n)^{m+1}} = \frac{1}{a} \int \frac{dx}{(a + bx^n)^m} - \frac{b}{a} \int \frac{x^n dx}{(a + bx^n)^{m+1}}$$

$$86. \int \frac{x^n dx}{(a + bx^n)^{p+1}} = \frac{1}{b} \int \frac{x^{m-n} dx}{(a + bx^n)^p} - \frac{a}{b} \int \frac{x^{m-n} dx}{(a + bx^n)^{p+1}}$$

$$87. \int \frac{dx}{x^m(a + bx^n)^{p+1}} = \frac{1}{a} \int \frac{dx}{x^m(a + bx^n)^p} - \frac{b}{a} \int \frac{dx}{x^{m-n}(a + bx^n)^{p+1}}$$

$$88. \int x^m(a + bx^n)^p dx = \begin{cases} \frac{1}{b(np + m + 1)} \left[x^{m-n+1}(a + bx^n)^{p+1} - a(m - n + 1) \int x^{m-n}(a + bx^n)^p dx \right] \\ \text{or} \\ \frac{1}{np + m + 1} \left[x^{m+1}(a + bx^n)^p + anp \int x^m(a + bx^n)^{p-1} dx \right] \\ \text{or} \\ \frac{1}{a(m + 1)} \left[x^{m+1}(a + bx^n)^{p+1} - (m + 1 + np + n)b \int x^{m+n}(a + bx^n)^p dx \right] \\ \text{or} \\ \frac{1}{an(p + 1)} \left[-x^{m+1}(a + bx^n)^{p+1} + (m + 1 + np + n) \int x^m(a + bx^n)^{p+1} dx \right] \end{cases}$$

FORMS CONTAINING $c^3 \pm x^3$

$$89. \int \frac{dx}{c^3 \pm x^3} = \pm \frac{1}{6c^2} \log \frac{(c \pm x)^3}{c^3 \pm x^3} + \frac{1}{c^2\sqrt{3}} \tan^{-1} \frac{2x \mp c}{c\sqrt{3}}$$

$$90. \int \frac{dx}{(c^3 \pm x^3)^2} = \frac{x}{3c^3(c^3 \pm x^3)} + \frac{2}{3c^3} \int \frac{dx}{c^3 \pm x^3}$$

$$91. \int \frac{dx}{(c^3 \pm x^3)^{n+1}} = \frac{1}{3nc^3} \left[\frac{x}{(c^3 \pm x^3)^n} + (3n - 1) \int \frac{dx}{(c^3 \pm x^3)^n} \right]$$

$$92. \int \frac{x dx}{c^3 \pm x^3} = \frac{1}{6c} \log \frac{c^3 \pm x^3}{(c \pm x)^3} \pm \frac{1}{c\sqrt{3}} \tan^{-1} \frac{2x \mp c}{c\sqrt{3}}$$

$$93. \int \frac{x dx}{(c^3 \pm x^3)^2} = \frac{x^2}{3c^3(c^3 \pm x^3)} + \frac{1}{3c^3} \int \frac{x dx}{c^3 \pm x^3}$$

INTEGRALS (Continued)

94. $\int \frac{x dx}{(c^3 \pm x^3)^{n+1}} = \frac{1}{3nc^3} \left[\frac{x^2}{(c^3 \pm x^3)^n} + (3n-2) \int \frac{x dx}{(c^3 \pm x^3)^n} \right]$
95. $\int \frac{x^2 dx}{c^3 \pm x^3} = \pm \frac{1}{3} \log(c^3 \pm x^3)$
96. $\int \frac{x^2 dx}{(c^3 \pm x^3)^{n+1}} = \mp \frac{1}{3n(c^3 \pm x^3)^n}$
97. $\int \frac{dx}{x(c^3 \pm x^3)} = \frac{1}{3c^3} \log \frac{x^3}{c^3 \pm x^3}$
98. $\int \frac{dx}{x(c^3 \pm x^3)^2} = \frac{1}{3c^3(c^3 \pm x^3)} + \frac{1}{3c^6} \log \frac{x^3}{c^3 \pm x^3}$
99. $\int \frac{dx}{x(c^3 \pm x^3)^{n+1}} = \frac{1}{3nc^3(c^3 \pm x^3)^n} + \frac{1}{c^3} \int \frac{dx}{x(c^3 \pm x^3)^n}$
100. $\int \frac{dx}{x^2(c^3 \pm x^3)} = -\frac{1}{c^3 x} \mp \frac{1}{c^3} \int \frac{x dx}{c^3 \pm x^3}$
101. $\int \frac{dx}{x^2(c^3 \pm x^3)^{n+1}} = \frac{1}{c^3} \int \frac{dx}{x^2(c^3 \pm x^3)^n} \mp \frac{1}{c^3} \int \frac{x dx}{(c^3 \pm x^3)^{n+1}}$

FORMS CONTAINING $c^4 \pm x^4$

102. $\int \frac{dx}{c^4 + x^4} = \frac{1}{2c^3\sqrt{2}} \left[\frac{1}{2} \log \frac{x^2 + cx\sqrt{2} + c^2}{x^2 - cx\sqrt{2} + c^2} + \tan^{-1} \frac{cx\sqrt{2}}{c^2 - x^2} \right]$
103. $\int \frac{dx}{c^4 - x^4} = \frac{1}{2c^3} \left[\frac{1}{2} \log \frac{c+x}{c-x} + \tan^{-1} \frac{x}{c} \right]$
104. $\int \frac{x dx}{c^4 + x^4} = \frac{1}{2c^2} \tan^{-1} \frac{x^2}{c^2}$
105. $\int \frac{x dx}{c^4 - x^4} = \frac{1}{4c^2} \log \frac{c^2 + x^2}{c^2 - x^2}$
106. $\int \frac{x^2 dx}{c^4 + x^4} = \frac{1}{2c\sqrt{2}} \left[\frac{1}{2} \log \frac{x^2 - cx\sqrt{2} + c^2}{x^2 + cx\sqrt{2} + c^2} + \tan^{-1} \frac{cx\sqrt{2}}{c^2 - x^2} \right]$
107. $\int \frac{x^2 dx}{c^4 - x^4} = \frac{1}{2c} \left[\frac{1}{2} \log \frac{c+x}{c-x} - \tan^{-1} \frac{x}{c} \right]$
108. $\int \frac{x^3 dx}{c^4 \pm x^4} = \pm \frac{1}{4} \log(c^4 \pm x^4)$

FORMS CONTAINING $(a+bx+cx^2)$

$$X = a + bx + cx^2 \text{ and } q = 4ac - b^2$$

If $q=0$, then $X = c\left(x + \frac{b}{2c}\right)^2$, and formulas starting with 23 should be used in place of these.

109. $\int \frac{dx}{X} = \frac{2}{\sqrt{q}} \tan^{-1} \frac{2cx+b}{\sqrt{q}}, \quad (q > 0)$
110. $\int \frac{dx}{X} = \begin{cases} \frac{-2}{\sqrt{-q}} \tanh^{-1} \frac{2cx+b}{\sqrt{-q}} \\ \text{or} \\ \frac{1}{\sqrt{-q}} \log \frac{2cx+b-\sqrt{-q}}{2cx+b+\sqrt{-q}}, \end{cases} \quad (q < 0)$
111. $\int \frac{dx}{X^2} = \frac{2cx+b}{qX} + \frac{2c}{q} \int \frac{dx}{X}$

INTEGRALS (Continued)

$$112. \int \frac{dx}{X^3} = \frac{2cx + b}{q} \left(\frac{1}{2X^2} + \frac{3c}{qX} \right) + \frac{6c^2}{q^2} \int \frac{dx}{X}$$

$$113. \int \frac{dx}{X^{n+1}} = \begin{cases} \frac{2cx + b}{nqX^n} + \frac{2(2n-1)c}{qn} \int \frac{dx}{X^n} \\ \text{or} \\ \frac{(2n)!}{(n!)^2} \left(\frac{c}{q} \right)^n \left[\frac{2cx + b}{q} \sum_{r=1}^n \left(\frac{q}{cX} \right)^r \frac{(r-1)!r!}{(2r)!} \right] + \int \frac{dx}{X} \end{cases}$$

$$114. \int \frac{x dx}{X} = \frac{1}{2c} \log X - \frac{b}{2c} \int \frac{dx}{X}$$

$$115. \int \frac{x dx}{X^2} = \frac{bx + 2a}{qX} - \frac{b}{q} \int \frac{dx}{X}$$

$$116. \int \frac{x dx}{X^{n+1}} = -\frac{2a + bx}{nqX^n} - \frac{b(2n-1)}{nq} \int \frac{dx}{X^n}$$

$$117. \int \frac{x^2}{X} dx = \frac{x}{c} - \frac{b}{2c^2} \log X + \frac{b^2 - 2ac}{2c^2} \int \frac{dx}{X}$$

$$118. \int \frac{x^2}{X^2} dx = \frac{(b^2 - 2ac)x + ab}{cqX} + \frac{2a}{q} \int \frac{dx}{X}$$

$$119. \int \frac{x^m dx}{X^{n+1}} = -\frac{x^{m-1}}{(2n-m+1)cX^n} - \frac{n-m+1}{2n-m+1} \cdot \frac{b}{c} \int \frac{x^{m-1} dx}{X^{n+1}} \\ + \frac{m-1}{2n-m+1} \cdot \frac{a}{c} \int \frac{x^{m-2} dx}{X^{n+1}}$$

$$120. \int \frac{dx}{xX} = \frac{1}{2a} \log \frac{x^2}{X} - \frac{b}{2a} \int \frac{dx}{X}$$

$$121. \int \frac{dx}{x^2X} = \frac{b}{2a^2} \log \frac{X}{x^2} - \frac{1}{ax} + \left(\frac{b^2}{2a^2} - \frac{c}{a} \right) \int \frac{dx}{X}$$

$$122. \int \frac{dx}{xX^n} = \frac{1}{2a(n-1)X^{n-1}} - \frac{b}{2a} \int \frac{dx}{X^n} + \frac{1}{a} \int \frac{dx}{xX^{n-1}}$$

$$123. \int \frac{dx}{x^m X^{n+1}} = -\frac{1}{(m-1)ax^{m-1}X^n} - \frac{n+m-1}{m-1} \cdot \frac{b}{a} \int \frac{dx}{x^{m-1}X^{n+1}} \\ - \frac{2n+m-1}{m-1} \cdot \frac{c}{a} \int \frac{dx}{x^{m-2}X^{n+1}}$$

FORMS CONTAINING $\sqrt{a+bx}$

$$124. \int \sqrt{a+bx} dx = \frac{2}{3b} \sqrt{(a+bx)^3}$$

$$125. \int x\sqrt{a+bx} dx = -\frac{2(2a-3bx)\sqrt{(a+bx)^3}}{15b^2}$$

$$126. \int x^2\sqrt{a+bx} dx = \frac{2(8a^2 - 12abx + 15b^2x^2)\sqrt{(a+bx)^3}}{105b^3}$$

$$127. \int x^m \sqrt{a+bx} dx = \begin{cases} \frac{2}{b(2m+3)} \left[x^m \sqrt{(a+bx)^3} - ma \int x^{m-1} \sqrt{a+bx} dx \right] \\ \text{or} \\ \frac{2}{b^{m+1}} \sqrt{a+bx} \sum_{r=0}^m \frac{m!(-a)^{m-r}}{r!(m-r)!(2r+3)} (a+bx)^{r+1} \end{cases}$$

INTEGRALS (Continued)

128. $\int \frac{\sqrt{a+bx}}{x} dx = 2\sqrt{a+bx} + a \int \frac{dx}{x\sqrt{a+bx}}$
129. $\int \frac{\sqrt{a+bx}}{x^2} dx = -\frac{\sqrt{a+bx}}{x} + \frac{b}{2} \int \frac{dx}{x\sqrt{a+bx}}$
130. $\int \frac{\sqrt{a+bx}}{x^m} dx = -\frac{1}{(m-1)a} \left[\frac{\sqrt{(a+bx)^3}}{x^{m-1}} + \frac{(2m-5)b}{2} \int \frac{\sqrt{a+bx}}{x^{m-1}} dx \right]$
131. $\int \frac{dx}{\sqrt{a+bx}} = \frac{2\sqrt{a+bx}}{b}$
132. $\int \frac{x dx}{\sqrt{a+bx}} = -\frac{2(2a-bx)}{3b^2} \sqrt{a+bx}$
133. $\int \frac{x^2 dx}{\sqrt{a+bx}} = \frac{2(8a^2 - 4abx - 3b^2x^2)}{15b^3} \sqrt{a+bx}$
134. $\int \frac{x^m dx}{\sqrt{a+bx}} = \begin{cases} \frac{2}{(2m+1)b} \left[x^m \sqrt{a+bx} - ma \int \frac{x^{m-1} dx}{\sqrt{a+bx}} \right] \\ \text{or} \\ \frac{2(-a)^m \sqrt{a+bx}}{b^{m+1}} \sum_{r=0}^m \frac{(-1)^r m!(a+bx)^r}{(2r+1)r!(m-r)! a^r} \end{cases}$
135. $\int \frac{dx}{x\sqrt{a+bx}} = \frac{1}{\sqrt{a}} \log \left(\frac{\sqrt{a+bx} - \sqrt{a}}{\sqrt{a+bx} + \sqrt{a}} \right), \quad (a > 0)$
136. $\int \frac{dx}{x\sqrt{a+bx}} = \frac{2}{\sqrt{-a}} \tan^{-1} \sqrt{\frac{a+bx}{-a}}, \quad (a < 0)$
137. $\int \frac{dx}{x^2\sqrt{a+bx}} = -\frac{\sqrt{a+bx}}{ax} - \frac{b}{2a} \int \frac{dx}{x\sqrt{a+bx}}$
138. $\int \frac{dx}{x^n\sqrt{a+bx}} = \begin{cases} -\frac{\sqrt{a+bx}}{(n-1)ax^{n-1}} - \frac{(2n-3)b}{(2n-2)a} \int \frac{dx}{x^{n-1}\sqrt{a+bx}} \\ \frac{(2n-2)!}{[(n-1)!]^2} \left[-\frac{\sqrt{a+bx}}{a} \sum_{r=1}^{n-1} \frac{r!(r-1)!}{x^r 2(r)!} \left(-\frac{b}{4a}\right)^{n-r-1} \right. \\ \left. + \left(-\frac{b}{4a}\right)^{n-1} \int \frac{dx}{x\sqrt{a+bx}} \right] \end{cases}$
139. $\int (a+bx)^{\pm \frac{n}{2}} dx = \frac{2(a+bx)^{\frac{2\pm n}{2}}}{b(2\pm n)}$
140. $\int x(a+bx)^{\pm \frac{n}{2}} dx = \frac{2}{b^2} \left[\frac{(a+bx)^{\frac{4\pm n}{2}}}{4\pm n} - \frac{a(a+bx)^{\frac{2\pm n}{2}}}{2\pm n} \right]$
141. $\int \frac{dx}{x(a+bx)^{\frac{m}{2}}} = \frac{1}{a} \int \frac{dx}{x(a+bx)^{\frac{m-2}{2}}} - \frac{b}{a} \int \frac{dx}{(a+bx)^{\frac{m}{2}}}$

INTEGRALS (Continued)

$$142. \int \frac{(a+bx)^{n/2} dx}{x} = b \int (a+bx)^{(n-2)/2} dx + a \int \frac{(a+bx)^{(n-2)/2}}{x} dx$$

$$143. \int f(x, \sqrt{a+bx}) dx = \frac{2}{b} \int f\left(\frac{z^2-a}{b}, z\right) z dz, \quad (z = \sqrt{a+bx})$$

FORMS CONTAINING $\sqrt{a+bx}$ and $\sqrt{c+dx}$

$$u = a+bx \quad v = c+dx \quad k = ad-bc$$

If $k=0$, then, $v = \frac{c}{a}u$, and formulas starting with 124 should be used in place of these.

$$144. \int \frac{dx}{\sqrt{uv}} = \begin{cases} \frac{2}{\sqrt{bd}} \tanh^{-1} \frac{\sqrt{bd}uv}{bv}, & bd > 0, k < 0 \\ \text{or} \\ \frac{2}{\sqrt{bd}} \tanh^{-1} \frac{\sqrt{bd}uv}{du}, & bd > 0, k > 0. \\ \text{or} \\ \frac{1}{\sqrt{bd}} \log \frac{(bv + \sqrt{bd}uv)^2}{v}, & (bd > 0) \end{cases}$$

$$145. \int \frac{dx}{\sqrt{uv}} = \begin{cases} \frac{2}{\sqrt{-bd}} \tan^{-1} \frac{\sqrt{-bd}uv}{bv} \\ \text{or} \\ -\frac{1}{\sqrt{-bd}} \sin^{-1} \left(\frac{2bdx + ad + bc}{|k|} \right), & (bd < 0) \end{cases}$$

$$146. \int \sqrt{uv} dx = \frac{k+2bv}{4bd} \sqrt{uv} - \frac{k^2}{8bd} \int \frac{dx}{\sqrt{uv}}$$

$$147. \int \frac{dx}{v\sqrt{u}} = \begin{cases} \frac{1}{\sqrt{kd}} \log \frac{d\sqrt{u} - \sqrt{kd}}{d\sqrt{u} + \sqrt{kd}} \\ \text{or} \\ \frac{1}{\sqrt{kd}} \log \frac{(d\sqrt{u} - \sqrt{kd})^2}{v}, & (kd > 0) \end{cases}$$

$$148. \int \frac{dx}{v\sqrt{u}} = \frac{2}{\sqrt{-kd}} \tan^{-1} \frac{d\sqrt{u}}{\sqrt{-kd}}, \quad (kd < 0)$$

$$149. \int \frac{x dx}{\sqrt{uv}} = \frac{\sqrt{uv}}{bd} - \frac{ad+bc}{2bd} \int \frac{dx}{\sqrt{uv}}$$

$$150. \int \frac{dx}{v\sqrt{uv}} = \frac{-2\sqrt{uv}}{kv}$$

$$151. \int \frac{v dx}{\sqrt{uv}} = \frac{\sqrt{uv}}{b} - \frac{k}{2b} \int \frac{dx}{\sqrt{uv}}$$

$$152. \int \frac{\sqrt{v}}{\sqrt{u}} dx = \frac{v}{|v|} \int \frac{v dx}{\sqrt{uv}}$$

$$153. \int v^m \sqrt{u} dx = \frac{1}{(2m+3)d} \left(2v^{m+1} \sqrt{u} + k \int \frac{v^m dx}{\sqrt{u}} \right)$$

INTEGRALS (Continued)

$$154. \int \frac{dx}{v^m \sqrt{u}} = -\frac{1}{(m-1)k} \left(\frac{\sqrt{u}}{v^{m-1}} + \left(m - \frac{3}{2}\right) b \int \frac{dx}{v^{m-1} \sqrt{u}} \right)$$

$$155. \int \frac{v^m dx}{\sqrt{u}} = \begin{cases} \frac{2}{b(2m+1)} \left[v^m \sqrt{u} - mk \int \frac{v^{m-1}}{\sqrt{u}} dx \right] \\ \text{or} \\ \frac{2(m!)^2 \sqrt{u}}{b(2m+1)!} \sum_{r=0}^m \left(-\frac{4k}{b}\right)^{m-r} \frac{(2r)!}{(r!)^2} v^r \end{cases}$$

FORMS CONTAINING $\sqrt{x^2 \pm a^2}$

$$156. \int \sqrt{x^2 \pm a^2} dx = \frac{1}{2} [x\sqrt{x^2 \pm a^2} \pm a^2 \log(x + \sqrt{x^2 \pm a^2})]$$

$$157. \int \frac{dx}{\sqrt{x^2 \pm a^2}} = \log(x + \sqrt{x^2 \pm a^2})$$

$$158. \int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{|a|} \sec^{-1} \frac{x}{a}$$

$$159. \int \frac{dx}{x\sqrt{x^2 + a^2}} = -\frac{1}{a} \log\left(\frac{a + \sqrt{x^2 + a^2}}{x}\right)$$

$$160. \int \frac{\sqrt{x^2 + a^2}}{x} dx = \sqrt{x^2 + a^2} - a \log\left(\frac{a + \sqrt{x^2 + a^2}}{x}\right)$$

$$161. \int \frac{\sqrt{x^2 - a^2}}{x} dx = \sqrt{x^2 - a^2} - |a| \sec^{-1} \frac{x}{a}$$

$$162. \int \frac{x dx}{\sqrt{x^2 \pm a^2}} = \sqrt{x^2 \pm a^2}$$

$$163. \int x\sqrt{x^2 \pm a^2} dx = \frac{1}{3} \sqrt{(x^2 \pm a^2)^3}$$

$$164. \int \sqrt{(x^2 \pm a^2)^3} dx = \frac{1}{4} \left[x\sqrt{(x^2 \pm a^2)^3} \pm \frac{3a^2 x}{2} \sqrt{x^2 \pm a^2} + \frac{3a^4}{2} \log(x + \sqrt{x^2 \pm a^2}) \right]$$

$$165. \int \frac{dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{\pm x}{a^2 \sqrt{x^2 \pm a^2}}$$

$$166. \int \frac{x dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{-1}{\sqrt{x^2 \pm a^2}}$$

$$167. \int x\sqrt{(x^2 \pm a^2)^3} dx = \frac{1}{5} \sqrt{(x^2 \pm a^2)^5}$$

$$168. \int x^2 \sqrt{x^2 \pm a^2} dx = \frac{x}{4} \sqrt{(x^2 \pm a^2)^3} \mp \frac{a^2}{8} x \sqrt{x^2 \pm a^2} - \frac{a^4}{8} \log(x + \sqrt{x^2 \pm a^2})$$

$$169. \int x^3 \sqrt{x^2 + a^2} dx = \left(\frac{1}{5}x^2 - \frac{2}{15}a^2\right) \sqrt{(a^2 + x^2)^3}$$

$$170. \int x^3 \sqrt{x^2 - a^2} dx = \frac{1}{5} \sqrt{(x^2 - a^2)^5} + \frac{a^2}{3} \sqrt{(x^2 - a^2)^3}$$

$$171. \int \frac{x^2 dx}{\sqrt{x^2 \pm a^2}} = \frac{x}{2} \sqrt{x^2 \pm a^2} \mp \frac{a^2}{2} \log(x + \sqrt{x^2 \pm a^2})$$

INTEGRALS (Continued)

172. $\int \frac{x^3 dx}{\sqrt{x^2 \pm a^2}} = \frac{1}{3} \sqrt{(x^2 \pm a^2)^3} \mp a^2 \sqrt{x^2 \pm a^2}$
173. $\int \frac{dx}{x^2 \sqrt{x^2 \pm a^2}} = \mp \frac{\sqrt{x^2 \pm a^2}}{a^2 x}$
174. $\int \frac{dx}{x^3 \sqrt{x^2 + a^2}} = \frac{\sqrt{x^2 + a^2}}{2a^2 x^2} + \frac{1}{2a^3} \log \frac{a + \sqrt{x^2 + a^2}}{x}$
175. $\int \frac{dx}{x^3 \sqrt{x^2 - a^2}} = \frac{\sqrt{x^2 - a^2}}{2a^2 x^2} + \frac{1}{2|a^3|} \sec^{-1} \frac{x}{a}$
176. $\int x^2 \sqrt{(x^2 \pm a^2)^3} dx = \frac{x}{6} \sqrt{(x^2 \pm a^2)^5} \mp \frac{a^2 x}{24} \sqrt{(x^2 \pm a^2)^3} - \frac{a^4 x}{16} \sqrt{x^2 \pm a^2}$
 $\mp \frac{a^6}{16} \log(x + \sqrt{x^2 \pm a^2})$
177. $\int x^3 \sqrt{(x^2 \pm a^2)^3} dx = \frac{1}{7} \sqrt{(x^2 \pm a^2)^7} \mp \frac{a^2}{5} \sqrt{(x^2 \pm a^2)^5}$
178. $\int \frac{\sqrt{x^2 \pm a^2} dx}{x^2} = -\frac{\sqrt{x^2 \pm a^2}}{x} + \log(x + \sqrt{x^2 \pm a^2})$
179. $\int \frac{\sqrt{x^2 + a^2}}{x^3} dx = -\frac{\sqrt{x^2 + a^2}}{2x^2} - \frac{1}{2a} \log \frac{a + \sqrt{x^2 + a^2}}{x}$
180. $\int \frac{\sqrt{x^2 - a^2}}{x^3} dx = -\frac{\sqrt{x^2 - a^2}}{2x^2} + \frac{1}{2|a|} \sec^{-1} \frac{x}{a}$
181. $\int \frac{\sqrt{x^2 \pm a^2}}{x^4} dx = \mp \frac{\sqrt{(x^2 \pm a^2)^3}}{3a^2 x^3}$
182. $\int \frac{x^2 dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{-x}{\sqrt{x^2 \pm a^2}} + \log(x + \sqrt{x^2 \pm a^2})$
183. $\int \frac{x^3 dx}{\sqrt{(x^2 \pm a^2)^3}} = \sqrt{x^2 \pm a^2} \pm \frac{a^2}{\sqrt{x^2 \pm a^2}}$
184. $\int \frac{dx}{x \sqrt{(x^2 + a^2)^3}} = \frac{1}{a^2 \sqrt{x^2 + a^2}} - \frac{1}{a^3} \log \frac{a + \sqrt{x^2 + a^2}}{x}$
185. $\int \frac{dx}{x \sqrt{(x^2 - a^2)^3}} = -\frac{1}{a^2 \sqrt{x^2 - a^2}} - \frac{1}{|a^3|} \sec^{-1} \frac{x}{a}$
186. $\int \frac{dx}{x^2 \sqrt{(x^2 \pm a^2)^3}} = -\frac{1}{a^4} \left[\frac{\sqrt{x^2 \pm a^2}}{x} + \frac{x}{\sqrt{x^2 \pm a^2}} \right]$
187. $\int \frac{dx}{x^3 \sqrt{(x^2 + a^2)^3}} = -\frac{1}{2a^2 x^2 \sqrt{x^2 + a^2}} - \frac{3}{2a^4 \sqrt{x^2 + a^2}} + \frac{3}{2a^5} \log \frac{a + \sqrt{x^2 + a^2}}{x}$
188. $\int \frac{dx}{x^3 \sqrt{(x^2 - a^2)^3}} = \frac{1}{2a^2 x^2 \sqrt{x^2 - a^2}} - \frac{3}{2a^4 \sqrt{x^2 - a^2}} - \frac{3}{2|a^5|} \sec^{-1} \frac{x}{a}$
189. $\int \frac{x^m}{\sqrt{x^2 \pm a^2}} dx = \frac{1}{m} x^{m-1} \sqrt{x^2 \pm a^2} \mp \frac{m-1}{m} a^2 \int \frac{x^{m-2}}{\sqrt{x^2 \pm a^2}} dx$

INTEGRALS (Continued)

190.
$$\int \frac{x^{2m}}{\sqrt{x^2 \pm a^2}} dx = \frac{(2m)!}{2^{2m}(m!)^2} \left[\sqrt{x^2 \pm a^2} \sum_{r=1}^m \frac{r!(r-1)!}{(2r)!} (\mp a^2)^{m-r} (2x)^{2r-1} + (\mp a^2)^m \log(x + \sqrt{x^2 \pm a^2}) \right]$$
191.
$$\int \frac{x^{2m+1}}{\sqrt{x^2 \pm a^2}} dx = \sqrt{x^2 \pm a^2} \sum_{r=0}^m \frac{(2r)!(m!)^2}{(2m+1)!(r!)^2} (\mp 4a^2)^{m-r} x^{2r}$$
192.
$$\int \frac{dx}{x^m \sqrt{x^2 \pm a^2}} = \mp \frac{\sqrt{x^2 \pm a^2}}{(m-1)a^2 x^{m-1}} \mp \frac{(m-2)}{(m-1)a^2} \int \frac{dx}{x^{m-2} \sqrt{x^2 \pm a^2}}$$
193.
$$\int \frac{dx}{x^{2m} \sqrt{x^2 \pm a^2}} = \sqrt{x^2 \pm a^2} \sum_{r=0}^{m-1} \frac{(m-1)!m!(2r)!2^{2m-2r-1}}{(r!)^2(2m)!(\mp a^2)^{m-r} x^{2r+1}}$$
194.
$$\int \frac{dx}{x^{2m+1} \sqrt{x^2 + a^2}} = \frac{(2m)!}{(m!)^2} \left[\frac{\sqrt{x^2 + a^2}}{a^2} \sum_{r=1}^m (-1)^{m-r+1} \frac{r!(r-1)!}{2(2r)!(4a^2)^{m-r} x^{2r}} + \frac{(-1)^{m+1}}{2^{2m} a^{2m+1}} \log \frac{\sqrt{x^2 + a^2} + a}{x} \right]$$
195.
$$\int \frac{dx}{x^{2m+1} \sqrt{x^2 - a^2}} = \frac{(2m)!}{(m!)^2} \left[\frac{\sqrt{x^2 - a^2}}{a^2} \sum_{r=1}^m \frac{r!(r-1)!}{2(2r)!(4a^2)^{m-r} x^{2r}} + \frac{1}{2^{2m} |a|^{2m+1}} \sec^{-1} \frac{x}{a} \right]$$
196.
$$\int \frac{dx}{(x-a)\sqrt{x^2 - a^2}} = -\frac{\sqrt{x^2 - a^2}}{a(x-a)}$$
197.
$$\int \frac{dx}{(x+a)\sqrt{x^2 - a^2}} = \frac{\sqrt{x^2 - a^2}}{a(x+a)}$$
198.
$$\int f(x, \sqrt{x^2 + a^2}) dx = a \int f(a \tan u, a \sec u) \sec^2 u du, \quad (u = \tan^{-1} \frac{x}{a}, a > 0)$$
199.
$$\int f(x, \sqrt{x^2 - a^2}) dx = a \int f(a \sec u, a \tan u) \sec u \tan u du, \quad (u = \sec^{-1} \frac{x}{a}, a > 0)$$

FORMS CONTAINING $\sqrt{a^2 - x^2}$

200.
$$\int \sqrt{a^2 - x^2} dx = \frac{1}{2} \left[x\sqrt{a^2 - x^2} + a^2 \sin^{-1} \frac{x}{|a|} \right]$$
201.
$$\int \frac{dx}{\sqrt{a^2 - x^2}} = \begin{cases} \sin^{-1} \frac{x}{|a|} \\ \text{or} \\ -\cos^{-1} \frac{x}{|a|} \end{cases}$$
202.
$$\int \frac{dx}{x\sqrt{a^2 - x^2}} = -\frac{1}{a} \log \left(\frac{a + \sqrt{a^2 - x^2}}{x} \right)$$
203.
$$\int \frac{\sqrt{a^2 - x^2}}{x} dx = \sqrt{a^2 - x^2} - a \log \left(\frac{a + \sqrt{a^2 - x^2}}{x} \right)$$
204.
$$\int \frac{x dx}{\sqrt{a^2 - x^2}} = -\sqrt{a^2 - x^2}$$
205.
$$\int x\sqrt{a^2 - x^2} dx = -\frac{1}{3} \sqrt{(a^2 - x^2)^3}$$

INTEGRALS (Continued)

206. $\int \sqrt{(a^2 - x^2)^3} dx = \frac{1}{4} \left[x\sqrt{(a^2 - x^2)^3} + \frac{3a^2x}{2}\sqrt{a^2 - x^2} + \frac{3a^4}{2} \sin^{-1} \frac{x}{|a|} \right]$
207. $\int \frac{dx}{\sqrt{(a^2 - x^2)^3}} = \frac{x}{a^2\sqrt{a^2 - x^2}}$
208. $\int \frac{x dx}{\sqrt{(a^2 - x^2)^3}} = \frac{1}{\sqrt{a^2 - x^2}}$
209. $\int x\sqrt{(a^2 - x^2)^3} dx = -\frac{1}{5}\sqrt{(a^2 - x^2)^5}$
210. $\int x^2\sqrt{a^2 - x^2} dx = -\frac{x}{4}\sqrt{(a^2 - x^2)^3} + \frac{a^2}{8} \left(x\sqrt{a^2 - x^2} + a^2 \sin^{-1} \frac{x}{|a|} \right)$
211. $\int x^3\sqrt{a^2 - x^2} dx = \left(-\frac{1}{5}x^2 - \frac{2}{15}a^2\right)\sqrt{(a^2 - x^2)^3}$
212. $\int x^2\sqrt{(a^2 - x^2)^3} dx = -\frac{1}{6}x\sqrt{(a^2 - x^2)^5} + \frac{a^2x}{24}\sqrt{(a^2 - x^2)^3} + \frac{a^4x}{16}\sqrt{a^2 - x^2} + \frac{a^6}{16}\sin^{-1} \frac{x}{|a|}$
213. $\int x^3\sqrt{(a^2 - x^2)^3} dx = \frac{1}{7}\sqrt{(a^2 - x^2)^7} - \frac{a^2}{5}\sqrt{(a^2 - x^2)^5}$
214. $\int \frac{x^2 dx}{\sqrt{a^2 - x^2}} = -\frac{x}{2}\sqrt{a^2 - x^2} + \frac{a^2}{2} \sin^{-1} \frac{x}{|a|}$
215. $\int \frac{dx}{x^2\sqrt{a^2 - x^2}} = -\frac{\sqrt{a^2 - x^2}}{a^2x}$
216. $\int \frac{\sqrt{a^2 - x^2}}{x^2} dx = -\frac{\sqrt{a^2 - x^2}}{x} - \sin^{-1} \frac{x}{|a|}$
217. $\int \frac{\sqrt{a^2 - x^2}}{x^3} dx = -\frac{\sqrt{a^2 - x^2}}{2x^2} + \frac{1}{2a} \log \frac{a + \sqrt{a^2 - x^2}}{x}$
218. $\int \frac{\sqrt{a^2 - x^2}}{x^4} dx = -\frac{\sqrt{(a^2 - x^2)^3}}{3a^2x^3}$
219. $\int \frac{x^2 dx}{\sqrt{(a^2 - x^2)^3}} = \frac{x}{\sqrt{a^2 - x^2}} - \sin^{-1} \frac{x}{|a|}$
220. $\int \frac{x^3 dx}{\sqrt{a^2 - x^2}} = -\frac{2}{3}(a^2 - x^2)^{3/2} - x^2(a^2 - x^2)^{1/2} = -\frac{1}{3}\sqrt{a^2 - x^2}(x^2 + 2a^2)$
221. $\int \frac{x^3 dx}{\sqrt{(a^2 - x^2)^3}} = 2(a^2 - x^2)^{1/2} + \frac{x^2}{(a^2 - x^2)^{1/2}} = -\frac{a^2}{\sqrt{a^2 - x^2}} + \sqrt{a^2 - x^2}$
222. $\int \frac{dx}{x^3\sqrt{a^2 - x^2}} = -\frac{\sqrt{a^2 - x^2}}{2a^2x^2} - \frac{1}{2a^3} \log \frac{a + \sqrt{a^2 - x^2}}{x}$
223. $\int \frac{dx}{x\sqrt{(a^2 - x^2)^3}} = \frac{1}{a^2\sqrt{a^2 - x^2}} - \frac{1}{a^3} \log \frac{a + \sqrt{a^2 - x^2}}{x}$
224. $\int \frac{dx}{x^2\sqrt{(a^2 - x^2)^3}} = \frac{1}{a^4} \left[-\frac{\sqrt{a^2 - x^2}}{x} + \frac{x}{\sqrt{a^2 - x^2}} \right]$
225. $\int \frac{dx}{x^3\sqrt{(a^2 - x^2)^3}} = -\frac{1}{2a^2x^2\sqrt{a^2 - x^2}} + \frac{3}{2a^4\sqrt{a^2 - x^2}} - \frac{3}{2a^5} \log \frac{a + \sqrt{a^2 - x^2}}{x}$

INTEGRALS (Continued)

226. $\int \frac{x^m}{\sqrt{a^2 - x^2}} dx = -\frac{x^{m-1}\sqrt{a^2 - x^2}}{m} + \frac{(m-1)a^2}{m} \int \frac{x^{m-2}}{\sqrt{a^2 - x^2}} dx$
227. $\int \frac{x^{2m}}{\sqrt{a^2 - x^2}} dx = \frac{(2m)!}{(m!)^2} \left[-\sqrt{a^2 - x^2} \sum_{r=1}^m \frac{r!(r-1)!}{2^{2m-2r+1}(2r)!} a^{2m-2r} x^{2r-1} + \frac{a^{2m}}{2^{2m}} \sin^{-1} \frac{x}{|a|} \right]$
228. $\int \frac{x^{2m+1}}{\sqrt{a^2 - x^2}} dx = -\sqrt{a^2 - x^2} \sum_{r=0}^m \frac{(2r)!(m!)^2}{(2m+1)!(r!)^2} (4a^2)^{m-r} x^{2r}$
229. $\int \frac{dx}{x^m \sqrt{a^2 - x^2}} = -\frac{\sqrt{a^2 - x^2}}{(m-1)a^2 x^{m-1}} + \frac{m-2}{(m-1)a^2} \int \frac{dx}{x^{m-2} \sqrt{a^2 - x^2}}$
230. $\int \frac{ax}{x^{2m} \sqrt{a^2 - x^2}} = -\sqrt{a^2 - x^2} \sum_{r=0}^{m-1} \frac{(m-1)!m!(2r)!2^{2m-2r-1}}{(r!)^2(2m)!a^{2m-2r}x^{2r+1}}$
231. $\int \frac{dx}{x^{2m+1} \sqrt{a^2 - x^2}} = \frac{(2m)!}{(m!)^2} \left[-\frac{\sqrt{a^2 - x^2}}{a^2} \sum_{r=1}^m \frac{r!(r-1)!}{2(2r)!(4a^2)^{m-r}x^{2r}} + \frac{1}{2^{2m}a^{2m+1}} \log \frac{a - \sqrt{a^2 - x^2}}{x} \right]$
232. $\int \frac{dx}{(b^2 - x^2)\sqrt{a^2 - x^2}} = \frac{1}{2b\sqrt{a^2 - b^2}} \log \frac{(b\sqrt{a^2 - x^2} + x\sqrt{a^2 - b^2})^2}{b^2 - x^2}, \quad (a^2 > b^2)$
233. $\int \frac{dx}{(b^2 - x^2)\sqrt{a^2 - x^2}} = \frac{1}{b\sqrt{b^2 - a^2}} \tan^{-1} \frac{x\sqrt{b^2 - a^2}}{b\sqrt{a^2 - x^2}}, \quad (b^2 > a^2)$
234. $\int \frac{dx}{(b^2 + x^2)\sqrt{a^2 - x^2}} = \frac{1}{b\sqrt{a^2 + b^2}} \tan^{-1} \frac{x\sqrt{a^2 + b^2}}{b\sqrt{a^2 - x^2}}$
235. $\int \frac{\sqrt{a^2 - x^2}}{b^2 + x^2} dx = \frac{\sqrt{a^2 + b^2}}{|b|} \sin^{-1} \frac{x\sqrt{a^2 + b^2}}{|a|\sqrt{x^2 + b^2}} - \sin^{-1} \frac{x}{|a|}$
236. $\int f(x, \sqrt{a^2 - x^2}) dx = a \int f(a \sin u, a \cos u) \cos u du, \quad (u = \sin^{-1} \frac{x}{a}, a > 0)$

FORMS CONTAINING $\sqrt{a + bx + cx^2}$

$$X = a + bx + cx^2, \quad q = 4ac - b^2, \quad \text{and } k = \frac{4c}{q}$$

If $q = 0$, then $\sqrt{X} = \sqrt{c} \left| x + \frac{b}{2c} \right|$

$$237. \int \frac{dx}{\sqrt{X}} = \begin{cases} \frac{1}{\sqrt{c}} \log(2\sqrt{cX} + 2cx + b) \\ \text{or} \\ \frac{1}{\sqrt{c}} \sinh^{-1} \frac{2cx + b}{\sqrt{q}}, \quad (c > 0) \end{cases}$$

$$238. \int \frac{dx}{\sqrt{X}} = -\frac{1}{\sqrt{-c}} \sin^{-1} \frac{2cx + b}{\sqrt{-q}}, \quad (c < 0)$$

$$239. \int \frac{dx}{X\sqrt{X}} = \frac{2(2cx + b)}{q\sqrt{X}}$$

INTEGRALS (Continued)

$$240. \int \frac{dx}{X^2\sqrt{X}} = \frac{2(2cx+b)}{3q\sqrt{X}} \left(\frac{1}{X} + 2k \right)$$

$$241. \int \frac{dx}{X^n\sqrt{X}} = \begin{cases} \frac{2(2cx+b)\sqrt{X}}{(2n-1)qX^n} + \frac{2k(n-1)}{2n-1} \int \frac{dx}{X^{n-1}\sqrt{X}} \\ \text{or} \\ \frac{(2cx+b)(n!)(n-1)!4^n k^{n-1}}{q[(2n)!]\sqrt{X}} \sum_{r=0}^{n-1} \frac{(2r)!}{(4kX)^r (r!)^2} \end{cases}$$

$$242. \int \sqrt{X} dx = \frac{(2cx+b)\sqrt{X}}{4c} + \frac{1}{2k} \int \frac{dx}{\sqrt{X}}$$

$$243. \int X\sqrt{X} dx = \frac{(2cx+b)\sqrt{X}}{8c} \left(X + \frac{3}{2k} \right) + \frac{3}{8k^2} \int \frac{dx}{\sqrt{X}}$$

$$244. \int X^2\sqrt{X} dx = \frac{(2cx+b)\sqrt{X}}{12c} \left(X^2 + \frac{5X}{4k} + \frac{15}{8k^2} \right) + \frac{5}{16k^3} \int \frac{dx}{\sqrt{X}}$$

$$245. \int X^n\sqrt{X} dx = \begin{cases} \frac{(2cx+b)X^n\sqrt{X}}{4(n+1)c} + \frac{2n+1}{2(n+1)k} \int X^{n-1}\sqrt{X} dx \\ \text{or} \\ \frac{(2n+2)!}{[(n+1)!]^2(4k)^{n+1}} \left[\frac{k(2cx+b)\sqrt{X}}{c} \sum_{r=0}^n \frac{r!(r+1)!(4kX)^r}{(2r+2)!} + \int \frac{dx}{\sqrt{X}} \right] \end{cases}$$

$$246. \int \frac{x dx}{\sqrt{X}} = \frac{\sqrt{X}}{c} - \frac{b}{2c} \int \frac{dx}{\sqrt{X}}$$

$$247. \int \frac{x dx}{X\sqrt{X}} = -\frac{2(bx+2a)}{q\sqrt{X}}$$

$$248. \int \frac{x dx}{X^n\sqrt{X}} = -\frac{\sqrt{X}}{(2n-1)cX^n} - \frac{b}{2c} \int \frac{dx}{X^n\sqrt{X}}$$

$$249. \int \frac{x^2 dx}{\sqrt{X}} = \left(\frac{x}{2c} - \frac{3b}{4c^2} \right) \sqrt{X} + \frac{3b^2 - 4ac}{8c^2} \int \frac{dx}{\sqrt{X}}$$

$$250. \int \frac{x^2 dx}{X\sqrt{X}} = \frac{(2b^2 - 4ac)x + 2ab}{cq\sqrt{X}} + \frac{1}{c} \int \frac{dx}{\sqrt{X}}$$

$$251. \int \frac{x^2 dx}{X^n\sqrt{X}} = \frac{(2b^2 - 4ac)x + 2ab}{(2n-1)cq X^{n-1}\sqrt{X}} + \frac{4ac + (2n-3)b^2}{(2n-1)cq} \int \frac{dx}{X^{n-1}\sqrt{X}}$$

$$252. \int \frac{x^3 dx}{\sqrt{X}} = \left(\frac{x^2}{3c} - \frac{5bx}{12c^2} + \frac{5b^2}{8c^3} - \frac{2a}{3c^2} \right) \sqrt{X} + \left(\frac{3ab}{4c^2} - \frac{5b^3}{16c^3} \right) \int \frac{dx}{\sqrt{X}}$$

$$253. \int \frac{x^n dx}{\sqrt{X}} = \frac{1}{nc} x^{n-1} \sqrt{X} - \frac{(2n-1)b}{2nc} \int \frac{x^{n-1} dx}{\sqrt{X}} - \frac{(n-1)a}{nc} \int \frac{x^{n-2} dx}{\sqrt{X}}$$

$$254. \int x\sqrt{X} dx = \frac{X\sqrt{X}}{3c} - \frac{b(2cx+b)}{8c^2} \sqrt{X} - \frac{b}{4ck} \int \frac{dx}{\sqrt{X}}$$

$$255. \int xX\sqrt{X} dx = \frac{X^2\sqrt{X}}{5c} - \frac{b}{2c} \int X\sqrt{X} dx$$

INTEGRALS (Continued)

256. $\int xX^n\sqrt{X} dx = \frac{X^{n+1}\sqrt{X}}{(2n+3)c} - \frac{b}{2c} \int X^n\sqrt{X} dx$
257. $\int x^2\sqrt{X} dx = \left(x - \frac{5b}{6c}\right) \frac{X\sqrt{X}}{4c} + \frac{5b^2 - 4ac}{16c^2} \int \sqrt{X} dx$
258. $\int \frac{dx}{x\sqrt{X}} = -\frac{1}{\sqrt{a}} \log \frac{2\sqrt{aX} + bx + 2a}{x}, \quad (a > 0)$
259. $\int \frac{dx}{x\sqrt{X}} = \frac{1}{\sqrt{-a}} \sin^{-1} \left(\frac{bx + 2a}{|x|\sqrt{-a}} \right), \quad (a < 0)$
260. $\int \frac{dx}{x\sqrt{X}} = -\frac{2\sqrt{X}}{bx}, \quad (a = 0)$
261. $\int \frac{dx}{x^2\sqrt{X}} = -\frac{\sqrt{X}}{ax} - \frac{b}{2a} \int \frac{dx}{x\sqrt{X}}$
262. $\int \frac{\sqrt{X} dx}{x} = \sqrt{X} + \frac{b}{2} \int \frac{dx}{\sqrt{X}} + a \int \frac{dx}{x\sqrt{X}}$
263. $\int \frac{\sqrt{X} dx}{x^2} = -\frac{\sqrt{X}}{x} + \frac{b}{2} \int \frac{dx}{x\sqrt{X}} + c \int \frac{dx}{\sqrt{X}}$

FORMS INVOLVING $\sqrt{2ax - x^2}$

264. $\int \sqrt{2ax - x^2} dx = \frac{1}{2} \left[(x-a)\sqrt{2ax - x^2} + a^2 \sin^{-1} \frac{x-a}{|a|} \right]$
265. $\int \frac{dx}{\sqrt{2ax - x^2}} = \begin{cases} \cos^{-1} \frac{a-x}{|a|} \\ \text{or} \\ \sin^{-1} \frac{x-a}{|a|} \end{cases}$
266. $\int x^n \sqrt{2ax - x^2} dx = \begin{cases} -\frac{x^{n-1}(2ax - x^2)^{3/2}}{n+2} + \frac{(2n+1)a}{n+2} \int x^{n-1} \sqrt{2ax - x^2} dx \\ \text{or} \\ \sqrt{2ax - x^2} \left[\frac{x^{n+1}}{n+2} - \sum_{r=0}^n \frac{(2n+1)!(r!)^2 a^{n-r+1}}{2^{n-r}(2r)!(n+2)!n!} x^r \right] \\ + \frac{(2n+1)!a^{n+2}}{2^n n!(n+2)!} \sin^{-1} \frac{x-a}{|a|} \end{cases}$
267. $\int \frac{\sqrt{2ax - x^2}}{x^n} dx = \frac{(2ax - x^2)^{3/2}}{(3-2n)ax^n} + \frac{n-3}{(2n-3)a} \int \frac{\sqrt{2ax - x^2}}{x^{n-1}} dx$
268. $\int \frac{x^n dx}{\sqrt{2ax - x^2}} = \begin{cases} \frac{-x^{n-1}\sqrt{2ax - x^2}}{n} + \frac{a(2n-1)}{n} \int \frac{x^{n-1}}{\sqrt{2ax - x^2}} dx \\ \text{or} \\ -\sqrt{2ax - x^2} \sum_{r=1}^n \frac{(2n)!(r-1)!a^{n-r}}{2^{n-r}(2r)!(n!)^2} x^{r-1} + \frac{(2n)!a^n}{2^n(n!)^2} \sin^{-1} \frac{x-a}{|a|} \end{cases}$

INTEGRALS (Continued)

$$269. \int \frac{dx}{x^n \sqrt{2ax - x^2}} = \begin{cases} \frac{\sqrt{2ax - x^2}}{a(1 - 2n)x^n} + \frac{n - 1}{(2n - 1)a} \int \frac{dx}{x^{n-1} \sqrt{2ax - x^2}} \\ \text{or} \\ -\sqrt{2ax - x^2} \sum_{r=0}^{n-1} \frac{2^{n-r}(n-1)!n!(2r)!}{(2n)!(r!)^2 a^{n-r} x^{r+1}} \end{cases}$$

$$270. \int \frac{dx}{(2ax - x^2)^{3/2}} = \frac{x - a}{a^2 \sqrt{2ax - x^2}}$$

$$271. \int \frac{x dx}{(2ax - x^2)^{3/2}} = \frac{x}{a \sqrt{2ax - x^2}}$$

MISCELLANEOUS ALGEBRAIC FORMS

$$272. \int \frac{dx}{\sqrt{2ax + x^2}} = \log(x + a + \sqrt{2ax + x^2})$$

$$273. \int \sqrt{ax^2 + c} dx = \frac{x}{2} \sqrt{ax^2 + c} + \frac{c}{2\sqrt{a}} \log(x\sqrt{a} + \sqrt{ax^2 + c}), \quad (a > 0)$$

$$274. \int \sqrt{ax^2 + c} dx = \frac{x}{2} \sqrt{ax^2 + c} + \frac{c}{2\sqrt{-a}} \sin^{-1}\left(x\sqrt{-\frac{a}{c}}\right), \quad (a < 0)$$

$$275. \int \sqrt{\frac{1+x}{1-x}} dx = \sin^{-1} x - \sqrt{1-x^2}$$

$$276. \int \frac{dx}{x\sqrt{ax^n + c}} = \begin{cases} \frac{1}{n\sqrt{c}} \log \frac{\sqrt{ax^n + c} - \sqrt{c}}{\sqrt{ax^n + c} + \sqrt{c}} \\ \text{or} \\ \frac{2}{n\sqrt{c}} \log \frac{\sqrt{ax^n + c} - \sqrt{c}}{\sqrt{x^n}}, \quad (c > 0) \end{cases}$$

$$277. \int \frac{dx}{x\sqrt{ax^n + c}} = \frac{2}{n\sqrt{-c}} \sec^{-1} \sqrt{-\frac{ax^n}{c}}, \quad (c < 0)$$

$$278. \int \frac{dx}{\sqrt{ax^2 + c}} = \frac{1}{\sqrt{a}} \log(x\sqrt{a} + \sqrt{ax^2 + c}), \quad (a > 0)$$

$$279. \int \frac{dx}{\sqrt{ax^2 + c}} = \frac{1}{\sqrt{-a}} \sin^{-1}\left(x\sqrt{-\frac{a}{c}}\right), \quad (a < 0)$$

$$280. \int (ax^2 + c)^{m+1/2} dx = \begin{cases} \frac{x(ax^2 + c)^{m+1/2}}{2(m+1)} + \frac{(2m+1)c}{2(m+1)} \int (ax^2 + c)^{m-1/2} dx \\ \text{or} \\ x\sqrt{ax^2 + c} \sum_{r=0}^m \frac{(2m+1)!(r!)^2 c^{m-r}}{2^{2m-2r+1} m!(m+1)!(2r+1)!} (ax^2 + c)^r \\ + \frac{(2m+1)!c^{m+1}}{2^{2m+1} m!(m+1)!} \int \frac{dx}{\sqrt{ax^2 + c}} \end{cases}$$

$$281. \int x(ax^2 + c)^{m+1/2} dx = \frac{(ax^2 + c)^{m+3/2}}{(2m+3)a}$$

INTEGRALS (Continued)

$$282. \int \frac{(ax^2 + c)^{m+1/2}}{x} dx = \begin{cases} \frac{(ax^2 + c)^{m+1/2}}{2m+1} + c \int \frac{(ax^2 + c)^{m-1/2}}{x} dx \\ \text{or} \\ \sqrt{ax^2 + c} \sum_{r=0}^m \frac{c^{m-r}(ax^2 + c)^r}{2r+1} + c^{m+1} \int \frac{dx}{x\sqrt{ax^2 + c}} \end{cases}$$

$$283. \int \frac{dx}{(ax^2 + c)^{m+1/2}} = \begin{cases} \frac{x}{(2m-1)c(ax^2 + c)^{m-1/2}} + \frac{2m-2}{(2m-1)c} \int \frac{dx}{(ax^2 + c)^{m-1/2}} \\ \text{or} \\ \frac{x}{\sqrt{ax^2 + c}} \sum_{r=0}^{m-1} \frac{2^{2m-2r-1}(m-1)!m!(2r)!}{(2m)!(r!)^2 c^{m-r}(ax^2 + c)^r} \end{cases}$$

$$284. \int \frac{dx}{x^m \sqrt{ax^2 + c}} = -\frac{\sqrt{ax^2 + c}}{(m-1)cx^{m-1}} - \frac{(m-2)a}{(m-1)c} \int \frac{dx}{x^{m-2} \sqrt{ax^2 + c}}$$

$$285. \int \frac{1+x^2}{(1-x^2)\sqrt{1+x^4}} dx = \frac{1}{\sqrt{2}} \log \frac{x\sqrt{2} + \sqrt{1+x^4}}{1-x^2}$$

$$286. \int \frac{1-x^2}{(1+x^2)\sqrt{1+x^4}} dx = \frac{1}{\sqrt{2}} \tan^{-1} \frac{x\sqrt{2}}{\sqrt{1+x^4}}$$

$$287. \int \frac{dx}{x\sqrt{x^n + a^2}} = -\frac{2}{na} \log \frac{a + \sqrt{x^n + a^2}}{\sqrt{x^n}}$$

$$288. \int \frac{dx}{x\sqrt{x^n - a^2}} = -\frac{2}{na} \sin^{-1} \frac{a}{\sqrt{x^n}}$$

$$289. \int \sqrt{\frac{x}{a^3 - x^3}} dx = \frac{2}{3} \sin^{-1} \left(\frac{x}{a} \right)^{3/2}$$

FORMS INVOLVING TRIGONOMETRIC FUNCTIONS

$$290. \int (\sin ax) dx = -\frac{1}{a} \cos ax$$

$$291. \int (\cos ax) dx = \frac{1}{a} \sin ax$$

$$292. \int (\tan ax) dx = -\frac{1}{a} \log \cos ax = \frac{1}{a} \log \sec ax$$

$$293. \int (\cot ax) dx = \frac{1}{a} \log \sin ax = -\frac{1}{a} \log \csc ax$$

$$294. \int (\sec ax) dx = \frac{1}{a} \log(\sec ax + \tan ax) = \frac{1}{a} \log \tan \left(\frac{\pi}{4} + \frac{ax}{2} \right)$$

$$295. \int (\csc ax) dx = \frac{1}{a} \log(\csc ax - \cot ax) = \frac{1}{a} \log \tan \frac{ax}{2}$$

$$296. \int (\sin^2 ax) dx = -\frac{1}{2a} \cos ax \sin ax + \frac{1}{2} x = \frac{1}{2} x - \frac{1}{4a} \sin 2ax$$

$$297. \int (\sin^3 ax) dx = -\frac{1}{3a} (\cos ax)(\sin^2 ax + 2)$$

$$298. \int (\sin^4 ax) dx = \frac{3x}{8} - \frac{\sin 2ax}{4a} + \frac{\sin 4ax}{32a}$$

$$299. \int (\sin^n ax) dx = -\frac{\sin^{n-1} ax \cos ax}{na} + \frac{n-1}{n} \int (\sin^{n-2} ax) dx$$

INTEGRALS (Continued)

300. $\int (\sin^{2m} ax) dx = -\frac{\cos ax}{a} \sum_{r=0}^{m-1} \frac{(2m)!(r!)^2}{2^{2m-2r}(2r+1)!(m!)^2} \sin^{2r+1} ax + \frac{(2m)!}{2^{2m}(m!)^2} x$
301. $\int (\sin^{2m+1} ax) dx = -\frac{\cos ax}{a} \sum_{r=0}^m \frac{2^{2m-2r}(m!)^2(2r)!}{(2m+1)!(r!)^2} \sin^{2r} ax$
302. $\int (\cos^2 ax) dx = \frac{1}{2a} \sin ax \cos ax + \frac{1}{2} x = \frac{1}{2} x + \frac{1}{4a} \sin 2ax$
303. $\int (\cos^3 ax) dx = \frac{1}{3a} (\sin ax)(\cos^2 ax + 2)$
304. $\int (\cos^4 ax) dx = \frac{3x}{8} + \frac{\sin 2ax}{4a} + \frac{\sin 4ax}{32a}$
305. $\int (\cos^n ax) dx = \frac{1}{na} \cos^{n-1} ax \sin ax + \frac{n-1}{n} \int (\cos^{n-2} ax) dx$
306. $\int (\cos^{2m} ax) dx = \frac{\sin ax}{a} \sum_{r=0}^{m-1} \frac{(2m)!(r!)^2}{2^{2m-2r}(2r+1)!(m!)^2} \cos^{2r+1} ax + \frac{(2m)!}{2^{2m}(m!)^2} x$
307. $\int (\cos^{2m+1} ax) dx = \frac{\sin ax}{a} \sum_{r=0}^m \frac{2^{2m-2r}(m!)^2(2r)!}{(2m+1)!(r!)^2} \cos^{2r} ax$
308. $\int \frac{dx}{\sin^2 ax} = \int (\csc^2 ax) dx = -\frac{1}{a} \cot ax$
309. $\int \frac{dx}{\sin^m ax} = \int (\csc^m ax) dx = -\frac{1}{(m-1)a} \cdot \frac{\cos ax}{\sin^{m-1} ax} + \frac{m-2}{m-1} \int \frac{dx}{\sin^{m-2} ax}$
310. $\int \frac{dx}{\sin^{2m} ax} = \int (\csc^{2m} ax) dx = -\frac{1}{a} \cos ax \sum_{r=0}^{m-1} \frac{2^{2m-2r-1}(m-1)!m!(2r)!}{(2m)!(r!)^2 \sin^{2r+1} ax}$
311. $\int \frac{dx}{\sin^{2m+1} ax} = \int (\csc^{2m+1} ax) dx$
 $= -\frac{1}{a} \cos ax \sum_{r=0}^{m-1} \frac{(2m)!(r!)^2}{2^{2m-2r}(m!)^2(2r+1)! \sin^{2r+2} ax} + \frac{1}{a} \cdot \frac{(2m)!}{2^{2m}(m!)^2} \log \tan \frac{ax}{2}$
312. $\int \frac{dx}{\cos^2 ax} = \int (\sec^2 ax) dx = \frac{1}{a} \tan ax$
313. $\int \frac{dx}{\cos^n ax} = \int (\sec^n ax) dx = \frac{1}{(n-1)a} \cdot \frac{\sin ax}{\cos^{n-1} ax} + \frac{n-2}{n-1} \int \frac{dx}{\cos^{n-2} ax}$
314. $\int \frac{dx}{\cos^{2m} ax} = \int (\sec^{2m} ax) dx = \frac{1}{a} \sin ax \sum_{r=0}^{m-1} \frac{2^{2m-2r-1}(m-1)!m!(2r)!}{(2m)!(r!)^2 \cos^{2r+1} ax}$
315. $\int \frac{dx}{\cos^{2m+1} ax} = \int (\sec^{2m+1} ax) dx$
 $= \frac{1}{a} \sin ax \sum_{r=0}^{m-1} \frac{(2m)!(r!)^2}{2^{2m-2r}(m!)^2(2r+1)! \cos^{2r+2} ax} + \frac{1}{a} \cdot \frac{(2m)!}{2^{2m}(m!)^2} \log(\sec ax + \tan ax)$
316. $\int (\sin mx)(\sin nx) dx = \frac{\sin(m-n)x}{2(m-n)} - \frac{\sin(m+n)x}{2(m+n)}, \quad (m^2 \neq n^2)$
317. $\int (\cos mx)(\cos nx) dx = \frac{\sin(m-n)x}{2(m-n)} + \frac{\sin(m+n)x}{2(m+n)}, \quad (m^2 \neq n^2)$
318. $\int (\sin ax)(\cos ax) dx = \frac{1}{2a} \sin^2 ax$

INTEGRALS (Continued)

$$319. \int (\sin mx)(\cos nx) dx = -\frac{\cos(m-n)x}{2(m-n)} - \frac{\cos(m+n)x}{2(m+n)}, \quad (m^2 \neq n^2)$$

$$320. \int (\sin^2 ax)(\cos^2 ax) dx = -\frac{1}{32a} \sin 4ax + \frac{x}{8}$$

$$321. \int (\sin ax)(\cos^m ax) dx = -\frac{\cos^{m+1} ax}{(m+1)a}$$

$$322. \int (\sin^m ax)(\cos ax) dx = \frac{\sin^{m+1} ax}{(m+1)a}$$

$$323. \int (\cos^m ax)(\sin^n ax) dx = \begin{cases} \frac{\cos^{m-1} ax \sin^{n+1} ax}{(m+n)a} + \frac{m-1}{m+n} \int (\cos^{m-2} ax)(\sin^n ax) dx \\ \text{or} \\ -\frac{\sin^{n-1} ax \cos^{m+1} ax}{(m+n)a} + \frac{n-1}{m+n} \int (\cos^m ax)(\sin^{n-2} ax) dx \end{cases}$$

$$324. \int \frac{\cos^m ax}{\sin^n ax} dx = \begin{cases} -\frac{\cos^{m+1} ax}{(n-1)a \sin^{n-1} ax} - \frac{m-n+2}{n-1} \int \frac{\cos^m ax}{\sin^{n-2} ax} dx \\ \text{or} \\ \frac{\cos^{m-1} ax}{a(m-n) \sin^{n-1} ax} + \frac{m-1}{m-n} \int \frac{\cos^{m-2} ax}{\sin^n ax} dx \end{cases}$$

$$325. \int \frac{\sin^m ax}{\cos^n ax} dx = \begin{cases} \frac{\sin^{m+1} ax}{a(n-1) \cos^{n-1} ax} - \frac{m-n+2}{n-1} \int \frac{\sin^m ax}{\cos^{n-2} ax} dx \\ \text{or} \\ -\frac{\sin^{m-1} ax}{a(m-n) \cos^{n-1} ax} + \frac{m-1}{m-n} \int \frac{\sin^{m-2} ax}{\cos^n ax} dx \end{cases}$$

$$326. \int \frac{\sin ax}{\cos^2 ax} dx = \frac{1}{a \cos ax} = \frac{\sec ax}{a}$$

$$327. \int \frac{\sin^2 ax}{\cos ax} dx = -\frac{1}{a} \sin ax + \frac{1}{a} \log \tan\left(\frac{\pi}{4} + \frac{ax}{2}\right)$$

$$328. \int \frac{\cos ax}{\sin^2 ax} dx = -\frac{1}{a \sin ax} = -\frac{\csc ax}{a}$$

$$329. \int \frac{dx}{(\sin ax)(\cos ax)} = \frac{1}{a} \log \tan ax$$

$$330. \int \frac{dx}{(\sin ax)(\cos^2 ax)} = \frac{1}{a} \left(\sec ax + \log \tan \frac{ax}{2} \right)$$

$$331. \int \frac{dx}{(\sin ax)(\cos^n ax)} = \frac{1}{a(n-1) \cos^{n-1} ax} + \int \frac{dx}{(\sin ax)(\cos^{n-2} ax)}$$

$$332. \int \frac{dx}{(\sin^2 ax)(\cos ax)} = -\frac{1}{a} \csc ax + \frac{1}{a} \log \tan\left(\frac{\pi}{4} + \frac{ax}{2}\right)$$

$$333. \int \frac{dx}{(\sin^2 ax)(\cos^2 ax)} = -\frac{2}{a} \cot 2ax$$

INTEGRALS (Continued)

$$334. \int \frac{dx}{\sin^m ax \cos^n ax} = \begin{cases} -\frac{1}{a(m-1)(\sin^{m-1} ax)(\cos^{n-1} ax)} \\ \quad + \frac{m+n-2}{m-1} \int \frac{dx}{(\sin^{m-2} ax)(\cos^n ax)} \\ \text{or} \\ \frac{1}{a(n-1)\sin^{m-1} ax \cos^{n-1} ax} - \frac{m+n-2}{n-1} \int \frac{dx}{\sin^m ax \cos^{n-2} ax} \end{cases}$$

$$335. \int \sin(a+bx) dx = -\frac{1}{b} \cos(a+bx)$$

$$336. \int \cos(a+bx) dx = \frac{1}{b} \sin(a+bx)$$

$$337. \int \frac{dx}{1 \pm \sin ax} = \mp \frac{1}{a} \tan\left(\frac{\pi}{4} \mp \frac{ax}{2}\right)$$

$$338. \int \frac{dx}{1 + \cos ax} = \frac{1}{a} \tan \frac{ax}{2}$$

$$339. \int \frac{dx}{1 - \cos ax} = -\frac{1}{a} \cot \frac{ax}{2}$$

$$*340. \int \frac{dx}{a+b \sin x} = \begin{cases} \frac{2}{\sqrt{a^2-b^2}} \tan^{-1} \frac{a \tan \frac{x}{2} + b}{\sqrt{a^2-b^2}} \\ \text{or} \\ \frac{1}{\sqrt{b^2-a^2}} \log \frac{a \tan \frac{x}{2} + b - \sqrt{b^2-a^2}}{a \tan \frac{x}{2} + b + \sqrt{b^2-a^2}} \end{cases}$$

$$*341. \int \frac{dx}{a+b \cos x} = \begin{cases} \frac{2}{\sqrt{a^2-b^2}} \tan^{-1} \frac{\sqrt{a^2-b^2} \tan \frac{x}{2}}{a+b} \\ \text{or} \\ \frac{1}{\sqrt{b^2-a^2}} \log \left(\frac{\sqrt{b^2-a^2} \tan \frac{x}{2} + a + b}{\sqrt{b^2-a^2} \tan \frac{x}{2} - a - b} \right) \end{cases}$$

$$*342. \int \frac{dx}{a+b \sin x + c \cos x} = \begin{cases} \frac{1}{\sqrt{b^2+c^2-a^2}} \log \frac{b - \sqrt{b^2+c^2-a^2} + (a-c) \tan \frac{x}{2}}{b + \sqrt{b^2+c^2-a^2} + (a-c) \tan \frac{x}{2}}, & \text{if } a^2 < b^2 + c^2, a \neq c \\ \text{or} \\ \frac{2}{\sqrt{a^2-b^2-c^2}} \tan^{-1} \frac{b + (a-c) \tan \frac{x}{2}}{\sqrt{a^2-b^2-c^2}}, & \text{if } a^2 > b^2 + c^2 \\ \text{or} \\ \frac{1}{a} \left[\frac{a - (b+c) \cos x - (b-c) \sin x}{a - (b-c) \cos x + (b+c) \sin x} \right], & \text{if } a^2 = b^2 + c^2, a \neq c. \end{cases}$$

*See note 6 on page A-19.

INTEGRALS (Continued)

$$*343. \int \frac{\sin^2 x \, dx}{a + b \cos^2 x} = \frac{1}{b} \sqrt{\frac{a+b}{a}} \tan^{-1} \left(\sqrt{\frac{a}{a+b}} \tan x \right) - \frac{x}{b}, \quad (ab > 0, \text{ or } |a| > |b|)$$

$$*344. \int \frac{dx}{a^2 \cos^2 x + b^2 \sin^2 x} = \frac{1}{ab} \tan^{-1} \left(\frac{b \tan x}{a} \right)$$

$$*345. \int \frac{\cos^2 cx}{a^2 + b^2 \sin^2 cx} dx = \frac{\sqrt{a^2 + b^2}}{ab^2 c} \tan^{-1} \frac{\sqrt{a^2 + b^2} \tan cx}{a} - \frac{x}{b^2}$$

$$346. \int \frac{\sin cx \cos cx}{a \cos^2 cx + b \sin^2 cx} dx = \frac{1}{2c(b-a)} \log(a \cos^2 cx + b \sin^2 cx)$$

$$347. \int \frac{\cos cx}{a \cos cx + b \sin cx} dx = \int \frac{dx}{a + b \tan cx} \\ = \frac{1}{c(a^2 + b^2)} [acx + b \log(a \cos cx + b \sin cx)]$$

$$348. \int \frac{\sin cx}{a \sin cx + b \cos cx} dx = \int \frac{dx}{a + b \cot cx} = \frac{1}{c(a^2 + b^2)} [acx - b \log(a \sin cx + b \cos cx)]$$

$$*349. \int \frac{dx}{a \cos^2 x + 2b \cos x \sin x + c \sin^2 x} = \begin{cases} \frac{1}{2\sqrt{b^2 - ac}} \log \frac{c \tan x + b - \sqrt{b^2 - ac}}{c \tan x + b + \sqrt{b^2 - ac}}, & (b^2 > ac) \\ \text{or} \\ \frac{1}{\sqrt{ac - b^2}} \tan^{-1} \frac{c \tan x + b}{\sqrt{ac - b^2}}, & (b^2 < ac) \\ \text{or} \\ -\frac{1}{c \tan x + b}, & (b^2 = ac) \end{cases}$$

$$350. \int \frac{\sin ax}{1 \pm \sin ax} dx = \pm x + \frac{1}{a} \tan \left(\frac{\pi}{4} \mp \frac{ax}{2} \right)$$

$$351. \int \frac{dx}{(\sin ax)(1 \pm \sin ax)} = \frac{1}{a} \tan \left(\frac{\pi}{4} \mp \frac{ax}{2} \right) + \frac{1}{a} \log \tan \frac{ax}{2}$$

$$352. \int \frac{dx}{(1 + \sin ax)^2} = -\frac{1}{2a} \tan \left(\frac{\pi}{4} - \frac{ax}{2} \right) - \frac{1}{6a} \tan^3 \left(\frac{\pi}{4} - \frac{ax}{2} \right)$$

$$353. \int \frac{dx}{(1 - \sin ax)^2} = \frac{1}{2a} \cot \left(\frac{\pi}{4} - \frac{ax}{2} \right) + \frac{1}{6a} \cot^3 \left(\frac{\pi}{4} - \frac{ax}{2} \right)$$

$$354. \int \frac{\sin ax}{(1 + \sin ax)^2} dx = -\frac{1}{2a} \tan \left(\frac{\pi}{4} - \frac{ax}{2} \right) + \frac{1}{6a} \tan^3 \left(\frac{\pi}{4} - \frac{ax}{2} \right)$$

$$355. \int \frac{\sin ax}{(1 - \sin ax)^2} dx = -\frac{1}{2a} \cot \left(\frac{\pi}{4} - \frac{ax}{2} \right) + \frac{1}{6a} \cot^3 \left(\frac{\pi}{4} - \frac{ax}{2} \right)$$

$$356. \int \frac{\sin x \, dx}{a + b \sin x} = \frac{x}{b} - \frac{a}{b} \int \frac{dx}{a + b \sin x}$$

$$357. \int \frac{dx}{(\sin x)(a + b \sin x)} = \frac{1}{a} \log \tan \frac{x}{2} - \frac{b}{a} \int \frac{dx}{a + b \sin x}$$

$$358. \int \frac{dx}{(a + b \sin x)^2} = \frac{b \cos x}{(a^2 - b^2)(a + b \sin x)} + \frac{a}{a^2 - b^2} \int \frac{dx}{a + b \sin x}$$

*See note 6 on page A-19.

INTEGRALS (Continued)

$$359. \int \frac{\sin x \, dx}{(a + b \sin x)^2} = \frac{a \cos x}{(b^2 - a^2)(a + b \sin x)} + \frac{h}{b^2 - a^2} \int \frac{dx}{a + b \sin x}$$

$$*360. \int \frac{dx}{a^2 + b^2 \sin^2 cx} = \frac{1}{ac\sqrt{a^2 + b^2}} \tan^{-1} \frac{\sqrt{a^2 + b^2} \tan cx}{a}$$

$$*361. \int \frac{dx}{a^2 - b^2 \sin^2 cx} = \begin{cases} \frac{1}{ac\sqrt{a^2 - b^2}} \tan^{-1} \frac{\sqrt{a^2 - b^2} \tan cx}{a}, & (a^2 > b^2) \\ \text{or} \\ \frac{1}{2ac\sqrt{b^2 - a^2}} \log \frac{\sqrt{b^2 - a^2} \tan cx + a}{\sqrt{b^2 - a^2} \tan cx - a}, & (a^2 < b^2) \end{cases}$$

$$362. \int \frac{\cos ax}{1 + \cos ax} dx = x - \frac{1}{a} \tan \frac{ax}{2}$$

$$363. \int \frac{\cos ax}{1 - \cos ax} dx = -x - \frac{1}{a} \cot \frac{ax}{2}$$

$$364. \int \frac{dx}{(\cos ax)(1 + \cos ax)} = \frac{1}{a} \log \tan \left(\frac{\pi}{4} + \frac{ax}{2} \right) - \frac{1}{a} \tan \frac{ax}{2}$$

$$365. \int \frac{dx}{(\cos ax)(1 - \cos ax)} = \frac{1}{a} \log \tan \left(\frac{\pi}{4} + \frac{ax}{2} \right) - \frac{1}{a} \cot \frac{ax}{2}$$

$$366. \int \frac{dx}{(1 + \cos ax)^2} = \frac{1}{2a} \tan \frac{ax}{2} + \frac{1}{6a} \tan^3 \frac{ax}{2}$$

$$367. \int \frac{dx}{(1 - \cos ax)^2} = -\frac{1}{2a} \cot \frac{ax}{2} - \frac{1}{6a} \cot^3 \frac{ax}{2}$$

$$368. \int \frac{\cos ax}{(1 + \cos ax)^2} dx = \frac{1}{2a} \tan \frac{ax}{2} - \frac{1}{6a} \tan^3 \frac{ax}{2}$$

$$369. \int \frac{\cos ax}{(1 - \cos ax)^2} dx = \frac{1}{2a} \cot \frac{ax}{2} - \frac{1}{6a} \cot^3 \frac{ax}{2}$$

$$370. \int \frac{\cos x \, dx}{a + b \cos x} = \frac{x}{b} - \frac{a}{b} \int \frac{dx}{a + b \cos x}$$

$$371. \int \frac{dx}{(\cos x)(a + b \cos x)} = \frac{1}{a} \log \tan \left(\frac{x}{2} + \frac{\pi}{4} \right) - \frac{b}{a} \int \frac{dx}{a + b \cos x}$$

$$372. \int \frac{dx}{(a + b \cos x)^2} = \frac{b \sin x}{(b^2 - a^2)(a + b \cos x)} - \frac{a}{b^2 - a^2} \int \frac{dx}{a + b \cos x}$$

$$373. \int \frac{\cos x}{(a + b \cos x)^2} dx = \frac{a \sin x}{(a^2 - b^2)(a + b \cos x)} - \frac{b}{a^2 - b^2} \int \frac{dx}{a + b \cos x}$$

$$*374. \int \frac{dx}{a^2 + b^2 - 2ab \cos cx} = \frac{2}{c(a^2 - b^2)} \tan^{-1} \left(\frac{a + b}{a - b} \tan \frac{cx}{2} \right)$$

$$*375. \int \frac{dx}{a^2 + b^2 \cos^2 cx} = \frac{1}{ac\sqrt{a^2 + b^2}} \tan^{-1} \frac{a \tan cx}{\sqrt{a^2 + b^2}}$$

$$*376. \int \frac{dx}{a^2 - b^2 \cos^2 cx} = \begin{cases} \frac{1}{ac\sqrt{a^2 - b^2}} \tan^{-1} \frac{a \tan cx}{\sqrt{a^2 - b^2}}, & (a^2 > b^2) \\ \text{or} \\ \frac{1}{2ac\sqrt{b^2 - a^2}} \log \frac{a \tan cx - \sqrt{b^2 - a^2}}{a \tan cx + \sqrt{b^2 - a^2}}, & (b^2 > a^2) \end{cases}$$

$$377. \int \frac{\sin ax}{1 \pm \cos ax} dx = \mp \frac{1}{a} \log(1 \pm \cos ax)$$

*See note 6 on page A-19.

INTEGRALS (Continued)

378. $\int \frac{\cos ax}{1 \pm \sin ax} dx = \pm \frac{1}{a} \log(1 \pm \sin ax)$
379. $\int \frac{dx}{(\sin ax)(1 \pm \cos ax)} = \pm \frac{1}{2a(1 \pm \cos ax)} + \frac{1}{2a} \log \tan \frac{ax}{2}$
380. $\int \frac{dx}{(\cos ax)(1 \pm \sin ax)} = \mp \frac{1}{2a(1 \pm \sin ax)} + \frac{1}{2a} \log \tan\left(\frac{\pi}{4} + \frac{ax}{2}\right)$
381. $\int \frac{\sin ax}{(\cos ax)(1 \pm \cos ax)} dx = \frac{1}{a} \log(\sec ax \pm 1)$
382. $\int \frac{\cos ax}{(\sin ax)(1 \pm \sin ax)} dx = -\frac{1}{a} \log(\csc ax \pm 1)$
383. $\int \frac{\sin ax}{(\cos ax)(1 \pm \sin ax)} dx = \frac{1}{2a(1 \pm \sin ax)} \pm \frac{1}{2a} \log \tan\left(\frac{\pi}{4} + \frac{ax}{2}\right)$
384. $\int \frac{\cos ax}{(\sin ax)(1 \pm \cos ax)} dx = -\frac{1}{2a(1 \pm \cos ax)} \pm \frac{1}{2a} \log \tan \frac{ax}{2}$
385. $\int \frac{dx}{\sin ax \pm \cos ax} = \frac{1}{a\sqrt{2}} \log \tan\left(\frac{ax}{2} \pm \frac{\pi}{8}\right)$
386. $\int \frac{dx}{(\sin ax \pm \cos ax)^2} = \frac{1}{2a} \tan\left(ax \mp \frac{\pi}{4}\right)$
387. $\int \frac{dx}{1 + \cos ax \pm \sin ax} = \pm \frac{1}{a} \log\left(1 \pm \tan \frac{ax}{2}\right)$
388. $\int \frac{dx}{a^2 \cos^2 cx - b^2 \sin^2 cx} = \frac{1}{2abc} \log \frac{b \tan cx + a}{b \tan cx - a}$
389. $\int x(\sin ax) dx = \frac{1}{a^2} \sin ax - \frac{x}{a} \cos ax$
390. $\int x^2(\sin ax) dx = \frac{2x}{a^2} \sin ax - \frac{a^2 x^2 - 2}{a^3} \cos ax$
391. $\int x^3(\sin ax) dx = \frac{3a^2 x^2 - 6}{a^4} \sin ax - \frac{a^2 x^3 - 6x}{a^3} \cos ax$
392. $\int x^m \sin ax dx = \begin{cases} -\frac{1}{a} x^m \cos ax + \frac{m}{a} \int x^{m-1} \cos ax dx \\ \text{or} \\ \cos ax \sum_{r=0}^{[m/2]} (-1)^{r+1} \frac{m!}{(m-2r)!} \cdot \frac{x^{m-2r}}{a^{2r+1}} \\ + \sin ax \sum_{r=0}^{[(m-1)/2]} (-1)^r \frac{m!}{(m-2r-1)!} \cdot \frac{x^{m-2r-1}}{a^{2r+2}} \end{cases}$
- Note: $[s]$ means greatest integer $\leq s$; $[3\frac{1}{2}] = 3$, $[\frac{1}{2}] = 0$, etc.
393. $\int x(\cos ax) dx = \frac{1}{a^2} \cos ax + \frac{x}{a} \sin ax$
394. $\int x^2(\cos ax) dx = \frac{2x \cos ax}{a^2} + \frac{a^2 x^2 - 2}{a^3} \sin ax$
395. $\int x^3(\cos ax) dx = \frac{3a^2 x^2 - 6}{a^4} \cos ax + \frac{a^2 x^3 - 6x}{a^3} \sin ax$

INTEGRALS (Continued)

$$396. \int x^m (\cos ax) dx = \begin{cases} \frac{x^m \sin ax}{a} - \frac{m}{a} \int x^{m-1} \sin ax dx \\ \text{or} \\ \sin ax \sum_{r=0}^{[m/2]} (-1)^r \frac{m!}{(m-2r)!} \cdot \frac{x^{m-2r}}{a^{2r+1}} \\ + \cos ax \sum_{r=0}^{[(m-1)/2]} (-1)^r \frac{m!}{(m-2r-1)!} \cdot \frac{x^{m-2r-1}}{a^{2r+2}} \end{cases}$$

See note integral 392.

$$397. \int \frac{\sin ax}{x} dx = \sum_{n=0}^r (-1)^n \frac{(ax)^{2n+1}}{(2n+1)(2n+1)!}$$

$$398. \int \frac{\cos ax}{x} dx = \log x + \sum_{n=1}^r (-1)^n \frac{(ax)^{2n}}{2n(2n)!}$$

$$399. \int x(\sin^2 ax) dx = \frac{x^2}{4} - \frac{x \sin 2ax}{4a} - \frac{\cos 2ax}{8a^2}$$

$$400. \int x^2(\sin^2 ax) dx = \frac{x^3}{6} - \left(\frac{x^2}{4a} - \frac{1}{8a^3}\right) \sin 2ax - \frac{x \cos 2ax}{4a^2}$$

$$401. \int x(\sin^3 ax) dx = \frac{x \cos 3ax}{12a} - \frac{\sin 3ax}{36a^2} - \frac{3x \cos ax}{4a} + \frac{3 \sin ax}{4a^2}$$

$$402. \int x(\cos^2 ax) dx = \frac{x^2}{4} + \frac{x \sin 2ax}{4a} + \frac{\cos 2ax}{8a^2}$$

$$403. \int x^2(\cos^2 ax) dx = \frac{x^3}{6} + \left(\frac{x^2}{4a} - \frac{1}{8a^3}\right) \sin 2ax + \frac{x \cos 2ax}{4a^2}$$

$$404. \int x(\cos^3 ax) dx = \frac{x \sin 3ax}{12a} + \frac{\cos 3ax}{36a^2} + \frac{3x \sin ax}{4a} + \frac{3 \cos ax}{4a^2}$$

$$405. \int \frac{\sin ax}{x^m} dx = -\frac{\sin ax}{(m-1)x^{m-1}} + \frac{a}{m-1} \int \frac{\cos ax}{x^{m-1}} dx$$

$$406. \int \frac{\cos ax}{x^m} dx = -\frac{\cos ax}{(m-1)x^{m-1}} - \frac{a}{m-1} \int \frac{\sin ax}{x^{m-1}} dx$$

$$407. \int \frac{x}{1 \pm \sin ax} dx = \mp \frac{x \cos ax}{a(1 \pm \sin ax)} + \frac{1}{a^2} \log(1 \pm \sin ax)$$

$$408. \int \frac{x}{1 + \cos ax} dx = \frac{x}{a} \tan \frac{ax}{2} + \frac{2}{a^2} \log \cos \frac{ax}{2}$$

$$409. \int \frac{x}{1 - \cos ax} dx = -\frac{x}{a} \cot \frac{ax}{2} + \frac{2}{a^2} \log \sin \frac{ax}{2}$$

$$410. \int \frac{x + \sin x}{1 + \cos x} dx = x \tan \frac{x}{2}$$

$$411. \int \frac{x - \sin x}{1 - \cos x} dx = -x \cot \frac{x}{2}$$

$$412. \int \sqrt{1 - \cos ax} dx = -\frac{2 \sin ax}{a\sqrt{1 - \cos ax}} = -\frac{2\sqrt{2}}{a} \cos\left(\frac{ax}{2}\right)$$

$$413. \int \sqrt{1 + \cos ax} dx = \frac{2 \sin ax}{a\sqrt{1 + \cos ax}} = \frac{2\sqrt{2}}{a} \sin\left(\frac{ax}{2}\right)$$

$$414. \int \sqrt{1 + \sin x} dx = \pm 2 \left(\sin \frac{x}{2} - \cos \frac{x}{2} \right),$$

[use + if $(8k-1)\frac{\pi}{2} < x \leq (8k+3)\frac{\pi}{2}$, otherwise -; k an integer]

INTEGRALS (Continued)

415. $\int \sqrt{1 - \sin x} \, dx = \pm 2 \left(\sin \frac{x}{2} + \cos \frac{x}{2} \right)$,
 [use + if $(8k - 3)\frac{\pi}{2} < x \leq (8k + 1)\frac{\pi}{2}$, otherwise -; k an integer]
416. $\int \frac{dx}{\sqrt{1 - \cos x}} = \pm \sqrt{2} \log \tan \frac{x}{4}$,
 [use + if $4k\pi < x < (4k + 2)\pi$, otherwise -; k an integer]
417. $\int \frac{dx}{\sqrt{1 + \cos x}} = \pm \sqrt{2} \log \tan \left(\frac{x + \pi}{4} \right)$,
 [use + if $(4k - 1)\pi < x < (4k + 1)\pi$, otherwise -; k an integer]
418. $\int \frac{dx}{\sqrt{1 - \sin x}} = \pm \sqrt{2} \log \tan \left(\frac{x}{4} - \frac{\pi}{8} \right)$,
 [use + if $(8k + 1)\frac{\pi}{2} < x < (8k + 5)\frac{\pi}{2}$, otherwise -; k an integer]
419. $\int \frac{dx}{\sqrt{1 + \sin x}} = \pm \sqrt{2} \log \tan \left(\frac{x}{4} + \frac{\pi}{8} \right)$,
 [use + if $(8k - 1)\frac{\pi}{2} < x < (8k + 3)\frac{\pi}{2}$, otherwise -; k an integer]
420. $\int (\tan^2 ax) \, dx = \frac{1}{a} \tan ax - x$
421. $\int (\tan^3 ax) \, dx = \frac{1}{2a} \tan^2 ax + \frac{1}{a} \log \cos ax$
422. $\int (\tan^4 ax) \, dx = \frac{\tan^3 ax}{3a} - \frac{1}{a} \tan x + x$
423. $\int (\tan^n ax) \, dx = \frac{\tan^{n-1} ax}{a(n-1)} - \int (\tan^{n-2} ax) \, dx$
424. $\int (\cot^2 ax) \, dx = -\frac{1}{a} \cot ax - x$
425. $\int (\cot^3 ax) \, dx = -\frac{1}{2a} \cot^2 ax - \frac{1}{a} \log \sin ax$
426. $\int (\cot^4 ax) \, dx = -\frac{1}{3a} \cot^3 ax + \frac{1}{a} \cot ax + x$
427. $\int (\cot^n ax) \, dx = -\frac{\cot^{n-1} ax}{a(n-1)} - \int (\cot^{n-2} ax) \, dx$
428. $\int \frac{x}{\sin^2 ax} \, dx = \int x(\csc^2 ax) \, dx = -\frac{x \cot ax}{a} + \frac{1}{a^2} \log \sin ax$
429. $\int \frac{x}{\sin^n ax} \, dx = \int x(\csc^n ax) \, dx = -\frac{x \cos ax}{a(n-1)\sin^{n-1} ax} - \frac{1}{a^2(n-1)(n-2)\sin^{n-2} ax}$
 $+ \frac{(n-2)}{(n-1)} \int \frac{x}{\sin^{n-2} ax} \, dx$
430. $\int \frac{x}{\cos^2 ax} \, dx = \int x(\sec^2 ax) \, dx = \frac{1}{a} x \tan ax + \frac{1}{a^2} \log \cos ax$
431. $\int \frac{x}{\cos^n ax} \, dx = \int x(\sec^n ax) \, dx = \frac{x \sin ax}{a(n-1) \cos^{n-1} ax} - \frac{1}{a^2(n-1)(n-2) \cos^{n-2} ax}$
 $+ \frac{n-2}{n-1} \int \frac{x}{\cos^{n-2} ax} \, dx$

INTEGRALS (Continued)

432. $\int \frac{\sin ax}{\sqrt{1+b^2 \sin^2 ax}} dx = -\frac{1}{ab} \sin^{-1} \frac{b \cos ax}{\sqrt{1+b^2}}$
433. $\int \frac{\sin ax}{\sqrt{1-b^2 \sin^2 ax}} dx = -\frac{1}{ab} \log(b \cos ax + \sqrt{1-b^2 \sin^2 ax})$
434. $\int (\sin ax) \sqrt{1+b^2 \sin^2 ax} dx = -\frac{\cos ax}{2a} \sqrt{1+b^2 \sin^2 ax} - \frac{1+b^2}{2ab} \sin^{-1} \frac{b \cos ax}{\sqrt{1+b^2}}$
435. $\int (\sin ax) \sqrt{1-b^2 \sin^2 ax} dx = -\frac{\cos ax}{2a} \sqrt{1-b^2 \sin^2 ax} - \frac{1-b^2}{2ab} \log(b \cos ax + \sqrt{1-b^2 \sin^2 ax})$
436. $\int \frac{\cos ax}{\sqrt{1+b^2 \sin^2 ax}} dx = \frac{1}{ab} \log(b \sin ax + \sqrt{1+b^2 \sin^2 ax})$
437. $\int \frac{\cos ax}{\sqrt{1-b^2 \sin^2 ax}} dx = \frac{1}{ab} \sin^{-1}(b \sin ax)$
438. $\int (\cos ax) \sqrt{1+b^2 \sin^2 ax} dx = \frac{\sin ax}{2a} \sqrt{1+b^2 \sin^2 ax} + \frac{1}{2ab} \log(b \sin ax + \sqrt{1+b^2 \sin^2 ax})$
439. $\int (\cos ax) \sqrt{1-b^2 \sin^2 ax} dx = \frac{\sin ax}{2a} \sqrt{1-b^2 \sin^2 ax} + \frac{1}{2ab} \sin^{-1}(b \sin ax)$
440. $\int \frac{dx}{\sqrt{a+b \tan^2 cx}} = \frac{\pm 1}{c\sqrt{a-b}} \sin^{-1} \left(\sqrt{\frac{a-b}{a}} \sin cx \right), \quad (a > |b|)$
 [use + if $(2k-1)\frac{\pi}{2} < x \leq (2k+1)\frac{\pi}{2}$, otherwise -; k an integer]

FORMS INVOLVING INVERSE TRIGONOMETRIC FUNCTIONS

441. $\int (\sin^{-1} ax) dx = x \sin^{-1} ax + \frac{\sqrt{1-a^2 x^2}}{a}$
442. $\int (\cos^{-1} ax) dx = x \cos^{-1} ax - \frac{\sqrt{1-a^2 x^2}}{a}$
443. $\int (\tan^{-1} ax) dx = x \tan^{-1} ax - \frac{1}{2a} \log(1+a^2 x^2)$
444. $\int (\cot^{-1} ax) dx = x \cot^{-1} ax + \frac{1}{2a} \log(1+a^2 x^2)$
445. $\int (\sec^{-1} ax) dx = x \sec^{-1} ax - \frac{1}{a} \log(ax + \sqrt{a^2 x^2 - 1})$
446. $\int (\csc^{-1} ax) dx = x \csc^{-1} ax + \frac{1}{a} \log(ax + \sqrt{a^2 x^2 - 1})$
447. $\int \left(\sin^{-1} \frac{x}{a} \right) dx = x \sin^{-1} \frac{x}{a} + \sqrt{a^2 - x^2}, \quad (a > 0)$
448. $\int \left(\cos^{-1} \frac{x}{a} \right) dx = x \cos^{-1} \frac{x}{a} - \sqrt{a^2 - x^2}, \quad (a > 0)$

INTEGRALS (Continued)

$$449. \int \left(\tan^{-1} \frac{x}{a} \right) dx = x \tan^{-1} \frac{x}{a} - \frac{a}{2} \log(a^2 + x^2)$$

$$450. \int \left(\cot^{-1} \frac{x}{a} \right) dx = x \cot^{-1} \frac{x}{a} + \frac{a}{2} \log(a^2 + x^2)$$

$$451. \int x [\sin^{-1}(ax)] dx = \frac{1}{4a^2} [(2a^2x^2 - 1) \sin^{-1}(ax) + ax \sqrt{1 - a^2x^2}]$$

$$452. \int x [\cos^{-1}(ax)] dx = \frac{1}{4a^2} [(2a^2x^2 - 1) \cos^{-1}(ax) - ax \sqrt{1 - a^2x^2}]$$

$$453. \int x^n [\sin^{-1}(ax)] dx = \frac{x^{n+1}}{n+1} \sin^{-1}(ax) - \frac{a}{n+1} \int \frac{x^{n+1} dx}{\sqrt{1 - a^2x^2}}, \quad (n \neq -1)$$

$$454. \int x^n [\cos^{-1}(ax)] dx = \frac{x^{n+1}}{n+1} \cos^{-1}(ax) + \frac{a}{n+1} \int \frac{x^{n+1} dx}{\sqrt{1 - a^2x^2}}, \quad (n \neq -1)$$

$$455. \int x(\tan^{-1} ax) dx = \frac{1 + a^2x^2}{2a^2} \tan^{-1} ax - \frac{x}{2a}$$

$$456. \int x^n(\tan^{-1} ax) dx = \frac{x^{n+1}}{n+1} \tan^{-1} ax - \frac{a}{n+1} \int \frac{x^{n+1}}{1 + a^2x^2} dx$$

$$457. \int x(\cot^{-1} ax) dx = \frac{1 + a^2x^2}{2a^2} \cot^{-1} ax + \frac{x}{2a}$$

$$458. \int x^n(\cot^{-1} ax) dx = \frac{x^{n+1}}{n+1} \cot^{-1} ax + \frac{a}{n+1} \int \frac{x^{n+1}}{1 + a^2x^2} dx$$

$$459. \int \frac{\sin^{-1}(ax)}{x^2} dx = a \log \left(\frac{1 - \sqrt{1 - a^2x^2}}{x} \right) - \frac{\sin^{-1}(ax)}{x}$$

$$460. \int \frac{\cos^{-1}(ax)}{x^2} dx = -\frac{1}{x} \cos^{-1}(ax) + a \log \frac{1 + \sqrt{1 - a^2x^2}}{x}$$

$$461. \int \frac{\tan^{-1}(ax)}{x^2} dx = -\frac{1}{x} \tan^{-1}(ax) - \frac{a}{2} \log \frac{1 + a^2x^2}{x^2}$$

$$462. \int \frac{\cot^{-1} ax}{x^2} dx = -\frac{1}{x} \cot^{-1} ax - \frac{a}{2} \log \frac{x^2}{a^2x^2 + 1}$$

$$463. \int (\sin^{-1} ax)^2 dx = x(\sin^{-1} ax)^2 - 2x + \frac{2\sqrt{1 - a^2x^2}}{a} \sin^{-1} ax$$

$$464. \int (\cos^{-1} ax)^2 dx = x(\cos^{-1} ax)^2 - 2x - \frac{2\sqrt{1 - a^2x^2}}{a} \cos^{-1} ax$$

$$465. \int (\sin^{-1} ax)^n dx = \begin{cases} x(\sin^{-1} ax)^n + \frac{n\sqrt{1 - a^2x^2}}{a} (\sin^{-1} ax)^{n-1} - n(n-1) \int (\sin^{-1} ax)^{n-2} dx \\ \text{or} \\ \sum_{r=0}^{[n/2]} (-1)^r \frac{n!}{(n-2r)!} x(\sin^{-1} ax)^{n-2r} \\ \quad + \sum_{r=0}^{[(n-1)/2]} (-1)^r \frac{n! \sqrt{1 - a^2x^2}}{(n-2r-1)! a} (\sin^{-1} ax)^{n-2r-1} \end{cases}$$

Note: $[s]$ means greatest integer $\leq s$. Thus $[3.5]$ means 3; $[5] = 5$, $[\frac{5}{2}] = 0$.

INTEGRALS (Continued)

$$466. \int (\cos^{-1} ax)^n dx = \begin{cases} x(\cos^{-1} ax)^n - \frac{n\sqrt{1-a^2x^2}}{a}(\cos^{-1} ax)^{n-1} - n(n-1) \int (\cos^{-1} ax)^{n-2} dx \\ \text{or} \\ \sum_{r=0}^{\lfloor n/2 \rfloor} (-1)^r \frac{n!}{(n-2r)!} x(\cos^{-1} ax)^{n-2r} \\ \sum_{r=0}^{\lfloor (n-1)/2 \rfloor} (-1)^r \frac{n!\sqrt{1-a^2x^2}}{(n-2r-1)!a} (\cos^{-1} ax)^{n-2r-1} \end{cases}$$

$$467. \int \frac{1}{\sqrt{1-a^2x^2}} (\sin^{-1} ax) dx = \frac{1}{2a} (\sin^{-1} ax)^2$$

$$468. \int \frac{x^n}{\sqrt{1-a^2x^2}} (\sin^{-1} ax) dx = -\frac{x^{n-1}}{na^2} \sqrt{1-a^2x^2} \sin^{-1} ax + \frac{x^n}{n^2a} + \frac{n-1}{na^2} \int \frac{x^{n-2}}{\sqrt{1-a^2x^2}} \sin^{-1} ax dx$$

$$469. \int \frac{1}{\sqrt{1-a^2x^2}} (\cos^{-1} ax) dx = -\frac{1}{2a} (\cos^{-1} ax)^2$$

$$470. \int \frac{x^n}{\sqrt{1-a^2x^2}} (\cos^{-1} ax) dx = -\frac{x^{n-1}}{na^2} \sqrt{1-a^2x^2} \cos^{-1} ax - \frac{x^n}{n^2a} + \frac{n-1}{na^2} \int \frac{x^{n-2}}{\sqrt{1-a^2x^2}} \cos^{-1} ax dx$$

$$471. \int \frac{\tan^{-1} ax}{a^2x^2+1} dx = \frac{1}{2a} (\tan^{-1} ax)^2$$

$$472. \int \frac{\cot^{-1} ax}{a^2x^2+1} dx = -\frac{1}{2a} (\cot^{-1} ax)^2$$

$$473. \int x \sec^{-1} ax dx = \frac{x^2}{2} \sec^{-1} ax - \frac{1}{2a^2} \sqrt{a^2x^2-1}$$

$$474. \int x^n \sec^{-1} ax dx = \frac{x^{n+1}}{n+1} \sec^{-1} ax - \frac{1}{n+1} \int \frac{x^n dx}{\sqrt{a^2x^2-1}}$$

$$475. \int \frac{\sec^{-1} ax}{x^2} dx = -\frac{\sec^{-1} ax}{x} + \frac{\sqrt{a^2x^2-1}}{x}$$

$$476. \int x \csc^{-1} ax dx = \frac{x^2}{2} \csc^{-1} ax + \frac{1}{2a^2} \sqrt{a^2x^2-1}$$

$$477. \int x^n \csc^{-1} ax dx = \frac{x^{n+1}}{n+1} \csc^{-1} ax + \frac{1}{n+1} \int \frac{x^n dx}{\sqrt{a^2x^2-1}}$$

$$478. \int \frac{\csc^{-1} ax}{x^2} dx = -\frac{\csc^{-1} ax}{x} - \frac{\sqrt{a^2x^2-1}}{x}$$

FORMS INVOLVING TRIGONOMETRIC SUBSTITUTIONS

$$479. \int f(\sin x) dx = 2 \int f\left(\frac{2z}{1+z^2}\right) \frac{dz}{1+z^2}, \quad \left(z = \tan \frac{x}{2}\right)$$

$$480. \int f(\cos x) dx = 2 \int f\left(\frac{1-z^2}{1+z^2}\right) \frac{dz}{1+z^2}, \quad \left(z = \tan \frac{x}{2}\right)$$

INTEGRALS (Continued)

$$*481. \int f(\sin x) dx = \int f(u) \frac{du}{\sqrt{1-u^2}}, \quad (u = \sin x)$$

$$*482. \int f(\cos x) dx = - \int f(u) \frac{du}{\sqrt{1-u^2}}, \quad (u = \cos x)$$

$$*483. \int f(\sin x, \cos x) dx = \int f(u, \sqrt{1-u^2}) \frac{du}{\sqrt{1-u^2}}, \quad (u = \sin x)$$

$$484. \int f(\sin x, \cos x) dx = 2 \int f\left(\frac{2z}{1+z^2}, \frac{1-z^2}{1+z^2}\right) \frac{dz}{1+z^2}, \quad \left(z = \tan \frac{x}{2}\right)$$

LOGARITHMIC FORMS

$$485. \int (\log x) dx = x \log x - x$$

$$486. \int x(\log x) dx = \frac{x^2}{2} \log x - \frac{x^2}{4}$$

$$487. \int x^2(\log x) dx = \frac{x^3}{3} \log x - \frac{x^3}{9}$$

$$488. \int x^n(\log ax) dx = \frac{x^{n+1}}{n+1} \log ax - \frac{x^{n+1}}{(n+1)^2}$$

$$489. \int (\log x)^2 dx = x(\log x)^2 - 2x \log x + 2x$$

$$490. \int (\log x)^n dx = \begin{cases} x(\log x)^n - n \int (\log x)^{n-1} dx, & (n \neq -1) \\ \text{or} \\ (-1)^n n! x \sum_{r=0}^n \frac{(-\log x)^r}{r!} \end{cases}$$

$$491. \int \frac{(\log x)^n}{x} dx = \frac{1}{n+1} (\log x)^{n+1}$$

$$492. \int \frac{dx}{\log x} = \log(\log x) + \log x + \frac{(\log x)^2}{2 \cdot 2!} + \frac{(\log x)^3}{3 \cdot 3!} + \dots$$

$$493. \int \frac{dx}{x \log x} = \log(\log x)$$

$$494. \int \frac{dx}{x(\log x)^n} = -\frac{1}{(n-1)(\log x)^{n-1}}$$

$$495. \int \frac{x^m dx}{(\log x)^n} = -\frac{x^{m+1}}{(n-1)(\log x)^{n-1}} + \frac{m+1}{n-1} \int \frac{x^m dx}{(\log x)^{n-1}}$$

$$496. \int x^m (\log x)^n dx = \begin{cases} \frac{x^{m+1} (\log x)^n}{m+1} - \frac{n}{m+1} \int x^m (\log x)^{n-1} dx \\ \text{or} \\ (-1)^n \frac{n!}{m+1} x^{m+1} \sum_{r=0}^n \frac{(-\log x)^r}{r!(m+1)^{n-r}} \end{cases}$$

$$497. \int x^p \cos(b \ln x) dx = \frac{x^{p+1}}{(p+1)^2 + b^2} \cdot [b \sin(b \ln x) + (p+1) \cos(b \ln x)] + c$$

$$498. \int x^p \sin(b \ln x) dx = \frac{x^{p+1}}{(p+1)^2 + b^2} \cdot [(p+1) \sin(b \ln x) - b \cos(b \ln x)] + c$$

$$499. \int [\log(ax+b)] dx = \frac{ax+b}{a} \log(ax+b) - x$$

* The square roots appearing in these formulas may be plus or minus, depending on the quadrant of x . Care must be used to give them the proper sign.

INTEGRALS (Continued)

$$500. \int \frac{\log(ax+b)}{x^2} dx = \frac{a}{b} \log x - \frac{ax+b}{bx} \log(ax+b)$$

$$501. \int x^m [\log(ax+b)] dx = \frac{1}{m+1} \left[x^{m+1} - \left(-\frac{b}{a}\right)^{m+1} \right] \log(ax+b) \\ - \frac{1}{m+1} \left(-\frac{b}{a}\right)^{m+1} \sum_{r=1}^{m+1} \frac{1}{r} \left(-\frac{ax}{b}\right)^r$$

$$502. \int \frac{\log(ax+b)}{x^m} dx = -\frac{1}{m-1} \frac{\log(ax+b)}{x^{m-1}} + \frac{1}{m-1} \left(-\frac{a}{b}\right)^{m-1} \log \frac{ax+b}{x} \\ + \frac{1}{m-1} \left(-\frac{a}{b}\right)^{m-1} \sum_{r=1}^{m-2} \frac{1}{r} \left(-\frac{b}{ax}\right)^r, \quad (m > 2)$$

$$503. \int \left[\log \frac{x+a}{x-a} \right] dx = (x+a) \log(x+a) - (x-a) \log(x-a)$$

$$504. \int x^m \left[\log \frac{x+a}{x-a} \right] dx = \frac{x^{m+1} - (-a)^{m+1}}{m+1} \log(x+a) - \frac{x^{m+1} - a^{m+1}}{m+1} \log(x-a) \\ + \frac{2a^{m+1} \sum_{r=1}^{[(m+1)/2]} 1}{m+1} \frac{1}{m-2r+2} \left(\frac{x}{a}\right)^{m-2r+2}$$

See note integral 392.

$$505. \int \frac{1}{x^2} \left[\log \frac{x+a}{x-a} \right] dx = \frac{1}{x} \log \frac{x-a}{x+a} - \frac{1}{a} \log \frac{x^2-a^2}{x^2}$$

$$506. \int (\log X) dx = \begin{cases} \left(x + \frac{b}{2c}\right) \log X - 2x + \frac{\sqrt{4ac-b^2}}{c} \tan^{-1} \frac{2cx+b}{\sqrt{4ac-b^2}}, & (b^2-4ac < 0) \\ \text{or} \\ \left(x + \frac{b}{2c}\right) \log X - 2x + \frac{\sqrt{b^2-4ac}}{c} \tanh^{-1} \frac{2cx+b}{\sqrt{b^2-4ac}}, & (b^2-4ac > 0) \\ \text{where} \\ X = a + bx + cx^2 \end{cases}$$

$$507. \int x^n (\log X) dx = \frac{x^{n+1}}{n+1} \log X - \frac{2c}{n+1} \int \frac{x^{n+2}}{X} dx - \frac{b}{n+1} \int \frac{x^{n+1}}{X} dx \\ \text{where } X = a + bx + cx^2$$

$$508. \int [\log(x^2+a^2)] dx = x \log(x^2+a^2) - 2x + 2a \tan^{-1} \frac{x}{a}$$

$$509. \int [\log(x^2-a^2)] dx = x \log(x^2-a^2) - 2x + a \log \frac{x+a}{x-a}$$

$$510. \int x [\log(x^2 \pm a^2)] dx = \frac{1}{2}(x^2 \pm a^2) \log(x^2 \pm a^2) - \frac{1}{2}x^2$$

$$511. \int [\log(x + \sqrt{x^2 \pm a^2})] dx = x \log(x + \sqrt{x^2 \pm a^2}) - \sqrt{x^2 \pm a^2}$$

$$512. \int x [\log(x + \sqrt{x^2 \pm a^2})] dx = \left(\frac{x^2}{2} \pm \frac{a^2}{4}\right) \log(x + \sqrt{x^2 \pm a^2}) - \frac{x\sqrt{x^2 \pm a^2}}{4}$$

$$513. \int x^m [\log(x + \sqrt{x^2 \pm a^2})] dx = \frac{x^{m+1}}{m+1} \log(x + \sqrt{x^2 \pm a^2}) - \frac{1}{m+1} \int \frac{x^{m+1}}{\sqrt{x^2 \pm a^2}} dx$$

INTEGRALS (Continued)

$$514. \int \frac{\log(x + \sqrt{x^2 + a^2})}{x^2} dx = -\frac{\log(x + \sqrt{x^2 + a^2})}{x} - \frac{1}{a} \log \frac{a + \sqrt{x^2 + a^2}}{x}$$

$$515. \int \frac{\log(x + \sqrt{x^2 - a^2})}{x^2} dx = -\frac{\log(x + \sqrt{x^2 - a^2})}{x} + \frac{1}{|a|} \sec^{-1} \frac{x}{a}$$

$$516. \int x^n \log(x^2 - a^2) dx = \frac{1}{n+1} \left[x^{n+1} \log(x^2 - a^2) - a^{n+1} \log(x - a) \right. \\ \left. - (-a)^{n+1} \log(x + a) - 2 \sum_{r=0}^{[n/2]} \frac{a^{2r} x^{n-2r+1}}{n-2r+1} \right]$$

See note integral 392.

EXPONENTIAL FORMS

$$517. \int e^x dx = e^x$$

$$518. \int e^{-x} dx = -e^{-x}$$

$$519. \int e^{ax} dx = \frac{e^{ax}}{a}$$

$$520. \int x e^{ax} dx = \frac{e^{ax}}{a^2} (ax - 1)$$

$$521. \int x^m e^{ax} dx = \begin{cases} \frac{x^m e^{ax}}{a} - \frac{m}{a} \int x^{m-1} e^{ax} dx \\ \text{or} \\ e^{ax} \sum_{r=0}^m (-1)^r \frac{m! x^{m-r}}{(m-r)! a^{r+1}} \end{cases}$$

$$522. \int \frac{e^{ax}}{x} dx = \log x + \frac{ax}{1!} + \frac{a^2 x^2}{2 \cdot 2!} + \frac{a^3 + x^3}{3 \cdot 3!} + \dots$$

$$523. \int \frac{e^{ax}}{x^m} dx = -\frac{1}{m-1} \frac{e^{ax}}{x^{m-1}} + \frac{a}{m-1} \int \frac{e^{ax}}{x^{m-1}} dx$$

$$524. \int e^{ax} \log x dx = \frac{e^{ax} \log x}{a} - \frac{1}{a} \int \frac{e^{ax}}{x} dx$$

$$525. \int \frac{dx}{1 + e^x} = x - \log(1 + e^x) = \log \frac{e^x}{1 + e^x}$$

$$526. \int \frac{dx}{a + be^{px}} = \frac{x}{a} - \frac{1}{ap} \log(a + be^{px})$$

$$527. \int \frac{dx}{ae^{mx} + be^{-mx}} = \frac{1}{m\sqrt{ab}} \tan^{-1} \left(e^{mx} \sqrt{\frac{a}{b}} \right), \quad (a > 0, b > 0)$$

$$528. \int \frac{dx}{ae^{mx} - be^{-mx}} = \begin{cases} \frac{1}{2m\sqrt{ab}} \log \frac{\sqrt{a} e^{mx} - \sqrt{b}}{\sqrt{a} e^{mx} + \sqrt{b}} \\ \text{or} \\ \frac{-1}{m\sqrt{ab}} \tanh^{-1} \left(\sqrt{\frac{a}{b}} e^{mx} \right), \quad (a > 0, b > 0) \end{cases}$$

$$529. \int (a^x - a^{-x}) dx = \frac{a^x + a^{-x}}{\log a}$$

$$530. \int \frac{e^{ax}}{b + ce^{ax}} dx = \frac{1}{ac} \log(b + ce^{ax})$$

$$531. \int \frac{x e^{ax}}{(1 + ax)^2} dx = \frac{e^{ax}}{a^2(1 + ax)}$$

INTEGRALS (Continued)

$$532. \int x e^{-x^2} dx = -\frac{1}{2}e^{-x^2}$$

$$533. \int e^{ax}[\sin(bx)] dx = \frac{e^{ax}[a \sin(bx) - b \cos(bx)]}{a^2 + b^2}$$

$$534. \int e^{ax}[\sin(bx)][\sin(cx)] dx = \frac{e^{ax}[(b-c) \sin(b-c)x + a \cos(b-c)x]}{2[a^2 + (b-c)^2]} - \frac{e^{ax}[(b+c) \sin(b+c)x + a \cos(b+c)x]}{2[a^2 + (b+c)^2]}$$

$$535. \int e^{ax}[\sin(bx)][\cos(cx)] dx = \begin{cases} \frac{e^{ax}[a \sin(b-c)x - (b-c) \cos(b-c)x]}{2[a^2 + (b-c)^2]} \\ + \frac{e^{ax}[a \sin(b+c)x - (b+c) \cos(b+c)x]}{2[a^2 + (b+c)^2]} \\ \text{or} \\ \frac{e^{ax}}{\rho} [(a \sin bx - b \cos bx) \cos(cx - \alpha) \\ - c(\sin bx) \sin(cx - \alpha)] \\ \text{where} \\ \rho = \sqrt{(a^2 + b^2 - c^2)^2 + 4a^2c^2}, \\ \rho \cos \alpha = a^2 + b^2 - c^2, \quad \rho \sin \alpha = 2ac \end{cases}$$

$$536. \int e^{ax}[\sin(bx)][\sin(bx+c)] dx = \frac{e^{ax} \cos c}{2a} - \frac{e^{ax}[a \cos(2bx+c) + 2b \sin(2bx+c)]}{2(a^2 + 4b^2)}$$

$$537. \int e^{ax}[\sin(bx)][\cos(bx+c)] dx = \frac{-e^{ax} \sin c}{2a} + \frac{e^{ax}[a \sin(2bx+c) - 2b \cos(2bx+c)]}{2(a^2 + 4b^2)}$$

$$538. \int e^{ax}[\cos(bx)] dx = \frac{e^{ax}}{a^2 + b^2} [a \cos(bx) + b \sin(bx)]$$

$$539. \int e^{ax}[\cos(bx)][\cos(cx)] dx = \frac{e^{ax}[(b-c) \sin(b-c)x + a \cos(b-c)x]}{2[a^2 + (b-c)^2]} + \frac{e^{ax}[(b+c) \sin(b+c)x + a \cos(b+c)x]}{2[a^2 + (b+c)^2]}$$

$$540. \int e^{ax}[\cos(bx)][\cos(bx+c)] dx = \frac{e^{ax} \cos c}{2a} + \frac{e^{ax}[a \cos(2bx+c) + 2b \sin(2bx+c)]}{2(a^2 + 4b^2)}$$

$$541. \int e^{ax}[\cos(bx)][\sin(bx+c)] dx = \frac{e^{ax} \sin c}{2a} + \frac{e^{ax}[a \sin(2bx+c) - 2b \cos(2bx+c)]}{2(a^2 + 4b^2)}$$

$$542. \int e^{ax}[\sin^n bx] dx = \frac{1}{a^2 + n^2b^2} \left[(a \sin bx - nb \cos bx) e^{ax} \sin^{n-1} bx + n(n-1)b^2 \int e^{ax}[\sin^{n-2} bx] dx \right]$$

$$543. \int e^{ax}[\cos^n bx] dx = \frac{1}{a^2 + n^2b^2} \left[(a \cos bx + nb \sin bx) e^{ax} \cos^{n-1} bx + n(n-1)b^2 \int e^{ax}[\cos^{n-2} bx] dx \right]$$

INTEGRALS (Continued)

$$\begin{aligned}
 544. \int x^m e^x \sin x \, dx &= \frac{1}{2} x^m e^x (\sin x - \cos x) \\
 &\quad - \frac{m}{2} \int x^{m-1} e^x \sin x \, dx + \frac{m}{2} \int x^{m-1} e^x \cos x \, dx
 \end{aligned}$$

$$545. \int x^m e^{ax} [\sin bx] \, dx = \begin{cases} x^m e^{ax} \frac{a \sin bx - b \cos bx}{a^2 + b^2} \\
 - \frac{m}{a^2 + b^2} \int x^{m-1} e^{ax} (a \sin bx - b \cos bx) \, dx \\
 \text{or} \\
 e^{ax} \sum_{r=0}^m \frac{(-1)^r m! x^{m-r}}{\rho^{r+1} (m-r)!} \sin[bx - (r+1)\alpha] \\
 \text{where} \\
 \rho = \sqrt{a^2 + b^2}, \quad \rho \cos \alpha = a, \quad \rho \sin \alpha = b \end{cases}$$

$$\begin{aligned}
 546. \int x^m e^x \cos x \, dx &= \frac{1}{2} x^m e^x (\sin x + \cos x) \\
 &\quad - \frac{m}{2} \int x^{m-1} e^x \sin x \, dx - \frac{m}{2} \int x^{m-1} e^x \cos x \, dx
 \end{aligned}$$

$$547. \int x^m e^{ax} \cos bx \, dx = \begin{cases} x^m e^{ax} \frac{a \cos bx + b \sin bx}{a^2 + b^2} \\
 - \frac{m}{a^2 + b^2} \int x^{m-1} e^{ax} (a \cos bx + b \sin bx) \, dx \\
 \text{or} \\
 e^{ax} \sum_{r=0}^m \frac{(-1)^r m! x^{m-r}}{\rho^{r+1} (m-r)!} \cos[bx - (r+1)\alpha] \\
 \rho = \sqrt{a^2 + b^2}, \quad \rho \cos \alpha = a, \quad \rho \sin \alpha = b \end{cases}$$

INTEGRALS (Continued)

$$\begin{aligned}
 548. \int e^{ax}(\cos^m x)(\sin^n x) dx = & \left\{ \begin{aligned} & \frac{e^{ax} \cos^{m-1} x \sin^n x [a \cos x + (m+n) \sin x]}{(m+n)^2 + a^2} \\ & - \frac{na}{(m+n)^2 + a^2} \int e^{ax}(\cos^{m-1} x)(\sin^{n-1} x) dx \\ & + \frac{(m-1)(m+n)}{(m+n)^2 + a^2} \int e^{ax}(\cos^{m-2} x)(\sin^n x) dx \\ & \text{or} \\ & \frac{e^{ax} \cos^m x [\sin^{n-1} x [a \sin x - (m+n) \cos x]}{(m+n)^2 + a^2} \\ & + \frac{ma}{(m+n)^2 + a^2} \int e^{ax}(\cos^{m-1} x)(\sin^{n-1} x) dx \\ & + \frac{(n-1)(m+n)}{(m+n)^2 + a^2} \int e^{ax}(\cos^m x)(\sin^{n-2} x) dx \\ & \text{or} \\ & \frac{e^{ax}(\cos^{m-1} x)(\sin^{n-1} x)(a \sin x \cos x + m \sin^2 x - n \cos^2 x)}{(m+n)^2 + a^2} \\ & + \frac{m(m-1)}{(m+n)^2 + a^2} \int e^{ax}(\cos^{m-2} x)(\sin^n x) dx \\ & + \frac{n(n-1)}{(m+n)^2 + a^2} \int e^{ax}(\cos^m x)(\sin^{n-2} x) dx \\ & \text{or} \\ & \frac{e^{ax}(\cos^{m-1} x)(\sin^{n-1} x)(a \cos x \sin x + m \sin^2 x - n \cos^2 x)}{(m+n)^2 + a^2} \\ & + \frac{m(m-1)}{(m+n)^2 + a^2} \int e^{ax}(\cos^{m-2} x)(\sin^{n-2} x) dx \\ & + \frac{(n-m)(n+m-1)}{(m+n)^2 + a^2} \int e^{ax}(\cos^m x)(\sin^{n-2} x) dx \end{aligned} \right.
 \end{aligned}$$

$$549. \int x e^{ax}(\sin bx) dx = \frac{x e^{ax}}{a^2 + b^2} (a \sin bx - b \cos bx) - \frac{e^{ax}}{(a^2 + b^2)^2} [(a^2 - b^2) \sin bx - 2ab \cos bx]$$

$$550. \int x e^{ax}(\cos bx) dx = \frac{x e^{ax}}{a^2 + b^2} (a \cos bx + b \sin bx) - \frac{e^{ax}}{(a^2 + b^2)^2} [(a^2 - b^2) \cos bx + 2ab \sin bx]$$

$$551. \int \frac{e^{ax}}{\sin^n x} dx = -\frac{e^{ax}[a \sin x + (n-2) \cos x]}{(n-1)(n-2) \sin^{n-1} x} + \frac{a^2 + (n-2)^2}{(n-1)(n-2)} \int \frac{e^{ax}}{\sin^{n-2} x} dx$$

$$552. \int \frac{e^{ax}}{\cos^n x} dx = -\frac{e^{ax}[a \cos x - (n-2) \sin x]}{(n-1)(n-2) \cos^{n-1} x} + \frac{a^2 + (n-2)^2}{(n-1)(n-2)} \int \frac{e^{ax}}{\cos^{n-2} x} dx$$

$$553. \int e^{ax} \tan^n x dx = e^{ax} \frac{\tan^{n-1} x}{n-1} - \frac{a}{n-1} \int e^{ax} \tan^{n-1} x dx - \int e^{ax} \tan^{n-2} x dx$$

HYPERBOLIC FORMS

$$554. \int (\sinh x) dx = \cosh x$$

$$555. \int (\cosh x) dx = \sinh x$$

INTEGRALS (Continued)

$$556. \int (\tanh x) dx = \log \cosh x$$

$$557. \int (\coth x) dx = \log \sinh x$$

$$558. \int (\operatorname{sech} x) dx = \tan^{-1}(\sinh x)$$

$$559. \int (\operatorname{csch} x) dx = \log \tanh\left(\frac{x}{2}\right)$$

$$560. \int x(\sinh x) dx = x \cosh x - \sinh x$$

$$561. \int x^n(\sinh x) dx = x^n \cosh x - n \int x^{n-1}(\cosh x) dx$$

$$562. \int x(\cosh x) dx = x \sinh x - \cosh x$$

$$563. \int x^n(\cosh x) dx = x^n \sinh x - n \int x^{n-1}(\sinh x) dx$$

$$564. \int (\operatorname{sech} x)(\tanh x) dx = -\operatorname{sech} x$$

$$565. \int (\operatorname{csch} x)(\coth x) dx = -\operatorname{csch} x$$

$$566. \int (\sinh^2 x) dx = \frac{\sinh 2x}{4} - \frac{x}{2}$$

$$567. \int (\sinh^m x)(\cosh^n x) dx = \begin{cases} \frac{1}{m+n}(\sinh^{m+1} x)(\cosh^{n-1} x) \\ + \frac{n-1}{m+n} \int (\sinh^m x)(\cosh^{n-2} x) dx \\ \text{or} \\ \frac{1}{m+n} \sinh^{m-1} x \cosh^{n+1} x \\ - \frac{m-1}{m+n} \int (\sinh^{m-2} x)(\cosh^n x) dx, \quad (m+n \neq 0) \end{cases}$$

$$568. \int \frac{dx}{(\sinh^m x)(\cosh^n x)} \begin{cases} -\frac{1}{(m-n)(\sinh^{m-1} x)(\cosh^{n-1} x)} \\ -\frac{m+n-2}{m-1} \int \frac{dx}{(\sinh^{m-2} x)(\cosh^n x)}, \quad (m \neq 1) \\ \text{or} \\ \frac{1}{(n-1) \sinh^{m-1} x \cosh^{n-1} x} \\ + \frac{m+n-2}{n-1} \int \frac{dx}{(\sinh^m x)(\cosh^{n-2} x)}, \quad (n \neq 1) \end{cases}$$

$$569. \int (\tanh^2 x) dx = x - \tanh x$$

$$570. \int (\tanh^n x) dx = -\frac{\tanh^{n-1} x}{n-1} + \int (\tanh^{n-2} x) dx, \quad (n \neq 1)$$

$$571. \int (\operatorname{sech}^2 x) dx = \tanh x$$

$$572. \int (\cosh^2 x) dx = \frac{\sinh 2x}{4} + \frac{x}{2}$$

INTEGRALS (Continued)

573. $\int (\coth^2 x) dx = x - \coth x$
574. $\int (\coth^n x) dx = -\frac{\coth^{n-1} x}{n-1} + \int \coth^{n-2} x dx, \quad (n \neq 1)$
575. $\int (\operatorname{csch}^2 x) dx = -\operatorname{ctnh} x$
576. $\int (\sinh mx)(\sinh nx) dx = \frac{\sinh(m+n)x}{2(m+n)} - \frac{\sinh(m-n)x}{2(m-n)}, \quad (m^2 \neq n^2)$
577. $\int (\cosh mx)(\cosh nx) dx = \frac{\sinh(m+n)x}{2(m+n)} + \frac{\sinh(m-n)x}{2(m-n)}, \quad (m^2 \neq n^2)$
578. $\int (\sinh mx)(\cosh nx) dx = \frac{\cosh(m+n)x}{2(m+n)} + \frac{\cosh(m-n)x}{2(m-n)}, \quad (m^2 \neq n^2)$
579. $\int \left(\sinh^{-1} \frac{x}{a}\right) dx = x \sinh^{-1} \frac{x}{a} - \sqrt{x^2 + a^2}, \quad (a > 0)$
580. $\int x \left(\sinh^{-1} \frac{x}{a}\right) dx = \left(\frac{x^2}{2} + \frac{a^2}{4}\right) \sinh^{-1} \frac{x}{a} - \frac{x}{4} \sqrt{x^2 + a^2}, \quad (a > 0)$
581. $\int x^n (\sinh^{-1} x) dx = \left(\frac{x^{n+1}}{n+1}\right) \sinh^{-1} x - \frac{1}{n+1} \int \frac{x^{n+1}}{(1+x^2)^{1/2}} dx, \quad (n \neq -1)$
582. $\int \left(\cosh^{-1} \frac{x}{a}\right) dx = \begin{cases} x \cosh^{-1} \frac{x}{a} - \sqrt{x^2 - a^2}, & \left(\cosh^{-1} \frac{x}{a} > 0\right) \\ \text{or} \\ x \cosh^{-1} \frac{x}{a} + \sqrt{x^2 - a^2}, & \left(\cosh^{-1} \frac{x}{a} < 0\right), \end{cases} \quad (a > 0)$
583. $\int x \left(\cosh^{-1} \frac{x}{a}\right) dx = \frac{2x^2 - a^2}{4} \cosh^{-1} \frac{x}{a} - \frac{x}{4} (x^2 - a^2)^{\frac{1}{2}}$
584. $\int x^n (\cosh^{-1} x) dx = \frac{x^{n+1}}{n+1} \cosh^{-1} x - \frac{1}{n+1} \int \frac{x^{n+1}}{(x^2 - 1)^{1/2}} dx, \quad (n \neq -1)$
585. $\int \left(\tanh^{-1} \frac{x}{a}\right) dx = x \tanh^{-1} \frac{x}{a} + \frac{a}{2} \log(a^2 - x^2), \quad \left(\left|\frac{x}{a}\right| < 1\right)$
586. $\int \left(\coth^{-1} \frac{x}{a}\right) dx = x \coth^{-1} \frac{x}{a} + \frac{a}{2} \log(x^2 - a^2), \quad \left(\left|\frac{x}{a}\right| > 1\right)$
587. $\int x \left(\tanh^{-1} \frac{x}{a}\right) dx = \frac{x^2 - a^2}{2} \tanh^{-1} \frac{x}{a} + \frac{ax}{2}, \quad \left(\left|\frac{x}{a}\right| < 1\right)$
588. $\int x^n (\tanh^{-1} x) dx = \frac{x^{n+1}}{n+1} \tanh^{-1} x - \frac{1}{n+1} \int \frac{x^{n+1}}{1-x^2} dx, \quad (n \neq -1)$
589. $\int x \left(\coth^{-1} \frac{x}{a}\right) dx = \frac{x^2 - a^2}{2} \coth^{-1} \frac{x}{a} + \frac{ax}{2}, \quad \left(\left|\frac{x}{a}\right| > 1\right)$
590. $\int x^n (\coth^{-1} x) dx = \frac{x^{n+1}}{n+1} \coth^{-1} x + \frac{1}{n+1} \int \frac{x^{n+1}}{x^2 - 1} dx, \quad (n \neq -1)$
591. $\int (\operatorname{sech}^{-1} x) dx = x \operatorname{sech}^{-1} x + \sin^{-1} x$
592. $\int x \operatorname{sech}^{-1} x dx = \frac{x^2}{2} \operatorname{sech}^{-1} x - \frac{1}{2} \sqrt{1 - x^2}$
593. $\int x^n \operatorname{sech}^{-1} x dx = \frac{x^{n+1}}{n+1} \operatorname{sech}^{-1} x + \frac{1}{n+1} \int \frac{x^n}{(1-x^2)^{1/2}} dx, \quad (n \neq -1)$
594. $\int \operatorname{csch}^{-1} x dx = x \operatorname{csch}^{-1} x + \frac{x}{|x|} \sinh^{-1} x$

INTEGRALS (Continued)

$$595. \int x \operatorname{csch}^{-1} x \, dx = \frac{x^2}{2} \operatorname{csch}^{-1} x + \frac{1}{2} \frac{x}{|x|} \sqrt{1+x^2}$$

$$596. \int x^n \operatorname{csch}^{-1} x \, dx = \frac{x^{n+1}}{n+1} \operatorname{csch}^{-1} x + \frac{1}{n+1} \frac{x}{|x|} \int \frac{x^n}{(x^2+1)^{\frac{1}{2}}} dx, \quad (n \neq -1)$$

DEFINITE INTEGRALS

$$597. \int_0^\infty x^{n-1} e^{-x} dx = \int_0^1 \left(\log \frac{1}{x}\right)^{n-1} dx = \frac{1}{n} \prod_{m=1}^\infty \frac{\left(1 + \frac{1}{m}\right)^n}{1 + \frac{n}{m}}$$

= $\Gamma(n)$, $n \neq 0, -1, -2, -3, \dots$ (Gamma Function)

$$598. \int_0^\infty t^n p^{-t} dt = \frac{n!}{(\log p)^{n+1}}, \quad (n = 0, 1, 2, 3, \dots \text{ and } p > 0)$$

$$599. \int_0^\infty t^{n-1} e^{-(a+1)t} dt = \frac{\Gamma(n)}{(a+1)^n}, \quad (n > 0, a > -1)$$

$$600. \int_0^1 x^m \left(\log \frac{1}{x}\right)^n dx = \frac{\Gamma(n+1)}{(m+1)^{n+1}}, \quad (m > -1, n > -1)$$

601. $\Gamma(n)$ is finite if $n > 0$, $\Gamma(n+1) = n\Gamma(n)$

602. $\Gamma(n) \cdot \Gamma(1-n) = \frac{\pi}{\sin n\pi}$

603. $\Gamma(n) = (n-1)!$ if $n = \text{integer} > 0$

604. $\Gamma\left(\frac{1}{2}\right) = 2 \int_0^\infty e^{-t^2} dt = \sqrt{\pi} = 1.7724538509 \dots = \left(-\frac{1}{2}\right)!$

605. $\Gamma\left(n + \frac{1}{2}\right) = \frac{1 \cdot 3 \cdot 5 \dots (2n-1)}{2^n} \sqrt{\pi} \quad n = 1, 2, 3, \dots$

606. $\Gamma\left(-n + \frac{1}{2}\right) = \frac{(-1)^n 2^n \sqrt{\pi}}{1 \cdot 3 \cdot 5 \dots (2n-1)} \quad n = 1, 2, 3, \dots$

$$607. \int_0^1 x^{m-1} (1-x)^{n-1} dx = \int_0^\infty \frac{x^{m-1}}{(1+x)^{m+n}} dx = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)} = B(m, n)$$

(Beta function)

608. $B(m, n) = B(n, m) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$, where m and n are any positive real numbers.

$$609. \int_a^b (x-a)^m (b-x)^n dx = (b-a)^{m+n+1} \frac{\Gamma(m+1) \cdot \Gamma(n+1)}{\Gamma(m+n+2)}, \quad (m > -1, n > -1, b > a)$$

$$610. \int_1^\infty \frac{dx}{x^m} = \frac{1}{m-1}, \quad [m > 1]$$

$$611. \int_0^\infty \frac{dx}{(1+x)x^p} = \pi \csc p\pi, \quad [p < 1]$$

$$612. \int_0^\infty \frac{dx}{(1-x)x^p} = -\pi \cot p\pi, \quad [p < 1]$$

$$613. \int_0^\infty \frac{x^{p-1} dx}{(1+x)} = \frac{\pi}{\sin p\pi}$$

= $B(p, 1-p) = \Gamma(p)\Gamma(1-p)$, $[0 < p < 1]$

$$614. \int_0^\infty \frac{x^{m-1} dx}{1+x^n} = \frac{\pi}{n \sin \frac{m\pi}{n}}, \quad [0 < m < n]$$

DEFINITE INTEGRALS (Continued)

615.
$$\int_0^\infty \frac{x^a dx}{(m+x^b)^c} = \frac{m^{(a+1-bc)/b}}{b} \left[\frac{\Gamma\left(\frac{a+1}{b}\right)\Gamma\left(c-\frac{a+1}{b}\right)}{\Gamma(c)} \right]$$

 ($a > -1, b > 0, m > 0, c > \frac{a+1}{b}$)
616.
$$\int_0^\infty \frac{dx}{(1+x)\sqrt{x}} = \pi$$
617.
$$\int_0^\infty \frac{a dx}{a^2+x^2} = \frac{\pi}{2}, \quad \text{if } a > 0; 0, \text{ if } a = 0; -\frac{\pi}{2}, \text{ if } a < 0$$
618.
$$\int_0^a (a^2-x^2)^{n/2} dx = \frac{1}{2} \int_{-a}^a (a^2-x^2)^{n/2} dx = \frac{1 \cdot 3 \cdot 5 \dots n}{2 \cdot 4 \cdot 6 \dots (n+1)} \cdot \frac{\pi}{2} \cdot a^{n+1} \quad (n \text{ odd})$$
619.
$$\int_0^a x^m (a^2-x^2)^{n/2} dx = \begin{cases} \frac{1}{2} a^{m+n+1} B\left(\frac{m+1}{2}, \frac{n+2}{2}\right) \\ \text{or} \\ \frac{1}{2} a^{m+n+1} \frac{\Gamma\left(\frac{m+1}{2}\right)\Gamma\left(\frac{n+2}{2}\right)}{\Gamma\left(\frac{m+n+3}{2}\right)} \end{cases}$$
620.
$$\int_0^{\pi/2} (\sin^n x) dx = \begin{cases} \int_0^{\pi/2} (\cos^n x) dx \\ \text{or} \\ \frac{1 \cdot 3 \cdot 5 \cdot 7 \dots (n-1)\pi}{2 \cdot 4 \cdot 6 \cdot 8 \dots (n)} \cdot \frac{\pi}{2}, & (n \text{ an even integer, } n \neq 0) \\ \text{or} \\ \frac{2 \cdot 4 \cdot 6 \cdot 8 \dots (n-1)}{1 \cdot 3 \cdot 5 \cdot 7 \dots (n)}, & (n \text{ an odd integer, } n \neq 1) \\ \text{or} \\ \frac{\sqrt{\pi} \Gamma\left(\frac{n+1}{2}\right)}{2 \Gamma\left(\frac{n}{2}+1\right)}, & (n > -1) \end{cases}$$
621.
$$\int_0^\infty \frac{\sin mx dx}{x} = \frac{\pi}{2}, \quad \text{if } m > 0; 0, \text{ if } m = 0; -\frac{\pi}{2}, \text{ if } m < 0$$
622.
$$\int_0^\infty \frac{\cos x dx}{x} = \infty$$
623.
$$\int_0^\infty \frac{\tan x dx}{x} = \frac{\pi}{2}$$
624.
$$\int_0^\pi \sin ax \cdot \sin bx dx = \int_0^\pi \cos ax \cdot \cos bx dx = 0, \quad (a \neq b; a, b \text{ integers})$$
625.
$$\int_0^{\pi/a} [\sin(ax)][\cos(ax)] dx = \int_0^\pi [\sin(ax)][\cos(ax)] dx = 0$$
626.
$$\int_0^\pi [\sin(ax)][\cos(bx)] dx = \frac{2a}{a^2-b^2}, \text{ if } a-b \text{ is odd, or } 0 \text{ if } a-b \text{ is even}$$
627.
$$\int_0^\infty \frac{\sin x \cos mx dx}{x} = 0, \quad \text{if } m < -1 \text{ or } m > 1; \frac{\pi}{4}, \text{ if } m = \pm 1; \frac{\pi}{2}, \text{ if } m^2 < 1$$

DEFINITE INTEGRALS (Continued)

628. $\int_0^\infty \frac{\sin ax \sin bx}{x^2} dx = \frac{\pi a}{2}, \quad (a \leq b)$
629. $\int_0^\pi \sin^2 mx \, dx = \int_0^\pi \cos^2 mx \, dx = \frac{\pi}{2}$
630. $\int_0^\infty \frac{\sin^2(px)}{x^2} dx = \frac{\pi p}{2}$
631. $\int_0^\infty \frac{\sin x}{x^p} dx = \frac{\pi}{2\Gamma(p)\sin(p\pi/2)}, \quad 0 < p < 1$
632. $\int_0^\infty \frac{\cos x}{x^p} dx = \frac{\pi}{2\Gamma(p)\cos(p\pi/2)}, \quad 0 < p < 1$
633. $\int_0^\infty \frac{1 - \cos px}{x^2} dx = \frac{\pi p}{2}$
634. $\int_0^\infty \frac{\sin px \cos qx}{x} dx = \left\{ 0, q > p > 0; \frac{\pi}{2}, p > q > 0; \frac{\pi}{4}, p = q > 0 \right\}$
635. $\int_0^\infty \frac{\cos(mx)}{x^2 + a^2} dx = \frac{\pi}{2|a|} e^{-|ma|}$
636. $\int_0^\infty \cos(x^2) dx = \int_0^\infty \sin(x^2) dx = \frac{1}{2}\sqrt{\frac{\pi}{2}}$
637. $\int_0^\infty \sin ax^n dx = \frac{1}{na^{1/n}} \Gamma(1/n) \sin \frac{\pi}{2n}, \quad n > 1$
638. $\int_0^\infty \cos ax^n dx = \frac{1}{na^{1/n}} \Gamma(1/n) \cos \frac{\pi}{2n}, \quad n > 1$
639. $\int_0^\infty \frac{\sin x}{\sqrt{x}} dx = \int_0^\infty \frac{\cos x}{\sqrt{x}} dx = \sqrt{\frac{\pi}{2}}$
640. (a) $\int_0^\infty \frac{\sin^3 x}{x} dx = \frac{\pi}{4}$ (b) $\int_0^\infty \frac{\sin^3 x}{x^2} dx = \frac{3}{4} \log 3$
641. $\int_0^\infty \frac{\sin^3 x}{x^3} dx = \frac{3\pi}{8}$
642. $\int_0^\infty \frac{\sin^4 x}{x^4} dx = \frac{\pi}{3}$
643. $\int_0^{\pi/2} \frac{dx}{1 + a \cos x} = \frac{\cos^{-1} a}{\sqrt{1 - a^2}}, \quad (a < 1)$
644. $\int_0^\pi \frac{dx}{a + b \cos x} = \frac{\pi}{\sqrt{a^2 - b^2}}, \quad (a > b \geq 0)$
645. $\int_0^{2\pi} \frac{dx}{1 + a \cos x} = \frac{2\pi}{\sqrt{1 - a^2}}, \quad (a^2 < 1)$
646. $\int_0^\infty \frac{\cos ax - \cos bx}{x} dx = \log \frac{b}{a}$
647. $\int_0^{\pi/2} \frac{dx}{a^2 \sin^2 x + b^2 \cos^2 x} = \frac{\pi}{2ab}$
648. $\int_0^{\pi/2} \frac{dx}{(a^2 \sin^2 x + b^2 \cos^2 x)^2} = \frac{\pi(a^2 + b^2)}{4a^3 b^3}, \quad (a, b > 0)$
649. $\int_0^{\pi/2} \sin^{n-1} x \cos^{m-1} x \, dx = \frac{1}{2} B\left(\frac{n}{2}, \frac{m}{2}\right), \quad m \text{ and } n \text{ positive integers}$

DEFINITE INTEGRALS (Continued)

$$650. \int_0^{\pi/2} (\sin^{2n+1} \theta) d\theta = \frac{2 \cdot 4 \cdot 6 \dots (2n)}{1 \cdot 3 \cdot 5 \dots (2n+1)}, \quad (n = 1, 2, 3, \dots)$$

$$651. \int_0^{\pi/2} (\sin^{2n} \theta) d\theta = \frac{1 \cdot 3 \cdot 5 \dots (2n-1)}{2 \cdot 4 \dots (2n)} \left(\frac{\pi}{2}\right), \quad (n = 1, 2, 3, \dots)$$

$$652. \int_0^{\pi/2} \frac{x}{\sin x} dx = 2 \left\{ \frac{1}{1^2} - \frac{1}{3^2} + \frac{1}{5^2} - \frac{1}{7^2} + \dots \right\}$$

$$653. \int_0^{\pi/2} \frac{dx}{1 + \tan^m x} = \frac{\pi}{4}$$

$$654. \int_0^{\pi/2} \sqrt{\cos \theta} d\theta = \frac{(2\pi)^{\frac{3}{2}}}{[\Gamma(\frac{3}{4})]^2}$$

$$655. \int_0^{\pi/2} (\tan^h \theta) d\theta = \frac{\pi}{2 \cos\left(\frac{h\pi}{2}\right)}, \quad (0 < h < 1)$$

$$656. \int_0^{\infty} \frac{\tan^{-1}(ax) - \tan^{-1}(bx)}{x} dx = \frac{\pi}{2} \log \frac{a}{b}, \quad (a, b > 0)$$

657. The area enclosed by a curve defined through the equation $x^{\frac{a}{c}} + y^{\frac{b}{c}} = a^{\frac{b}{c}}$ where $a > 0$, c a positive odd integer and b a positive even integer is given by

$$\frac{[\Gamma(\frac{c}{b})]^2}{\Gamma(\frac{2c}{b})} \left(\frac{2ca^2}{b}\right)$$

658. $I = \iiint_R x^{h-1} y^{m-1} z^{n-1} dv$, where R denotes the region of space bounded by the

co-ordinate planes and that portion of the surface $\left(\frac{x}{a}\right)^p + \left(\frac{y}{b}\right)^q + \left(\frac{z}{c}\right)^k = 1$, which lies in the first octant and where $h, m, n, p, q, k, a, b, c$, denote positive real numbers is given by

$$\int_0^a x^{h-1} dx \int_0^{a^{1-(x/a)^p}] y^{m-1} dy \int_0^{a^{1-(x/a)^p-(y/b)^q}] z^{n-1} dz = \frac{a^h b^m c^n}{p q k} \frac{\Gamma\left(\frac{h}{p}\right) \Gamma\left(\frac{m}{q}\right) \Gamma\left(\frac{n}{k}\right)}{\Gamma\left(\frac{h}{p} + \frac{m}{q} + \frac{n}{k} + 1\right)}$$

$$659. \int_0^{\infty} e^{-ax} dx = \frac{1}{a}, \quad (a > 0)$$

$$660. \int_0^{\infty} \frac{e^{-ax} - e^{-bx}}{x} dx = \log \frac{b}{a}, \quad (a, b > 0)$$

$$661. \int_0^{\infty} x^n e^{-ax} dx = \begin{cases} \frac{\Gamma(n+1)}{a^{n+1}}, & (n > -1, a > 0) \\ \text{or} \\ \frac{n!}{a^{n+1}}, & (a > 0, n \text{ positive integer}) \end{cases}$$

$$662. \int_0^{\infty} x^n \exp(-ax^p) dx = \frac{\Gamma(k)}{pa^k}, \quad \left(n > -1, p > 0, a > 0, k = \frac{n+1}{p}\right)$$

$$663. \int_0^{\infty} e^{-a^2 x^2} dx = \frac{1}{2a} \sqrt{\pi} = \frac{1}{2a} \Gamma\left(\frac{1}{2}\right), \quad (a > 0)$$

$$664. \int_0^{\infty} x e^{-x^2} dx = \frac{1}{2}$$

DEFINITE INTEGRALS (Continued)

665. $\int_0^{\infty} x^2 e^{-x^2} dx = \frac{\sqrt{\pi}}{4}$
666. $\int_0^{\infty} x^{2n} e^{-ax^2} dx = \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{2^{n+1} a^n} \sqrt{\frac{\pi}{a}}$
667. $\int_0^{\infty} x^{2n+1} e^{-ax^2} dx = \frac{n!}{2a^{n+1}}, \quad (a > 0)$
668. $\int_0^1 x^m e^{-ax} dx = \frac{m!}{a^{m+1}} \left[1 - e^{-a} \sum_{r=0}^m \frac{a^r}{r!} \right]$
669. $\int_0^{\infty} e^{(-x^2 - a^2/x^2)} dx = \frac{e^{-2a} \sqrt{\pi}}{2}, \quad (a \geq 0)$
670. $\int_0^{\infty} e^{-nx} \sqrt{x} dx = \frac{1}{2n} \sqrt{\frac{\pi}{n}}$
671. $\int_0^{\infty} \frac{e^{-nx}}{\sqrt{x}} dx = \sqrt{\frac{\pi}{n}}$
672. $\int_0^{\infty} e^{-ax} (\cos mx) dx = \frac{a}{a^2 + m^2}, \quad (a > 0)$
673. $\int_0^{\infty} e^{-ax} (\sin mx) dx = \frac{m}{a^2 + m^2}, \quad (a > 0)$
674. $\int_0^{\infty} x e^{-ax} [\sin(bx)] dx = \frac{2ab}{(a^2 + b^2)^2}, \quad (a > 0)$
675. $\int_0^{\infty} x e^{-ax} [\cos(bx)] dx = \frac{a^2 - b^2}{(a^2 + b^2)^2}, \quad (a > 0)$
676. $\int_0^{\infty} x^n e^{-ax} [\sin(bx)] dx = \frac{n![(a+ib)^{n+1} - (a-ib)^{n+1}]}{2i(a^2 + b^2)^{n+1}}, \quad (i^2 = -1, a > 0)$
677. $\int_0^{\infty} x^n e^{-ax} [\cos(bx)] dx = \frac{n![(a-ib)^{n+1} + (a+ib)^{n+1}]}{2(a^2 + b^2)^{n+1}}, \quad (i^2 = -1, a > 0)$
678. $\int_0^{\infty} \frac{e^{-ax} \sin x}{x} dx = \cot^{-1} a, \quad (a > 0)$
679. $\int_0^{\infty} e^{-a^2 x^2} \cos bx dx = \frac{\sqrt{\pi}}{2a} \exp\left(-\frac{b^2}{4a^2}\right), \quad (ab \neq 0)$
680. $\int_0^{\infty} e^{-t \cos \phi} t^{b-1} [\sin(t \sin \phi)] dt = [\Gamma(b)] \sin(b\phi), \quad \left(b > 0, -\frac{\pi}{2} < \phi < \frac{\pi}{2}\right)$
681. $\int_0^{\infty} e^{-t \cos \phi} t^{b-1} [\cos(t \sin \phi)] dt = [\Gamma(b)] \cos(b\phi), \quad \left(b > 0, -\frac{\pi}{2} < \phi < \frac{\pi}{2}\right)$
682. $\int_0^{\infty} t^{b-1} \cos t dt = [\Gamma(b)] \cos\left(\frac{b\pi}{2}\right), \quad (0 < b < 1)$
683. $\int_0^{\infty} t^{b-1} (\sin t) dt = [\Gamma(b)] \sin\left(\frac{b\pi}{2}\right), \quad (0 < b < 1)$
684. $\int_0^1 (\log x)^n dx = (-1)^n \cdot n!$
685. $\int_0^1 \left(\log \frac{1}{x}\right)^{\frac{1}{2}} dx = \frac{\sqrt{\pi}}{2}$
686. $\int_0^1 \left(\log \frac{1}{x}\right)^{-\frac{1}{2}} dx = \sqrt{\pi}$

DEFINITE INTEGRALS (Continued)

687. $\int_0^1 \left(\log \frac{1}{x}\right)^n dx = n!$
688. $\int_0^1 x \log(1-x) dx = -\frac{3}{4}$
689. $\int_0^1 x \log(1+x) dx = \frac{1}{4}$
690. $\int_0^1 x^m (\log x)^n dx = \frac{(-1)^n n!}{(m+1)^{n+1}}, \quad m > -1, n = 0, 1, 2, \dots$
 If $n \neq 0, 1, 2, \dots$ replace $n!$ by $\Gamma(n+1)$.
691. $\int_0^1 \frac{\log x}{1+x} dx = -\frac{\pi^2}{12}$
692. $\int_0^1 \frac{\log x}{1-x} dx = -\frac{\pi^2}{6}$
693. $\int_0^1 \frac{\log(1+x)}{x} dx = \frac{\pi^2}{12}$
694. $\int_0^1 \frac{\log(1-x)}{x} dx = -\frac{\pi^2}{6}$
695. $\int_0^1 (\log x)[\log(1+x)] dx = 2 - 2 \log 2 - \frac{\pi^2}{12}$
696. $\int_0^1 (\log x)[\log(1-x)] dx = 2 - \frac{\pi^2}{6}$
697. $\int_0^1 \frac{\log x}{1-x^2} dx = -\frac{\pi^2}{8}$
698. $\int_0^1 \log\left(\frac{1+x}{1-x}\right) \cdot \frac{dx}{x} = \frac{\pi^2}{4}$
699. $\int_0^1 \frac{\log x dx}{\sqrt{1-x^2}} = -\frac{\pi}{2} \log 2$
700. $\int_0^1 x^m \left[\log\left(\frac{1}{x}\right)\right]^n dx = \frac{\Gamma(n+1)}{(m+1)^{n+1}}, \quad \text{if } m+1 > 0, n+1 > 0$
701. $\int_0^1 \frac{(x^p - x^q) dx}{\log x} = \log\left(\frac{p+1}{q+1}\right), \quad (p+1 > 0, q+1 > 0)$
702. $\int_0^1 \frac{dx}{\sqrt{\log\left(\frac{1}{x}\right)}} = \sqrt{\pi}, \text{ (same as integral 686)}$
703. $\int_0^\infty \log\left(\frac{e^x + 1}{e^x - 1}\right) dx = \frac{\pi^2}{4}$
704. $\int_0^{\pi/2} (\log \sin x) dx = \int_0^{\pi/2} \log \cos x dx = -\frac{\pi}{2} \log 2$
705. $\int_0^{\pi/2} (\log \sec x) dx = \int_0^{\pi/2} \log \csc x dx = \frac{\pi}{2} \log 2$
706. $\int_0^\pi x(\log \sin x) dx = -\frac{\pi^2}{2} \log 2$
707. $\int_0^{\pi/2} (\sin x)(\log \sin x) dx = \log 2 - 1$

DEFINITE INTEGRALS (Continued)

$$708. \int_0^{\pi/2} (\log \tan x) dx = 0$$

$$709. \int_0^{\pi} \log(a \pm b \cos x) dx = \pi \log\left(\frac{a + \sqrt{a^2 - b^2}}{2}\right), \quad (a \geq b)$$

$$710. \int_0^{\pi} \log(a^2 - 2ab \cos x + b^2) dx = \begin{cases} 2\pi \log a, & a \geq b > 0 \\ 2\pi \log b, & b \geq a > 0 \end{cases}$$

$$711. \int_0^{\infty} \frac{\sin ax}{\sinh bx} dx = \frac{\pi}{2b} \tanh \frac{a\pi}{2b}$$

$$712. \int_0^{\infty} \frac{\cos ax}{\cosh bx} dx = \frac{\pi}{2b} \operatorname{sech} \frac{a\pi}{2b}$$

$$713. \int_0^{\infty} \frac{dx}{\cosh ax} = \frac{\pi}{2a}$$

$$714. \int_0^{\infty} \frac{x dx}{\sinh ax} = \frac{\pi^2}{4a^2}$$

$$715. \int_0^{\infty} e^{-ax} (\cosh bx) dx = \frac{a}{a^2 - b^2}, \quad (0 \leq |b| < a)$$

$$716. \int_0^{\infty} e^{-ax} (\sinh bx) dx = \frac{b}{a^2 - b^2}, \quad (0 \leq |b| < a)$$

$$717. \int_0^{\infty} \frac{\sinh ax}{e^{bx} + 1} dx = \frac{\pi}{2b} \operatorname{csc} \frac{a\pi}{b} - \frac{1}{2a}$$

$$718. \int_0^{\infty} \frac{\sinh ax}{e^{bx} - 1} dx = \frac{1}{2a} - \frac{\pi}{2b} \cot \frac{a\pi}{b}$$

$$719. \int_0^{\pi/2} \frac{dx}{\sqrt{1 - k^2 \sin^2 x}} = \frac{\pi}{2} \left[1 + \left(\frac{1}{2}\right)^2 k^2 + \left(\frac{1 \cdot 3}{2 \cdot 4}\right)^2 k^4 + \left(\frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6}\right)^2 k^6 + \dots \right], \quad \text{if } k^2 < 1$$

$$720. \int_0^{\pi/2} \sqrt{1 - k^2 \sin^2 x} dx = \frac{\pi}{2} \left[1 - \left(\frac{1}{2}\right)^2 k^2 - \left(\frac{1 \cdot 3}{2 \cdot 4}\right)^2 \frac{k^4}{3} - \left(\frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6}\right)^2 \frac{k^6}{5} - \dots \right], \quad \text{if } k^2 < 1$$

$$721. \int_0^{\infty} e^{-x} \log x dx = -\gamma = -0.5772157 \dots$$

$$722. \int_0^{\infty} e^{-x^2} \log x dx = -\frac{\sqrt{\pi}}{4} (\gamma + 2 \log 2)$$

$$723. \int_0^{\infty} \left(\frac{1}{1 - e^{-x}} - \frac{1}{x} \right) e^{-x} dx = \gamma = 0.5772157 \dots \quad [\text{Euler's Constant}]$$

$$724. \int_0^{\infty} \frac{1}{x} \left(\frac{1}{1+x} - e^{-x} \right) dx = \gamma = 0.5772157 \dots$$

For n even:

$$725. \int \cos^n x dx = \frac{1}{2^{n-1}} \sum_{k=0}^{n/2-1} \binom{n}{k} \frac{\sin(n-2k)x}{(n-2k)} + \frac{1}{2^n} \binom{n}{n/2} x$$

DEFINITE INTEGRALS (Continued)

$$726. \int \sin^n x \, dx = \frac{1}{2^{n-1}} \sum_{k=0}^{n/2-1} \binom{n}{k} \frac{\sin \left[(n-2k) \left(\frac{\pi}{2} - x \right) \right]}{2k-n} + \frac{1}{2^n} \binom{n}{n/2} x$$

For n odd:

$$727. \int \cos^n x \, dx = \frac{1}{2^{n-1}} \sum_{k=0}^{(n-1)/2} \binom{n}{k} \frac{\sin(n-2k)x}{n-2k}$$

$$728. \int \sin^n x \, dx = \frac{1}{2^{n-1}} \sum_{k=0}^{(n-1)/2} \binom{n}{k} \frac{\sin \left[(n-2k) \left(\frac{\pi}{2} - x \right) \right]}{2k-n}$$

DIFFERENTIAL EQUATIONS

SPECIAL FORMULAS

Certain types of differential equations occur sufficiently often to justify the use of formulas for the corresponding particular solutions. The following set of tables I to XIV covers all first, second, and n th order ordinary linear differential equations with constant coefficients for which the right members are of the form $P(x)e^{rx} \sin sx$ or $P(x)e^{rx} \cos sx$, where r and s are constants and $P(x)$, is a polynomial of degree n .

When the right member of a reducible linear partial differential equation with constant coefficients is not zero, particular solutions for certain types of right members are contained in tables XV to XXI. In these tables both F and P are used to denote polynomials, and it is assumed that no denominator is zero. In any formula the roles of x and y may be reversed throughout, changing a formula in which x dominates to one in which y dominates. Tables XIX, XX, XXI are applicable whether the equations are reducible or not. The symbol $\binom{m}{n}$ stands for $\frac{m!}{(m-n)!n!}$ and is the $n+1$ st coefficient in the expansion of $(a+b)^m$. Also $0! = 1$ by definition.

The tables as herewith given are those contained in the text *Differential Equations* by Ginn and Company (1955) and are published with their kind permission and that of the author, Professor Frederick H. Steen.

Solution of Linear Differential Equations with Constant Coefficients

Any linear differential equation with constant coefficients may be written in the form

$$p(D)y = R(x)$$

where D is the differential operation

$$Dy = \frac{dy}{dx}$$

$p(D)$ is a polynomial in D ,

y is the dependent variable,

x is the independent variable,

$R(x)$ is an arbitrary function of x .

A power of D represents repeated differentiation, that is

$$D^n y = \frac{d^n y}{dx^n}$$

For such an equation, the general solution may be written in the form

$$y = y_c + y_p$$

where y_p is any particular solution, and y_c is called the *complementary function*. This complementary function is defined as the general solution of the *homogeneous equation*, which is the original differential equation with the right side replaced by zero, i.e.

$$p(D)y = 0$$

The complementary function y_c may be determined as follows:

1. Factor the polynomial $p(D)$ into real and complex linear factors, just as if D were a variable instead of an operator.
2. For each nonrepeated linear factor of the form $(D - a)$, where a is real, write down a term of the form

$$ce^{ax}$$

where c is an arbitrary constant.

3. For each repeated real linear factor of the form $(D - a)^n$, write down n terms of the form

$$c_1 e^{ax} + c_2 x e^{ax} + c_3 x^2 e^{ax} + \dots + c_n x^{n-1} e^{ax}$$

where the c_i 's are arbitrary constants.

4. For each non-repeated conjugate complex pair of factors of the form $(D - a + ib)(D - a - ib)$, write down 2 terms of the form

$$c_1 e^{ax} \cos bx + c_2 e^{ax} \sin bx$$

5. For each repeated conjugate complex pair of factors of the form $(D - a + ib)^n (D - a - ib)^n$, write down $2n$ terms of the form

$$c_1 e^{ax} \cos bx + c_2 e^{ax} \sin bx + c_3 x e^{ax} \cos bx + c_4 x e^{ax} \sin bx \\ + \dots + c_{2n-1} x^{n-1} e^{ax} \cos bx + c_{2n} x^{n-1} e^{ax} \sin bx$$

6. The sum of all the terms thus written down is the complementary function y_c .

To find the particular solution y_p , use the following tables, as shown in the examples. For cases not shown in the tables, there are various methods of finding y_p . The most general method is called *variation of parameters*. The following example illustrates the method:

Find y_p for $(D^2 - 4)y = e^x$.

This example can be solved most easily by use of equation 63 in the tables following. However it is given here as an example of the method of variation of parameters.

The complementary function is

$$y_c = c_1 e^{2x} + c_2 e^{-2x}$$

To find y_p , replace the constants in the complementary function with unknown functions,

$$y_p = u e^{2x} + v e^{-2x}$$

We now prepare to substitute this assumed solution into the original equation. We begin by taking all the necessary derivatives:

$$y_p = u e^{2x} + v e^{-2x} \\ y_p' = 2u e^{2x} + 2v e^{-2x} + u' e^{2x} - v' e^{-2x}$$

For each derivative of y_p except the highest, we set the sum of all the terms containing u' and v' to 0. Thus the above equation becomes

$$u' e^{2x} + v' e^{-2x} = 0 \quad \text{and} \quad y_p' = 2u e^{2x} - 2v e^{-2x}$$

Continuing to differentiate, we have

$$y_p'' = 4u e^{2x} + 4v e^{-2x} + 2u' e^{2x} - 2v' e^{-2x}$$

When we substitute into the original equation, all the terms not containing u' or v' cancel out. This is a consequence of the method by which y_p was set up.

Thus all that is necessary is to write down the terms containing u' or v' in the highest order derivative of y_p , multiply by the constant coefficient of the highest power of D in $p(D)$, and set it equal to $R(x)$. Together with the previous terms in u' and v' which were set equal to 0, this gives us as many linear equations in the first derivatives of the unknown functions as there are unknown functions. The first derivatives may then be solved for by algebra, and the unknown functions found by integration. In the present example, this becomes

$$u' e^{2x} + v' e^{-2x} = 0 \\ 2u' e^{2x} - 2v' e^{-2x} = e^x$$

We eliminate v' and u' separately, getting

$$4u' e^{2x} = e^x \\ 4v' e^{-2x} = -e^x$$

Thus

$$u' = \frac{1}{4} e^{-x} \\ v' = -\frac{1}{4} e^{3x}$$

Therefore, by integrating

$$u = -\frac{1}{4} e^{-x} \\ v = -\frac{1}{12} e^{3x}$$

A constant of integration is not needed, since we need only one particular solution. Thus

$$y_p = u e^{2x} + v e^{-2x} = -\frac{1}{4} e^{-x} e^{2x} - \frac{1}{12} e^{3x} e^{-2x} \\ = -\frac{1}{4} e^x - \frac{1}{12} e^x = -\frac{1}{3} e^x$$

and the general solution is

$$y = y_c + y_p = c_1 e^{2x} + c_2 e^{-2x} - \frac{1}{3} e^x$$

The following samples illustrate the use of the tables.

Example 1. Solve $(D^2 - 4)y = \sin 3x$.

Substitution of $q = -4$, $s = 3$ in formula 24 gives

$$y_p = \frac{\sin 3x}{-9 - 4}$$

wherefore the general solution is

$$y = c_1 e^{2x} + c_2 e^{-2x} - \frac{\sin 3x}{13}$$

Example 2. Obtain a particular solution of $(D^2 - 4D + 5)y = x^2 e^{3x} \sin x$.

Applying formula 40 with $a = 2$, $b = 1$, $r = 3$, $s = 1$, $P(x) = x^2$, $s + b = 2$, $s - b = 0$, $a - r = -1$, $(a - r)^2 + (s + b)^2 = 5$, $(a - r)^2 + (s - b)^2 = 1$, we have

$$\begin{aligned} y_p &= \frac{e^{3x} \sin x}{2} \left[\left(\frac{2}{5} - \frac{0}{1} \right) x^2 + \left(\frac{2(-1)2}{25} - \frac{2(-1)0}{1} \right) 2x + \left(\frac{3 \cdot 1 \cdot 2 - 2^3}{125} - \frac{3 \cdot 1 \cdot 0 - 0}{1} \right) 2 \right] \\ &\quad - \frac{e^{3x} \cos x}{2} \left[\left(\frac{-1}{5} - \frac{-1}{1} \right) x^2 + \left(\frac{1-4}{25} - \frac{1-0}{1} \right) 2x + \left(\frac{-1-3(-1)4}{125} - \frac{-1-3(-1)0}{1} \right) 2 \right] \\ &= \left(\frac{1}{5} x^2 - \frac{4}{25} x - \frac{2}{125} \right) e^{3x} \sin x + \left(-\frac{2}{5} x^2 + \frac{28}{25} x - \frac{136}{125} \right) e^{3x} \cos x \end{aligned}$$

The special formulas effect a very considerable saving of time in problems of this type.

Example 3. Obtain a particular solution of $(D^2 - 4D + 5)y = x^2 e^{2x} \cos x$. (Compare with Example 2.)

Formula 40 is not applicable here since for this equation $r = a$, $s = b$, wherefore the denominator $(a - r)^2 + (s - b)^2 = 0$. We turn instead to formula 44. Substituting $a = 2$, $b = 1$, $P(x) = x^2$ and replacing \sin by \cos , \cos by $-\sin$, we obtain

$$\begin{aligned} y_p &= \frac{e^{2x} \cos x}{4} \left(x^2 - \frac{2}{4} \right) + \frac{e^{2x} \sin x}{2} \int \left(x^2 - \frac{1}{2} \right) dx \\ &= \left(\frac{x^2}{4} - \frac{1}{8} \right) e^{2x} \cos x + \left(\frac{x^3}{6} - \frac{x}{4} \right) e^{2x} \sin x \end{aligned}$$

which is the required solution.

Example 4. Find z_p for $(D_x - 3D_y)z = \ln(y + 3x)$.

Referring to Table XV we note that formula 69 (not 68) is applicable. This gives

$$z_p = x \ln(y + 3x)$$

It is easily seen that $-y/3 \ln(y + 3x)$ would serve equally well.

Example 5. Solve $(D_x + 2D_y - 4)z = y \cos(y - 2x)$.

Since R in formula 76 contains a polynomial in x , not y , we rewrite the given equation in the form

$$(D_y + \frac{1}{2} D_x - 2)z = \frac{1}{2} y \cos(y - 2x)$$

Then

$$z_c = e^{2y} F\left(x - \frac{2}{1} y\right) = e^{2x} f(2x - y)$$

and by the formula

$$\begin{aligned} z_p &= -\frac{1}{2} \cos(y - 2x) \cdot \left(\frac{y}{2} + \frac{1}{2} \right) \\ &= -\frac{1}{8} (2y + 1) \cos(y - 2x) \end{aligned}$$

Example 6. Find z_p for $(D_x + 4D_y)^3 z = (2x - y)^2$.

Using formula 79, we obtain

$$z_p = \frac{\iiint u^2 du^3}{[2 + 4(-1)]^3} = \frac{u^5}{5 \cdot 4 \cdot 3 \cdot (-8)} = -\frac{(2x - y)^5}{480}$$

Example 7. Find z_p for $(D_x^3 + 5D_x^2 D_y - 7D_x + 4)z = e^{2x+3y}$.

By formula 87

$$z_p = \frac{e^{2x+3y}}{2^3 + 5 \cdot 2^2 \cdot 3 - 7 \cdot 2 + 4} = \frac{e^{2x+3y}}{58}$$

Example 8. Find z_p for

$$(D_x^4 + 6D_x^3 D_y + D_x D_y + D_y^2 + 9)z = \sin(3x + 4y)$$

Since every term in the left member is of even degree in the two operators D_x and D_y , formula 90 is applicable. It gives

$$z_p = \frac{\sin(3x + 4y)}{(-9)^2 + 6(-9)(-12) + (-12) + (-16) + 9}$$

$$= \frac{\sin(3x + 4y)}{710}$$

TABLE I: $(D - a)y = R$

R	y_p
1. e^{rx}	$\frac{e^{rx}}{r - a}$
2. $\sin sx^*$	$-\frac{a \sin sx + s \cos sx}{a^2 + s^2} = \frac{1}{\sqrt{a^2 + s^2}} \sin\left(sx + \tan^{-1} \frac{s}{a}\right)$
3. $P(x)$	$-\frac{1}{a} \left[P(x) + \frac{P'(x)}{a} + \frac{P''(x)}{a^2} + \dots + \frac{P^{(n)}(x)}{a^n} \right]$
4. $e^{rx} \sin sx^*$	Replace a by $a - r$ in formula 2 and multiply by e^{rx} .
5. $P(x) e^{rx}$	Replace a by $a - r$ in formula 3 and multiply by e^{rx} .
6. $P(x) \sin sx^*$	$-\sin sx \left[\frac{a}{a^2 + s^2} P(x) + \frac{a^2 - s^2}{(a^2 + s^2)^2} P'(x) + \frac{a^3 - 3as^2}{(a^2 + s^2)^3} P''(x) + \dots + \frac{a^k - \binom{k}{2} a^{k-2} s^2 + \binom{k}{4} a^{k-4} s^4 - \dots}{(a^2 + s^2)^k} P^{(k-1)}(x) + \dots \right]$ $-\cos sx \left[\frac{s}{a^2 + s^2} P(x) + \frac{2as}{(a^2 + s^2)^2} P'(x) + \frac{3a^2 s - s^3}{(a^2 + s^2)^3} P''(x) + \dots + \frac{\binom{k}{1} a^{k-1} s - \binom{k}{3} a^{k-3} s^3 + \dots}{(a^2 + s^2)^k} P^{(k-1)}(x) + \dots \right]$
7. $P(x)e^{rx} \sin sx^*$	Replace a by $a - r$ in formula 6 and multiply by e^{rx} .
8. e^{ax}	$x e^{ax}$
9. $e^{ax} \sin sx^*$	$-\frac{e^{ax} \cos sx}{s}$
10. $P(x)e^{ax}$	$e^{ax} \int P(x) dx$
11. $P(x)e^{ax} \sin sx$	$\frac{e^{ax} \sin sx}{s} \left[\frac{P'(x)}{s^3} - \frac{P''(x)}{s^3} + \frac{P'''(x)}{s^5} - \dots \right] - \frac{e^{ax} \cos sx}{s} \left[P(x) - \frac{P'(x)}{s^2} + \frac{P^{iv}(x)}{s^4} - \dots \right]$

*For $\cos sx$ in R replace "sin" by "cos" and "cos" by "- sin" in y_p .

$$D^n = \frac{d^n}{dx^n} \quad \binom{m}{n} = \frac{m!}{(m-n)!n!} \quad 0! = 1$$

TABLE II: $(D - a)^2 y = R$

R	y_p
12. e^{rx}	$\frac{e^{rx}}{(r - a)^2}$
13. $\sin sx^*$	$\frac{1}{(a^2 + s^2)} [(a^2 - s^2) \sin sx + 2as \cos sx] = \frac{1}{a^2 + s^2} \sin\left(sx + \tan^{-1} \frac{2as}{a^2 - s^2}\right)$
14. $P(x)$	$\frac{1}{a^2} \left[P(x) + \frac{2P'(x)}{a} + \frac{3P''(x)}{a^2} + \dots + \frac{(n+1)P^{(n)}(x)}{a^n} \right]$
15. $e^{rx} \sin sx^*$	Replace a by $a - r$ in formula 13 and multiply by e^{rx} .
16. $P(x)e^{rx}$	Replace a by $a - r$ in formula 14 and multiply by e^{rx} .
17. $P(x) \sin sx^*$	$\sin sx \left[\frac{a^2 - s^2}{(a^2 + s^2)^2} P(x) + 2 \frac{a^3 - 3as^2}{(a^2 + s^2)^3} P'(x) + 3 \frac{a^4 - 6a^2 s^2 + s^4}{(a^2 + s^2)^4} P''(x) + \dots \right]$ $+ (k-1) \frac{a^k - \binom{k}{2} a^{k-2} s^2 + \binom{k}{4} a^{k-4} s^4 - \dots}{(a^2 + s^2)^k} P^{(k-2)}(x) + \dots$ $+ \cos sx \left[\frac{2as}{(a^2 + s^2)^2} P(x) + 2 \frac{3a^2 s - s^3}{(a^2 + s^2)^3} P'(x) + 3 \frac{4a^3 s - 4as^3}{(a^2 + s^2)^4} P''(x) + \dots \right]$ $+ (k-1) \frac{\binom{k}{1} a^{k-1} s - \binom{k}{3} a^{k-3} s^3 + \dots}{(a^2 + s^2)^k} P^{(k-2)}(x) + \dots$
18. $P(x)e^{rx} \sin sx^*$	Replace a by $a - r$ in formula 17 and multiply by e^{rx} .
19. e^{ax}	$\frac{1}{2} x^2 e^{ax}$
20. $e^{ax} \sin sx^*$	$-\frac{e^{ax} \sin sx}{s^2}$
21. $P(x)e^{ax}$	$e^{ax} \int \int P(x) dx dx$
22. $P(x)e^{ax} \sin sx^*$	$-\frac{e^{ax} \sin sx}{s^2} \left[P(x) - \frac{3P''(x)}{s^2} + \frac{5P^{iv}(x)}{s^4} - \frac{7P^{vi}(x)}{s^6} + \dots \right] - \frac{e^{ax} \cos sx}{s^2} \left[\frac{2P'(x)}{s} + \frac{4P'''(x)}{s^3} - \frac{6P^v(x)}{s^5} - \dots \right]$

*For $\cos sx$ in R replace "sin" by "cos" by "- sin" in y_p .

DIFFERENTIAL EQUATIONS (Continued)

TABLE III: $(D^2 + q)y = R$

R	y_p
23. e^{rx}	$\frac{e^{rx}}{r^2 + q}$
24. $\sin sx^*$	$\frac{\sin sx}{-s^2 + q}$
25. $P(x)$	$\frac{1}{q} \left[P(x) - \frac{P'(x)}{q} + \frac{P^{iv}(x)}{q^2} - \dots + (-1)^k \frac{P^{(2k)}(x)}{q^k} \dots \right]$
26. $e^{rx} \sin sx$	$\frac{(r^2 - s^2 + q)e^{rx} \sin sx - 2rse^{rx} \cos sx}{(r^2 - s^2 + q)^2 + (2rs)^2} = \frac{e^{rx}}{\sqrt{(r^2 - s^2 + q)^2 + (2rs)^2}} \sin \left[sx - \tan^{-1} \frac{2rs}{r^2 - s^2 + q} \right]$
27. $P(x)e^{rx}$	$\frac{e^{rx}}{r^2 + q} \left[P(x) - \frac{2r}{r^2 + q} P'(x) + \frac{3r^2 - q}{(r^2 + q)^2} P''(x) - \frac{4r^3 - 4qr}{(r^2 + q)^3} P'''(x) + \dots \right. \\ \left. + \dots + (-1)^{k-1} \frac{\binom{k}{1}r^{k-1} - \binom{k}{5}r^{k-3}q + \binom{k}{9}r^{k-5}q^2 - \dots}{(r^2 + q)^{k-1}} P^{(k-1)}(x) + \dots \right]$
28. $P(x) \sin sx^*$	$\frac{\sin sx}{(-s^2 + q)} \left[P(x) - \frac{3s^2 + q}{(-s^2 + q)^2} P'(x) + \frac{5s^4 + 10s^2q + q^2}{(-s^2 + q)^4} P^{iv}(x) + \dots \right. \\ \left. + (-1)^k \frac{\binom{2k+1}{1}s^{2k} + \binom{2k+1}{3}s^{2k-2}q + \binom{2k+1}{5}s^{2k-4}q^2 + \dots}{(-s^2 + q)^{2k}} P^{(2k)}(x) + \dots \right] \\ - \frac{s \cos sx}{(-s^2 + q)} \left[\frac{2P'(x)}{(-s^2 + q)} - \frac{4s^2 + 4q}{(-s^2 + q)^3} P'''(x) + \dots + (-1)^{k+1} \frac{\binom{2k}{1}s^{2k-2} + \binom{2k}{3}s^{2k-4}q + \dots}{(-s^2 + q)^{2k-1}} P^{(2k-1)}(x) + \dots \right]$

TABLE IV: $(D^2 + b^2)y = R$

29. $\sin bx^*$	$-\frac{x \cos bx}{2b}$
30. $P(x) \sin bx^*$	$\frac{\sin bx}{(2b)^2} \left[P(x) - \frac{P'(x)}{(2b)^2} + \frac{P^{iv}(x)}{(2b)^4} - \dots \right] - \frac{\cos bx}{2b} \int \left[P(x) - \frac{P'(x)}{(2b)^2} + \dots \right] dx$

* For $\cos sx$ in R replace "sin" by "cos" and "cos" by "-sin" in y_p .

TABLE V: $(D^2 + pD + q)y = R$

R	y_p
31. e^{rx}	$\frac{e^{rx}}{r^2 + pr + q}$
32. $\sin sx^*$	$\frac{(q - s^2) \sin sx - ps \cos sx}{(q - s^2)^2 + (ps)^2} = \frac{1}{\sqrt{(q - s^2)^2 + (ps)^2}} \sin \left(sx - \tan^{-1} \frac{ps}{q - s^2} \right)$
33. $P(x)$	$\frac{1}{q} \left[P(x) - \frac{p}{q} P'(x) + \frac{p^2 - q}{q^2} P''(x) - \frac{p^3 - 2pq}{q^3} P'''(x) + \dots + (-1)^n \frac{p^n - \binom{n-1}{1}p^{n-2}q + \binom{n-2}{2}p^{n-4}q^2 - \dots}{q^n} P^{(n)}(x) \right]$
34. $e^{rx} \sin sx^*$	Replace p by $p + 2r$, q by $q + pr + r^2$ in formula 32 and multiply by e^{rx} .
35. $P(x)e^{rx}$	Replace p by $p + 2r$, q by $q + pr + r^2$ in formula 33 and multiply by e^{rx} .

TABLE VI: $(D - b)(D - a)y = R$

36. $P(x) \sin sx^*$	$\frac{\sin sx}{b - a} \left[\left(\frac{a}{a^2 + s^2} - \frac{b}{b^2 + s^2} \right) P(x) + \left(\frac{a^2 - s^2}{(a^2 + s^2)^2} - \frac{b^2 - s^2}{(b^2 + s^2)^2} \right) P'(x) + \left(\frac{a^3 - 3as^2}{(a^2 + s^2)^3} - \frac{b^3 - 3bs^2}{(b^2 + s^2)^3} \right) P''(x) + \dots \right] \\ + \frac{\cos sx}{b - a} \left[\left(\frac{s}{a^2 + s^2} - \frac{s}{b^2 + s^2} \right) P(x) + \left(\frac{2as}{(a^2 + s^2)^2} - \frac{2bs}{(b^2 + s^2)^2} \right) P'(x) \right. \\ \left. + \left(\frac{3a^2s - s^2}{(a^2 + s^2)^3} - \frac{3b^2s - s^3}{(b^2 + s^2)^3} \right) P''(x) + \dots \right]^\dagger$
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37. $P(x)e^{rx} \sin sx^*$	Replace a by $a - r$, b by $b - r$ in formula 36 and multiply by e^{rx} .
38. $P(x)e^{ax}$	$\frac{e^{ax}}{a - b} \left[\int P(x) dx + \frac{P(x)}{(b - a)} + \frac{P'(x)}{(b - a)^2} + \frac{P''(x)}{(b - a)^3} + \dots + \frac{P^{(n)}(x)}{(b - a)^{n+1}} \right]$

*For $\cos sx$ in R replace "sin" by "cos" and "cos" by "-sin" in y_p .
 †For additional terms, compare with formula 6.

DIFFERENTIAL EQUATIONS (Continued)

TABLE VII: $(D^2 - 2aD + a^2 + b^2)y = R$

R	y_p
39. $P(x) \sin sx^*$	$\frac{\sin sx}{2b} \left[\left(\frac{s+b}{a^2 + (s+b)^2} - \frac{s-b}{a^2 + (s-b)^2} \right) P(x) + \left(\frac{2a(s+b)}{[a^2 + (s+b)^2]^2} - \frac{2a(s-b)}{[a^2 + (s-b)^2]^2} \right) P'(x) \right.$ $\left. + \left(\frac{3a^2(s+b) - (s+b)^3}{[a^2 + (s+b)^2]^3} - \frac{3a^2(s-b) - (s-b)^3}{[a^2 + (s-b)^2]^3} \right) P''(x) + \dots \right]$ $- \frac{\cos sx}{2b} \left[\left(\frac{a}{a^2 + (s+b)^2} - \frac{a}{a^2 + (s-b)^2} \right) P(x) + \left(\frac{a^2 - (s+b)^2}{[a^2 + (s+b)^2]^2} - \frac{a^2 - (s-b)^2}{[a^2 + (s-b)^2]^2} \right) P'(x) \right.$ $\left. + \left(\frac{a^2 - 3a(s+b)^2}{[a^2 + (s+b)^2]^3} - \frac{a^2 - 3a(s-b)^2}{[a^2 + (s-b)^2]^3} \right) P''(x) + \dots \right]^\dagger$

40. $P(x)e^{rx} \sin sx^*$ Replace a by $a-r$ in formula 39 and multiply by e^{rx} .

41. $P(x)e^{ax}$ $\frac{e^{ax}}{b^2} \left[P(x) - \frac{P'(x)}{b^2} + \frac{P^{iv}(x)}{b^4} - \dots \right]$

42. $e^{ax} \sin sx^*$ $\frac{e^{ax} \sin sx}{-s^2 + b^2}$

43. $e^{ax} \sin bx^*$ $-\frac{x e^{ax} \cos bx}{2b}$

44. $P(x)e^{ax} \sin bx^*$ $\frac{e^{ax} \sin bx}{(2b)^2} \left[P(x) - \frac{P'(x)}{(2b)^2} + \frac{P^{iv}(x)}{(2b)^4} - \dots \right] - \frac{e^{ax} \cos bx}{2b} \int \left[P(x) - \frac{P'(x)}{(2b)^2} + \frac{P^{iv}(x)}{(2b)^4} - \dots \right] dx$

*For $\cos sx$ in R replace "sin" by "cos" and "cos" by "-sin" in y_p .

†For additional terms, compare with formula 6.

TABLE VIII: $f(D)y = [D^n + a_{n-1}D^{n-1} + \dots + a_1D + a_0]y = R$

R	y_p
45. e^{rx}	$\frac{e^{rx}}{f(r)}$
46. $\sin sx^*$	$\frac{[a_0 - a_2s^2 + a_4s^4 - \dots] \sin sx - [a_1s - a_3s^3 + a_5s^5 + \dots] \cos sx}{[a_0 - a_2s^2 + a_4s^4 - \dots]^2 + [a_1s - a_3s^3 + a_5s^5 - \dots]^2}$

TABLE IX: $f(D^2)y = R$

47. $\sin sx^*$ $\frac{\sin sx}{f(-s^2)} = \frac{\sin sx}{a_0 - a_2s^2 + \dots \pm s^{2n}}$

TABLE X: $(D-a)^n y = R$

48. e^{rx} $\frac{e^{rx}}{(r-a)^n}$

49. $\sin sx^*$ $\frac{(-1)^n}{(a^2 + s^2)^2} \{ [a^n - \binom{n}{2}a^{n-2}s^2 + \binom{n}{4}a^{n-4}s^4 - \dots] \sin sx + [\binom{n}{1}a^{n-1}s - \binom{n}{3}a^{n-3}s^3 + \dots] \cos sx \}$

50. $P(x)$ $\frac{(-1)^n}{a^n} \left[P(x) + \binom{n}{1} \frac{P'(x)}{a} + \binom{n+1}{2} \frac{P''(x)}{a^2} + \binom{n+2}{3} \frac{P'''(x)}{a^3} + \dots \right]$

51. $e^{rx} \sin sx^*$ Replace a by $a-r$ in formula 49 and multiply by e^{rx} .

52. $e^{rx} P(x)$ Replace a by $a-r$ in formula 50 and multiply by e^{rx} .

53. $P(x) \sin sx^*$ $(-1)^n \sin sx [A_n P(x) + \binom{n}{1} A_{n+1} P'(x) + \binom{n+1}{2} A_{n+2} P''(x) + \binom{n+2}{3} A_{n+3} P'''(x) + \dots]$

$+ (-1)^n \cos sx [B_n P(x) + \binom{n}{1} B_{n+1} P'(x) + \binom{n+1}{2} B_{n+2} P''(x) + \binom{n+2}{3} B_{n+3} P'''(x) + \dots]$

$A_1 = \frac{a}{a^2 + s^2}, A_2 = \frac{a^2 - s^2}{(a^2 + s^2)^2}, \dots, A_k = \frac{a^k - \binom{k}{2}a^{k-2}s^2 + \binom{k}{4}a^{k-4}s^4 - \dots}{(a^2 + s^2)^k}$

$B_1 = \frac{a}{a^2 + s^2}, B_2 = \frac{2as}{(a^2 + s^2)^2}, \dots, B_k = \frac{\binom{k}{1}a^{k-1}s - \binom{k}{3}a^{k-3}s^3 + \dots}{(a^2 + s^2)^k}$

54. $e^{rx} \sin sx^*$ Replace a by $a-r$ in formula 53 and multiply by e^{rx} .

DIFFERENTIAL EQUATIONS (Continued)

55. $e^{ax}P(x)$ $e^{ax} \int \dots \int P(x) dx^n$

56. $P(x)e^{ax} \sin sx^*$ $\frac{(-1)^{(n-1)/2} e^{ax} \sin sx}{s^n} \left[\binom{n}{n-1} \frac{P'(x)}{s} - \binom{n+2}{n-1} \frac{P''(x)}{s^3} + \binom{n+4}{n-1} \frac{P'''(x)}{s^5} - \dots \right]$

$+ \frac{(-1)^{(n+1)/2} e^{ax} \cos sx}{s^n} \left[\binom{n-1}{n-1} P(x) - \binom{n+1}{n-1} \frac{P'(x)}{s^2} + \binom{n+3}{n-1} \frac{P''(x)}{s^4} - \dots \right]$ (n odd)

$\frac{(-1)^{n/2} e^{ax} \sin sx}{s^n} \left[\binom{n-1}{n-1} P(x) - \binom{n+1}{n-1} \frac{P'(x)}{s^2} + \binom{n+3}{n-1} \frac{P''(x)}{s^4} - \dots \right]$

$+ \frac{(-1)^{n/2} e^{ax} \cos sx}{s^n} \left[\binom{n}{n-1} \frac{P'(x)}{s} - \binom{n+2}{n-1} \frac{P''(x)}{s^3} + \binom{n+4}{n-1} \frac{P'''(x)}{s^5} - \dots \right]$ (n even)

*For $\cos sx$ in R replace "sin" by "cos" and "cos" by "-sin" in y_p .

TABLE XI: $(D - a)^n f(D)y = R$

57. e^{ax} $\frac{x^n \cdot e^{ax}}{n! \cdot f(a)}$

*For $\cos sx$ in R replace "sin" by "cos" and "cos" by "-sin" in y_p .

TABLE XII: $(D^2 + q)^n y = R$

R	y_p
58. e^{rx}	$e^{rx}/(r^2 + q)^n$
59. $\sin sx^*$	$\sin sx/(q - s^2)^n$
60. $P(x)$	$\frac{1}{q^n} \left[P(x) - \binom{n}{1} \frac{P'(x)}{q^2} + \binom{n+1}{2} \frac{P''(x)}{q^2} - \binom{n+2}{3} \frac{P'''(x)}{q^3} + \dots \right]$
61. $e^{rx} \sin sx^*$	$\frac{e^{rx}}{(A^2 + B^2)^n} \{ [A^n - \binom{n}{2} A^{n-2} B^2 + \binom{n}{4} A^{n-4} B^4 - \dots] \sin sx - [\binom{n}{1} A^{n-1} B - \binom{n}{3} A^{n-3} B^3 + \dots] \cos sx \}$ $A = r^2 - s^2 + q, \quad B = 2rs$

TABLE XIII: $(D^2 + b^2)^n y = R$

62. $\sin bx^*$ $(-1)^{(n+1)/2} \frac{x^n \cos bx}{n!(2b)^n}$ (n odd), $(-1)^{n/2} \frac{x^n \sin bx}{n!(2b)^n}$ (n even)

TABLE XIV: $(D^n - q)y = R$

63. e^{rx} $e^{rx}/(r^n - q)$

64. $P(x)$ $-\frac{1}{q} \left[P(x) \frac{P^{(n)}(x)}{q} + \frac{P^{(2n)}(x)}{q^2} + \dots \right]$

65. $\sin sx^*$ $-\frac{q \sin sx + (-1)^{(n-1)/2} s^n \cos sx}{q^2 + s^{2n}}$ (n odd), $\frac{\sin sx}{(-s^2)^{n/2} - q}$ (n even)

66. $e^{rx} \sin sx^*$ $\frac{Ae^{rx} \sin sx - Be^{rx} \cos sx}{A^2 + B^2} = \frac{e^{rx}}{\sqrt{A^2 + B^2}} \sin \left(sx - \tan^{-1} \frac{B}{A} \right)$

$A = [r^n - \binom{n}{2} r^{n-2} s^2 + \binom{n}{4} r^{n-4} s^4 - \dots] - q, \quad B = [\binom{n}{1} r^{n-1} s - \binom{n}{3} r^{n-3} s^3 + \dots]$

*For $\cos sx$ in R replace "sin" by "cos" and "cos" by "- sin" in y_p .

TABLE XV: $(D_x + mD_y)z = R$

R	z_p
67. e^{ax+by}	$\frac{e^{ax+by}}{a + mb}$
68. $f(ax + by)$	$\frac{\int f(u) du}{a + mb}, \quad u = ax + by$
69. $f(y - mx)$	$xf(y - mx)$
70. $\phi(x, y)f(y - mx)$	$f(y - mx) \int \phi(x, a + mx) dx \quad (a = y - mx \text{ after integration})$

DIFFERENTIAL EQUATIONS (Continued)

TABLE XVI: $(D_x + mD_y - k)z = R$

71. e^{ax+by}	$\frac{e^{ax+by}}{a + mb - k}$
72. $\sin(ax + by)^*$	$-\frac{(a + bm)\cos(ax + by) + k\sin(ax + by)}{(a + bm)^2 + k^2}$
73. $e^{\alpha x + \beta y} \sin(ax + by)^*$	Replace k in 72 by $k - \alpha - m\beta$ and multiply by $e^{\alpha x + \beta y}$
74. $e^{kx} f(ax + by)$	$\frac{e^{kx} \int f(u) du}{a + mb}, \quad u = ax + by$
75. $f(y - mx)$	$-\frac{f(y - mx)}{k}$
76. $p(x)f(y - mx)$	$-\frac{1}{k} f(y - mx) \left[p(x) + \frac{P'(x)}{k} + \frac{P''(x)}{k^2} + \dots + \frac{P^{(n)}(x)}{k^n} \right]$
77. $e^{kx} f(y - mx)$	$x e^{kx} f(y - mx)$ *For $\cos(ax + by)$ replace "sin" by "cos" and "cos" by "-sin" in z_p .

$$D_x = \frac{\partial}{\partial x}; \quad D_y = \frac{\partial}{\partial y}; \quad D_x^s D_y^r = \frac{\partial^{s+r}}{\partial x^s \partial y^r}$$

TABLE XVII: $(D_z + mD_y)^n z = R$

R	z_p
78. e^{ax+by}	$\frac{e^{ax+by}}{(a + mb)^n}$
79. $f(ax + by)$	$\frac{\int \dots \int f(u) du^n}{(a + mb)^n}, \quad u = ax + by$
80. $f(y - mx)$	$\frac{x^n}{n!} f(y - mx)$
81. $\phi(x, y)f(y + mx)$	$f(y - mx) \int \dots \int \phi(x, a + mx) dx^n \quad (a = y - mx \text{ after integration})$

TABLE XVIII: $(D_x + mD_y - k)^n z = R$

82. e^{ax+by}	$\frac{e^{ax+by}}{(a + mb - k)^n}$
83. $f(y - mx)$	$\frac{(-1)^n f(y - mx)}{k^n}$
84. $P(x)f(y - mx)$	$\frac{(-1)^n}{k^n} f(y - mx) \left[P(x) + \binom{n}{1} \frac{P'(x)}{k} + \binom{n+1}{2} \frac{P''(x)}{k^2} + \binom{n+2}{3} \frac{P'''(x)}{k^3} + \dots \right]$
85. $e^{kz} f(ax + by)$	$\frac{e^{kz} \int \dots \int f(u) du^n}{(a + mb)^n}, \quad u = ax + by$
86. $e^{kx} f(y - mx)$	$\frac{x^n}{n!} e^{kx} f(y - mx)$

TABLE XIX: $[D_x^n + a_1 D_x^{n-1} D_y + a_2 D_x^{n-2} D_y^2 + \dots + a_n D_y^n] z = R$

87. e^{ax+by}	$\frac{e^{ax+by}}{a + a_1 a^{n-1} b + a_2 a^{n-2} b^2 + \dots + a_n b^n}$
88. $f(ax + by)$	$\frac{\int \dots \int f(u) du^n}{a^n + a_1 a^{n-1} b + a_2 a^{n-2} b^2 + \dots + a_n b^n}, \quad (u = ax + by)$

TABLE XX: $F(D_x, D_y)z = R$

89. e^{ax+by}	$\frac{e^{ax+by}}{F(a, b)}$
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TABLE XXI: $F(D_x^2, D_x D_y, D_y^2)z = R$

90. $\sin(ax + by)^*$	$\frac{\sin(ax + by)}{F(-a^2, -ab, -b^2)}$ *For $\cos(ax + by)$ replace "sin" by "cos", and "cos" by "-sin" in z_p .
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DIFFERENTIAL EQUATIONS

Differential equation	Method of solution
Separation of variables $f_1(x)g_1(y) dx + f_2(x)g_2(y) dy = 0$	$\int \frac{f_1(x)}{f_2(x)} dx + \int \frac{g_2(y)}{g_1(y)} dy = c$
Exact equation $M(x, y) dx + N(x, y) dy = 0$ where $\partial M/\partial y = \partial N/\partial x$	$\int M \partial x + \int \left(n - \frac{\partial}{\partial y} \int M \partial x \right) dy = c$ <p>where ∂x indicates that the integration is to be performed with respect to x keeping y constant.</p>
Linear first order equation $\frac{dy}{dx} + P(x)y = Q(x)$	$ye^{\int P dx} = \int Qe^{\int P dx} dx + c$
Bernoulli's equation $\frac{dy}{dx} + P(x)y = Q(x)y^n$	$ve^{(1-n)\int P dx} = (1-n) \int Qe^{(1-n)\int P dx} dx + c$ <p>where $v = y^{1-n}$. If $n = 1$, the solution is</p> $\ln y = \int (Q - P) dx + c$
Homogeneous equation $\frac{dy}{dx} = F\left(\frac{y}{x}\right)$	$\ln x = \int \frac{dv}{F(v) - v} + c$ <p>where $v = y/x$. If $F(v) = v$, the solution is $y = cx$</p>
Reducible to homogeneous $(a_1x + b_1y + c_1) dx + (a_2x + b_2y + c_2) dy = 0$ $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	Set $u = a_1x + b_1y + c_1$ $v = a_2x + b_2y + c_2$ Eliminate x and y and the equation becomes homogenous
Reducible to separable $(a_1x + b_1y + c_1) dx + (a_2x + b_2y + c_2) dy = 0$ $\frac{a_1}{a_2} = \frac{b_1}{b_2}$	Set $u = a_1x + b_1y$ Eliminate x or y and equation becomes separable

DIFFERENTIAL EQUATIONS (Continued)

$yF(xy) dx + xG(xy) dy = 0$	$\ln x = \int \frac{G(v) dv}{v\{G(v) - F(v)\}} + c$ <p style="text-align: center;">where $v = xy$. If $G(v) = F(v)$, the solution is $xy = c$.</p>
<p>Linear, homogeneous second order equation</p> $\frac{d^2y}{dx^2} + b \frac{dy}{dx} + cy = 0$ <p>b, c are real constants</p>	<p>Let m_1, m_2 be the roots of $m^2 + bm + c = 0$. Then there are 3 cases:</p> <p>Case 1. m_1, m_2 real and distinct:</p> $y = c_1 e^{m_1 x} + c_2 e^{m_2 x}$ <p>Case 2. m_1, m_2 real and equal:</p> $y = c_1 e^{m_1 x} + c_2 x e^{m_1 x}$ <p>Case 3. $m_1 = p + qi, m_2 = p - qi$:</p> $y = e^{px} (c_1 \cos qx + c_2 \sin qx)$ <p style="text-align: center;">where $p = -b/2, q = \sqrt{4c - b^2}/2$</p>
<p>Linear, nonhomogeneous second order equation</p> $\frac{d^2y}{dx^2} + b \frac{dy}{dx} + cy = R(x)$ <p>b, c are real constants</p>	<p>There are 3 cases corresponding to those immediately above:</p> <p>Case 1.</p> $y = c_1 e^{m_1 x} + c_2 e^{m_2 x} + \frac{e^{m_1 x}}{m_1 - m_2} \int e^{-m_1 x} R(x) dx + \frac{e^{m_2 x}}{m_2 - m_1} \int e^{-m_2 x} R(x) dx$ <p>Case 2.</p> $y = c_1 e^{m_1 x} + c_2 x e^{m_1 x} + x e^{m_1 x} \int e^{-m_1 x} R(x) dx - e^{m_1 x} \int x e^{-m_1 x} R(x) dx$ <p>Case 3.</p> $y = e^{px} (c_1 \cos qx + c_2 \sin qx) + \frac{e^{px} \sin qx}{q} \int e^{-px} R(x) \cos qx dx - \frac{e^{px} \cos qx}{q} \int e^{-px} R(x) \sin qx dx$

DIFFERENTIAL EQUATIONS (Continued)

<p>Euler or Cauchy equation</p> $x^2 \frac{d^2 y}{dx^2} + bx \frac{dy}{dx} + cy = S(x)$	<p>Putting $x = e^t$, the equation becomes</p> $\frac{d^2 y}{dt^2} + (b-1) \frac{dy}{dt} + cy = S(e^t)$ <p>and can then be solved as a linear second order equation.</p>
<p>Bessel's equation</p> $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (\lambda^2 x^2 - n^2)y = 0$	$y = c_1 J_n(\lambda x) + c_2 Y_n(\lambda x)$
<p>Transformed Bessel's equation</p> $x^2 \frac{d^2 y}{dx^2} + (2p+1)x \frac{dy}{dx} + (\alpha^2 x^{2r} + \beta^2)y = 0$	$y = x^{-p} \left\{ c_1 J_{q/r} \left(\frac{\alpha}{r} x^r \right) + c_2 Y_{q/r} \left(\frac{\alpha}{r} x^r \right) \right\}$ <p>where $q = \sqrt{p^2 - \beta^2}$.</p>
<p>Legendre's equation</p> $(1-x^2) \frac{d^2 y}{dx^2} - 2x \frac{dy}{dx} + n(n+1)y = 0$	$y = c_1 P_n(x) + c_2 Q_n(x)$

FOURIER SERIES

If $f(x)$ is a bounded periodic function of period $2L$ (i.e. $f(x+2L) = f(x)$), and satisfies the *Dirichlet conditions*:

- A. In any period $f(x)$ is continuous, except possibly for a finite number of jump discontinuities.
- B. In any period $f(x)$ has only a finite number of maxima and minima.

Then $f(x)$ may be represented by the *Fourier series*

$$\frac{a_0}{2} + \sum_{n=1}^{\infty} \left(a_n \cos \frac{n\pi x}{L} + b_n \sin \frac{n\pi x}{L} \right)$$

where a_n and b_n are as determined below. This series will converge to $f(x)$ at every point where $f(x)$ is continuous, and to

$$\frac{f(x^+) + f(x^-)}{2}$$

(i.e., the average of the left-hand and right-hand limits) at every point where $f(x)$ has a jump discontinuity.

$$a_n = \frac{1}{L} \int_{-L}^L f(x) \cos \frac{n\pi x}{L} dx, \quad n = 0, 1, 2, 3, \dots,$$

$$b_n = \frac{1}{L} \int_{-L}^L f(x) \sin \frac{n\pi x}{L} dx, \quad n = 1, 2, 3, \dots$$

we may also write

$$a_n = \frac{1}{L} \int_{\alpha}^{\alpha+2L} f(x) \cos \frac{n\pi x}{L} dx \quad \text{and} \quad b_n = \frac{1}{L} \int_{\alpha}^{\alpha+2L} f(x) \sin \frac{n\pi x}{L} dx$$

where α is any real number. Thus if $\alpha = 0$,

$$a_n = \frac{1}{L} \int_0^{2L} f(x) \cos \frac{n\pi x}{L} dx, \quad n = 0, 1, 2, 3, \dots,$$

$$b_n = \frac{1}{L} \int_0^{2L} f(x) \sin \frac{n\pi x}{L} dx, \quad n = 1, 2, 3, \dots$$

2. If in addition to the above restrictions, $f(x)$, is even (i.e., $f(-x) = f(x)$) the Fourier series reduces to

$$\frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos \frac{n\pi x}{L}$$

That is, $b_n = 0$. In this case, a simpler formula for a_n is

$$a_n = \frac{2}{L} \int_0^L f(x) \cos \frac{n\pi x}{L} dx, \quad n = 0, 1, 2, 3, \dots$$

3. If in addition to the restrictions in (1), $f(x)$ is an odd function (i.e., $f(-x) = -f(x)$), then the Fourier series reduces to

$$\sum_{n=1}^{\infty} b_n \sin \frac{n\pi x}{L}$$

That is, $a_n = 0$. In this case, simpler formula for the b_n is

$$b_n = \frac{2}{L} \int_0^L f(x) \sin \frac{n\pi x}{L} dx, \quad n = 1, 2, 3, \dots$$

4. If in addition to the restrictions in (2) above, $f(x) = -f(L-x)$, then a_n will be 0 for all even values of n , including $n=0$. Thus in this case, the expansion reduces to

$$\sum_{m=1}^{\infty} a_{2m-1} \cos \frac{(2m-1)\pi x}{L}$$

5. If in addition to the restrictions in (3) above, $f(x) = f(L-x)$, then b_n will be 0 for all even values of n . Thus in this case, the expansion reduces to

$$\sum_{m=1}^{\infty} b_{2m-1} \sin \frac{(2m-1)\pi x}{L}$$

(The series in (4) and (5) are known as *odd-harmonic series*, since only the odd harmonics appear. Similar rules may be stated for even-harmonic series, but when a series appears in the even-harmonic form, it means that $2L$ has not been taken as the smallest period of $f(x)$. Since any integral multiple of a period is also a period, series obtained in this way will also work, but in general computation is simplified if $2L$ is taken to be the smallest period.)

6. If we write the Euler definitions for $\cos \theta$ and $\sin \theta$, we obtain the complex form of the Fourier Series known either as the "Complex Fourier Series" or the "Exponential Fourier Series" of $f(x)$. It is represented as

$$f(x) = \frac{1}{2} \sum_{n=-\infty}^{n=+\infty} c_n e^{i\omega_n x}$$

where

$$c_n = \frac{1}{L} \int_{-L}^L f(x) e^{-i\omega_n x} dx, \quad n = 0, \pm 1, \pm 2, \pm 3, \dots$$

with $\omega_n = \frac{n\pi}{L}$, $n = 0, \pm 1, \pm 2, \dots$

The set of coefficients $\{c_n\}$ is often referred to as the Fourier spectrum.

7. If both sine and cosine terms are present and if $f(x)$ is of period $2L$ and expandable by a Fourier series, it can be represented as

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} c_n \sin \left(\frac{n\pi x}{L} + \phi_n \right), \quad \text{where } a_n = c_n \sin \phi_n, \\ b_n = c_n \cos \phi_n, \quad c_n = \sqrt{a_n^2 + b_n^2}, \quad \phi_n = \arctan \left(\frac{a_n}{b_n} \right)$$

It can also be represented as

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} c_n \cos \left(\frac{n\pi x}{L} + \phi_n \right), \quad \text{where } a_n = c_n \cos \phi_n, \\ b_n = -c_n \sin \phi_n, \quad c_n = \sqrt{a_n^2 + b_n^2}, \quad \phi_n = \arctan \left(-\frac{b_n}{a_n} \right)$$

where ϕ_n is chosen so as to make a_n , b_n , and c_n hold.

8. The following table of trigonometric identities should be helpful for developing Fourier Series.

	n	n even	n odd	$n/2$ odd	$n/2$ even
$\sin n\pi$	0	0	0	0	0
$\cos n\pi$	$(-1)^n$	+1	-1	+1	+1
* $\sin \frac{n\pi}{2}$		0	$(-1)^{(n-1)/2}$	0	0
* $\cos \frac{n\pi}{2}$		$(-1)^{n/2}$	0	-1	+1
$\sin \frac{n\pi}{4}$			$\frac{\sqrt{2}}{2}(-1)^{(n^2+4n+11)/8}$	$(-1)^{(n-2)/4}$	0

*A useful formula for $\sin \frac{n\pi}{2}$ and $\cos \frac{n\pi}{2}$ is given by

$$\sin \frac{n\pi}{2} = \frac{(i)^{n+1}}{2} [(-1)^n - 1] \text{ and } \cos \frac{n\pi}{2} = \frac{(i)^n}{2} [(-1)^n + 1], \text{ where } i^2 = -1.$$

AUXILIARY FORMULAS FOR FOURIER SERIES

$$1 = \frac{4}{\pi} \left[\sin \frac{\pi x}{k} + \frac{1}{3} \sin \frac{3\pi x}{k} + \frac{1}{5} \sin \frac{5\pi x}{k} + \dots \right] \quad [0 < x < k]$$

$$x = \frac{2k}{\pi} \left[\sin \frac{\pi x}{k} - \frac{1}{2} \sin \frac{2\pi x}{k} + \frac{1}{3} \sin \frac{3\pi x}{k} - \dots \right] \quad [-k < x < k]$$

$$x = \frac{k}{2} - \frac{4k}{\pi^2} \left[\cos \frac{\pi x}{k} + \frac{1}{3^2} \cos \frac{3\pi x}{k} + \frac{1}{5^2} \cos \frac{5\pi x}{k} + \dots \right] \quad [0 < x < k]$$

$$x^2 = \frac{2k^2}{\pi^3} \left[\left(\frac{\pi^2}{1} - \frac{4}{1} \right) \sin \frac{\pi x}{k} - \frac{\pi^2}{2} \sin \frac{2\pi x}{k} + \left(\frac{\pi^2}{3} - \frac{4}{3^3} \right) \sin \frac{3\pi x}{k} \right. \\ \left. - \frac{\pi^2}{4} \sin \frac{4\pi x}{k} + \left(\frac{\pi^2}{5} - \frac{4}{5^3} \right) \sin \frac{5\pi x}{k} + \dots \right] \quad [0 < x < k]$$

$$x^2 = \frac{k^2}{3} - \frac{4k^2}{\pi^2} \left[\cos \frac{\pi x}{k} - \frac{1}{2^2} \cos \frac{2\pi x}{k} + \frac{1}{3^2} \cos \frac{3\pi x}{k} - \frac{1}{4^2} \cos \frac{4\pi x}{k} + \dots \right] \quad [-k < x < k]$$

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}$$

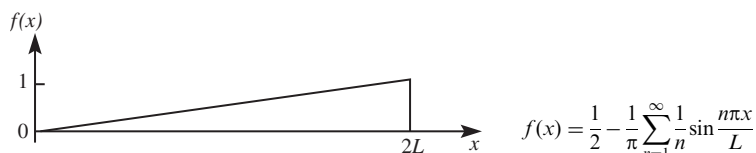
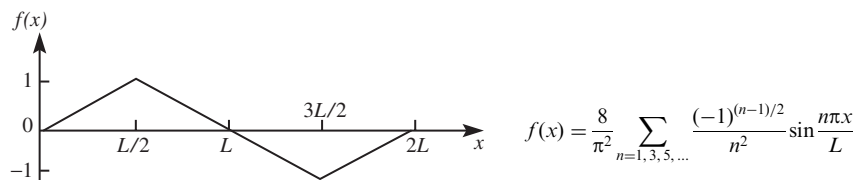
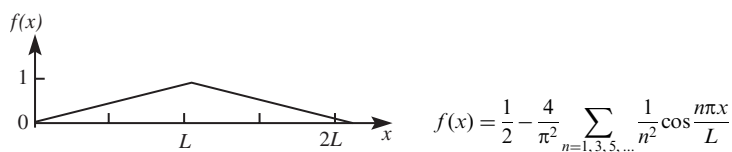
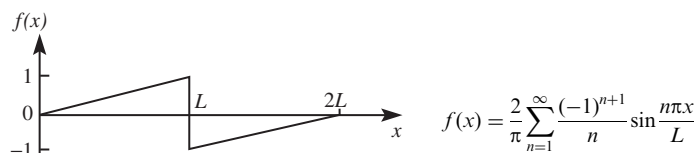
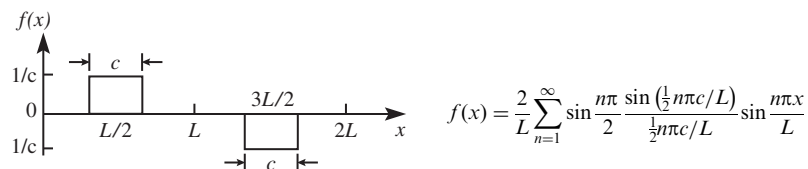
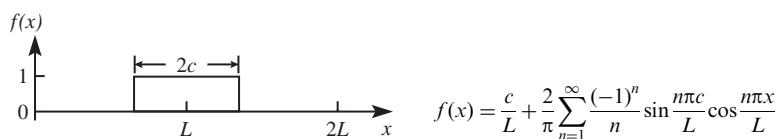
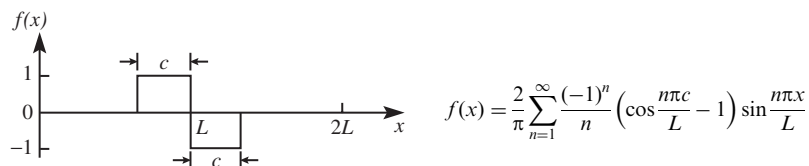
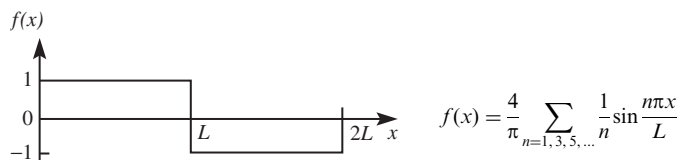
$$1 - \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \dots = \frac{\pi^2}{6}$$

$$1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots = \frac{\pi^2}{12}$$

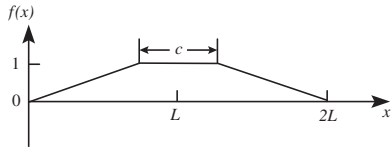
$$1 + \frac{1}{3^2} + \frac{1}{5^2} - \frac{1}{7^2} + \dots = \frac{\pi^2}{8}$$

$$\frac{1}{2^2} + \frac{1}{4^2} + \frac{1}{6^2} + \frac{1}{8^2} + \dots = \frac{\pi^2}{24}$$

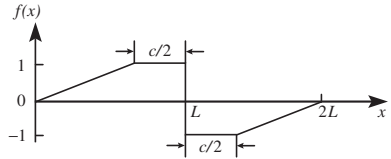
FOURIER EXPANSIONS FOR BASIC PERIODIC FUNCTIONS



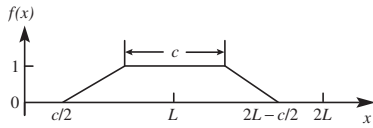
FOURIER EXPANSIONS FOR BASIC PERIODIC FUNCTIONS (Continued)



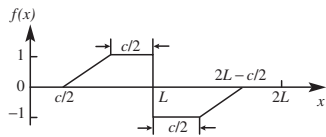
$$f(x) = \frac{1}{2}(1+a) + \frac{2}{\pi^2(1-a)} \sum_{n=1}^{\infty} \frac{1}{n^2} [(-1)^n \cos n\pi a - 1] \cos \frac{n\pi x}{L}; \quad \left(a = \frac{c}{2L}\right)$$



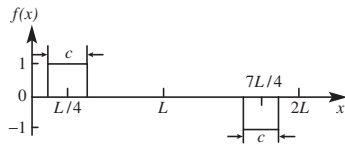
$$f(x) = \frac{2}{\pi} \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n} \left[1 + \frac{\sin n\pi a}{n\pi(1-a)} \right] \sin \frac{n\pi x}{L}; \quad \left(a = \frac{c}{2L}\right)$$



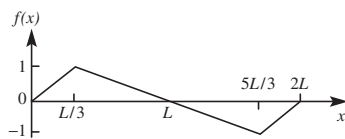
$$f(x) = \frac{1}{2} - \frac{4}{\pi^2(1-2a)} \sum_{n=1,3,5,\dots}^{\infty} \frac{1}{n^2} \cos n\pi a \cos \frac{n\pi x}{L}; \quad \left(a = \frac{c}{2L}\right)$$



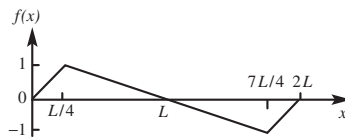
$$f(x) = \frac{2}{\pi} \sum_{n=1}^{\infty} \frac{(-1)^n}{n} \left[1 + \frac{1+(-1)^n}{n\pi(1-2a)} \sin n\pi a \right] \sin \frac{n\pi x}{L}; \quad \left(a = \frac{c}{2L}\right)$$



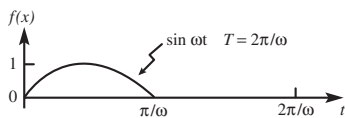
$$f(x) = \frac{4}{\pi} \sum_{n=1}^{\infty} \frac{1}{n} \sin \frac{n\pi c}{4} \sin n\pi a \sin \frac{n\pi x}{L}; \quad \left(a = \frac{c}{2L}\right)$$



$$f(x) = \frac{9}{\pi^2} \sum_{n=1}^{\infty} \frac{1}{n^2} \sin \frac{n\pi}{3} \sin \frac{n\pi x}{L}; \quad \left(a = \frac{c}{2L}\right)$$



$$f(x) = \frac{32}{3\pi^2} \sum_{n=1}^{\infty} \frac{1}{n^2} \sin \frac{n\pi}{4} \sin \frac{n\pi x}{L}; \quad \left(a = \frac{c}{2L}\right)$$



$$f(x) = \frac{1}{\pi} + \frac{1}{2} \sin \omega t - \frac{2}{\pi} \sum_{n=2,4,6,\dots}^{\infty} \frac{1}{n^2-1} \cos n\omega t$$

Extracted from graphs and formulas, pages 372, 373, Differential Equations in Engineering Problems, Salvadori and Schwarz, published by Prentice-Hall, Inc., 1954.

THE FOURIER TRANSFORMS*

R. E. Gaskell

For a piecewise continuous function $F(x)$ over a finite interval $0 \leq x \leq \pi$, the *finite Fourier cosine transform* of $F(x)$ is

$$f_c(n) = \int_0^\pi F(x) \cos nx \, dx \quad (n = 0, 1, 2, \dots) \quad (1)$$

If x ranges over the interval $0 \leq x \leq L$, the substitution $x' = \pi x/L$ allows the use of this definition, also. The inverse transform is written.

$$\bar{F}(x) = \frac{1}{\pi} f_c(0) - \frac{2}{\pi} \sum_{n=1}^x f_c(n) \cos nx \quad (0 < x < \pi) \quad (2)$$

where $F(x) = \frac{[F(x+o) + F(x-o)]}{2}$. We observe that $F(x) = F(x) =$ at point of continuity. The formula

$$\begin{aligned} f_c^{(2)}(n) &= \int_0^\pi F''(x) \cos nx \, dx \\ &= -n^2 f_c(n) - F'(0) + (-1)^n F'(\pi) \end{aligned} \quad (3)$$

makes the finite Fourier cosine transform useful in certain boundary value problems.

Analogously, the *finite Fourier sine transform* of $F(x)$ is

$$f_s(n) = \int_0^\pi F(x) \sin nx \, dx \quad (n = 1, 2, 3, \dots) \quad (4)$$

and

$$\bar{F}(x) = \frac{2}{\pi} \sum_{n=1}^\infty f_s(n) \sin nx \quad (0 < x < \pi) \quad (5)$$

Corresponding to (3) we have

$$\begin{aligned} f_s^{(2)}(n) &= \int_0^\pi F''(x) \sin nx \, dx \\ &= -n^2 f_s(n) - n F(0) - n(-1)^n F(\pi) \end{aligned} \quad (6)$$

Fourier Transforms

If $F(x)$ is defined for $x \geq 0$ and is piecewise continuous over any finite interval, and if

$$\int_0^x F(x) \, dx$$

is absolutely convergent, then

$$f_c(\alpha) = \sqrt{\frac{2}{\pi}} \int_0^x F(x) \cos(\alpha x) \, dx \quad (7)$$

is the *Fourier cosine transform* of $F(x)$. Furthermore,

$$\bar{F}(x) = \sqrt{\frac{2}{\pi}} \int_0^x f_c(\alpha) \cos(\alpha x) \, d\alpha \quad (8)$$

if $\lim_{x \rightarrow \infty} \frac{d^n F}{dx^n} = 0$, an important property of the Fourier cosine transform

$$\begin{aligned} f_c^{(2r)}(\alpha) &= \sqrt{\frac{2}{\pi}} \int_0^x \left(\frac{d^{2r} F}{dx^{2r}} \right) \cos(\alpha x) \, dx \\ &= -\sqrt{\frac{2}{\pi}} \sum_{n=0}^{r-1} (-1)^n a_{2r-2n-1} \alpha^{2n} + (-1)^r \alpha^{2r} f_c(\alpha) \end{aligned} \quad (9)$$

where $\lim_{x \rightarrow \infty} \frac{d^r F}{dx^r} = a_r$, makes it useful in the solution of many problems.

Under the same conditions.

$$f_s(\alpha) = \sqrt{\frac{2}{\pi}} \int_0^x F(x) \sin(\alpha x) \, dx \quad (10)$$

*From Beyer, W. H., Ed., *CRC Handbook of Mathematical Sciences*, 5th ed., CRC Press, Boca Raton, 1978, 592-598. With permission.

defines the *Fourier sine transform* of $F(x)$, and

$$\bar{F}(x) = \sqrt{\frac{2}{\pi}} \int_0^x f_s(\alpha) \sin(\alpha x) d\alpha \quad (11)$$

Corresponding to (9) we have

$$\begin{aligned} f_s^{(2r)}(\alpha) &= \sqrt{\frac{2}{\pi}} \int_0^\infty \frac{d^{2r} F}{dx^{2r}} \sin(\alpha x) dx \\ &= -\sqrt{\frac{2}{\pi}} \sum_{n=1}^r (-1)^n \alpha^{2n-1} a_{2r-2n} + (-1)^{r-1} \alpha^{2r} f_s(\alpha) \end{aligned} \quad (12)$$

Similarly, if $F(x)$ is defined for $-\infty < x < \infty$, and if $\int_{-\infty}^\infty F(x) dx$ is absolutely convergent, then

$$f(\alpha) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^\infty F(x) e^{i\alpha x} dx \quad (13)$$

is the *Fourier transform* of $F(x)$, and

$$\bar{F}(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^\infty f(\alpha) e^{-i\alpha x} d\alpha \quad (14)$$

Also, if

$$\lim_{|x| \rightarrow \infty} \left| \frac{d^n F}{dx^n} \right| = 0 \quad (n = 1, 2, \dots, r-1)$$

then

$$f^{(r)}(\alpha) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^\infty F^{(r)}(x) e^{i\alpha x} dx = (-i\alpha)^r f(\alpha) \quad (15)$$

Finite Sine Transforms

	$f_s(n)$	$F(x)$
1	$f_s(n) = \int_0^\pi F(x) \sin nx dx \quad (n = 1, 2, \dots)$	$F(x)$
2	$(-1)^{n+1} f_s(n)$	$F(\pi - x)$
3	$\frac{1}{n}$	$\frac{\pi - x}{\pi}$
4	$\frac{(-1)^{n+1}}{n}$	$\frac{x}{\pi}$
5	$\frac{1 - (-1)^n}{n}$	1
6	$\frac{2}{n^2} \sin \frac{n\pi}{2}$	$\begin{cases} x & \text{when } 0 < x < \pi/2 \\ \pi - x & \text{when } \pi/2 < x < \pi \end{cases}$
7	$\frac{(-1)^{n+1}}{n^3}$	$\frac{x(\pi^2 - x^2)}{6\pi}$
8	$\frac{1 - (-1)^n}{n^3}$	$\frac{x(\pi - x)}{2}$
9	$\frac{\pi^2 (-1)^{n-1}}{n} - \frac{2[1 - (-1)^n]}{n^3}$	x^2
10	$\pi (-1)^n \left(\frac{6}{n^3} - \frac{\pi^2}{n} \right)$	x^3
11	$\frac{n}{n^2 + c^2} [1 - (-1)^n e^{c\pi}]$	e^{cx}
12	$\frac{n}{n^2 + c^2}$	$\frac{\sinh c(\pi - x)}{\sinh c\pi}$
13	$\frac{n}{n^2 - k^2} \quad (k \neq 0, 1, 2, \dots)$	$\frac{\sin k(\pi - x)}{\sin k\pi}$
14	$\begin{cases} \frac{\pi}{2} & \text{when } n = m \\ 0 & \text{when } n \neq m \end{cases} \quad (m = 1, 2, \dots)$	$\sin mx$

$f_s(n)$	$F(x)$
15 $\frac{n}{n^2 - k^2} [1 - (-1)^n \cos k\pi]$ ($k \neq 1, 2, \dots$)	$\cos kx$
16 $\begin{cases} \frac{n}{n^2 - m^2} [1 - (-1)^{n+m}] \\ 0 \text{ when } n \neq m = 1, 2, \dots \\ 0 \text{ when } n = m \end{cases}$	$\cos mx$
17 $\frac{n}{(n^2 - k^2)^2}$ ($k \neq 0, 1, 2, \dots$)	$\frac{\pi \sin kx}{2k \sin^2 k\pi} - \frac{x \cos k(\pi - x)}{2k \sin k\pi}$
18 $\frac{b^n}{n}$ ($|b| \leq 1$)	$\frac{2}{\pi} \arctan \frac{b \sin x}{1 - b \cos x}$
19 $\frac{1 - (-1)^n}{n} b^n$ ($|b| \leq 1$)	$\frac{2}{\pi} \arctan \frac{2b \sin x}{1 - b^2}$

Finite Cosine Transforms

$f_c(n)$	$F(x)$
1 $f_c(n) = \int_0^\pi F(x) \cos nx \, dx$ ($n = 0, 1, 2, \dots$)	$F(x)$
2 $(-1)^n f_c(n)$	$F(\pi - x)$
3 0 when $n = 1, 2, \dots$; $f_c(0) = \pi$	1
4 $\frac{2}{n} \sin \frac{n\pi}{2}$; $f_c(0) = 0$	$\begin{cases} 1 & \text{when } 0 < x < \pi/2 \\ -1 & \text{when } \pi/2 < x < \pi \end{cases}$
5 $-\frac{1 - (-1)^n}{n^2}$; $f_c(0) = \frac{\pi^2}{2}$	x
6 $\frac{(-1)^n}{n^2}$; $f_c(0) = \frac{\pi^2}{6}$	$\frac{x^2}{2\pi}$
7 $\frac{1}{n^2}$; $f_c(0) = 0$	$\frac{(\pi - x)^2}{2\pi} - \frac{\pi}{6}$
8 $3\pi^2 \frac{(-1)^n}{n^2} - 6 \frac{1 - (-1)^n}{n^4}$; $f_c(0) = \frac{\pi^4}{4}$	x^3
9 $\frac{(-1)^n e^c \pi - 1}{n^2 + c^2}$	$\frac{1}{c} e^{cx}$
10 $\frac{1}{n^2 + c^2}$	$\frac{\cosh c(\pi - x)}{c \sinh c\pi}$
11 $\frac{k}{n^2 - k^2} [(-1)^n \cos \pi k - 1]$ ($k \neq 0, 1, 2, \dots$)	$\sin kx$
12 $\frac{(-1)^{n+m} - 1}{n^2 - m^2}$; $f_c(m) = 0$ ($m = 1, 2, \dots$)	$\frac{1}{m} \sin mx$
13 $\frac{1}{n^2 - k^2}$ ($k \neq 0, 1, 2, \dots$)	$-\frac{\cos k(\pi - x)}{k \sin k\pi}$
14 0 when $n = 1, 2, \dots$; $f_c(m) = \frac{\pi}{2}$ ($m = 1, 2, \dots$)	$\cos mx$

Fourier Sine Transforms*

$F(x)$	$f_s(\alpha)$
1 $\begin{cases} 1 & (0 < x < a) \\ 0 & (x > a) \end{cases}$	$\sqrt{\frac{2}{\pi}} \left[\frac{1 - \cos \alpha}{\alpha} \right]$
2 x^{p-1} ($0 < p < 1$)	$\sqrt{\frac{2}{\pi}} \frac{\Gamma(p)}{\alpha^p} \sin \frac{p\pi}{2}$
3 $\begin{cases} \sin x & (0 < x < a) \\ 0 & (x > a) \end{cases}$	$\frac{1}{\sqrt{2\pi}} \left[\frac{\sin[a(1 - \alpha)]}{1 - \alpha} - \frac{\sin[a(1 + \alpha)]}{1 + \alpha} \right]$
4 e^{-x}	$\sqrt{\frac{2}{\pi}} \left[\frac{\alpha}{1 + \alpha^2} \right]$
5 $xe^{-x^2/2}$	$\alpha e^{-\alpha^2/2}$
6 $\cos \frac{x^2}{2}$	$\sqrt{2} \left[\sin \frac{\alpha^2}{2} c \left(\frac{\alpha^2}{2} \right) - \cos \frac{\alpha^2}{2} S \left(\frac{\alpha^2}{2} \right) \right]^*$

$F(x)$	$f_s(\alpha)$
7 $\sin \frac{x^2}{2}$	$\sqrt{2} \left[\cos \frac{\alpha^2}{2} C\left(\frac{\alpha^2}{2}\right) + \sin \frac{\alpha^2}{2} S\left(\frac{\alpha^2}{2}\right) \right]^*$

* $C(y)$ and $S(y)$ are the Fresnel integrals

$$C(y) = \frac{1}{\sqrt{2\pi}} \int_0^y \frac{1}{\sqrt{t}} \cos t \, dt,$$

$$S(y) = \frac{1}{\sqrt{2\pi}} \int_0^y \frac{1}{\sqrt{t}} \sin t \, dt$$

*More extensive tables of the Fourier sine and cosine transforms can be found in Fritz Oberhettinger, *Tabellen zur-Fourier Transformation*, Springer, 1957.

Fourier Cosine Transforms

$F(x)$	$f_c(\alpha)$
1 $\begin{cases} 1 & (0 < x < a) \\ 0 & (x > a) \end{cases}$	$\sqrt{\frac{2}{\pi}} \frac{\sin \alpha a}{\alpha}$
2 $x^{p-1} \quad (0 < p < 1)$	$\sqrt{\frac{2}{\pi}} \frac{\Gamma(p)}{\alpha^p} \cos \frac{p\pi}{2}$
3 $\begin{cases} \cos x & (0 < x < a) \\ 0 & (x > a) \end{cases}$	$\frac{1}{\sqrt{2\pi}} \left[\frac{\sin[\alpha(1-\alpha)]}{1-\alpha} + \frac{\sin[\alpha(1+\alpha)]}{1+\alpha} \right]$
4 e^{-x}	$\sqrt{\frac{2}{\pi}} \left(\frac{1}{1+\alpha^2} \right)$
5 $e^{-x^2/2}$	$e^{-\alpha^2/2}$
6 $\cos \frac{x^2}{2}$	$\cos \left(\frac{\alpha^2}{2} - \frac{\pi}{4} \right)$
7 $\sin \frac{x^2}{2}$	$\cos \left(\frac{\alpha^2}{2} + \frac{\pi}{4} \right)$

Fourier Transforms

$F(x)$	$f_s(\alpha)$
1 $\frac{\sin ax}{x}$	$\begin{cases} \sqrt{\frac{\pi}{2}} & |\alpha| < a \\ 0 & |\alpha| > a \end{cases}$
2 $\begin{cases} e^{iwx} & (p, x < q) \\ 0 & (x < p, x > q) \end{cases}$	$\frac{i}{\sqrt{2\pi}} \frac{e^{ip(w+\alpha)} - e^{iq(w+\alpha)}}{(w+\alpha)}$
3 $\begin{cases} e^{-cx+iwx} & (x > 0) \\ 0 & (x < 0) \end{cases} \quad (c > 0)$	$\frac{i}{\sqrt{2\pi}(w+\alpha+ic)}$
4 $e^{-px^2} \quad R(p) > 0$	$\frac{1}{\sqrt{2p}} e^{-\alpha^2/4p}$
5 $\cos px^2$	$\frac{1}{\sqrt{2p}} \cos \left[\frac{\alpha^2}{4p} - \frac{\pi}{4} \right]$
6 $\sin px^2$	$\frac{1}{\sqrt{2p}} \cos \left[\frac{\alpha^2}{4p} + \frac{\pi}{4} \right]$
7 $|x|^{-p} \quad (0 < p < 1)$	$\frac{\sqrt{2}}{\pi} \frac{\Gamma(1-p) \sin \frac{p\pi}{2}}{|\alpha|^{(1-p)}}$
8 $\frac{e^{-a|x|}}{\sqrt{|x|}}$	$\frac{\sqrt{\sqrt{(a^2+\alpha^2)+a}}}{\sqrt{a^2+\alpha^2}}$
9 $\frac{\cosh ax}{\cosh \pi x} \quad (-\pi < a < \pi)$	$\frac{\sqrt{2}}{\pi} \frac{\cos \frac{\alpha}{2} \cosh \frac{\alpha}{2}}{\cosh \alpha + \cos a}$
10 $\frac{\sinh ax}{\sinh \pi x} \quad (-\pi < a < \pi)$	$\frac{1}{\sqrt{2\pi}} \frac{\sin a}{\cosh \alpha + \cos a}$
11 $\begin{cases} \frac{1}{\sqrt{a^2-x^2}} & (|x| < a) \\ 0 & (|x| > a) \end{cases}$	$\sqrt{\frac{\pi}{2}} J_0(a\alpha)$

	$F(x)$	$f(\alpha)$
12	$\frac{\sin[b\sqrt{a^2+x^2}]}{\sqrt{a^2+x^2}}$	$\begin{cases} 0 & (|\alpha| > b) \\ \sqrt{\frac{\pi}{2}} J_0(a\sqrt{b^2-\alpha^2}) & (|\alpha| < b) \end{cases}$
13	$\begin{cases} p_n(x) & (|x| < 1) \\ 0 & (|x| > 1) \end{cases}$	$\frac{i^n}{\sqrt{\alpha}} J_{n+\frac{1}{2}}(\alpha)$
14	$\begin{cases} \frac{\cos[b\sqrt{a^2-x^2}]}{\sqrt{a^2-x^2}} & (|x| < a) \\ 0 & (|x| > a) \end{cases}$	$\sqrt{\frac{\pi}{2}} J_0(a\sqrt{a^2+b^2})$
15	$\begin{cases} \frac{\cosh[b\sqrt{a^2-x^2}]}{\sqrt{a^2-x^2}} & (|x| < a) \\ 0 & (|x| > a) \end{cases}$	$\sqrt{\frac{\pi}{2}} J_0(a\sqrt{a^2-b^2})$

* More extensive tables of Fourier transforms can be found in W. Magnus and F. Oberhettinger, *Formulas and Theorems of the Special Functions of Mathematical Physics*. Chelsea, 1949, 116–120.

The following functions appear among the entries of the tables on transforms.

Function	Definition	Name
$Ei(x)$	$\int_{-x}^x \frac{e^v}{v} dv$; or sometimes defined as $-Ei(-x) = \int_x^x \frac{e^{-v}}{v} dv$	Sine, Cosine, and Exponential Integral tables pages 548–556
$Si(x)$	$\int_0^x \frac{\sin v}{v} dv$	Sine, Cosine, and Exponential Integral tables pages 548–556
$Ci(x)$	$\int_x^x \frac{\cos v}{v} dv$; or sometimes defined as negative of this integral	Sine, Cosine, and Exponential Integral tables pages 548–556
$erf(x)$	$\frac{2}{\sqrt{\pi}} \int_0^x e^{-v^2} dv$	Error function
$erfc(x)$	$1 - erf(x) = \frac{2}{\sqrt{\pi}} \int_x^\infty e^{-v^2} dv$	Complementary function to error function
$L_n(x)$	$\frac{e^x}{n!} \frac{d^n}{dx^n} (x^n e^{-x})$, $n = 0, 1, \dots$	Laguerre polynomial of degree n

SERIES EXPANSION

The expression in parentheses following certain of the series indicates the region of convergence. If not otherwise indicated it is to be understood that the series converges for all finite values of x .

BINOMIAL

$$(x+y)^n = x^n + nx^{n-1}y + \frac{n(n-1)}{2!}x^{n-2}y^2 + \frac{n(n-1)(n-2)}{3!}x^{n-3}y^3 + \dots \quad (y^2 < x^2)$$

$$(1 \pm x)^n = 1 \pm nx + \frac{n(n-1)x^2}{2!} \pm \frac{n(n-1)(n-2)x^3}{3!} + \dots \quad (x^2 < 1)$$

$$(1 \pm x)^{-n} = 1 \mp nx + \frac{n(n+1)x^2}{2!} \mp \frac{n(n+1)(n+2)x^3}{3!} + \dots \quad (x^2 < 1)$$

$$(1 \pm x)^{-1} = 1 \mp x + x^2 \mp x^3 + x^4 \mp x^5 + \dots \quad (x^2 < 1)$$

$$(1 \pm x)^{-2} = 1 \mp 2x + 3x^2 \mp 4x^3 + 5x^4 \mp 6x^5 + \dots \quad (x^2 < 1)$$

REVERSION OF SERIES

Let a series be represented by

$$y = a_1x + a_2x^2 + a_3x^3 + a_4x^4 + a_5x^5 + a_6x^6 + \dots \quad (a_j \neq 0)$$

to find the coefficients of the series

$$x = A_1y + A_2y^2 + A_3y^3 + A_4y^4 + \dots$$

$$A_1 = \frac{1}{a_1} \quad A_2 = -\frac{a_2}{a_1^3} \quad A_3 = \frac{1}{a_1^5} (2a_2^2 - a_1a_3)$$

$$A_4 = \frac{1}{a_1^7} (5a_1a_2a_3 - a_1^2a_4 - 5a_2^3)$$

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$$A_4 = \frac{1}{a_1^7}(5a_1a_2a_3 - a_1^2a_4 - 5a_2^3)$$

$$\begin{aligned}
 A_5 &= \frac{1}{a_1^9} (6a_1^2 a_2 a_4 + 3a_1^2 a_3^2 + 14a_2^4 - a_1^3 a_5 - 21a_1 a_2^2 a_3) \\
 A_6 &= \frac{1}{a_1^{11}} (7a_1^3 a_2 a_5 + 7a_1^3 a_3 a_4 + 84a_1 a_2^2 a_3 - a_1^4 a_6 - 28a_1^2 a_2^2 a_4 - 28a_1^2 a_2 a_3^2 - 42a_2^5) \\
 A_7 &= \frac{1}{a_1^{13}} (8a_1^4 a_2 a_6 + 8a_1^4 a_3 a_5 + 4a_1^4 a_4^2 + 120a_1^2 a_2^3 a_4 + 180a_1^2 a_2^2 a_3^2 + 132a_2^6 - a_1^5 a_7 \\
 &\quad - 36a_1^3 a_2^2 a_5 - 72a_1^3 a_2 a_3 a_4 - 12a_1^3 a_3^3 - 330a_1 a_2^4 a_3)
 \end{aligned}$$

TAYLOR

$$\begin{aligned}
 1. \quad f(x) &= f(a) + (x-a)f'(a) + \frac{(x-a)^2}{2!}f''(a) + \frac{(x-a)^3}{3!}f'''(a) \\
 &+ \dots + \frac{(x-a)^n}{n!}f^{(n)}(a) + \dots \text{ (Taylor's Series)} \\
 &\text{(Increment form)}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad f(x+h) &= f(x) + hf'(x) + \frac{h^2}{2!}f''(x) + \frac{h^3}{3!}f'''(x) + \dots \\
 &= f(h) + xf'(h) + \frac{x^2}{2!}f''(h) + \frac{x^3}{3!}f'''(h) + \dots
 \end{aligned}$$

3. If $f(x)$ is a function possessing derivatives of all orders throughout the interval $a \leq x \leq b$, then there is a value X , with aXb , such that

$$\begin{aligned}
 f(b) &= f(a) + (b-a)f'(a) + \frac{(b-a)^2}{2!}f''(a) + \dots + \frac{(b-a)^{n-1}}{(n-1)!}f^{(n-1)}(a) + \frac{(b-a)^n}{n!}f^{(n)}(X) \\
 f(a+h) &= f(a) + hf'(a) + \frac{h^2}{2!}f''(a) + \dots + \frac{h^{n-1}}{(n-1)!}f^{(n-1)}(a) + \frac{h^n}{n!}f^{(n)}(a+\theta h), \quad b = a+h, \quad 0 < \theta < 1.
 \end{aligned}$$

or

$$f(x) = f(a) + (x-a)f'(a) + \frac{(x-a)^2}{2!}f''(a) + \dots + (x-a)^{n-1}\frac{f^{(n-1)}(a)}{(n-1)!} + R_n,$$

where

$$R_n = \frac{f^{(n)}[a + \theta \cdot (x-a)]}{n!}(x-a)^n, \quad 0 < \theta < 1.$$

The above forms are known as Taylor's series with the remainder term.

4. Taylor's series for a function of two variables

$$\begin{aligned}
 \text{If } \left(h \frac{\partial}{\partial x} + k \frac{\partial}{\partial y} \right) f(x, y) &= h \frac{\partial f(x, y)}{\partial x} + k \frac{\partial f(x, y)}{\partial y}; \\
 \left(h \frac{\partial}{\partial x} + k \frac{\partial}{\partial y} \right)^2 f(x, y) &= h^2 \frac{\partial^2 f(x, y)}{\partial x^2} + 2hk \frac{\partial^2 f(x, y)}{\partial x \partial y} + k^2 \frac{\partial^2 f(x, y)}{\partial y^2}
 \end{aligned}$$

etc., and if $\left(h \frac{\partial}{\partial x} + k \frac{\partial}{\partial y} \right)^n f(x, y) \Big|_{x=a, y=b}$ with the bar and subscripts means that after differentiation we are to replace x by a and y by b ,

$$f(a+h, b+k) = f(a, b) + \left(h \frac{\partial}{\partial x} + k \frac{\partial}{\partial y} \right) f(x, y) \Big|_{x=a, y=b} + \dots + \frac{1}{n!} \left(h \frac{\partial}{\partial x} + k \frac{\partial}{\partial y} \right)^n f(x, y) \Big|_{x=a, y=b} + \dots$$

MACLAURIN

$$f(x) = f(0) + xf'(0) + \frac{x^2}{2!}f''(0) + \frac{x^3}{3!}f'''(0) + \dots + x^{n-1}\frac{f^{(n-1)}(0)}{(n-1)!} + R_n,$$

where

$$R_n = \frac{x^n f^{(n)}(\theta x)}{n!}, \quad 0 < \theta < 1.$$

EXPONENTIAL

$$\begin{aligned}
 e &= 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \dots \\
 e^x &= 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots \quad \text{(all real values of } x)
 \end{aligned}$$

$$a^x = 1 + x \log_e a + \frac{(x \log_e a)^2}{2!} + \frac{(x \log_e a)^3}{3!} + \dots$$

$$e^x = e^a \left[1 + (x-a) + \frac{(x-a)^2}{2!} + \frac{(x-a)^3}{3!} + \dots \right]$$

LOGARITHMIC

$$\log_e x = \frac{x-1}{x} + \frac{1}{2} \left(\frac{x-1}{x} \right)^2 + \frac{1}{3} \left(\frac{x-1}{x} \right)^3 + \dots \quad (x > \frac{1}{2})$$

$$\log_e x = (x-1) - \frac{1}{2}(x-1)^2 + \frac{1}{3}(x-1)^3 - \dots \quad (2 \geq x > 0)$$

$$\log_e x = 2 \left[\frac{x-1}{x+1} + \frac{1}{3} \left(\frac{x-1}{x+1} \right)^3 + \frac{1}{5} \left(\frac{x-1}{x+1} \right)^5 + \dots \right] \quad (x > 0)$$

$$\log_e(1+x) = x - \frac{1}{2}x^2 + \frac{1}{3}x^3 - \frac{1}{4}x^4 + \dots \quad (-1 < x \leq 1)$$

$$\log_e(n+1) - \log_e(n-1) = 2 \left[\frac{1}{n} + \frac{1}{3n^3} + \frac{1}{5n^5} + \dots \right]$$

$$\log_e(a+x) = \log_e a + 2 \left[\frac{x}{2a+x} + \frac{1}{3} \left(\frac{x}{2a+x} \right)^3 + \frac{1}{5} \left(\frac{x}{2a+x} \right)^5 + \dots \right] \quad (a > 0, -a < x < +\infty)$$

$$\log_e \frac{1+x}{1-x} = 2 \left[x + \frac{x^3}{3} + \frac{x^5}{5} + \dots + \frac{x^{2n-1}}{2n-1} + \dots \right] \quad -1 < x < 1$$

$$\log_e x = \log_e a + \frac{(x-a)}{a} - \frac{(x-a)^2}{2a^2} + \frac{(x-a)^3}{3a^3} - \dots \quad 0 < x \leq 2a$$

TRIGONOMETRIC

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots \quad (\text{all real values of } x)$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \dots \quad (\text{all real values of } x)$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \frac{62x^9}{2835} + \dots + \frac{(-1)^{n-1} 2^{2n} (2^{2n} - 1) B_{2n}}{(2n)!} x^{2n-1} + \dots,$$

[$x^2 < \frac{\pi^2}{4}$, and B_n represents the n th Bernoulli number.]

$$\cot x = \frac{1}{x} - \frac{x}{3} + \frac{x^3}{45} - \frac{2x^5}{945} + \frac{x^7}{4725} - \dots - \frac{(-1)^{n+1} 2^{2n}}{(2n)!} B_{2n} x^{2n-1} - \dots,$$

[$x^2 < \pi^2$, and B_n represents the n th Bernoulli number.]

$$\sec x = 1 + \frac{x^2}{2} + \frac{5}{24} x^4 + \frac{61}{720} x^6 + \frac{277}{8064} x^8 + \dots + \frac{(-1)^n E_{2n}}{(2n)!} x^{2n} + \dots,$$

[$x^2 < \frac{\pi^2}{4}$, and E_n represents the n th Euler number.]

$$\csc x = \frac{1}{x} + \frac{x}{6} + \frac{7}{360} x^3 + \frac{31}{15,120} x^5 + \frac{127}{604,800} x^7 + \dots$$

$$+ \frac{(-1)^{n+1} 2(2^{2n-1} - 1) B_{2n} x^{2n-1}}{(2n)!} + \dots,$$

[$x^2 < \pi^2$, and B_n represents n th Bernoulli number.]

$$\sin x = x \left(1 - \frac{x^2}{\pi^2} \right) \left(1 - \frac{x^2}{2^2 \pi^2} \right) \left(1 - \frac{x^2}{3^2 \pi^2} \right) \dots \quad (x^2 < \infty)$$

$$l \cos x = \left(1 - \frac{4x^2}{\pi^2} \right) \left(1 - \frac{4x^2}{3^2 \pi^2} \right) \left(1 - \frac{4x^2}{5^2 \pi^2} \right) \dots \quad (x^2 < \infty)$$

$$\sin^{-1} x = x + \frac{x^3}{2 \cdot 3} + \frac{1 \cdot 3}{2 \cdot 4 \cdot 5} x^5 + \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 7} x^7 + \dots \quad \left(x^2 < 1, -\frac{\pi}{2} < \sin^{-1} x < \frac{\pi}{2} \right)$$

$$\cos^{-1} x = \frac{\pi}{2} - \left(x + \frac{x^3}{2 \cdot 3} + \frac{1 \cdot 3}{2 \cdot 4 \cdot 5} x^5 + \frac{1 \cdot 3 \cdot 5 x^7}{2 \cdot 4 \cdot 6 \cdot 7} + \dots \right) \quad (x^2 < 1, 0 < \cos^{-1} x < \pi)$$

$$\tan^{-1} x = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots \quad (x^2 < 1)$$

$$\tan^{-1} x = \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \frac{1}{7x^7} - \dots \quad (x > 1)$$

$$\tan^{-1} x = -\frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \frac{1}{7x^7} - \dots \quad (x < -1)$$

$$\cot^{-1} x = \frac{\pi}{2} - x + \frac{x^3}{3} - \frac{x^5}{5} + \frac{x^7}{7} - \dots \quad (x^2 < 1)$$

$$\begin{aligned} \log_e \sin x &= \log_e x - \frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \dots && (x^2 < \pi^2) \\ \log_e \cos x &= -\frac{x^2}{2} - \frac{x^4}{12} - \frac{x^6}{45} - \frac{17x^8}{2520} - \dots && \left(x^2 < \frac{\pi^2}{4}\right) \\ \log_e \tan x &= \log_e x + \frac{x^2}{3} + \frac{7x^4}{90} + \frac{62x^6}{2835} + \dots && \left(x^2 < \frac{\pi^2}{4}\right) \\ e^{\sin x} &= 1 + x + \frac{x^2}{2!} - \frac{3x^4}{4!} - \frac{8x^5}{5!} - \frac{3x^6}{6!} + \frac{56x^7}{7!} + \dots \\ e^{\cos x} &= e \left(1 - \frac{x^2}{2!} + \frac{4x^4}{4!} - \frac{31x^6}{6!} + \dots \right) \\ e^{\tan x} &= 1 + x + \frac{x^2}{2!} + \frac{3x^3}{3!} + \frac{9x^4}{4!} + \frac{37x^5}{5!} + \dots && \left(x^2 < \frac{\pi^2}{4}\right) \\ \sin x &= \sin a + (x-a) \cos a - \frac{(x-a)^2}{2!} \sin a \\ &\quad - \frac{(x-a)^3}{3!} \cos a + \frac{(x-a)^4}{4!} \sin a + \dots \end{aligned}$$

VECTOR ANALYSIS

Definitions

Any quantity which is completely determined by its magnitude is called a *scalar*. Examples of such are mass, density, temperature, etc. Any quantity which is completely determined by its magnitude and direction is called a *vector*. Examples of such are velocity, acceleration, force, etc. A vector quantity is represented by a directed line segment, the length of which represents the magnitude of the vector. A vector quantity is usually represented by a boldfaced letter such as \mathbf{V} . Two vectors \mathbf{V}_1 and \mathbf{V}_2 are equal to one another if they have equal magnitudes and are acting in the same directions. A negative vectors written as $-\mathbf{V}$, is one which acts in the opposite direction to \mathbf{V} , but is of equal magnitude to it. If we represent the magnitude of \mathbf{V} by v , we write $|\mathbf{V}| = v$. A vector parallel to \mathbf{V} , but equal to the reciprocal of its magnitude is written as \mathbf{V}^{-1} or as $\frac{1}{\mathbf{V}}$.

The *unit vector* $\frac{\mathbf{V}}{v}$ ($v \neq 0$) is that vector which has the same direction as \mathbf{V} , but has a magnitude of unity (sometimes represented as \mathbf{V}_0 or $\hat{\mathbf{v}}$).

Vector Algebra

The vector sum of \mathbf{V}_1 and \mathbf{V}_2 is represented by $\mathbf{V}_1 + \mathbf{V}_2$. The vector sum of \mathbf{V}_1 and $-\mathbf{V}_2$, or the difference of the vector \mathbf{V}_2 from \mathbf{V}_1 is represented by $\mathbf{V}_1 - \mathbf{V}_2$.

If r is a scalar, then $r\mathbf{V} = \mathbf{V}r$, and represents a vector r times the magnitude of \mathbf{V} , in the same direction as \mathbf{V} if r is positive, and in the opposite direction if r is negative. If r and s are scalars, $\mathbf{V}_1, \mathbf{V}_2, \mathbf{V}_3$, vectors, then the following rules of scalars and vectors hold:

$$\begin{aligned}\mathbf{V}_1 + \mathbf{V}_2 &= \mathbf{V}_2 + \mathbf{V}_1 \\ (r + s)\mathbf{V}_1 &= r\mathbf{V}_1 + s\mathbf{V}_1; \quad r(\mathbf{V}_1 + \mathbf{V}_2) = r\mathbf{V}_1 + r\mathbf{V}_2 \\ \mathbf{V}_1 + (\mathbf{V}_2 + \mathbf{V}_3) &= (\mathbf{V}_1 + \mathbf{V}_2) + \mathbf{V}_3 = \mathbf{V}_1 + \mathbf{V}_2 + \mathbf{V}_3\end{aligned}$$

Vectors in Space

A plane is described by two distinct vectors \mathbf{V}_1 and \mathbf{V}_2 . Should these vectors not intersect each other, then one is displaced parallel to itself until they do (fig. 1). Any other vector \mathbf{V} lying in this plane is given by

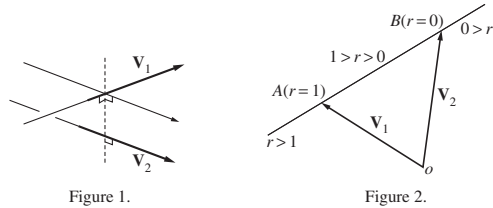
$$\mathbf{V} = r\mathbf{V}_1 + s\mathbf{V}_2$$

A *position vector* specifies the position in space of a point relative to a fixed origin. If therefore \mathbf{V}_1 and \mathbf{V}_2 are the position vectors of the points A and B , relative to the origin O , then any point P on the line AB has a position vector \mathbf{V} given by

$$\mathbf{V} = r\mathbf{V}_1 + (1 - r)\mathbf{V}_2$$

The scalar " r " can be taken as the parametric representation of P since $r = 0$ implies $P = B$ and $r = 1$ implies $P = A$ (fig. 2). If P divides the line AB in the ratio $r : s$ then

$$\mathbf{V} = \left(\frac{r}{r+s}\right)\mathbf{V}_1 + \left(\frac{s}{r+s}\right)\mathbf{V}_2$$



The vectors $V_1, V_2, V_3, \dots, V_n$ are said to be *linearly dependent* if there exist scalars $r_1, r_2, r_3, \dots, r_n$, not all zero, such that

$$r_1 V_1 + r_2 V_2 + \dots + r_n V_n = 0$$

A vector V is linearly dependent upon the set of vectors $V_1, V_2, V_3, \dots, V_n$ if

$$V = r_1 V_1 + r_2 V_2 + r_3 V_3 + \dots + r_n V_n$$

Three vectors are linearly dependent if and only if they are co-planar.

All points in space can be uniquely determined by linear dependence upon three *base vectors* i.e., three vectors any one of which is linearly independent of the other two. The simplest set of base vectors are the unit vectors along the coordinate Ox, Oy and Oz axes. These are usually designated by i, j and k respectively.

If V is a vector in space, and a, b and c are the respective magnitudes of the vector along the axes then

$$V = ai + bj + ck$$

and

$$v = \sqrt{a^2 + b^2 + c^2}$$

and the direction cosines of V are

$$\cos \alpha = a/v, \quad \cos \beta = b/v, \quad \cos \gamma = c/v.$$

The law of addition yields

$$V_1 + V_2 = (a_1 + a_2)i + (b_1 + b_2)j + (c_1 + c_2)k$$

The Scalar, Dot, or Inner Product of Two Vectors V_1 and V_2

This product is represented as $V_1 \cdot V_2$ and is defined to be equal to $v_1 v_2 \cos \theta$, where θ is the angle from V_1 to V_2 , i.e.,

$$V_1 \cdot V_2 = v_1 v_2 \cos \theta$$

The following rules apply for this product:

$$V_1 \cdot V_2 = a_1 a_2 + b_1 b_2 + c_1 c_2 = V_2 \cdot V_1$$

It should be noted that this verifies that scalar multiplication is commutative.

$$(V_1 + V_2) \cdot V_3 = V_1 \cdot V_3 + V_2 \cdot V_3$$

$$V_1 \cdot (V_2 + V_3) = V_1 \cdot V_2 + V_1 \cdot V_3$$

If V_1 is perpendicular to V_2 then $V_1 \cdot V_2 = 0$, and if V_1 is parallel to V_2 then $V_1 \cdot V_2 = v_1 v_2 = r w_1^2$

In particular

$$i \cdot i = j \cdot j = k \cdot k = 1,$$

and

$$i \cdot j = j \cdot k = k \cdot i = 0$$

The Vector or Cross Product of Vectors V_1 and V_2

This product is represented as $V_1 \times V_2$ and is defined to be equal to $v_1 v_2 (\sin \theta) \mathbf{1}$, where θ is the angle from V_1 to V_2 and $\mathbf{1}$ is a unit vector perpendicular to the plane of V_1 and V_2 , and so directed that a right-handed screw driven in the direction of $\mathbf{1}$ would carry V_1 into V_2 , i.e.,

$$V_1 \times V_2 = v_1 v_2 (\sin \theta) \mathbf{1}$$

and

$$\tan \theta = \frac{|V_1 \times V_2|}{V_1 \cdot V_2}$$

The following rules apply for vector products:

$$V_1 \times V_2 = -V_2 \times V_1$$

$$V_1 \times (V_2 + V_3) = V_1 \times V_2 + V_1 \times V_3$$

$$(V_1 + V_2) \times V_3 = V_1 \times V_3 + V_2 \times V_3$$

$$V_1 \times (V_2 \times V_3) = V_2(V_3 \cdot V_1) - V_3(V_1 \cdot V_2)$$

$$i \times i = j \times j = k \times k = \mathbf{0.1} \text{ (zero vector)} \\ = \mathbf{0}$$

$$i \times j = k, \quad j \times k = i, \quad k \times i = j$$

If $\mathbf{V}_1 = a_1\mathbf{i} + b_1\mathbf{j} + c_1\mathbf{k}$, $\mathbf{V}_2 = a_2\mathbf{i} + b_2\mathbf{j} + c_2\mathbf{k}$, $\mathbf{V}_3 = a_3\mathbf{i} + b_3\mathbf{j} + c_3\mathbf{k}$,
then

$$\mathbf{V}_1 \times \mathbf{V}_2 = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix} = (b_1c_2 - b_2c_1)\mathbf{i} + (c_1a_2 - c_2a_1)\mathbf{j} + (a_1b_2 - a_2b_1)\mathbf{k}$$

It should be noted that, since $\mathbf{V}_1 \times \mathbf{V}_2 = -\mathbf{V}_2 \times \mathbf{V}_1$, the vector product is not commutative.

Scalar Triple Product

There is only one possible interpretation of the expression $\mathbf{V}_1 \cdot \mathbf{V}_2 \times \mathbf{V}_3$ and that is $\mathbf{V}_1 \cdot (\mathbf{V}_2 \times \mathbf{V}_3)$ which is obviously a scalar.

Further $\mathbf{V}_1 \cdot (\mathbf{V}_2 \times \mathbf{V}_3) = (\mathbf{V}_1 \times \mathbf{V}_2) \cdot \mathbf{V}_3 = \mathbf{V}_2 \cdot (\mathbf{V}_3 \times \mathbf{V}_1)$

$$= \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} \\ = r_1r_2r_3 \cos \phi \sin \theta,$$

Where θ is the angle between \mathbf{V}_2 and \mathbf{V}_3 and ϕ is the angle between \mathbf{V}_1 and the normal to the plane of \mathbf{V}_2 and \mathbf{V}_3 . This product is called the *scalar triple product* and is written as $[\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3]$.

The determinant indicates that it can be considered as the volume of the parallelepiped whose three determining edges are \mathbf{V}_1 , \mathbf{V}_2 and \mathbf{V}_3 .

It also follows that cyclic permutation of the subscripts does not change the value of the scalar triple product so that

$$[\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3] = [\mathbf{V}_2\mathbf{V}_3\mathbf{V}_1] = [\mathbf{V}_3\mathbf{V}_1\mathbf{V}_2]$$

$$\text{but } [\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3] = -[\mathbf{V}_2\mathbf{V}_1\mathbf{V}_3] \text{ etc. and } [\mathbf{V}_1\mathbf{V}_1\mathbf{V}_2] \equiv 0 \text{ etc.}$$

Given three non-coplanar reference vectors \mathbf{V}_1 , \mathbf{V}_2 and \mathbf{V}_3 , the *reciprocal system* is given by \mathbf{V}_1^* , \mathbf{V}_2^* and \mathbf{V}_3^* , where

$$1 = v_1v_1^* = v_2v_2^* = v_3v_3^*$$

$$0 = v_1v_2^* = v_1v_3^* = v_2v_1^* \text{ etc.}$$

$$\mathbf{V}_1^* = \frac{\mathbf{V}_2 \times \mathbf{V}_3}{[\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3]}, \quad \mathbf{V}_2^* = \frac{\mathbf{V}_3 \times \mathbf{V}_1}{[\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3]}, \quad \mathbf{V}_3^* = \frac{\mathbf{V}_1 \times \mathbf{V}_2}{[\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3]}$$

The system \mathbf{i} , \mathbf{j} , \mathbf{k} is its own reciprocal.

Vector Triple Product

The product $\mathbf{V}_1 \times (\mathbf{V}_2 \times \mathbf{V}_3)$ defines the *vector triple product*. Obviously, in this case, the brackets are vital to the definition.

$$\mathbf{V}_1 \times (\mathbf{V}_2 \times \mathbf{V}_3) = (\mathbf{V}_1 \cdot \mathbf{V}_3)\mathbf{V}_2 - (\mathbf{V}_1 \cdot \mathbf{V}_2)\mathbf{V}_3 \\ = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_1 & b_1 & c_1 \\ \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} & \begin{vmatrix} c_2 & a_2 \\ c_3 & a_3 \end{vmatrix} & \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix} \end{vmatrix}$$

i.e. it is a vector, perpendicular to \mathbf{V}_1 , lying in the plane of \mathbf{V}_2 , \mathbf{V}_3 .

Similarly

$$(\mathbf{V}_1 \times \mathbf{V}_2) \times \mathbf{V}_3 = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \begin{vmatrix} b_1 & c_1 \\ b_2 & c_2 \end{vmatrix} & \begin{vmatrix} c_1 & a_1 \\ c_2 & a_2 \end{vmatrix} & \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} \\ a_3 & b_3 & c_3 \end{vmatrix} \\ \mathbf{V}_1 \times (\mathbf{V}_2 \times \mathbf{V}_3) + \mathbf{V}_2 \times (\mathbf{V}_3 \times \mathbf{V}_1) + \mathbf{V}_3 \times (\mathbf{V}_1 \times \mathbf{V}_2) \equiv 0$$

If $\mathbf{V}_1 \times (\mathbf{V}_2 \times \mathbf{V}_3) = (\mathbf{V}_1 \times \mathbf{V}_2) \times \mathbf{V}_3$ then \mathbf{V}_1 , \mathbf{V}_2 , \mathbf{V}_3 form an *orthogonal set*. Thus \mathbf{i} , \mathbf{j} , \mathbf{k} form an orthogonal set.

Geometry of the Plane, Straight Line and Sphere

The position vectors of the fixed points A , B , C , D relative to O are \mathbf{V}_1 , \mathbf{V}_2 , \mathbf{V}_3 , \mathbf{V}_4 and the position vector of the variable point P is \mathbf{V} .

The vector form of the equation of the straight line through A parallel to \mathbf{V}_2 is

$$\mathbf{V} = \mathbf{V}_1 + r\mathbf{V}_2$$

$$\text{or } (\mathbf{V} - \mathbf{V}_1) = r\mathbf{V}_2$$

$$\text{or } (\mathbf{V} - \mathbf{V}_1) \times \mathbf{V}_2 = 0$$

while that of the plane through A perpendicular to \mathbf{V}_2 is

$$(\mathbf{V} - \mathbf{V}_1) \cdot \mathbf{V}_2 = 0$$

The equation of the line AB is

$$\mathbf{V} = r\mathbf{V}_1 + (1 - r)\mathbf{V}_2$$

and those of the bisectors of the angles between \mathbf{V}_1 and \mathbf{V}_2 are

$$\mathbf{V} = r \left(\frac{\mathbf{V}_1}{v_1} \pm \frac{\mathbf{V}_2}{v_2} \right)$$

$$\text{or } \mathbf{V} = r(\hat{\mathbf{v}}_1 \pm \hat{\mathbf{v}}_2)$$

The perpendicular from C to the line through A parallel to \mathbf{V}_2 has as its equation

$$\mathbf{V} = \mathbf{V}_1 - \mathbf{V}_3 - \hat{\mathbf{v}}_2 \cdot (\mathbf{V}_1 - \mathbf{V}_3) \hat{\mathbf{v}}_2.$$

The condition for the intersection of the two lines,

$$\mathbf{V} = \mathbf{V}_1 + r\mathbf{V}_3$$

$$\text{and } \mathbf{V} = \mathbf{V}_2 + s\mathbf{V}_4$$

$$\text{is } [(\mathbf{V}_1 - \mathbf{V}_2)\mathbf{V}_3\mathbf{V}_4] = 0.$$

The common perpendicular to the above two lines is the line of intersection of the two planes

$$[(\mathbf{V} - \mathbf{V}_1)\mathbf{V}_3(\mathbf{V}_3 \times \mathbf{V}_4)] = 0$$

$$\text{and } [(\mathbf{V} - \mathbf{V}_2)\mathbf{V}_4(\mathbf{V}_3 \times \mathbf{V}_4)] = 0$$

and the length of this perpendicular is

$$\frac{[(\mathbf{V}_1 - \mathbf{V}_2)\mathbf{V}_3\mathbf{V}_4]}{|\mathbf{V}_3 \times \mathbf{V}_4|}.$$

The equation of the line perpendicular to the plane ABC is

$$\mathbf{V} = \mathbf{V}_1 \times \mathbf{V}_2 + \mathbf{V}_2 \times \mathbf{V}_3 + \mathbf{V}_3 \times \mathbf{V}_1$$

and the distance of the plane from the origin is

$$\frac{[\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3]}{|(\mathbf{V}_2 - \mathbf{V}_1) \times (\mathbf{V}_3 - \mathbf{V}_1)|}.$$

In general the vector equation

$$\mathbf{V} \cdot \mathbf{V}_2 = r$$

defines the plane which is perpendicular to \mathbf{V}_2 , and the perpendicular distance from A to this plane is

$$\frac{r - \mathbf{V}_1 \cdot \mathbf{V}_2}{v_2}$$

The distance from A , measured along a line parallel to \mathbf{V}_3 , is

$$\frac{r - \mathbf{V}_1 \cdot \mathbf{V}_2}{\mathbf{V}_2 \cdot \hat{\mathbf{v}}_3} \quad \text{or} \quad \frac{r - \mathbf{V}_1 \cdot \mathbf{V}_2}{v_2 \cos \theta}$$

where θ is the angle between \mathbf{V}_2 and \mathbf{V}_3 .

(If this plane contains the point C then $r = \mathbf{V}_3 \cdot \mathbf{V}_2$ and if it passes through the origin then $r = 0$.)

Given two planes

$$\mathbf{V} \cdot \mathbf{V}_1 = r$$

$$\mathbf{V} \cdot \mathbf{V}_2 = s$$

then any plane through the line of intersection of these two planes is given by

$$\mathbf{V} \cdot (\mathbf{V}_1 + \lambda\mathbf{V}_2) = r + \lambda s$$

where λ is a scalar parameter. In particular $\lambda = \pm v_1/v_2$ yields the equation of the two planes bisecting the angle between the given planes.

The plane through A parallel to the plane of $\mathbf{V}_2, \mathbf{V}_3$ is

$$\mathbf{V} = \mathbf{V}_1 + r\mathbf{V}_2 + s\mathbf{V}_3$$

$$\text{or } (\mathbf{V} - \mathbf{V}_1) \cdot \mathbf{V}_2 \times \mathbf{V}_3 = 0$$

$$\text{or } [\mathbf{V}\mathbf{V}_2\mathbf{V}_3] - [\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3] = 0$$

so that the expansion in rectangular Cartesian coordinates yields

$$\begin{vmatrix} (x - a_1) & (y - b_1) & (z - c_1) \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0 \quad (\mathbf{V} \equiv x\mathbf{i} + y\mathbf{j} + z\mathbf{k})$$

which is obviously the usual linear equation in x, y and z .

The plane through AB parallel to \mathbf{V}_3 is given by

$$[(\mathbf{V} - \mathbf{V}_1)(\mathbf{V}_1 - \mathbf{V}_2)\mathbf{V}_3] = 0$$

$$\text{or } [\mathbf{V}\mathbf{V}_2\mathbf{V}_3] - [\mathbf{V}\mathbf{V}_1\mathbf{V}_3] - [\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3] = 0$$

The plane through the three points A, B and C is

$$\mathbf{V} = \mathbf{V}_1 + s(\mathbf{V}_2 - \mathbf{V}_1) + t(\mathbf{V}_3 - \mathbf{V}_1)$$

$$\begin{aligned} \text{or } \mathbf{V} &= r\mathbf{V}_1 + s\mathbf{V}_2 + t\mathbf{V}_3 \quad (r + s + t \equiv 1) \\ \text{or } &[(\mathbf{V} - \mathbf{V}_1)(\mathbf{V}_1 - \mathbf{V}_2)(\mathbf{V}_2 - \mathbf{V}_3)] = 0 \\ \text{or } &[\mathbf{V}\mathbf{V}_1\mathbf{V}_2] + [\mathbf{V}\mathbf{V}_2\mathbf{V}_3] + [\mathbf{V}\mathbf{V}_3\mathbf{V}_1] - [\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3] = 0 \end{aligned}$$

For four points A, B, C, D to be coplanar, then

$$r\mathbf{V}_1 + s\mathbf{V}_2 + t\mathbf{V}_3 + u\mathbf{V}_4 \equiv 0 \equiv r + s + t + u$$

The following formulae relate to a sphere when the vectors are taken to lie in three dimensional space and to a circle when the space is two dimensional. For a circle in three dimensions take the intersection of the sphere with a plane.

The equation of a sphere with center O and radius OA is

$$\begin{aligned} \mathbf{V} \cdot \mathbf{V} &= v_1^2 \quad (\text{not } \mathbf{V} = \mathbf{V}_1) \\ \text{or } (\mathbf{V} - \mathbf{V}_1) \cdot (\mathbf{V} + \mathbf{V}_1) &= 0 \end{aligned}$$

while that of a sphere with center B radius v_1 is

$$\begin{aligned} (\mathbf{V} - \mathbf{V}_2) \cdot (\mathbf{V} - \mathbf{V}_2) &= v_1^2 \\ \text{or } \mathbf{V} \cdot (\mathbf{V} - 2\mathbf{V}_2) &= v_1^2 - v_2^2 \end{aligned}$$

If the above sphere passes through the origin then

$$\mathbf{V} \cdot (\mathbf{V} - 2\mathbf{V}_2) = 0$$

(note that in two dimensional polar coordinates this is simply)

$$r = 2a \cdot \cos \theta$$

while in three dimensional Cartesian coordinates it is

$$x^2 + y^2 + z^2 - 2(a_2x + b_2y + c_2z) = 0.$$

The equation of a sphere having the points A and B as the extremities of a diameter is

$$(\mathbf{V} - \mathbf{V}_1) \cdot (\mathbf{V} - \mathbf{V}_2) = 0.$$

The square of the length of the tangent from C to the sphere with center B and radius v_1 is given by

$$(\mathbf{V}_3 - \mathbf{V}_2) \cdot (\mathbf{V}_3 - \mathbf{V}_2) = v_1^2$$

The condition that the plane $\mathbf{V} \cdot \mathbf{V}_3 = s$ is tangential to the sphere $(\mathbf{V} - \mathbf{V}_2) \cdot (\mathbf{V} - \mathbf{V}_2) = v_1^2$ is

$$(s - \mathbf{V}_3 \cdot \mathbf{V}_2) \cdot (s - \mathbf{V}_3 \cdot \mathbf{V}_2) = v_1^2 v_3^2.$$

The equation of the tangent plane at D , on the surface of sphere $(\mathbf{V} - \mathbf{V}_2) \cdot (\mathbf{V} - \mathbf{V}_2) = v_1^2$, is

$$\begin{aligned} (\mathbf{V} - \mathbf{V}_4) \cdot (\mathbf{V}_4 - \mathbf{V}_2) &= 0 \\ \text{or } \mathbf{V} \cdot \mathbf{V}_4 - \mathbf{V}_2 \cdot (\mathbf{V} + \mathbf{V}_4) &= v_1^2 - v_2^2 \end{aligned}$$

The condition that the two circles $(\mathbf{V} - \mathbf{V}_2) \cdot (\mathbf{V} - \mathbf{V}_2) = v_1^2$ and $(\mathbf{V} - \mathbf{V}_4) \cdot (\mathbf{V} - \mathbf{V}_4) = v_3^2$ intersect orthogonally is clearly

$$(\mathbf{V}_2 - \mathbf{V}_4) \cdot (\mathbf{V}_2 - \mathbf{V}_4) = v_1^2 + v_3^2$$

The polar plane of D with respect to the circle

$$\begin{aligned} (\mathbf{V} - \mathbf{V}_2) \cdot (\mathbf{V} - \mathbf{V}_2) &= v_1^2 \quad \text{is} \\ \mathbf{V} \cdot \mathbf{V}_4 - \mathbf{V}_2 \cdot (\mathbf{V} + \mathbf{V}_4) &= v_1^2 - v_2^2 \end{aligned}$$

Any sphere through the intersection of the two spheres $(\mathbf{V} - \mathbf{V}_2) \cdot (\mathbf{V} - \mathbf{V}_2) = v_1^2$ and $(\mathbf{V} - \mathbf{V}_4) \cdot (\mathbf{V} - \mathbf{V}_4) = v_3^2$ is given by

$$(\mathbf{V} - \mathbf{V}_2) \cdot (\mathbf{V} - \mathbf{V}_2) + \lambda(\mathbf{V} - \mathbf{V}_4) \cdot (\mathbf{V} - \mathbf{V}_4) = v_1^2 + \lambda v_3^2$$

while the radical plane of two such spheres is

$$\mathbf{V} \cdot (\mathbf{V}_2 - \mathbf{V}_4) = -\frac{1}{2}(v_1^2 - v_2^2 - v_3^2 + v_4^2)$$

Differentiation of Vectors

If $\mathbf{V}_1 = a_1\mathbf{i} + b_1\mathbf{j} + c_1\mathbf{k}$, and $\mathbf{V}_2 = a_2\mathbf{i} + b_2\mathbf{j} + c_2\mathbf{k}$, and if \mathbf{V}_1 and \mathbf{V}_2 are functions of the scalar t , then

$$\begin{aligned} \frac{d}{dt}(\mathbf{V}_1 + \mathbf{V}_2 + \dots) &= \frac{d\mathbf{V}_1}{dt} + \frac{d\mathbf{V}_2}{dt} + \dots, \\ \text{where } \frac{d\mathbf{V}_1}{dt} &= \frac{da_1}{dt}\mathbf{i} + \frac{db_1}{dt}\mathbf{j} + \frac{dc_1}{dt}\mathbf{k}, \text{ etc.} \\ \frac{d}{dt}(\mathbf{V}_1 \cdot \mathbf{V}_2) &= \frac{d\mathbf{V}_1}{dt} \cdot \mathbf{V}_2 + \mathbf{V}_1 \cdot \frac{d\mathbf{V}_2}{dt} \\ \frac{d}{dt}(\mathbf{V}_1 \times \mathbf{V}_2) &= \frac{d\mathbf{V}_1}{dt} \times \mathbf{V}_2 + \mathbf{V}_1 \times \frac{d\mathbf{V}_2}{dt} \\ \mathbf{V} \cdot \frac{d\mathbf{V}}{dt} &= v \cdot \frac{dv}{dt} \end{aligned}$$

In particular, if \mathbf{V} is a vector of constant length then the right hand side of the last equation is identically zero showing that \mathbf{V} is perpendicular to its derivative.

The derivatives of the triple products are

$$\frac{d}{dt}[\mathbf{V}_1 \mathbf{V}_2 \mathbf{V}_3] = \left[\left(\frac{d\mathbf{V}_1}{dt} \right) \mathbf{V}_2 \mathbf{V}_3 \right] + \left[\mathbf{V}_1 \left(\frac{d\mathbf{V}_2}{dt} \right) \mathbf{V}_3 \right] + \left[\mathbf{V}_1 \mathbf{V}_2 \left(\frac{d\mathbf{V}_3}{dt} \right) \right]$$

and
$$\frac{d}{dt}(\mathbf{V}_1 \times (\mathbf{V}_2 \times \mathbf{V}_3)) = \left(\frac{d\mathbf{V}_1}{dt} \right) \times (\mathbf{V}_2 \times \mathbf{V}_3) + \mathbf{V}_1 \times \left(\left(\frac{d\mathbf{V}_2}{dt} \right) \times \mathbf{V}_3 \right) + \mathbf{V}_1 \times \left(\mathbf{V}_2 \times \left(\frac{d\mathbf{V}_3}{dt} \right) \right)$$

Geometry of Curves in Space

s = the length of arc, measured from some fixed point on the curve (fig. 3).

\mathbf{V}_1 = the position vector of the point A on the curve

$\mathbf{V}_1 + \delta\mathbf{V}_1$ = the position vector of the point P in the neighborhood of A

$\hat{\mathbf{t}}$ = the unit tangent to the curve at the point A , measured in the direction of s increasing.

The normal plane is that plane which is perpendicular to the unit tangent. The principal normal is defined as the intersection of the normal plane with the plane defined by \mathbf{V}_1 and $\mathbf{V}_1 + \delta\mathbf{V}_1$ in the limit as $\delta\mathbf{V}_1 \rightarrow 0$.

$\hat{\mathbf{n}}$ = the unit normal (principal) at the point A . The plane defined by $\hat{\mathbf{t}}$ and $\hat{\mathbf{n}}$ is called the *osculating plane* (alternatively plane of curvature or local plane).

ρ = the radius of curvature at A .

$\delta\theta$ = the angle subtended at the origin by $\delta\mathbf{V}_1$.

$$\kappa = \frac{d\theta}{ds} = \frac{1}{\rho}$$

$\hat{\mathbf{b}}$ = the unit binormal i.e. the unit vector which is parallel to $\hat{\mathbf{t}} \times \hat{\mathbf{n}}$ at the point A :

λ = the torsion of the curve at A

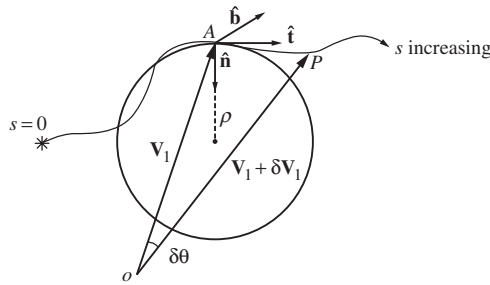


Figure 3.

Frenet's Formulae:

$$\begin{aligned} \frac{d\hat{\mathbf{t}}}{ds} &= \kappa \hat{\mathbf{n}} \\ \frac{d\hat{\mathbf{n}}}{ds} &= -\kappa \hat{\mathbf{t}} + \lambda \hat{\mathbf{b}} \\ \frac{d\hat{\mathbf{b}}}{ds} &= -\lambda \hat{\mathbf{n}} \end{aligned}$$

The following formulae are also applicable:

Unit tangent	$\hat{\mathbf{t}} = \frac{d\mathbf{V}_1}{ds}$
Equation of the tangent	$(\mathbf{V} - \mathbf{V}_1) \times \hat{\mathbf{t}} = 0$
or	$\mathbf{V} = \mathbf{V}_1 + q\hat{\mathbf{t}}$
Unit normal	$\hat{\mathbf{n}} = \frac{1d^2\mathbf{V}_1}{\kappa ds^2}$
Equation of the normal plane	$(\mathbf{V} - \mathbf{V}_1) \cdot \hat{\mathbf{t}} = 0$
Equation of the normal	$(\mathbf{V} - \mathbf{V}_1) \times \hat{\mathbf{n}} = 0$
or	$\mathbf{V} = \mathbf{V}_1 + r\hat{\mathbf{n}}$
Unit binormal	$\hat{\mathbf{b}} = \hat{\mathbf{t}} \times \hat{\mathbf{n}}$
Equation of the binormal	$(\mathbf{V} - \mathbf{V}_1) \times \hat{\mathbf{b}} = 0$
or	$\mathbf{V} = \mathbf{V}_1 + u\hat{\mathbf{b}}$
or	$\mathbf{V} = \mathbf{V}_1 + w \frac{d\mathbf{V}_1}{ds} \times \frac{d^2\mathbf{V}_1}{ds^2}$

Equation of the osculating plane:

$$[(\mathbf{V} - \mathbf{V}_1)\hat{\mathbf{t}}\hat{\mathbf{n}}] = 0$$

or
$$\left[(\mathbf{V} - \mathbf{V}_1) \left(\frac{d\mathbf{V}_1}{ds} \right) \left(\frac{d^2\mathbf{V}_1}{ds^2} \right) \right] = 0$$

A *geodesic line* on a surface is a curve, the osculating plane of which is everywhere normal to the surface.

The differential equation of the geodesic is

$$[\hat{\mathbf{n}} d\mathbf{V}_1 d^2\mathbf{V}_1] = 0$$

Differential Operators—Rectangular Coordinates

$$dS = \frac{\partial S}{\partial x} \cdot dx + \frac{\partial S}{\partial y} \cdot dy + \frac{\partial S}{\partial z} \cdot dz$$

By definition

$$\nabla \equiv \text{del} \equiv \mathbf{i} \frac{\partial}{\partial x} + \mathbf{j} \frac{\partial}{\partial y} + \mathbf{k} \frac{\partial}{\partial z}$$

$$\nabla^2 \equiv \text{Laplacian} \equiv \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}$$

If S is a scalar function, then

$$\nabla S \equiv \text{grad } S \equiv \frac{\partial S}{\partial x} \mathbf{i} + \frac{\partial S}{\partial y} \mathbf{j} + \frac{\partial S}{\partial z} \mathbf{k}$$

Grad S defines both the direction and magnitude of the maximum rate of increase of S at any point. Hence the name *gradient* and also its vectorial nature. ∇S is independent of the choice of rectangular coordinates.

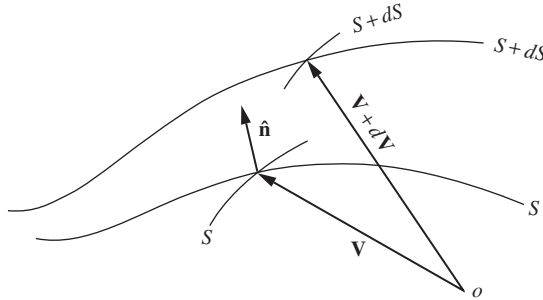


Figure 4.

$$\nabla S = \frac{\partial S}{\partial n} \hat{\mathbf{n}}$$

where $\hat{\mathbf{n}}$ is the unit normal to the surface $S = \text{constant}$, in the direction of S increasing. The total derivative of S at a point having the position vector \mathbf{V} is given by (fig. 4)

$$\begin{aligned} dS &= \frac{\partial S}{\partial n} \hat{\mathbf{n}} \cdot d\mathbf{V} \\ &= d\mathbf{V} \cdot \nabla S \end{aligned}$$

and the directional derivative of S in the direction of \mathbf{U} is

$$\mathbf{U} \cdot \nabla S = \mathbf{U} \cdot (\nabla S) = (\mathbf{U} \cdot \nabla) S$$

Similarly the directional derivative of the vector \mathbf{V} in the direction of \mathbf{U} is

$$(\mathbf{U} \cdot \nabla) \mathbf{V}$$

The *distributive* law holds for finding a gradient. Thus if S and T are scalar functions

$$\nabla(S + T) = \nabla S + \nabla T$$

The *associative* law becomes the rule for differentiating a product:

$$\nabla(ST) = S\nabla T + T\nabla S$$

If \mathbf{V} is a vector function with the magnitudes of the components parallel to the three coordinate axes V_x, V_y, V_z , then

$$\nabla \cdot \mathbf{V} \equiv \text{div } \mathbf{V} \equiv \frac{\partial V_x}{\partial x} + \frac{\partial V_y}{\partial y} + \frac{\partial V_z}{\partial z}$$

The divergence obeys the distributive law. Thus, if \mathbf{V} and \mathbf{U} are vector functions, then

$$\nabla \cdot (\mathbf{V} + \mathbf{U}) = \nabla \cdot \mathbf{V} + \nabla \cdot \mathbf{U}$$

$$\nabla \cdot (S\mathbf{V}) = (\nabla S) \cdot \mathbf{V} + S(\nabla \cdot \mathbf{V})$$

$$\nabla \cdot (\mathbf{U} \times \mathbf{V}) = \mathbf{V} \cdot (\nabla \times \mathbf{U}) - \mathbf{U} \cdot (\nabla \times \mathbf{V})$$

As with the gradient of a scalar, the divergence of a vector is invariant under a transformation from one set of rectangular coordinates to another.

$$\nabla \times \mathbf{V} \equiv \text{curl } \mathbf{V} \text{ (sometimes } \nabla \wedge \mathbf{V} \text{ or rot } \mathbf{V})$$

$$\equiv \left(\frac{\partial V_x}{\partial y} - \frac{\partial V_y}{\partial x} \right) \mathbf{i} + \left(\frac{\partial V_x}{\partial z} - \frac{\partial V_z}{\partial x} \right) \mathbf{j} + \left(\frac{\partial V_y}{\partial z} - \frac{\partial V_z}{\partial y} \right) \mathbf{k}$$

$$= \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ V_x & V_y & V_z \end{vmatrix}$$

The *curl* (or *rotation*) of a vector is a vector which is invariant under a transformation from one set of rectangular coordinates to another.

$$\begin{aligned}\nabla \times (\mathbf{U} + \mathbf{V}) &= \nabla \times \mathbf{U} + \nabla \times \mathbf{V} \\ \nabla \times (S\mathbf{V}) &= (\nabla S) \times \mathbf{V} + S(\nabla \times \mathbf{V}) \\ \nabla \times (\mathbf{U} \times \mathbf{V}) &= (\mathbf{V} \cdot \nabla)\mathbf{U} - (\mathbf{U} \cdot \nabla)\mathbf{V} + \mathbf{U}(\nabla \cdot \mathbf{V}) - \mathbf{V}(\nabla \cdot \mathbf{U}) \\ \text{grad}(\mathbf{U} \cdot \mathbf{V}) &= \nabla(\mathbf{U} \cdot \mathbf{V}) \\ &= (\mathbf{V} \cdot \nabla)\mathbf{U} + (\mathbf{U} \cdot \nabla)\mathbf{V} + \mathbf{V} \times (\nabla \times \mathbf{U}) + \mathbf{U} \times (\nabla \times \mathbf{V})\end{aligned}$$

If

$$\begin{aligned}\mathbf{V} &= V_x \mathbf{i} + V_y \mathbf{j} + V_z \mathbf{k} \\ \nabla \cdot \mathbf{V} &= \nabla V_x \cdot \mathbf{i} + \nabla V_y \cdot \mathbf{j} + \nabla V_z \cdot \mathbf{k} \\ \text{and } \nabla \times \mathbf{V} &= \nabla V_x \times \mathbf{i} + \nabla V_y \times \mathbf{j} + \nabla V_z \times \mathbf{k}\end{aligned}$$

The operator ∇ can be used more than once. The number of possibilities where ∇ is used twice are

$$\begin{aligned}\nabla \cdot (\nabla \theta) &\equiv \text{div grad } \theta \\ \nabla \times (\nabla \theta) &\equiv \text{curl grad } \theta \\ \nabla(\nabla \cdot \mathbf{V}) &\equiv \text{grad div } \mathbf{V} \\ \nabla \cdot (\nabla \times \mathbf{V}) &\equiv \text{div curl } \mathbf{V} \\ \nabla \times (\nabla \times \mathbf{V}) &\equiv \text{curl curl } \mathbf{V}\end{aligned}$$

Thus:

$$\begin{aligned}\text{div grad } S &\equiv \nabla \cdot (\nabla S) \equiv \text{Laplacian } S \equiv \nabla^2 S \\ &\equiv \frac{\partial^2 S}{\partial x^2} + \frac{\partial^2 S}{\partial y^2} + \frac{\partial^2 S}{\partial z^2}\end{aligned}$$

curl grad $S \equiv 0$;

$$\begin{aligned}\text{curl curl } \mathbf{V} &\equiv \text{grad div } \mathbf{V} - \nabla^2 \mathbf{V}; \\ \text{div curl } \mathbf{V} &\equiv 0\end{aligned}$$

Taylor's expansion in three dimensions can be written

$$\begin{aligned}\text{where } f(\mathbf{V} + \varepsilon) &= e^{\varepsilon \cdot \nabla} f(\mathbf{V}) \\ \text{and } \mathbf{V} &= x\mathbf{i} + y\mathbf{j} + z\mathbf{k} \\ \text{and } \varepsilon &= h\mathbf{i} + l\mathbf{j} + m\mathbf{k}\end{aligned}$$

(note the analogy with $f_p = e^{phD} f_0$ in finite difference methods).

Orthogonal Curvilinear Coordinates

If at a point P there exist three uniform point functions u , v and w so that the surfaces $u = \text{const.}$, $v = \text{const.}$, and $w = \text{const.}$, intersect in three distinct curves through P then the surfaces are called the *coordinate surfaces* through P . The three lines of intersection are referred to as the *coordinate lines* and their tangents a , b , and c as the *coordinate axes*. When the coordinate axes form an orthogonal set the system is said to define *orthogonal curvilinear coordinates* at P .

Consider an infinitesimal volume enclosed by the surfaces u , v , w , $u + du$, $v + dv$, and $w + dw$ (fig. 5).

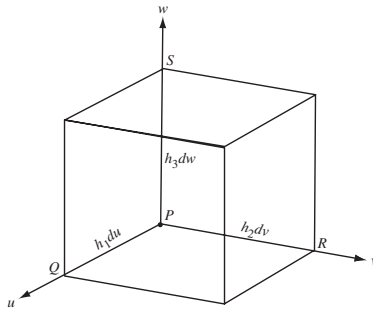


Figure 5.

The surface $PRS \equiv u = \text{const.}$, and the face of the curvilinear figure immediately opposite this is $u + du = \text{const.}$ etc.

In terms of these surface constants

$$\begin{aligned}P &= P(u, v, w) \\ Q &= Q(u + du, v, w) \quad \text{and} \quad PQ = h_1 du\end{aligned}$$

$$R = R(u, v + dv, w) \quad PR = h_2 dv$$

$$S = S(u, v, w + dw) \quad PS = h_3 dw$$

where $h_1, h_2,$ and h_3 are functions of $u, v,$ and $w.$

In rectangular Cartesians $\mathbf{i}, \mathbf{j}, \mathbf{k}$

$$h_1 = 1, \quad h_2 = 1, \quad h_3 = 1.$$

$$\frac{\hat{\mathbf{a}}}{h_1} \frac{\partial}{\partial u} = \mathbf{i} \frac{\partial}{\partial x}, \quad \frac{\hat{\mathbf{b}}}{h_2} \frac{\partial}{\partial v} = \mathbf{j} \frac{\partial}{\partial y}, \quad \frac{\hat{\mathbf{c}}}{h_3} \frac{\partial}{\partial w} = \mathbf{k} \frac{\partial}{\partial z}$$

In cylindrical coordinates $\hat{\mathbf{r}}, \hat{\boldsymbol{\phi}}, \hat{\mathbf{k}}$

$$h_1 = 1, \quad h_2 = r, \quad h_3 = 1.$$

$$\frac{\hat{\mathbf{a}}}{h_1} \frac{\partial}{\partial u} = \hat{\mathbf{r}} \frac{\partial}{\partial r}, \quad \frac{\hat{\mathbf{b}}}{h_2} \frac{\partial}{\partial v} = \frac{\hat{\boldsymbol{\phi}}}{r} \frac{\partial}{\partial \phi}, \quad \frac{\hat{\mathbf{c}}}{h_3} \frac{\partial}{\partial w} = \hat{\mathbf{k}} \frac{\partial}{\partial z}$$

In spherical coordinates $\hat{\mathbf{r}}, \hat{\boldsymbol{\theta}}, \hat{\boldsymbol{\phi}}$

$$h_1 = 1, \quad h_2 = r, \quad h_3 = r \sin \theta$$

$$\frac{\hat{\mathbf{a}}}{h_1} \frac{\partial}{\partial u} = \hat{\mathbf{r}} \frac{\partial}{\partial r}, \quad \frac{\hat{\mathbf{b}}}{h_2} \frac{\partial}{\partial v} = \frac{\hat{\boldsymbol{\phi}}}{r} \frac{\partial}{\partial \theta}, \quad \frac{\hat{\mathbf{c}}}{h_3} \frac{\partial}{\partial w} = \frac{\hat{\boldsymbol{\phi}}}{r \sin \theta} \frac{\partial}{\partial \phi}$$

The general expressions for grad, div and curl together with those for ∇^2 and the directional derivative are, in orthogonal curvilinear coordinates, given by

$$\nabla S = \frac{\hat{\mathbf{a}}}{h_1} \frac{\partial S}{\partial u} + \frac{\hat{\mathbf{b}}}{h_2} \frac{\partial S}{\partial v} + \frac{\hat{\mathbf{c}}}{h_3} \frac{\partial S}{\partial w}$$

$$(\mathbf{V} \cdot \nabla)S = \frac{V_1}{h_1} \frac{\partial S}{\partial u} + \frac{V_2}{h_2} \frac{\partial S}{\partial v} + \frac{V_3}{h_3} \frac{\partial S}{\partial w}$$

$$\nabla \cdot \mathbf{V} = \frac{1}{h_1 h_2 h_3} \left\{ \frac{\partial}{\partial u} (h_2 h_3 V_1) + \frac{\partial}{\partial v} (h_3 h_1 V_2) + \frac{\partial}{\partial w} (h_1 h_2 V_3) \right\}$$

$$\nabla \times \mathbf{V} = \frac{\hat{\mathbf{a}}}{h_2 h_3} \left\{ \frac{\partial}{\partial v} (h_3 V_3) - \frac{\partial}{\partial w} (h_2 V_2) \right\} + \frac{\hat{\mathbf{b}}}{h_3 h_1} \left\{ \frac{\partial}{\partial w} (h_1 V_1) - \frac{\partial}{\partial u} (h_3 V_3) \right\}$$

$$+ \frac{\hat{\mathbf{c}}}{h_1 h_2} \left\{ \frac{\partial}{\partial u} (h_2 V_2) - \frac{\partial}{\partial v} (h_1 V_1) \right\}$$

$$\nabla^2 S = \frac{1}{h_1 h_2 h_3} \left\{ \frac{\partial}{\partial u} \left(\frac{h_2 h_3}{h_1} \frac{\partial S}{\partial u} \right) + \frac{\partial}{\partial v} \left(\frac{h_3 h_1}{h_2} \frac{\partial S}{\partial v} \right) + \frac{\partial}{\partial w} \left(\frac{h_1 h_2}{h_3} \frac{\partial S}{\partial w} \right) \right\}$$

FORMULAS OF VECTOR ANALYSIS

	Rectangular coordinates	Cylindrical coordinates	Spherical coordinates
Conversion to rectangular coordinates		$x = r \cos \phi \quad y = r \sin \phi \quad z = z$	$x = r \cos \phi \sin \theta \quad y = r \sin \phi \sin \theta$ $z = r \cos \theta$
Gradient	$\nabla \phi = \frac{\partial \phi}{\partial x} \mathbf{i} + \frac{\partial \phi}{\partial y} \mathbf{j} + \frac{\partial \phi}{\partial z} \mathbf{k}$	$\nabla \phi = \frac{\partial \phi}{\partial r} \mathbf{r} + \frac{1}{r} \frac{\partial \phi}{\partial \phi} \boldsymbol{\phi} + \frac{\partial \phi}{\partial z} \mathbf{k}$	$\nabla \phi = \frac{\partial \phi}{\partial r} \mathbf{r} + \frac{1}{r} \frac{\partial \phi}{\partial \theta} \boldsymbol{\theta} + \frac{1}{r \sin \theta} \frac{\partial \phi}{\partial \phi} \boldsymbol{\phi}$
Divergence	$\nabla \cdot \mathbf{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$	$\nabla \cdot \mathbf{A} = \frac{1}{r} \frac{\partial (r A_r)}{\partial r} + \frac{1}{r} \frac{\partial A_\phi}{\partial \phi} + \frac{\partial A_z}{\partial z}$	$\nabla \cdot \mathbf{A} = \frac{1}{r^2} \frac{\partial (r^2 A_r)}{\partial r} + \frac{1}{r \sin \theta} \frac{\partial (A_\theta \sin \theta)}{\partial \theta} + \frac{1}{r \sin \theta} \frac{\partial A_\phi}{\partial \phi}$
Curl	$\nabla \times \mathbf{A} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ A_x & A_y & A_z \end{vmatrix}$	$\nabla \times \mathbf{A} = \begin{vmatrix} \frac{1}{r} \mathbf{r} & \boldsymbol{\phi} & \frac{1}{r} \mathbf{k} \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \phi} & \frac{\partial}{\partial z} \\ A_r & r A_\phi & A_z \end{vmatrix}$	$\nabla \times \mathbf{A} = \begin{vmatrix} \mathbf{r} & \boldsymbol{\theta} & \boldsymbol{\phi} \\ r^2 \sin \theta & r \sin \theta & r \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial \phi} \\ A_r & r A_\theta & r A_\phi \sin \theta \end{vmatrix}$
Laplacian	$\nabla^2 \phi = \frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + \frac{\partial^2 \phi}{\partial z^2}$	$\nabla^2 \phi = \frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial \phi}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 \phi}{\partial \phi^2} + \frac{\partial^2 \phi}{\partial z^2}$	$\nabla^2 \phi = \frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial \phi}{\partial r} \right) + \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial \phi}{\partial \theta} \right) + \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2 \phi}{\partial \phi^2}$

Transformation of Integrals

s = the distance along some curve “ C ” in space and is measured from some fixed point.

S = a surface area

V = a volume contained by a specified surface

$\hat{\mathbf{t}}$ = the unit tangent to C at the point P

$\hat{\mathbf{n}}$ = the unit outward pointing normal

F = some vector function

ds = the vector element of curve (= $\hat{\mathbf{t}} ds$)

dS = the vector element of surface (= $\hat{\mathbf{n}} dS$)

Then

$$\int_{(c)} \mathbf{F} \cdot \hat{\mathbf{t}} ds = \int_{(c)} \mathbf{F} \cdot ds$$

and when

$$\mathbf{F} = \nabla\phi$$

$$\int_{(c)} (\nabla\phi) \cdot \hat{\mathbf{t}} ds = \int_{(c)} d\phi$$

Gauss' Theorem (Green's Theorem)

When S defines a closed region having a volume V

$$\iiint_{(v)} (\nabla \cdot \mathbf{F}) dV = \iint_{(s)} (\mathbf{F} \cdot \hat{\mathbf{n}}) dS = \int \int \int_{(s)} \mathbf{F} \cdot dS$$

also

$$\iiint_{(v)} (\nabla\phi) dV = \iint_{(s)} \phi \hat{\mathbf{n}} dS$$

and

$$\iiint_{(v)} (\nabla \times \mathbf{F}) dV = \iint_{(s)} (\hat{\mathbf{n}} \times \mathbf{F}) dS$$

Stokes' Theorem

When C is closed and bounds the open surface S .

$$\iint_{(s)} \hat{\mathbf{n}} \cdot (\nabla \times \mathbf{F}) dS = \int_{(c)} \mathbf{F} \cdot ds$$

also

$$\iint_{(s)} (\hat{\mathbf{n}} \times \nabla\phi) dS = \int_{(c)} \phi ds$$

Green's Theorem

$$\begin{aligned} \iint_{(s)} (\nabla\phi \cdot \nabla\theta) dS &= \iint_{(s)} \phi \hat{\mathbf{n}} \cdot (\nabla\theta) dS = \iiint_{(v)} \phi (\nabla^2\theta) dV \\ &= \iint_{(s)} \theta \cdot \hat{\mathbf{n}} (\nabla\phi) dS = \iiint_{(v)} \theta (\nabla^2\phi) dV \end{aligned}$$

MOMENT OF INERTIA FOR VARIOUS BODIES OF MASS

The mass of the body is indicated by m

Body	Axis	Moment of inertia	Body	Axis	Moment of inertia
Uniform thin rod	Normal to the length, at one end	$m\frac{l^2}{3}$	Spherical shell, very thin, mean radius, r	Any diameter	$m\frac{2}{3}r^2$
Uniform thin rod	Normal to the length, at the center	$m\frac{l^2}{12}$	Right circular cylinder of radius r , length l	The longitudinal axis of the solid	$m\frac{r^2}{2}$
The rectangular sheet, sides a and b	Through the center parallel to b	$m\frac{a^2}{12}$	Right circular cylinder of radius r , length l	Transverse diameter	$m\left(\frac{r^2}{4} + \frac{l^2}{12}\right)$
Thin rectangular sheet, sides a and b	Through the center perpendicular to the sheet	$m\frac{a^2 + b^2}{12}$	Hollow circular cylinder, length l , radii r_1 and r_2	The longitudinal axis of the figure	$m\frac{(r_1^2 + r_2^2)}{2}$
Thin circular sheet of radius r	Normal to the plate through the center	$m\frac{r^2}{2}$	Thin cylindrical shell, length l , mean radius, r	The longitudinal axis of the figure	mr^2
Thin circular sheet of radius r	Along any diameter	$m\frac{r^2}{4}$	Hollow circular cylinder, length l , radii r_1 and r_2	Transverse diameter	$m\left[\frac{r_1^2 + r_2^2}{4} + \frac{l^2}{12}\right]$
Thin circular ring. Radii r_1 and r_2	Through center normal to plane of ring	$m\frac{r_1^2 + r_2^2}{2}$	Hollow circular cylinder, length l , very thin, mean radius	Transverse diameter	$m\left(\frac{r^2}{2} + \frac{l^2}{12}\right)$
Thin circular ring. Radii r_1 and r_2	Any diameter	$m\frac{r_1^2 + r_2^2}{4}$	Elliptic cylinder, length l , transverse semiaxes a and b	Longitudinal axis	$m\left(\frac{a^2 + b^2}{4}\right)$
Rectangular parallelepiped, edges a , b , and c	Through center perpendicular to face ab , (parallel to edge c)	$m\frac{a^2 + b^2}{12}$	Right cone, altitude h , radius of base r	Axis of the figure	$m\frac{3}{10}r^2$
Sphere, radius r	Any diameter	$m\frac{2}{5}r^2$	Spheroid of revolution, equatorial radius r	Polar axis	$m\frac{2r^2}{5}$
Spherical shell, external radius, r_1 , internal radius r_2	Any diameter	$m\frac{2(r_1^5 - r_2^5)}{5(r_1^3 - r_2^3)}$	Ellipsoid, axes $2a$, $2b$, $2c$	Axis $2a$	$m\frac{(b^2 + c^2)}{5}$

Bessel Functions*

1. Bessel's differential equation for a real variable x is

$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (x^2 - n^2)y = 0$$

* From Beyer, W. H., Ed., *CRC Handbook of Mathematical Sciences*, 5th ed., CRC Press, Boca Raton, 1978, 500–503. With permission.

2. When n is not an integer, two independent solutions of the equation are $J_n(x)$, $J_{-n}(x)$, where

$$J_n(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{k! \Gamma(n+k+1)} \left(\frac{x}{2}\right)^{n+2k}$$

3. If n is an integer $J_{-n}(x) = (-1)^n J_n(x)$, where

$$J_n(x) = \frac{x^n}{2^n n!} \left\{ 1 - \frac{x^2}{2^2 \cdot 1!(n+1)} + \frac{x^4}{2^4 \cdot 2!(n+1)(n+2)} + \frac{x^6}{2^6 \cdot 3!(n+1)(n+2)(n+3)} + \dots \right\}$$

4. For $n=0$ and $n=1$, this formula becomes

$$\begin{aligned} J_0(x) &= 1 - \frac{x^2}{2^2(1!)^2} + \frac{x^4}{2^4(2!)^2} - \frac{x^6}{2^6(3!)^2} + \frac{x^8}{2^8(4!)^2} - \dots \\ J_1(x) &= \frac{x}{2} - \frac{x^3}{2^3 \cdot 1!2!} + \frac{x^5}{2^5 \cdot 2!3!} - \frac{x^7}{2^7 \cdot 3!4!} + \frac{x^9}{2^9 \cdot 4!5!} - \dots \end{aligned}$$

5. When x is large and positive, the following asymptotic series may be used

$$\begin{aligned} J_0(x) &= \left(\frac{2}{\pi x}\right)^{\frac{1}{2}} \left\{ P_0(x) \cos\left(x - \frac{\pi}{4}\right) - Q_0(x) \sin\left(x - \frac{\pi}{4}\right) \right\} \\ J_1(x) &= \left(\frac{2}{\pi x}\right)^{\frac{1}{2}} \left\{ P_1(x) \cos\left(x - \frac{3\pi}{4}\right) - Q_1(x) \sin\left(x - \frac{3\pi}{4}\right) \right\} \end{aligned}$$

where

$$\begin{aligned} P_0(x) &\sim 1 - \frac{1^2 \cdot 3^2}{2!(8x)^2} + \frac{1^2 \cdot 3^2 \cdot 5^2 \cdot 7^2}{4!(8x)^4} - \frac{1^2 \cdot 3^2 \cdot 5^2 \cdot 7^2 \cdot 9^2 \cdot 11^2}{6!(8x)^6} + \dots \\ Q_0(x) &\sim -\frac{1^2}{1!8x} + \frac{1^2 \cdot 3^2 \cdot 5^2}{3!(8x)^3} - \frac{1^2 \cdot 3^2 \cdot 5^2 \cdot 7^2 \cdot 9^2}{5!(8x)^5} + \dots \\ P_1(x) &\sim 1 + \frac{1^2 \cdot 3 \cdot 5}{2!(8x)^2} - \frac{1^2 \cdot 3^2 \cdot 5^2 \cdot 7 \cdot 9}{4!(8x)^4} + \frac{1^2 \cdot 3^2 \cdot 5^2 \cdot 7^2 \cdot 9^2 \cdot 11 \cdot 13}{6!(8x)^6} - \dots \\ Q_1(x) &\sim \frac{1 \cdot 3}{1!8x} - \frac{1^2 \cdot 3^2 \cdot 5 \cdot 7}{3!(8x)^3} + \frac{1^2 \cdot 3^2 \cdot 5^2 \cdot 7^2 \cdot 9 \cdot 11}{5!(8x)^5} - \dots \end{aligned}$$

[In $P_1(x)$ the signs alternate from + to – after the first term]

6. If $x > 25$, it is convenient to use the formulas

$$\begin{aligned} J_0(x) &= A_0(x) \sin x + B_0(x) \cos x \\ J_1(x) &= B_1(x) \sin x - A_1(x) \cos x \end{aligned}$$

where

$$\begin{aligned} A_0(x) &= \frac{P_0(x) - Q_0(x)}{(\pi x)^{\frac{1}{2}}} \quad \text{and} \quad A_1(x) = \frac{P_1(x) - Q_1(x)}{(\pi x)^{\frac{1}{2}}} \\ B_0(x) &= \frac{P_0(x) + Q_0(x)}{(\pi x)^{\frac{1}{2}}} \quad \text{and} \quad B_1(x) = \frac{P_1(x) + Q_1(x)}{(\pi x)^{\frac{1}{2}}} \end{aligned}$$

7. The zeros of $J_0(x)$ and $J_1(x)$

If $j_{0,s}$ and $j_{1,s}$ are the s th zeros of $J_0(x)$ and $J_1(x)$ respectively, and if $a = 4_s - 1$, $b = 4_s + 1$

$$\begin{aligned} j_{0,s} &\sim \frac{1}{4} \pi a \left\{ 1 + \frac{2}{\pi^2 a^2} - \frac{62}{3\pi^4 a^4} + \frac{15,116}{15\pi^6 a^6} - \frac{12,554,474}{105\pi^8 a^8} + \frac{8,368,654,292}{315\pi^{10} a^{10}} - \dots \right\} \\ j_{1,s} &\sim \frac{1}{4} \pi b \left\{ 1 - \frac{6}{\pi^2 b^2} + \frac{6}{\pi^4 b^4} - \frac{4716}{5\pi^6 b^6} + \frac{3,902,418}{35\pi^8 b^8} - \frac{895,167,324}{35\pi^{10} b^{10}} + \dots \right\} \\ J_1(j_{0,s}) &\sim \frac{(-1)^{s+1} 2^{\frac{3}{2}}}{\pi a^{\frac{1}{2}}} \left\{ 1 - \frac{56}{3\pi^4 a^4} + \frac{9664}{5\pi^6 a^6} - \frac{7,381,280}{21\pi^8 a^8} + \dots \right\} \\ J_0(j_{1,s}) &\sim \frac{(-1)^s 2^{\frac{3}{2}}}{\pi b^{\frac{1}{2}}} \left\{ 1 + \frac{24}{\pi^4 b^4} - \frac{19,584}{10\pi^6 b^6} + \frac{2,466,720}{7\pi^8 b^8} - \dots \right\} \end{aligned}$$

8. Table of zeros for $J_0(x)$ and $J_1(x)$

$J_1(\alpha_n) = 0$		$J_0(\beta_n) = 0$	
Roots α_n	$J_1(\alpha_n)$	Roots β_n	$J_0(\beta_n)$
2.4048	0.5191	0.0000	1.0000
5.5201	-0.3403	3.8317	-0.4028
8.6537	0.2715	7.0156	0.3001
11.7915	-0.2325	10.1735	-0.2497
14.9309	0.2065	13.3237	0.2184
18.0711	-0.1877	16.4706	-0.1965
21.2116	0.1733	19.6159	0.1801

9. Recurrence formulas

$$J_{n-1}(x) + J_{n+1}(x) = \frac{2n}{x} J_n(x) \qquad nJ_n(x) + xJ'_n(x) = xJ_{n-1}(x)$$

$$J_{n-1}(x) - J_{n+1}(x) = 2J'_n(x) \qquad nJ_n(x) - xJ'_n(x) = xJ_{n+1}(x)$$

10. If J_n is written for $J_n(x)$ and $J_n^{(k)}$ is written for $\frac{d^k}{dx^k} \{J_n(x)\}$, then the following derivative relationships are important

$$J_0^{(r)} = -J_1^{(r-1)}$$

$$J_0^{(2)} = -J_0 + \frac{1}{x} J_1 = \frac{1}{2} (J_2 - J_0)$$

$$J_0^{(3)} = \frac{1}{x} J_0 + \left(1 - \frac{2}{x^2}\right) J_1 = \frac{1}{4} (-J_3 + 3J_1)$$

$$J_0^{(4)} = \left(1 - \frac{3}{x^2}\right) J_0 - \left(\frac{2}{x} - \frac{6}{x^3}\right) J_1 = \frac{1}{8} (J_4 - 4J_2 + 3J_0), \text{ etc.}$$

11. Half order Bessel functions

$$J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$$

$$J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \cos x$$

$$J_{n+\frac{1}{2}}(x) = -x^{n+\frac{1}{2}} \frac{d}{dx} \{x^{-(n+\frac{1}{2})} J_{n+\frac{1}{2}}(x)\}$$

$$J_{n-\frac{1}{2}}(x) = x^{-(n+\frac{1}{2})} \frac{d}{dx} \{x^{n+\frac{1}{2}} J_{n-\frac{1}{2}}(x)\}$$

n	$\left(\frac{\pi x}{2}\right)^{\frac{1}{2}} J_{n+\frac{1}{2}}(x)$	$\left(\frac{\pi x}{2}\right)^{\frac{1}{2}} J_{-(n+\frac{1}{2})}(x)$
0	$\sin x$	$\cos x$
1	$\frac{\sin x}{x} - \cos x$	$-\frac{\cos x}{x} - \sin x$
2	$\left(\frac{3}{x^2} - 1\right) \sin x - \frac{3}{x} \cos x$	$\left(\frac{3}{x^2} - 1\right) \cos x + \frac{3}{x} \sin x$
3	$\left(\frac{15}{x^3} - \frac{6}{x}\right) \sin x - \left(\frac{15}{x^2} - 1\right) \cos x$	$-\left(\frac{15}{x^3} - \frac{6}{x}\right) \cos x - \left(\frac{15}{x^2} - 1\right) \sin x$
	etc.	

12. Additional solutions to Bessel's equation are

$Y_n(x)$ (also called Weber's function, and sometimes denoted by $N_n(x)$)
 $H_n^{(1)}(x)$ and $H_n^{(2)}(x)$ (also called Hankel functions)

These solutions are defined as follows

$$Y_n(x) = \begin{cases} \frac{J_n(x) \cos(n\pi) - J_{-n}(x)}{\sin(n\pi)} & n \text{ not an integer} & H_n^{(1)}(x) = J_n(x) + iY_n(x) \\ \lim_{\nu \rightarrow n} \frac{J_\nu(x) \cos(\nu\pi) - J_{-\nu}(x)}{\sin(\nu\pi)} & n \text{ an integer} & H_n^{(2)}(x) = J_n(x) - iY_n(x) \end{cases}$$

The additional properties of these functions may all be derived from the above relations and the known properties of $J_n(x)$.

13. Complete solutions to Bessel's equation may be written as

or $c_1 J_n(x) + c_2 J_{-n}(x)$ if n is not an integer

or $\left. \begin{matrix} c_1 J_n(x) + c_2 Y_n(x) \\ c_1 H_n^{(1)}(x) + c_2 H_n^{(2)}(x) \end{matrix} \right\}$ for any value of n

14. The modified (or hyperbolic) Bessel's differential equation is

$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} - (x^2 + n^2)y = 0$$

15. When n is not an integer, two independent solutions of the equation are $I_n(x)$ and $I_{-n}(x)$, where

$$I_n(x) = \sum_{k=0}^{\infty} \frac{1}{k! \Gamma(n+k+1)} \left(\frac{x}{2}\right)^{n+2k}$$

16. If n is an integer,

$$I_n(x) = I_{-n}(x) = \frac{x^n}{2^n n!} \left\{ 1 + \frac{x^2}{2^2 \cdot 1!(n+1)} + \frac{x^4}{2^4 \cdot 2!(n+1)(n+2)} + \frac{x^6}{2^6 \cdot 3!(n+1)(n+2)(n+3)} + \dots \right\}$$

17. For $N=0$ and $n=1$, this formula becomes

$$I_0(x) = 1 + \frac{x^2}{2^2(1!)^2} + \frac{x^4}{2^4(2!)^2} + \frac{x^6}{2^6(3!)^2} + \frac{x^8}{2^8(4!)^2} + \dots$$

$$I_1(x) = \frac{x}{2} + \frac{x^3}{2^3 \cdot 1!2!} + \frac{x^5}{2^5 \cdot 2!3!} + \frac{x^7}{2^7 \cdot 3!4!} + \frac{x^9}{2^9 \cdot 4!5!} + \dots$$

18. Another solution to the modified Bessel's equation is

$$K_n(x) = \begin{cases} \frac{1}{2} \pi \frac{I_{-n}(x) - I_n(x)}{\sin(n\pi)} & n \text{ not an integer} \\ \lim_{\nu \rightarrow n} \frac{1}{2} \pi \frac{I_{-\nu}(x) - I_{\nu}(x)}{\sin(\nu\pi)} & n \text{ an integer} \end{cases}$$

This function is linearly independent of $I_n(x)$ for all values of n . Thus the complete solution to the modified Bessel's equation may be written as

$$c_1 I_n(x) + c_2 I_{-n}(x) \quad n \text{ not an integer}$$

or

$$c_1 I_n(x) + c_2 K_n(x) \quad \text{any } n$$

19. The following relations hold among the various Bessel functions:

$$I_n(z) = i^{-n} J_n(iz)$$

$$Y_n(iz) = (i)^{n+1} I_n(z) - \frac{2}{\pi} i^{-n} K_n(z)$$

Most of the properties of the modified Bessel function may be deduced from the known properties of $J_n(x)$ by use of these relations and those previously given.

20. Recurrence formulas

$$I_{n-1}(x) - I_{n+1}(x) = \frac{2n}{x} I_n(x) \quad I_{n-1}(x) + I_{n+1}(x) = 2I'_n(x)$$

$$I_{n-1}(x) - \frac{n}{x} I_n(x) = I'_n(x) \quad I'_n(x) = I_{n+1}(x) + \frac{n}{x} I_n(x)$$

The Gamma Function*

Definition: $\Gamma(n) = \int_0^{\infty} t^{n-1} e^{-t} dt \quad n > 0$

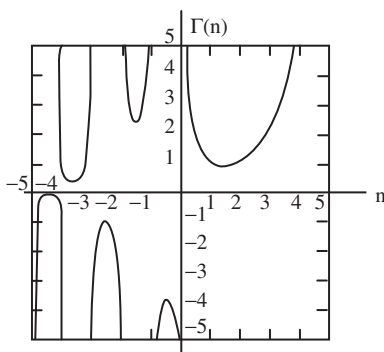
Recursion Formula: $\Gamma(n+1) = n\Gamma(n)$
 $\Gamma(n+1) = n!$, if $n = 0, 1, 2, \dots$ where $0! = 1$
 For $n < 0$ the gamma function can be defined by using

$$\Gamma(n) = \frac{\Gamma(n+1)}{n}$$

* From Beyer, W. H., Ed., *CRC Handbook of Mathematical Sciences*, 5th ed., CRC Press, Boca Raton, 1978, 484-485. With permission.

$$\Gamma(n) = \frac{\Gamma(n+1)}{n}$$

Graph:



Special Values:

$$\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$$

$$\Gamma\left(m + \frac{1}{2}\right) = \frac{1 \cdot 3 \cdot 5 \cdots (2m-1)}{2^m} \sqrt{\pi} \quad m = 1, 2, 3, \dots$$

$$\Gamma\left(-m + \frac{1}{2}\right) = \frac{(-1)^m 2^m \sqrt{\pi}}{1 \cdot 3 \cdot 5 \cdots (2m-1)} \quad m = 1, 2, 3, \dots$$

Definition:

$$\Gamma(x+1) = \lim_{k \rightarrow \infty} \frac{1 \cdot 2 \cdot 3 \cdots k}{(x+1)(x+2) \cdots (x+k)} k^x$$

$$\frac{1}{\Gamma(x)} = x e^{\gamma x} \prod_{m=1}^{\infty} \left\{ \left(1 + \frac{x}{m}\right) e^{-x/m} \right\}$$

This is an infinite product representation for the gamma function where γ is Euler's constant.

Properties:

$$\Gamma'(1) = \int_0^{\infty} e^{\gamma x} \ln x dx = -\gamma$$

$$\frac{\Gamma'(x)}{\Gamma(x)} = -\gamma + \left(\frac{1}{1} - \frac{1}{x}\right) + \left(\frac{1}{2} - \frac{1}{x+1}\right) + \cdots + \left(\frac{1}{n} - \frac{1}{x+n-1}\right) + \cdots$$

$$\Gamma(x+1) = \sqrt{2\pi x} x^x e^{-x} \left\{ 1 + \frac{1}{12x} + \frac{1}{288x^2} - \frac{139}{51,840x^3} + \cdots \right\}$$

This is called *Stirling's asymptotic series*.

If we let $x = n$ a positive integer, then a useful approximation for $n!$ where n is large (e.g., $n > 10$) is given by *Stirling's formula*

$$n! \approx \sqrt{2\pi n} n^n e^{-n}$$

The Gamma Function*

Values of $\Gamma(n) = \int_0^{\infty} e^{-x} x^{n-1} dx$; $\Gamma(n+1) = n\Gamma(n)$

n	$\Gamma(n)$	n	$\Gamma(n)$	n	$\Gamma(n)$	n	$\Gamma(n)$
1.00	1.00000	1.25	0.90640	1.50	.88623	1.75	.91906
1.01	.99433	1.26	.90440	1.51	.88659	1.76	.92137
1.02	.98884	1.27	.90250	1.52	.88704	1.77	.92376
1.03	.98355	1.28	.90072	1.53	.88757	1.78	.92623
1.04	.97844	1.29	.89904	1.54	.88818	1.79	.92877
1.05	.97350	1.30	.89747	1.55	.88887	1.80	.93138
1.06	.96874	1.31	.89600	1.56	.88964	1.81	.93408
1.07	.96415	1.32	.89464	1.57	.89049	1.82	.93685
1.08	.95973	1.33	.89338	1.58	.89142	1.83	.93969
1.09	.95546	1.34	.89222	1.59	.89243	1.84	.94261
1.10	.95135	1.35	.89115	1.60	.89352	1.85	.94561
1.11	.94740	1.36	.89018	1.61	.89468	1.86	.94869
1.12	.94359	1.37	.88931	1.62	.89592	1.87	.95184
1.13	.93993	1.38	.88854	1.63	.89724	1.88	.95507
1.14	.93642	1.39	.88785	1.64	.89864	1.89	.95838
1.15	.93304	1.40	.88726	1.65	.90012	1.90	.96177
1.16	.92980	1.41	.88676	1.66	.90167	1.91	.96523
1.17	.92670	1.42	.88636	1.67	.90330	1.92	.96877
1.18	.92373	1.43	.88604	1.68	.90500	1.93	.97240
1.19	.92089	1.44	.88581	1.69	.90678	1.94	.97610
1.20	.91817	1.45	.88566	1.70	.90864	1.95	.97988
1.21	.91558	1.46	.88560	1.71	.91057	1.96	.98374
1.22	.91311	1.47	.88563	1.72	.91258	1.97	.98768
1.23	.91075	1.48	.88575	1.73	.91466	1.98	.99171
1.24	.90852	1.49	.88595	1.74	.91683	1.99	.99581
						2.00	1.00000

* For large positive values of x , $\Gamma(x)$ approximates Stirling's asymptotic series

$$x^x e^{-x} \sqrt{\frac{2\pi}{x}} \left[1 + \frac{1}{12x} + \frac{1}{288x^2} - \frac{139}{51840x^3} - \frac{571}{2488320x^4} + \dots \right]$$

The Beta Function*

Definition: $B(m, n) = \int_0^1 t^{m-1}(1-t)^{n-1} dt$ $m > 0, n > 0$

Relationship with

Gamma Function: $B(m, n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$

Properties:

$$B(m, n) = B(n, m)$$

$$B(m, n) = 2 \int_0^{\pi/2} \sin^{2m-1} \theta \cos^{2n-1} \theta d\theta$$

$$B(m, n) = \int_0^{\infty} \frac{t^{m-1}}{(1+t)^{m+n}} dt$$

$$B(m, n) = r^n (r+1)^m \int_0^1 \frac{t^{m-1}(1-t)^{n-1}}{(r+t)^{m+n}} dt$$

The Error Function

Definition: $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$

Series: $erf(x) = \frac{2}{\sqrt{\pi}} \left(x - \frac{x^3}{3} + \frac{1}{2!} \frac{x^5}{5} - \frac{1}{3!} \frac{x^7}{7} + \dots \right)$

Property: $erf(x) = -erf(-x)$

Relationship with Normal Probability Function $f(t)$: $\int_0^x f(t) dt = \frac{1}{2} erf\left(\frac{x}{\sqrt{2}}\right)$

To evaluate $erf(2.3)$, one proceeds as follows: Since $\frac{x}{\sqrt{2}} = 2.3$, one finds $x = (2.3)(\sqrt{2}) = 3.25$. In the normal probability function table (page A-104), one finds the entry 0.4994 opposite the value 3.25. Thus $erf(2.3) = 2(0.4994) = 0.9988$.

$$erfc(z) = 1 - erf(z) = \frac{2}{\sqrt{\pi}} \int_z^{\infty} e^{-t^2} dt$$

is known as the complementary error function.

Orthogonal Polynomials*

I

Name: Legendre *Symbol:* $P_n(x)$ *Interval:* $[-1, 1]$

Differential Equation: $(1 - x^2)y'' - 2xy' + n(n+1)y = 0$

$$y = P_n(x)$$

Explicit Expression: $P_n(x) = \frac{1}{2^n} \sum_{m=0}^{\lfloor n/2 \rfloor} (-1)^m \binom{n}{m} \binom{2n-2m}{n} x^{n-2m}$

Recurrence Relation: $(n+1)P_{n+1}(x) = (2n+1)xP_n(x) - nP_{n-1}(x)$

Weight: 1 *Standardization:* $P_n(1) = 1$

Norm: $\int_{-1}^{+1} [P_n(x)]^2 dx = \frac{2}{2n+1}$

Rodrigues' Formula: $P_n(x) = \frac{(-1)^n}{2^n n!} \frac{d^n}{dx^n} \{(1-x^2)^n\}$

Generating Function: $R^{-1} = \sum_{n=0}^{\infty} P_n(x)z^n, -1 < x < 1, |z| < 1,$

$$R = \sqrt{1 - 2xz + z^2}$$

Inequality: $|P_n(x)| \leq 1, -1 \leq x \leq 1.$

II

Name: Tschebysheff, First Kind *Symbol:* $T_n(x)$ *Interval:* $[-1, 1]$

Differential Equation: $(1-x^2)y - xy' + n^2y = 0$

$$y = T_n(x)$$

Explicit Expression: $\frac{n}{2} \sum_{m=0}^{\lfloor n/2 \rfloor} (-1)^m \frac{(n-m-1)!}{m!(n-2m)!} (2x)^{n-2m} = \cos(n \arccos x) = T_n(x)$

Recurrence Relation: $T_{n+1}(x) = 2xT_n(x) - T_{n-1}(x)$

Weight: $(1-x^2)^{-1/2}$ *Standardization:* $T_n(1) = 1$

Norm: $\int_{-1}^{+1} (1-x^2)^{-1/2} [T_n(x)]^2 dx = \begin{cases} \pi/2, & n \neq 0 \\ \pi, & n = 0 \end{cases}$

Rodrigues' Formula: $\frac{(-1)^n (1-x^2)^{1/2} \sqrt{\pi}}{2^{n+1} \Gamma(n+\frac{1}{2})} \frac{d^n}{dx^n} \{(1-x^2)^{n-(1/2)}\} = T_n(x)$

Generating Function: $\frac{1-xz}{1-2xz-z^2} = \sum_{n=0}^{\infty} T_n(x) z^n, -1 < x < 1, |z| < 1$

Inequality: $|T_n(x)| \leq 1, -1 \leq x \leq 1.$

III

Name: Tschebysheff, Second Kind *Symbol:* $U_n(x)$ *Interval:* $[-1, 1]$

Differential Equation: $(1-x^2)y'' - 3xy' + n(n+2)y = 0$

$$y = U_n(x)$$

Explicit Expression: $U_n(x) = \sum_{m=0}^{\lfloor n/2 \rfloor} (-1)^m \frac{(m-n)!}{m!(n-2m)!} (2x)^{n-2m}$

$$U_n(\cos \theta) = \frac{\sin[(n+1)\theta]}{\sin \theta}$$

* From Beyer, W. H., Ed., *CRC Handbook of Mathematical Sciences*, 5th ed., CRC Press, Boca Raton, 1978, 557-560. With permission.

Recurrence Relation: $U_{n+1}(x) = 2xU_n(x) - U_{n-1}(x)$

Weight: $(1-x^2)^{1/2}$ Standardization: $U_n(1) = n+1$

Norm: $\int_{-1}^{+1} (1-x^2)^{1/2} [U_n(x)]^2 dx = \frac{\pi}{2}$

Rodrigues' Formula: $U_n(x) = \frac{(-1)^n (n+1) \sqrt{\pi}}{(1-x^2)^{1/2} 2^{n+1} \Gamma(n+\frac{3}{2})} \frac{d^n}{dx^n} \{(1-x^2)^{n+(1/2)}\}$

Generating Function: $\frac{1}{1-2xz+z^2} = \sum_{n=0}^{\infty} U_n(x) z^n, -1 < x < 1, |z| < 1$

Inequality: $|U_n(x)| \leq n+1, -1 \leq x \leq 1.$

IV

Name: Jacobi Symbol: $P_n^{(\alpha, \beta)}(x)$ Interval: $[-1, 1]$

Differential Equation:

$$(1-x^2)y'' + [\beta - \alpha - (\alpha + \beta + 2)x]y' + n(n + \alpha + \beta + 1)y = 0$$

$$y = P_n^{(\alpha, \beta)}(x)$$

Explicit Expression: $P_n^{(\alpha, \beta)}(x) = \frac{1}{2^n} \sum_{m=0}^n \binom{n+\alpha}{m} \binom{n+\beta}{n-m} (x-1)^{n-m} (x+1)^m$

Recurrence Relation: $2(n+1)(n+\alpha+\beta+1)(2n+\alpha+\beta)P_{n+1}^{(\alpha, \beta)}(x)$
 $= (2n+\alpha+\beta+1)[(\alpha^2 - \beta^2) + (2n+\alpha+\beta+2)$
 $\times (2n+\alpha+\beta)x]P_n^{(\alpha, \beta)}(x)$
 $- 2(n+\alpha)(n+\beta)(2n+\alpha+\beta+2)P_{n-1}^{(\alpha, \beta)}(x)$

Weight: $(1-x)^\alpha(1+x)^\beta; \alpha, \beta > -1$ Standardization: $P_n^{(\alpha, \beta)}(x) = \binom{n+\alpha}{n}$

Norm: $\int_{-1}^{+1} (1-x)^\alpha(1+x)^\beta [P_n^{(\alpha, \beta)}(x)]^2 dx = \frac{2^{\alpha+\beta+1} \Gamma(n+\alpha+1) \Gamma(n+\beta+1)}{(2n+\alpha+\beta+1)n! \Gamma(n+\alpha+\beta+1)}$

Rodrigues' Formula: $P_n^{(\alpha, \beta)}(x) = \frac{(-1)^n}{2^n n! (1-x)^\alpha (1+x)^\beta} \frac{d^n}{dx^n} \{(1-x)^{n+\alpha} (1+x)^{n+\beta}\}$

Generating Function: $R^{-1}(1-z+R)^{-\alpha}(1+z+R)^{-\beta} = \sum_{n=0}^{\infty} 2^{-\alpha-\beta} P_n^{(\alpha, \beta)}(x) z^n,$

$$R = \sqrt{1-2xz+z^2}, |z| < 1$$

Inequality: $\max_{-1 \leq x \leq 1} |P_n^{(\alpha, \beta)}(x)| = \begin{cases} \binom{n+q}{n} \sim n^q \text{ if } q = \max(\alpha, \beta) \geq -\frac{1}{2} \\ |P_n^{(\alpha, \beta)}(x')| \sim n^{-1/2} \text{ if } q < -\frac{1}{2} \\ x' \text{ is one of the two maximum points nearest} \\ \frac{\beta - \alpha}{\alpha + \beta + 1} \end{cases}$

V

Name: Generalized Laguerre Symbol: $L_n^{(\alpha)}(x)$ Interval: $[0, \infty]$

Differential Equation: $xy'' + (\alpha+1-x)y' + ny = 0$

$$y = L_n^{(\alpha)}(x)$$

Explicit Expression: $L_n^{(\alpha)}(x) = \sum_{m=0}^n (-1)^m \binom{n+\alpha}{n-m} \frac{1}{m!} x^m$

Recurrence Relation: $(n+1)L_n^{(\alpha)} + 1(x) = [(2n+\alpha+1)-x]L_n^{(\alpha)}(x) - (n+\alpha)L_n^{(\alpha)} - 1(x)$

Weight: $x^\alpha e^{-x}, \alpha > -1$ Standardization: $L_n^{(\alpha)}(x) = \frac{(-1)^n}{n!} x^n + \dots$

Norm: $\int_0^\infty x^\alpha e^{-x} [L_n^{(\alpha)}(x)]^2 dx = \frac{\Gamma(n+\alpha+1)}{n!}$

Rodrigues' Formula: $L_n^{(\alpha)}(x) = \frac{1}{n! x^\alpha e^{-x}} \frac{d^n}{dx^n} \{x^{n+\alpha} e^{-x}\}$

Generating Function: $(1-z)^{-\alpha-1} \exp\left(\frac{xz}{z-1}\right) = \sum_{n=0}^{\infty} L_n^{(\alpha)}(x)z^n$

Inequality: $|L_n^{(\alpha)}(x)| \leq \frac{\Gamma(n+\alpha+1)}{n!\Gamma(\alpha+1)} e^{x/2}; \quad x \geq 0$
 $\alpha > 0$

$|L_n^{(\alpha)}(x)| \leq \left[2 - \frac{\Gamma(\alpha+n+1)}{n!\Gamma(\alpha+1)}\right] e^{x/2}; \quad x \geq 0$
 $-1 < \alpha < 0$

Orthogonal Polynomials

Name: Hermite Symbol: $H_n(x)$ Interval: $[-\infty, \infty]$

Differential Equation: $y'' - 2xy' + 2ny = 0$

Explicit Expression: $H_n(x) = \sum_{m=0}^{\lfloor n/2 \rfloor} \frac{(-1)^m n! (2x)^{n-2m}}{m!(n-2m)!}$

Recurrence Relation: $H_{n+1}(x) = 2xH_n(x) - 2nH_{n-1}(x)$

Weight: e^{-x^2} Standardization: $H_n(1) = 2^n x^n + \dots$

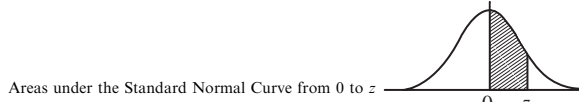
Norm: $\int_{-\infty}^{\infty} e^{-x^2} [H_n(x)]^2 dx = 2^n n! \sqrt{\pi}$

Rodrigues' Formula: $H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n} (e^{-x^2})$

Generating Function: $e^{-z^2+2zx} = \sum_{n=0}^{\infty} H_n(x) \frac{z^n}{n!}$

Inequality: $|H_n(x)| < e^{x^2/2} k 2^{n/2} \sqrt{n!} \quad k \approx 1.086435$

NORMAL PROBABILITY FUNCTION



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2652	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

$F(z)$ below refers to area under Standard Normal Curve from $-\infty$ to z

z	1.282	1.645	1.960	2.326	2.576	3.090
$F(z)$	.90	.95	.975	.99	.995	.999
$2[1 - F(z)]$	.20	.10	.05	.02	.01	.002

PERCENTAGE POINTS, STUDENT'S *t*-DISTRIBUTION

This table gives values of *t* such that

$$F(t) = \int_{-\infty}^t \frac{\Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi}\Gamma\left(\frac{n}{2}\right)} \left(1 + \frac{x^2}{n}\right)^{-\frac{n+1}{2}} dx$$

for *n*, the number of degrees of freedom, equal to 1, 2, . . . , 30, 40, 60, 120, ∞; and for *F*(*t*) = 0.60, 0.75, 0.90, 0.95, 0.975, 0.99, 0.995, and 0.9995. The *t*-distribution is symmetrical, so that *F*(−*t*) = 1 − *F*(*t*)

<i>n</i> \ <i>F</i>	.60	.75	.90	.95	.975	.99	.995	.9995
1	.325	1.000	3.078	6.314	12.706	31.821	63.657	636.619
2	.289	.816	1.886	2.920	4.303	6.965	9.925	31.598
3	.277	.765	1.638	2.353	3.182	4.541	5.841	12.924
4	.271	.741	1.533	2.132	2.776	3.747	4.604	8.610
5	.267	.727	1.476	2.015	2.571	3.365	4.032	6.869
6	.265	.718	1.440	1.943	2.447	3.143	3.707	5.959
7	.263	.711	1.415	1.895	2.365	2.998	3.499	5.408
8	.262	.706	1.397	1.860	2.306	2.896	3.355	5.041
9	.261	.703	1.383	1.833	2.262	2.821	3.250	4.781
10	.260	.700	1.372	1.812	2.228	2.764	3.169	4.587
11	.260	.697	1.363	1.796	2.201	2.718	3.106	4.437
12	.259	.695	1.356	1.782	2.179	2.681	3.055	4.318
13	.259	.694	1.350	1.771	2.160	2.650	3.012	4.221
14	.258	.692	1.345	1.761	2.145	2.624	2.977	4.140
15	.258	.691	1.341	1.753	2.131	2.602	2.947	4.073
16	.258	.690	1.337	1.746	2.120	2.583	2.921	4.015
17	.257	.689	1.333	1.740	2.110	2.567	2.898	3.965
18	.257	.688	1.330	1.734	2.101	2.552	2.878	3.922
19	.257	.688	1.328	1.729	2.093	2.539	2.861	3.883
20	.257	.687	1.325	1.725	2.086	2.528	2.845	3.850
21	.257	.686	1.323	1.721	2.080	2.518	2.831	3.819
22	.256	.686	1.321	1.717	2.074	2.508	2.819	3.792
23	.256	.685	1.319	1.714	2.069	2.500	2.807	3.767
24	.256	.685	1.318	1.711	2.064	2.492	2.797	3.745
25	.256	.684	1.316	1.708	2.060	2.485	2.787	3.725
26	.256	.684	1.315	1.706	2.056	2.479	2.779	3.707
27	.256	.684	1.314	1.703	2.052	2.473	2.771	3.690
28	.256	.683	1.313	1.701	2.048	2.467	2.763	3.674
29	.256	.683	1.311	1.699	2.045	2.462	2.756	3.659
30	.256	.683	1.310	1.697	2.042	2.457	2.750	3.646
40	.255	.681	1.303	1.684	2.021	2.423	2.704	3.551
60	.254	.679	1.296	1.671	2.000	2.390	2.660	3.460
120	.254	.677	1.289	1.658	1.980	2.358	2.617	3.373
∞	.253	.674	1.282	1.645	1.960	2.326	2.576	3.291

* This table is abridged from the "Statistical Tables" of R. A. Fisher and Frank Yates published by Oliver & Boyd, Ltd., Edinburgh and London, 1938. It is here published with the kind permission of the authors and their publishers.

PERCENTAGE POINTS, CHI-SQUARE DISTRIBUTION

This table gives values of χ^2 such that

$$F(\chi^2) = \int_0^{\chi^2} \frac{1}{2^{\frac{n}{2}}\Gamma(n/2)} x^{(n-2)/2} e^{-(x/2)} dx$$

for n , the number of degrees of freedom, equal to 1, 2, ..., 30. For $n > 30$, a normal approximation is quite accurate. The expression $\sqrt{2\chi^2} - \sqrt{2n-1}$ is approximately normally distributed as the standard normal distribution. Thus χ_{α}^2 , the α -point of the distribution, may be computed by the formula

$$\chi_{\alpha}^2 = \frac{1}{2}[x_{\alpha} + \sqrt{2n-1}]^2,$$

where x_{α} is the α -point of the cumulative normal distribution. For even values of n , $F(\chi^2)$ can be written as

$$1 - F(\chi^2) = \sum_{x=0}^{x'-1} \frac{e^{-\lambda} \lambda^x}{x!}$$

with $\lambda = \frac{1}{2}\chi^2$ and $x' = \frac{1}{2}n$. Thus the cumulative Chi-Square distribution is related to the cumulative Poisson distribution.

Another approximate formula for large n

$$\chi^2_\alpha = n \left(1 - \frac{2}{9n} + z_\alpha \sqrt{\frac{2}{9n}} \right)^3$$

n = degrees of freedom

z_α = the normal deviate (the value of x for which $F(x)$ = the desired percentile).

x	1.282	1.645	1.960	2.326	2.576	3.090
$F(x)$	.90	.95	.975	.99	.995	.999

$\chi^2_{.99} = 60[1 - 0.00370 + 2.326(0.06086)]^3 = 88.4$ is the 99th percentile for 60 degrees of freedom.

$$F(\chi^2) = \int_0^{\chi^2} \frac{1}{2^{n/2} \Gamma(\frac{n}{2})} x^{(n-2)/2} e^{-x/2} dx$$

$n \backslash F$	.005	.010	.025	.050	.100	.250	.500	.750	.900	.950	.975	.990	.995
1	.0000393	.000157	.000982	.00393	.0158	.102	.455	1.32	2.71	3.84	5.02	6.63	7.88
2	.0100	.0201	.0506	.103	.211	.575	1.39	2.77	4.61	5.99	7.38	9.21	10.6
3	.0717	.115	.216	.352	.584	1.21	2.37	4.11	6.25	7.81	9.35	11.3	12.8
4	.207	.297	.484	.711	1.06	1.92	3.36	5.39	7.78	9.49	11.1	13.3	14.9
5	.412	.554	.831	1.15	1.61	2.67	4.35	6.63	9.24	11.1	12.8	15.1	16.7
6	.676	.872	1.24	1.64	2.20	3.45	5.35	7.84	10.6	12.6	14.4	16.8	18.5
7	.989	1.24	1.69	2.17	2.83	4.25	6.35	9.04	12.0	14.1	16.0	18.5	20.3
8	1.34	1.65	2.18	2.73	3.49	5.07	7.34	10.2	13.4	15.5	17.5	20.1	22.0
9	1.73	2.09	2.70	3.33	4.17	5.90	8.34	11.4	14.7	16.9	19.0	21.7	23.6
10	2.16	2.56	3.25	3.94	4.87	6.74	9.34	12.5	16.0	18.3	20.5	23.2	25.2
11	2.60	3.05	3.82	4.57	5.58	7.58	10.3	13.7	17.3	19.7	21.9	24.7	26.8
12	3.07	3.57	4.40	5.23	6.30	8.44	11.3	14.8	18.5	21.0	23.3	26.2	28.3
13	3.57	4.11	5.01	5.89	7.04	9.30	12.3	16.0	19.8	22.4	24.7	27.7	29.8
14	4.07	4.66	5.63	6.57	7.79	10.2	13.3	17.1	21.1	23.7	26.1	29.1	31.3
15	4.60	5.23	6.26	7.26	8.55	11.0	14.3	18.2	22.3	25.0	27.5	30.6	32.8
16	5.14	5.81	6.91	7.96	9.31	11.9	15.3	19.4	23.5	26.3	28.8	32.0	34.3
17	5.70	6.41	7.56	8.67	10.1	12.8	16.3	20.5	24.8	27.6	30.2	33.4	35.7
18	6.26	7.01	8.23	9.39	10.9	13.7	17.3	21.6	26.0	28.9	31.5	34.8	37.2
19	6.84	7.63	8.91	10.1	11.7	14.6	18.3	22.7	27.2	30.1	32.9	36.2	38.6
20	7.43	8.26	9.59	10.9	12.4	15.5	19.3	23.8	28.4	31.4	34.2	37.6	40.0
21	8.03	8.90	10.3	11.6	13.2	16.3	20.3	24.9	29.6	32.7	35.5	38.9	41.4
22	8.64	9.54	11.0	12.3	14.0	17.2	21.3	26.0	30.8	33.9	36.8	40.3	42.8
23	9.26	10.2	11.7	13.1	14.8	18.1	22.3	27.1	32.0	35.2	38.1	41.6	44.2
24	9.89	10.9	12.4	13.8	15.7	19.0	23.3	28.2	33.2	36.4	39.4	43.0	45.6
25	10.5	11.5	13.1	14.6	16.5	19.9	24.3	29.3	34.4	37.7	40.6	44.3	46.9
26	11.2	12.2	13.8	15.4	17.3	20.8	25.3	30.4	35.6	38.9	41.9	45.6	48.3
27	11.8	12.9	14.6	16.2	18.1	21.7	26.3	31.5	36.7	40.1	43.2	47.0	49.6
28	12.5	13.6	15.3	16.9	18.9	22.7	27.3	32.6	37.9	41.3	44.5	48.3	51.0
29	13.1	14.3	16.0	17.7	19.8	23.6	28.3	33.7	39.1	42.6	45.7	49.6	52.3
30	13.8	15.0	16.8	18.5	20.6	24.5	29.3	34.8	40.3	43.8	47.0	50.9	53.7

PERCENTAGE POINTS, F -DISTRIBUTION

This table gives values of F such that

$$F(F) = \int_0^F \frac{\Gamma\left(\frac{m+n}{2}\right)}{\Gamma\left(\frac{m}{2}\right)\Gamma\left(\frac{n}{2}\right)} m^{m/2} n^{n/2} x^{(m-2)/2} (n+mx)^{-(m+n)/2} dx$$

for selected values of m , the number of degrees of freedom of the numerator of F ; and for selected values of n , the number of degrees of freedom of the denominator of F . The table also provides values corresponding to $F(F) = .10, .05, .025, .01, .005, .001$ since $F_{1-\alpha}$ for m and n degrees of freedom is the reciprocal of F_α for n and m degrees of freedom. Thus

$$F_{.05}(4, 7) = \frac{1}{F_{.95}(7, 4)} = \frac{1}{6.09} = .164$$

$$F(F) = \int_0^F \frac{\Gamma\left(\frac{m+n}{2}\right)}{\Gamma\left(\frac{m}{2}\right)\Gamma\left(\frac{n}{2}\right)} m^{m/2} n^{n/2} x^{m/2-1} (n+mx)^{-(m+n)/2} dx = .90$$

$\frac{m}{n}$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44	59.86	60.19	60.71	61.22	61.74	62.00	62.26	62.53	62.79	63.06	63.33
2	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38	9.39	9.41	9.42	9.44	9.45	9.46	9.47	9.47	9.48	9.49
3	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24	5.23	5.22	5.20	5.18	5.18	5.17	5.16	5.15	5.14	5.13
4	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94	3.92	3.90	3.87	3.84	3.83	3.82	3.80	3.79	3.78	3.76
5	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32	3.30	3.27	3.24	3.21	3.19	3.17	3.16	3.14	3.12	3.10
6	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96	2.94	2.90	2.87	2.84	2.82	2.80	2.78	2.76	2.74	2.72
7	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72	2.70	2.67	2.63	2.59	2.58	2.56	2.54	2.51	2.49	2.47
8	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56	2.54	2.50	2.46	2.42	2.40	2.38	2.36	2.34	2.32	2.29
9	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.47	2.44	2.42	2.38	2.34	2.30	2.28	2.25	2.23	2.21	2.18	2.16
10	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35	2.32	2.28	2.24	2.20	2.18	2.16	2.13	2.11	2.08	2.06
11	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.30	2.27	2.25	2.21	2.17	2.12	2.10	2.08	2.05	2.03	2.00	1.97
12	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21	2.19	2.15	2.10	2.06	2.04	2.01	1.99	1.96	1.93	1.90
13	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.20	2.16	2.14	2.10	2.05	2.01	1.98	1.96	1.93	1.90	1.88	1.85
14	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.15	2.12	2.10	2.05	2.01	1.96	1.94	1.91	1.89	1.86	1.83	1.80
15	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09	2.06	2.02	1.97	1.92	1.90	1.87	1.85	1.82	1.79	1.76
16	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.09	2.06	2.03	1.99	1.94	1.89	1.87	1.84	1.81	1.78	1.75	1.72
17	3.03	2.64	2.44	2.31	2.22	2.15	2.10	2.06	2.03	2.00	1.96	1.91	1.86	1.84	1.81	1.78	1.75	1.72	1.69
18	3.01	2.62	2.42	2.29	2.20	2.13	2.08	2.04	2.00	1.98	1.93	1.89	1.84	1.81	1.78	1.75	1.72	1.69	1.66
19	2.99	2.61	2.40	2.27	2.18	2.11	2.06	2.02	1.98	1.96	1.91	1.86	1.81	1.79	1.76	1.73	1.70	1.67	1.63
20	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2.00	1.96	1.94	1.89	1.84	1.79	1.77	1.74	1.71	1.68	1.64	1.61
21	2.96	2.57	2.36	2.23	2.14	2.08	2.02	1.98	1.95	1.92	1.87	1.83	1.78	1.75	1.72	1.69	1.66	1.62	1.59
22	2.95	2.56	2.35	2.22	2.13	2.06	2.01	1.97	1.93	1.90	1.86	1.81	1.76	1.73	1.70	1.67	1.64	1.60	1.57
23	2.94	2.55	2.34	2.21	2.11	2.05	1.99	1.95	1.92	1.89	1.84	1.80	1.74	1.72	1.69	1.66	1.62	1.59	1.55
24	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.94	1.91	1.88	1.83	1.78	1.73	1.70	1.67	1.64	1.61	1.57	1.53
25	2.92	2.53	2.32	2.18	2.09	2.02	1.97	1.93	1.89	1.87	1.82	1.77	1.72	1.69	1.66	1.63	1.59	1.56	1.52
26	2.91	2.52	2.31	2.17	2.08	2.01	1.96	1.92	1.88	1.86	1.81	1.76	1.71	1.68	1.65	1.61	1.58	1.54	1.50
27	2.90	2.51	2.30	2.17	2.07	2.00	1.95	1.91	1.87	1.85	1.80	1.75	1.70	1.67	1.64	1.60	1.57	1.53	1.49
28	2.89	2.50	2.29	2.16	2.06	2.00	1.94	1.90	1.87	1.84	1.79	1.74	1.69	1.66	1.63	1.59	1.56	1.52	1.48
29	2.89	2.50	2.28	2.15	2.06	1.99	1.93	1.89	1.86	1.83	1.78	1.73	1.68	1.65	1.62	1.58	1.55	1.51	1.47
30	2.88	2.49	2.28	2.14	2.05	1.98	1.93	1.88	1.85	1.82	1.77	1.72	1.67	1.64	1.61	1.57	1.54	1.50	1.46
40	2.84	2.44	2.23	2.09	2.00	1.93	1.87	1.83	1.79	1.76	1.71	1.66	1.61	1.57	1.54	1.51	1.47	1.42	1.38
60	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77	1.74	1.71	1.66	1.60	1.54	1.51	1.48	1.44	1.40	1.35	1.29
120	2.75	2.35	2.13	1.99	1.90	1.82	1.77	1.72	1.68	1.65	1.60	1.55	1.48	1.45	1.41	1.37	1.32	1.26	1.19
∞	2.71	2.30	2.08	1.94	1.85	1.77	1.72	1.67	1.63	1.60	1.55	1.49	1.42	1.38	1.34	1.30	1.24	1.17	1.00

$F = \frac{s_1^2}{s_2^2} = \frac{S_1}{m} / \frac{S_2}{n}$, where $s_1^2 = S_1/m$ and $s_2^2 = S_2/n$ are independent mean squares estimating a common variance σ^2 and based on m and n degrees of freedom, respectively.

$$F(F) = \int_0^F \frac{\Gamma\left(\frac{m+n}{2}\right)}{\Gamma\left(\frac{m}{2}\right)\Gamma\left(\frac{n}{2}\right)} m^{m/2} n^{n/2} x^{m/2-1} (n+mx)^{-(m+n)/2} dx = .95$$

$\frac{m}{n}$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.8			

$$F(F) = \int_0^F \frac{\Gamma(\frac{m+n}{2})}{\Gamma(\frac{m}{2})\Gamma(\frac{n}{2})} m^{m/2} n^{n/2} x^{m/2-1} (n+mx)^{-(m+n)/2} dx = .975$$

$\frac{m}{n}$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	647.8	799.5	864.2	899.6	921.8	937.1	948.2	956.7	963.3	968.6	976.7	984.9	993.1	997.2	1001	1006	1010	1014	1018
2	38.51	39.00	39.17	39.25	39.30	39.33	39.36	39.37	39.39	39.40	39.41	39.43	39.45	39.46	39.46	39.47	39.48	39.49	39.50
3	17.44	16.04	15.44	15.10	14.88	14.73	14.62	14.54	14.47	14.42	14.34	14.25	14.17	14.12	14.08	14.04	13.99	13.95	13.90
4	12.22	10.65	9.98	9.60	9.36	9.20	9.07	8.98	8.90	8.84	8.75	8.66	8.56	8.51	8.46	8.41	8.36	8.31	8.26
5	10.01	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68	6.62	6.52	6.43	6.33	6.28	6.23	6.18	6.12	6.07	6.02
6	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60	5.52	5.46	5.37	5.27	5.17	5.12	5.07	5.01	4.96	4.90	4.85
7	8.07	6.54	5.89	5.52	5.29	5.12	4.99	4.90	4.82	4.76	4.67	4.57	4.47	4.42	4.36	4.31	4.25	4.20	4.14
8	7.57	6.06	5.42	5.05	4.82	4.65	4.53	4.43	4.36	4.30	4.20	4.10	4.00	3.95	3.89	3.84	3.78	3.73	3.67
9	7.21	5.71	5.08	4.72	4.48	4.32	4.20	4.10	4.03	3.96	3.87	3.77	3.67	3.61	3.56	3.51	3.45	3.39	3.33
10	6.94	5.46	4.83	4.47	4.24	4.07	3.95	3.85	3.78	3.72	3.62	3.52	3.42	3.37	3.31	3.26	3.20	3.14	3.08
11	6.72	5.26	4.63	4.28	4.04	3.88	3.76	3.66	3.59	3.53	3.43	3.33	3.23	3.17	3.12	3.06	3.00	2.94	2.88
12	6.55	5.10	4.47	4.12	3.89	3.73	3.61	3.51	3.44	3.37	3.28	3.18	3.07	3.02	2.96	2.91	2.85	2.79	2.72
13	6.41	4.97	4.35	4.00	3.77	3.60	3.48	3.39	3.31	3.25	3.15	3.05	2.95	2.89	2.84	2.78	2.72	2.66	2.60
14	6.30	4.86	4.24	3.89	3.66	3.50	3.38	3.29	3.21	3.15	3.05	2.95	2.84	2.79	2.73	2.67	2.61	2.55	2.49
15	6.20	4.77	4.15	3.80	3.58	3.41	3.29	3.20	3.12	3.06	2.96	2.86	2.76	2.70	2.64	2.59	2.52	2.46	2.40
16	6.12	4.69	4.08	3.73	3.50	3.34	3.22	3.12	3.05	2.99	2.89	2.79	2.68	2.63	2.57	2.51	2.45	2.38	2.32
17	6.04	4.62	4.01	3.66	3.44	3.28	3.16	3.06	2.98	2.92	2.82	2.72	2.62	2.56	2.50	2.44	2.38	2.32	2.25
18	5.98	4.56	3.95	3.61	3.38	3.22	3.10	3.01	2.93	2.87	2.77	2.67	2.56	2.50	2.44	2.38	2.32	2.26	2.19
19	5.92	4.51	3.90	3.56	3.33	3.17	3.05	2.96	2.88	2.82	2.72	2.62	2.51	2.45	2.39	2.33	2.27	2.20	2.13
20	5.87	4.46	3.86	3.51	3.29	3.13	3.01	2.91	2.84	2.77	2.68	2.57	2.46	2.41	2.35	2.29	2.22	2.16	2.09
21	5.83	4.42	3.82	3.48	3.25	3.09	2.97	2.87	2.80	2.73	2.64	2.53	2.42	2.37	2.31	2.25	2.18	2.11	2.04
22	5.79	4.38	3.78	3.44	3.22	3.05	2.93	2.84	2.76	2.70	2.60	2.50	2.39	2.33	2.27	2.21	2.14	2.08	2.00
23	5.75	4.35	3.75	3.41	3.18	3.02	2.90	2.81	2.73	2.67	2.57	2.47	2.36	2.30	2.24	2.18	2.11	2.04	1.97
24	5.72	4.32	3.72	3.38	3.15	2.99	2.87	2.78	2.70	2.64	2.54	2.44	2.33	2.27	2.21	2.15	2.08	2.01	1.94
25	5.69	4.29	3.69	3.35	3.13	2.97	2.85	2.75	2.68	2.61	2.51	2.41	2.30	2.24	2.18	2.12	2.05	1.98	1.91
26	5.66	4.27	3.67	3.33	3.10	2.94	2.82	2.73	2.65	2.59	2.49	2.39	2.28	2.22	2.16	2.09	2.03	1.95	1.88
27	5.63	4.24	3.65	3.31	3.08	2.92	2.80	2.71	2.63	2.57	2.47	2.36	2.25	2.19	2.13	2.03	2.00	1.93	1.85
28	5.61	4.22	3.63	3.29	3.06	2.90	2.78	2.69	2.61	2.55	2.45	2.34	2.23	2.17	2.11	2.05	1.98	1.91	1.83
29	5.59	4.20	3.61	3.27	3.04	2.88	2.76	2.67	2.59	2.53	2.43	2.32	2.21	2.15	2.09	2.03	1.96	1.89	1.81
30	5.57	4.18	3.59	3.25	3.03	2.87	2.75	2.65	2.57	2.51	2.41	2.31	2.20	2.14	2.07	2.01	1.94	1.87	1.79
40	5.42	4.05	3.46	3.13	2.90	2.74	2.62	2.53	2.45	2.39	2.29	2.18	2.07	2.01	1.94	1.88	1.80	1.72	1.64
60	5.29	3.93	3.34	3.01	2.79	2.63	2.51	2.41	2.33	2.27	2.17	2.06	1.94	1.88	1.82	1.74	1.67	1.58	1.48
120	5.15	3.80	3.23	2.89	2.67	2.52	2.39	2.30	2.22	2.16	2.05	1.94	1.82	1.76	1.69	1.64	1.53	1.43	1.31
∞	5.02	3.69	3.12	2.79	2.57	2.41	2.29	2.19	2.11	2.05	1.94	1.83	1.71	1.64	1.57	1.48	1.39	1.24	1.00

$F = \frac{s_1^2}{s_2^2} = \frac{S_1}{m} / \frac{S_2}{n}$, where $s_1^2 = S_1/m$ and $s_2^2 = S_2/n$ are independent mean squares estimating a common variance σ^2 and based on m and n degrees of freedom, respectively.

$$F(F) = \int_0^F \frac{\Gamma(\frac{m+n}{2})}{\Gamma(\frac{m}{2})\Gamma(\frac{n}{2})} m^{m/2} n^{n/2} x^{m/2-1} (n+mx)^{-(m+n)/2} dx = .99$$

$\frac{m}{n}$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	4052	4999.5	5403	5625	5764	5859	5928	5982	6022	6056	6106	6157	6209	6235	6261	6287	6313	6339	6366
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	99.40	99.42	99.43	99.45	99.46	99.47	99.47	99.48	99.49	99.50
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23	27.05	26.87	26.69	26.60	26.50	26.41	26.32	26.22	26.13
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55	14.37	14.20	14.02	13.93	13.84	13.75	13.65	13.56	13.46
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05	9.89	9.72	9.55	9.47	9.38	9.29	9.20	9.11	9.02
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56	7.40	7.31	7.23	7.14	7.06	6.97	6.88
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.47	6.31	6.16	6.07	5.99	5.91	5.82	5.74	5.65
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.52	5.36	5.28	5.20	5.12	5.03	4.95	4.86
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	4.96	4.81	4.73	4.65	4.57	4.48	4.40	4.31
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.56	4.41	4.33	4.25	4.17	4.08	4.00	3.91
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.25	4.10	4.02	3.94	3.86	3.78	3.69	3.60
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.01	3.86	3.78	3.70	3.62	3.54	3.45	3.36
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.82	3.66	3.59	3.51	3.43	3.34	3.25	3.17
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.80	3.66	3.51	3.43	3.35	3.27	3.18	3.09	3.00
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.52	3.37	3.29	3.21	3.13	3.05	2.96	2.87
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.41	3.26	3.18	3.10	3.02	2.93	2.84	2.75
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.31	3.16	3.08	3.00	2.92	2.83	2.75	2.65
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.23	3.08	3.00	2.92	2.84	2.75	2.66	2.57
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.15	3.00	2.92	2.84	2.76	2.67	2.58	2.49
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.09	2.94	2.86	2.78	2.69	2.61	2.52	2.42
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.03	2.88	2.80	2.72	2.64	2.55	2.46	2.36
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	2.98	2.83	2.75	2.67	2.58	2.50	2.40	2.31
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.93	2.78	2.70	2.62	2.54	2.45	2.35	2.26
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.89	2.74	2.66	2.58	2.49	2.40	2.31	2.21
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	3.13	2.99	2.85	2.70	2.62	2.54	2.45	2.36	2.27	2.17
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	2.96	2.81	2.66	2.58	2.50	2.42	2.33	2.23	2.13
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15	3.06	2.93	2.78	2.63	2.55	2.47	2.38	2.29	2.20	2.10
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.90	2.75	2.60	2.52	2.44	2.35	2.26	2.17	2.06
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09										

$$F(F) = \int_0^F \frac{\Gamma\left(\frac{m+n}{2}\right)}{\Gamma\left(\frac{m}{2}\right)\Gamma\left(\frac{n}{2}\right)} m^{m/2} n^{n/2} x^{m/2-1} (n+mx)^{-(m+n)/2} dx = .995$$

$n \backslash m$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	16211	2000	21615	22500	23056	23437	23715	23925	24091	24224	24266	24630	24836	24940	25044	25148	25253	25359	25465
2	198.5	199.0	199.2	199.2	199.3	199.3	199.4	199.4	199.4	199.4	199.4	199.4	199.4	199.5	199.5	199.5	199.5	199.5	199.5
3	55.55	49.80	47.47	46.19	45.39	44.84	44.43	44.13	43.88	43.69	43.39	43.08	42.78	42.62	42.47	42.31	42.15	41.99	41.83
4	31.33	26.28	24.26	23.15	22.46	21.97	21.62	21.35	21.14	20.97	20.70	20.44	20.17	20.03	19.89	19.75	19.61	19.47	19.32
5	22.78	18.31	16.53	15.56	14.94	14.51	14.20	13.96	13.77	13.62	13.38	13.15	12.90	12.78	12.66	12.53	12.40	12.27	12.14
6	18.63	14.54	12.92	12.03	11.46	11.07	10.79	10.57	10.39	10.25	10.03	9.81	9.59	9.47	9.36	9.24	9.12	9.00	8.88
7	16.24	12.40	10.88	10.05	9.52	9.16	8.89	8.68	8.51	8.38	8.18	7.97	7.75	7.65	7.53	7.42	7.31	7.19	7.08
8	14.69	11.04	9.60	8.81	8.30	7.95	7.69	7.50	7.34	7.21	7.01	6.81	6.61	6.50	6.40	6.29	6.18	6.06	5.95
9	13.61	10.11	8.72	7.96	7.47	7.13	6.88	6.69	6.54	6.42	6.23	6.03	5.83	5.73	5.62	5.52	5.41	5.30	5.19
10	12.83	9.43	8.08	7.34	6.87	6.54	6.30	6.12	5.97	5.85	5.66	5.47	5.27	5.17	5.07	4.97	4.86	4.75	4.64
11	12.23	8.91	7.60	6.88	6.42	6.10	5.86	5.68	5.54	5.42	5.24	5.05	4.86	4.76	4.65	4.55	4.44	4.34	4.23
12	11.75	8.51	7.23	6.52	6.07	5.76	5.52	5.35	5.20	5.09	4.91	4.72	4.53	4.43	4.33	4.23	4.12	4.01	3.90
13	11.37	8.19	6.93	6.23	5.79	5.48	5.25	5.08	4.94	4.82	4.64	4.46	4.27	4.17	4.07	3.97	3.87	3.76	3.65
14	11.06	7.92	6.68	6.00	5.56	5.26	5.03	4.86	4.72	4.60	4.43	4.25	4.06	3.96	3.86	3.76	3.66	3.55	3.44
15	10.80	7.70	6.48	5.80	5.37	5.07	4.85	4.67	4.54	4.42	4.25	4.07	3.88	3.79	3.69	3.58	3.48	3.37	3.26
16	10.58	7.51	6.30	5.64	5.21	4.91	4.69	4.52	4.38	4.27	4.10	3.92	3.73	3.64	3.54	3.44	3.33	3.22	3.11
17	10.38	7.35	6.16	5.50	5.07	4.78	4.56	4.39	4.25	4.14	3.97	3.79	3.61	3.51	3.41	3.31	3.21	3.10	2.98
18	10.22	7.21	6.03	5.37	4.96	4.66	4.44	4.28	4.14	4.03	3.86	3.68	3.50	3.40	3.30	3.20	3.10	2.99	2.87
19	10.07	7.09	5.92	5.27	4.85	4.56	4.34	4.18	4.04	3.93	3.76	3.59	3.40	3.31	3.21	3.11	3.00	2.89	2.78
20	9.94	6.99	5.82	5.17	4.76	4.47	4.26	4.09	3.96	3.85	3.68	3.50	3.32	3.22	3.12	3.02	2.92	2.81	2.69
21	9.83	6.89	5.73	5.09	4.68	4.39	4.18	4.01	3.88	3.77	3.60	3.43	3.24	3.15	3.05	2.95	2.84	2.73	2.61
22	9.73	6.81	5.65	5.02	4.61	4.32	4.11	3.94	3.81	3.70	3.54	3.36	3.18	3.08	2.98	2.88	2.77	2.66	2.55
23	9.63	6.73	5.58	4.95	4.54	4.26	4.05	3.88	3.75	3.64	3.47	3.30	3.12	3.02	2.92	2.82	2.71	2.60	2.48
24	9.55	6.66	5.52	4.89	4.49	4.20	3.99	3.83	3.69	3.59	3.42	3.25	3.06	2.97	2.87	2.77	2.66	2.55	2.43
25	9.48	6.60	5.46	4.84	4.43	4.15	3.94	3.78	3.64	3.54	3.37	3.20	3.01	2.92	2.82	2.72	2.61	2.50	2.38
26	9.41	6.54	5.41	4.79	4.38	4.10	3.89	3.73	3.60	3.49	3.33	3.15	2.97	2.87	2.77	2.67	2.56	2.45	2.33
27	9.34	6.49	5.36	4.74	4.34	4.06	3.85	3.69	3.56	3.45	3.28	3.11	2.93	2.83	2.73	2.63	2.52	2.41	2.29
28	9.28	6.44	5.32	4.70	4.30	4.02	3.81	3.65	3.52	3.41	3.25	3.07	2.89	2.79	2.69	2.59	2.48	2.37	2.25
29	9.23	6.40	5.28	4.66	4.26	3.98	3.77	3.61	3.48	3.38	3.21	3.04	2.86	2.76	2.66	2.56	2.45	2.33	2.24
30	9.18	6.35	5.24	4.62	4.23	3.95	3.74	3.58	3.45	3.34	3.18	3.01	2.82	2.73	2.63	2.52	2.42	2.30	2.18
40	8.83	6.07	4.98	4.37	3.99	3.71	3.51	3.35	3.22	3.12	2.95	2.78	2.60	2.50	2.40	2.30	2.18	2.06	1.93
60	8.49	5.79	4.73	4.14	3.76	3.49	3.29	3.13	3.01	2.90	2.74	2.57	2.39	2.29	2.19	2.08	1.96	1.83	1.69
120	8.18	5.54	4.50	3.92	3.55	3.28	3.09	2.93	2.81	2.71	2.54	2.37	2.19	2.09	1.98	1.87	1.75	1.61	1.43
∞	7.88	5.30	4.28	3.72	3.35	3.09	2.90	2.74	2.62	2.52	2.36	2.19	2.00	1.90	1.79	1.67	1.53	1.36	1.00

$F = \frac{s_1^2}{s_2^2} = \frac{S_1}{m} / \frac{S_2}{n}$, where $s_1^2 = S_1/m$ and $s_2^2 = S_2/n$ are independent mean squares estimating a common variance σ^2 and based on m and n degrees of freedom, respectively.

$$F(F) = \int_0^F \frac{\Gamma\left(\frac{m+n}{2}\right)}{\Gamma\left(\frac{m}{2}\right)\Gamma\left(\frac{n}{2}\right)} m^{m/2} n^{n/2} x^{m/2-1} (n+mx)^{-(m+n)/2} dx = .999$$

$n \backslash m$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	4053*	5000*	5404*	5625*	5764*	5859*	5929*	5981*	6023*	6056*	6107*	6158*	6209*	6235*	6261*	6287*	6313*	6340*	6366*
2	998.5	999.0	999.2	999.2	999.3	999.3	999.4	999.4	999.4	999.4	999.4	999.4	999.4	999.5	999.5	999.5	999.5	999.5	999.5
3	167.0	148.5	141.1	137.1	134.6	132.8	131.6	130.6	129.9	129.2	128.3	127.4	126.4	125.9	125.4	125.0	124.5	124.0	123.5
4	74.14	61.25	56.18	53.44	51.71	50.53	49.66	49.00	48.47	48.05	47.41	46.76	46.10	45.77	45.43	45.09	44.75	44.40	44.05
5	47.18	37.12	33.20	31.09	29.75	28.84	28.16	27.64	27.24	26.92	26.42	25.91	25.39	25.14	24.87	24.60	24.33	24.06	23.79
6	35.51	27.00	23.70	21.92	20.81	20.03	19.46	19.03	18.69	18.41	17.99	17.56	17.12	16.89	16.67	16.44	16.21	15.99	15.75
7	29.25	21.69	18.77	17.19	16.21	15.52	15.02	14.63	14.33	14.08	13.71	13.32	12.93	12.73	12.53	12.33	12.12	11.91	11.70
8	25.42	18.49	15.83	14.39	13.49	12.86	12.40	12.04	11.77	11.54	11.19	10.84	10.48	10.30	10.11	9.92	9.73	9.53	9.33
9	22.86	16.39	13.90	12.56	11.71	11.13	10.70	10.37	10.11	9.89	9.57	9.24	8.90	8.72	8.55	8.37	8.19	8.00	7.81
10	21.04	14.91	12.55	11.28	10.48	9.92	9.52	9.20	8.96	8.75	8.45	8.13	7.80	7.64	7.47	7.30	7.12	6.94	6.76
11	19.69	13.81	11.56	10.35	9.58	9.05	8.66	8.35	8.12	7.92	7.63	7.32	7.01	6.85	6.68	6.52	6.35	6.17	6.00
12	18.64	12.97	10.80	9.63	8.89	8.38	8.00	7.71	7.48	7.29	7.00	6.71	6.40	6.25	6.09	5.93	5.76	5.59	5.42
13	17.81	12.31	10.21	9.07	8.35	7.86	7.49	7.21	6.98	6.80	6.52	6.23	5.93	5.78	5.63	5.47	5.30	5.14	4.97
14	17.14	11.78	9.73	8.62	7.92	7.43	7.08	6.80	6.58	6.40	6.13	5.85	5.56	5.41	5.25	5.10	4.94	4.77	4.60
15	16.59	11.34	9.34	8.25	7.57	7.09	6.74	6.47	6.26	6.08	5.81	5.54	5.25	5.10	4.95	4.80	4.64	4.47	4.31
16	16.12	10.97	9.00	7.94	7.27	6.81	6.46	6.19	5.98	5.81	5.55	5.27	4.99	4.85	4.70	4.54	4.39	4.23	4.06
17	15.72	10.66	8.73	7.68	7.02	6.56	6.22	5.96	5.75	5.58	5.32	5.05	4.78	4.63	4.48	4.33	4.18	4.02	3.85
18	15.38	10.39	8.49	7.46	6.81	6.35	6.02	5.76	5.56	5.39	5.13	4.87	4.59	4.45	4.30	4.15	4.00	3.84	3.67
19	15.08	10.16	8.28	7.26	6.62	6.18	5.85	5.59	5.39	5.22	4.97	4.70	4.43	4.29	4.14	3.99	3.84	3.68	3.51
20	14.82	9.95	8.10	7.10	6.46	6.02	5.69	5.44	5.24	5.08	4.82	4.56	4.29	4.15	4.00	3.86	3.70	3.54	3.38
21	14.59	9.77	7.94	6.95	6.32	5.88	5.56	5.31	5.11	4.95	4.70	4.44	4.17	4.03	3.88	3.74	3.58	3.42	3.26
22	14.38	9.61	7.80	6.81	6.19	5.76	5.44	5.19	4.99	4.83	4.58	4.33	4.06	3.92	3.78	3.63	3.48	3.32	3.15
23	14.19	9.47	7.67	6.69	6.08	5.65	5.33	5.09	4.89	4.73	4.48	4.23	3.96	3.82	3.68	3.53	3.38	3.22	3.05
24	14.03	9.34	7.55	6.59	5.98	5.55	5.23	4.99	4.80	4.64	4.39	4.14	3.87	3.74	3.59	3.45	3.29	3.14	2.97
25	13.88	9.22	7.45	6.49	5.88	5.46	5.15	4.91	4.71	4.56	4.31	4.06	3.79	3.66	3.52	3.37	3.22	3.06	2.89
26	13.74	9.12	7.36	6.41	5.80	5.38	5.07	4.83	4.64	4.48	4.24	3.99	3.72	3.59	3.44	3.30	3.15	2.99	2.82
27	13.61	9.02	7.27	6.33	5.73	5.31	5.00	4.76	4.57	4.41	4.17	3.92	3.66	3.52	3.38	3.23	3.08	2.92	2.75
28	13.50	8.93	7.19	6.25	5.66	5.24	4.93	4.69	4.50	4.35	4.11	3.86	3.60						

SOURCES OF PHYSICAL AND CHEMICAL DATA

In addition to the primary research journals, there are many useful sources of property data of the type contained in the *CRC Handbook of Chemistry and Physics*. A selected list of these is presented here, with emphasis on print and electronic sources whose contents have been subject to a reasonable level of quality control.

A. Data Journals

1. **Journal of Physical and Chemical Reference Data** – Published jointly by the National Institute of Standards and Technology and the American Institute of Physics, this quarterly journal contains compilations of evaluated data in chemistry, physics, and materials science. It is available in print and on the Internet. [ojps.aip.org/jpcrd/]
2. **Journal of Chemical and Engineering Data** – This bimonthly journal of the American Chemical Society publishes articles reporting original experimental measurements carried out under carefully controlled conditions. The main emphasis is on thermochemical and thermophysical properties. Review articles with evaluated data from the literature are also published. [pubs.acs.org/journals/jceax/index.html]
3. **Journal of Chemical Thermodynamics** – This journal publishes original research papers that include highly accurate measurements of thermodynamic and thermophysical properties. [http://www.sciencedirect.com]
4. **Atomic Data and Nuclear Data Tables** – This is a bimonthly journal containing compilations of data in atomic physics, nuclear physics, and related fields. [www.sciencedirect.com]
5. **Journal of Phase Equilibria** – This journal presents critically evaluated phase diagrams and related data on alloy systems. It is published by ASM International and is the successor to the previous ASM periodical *Bulletin Of Alloy Phase Diagrams*. [www.asm-intl.org.]
6. **Journal of Chemical Information and Computer Sciences** – Although not a true data journal, it contains many papers on the prediction of physical property data from molecular structure. It is published by the American Chemical Society. [pubs.acs.org/journals/jcis8/index.html]

B. Data Centers

This section lists selected organizations that perform a continuing function of compiling and critically evaluating data in specific fields of science.

1. **National Institute of Standards and Technology** – Under its Standard Reference Data program, NIST supports a number of data centers in chemistry, physics, and materials science. Topics covered include thermodynamics, fluid properties, chemical kinetics, mass spectroscopy, atomic spectroscopy, fundamental physical constants, ceramics, and crystallography. Address: Office of Standard Reference Data, National Institute of Standards and Technology, Gaithersburg, MD 20899 [www.nist.gov/srd/].
2. **Thermodynamics Research Center** – Now located at the National Institute of Standards and Technology, TRC maintains an extensive archive of data covering thermodynamic, thermochemical, and transport properties of organic compounds and mixtures. Data are distributed in both print and electronic form. Address: Mailcode 838.00, 325 Broadway, Boulder, CO 80305-3328 [www.trc.nist.gov].
3. **Design Institute for Physical Property Data** – Under the auspices of the American Institute of Chemical Engineers [www.aiche.org/dippr/], DIPPR offers evaluated data on industrially-important chemical compounds. The largest project deals with physical, thermodynamic, and transport properties of pure compounds. Address: Brigham Young University, Provo, UT 84602 [dippr.byu.edu].
4. **Dortmund Data Bank** – Maintains extensive databases on thermodynamic and transport properties of pure compounds and mixtures of industrial interest. The data are distributed through DECHEMA, FIZ CHEMIE, and other outlets. An abbreviated database system is also available for educational use. Address: DDBST GmbH, Industriestr. 1, 26121 Oldenburg, Germany [www.ddbst.de].
5. **Cambridge Crystallographic Data Centre** – Maintains the Cambridge Structural Database of over 250,000 organic compounds. The data files and manipulation software are distributed in several ways. Address: 12 Union Rd., Cambridge CB2 1EZ, UK [www.ccdc.cam.ac.uk].
6. **FIZ Karlsruhe** – In addition to many bibliographic databases, FIZ Karlsruhe maintains the Inorganic Crystal Structure Database in collaboration with the National Institute of Standards and Technology. The ICSD contains the atomic coordinates and related data on over 50,000 inorganic crystals. Address: Fachinformationszentrum (FIZ) Karlsruhe, Hermann-von-Helmholtz-Platz 1, D-76344 Eggenstein-Leopoldshafen, Germany [crystal.fiz-karlsruhe.de].
7. **International Centre for Diffraction Data** – Maintains and distributes the Powder Diffraction File (PDF), a file of x-ray powder diffraction patterns used for identification of crystalline materials. The ICDD also distributes the NIST Crystal Data file, which contains lattice parameters for over 235,000 inorganic and organic crystalline materials. Address: 12 Campus Blvd., Newton Square, PA 19073-3273 [icdd.com].
8. **Research Collaboratory for Structural Bioinformatics** – Maintains the Protein Data Bank (PDB), a file of 3-dimensional structures of proteins and other biological macromolecules. Address: Department of Chemistry and Chemical Biology, Rutgers University, 610 Taylor Road, Piscataway, NJ 08854-8087 [www.rcsb.org].
9. **Toth Information Systems** – Maintains the Metals Crystallographic Data File (CRYSTMET). Address: 2045 Quincy Ave., Gloucester, ON, Canada K1J 6B2 [www.tothcanada.com].
10. **Atomic Mass Data Center** – Collects and evaluates high-precision data on masses of individual isotopes and maintains a comprehensive database. Address: C.S.N.S.M (IN2P3-CNRS), Batiment 108, F-91405 Orsay Campus, France [csnwww.in2p3.fr/amdc/].
11. **Particle Data Group** – International center for data of high-energy physics; maintains database of properties of fundamental particles, which is published in both print and electronic form. Address: MS 50-308, Lawrence Berkeley National Laboratory, Berkeley, CA 94720 [pdg.lbl.gov].
12. **National Nuclear Data Center** – Maintains databases on nuclear structure and reactions, including neutron cross sections. The NNDC is the U. S. node in an international network of nuclear data centers. Address: Brookhaven National Laboratory, Upton, NY 11973-5000 [www.nndc.bnl.gov].

SOURCES OF PHYSICAL AND CHEMICAL DATA (continued)

13. **International Union of Pure and Applied Chemistry** – Address: PO Box 13757, Research Triangle Park, NC 27709-3757 [www.iupac.org]. IUPAC supports a number of long-term data projects, including these examples:
 - a. **Solubility Data Project** – Carries out evaluation of all types of solubility data. The results are published in the Solubility Data Series, whose current outlet is the *Journal of Physical and Chemical Reference Data*. [www.unileoben.ac.at/~eschedor/]
 - b. **Kinetic Data for Atmospheric Chemistry** – Maintains a comprehensive database on the kinetics of reactions important in the chemistry of the atmosphere. [www.iupac-kinetic.ch.cam.ac.uk/]
 - c. **International Thermodynamic Tables for the Fluid State** – Prepares definitive tables of the thermodynamic properties of industrially important fluids. Thirteen volumes have been published by IUPAC. [http://www.iupac.org/publications/books/seriestitles/]

C. Major Multi-Volume Handbook Series

1. **Chapman & Hall/CRC Chemical Dictionaries** – These originally appeared in print form as the *Dictionary of Organic Compounds*, *Dictionary of Natural Products*, etc. They are now published in electronic form and are available in CDROM format [www.crcpress.com] and on the Internet [www.chemnetbase.com]. The consolidated version, called the *Combined Chemical Dictionary*, has data on more than 450,000 compounds spanning all branches of chemistry. The coverage includes physical properties, biological sources, hazard information, uses, and literature references.
2. **Properties of Organic Compounds** – Originally published in three editions as the *Handbook of Data on Organic Compounds*, it is now in electronic form as *Properties of Organic Compounds*. The database includes about 30,000 compounds; physical properties and spectral data (mass, infrared, Raman, ultraviolet, and NMR) are covered. It is offered as CDROM [www.crcpress.com] and web access [www.chemnetbase.com].
3. **Beilstein Handbook of Organic Chemistry** – The classic source of data on organic compounds, dating from the 18th century, *Beilstein* was converted to electronic form in the last decade of the 20th century. Over 8 million compounds and 5 million chemical reactions are now covered, with a broad range of physical properties as well as synthetic methods and ecological data. The database is accessed by the CrossFire software [www.mdli.com].
4. **Gmelin Handbook of Inorganic and Organometallic Chemistry** – A subset of the information in the print series has been converted to electronic form and is now distributed in the same manner as *Beilstein*. In addition to the standard physical properties, the coverage includes a wide range of optical, magnetic, spectroscopic, thermal, and transport properties for about 1.4 million compounds [www.mdli.com].
5. **DECHEMA Chemical Data Series** – DECHEMA distributes the DITHERM database, which emphasizes data used in process design in the chemical industry, including thermodynamic and transport properties of about 20,000 pure compounds and 90,000 mixtures. Access is available through in-house databases and via the Internet. [www.dechema.de].
6. **Landolt-Börnstein Numerical Data and Functional Relationships in Science and Technology - Landolt-Börnstein** covers a very broad range of data in physics, chemistry, crystallography, materials science, biophysics, astronomy, and geophysics. Hard-copy volumes in the New Series (started in 1961) are still being published, and the entire New Series is now accessible on the Internet [www.landolt-boernstein.com].

D. Selected Single-Volume Handbooks

The following handbooks offer broad coverage of high-quality data in a single volume. This list is only representative; an extensive listing of handbooks in all fields of science may be found in *Handbooks and Tables in Science and Technology, Third Edition* (Russell H. Powell, ed., Oryx Press, Westport, CT, 1994).

1. **American Institute of Physics Handbook** – Although an old book, it contains much data that is still useful, especially in acoustics, mechanics, optics, and solid state physics. (Dwight E. Gray, ed., McGraw-Hill, New York, 1972)
2. **Constants of Inorganic Substances** - This book presents physical constants, thermodynamic data, solubility, reactivity, and other information on over 3000 inorganic compounds. Since it draws heavily on Russian literature, it contains a great deal of data that does not make its way into most U. S. handbooks. (R. A. Lidin, L. L. Andreeva, and V. A. Molochko, Begell House, New York, 1995)
3. **Handbook of Chemistry and Physics** – Now in the 84th Edition, the *CRC Handbook* covers data from most branches of chemistry and physics. The annual revisions permit regular updating of the information. Also available on CDROM [www.crcpress.com] and the web [hbcnpnetbase.com]. (David R. Lide, ed., CRC Press, Boca Raton, FL, 2002)
4. **Handbook of Inorganic Compounds** – This book covers physical constants and solubility for about 3300 inorganic compounds. Also available on CDROM [www.crcpress.com]. (Dale L. Perry and Sidney L. Phillips, eds., CRC Press, Boca Raton, FL, 1995)
5. **Handbook of Physical Properties of Liquids and Gases** – This is a valuable source of data on all types of fluids, ranging from liquid and gaseous hydrocarbons to molten metals and ionized gases. Detailed tables of physical, thermodynamic, and transport properties are given for temperatures from the cryogenic region to 6000 K. Both Western and Russian literature is covered. (N. B. Vargaftik, Y. K. Vinogradov, and V. S. Yargin, Begell House, New York, 1996)
6. **Handbook of Physical Quantities** – The range of coverage is somewhat similar to the *CRC Handbook of Chemistry and Physics*, but with a stronger emphasis on physics than on chemistry. Solid state physics, lasers, nuclear physics, geophysics, and astronomy receive considerable attention. (Igor S. Grigor'ev and Evgenii Z. Meilikhov, eds., CRC Press, Boca Raton, FL, 1997)
7. **Kaye & Laby Tables of Physical and Chemical Constants** – *Kaye & Laby* dates from 1911, and the 16th Edition was prepared in 1995 by a committee of experts. The coverage extends to almost every field of physics and chemistry; data on a limited number of representative substances or materials are given for each topic. (Longman Group Limited, Harlow, Essex, UK, 1995)

SOURCES OF PHYSICAL AND CHEMICAL DATA (continued)

8. *Lange's Handbook of Chemistry* – Provides broad coverage of chemical data; last updated in 1998. Also available on the web [www.knovel.com]. (John A. Dean, ed., McGraw-Hill, New York, 1998)
9. *Recommended Reference Materials for the Realization of Physicochemical Properties* – This IUPAC book emphasizes highly accurate data on substances and materials that can be used as calibration standards. It covers physical, thermal, optical, and electrical properties. (K. N. Marsh, ed., Blackwell Scientific Publications, Oxford, 1987)
9. *The Merck Index* – Now in its 13th Edition (published in 2001), The Merck Index is a widely used source of data on over 10,000 compounds, chosen particularly for their importance in biology, medicine, and ecology. A short monograph on each compound gives information on the synthesis and uses as well as physical and toxicological properties. Also available on CDROM [www.camsoft.com]. (Maryadele J. O'Neil, ed., Merck & Co., Whitehouse Station, NJ, 2001)

E. Summary of Useful Web Sites for Physical and Chemical Properties

Most of the web sites in the following list provide direct access to factual data on physical and chemical properties. However, the list also includes portals that link to different property databases or describe the procedure for gaining access to electronic sources of property data. There are also a few chemical directory sites, which are useful for obtaining formulas, synonyms, and registry numbers for substances of interest.

Web Site	Address	Comments
Acronyms and Symbols	www3.interscience.wiley.com/stasa/	Free service; useful for indentifying acronyms for chemicals
Advanced Chemistry Development	www.acdlabs.com	Chemical directory, with programs for estimating physical and spectral properties
Alloys Online	alloys.asminternational.org	Physical, electrical, thermal, and mechanical properties of alloys
Atomic Mass Data Center	csnwww.in2p3.fr/amdc/	See B.10
Beilstein	www.mdli.com	See C.3
Cambridge Structural Database	www.ccdc.cam.ac.uk	See B.5
Chapman & Hall/CRC Combined Chemical Dictionary	www.chemnetbase.com/scripts/ccdweb.exe	See C.1
Chemfinder	www.chemfinder.com	Chemical directory, with links to several property databases
Chemical Acronyms Database	www.oscar.chem.indiana.edu/cfdocs/libchem/acronyms/acronymsearch.html	Useful for associating chemical names and acronyms
ChemIDplus	chem.sis.nlm.nih.gov/chemidplus/	Chemical directory
ChemIndustry	www.chemindustry.com/chemicals/	Chemical directory
CHEMnetBASE	www.chemnetbase.com	Portal to <i>C&H/CRC Chemical Dictionaries, Handbook of Chemistry and Physics, Properties of Organic Compounds</i> , etc.
ChemWeb Databases	www.chemweb.com/databases/	Portal to many databases
Coblentz Infrared Spectra	www.galactic.com/coblentz/	IR spectra on CDROM
CODATA Home Page	www.codata.org	Thermodynamic key values and fundamental constants
DECHEMA (DETHERM)	www.dechema.de	See C.5
DIPPR Pure Compound Database	dippr.byu.edu	See B.3
Dortmund Data Bank	www.ddbst.de	See B.4
Enzyme Nomenclature Database	www.expasy.ch/enzyme/	IUBMB nomenclature for enzymes
FDM Reference Spectra Databases	www.fdmspectra.com/	Infrared spectra
FIZ Chemie Berlin	www.fiz-chemie.de	Portal to DETHERM (C.5) and Dortmund Data Bank (B.4)
FIZ Karlsruhe - ICSD	crystal.fiz-karlsruhe.de	See B.6
Fundamental Physical Constants	physics.nist.gov/cuu/	CODATA fundamental constants
Gmelin	www.mdli.com	See C.4
Handbook of Chemistry and Physics	hbcnetbase.com	Web version of CRC Handbook
Hazardous Substances Data Bank	toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB	Physical and toxicological properties of chemicals of health or environmental importance
IUPAC Home Page	www.iupac.org	See B.13
IUPAC Kinetics Data	www.iupac-kinetic.ch.cam.ac.uk/	See B.13.b
IUPAC Nomenclature Rules	www.chem.qmw.ac.uk/iupac/	Useful site for organic and biochemical nomenclature
IUPAC Solubility Data Project	www.unileoben.ac.at/~eschedor/	See B.13.a
Knovel.com	www.knovel.com	Portal to <i>Lange's Handbook, Perry's Chemical Engineers' Handbook</i> , etc.
Landolt-Börnstein	www.landolt-boernstein.com	See C.6
MatWeb	www.matweb.com	Thermal, electrical, and mechanical properties of engineering materials
Metals Crystallographic Data File	www.tothcanada.com	See B.9
NASA Chemical Kinetics Data	jpldataeval.jpl.nasa.gov	Kinetic and photochemical data for stratospheric modeling

SOURCES OF PHYSICAL AND CHEMICAL DATA (continued)

Web Site	Address	Comments
National Center for Biotechnology Information	www.ncbi.nlm.nih.gov	Portal to GenBank and other sequence databases
National Nuclear Data Center	www.nndc.bnl.gov	See B.12
National Toxicology Program	ntp-server.niehs.nih.gov	Chemical health and safety data
NIST Atomic Spectra Database	physics.nist.gov/cgi-bin/AtData/main_asd	Energy levels, wavelengths, and transition probabilities of atoms and atomic ions
NIST Ceramics Webbook	www.ceramics.nist.gov/webbook/webbook.htm	See B.1
NIST Chemistry Webbook	webbook.nist.gov	Broad range of physical, thermal, and spectral properties
NIST Data Gateway	srdata.nist.gov/gateway/	Portal to all NIST data systems; see B.1
NIST Physical Reference Data	physics.nist.gov/PhysRefData/	Atomic and molecular spectra, cross sections, x-ray attenuation, and dosimetry data
NLM Gateway	gateway.nlm.nih.gov/gw/Cmd	Portal to all National Library of Medicine databases
Particle Data Group	pdg.lbl.gov	See B.11
Polymers — A Property Database	www.polymersdatabase.com/polymers/	Properties of commercial polymers
Powder Diffraction File	icdd.com	See B.7
Properties of Organic Compounds	www.chemnetbase.com/scripts/pocweb.exe	See C.2
Protein Data Bank	www.rcsb.org	See B.8
SpecInfo	www.chemicalconcepts.com	IR, NMR, and mass spectra
Spectra Online	spectra.galactic.com/SpectraOnline/	IR, UV, NMR, Raman, and mass spectra (unreviewed)
STN Easy	stneasy.cas.org	Chemical directory (and access to Chemical Abstracts)
STN Easy-Europe	stneasy.fiz-karlsruhe.de	
STN Easy-Japan	stneasy-japan.cas.org	
Syracuse Research Corporation	esc.syrres.com/interkow/database.htm	Properties of environmental interest
Table of Isotopes	ie.lbl.gov/education/isotopes.htm	Nuclear energy levels, moments, and other properties
Thermodynamics Research Center	www.trc.nist.gov	See B.2
TOXNET	toxnet.nlm.nih.gov	Portal to HSDB and other databases on hazardous chemicals
Wiley Interscience	www3.interscience.wiley.com/reference.html	Portal to <i>Kirk-Othmer Encyclopedia of Chemical Technology</i> , <i>Ullmann's Encyclopedia of Industrial Chemistry</i> , <i>Encyclopedia of Reagents for Organic Synthesis</i> , etc.